Shell Global Solutions

Quick Overview of Complexity Issues In Refinery Modeling

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Context of this Informal Talk

- Refinery Expert, not a Modeler
- Use model to quantify answer, not determine answer
- Model must correctly mirror refinery response
- Be as simple/flexible as possible while doing above
- Case study, not LP, so user's refy expertise, not LP logic, drives the solution
- Used in widely differing applications (next slide)
- NEMS interests seem even wider, but not to the point that there are obvious deal breakers
- Will give a 20 minute glimpse of the simple approach

Range of Simple Model Applications

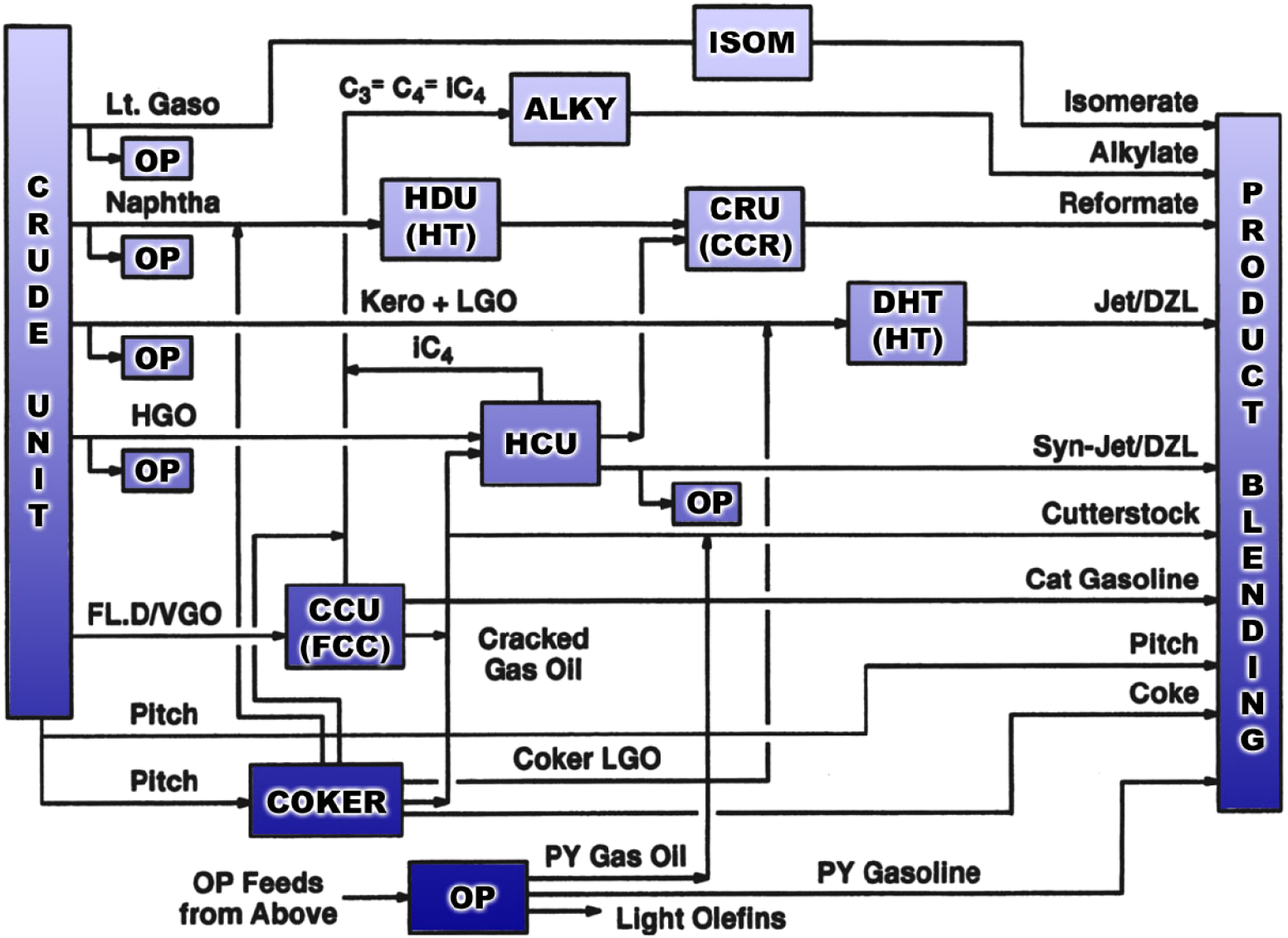
- Design and quantify economics of major refy expan, including those for unconventionals like tar sands
- Determine best way of meeting new specs like ULSD, 30ppm sulfur mogas, RFG, and oxygenates
- Support refy efficiency studies by quantifying economics of individual process unit improvements
- Determine what factors drive refy CO2 emissions, both total refy and allocation into products
- Cannot fine tune optimize, but that's not needed for most applications, probably not for NEMS either

Two Types of Model Complexity

- Topology Complexity
  - Detailed for fine tuning and/or LP
  - Simple for case study to establish basic story
    - ✓ Good enough for most uses, including major, multi billion $$ project choices/economics

- Process Unit Yield Complexity
  - Process models needed in control or final design
  - Base/delta models generated from process models OK for LP or case study

General Refinery Layout (with OP Insert)



Critical Issues to Get The Big Picture Right

- Mass Balance
- Density to get proper volumetric gain
- Conservation of Carbon and Hydrogen Atoms
- Major feed quality params, crude and inter-unit
- Individual unit operating severity

- Get the above by using process models to generate base/delta unit representations
- Then use base/delta in LP or case study refy models

Illustrative Base/Delta Yield Table

Reference Feed Qual		65%	22%
100 Octane	Base	1% N+A	1% 180F-
H2 SCFB	1100	25	-20
Reformate %	81	.5	-.4
Cap Factor	1.2	-.02	.03
98 Octane			
H2 SCFB	1000	20	-15
Reformate %	83	.4	-.3
Cap Factor	1.0	-.01	.02

LP versus Case Study

- LP better for fine tuning, but:
  - Prone to errors from “constraint gridlock”, especially in non-routine situations
  - Complex, lengthy build/fit time

- Case study better for most other applications
  - Same base/delta yields as LP
  - Less complex topology
  - Very good at getting the right basic answer even in non-routine situations
  - Simpler/faster/easier to work with

Two Types of Case Study Models

- Common Factors
  - Base/delta yields (like LP), simple topology (unlike LP)
- Dedicated Modeling Platform
  - Easier quality control
  - Integrates well with other models
  - More protections for less experienced people
- Spreadsheet
  - Maximum flexibility, fastest
  - Complex refy file is about 500kb, 100 streams
  - 500 rows by 150 cols