Background

The problems of sediment erosion and secondary (unwanted) flow in Francis turbines is simultaneous in nature. Depending upon the type of flow phenomena in particular regions and operating conditions, the sediment particles having certain geometric and material properties create distinct erosion patterns on those regions. The erosion on the other hand, deteriorates the surface morphology, aggravating the flow. The combined effect of these two problems contributes to more losses, vibrations, fatigue problems and failure of the turbine. This PhD deals with the regions around guide vanes, where the flow is highly unsteady due to leakages through clearance gap, horseshoe vortex, rotor-stator-interaction and turbulences supported by high velocity and acceleration. A small clearance is present between guide vane and cover plates to adjust the angle corresponding to the certain operating condition. When the sediment particles carried by the flow passes through this gap as a leakage from pressure side to the suction side of the vane, the facing walls are heavily eroded. This erosion increases the gap size and eventually, aggravates the flow. This PhD is a part of a project called SEDIPASS which is being coordinated by NTNU. Moreover, it is a joint PhD program between Kathmandu University (KU) and NTNU.

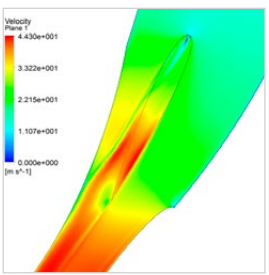
Objectives

a) Numerical and experimental investigation of the leakage flow through clearance gap of guide vanes in high head Francis turbines

   I. Numerical and PIV experiment of existing 1 GV cascade rig including clearance gaps

   II: Design and development of 3 GV cascade rig for TTL in Kathmandu University and conduct the PIV experiments in that rig

b) Guide vane design optimization to reduce the secondary flow and its consequent effects on turbine erosion in sediment laden hydropower projects.



Flow through a clearance gap of GV cascade rig.

Erosion in GV of Jhimruk HP, Nepal.

PhD Thesis

Department of Energy and Process Engineering

2015 – 2018

Secondary flow and Sediment erosion in Francis turbines

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