Hydroprocessing Technology Leadership

Platt’s African Refining Summit
Cape Town
November 17-18, 2014
CLG Hydroprocessing Technology Experiences

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18 November 2014
CLG is a 50:50 JV between Chevron and CB&I Lummus Technology

- Chevron is a fully integrated oil company with 59,000 employees. Chevron has operated high-pressure hydrocracking units since 1962.

- CB&I is the world’s leading energy services provider with 55,000 employees and operations in over 100 countries.

- Through its parent companies CLG has access to all major refining and petrochemicals technologies.
CLG... Not Just a Catalyst and Licensing Company

- 7 wholly owned Chevron refineries have 73 hydroprocessing reactors (41 high pressure and 32 <1000 psi)
- 6 partially owned Chevron refineries (Caltex) have 40 hydroprocessing reactors
- CLG and all Chevron hydroprocessing units are linked into the **Chevron Hydroprocessing Best Practice Network**
- More than 250 CLG hydroprocessing licensees worldwide!

Chevron Richmond Refinery TKN/ISO – Continuous Operations Since 1966
Chevron Lummus Global LLC

- Refinery Planning
- Refinery Operations
- Process Engineering
- Catalyst Supply
- Research and Development
  - Catalyst
  - Process
- Startup, Commissioning and Training
- Continuing Technical Service
R&D Facilities

- **25+ Pilot Plants**
  - Complete Miniatures of Commercial Hydroprocessing Units
  - Pilot Plant Data Used to Design Commercial Hydroprocessing Units and to evaluate new catalysts and Process Innovations

- **80+ Total Micro-Units**
  - 30+ Hydroprocessing
  - Balance for other technologies
CLG Focuses on Hydroprocessing

Since 2000 CLG has licensed:

- 1,716,065 BPSD of Resid Hydrotreating
  - RDS, VRDS, OCR, UFR
- 277,000 BPSD of Resid Hydrocracking
  - LC-FINING
- 4,716,327 BPSD of Distillate Hydroprocessing
  - ISOCRACKING
  - ISOTREATING
- 205,670 BPSD of Lube Base Oil
  - ISOCRACKING
  - ISODEWAXING
  - ISOFINISHING
CLG is a Leader in Hydroprocessing Technology

Competitively Bid License Share in Last 10 Years

Hydrocracking
Total Units: 72
- CLG, 36, 50%
- UOP, 22, 31%
- FWC, 1, 1%
- HT, 1, 2%
- SGS, 6, 8%
- Axens, 6, 8%

Lube Base Oils
Total Units: 20
- CLG, 13, 65%
- XOM, 7, 35%

Ebullated Bed
Total Units: 5
- CLG, 3, 60%
- Axens, 2, 40%

RDS/VRDS
Total Units: 24
- CLG, 19, 79%
- Axens, 3, 13%
- UOP, 2, 8%
Hydrocracking is Formula 1 of Refining Technologies

- Typical feeds are Vacuum Gas Oil and (heavy) Coker Gas Oils
- Products are ULSD, Kerosene and Naphtha

- Demanding operating conditions
  - Reactor pressures 100 – 200 bar
  - Temperatures 350 – 430 degrees centigrade
  - 99.9% pure hydrogen gas
  - System contains NH3 and H2S
Two-Stage Recycle (TSR)

Maximum Liquid Yield and Highest Quality

Make-up Hydrogen

Fresh Feed

Make-up Hydrogen

Recycle Gas

First-Stage Product

Product Gas

Light Naphtha

Heavy Naphtha

Kerosene

Diesel

Second-Stage Product

Recycle Gas
Even before the inquiry things can go wrong: good market research, feasibility study, investors’ appetite
Project Life Cycle

Level of Influence

Business Planning | Study Phase | Basic Design & FEED Phase | Investment Approval | Mechanical Completion | Commissioning /Start-Up | EPC

Influence Curve | Project Cost

Cost Curve

Source: Fluor
Many Aspects to a Project that require careful Consideration

- Preparation, studies
- Project Management
- Technology Provider(s)
- Engineering, Procurement and Construction
  - EPC contractor selection
  - Vendor selection
- Finance
- Partner
Outside Factors

- Political support and stability
- Permits
- Stable market conditions
Check Permits before starting Design and Engineering

- European Refiner
- Refinery located next to a city
- Expand existing refinery with a hydrocracker to make ULSD
- CLG ISOCRACKING technology licensed
- CLG Basic Design Package completed
- Authorities refused to renew environmental permits due to presence of a coker at the refinery
- Refinery shut down
Maximize use of Assets

- Iraqi Refiner
- New refinery
- Basic Design and FEED completed
- EPC bid cancelled due to insufficient interest of bidders
- Risk/Reward
- New EPC strategy developed
- Tying refinery EPC contract to oil field exploration contract
Conduct Market Research

- Saudi Base Oil Manufacturer
- Initial plan was to build a group III base oil plant
- Hydrocracker and ISODEWAXING/ISOFINISHING plant
Licensee decided to do a thorough market study and decided that they wanted to manufacture and sell group II base oil instead.

Recently other group III base oil capacity has come on stream and demand no longer exceeds supply capacity.
One of the former CIS states
New refinery project
Including a hydrocracker and a base oil plant
Still in technology selection phase
Fast increasing local demand in fuels
New fuels regulations set by the Government
The new refinery project was put on hold and existing refinery upgraded to meet increasing fuels demand
Other projects given priority, e.g. petrochemicals
Integration Lowers Investment Cost

- BPCL India
  - Novel addition of Lube unit to HCR
  - Energy and capital savings
- BP Bulwer Island Australia
  - Integrated HCR and HDT
  - Investment and energy savings
- GS Caltex, Korea
  - Two-stage HCR with Lube
  - Control of Gr II vs Gr III production
- ENI, Italy
  - VRDS with integrated HCR

Courtesy of GSC – HCR (Hydrocracker)
Revamps Extend Performance of Existing Units

- **MRC HCR, Malaysia**
  - Applied SSRS for energy efficiency
  - 80% increase in capacity

- **CPCL HCR, India**
  - Added HCGO HDT integrated with HCR

- **GS Caltex HCR, South Korea**
  - Added ISODEWAXING Base Oil Unit
  - No additional H2 capacity needed
  - No additional compressor

*Courtesy of CPCL India Hydrocracker and Visbreaker*
Lessons Learned – Do your Home Work

- Know the place where you plan to build your refinery (units)
- Do thorough business planning including feasibility and market studies
- Consider integration of units to reduce CAPEX significantly
- Revamping of existing facilities may also deliver the desired products
- Start “paperwork” early on to avoid surprises
- Contract experienced contractors and technology providers
Thank you