# 16th STS-AIChE Southwest Process Technology Conference

- Pinch Analysis of a Complex Reboiler System
- Cliff Maat and Matt Lumnitzer
- TPC Group




Sept 22-23, 2025, University of Houston

# TPC GROUP QUICK FACTS

- » **Headquartered in Houston, Texas**
- » **Products sold into a wide range of performance, specialty and intermediate applications, including synthetic rubber, fuel additives and plastics**
- » **A leading producer of value-added products derived from niche petrochemical raw materials such as C4 hydrocarbons.**
- » **Manufacturing facility in the industrial corridor adjacent to the Houston Ship Channel and product terminals in Port Neches, Texas and Lake Charles, Louisiana**
- » **Major contributor to the areas in which it operates:**
  - Purchases of goods and services annually add $350 million to the local economy
  - Contributes more than $10 million each year collectively in property taxes to various city, county and school authorities
  - Nearly 800 employees and full-time contractors

**Clifford Maat, PE** is a Principal Process Engineer at TPC Group in Houston, working in dehydrogenation and distillation technologies. Prior to his work with TPC Group, Cliff worked in both petrochemical and refining processes, completing process engineering designs and optimizing commercial processes with Phillips, Sasol (North America and South Africa), and Shell Global Solutions. He earned his Bachelor’s Degree in Chemical Engineering from the University of California, San Diego, in 1987. Cliff has also served as a Peace Corps Volunteer in Ghana and Russia.

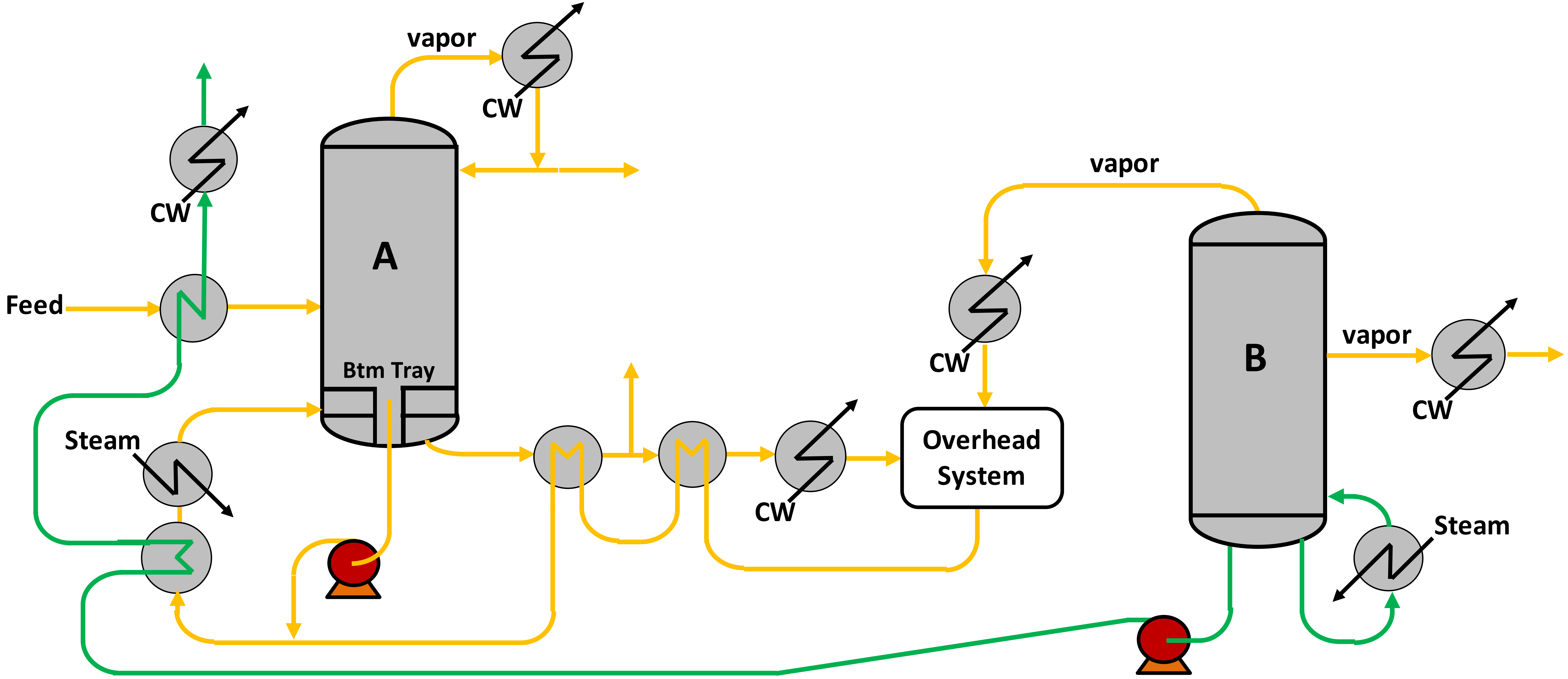
**Matthew Lumnitzer** is a Staff Process Engineer at TPC Group in Houston, working primarily with butadiene extraction and other C4 petrochemical processes.  Matt has prior experience in operations, process improvement, and process design for olefins processes at LyondellBasell and pesticides processes at DuPont. He earned his Bachelor’s Degree in Chemical Engineering from Virginia Tech in 2013.

# Pinch Analysis of a Complex Reboiler System

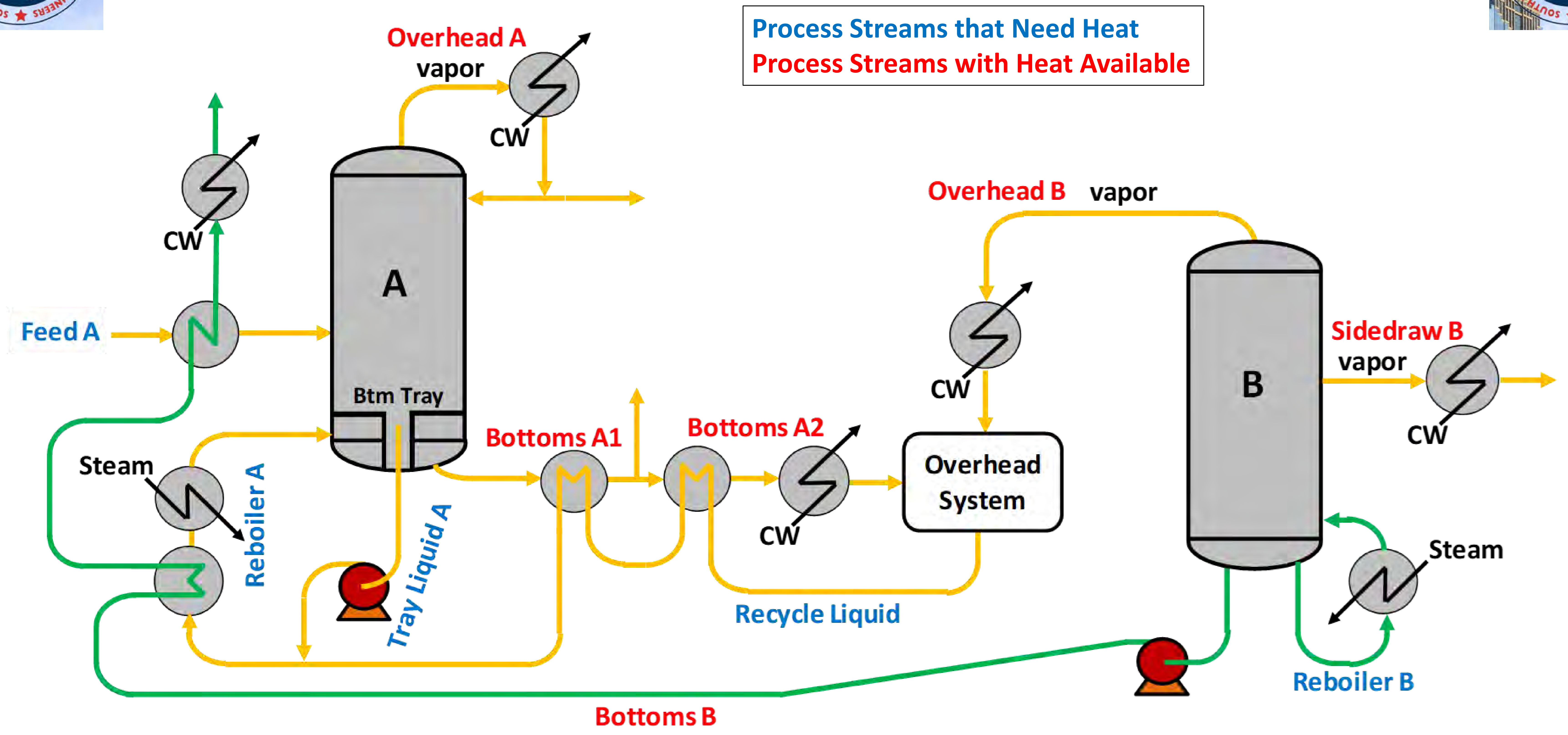
**Part 1**

Energy Savings Identified by Pinch Analysis and Realized with a Capital Project

# Process Flow Diagram



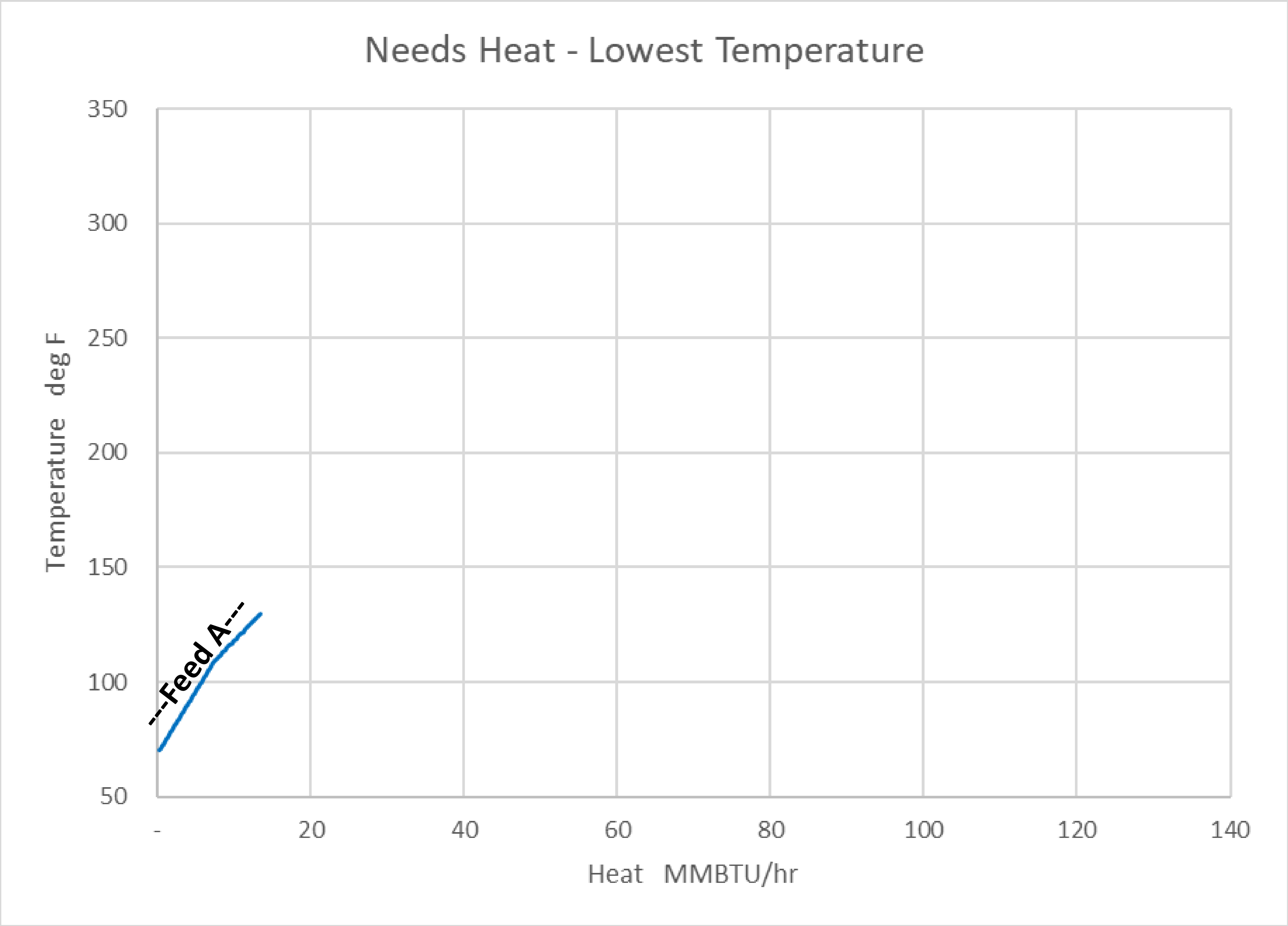
# Process Flow Diagram



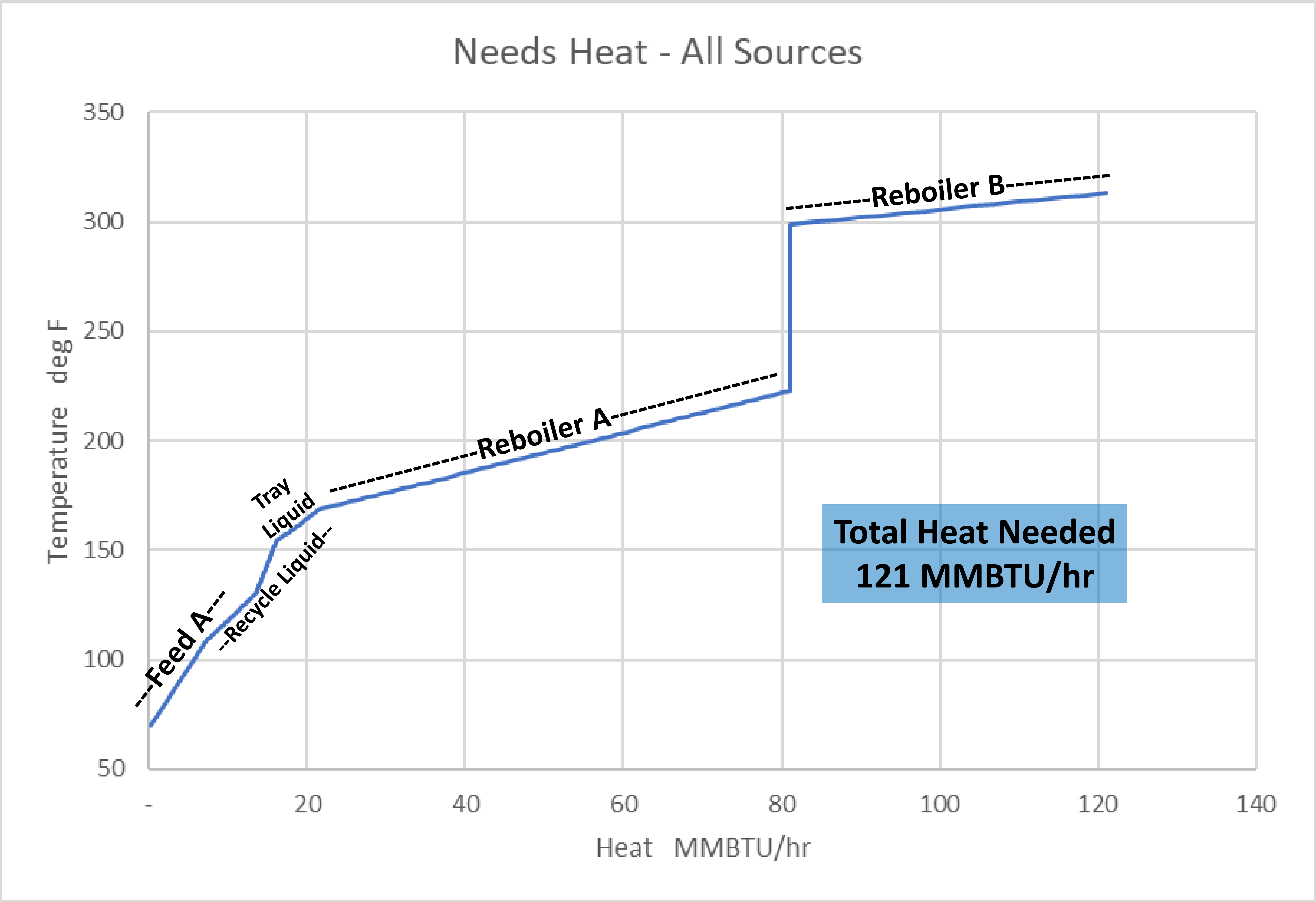
# Heat Transfer Requirements

| **Process Streams** | | Inlet Temp deg F | Outlet Temp deg F | MCp MMBTU/(hr F) | Enthalpy MMBTU/hr |
|---|---|---|---|---|---|
| Feed A | Needs Heat | **70** | 130 | 0.19 | 11.3 |
| Recycle Liquid | Needs Heat | **110** | 170 | 0.11 | 6.5 |
| Tray Liquid A | Needs Heat | **155** | 170 | 0.28 | 4.3 |
| Reboiler A | Needs Heat | **170** | 223 | 1.11 | 59.0 |
| Reboiler B | Needs Heat | **300** | 313 | 3.09 | 40.0 |
| Bottoms A2 | Heat Available | 211 | **90** | (0.07) | 9.0 |
| Overhead A | Heat Available | 111 | **106** | (5.10) | 25.7 |
| Bottoms B | Heat Available | 300 | **111** | (0.28) | 52.2 |
| Overhead B | Heat Available | 204 | **120** | (0.07) | 6.2 |
| Sidedraw Vapor B | Heat Available | 260 | **165** | (0.03) | 2.7 |
| Bottoms A1 | Heat Available | 222 | **211** | (0.44) | 5.0 |

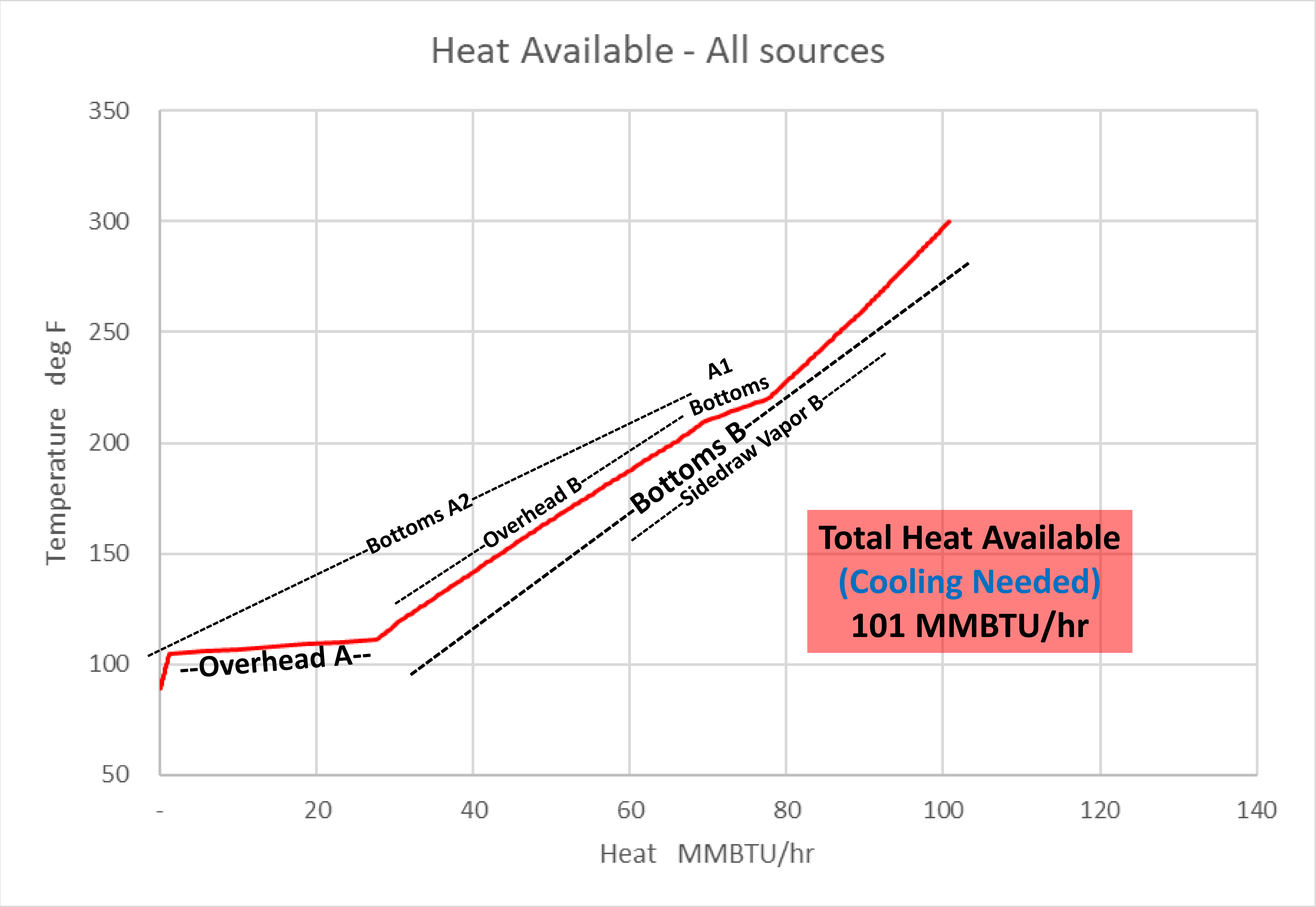
# Build the Composite Curve #1



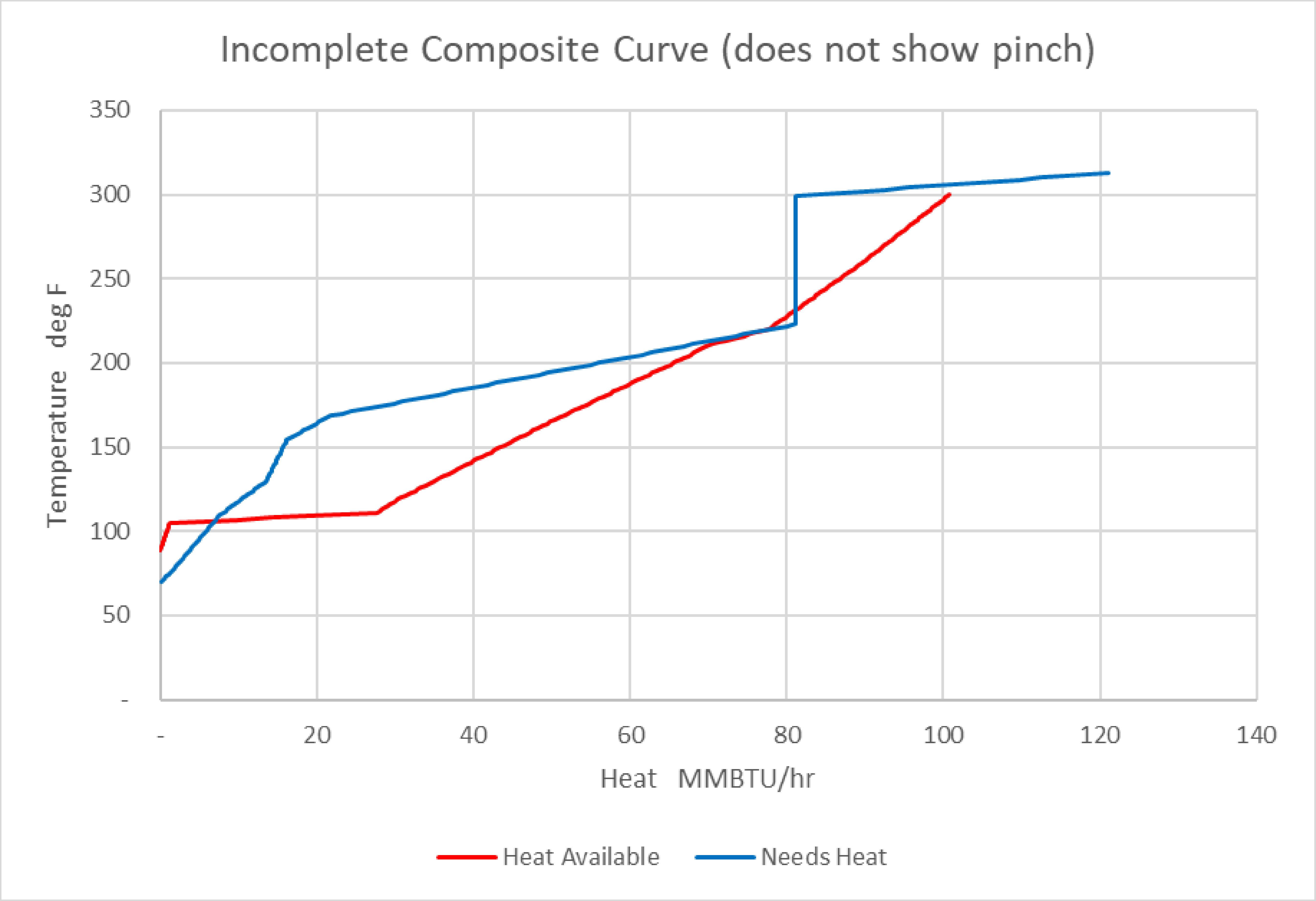
# Build the Composite Curve #2



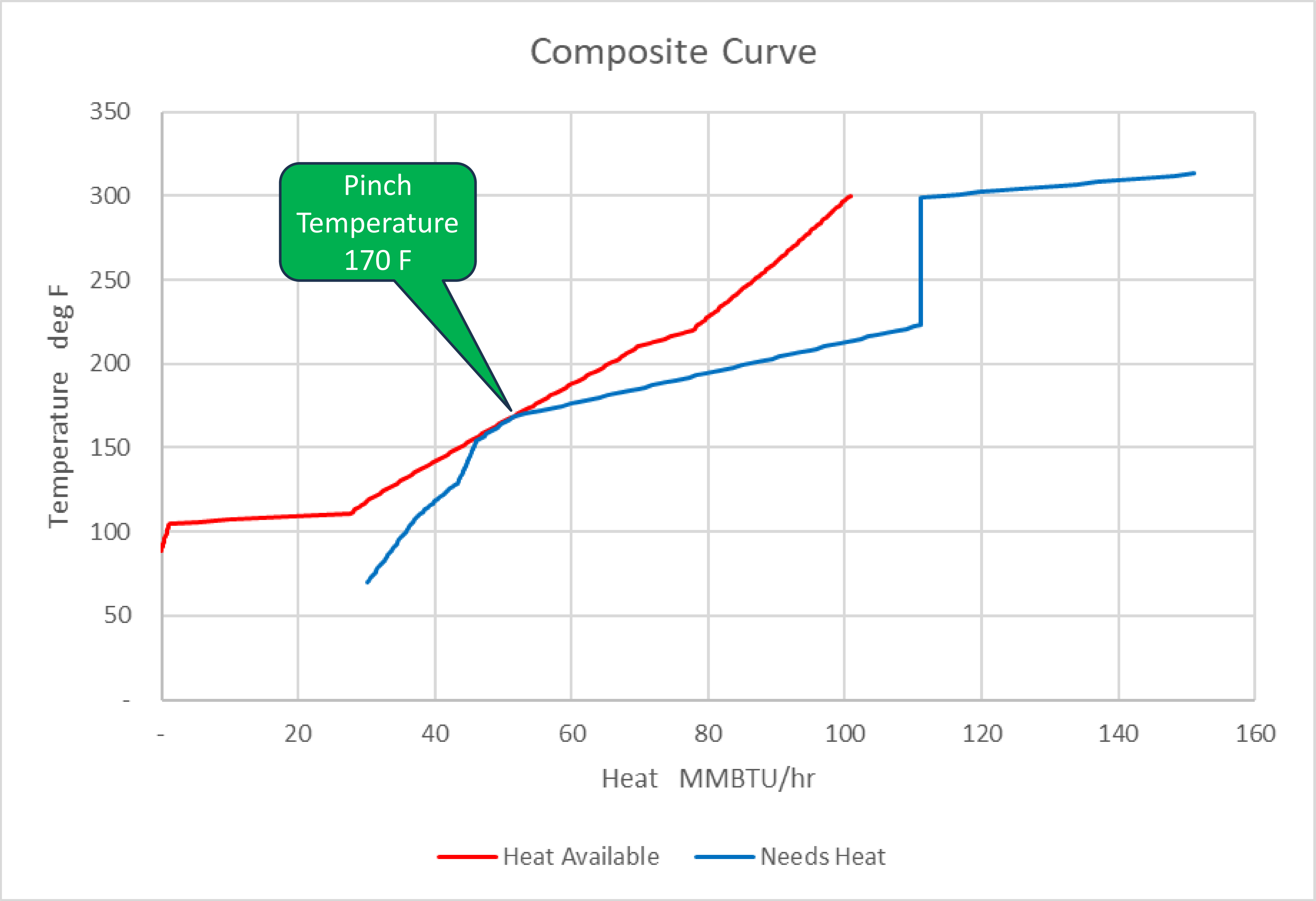
# Build the Composite Curve #3



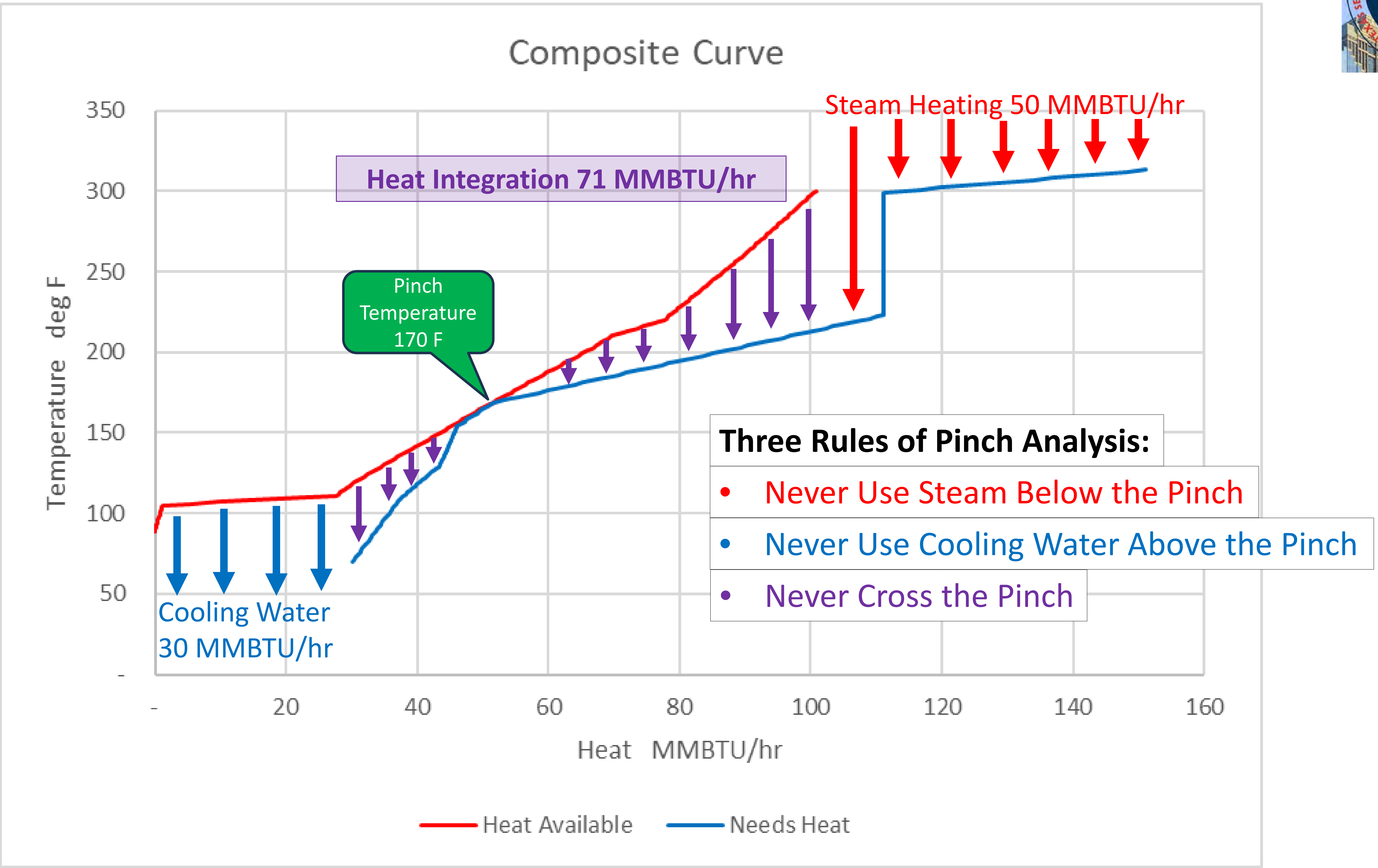
# Build the Composite Curve #4



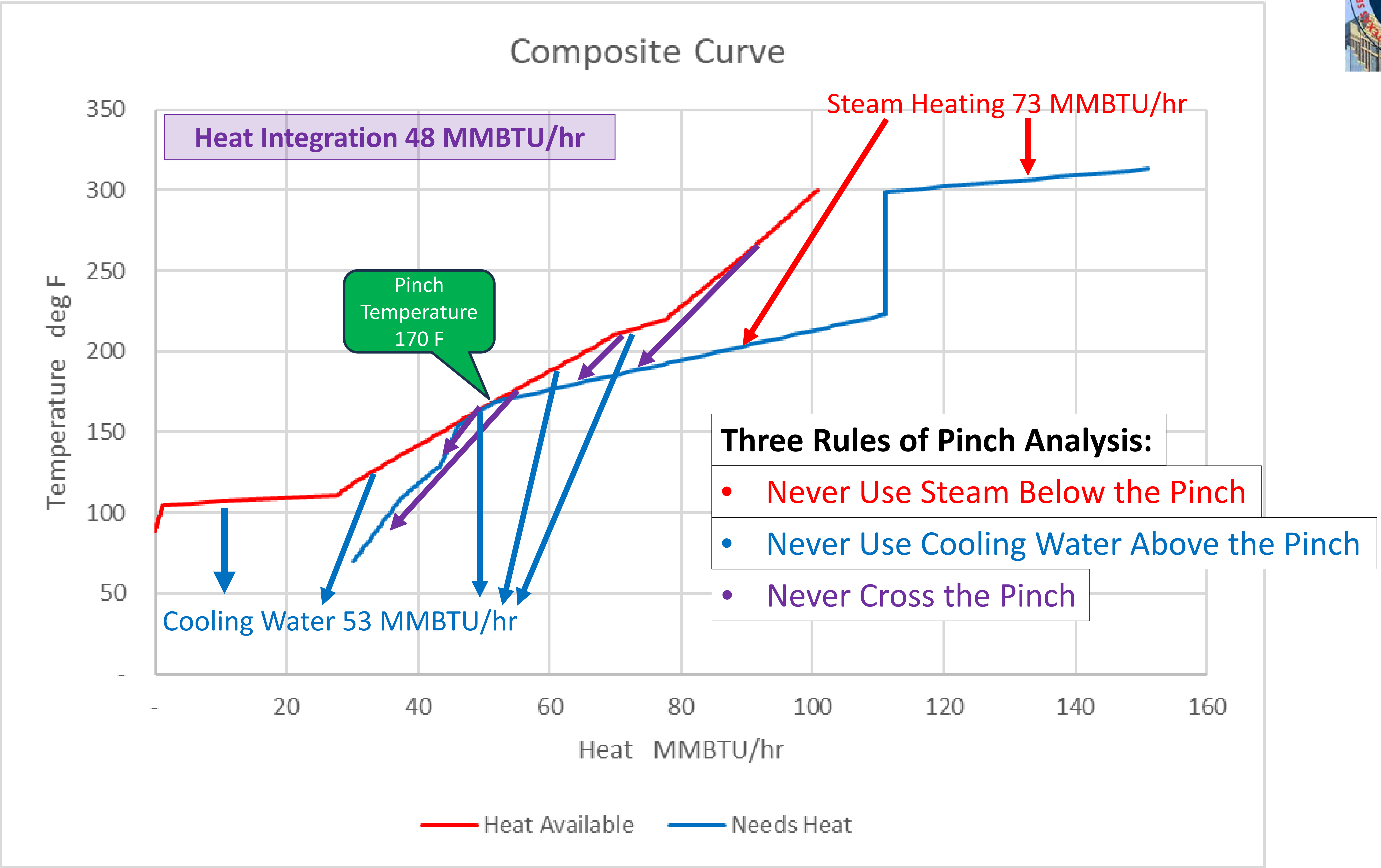
# Build the Composite Curve #5



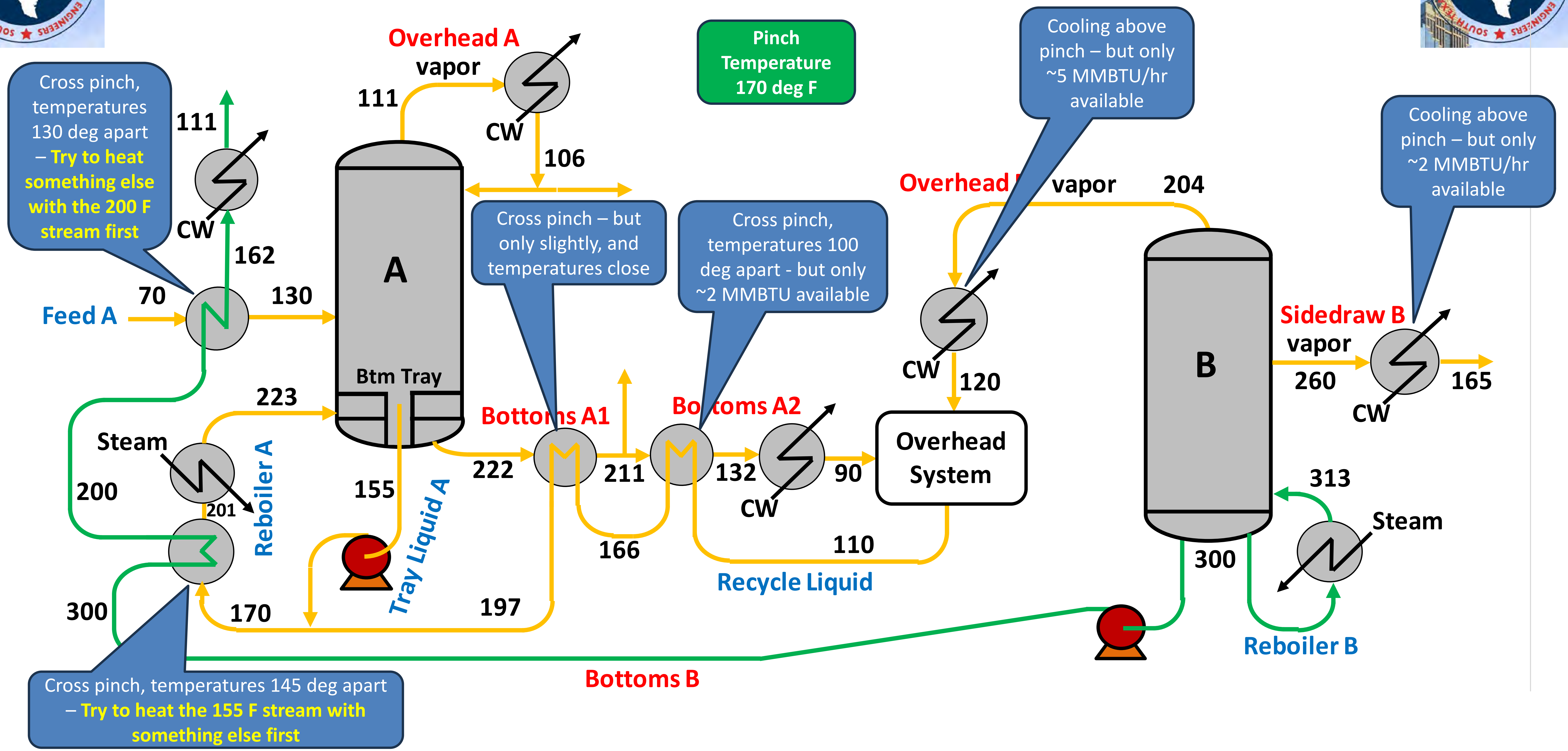
# Perfect Heat Integration



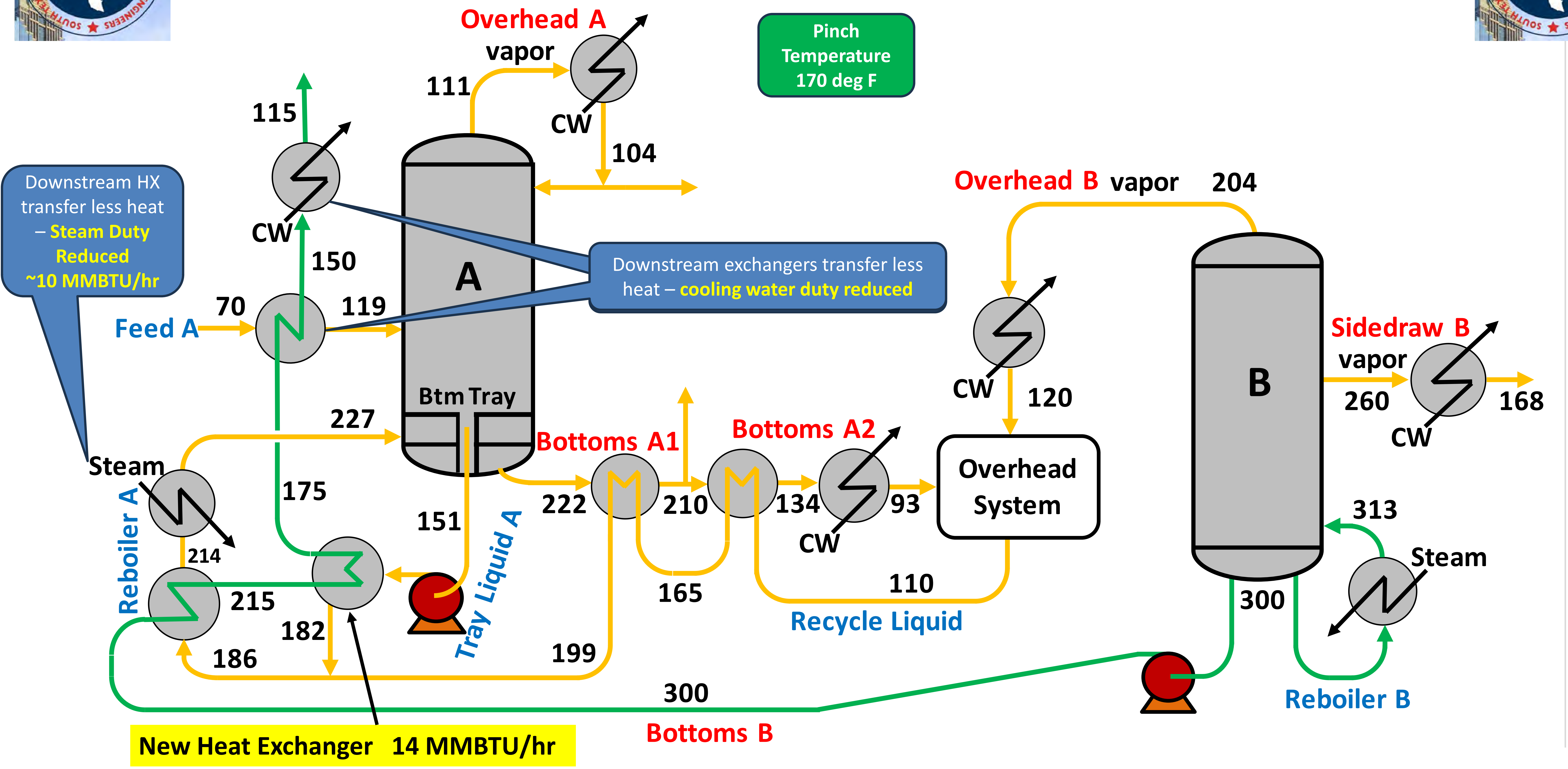
# Actual Heat Integration (prior to project)



# Process Flow Diagram With Operating Temperatures



# Process Flow Diagram With New Operating Temperatures



# Energy Efficiency with New Heat Recovery Exchanger

| | Number of Heat Recovery Exchangers | Duty of all Heat Recovery Exchangers | Required Steam Duty |
|---|---|---|---|
| Original Design | 4 | 48 MMBTU/hr | 73 MMBTU/hr |
| With New Heat Recovery Exchanger | 5 | 58 MMBTU/hr | 63 MMBTU/hr |
| Perfect Heat Integration | Many | 71 MMBTU/hr | 50 MMBTU/hr |

# Pinch Analysis of a Complex Reboiler System

## **Part 2**

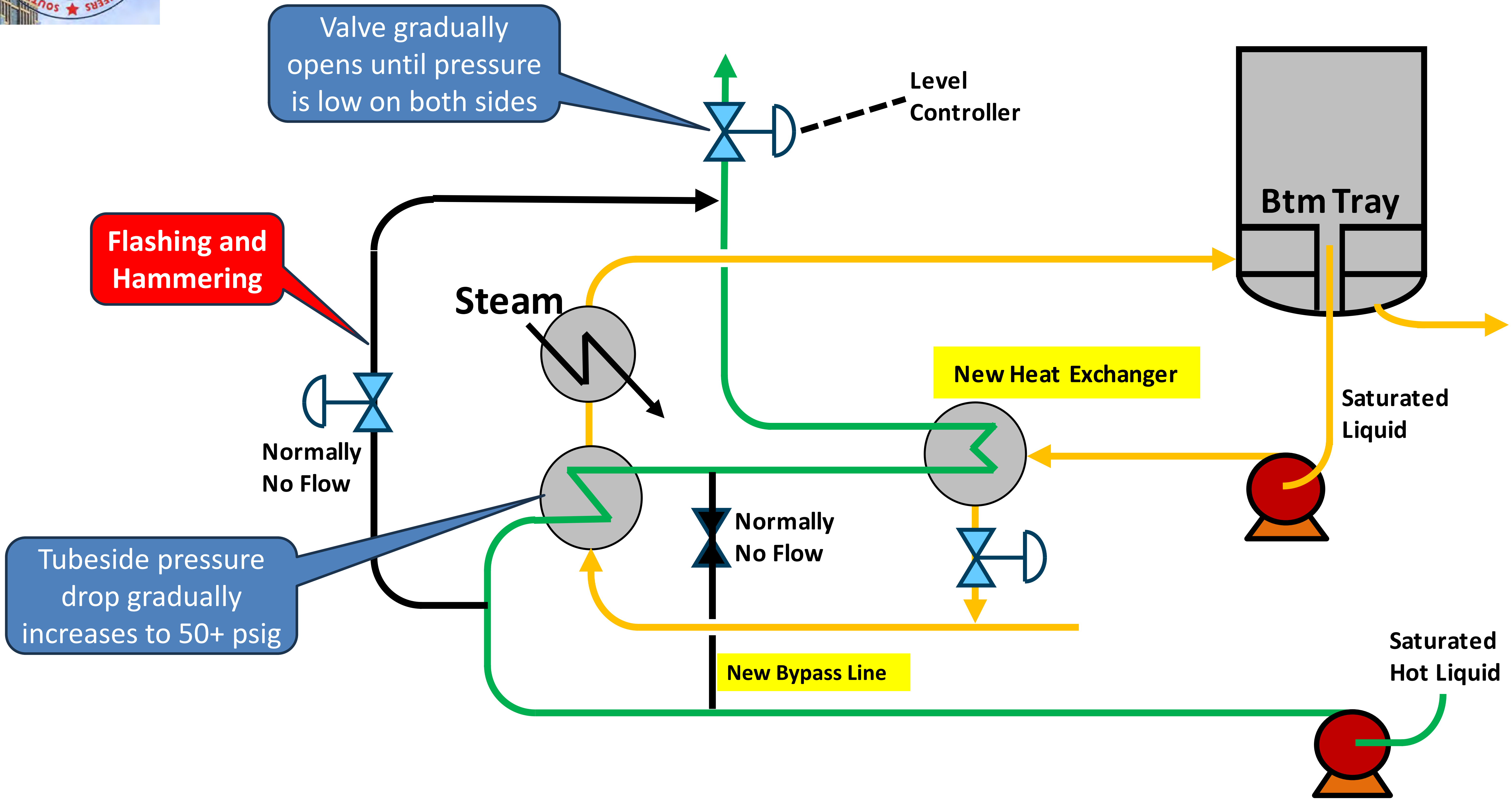
Unexpected Operating Problems

or

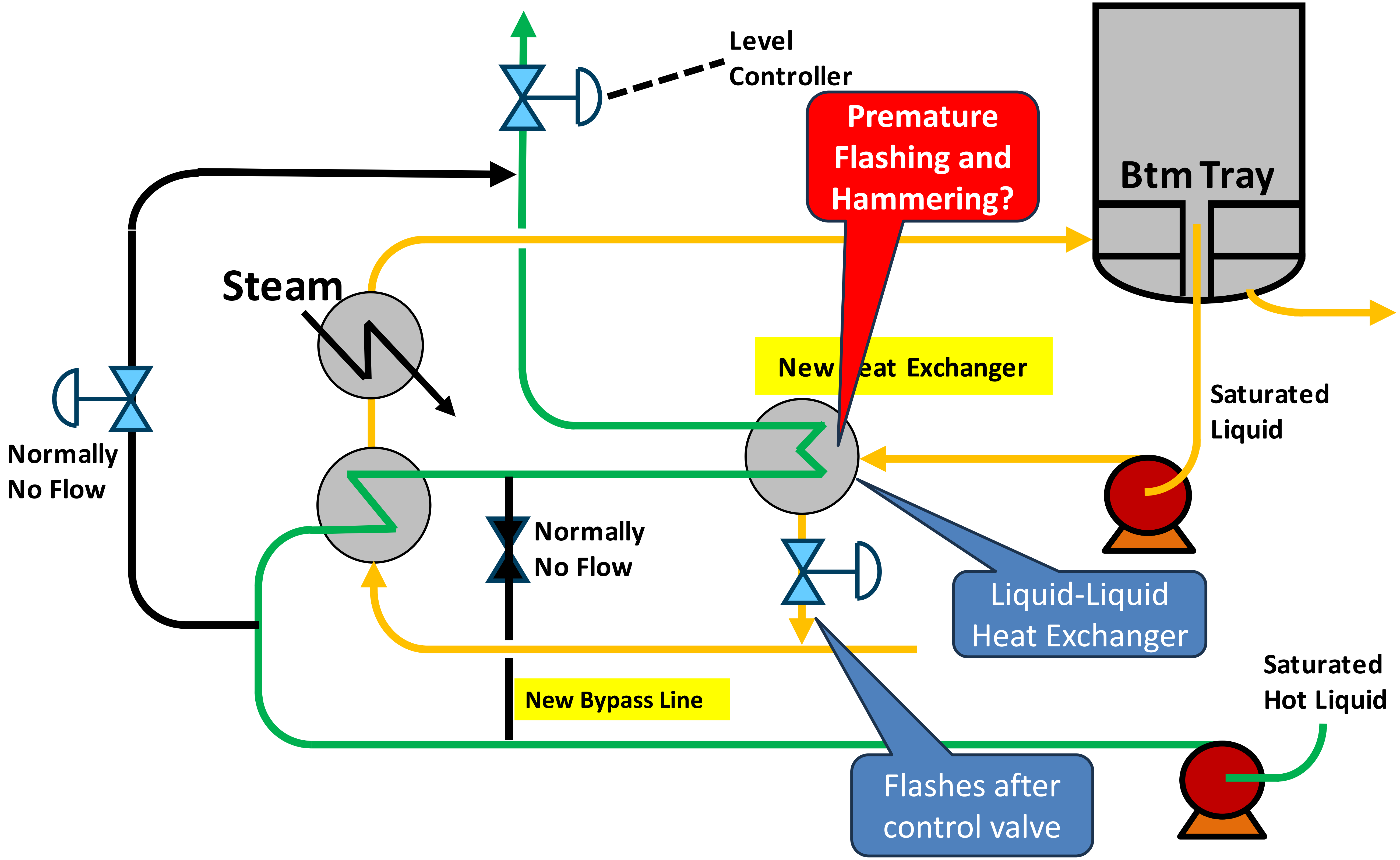
How Often Does New Equipment Work

***Exactly*** as Designed?

# Complex Reboiler System Issue #1



# Complex Reboiler System Issue #2



# CONCLUSIONS

1. Continue to do pinch analyses – they always identify energy savings opportunities, and a few of them will be worth the capital cost.

2. Design for steady state, but also consider startup, shutdown, maintenance, and any other unusual operation you can think of.

# Pinch Analysis of a Complex Reboiler System

Questions, Comments?