Annual Steam Startup at Cornell University

Frank Perry
Utilities & Energy Management
Steve Hubbell
CU Pipe Shop General Foreperson

IDEA CampusEnergy2018
Baltimore, MD
March 5, 2018
Agenda

• Overview of Cornell District Steam System
• Steam Startup Awareness
• Review of Cornell’s Annual 3-day Steam Shutdown
• Single Steam Pipe Startup
• Steam Startup Safety
• Steam Pipe Startup Video
• Questions
Cornell District Steam System

- Cornell Ithaca Campus
  - 21,000 Students + 11,000 Staff & Faculty
  - 2 Square Miles
  - 15.83M GSF

- Steam System
  - Peak Load of ~380 K#/hr
  - 9 Miles of Main & 3 Miles of Laterals w/ ~175 vaults
  - 40 psi Summer and 80 psi Winter
Steam Pipe Startup Awareness

• Points to Remember
  – Go Slow
  – Identify potential issues ahead of time
    Where could condensate puddle?
  – Verify there isn’t any water on the other side of the valves
  – Verify drains are not plugged
  – Install temporary traps if necessary
  – Energize the line downhill if possible
  – Make sure to continually remove all air and water w/ trained personnel

• Campus Wide – Hot vs Cold System
  – Many pipe sizes
  – Differing insulation types
  – Differing slopes
  – Many drip points

• Section of pipe
  – One or two pipe sizes
  – Similar insulation
  – One slope
  – Few drip points
Annual 3-Day Steam Shutdown

– Conduct an annual 3-day steam shutdown from 5 am the day after Memorial Day to 5 pm that Thursday evening.

– Allows for Plant, Distribution, and HP Gas line maintenance.
Preparation for the System Startup

• Central Heating Plant / Management
  – Verify plant work is complete
  – Verify building projects are complete
  – Verify communications for start times with CHP

• Pipe Shop
  – Install temporary steam boiler for the Statler Hotel
  – Crews go to ALL vaults to clean and drain drip legs
    • Usually not the Steam Crew due to shutdown work load
  – Visit all drip points and open and clean all drip legs
    • Open all remote drip drains
  – Startup Personnel List w/ assignments, phone number & radio number
  – Coordinate 60 tradespersons to work overtime
  – Prepared all safety barricades, radios, tripods
  – Pre-Startup meeting & dinner
Campus Drip Map
Steam Startup Work Tasks

- Pipe Shop steam crew (4) at first 2 drip points (Creek and MH-F) until traps working
- Distribution Mgmt follows the steam and directs the CHP when to increase steam flow
- Steam Crew circulates and verify traps are cycling at drip stations and closes the drain.
- Once initial water is out of the system the CHP takes control of the steam output
- Once traps are all working and extra personnel have left, the steam crew disconnects the temporary boiler.
- At end, the Steam Crew makes a lap around Campus to visually look for issues/steam plumes.
<table>
<thead>
<tr>
<th>#</th>
<th>Building or Manhole Identifier</th>
<th>Drip Location</th>
<th>Remote Drip</th>
<th>What To Do</th>
<th>Name</th>
<th>Cell #</th>
<th>Radio#</th>
<th>Condensate Started to Flow</th>
<th>Time Steam Started to Flow</th>
<th>Time Steam Condensed to Flow</th>
<th>Issues &amp; Special Notes</th>
<th>Tripod</th>
<th>Barricade</th>
<th>Location</th>
<th>Access</th>
<th>Keys / Card</th>
<th># of staff needed for start up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Creek Dike MH</td>
<td>366 Side of Creek</td>
<td>Yes</td>
<td>Drain &amp; close -- by pass open</td>
<td>Porter, Chas</td>
<td>3</td>
<td>F 3.24</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td>Remember to shut down bypass</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>MH 35-6</td>
<td>Across creek</td>
<td>No</td>
<td>Drain &amp; leave partially open</td>
<td>Porter, Chas</td>
<td>3</td>
<td>F 3.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>MH F</td>
<td>Campus rd across - Bartels</td>
<td>No</td>
<td>Drain &amp; staff @ startup</td>
<td>Porter, Chas</td>
<td>3</td>
<td>F 3.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>MH 35-1</td>
<td>next to Mh F</td>
<td>Yes</td>
<td>Drain &amp; staff @ startup</td>
<td>Porter, Chas</td>
<td>3</td>
<td>F 3.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>MH G</td>
<td>Sidewalk Field house</td>
<td>Yes</td>
<td>Drain &amp; staff @ startup</td>
<td>Porter, Chas</td>
<td>3</td>
<td>F 3.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>MH 27-1</td>
<td>Hoy Rd / Parking Garage</td>
<td>Yes</td>
<td>Drain &amp; leave open</td>
<td>Porter, Chas</td>
<td>3</td>
<td>F 3.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>MH A-2</td>
<td>Lot near Bradfield</td>
<td>Yes</td>
<td>Drain &amp; staff @ startup</td>
<td>Bergen, Jeremy</td>
<td>17</td>
<td>F 5.15</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>MH-2</td>
<td>middle of Alumni field</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Bergen, Jeremy</td>
<td>17</td>
<td>F 5.15</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>MH 43-1</td>
<td>in front of Wrestling Fac.</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Conley, Dan</td>
<td>2</td>
<td>F 5.15</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>MH 43-2</td>
<td>Wilson Lab vault</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Conley, Dan</td>
<td>2</td>
<td>F 5.15</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>MH 36-5</td>
<td>Tower Rd. near Bradfield</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Thomas, Rob</td>
<td>9</td>
<td>F 7.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td>TS - 9.40</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>LSTB (Well Hall)</td>
<td>Base MR</td>
<td>No</td>
<td>Drain &amp; staff @ startup</td>
<td>Eastman, Paul</td>
<td>10</td>
<td>F 7.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>MH 51-2</td>
<td>Campus rd. south of Surge III</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Strong, Ray</td>
<td>11</td>
<td>F 7.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td>TS - 8.30</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>MH K</td>
<td>sw corner of Barton Hall</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Lell, Bill</td>
<td>12</td>
<td>F 7.33</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>MH AF</td>
<td>W. Wing dr / Riley Robb</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Hotchkins, Brian</td>
<td>40</td>
<td>F 10.40</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Corson Hall</td>
<td>nr. in Corson start up trap</td>
<td>No</td>
<td>Drain &amp; staff @ startup</td>
<td>Humphrey, John</td>
<td>15</td>
<td>F 7.39</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>17</td>
<td>BioTech</td>
<td>Base MR</td>
<td>No</td>
<td>Drain &amp; staff @ startup</td>
<td>Humphrey, John</td>
<td>15</td>
<td>F 7.39</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>18</td>
<td>Comstock Hall</td>
<td>nr. in Comstock</td>
<td>Yes</td>
<td>Drain &amp; staff @ startup</td>
<td>Fossacecca, Mark</td>
<td>16</td>
<td>F 7.39</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>Plant Sci. Warren</td>
<td>MR &amp; Tunnel</td>
<td>No</td>
<td>Drain &amp; staff @ startup</td>
<td>Carr, Dan</td>
<td>8</td>
<td>F 10.40</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>Plant Sci. West Tunnel MH</td>
<td>West of Plant Science in Sidewall</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Kelly, John</td>
<td>18</td>
<td>F 5.29</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>21</td>
<td>MH 36-7</td>
<td>Ag Quad West of Minns Garden</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Kelly, John</td>
<td>18</td>
<td>F 5.29</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>MH VMC</td>
<td>S.W. end of VMC L D.drive</td>
<td>Yes</td>
<td>Drain &amp; leave open, staff@ startup</td>
<td>Moon, Mike</td>
<td>13</td>
<td>F 5.15</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td>VMC</td>
<td>in diesel gen. rm &amp; air way</td>
<td>No</td>
<td>Drain &amp; staff @ startup</td>
<td>Moon, Mike</td>
<td>13</td>
<td>F 5.15</td>
<td>11:42:00</td>
<td>10:00:00</td>
<td>10:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>
• Install pressure gauge (E) if possible
• Drain out any water at (A) and leave fully open
• At (B) drain verify there is no water on both sides of hot valve. Best to install temporary trap at this location
• Crack valve (C) and slowly let by steam to warm up main
• At (A) listen for air, then water. If water is more than drain can handle partially close valve (C)
• Once steam is present at (A) slowly start closing the valve to reduce the steam loss but still allowing water to drain
• Continue to slowly open (C)
• Once pressure has stabilized open downstream valve (S)
Steam Startup Safety

• Campus notification & feedback
• Startup Mgr. notifies the buildings and CU Police
• Pre-Startup meeting/dinner to review safety issues and to thank everyone for the overtime.
• Sheet of assignments
• Customer Service/radios/cell phones – Personnel report to CS with times which Startup Mgr. monitors.
• Last year's times listed on a map for Startup Mgr. and all personnel.
• Crew size – 60 people w/ only 6 or 7 with steam experience
• External drip accessible from above ground
• Only Pipe Crew enters the vaults
• Same people at same locations every year if possible
• Pipe Crew floats where needed
• Clear identification of Roles and Responsibilities
Steam Startup Video

- Note this is a mockup of a vault dripleg/trap assembly.
- An actual trap would be 100% welded past up to and including the trap root valve and the drain valve.
- All piping would be carbon steel.
- Trap is a thermal dynamic type with integral strainer and blowdown.
- In the vault, the trap can only be heard, not seen working.
- The check valve would normally be just before the condensate main root valve.
Questions?