Reinhold Environmental Ltd.

2010 NOx-Combustion Round Table & Expo Presentation

February 8 & 9, 2010 Chattanooga, TN

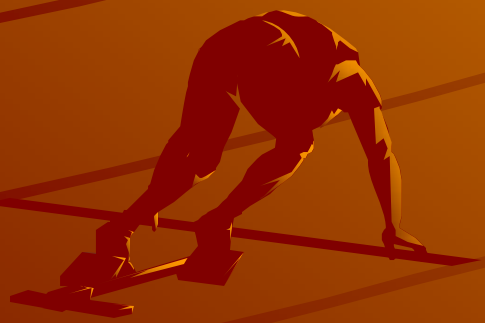
SCR 101

Ammonia Supply & Transfer

Mike Vukmir – Environmental Equipment Services

Inlet Mixing

Darren Hanby – AEP



AIG Tuning

Marilyn Martin – Evonik

2010 NOx – Combustion/PCUG Conference

SCR 101

Inlet Mixing

Darren Hanby – AEP

Environmental Equipment Performance

2010 NOx – Combustion/PCUG Conference

Why I was working Sunday night on this class material

Oops.. Forgot to shovel the driveway

Job Well Done

Refreshment after all that "WORK"

HOT Chocolate (good to the last drop)

But is it always?

Just as in Hot CoCo The key to efficient NOx removal is ….

MIXING

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What is Inlet Mixing?

A system of flow modification devices that displace or straighten the flue gas to assure the appropriate mixture of NOx and NH_3 at the face of the SCR catalyst.

Where to start?

Conditions to mixing system.

NOx Profile Testing (load range and mill change stability)

Temperature and flow profiles.

Check for evidence of LPA (Entry to Air Heaters)

What are the Goals of your SCR?

- To meet target NOx levels

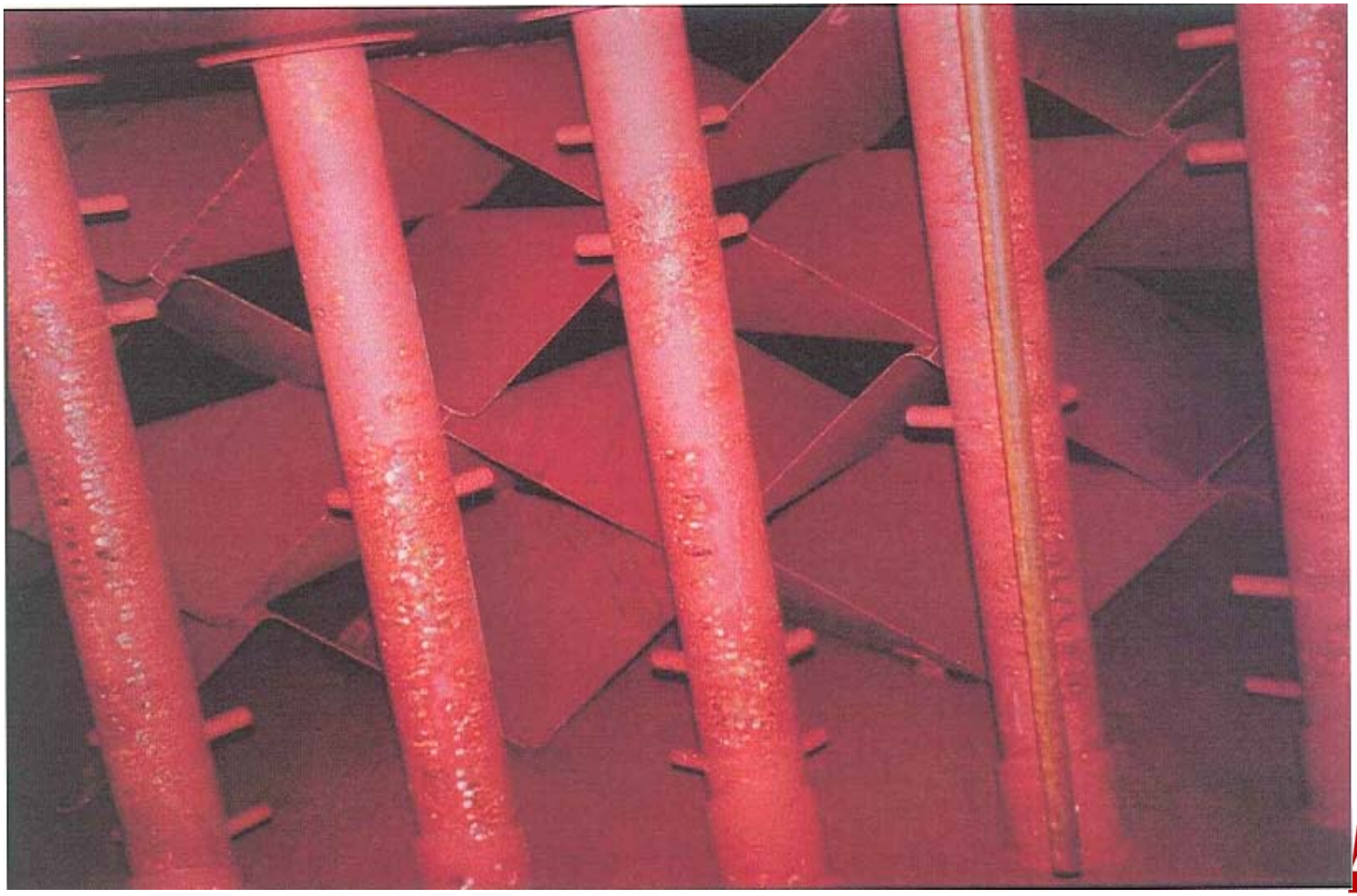
- Highest potential for removal of NOx

Types of Mixing Systems

Straight Line – Devices straighten flow, intensive grid to match NOx profile

Shifting Mixers – Devices alternately shift gases horizontally and vertically, NH_3 injected through one or more multi-nozzled header.

Sulzer Mixer



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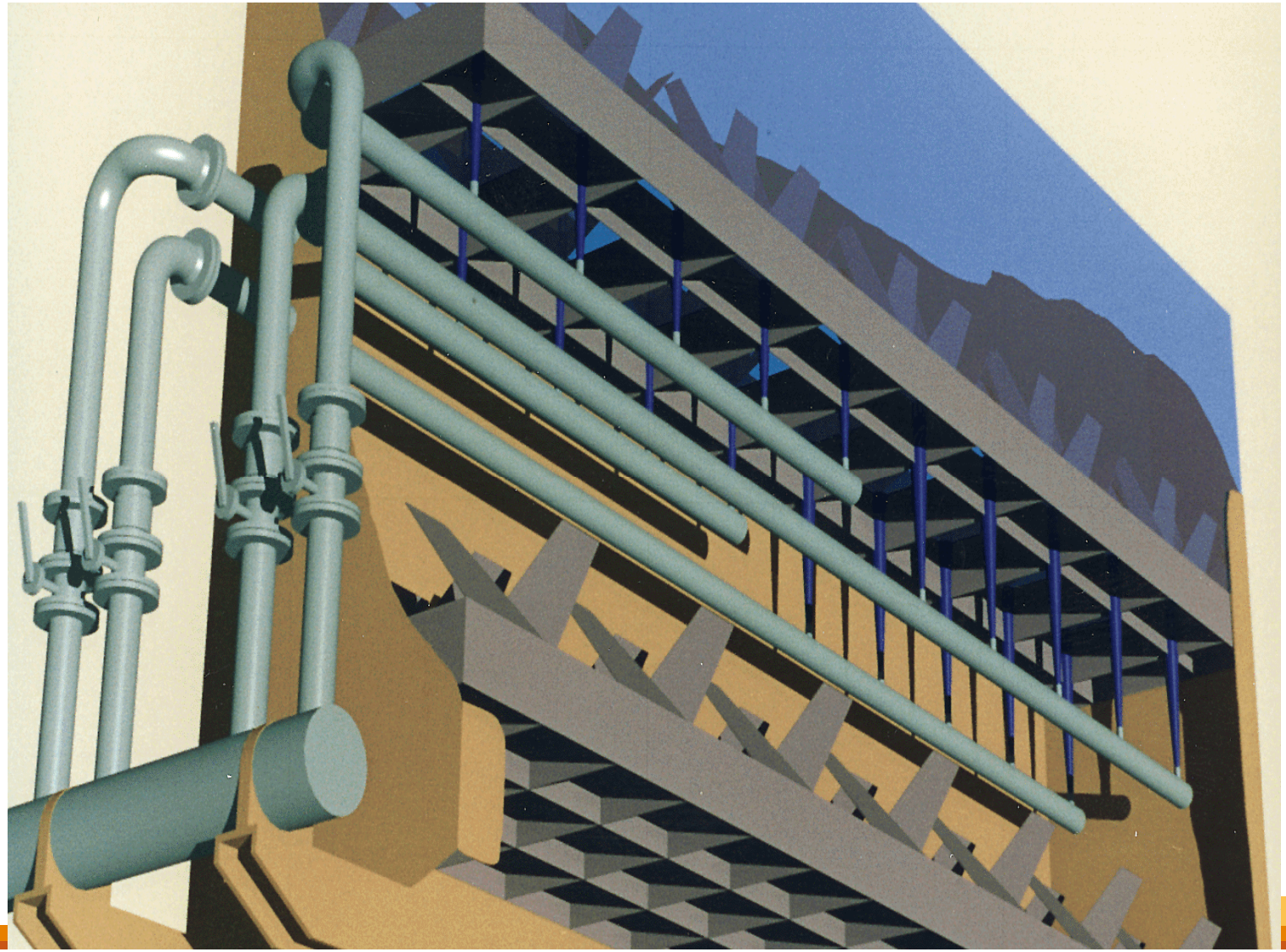
Zonal Mixers - Devices divide duct into zones with intensive mixing, NH_3 adjusted for each zone.

PARMIX & TURBOMIX
developed by Siemens



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Vortex Mixers - Devices create vortices throughout duct, NH_3 injected into a voertex created by the device.

Delta Wing® Mixing from Babcock Power

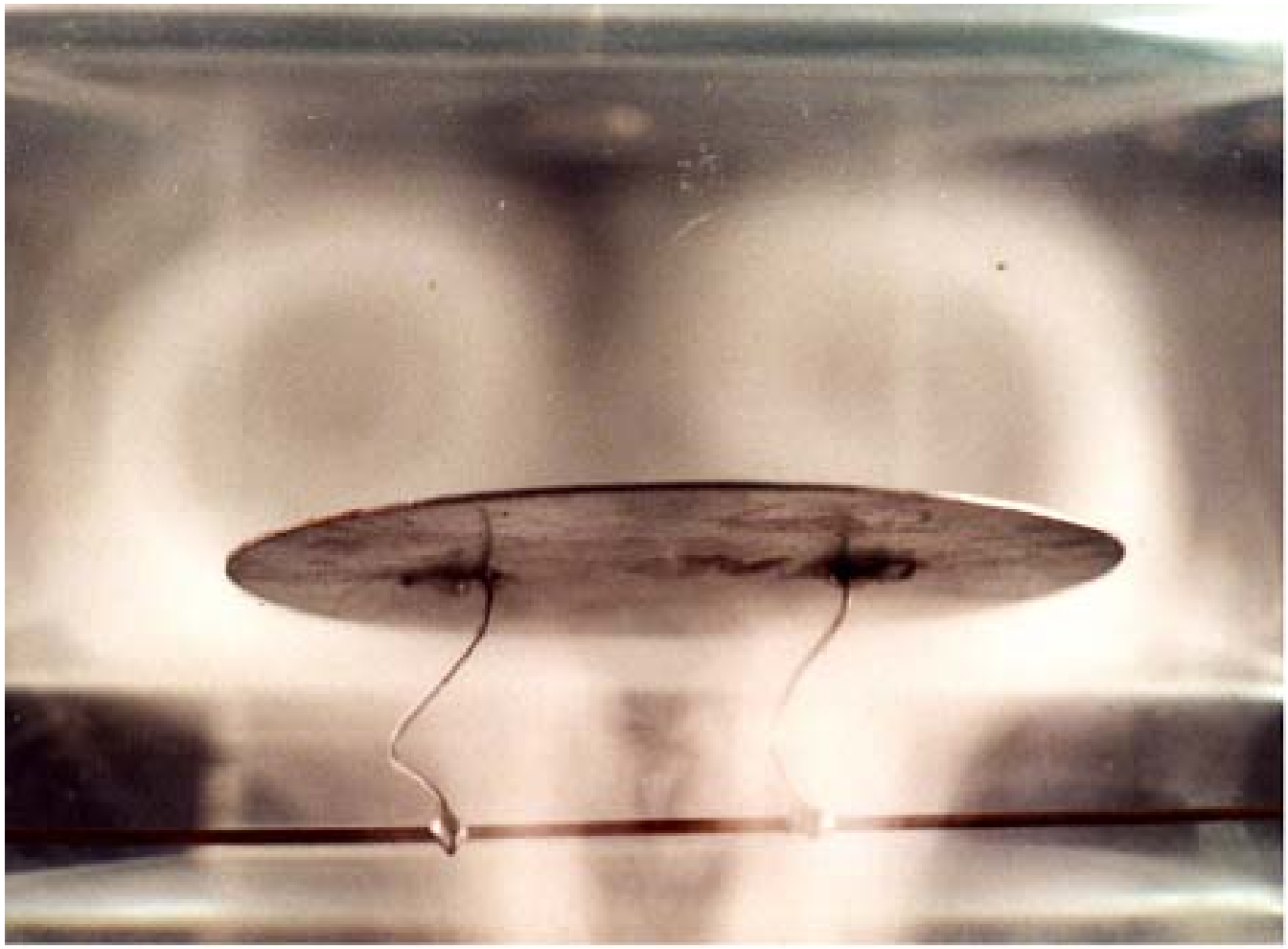
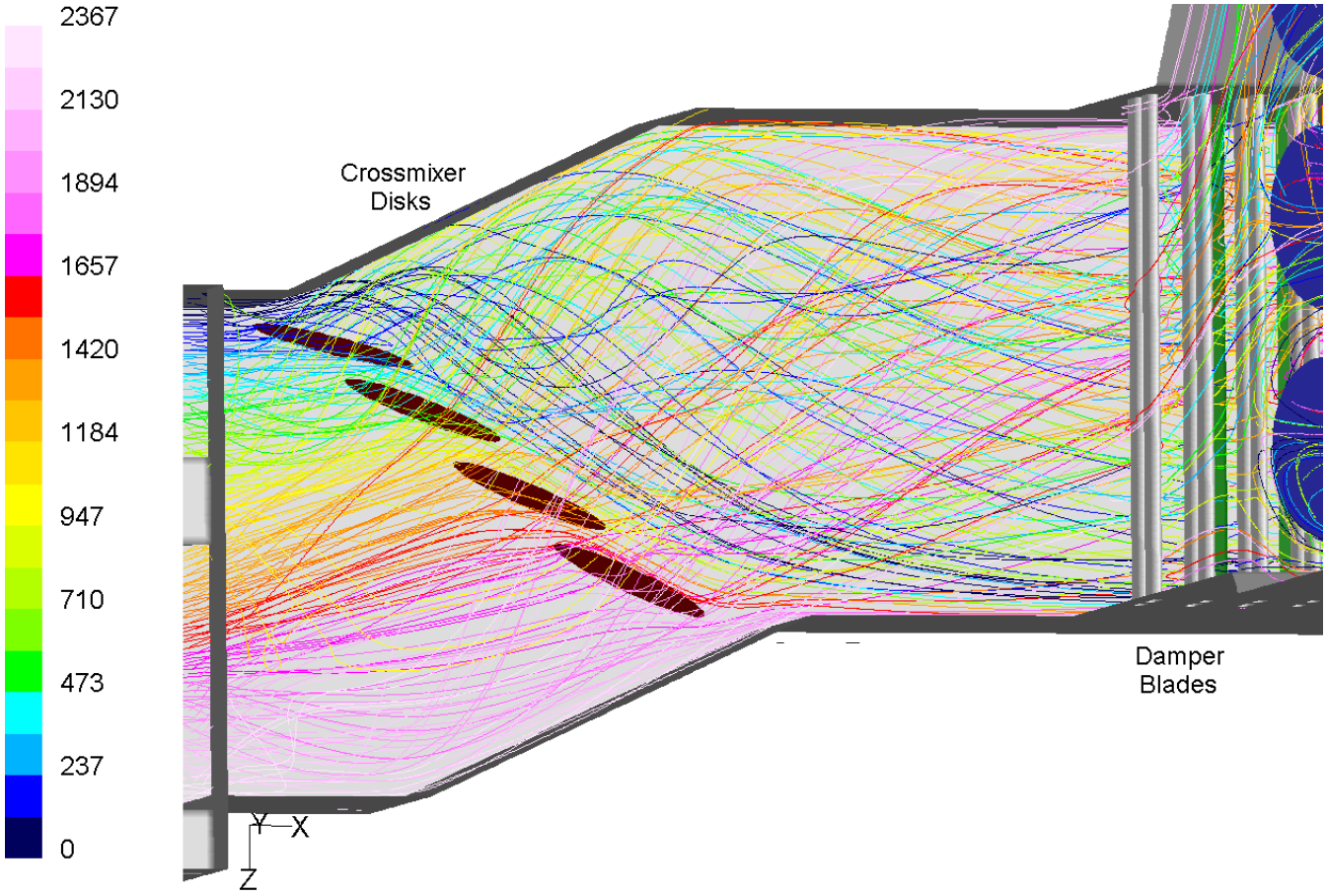


Photo Courtesy of Balcke-Dürr GmbH, Germany

Cross mixing flow

Photo courtesy of Riley Power



Modeling

Whether CFD or scale the most important thing to remember is the model output is only as good as its input.

Model worst case then some NOx, temperature, and velocity variations.

Dust loading and hang out can be critical.

LPA Should be modeled if any indication of it is seen.

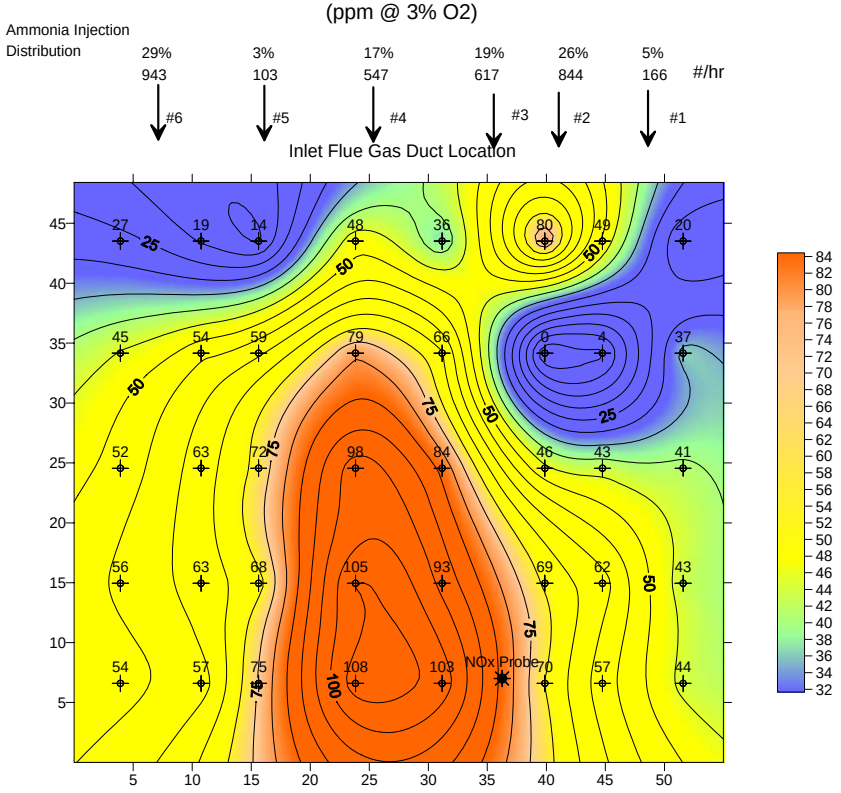
Installation

Mixing distances and orientation can be very critical with all designs. Relatively small errors can have a significant impact on performance.

Installation Errors Impact

VARIATION OF CATALYST OUTLET NOx CONCENTRATION

(ppm @ 3% O2)



Reactor Platform and Test Probe Location

BBP Contract #: 100109 Project Name: AEP Unit: Big Sandy 2 Reactor: R2

Test: Big Sandy 2 R2082303 Test 21 Test Date: 8/23/03 Test Start Time: 1617 Test End Time: 1645

Test Drescription: Full Load Lowered SP by 10ppm to 65ppm

Avg Outlet NOx ppm: 57 % Removal: 89 Std Deviation: 5.5

Suggested Error Correction Steps

Carefully measure to find installation error.

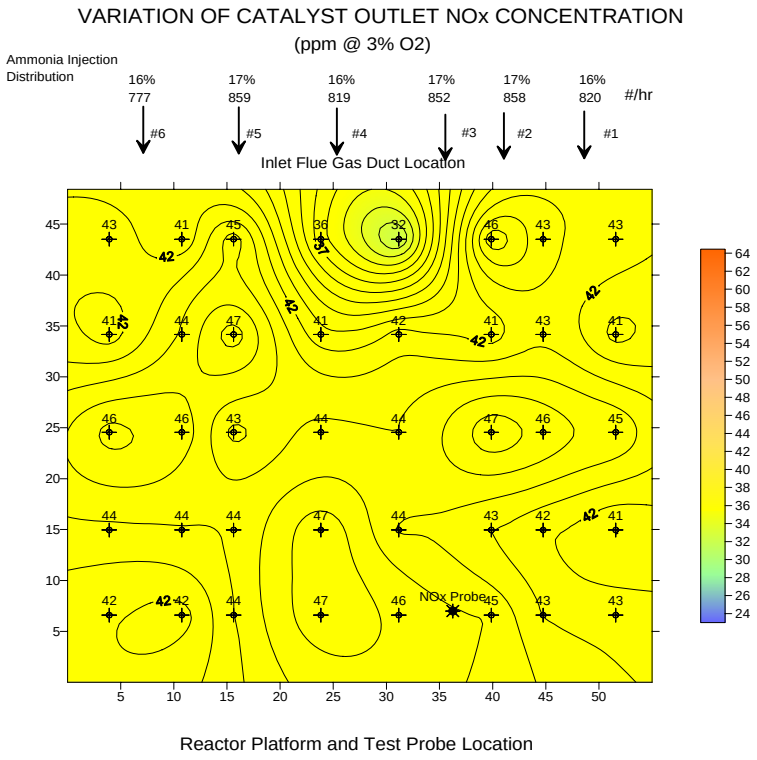
Model the error to verify the modeling.

Model a solution whether original or new.

Install modification with close attention to detail.

Suck some gas to see improvements.

Definite Improvement



BBP Contract #: 100109 Project Name: AEP Unit: Big Sandy 2 Reactor: R2

Test: BS2 R2 042704 Test 4 Test Date: 4/27/04 Test Start Time: 18:30 Test End Time: 18:52

Test Drescription: Full Load, After valve adjustments, All mills in service

Avg Outlet NOx ppm: 43 % Removal: 91 Std Deviation: 0.7

Summary

Mixing is CRITICAL to achieve the goals of your SCR.

Be aware of the impact of the mixing system on reaching your SCR performance goals.

Choose the mixing system that best fits your application.

QUESTIONS?