Coke Handling Cranes
From Konecranes

Coking.com Conference
RIO, BRAZIL 2009

Don Paulino
Konecranes America, Inc.
Konecranes

Around the World

• Global crane builder with US$2.5 billion annual sales
• Over 8500 employees in 43 countries
• World’s largest manufacturer of process cranes
• World’s largest crane service company with over 300,000 cranes under service contract
• Annual production includes:
  - Over 400 process cranes
  - 13,000 industrial cranes and hoists
  - 60,000 motors
  - 5,000 motor controls
  - 4,500 heavy service gearboxes

SAFETY, RELIABILITY, PRODUCTIVITY
Konecranes in Brazil

- Konecranes Talhas, Pontes Rolantes e Serviços Ltda is located in Barueri / state of São Paulo.
- Cranes sales, Spare parts sales
- Crane services
  - On calls
  - Inspections
  - Predictive maintenance
- Customers References in Brazil
  - Aracruz
  - Metso
  - Voith
  - International Paper
  - Veracell
  - Arcelor Mittal
  - Estaleiro Atlantico Sul
  - Klabin
  - Alstom
  - Siemens Vai
  - ThyssenKrupp
  - Terminal Containers da Paranagua, TCP
  - Wellstream

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SAFETY, RELIABILITY, PRODUCTIVITY
<table>
<thead>
<tr>
<th>Ordered</th>
<th>Customer</th>
<th>Project</th>
<th>Qty.</th>
<th>Capacity</th>
<th>Bucket</th>
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<tr>
<td>2009</td>
<td>Naftogaz India Ltd.</td>
<td>HMEL, Bathinda, India</td>
<td>1</td>
<td>40 MT</td>
<td>20 M. Mech.</td>
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<tr>
<td>2008</td>
<td>Fluor</td>
<td>TOTAL, Port Arthur, TX</td>
<td>1</td>
<td>44 Ton</td>
<td>25 Yd. Mech.</td>
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<td>2008</td>
<td>Fluor</td>
<td>Marathon, Detroit, MI</td>
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<td>17 Yd. Mech.</td>
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<td>33 MT</td>
<td>15 M. Mech.</td>
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<td>2003</td>
<td>Larsen &amp; Toubro</td>
<td>Indian Oil Co., Panipat</td>
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<td>44 MT</td>
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<td>1984</td>
<td>Texaco</td>
<td>Anacortes, WA</td>
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<td>17 Ton</td>
<td>8 Yd. Hyd.</td>
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<td>Total 28</td>
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COKER CRANE TYPES

• BRIDGE TYPE WITH FIXED HOPPER
• SINGLE LEG GANTRY TYPE – FIXED HOPPER
• SINGLE LEG GANTRY TYPE – TRAVELING HOPPER
• SINGLE LEG GANTRY w/CANTILEVER

SAFETY, RELIABILITY, PRODUCTIVITY
BRIDGE TYPE WITH FIXED HOPPER

22 M Ton w/ 12.5 Cu.M. Bucket

30 Short Ton w/17 Cu.Yd. Bucket

SAFETY, RELIABILITY, PRODUCTIVITY
SINGLE LEG GANTRY with FIXED HOPPER & CANTILEVER

44 M Ton w/ 25 Cu.M. Bucket

SAFETY, RELIABILITY, PRODUCTIVITY
SINGLE LEG GANTRY with MOTORIZED TRAVELING HOPPER

View of Hopper from inside Operator's Cab

SAFETY, RELIABILITY, PRODUCTIVITY
SINGLE LEG GANTRY with
ON BOARD HOPPER &
CANTILEVER

25 M Ton w/ 11.5 Cu.M. Bucket

SAFETY, RELIABILITY, PRODUCTIVITY
SINGLE LEG GANTRY with ON BOARD HOPPER on CANTILEVER. LOADS RAILCARS

SAFETY, RELIABILITY, PRODUCTIVITY

27 Short Tons w/ 18 Cu Yd Bucket
DATA ANALYSIS

• Analyzing the layout
• Analyzing the operations plan
• Determining the tons per hour handling rate
• Calculating the Material Flow Path
• Selecting the bucket size & crane speeds
• Work Cycle Analysis

SAFETY, RELIABILITY, PRODUCTIVITY
Analysis
Pit Layout
Plan View (finds long travel dimen)

(2) Fixed Hoppers

115.8 m Runway

(6) Coke Drums

Dimensions Typical, not project specific.

SAFETY, RELIABILITY, PRODUCTIVITY
Analysis
Pit Layout
Elevation View (find trolley and hoist dist)

Dimensions Assumed, Verification Needed.

SAFETY, RELIABILITY, PRODUCTIVITY
WORK CYCLE CALCULATION

TYPICAL EXAMPLE OF A WORK CYCLE CALCULATION:

INDICATES 40 TON CRANE WITH 20 CUBIC METER BUCKET WITH SPEEDS SELECTED TO MOVE 411 TONS PER HOUR.
BENEFITS OF LONG TERM OPERATIONS & MAINTENANCE CONTRACTS

• KEY TO HIGHEST LEVELS OF PERFORMANCE AND RELIABILITY
• FASTER START-UP AND PRODUCTION RAMP-UP
• CRANE AVAILABILITY = 99% +
• LOWER OPERATING COSTS OVER LONG TERM
• LESS DAMAGE TO CRANE AND ITS SURROUNDINGS
• PERFORMANCE AND AVAILABILITY GUARANTEES

Allows refinery management to concentrate human resources on it’s core competence!

SAFETY, RELIABILITY, PRODUCTIVITY
OPERATIONS & MAINTENANCE CONTRACTS:

(Contract term can be 3 to 5 years with annual reviews)

ACCOMPLISHED WITH:

• HIGHLY TRAINED AND SKILLED PERSONNEL
• CROSS TRAINING OF OPERATORS & TECHNICIANS
• DEDICATED PROFESSIONALS WITH EQUIPMENT OWNERSHIP.
• SPECIFIC TRAINING ON COKER CRANES
• EXPERIENCE WITH THE CRANE SYSTEMS
Principal Issues

Safety

Konecranes Solutions

Design for Improved Safety

Crane Operator’s Environment:

- Enclosed A/C Cab with HEPA particulate filter
- Purafil chemical filter.
- Enclosed environmentally controlled E-Room
- Filtered air
- Out-of-elements electrical maintenance
- AutOPilot Semi-Automation
- Independent Traveling Cab

SAFETY, RELIABILITY, PRODUCTIVITY
Safety

Operator’s Cab

Rotating Chair

Full Vision Cab

Windows open for cleaning, windshield wipers on 3 sides
CABIN CHEMICAL FILTER

• Cleans air for Crane Operator
• Great Benefit to Operator’s Health
• Stainless Steel Enclosure
• Compact Design for Tight Space
• Make-up Air for Cab Pressure

SAFETY, RELIABILITY, PRODUCTIVITY
Safety

Environment

Corrosive Coke Pit Environment:
- Moisture / Steam
- Corrosive Fumes
- Ignitable Fumes
- Conductive Dust
- Exposed to Rain, Ice, Weather
- Abrasive Coke Dust
- Hazards for Operators
## Principal Issues

### Reliability

**Limited Time Available for Maintenance:**
- Short weekly maintenance intervals
- Infrequent turnarounds for major repairs

### Konecranes Solutions

**Maintenance Reducing Features:**
- Control House, Pressurized, with A/C
- Wired-In Spare Inverters
- Regenerative Network Braking
- Platformed Maintenance Access for All Mechanical and Electrical Components
- Inverter Duty Motors
- Improving access to components
- Designing longer lifetimes

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**Safety, Reliability, Productivity**
Control House

Walkway and emergency lighting

Stainless exterior and doors

Computer floor removed for final wiring

SAFETY, RELIABILITY, PRODUCTIVITY
CONTROL HOUSE CHEMICAL FILTRATION

Installed inside E room

Recirculates E Room air thru filter to remove corrosives.

SAFETY, RELIABILITY, PRODUCTIVITY
## Reliability

### Resistor Issues

Resistor Bank Problems:
- Coke Dust on Resistors
- Reduced Resistance, Burn-Out
- Damage to Inverter Drives
- Maintenance Time for Cleaning

### Konecranes DynAReg

Regenerative Control:
- Eliminates Braking Resistors
- Reduced Risk of Failures
- Reduced Maintenance Time
- Active Front End Cleans Incoming Power, Protecting Drives
- Power Going Back to Grid is Cleaned, Protecting Adjacent Equipment
Konecranes DynAReg
Regenerative Control
Energy Flow – Regeneration

Non-Regen. System

Incoming Power
3ph, AC-supply

Heat

Resistor Bank

Braking Energy

On coker cranes, resistors may become caked with coke and burn out.

In a Non-Regen. system, braking energy is returned from the motor and wasted as heat in resistor banks.

Regenerative System

Power is either returned to the line, or is available for other motions, depending on demand. Resistors are eliminated.

Braking energy is returned from the motor to the DC bus.

Hoisting Motor

Braking Energy

Hoisting

Aux. hoisting

Trolley traversing

Bridge travelling

线接触器

网络制动单元

M 3～

M 3～

M 3～

M 3～

M 3～

M 3～

Common DC-bus

Konecranes DynAReg
Lifting Businesses

SAFETY, RELIABILITY, PRODUCTIVITY

Coker Cranes From Konecranes 2007  25
Hoist Control

DynAGrab Synchronization Controller

Features:
• Load Balancing
• Automatic Sinking & Filling
• Enhanced Speed vs. Load Control
• Fast Stop / Slack Rope Control
• Drum Rotation Synchronization
• Fault Detection
• Jammed Grab Detection
• SAFETY: Overload Protection
• Less Demanding of Operator
• Higher Coke Handling Thru-put

SAFETY, RELIABILITY, PRODUCTIVITY
Productivity

Load Control

Damage from Collisions:
- Bucket impacts on hopper
- Bucket impacts on pit wall
- Difficulties in fines basins
- Excessive load spillage

DynAPilot Sway Control

Sway Dampening / Zone Control:
- Reduced load sway
- Restricted areas (pit walls, hopper)
- Smart Limits / Reduced Creep Areas
- Quicker, safer movements
- Reduced spillage at hopper
- Eliminates lost time caused by load swinging
CMS

Konecranes Data Archiving

- On Board Computer System
- Over 400 data points monitored on a typical coker crane
- Voltage, current, temperature, over/under speed, brake wear, limit switches, etc.
- Reports on status, condition and faults on operator display panel.
- Remote data access option.
- Alert user to potential problems before they are catastrophic
- Analyze data from the manufacturing process
- Real time reporting
- 4-Year Operating History Archive
Maintenance Data Analysis

CMS & Remote Monitoring

- Real time data is available in multiple locations
- Troubleshoot problems before getting on crane
- Remote Expert Assistance
- Diagnose problem off line in clean, safe environment
- Predictive maintenance can adjust maintenance intervals to suit changing crane usage
- Promotes Pro-active vs. Re-active Maintenance
- Remote to Maintenance Office

SAFETY, RELIABILITY, PRODUCTIVITY
CMS-WiFi Diagram
Typical Pit Layout

120v + Ethernet Line by Customer
May need signal repeaters depending on length.

“Fixed” WiFi + RS-232 Conn.
By Konecranes

PC by Customer.

Pad Area

Pit

Fines Basin

Maint. Area

Remote Monitoring

Remote Expert

Plan View

Typical, not project specific.

SAFETY, RELIABILITY, PRODUCTIVITY
## Reliability

### Runways

**Structure Problems:**
- Skewing of Bridge Effects
- Rail Alignment
- Damage to Rail Attachments
- Misalignment of Beams and Columns
- Wheel and Rail Wear
- Stress on Wheel Bearings and Crane Structure

### DynATrak

**Konecranes Auto-Steering Control:**
- Harmful Lateral Loads Virtually Eliminated
- Dramatic Reduction in Wheel/Rail Wear
- Reduced Stress on Wheel Bearings
- Reduced Stress to Crane Structure
- Alignment of Runway Preserved
- Improves Safety by Limiting Structural Overloads

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**SAFETY, RELIABILITY, PRODUCTIVITY**

Coker Cranes From Konecranes 2007 31
DynaTrak
(Laser Guided Tracking)

U.S. Patent # 5,866,997

- Automatic Steering
- Centering wheels on rail
- Reduces lateral loads
- Minimizes wheel wear and loads to runway structure.

SAFETY, RELIABILITY, PRODUCTIVITY

KONECRANES
Lifting Businesses™
Konecranes DynATrak

Laser-Based DynATrak/R

- PLC drives bridge via 2 separate inverters
- Laser measurement maintains constant flange-to-railhead distance

SAFETY, RELIABILITY, PRODUCTIVITY

U.S. Patent # 5,866,997
Productivity

Other Systems Don’t Prevent Flanging

Normal Running

Drift Condition

Typical Anti-Skew Systems do not prevent or correct flanging, they only keep crane bumpers equidistant from the end stops.

Here, even though the crane is not skewed, it has drifted over, and the flanges are contacting the rail head.

Example:
Wheel Tread = 145mm
Rail Head = 105mm
Wheel Float = 40mm
Productivity

Anti-Flanging and Anti-Skew

Normal Running

DynATrak/P prevents both skewing and drifting, by “steering” the crane to center the wheels on the rail, reducing flange and rail wear and reducing skew forces to the rail, rail attachments and runway structure.

Skew Condition
OPERATOR SAFETY

BACK SAVER SYSTEM

Operator’s Normal Posture: Back Bent Over

Operator’s view of bucket digging

SAFETY, RELIABILITY, PRODUCTIVITY
BACK SAVER VISION SYSTEM

• LOOK DOWN CAMERA INSIDE CAB

SAFETY, RELIABILITY, PRODUCTIVITY
OPERATOR CAN LOOK AHEAD WITH BACK SUPPORTED AGAINST BACKREST

SAFETY, RELIABILITY, PRODUCTIVITY
Independent Traveling Cab

- Mounted on twinTrack monorail
- Independent traveling
- Operator selects best location on span
- Increased safety away from vapors.
- Best line of vision can be selected.
- Increased comfort level
- Improved operator ride comfort

SAFETY, RELIABILITY, PRODUCTIVITY
Reliability Solutions:

PLC Platform

Programmable Logic Controller (PLC)

Drive commands
Status Request

Konecranes Inverter Controls

Communication via Profibus Cable

Operator’s Panel

Status Response
Diagnostic data

 Encoders
 Laser
 Sensors
 Radio
 etc.

SAFETY, RELIABILITY, PRODUCTIVITY
PLC Platform – inside Control House

Primary and spare trolley inverters with profibus connection to PLC

Siemens S7 PLC

HMI panels in control house and operator’s cab

SAFETY, RELIABILITY, PRODUCTIVITY
HMI OPERATOR DISPLAY PANEL

Operator’s Cab

Inside Control House

Inside Operator’s Cab

SAFETY, RELIABILITY, PRODUCTIVITY
Semi automatic control

• Semi automation is used by operator for moving the grab automatically from the pit to the hopper and back to the pit. Semi automation start/stop control is done with single push button and indication light in the operators cabin pulpit. If the operator touches joystick controller cycle is interrupted.
DynaPilot antisway control and zone protection

- Dynapilot, electronic anti sway control, enables overlapping movements of all three motions which makes movements smooth. Dynapilot is utilized in protected zone function to create no-go zones to prevent grab hitting pit walls or separation walls.
Automation
Semi-automatic Cycle

Task:
Automatic Hopper Loading.

Digging location by operator: Travel to hopper and back with semi-automatic control.
On Board Spare Inverters

Safety, Reliability, Productivity
DynAReg

Redundant Drives and DynAReg Modules

480V 3Ph 60Hz

LCL filter

Normal use
Redundancy

DC Bus

M
M

Hold & Close Hoists

M
M

Bridge

M
M

Main Trolley

SAFETY, RELIABILITY, PRODUCTIVITY