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Topic	Environmental Engineering
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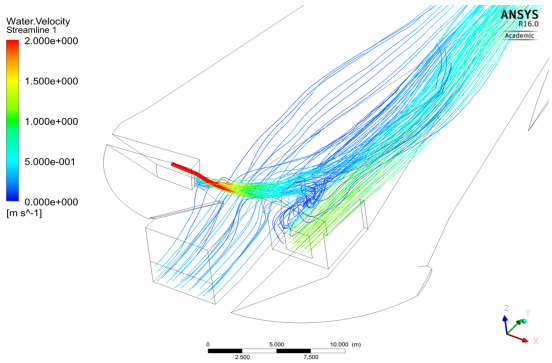
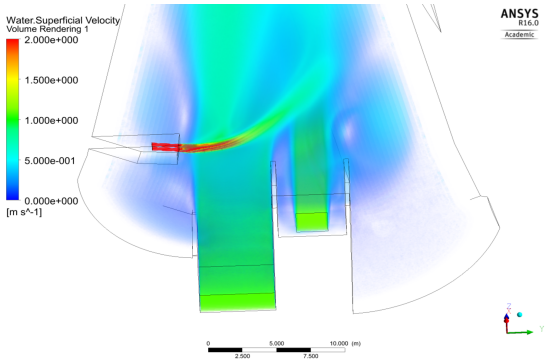
Influence of a hydro power plant on upstream fish migration

CFX modelling

Hydro power plant in Robertsforts, Sweden, with two turbine outlets (centre) and a fish way combined with an attraction water pipe (right).



Streamlines showing the flow behaviour of the water coming from the four inlets. The highest flow velocity is reached in the attraction water pipe.



The efficiency of the fish way could be improved by moving it further downstream and adding a second attraction water pipe.

Introduction: Hydro power has many useful aspects concerning the environment, especially in regard of greenhouse gas emissions, compared to other kind of power generation. However, fish migration is strongly influenced by hydro power plants. Fish is attracted to high water flow velocities. Hence, when the water downstream of a hydro plant flows faster then the so-called «attraction water» of the fish way, the fish are misled and swim into the outlet of the turbine, because they can't find the entrance to the fish-way. In this thesis the situation of the water flow after two turbines run by Skellefteå Kraft in Robertsfors, Sweden, in regard to upstream fish migration is examined. This includes the water flow coming from the two turbines, the fish way as well as the one from the attraction water pipe.

Proceeding: After installing the new turbine «Streamdiver» next to the already existing unit G3, its influence on the efficiency of the fish way is to be examined. For this, a model of the current situation of the water flow is created with ANSYS CFX. Observations on site are carried out to verify the results received by the simulation models. Examined are the situation before the installation of the Streamdiver, the currents situation as well as possible improvements. Such are the displacement of the fish way further downstream, a change of the angle between the fish way and the main flow or an increase in the attraction water mass flow.

Result: In the current situation the efficiency of the fish way is decreased because of a wall underneath the water surface which prevents the attraction water pipe from mixing with the flow coming from the Streamdiver. With the models it can be shown that all changes (moving further downstream, changing the angle and increasing the mass flow) lead to a higher efficiency of the fish ladder, especially if combined. Because of the wall between the turbine outlets acting as a barrier, the displacement has the biggest influence as the barrier can be avoided. The installation of the Streamdiver itself did hardly have any influence on the efficiency of the fish ladder as its outlet is further away from the fish way than the outlet from the G3 unit and the wall between the two outlets was already there before the installation, preventing the attraction water from flowing into the tail race channel of the Streamdiver.