A phenomenologically based airline model of a 2 MW Gas Engine

VALENCIA, G. E. [a*], CONSUEGRA, F. E. [b], OSORIO, M[c]

a. Universidad del Atlántico, Área Metropolitana de Barranquilla

b. Universidad del Norte, Área Metropolitana de Barranquilla

c. Universidad Pontificia Bolivariana, Medellin

**Corresponding author, guillermoevalencia@mail.uniatlántico.edu.co*

Abstract

With the continuous advance and technological growth of society, the demand for energy has increased, more specifically the consumption of electrical power. This has led to the development of renewable energy sources such as wind power or solar energy. Despite their numerous advantages, such as environmental and economic benefits, at an industrial level, higher reliability and generating capacity energy sources are preferred. Because of this, nowadays many industrial sectors prefer fossil fuel-based energy generation, frequently using turbines and internal combustion engines as a primary energy source. The choice of one or other primary energy generation option depends on how variable the electricity demand is, as it causes continuous change in generator load. If a constant energy demand and economic feasibility study are required, a gas turbine can be chosen, despite having lower thermal efficiency than internal combustion engines. Otherwise, an engine is a better choice whether operating on diesel or natural gas as a fuel, because its high robustness allows it to adapt better to variable load rates. Considering the above, it is not surprising that in Colombia, a high percentage of industries uses generation engines to self-generate a part of its electric consumption. Considering that, usually, these generation engines must supply electrical power to industrial plants in a 24-7 regime, it is not feasible to keep them out of operation, neither in unexpected operation regimes for long periods of time. This, together with the manufacturer's restrictions and the laborious nature of making changes within the processing and control unit of an equipment, make it necessary to carry out a simulation of the system with its respective results, which can be transferred to the real system later. Therefore, the generator-engine assembly has been defined as a set of process systems, where the operational behavior of the equipment can be simulated using mathematical equations, obtaining a phenomenologically based semi-physical model that can be used to perform experiments in simulations. Finally, this work focuses on the implementation of the methodology for combining phenomenologically based semi-physical models to obtain a dynamic of the air line of a 2 MW Jenbacher natural gas internal combustion engine, focusing on modeling of mean values that involves the study of some engine parameters such as the intake manifold temperature and pressure, the mass flow through the throttle and turbo-bypass valve in the engine, the electric power and the gas emission.

Keywords: *Mean Value Model, Gas Engine, Phenomenological Semiphysical model*