Thermal Analysis of Liquid Hydrogen Turbine Inlet Manifold
Using CFD

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ABSTRACT:
This study takes a look at the design process of the air intake system of the Liquid Hydrogen Turbine Inlet Manifold. Differences in turbine outputs and applications require different designs of intake-air manifolds in order to achieve the best volumetric efficiency and thus the best turbine performance. In the present work, the flow characteristics of liquid hydrogen flowing in various designs of air-intake manifold will be studied. The study is done by three dimensional simulations of the flow of air within two designs of air-intake manifold into the turbine by using commercial CFD software, ANSYS. The simulation results are validated by an experimental study performed using a flow bench. The study reveals that the variations in the geometry of the air-intake system can result in a difference of up to 20% in the mass flow rate of air entering the combustion chamber.

The design will be done in a 3D software Catia and analysis carried in FEA software called Ansys.

Keywords: Thermal Analysis, Turbine, CFD.

I. INTRODUCTION
A turbine is a rotary mechanical device that extracts energy from a fluid flow and converts it into useful work. A turbine is a turbo machine with at least one moving part called a rotor assembly, which is a shaft or drum with blades attached. Moving fluid acts on the blades so that they move and impart rotational energy to the rotor. Early turbine examples are windmills and waterwheels.
THERMAL ANALYSIS OF ORGINAL MODEL WITH CAST IRON

IMPORT MODEL

MESH MODEL

INPUT DATA

TEMPERATURE
TOTAL HEAT FLUX

THERMAL ANALYSIS OF ORIGINAL MODEL WITH STAIN LESS STEEL

TEMPERATURE

DIRECTIONAL HEAT FLUX

TOTAL HEAT FLUX
THERMAL ANALYSIS MODIFIED MODEL WITH CAST IRON

IMPORT MODEL
DIRECTIONAL HEAT FLUX

THERMAL ANALYSIS OF MODIFIED MODEL WITH STAINLESS STEEL TEMPERATURE

TOTAL HEAT FLUX

DIRECTIONAL HEAT FLUX

CFD ANALYSIS OF ORIGINAL MODEL

Input data

Density
CFD ANALYSIS OF MODIFIED TURBINE MODEL

INPUT DATA

DENSITY
PRESSURE

TEMPERATURE

TURBULENCE

VELOCITY

STRESS

RESULTS TABLE

ORIGINAL MODEL

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<th>DIRECTIONAL HEAT FLUX</th>
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<td>MIN</td>
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MODIFIED MODEL:

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CONCLUSION

This study takes a look at the design process of the air intake system of the Liquid Hydrogen Turbine Inlet Manifold. Differences in turbine outputs and applications require different designs of intake-air manifolds in order to achieve the best volumetric efficiency and thus the best turbine performance. In the present work, the flow characteristics of liquid hydrogen flowing in various designs of air-intake manifold will be studied. The study is done by three dimensional simulations of the flow of air within two designs of air-intake manifold into the turbine by using commercial CFD software, ANSYS.

Here we have done thermal analysis on the original model and even on the modified model with the materials cast iron and stainless steel, as if we compare the results obtained we have plotted them in a tubular form, so by the results we can conclude that modified model with stainless steel is the best material as it is having very low heat flux and even the directional heat flux.

As we observe here all the results which are obtained here are plotted in to tabular and graph form, as we can observe in all the variants here the modified model is considered as the best model as here there is a lot of difference in stress and velocity and temperature difference. As for the modified model it is very low, so here we can conclude that the modified model is the best model.

REFERENCES

4. Gas Turbine Performance, Philip Walsh, Paul Fletcher, John Wiley & Sons, 15-Apr-2008

AUTHORS

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2. GUIDE 1

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3. GUIDE 2

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