EXHIBIT B

NPRA

Annual Meeting
March 9-11, 2008
Manchester Grand Hyatt
San Diego,CA

AM-08-17

Tesoro Upgrade Project – Salt Lake City

FCC Regenerator Mechanical Upgrades to Improve Coke Burning Efficiency and Improve Emissions

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1.0 SUMMARY

During Spring 2007 cat cracker turnaround, Tesoro Refining & Marketing Company (Tesoro) implemented RMS Engineering Inc. (RMS) propriety technologies to improve the performance of its Salt Lake City (SLC) FCCU regenerator. RMS was responsible for providing the total engineering design that included front end engineering design (FEED), as well as detail engineering activities. It should be noted that Tesoro employed Shaw Stone & Webster, Inc. technologies and engineering services for modifications to the FCCU "reactor" system.

This presentation highlights RMS' FCC regenerator technologies, compares the cat cracker performance pre- and post- turnaround, and demonstrates how the Tesoro SLC refinery benefited from installing these retrofits in its FCCU regenerator.

Many individuals in the Tesoro organization were responsible for this success story. In particular RMS is grateful to Matt Baebler, Ray Lahti, John Postacchini, and Herb Telidetzki.

2.0 INTRODUCTION

In October 2004, RMS Engineering, Inc. (RMS) began evaluating the mechanical options to enhance distribution of the FCC spent catalyst and the combustion air in the Tesoro Salt Lake City FCCU regenerator. The objectives also included mechanical upgrade of the regenerator cyclone system. RMS went through various evolutions to arrive at the final design configuration.

2.1 <u>The overall objectives of these upgrades were:</u>

1) To improve the efficiency of coke burn-off in the regenerator that would:
   - Reduce afterburning in the regenerator dilute phase/cyclones
   - Enhance the effectiveness of SO_2 reducing additive
   - Maintain or reduce NOx generation in the regenerator
   - Lower excess oxygen concentration in the regenerator flue gas
2) To enhance the mechanical integrity of the combustion air distributors
3) To provide flexibility to deliver more air to the regenerator from a lower ΔP in the air distributor and higher discharge elevation of new spent catalyst distributors
4) To increase the long-term collection efficiency and reliability of the regenerator cyclones
5) To provide the flexibility to increase the catalyst circulation rate
6) To maintain the effectiveness of the SO_2 reducing additive in partial combustion mode.
7) To install these mechanical upgrades within 30-days turnaround window

2.2 <u>The Scope of Work for the FCC regenerator modifications involved the following:</u>

1) New regenerated catalyst internal hopper with a fluffing air ring distributor
2) New air pipe grid assemblies (3)
3) New spent catalyst riser and five (5) arm distributor
4) New regenerator hemispherical top head with 10'-0" shell extension
5) Eight (8) sets of new primary and secondary cyclones with:

- New cyclone beam hanger support system
- New internal plenum

6) New 10 foot long, straight "pup piece" added to the flue gas overhead line (which is shaped like a candy cane)

7) New external ladders, platforms, and a catwalk

8) No changes were made to the FCCU air blower

2.3 <u>Aside from the process and mechanical design of the regenerator internal components, the scope of RMS' services also included the following:</u>

1) Development of a comprehensive set of process/mechanical specifications for the new regenerator cyclones

2) Turning the above design specifications into a request for quotation (RFQ) document to solicit bids from two (2) cyclone vendors

3) Evaluation/conditioning of the two received bids and issuance of a report with the recommended choice

4) Preparing the total material cost estimates through issuance of RFQ documents to various component fabricators and refractory installers

3.0 TESORO SLC FCCU KEY FEATURES - PRE 2007 TURNAROUND

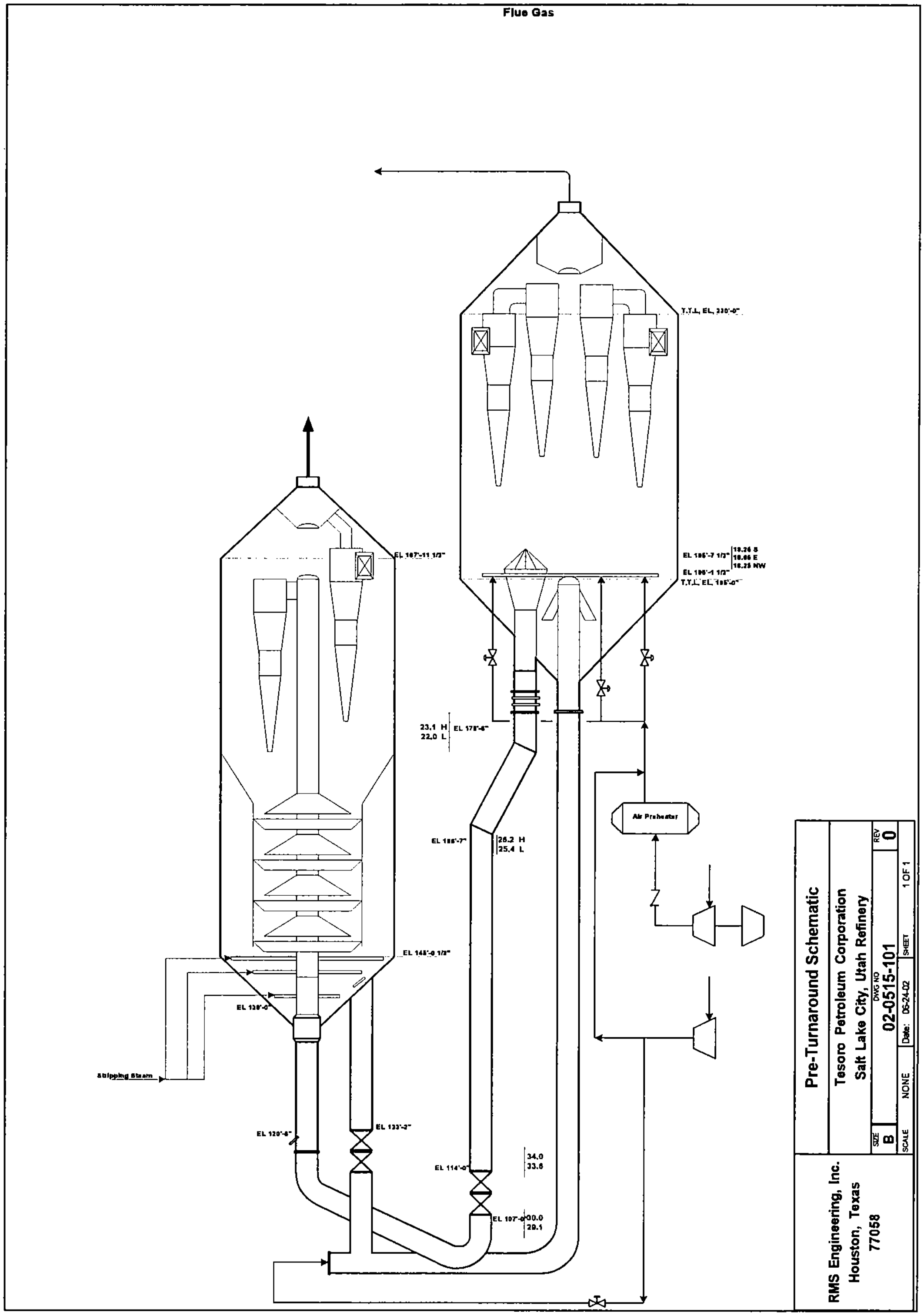
The Salt Lake City FCC Unit is a Model II design that came on stream in 1944. The fresh feed rate to the unit is about 20,000 BPD and the entire FCC feedstock comes from the crude unit bottoms (reduced crude).

The catalyst circulation rate was controlled with one of the tandem slide valves. The regenerated catalyst left the regenerator through an overflow hopper/standpipe. The catalyst contacted the fresh feed nozzles downstream of the J-bend piping.

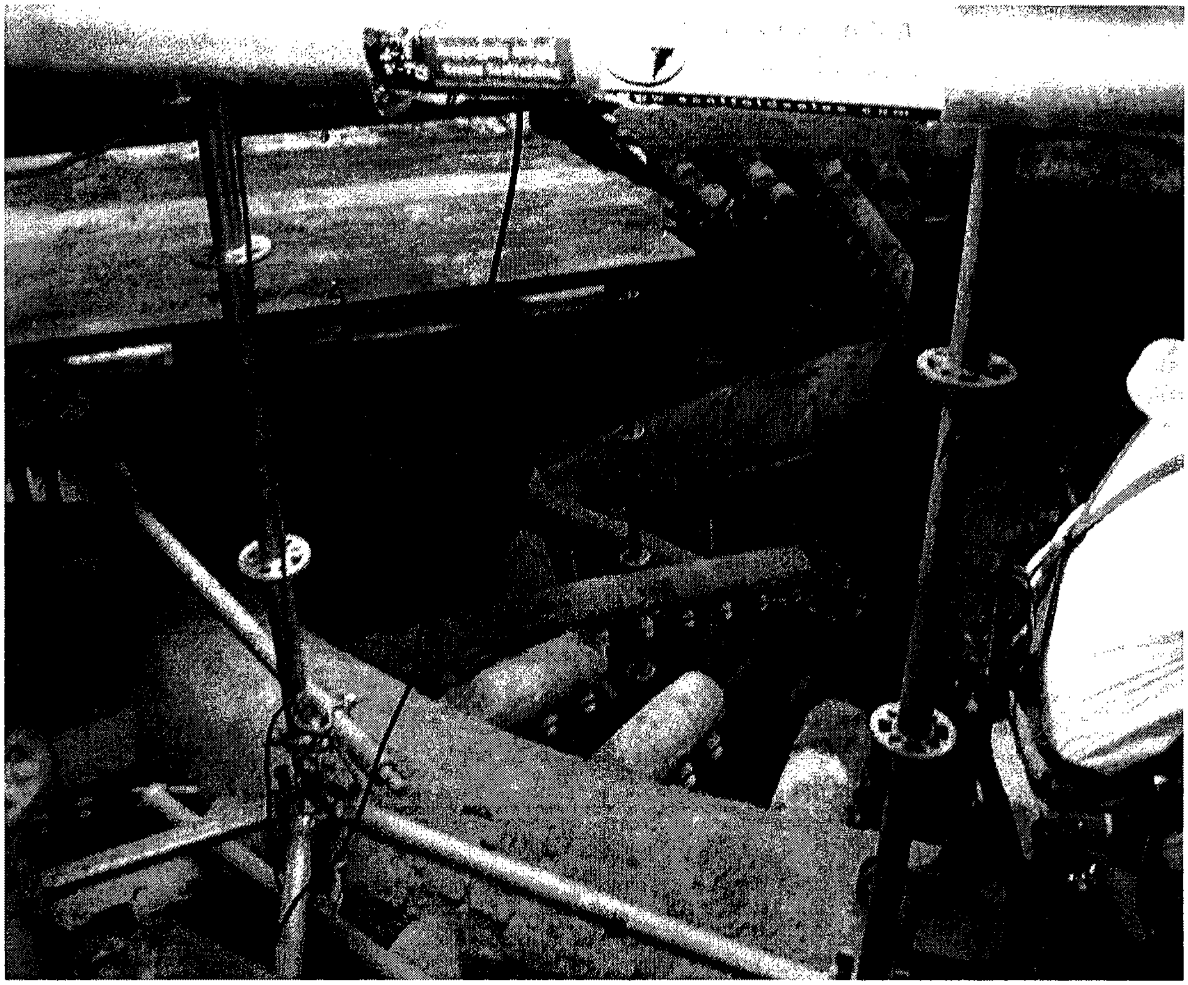
Combustion air was delivered to the regenerator through three (3) segment air rings. The flow of combustion air to each segment was regulated to minimize the afterburning reaction. These air distributors were installed in 1995. The FCCU uses two (2) air blowers (main and auxiliary) to supply both the combustion air and carrier air to the regenerator. The auxiliary air blower, having a higher discharge pressure, is used to provide the carrier air to the spent catalyst riser. There were six (6) two-stage cyclones in the regenerator. These cyclones were installed in 1972.

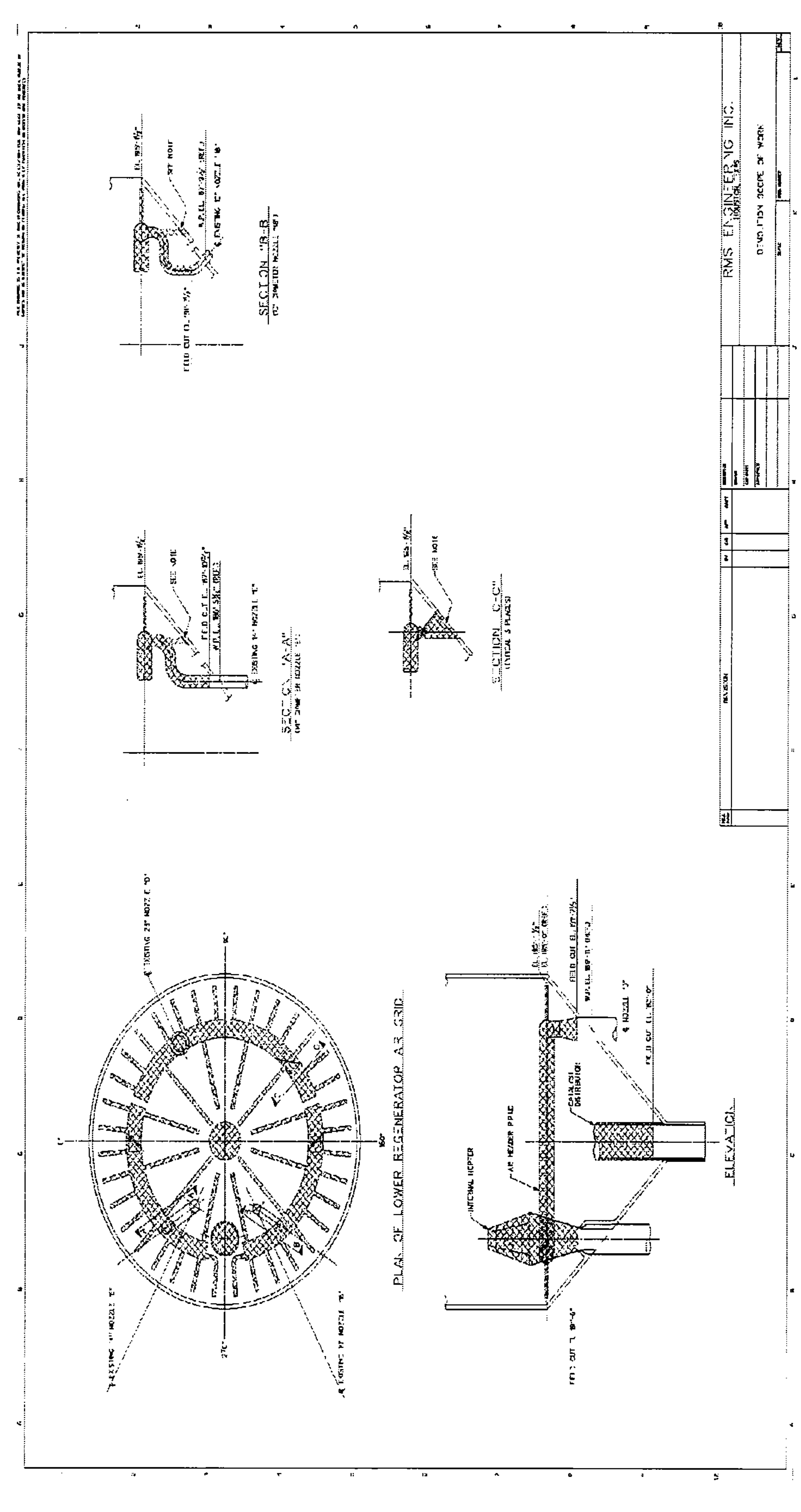
The spent catalyst is transferred into the regenerator using "carrier air" from the booster blower. The spent catalyst entered the regenerator through a center hub having three (3) distributor arms.

The regenerator operated in "full combustion" mode, in which all of the carbon on the spent catalyst is burned to CO_2. Steam is injected in the cyclone outlets and the plenum to keep the afterburning temperature under control.

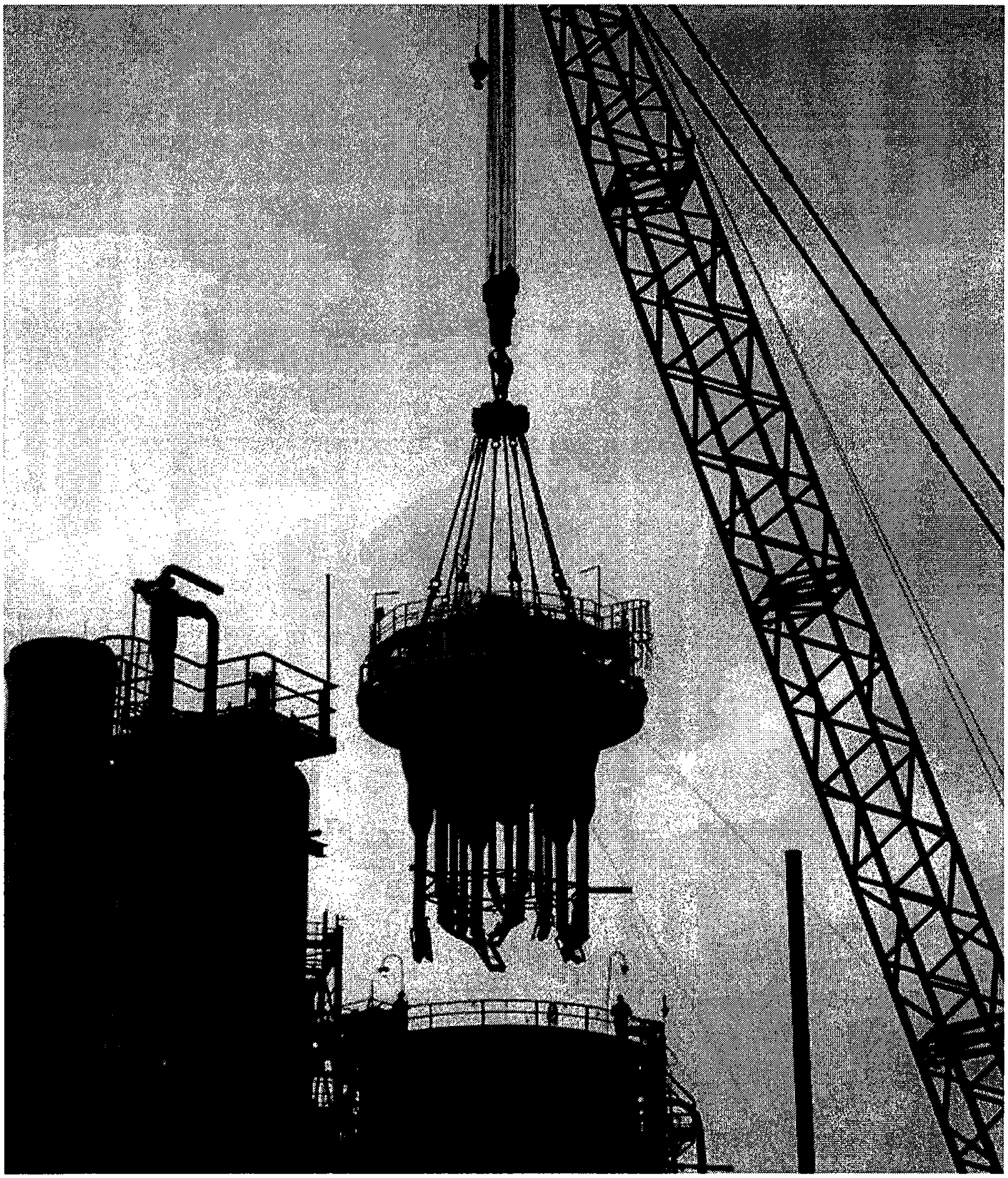

Flue Gas
Air Preheater
Stripping Steam
23.1 H
22.0 L
26.2 H
25.4 L
34.0
33.6
Pre-Turnaround Schematic
Tesoro Petroleum Corporation
Salt Lake City, Utah Refinery
DWG NO
02-0515-101
REV
0
SIZE
B
SCALE
NONE
Date: 06-24-02
SHEET
1 OF 1
RMS Engineering, Inc.
Houston, Texas
77058

OLD REGENERATOR INTERNALS




SECTION "B-B"
SECTION "A-A"
SECTION "C-C"
PLAN OF LOWER REGENERATOR AIR GRID
ELEVATION
RMS ENGINEERING INC.

OLD REGENERATOR HEAD LIFT



4.0 NEW EQUIPMENT DESCRIPTION

4.1 Spent Catalyst Distributor

The spent catalyst distributor is fabricated from 304#SS and is attached to the existing riser inlet stub. Below the riser top head tangent line are five (5) pipe distributors aimed downward 20 degrees from horizontal. The five arms are laid out using a modified six-space layout, with the largest space oriented toward the new catalyst withdrawal hopper, minimizing any potential catalyst short-circuiting. The new spent catalyst riser and distributor arms are internally lined with 1" thick refractory in hexmesh. The spent catalyst riser top head has 2" thick internal refractory lining.

4.2 Air Pipe Grid Distributor

The new combustion air distributor consists of three (3) pipe grid distributor assemblies that employ two-stage nozzles to provide maximum coverage while producing small air bubble jets. All of the pipe grid assemblies have 1" thick external refractory lining. Each of the pipe grid assemblies is fed from an existing regenerator nozzle in the bottom cone head.

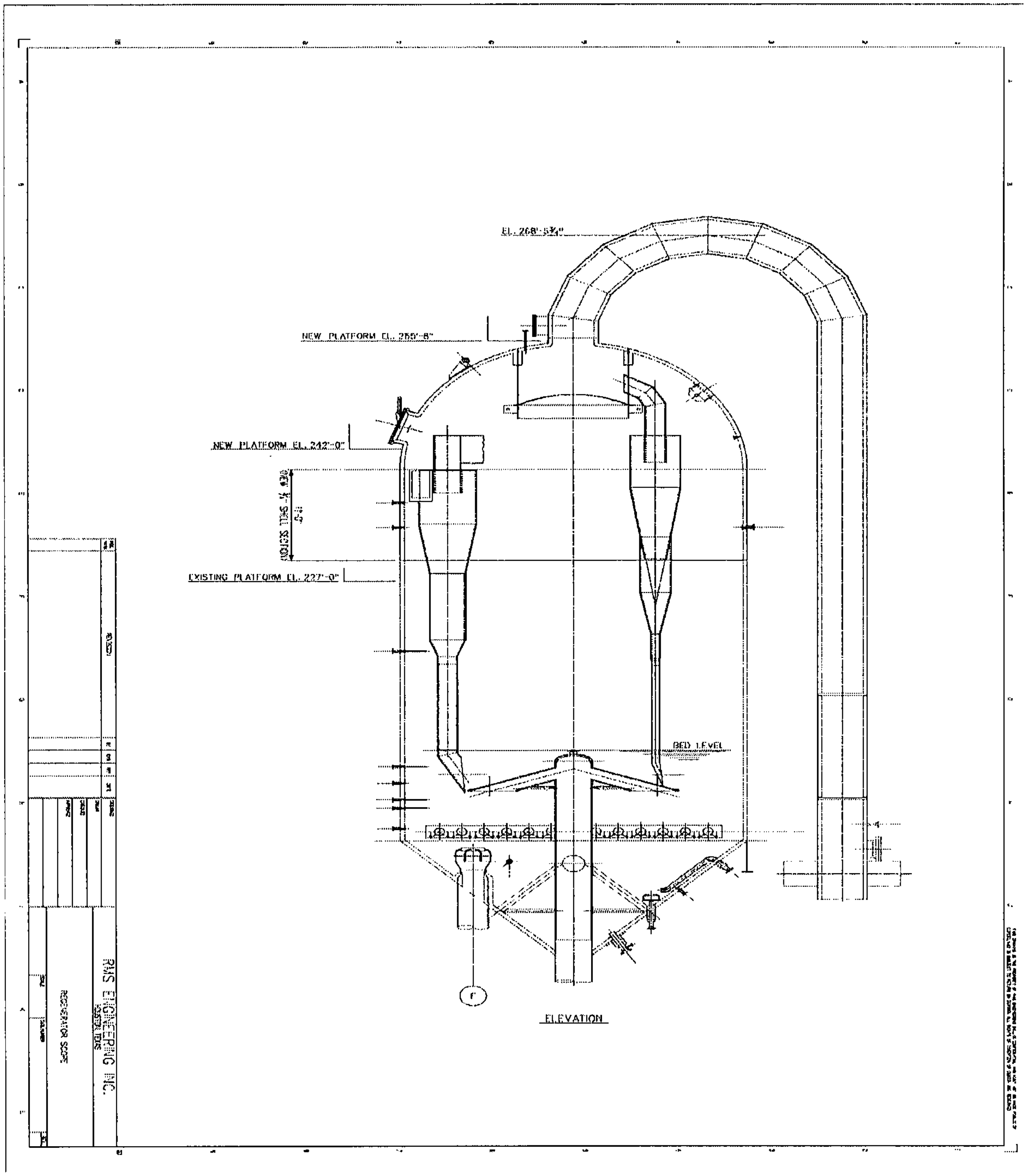
4.3 Catalyst Withdrawal Hopper

The new catalyst withdrawal hopper attaches to the existing outlet stub. T o ensure that the regenerated catalyst is "properly" fluidized prior to entering the standpipe, a new air fluffing ring distributor was installed. This air fluffing ring distributor has 1" thick external refractory lining.

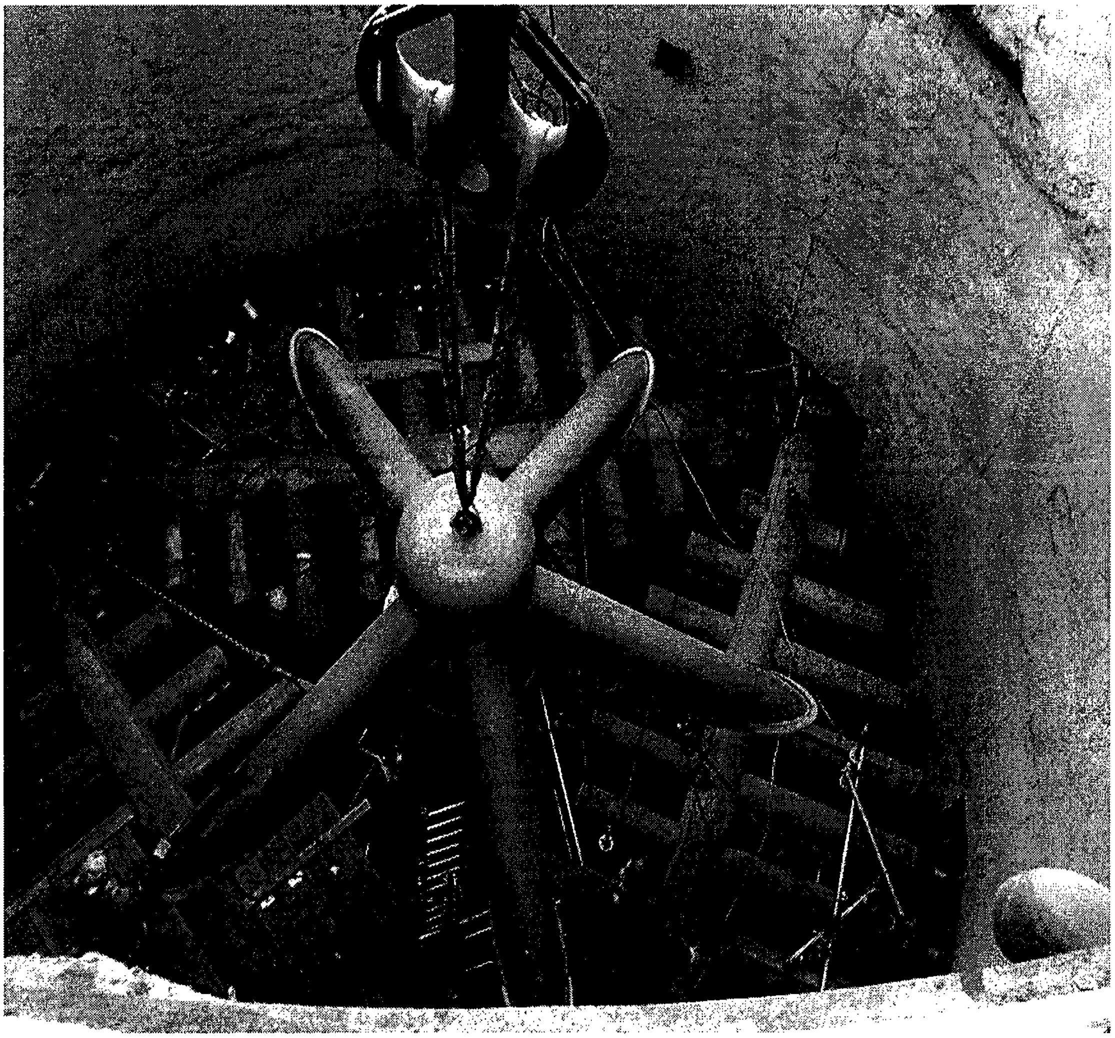
4.4 Regenerator Cyclones

The previous six (6) sets of two-stage cyclones were replaced with eight (8) sets of two-stage cyclones. In order to accommodate these new regenerator cyclones, the existing regenerator cone head was removed and a replacement hemispherical head and a 10'-0" shell extension were installed. They have two levels of dipleg bracing, and they are supported, using a "beam hanger" support system.

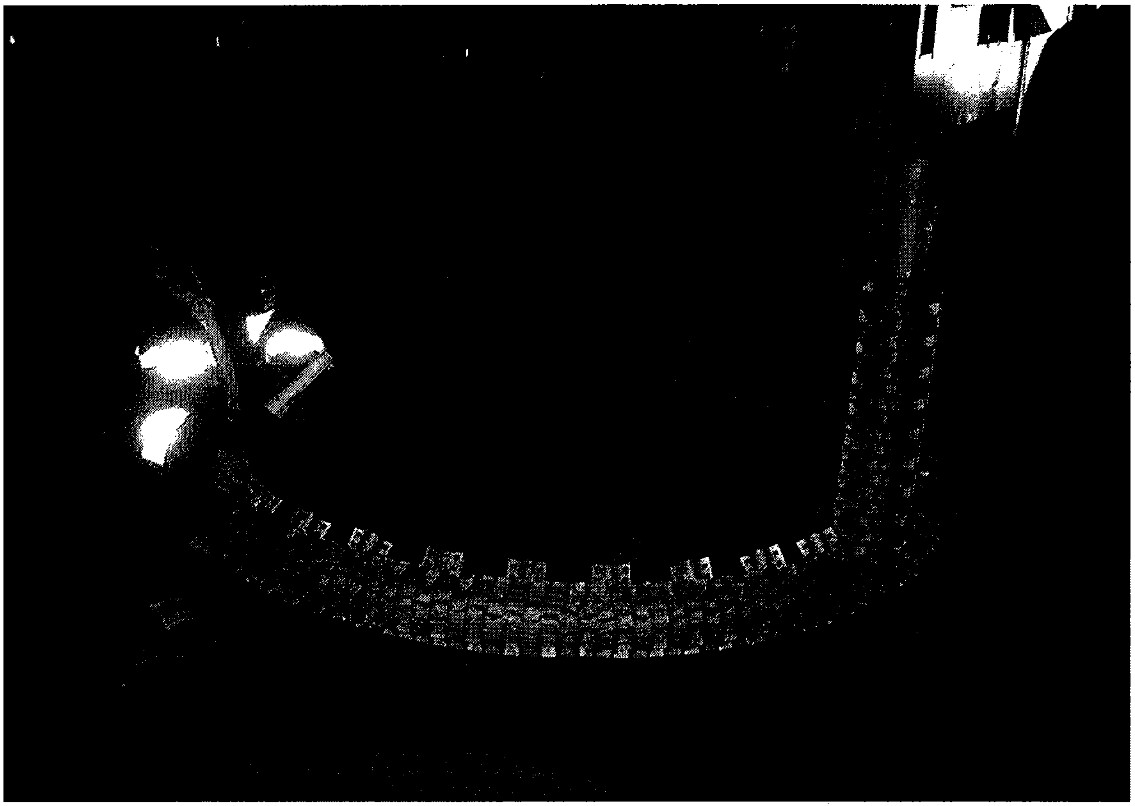
REGENERATOR SCOPE AND DESIGN DRAWING



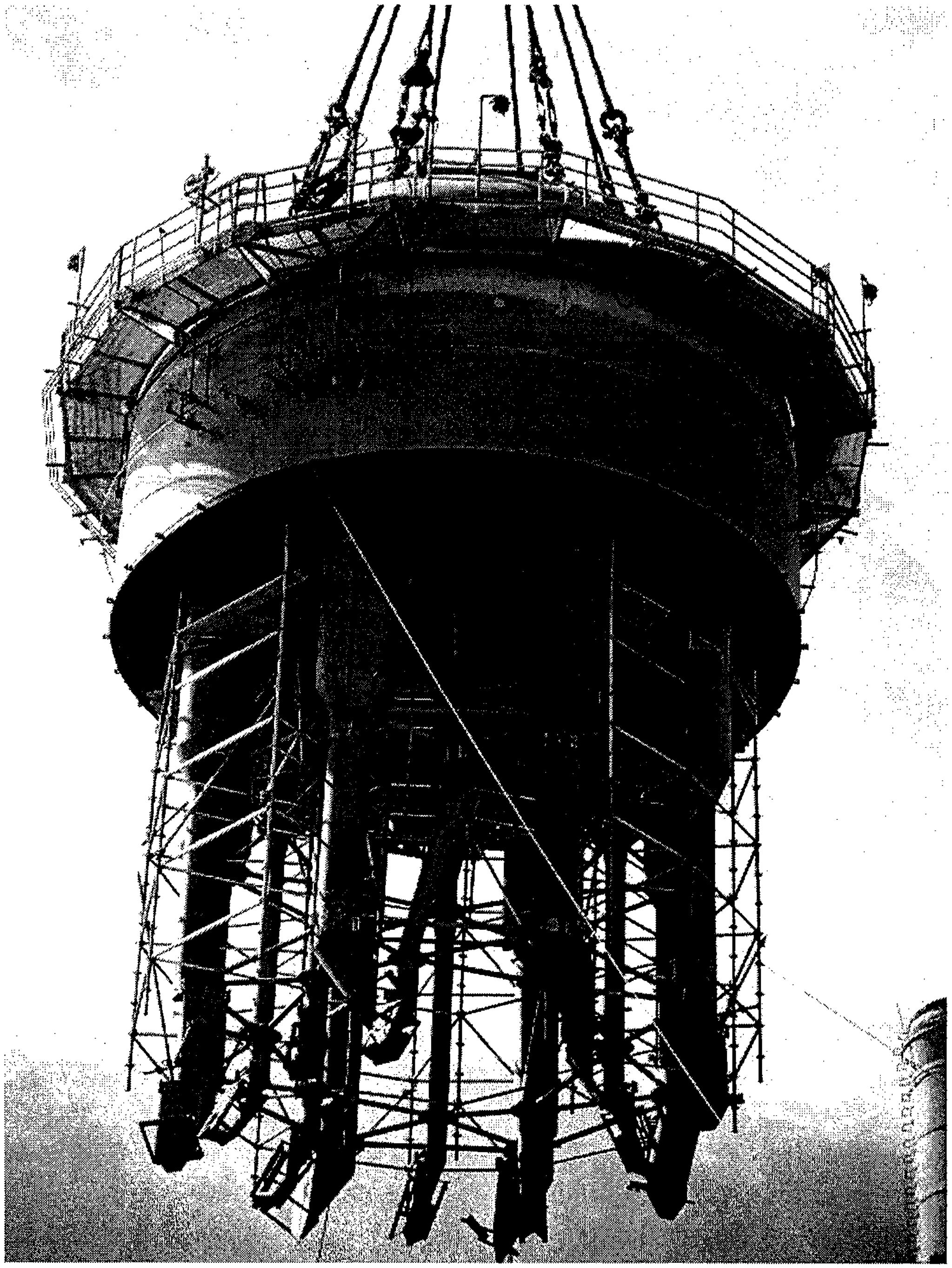
AIR GRID ASSEMBLY-SPENT CAT DISTRIBUTOR



FLUFFING RING FOR WITHDRAWAL HOPPER



REGENERATOR HEAD LIFT



5.0 DISCUSSION

To evaluate performance effectiveness of the implemented modifications, RMS used the daily operating data pre- and post-2007 turnaround. The pre-turnaround period was based on the average of 2006 operating conditions and the post-turnaround period was based on April 15, 2007 through December 1, 2007. On December 5, 2007, the mode of catalyst regeneration was switched from full burn to partial combustion.

Analysis of the data revealed the following:

The regenerator has four (4) temperature indicators that measure the dense bed temperature. The difference between the hottest to coolest temperature was **5 °F** post-turnaround, versus **9 °F** pre-turnaround, indicating uniform catalyst/air mixing. It should be noted that the average dense bed temperature was **18 °F** cooler post-turnaround.

1) The gap between the lowest and highest regenerator cyclone inlet temperature was **92 °F** pre-turnaround, versus only **2 °F** post-turnaround. This is phenomenal, again indicating uniformity of air/catalyst mixing.

2) The difference between the lowest and highest regenerator cyclone outlet temperature was **95 °F** pre-turnaround, versus only **13 °F** post-turnaround; once again, confirming the evenness of combustion across the regenerator.

3) Pre-turnaround, the unit operators had to inject an average of **5,800 lb/hr** of steam into the primary cyclone outlets and the regenerator plenum in hopes of controlling the excessive afterburning. There were no steam connections in the new 10' regenerator shell extension.

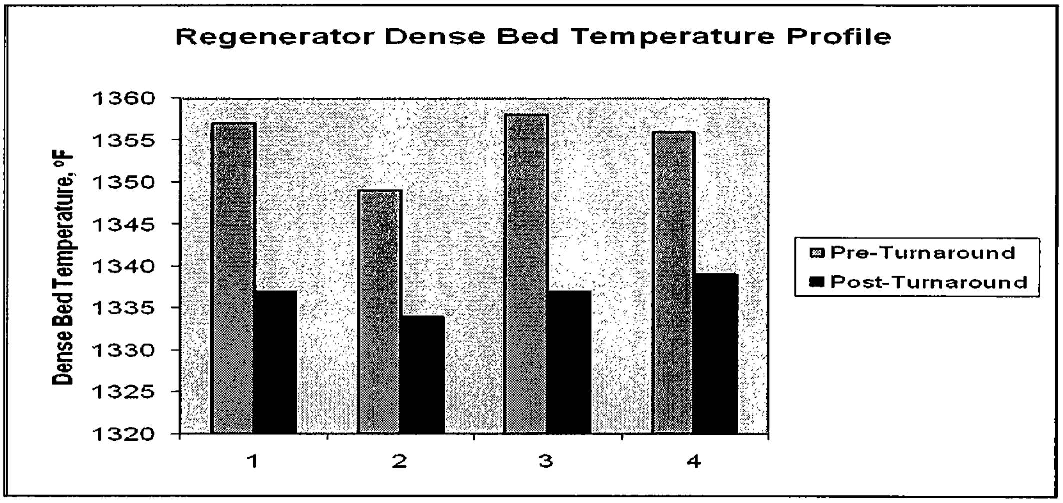
4) The CO concentration of the regenerator flue gas declined by **66%**, while the flue gas excess oxygen went down by **3%**. In the meantime, the carbon on the regenerated catalyst dropped by **33%**. The reduction of CO and the cleaner catalyst further demonstrate improved combustion.

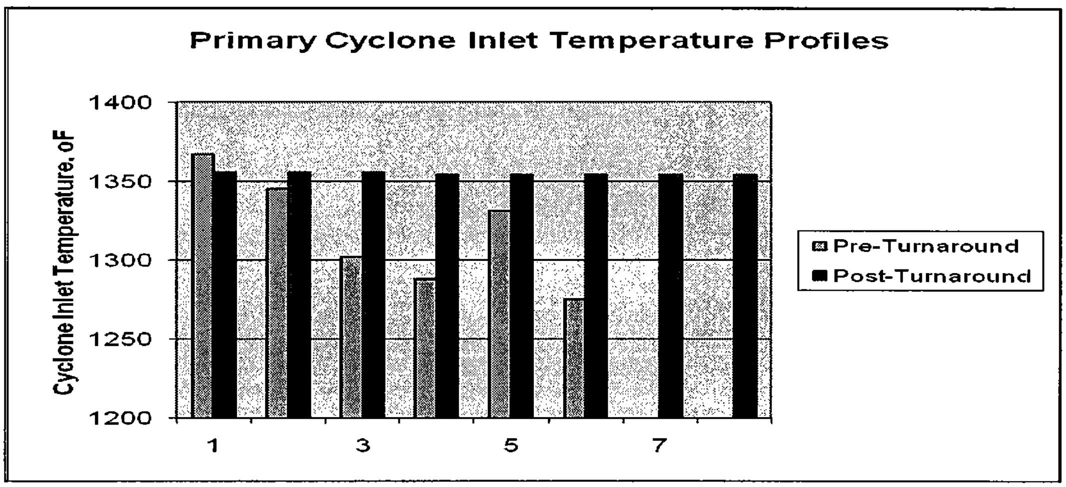
5) The flue gas NOx rate was maintained in compliance post-turnaround.

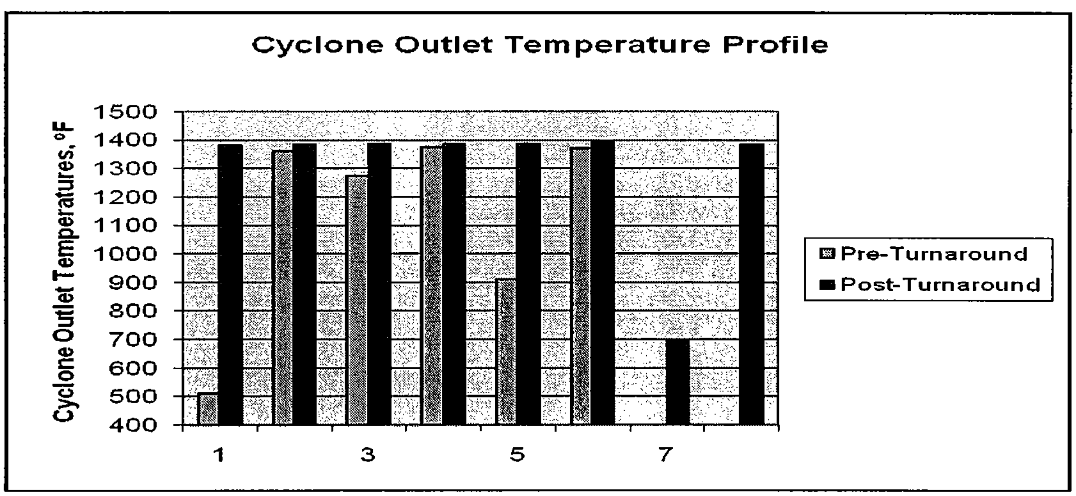
6) The improved catalyst mixing enabled the refinery to switch from full to partial combustion mode with only a slight increase in the usage of the SO_2 reducing additive. This switch has resulted in a **42 °F** decline in the regenerator dense bed temperature, enabling the refinery to maximize cat/oil ratio, and hence unit conversion.

7) The stack opacity declined by **40%** although the catalyst loading to the cyclones went up by **35%**. The careful design of the air/spent catalyst distributors, as well as properly designed regenerator cyclones, were responsible for this decline in the stack opacity.

8) The pressure gain across the regenerated catalyst standpipe remained unchanged although the catalyst circulation rate increased by **12%**. The ΔP across the regenerated catalyst slide valve went up by **2 psi**, largely due to the change from J-bend to Wye piping. More importantly, the catalyst circulation rate has been noticeably steadier than pre-turnaround.


Regenerator Dense Bed Temperature Profile
Dense Bed Temperature, °F
1360
1355
1350
1345
1340
1335
1330
1325
1320
1
2
3
4
Pre-Turnaround
Post-Turnaround


Primary Cyclone Inlet Temperature Profiles
Cyclone Inlet Temperature, oF
1400
1350
1300
1250
1200
1
3
5
7
Pre-Turnaround
Post-Turnaround


Cyclone Outlet Temperature Profile
Cyclone Outlet Temperatures, °F
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
1
3
5
7
Pre-Turnaround
Post-Turnaround

6.0 CONCLUSIONS

The mechanical upgrade of the Tesoro SLC regenerator internals was a huge success in that:

- RMS Engineering, Inc. was selected by Tesoro as a cost effective choice because of its expertise/know-how.
- The modifications improved the coke burning efficiency of the regenerator. It allowed the refinery to remove 5,800 lb/hr of steam introduced into the regenerator cyclones.
- The retrofits allowed for a 12% increase in the catalyst circulation rate, while delivering "steady" catalyst flow to the feed nozzles.
- The modifications allowed the refinery to operate the regenerator in "partial combustion" mode, while meeting the SO_2 and NOx emission limits.
- The revisions reduced the stack opacity by 40% and catalyst losses by 52% from the regenerator, despite the 35% increase in the catalyst loading to the cyclones.