HYDRAULIC TURBOMACHINES
Exercises 5
Cavitation

Settling level of a Francis turbine

In Figure 1, the installation of the turbine and setting level are shown.
Consider the following input data:

$C_{\bar{I}} = 0.86 \ \text{m}\cdot\text{s}^{-1}$

$Z_{\bar{B}} = 175.6 \ \text{m}$

$p_{atm} = 1.0 \ \text{bar}$

$p_v = 2343 \ \text{Pa}$

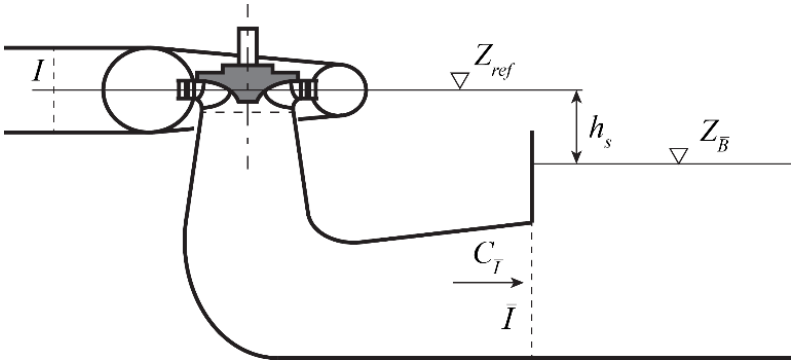

Figure 1. Machine setting level

1) Express the Net Positive Suction Specific Energy (*NPSE*) by $gH_{\bar{I}}$, Z_{ref}, and a saturated pressure p_v.

2) Express Thoma number σ defined by $\frac{NPSE}{E}$, using the setting level $h_s = Z_{ref} - Z_{\bar{B}}$, the flow velocity $C_{\bar{I}}$, the saturated pressure p_v and the atmosphere pressure p_a. Assume that the draft tube outlet is considered as a water outflow (K_v = 1).

3) Compute Z_{ref} the setting elevation of the turbine units, to achieve a net positive suction head (NPSH) of 13.4 m.

Lausanne, 19 October 2023