

Full-Scale Demonstration of a Mercury Oxidation Catalyst Upstream of a Wet FGD System

DOE-NETL Cooperative Agreement DE-FC26-06NT42778

Gary Blythe
URS Corporation

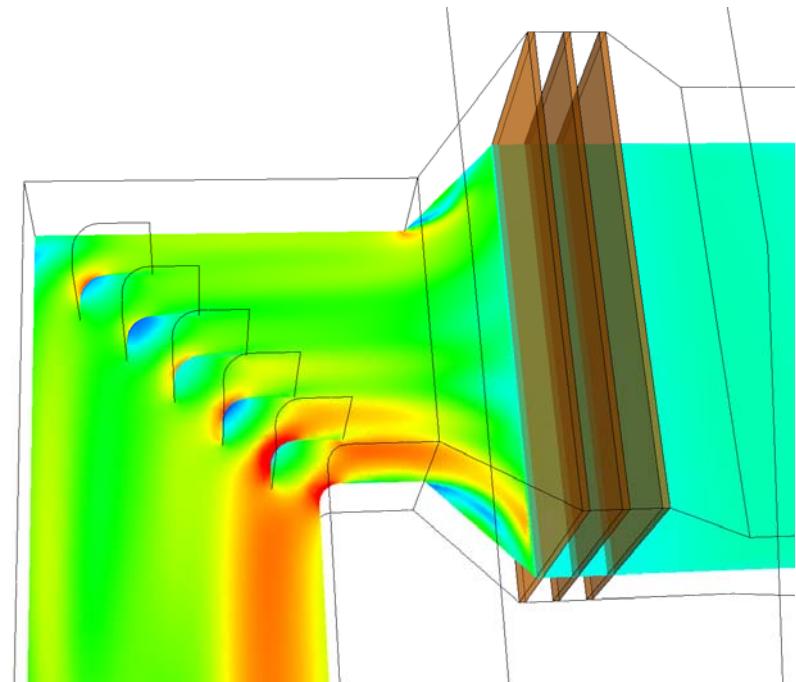
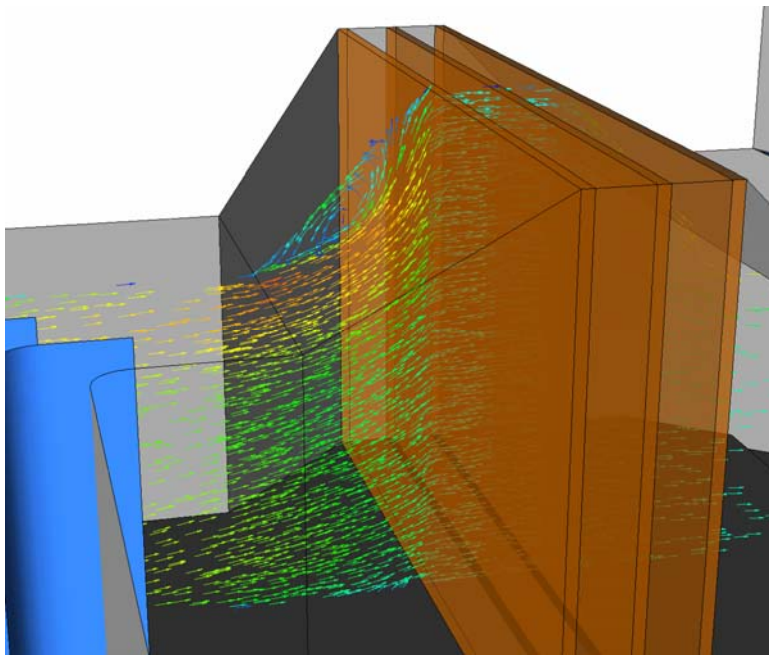
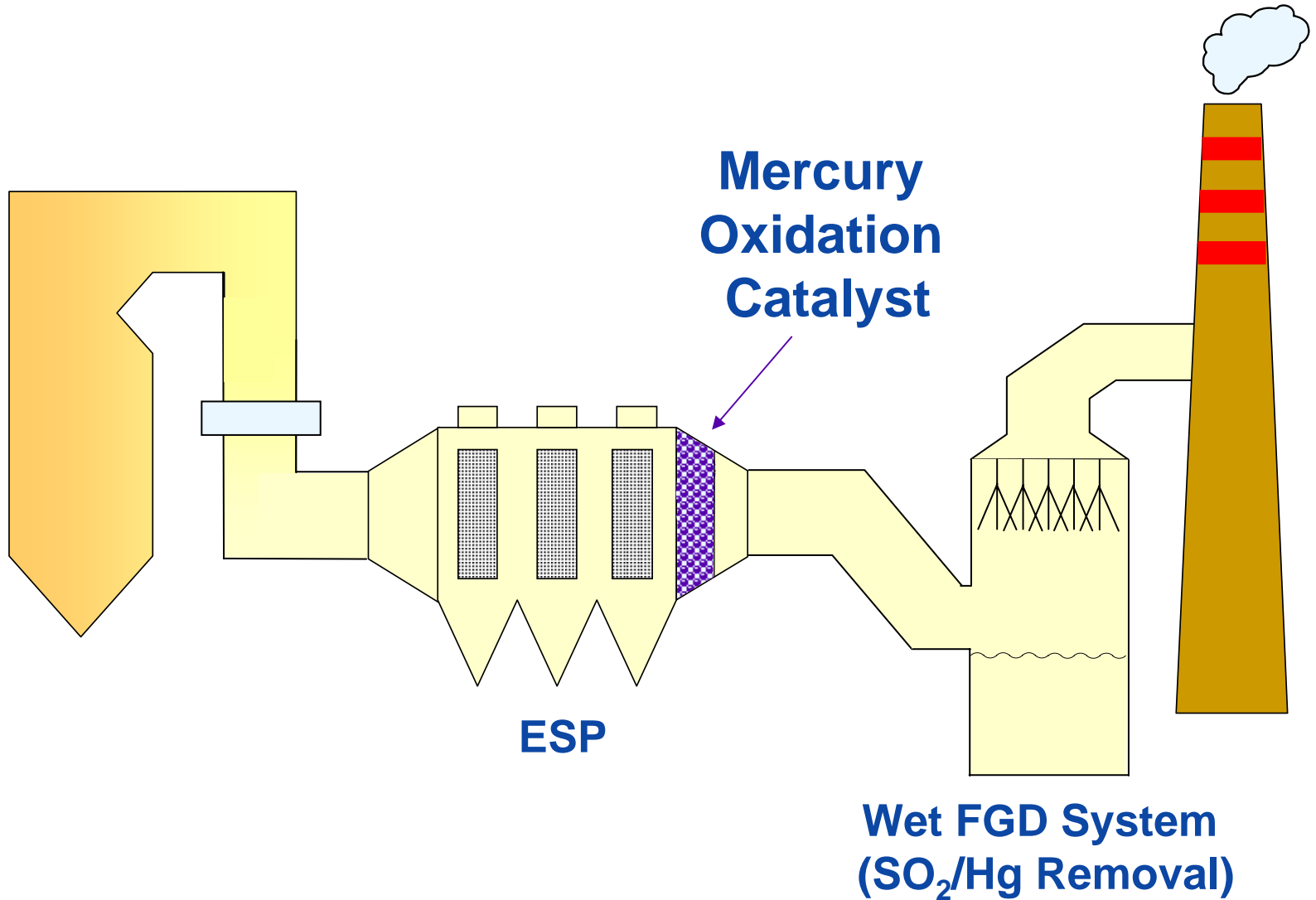


Illustration of Process Concept



Project Overview

- ◆ Demonstrate gold catalyst upstream of a full-scale wet FGD module for oxidizing Hg^0 , enhancing FGD removal of Hg
- ◆ Being conducted at the Lower Colorado River Authority's (LCRA) Fayette Power Project Unit 3
 - Located near LaGrange, Texas
 - 460 MW
 - Fires PRB coal
 - Low NO_x burners, cold-side ESP, LSFO wet FGD
 - FGD has 3 absorbers, 2 operate at full unit load
 - ~5% flue gas bypass around FGD system
 - Only Module C will have catalyst retrofitted (~200 MW)

LCRA's Fayette Power Project



Project Description

- ◆ NETL Project Manager: Chuck Miller
- ◆ Total Value: \$4.40 million (\$2.33 million DOE share)
- ◆ Period of Performance: 7/24/06-4/30/10
- ◆ Project Co-funders/Participants:
 - LCRA (Johnny Madrid, Project Manager)
 - EPRI
 - Great River Energy
 - Johnson Matthey (catalyst supplier)
 - Ontario Power
 - Southern Company
 - SRP
 - TVA (patent holder)
 - URS (prime contractor)
 - Westar

Project Objectives

- ◆ Confirm catalyst quantities and life for achieving:
 - Average of $\geq 70\%$ oxidation of Hg^0 in PRB flue gas over 24 months
 - Corresponding increase in FGD capture of Hg
- ◆ Meet or exceed solicitation objectives:
 - 50% to 70% Hg removal beyond baseline removal
 - Cost at least 50% lower than baseline of \$60,000/lb of Hg removed

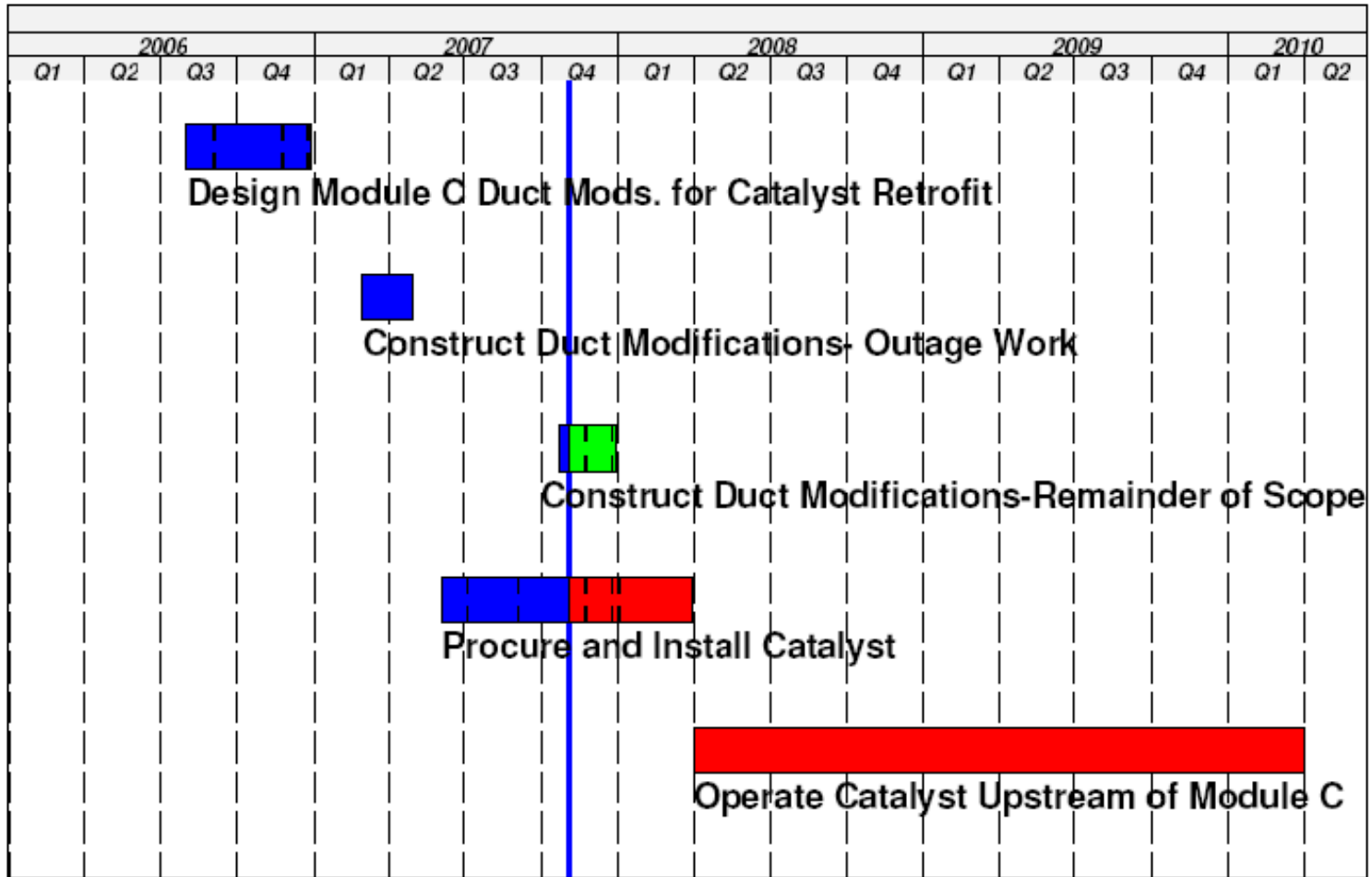
Original Project Plan

- ◆ Design Module C duct modifications for catalyst retrofit (Aug-Dec 06)
 - Reduce gas velocity to ~15 ft/sec at catalyst
 - CFD modeling of gas flow distribution
 - Note: future application on entire unit would likely be installed at ESP outlet (~5 ft/sec)
- ◆ Construct duct modifications (Dec 06-May 07)
- ◆ Procure and install catalyst (Dec 06-July 07)
- ◆ Operate catalyst upstream of Module C (July 07-June 09)

Schedule Issues in Spring 2007

- ◆ Apparent funding shortfall
 - Bid for duct modification construction came in ~2 times original budget (only 1 bidder)
 - Loss of NETL GFY08 co-funding
- ◆ Requirement to complete some ductwork mods during Unit 3 Spring 07 outage
- ◆ Resolution:
 - Raised additional cost sharing from co-funders
 - Completed only outage-critical work with original bidder
 - Re-bid remaining construction scope for later in year
 - » successful bidder was closer to original budget

Revised Project Schedule



Start Date 01JAN06
 Finish Date 31MAR10
 Data Date 02NOV07
 Run Date 05DEC07 09:21

Early Bar
 Progress Bar
 Critical Activity

HG17
 MERCURY OXIDATION CATALYST TEST
 SUMMARY

Date	Revision	Checked	Approved



Long-term Catalyst Evaluation

- ◆ 24 months duration
- ◆ Bimonthly SCEM measurements
 - Hg⁰ oxidation across catalyst,
 - Net removal of Hg across FGD Module C
 - Compare to other FGD module in service
- ◆ Three sets of Ontario Hydro verification measurements (each w/triplicate runs)
 - Catalyst inlet, catalyst outlet, Module C outlet
 - “Baseline” sampling across other FGD module
- ◆ Track catalyst pressure drop vs. time
- ◆ Other flue gas characterization (HCl, etc.)

Catalyst Specifications

Catalyst Type	Gold on gamma alumina, ceramic substrate
Supplier	Johnson Matthey
Cell Pitch	64 cpsi
Catalyst Depth	20 inches (two 6-in. layers, one 8-in. layer)
Design Superficial Velocity	15 ft/sec
Total Catalyst Volume	1174 ft ³ (8712 pieces)
Design Space Velocity	21,300 ^{-hr} (32°F)

Pro Forma Economics for Fayette Demo (200 MW, 2 yrs operation)

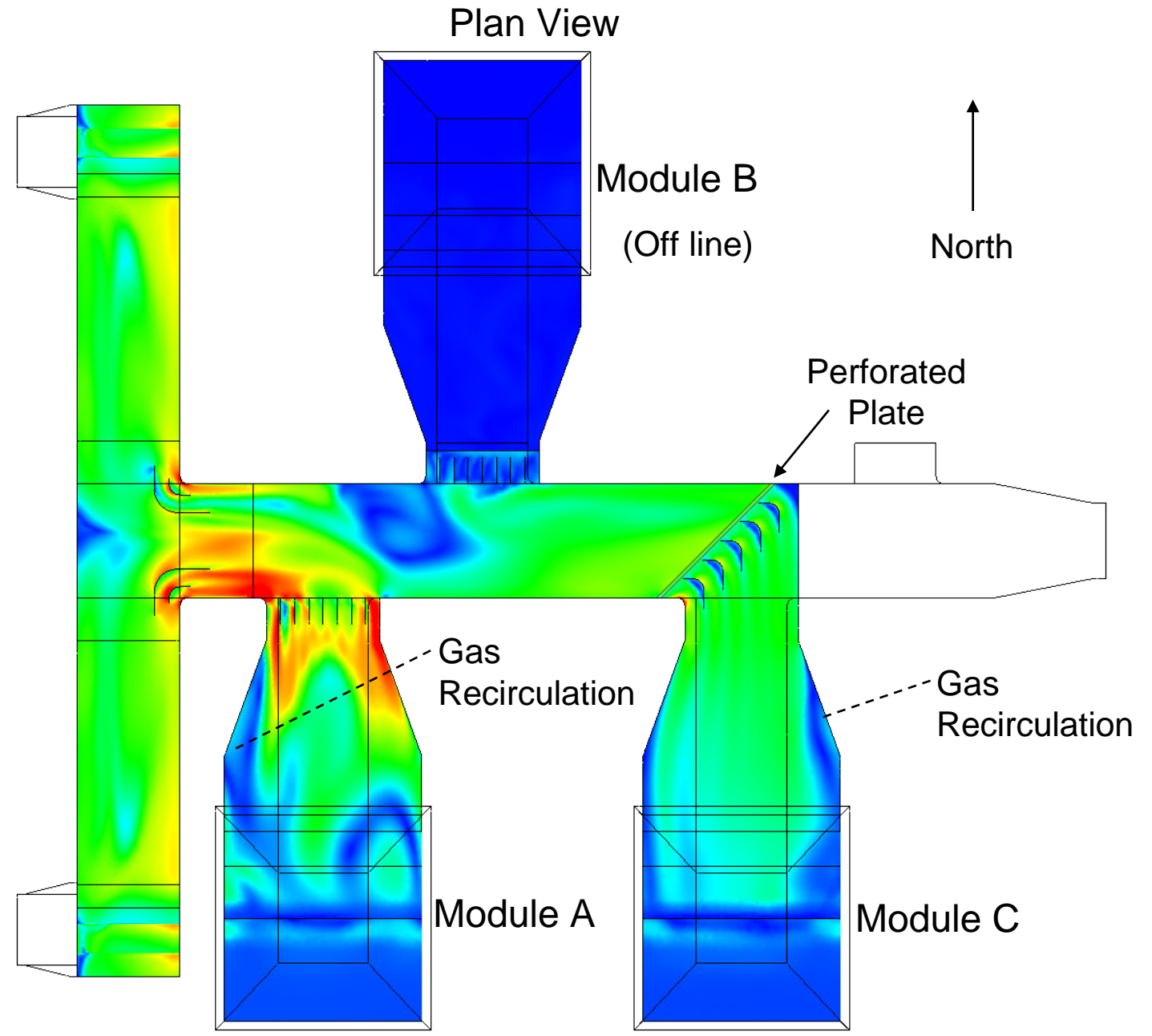
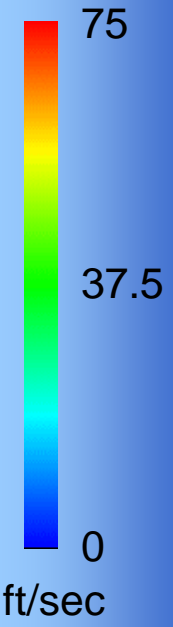
		Catalyst Cost, \$/lb of Hg removed*
Catalyst Cost	\$1.66 million*	-
Additional Hg removal @50% improvement	120 lb	\$13,800
Additional Hg removal @70% improvement	170 lb	\$9,800
Value of Fly Ash Sales Retained	\$1.11 million	-

*Does not include capital for ductwork modifications

Net catalyst cost is in the range of \$3000 to \$5000/lb Hg compared to technologies that would adversely affect fly ash sales

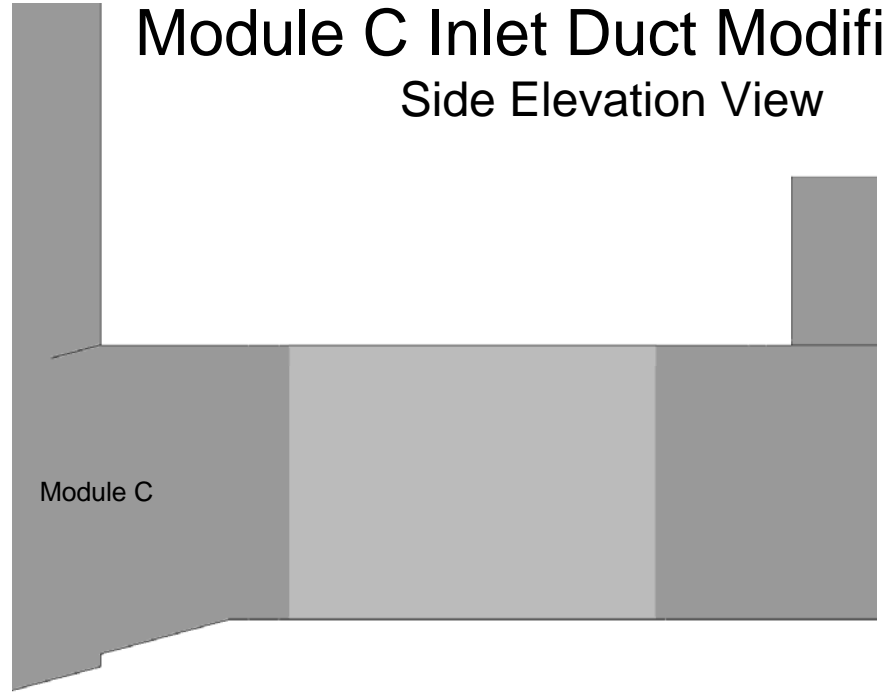
Case 1:
Existing
Operation with
A&C In Service

CFD Modeling Results: Existing Gas Velocity Magnitude

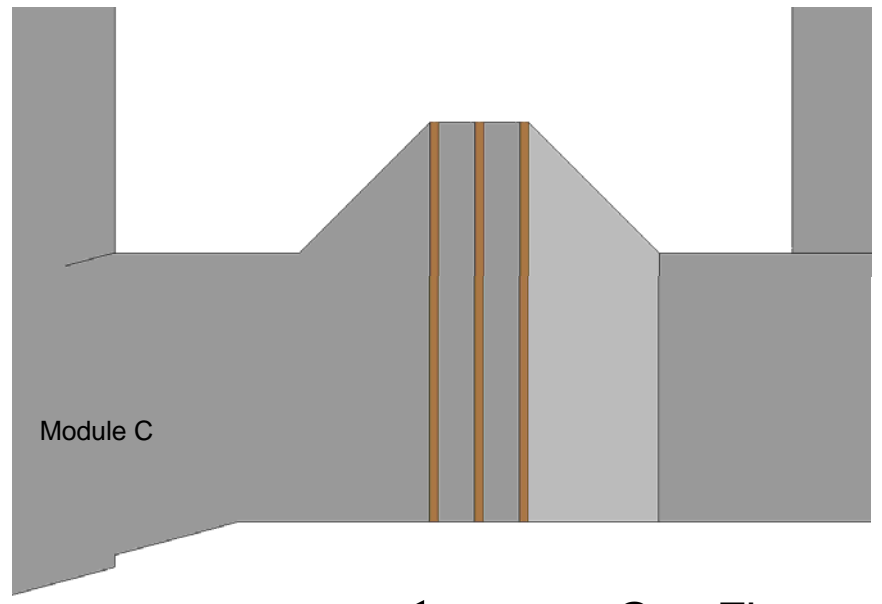


Module C Inlet Duct Modifications

Side Elevation View



Existing Module C Inlet Duct



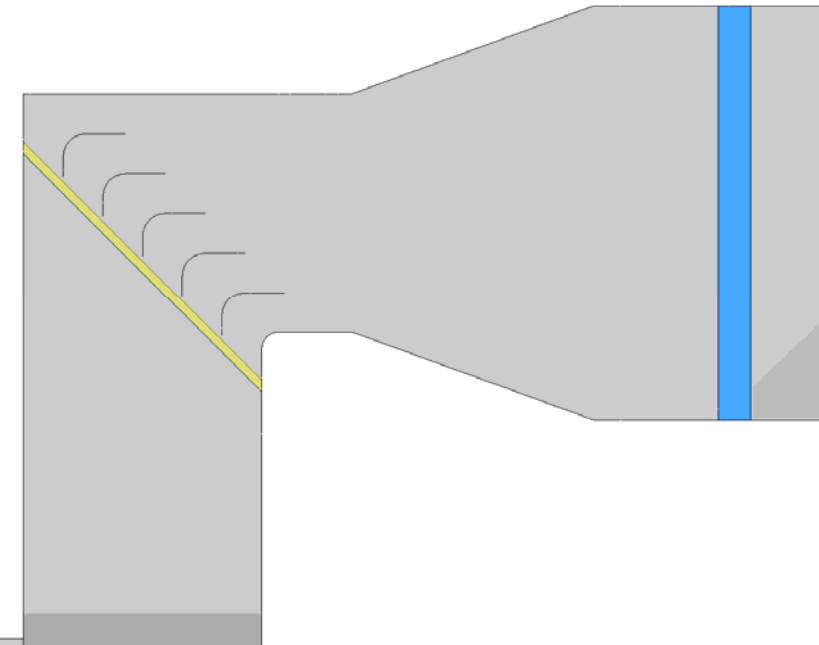
Modified Module C Inlet Duct

← Gas Flow

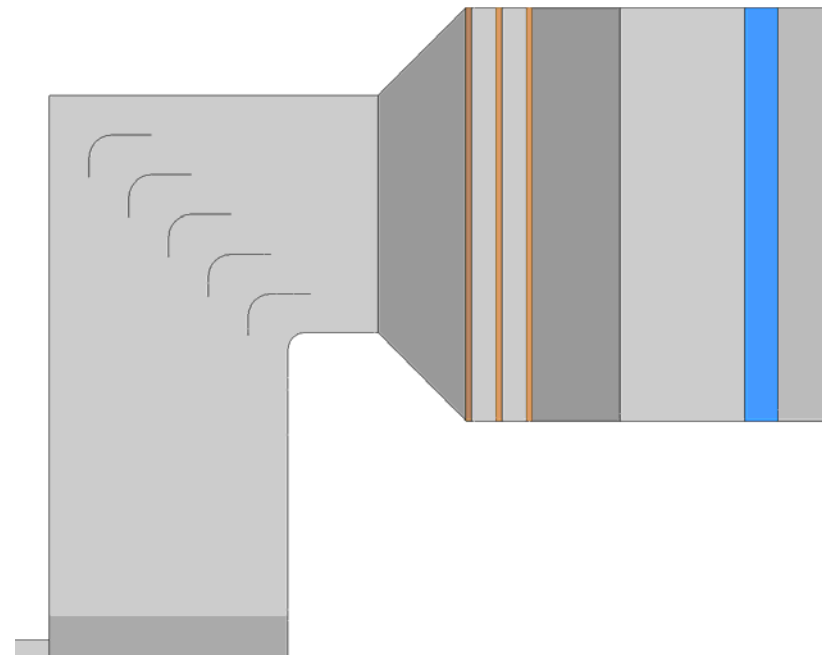
Module C Inlet Duct Modifications

Plan View

Gas Flow →

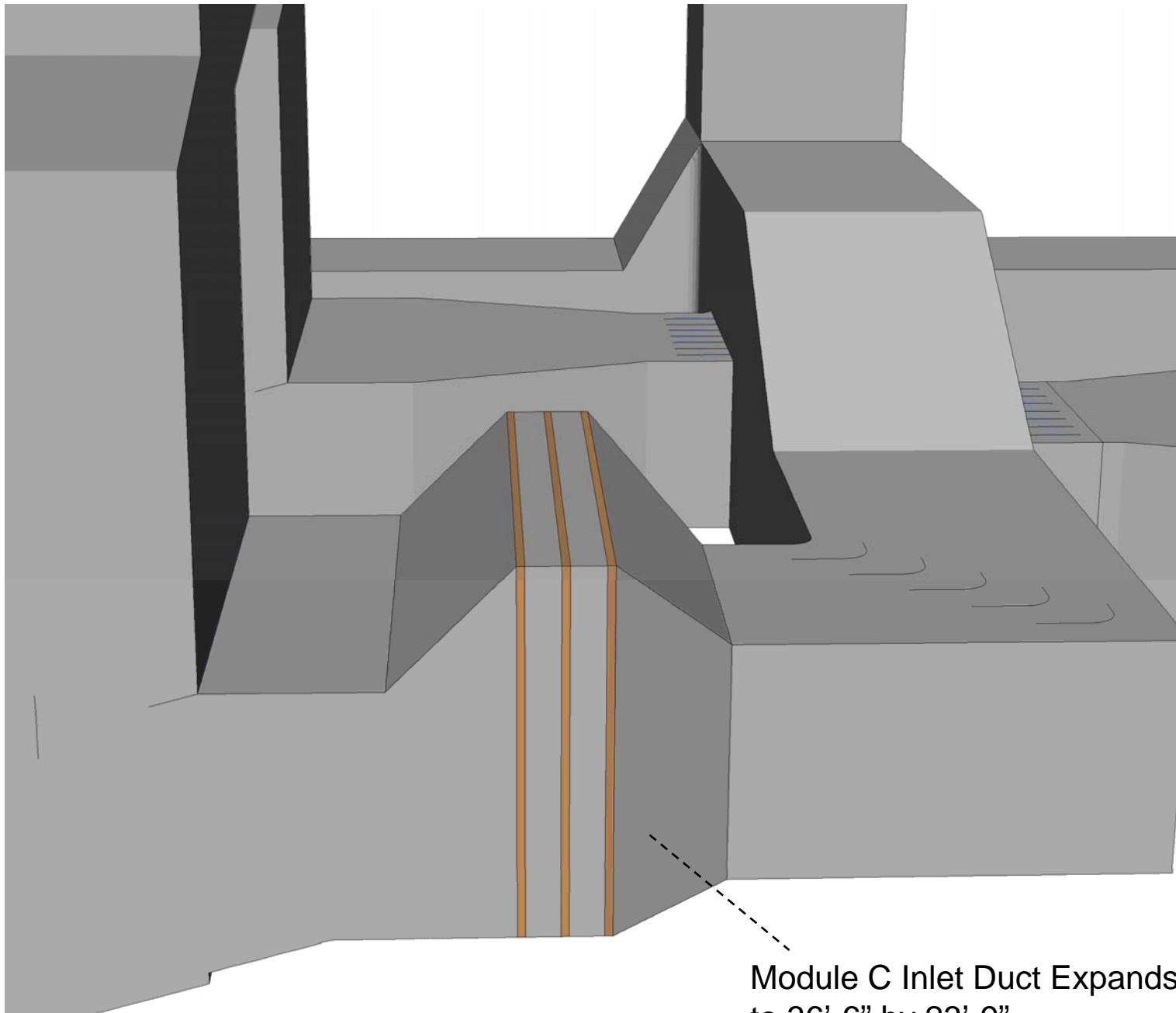


Existing Module C Inlet Duct



Modified Module C Inlet Duct

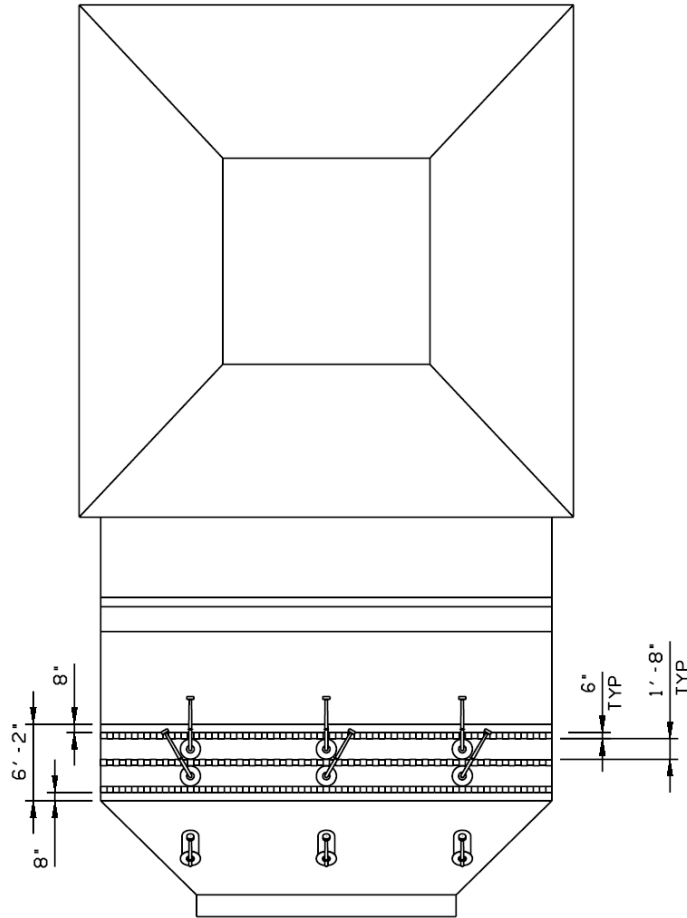
Module C Inlet Duct Modifications



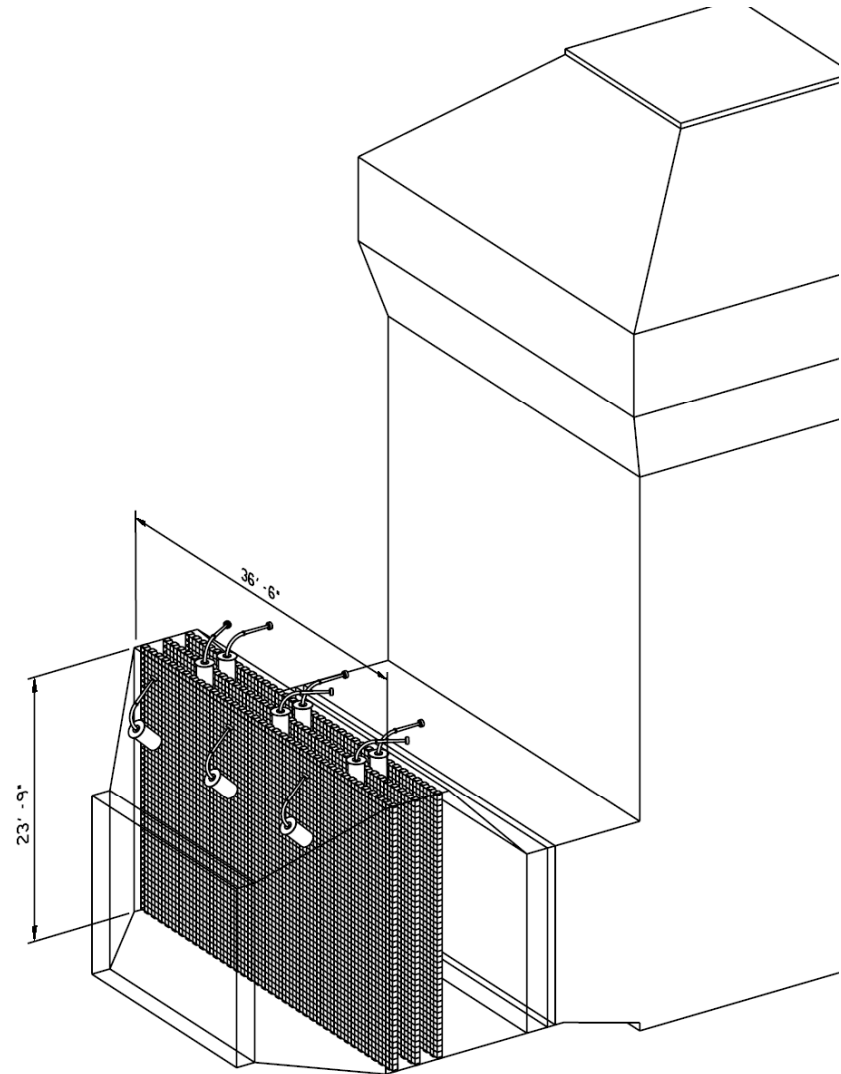
Module C Inlet Duct Expands
to 36'-6" by 23'-9"

Sonic Horn Layout

(conservative design to help prevent fly ash buildup)



TOP VIEW

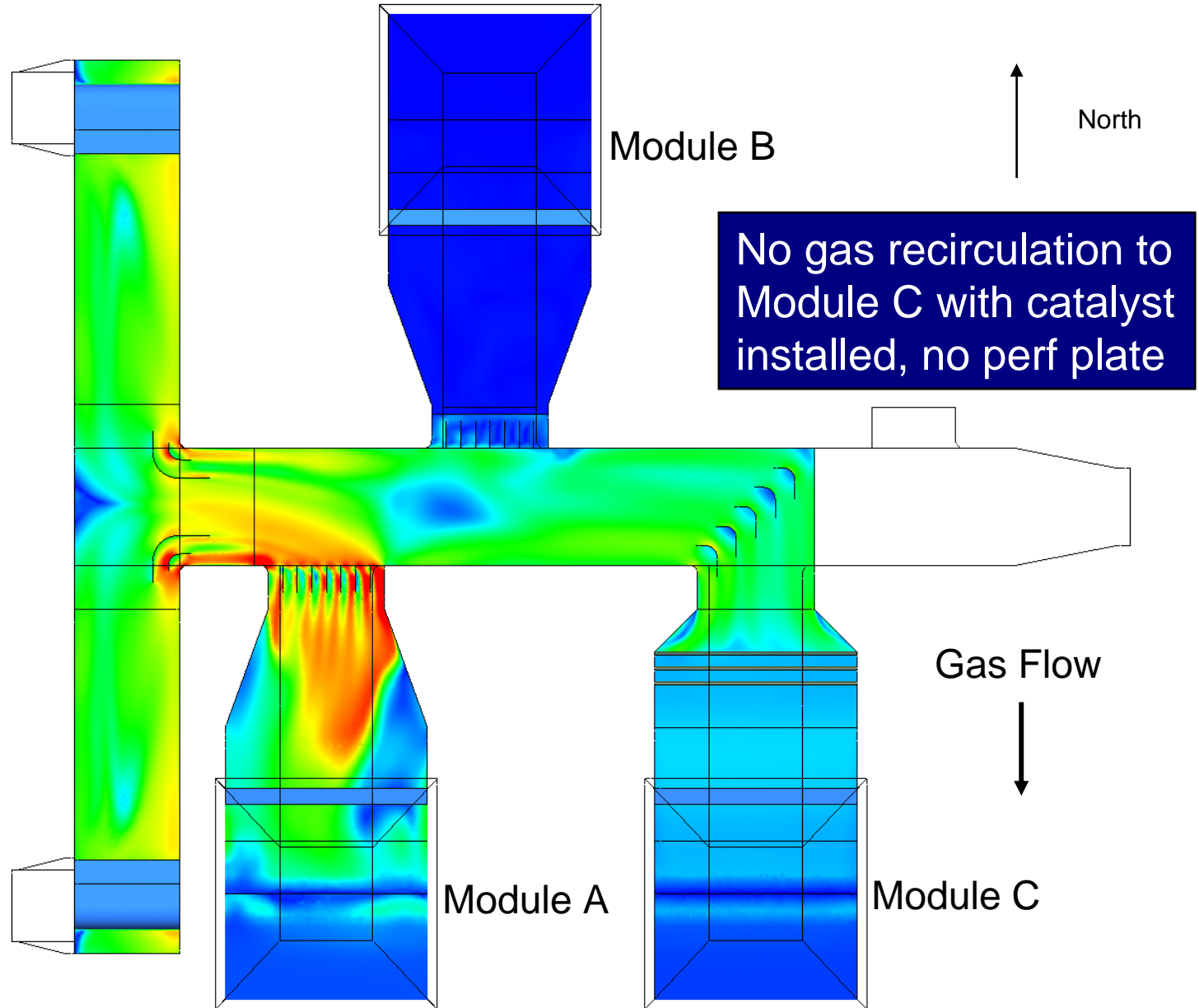


ISOMETRIC VIEW

Case 9:
Oxidation
Catalyst,
Perf Plate
Removed,
A&C In Service

Gas Velocity Magnitude

Plan View



Summary of CFD Results

Case	Description	Gas Flow Split to FGD Modules			Perf Plate dP IWG	Catalyst dP IWG	Average Superficial Gas Velocity (ft/sec)
		A	B	C			
1	Existing Operation	50.5		49.5	0.80		
2	Existing Operation		51.0	49.0	0.80		
9	Catalyst	54.8		45.2		1.40	13.2
10	Catalyst		55.1	44.9		1.40	13.1

CFD Modeling Conclusions:

- Existing perforated plate can be removed
- No gas flow straighteners required at catalyst chamber
- Predicted 0.6 IWG pressure drop increase to Module C will not significantly alter gas flow distribution to modules

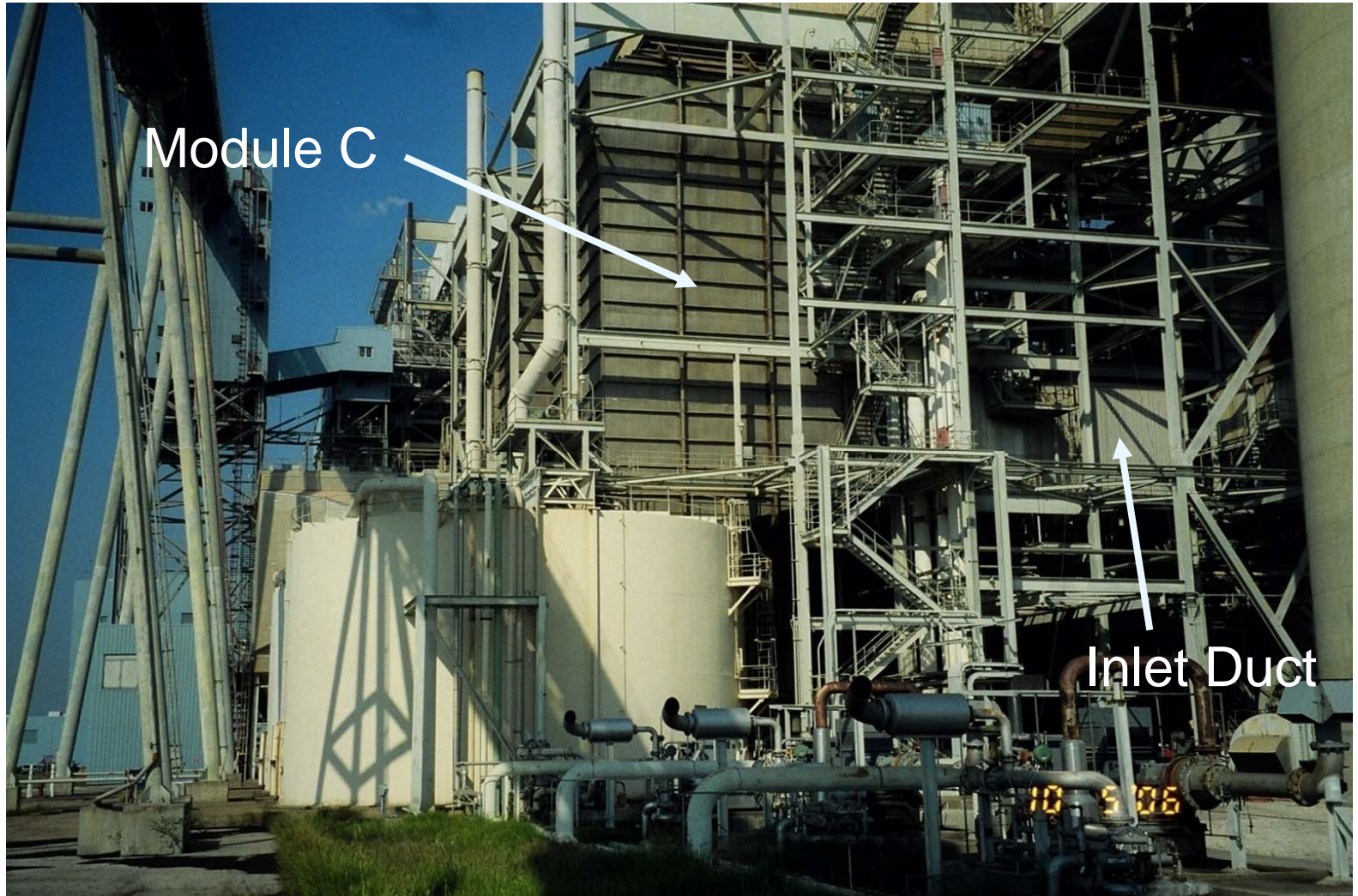
Ductwork Modifications During Fabrication



Ductwork Modifications During Fabrication (continued)



Side View of Module C Inlet Duct Before Construction



Ductwork Modifications – Demolition of Existing Duct Between Guillotine and Absorber Inlet



Ductwork Modifications – Site Construction (new side wall)



Ductwork Modifications – Site Construction (top hatch for catalyst loading)



What's Next?

- ◆ Complete construction effort (December 07)
- ◆ Ship catalyst to site (expected end of January 08 – ahead of schedule)
- ◆ Install catalyst (expected February 08)
- ◆ Begin 2-yr demonstration (March 08)