CampusEnergy2019

HILTON NEW ORLEANS RIVERSIDE

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Wild Flow, Concourse Expansion, and Other Pumping Adventures at Denver International Airport

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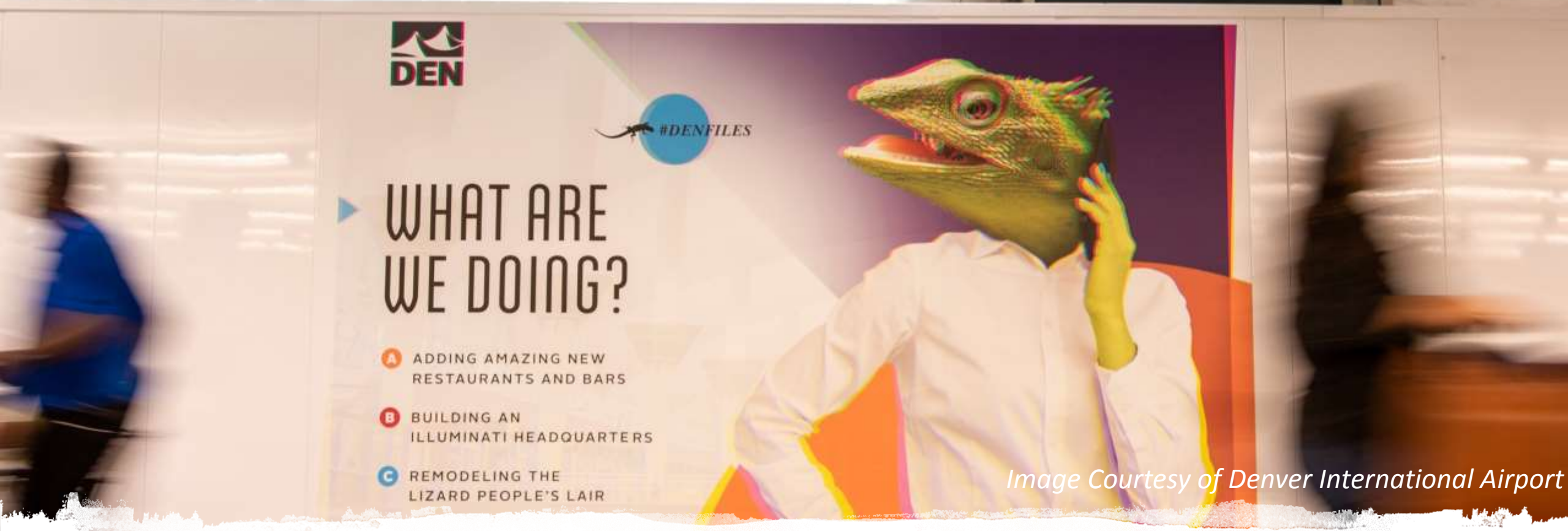


Image Courtesy of Denver International Airport

AGENDA

- Background
- Existing System
- Capital Project Approach
- System Details
- Design Analysis
- Design Approach
- Current Status
- What Did We Learn

BACKGROUND

- Opened February 1995
- 5th Busiest Airport
  - 64.5 million travelers in 2018
- Largest US Airport by Land Area
  - 53 square miles
- Current Square Footage:
  - 7,720,000 square feet
- Future Square Footage:
  - 8,969,000 square feet

Image Courtesy of Denver International Airport

AIRPORT OFFICE BUILDING (AOB)

CONCOURSE A (CCA)

CONCOURSE B (CCB)

CONCOURSE C (CCC)

TERMINAL

HOTEL & TRANSIT CENTER (HTC)

CENTRAL UTILITY PLANT (CUP)

BACKGROUND

- Central Utility Plant:
  - Chilled & Heating Water
  - Serves Seven “Buildings”
  - 40 feet Below Grade
- Concourse expansions:
  - 39 additional gates
  - 1.25 million square feet
- More expansions coming…

Image Courtesy of Denver International Airport

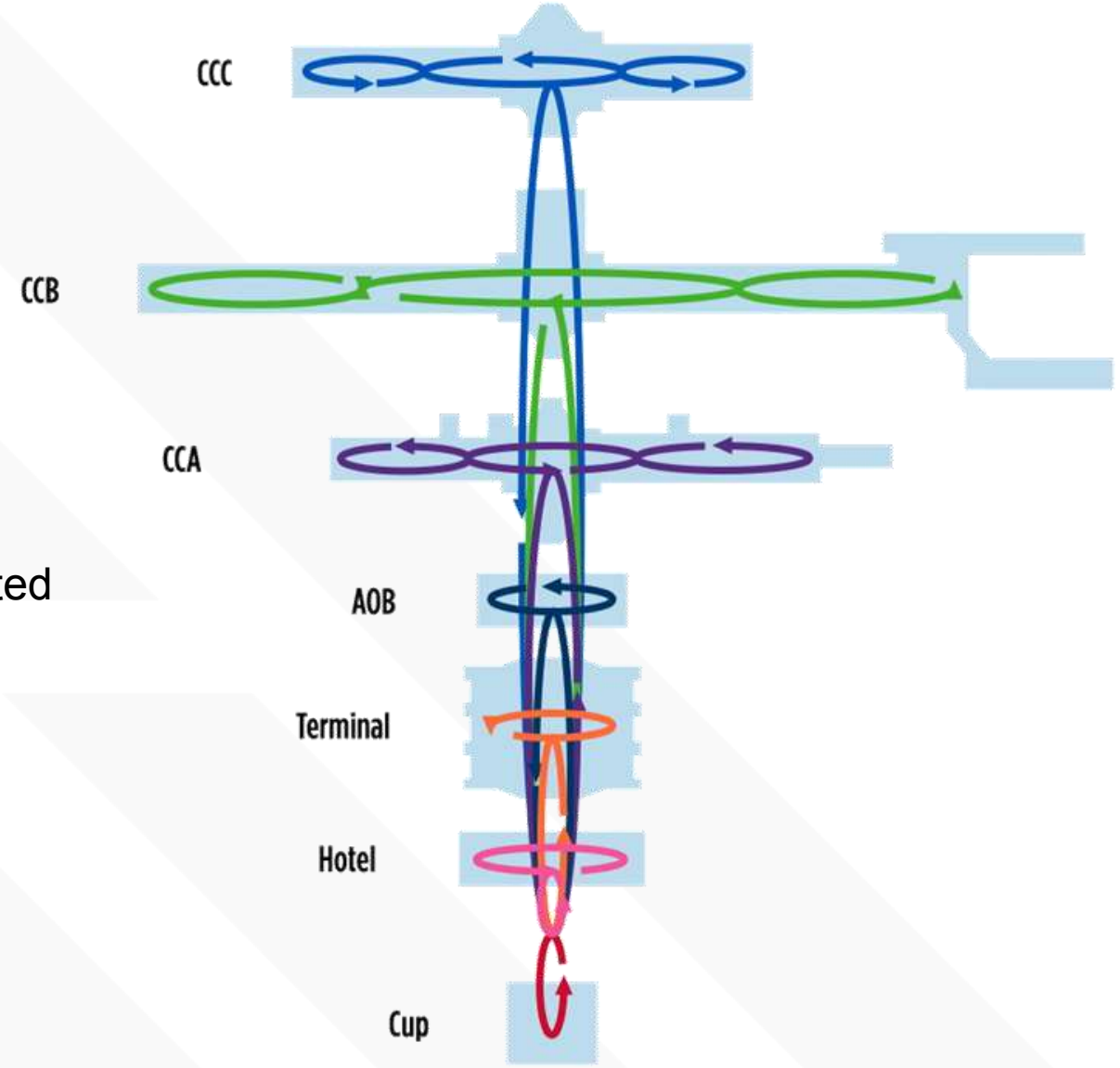
EXISTING SYSTEM

- HISTORY
  - Chilled Water
    - Natural Gas driven chillers
  - Heating Water
    - Water-tube Boilers, 60 MMBtu
    - Jet-A back-up fuel
    - High temperature issues
  - Pumping
    - Constant Flow, Variable Temp
      - Primary
      - Building Secondary
      - Tertiary Boosters

Image Courtesy of Denver International Airport

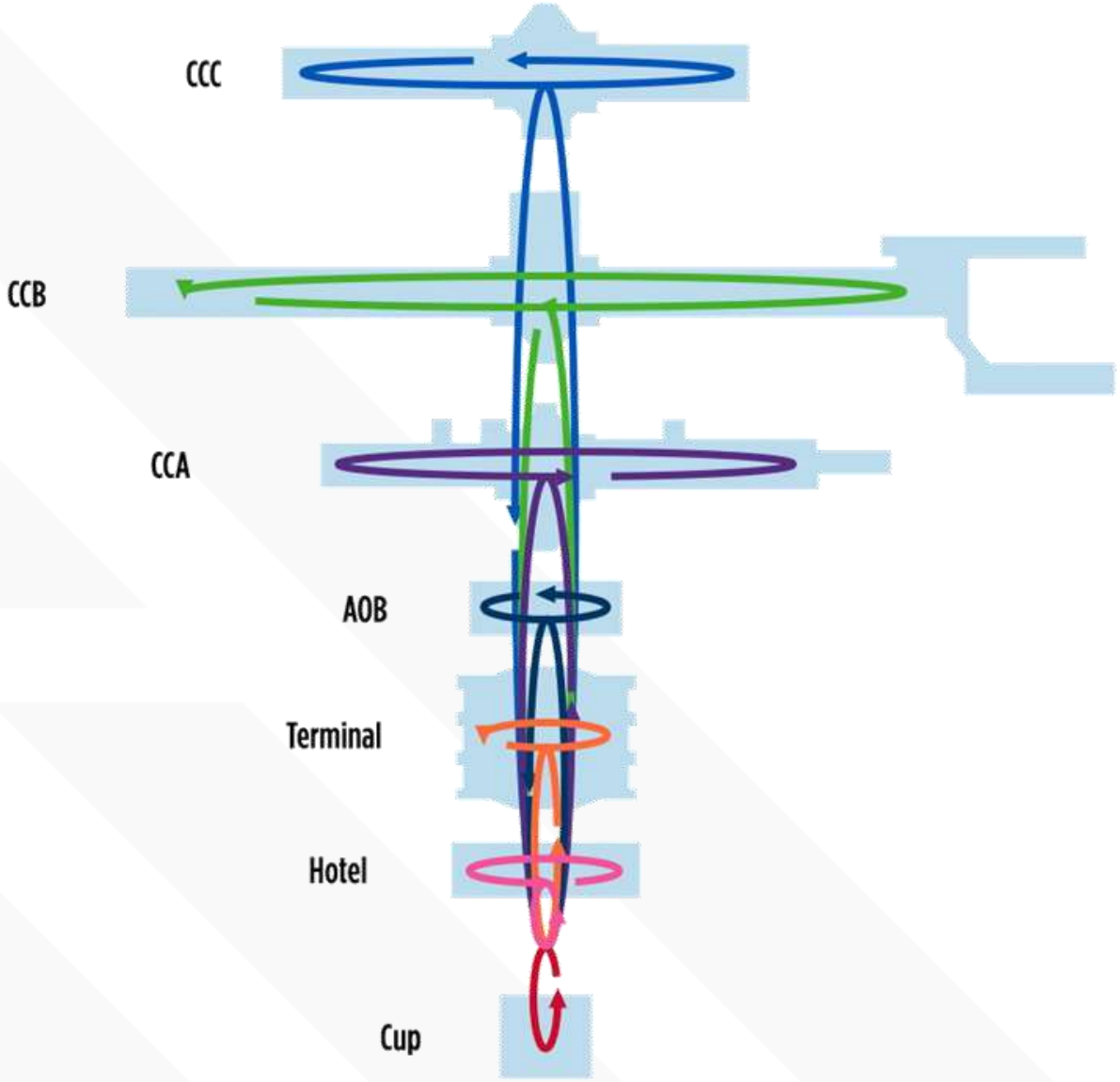
EXISTING SYSTEM

- HYDRONIC OPTIMIZATION PROJECT
  - 2010-2014 Timeframe
  - Heating Water building pumps
  - Pumped coils
  - Removed >200 pumps
  - “Major” two-way and three-way control valves
    - Quantity of “Minor” valves was under estimated



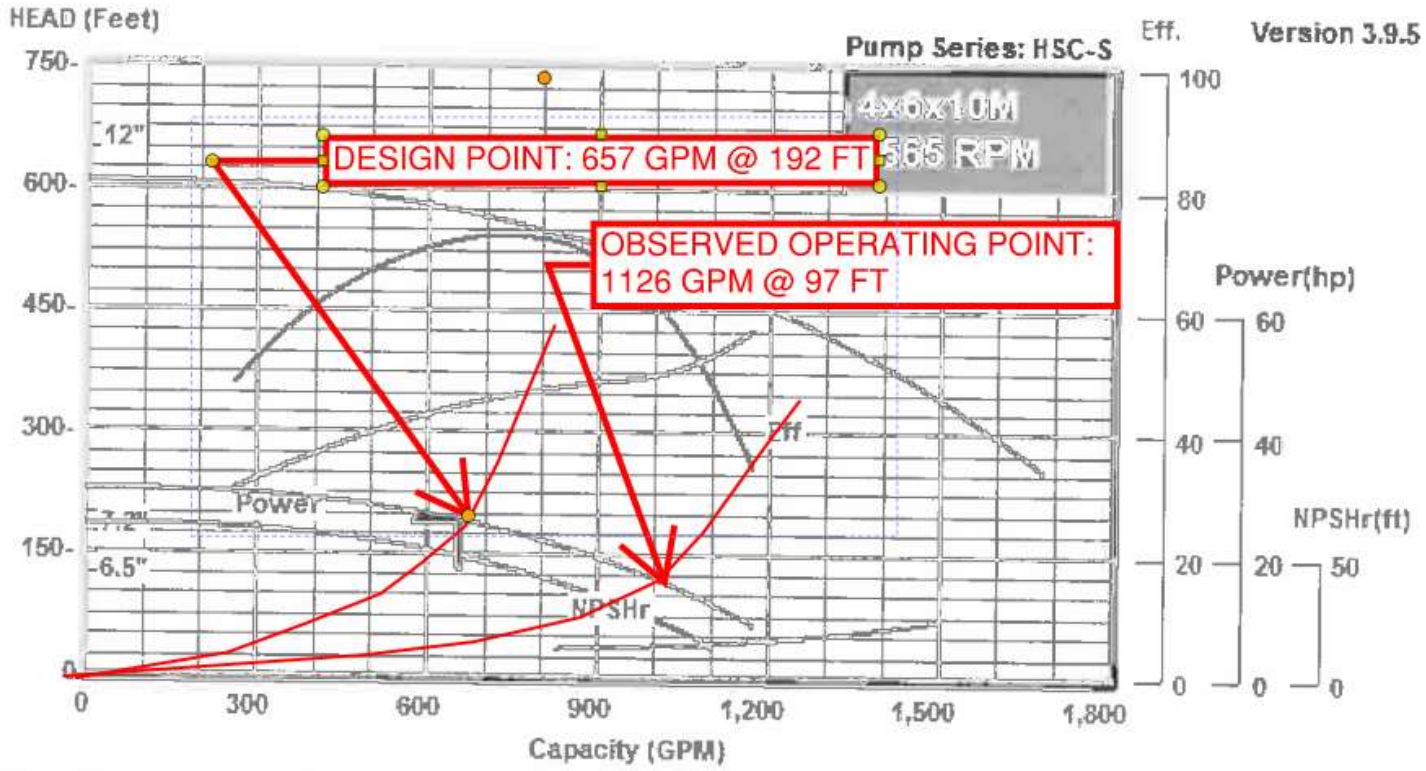
EXISTING SYSTEM

- LEGACY DECOUPLER OPERATION
  - Heating Water:
    - Historically open
    - Boilers staged based on return temperature
    - Secondary system overflowing the CUP
    - This winter it has been closed
  - Chilled Water:
    - Historically open
    - Operating with flow offset, ≤50 GPM positive
    - Plans to close



EXISTING SYSTEM

- ON-GOING CHALLENGES
  - Wild Flows
    - Previous tenant build-out
    - Severe over pumping
    - Unhealthy operation
  - Hydraulic Instability
    - CCB starves CCC
    - Building-level balance valves
    - Adjustment to failure
  - Enforcement of Design Standards
  - Loss of institutional knowledge



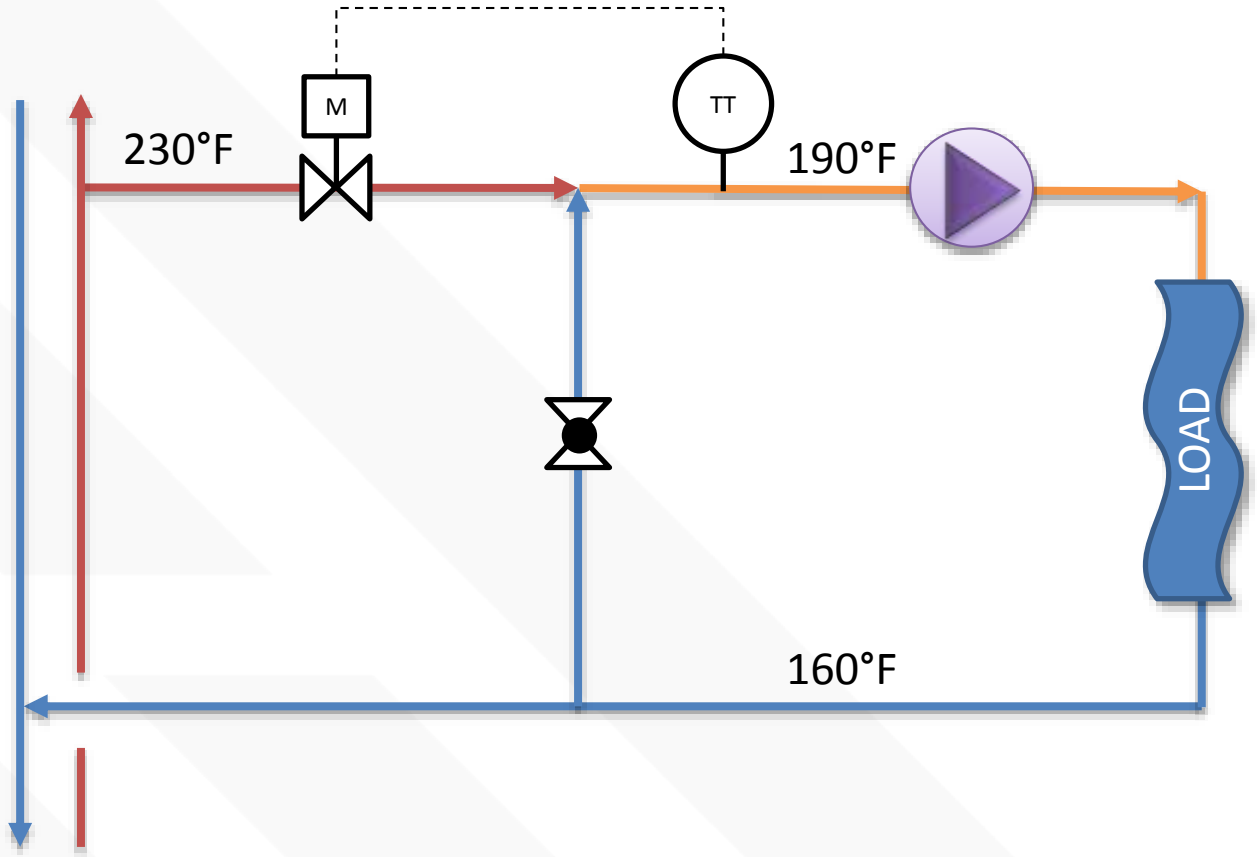
CAPITAL PROJECT APPROACH

- CAPITAL PROJECT APPROACH
  - Maintenance-Driven Projects
    - Nagging, systemic issues
  - Planning/Enabling Projects
    - Capacity/Redundancy
  - Packaging the Scopes
    - Initial Reluctance
    - Unexpected benefits

Image Courtesy of Denver International Airport

SYSTEM DETAILS

- HOT WATER
  - Production at CUP at 230°F
  - Building-level blending loops
  - Balance valve on building return
  - Adjustments currently impact CUP



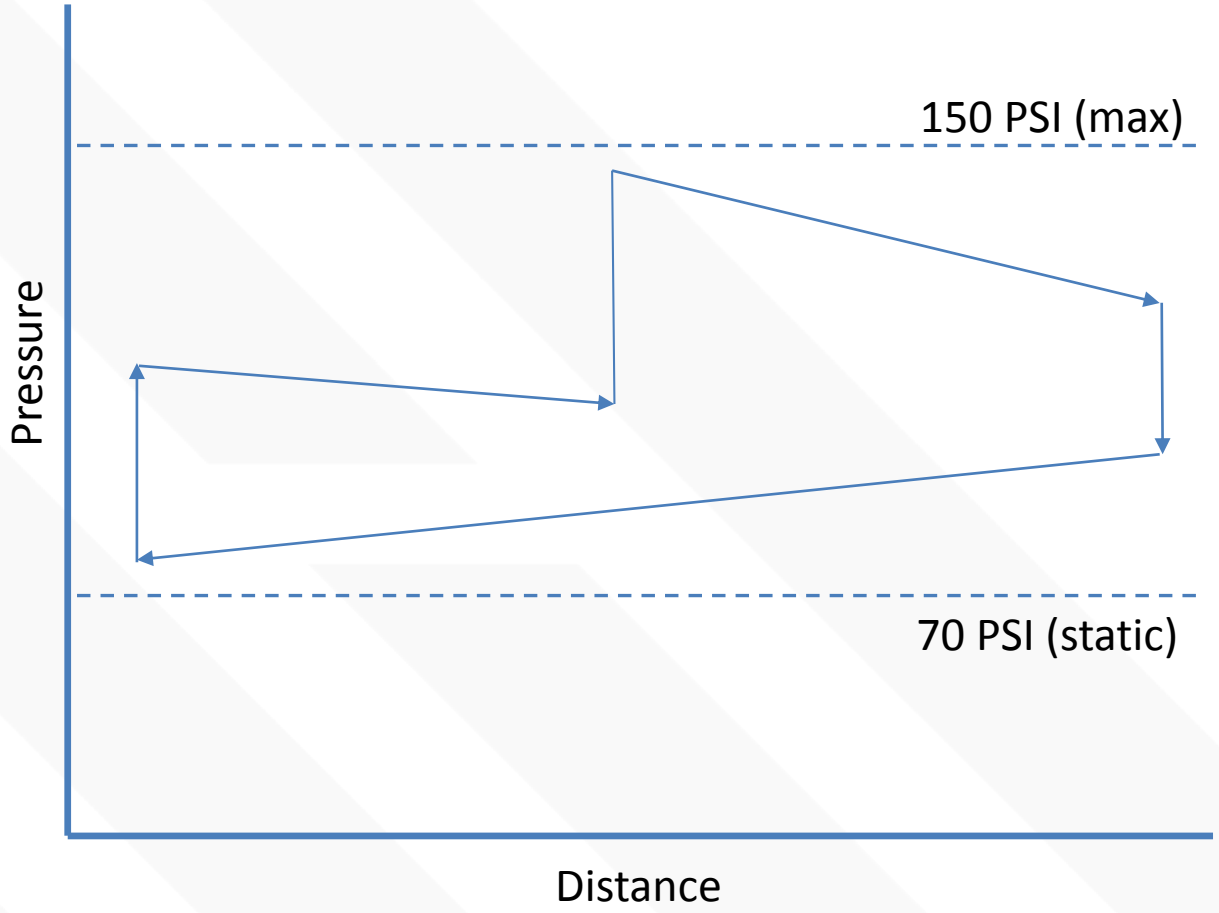
SYSTEM DETAILS

- CHILLED WATER
  - Production at CUP 42-56˚F ΔT
  - Currently in construction
  - 20,000 tons ultimate
  - 8 x 2,500 ton VFD chillers
  - Tied to MANY critical systems
    - Limited outage opportunity

Image Courtesy of Denver International Airport

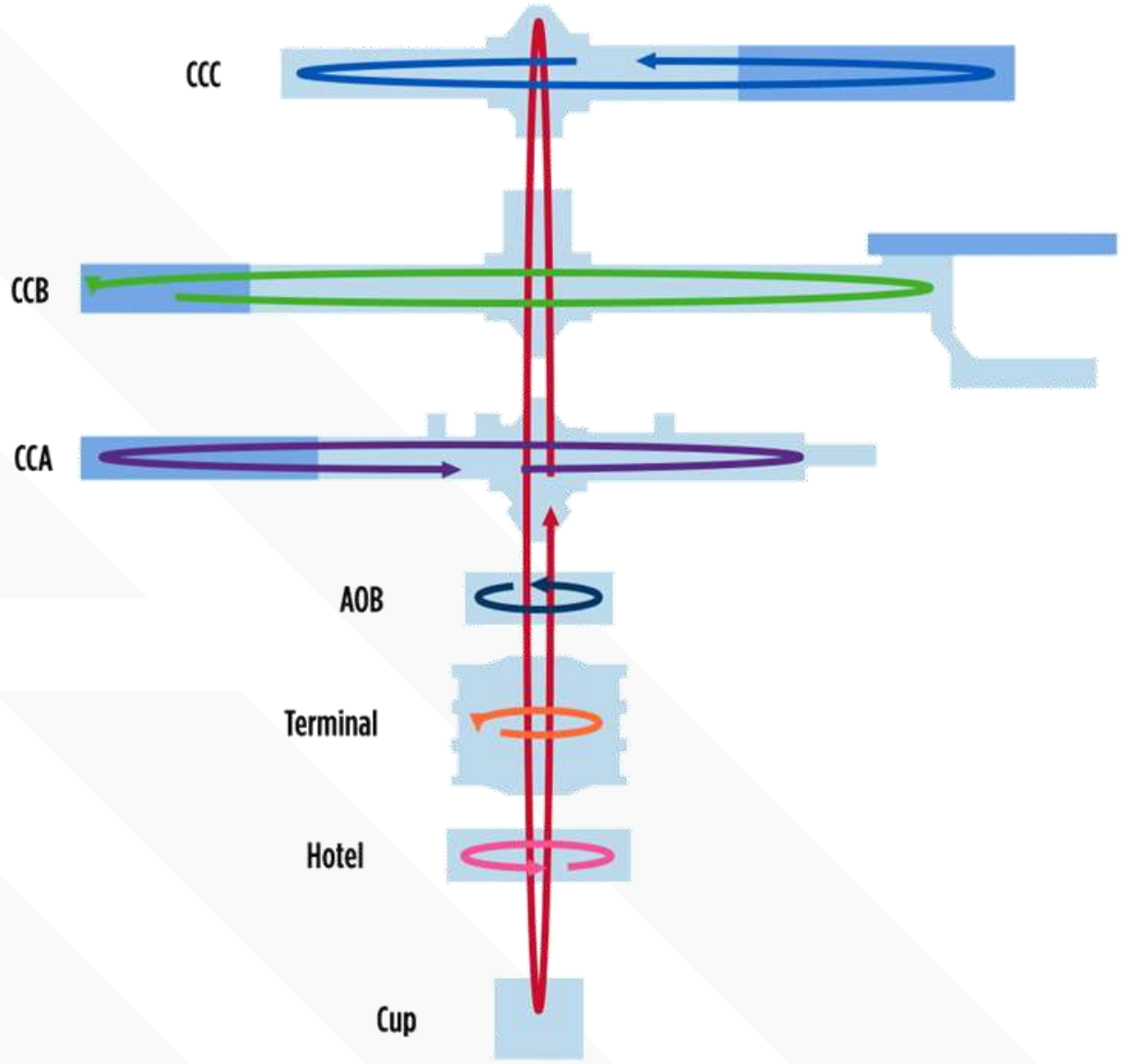
DESIGN ANALYSIS

- SYSTEM LIMITATIONS
  - 70 PSI static pressure
  - Hard limit 150 PSI
  - Pipe Velocity
  - Electrical Service
- QUANTIFY
  - Sparse data
  - Historical logs
  - Rumors
- SYSTEM TESTING



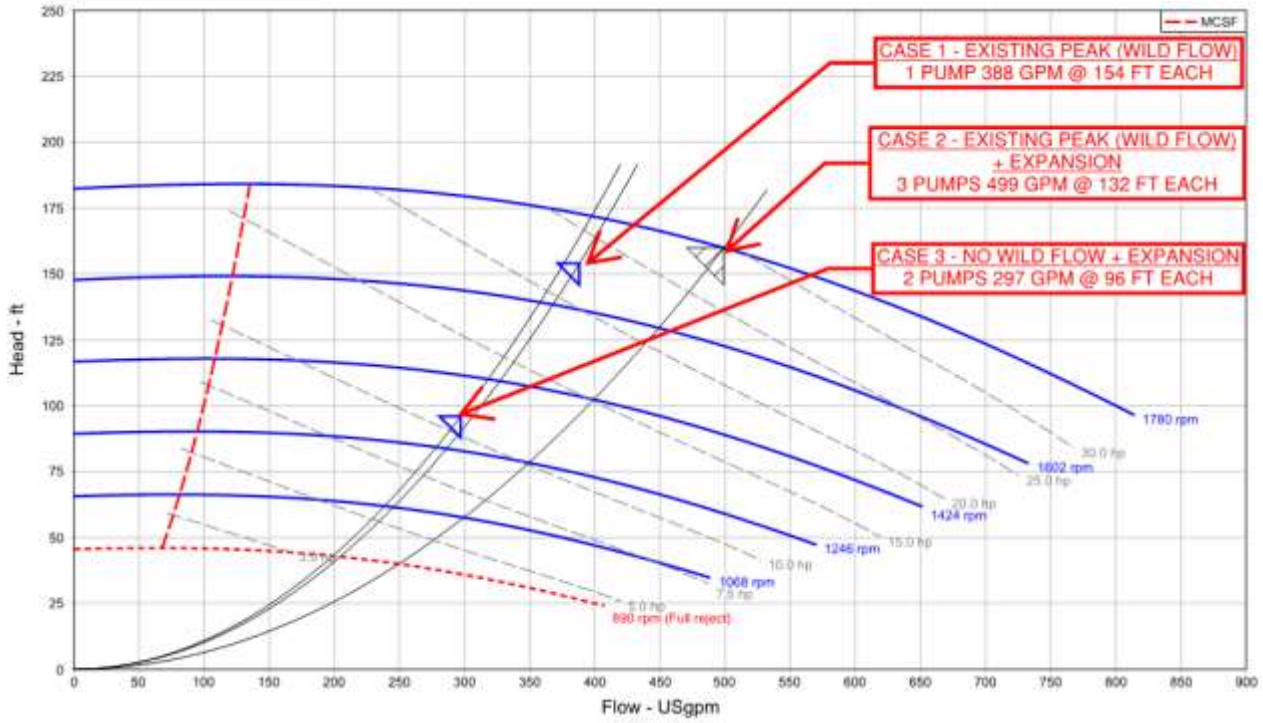
DESIGN ANALYSIS

- SYSTEM TESTING
  - Hot Water
    - Goal: Gain stability and minimize flow
    - Results: Success
      - Primary CUP flow reduced
      - Stable pumping
      - Building level pumping reduction
      - Positive pressure at CCC end of line
  - Chilled Water
    - Goal: confirm pump rooms can be bypassed
    - Results: Success
      - Stable ΔP pumping control
      - Building-level pumping reduction
      - AOB pressure met from CUP
      - Pump rooms can be bypassed



DESIGN APPROACH

- HW PUMP SELECTION
  - Existing + Wild Flow
  - Expansions + Wild Flow
  - Expanded - Wild Flow
- DESIGN TO LIMITS
  - Pipe velocity
  - Max pressure
  - Electrical Input
- CONCLUSION
  - Load met with reduced end of line ΔP
  - Addressing wild flow improves operating point

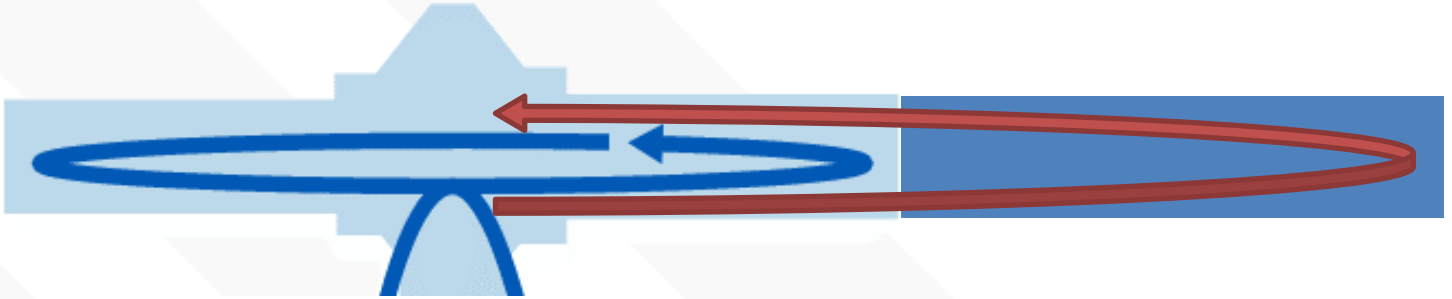


DESIGN APPROACH

- HOLD EVERYTHING!!
  - Expansions…a moving, GROWING target
  - Multiple teams working in parallel
  - Designers unclear on system capabilities
- COORDINATION MEETINGS
  - Educate on system limits
  - Detail load reviews
  - Point of connection strategy
  - Pressure negotiation

CURRENT STATUS

- COMPLETE DESIGN
  - Larger Expansions
  - Express line required
  - Additional pump power
  - Electrical load study
- ENABLING PROJECTS
  - Control valves
  - Large quantity, first cost
  - Challenge with expansions



WHAT DID WE LEARN

- INVEST IN METERING / DATA
  - Many hours spent deducing the system operation
  - Calibrate existing instrumentation
- ENFORCE DESIGN STANDARDS
  - Short-term blind eye = long-term impacts
- COORDINATE WITH PLANNING
  - Future can change in a short time
- VISION & COMMUNICATION
  - Engineering
  - Operations
  - Maintenance
  - A/E Partners

Image Courtesy of Denver International Airport

QUESTIONS

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