Steam System Operation and Distribution System Optimization
Session Presenters

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Session Logistics

- **Session Time** – 1:30pm – 3:00pm
- **Main Presentation** – 1:30pm – 2:45pm
- **Questions and Answers** – 2:45pm – 3:00pm
- **Phones** – Please put them on vibrate mode, also be considerate of others and take your calls outside
What We Do

• A Full Range of Services for Building Energy Efficiency
  – Energy Audits, Green Building Design for Existing Buildings and New Construction
  – Energy Efficiency Program Design and Implementation
  – Energy Efficiency Training
Chapter List:

• Chapter 1 – Managing Multifamily Weatherization
• Chapter 2 – Understanding Multifamily Housing Stock
• Chapter 3 – Multifamily Energy Auditing
• Chapter 4 – Multifamily Building Enclosures
• Chapter 5 – Heating and Domestic Hot Water Systems
• Chapter 6 – Cooling and Heat Pump Systems
• Chapter 7 – Mechanical Ventilation Systems
• Chapter 8 – Lighting and Electrical Base Load
• Chapter 9 – Energy Modeling and Savings Analysis
• Chapter 10 – Project and Construction Management
• Chapter 11 – Health and Safety Considerations

Learning Objectives

• One Pipe Steam Distribution System Operation
  – Steam Movement and Heat Transfer
  – Air Vent Operation
  – Condensation Return

• One Pipe Steam Distribution System Issues
  – Distribution Imbalance (Over-heating and Under-heating)

• CNT Energy Case Study
  – One Pipe Steam Distribution System Optimization
  – Energy Savings Associated with Distribution Measures
One Pipe Steam System
One Pipe Steam System

• Off Cycle
  – Notice the water level at both ends of the building is equal.
Steam Boilers
Pressuretrols
One Pipe Steam System

• A Few Minutes After Start Up
  – Notice the air in the distribution system venting out.
One Pipe Steam System

- A Few More Minutes After Start Up
One Pipe Steam System

• Radiators Getting Filled With Steam
  – Notice:
    • Condensate
    • Steam
    • Water Level, Etc…
One Pipe Steam System

- All Radiators Filled With Steam
One Pipe Steam System

- Air vent working principle:
  - Lets air out, but not steam
  - The alcohol/water mixture expands and contracts depending what is surrounding it (steam or hot condensate)
One Pipe Steam System

Why Doesn’t This Radiator Get Hot?

- The air vent needs to be pointing upward, otherwise no air can get out and no steam can get into the radiator.
One Pipe Steam System

Where Do I Change The Air Vent?
One Pipe Steam System

- Wrong air vent:
  - A straight vent rather than an angle vent.
One Pipe Steam System

- Steam Leaks
Temperature Imbalance

- Stack Effect
  - Upper Floors are Overheated
Temperature Imbalance

- Energy Improvements
  - Insulation
  - Air Sealing
  - Window Replacement
    - Oversized Heating System
One Pipe Steam System

How Do We Balance A One Pipe Steam System?
One Pipe Steam System

Balancing a One Pipe Steam System

• Let’s see what’s going on here:
  – Steam and condensate pass through the same valve
    • So What?
One Pipe Steam System

Balancing a One Pipe Steam System

You cannot throttle this valve because...
If you throttle this valve, you restrict the flow area and now steam and condensate compete to pass through limited space and we have water hammer problem.
Use Different Capacity Vents
One Pipe Steam System

Balancing a One Pipe Steam System

• Use larger capacity vents for radiators farther from the boiler and smaller capacity vents for radiators closer to the boiler. Why??
  – Remember flow seeks path of least resistance
One Pipe Steam System

Distribution Piping Layouts

- Which riser is “furthest” from the boiler?
- What do you need to do to be able to tell?
One Pipe Steam System

Master Venting
One Pipe Steam System

Master Venting

Correct

Main Vent

6” - 10”

15”

Incorrect

Main Vent
One Pipe Steam System
Master Venting – Improper Installation

Air Vent with Cracked Float

Last Riser

Horizontal Main

Drip Return to Boiler
One Pipe Steam System

Distribution Controls

- Non-electric thermostatic radiator valves ("TRV")
One Pipe Steam TRV
Thank You!