Mega – Cokers
Commissioning Experience

October 2013
New Delhi, India

Raj Sharma
Coker Consultant
SAFETY TIME

- Safety First
- Awareness – key for successful startups
Emerging Cokers due to heavier Crude Blends

- Old Cokers at Digboi, Gauhati, Bongaigaon and Barauni
- New Cokers at Jamnagar (Reliance), Essar Oil, IOC-Panipat, Vadodara, Bina and Bhatinda.
- Proposed /Under construction Cokers at IOC-Paradeep, MRPL-Mangalore, Cochin and Chennai.
- 2 Cokers at Reliance Jamnagar are having 8 coke drums each with capacity of 162000 and 175000 BPD.
Mega cokers

- Mega cokers in India are 9MMTPA + capacity
- 8 Coke drums with single fractionator
- Commissioning was done phase wise based on construction progress. This earned extra revenue due to early startup of 4 drums.
- Part commissioning was a safety challenge as many common lines like CBD/pump drains/OWS/Fire water /DCS/Alarm system/Gas detector system/Utilities were common
Mega Coker - Early startup Plan

- Steps at early stage to achieve stage wise start up if required. Mega cokers have lot of flexibility.
- 4 drums clubbed with independent Blow down system. So plant is 4+4 drums operability.
- Next each pair of coke drums with heater made an independent block. So total 4 blocks.
- Gas plant was common with suitable turn down capability. All trays were designed for this load.
Early startup plan

- Exhaustive positive isolation (Blind list) with proper Tags and administrative control.
- Additional isolation valves were provided to achieve positive isolation. Also these isolation valves at construction interphase were chain locked additionally and position logged every shift.
- All utilities were also provided with additional isolation valves with blinds including Flare header.
Early Startup/Seggregation

1. Whole area was hard-barricaded
2. Security person manned the gates with cards
3. Block 1 Area declared safety permit area
4. Construction area (block 4) was barricaded by GI sheet / Fire blankets up to coke drum platforms
5. Live lines in non operating area were painted red & tagged. Valves were positive blinded and chain locked
6. Visible lights provided blockwise at each deck
Escape routes

- Existing escape routes reviewed in the new barricaded scenario and new escape route marked wherever applicable considering wind directions
- Minimum two gates considered for entry/exit
- Additional wind socks will be provided in prominent locations for easy identification of wind directions

Assembly points

- Additional assembly points provided at suitable locations for both construction and operation personnel
- Mock drills will be conducted to ensure rapid & orderly evacuation of people, in case of emergency
Early Startup-Segregation

UNDERGROUND SYSTEM
Underground isolation: OWS

01-Oct-13

Raj Sharma
Underground CBD isolated
Early Start up- Segregation

ABOVE GROUND SYSTEM
U/S of These valves will be blinded & inspected in every shift.
DCS graphics were also divided in Blockwise along with DS alarms grouping.

Since 4 drums startup was envisaged, underground piping was designed for such isolation facility.

Physical barricading was engineered between 4 live coke drums and rest, both at coke drum structure(at all levels) and at grade plot.
Early Startup Plan

- Safety interlocks were designed blockwise to avoid interference. Specific inputs from outside (load shedding) were identified.
- Construction priority was given for systems in 4 drums, 2 drums and then last 2 drums
- 4 Drums started = 23rd January 2009
- Next 2 drums started = 16th May 2009
- Last 2 drums started = 23rd July 2009
- Extra Revenue earned = millions of Dollars
Major Focus

- Zero LTI- safety first during construction/Pre-comm/startup
- Zero fire – Fire free startup
- Zero flaring during startup – save money
- Zero/Minimum Recycle – Maximize throughput
- Zero/Minimum slops (generation- Reprocess)
- Zero sludge – Reprocess all
- Zero steam leak – Steam traps/ flanges tightness
Start up Outline

• Methodology & Sequence – Define, Microplan

• Focus - Project basis, P&IDs, Hazops, Manpower (Team coker), Training

• Expedite - Engineering

• Ensure - Procurement in time

• Quality Assurance - Construction, Systemwise priority, Milestones, Critical Paths, ‘S’ Curve

• Essential - Proving – Precommissioning, RFSU

• Safety – PSSR, DCS, Startup

• Maximize - Revenue by operational excellence
Mega Coker - Essentials

- Building Team Coker. Process/Operation/Maintenance. Organogram
- EPCO Team concept. (Engg/Project/Construction/O&M. Focus on Safety/Quality/schedule/operability
- Integration within and Other Refinery units/Upstream/downstream/Utilities Teams
- Define clear responsibility to each team member. Set defined targets for everyone.
Mega Coker - Essentials

- Select Process Licensor early
- Assist Project group
- Process Package/Layout/PFD/P&ID/Hazops

Assist Engineering group
- EPC/Engineering/Equipment Data sheet/PDS Model/ISOs review /Spools/Fabrication

Assist procurement group
- Equipment PR/Procurement/Vendor packages
Mega Coker - Essentials

Assist Construction group

- System-sub system- owners
- Priority/Schedule/
  Equipment preservation, Erection/QA, QC
  Alignment/Hydrotest loops/PMI
- Mechanical completion/Check Lists/
  Internals/Gaskets/Flushing/Cleaning/
- Steam blow/RFC
Mega Coker - Essentials

- Operation preparedness.
  
  Operating-manuals/SOP,SMP/Training manual/Safety manual
  Communication/safety permit/shift /Licensor/manpower /op-shelters

  DCS-system
  Graphics, Alarm priority, Inter-connectivity

  Operator Training/on site/Simulator/validation/learning from incidents

  System proving including vendor packages and instrumentation, safety interlocks
Mega Coker - Essentials

- PSSR-Include all systems like electrical substation, PIB, safety systems like fire/gas detectors
- Hydrocarbon-In/Refractory dryout/Circulation
- RFSU
- Commissioning/Feed Cut In/Product-out
- Stabilization/Test Run
Use learning from past Incidents

- Major startup Pitfalls
- PMI – misses
- Heater coke up, Heater tube failure/BMS failures/Burner extinguish
- Coke drum foam over- Level problems/Delays in Cycle,
- Fractionator upsets/level losses/Feed failures
Mega Cokers- Mega Problems

- Identify right block- measures
- Flange leakages/opening- measures
- Wrong operation of coke drum- measures, valves- interlock/Isolators
- Power failure- Tarry drum
- Utilities failure – Control fractionator temp
- Pump seal failures- seal selection, plan
- Pump failures due to strainer chock up-hot circulation- more time
- Compressor failures
Mega Cokers- Mega Problems

- Expansion loops fouling with other piping-measures taken
- Water hammers-steam headers
- Steam traps malfunctions-heater coke up
- Heater pass flow failures. Heater trips
- Coke drum cave in- shot coke problems
- Cutting tool jamming- experience manpower
Mega Cokers - Mega Problems

- Coke drum hot spot/Blow over
- Fire at Blow down tower/air coolers
- Fire-MOC-PMI misses
- Down stream units upsets- product storage-air cooler sudden expansion
- Gas/H2S leakages
- Sampling errors
- Bad line breaks
- Coke drum cycle delays
Mega Cokers- Mega Problems

- Check valves in wrong direction
- Fire at coke drums- Safety valve blows
- Products going off specs. LPG, Naphtha
- Coke cutting Hose failures-Hose quality
- Instrument ferrules leakages- Hydrotest problems
- HPV/LPD vibration cracks- gusset support- engg standards
WE WILL MAKE IT HAPPEN ...
Commissioned 5 Cokers in the world, Including IOCL, KNPC & Reliance Jamnagar.
Enhanced capacity by 140% - 17500 bpd
Reduced Coke drum cycle to 12 hrs

Contact: raj877@gmail.com
Mobile: +91 8130577115
Landline: +91 124 2219558
11, Birch Court, Nirvana Country, Gurgaon (122018)
<table>
<thead>
<tr>
<th>Sl No</th>
<th>DESCRIPTION</th>
<th>LICENSOR</th>
<th>LOCATION</th>
<th>CAPACITY BPD</th>
<th>YEAR OF START</th>
<th>COKE DRUMS</th>
<th>Unheading System</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>INDIAN COKERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Reliance Industries Limited – Coker 1</td>
<td>FWUSA</td>
<td>Jamnagar Gujrat</td>
<td>161000</td>
<td>1999</td>
<td>8 DELTA</td>
<td></td>
<td>1999</td>
</tr>
<tr>
<td>2</td>
<td>Reliance Industries Limited – Coker 2</td>
<td>FWUSA</td>
<td>Jamnagar Gujrat</td>
<td>175000</td>
<td>2009</td>
<td>8 DELTA</td>
<td></td>
<td>2009</td>
</tr>
<tr>
<td>3</td>
<td>Essar Oil Limited</td>
<td>ABB LUMMUS</td>
<td>Jamnagar Gujrat</td>
<td>60000</td>
<td>2010</td>
<td>6 DELTA</td>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>4</td>
<td>IOC Baroda</td>
<td>ABB LUMMUS</td>
<td>Baroda Gujrat</td>
<td>71204</td>
<td>2010</td>
<td>4 ZIMMERMAN JENSON</td>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BPCL/Oman Petroleum-Joint venture</td>
<td>ABB LUMMUS</td>
<td>Bina M.P</td>
<td>60000</td>
<td>2010</td>
<td>4 ZIMMERMAN JENSON</td>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>HPCL/Mittal</td>
<td>ABB LUMMUS</td>
<td>Bhatinda Punjab</td>
<td>60000</td>
<td>2012</td>
<td>4 ZIMMERMAN JENSON</td>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>IOC Barauni - 2 Units</td>
<td>EIL</td>
<td>Baurani Bihar</td>
<td>30000</td>
<td>1984</td>
<td>2 MANUAL TROLLY</td>
<td>1985</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>IOC Bongaigaon</td>
<td>EIL</td>
<td>Bongaigaon Assam</td>
<td>30000</td>
<td>1981</td>
<td>2 MANUAL TROLLY</td>
<td>1980</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>IOC Bongaigaon</td>
<td>EIL</td>
<td>Bongaigaon Assam</td>
<td>30000</td>
<td>1990</td>
<td>2 MANUAL TROLLY</td>
<td>1990</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>IOC Assam</td>
<td>EIL</td>
<td>Assam</td>
<td>30000</td>
<td>1990</td>
<td>2 MANUAL TROLLY</td>
<td>1990</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Oil India Limited</td>
<td>OLD</td>
<td>Assam Digboi</td>
<td>5000</td>
<td>1942</td>
<td>2 MANUAL TROLLY</td>
<td>1945</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>IOC Guahati</td>
<td>EIL</td>
<td>Guahati Assam</td>
<td>25000</td>
<td>1977</td>
<td>2 MANUAL TROLLY</td>
<td>1967</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>IOC Panipat</td>
<td>ABB LUMMUS</td>
<td>Panipat Haryana</td>
<td>60000</td>
<td>2005</td>
<td>4 HAAN &amp; CLAY</td>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>MRPL Manglore</td>
<td>ABB LUMMUS</td>
<td>Manglore Karnataka</td>
<td>60000</td>
<td>2014</td>
<td>4 ZIMMERMAN JENSON</td>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>BPCL Cochin</td>
<td>ABB LUMMUS</td>
<td>Cochin Kerala</td>
<td>60000</td>
<td>2015</td>
<td>4 ZIMMERMAN JENSON</td>
<td>2015</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>IOC Paradeep Orissa</td>
<td>FWUK</td>
<td>Paradeep Orissa</td>
<td>74000</td>
<td>2014</td>
<td>4 DELTA</td>
<td></td>
<td>2014</td>
</tr>
<tr>
<td>17</td>
<td>Chennai Petroleum</td>
<td>ABB LUMMUS</td>
<td>Chennai Tamilnadu</td>
<td>40000</td>
<td>2015</td>
<td></td>
<td></td>
<td>2015</td>
</tr>
<tr>
<td>18</td>
<td>IOC Mathura</td>
<td>Projected</td>
<td>Uttar Pradesh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>IOC- Haldia</td>
<td>Projected</td>
<td>Bengal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# PRE-START-UP SAFETY REVIEW CHECKLIST

<table>
<thead>
<tr>
<th>SR NO</th>
<th>DESCRIPTION</th>
<th>Supporting Documents</th>
<th>STATUS YES/NO</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>SAFETY AND HEALTH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>“General&quot; Safety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.1</td>
<td>Has adequate and appropriate PPE (Personal Protective Equipment) specified and provided in control room, field, SFE / FE porta cabin?</td>
<td>PSCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.5</td>
<td>Are points of isolation clearly marked/labelled and readily accessible?</td>
<td>PSCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.6</td>
<td>Have bump/trip hazards been identified and all sharp edges removed?</td>
<td>PSCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.7</td>
<td>Has proper guarding, handrails/barriers, been provided to prevent falls?</td>
<td>PSCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.8</td>
<td>Are Safety Showers and Eye Wash facilities provided, adequate &amp; operational?</td>
<td>PSCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.9</td>
<td>Has sufficient lighting been provided so that operation, servicing, maintenance and repair of the facility can be carried out safely?</td>
<td>PSCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.10</td>
<td>Are display systems for providing operational instructions, safety warnings and emergency information provided and positioned so that they are clearly visible and easily read?</td>
<td>PSCL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### System Priority

<table>
<thead>
<tr>
<th>Sys</th>
<th>System Description</th>
<th>PREREQUISITES</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td></td>
<td>SY SREQD FROM CONST ON</td>
</tr>
<tr>
<td>371-SO</td>
<td>Office space</td>
<td>01.03.07</td>
</tr>
<tr>
<td>371-SOA</td>
<td>Porta cabin</td>
<td></td>
</tr>
<tr>
<td>371-SOB</td>
<td>Site office space</td>
<td></td>
</tr>
<tr>
<td>371-SOC</td>
<td>CCR office</td>
<td></td>
</tr>
<tr>
<td>371 C&amp;T</td>
<td>Communication &amp; Transportation</td>
<td>01.03.07</td>
</tr>
<tr>
<td>371 C&amp;T-1</td>
<td>Telephone, Plant radio</td>
<td></td>
</tr>
<tr>
<td>371 C&amp;T-2</td>
<td>PC network</td>
<td></td>
</tr>
<tr>
<td>371/372-ELE</td>
<td>Electricity</td>
<td>15.10.07</td>
</tr>
<tr>
<td>371/372-ELE-A</td>
<td>Electric sub station charging</td>
<td></td>
</tr>
<tr>
<td>371/372-ELE-B</td>
<td>Emergency power generator</td>
<td></td>
</tr>
<tr>
<td>371/372 LT</td>
<td>Plant lighting system</td>
<td>15.10.07</td>
</tr>
<tr>
<td>371-CS</td>
<td>Storm water sewer(CS)</td>
<td>10.10.07</td>
</tr>
<tr>
<td>371-OS</td>
<td>Oily sewer(OS)</td>
<td>10.10.07</td>
</tr>
<tr>
<td>371-SH</td>
<td>Closed drain(SH&amp;SC)</td>
<td>10.10.07</td>
</tr>
<tr>
<td>371-CA</td>
<td>Chemical drain</td>
<td>10.10.08</td>
</tr>
<tr>
<td>371-CP</td>
<td>Coke pit / maze</td>
<td>10.10.07</td>
</tr>
<tr>
<td>371-WF</td>
<td>Fire water</td>
<td>10.10.07</td>
</tr>
<tr>
<td>371-WU</td>
<td>Utility water</td>
<td>01.11.07</td>
</tr>
<tr>
<td>371-WD</td>
<td>Potable water/Drinking water</td>
<td>20.10.07</td>
</tr>
<tr>
<td>371-WC</td>
<td>Cooling tower/ CT 3</td>
<td>10.12.07</td>
</tr>
<tr>
<td>371-WP</td>
<td>Process water</td>
<td>15.11.07</td>
</tr>
<tr>
<td>371-BFW</td>
<td>MP&amp;LP BFW</td>
<td>20.01.08</td>
</tr>
<tr>
<td>371-BFW</td>
<td>HP BFW</td>
<td>20.02.08</td>
</tr>
</tbody>
</table>

Oct'07

- **SS** charging
- **Plant lighting charging**
- **Closed drain(SH&SC)**
- **Chem drain**
- **Drain to maze**
- **Fire water**

01-Oct-13  Raj Sharma
Avoid Pit-Falls
Expedite Construction
PMI- Audit

C.S Portion
Flanges not aligned
Misaligned flanges will result in leakage
Low Point Drains Need Valves
Low Point Drains Need Valves
Small bore pipe needs bracing for strength
The Right Gasket can be identified by color coding

**Spiral Wound Gaskets**

**Gasket Identification Guide Ring Color Coding**

**Color Coding for the Gaskets You Need.** Gaskets are color coded to help expedite the selection and identity of the gasket you need. The color on the outside edge of the centering ring identifies both the winding and filler materials. The metallic winding material is designated by a solid color. The filler materials are designated by color stripes at equal intervals on the outside edge of the centering ring.

**Metallic Winding Materials**

The metallic winding material is designated by a solid color identification around the outside edge of the centering ring.

- 304 SS: Yellow
- 316L SS: Green
- 317L SS: Maroon
- 321 SS: Turquoise
- 347 SS: Blue
- 310 SS: No color
- 304L SS: No color
- 309 SS: No color
- 450 SS: No color
- Alloy 20: Black
- Inconel: Purple
- Incoloy: 800/825: Gold
- Incoloy: 800/825: White
- Hastelloy® C226: Beige
- Hastelloy® B2: Brown
- Nickel 200: Red
- Zirconium: No color
- Carbon Steel: Silver
The Right Gasket Will Fit Properly in The Right Flange
Proper nuts and bolts can be verified with stamp
Fractionator - Inspection

No provision for installation of Heat shield

Coke drum vapor inlet nozzle
Fractionator wrong LT tapping

LP TAPPING OF LG601 IN THE DOWNCOMER OF TRAY NO 12

HP TAPPING OF LG601 IN PAN 1
Debris in pipe line
POSITIVE MATERIAL IDENTIFICATION
Coke drum valve isolator
Heater- Overheated Tubes