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)
Approach

- Interviews with plant staff
- Load analysis
- 3D laser scanning
- Condition assessments
  - Boiler
  - Plant auxiliary systems
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)
External stay welds tested

Furnace tube welds MT - OK

General view (front) Boiler #2

Critical welds tested - OK

Isolated pitting on boiler tubes

No wastage or weld cracks on diagonal stays
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
Findings

• 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
Energy Improvements

**BOILERS**
- Draft control
- $O_2$ 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
• 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

• Existing conditions
• Revised tank room design
• Challenges with integrating boiler control systems
• Review coordination drawings with Owner & Contractor
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