Welcome……

ENGINEERING PHARMACEUTICAL INNOVATION

The Basics of HVAC Operation and the Role of Automation

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Agenda

- Introduction / Overview
- HVAC Basics
- HVAC in Life Science Market
- Automation's role in it all

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Introduction / Overview

1. Automation systems
   - The misunderstood black box – If something is wrong, it must be the controls!
2. Automation doesn't solve mechanical problems
   - BUT Automation can minimize the impact
3. Understand the system and you can understand the automation

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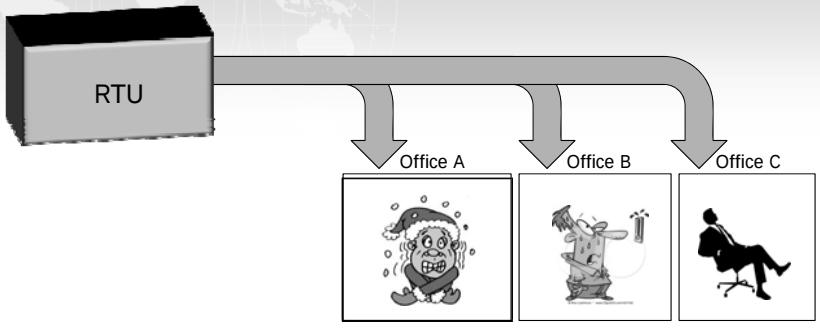
HVAC Basics – The Most Basic of Commercial Offices



- Guess who owns the Thermostat??
- Will Automation fix this problem??

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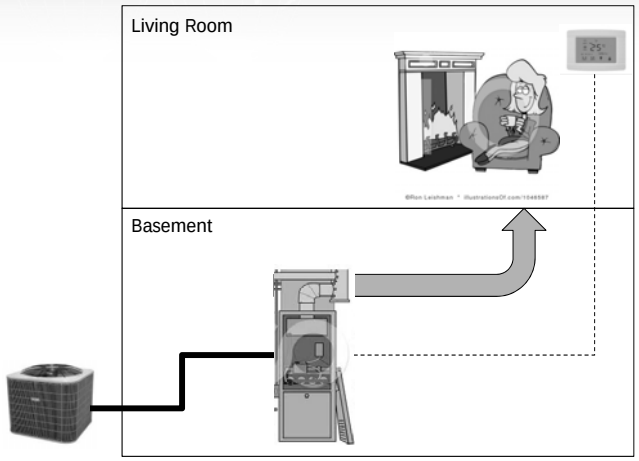
Basic Equipment

- What is an RTU - Roof Top Unit



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Basic Equipment

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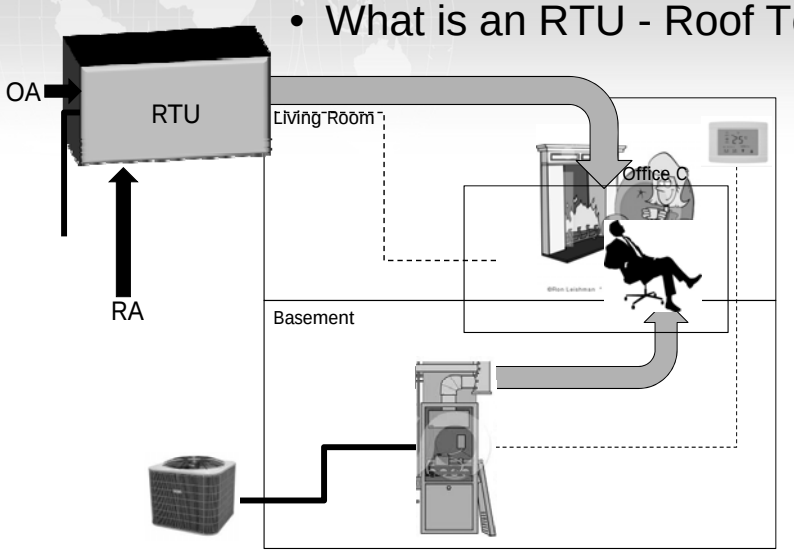

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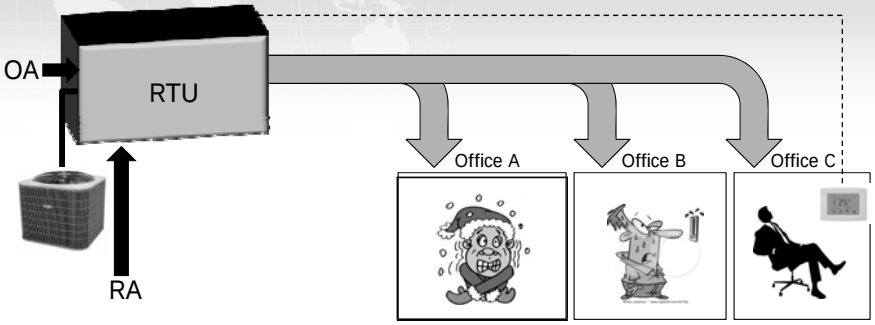
Back to the Basics



- How do we fix this problem?
- What's the downside?
- How does automation fit in?

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Back to the Basics – Fixing the Problem

1. How do we fix this problem?
   - Recalculate largest cooling loads
   - Rebalance the system to ensure each room gets the required cooling from the RTU to overcome the maximum cooling load
   - Provide constant supply cooling air to each office
     - Bonus Question – What supply air temperature is standard and why??
   - Provide individual heating to each office controlled by individual room thermostats

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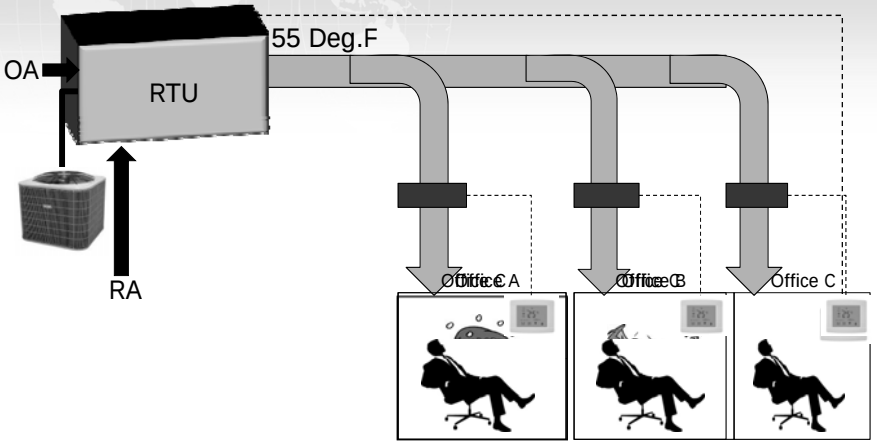
Back to the Basics – Fixing the Problems



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Designing a Better System

1. What's the downside of this?
   - Providing the maximum amount of cooling required for each office and then reheating
   - BIG waste of energy
2. How do we reduce wasted energy?
   - Control the amount of cooled air going to each room
   - VAV – Variable Air Volume
3. Sequence of operation:
   - Temperature rises above setpoint, provide more air / cooling
   - Temperature drops below setpoint, provide less air / cooling
   - With airflow at a minimum (based on required fresh air or air change requirements) and temperature continues to drop below setpoint, turn on the heat for the room
4. Provides individual space temperature (and dehumification) control at lowest energy costs

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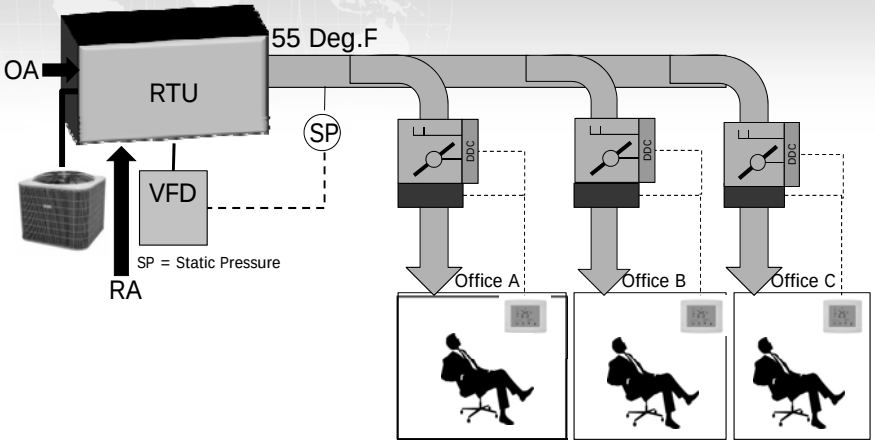
Designing a Better System



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Moving into the world of Life Sciences

1. Need tight control of temperature, humidity, room pressure, and airflow for fume hoods
2. Energy takes a back seat to stability and safety but is still important
3. Much more complicated systems
4. To meet the demands, a good automation product and supplier is a must!

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AHU vs RTU – Tightening up the control at the central systems

RTU is gas fired / DX

- Step Control for heating and cooling
- Can not provide tight control

AHU has chilled water / hot water coils

- Modulating control
- Ability to provide tight control
- IF DESIGNED PROPERLY!

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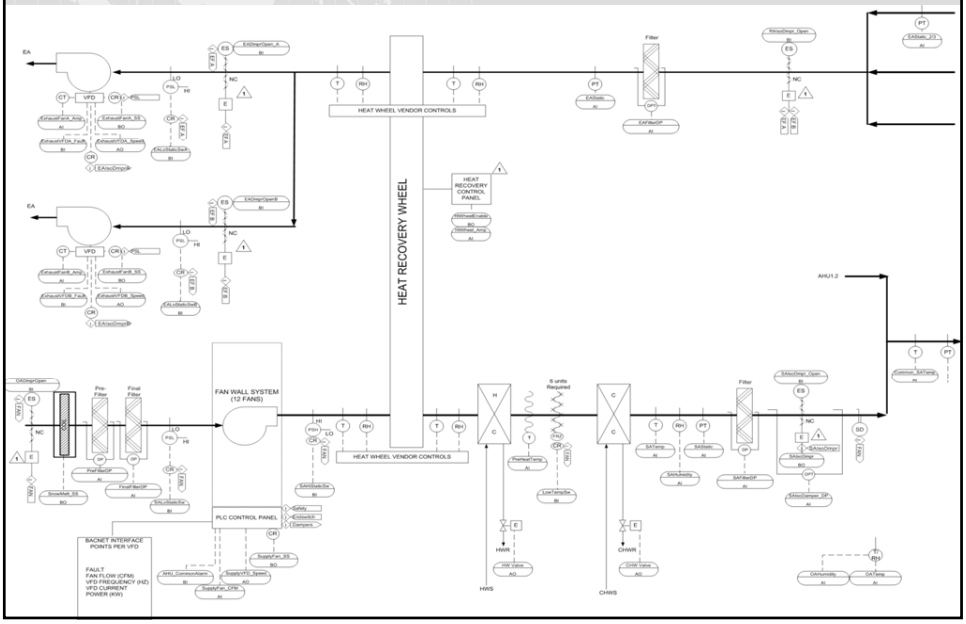
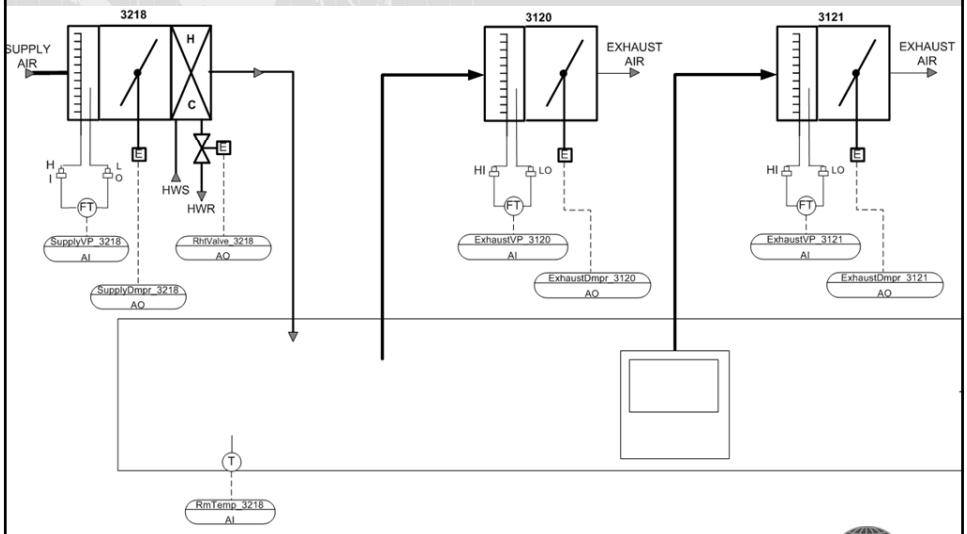
AHU for Clean Rooms



Typical Laboratory w/ CV Hood



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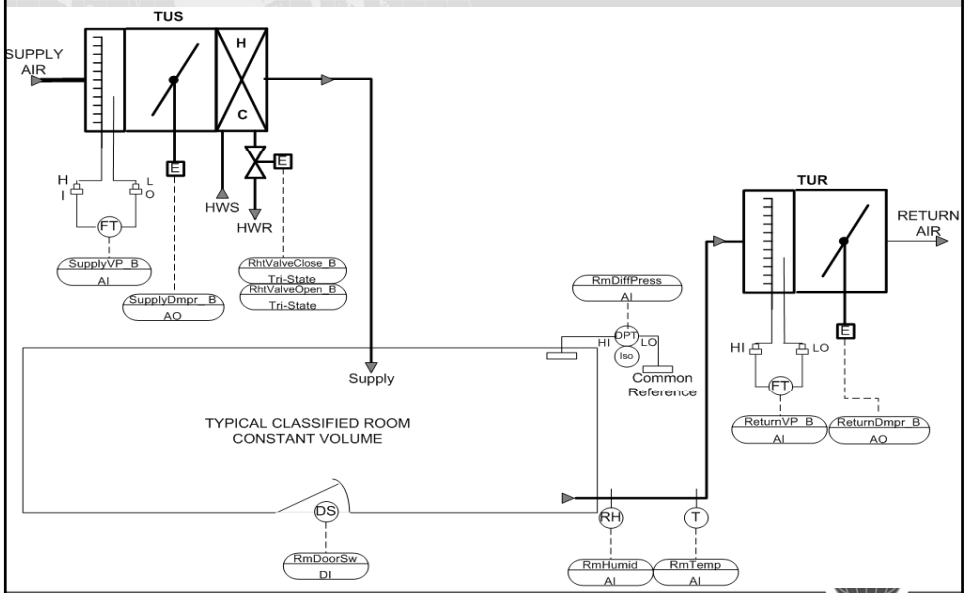
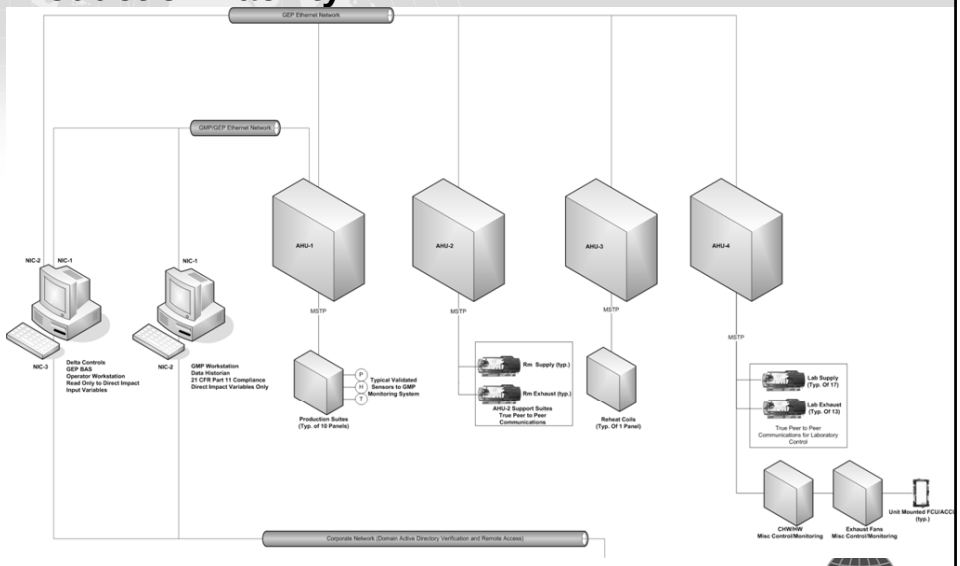
Typical Clean Room



Typical HVAC Automation Architecture For GMP Production Facility



Now you can see the need for Automation!

1. All systems need to work in concert
2. Automation maintains process variable control
   - Temperature – Product Stability, Creature Comfort
   - Humidity – Product Stability, Creature Comfort
   - Air Flow Pressurization –Product Cross Contamination, Containment, Safety
3. Even a simple office VAV box has many variables, complex code, and central functions
   - Scheduling
   - Alarming
   - Reporting
4. Central Systems require complex code to meet sequences of operation

Summary……..

- Understand the systems being controlled
- Automation systems can only control to the capabilities of the mechanical systems
- If properly designed and installed, 9 times out of 10, the automation system is not the issue
- All stakeholders need to provide input to the requirements before system design and automation implementation

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Thank You…….

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Bonus Question – The Psych Chart