Analyze and Implement: Modernizing an Airport Central Utility Plant

Sustaining Our Success

June 26-29, 2017

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- Introduction
- Owner Considerations
- Growth / Challenges
- Modernization Analysis
- Heating Upgrades
- Cooling Upgrades
- Construction Phasing
- Next Steps

BURNS McDONNELL

INTRODUCTION

DENVER INTERNATIONAL AIRPORT

- Opened February 28, 1995
- 58.3 million travelers in 2016 (Record!)
- 53 sq. miles (Largest Land Area Airport in US)
- 76,000 Feet of Length on Six Runways
- 19 consecutive months of record-setting traffic
- >6M Square Feet of Space Under Roof
  - Terminal, 3 Concourses & Airport Office Building
- **Served by Single Central Utility Plant**
- Secret Underground Bunkers ☺

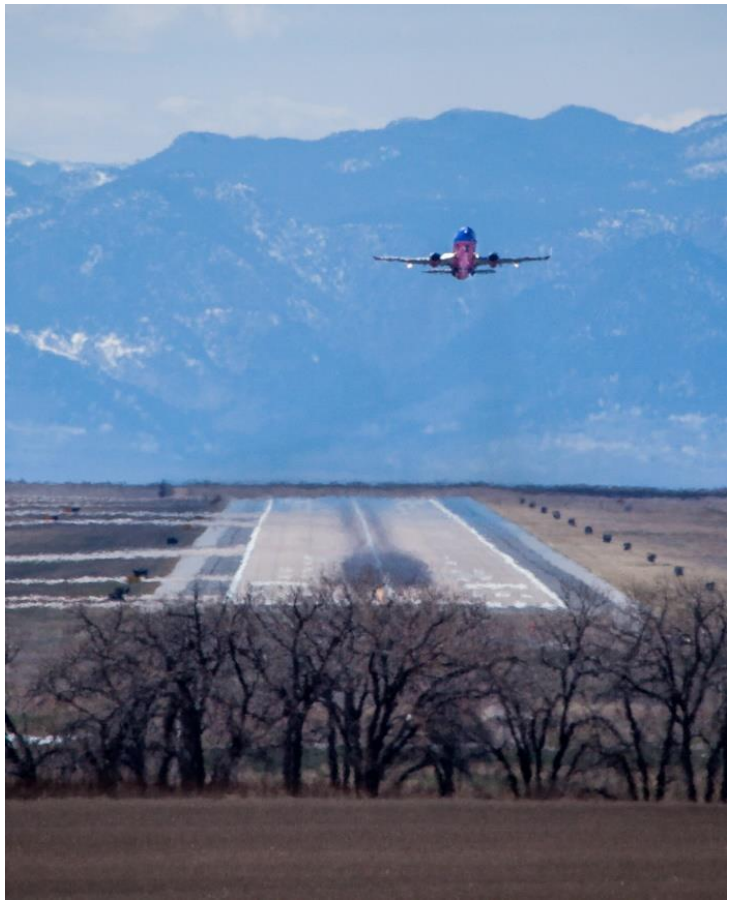

Photo Courtesy of Denver International Airport

INTRODUCTION

CENTRAL PLANT – EXISTING ASSETS

Heating Water

- Medium Temp Hot Water Boilers (230F Delivery)
- 70 deg *design* dT
- Original: 3 x 60 MMBTU, 1 x 17 MMBTU
  - 60's derated to 42 MMBTU
- Supplemental: 1 x 47 MMBTU

Chilled Water

- 3 x 4,150 ton R-22 Chillers
- 2 x 2,500 ton R-123 Chillers (2015, VFD)
- 2 x 1,200 ton Free Cooling HX
- 1 x 4,150 ton Free Cooling HX
- 8 x 2,708 ton Cooling Towers (VFD)

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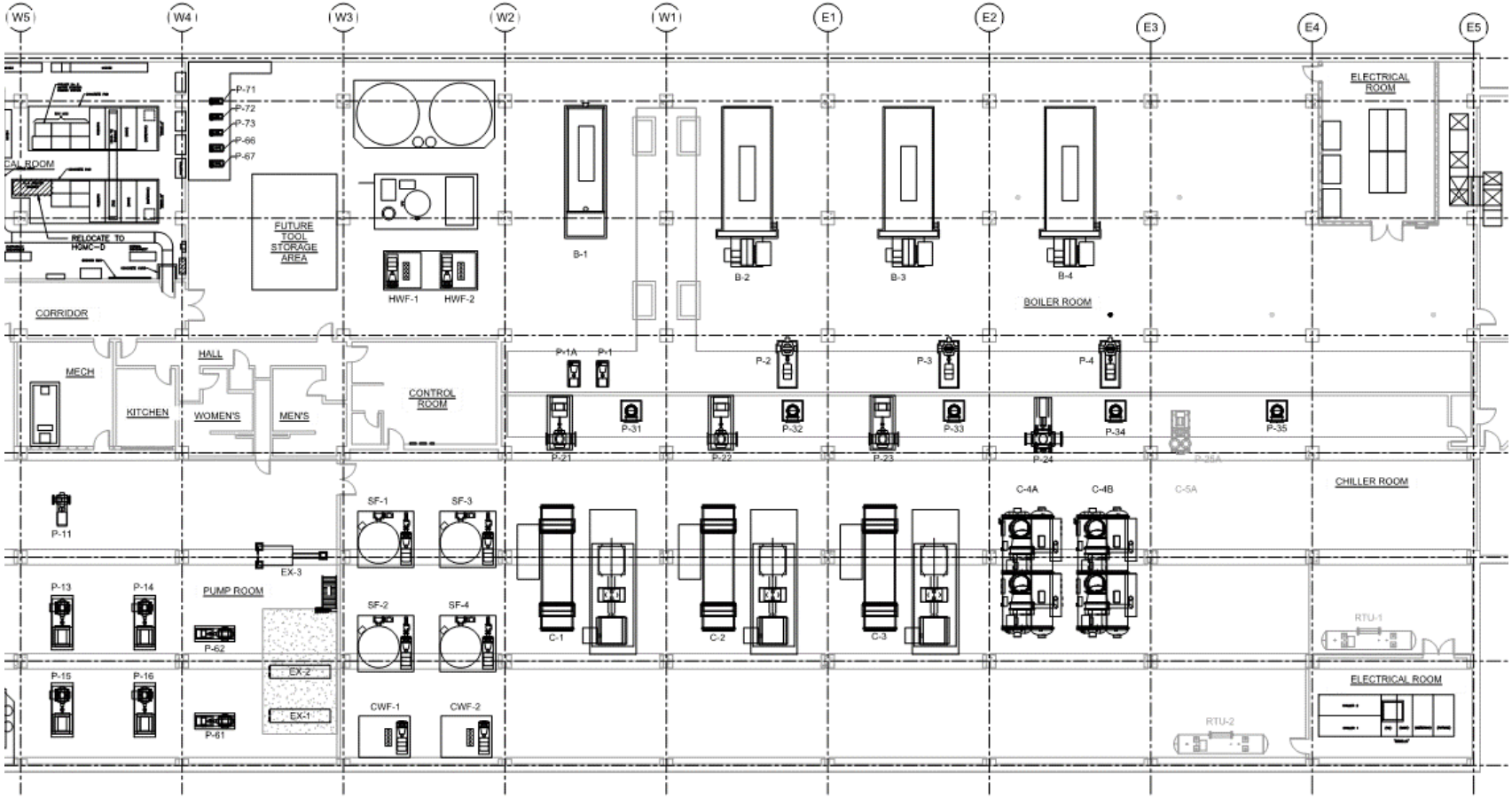
INTRODUCTION

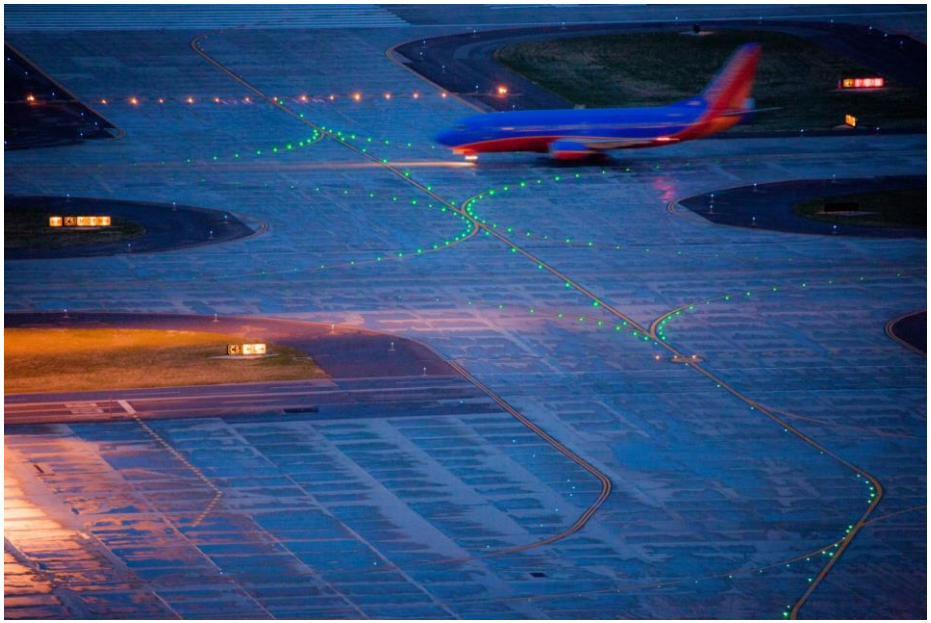
CENTRAL PLANT – ASSETS (2015)



OWNER CONSIDERATIONS

INTERNAL PROCESS

- Stakeholder Engagement
  - Operations & Maintenance
  - Finance
  - Energy Management
- DEN In-house QA/QC Staff
- On-Call Contracting
  - Design Professionals
  - Commissioning



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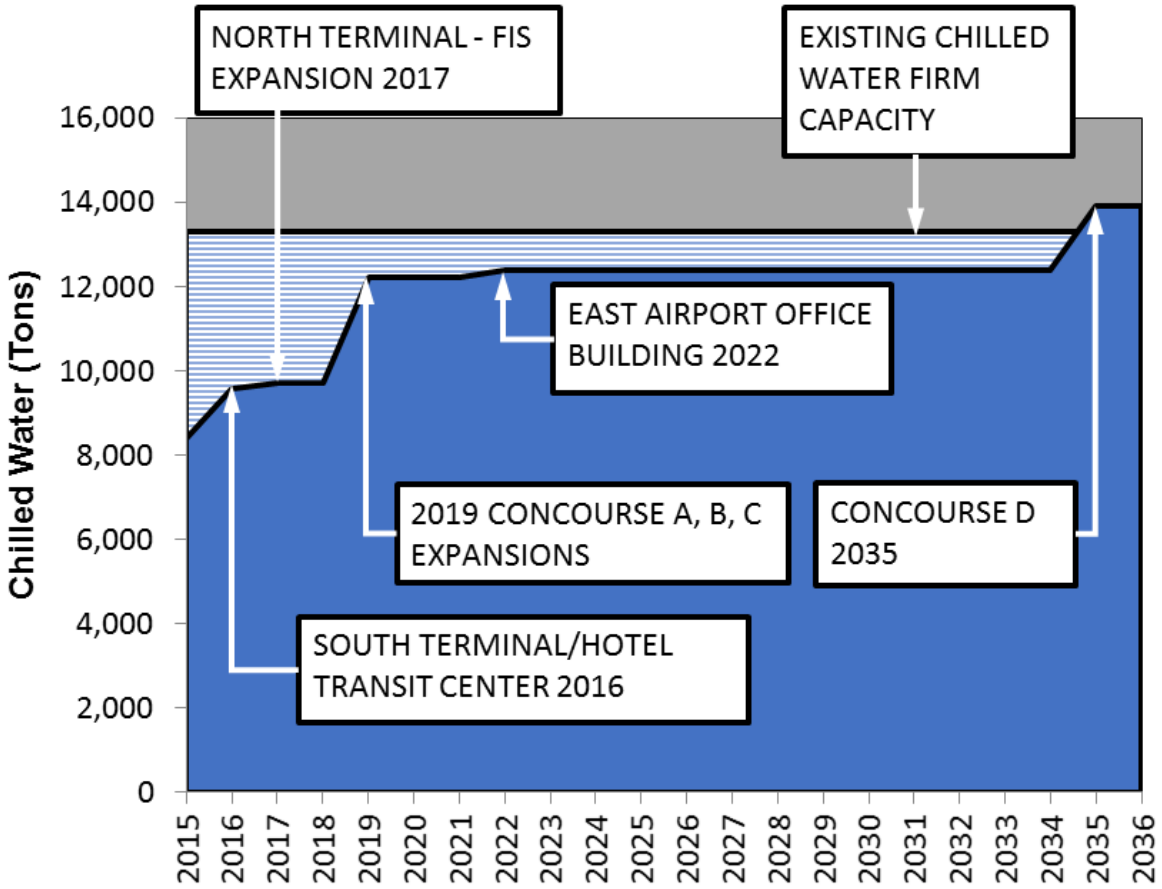
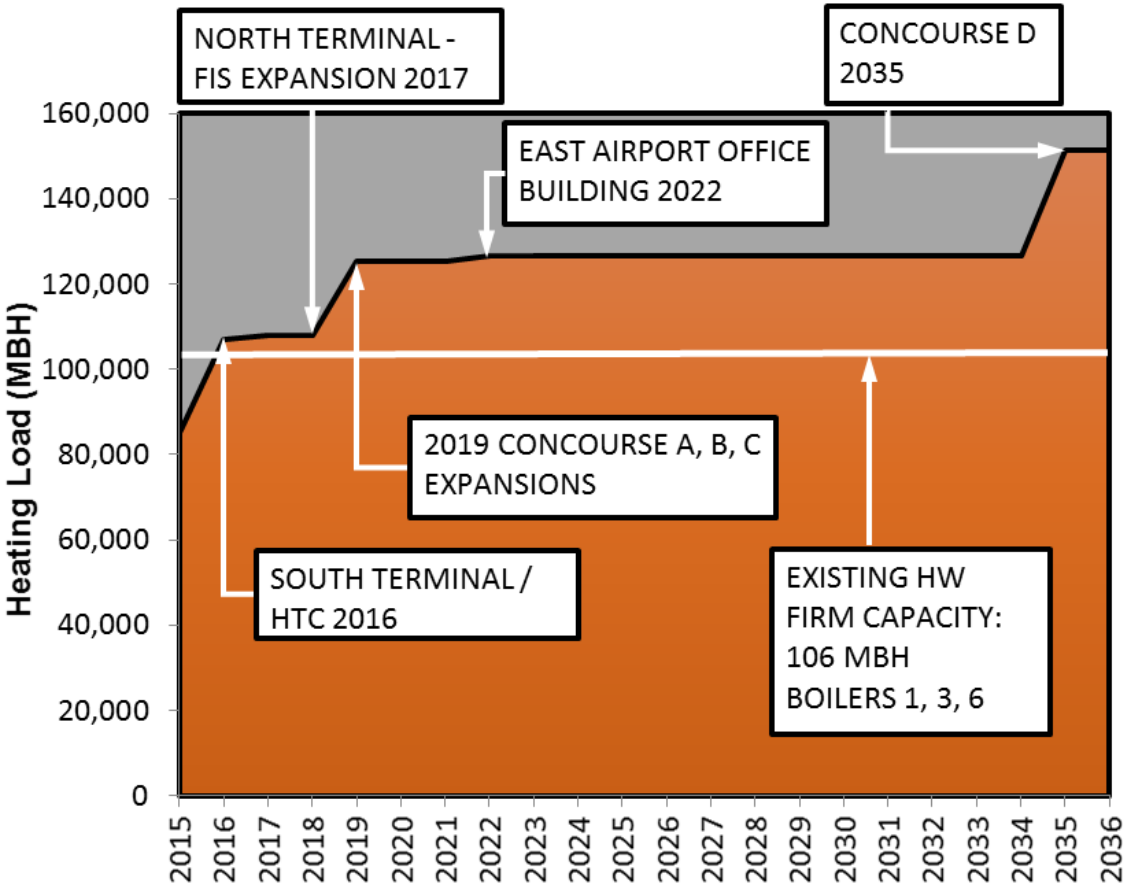
GROWTH!

CHILLED WATER



GROWTH!

HEATING WATER



CHALLENGES

EXISTING CUP STRUGGLES

- Completely land-locked
- Subsurface CUP
- Cooling tower above
- Legacy water treatment issues
- Operating inefficiencies
- Optimization opposition

Photo Courtesy of Google Maps

CHALLENGES

EXISTING CUP STRUGGLES

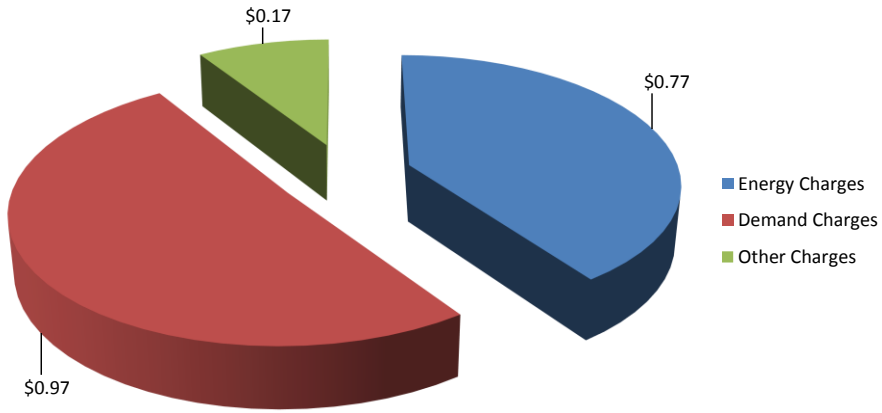
- Heating
  - Firm capacity
  - Redundancy profile
  - Dedicated pumping
  - Flue stack design, orientation and deterioration
- Cooling
  - R-22 Phase-out
  - CW pumping issues
  - Redundancy profile
  - Load Transition/Sequencing – low dT

ANALYSIS

CUP MODERNIZATION

Goals

- Define future utility system requirements
- Identify technology options
- Analyze ancillary modifications
- Economic Analysis of options
- Provide a utility “Roadmap”



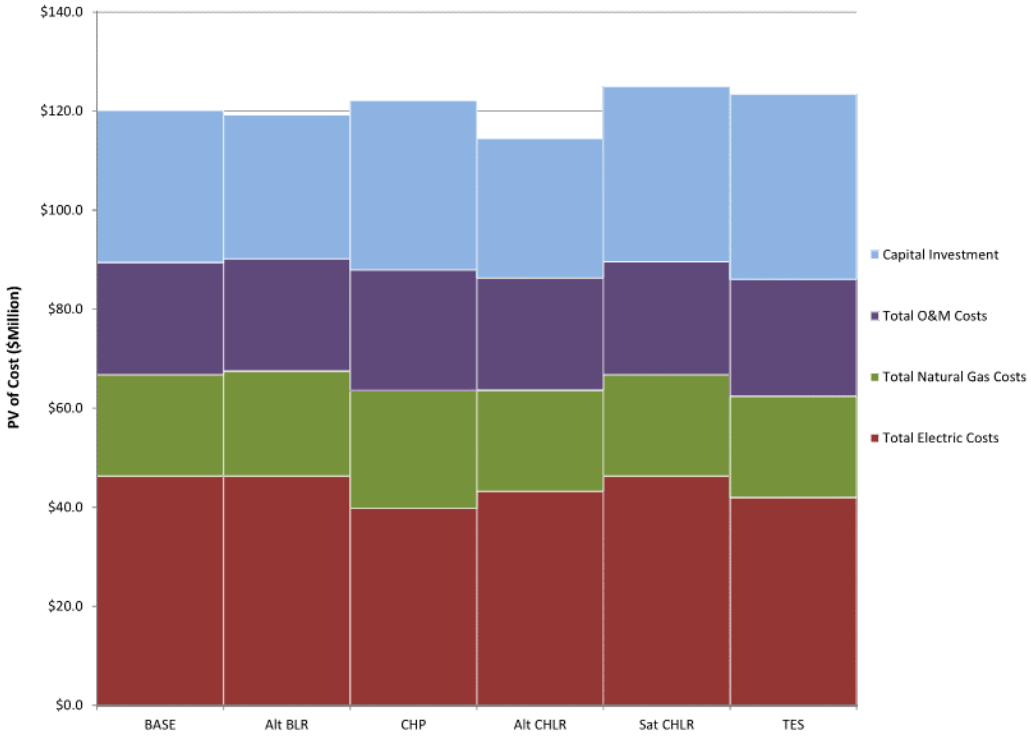
		Incremental Values to Base Case		
	PV Cost (2016 $MM)	NPV (2016 $MM)	Cumulative Net Cash Flow ($MM)	Simple Payback
Base Case	$116.2			
Alt Boiler Size	$113.4	$2.8	$3.0	N/A
Combined Heat and Power	$118.2	($2.0)	($1.7)	29.0
Alt Chiller Size	$109.5	$6.7	$11.2	N/A
Satellite Chiller Plant	$121.0	($4.8)	($10.6)	N/A
Thermal Energy Storage	$119.5	($3.3)	($2.1)	30

ANALYSIS

CUP MODERNIZATION

Technology Options Considered

- Alternative Boiler Size*
- Combined Heat and Power
- Alternative Chiller Size*
- Satellite Central Plant
- Thermal Energy Storage
- Additional Electrical Service



HEATING UPGRADES

ALTERNATE BOILER SIZING

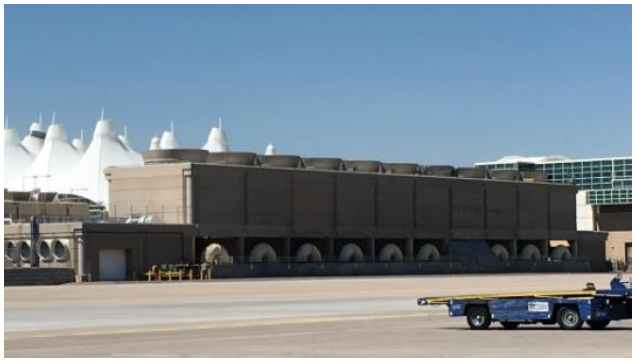
- Phase 1 – Boiler #2 Replacement
- Phase 2 – Boiler #1, 3, 4 Replacement
  - Full Build = 8 x 20 MMBTU

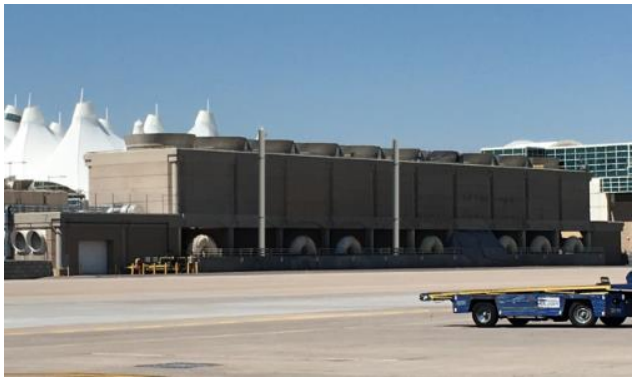
Challenges

- Maintain airport heating service
- Interim solution/control for mix of boiler/pumps
- Flue configuration / aesthetic

System Improvements

- Variable-primary pumping
- Common pumping header
- Flue stack improvements
- Integrate/update controls





COOLING UPGRADES

ALTERNATE CHILLER SIZING

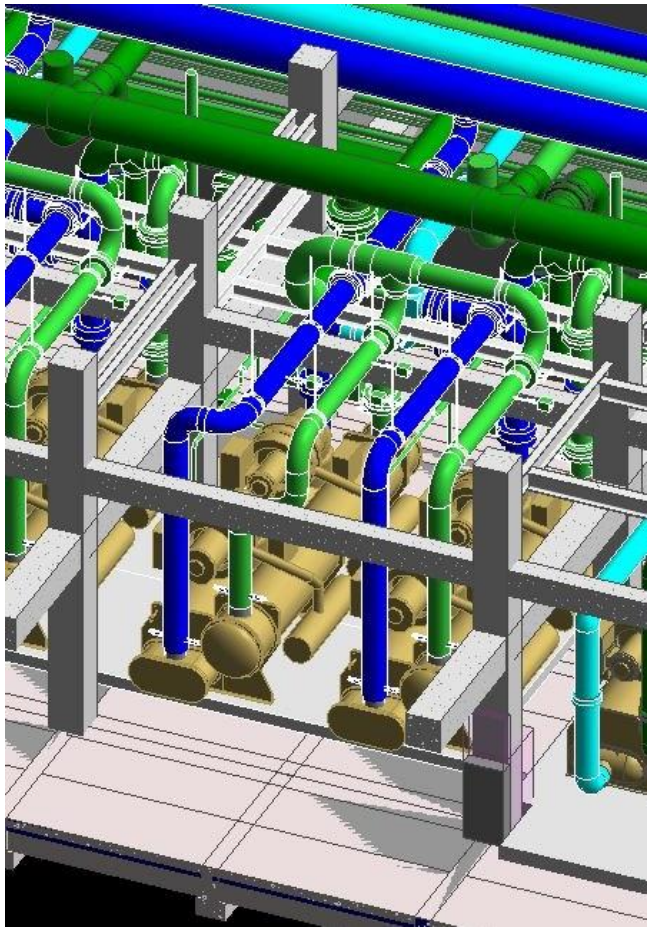
- 8 x 2,500 ton VFD Chillers – 2 per chiller bay
- Single set of CW pumps

Challenges

- Maintain airport cooling capacity
- Phased, seasonal construction
- Electrical service realignment
- Space for variable frequency drives
- Refrigerant phase-out solution (R-22)

System Improvements

- CW Pumping – VS for Free cooling + Optimization
- Staging / Control



CONSTRUCTION PHASING

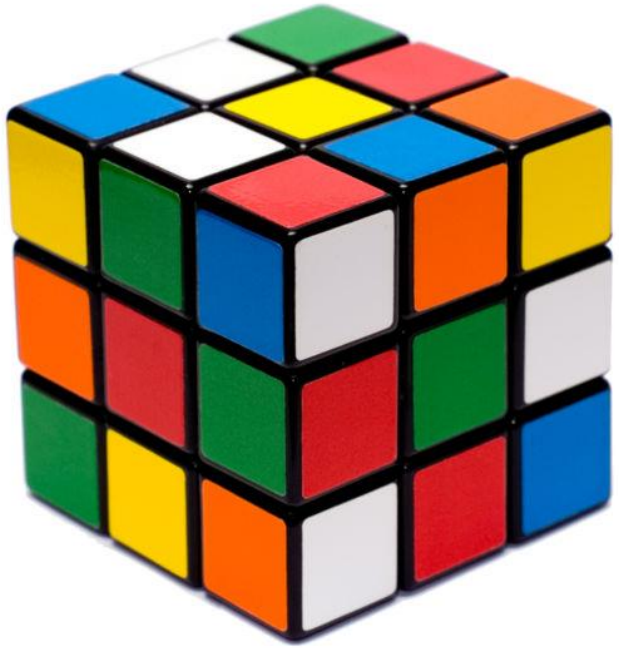
OWNER CONSIDERATIONS

- Contracting method/timing
- Early Equipment Procurement?
- Owner-performed work?
- Robust Division 01 Specs
  - CUP Operations
  - Equipment Protections
  - Critical Hours
- Strictly define outage tolerances
  - 100% continuous operation?
  - Temperature float allowed?
  - Financial Implications?

CONSTRUCTION PHASING

DESIGN CONSIDERATIONS

- Equipment Pathway
- Seasonal loading
  - Zero or low load periods?
  - Alternate means to meet load?
- Controls expectations?
- Valve inventory….can they be trusted?
- Interdependent systems
- Clear communication of plan



CONSTRUCTION PHASING

CONSTRUCTION CONSIDERATIONS

- Work in an operating CUP
- Additional protections
- Reduced labor efficiency
- Confirm Rigging/Pathway
- Diligent Communication

NEXT STEPS

FINISH THE FIGHT!

- Boiler #1, #3, #4 Replacement
  - Early Design Underway
  - Secondary Pump replacements
  - Construction Complete Fall 2018
- Chiller Replacement Construction
  - Starting in Fall 2017
  - 15,000 tons installed
  - 2-year duration with phasing
- Continuous Improvement
  - Maintenance Programs
  - Optimization Strategies

Photo Courtesy of Denver International Airport

QUESTIONS?

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