NOTES:

1. All dimensions in inches
2. All welds shall be root in appearance, free from slag and other defects.
3. Vessel to be cleaned of scale, oil, weld spatter and all other foreign material, prior to hydrostatic test.
4. Round all sharp edges on nozzles (1/8" minimum radius)
5. Pipe to support internal loads only
6. Maximum misalignment of flange joints is limited to 2.5º
7. All flanges to be in accordance with ASME B16.5 standards.
8. Flanges to be flanged to flange flanges center lines.
BILLC OF MATERIALS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>Pipe: 10 NPS Sch 40 Stainless</td>
<td>A-312 TP310</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Flange: NPS 10 Class 150 RFWN Slide On Type</td>
<td>A-105 FF300</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>90° Elbow: 10 NPS Sch 40</td>
<td>A-403 WP500</td>
</tr>
</tbody>
</table>

NOTES:

1. All dimensions in inches
2. All welds shall be mast in appearance, free from slag and other defects.
3. Vest to be cleaned of scale, oil, weld spatter and all other foreign material, prior to hydrostatic test.
4. Remove all sharp edges on branches (1/8" minimum radius)
5. Pipe to support internal loads only.
6. Maximum misalignment of butt welds is limited to 25T
7. All fittings conform to B 16.5 standards.
8. All flanges to conform to B 16.5 standards.
9. Flange bolts to be straight natural centre lines.

LO-2-SS

Circ. Weld
NOTES:

1. All dimensions are in inches.
2. All welds shall be neat in appearance, free from slag and other defects.
3. Vessel to be cleaned out, oil, weld spatter and all other foreign material, prior to hydrostatic test.
4. Remove all sharp edges on nozzle (3/8" minimum radius)
5. Pipe to support nominal loads only.
6. Maximum misalignment of bell joints is limited to .25T
7. All fittings conform to BS 15 standards.
8. All flanges to conform to BS 15 standards.
9. Flange bolt holes to be milled natural center lines.

BILLY OF MATERIALS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>Pipe: 6 NPS Sch 40</td>
<td>A-316 L</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Flange: NPS 6 Class 150 RF WN Sch 40 Rise</td>
<td>A-105</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>LR Elbow: NPS 5 Sch 40</td>
<td>A-234 WPB</td>
</tr>
</tbody>
</table>

CW-1-CS

1:12

See BOM

This drawing and its information herein is confidential, and must not be reproduced or used in any way without the written permission of Pressure Vessel Engineering Ltd.
NOTES:

1. All dimensions in inches.
2. All welds shall be free of cracks, burns, slag inclusions, or other foreign material, prior to hydrostatic test.
3. All welds shall be free of cracks, burns, slag inclusions, or other foreign material, prior to hydrostatic test.
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7. All welds shall be free of cracks, burns, slag inclusions, or other foreign material, prior to hydrostatic test.
8. All welds shall be free of cracks, burns, slag inclusions, or other foreign material, prior to hydrostatic test.
9. All welds shall be free of cracks, burns, slag inclusions, or other foreign material, prior to hydrostatic test.
### Design Conditions

<table>
<thead>
<tr>
<th>Code: ASME B31.3</th>
<th>Year: 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addenda: -</td>
<td></td>
</tr>
<tr>
<td>MAWP: 200 psi</td>
<td>MEAWP: 0 psi</td>
</tr>
<tr>
<td>Max. Temp.: 120 °F</td>
<td>MDMT: 32 °F</td>
</tr>
<tr>
<td>MDMT Press.: 200 psi</td>
<td></td>
</tr>
</tbody>
</table>

- Corrosion Allowance: 0.0625 in
- Hydrotest: 301 psi
- Impact Testing: None
- Impact Exemption: 323.2.2
- Radiography: 5%

### 301 Loads Considered

- (301.2) Design Pressure: Yes
- (301.3) Design Temperature: Yes
- (301.4) Ambient Effects: No
- (301.5) Dynamic Effects: No
- (301.6) Weight Effects: No
- (301.7) Thermal Expansion Effects: No
- (301.8) Support Effects: No
- (301.9) Reduced Ductility Effects: No
- (301.10) Cyclic Effects: No
- (301.11) Air Condensation Effects: No

### ASME B31.3 Piping Calculations

- Cust: Pressure Vessel Engineering
- File: PVEclc-6950-2.0
- Desc: Cooling Water Piping
- Dwg: PVEpid-6950-1.0
- Date: October 17, 2013

### Conclusion

The cooling water piping has been calculated to ASME B31.3. and is found to be acceptable for the given pressure and temperature ratings.
### Table of Contents

<table>
<thead>
<tr>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover</td>
<td>1</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>2</td>
</tr>
<tr>
<td>Material Properties</td>
<td>3</td>
</tr>
<tr>
<td>8 inch Pipe</td>
<td>4</td>
</tr>
<tr>
<td>8 inch Elbow</td>
<td>5</td>
</tr>
<tr>
<td>CI 150 Flange</td>
<td>6</td>
</tr>
</tbody>
</table>

**Drawing:**
- CBM

**Calculation Method:**
- CBM

**Calculation Results:**
- CBM

**Author:**
- CBM

**Reviewer:**
- JLL

**Revision(s):**

<table>
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<th>Description</th>
<th>Date</th>
<th>By</th>
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<tbody>
<tr>
<td>0</td>
<td>Release</td>
<td>17-Oct-13</td>
<td>CBM</td>
</tr>
</tbody>
</table>
**Design Pressure:**

- **P**, internal operating pressure at top of vessel (psig) = 200.0
- **P**, mPa, external operation pressure = 0.0
- **Water**, Operating Fluid
- **h**, fluid height (ft) = 3
- **rho**, fluid density (1.0 for water) = 1.000

Static Head = \( 0.4331 \times \text{rho} \times \text{h} \) = 0.4331 * 1 * 3

Design Pressure = \( P + sH \) = 200 + 1.3

\[ sH = 1.3 \]
\[ mDp = 201.3 \]

**Hydro Test** (ASME B31.3-2008 - 345.4.2)

Test Pressure = \( 1.5 \times mDp \times MR - sH \) = 1.5 * 201.3 * 1 - 1.3

\[ mTp = 301 \]

**Material Properties** (ASME B31.3 Table A-1)

- **mTemp**, design temp ºF
- Test at ambient temp

<table>
<thead>
<tr>
<th>Material</th>
<th>Where Used</th>
<th>Ambient Strength</th>
<th>Design Strength</th>
<th>Strength Ratio</th>
<th>Max ºF</th>
<th>Ext Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS Spec A-106 Gr-B pipes &amp; tubes</td>
<td>Pipe</td>
<td>20000</td>
<td>20000</td>
<td>1.000</td>
<td>1100</td>
<td></td>
</tr>
<tr>
<td>CS Spec A-105 forgings</td>
<td>Flanges &amp; O-lets</td>
<td>23300</td>
<td>23170</td>
<td>1.006</td>
<td>1100</td>
<td></td>
</tr>
<tr>
<td>CS Spec A-234 Gr-WPB forgings</td>
<td>Elbows</td>
<td>20000</td>
<td>20000</td>
<td>1.000</td>
<td>1100</td>
<td></td>
</tr>
</tbody>
</table>

Min Ratio (MR) = 1.000

*Per ASME B16.9, Reducers are calculated as equivalent straight seamless pipe*
**B31.3-Pipe** ver 6.01

### 8 inch Pipe Description

**Dimensions:**

- **D** [in] - outside diameter
- **tnom** [in] - nominal thickness
- **h** [in] - thread allowance B1.20.2
- **UT** [%] - undertolerance allowance
- **Ca** [in] - corrosion allowance
- **Ma** [in] - mechanical allowance

- **8.625**
- **0.322**
- **0.000**
- **12.500%**
- **0.063**
- **0.000**

**Material and Conditions:**

- **FerriticSteel** - material group
- **120** [°F] - design temperature
- **Spec A-106 Gr-B** - material
- **Table211** - applicable material group in B16.5
- **20,000** [psi] - allowable stress level
- **1.00** - longitudinal efficiency (circ. stress)
- **1.00** - weld joint reduction factor
- **201.3** [psi] - design pressure

**Variables:**

- **ci** [in] = **Ma+Ca**
- **co** [in] = **h**
- **c** [in] = **ci+co**
- **T** [in] = **tnom*(1-UT)**
- **d** [in] = **D-2*T**
- **Y1** = From Table 304.1.1
- **Y2** = \((d+2*c)/(D+d+2*c)\)

**Interior Pressure:**

- **t1** [in] = \(P*D/(2*(S*E*W+P*Y1))\)
- **t2** [in] = \(P*D/(2*(S*E*W+P*Y2))\)
- **t** [in] = \(if(t1>=D/6,t2,t1)\)
- **tm** [in] = **t+c**

**CheckT** = **T >= tm**

- 0.063 + 0.0625 = 0.1255
- 0 = 0.0000
- 0.0625 + 0 = 0.0625
- 0.322 * (1 - 0.125) = 0.2818
- 8.625 - 2 * 0.2818 = 8.0615
- \((8.0615 + 2 * 0.0625) / (8.625 + 8.0615 + 2 * 0.0625)\) = 0.4870
- 201.3 * 8.625 / (2 * (20000 * 1 * 1 + 201.3 * 0.4)) = 0.0432
- 201.3 * 8.625 / (2 * (20000 * 1 * 1 + 201.3 * 0.487)) = 0.0432
- IF(0.0432 >= 8.625/6, 0.0432, 0.0432) = 0.0432
- 0.0432 + 0.0625 = 0.1057
- 0.2818 >= 0.1057 = Acceptable
Dimensions:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D [in] - outside diameter</td>
<td>8.625</td>
</tr>
<tr>
<td>tnom [in] - nominal thickness</td>
<td>0.322</td>
</tr>
<tr>
<td>h [in] - thread allowance B1.20.2</td>
<td>0.000</td>
</tr>
<tr>
<td>UT [%] - undertolerance allowance</td>
<td>12.500</td>
</tr>
<tr>
<td>Ca [in] - corrosion allowance</td>
<td>0.063</td>
</tr>
<tr>
<td>Ma [in] - mechanical allowance</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Material and Conditions:

<table>
<thead>
<tr>
<th>Group</th>
<th>Material</th>
<th>Temp [°F]</th>
<th>Spec A-234 Gr-WPB</th>
<th>Table</th>
<th>S [psi]</th>
<th>E</th>
<th>W</th>
<th>P [psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FerriticSteel</td>
<td>Spec A-234 Gr-WPB</td>
<td>120</td>
<td>Table221</td>
<td>20,000</td>
<td>1.00</td>
<td>1.00</td>
<td>201.3</td>
<td></td>
</tr>
</tbody>
</table>

Variables:

\[ ci = Ma+Ca \]
\[ co = h \]
\[ c = ci+co \]
\[ T = tnom*(1-UT) \]
\[ d = D-2*T \]
\[ Y1 = \frac{201.3*8.625}{2*(20000*1*1+201.3*0.4)} = 0.0432 \]
\[ Y2 = \frac{201.3*8.625}{2*(20000*1*1+201.3*0.487)} = 0.0432 \]
\[ t = \frac{201.3*8.625}{2*(20000*1*1+201.3*0.487)} = 0.0432 \]
\[ tm = t+c \]
\[ CheckT = T >= tm \]

Interior Pressure:

\[ t1 = \frac{P*D}{2*(S*E*W+P*Y1)} \]
\[ t2 = \frac{P*D}{2*(S*E*W+P*Y2)} \]
\[ t = \text{IF}(t1 >= D/6,t2,t1) \]
\[ tm = t+c \]
\[ CheckT = T >= tm \]
B16.5 Flange Rating

**Flange Inputs:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Class - pressure class</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA 105</td>
<td>Cl 150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P [psi] - design pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>201.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temp [°F] - design temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
</tr>
</tbody>
</table>

**Geometry Constraints and Data:**

<table>
<thead>
<tr>
<th>Comp = Vlookup(Material,FlangeMatChart,3)</th>
<th>composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C-Si</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table = Vlookup(Material,FlangeMatChart,2)</th>
<th>pressure table</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Table211</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TM [°F] = Vlookup(Material,FlangeMatChart,5)</th>
<th>max temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ckTemp = TM&gt;=Temp</th>
<th>1000&gt;=120 = Acceptable</th>
</tr>
</thead>
</table>

**Pressure Rating:**

<table>
<thead>
<tr>
<th>Pclass [psi] = PVELookup(Table,&quot;Int1Dlin&quot;,Class,Temp)</th>
<th>rated pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>280</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ckP = Pclass&gt;=P</th>
<th>280&gt;=201.3 = Acceptable</th>
</tr>
</thead>
</table>
