PROBLEM 12-7N QUESTION
Computation Of The Axial Distribution Of Thermal And Hydraulic Characteristics Of A Horizontal Steam Generator

1) Operating conditions: see Table 1
2) Properties: determine using the given operating conditions
3) Material and geometry: see Table 1
4) Questions: compute the axial distribution of the following parameters on the secondary side:
   a) Temperature
   b) Enthalpy
   c) Quality
   d) Void fraction
   e) Mass flux (liquid, vapor, total)
   f) Volume flux (liquid, vapor, total)
5) Assumptions:
   • 1 dimension flow
   • Thermodynamic equilibrium
   • Slip ratio = 1.5
   • Once-through steam generator

Table 1

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Thermal</th>
<th>Hydrodynamic</th>
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<tbody>
<tr>
<td>Primary: Horizontal U-Tube (Full-Power Conditions)</td>
<td>Tube O.D. = 0.687 in&lt;br&gt;Tube thickness = 0.050 in&lt;br&gt;Average tube length = 23.78 ft&lt;br&gt;Number of tubes = 13856&lt;br&gt;Heat transfer area = 59,260 ft²</td>
<td>Inlet temp. = 619.2°F&lt;br&gt;Outlet temp. = 555.0°F&lt;br&gt;Power = 900 MW&lt;br&gt;h = 950 Btu/hr·ft²·°F</td>
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<tr>
<td>Secondary</td>
<td>Steam temp. = 540.2°F&lt;br&gt;Feedwater temp. = 440.0°F</td>
<td>Steam pressure = 964.2 psia&lt;br&gt;Flow rate = 3.96 x 10⁶ lbm/hr</td>
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<td>Overall</td>
<td>Tube bundle height = 12.25 ft&lt;br&gt;Tube bundle cross-sectional area (for axial secondary flow) = 471.75 ft²&lt;br&gt;Shell I.D. = 19.5 ft&lt;br&gt;Shell length = 39.0 ft&lt;br&gt;Collector I.D. = 48 in.</td>
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