Three Dimensional Variable Turbulent Intensity Flow Field Characterization of a Vertical Axis Wind Turbine

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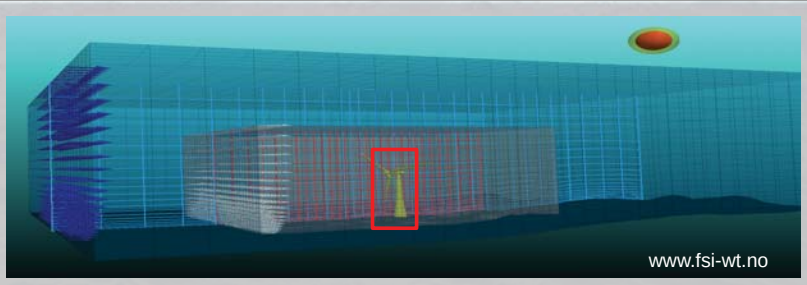
INTRODUCTION

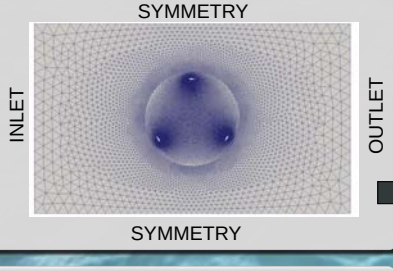
High fidelity three dimensional numerical simulation of flow around a rotating vertical axis wind turbine.

- Use of sliding mesh technique to account for the affect of varying turbulent intensity level on the overall performance.
- Flow visualization to see the disturbances caused by different components of wind turbine on the flow field.
- Detailed torque ripple analysis of individual blade over multiple cycles of turbine rotation.

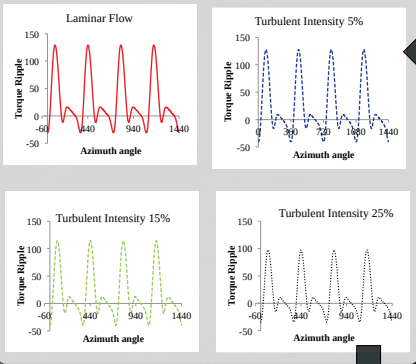


GEOMETRY MODELLING

COMPUTATIONAL MESH



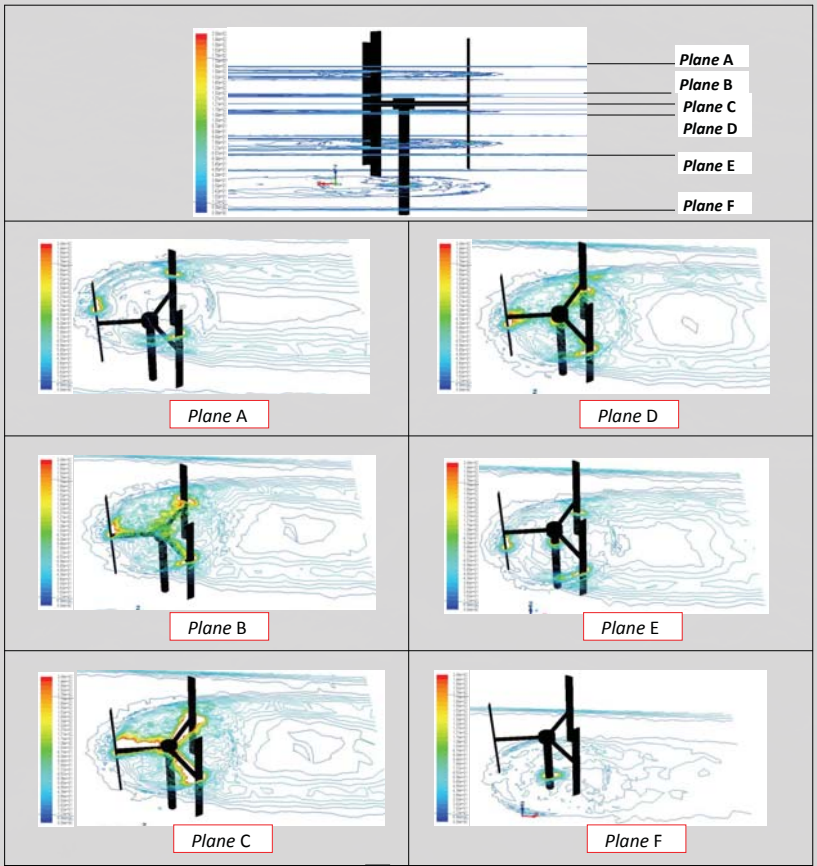
EFFECT OF TURBULENT INTENSITY ON TORQUE RIPPLE



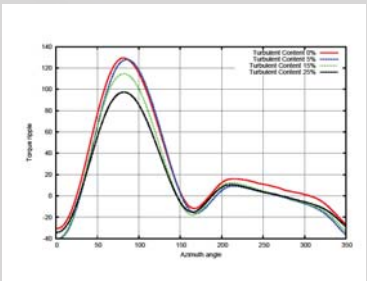
CONCLUSIONS

- Deterioration of the performance of the turbine with an increase in the turbulent intensity of the incoming wind
- Steady torque for H-type VAWT as compared to egg beater type VAWT.
- In comparsion to Laminar case, turbulent intensity levels of 5%, 15%, 20% results in a % drop in performance of 23%, 33% and 42% respectively.

CONTOURS OF VORTICITY ALONG SPANWISE PLANES



COMPARISON OF TORQUE RIPPLE AT DIFFERENT TURBULENT INTENSITY.



QUANTIFICATION OF AVERAGE TORQUE W.R.T TURBULENT INTENSITY

S.No	Turbulent intensity	Average Torque One Blade	% drop in comparison to Laminar
Case I	0% (Laminar)	25.866	0%
Case II	5%	19.72	23%
Case III	15%	17.16	33%
Case IV	25%	14.8	42%

Planned work:

LES analysis to get enhanced visulalization of the flow physics.

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