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Performance evaluation of selected gas turbine power plants in Nigeria using energy and exergy methods

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Abstract:

This study presents thermodynamic analysis of the design and performance of eleven selected gas turbine power plants using the first and second laws of thermodynamics concepts. Energy and exergy analyses were conducted using operating data collected from the power plants to determine the energy loss and exergy destruction of each major component of the gas turbine plant. Energy analysis showed that the combustion chamber and the turbine are the components having the highest proportion of energy loss in the plants. Energy loss in combustion chamber and turbine varied from 33.31 to 39.95% and 30.83 to 35.24% respectively. The exergy analysis revealed that the combustion chamber is the most exergy destructive component compared to other cycle components. Exergy destruction in the combustion chamber varied from 86.05 to 94.67%. Combustion chamber has the highest exergy improvement potential which range from 30.21 to 88.86 MW. Also, its exergy efficiency is lower than that of other components studied, which is due to the high temperature difference between working fluid and burner temperature. Increasing gas turbine inlet temperature (GTIT), the exergy destruction of this component can be reduced.

Keywords:

Energy, Exergy, Exergy efficiency, Exergy destruction, Gas turbine

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