

Water Side Dynamics of an OTSG

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Homework assignment

A small OTSG has 150°C feed water, and generates wet steam at 7,000 kPaa. Feed water rate is 70,000 kg/hr, Heat input from firing is 125 GJ/hr. Tube volume is 9 m³, with 4 tube passes.

- 1) What is the water inlet enthalpy? What is the enthalpy of boiling water (0% quality), and saturated steam (100% quality). Sketch on a graph of enthalpy vs total tube volume. Use steam tables.
- 2) What is outlet steam quality? Assume the heat is added uniformly along the tube. Draw the operating line.
- 3) What is the liquid filled volume? How much time is needed for water to travel from the inlet to the boiling location. This is the time needed to reach steady state.
- 4) Firing rate is increased from 125 GJ/h to 140 GJ/h. What is new steam quality? Show the new operating line and saturation line. What is the new liquid filled volume? How much water mass was gained or lost by the time the OTSG lines out?
- 5) Assume the water mass is removed uniformly while the OTSG lines out. What is the total outlet mass flow of water + steam during the transient? Does the Venturi DP increase or decrease, and why? Will the estimated steam quality read a false HIGH or a false LOW?