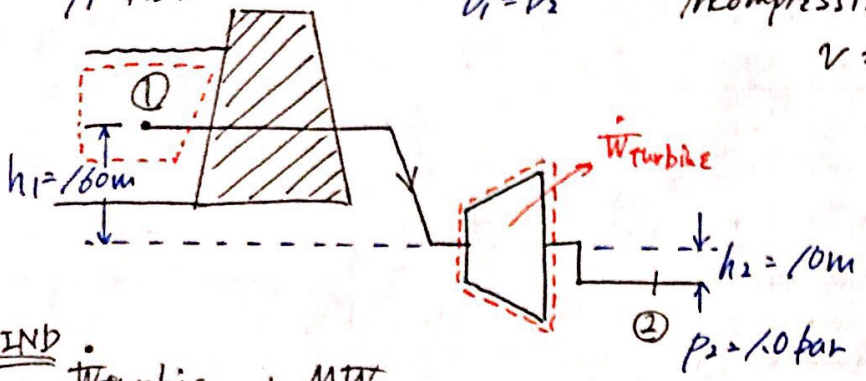
GIVEN & <EFD>



FIND

$\dot{W}_{turbine}$, in MW

ASSUME

open sys, SSSF, 1-DUF, $\Delta KE = 0$, internally rev., isentropic, incompressible fluid.

EQN

$$\frac{dm}{dt}\Big|_{sys} = \sum_i \dot{m}_i - \sum_e \dot{m}_e \quad , \quad \frac{dE}{dt}\Big|_{sys} = \dot{Q} - \dot{W} + \sum_i \dot{m}_i (h + pe + ke)_i - \sum_e \dot{m}_e (h + pe + ke)_e$$

$$\frac{dS}{dt}\Big|_{sys} = \sum \frac{\dot{Q}}{T} + \sum_i \dot{m}_i s_i - \sum_e \dot{m}_e s_e + \dot{\sigma}_{gen} \quad , \quad \dot{w} = \int_1^2 v\,dp + g(z_2 - z_1)$$

SOLN

if we are looking for the maximum power output the turbine is internally reversible and isentropic

$$\dot{W}_{turbine} = \dot{m}\left[v(p_2 - p_1) + g(z_2 - z_1) \right]$$

$$= (950 \text{ kg/s})\left[(10^{-3} \text{ m}^3/\text{kg})(1.5 \times 10^5 \text{ Pa} - 1.0 \times 10^5 \text{ Pa}) + (9.8 \text{ m/s}^2)(160\text{m} + 10\text{m}) \right]$$

$$= 1630200 \text{ W}$$

$$\approx \boxed{1.63 \text{ MW}}$$