Improving the Safety, Reliability and Productivity of Coke Handling Bucket Cranes

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Product Specialist

Coking.com Safety Seminar
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User's List
Coker Cranes by Konecranes

<table>
<thead>
<tr>
<th>Ordered</th>
<th>Customer</th>
<th>Project</th>
<th>Qty</th>
<th>Capacity</th>
<th>Bucket</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>Fluor</td>
<td>Marathon, Garyville, LA</td>
<td>1</td>
<td>30 Ton</td>
<td>17 Yd. Mech.</td>
<td>Bridge Crane</td>
</tr>
<tr>
<td>2006</td>
<td>Bechtel - France</td>
<td>Reliance India</td>
<td>2</td>
<td>35 MT</td>
<td>20 Yd. Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>2005</td>
<td>Fluor</td>
<td>Tesoro Golden Eagle</td>
<td>1</td>
<td>44 Ton</td>
<td>25 Yd. Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>2006</td>
<td>Foster Wheeler Iberia</td>
<td>BP Spain</td>
<td>1</td>
<td>17 MT</td>
<td>8 M Mech.</td>
<td>Semi-Gantry</td>
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<tr>
<td>2005</td>
<td>Bechtel, ConocoPhillips</td>
<td>Borger Refinery, TX</td>
<td>1</td>
<td>30 Ton</td>
<td>12 Yd. Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>2004</td>
<td>ConocoPhillips</td>
<td>Alliance Refinery, LA</td>
<td>1</td>
<td>18 Ton</td>
<td>10.5 Yd. Mech.</td>
<td>Bridge Crane</td>
</tr>
<tr>
<td>2003</td>
<td>Larsen &amp; Toubro</td>
<td>Indian Oil Co., Panipat</td>
<td>1</td>
<td>44 MT</td>
<td>25 M Mech.</td>
<td>Semi-Gantry</td>
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<tr>
<td>2001</td>
<td>Bechtel</td>
<td>Hoevena, St. Croix</td>
<td>1</td>
<td>45 Ton</td>
<td>25 Yd. Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>2000</td>
<td>Bechtel</td>
<td>Marathon, Garyville, LA</td>
<td>1</td>
<td>27 Ton</td>
<td>17 Yd. Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>1998</td>
<td>Consorcio Contrina</td>
<td>VEHOF, Venezuela</td>
<td>2</td>
<td>22 m-ton</td>
<td>12.5 Yd. Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>1997</td>
<td>Chiyoda Corp.</td>
<td>Melaka Refinery</td>
<td>1</td>
<td>15 m-ton</td>
<td>8 M Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>1991</td>
<td>Bechtel / Conoco</td>
<td>Billings, MT</td>
<td>1</td>
<td>8 ton</td>
<td>4 Yd. Mech.</td>
<td>Bridge Crane</td>
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<tr>
<td>1984</td>
<td>Texaco</td>
<td>Anacontes, WA</td>
<td>1</td>
<td>17 Ton</td>
<td>6 Yd. Hyd.</td>
<td>Semi-Gantry</td>
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<tr>
<td>1983</td>
<td>Fluor</td>
<td>Puget Sound Plant</td>
<td>1</td>
<td>14 ton</td>
<td>8 Yd. Hyd.</td>
<td>Bridge Crane</td>
</tr>
</tbody>
</table>

Total 23
### Principal Issues

<table>
<thead>
<tr>
<th>Safety</th>
<th>Konecranes Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design for Improved Safety</strong></td>
<td><strong>Crane Operator's Environment:</strong></td>
</tr>
<tr>
<td></td>
<td>• Enclosed A/C Cab with HEPA particulate filter</td>
</tr>
<tr>
<td></td>
<td>• Purafil chemical filter.</td>
</tr>
<tr>
<td></td>
<td>• Enclosed environmentally controlled E-Room</td>
</tr>
<tr>
<td></td>
<td>• Filtered air</td>
</tr>
<tr>
<td></td>
<td>• Out of elements electrical maintenance</td>
</tr>
<tr>
<td></td>
<td>• AutOPilot Semi-Automation</td>
</tr>
<tr>
<td></td>
<td>• Independent Traveling Cab</td>
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</tbody>
</table>

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### Principal Issues

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Konecranes Solutions</th>
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<tr>
<td><strong>Limited Time Available for Maintenance:</strong></td>
<td><strong>Maintenance Reducing Features:</strong></td>
</tr>
<tr>
<td>• Short weekly maintenance intervals</td>
<td>• Control House, Pressurized, with A/C</td>
</tr>
<tr>
<td>• Infrequent turnarounds for major repairs</td>
<td>• Wired-In Spare Inverters</td>
</tr>
<tr>
<td></td>
<td>• Regenerative Network Braking</td>
</tr>
<tr>
<td></td>
<td>• Platformed Maintenance Access for All Mechanical and Electrical Components</td>
</tr>
<tr>
<td></td>
<td>• Inverter Duty Motors</td>
</tr>
<tr>
<td></td>
<td>• Improving access to components</td>
</tr>
<tr>
<td></td>
<td>• Designing longer lifetimes</td>
</tr>
</tbody>
</table>
Principal Issues

Designing for Higher Reliability
- Longer key component lifetime.
- Shorter repair times
- Quicker problem solving.

Konecranes Solutions

Reliability Improvements:
- Moment Isolation System
- 50,000 Hrs Bearing Life
- Carburized Gearing
- Grouped Lubrication Fittings
- Rope Over-wrap Preventors
- Rope storage on drum to re-reeve Bucket 3 Times
- Load Cells on Each Drum, with Summing
- Higher drum/sheave to rope ratios 30:1 vs. 24:1

Reliability Solutions:

PLC Platform

Programmable Logic Controller (PLC)

Drive commands Status Request

Status Response Diagnostic data

Konecranes Inverter Controls

Communication via Profibus Cable

- Encoders
- Laser
- Sensors
- Radio
- etc.
Productivity

DynAGrab Hoist Control

Hoist Control Issues:
- Manual Joystick Control
  Difficult to Learn
- Long Training Time Needed
- Inefficient Handling, Spillage
- Uneven Load Sharing Between Hoists
- Overloading Motors, Burn-Outs
- Snapped Ropes

Closing/Holding Drum Synchronization:
- Reduced Operator Train-up Time
- More Effective Load Handling
- Even Sharing of Load Between Hoists
- Reduced Stress on Machinery
- Longer Rope Life

Hoist Control
DynAGrab Synchronization Controller

Features:
- Load Balancing
- Automatic Sinking & Filling
- Field Weakening
- 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
Load Control Issues

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

Maintenance Feedback

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
- PowerGoing Back to Grid is Cleaned, Protecting Adjacent Equipment
Coker Crane
Typical Configuration
Data Collection – Remote Monitoring

Condition Monitoring
& Reporting
DynAMonitor

- Over 400 data points monitored on a typical process 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
- Common in other industries
- Real time reporting.
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
- Archives about 4 Years of Data

Runway Structure Issues

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

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
Konecranes DynATtrak
Laser-Based DynATtrak/R Configuration

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

Environmental Issues

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

Konecranes Solutions

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

Fully Enclosed
Operator's Cab:
  - Temperature & Humidity Controlled
  - Protected Environment for Operator
  - Ergonomic Chair and Controls
  - Windows Arranged for Maximum Visibility
  - Safe, Comfortable Work Area
  - Pressurizing Filtration
  - Redundant A/C Available
  - Stainless Steel Exterior Available
  - Chemical Filtration Available

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Environmental Issues

Operator's Cab

Rotating Chair

Full Vision Cab

Windows open for cleaning, windshield wipers on 3 sides

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Control Issues

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Large Control Components:
- Significant time and effort to change out a failed inverter
- Rewiring necessary
- Large, heavy components
- Crane down during change-outs

Wired-In Spare Inverters:
- Increase Crane Reliability Proposition
- Quick switch over from problem VF Drive Unit to Stand-by
- Allows “Off Line” repair when time available
- Prolongs lifetime of Spare Drives with Energized Environment.
- Significant savings in unplanned down time.

Gearing Issues

Konecranes Solutions

Low Quality Gearing:
- Long Lead / Expensive Spares
- Must open gearbox to remove drum
- Hoist gear quality traditionally low, AGMA 4 to 6
- Failures can be catastrophic, damaging hoist machinery

High-Quality Gearing:
- All gearing 58 HRC, carburized, finish ground
- AGMA Class 11 minimum
- Moment isolation mounting preserves alignment
- 50,000 hrs Bearing Life exceeds CMAA Class F
Mechanical Issues

Reported Problems: Hoist Machinery Problems:
- Cracked Drum Welds
- Leaking Oil Seals
- Drum Gear Misalignment
- Complicated Disassembly
- Fatigue in Drum Shaft

Konecranes Solutions
Konecranes Moment Isolating Machinery Mounting:
- Eliminates Drum Gear Misalignment
- Eliminates Cracking of Drum Welds
- Drum Removable Without Opening Gear Box
- No Fatigue on Non-Rotating Drum Shaft

Mechanical Issues
Konecranes Moment Isolation

Conventional Hoist
2 Bearings and Seal

Misalignment of Pinion/Gear

Seal Side

Fatigue Failure

Drum Load

Load