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# Lifecycle costs for energy equipment FMECA for gas turbine

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**Abstract**

The procedure of reliability analysis for gas turbine unit (GTU) cogeneration-type SGT-800 is discussed. The example of creating a functional structure and categories of the failures criticality for GTU is provided. The qualitative matrix for GTU structural elements analysis is constructed and the criticality values are calculated.



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*Keywords*: gas turbine; functional structure; criticality of failure; the number of criticality; FMECA

## 1. Introduction

Modern engineering used a set of standardized methods and procedures for the analysis of industrial equipment failures named as Failure Mode Effect and Criticality Analysis (hereafter called FMECA). For example, NASA adopted this methodology primarily for military aircraft development. FMECA methodology is used for identifying, critical priorities and compensating actions to eliminate potential failures in a system, structure or process. An important point in FMECA is to identify the functions of equipment and structural elements, which required special attention in the design and operation of support. [2,3].

FMECA method must be planned and carried out simultaneously with the construction process. In ideal the analysis starts at the design stage during structure performance parameters and range of tasks definition. This "top-down" approach has a functional orientation. The biggest interest is FMECA application for the operated equipment where the critical failure analysis helps to build a rational system of maintenance and material supply.

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## 2. Experimental

The cogeneration heat and power gas turbine SGT-800 used at gas turbine power plants was chosen as a study subject [4]. For this type of gas turbine functional structure has been created that reflects the list of the main functions of the installation and the structural elements responsible for their implementation. First of all, it is necessary to identify all the components of the equipment which are relevant for the study. At this point it is necessary to identify all the basic functions of the turbine, starting from the most aggregated and finishing with the most detailed ones, and associate to every function the physical element which provides that function (Table 1).

Table 1. Association of all the functions to a single physical element.

| 1st level function | 2nd level functions | 3rd level functions | Elements of construction structure |
|---|---|---|---|
| Production of electrical energy | Translate thermal energy into mechanical energy | Address combustion products into turbine's blades | Compressor exit and exit of every pressure level of the turbine |
| | | Cool working wheel | Air pipe from compressor to turbine, shape and inner structure of working wheel |
| | | Control pressure after every step | Pressure sensors after every pressure step |
| | | Fixation of working wheel | Ties of turbine |
| | Burn air and fuel (Exothermic reaction to create heat) | Fuel injection | Injector, fuel pump |
| | | Air supply | Air addressing device |
| | | Inflammation | Spark plugs |
| | | Tubes' cooling | Air tubes |
| | | Temperature control in the combustion chamber | Temperature sensors |
| | | Maintaining stable combustion | Flue |
| | Translate mechanical energy into electrical energy with the necessary frequency | Translate mechanical energy into electricity | Generator |
| | | Low the number of rounds until the necessary level | Speed reducer |
| | | Providing connections from PTO to turbine shaft | Joint/Gasket |
| | Air compression | Providing connections from compressor shaft to turbine shaft | Compressor ties and wheel |
| | | Air supply to the compressor | Inlet nozzle |
| | | Address air to compressor's blades | Entrance to compressor and entrance of every pressure step |
| | | Ensure a minimum free space between the rotor and the starter | Compressor's graphite sealing |
| | | Pressure control after every pressure step | Pressure sensors after every step |
| | Warranty of safe work | Fuel filtering from particles | Fuel filter |
| | | Construction fixation | Supports |
| | | Clear air supply | Air filter |
| | | Control of noize | Silencer |

The procedure for the qualitative analysis of criticality is to appoint a functional failure with types of corrective actions depending on the priorities of the failure probability (Table 2) and the Degree of the Seriousness of the Failures (Table 3).