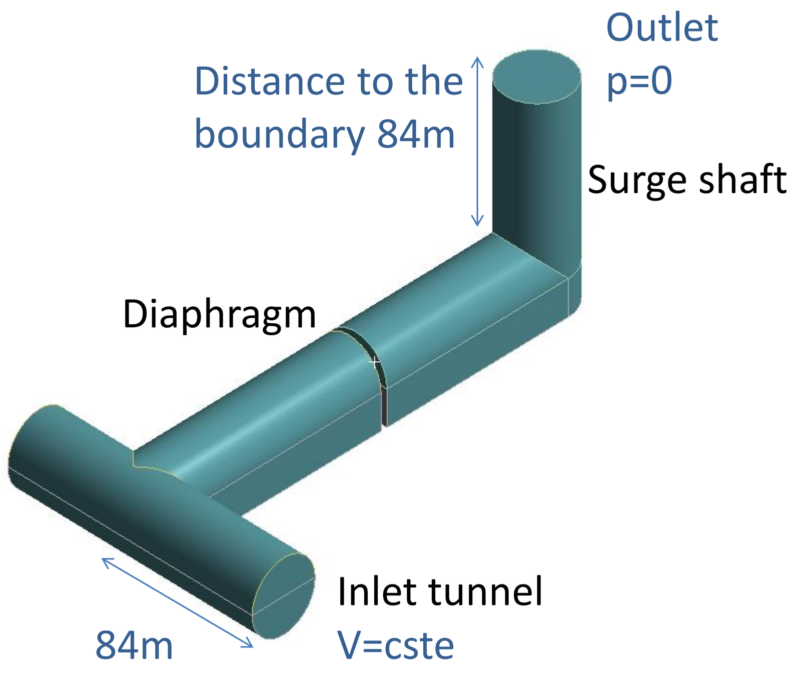
Head loss estimation in diaphragm type configuration at EDF hydraulic engineering

A.GRAND-CLÉMENT

Contextualization and Mesh configurations to optimize computational time

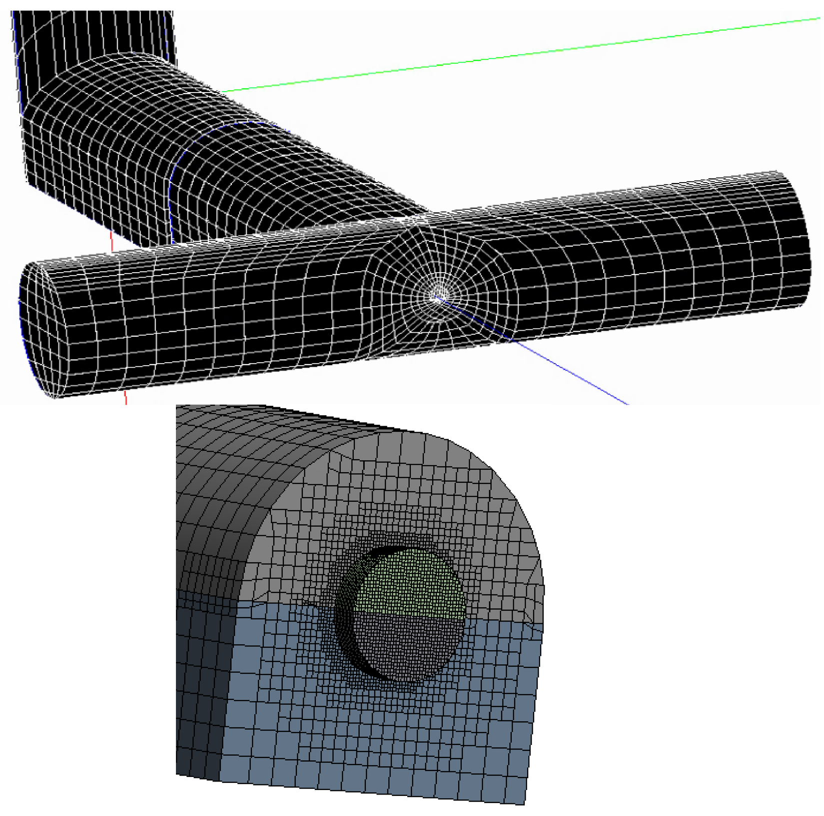


Surge chamber geometry

✓Concerns : The surge chamber allows to decrease the high pressure level in the inlet tunnel and penstock.

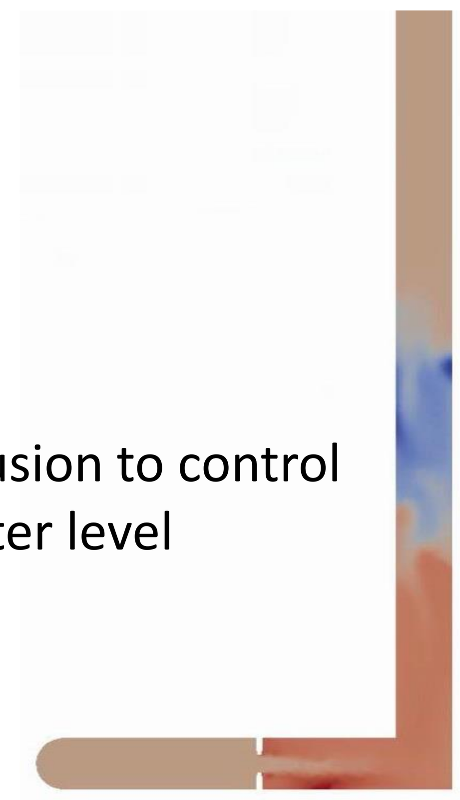
✓The high pressure drop in the diaphragm reduces the water level variation in the surge shaft

✓The sizing of this device is an important part to control water level and to avoid overflowing in the valley.



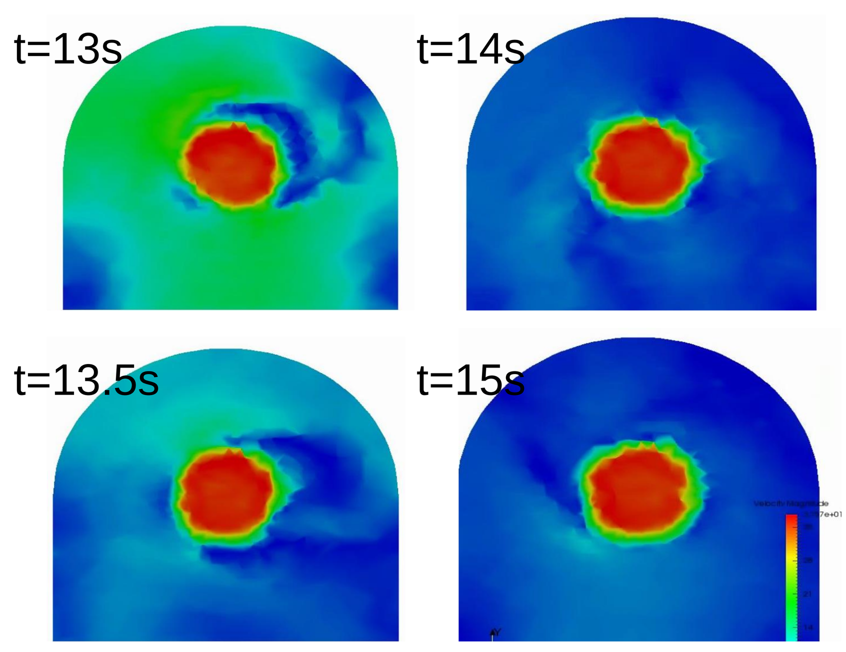
Horseshoe-shaped diaphragm mesh

Scalar diffusion to control water level

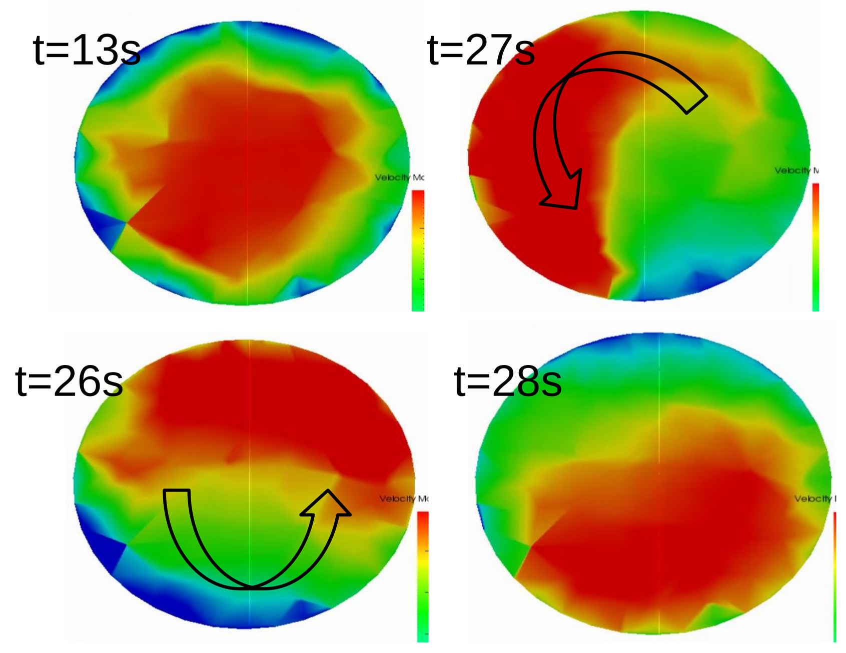


Physical phenomena

Small unsteadyness after diaphragm



Flow recirculation after the bent

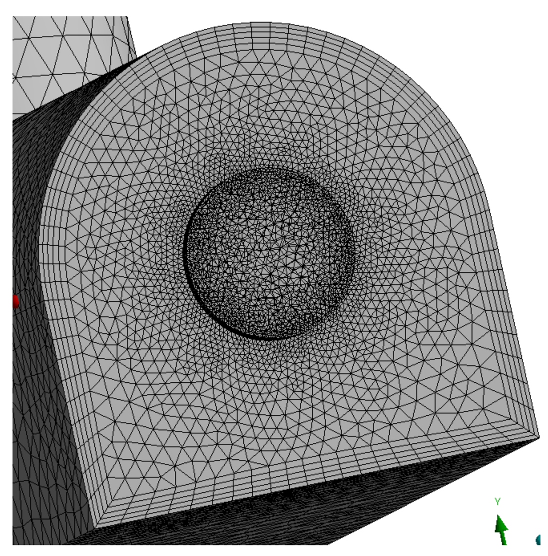


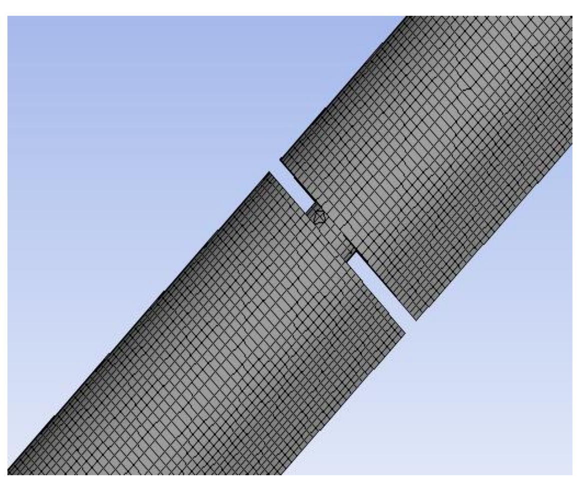
Comparison between steady and unsteady algorithm

	Steady algorithm	Unsteady algorithm
K [m-5.s-2] Head losses coefficient	0.027	0.028

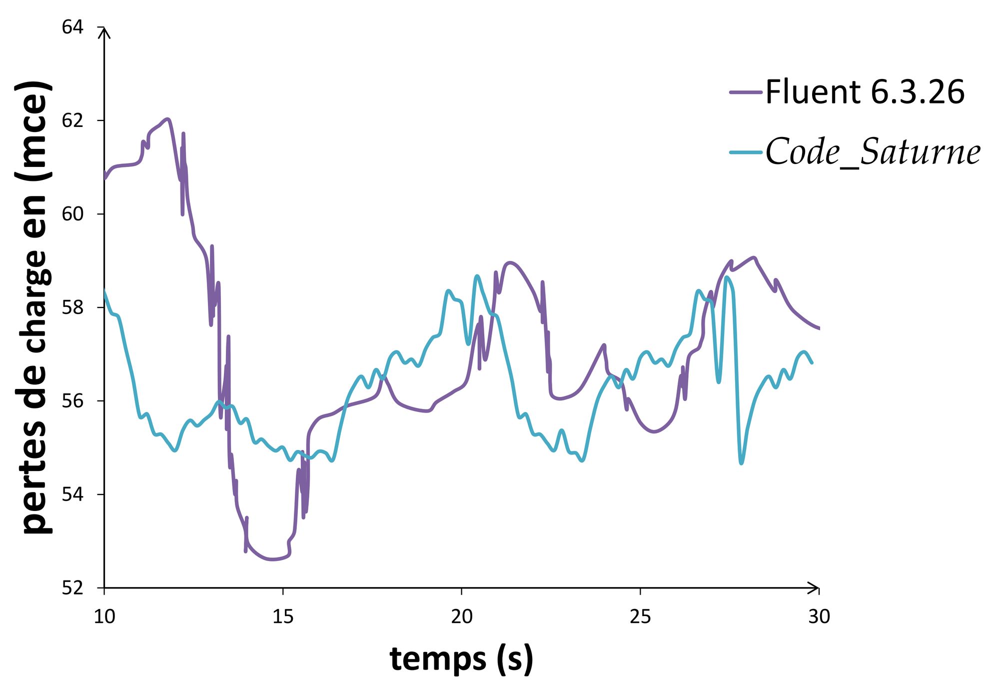
Comparison results for different mesh generators with *Code_Saturne*

Tetra mesh with refinement and boundary layers





Hexa mesh without refinement and boundary layers



Pressure drop profiles in unsteady calculation Comparison between Fluent and Code_Saturne (present study) results

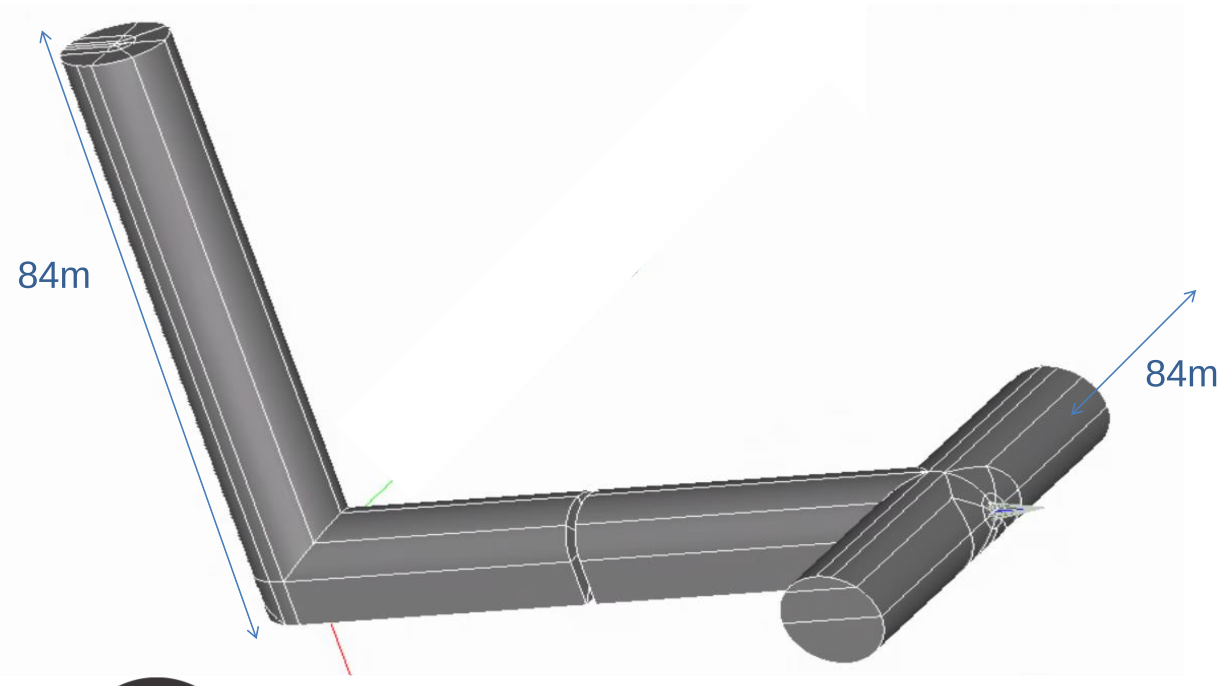
	K hexa mesh	K tetra mesh
Salomé	K=0.0375	K=0.028
Element number	56889	1226000
Ansys	K=0.0345	K=0.025
Element number	40000	231823
Experimental	K=0.0240	
Lowest deviation (%)	4%	

✓ Similar results compared with previous computational calculations

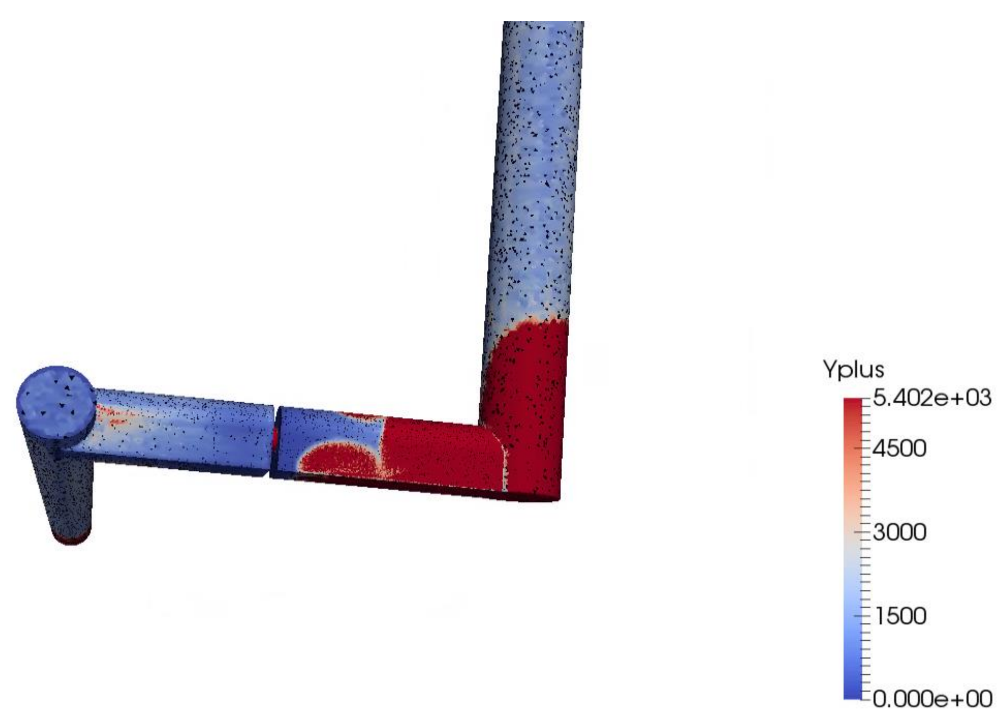
✓4% deviation with experimental results for the tetrahedral mesh with fine discretization at the diaphragm surface and boundary layers

Difficulties encountered

- Block division for the hexa mesh generation



- y+ too high in the interest domain even for k-eps model



✓Difficulties to handle the meshes defaults

✓Divergence solver for boundary layers with hexaedral mesh

✓Method for extracting value on a surface