Key Learning Point

Emphasis on Process Side
- Design and Operation

Neglect on Utility Side
- Design and Operation

Consequence – Reduced Reliability
SRU Utilities

- Steam (imported and exported);
- Boiler Feed Water, Utility and Make-up Water;
- Fuel Gas and Natural Gas;
- Nitrogen;
- Instrument Air;
- Electricity.
Steam - Imported

- Excessive Moisture – heat loss/trap overload
- Corrosion due to non-condensibles
- Mechanical design
  - Strength weld
  - Seal weld
- Process Design
  - Fouling factor
  - Steam traps
  - Insulation
  - Purge design
- High temperature – sulfur viscosity
Steam Trap Installation Detail

Keep SRU Hot!
Steam/Condensate Connections for Steam Jacket

Condensate

To Valve

Tubing

Steam Jacket on Valve
Sulfur Pump Supply Pressure Control
Pure Sulfur Viscosity Curve
Seal Weld Procedure

TYPE 1
"J"-GROOVE

GAS SIDE  WATER SIDE
Strength Weld Procedure

TYPE 3
INNER-BORE

GAS SIDE

WATER SIDE
550 psig Steam Reheater Failure
550 psig Steam Reheater Leak
Boiler Design Changes

- Higher Steam Side Operating Pressures
  - Older Designs:
    - Pressure Range: 150 to 250 psig (10 to 17 barg)
    - Steam Temperature: 354 to 399 °F (179 to 204 °C)
  - Modern Designs:
    - Pressure Range: 450 to 600 psig (31 to 41 barg)
    - Steam Temperature: 457 to 484 °F (236 to 251 °C)
- Carbon Steel Sulfidation Temperature: 650 °F (343 °C)

Smaller Margin For Error
WHB Operating Regime

Smaller Margin For Error
Typical Waste Heat Boiler Design
Typical Waste Heat Boiler Design

Older Designs
- Common to have two or three intermittent blowdown connections.
- Common to include intermittent blowdown at both hot and cold end.
- Kettle Style: water sample from exchanger: representative

Modern Designs
- Common to have only one intermittent blowdown.
- Typically located at cold end; WRONG END
- Thermosyphon: water sample from Steam Drum: risky

More Prone to Failure
# Recommended Boiler Water Limits

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Boiler Blowdown

- Remove water containing suspended and dissolved solids; replaced with relatively pure feedwater.

- Scale forming salts concentrate and crystallize on the heating surfaces.

- Result can be tube failures, tube-to-tubesheet failures.

- Two principal types of blowdown:
  - intermittent and continuous.

- Intermittent is done manually AND is necessary for operation of boiler regardless of whether or not continuous blowdown is employed.

- Continuous blowdown is a continuous and automatic removal of concentrated boiler water.
Boiler Blowdown

- Outside activity reduced; many factors.
- Intermittent blowdown not always a routine procedure.
- Intermittent blowdown NOT a routine procedure.
- Located at WHB outlet.
- Failure of IBD line in winter operation.
Failure to recognize importance of BFW quality and blow down procedures.

**Result**

Two WHB failures in 10 months.
WHB Tubesheet High Temperature Sulfide Attack
Critical Burner Nozzle Purges

- Flame scanners
- Sight glasses on the burner and reaction furnace
- Igniter port
- Reaction furnace temperature measurement
- Idle ports such as natural gas
Purge Rotameter Assembly
Nitrogen Purge Header Detail

Each Purge MUST have its own rotameter

Nitrogen to Burner and Furnace Ports

Set @ 25 psig

Nasato Consulting Ltd
Partially Plugged Furnace Port
Fuel Gas/Natural Gas

- There is a DIFFERENCE
- Composition
  - Air required
  - Contaminants
- Burner Design/Operation
  - Flame moderation
  - Options – excess air, steam, nitrogen
- Effects on SRU
  - Sulfur fires
  - Soot
- Refractory Design
Natural Gas Firing Temperatures w/ Steam Moderation
Low Pressure Steam Requirement for Flame Moderation when Firing Natural Gas at 95% Stoichiometry
THERMAL SHOCK DUE TO HIGH TEMPERATURE RESTART WHEN FURNACE WAS OFF LINE FOR SEVERAL HOURS
Liquid Storage
SRU Utilities

Key to successful SRU operation:

Pay special attention to the design and operation of the utility components
Conclusions

- Operations:
  - Training include Utilities
  - “Walk through the Metal Forest”

- Design:
  - “Devil in the Details”

- DO NOT IGNORE UTILITIES