

Western Farmers Electrical Cooperative

Agenda:

1. Historical Slag Problems
 2. Targeted In-Furnace Injection
 3. Program Success
 4. CFD Model
 5. Q & A
- 

WFEC Hugo Power Station

Fuel Tech

Targeted In-Furnace Injection For Slag Control

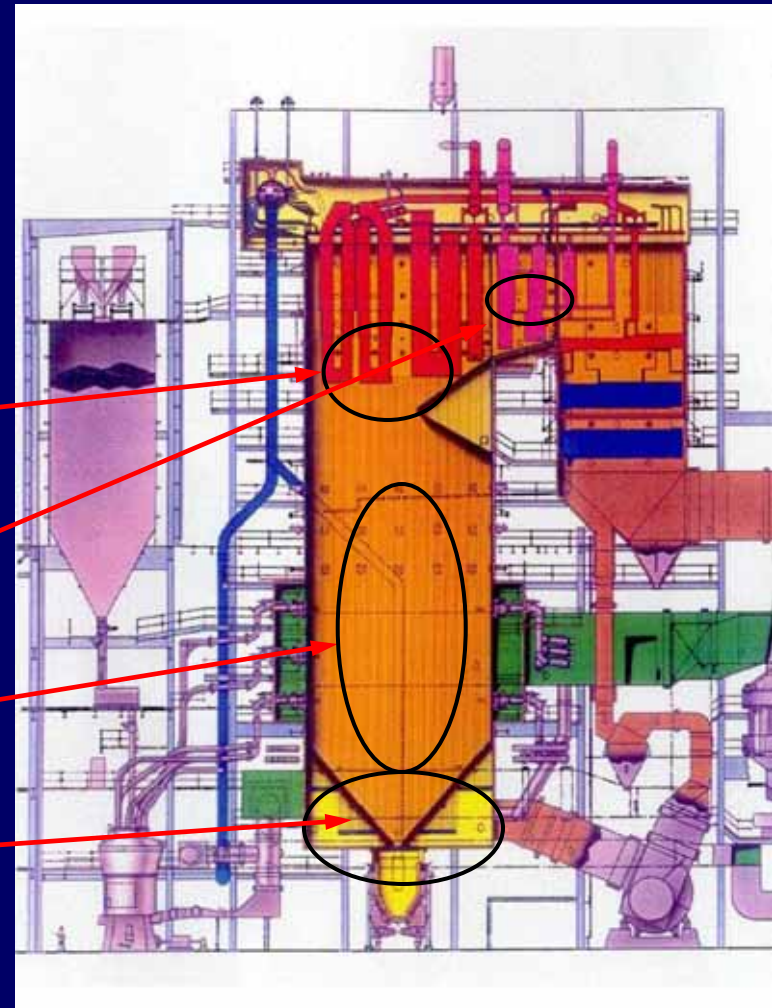
OVERVIEW

- B & W Boiler
- 1981 Construction
- Rated at 475 MW
- PRB fuel at 6200 tons/day
- Buckskin, North Rochelle and Eagle Butte mines



Problem Areas

- ***Pendant Section***
- ***Convection Pass Reheat Section***
- ***Wall Cleaning***
- ***Bottom Slopes***



Pendant Section

- Tube leaks from clinker falls
- Dripping and Falling Slag to lower slope tubes
- Loss of heat transfer



Convection Pass

- Limiting factors
 - High exit temperatures
 - ID Fan Stall
- Increased soot blowing results in erosion.



Furnace

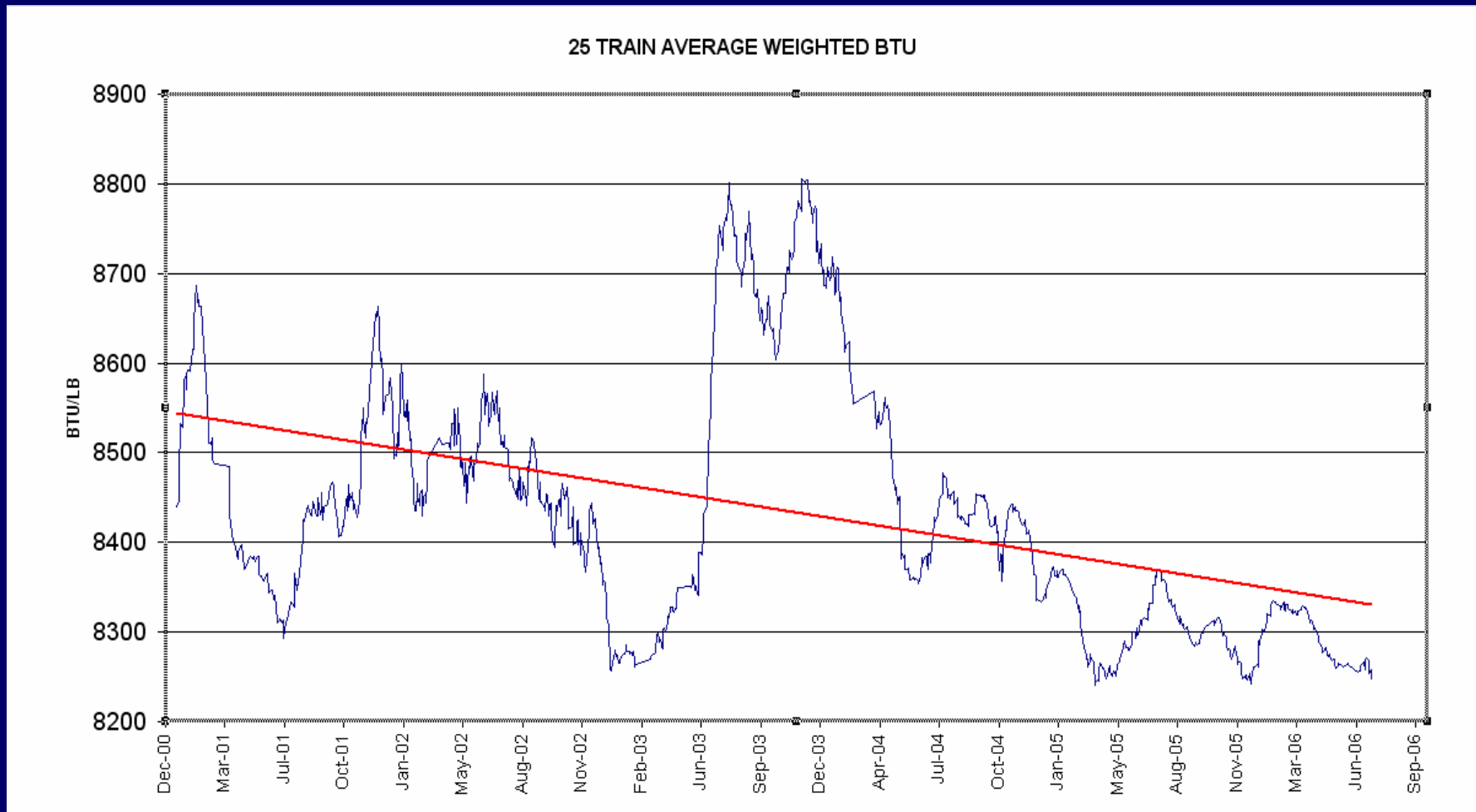
- Walls

- Inadequate removal of heat – creating high FEGT

- Lower Slopes

- Removal of clinkers that form and fall on slopes
- Damage from clinker falls

Fuel Problems

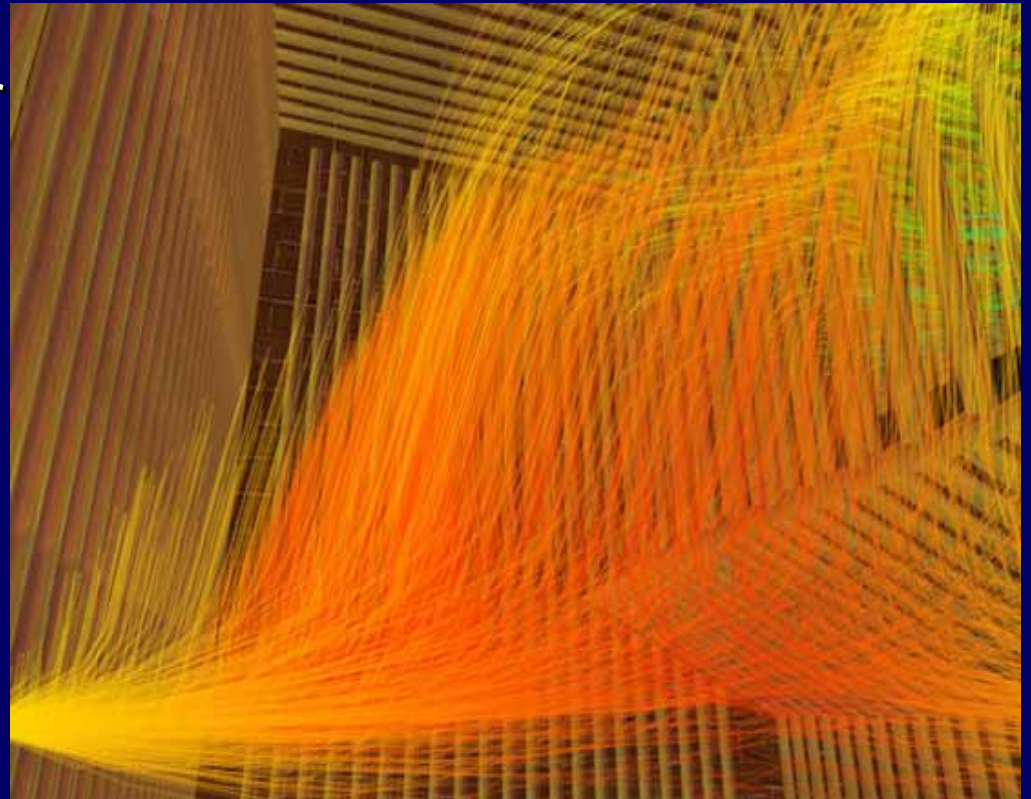


Fuel Tech Proposal

- Approached by Fuel Tech to conduct 90 Day Demonstration
 - WFEC to provide air, water, electricity and Bulk storage tanks.
- Trial began May 2003
- Cleaning outage to verify results

How It Works

- Detailed boiler configuration along with air and fuel flow rates were provided for modeling of the boiler

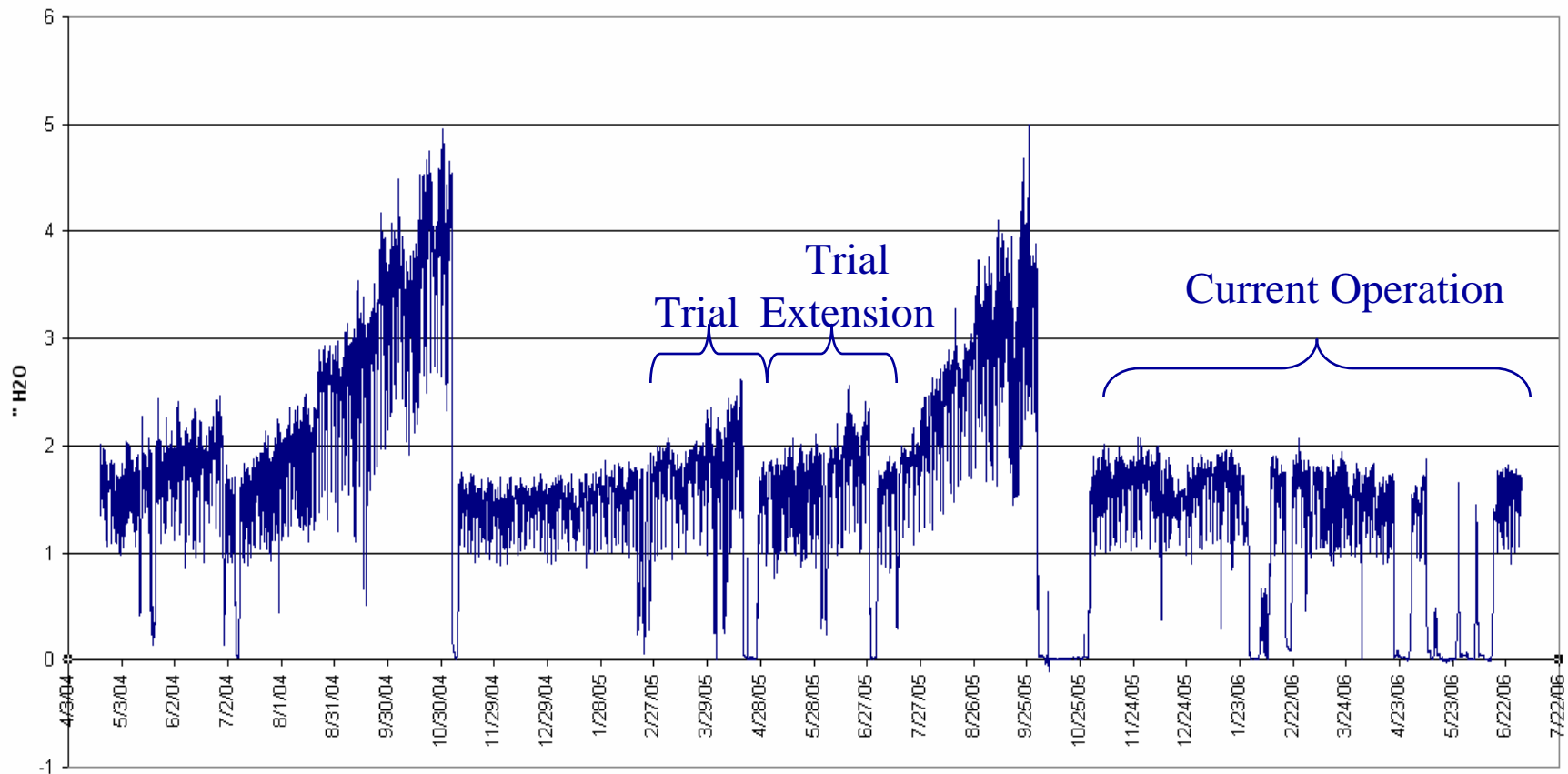


How it Works



SUMMARY

REHEAT DIFFERENTIAL PRESSURE



Additional Benefits

- Reduced Outage Cleaning Times
- Reduced Maintenance Cost
 - Tube Repairs (wall and slope)
 - Slag Removal Contract
 - Soot Blower Repair
- Reduced Power De-rates
- Reduced Excessive Oxygen

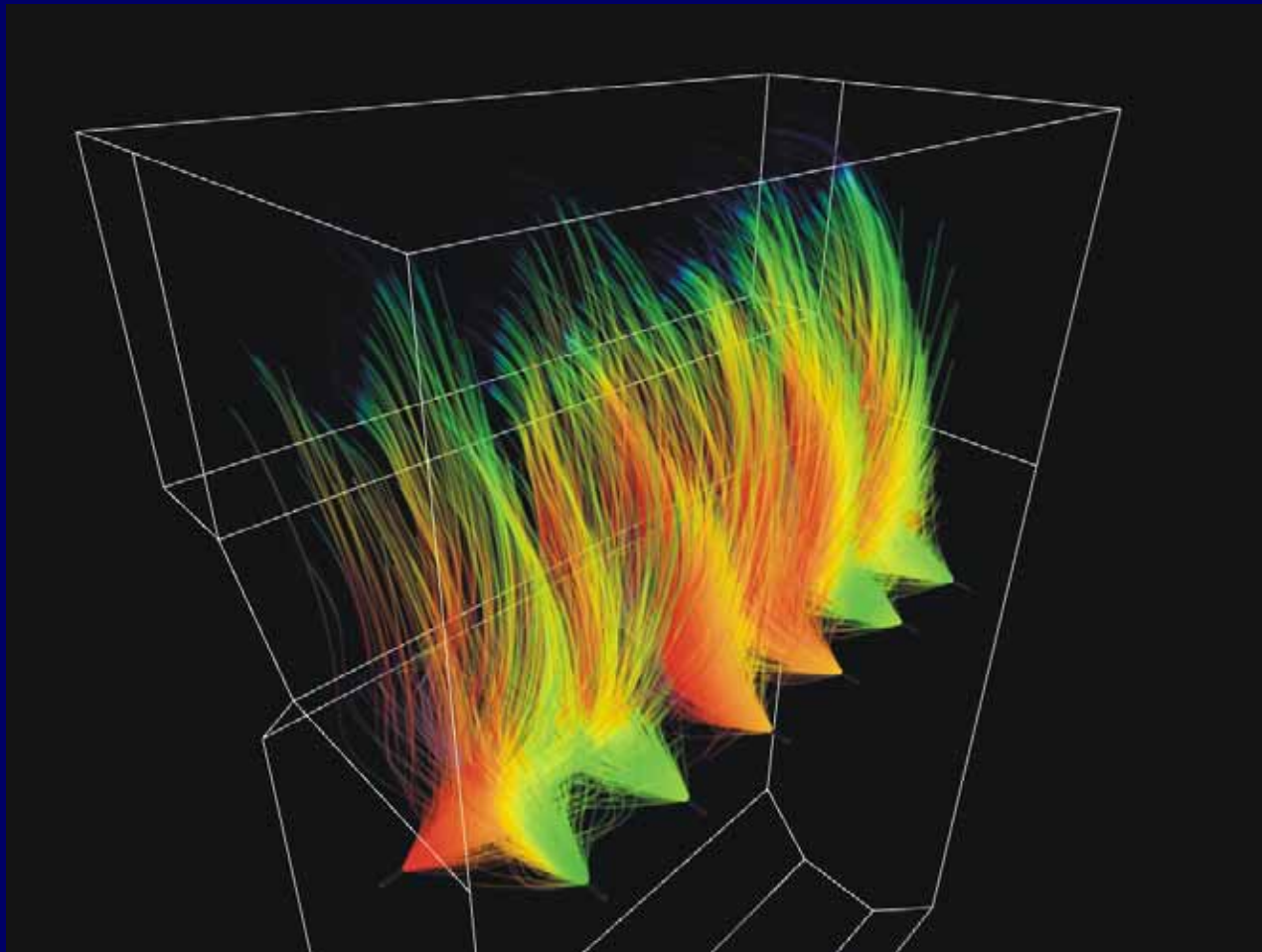
Additional Possibilities

- Opportunity for proportional control
- Discontinue feed at low loads
- Reduction in feed rate
- Reduce feed or discontinue with better fuels

Program Benefit Summary

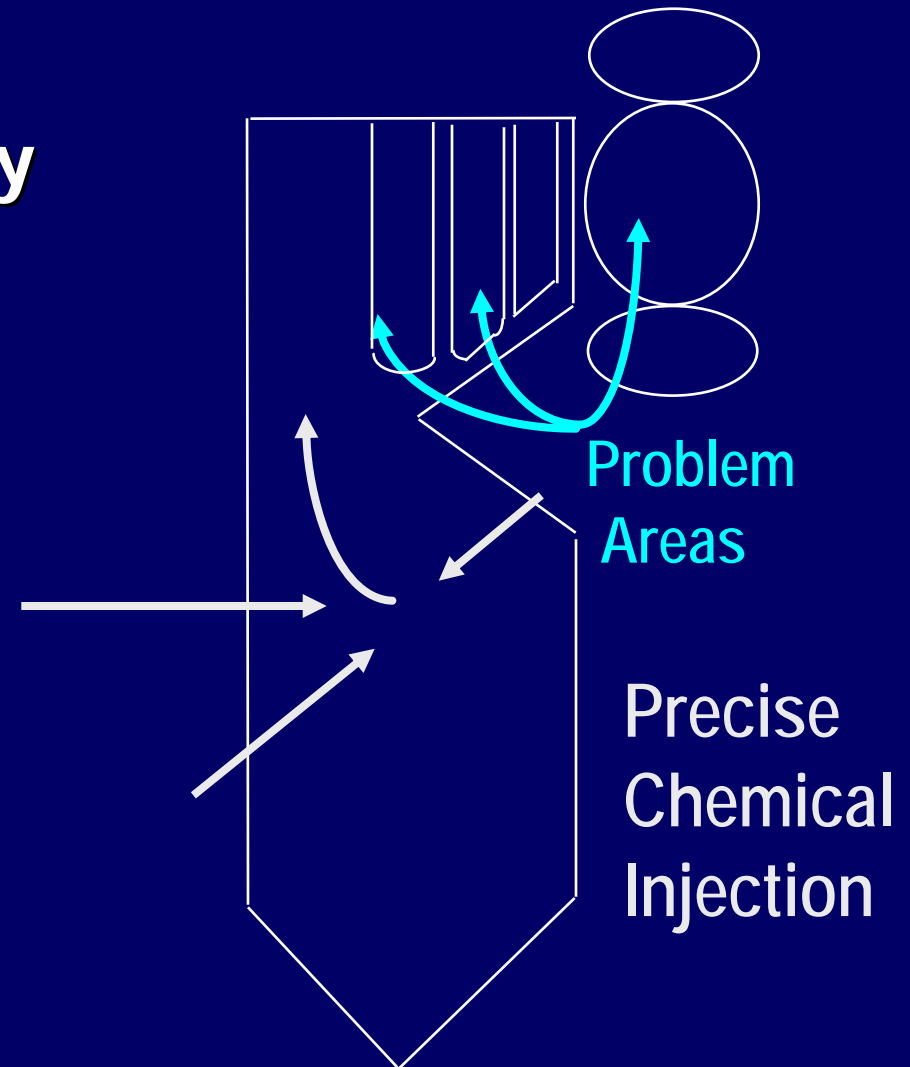
- **Restriction & Downtime Reduction (Increased Mega-Watts)**
- **Slag Accumulation Reduction**
- **Reduced Soot Blowing ,Water Lance ,Cannon use**
- **Reduced Outage Cleaning Time (& Associated Costs)**
- **Heat Transfer and Heat Rate Improvement**
- **Increased Coal Purchase Choice**
- **Reduced Excessive Oxygen**
- **Increased Net Capacity Factor**

3D VISUALIZATION – Precise Distribution



Precise TIFI Approach:

- Custom Feed Strategy For Each Unit
- 90% Goes to Treat Targeted Areas
- Result: Economics & Performance are Excellent



HUGO - Port 4

(B & W 475 Hugo Station unit) Fuel Chem Trial began May 15th. Port #4 represents the center most section of the boiler, and is traditionally the most problematic.



May 14, 2003



June 6, 2003

Before and After TIFI



Consistency Prior to Chemical feed



Consistency After Chemical feed

WFEC: Hugo Station

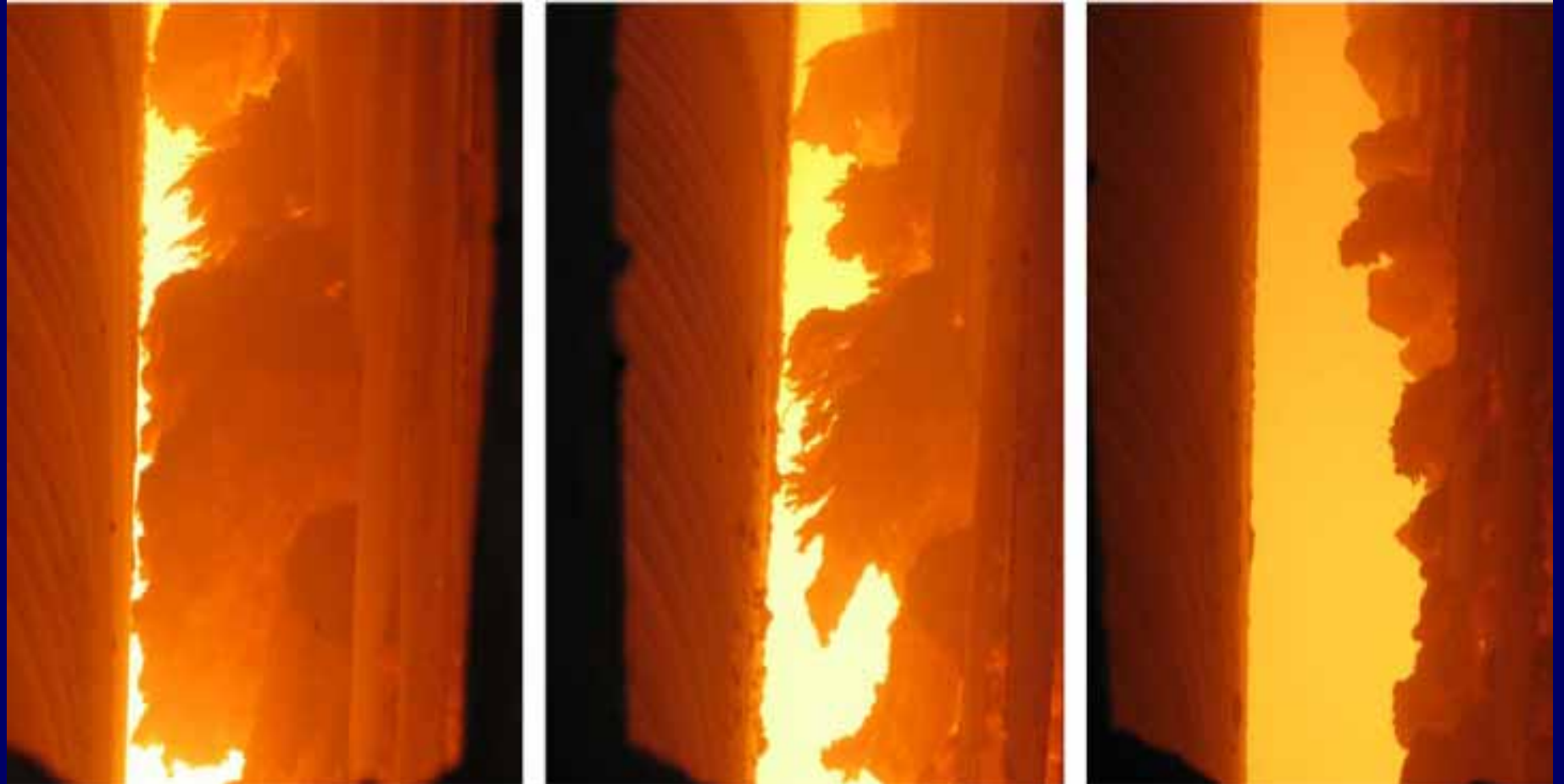


Hugo Station

- B & W Wall Fired Unit (475mw)
- 100% PRB (North Rochelle & Buckskin Mines)

- **Program ROI Highlights:**
 1. MW Recovery (20mw/day)
 2. Load Reduction for De-Slagging 250MW Weekly (For 5 to 6 hours)
 3. Cleaning Reduction (6-8 Days/Year RECOVERED!)
 4. O2 Reduction (3.0+ to 2.5)
 5. Economizer Ash System Handling Improvement
 6. Higher Sodium Coal Burned
 7. Clinker Grinder Performance Improvement
 8. Eye Brow Elimination
 9. Overall Operational Cost Reduction

The "TIFI" Effect on Slag



7/1/2004 9:30 a.m.

7/1/2004 5:30 p.m.

7/2/2004 9:30 a.m.

“OLD KING COAL COMES BACK”

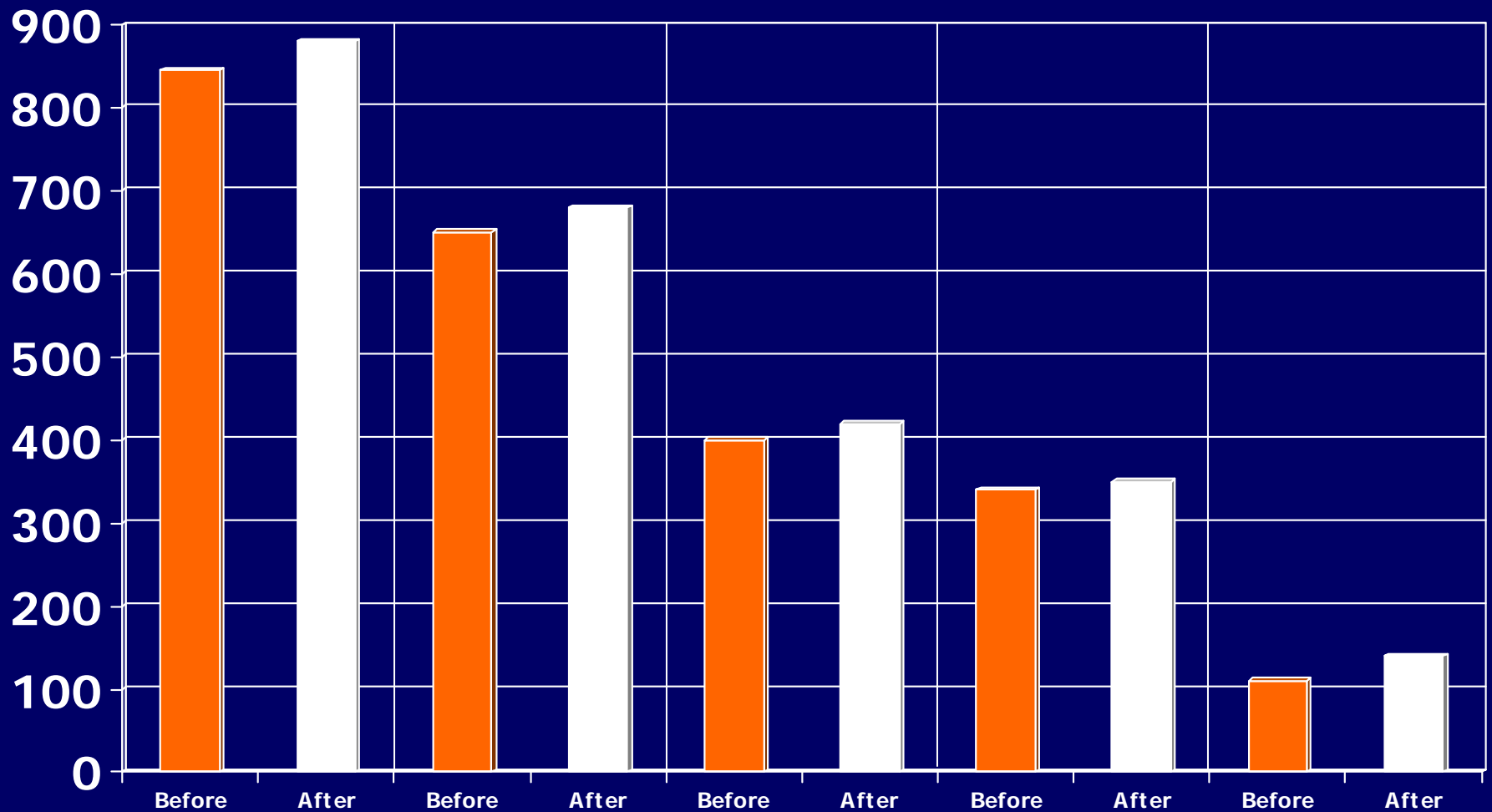
Feb 21, 2005 By: Jeremy Miain



“Western Farmer’s Electric Cooperative, an Oklahoma utility, was using 100% Western coal at its Hugo plant and as a result had to shut down twice a year for five or six days to attack the slag. The utility solved the problem three years ago by adopting Fuel-Tech’s system, know as TIFI (for targeted in-furnace injection).”

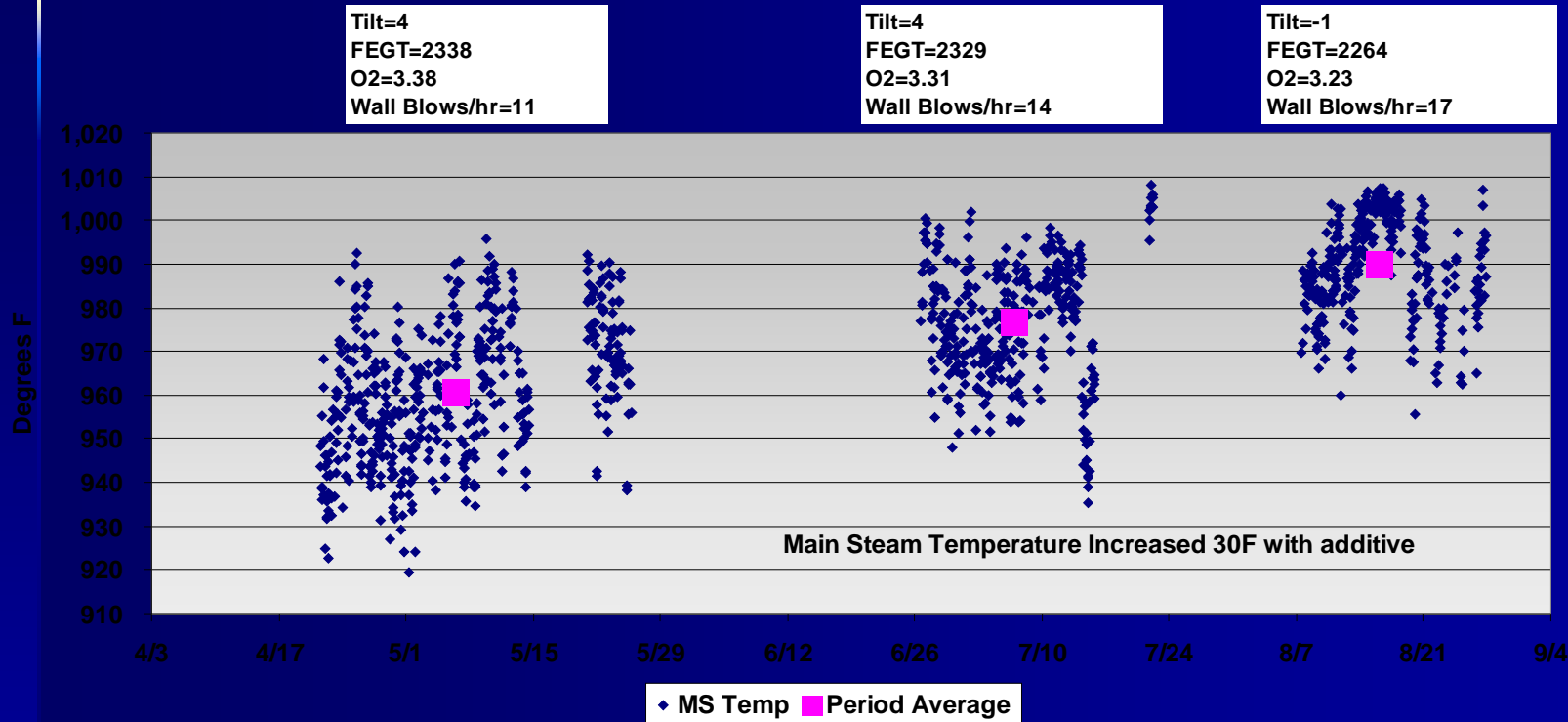
**Fortune’s “Industrial
Management & Technology”
Section**

MW GAINS SEEN IN VARIOUS SIZE UNITS



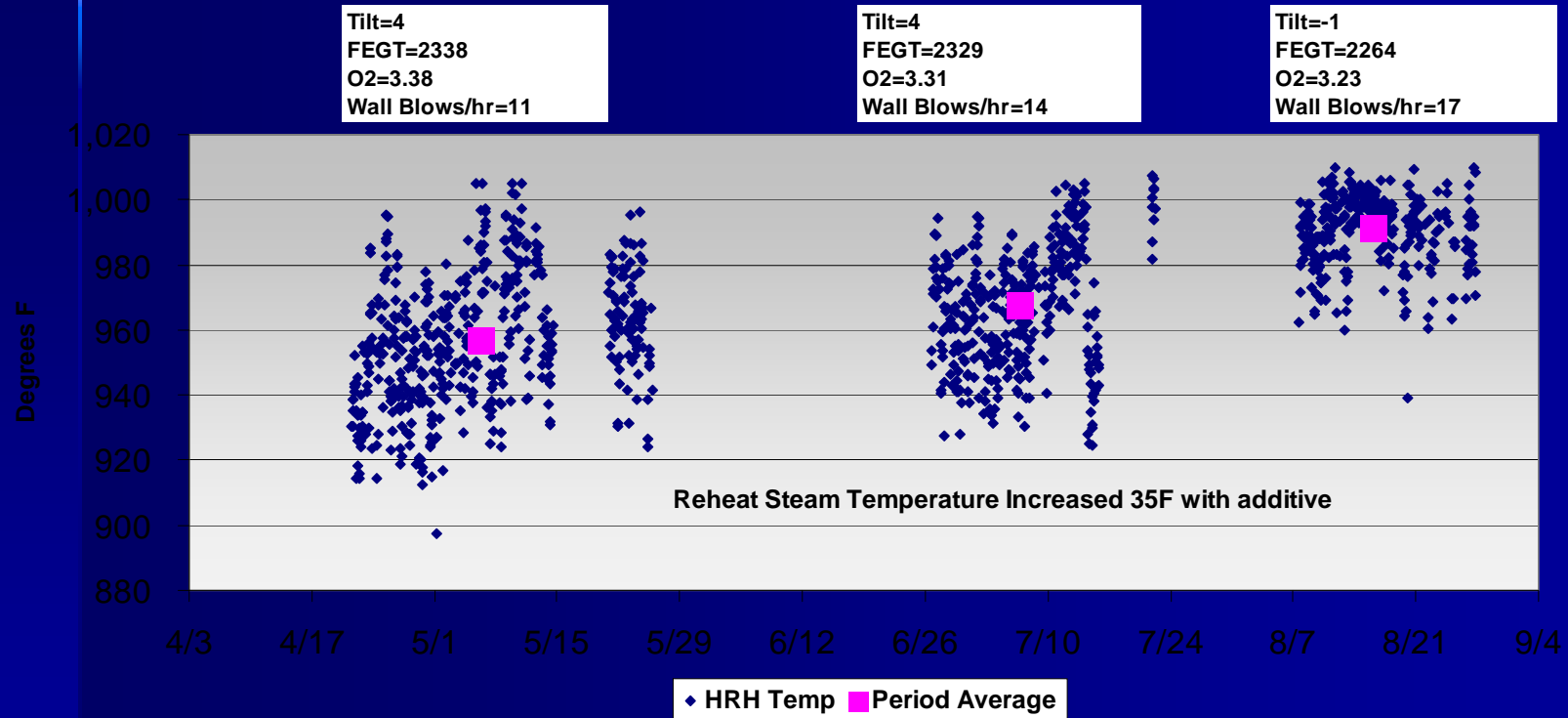


Hourly Average Main Steam Temperature INCREASED 30F w/TIFI

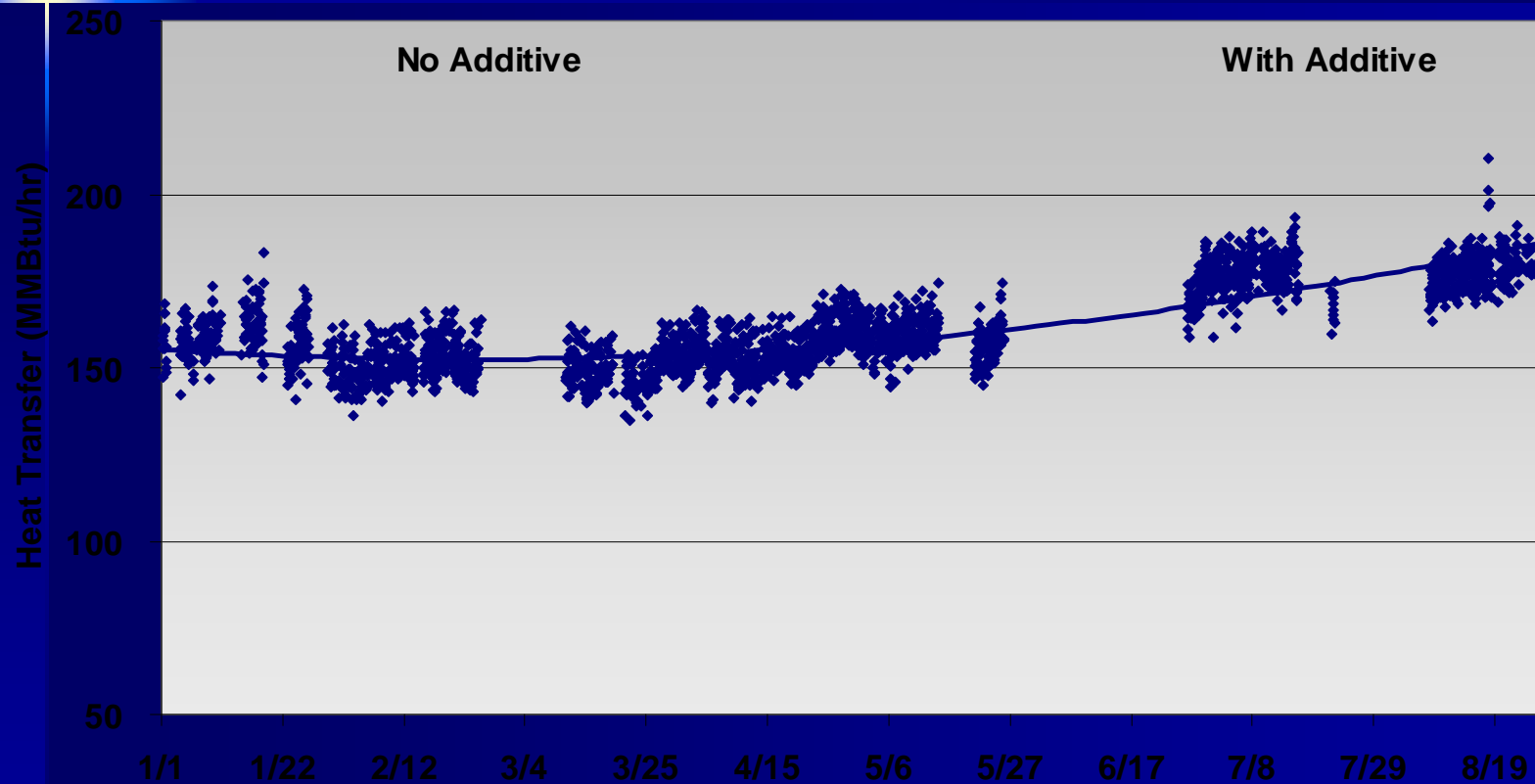




Hourly Average Reheat Steam Temperature INCREASED 35F



Superheat Front Pendant (Final) Heat Transfer



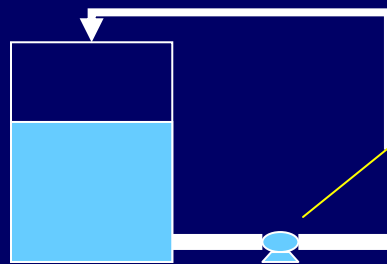
Trial Demonstration Success Key:

- Two Motivated Parties Working Together to Achieve Desired Program Success
- Teamwork & Maximum ROI are LINKED Together



FEED EQUIPMENT

Chemical Tank Level

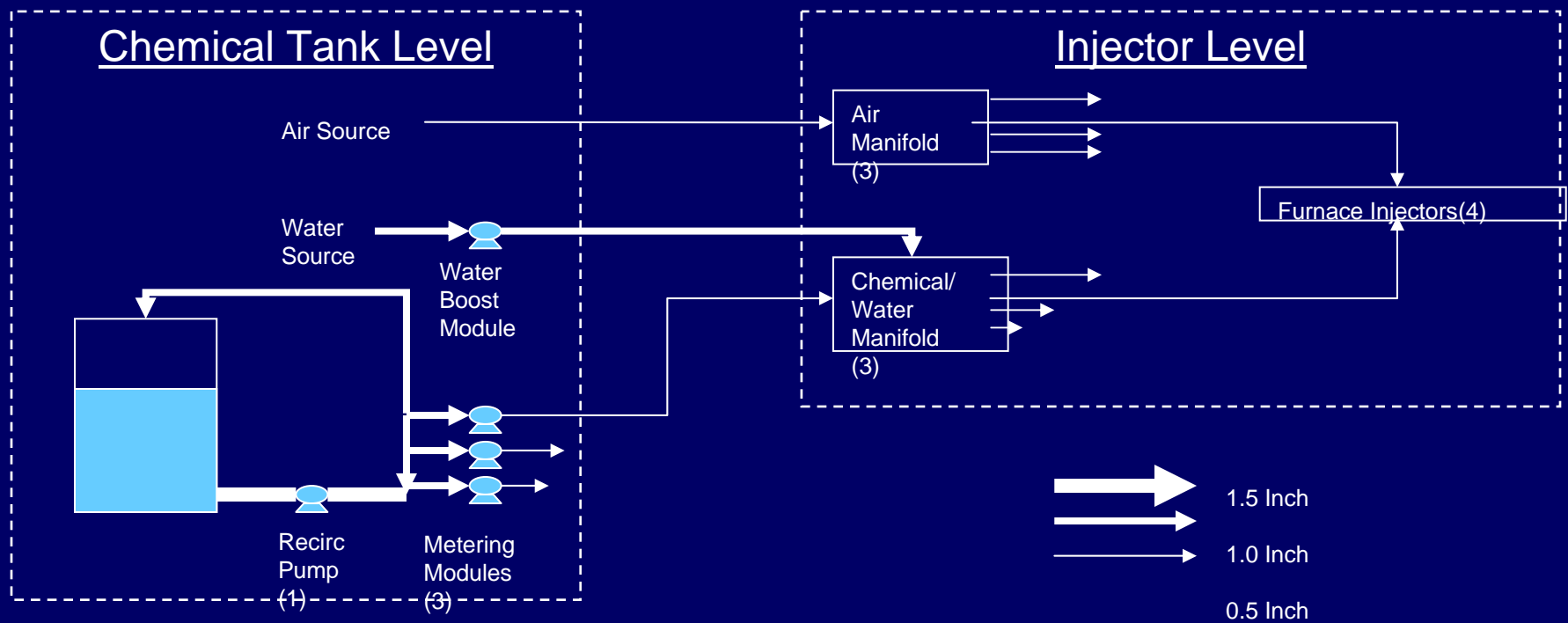


Recirc
Pump
(1)

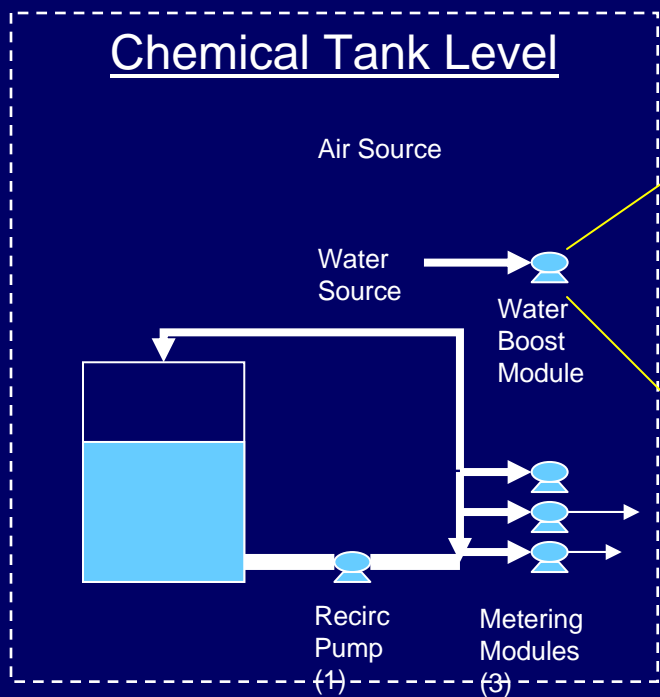
Recirculation Pump



FEED EQUIPMENT

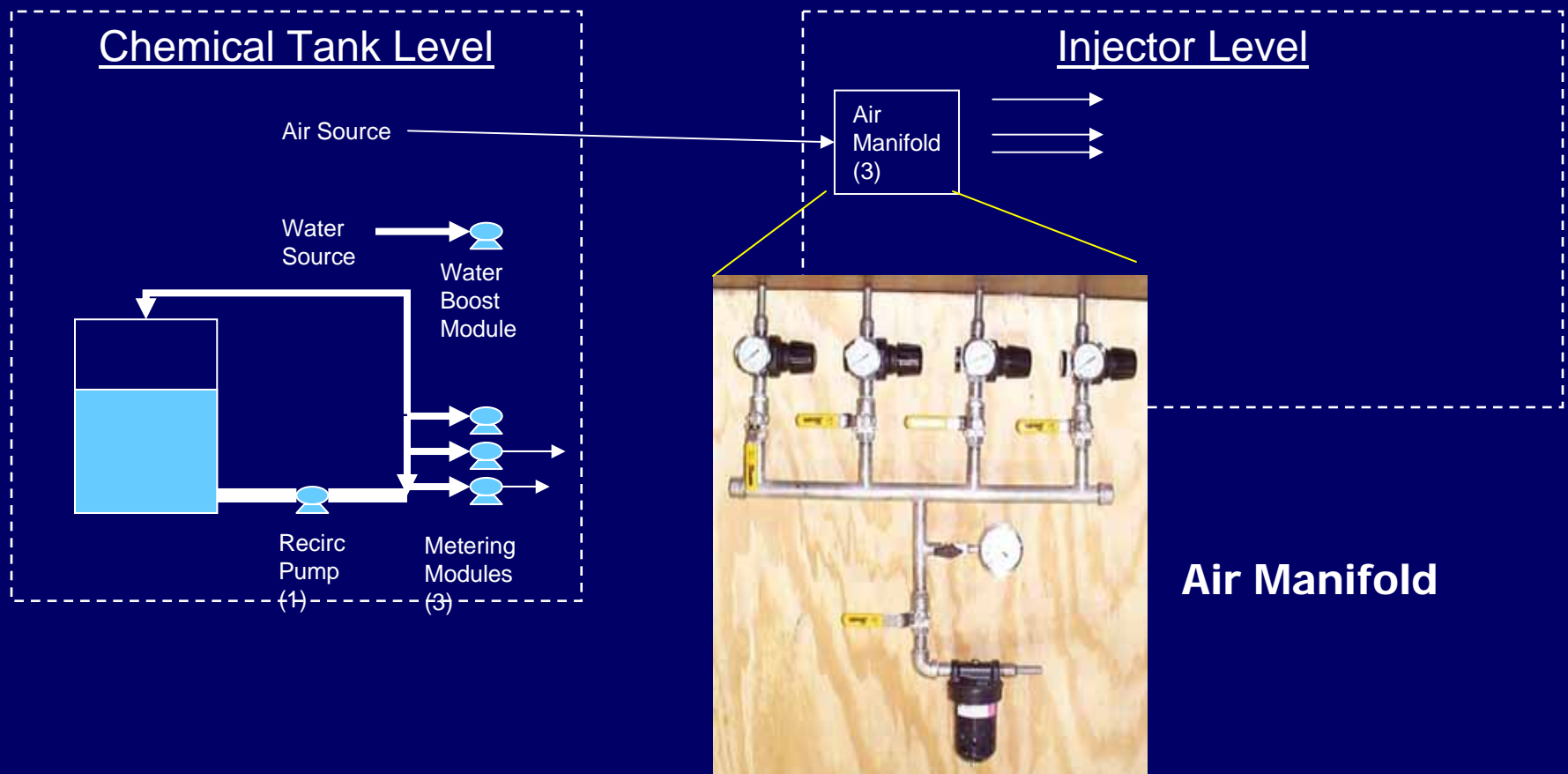


FEED EQUIPMENT

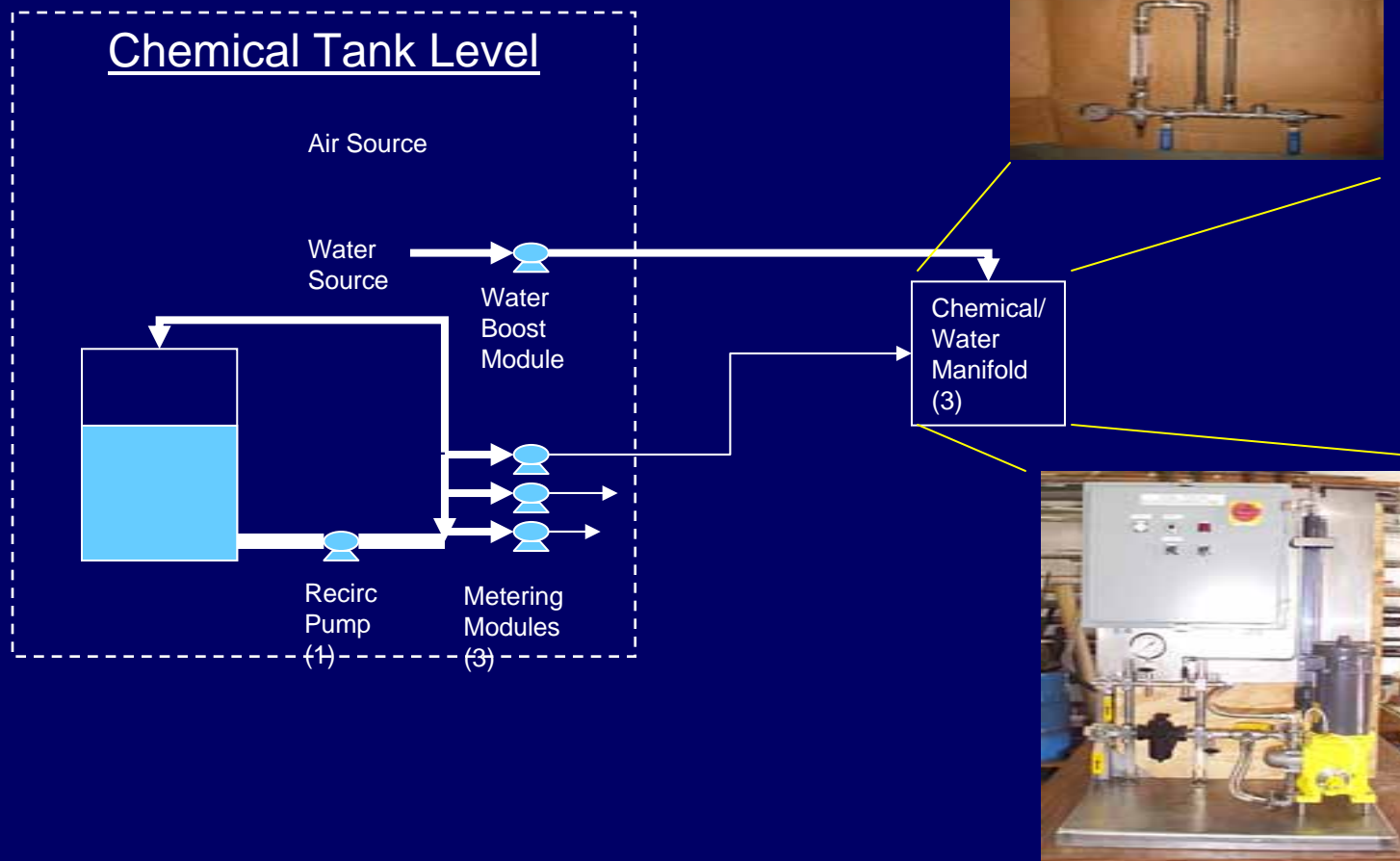


Water Boost Module

FEED EQUIPMENT



FEED EQUIPMENT

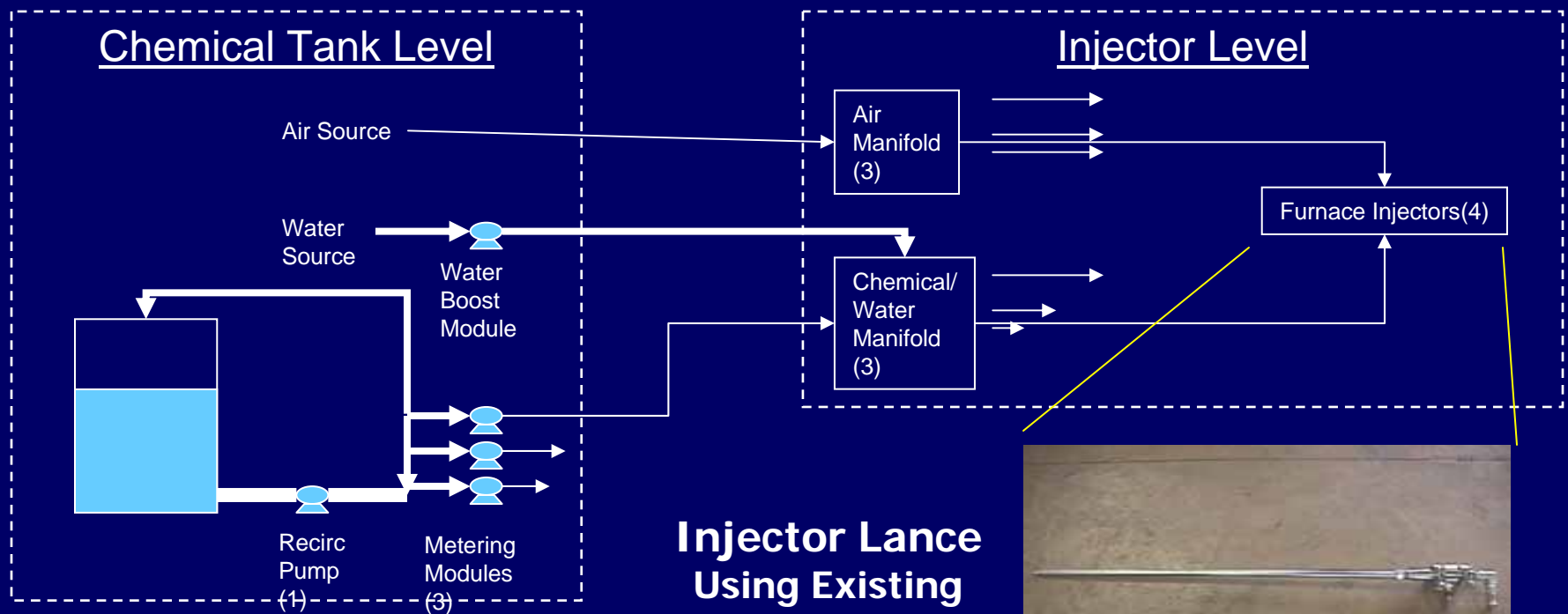


Water Manifold



Chemical Manifold

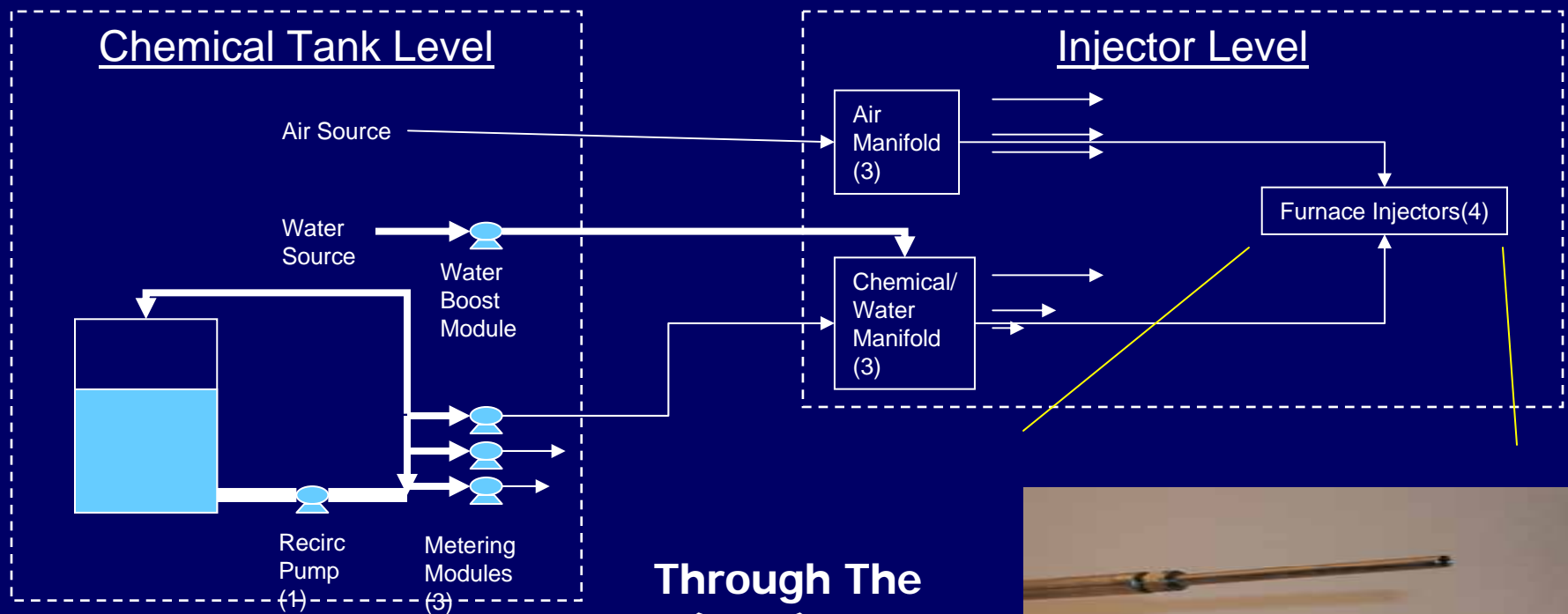
FEED EQUIPMENT



**Injector Lance
Using Existing
Ports or Tube
Bends**



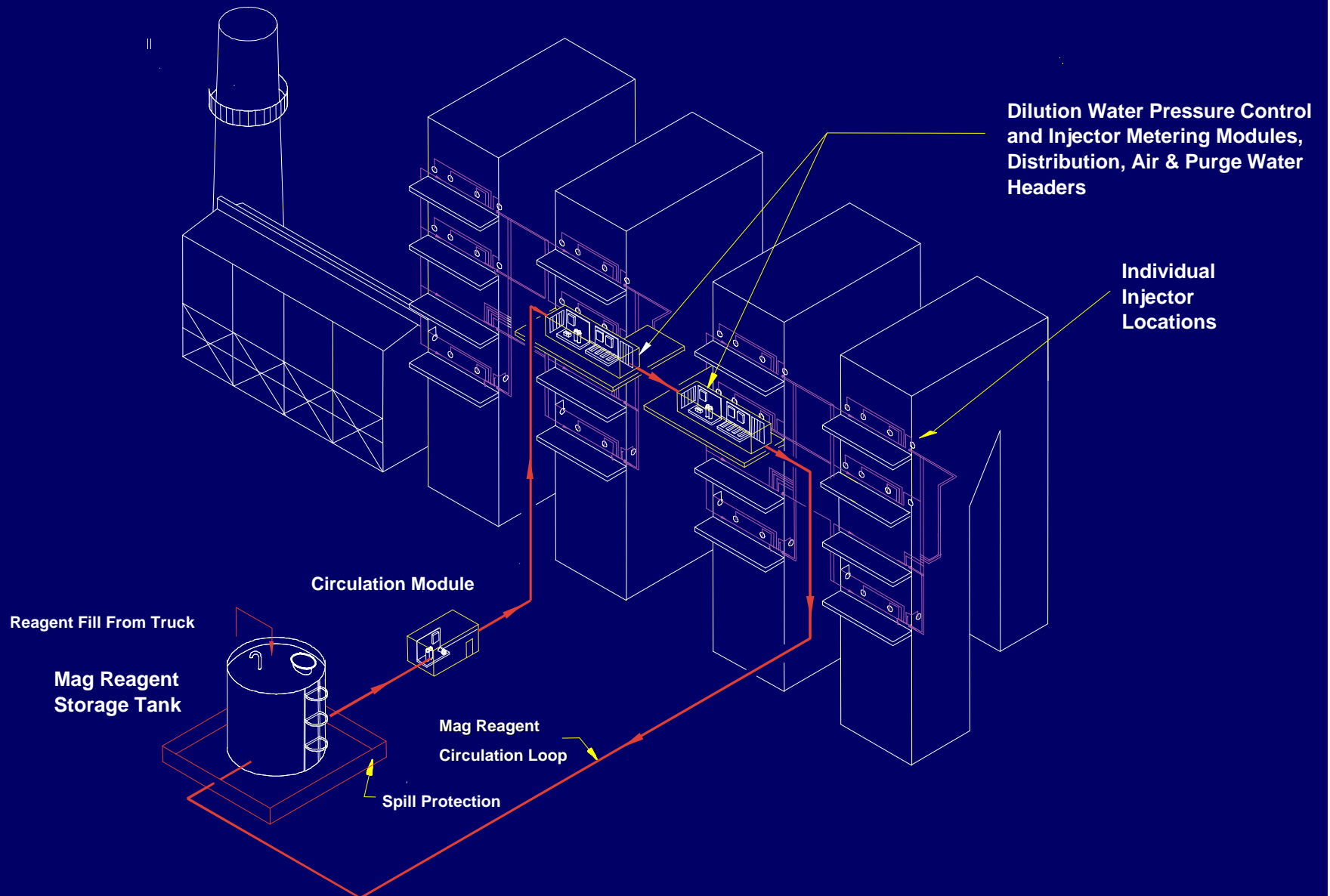
FEED EQUIPMENT



Through The
Web (TTW) Injector



TIFI SLAG CONTROL PROCESS SCHEMATIC



Keys to "Targeted In Furnace Injection" Success

- **Precise Chemical Application:** *"We run the Trial BEFORE we run the Trial"*
- **Optimal Chemistry**
 - **Particle Explosion Allows MgO Penetration INTO Deposit**
 - **50%+ Tensile Strength Reduction**
 - **Bonding Agent Reduction**
 - **Highly Reactive**
- **System Design**
 - **Simple & Durable**
 - **Service Team**

**QUESTIONS ? –
DISCUSSION**