

Worldwide Pollution Control Association

IL Regional Technical Seminar
September 13-15, 2011

W
P
C
A



Visit our website at www.wpca.info



SO₂ Control for Small Boilers for U-MACT and CSAPR Compliance

Presentation to:

**2011 WPCA IL Regional Technical
Seminar**

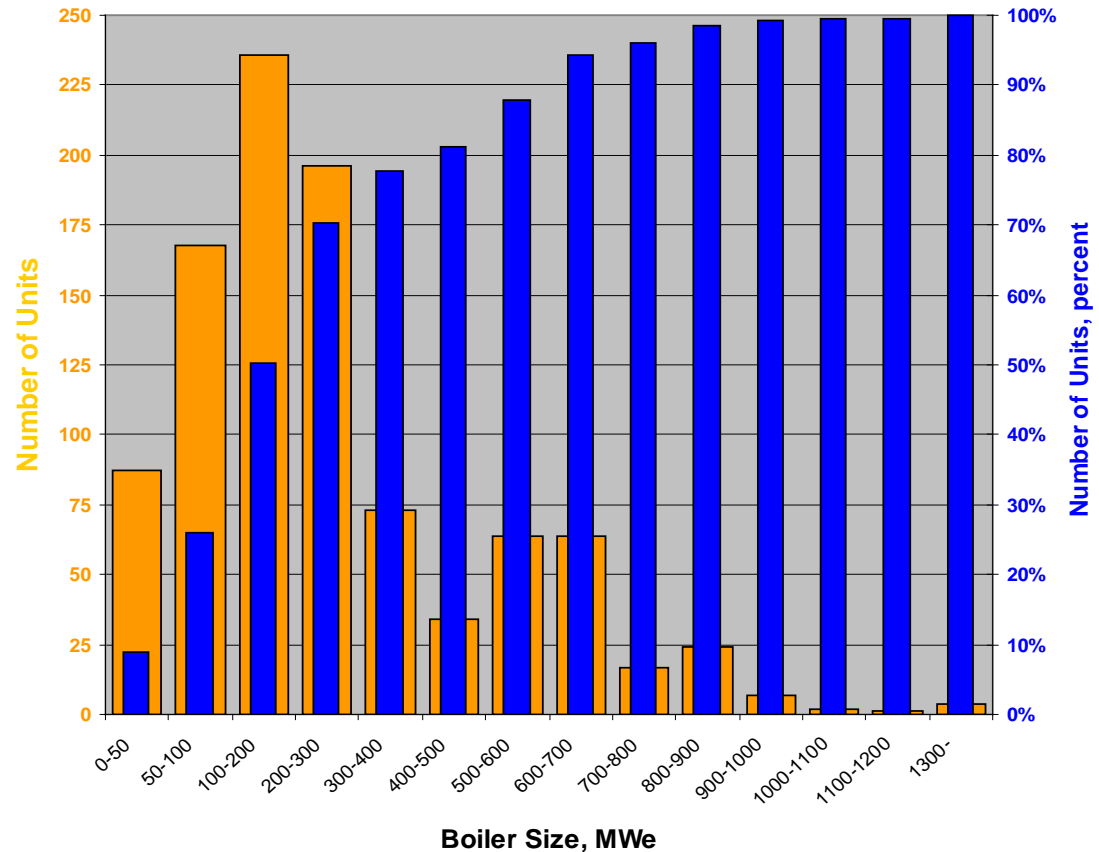
September 15, 2011

- Small Boiler Market Overview
- Available FGD Technology for Small Boilers
- URS Concept for Small Boiler Wet FGD System, Co-Flo™
 - ✓ Design
 - ✓ Performance
 - ✓ Schedule
 - ✓ Capital Cost

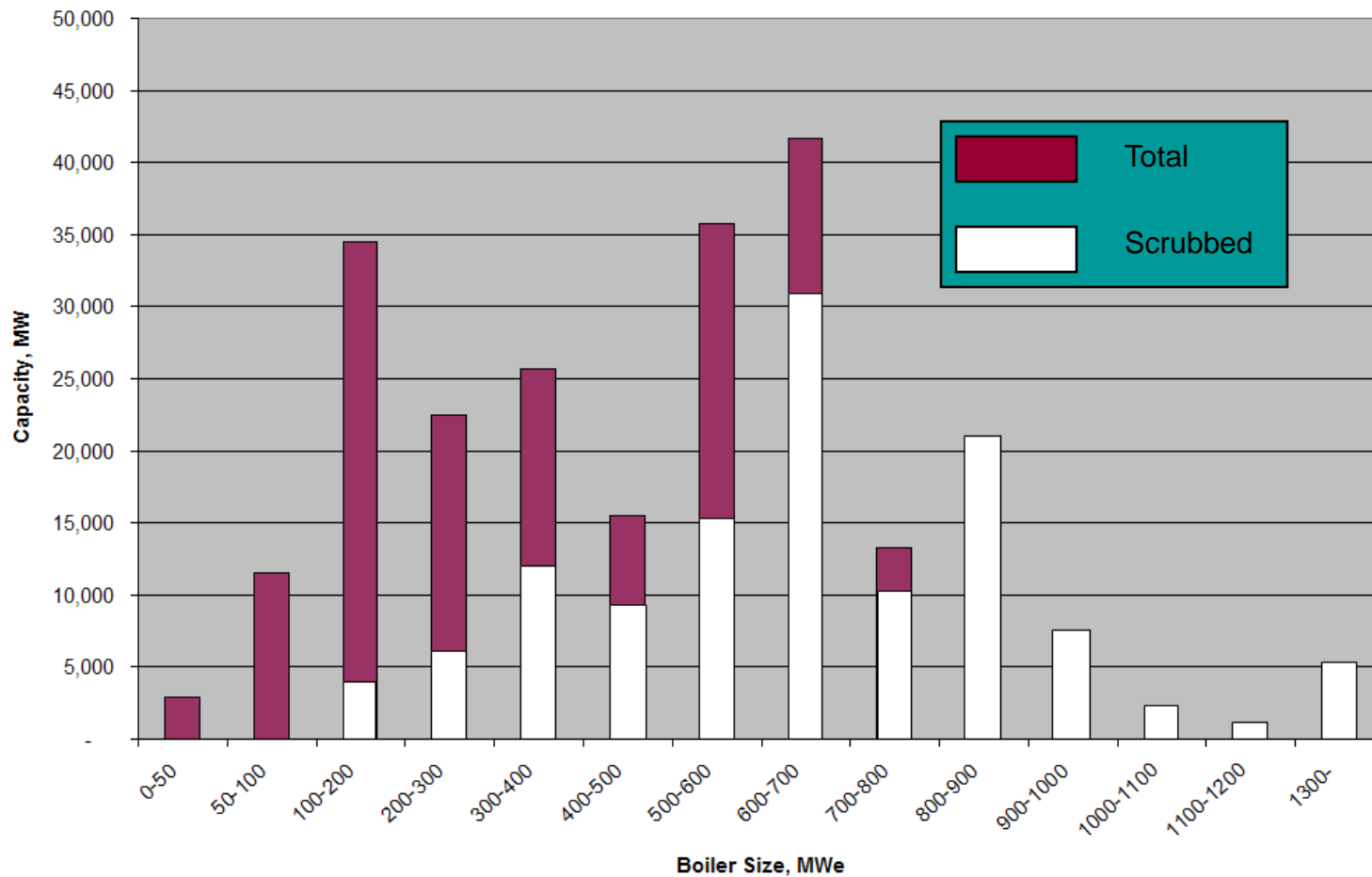
Small Boiler Market Overview

Number of Coal-fired Boilers

- 70 percent of U.S. boilers are less than 300 MW
- There are 485 boilers less than 300 MW still in operation
- Boilers below 300 MW produce 38% of coal-fired generation
- Most boilers below 300 MW are not scrubbed



Scrubbed Boilers

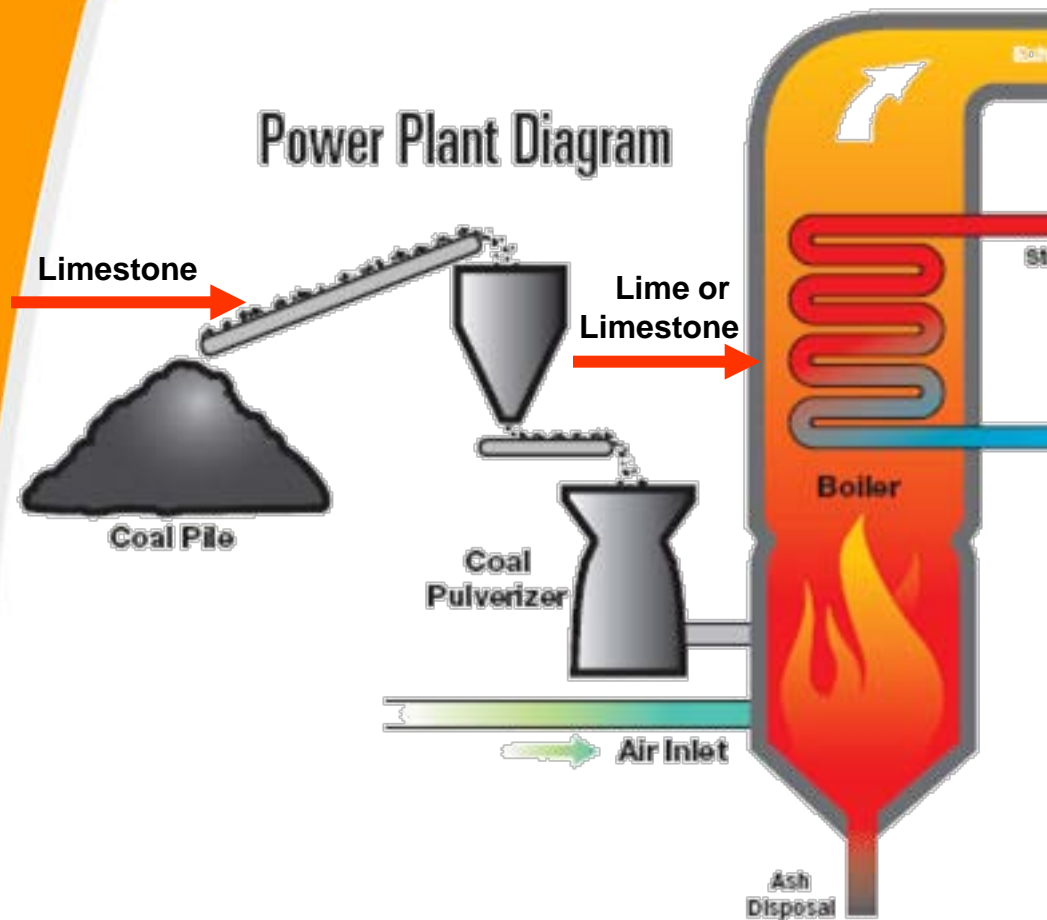


Available FGD Technology for Small Boilers

Small PC Boiler FGD Systems

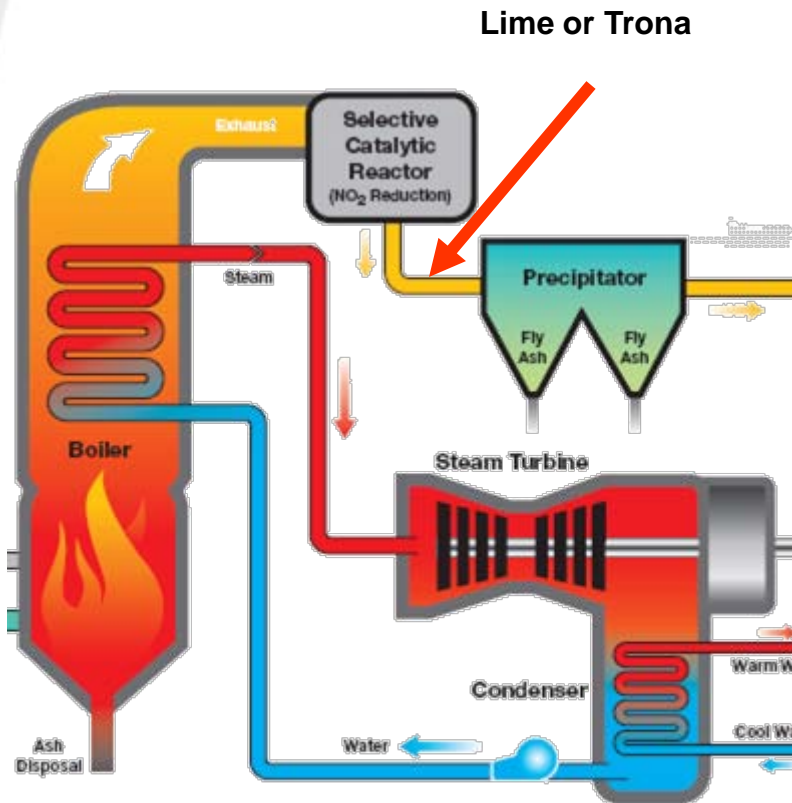
- 1st tier (high removal)
 - ✓ Conventional Dry FGD Systems
 - × Lime
 - ✓ Circulating Dry Scrubbers
 - × Lime
 - ✓ Wet FGD Systems
 - × Limestone
- 2nd Tier (moderate removal)
 - ✓ Furnace Injection
 - × Lime or limestone
 - ✓ Dry Sorbent Injection
 - × Trona or other sodium salts
 - × High surface area hydrated lime

Furnace Injection



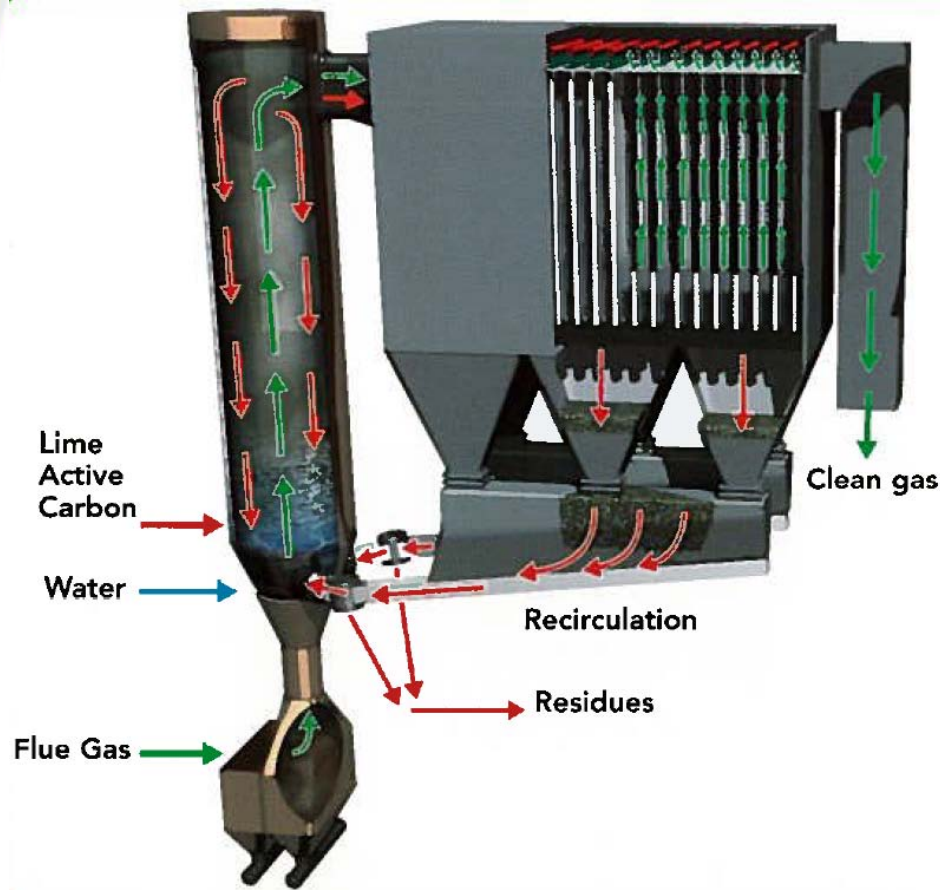
- Very low capital
- Low removal
 - ✓ 30 to 60 percent
- Poor limestone utilization
- Slagging issues
- Heat rate impacts
- Fly Ash quality

Dry Sorben Injection



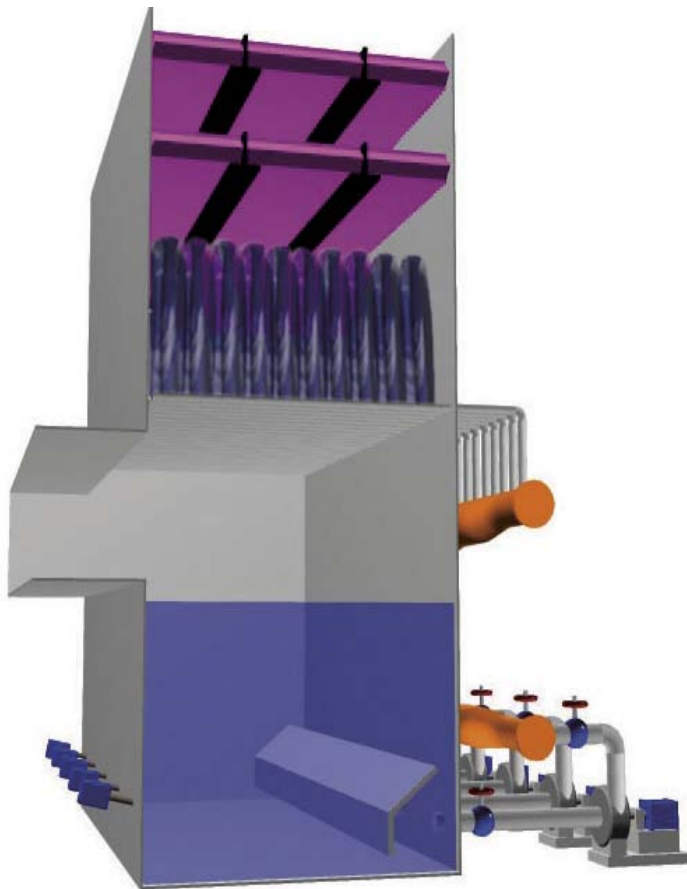
- Low Capital
- Moderate removal of SO₂ and HCl
 - ✓ 30 to 70 percent
- Best performance for low S fuel used upstream of PJFF
- Poor lime utilization
- Expensive reagent
- Potential impacts to fly ash and landfill

Circulating Dry FGD



- Circulating fluid bed scrubber
 - ✓ Lime based system
 - ✓ Fluid bed with no rotating parts
 - ✓ Baghouse
- 90 - 98% SO₂ removal up to 5 lb/MM btu fuel
- Multi-pollutant control
- Dry byproduct
- High vertical profile
- 10-14 inch pressure drop
- Dry byproduct

Conventional Wet FGD

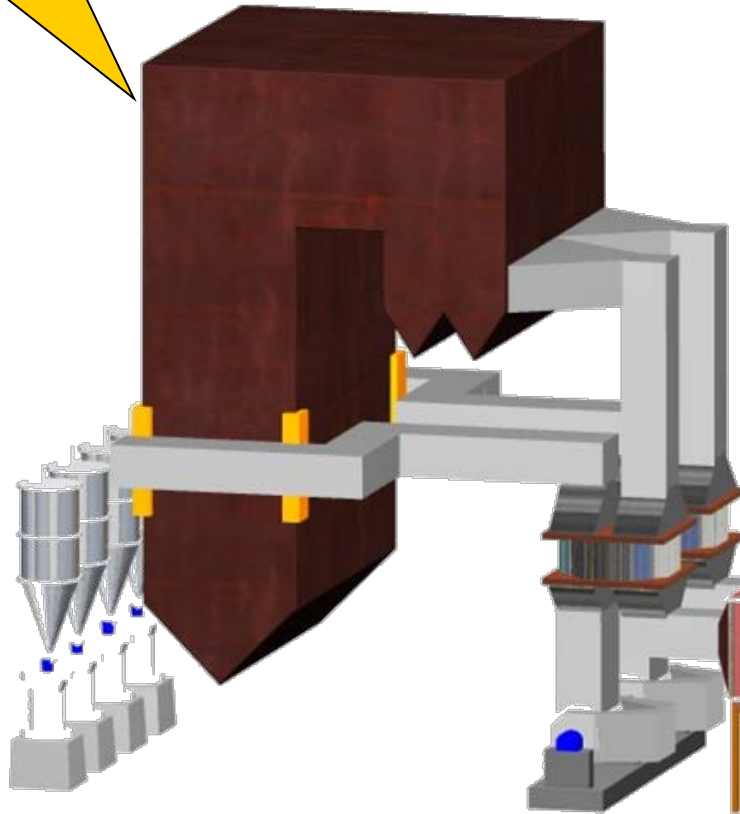


- Highest removal (>99%) especially at high inlet SO₂ levels
- Good turndown capabilities
- High capital costs
- Good multi-pollutant control capabilities
- Does not produce a dry byproduct but byproduct may be saleable

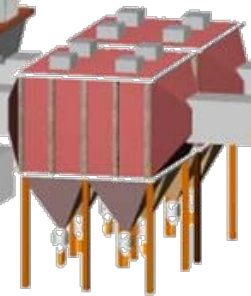
Wet FGD System Designed Specifically for Smaller Boilers

Small Boiler Characteristics

Forced Draft
Positive
Pressure
Boiler



Small
Marginal
ESP



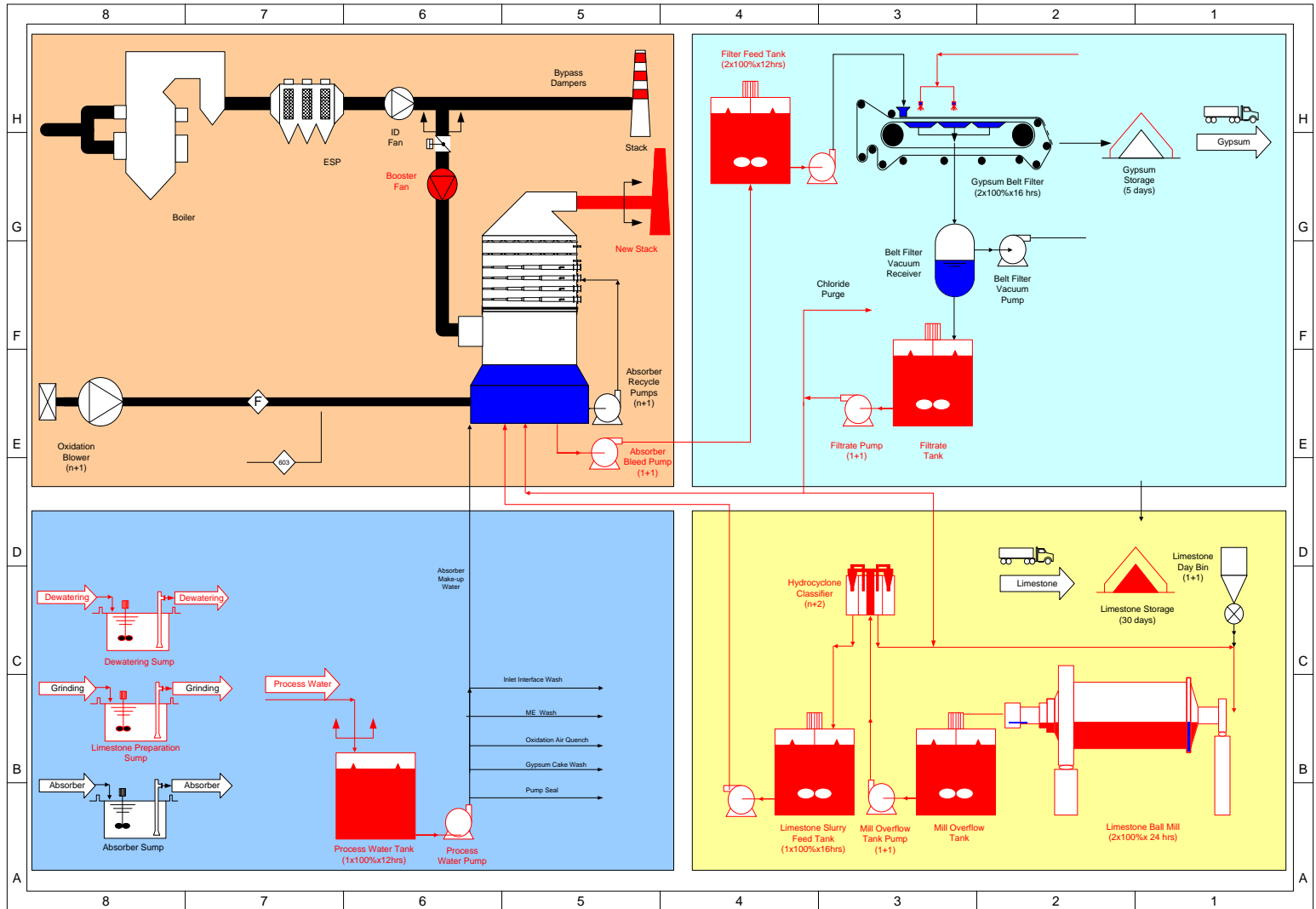
Low
Elevation
Stack
Breach



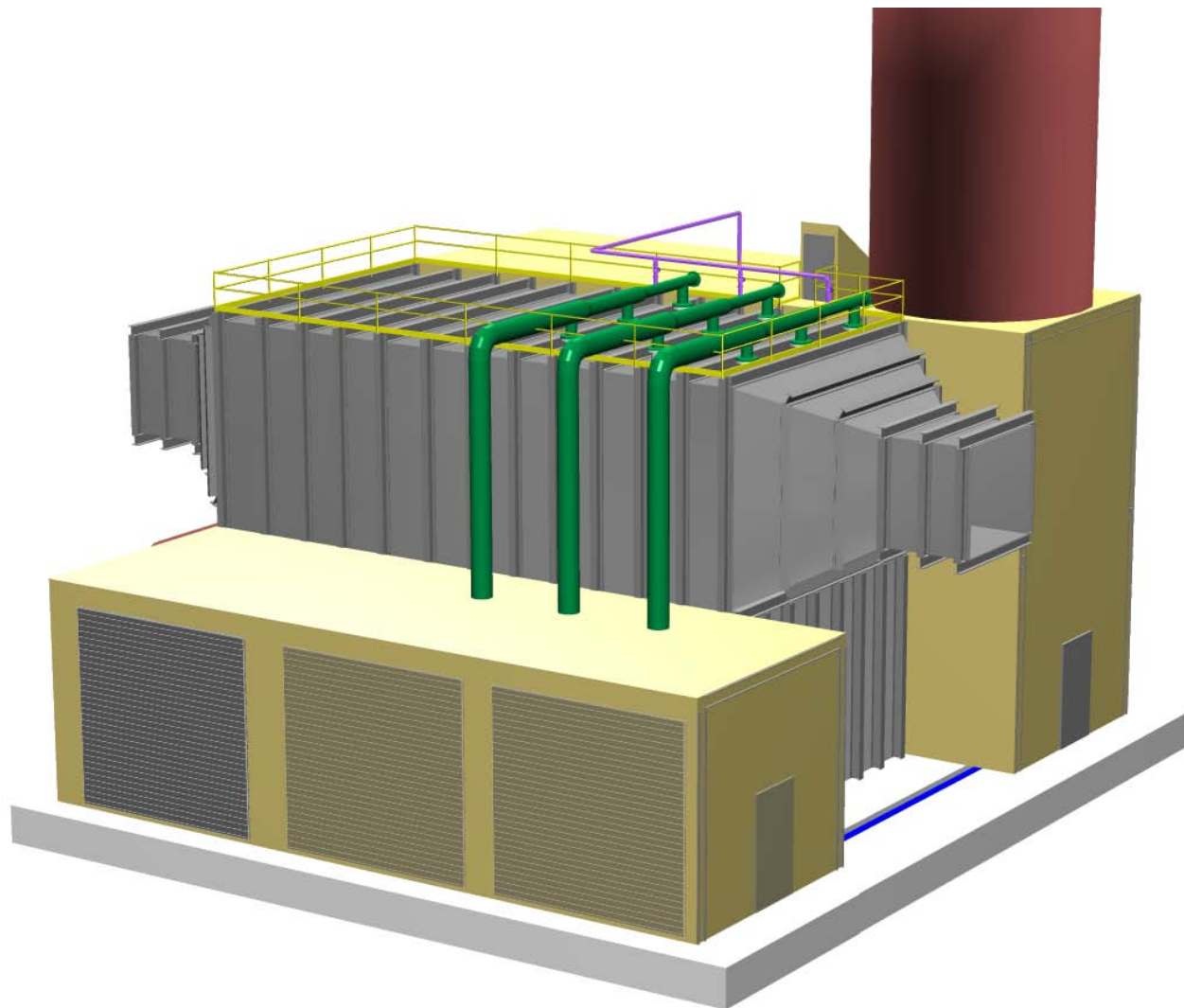
Small Boiler FGD Wish List

- No pressure drop
 - ✓ Avoid balance draft conversion and costly structural reinforcement of boiler and ductwork
- Multi-pollutant control
 - ✓ Greater than 98% SO₂ removal
 - ✓ Greater than 90% ionic Hg removal
- Low cost reagent
 - ✓ Limestone
- Marketable or disposable byproducts
 - ✓ Gypsum
 - ✓ Fly ash
- Zero liquid discharge
- Reusable stack
- Low capital cost
- Short project schedule

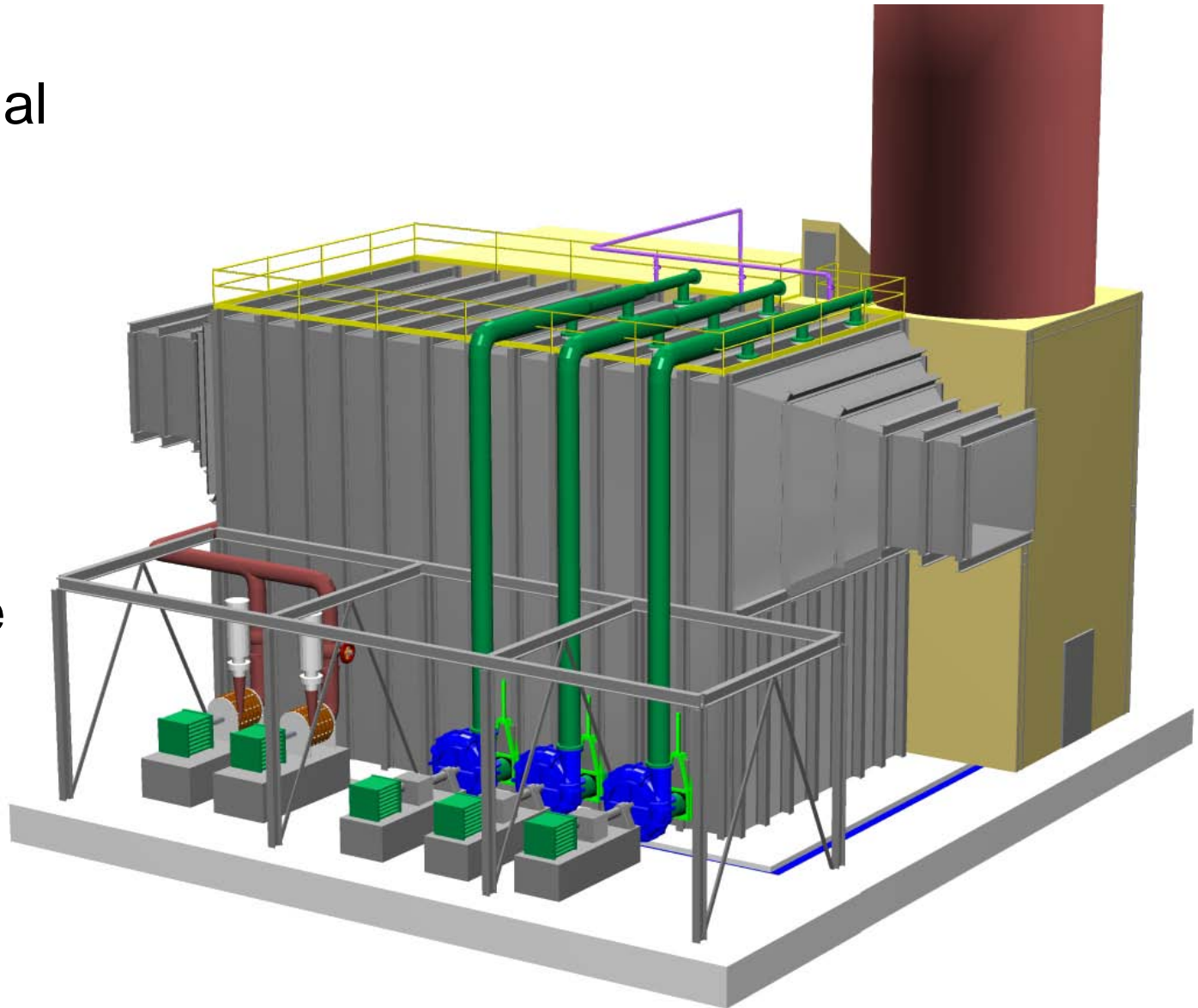
Typical Wet Scrubber Process Islands



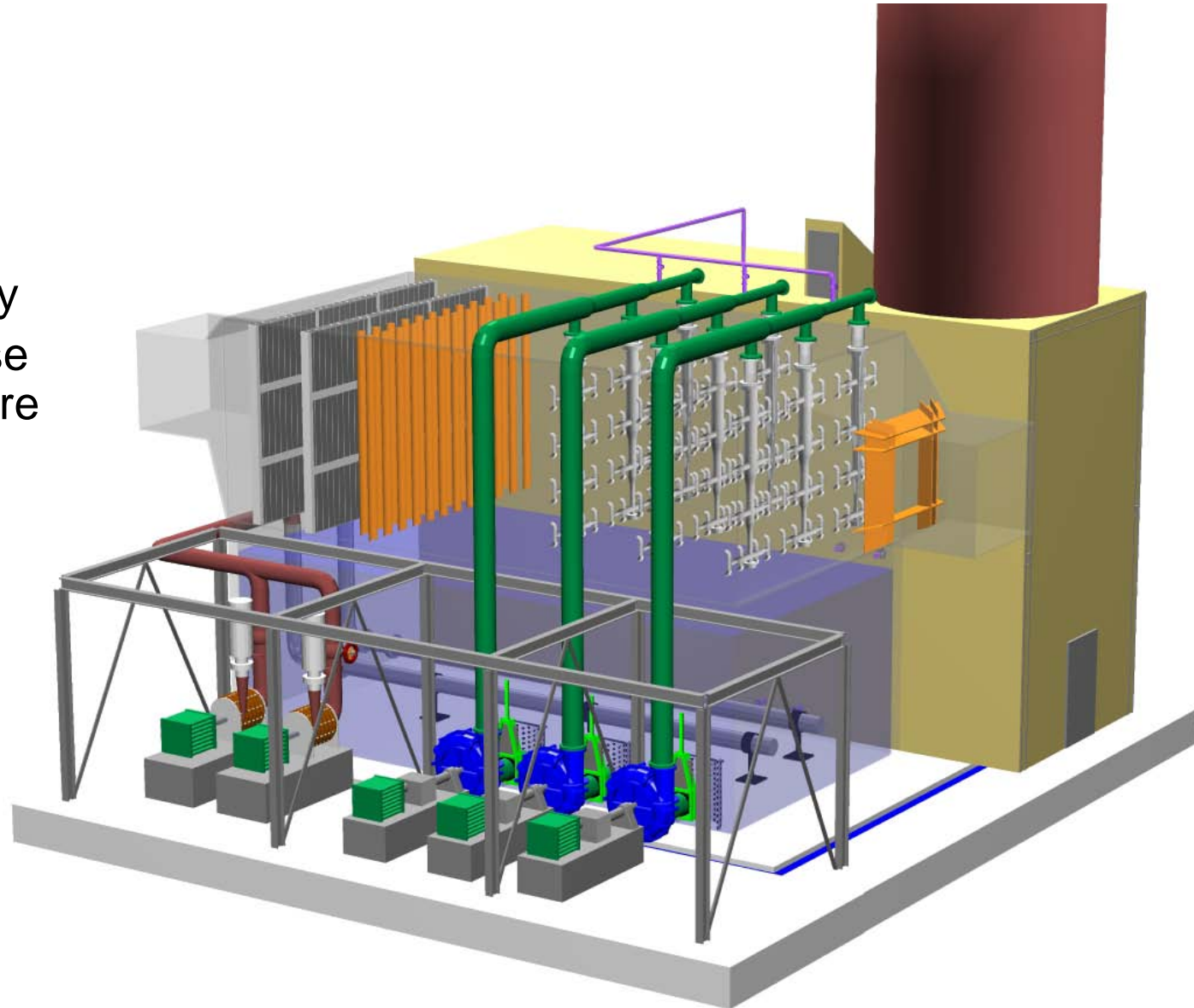
- Integrated process island
 - ✓ Reagent prep
 - ✓ Absorber
 - ✓ Dewatering
- Integrated Structure
 - ✓ No free standing buildings
- Low Profile
 - ✓ 40 ft
- Small footprint

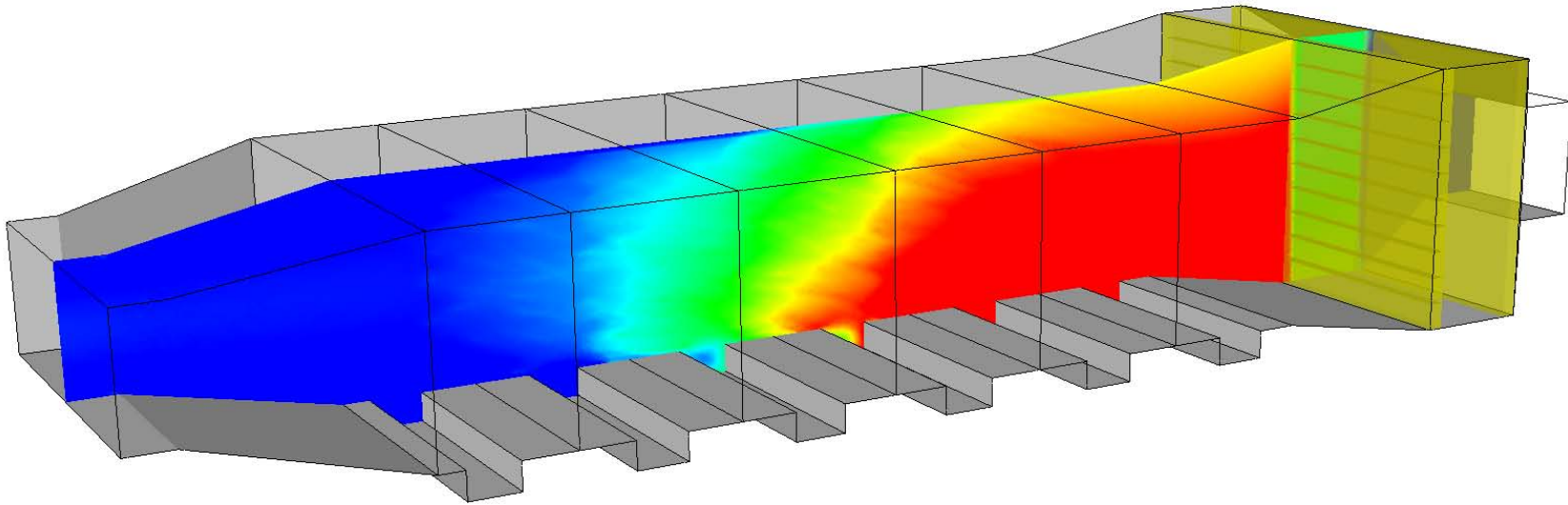


- Conventional recycle pumps and spray headers
- Air blowers for forced oxidation and recycle tank agitation
- No bleed pumps



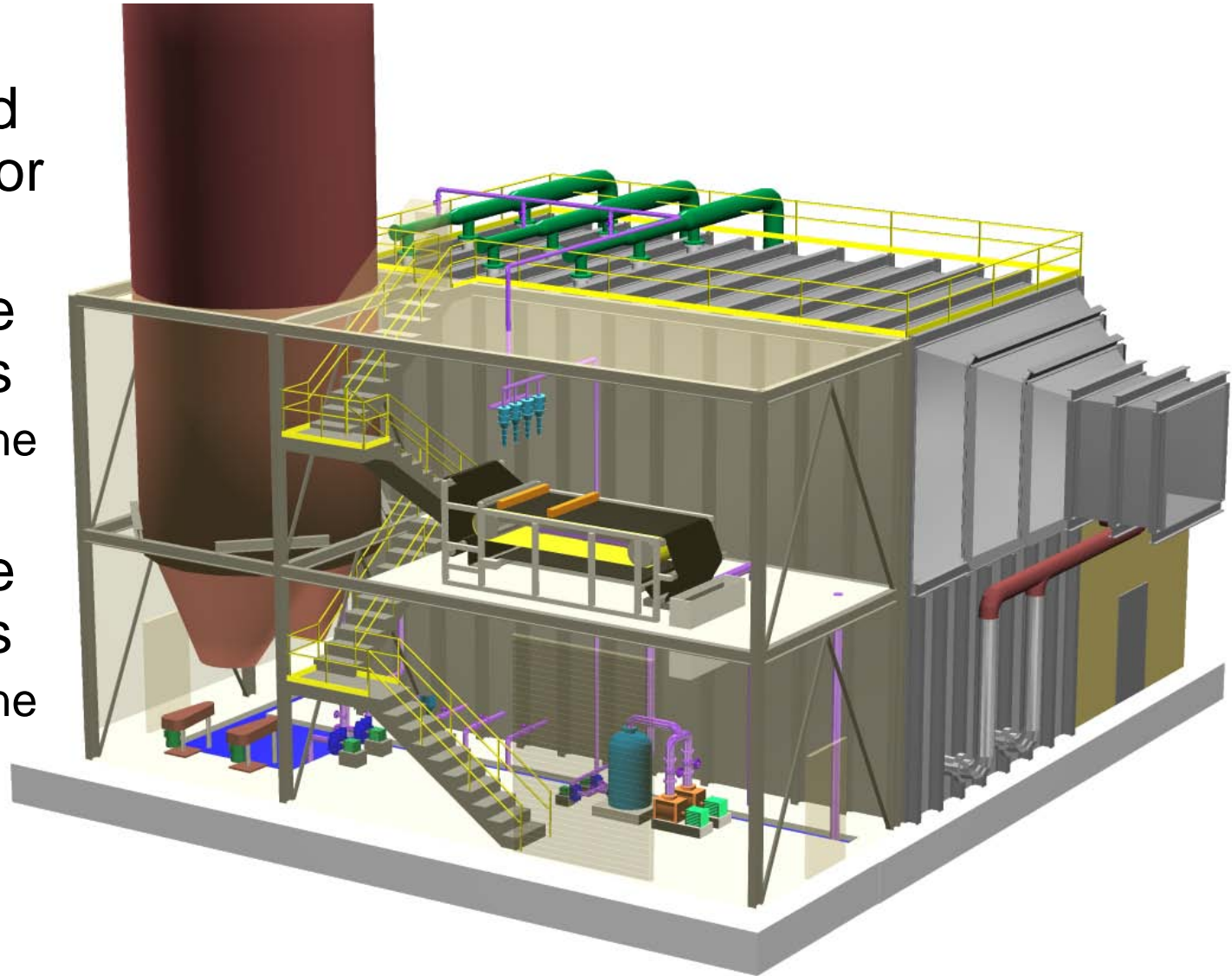
- Co-current spray headers
 - ✓ High velocity
 - ✓ Pressure rise – no pressure drop
- BES and 2-stage horizontal mist eliminator



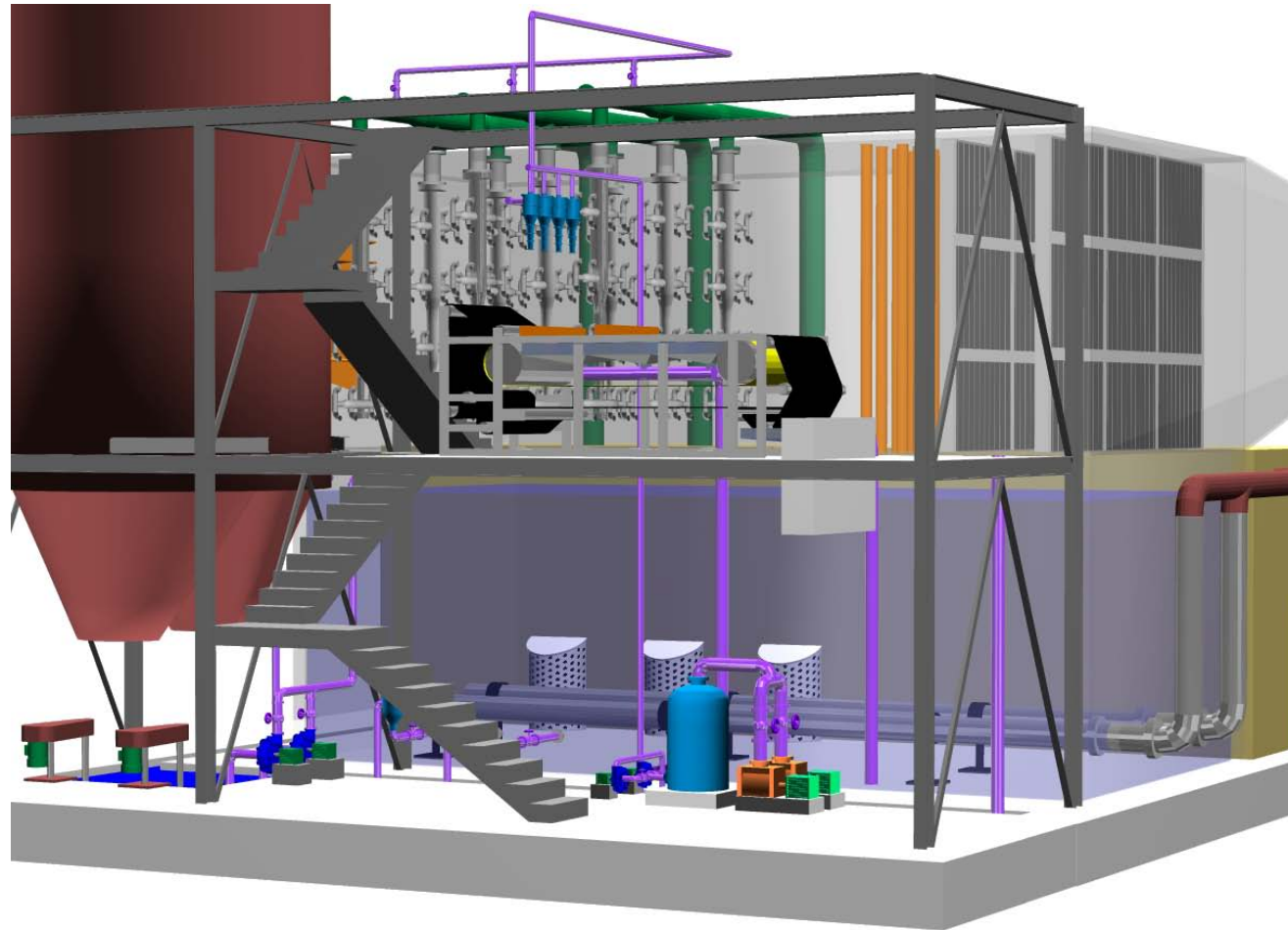


Static + Dynamic Pressure

- Pre-ground limestone or lime
- Marketable byproducts
 - ✓ Hydroclone
 - ✓ Belt filter
- Disposable byproducts
 - ✓ Hydroclone
 - ✓ Pug mill



- Integrated Process Island
 - ✓ Limited piping and electrical cable runs
- Limited rotating equipment
 - ✓ Full redundancy
- No process tanks
 - ✓ One sump
 - ✓ No free standing tanks and associated equipment



Performance

● Conventional Performance

✓ Sulfur Dioxide

- ✗ Low to high sulfur coal
- ✗ Greater than 98 percent producing a gypsum byproduct

✓ Pressure drop

- ✗ Absorber – 1 inch pressure rise
- ✗ System – less than one inch pressure drop
- ✗ Higher removal or higher coal sulfur results in higher pressure rise

✓ Mercury

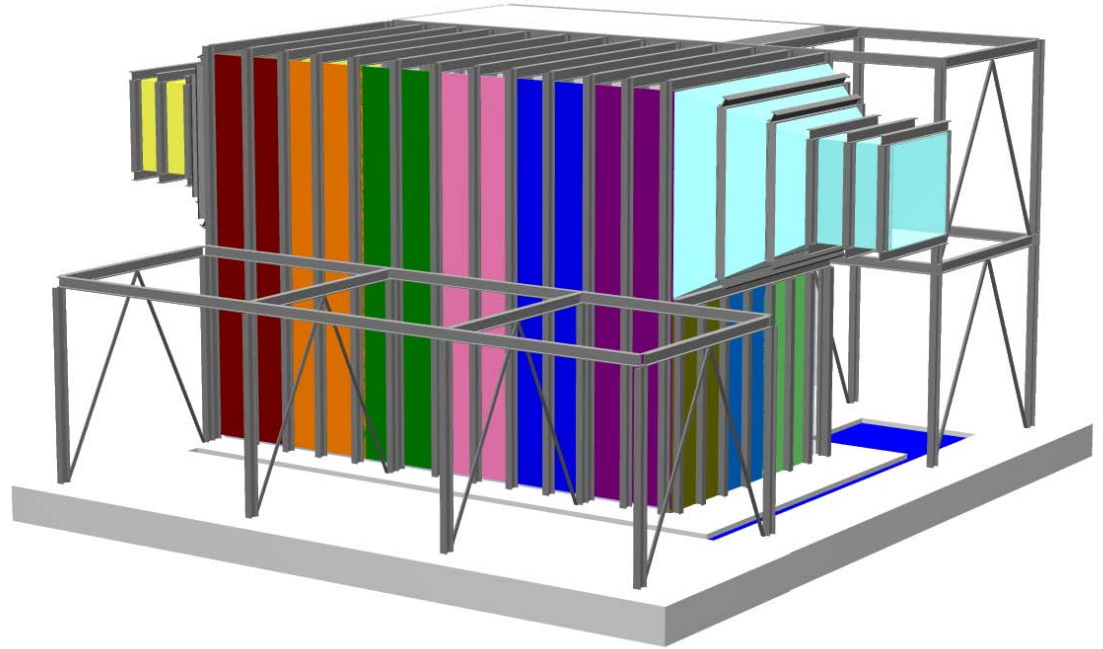
- ✗ Greater than 90 percent removal of oxidized mercury

✓ Particulate

- ✗ 90 percent measured

Schedule

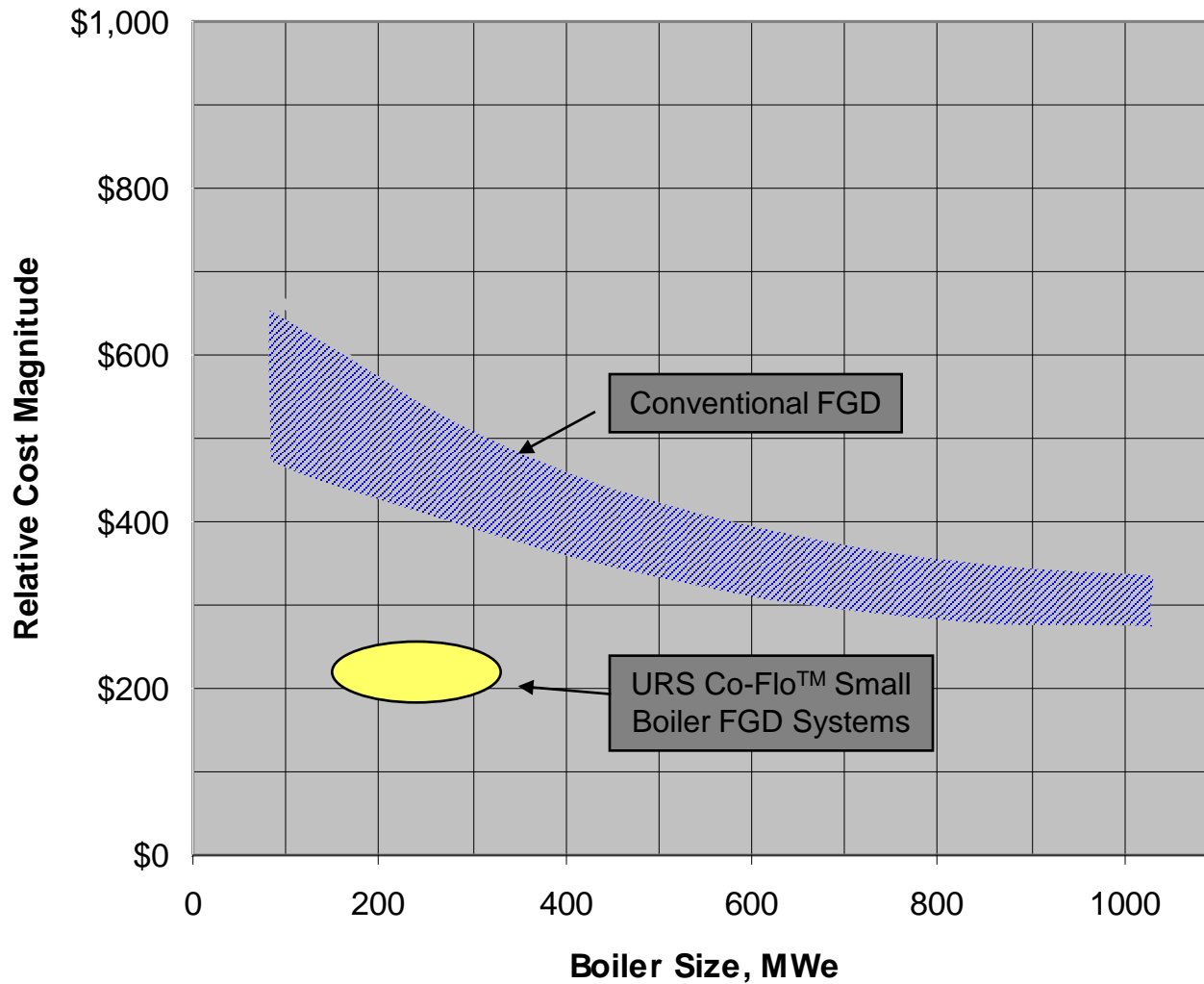
- Modular Design
- Prefabrication of 10' by 40' panels
- Delivery by truck, rail or barge



- Fast Track Schedule
 - ✓ 24 months total project schedule
 - Prefabricated absorber panels
 - × Standardized
 - 100, 200, 300 MWe designs

Cost

Expected Cost

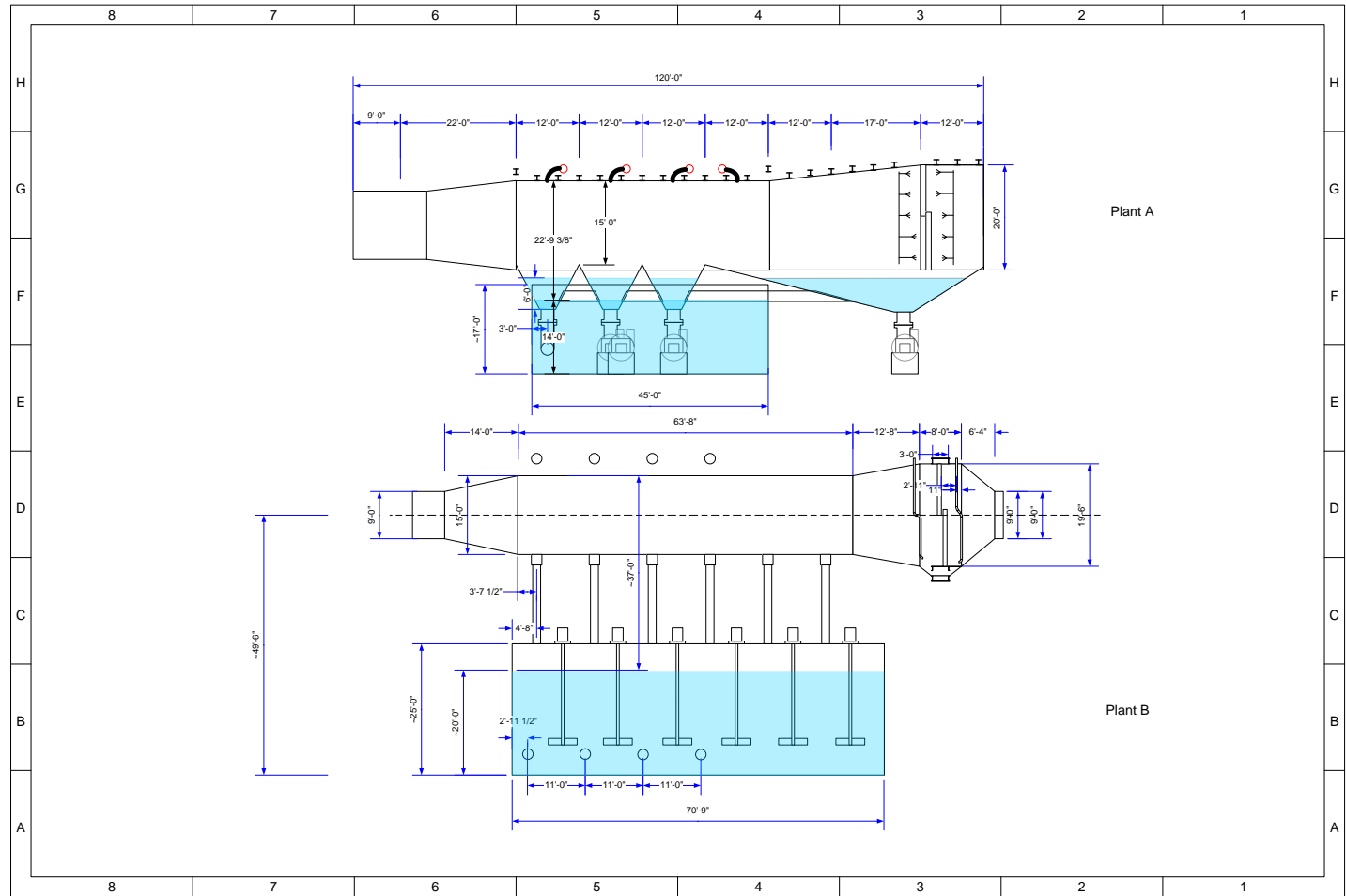




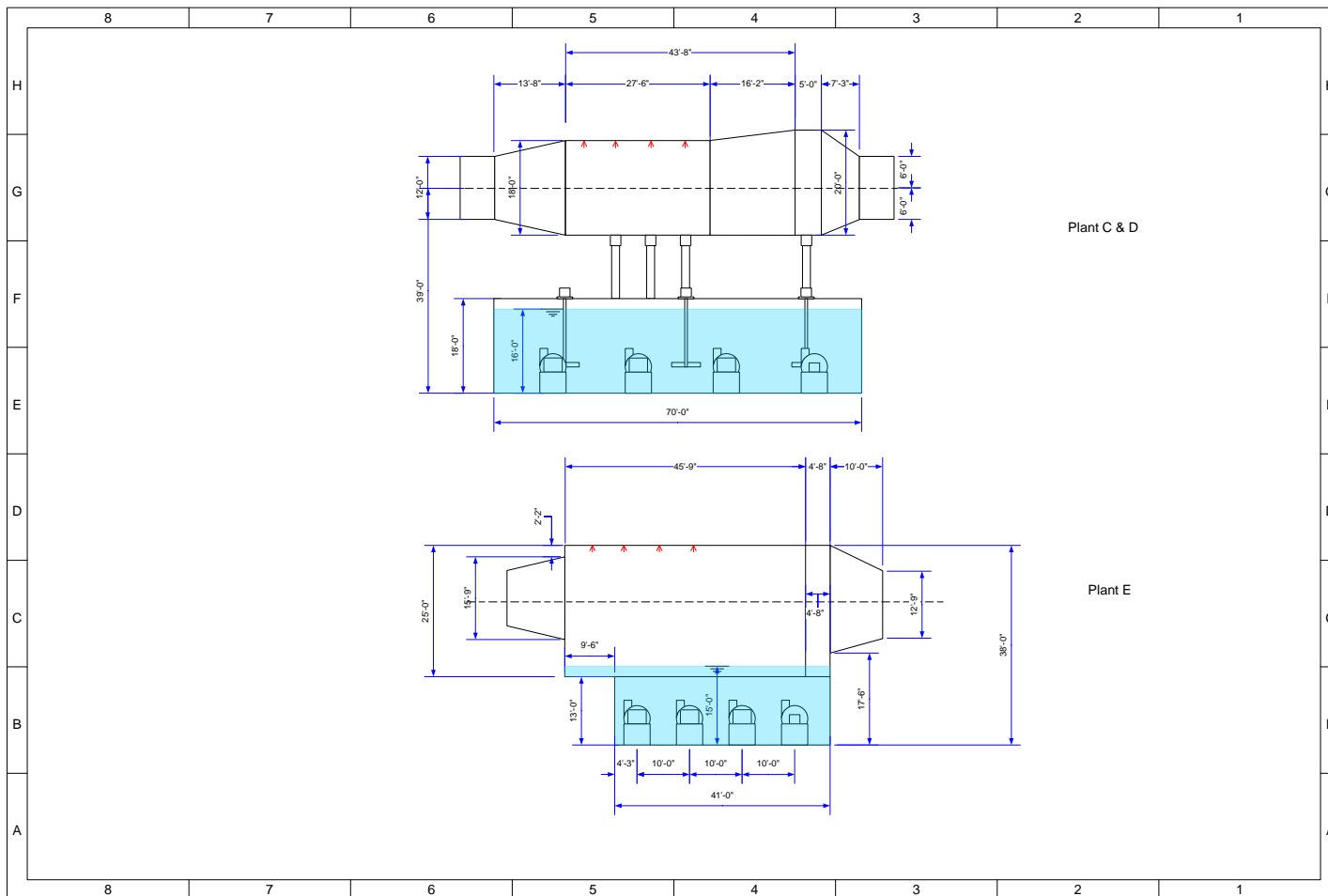
Gordon Maller – URS Corporation
gordon_maller@urscorp.com

- Horizontal scrubbers
 - ✓ Cost Effective
 - ✓ Very competitive in the early 1980's
 - ✓ 5 built in the U.S. in a 6-year time period.
 - ✓ No time for feedback from lesson's learned
- Performance
 - ✓ Serious design flaw prevented reliable performance
 - ✓ URS has upgrade two and are working on two more

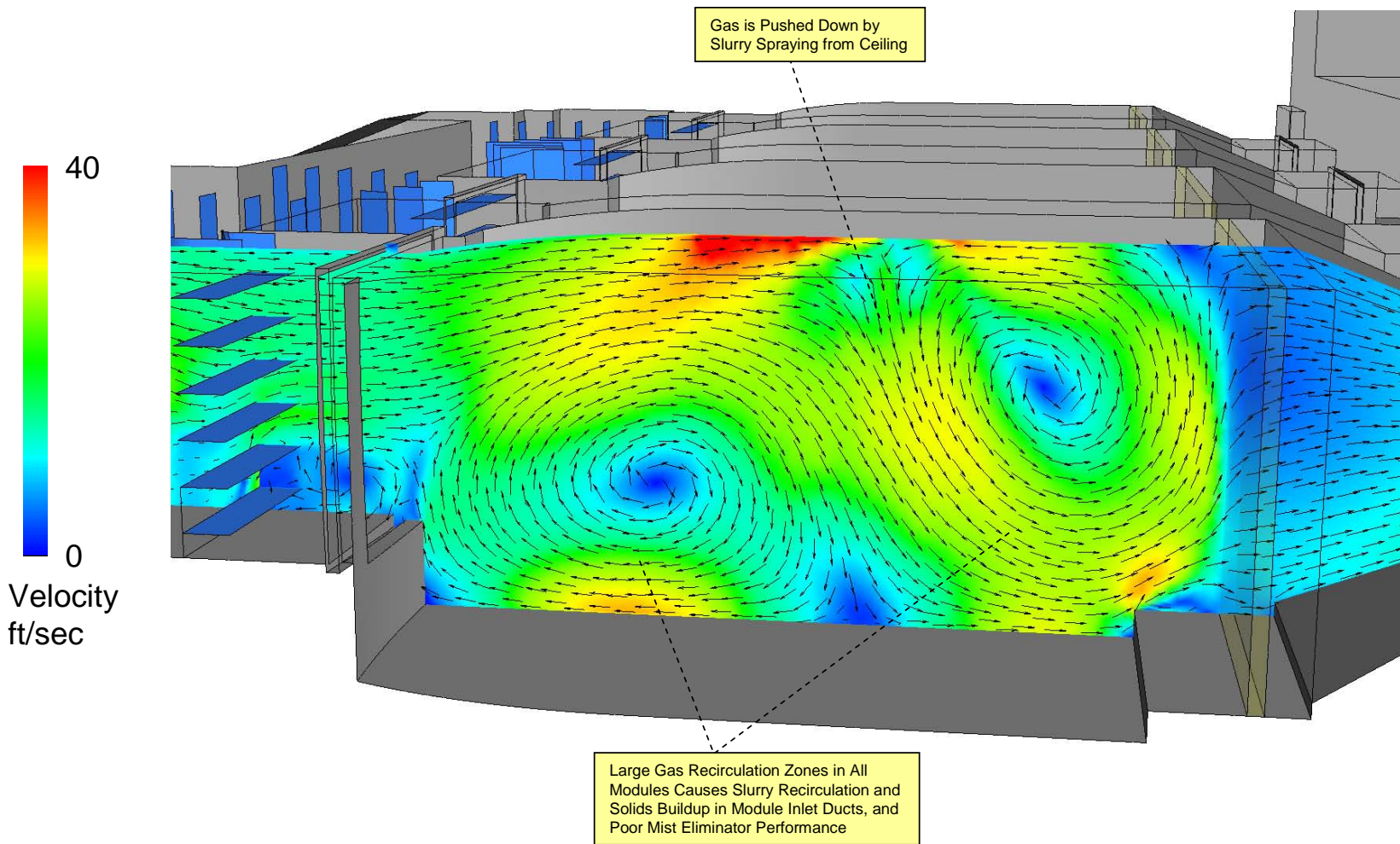
Existing Horizontal Absorber Designs



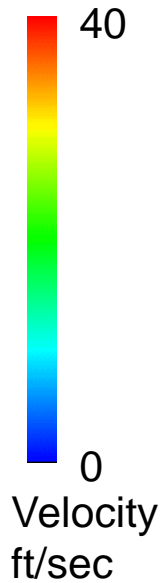
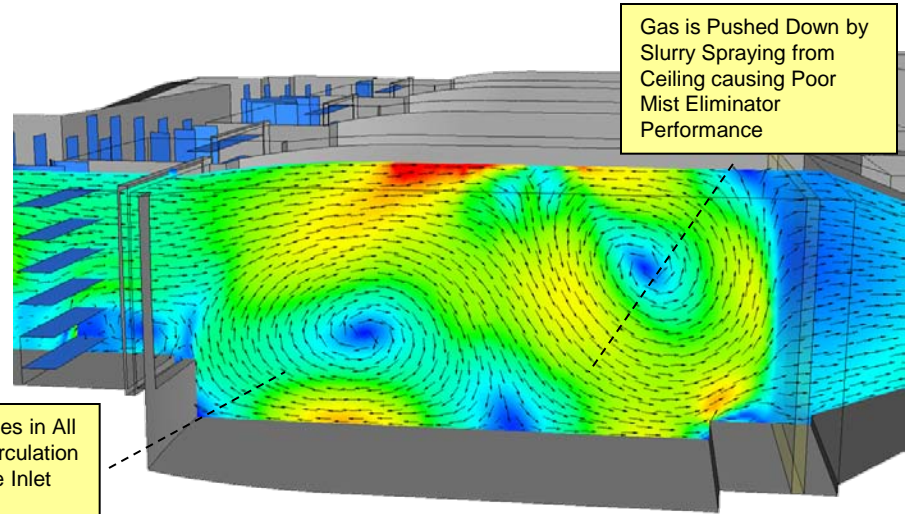
Existing Horizontal Absorber Designs



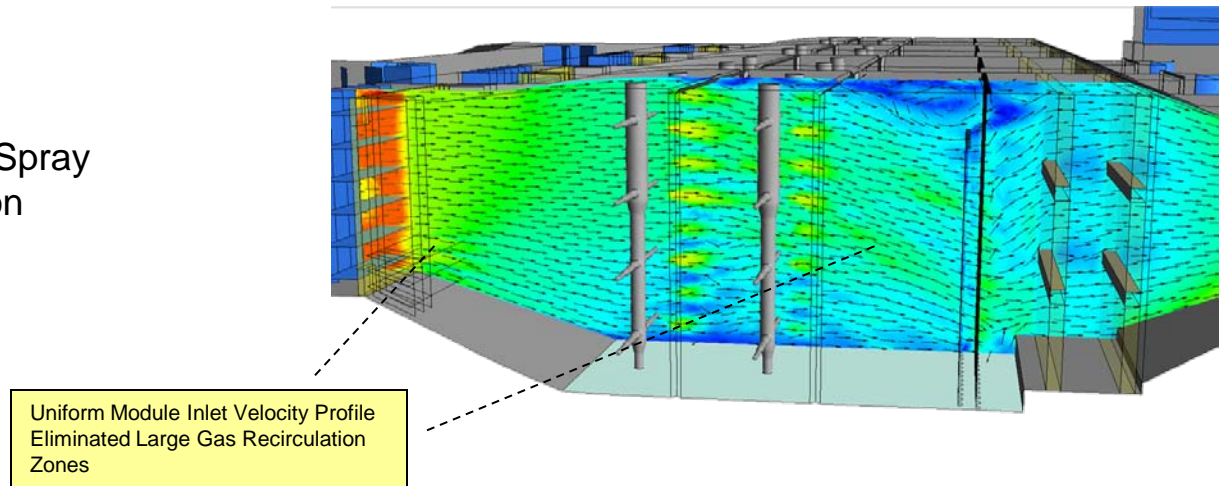
Inlet and Outlet Duct Scaling



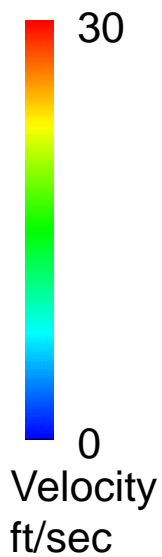
Original Crossflow Configuration



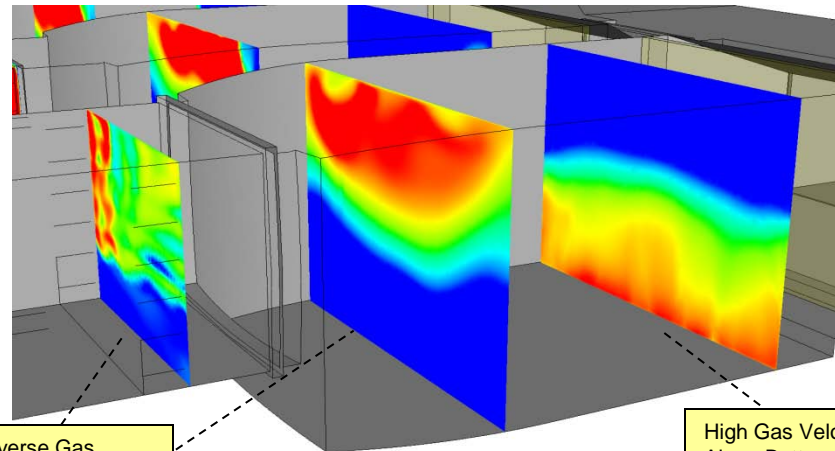
Co-Flo™ Spray Conversion



Gas Distribution – H-Scrubber Headers



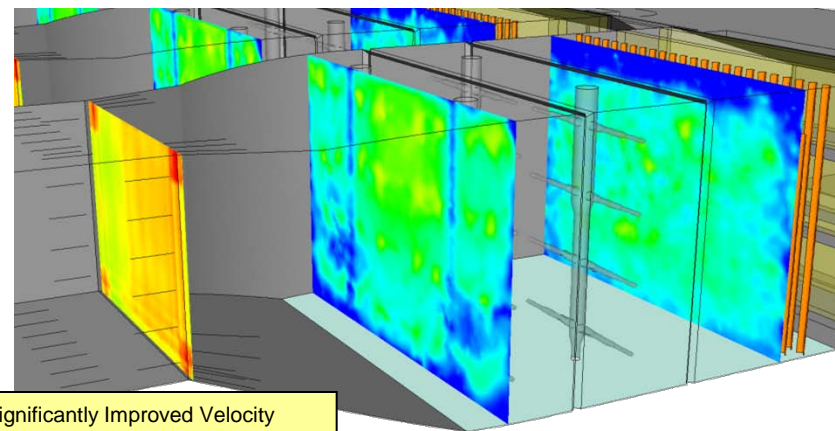
Original Crossflow Configuration



Reverse Gas Velocity In Module Inlet

High Gas Velocity Along Bottom Half of ME

H-Scrubber Spray Conversion



Significantly Improved Velocity Profiles Relative to Existing Crossflow Operation

- 914 MWe
- 4+1 Modules
- 95% SO₂ Removal Guarantee
- 6 lb/MM BTU
- Mag lime
- Startup 11/07

