ANALYSIS OF GAS TURBINES POWER OUTPUT BASED ON INDUSTRIAL PRODUCTION MODEL

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ABSTRACT

The study looked at the analysis of gas turbines operation efficiency and power output based on industrial production. The study is limited to the analysis of gross and net power output of Aslando Energia model, turbine production models and Alsom Power design models. The findings of table showed that GT 24 model of Alsom turbine production has higher power production output, and GT11N2 had lesser power output production when compared to GT13E2 model. This reveals that on larger supply of power production and distribution, GT 24 model is more preferable to use. Also, AE94.2 model of Aslando Energia turbine production has a higher power production output and AE94.2K had a power output depending on case by case condition which also resulted to a difference of 430.0. Based on the findings of the study, it would be recommended that larger supply of power production and distribution, GT 24 model should be used to feed areas with bigger load consumption.

Keywords: *Gas turbines, Power Output Based and Industrial production*

INTRODUCTION

A turbine is defined as a spinning device that uses the action of a steam fluid to produce work or energy. Typical fluids used for this operation are air, wind, water, steam and helium. Windmills and hydroelectric dams have used turbine action for decades to turn the core of an electrical generator to produce power for both industrial and residential consumption. Simpler turbines are much older, with the first known appearance dating to the time of ancient Greece.

The turbine section of the gas turbine engine has the task of producing usable output shaft power to drive the propeller. In addition, it must also provide power to drive the compressor and all engine accessories. It does this by expanding the high temperature, pressure, and velocity gas and converting the gaseous energy to mechanical energy in the form of shaft power. A large mass of air must be supplied to the turbine in order to produce the necessary power. This mass of air is supplied by the compressor, which draws the air into the engine and squeezes it to provide high-pressure air to the turbine. The compressor does this by converting mechanical energy from the turbine to gaseous energy in the form of pressure and temperature.

If the compressor and the turbine were 100% efficient, the compressor would supply all the air needed by the turbine. At the same time, the turbine would supply the necessary power to drive the compressor. In this case, a perpetual motion machine would exist. However, frictional losses and mechanical system inefficiencies do not allow a perpetual motion machine to operate. Additional energy must be added to the air to accommodate for these losses. Power output is also desired from the engine (beyond simply driving the compressor); thus, even more energy must be added to the air to produce this excess power. Energy addition to the system is accomplished in the combustor. Chemical energy from fuel as it is burned is converted to gaseous energy in the form of high temperatures and high velocity as the air passes through the combustor. The gaseous energy is converted back to mechanical energy in the turbine, providing power to drive the compressor and the output shaft.

The name "gas turbine" is somewhat misleading, because to many it implies a turbine engine that uses gas as its fuel. Actually a gas turbine has a compressor to draw in and compress gas (most usually air); a combustor (or burner) to add fuel to heat the compressed air, and a turbine to extract power from the hot air flow. The gas turbine is an internal combustion (IC) engine employing a continuous combustion process. This differs from the intermittent combustion occurring in Diesel and automotive IC engines. Because the 1939 origin of the gas turbine lies simultaneously in the electric power field and in aviation, there have been a profusion of "other names" for the gas turbine. For electrical power generation and marine applications it is generally called a gas turbine, also a combustion turbine (CT), a turboshaft engine, and sometimes a gas turbine engine. For aviation applications it is usually called a jet engine, and various other names depending on the particular engine configuration or application, such as: jet turbine engine; turbojet; turbofan; fanjet; and turboprop or prop jet (if it is used to drive a propeller). The compressor combustor-turbine part of the gas turbine is commonly termed the gas generator.

Gas turbine technology has steadily advanced since its inception and continues to evolve. Development is actively producing both smaller gas turbines and more powerful and efficient engines. Aiding in these advances are computer based design (specifically CFD and finite element analysis) and the development of advanced materials: Base materials with superior high temperature strength (e.g., single-crystal super alloys that exhibit yield strength anomaly) or thermal barrier coatings that protect the structural material from ever higher temperatures. These advances allow higher compression ratios and turbine inlet temperatures, more efficient combustion and better cooling of engine parts.

The simple-cycle efficiencies of early gas turbines were practically doubled by incorporating inter-cooling, regeneration (or recuperation), and reheating. These improvements, of course, come at the expense of increased initial and operation costs, and they cannot be justified unless the decrease in fuel costs offsets the increase in other costs. The relatively low fuel prices, the general desire in the industry to minimize installation costs, and the tremendous increase in the simple-cycle efficiency to about 40 percent left little desire for opting for these modifications.

On the emissions side, the challenge is to increase turbine inlet temperatures while at the same time reducing peak flame temperature in order to achieve lower NOx emissions and meet the latest emission regulations. In May 2011, Mitsubishi Heavy Industries achieved a turbine inlet temperature of 1,600 °C on a 320 megawatt gas turbine, and 460 MW in gas turbine combined-cycle power generation applications in which gross thermal efficiency exceeds 60%.

Literature Review

The Gas Turbine Process

Gas turbine engines are, theoretically, extremely simple. They have three parts:

- Compressor - Compresses the incoming air to high pressure
- Combustion area - Burns the fuel and produces high-pressure, high -velocity gas
- Turbine - Extracts the energy from the high-pressure, high -velocity gas flowing from the combustion chamber

In this engine, air is sucked in from the right by the compressor. The compressor is basically a cone -shaped cylinder with small fan blades attached in rows (eight rows of blades are represented here). Assuming the light blue represents air at normal air pressure, then as the air is forced through the compression stage its pressure rises significantly. In some engines, the pressure of the air can rise by a factor of 30. The high -pressure air produced by the compressor is shown in dark blue.

Purpose of the Study

The study looked at the analysis of gas turbines power output based on industrial production model. Specifically the sought to:

1. Find out the differences in gross power output of GT26 GT24, GT13E2 and GT11N2 of turbines.
2. Determine the differences in Net power output performance of Anslando Energia model of AE64.3A, AE94.2, AE94.2K and AE94.3A.

Scope of the Study

The study is limited to the analysis of gross and net power output of Aslando Energia model, turbine production models and Alsom Power design models.

Methods

A sample of two turbine models was used based on the analysis of eight different productions. Simple identification and comparative calculation of power output differences of turbine production was used.

Analysis of data

Table 1: Comparative Analysis of Power Output Differences on Alsom Power Production Models

Model	Gross Power Output	Power Difference
GT26	326	
GT24	230.7	95.30
GT13E2	202.7	
GT11N2	113.6	89.10

From the analysis in table 1, it was revealed that GT 26 had a power output of 326 and GT 24 had a power output of 230.7 which resulted to a difference of 95.30. This indicates that GT 24 model of Alsom turbine production has higher power production output. Also, GT13E2 had a power output of 202.7 and GT11N2 had a power output of 113.6 which also resulted to a difference of 89.10. This shows that GT11N2 had lesser power output production when compared to GT13E2 model.

Table 2: Comparative Analysis Differences in Net power output performance of Anslando Energia model of Gas Turbine Model

Anslando Energia Model	Net Power Output	Net Power Difference
AE64.3A	111.7	
AE94.2	258.4	146.7
AE94.2K	Case by Case	
AE94.3A	430.0	430.0

From the analysis in table 2, it was revealed that AE64.3 A had a power output of 111.7 and AE94.2 had a power output of 258.4 which resulted to a difference of 146.7. This indicates that AE94.2 model of Aslando Energia turbine production has higher power production output. Also, AE94.3A had a power output of 430.0 and AE94.2K had a power output depending on case by case which also resulted to a difference of 430.0.

Discussion

The findings of the table showed that GT 24 model of Alsom turbine production has higher power production output. And GT11N2 had lesser power output production when compared to GT13E2 model. This reveals that on larger supply of power production and distribution, GT 24 model is more preferable to use.

Also, AE94.2 model of Aslando Energia turbine production has a higher power production output and AE94.2K had a power output depending on case by case condition which also resulted to a difference of 430.0.

Conclusion

In all, different products of Aslando Energia and Alsom turbine models were discussed. The findings revealed that these production models have different power output range while others had lower net power output.

Recommendations

Based on the findings of the study, it would be recommended that:

1. The larger supply of power production and distribution, GT 24 model should be used to feed areas with bigger load consumption.
2. Proper selections should be made by purchasers of gas turbine and consideration should be given to power range output before selection.

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