CENTRAX
GAS TURBINES

CFD Analysis of CX501 Generator Set Package Ventilation

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1. Introduction

This project was for Centrax Gas Turbines; an engineering company based in Newton Abbot who manufacture gas turbine power generation packages. The package enclosure is ventilated (by a fan positioned at the outlet) to remove heat rejected from the gas turbine engine, and also to provide sufficient airflow to disperse any minor gas leaks. Centrax want to bleed air from the boost compressor attached to the gas turbine engine, into the package ventilation for the CX501 gas turbine power generation package (see Figure 1).

Aim

The aim of this project was to comment on the feasibility of adding boost compressor bleed air into the package ventilation air for the CX501 package.

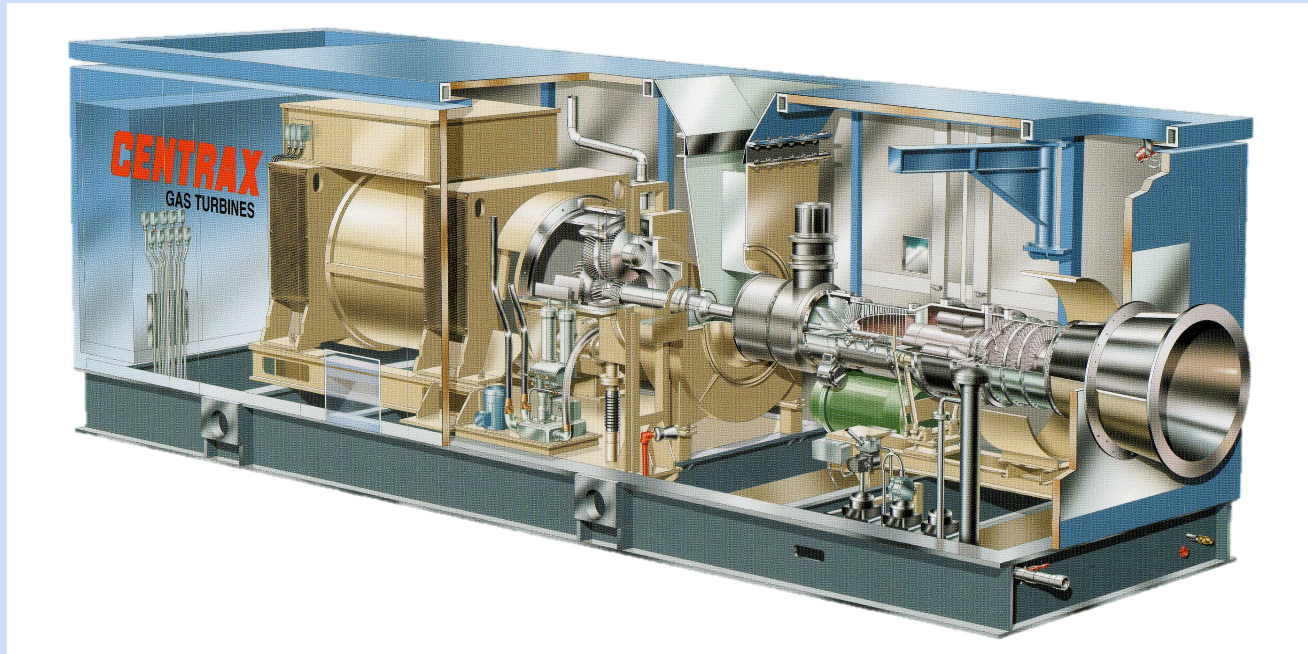

Figure 1 – CX501 Generator Set Package [1]

2. Methodology

Computational Fluid Dynamics (CFD) was used to create two models of the CX501 package - one with the boost compressor air bleed, and one without. The two models were then compared to assess the effect, of bleeding air from the boost compressor, on the package ventilation.

The geometry of the CFD model can be seen in Figure 2 below. Only the area of the package that is classed as hazardous was modeled. This is the area from the combustion air inlet to the exhaust (containing the gas turbine) .

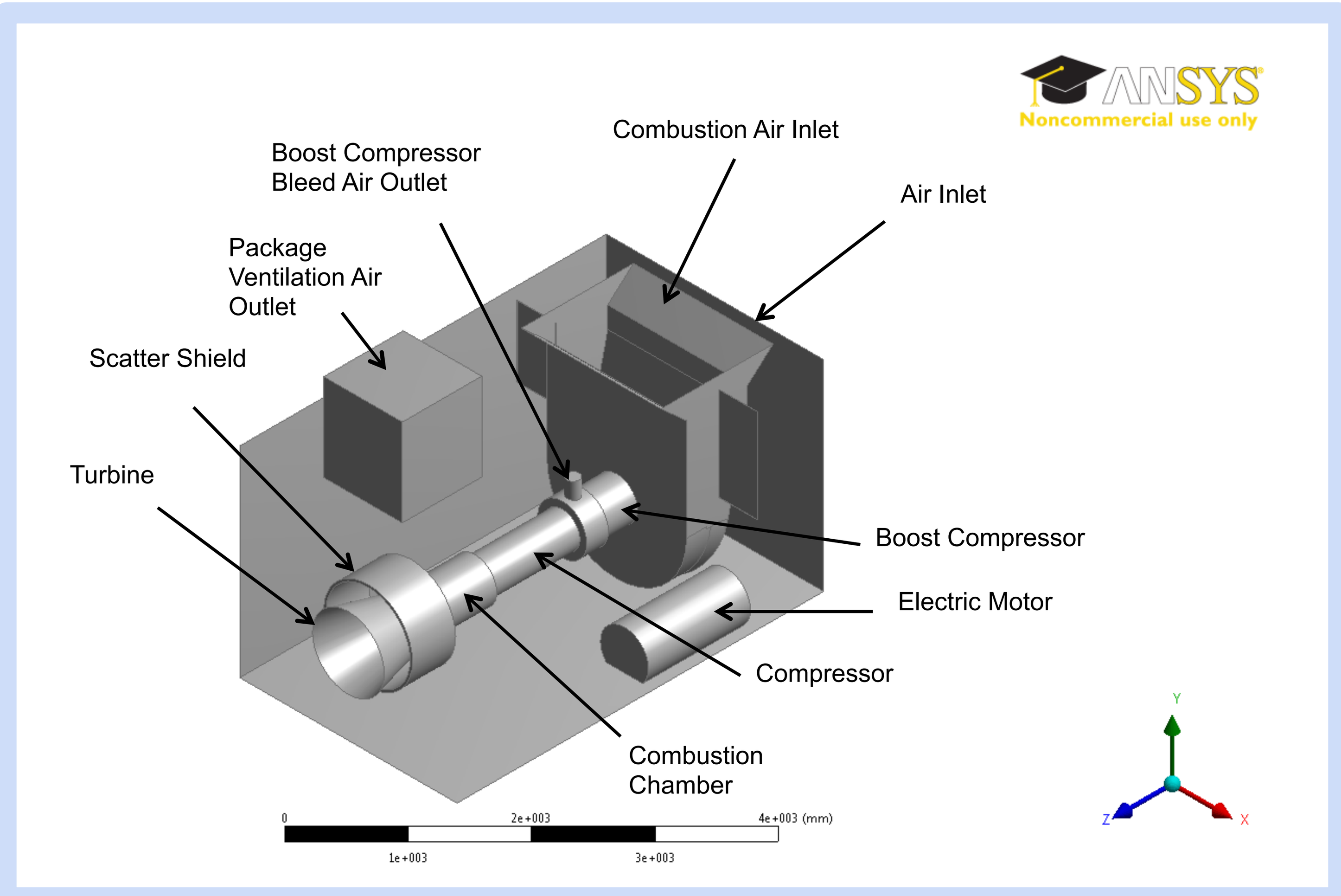

Figure 2 – Labelled geometry of CFD model

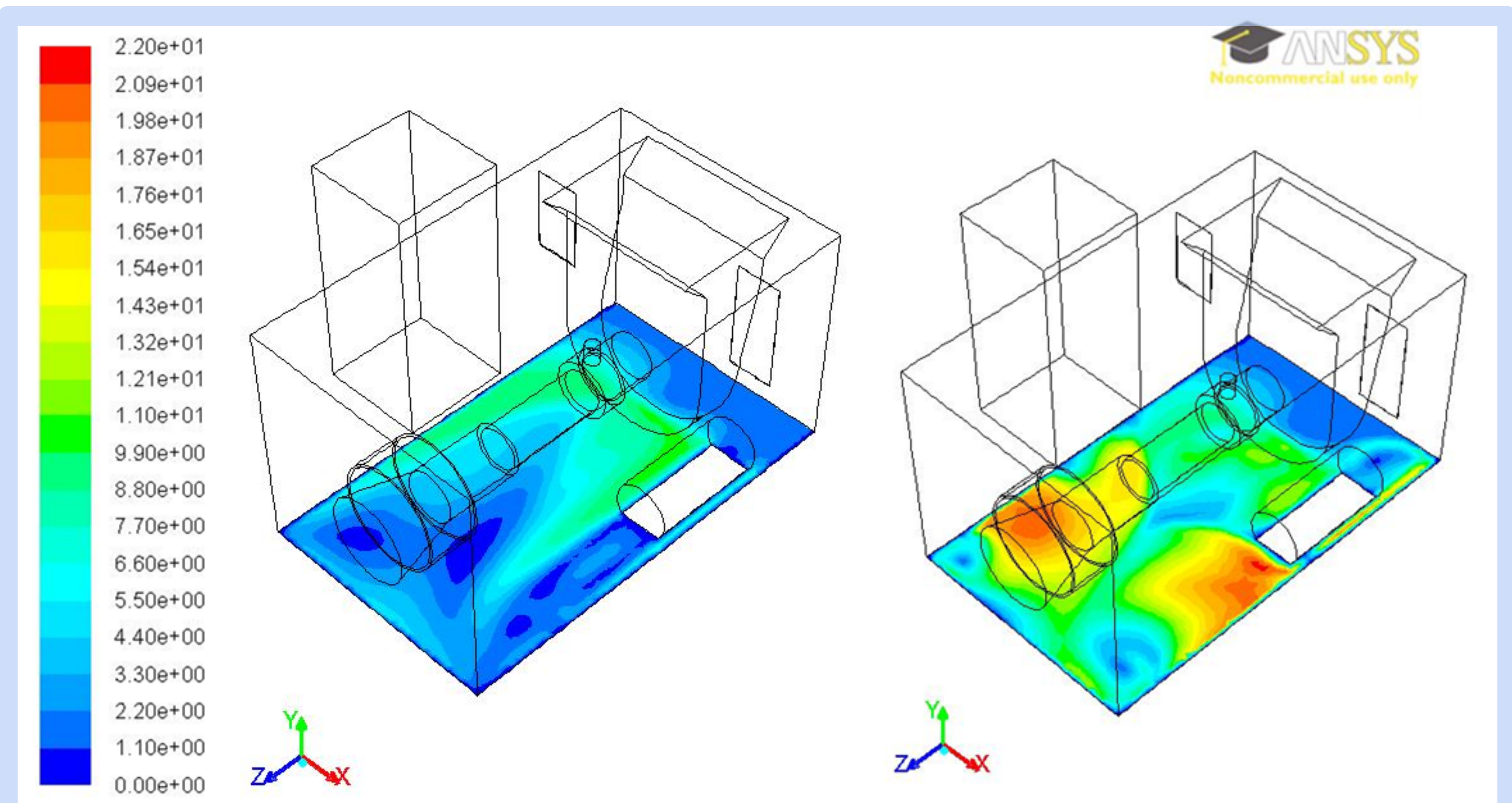

Figure 4 – Contours of velocity magnitude (m/s) on the bottom face for both models, without boost compressor air bleed (left) and with boost compressor air bleed (right)

3. Results

This project found that adding boost compressor air bleed into the package ventilation had the following effects:

1. Temperature: The ventilation air temperature at the outlet of the package was 15K higher. Figure 3 shows the temperature contours for both models.

2. Velocity: The velocity on the bottom face of the model increased from 4.4 m/s to 9.7 m/s. The bottom face of the model is where the tread plate is located on the CX501 package. Underneath the tread plate there is a dense network of pipes including gas pipes. Consequently it is the airflow on this face which disperses any minor gas leaks. Figure 4 shows the velocity contours on the bottom face for both models.

3. Overall Ventilation: Caused greater mixing of air within the package and therefore helped to disperse hot pockets of air forming in areas of low ventilation velocity around the gas turbine engine.

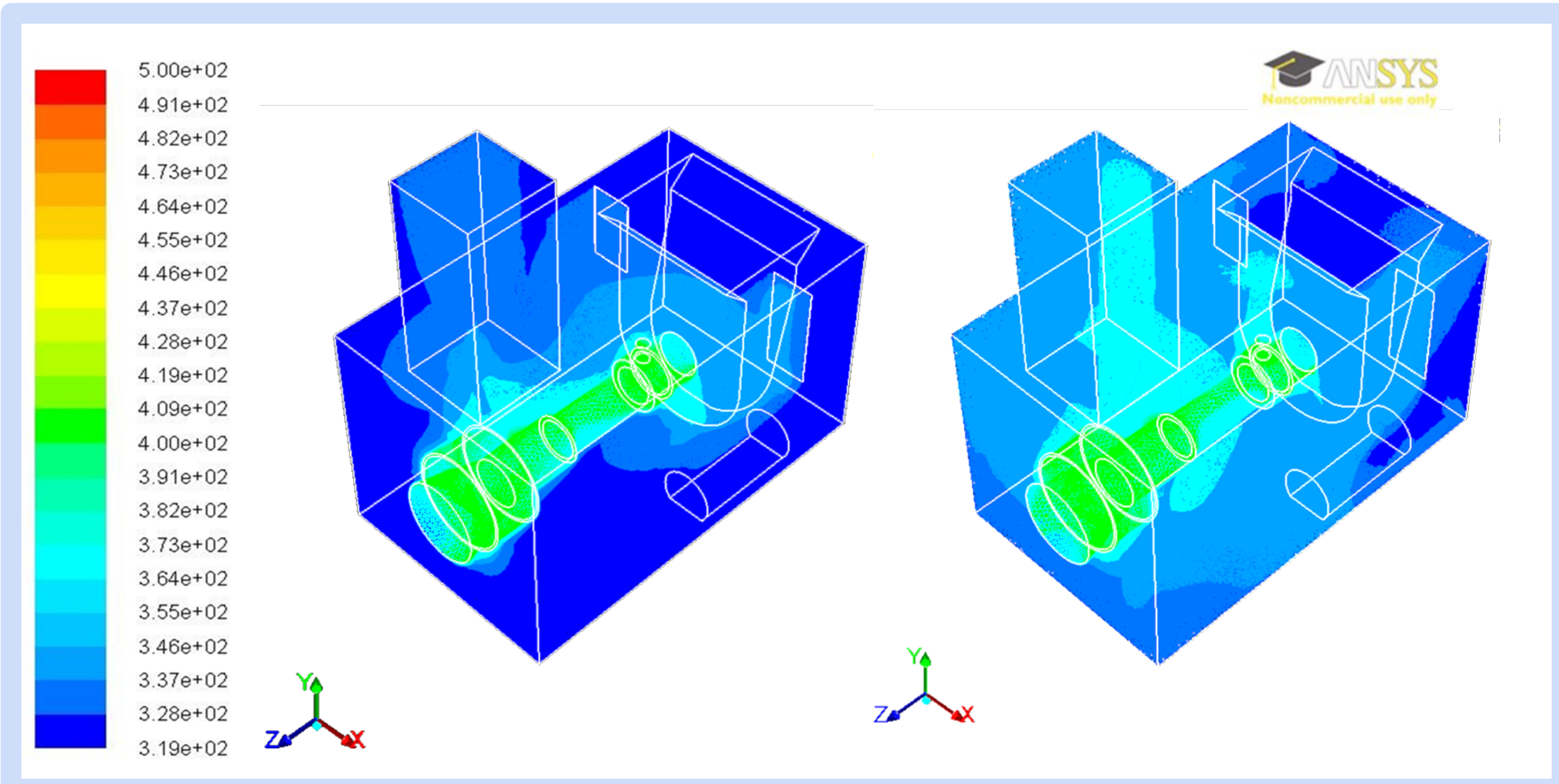

Figure 3 – Contours of total temperature (K) for both models, without boost compressor air bleed (left) and with boost compressor air bleed (right)

4. Conclusions

- With the addition of boost compressor air bleed the air temperature at the outlet of the model is greater than the specified operating temperature range for the current ventilation fan. Therefore a new ventilation fan may need to be sourced.
- A flow rate of 9.7 m/s on the bottom surface of the model may be too high (it could mask a potential gas leak). Therefore the safety implications of this increase should be investigated.
- Further work should be carried out to investigate different ways of modelling the surface of the gas turbine engine: e.g. with a semi-porous region.

[1] Centrax Gas Turbines | Publications. [online] Available at www.centraxgt.com

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