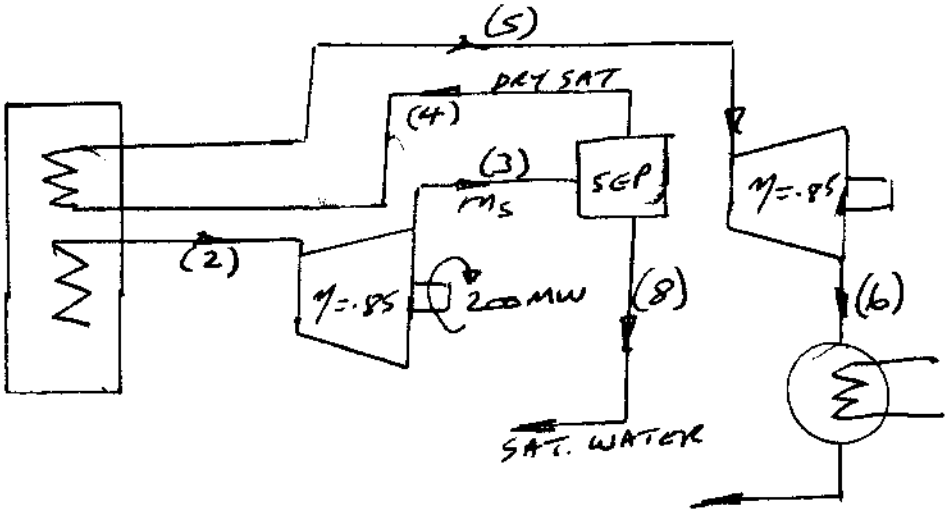
Q1 2002



FROM TABLES

Point (2) $h = h_g$ @ 55G = 2790 kJ/kg

TURBINE $s = s_g$ @ 55G = 5.931 kJ/kg K

IDEAL EXPANSION 2→3'

$s_2 = s_3' = s_f + x_3' s_{fg}$ @ 15 bar

$5.931 = 2.315 + x_3' \times 4.130$ $\quad x_3' = 0.8755$

$h_3' = h_f + x h_{fg}$ @ 15 bar

$h_3' = 845 + 0.8755 \times 1947 = 2549.7$ kJ/kg

ISENTROPIC EFFICIENCY $= 0.85 = \dfrac{2790 - h_3}{2790 - 2549.7}$

$h_3 = 2585.7$ kJ/kg

$2585.7 = 845 + x_3 \times 1947$ $\quad x_3 = 0.894$

POWER $= 200\,000$ kW $= \dot{m}_s (2790 - 2585.7)$

$\dot{m}_s = 978.95$ kg/s

SEPARATOR

$h_8 = h_f$ @ 15 bar $= 845$ kJ/kg

$h_4 = h_g$ @ 15 bar $= 1947$ kJ/kg

$\dot{m}_4 = 978.95 \times 0.894 = 875.2$ kg/s

$\dot{m}_8 = 103.8$ kg/s

2nd TURBINE

$h_5 = 3039 \text{ kJ/kg} \qquad s_5 = 6.919 \text{ kJ/kg K}$

$s_5 = s_6' = 0.832 + x_6' 7.075 = 6.919 \text{ kJ/kg K}$

$x_6' = \dfrac{6.919 - 0.832}{7.075} = 0.860$

$h_6' = 251 + 0.860 \times 2358 = 2279.7 \text{ kJ/kg}$

$\eta_{is} = 0.85 = \dfrac{3039 - h_6}{3039 - 2279.7} \qquad h_6 = 2394 \text{ kJ/kg}$

Power

$P = \dot{m} \Delta h = 875.2 (3039 - 2394)$

$P = 564,848 \text{ kW}$

$P = 564.8 \text{ MW}$

TOTAL TURBINE POWER = 764.8 MW

CONDENSER

$\dot{Q}_{out} = \dot{m} \Delta h = 875.2 (2394 - 251)$

$= 1875.6 \times 10^3 \text{ kW}$

$= 1875.6 \text{ MW}$

BOILER

$\dot{Q}_{in} = P + \dot{Q}_{out} = 764.8 + 1875.6$

$\dot{Q}_{in} = 2640.4 \text{ MW}$

EFFICIENCY $\eta = \dfrac{P}{\dot{Q}_{in}} = \dfrac{764.8}{2640.4} = 0.29$

$\eta = 29\%$