



Driving Excellence

4th Quarter 2006

Helping Clients Achieve Operational and Capital Excellence



KBC Integrates Planning, Scheduling, and Simulation System for Refinery in Taiwan

by Lim Chin

Formosa Petrochemical Corporation (FPCC), the leading refinery in Taiwan, first began commercial production in the year 2000. In 2006, it made the Platts Top 250 Global Energy Company rankings for 2005. FPCC also ranked 10th on overall global performance and 7th in Refining and Marketing worldwide.

Despite being a relatively new refinery, it has continuously implemented various profit improvement and reliability and maintenance programs over the last few years. KBC is already a familiar face in FPCC, as we have successfully helped drive some of these refinery improvement programs. Most recently, FPCC engaged KBC for Phase 1 of an Integrated Planning, Scheduling, and Simulation project. Additional Phases are planned for further business improvements.

Phase 1

The scope of Phase 1 included KBC's simulation software, energy, and planning elements.

FPCC had previously licensed FCC-SIM[®] and RHDS-SIM[®] from KBC, and these models are used to regularly update and enhance the results of their PIMS[™] LP model.

To help FPCC further improve its current planning system, KBC Planning Services upgraded the existing ARDS LP Data Generation Application (DGA) using RHDS-SIM and RCC LP DGA (using FCC-SIM). Output from the DGA was used to update the LP vectors. We also provided software customisation services for the DC-SIM[®] model, which was calibrated and tuned to match DCU operations. KBC Planning Services, together with a global management consultancy, customised the Orion[™] scheduling application for FPCC. A client-specific ProSteam[®] model was also developed by the KBC Energy Services team to aid FPCC in identifying energy optimisation solutions.

We reviewed and upgraded the existing RCC and RDS LP sub-models structure

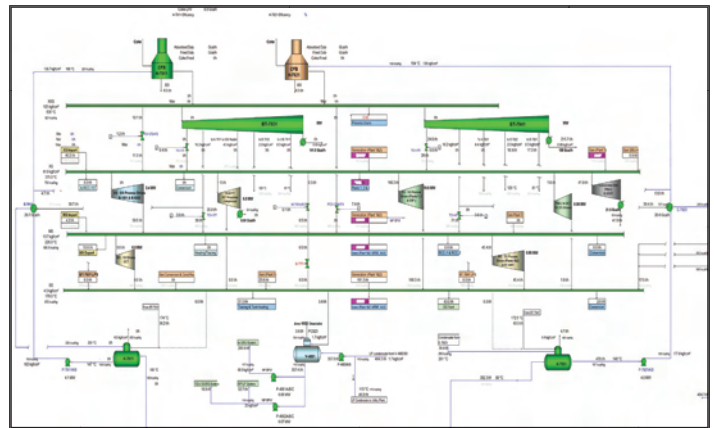


Figure 1 - Extract of KBC Utility Model

and accuracy based on current industry Best Practices and experience gained by FPCC over the past few years.

Strategic Energy Review

Energy saving opportunities are "hot" especially in today's environment. The FPCC refinery process units were challenging, since it is still a relatively young, energy-efficient refinery with established energy saving techniques and a strong energy savings culture. The KBC Energy Services team reviewed FPCC plant data, discussed the processes with plant management, and set up a simulation model of the site utility system using ProSteam. This model was then used to relate individual project savings to reductions in fuel

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KBC offers a comprehensive range of consulting, implementation, and training solutions to provide sustainable competitive advantage to our process industry clients worldwide.

OUR SERVICES INCLUDE:

CapX - Capital Excellence

- Market Analysis & Forecasting
- Business Strategy Review
- Merger, Acquisition & Integration Studies
- Feasibility Studies
- Capital Project Support

OpX - Operational Excellence

- Operational Planning
- Process Optimisation
- Energy
- HSE
- Reliability, Availability & Maintenance
- Human Performance Improvement
- Software Solutions

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FEATURE STORY

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and power; ProSteam could also be used for planning purposes or as a manual, off-line optimiser.

Additionally, KBC carried out a Best Technology (BT) assessment. The KBC BT index was used to benchmark FPCC utilities system's energy performance against the best practical configuration, identify and quantify the main contributors to the actual energy performance of site, to determine possible areas of benefit. The FPCC BT index corresponded to first quartile performance compared with other refineries where KBC has carried out energy assessments. To interpret the results of the BT analysis, KBC carried out a Gap Analysis. This analysis explained the reasons for FPCC's particular position in the BT ranking table and identified specific areas of energy inefficiency and quantified the contribution of each of these areas to the overall BT index. Through this comprehensive approach, KBC energy specialists identified many heat recovery and utility-related opportunities. The team also provided on-site support for test runs conducted by the refinery to implement quick hit items with no capital cost. Considering all potential identified improvements in heat recovery and utilities systems, energy savings for FPCC is estimated at US\$10M/year. About 30% of this savings can be achieved through optimisation of the operation of some process units and the utility system, while requiring minimum or no capital investment.

Scheduling Application

The FPCC refinery complex has a total capacity of 480,000 bpd and various upgrading process units. It supplies products to both domestic and export markets. The refinery also supplies feedstock to neighbouring Formosa Group Petrochemical and Plastics plants. Efficient daily management of Crude VLCC and transport of products by pipeline, truck and tankers, tank inventory, product quality, and process operations changes are required.

FPCC selected Orion for their scheduling tool to improve the efficiency of their refinery scheduling work process. While a management consultancy set up in-

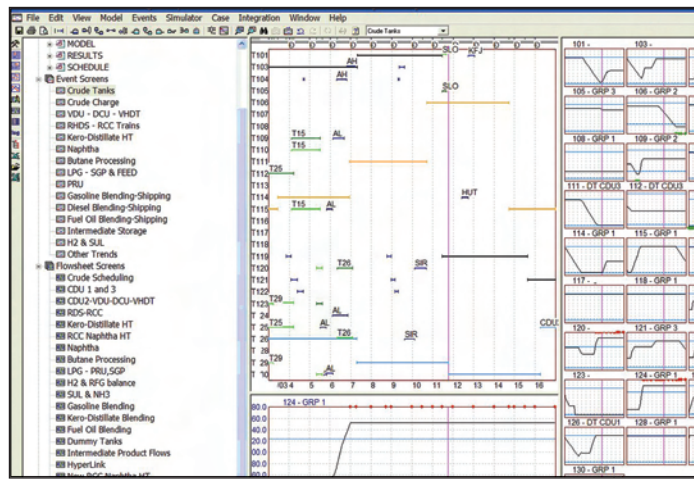


Figure 2 - Extract of Event-based Graphical User Chart

tegration systems of many other FPCC plant applications with Orion, KBC, with strong expertise in planning and scheduling area, reviewed current scheduling work processes and developed the Orion model and database.

The development work was accomplished systematically in several stages beginning with a discussion of all scheduling requirements and current work process of all crude and product schedulers. It was important that Orion and the use of this software fit suitably into work processes with various interfaces. KBC designed and built the model according to the refinery's crude and process information. This model includes crude receipts, crude process units and operating parameters, and inventory and shipping. KBC also built-in user calculations tailored to FPCC's specific scheduling needs. FPCC promptly started trial use upon completion of a basic working model. Through this trial use and testing, further model enhancements were made.

During the project, the FPCC planning engineer actively participated in the development work. KBC and a global management consultancy introduced early the basic working model to all FPCC refinery schedulers. This familiarisation with the model helped them incorporate it into the scheduling work process and, subsequently, suggest the features necessary for their needs. KBC and the management consultancy also conducted training for FPCC crude and product schedulers on the use of the Orion tool into their scheduling work process. The project was fast-paced with a dedicated and supportive FPCC planning engineer and the monthly on-site support of KBC and the management consultancy. FPCC was able to put Orion to on-stream use in less than a year from project kick-off.

EVENTS

8th Annual Middle East Refining Conference

4-5 Feb – Abu Dhabi, UAE

Mr Simon Rogers, Chief Information Officer of KBC, will describe the use of rigorous refinery-wide simulation to optimise refinery configuration. Improved refinery margins and the need to make clean fuels and minimise the impact on the environment has led to a significant increase in investment in refineries in all areas of the World.

Middle East Fuels Conference

6-7 Feb – Abu Dhabi, UAE

Mr Kevin Clarke, KBC's Executive VP EMEA, will present "The Development of a Clean Fuels Investment Masterplan for an African Refinery."

IDTC – 8th International Downstream Technology Conference & Exhibit

14-15 Feb – London, UK

KBC's Mr Simon Calverley, Senior Staff Consultant, will present, "Development of Refinery Configuration for production of Clean Fuels." This paper will cover: Understanding current refinery operation and configuring a refinery-wide simulation model of current operation. Selecting configuration for future operation (increased crude rate and tighter specifications). Developing cost estimates and PFDs for new equipment, configuration, and producing revised utility, hydrogen, and fuel balances.

NPRA Annual Meeting

18-20 Mar – San Antonio, TX, US

KBC's Robert Ohmes, Senior Consultant, will present "Addressing the Clean Fuels Challenge" and KBC's Darren Le Geyt, KBC Petrochemical Consultant, will present "Refinery & Petrochemical Integration – Is the Glass Half Empty or Half Full.....?"

ARTC 10th Annual Meeting

20-22 Mar – Bangkok, Thailand

KBC's Antonio Della Pelle, Senior Consultant, will present "Optimise the Total Site Energy Performance"

3rd RAMS Conference 2007

2-4 Apr – Kuala Lumpur, Malaysia

KBC's Greg Gustafson, Senior Staff Consultant will present on a Reliability, Availability, and Maintenance topic yet to be decided.

RPEC – 2nd Russia & CIS Refining Equipment Conference & Exhibition

16-17 Apr – Moscow, Russia

Mr John Rains, KBC Senior Consultant, describes the use of a proven, easy-to-use Risk-Based Decision-Making tool to produce a total asset care policy, including Pm, Inspection, PdM, Maintenance by Operators, and Engineering upgrades. This paper will illustrate a methodology of combining Risk-Based Decision-Making, critical failure analysis, Best Practice reliability/maintenance technologies, and engineering in a focused process that applies the greatest effort to mitigating the highest risks to your business.



REFINING MARGINS

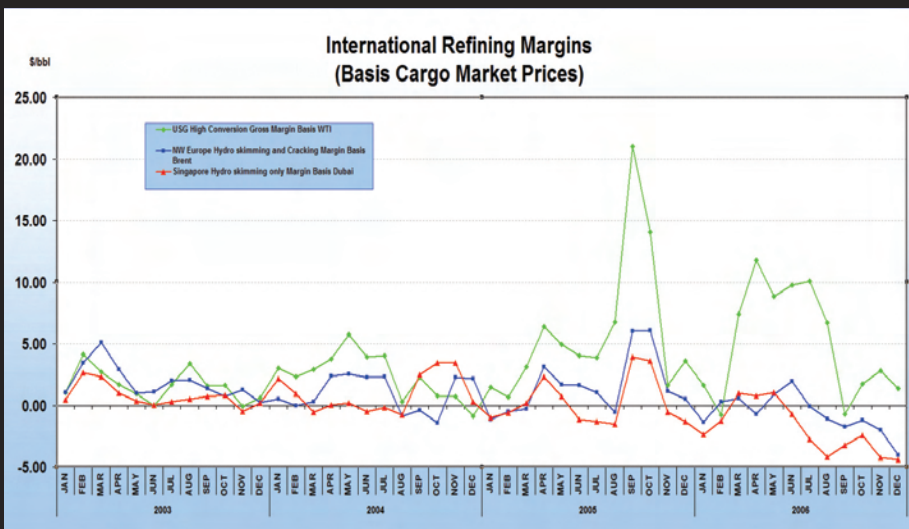
by Richard Warner

Global unseasonably mild weather undermined middle distillate prices in the fourth quarter, and it consequently removed some support for global refining margins.

High conversion WTI margins in the US Gulf remained above marginal cost break even, although at significantly lower levels than during the summer. Sharply weaker WTI prices lent some support to the margin during October and November, together with good gasoline and fuel oil crack spreads. However, a weakening in all products relative to crude in December undermined returns.

In contrast, hydro-skimming and cracking margins for Brent in Europe and simple topping margins for Dubai remained firmly below marginal cost breakeven, despite sharp crude oil price falls. In Europe, product crack spreads weakened for naphtha, heating gas oil, and fuel oil, which seriously undermined margins. This led to some refiners implementing run cuts. The persistent lack of product support pushed the Brent margin sharply weaker in December as crude oil prices recovered.

At Singapore, supportive gasoline, jet, and, to some extent, fuel oil prices kept margins stable between October and November. Weakness in fuel oil in December, together with a rebound in the Dubai price, pushed the margin to below minus \$4/bbl. Upgrading margins (not shown here) actually improved marginally as gasoline, naphtha and kero prices improved.



FEATURED PROJECTS

Operational Excellence (OpX) Program Implementation

St Croix, USVI

HOVENSA L.L.C. (HOVENSA) has appointed TTS Performance Systems, Inc. (TTS), KBC's Human Performance Improvement division, to assist them in becoming a Production-centered Organisation (PCO) through the implementation of a full-scale Operational Excellence (OpX) program across the entire refinery. We are currently working with HOVENSA management and staff on all aspects of this organisational change from conceptual design and strategy development, through program management and design of specific systems, to point-of-manufacture implementation.

One key element of this change is to increase the organisation's investment in its human assets and upgrade its approach to training, performance management, and performance support. As part of this effort, HOVENSA engaged TTS in April 2005 to assess its operations practices and behaviours against industry best practices. To address the assessment findings and continue its move toward becoming a PCO, HOVENSA asked us to assist in the development and implementation of the next phase of the performance improvement process.

Three high-priority areas were identified for initial focus:

- Refinery Operating Vision, Philosophy,

and Improvement Strategies

- Job Performance Profile Development
- Training System Design and Development

Refinery Operating Vision, Philosophy and Improvement Strategies

KBC and TTS consultants worked with the Refinery Leadership Team to facilitate the design of a Refinery Operating Philosophy, in alignment with the Refinery's Vision. This will enable the transition to becoming a PCO. In addition, we have assisted in defining key improvement strategies and tactical improvement plans.

Job Performance Profile Development

Job Performance Profiles are currently being developed for all point-of-manufacturing positions based on the refinery's operating vision and philosophy. The profiles will provide the basis for the redesign of point-of-manufacturing training and an on-going performance management initiative

Training System Design and Development

The Training System Design will provide the structure for managing the training function, and it will establish the course curriculum for the identified Operations positions. The design is formally captured in the Training System Design Document, which consists of two sections: Training Management Guide and a Training Master Plan.

While assisting HOVENSA in preparing for the future, we have provided on-going training development and deployment for HOVENSA's Low Sulfur Gasoline project as well as training for refinery operations. This includes: Process Systems, Equipment Care and Condition Monitoring, Process Control, Abnormal Situations Management, and Training of Trainers.

TTS and HOVENSA personnel will work collaboratively over the next few years to design, develop, and implement targeted, holistic improvement projects in pursuit of the achievement of OpX. Examples of key OpX implementation activities that will be completed over the next several years are:

- Operator and Maintenance Training Program Development and Delivery
- On-going Organisational Alignment Activities

LPG Recovery Study

Europe

A European client engaged KBC to perform an LPG recovery study as a result of a recent energy review. A substantial fraction of the LPG that is produced at the refinery ended-up as fuel gas. This is due to cooling constraints, FCC absorber operational problems, and a complex fuel gas/LPG network. All of this results in interactions between the different units that are not always obvious.

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The situation is further aggravated by the fact that, due to cooling constraints, the refinery produces excess fuel gas in summer, resulting in gas flaring. Consequently, the improved recovery of LPG increases is highly beneficial, especially in the summer.

KBC set-up a refinery-wide Petro-SIM™ model of the LPG and fuel gas network, including all absorbers, stabilizers and strippers involved.

The model demonstrated that a number of improvements in particular areas of the refinery will reduce LPG losses substantially. Implementation of these improvements requires a combination of simple adjustment of operational changes, correcting poor column design, and investment in additional equipment. Therefore, in addition to the simulation work, KBC developed an implementation Roadmap for the refinery.

The combined implementation of the suggested improvements will increase LPG recovery by 3.3t/h, which will increase the net refinery benefit by €4.4M/year. The investment cost required to achieve these benefits is estimated at less than €1M.

UPCOMING HUMAN PERFORMANCE IMPROVEMENT SEMINARS

Training Skills for Process Plant Trainers

• 7-9 Feb – Houston, TX, USA

Achieving and Sustaining Operational Excellence (OpX)

- 7-9 Feb – Vienna, Austria
- 7-9 Mar – Claxton Bay, Trinidad & Tobago
- 28-30 Mar – Tampa, FL, USA
- 11-13 Apr – Seoul, South Korea

Improving and Sustaining Process Plant Operator Performance

• 11-13 Apr – Houston, TX, USA

Supervising for Operational Effectiveness

• 9-11 May – Houston, TX, USA

To register, visit us online at:

http://www.ttsperformancesystems.com/Seminars_toc.php.

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KBC Advanced Technologies Inc.

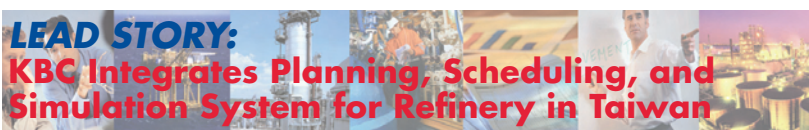
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