Designing Desuperheater Options for the University of Iowa Low Pressure Steam System

Ben Anderson – University of Iowa

Ben Niedergeses – Stanley Consultants

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Agenda

- Introductions
- Overview of Plant & Distribution System
- Low Pressure Steam System Issues
- Design Considerations & Desuperheater Options
- Project Construction
- Impact of Modifications
- Questions & Discussion

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Introductions

- Ben Anderson – University of Iowa
  - Power Plant Manager
  - BSME from Iowa State University
  - Petro-chemical Background

- Ben Niedergeses – Stanley Consultants
  - Mechanical Engineer – Energy Business Group
  - BSME from Iowa State University
  - Power Plant Consulting Background

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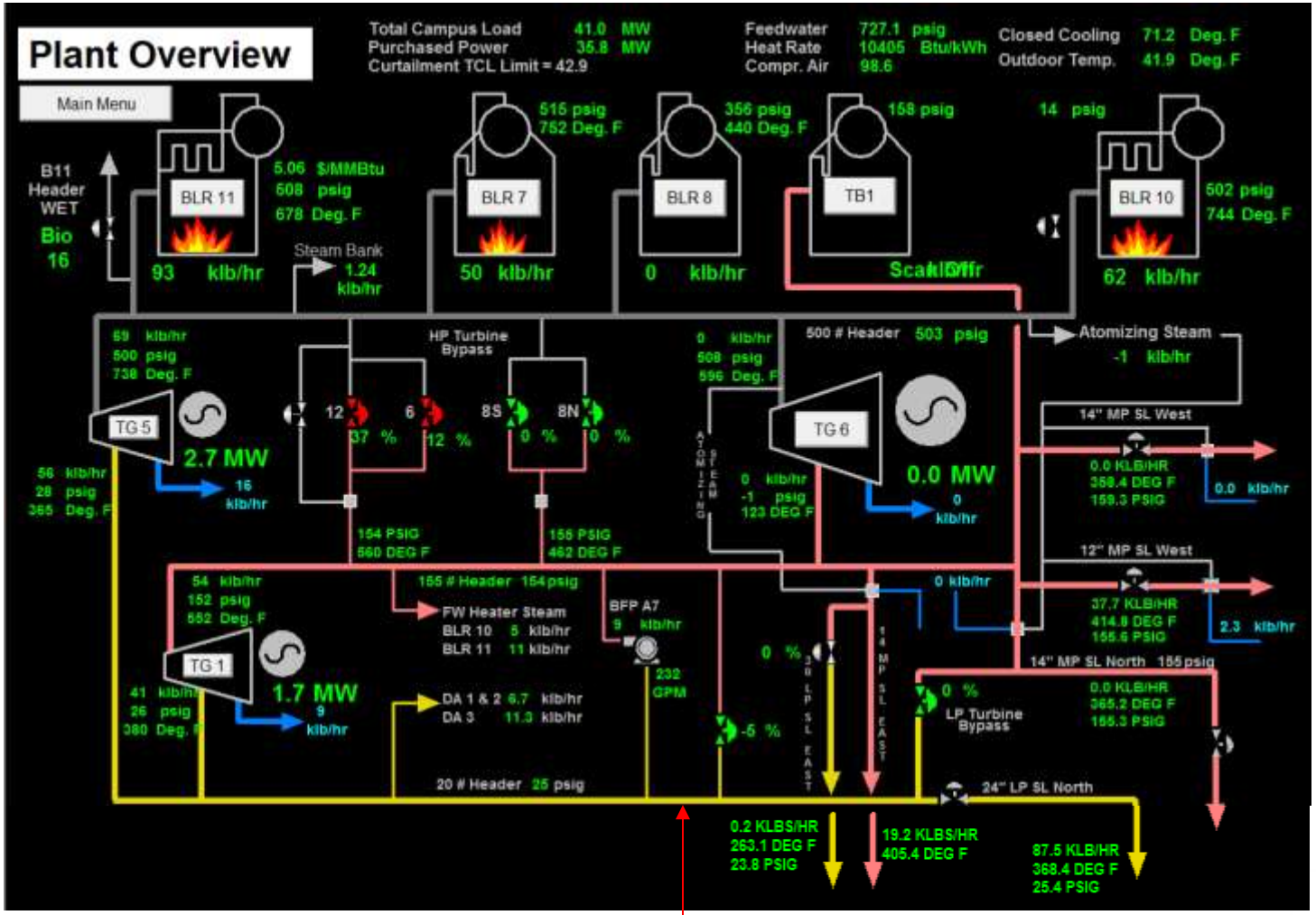
Power Plant Overview



20 psi – LP steam header

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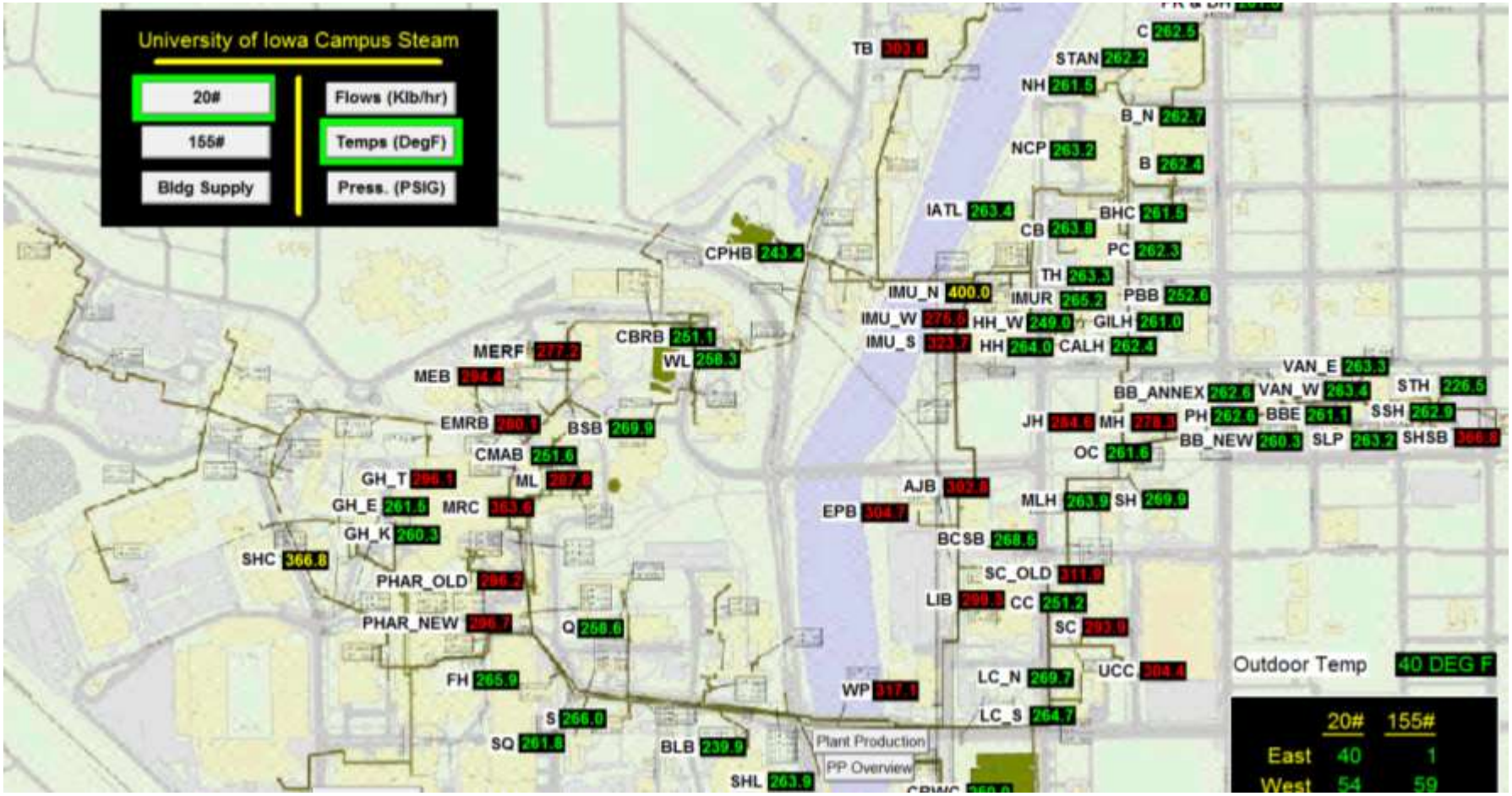
Campus Steam Distribution



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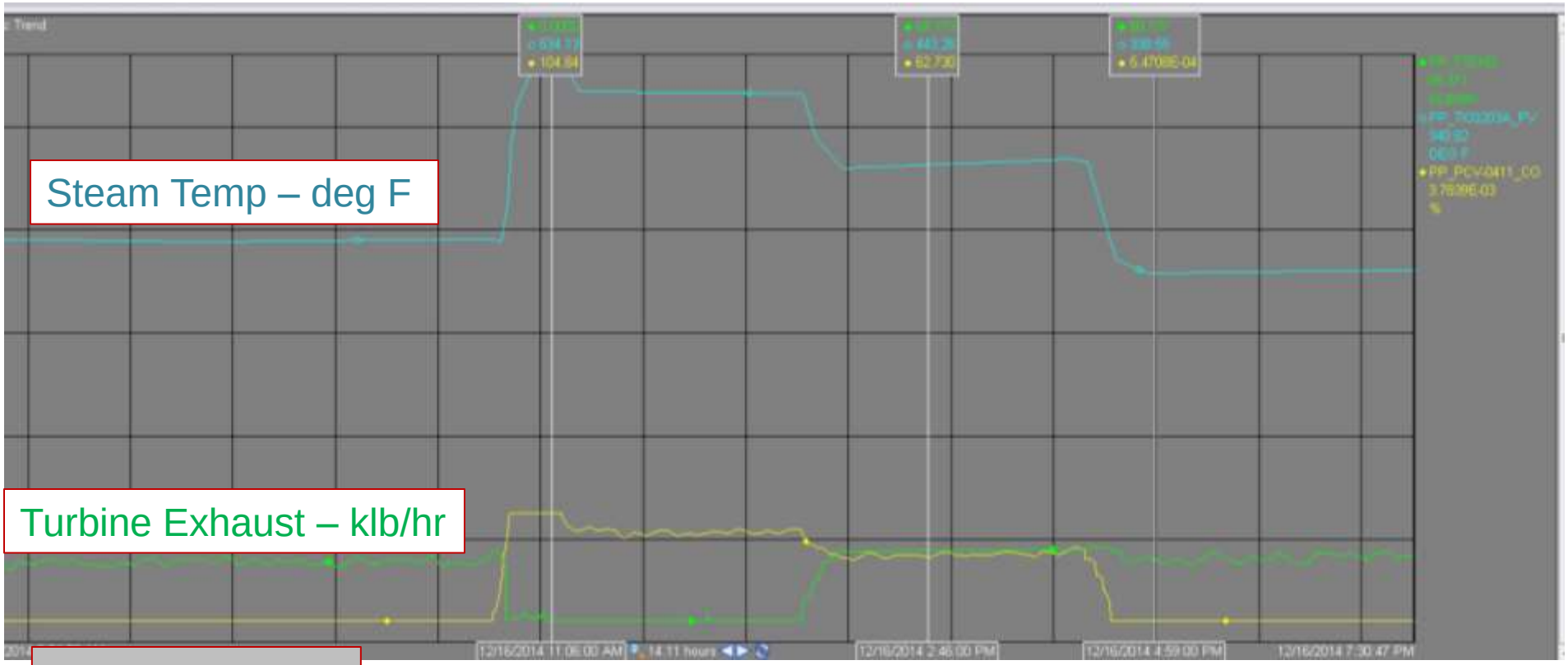
Plant Line-up Effect on LP Steam Temp



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Campus Concerns & Solution

- High temperature steam damaging equipment
  - Dorms equipped with antiquated steam control system with on/off design
  - Steam trap damage significant
  - Upgraded control system still couldn't handle high temps
- Install Low Pressure (20#) Steam desuperheaters to reliably provide proper steam temp for customers

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System Conditions

- Design Criteria
  - Low Pressure Steam Flow:
    - Maximum: 135,000 lb/hr
    - Minimum: 15,000 lb/hr
  - Initial Inlet Steam Conditions: 26 psig, 388°F
  - New Outlet Temperature: 280°F
  - Line Size:
    - East Sideline: 30”
    - North Sideline: 24” reducing to 20” at Bulkhead

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East Sideline

- East Sideline Pipe Size
  - 30” Line Sized for Major Future Expansion
  - Current Line Velocity at Minimum Flow: 13 ft/s
  - Vendor Representative Selections Required 20 ft/s – 30 ft/s

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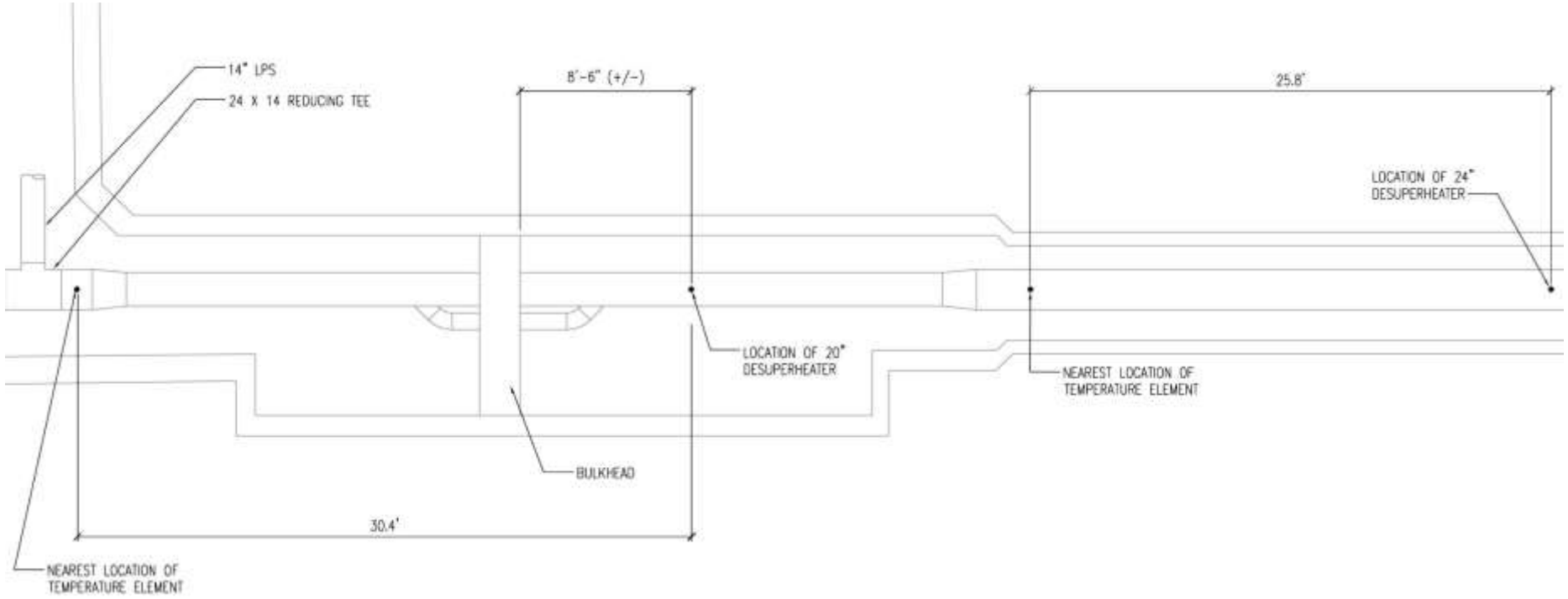
Desuperheater Options

- Steam Assist Desuperheater
  - Requires Medium Pressure Steam Line (150 psig)
  - Achieves Minimum Flow of 25,000 lb/hr (21 ft/s)
- Basic Mechanical Desuperheater
  - Simple and Inexpensive
  - Achieves Minimum Flow of 36,000 lb/hr (30 ft/s)

Desuperheater Options

- Solutions
  - Line Modifications
    - Replace Line with Reduced Size for Required Straight Pipe Length
    - New Piping Parallel to Existing Line
    - Modifications Upstream of 30” Line
  - Accept Higher Minimum Flow
    - 25,000 or 36,000 lb/hr versus 15,000 lb/hr

North Sideline



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Design Considerations

- North Sideline Layout
  - Main Tunnel Installation
    - Sufficient Pipe Length to Install Element
    - Desuperheater in Primary Piping Blocks Tunnel Access
    - 24” Pipe in Main Tunnel
    - Reduces to 20” at Bulkhead

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Design Considerations

- North Sideline Layout
  - Bulkhead Installation
    - Temperature Element Located Beyond Watertight Bulkhead
    - Limited Downstream Pipe Length Available
    - Smaller Pipe Improves Low Flow Performance

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Desuperheater Options

- Steam Assist Desuperheater
  - Requires Medium Pressure Steam Line (150 psig)
  - Achieves Minimum Flow of 10,500 lb/hr
- Multi-Nozzle Desuperheater
  - Simpler and Less Expensive - No Steam Required
  - Achieves Minimum Flow of 15,600 lb/hr

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Desuperheater Options

- Solutions
  - Main Tunnel Installation Created an Excessive Obstruction, Bulkhead Installation Pursued
  - Wall Penetration for Conduit
    - No Available Conduit to Utilize
    - Core Drill with Water Seal
  - Vendor's Distance to Element Requirements Fit Within the Pipe Length Available

North Sideline Installation

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East Sideline Installation

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Commissioning & Operation

- Commissioned in December 2014
- Steam Temperature controlled down to 280 F per control loop
  - High temps still noted during cold weather at downstream equipment (confirmed with field measurements
- Troubleshooting with vendor to determine cause
- Planning shutdown for inspection of well and Desuperheater and Thermowell

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Questions

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