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Constant Progress

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# Redesign of Virginia Military Institute Central Heat Plant

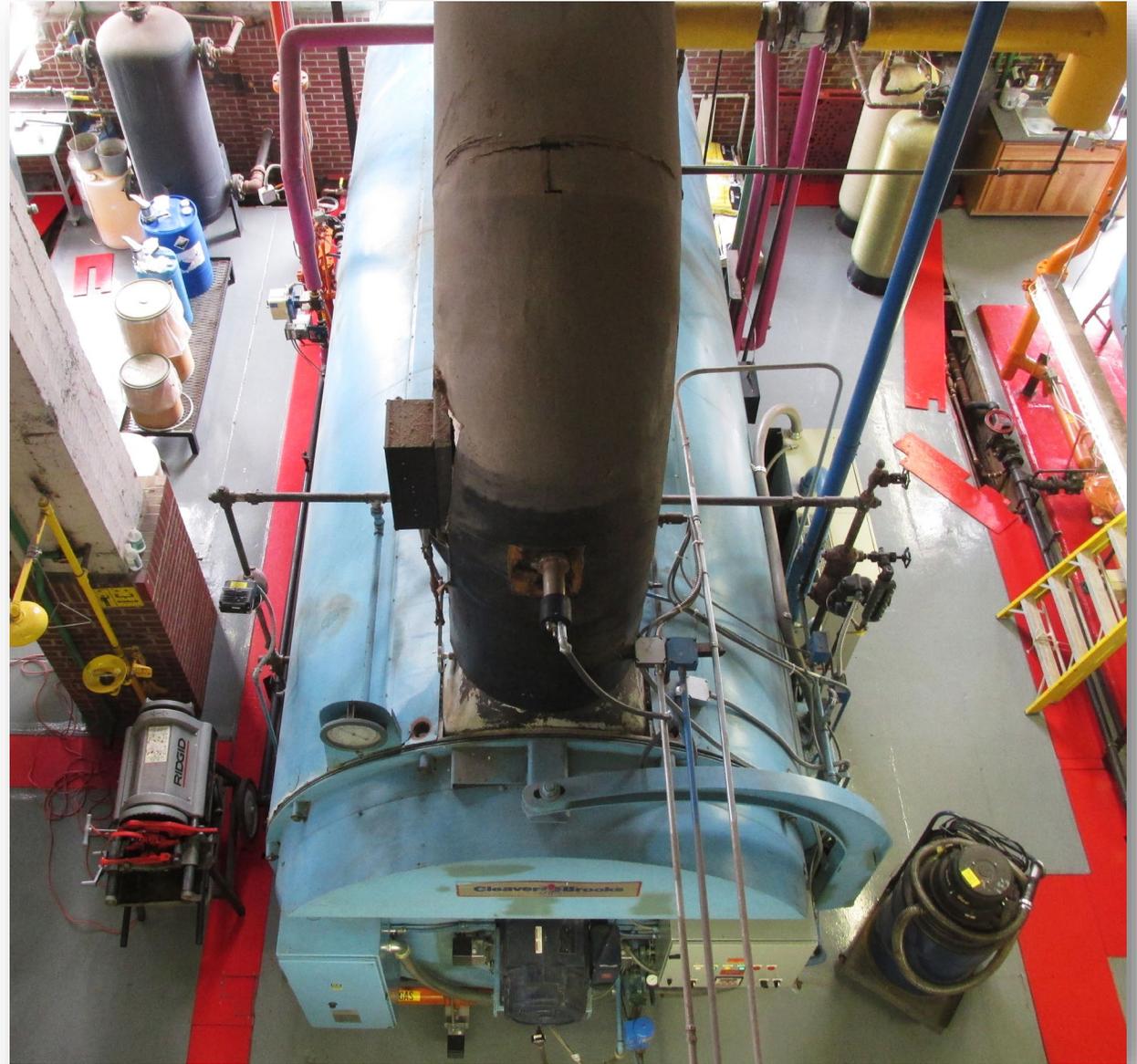
# GOALS

Infrastructure

Resiliency

Efficiency

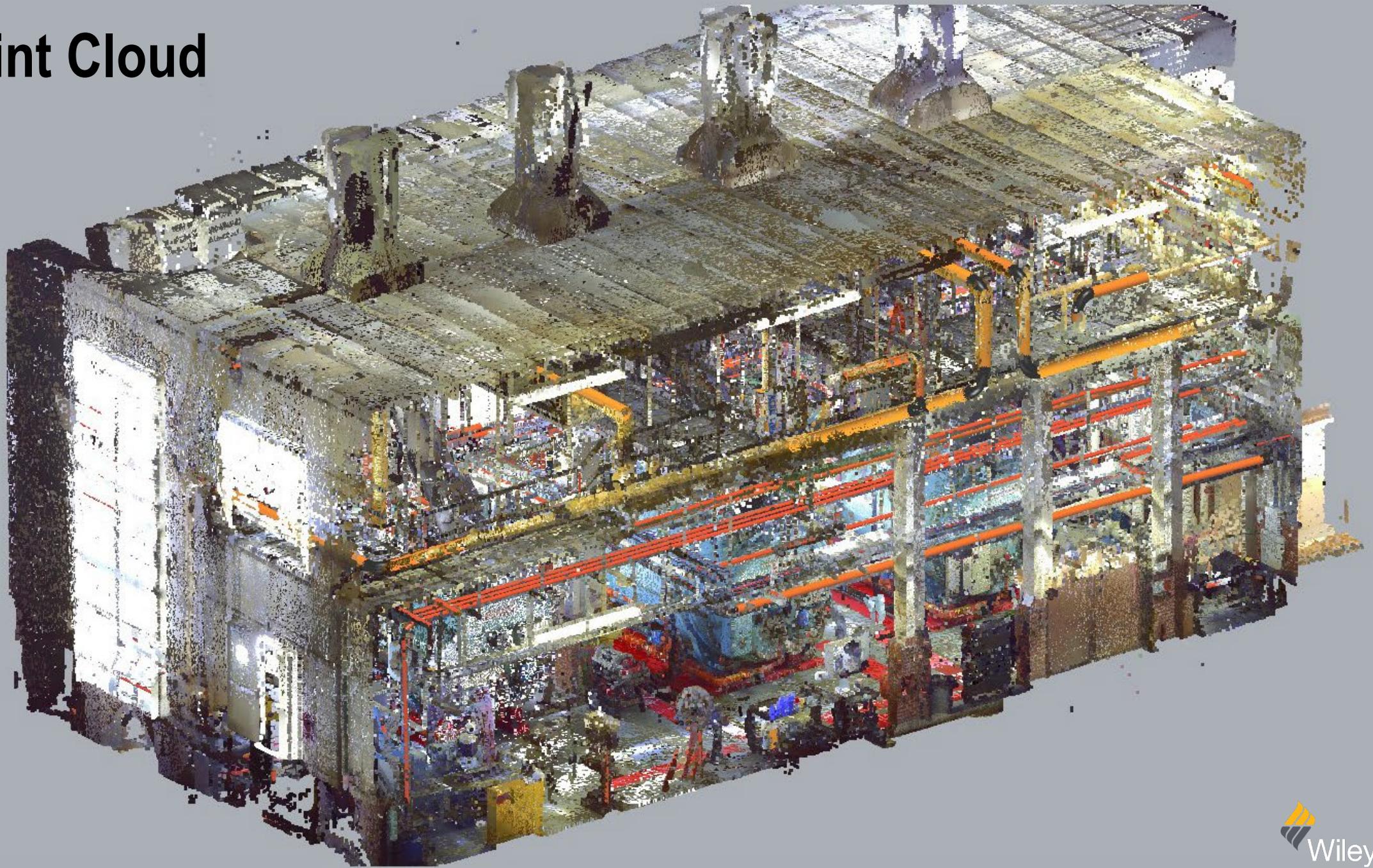
- 1905 historic structure
- Generated at 100 psig, distributed at 100 & 60 psig
  - Building heating
  - Domestic hot water
  - Laundry
- Firetube boilers
  - Boiler 1: 400 BHP (1994)
  - Boiler 2: 800 BHP (1994)
  - Boiler 3: 400 BHP (1986)

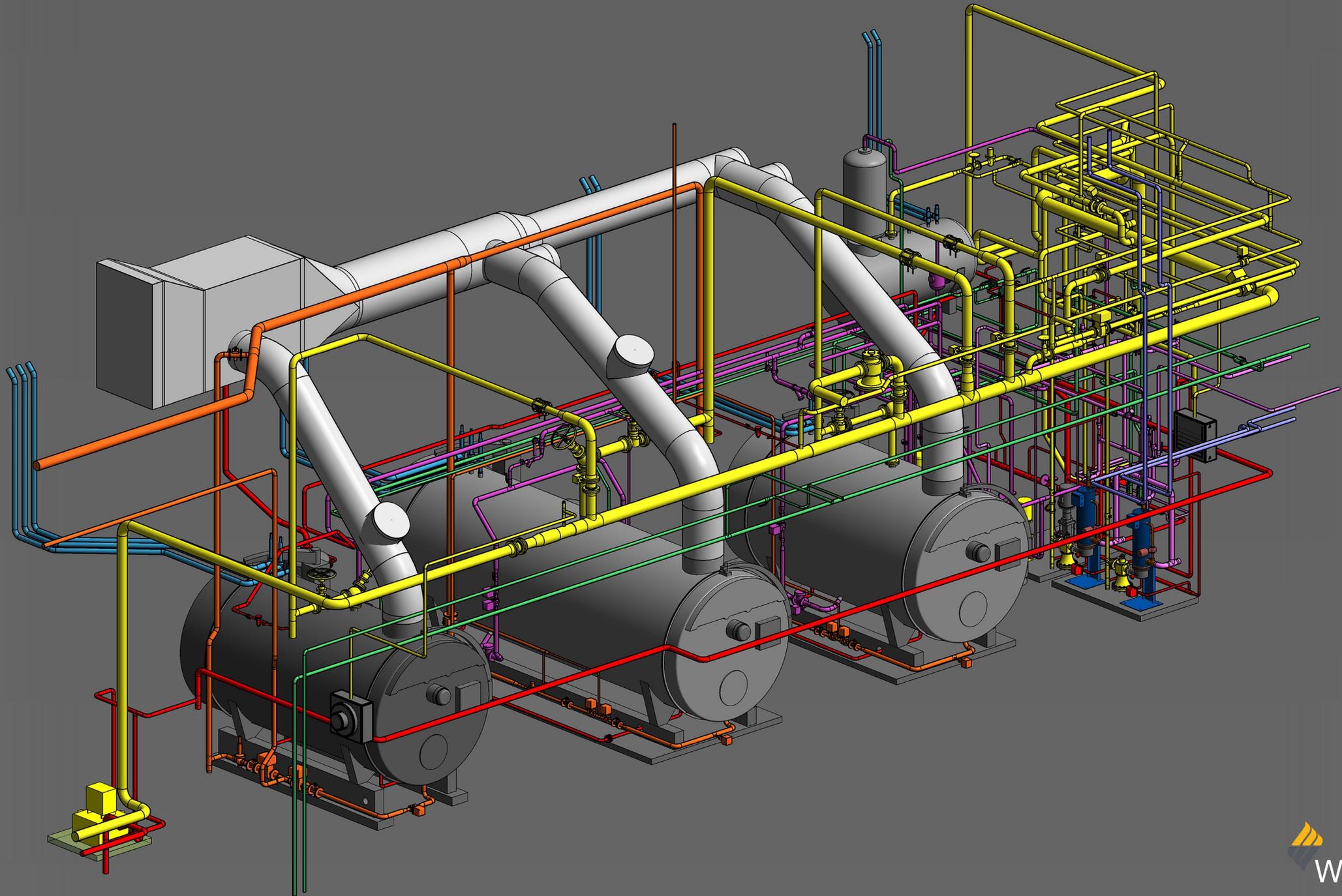


- Interviews with plant staff
- Load analysis
- 3D laser scanning
- Condition assessments
  - Boiler
  - Plant auxiliary systems



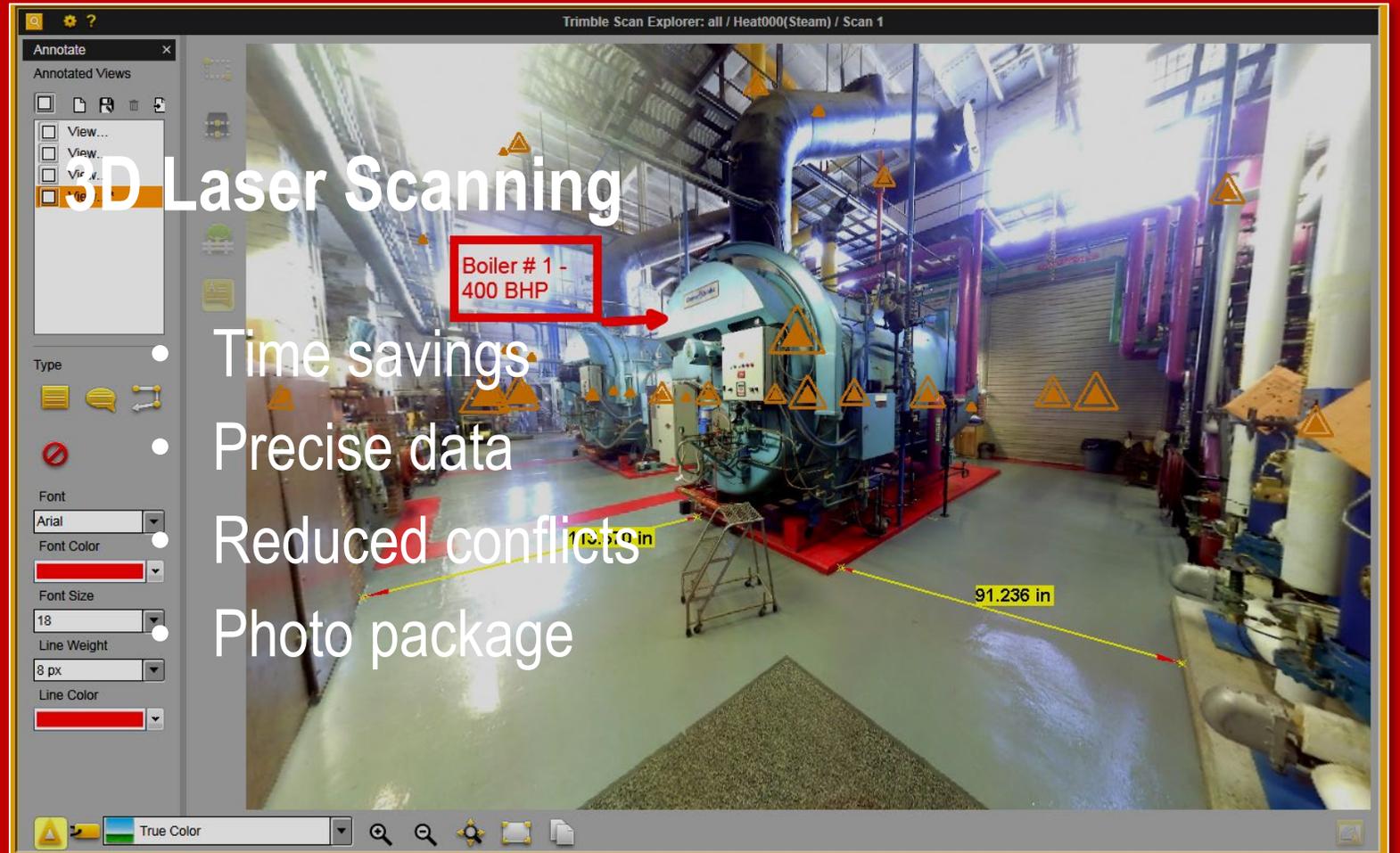
# Point Cloud



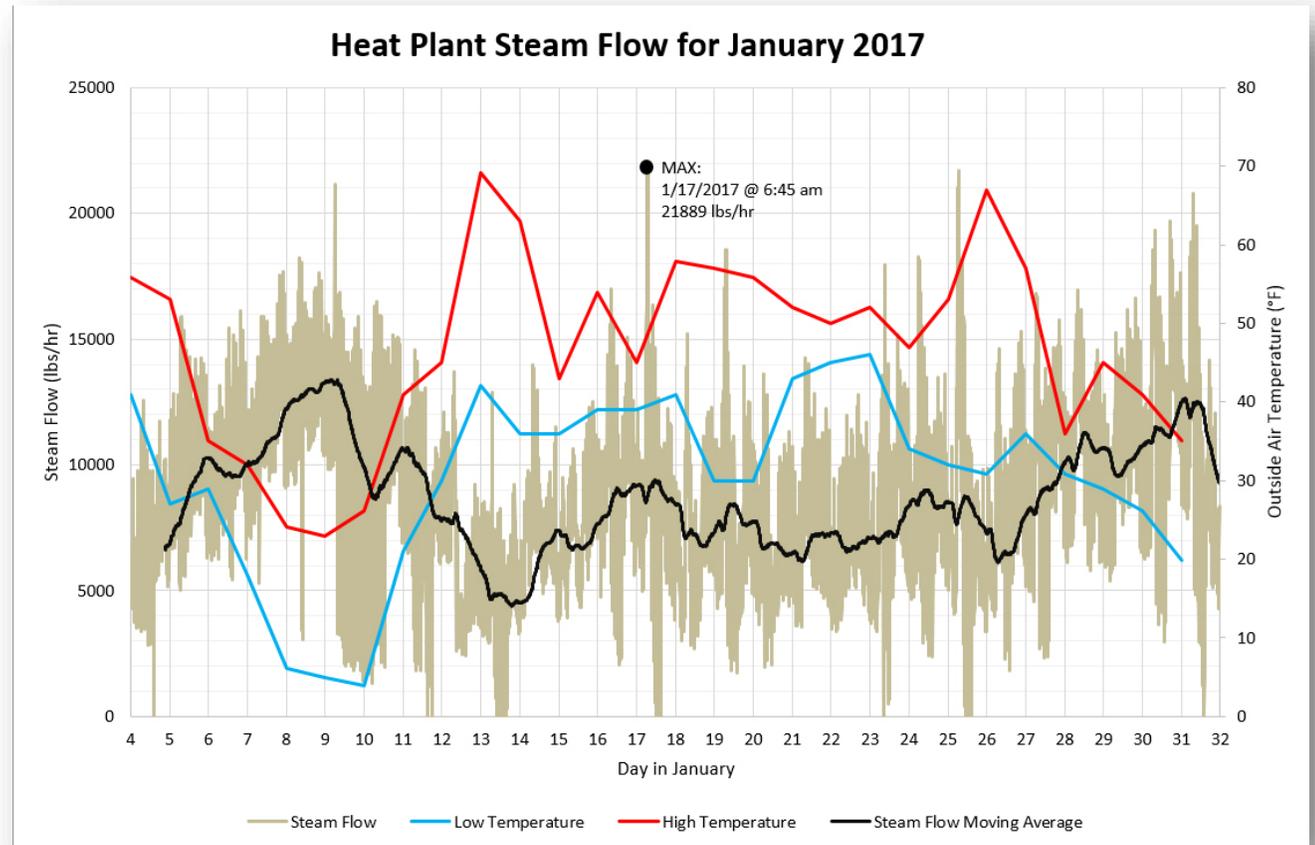


# 3D Laser Scanning

- Time savings
- Precise data
- Reduced conflicts
- Photo package



- Limited trending data
- Calculated vs nameplate steam loads
- Boiler 2 de-rated to 700 BHP
- Capacity
  - 1,500 BHP total (51,750 lbs/hr)
  - 800 BHP firm (27,600 lbs/hr)
- Design
  - 1,000 BHP firm (34,500 lbs/hr)



Steam Load due to:	Peak Steam Load
Building Heat	12,000 lbs/hr
Scott-Shipp Future Estimated Load	1,000 lbs/hr
Laundry (Richardson)	6,000 lbs/hr
Showering (Domestic hot water)	13,000 lbs/hr
<b>Total Calculated Peak Steam Load</b>	<b>32,000 lbs/hr</b>
<b>Maximum Recorded Steam Load</b>	<b>21,889 lbs/hr</b>



External stay welds tested



Critical welds tested - OK



General view (front) Boiler #2



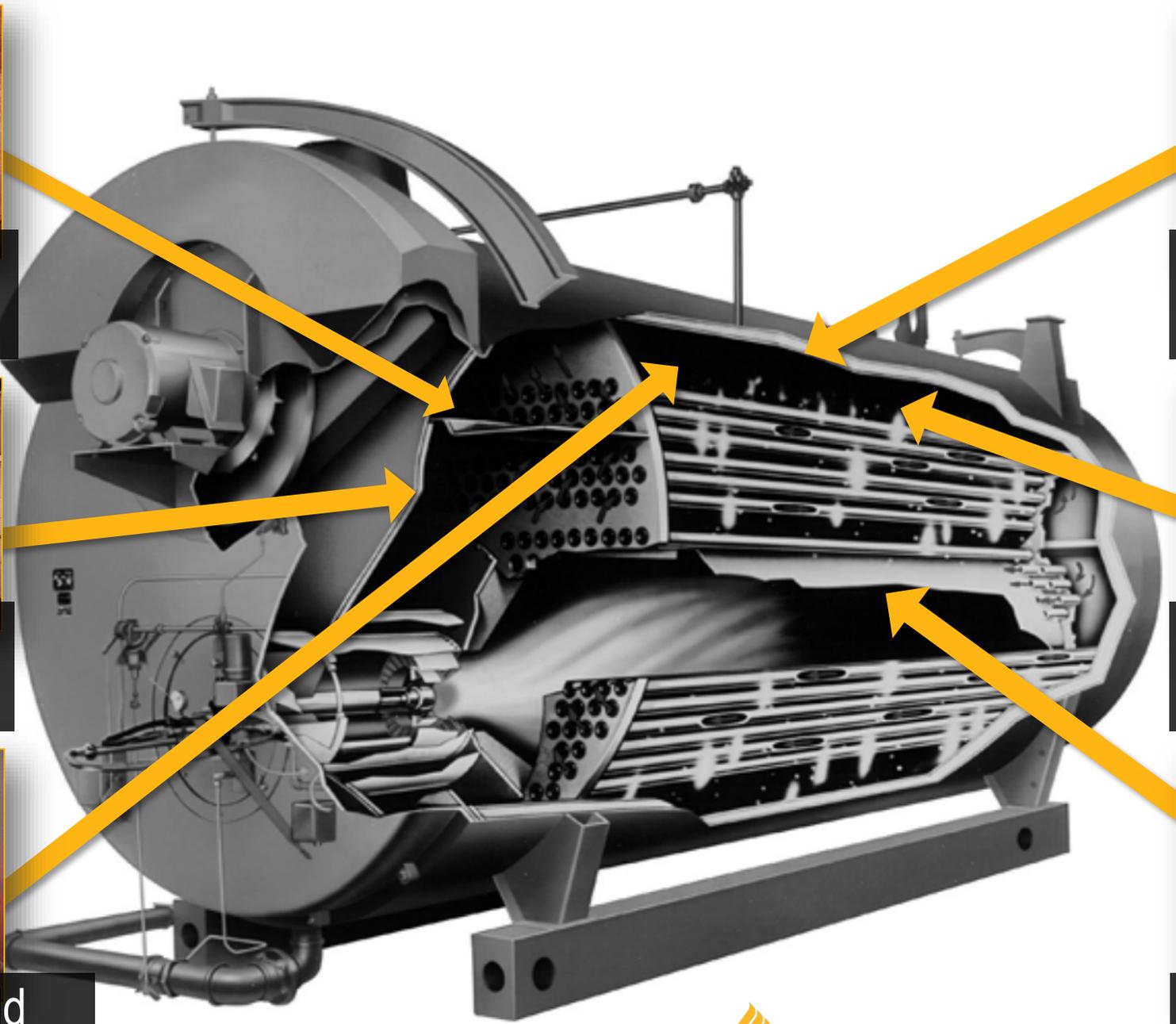
Isolated pitting on boiler tubes

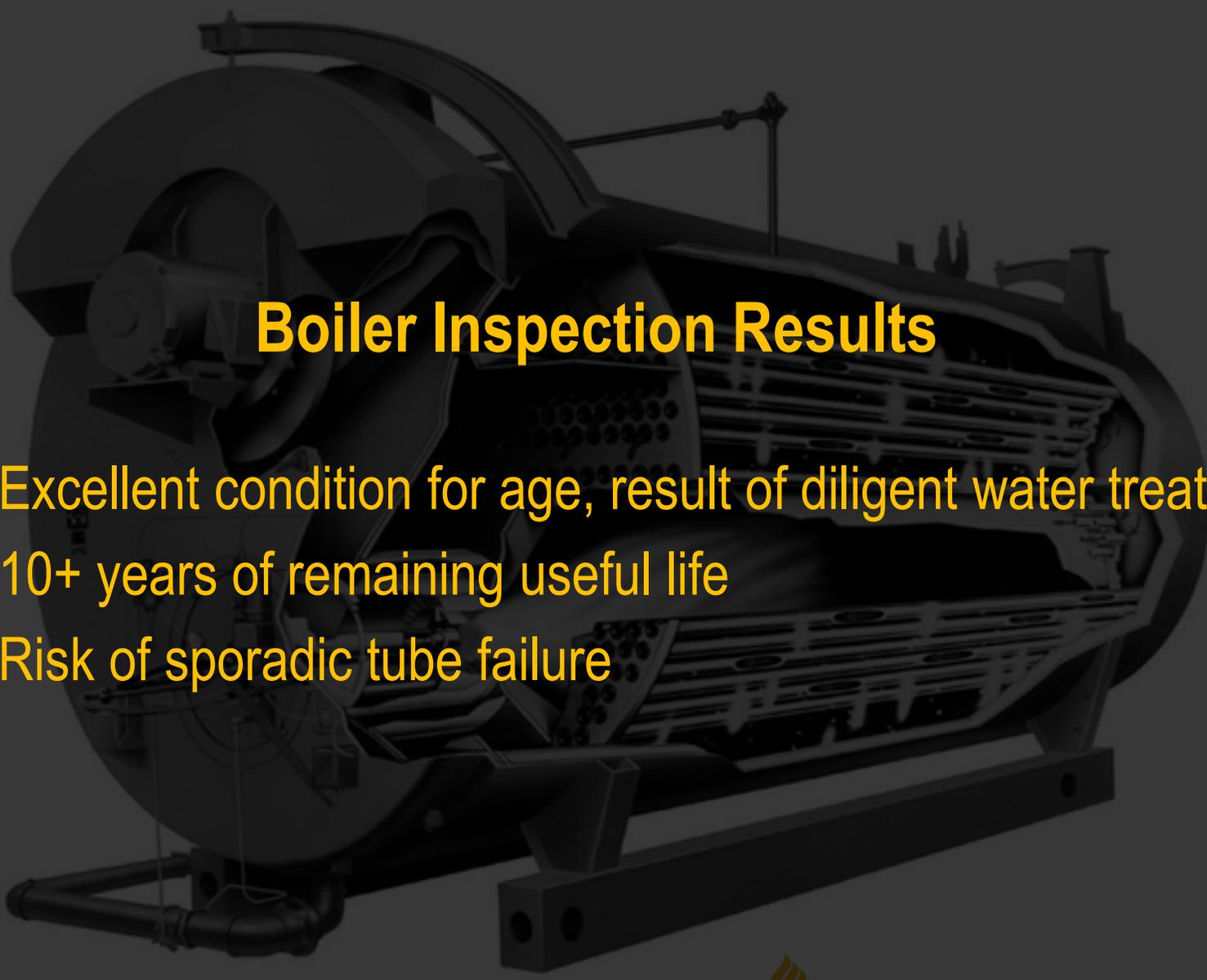


No wastage or weld cracks on diagonal stays



Furnace tube welds MT - OK

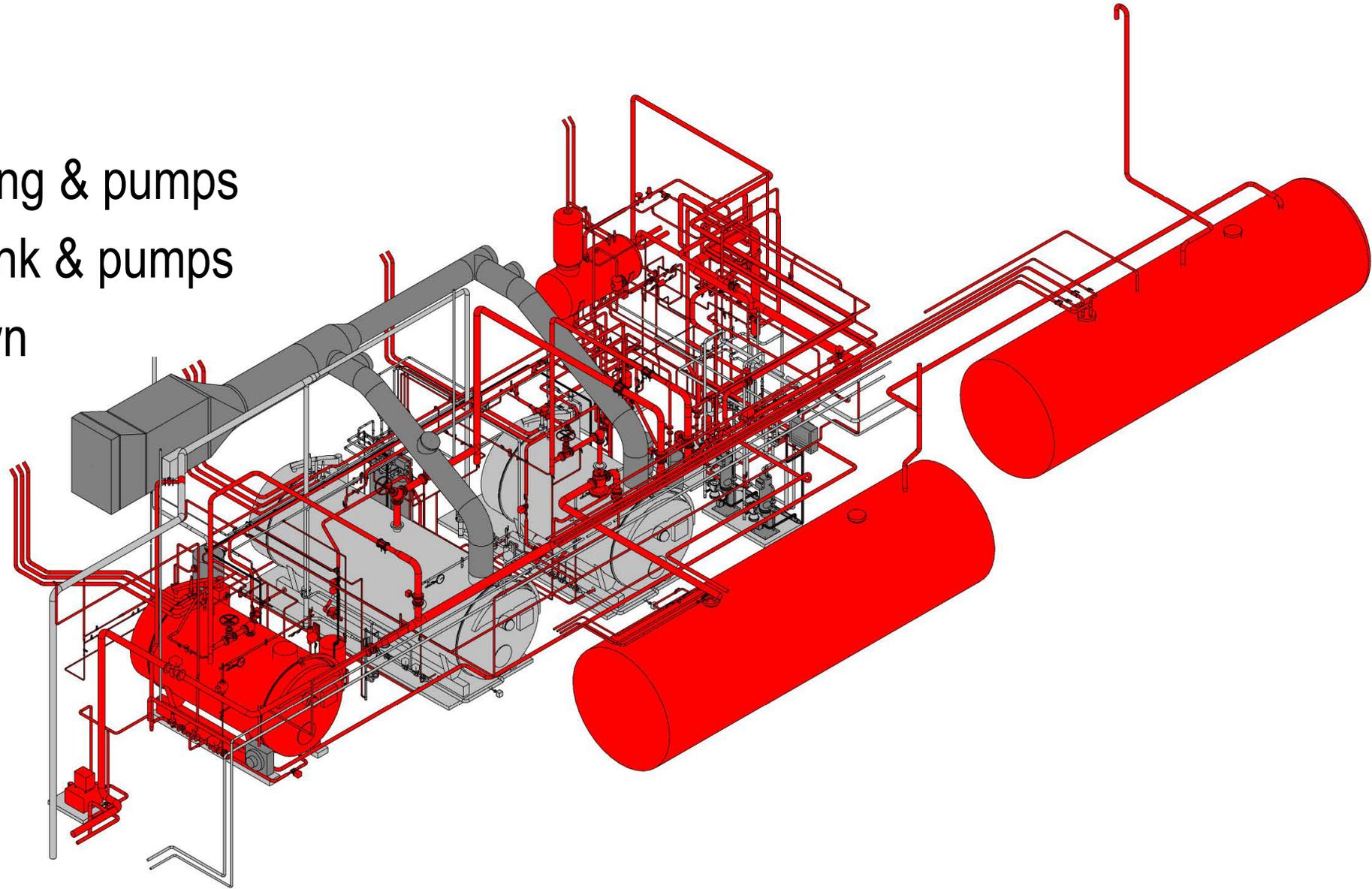




## Boiler Inspection Results

- Excellent condition for age, result of diligent water treatment
- 10+ years of remaining useful life
- Risk of sporadic tube failure

- Auxiliary systems
  - Deaerator
  - Feedwater piping & pumps
  - Condensate tank & pumps
  - Boiler blowdown
  - Controls

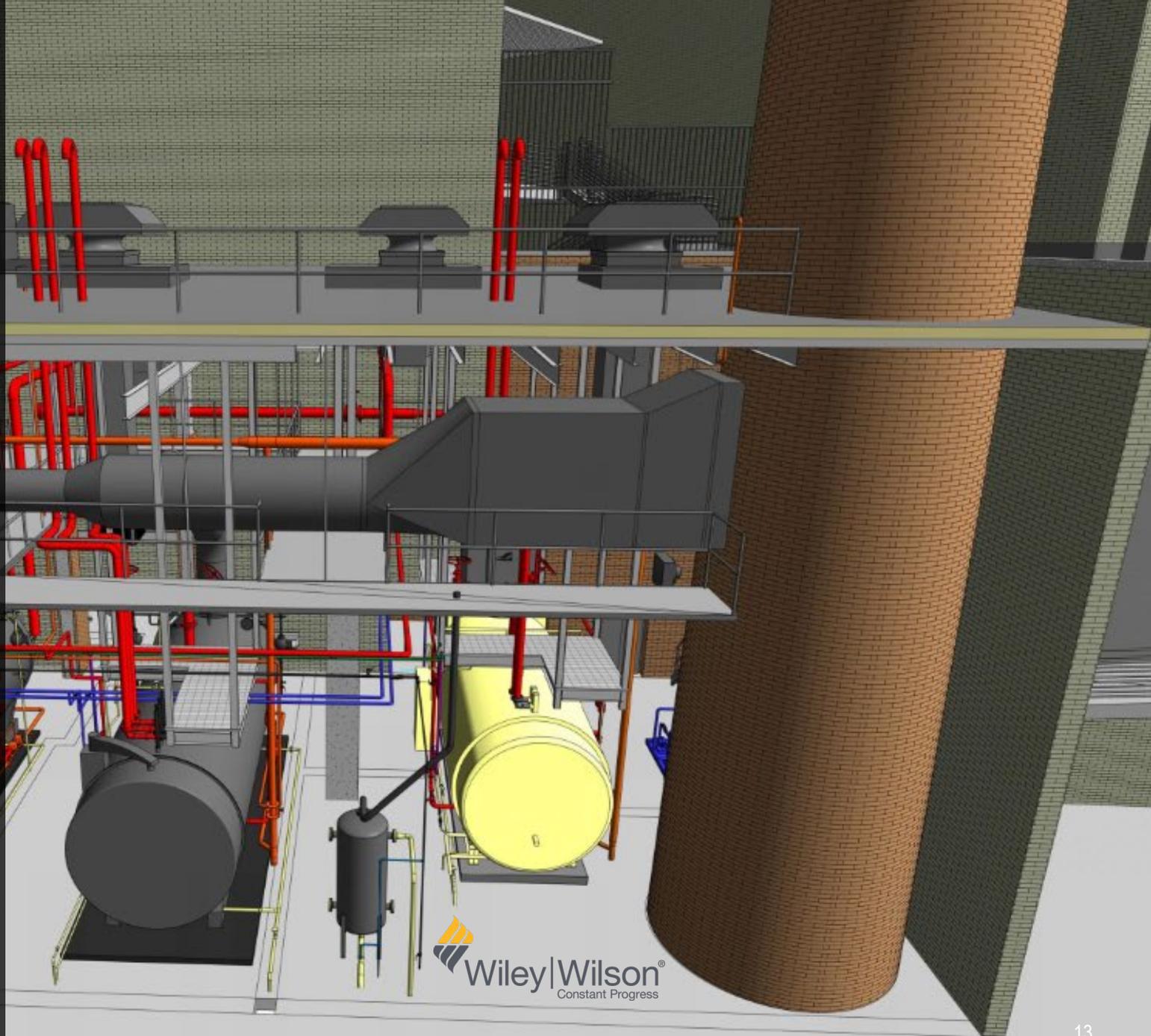


- Redundant PRV stations
- Interruptible NG without secondary fuel
- Steam flow meters
- Electrical system



# Solutions

- Boilers
  - Increase firm capacity to 1,000 BHP
  - Replace Boiler 3
    - 600 BHP
    - 4-pass, dry-back
    - 83.5% eff. NG
    - 86.8% eff. FO
  - Re-tube Boilers 1 & 2
  - Re-rate Boiler 2
    - 800 BHP (from 700 BHP)
- New auxiliary equipment

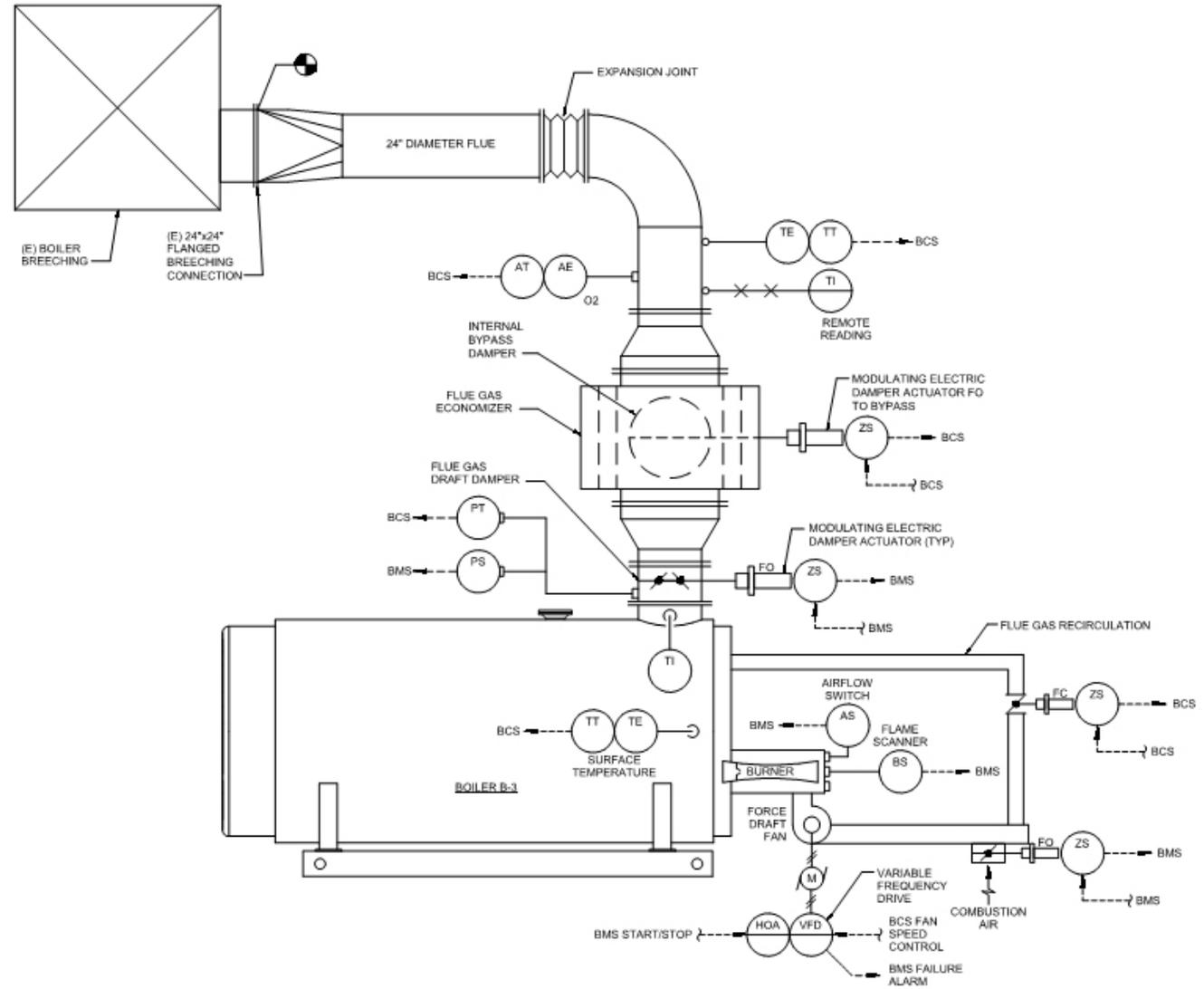


- Tray style DA tank
- Feedwater pumps, header arrangement
- Condensate tank & pumps in plant
- PRV stations
- New electrical equipment



# Controls

- Auxiliary systems controlled by DDC
- PLC based control system for boilers
- All controls integrated with Post-wide BAS



3 BOILER B-3 COMBUSTION AIR / FLUE GAS P&ID  
NOT TO SCALE

# Energy Improvements

## BOILERS

- Draft control
- O<sub>2</sub> trim
- Control improvements

## VFDs

- Boiler draft fan
- Feedwater pumps
- Condensate pumps

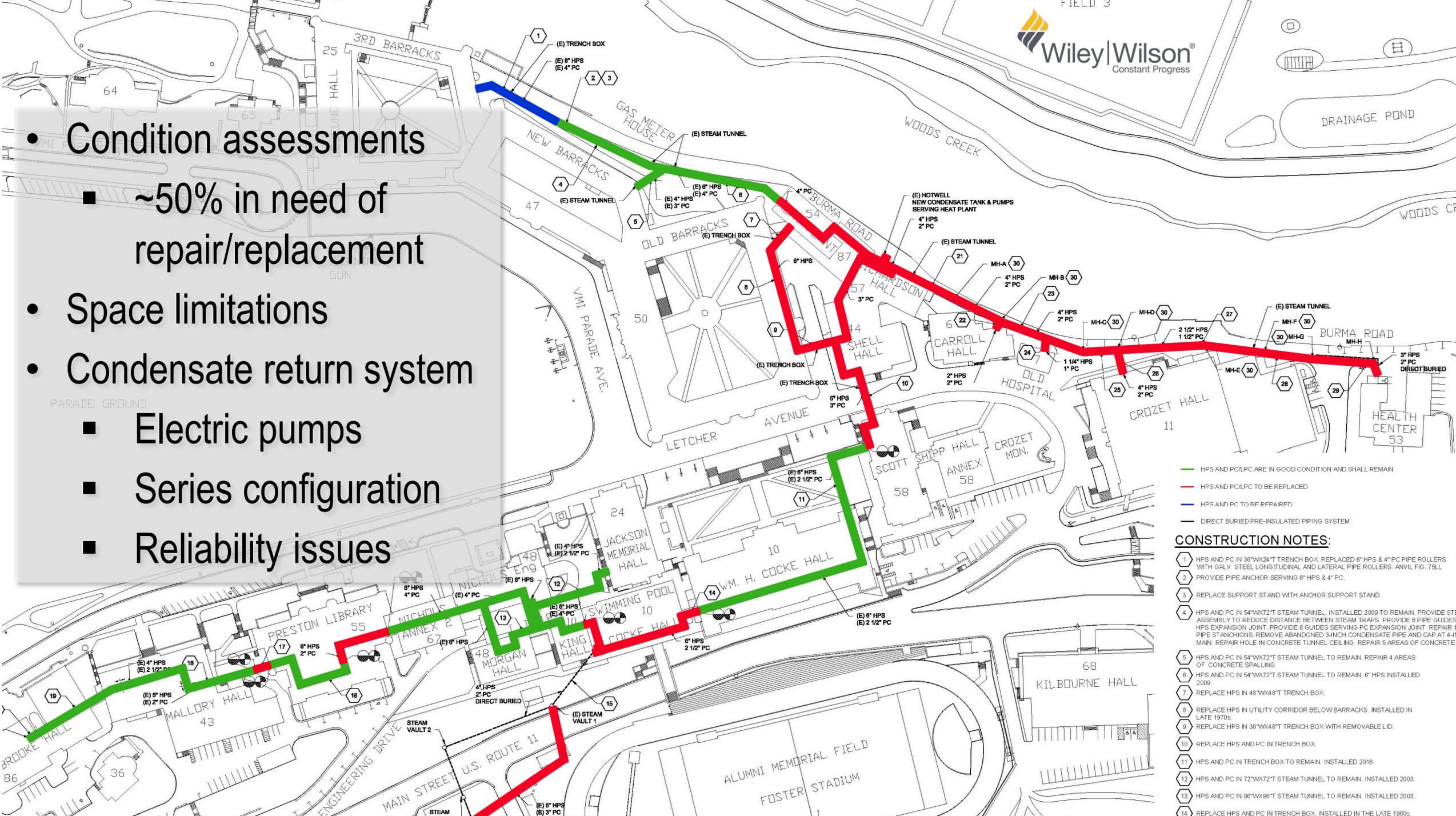
## FEEDWATER PUMPS

- Dedicated summer load pump
- Feedwater recirculation based on steam flow (vs. fixed recirc flow)

- Removable curtain wall for boiler tube pull
- New fuel oil tank
- Generator serving entire plant



- Condition assessments
  - ~50% in need of repair/replacement
- Space limitations
- Condensate return system
  - Electric pumps
  - Series configuration
  - Reliability issues

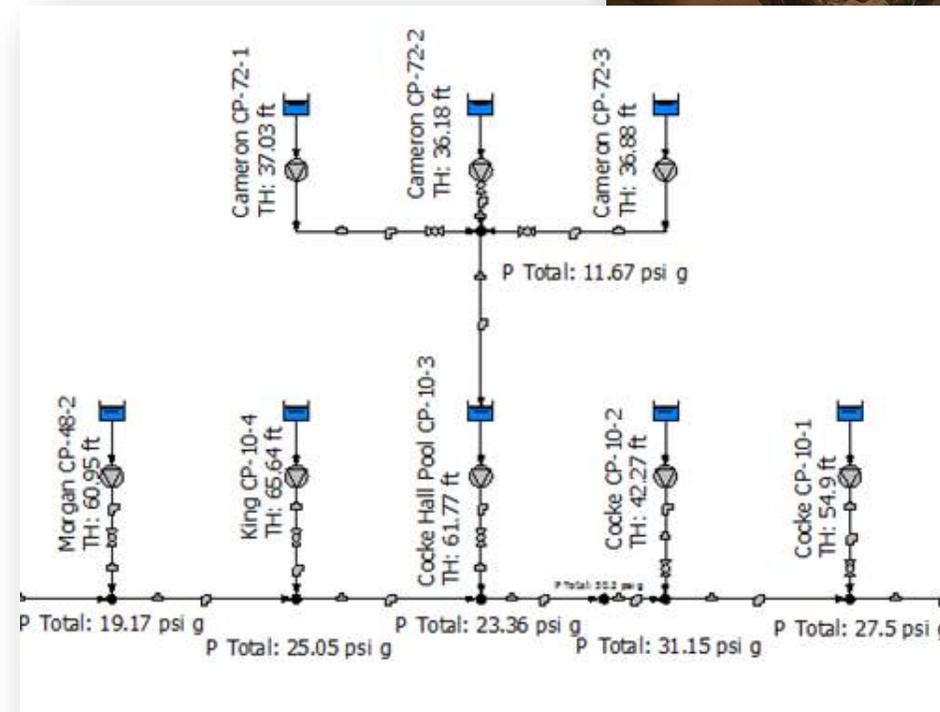


- HPS and POL/PC ARE IN GOOD CONDITION AND SHALL REMAIN
- HPS AND POL/PC TO BE REPLACED
- HPS AND PC TO BE REPAIRED
- DIRECT BURIED PRE-INSULATED PIPING SYSTEM

**CONSTRUCTION NOTES:**

- 1 HPS AND PC IN 36"WX24\" TRENCH BOX. REPLACED 6\" HPS & 4\" PC PIPE ROLLERS WITH GALV. STEEL LONGITUDINAL AND LATERAL PIPE ROLLERS. ANVL FIG. 75LL
- 2 PROVIDE PIPE ANCHOR SERVING 6\" HPS & 4\" PC.
- 3 REPLACE SUPPORT STAND WITH ANCHOR SUPPORT STAND.
- 4 HPS AND PC IN 54\"WX72\" STEAM TUNNEL. INSTALLED 2009 TO REMAIN. PROVIDE STEEL ASSEMBLY TO REDUCE DISTANCE BETWEEN STEAM TRAPS. PROVIDE 6\" PIPE GUIDES. HPS EXPANSION JOINT. PROVIDE 6\" GUIDES SERVING PC EXPANSION JOINT. REPAIR 1\" PIPE STANCHIONS. REMOVE ABANDONED SINCH CONDENSATE PIPE AND CAP AT 4.4\" MAIN. REPAIR HOLE IN CONCRETE TUNNEL CEILING. REPAIR 5 AREAS OF CONCRETE SPALLING.
- 5 HPS AND PC IN 54\"WX72\" STEAM TUNNEL TO REMAIN. REPAIR 4 AREAS OF CONCRETE SPALLING.
- 6 HPS AND PC IN 54\"WX72\" STEAM TUNNEL TO REMAIN. 6\" HPS INSTALLED 2009.
- 7 REPLACE HPS IN 48\"WX48\" TRENCH BOX.
- 8 REPLACE HPS IN UTILITY CORRIDOR BELOW BARRACKS. INSTALLED IN LATE 1970s.
- 9 REPLACE HPS IN 36\"WX48\" TRENCH BOX WITH REMOVABLE LID.
- 10 REPLACE HPS AND PC IN TRENCH BOX.
- 11 HPS AND PC IN TRENCH BOX TO REMAIN. INSTALLED 2016.
- 12 HPS AND PC IN 72\"WX72\" STEAM TUNNEL TO REMAIN. INSTALLED 2003.
- 13 HPS AND PC IN 96\"WX96\" STEAM TUNNEL TO REMAIN. INSTALLED 2003.
- 14 REPLACE HPS AND PC IN TRENCH BOX. INSTALLED IN THE LATE 1990s.

- Replace steam & condensate piping
  - Tunnels, trench boxes, buildings, direct buried
  - Expansion joints, anchors, supports
- Condensate system
  - Convert buildings in series to parallel
  - Replace electric pumps with steam pressure powered pumps
    - Level switches & temperature transmitters connected to BAS

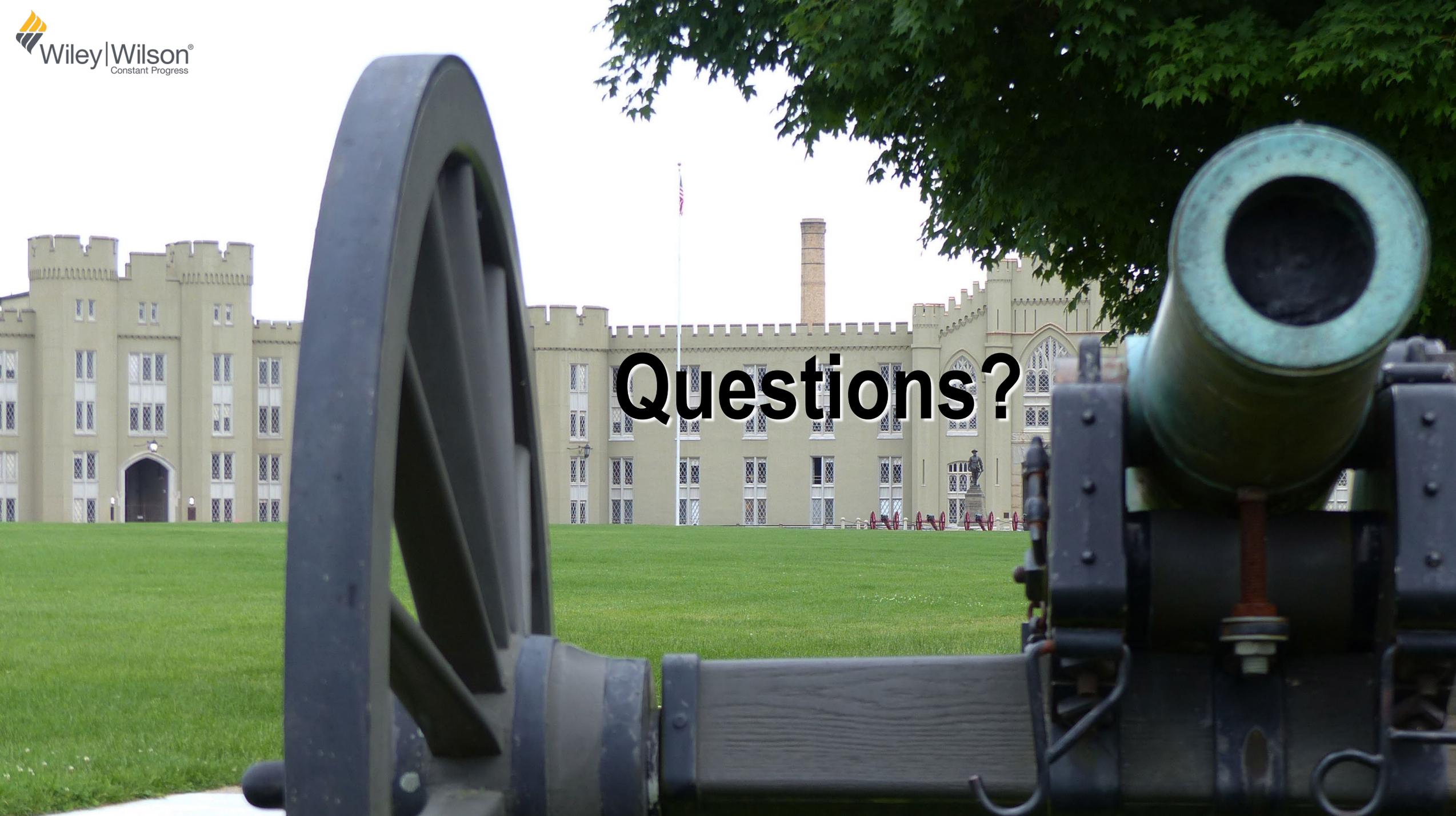




# Lessons Learned



- Challenges with integrating boiler control systems
- Review coordination drawings with Owner & Contractor



**Questions?**



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**Thank You**



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