More Propylene in Existing FCC Units & Revamps

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Purpose (Objective)

- To present and briefly discuss producing more propylene (C3=) in conventional FCC's, potential revamps and concerns

Contents - Covering 4 Points

- Why Propylene from FCCU's ?
- Current operating modes & feedstocks (G&A)
  - Different Mode – More Distillate + C3=
- Utilizing other feedstocks
- Revamps to Existing Units

Why Propylene from FCCU's ?

- Europe, North America (US) refineries are facing <u>profitability challenges</u>
  - Gasoline demand declining both areas
  - Middle Distillates (Diesel) markets increasing both areas
  - European surplus gasoline export markets are declining
  - US lighter shale crudes, "tight oil" use is increasing that produce more naphtha and less diesel
- **C3= shortages are expected; C3= Prices >> Gasoline (Chemical & Polymer Grades)**
- Existing FCC's & Steam Crackers can't meet the demand

More Propylene in Existing Units

- Operating Variables
- Catalysts
- Feedstock Changes
- Hardware Changes
  - New HOFCC Designs - Revamps

More Propylene in Existing Units

- Operating Variables
  - Increase Severity (Increase conversion)
    - Reactor Temps
    - Residence Times
    - High Cat/Oil Ratios
  - Lower Partial Pressure *

✓ Recycle Cracked Naphtha

More Propylene in Existing Units Pg. 2

✓ **Catalysts**

- ZSM-5
- Lower RE, UCS
- Higher Activity (?)

- **Feedstocks Changes**
  - More H2 content
- **Hardware Changes**
  - New HOFCC* Designs Components for Revamps

* HOFCC - High Olefin FCC

Distillate Mode – More Propylene

- Catalyst
  - ZSM-5
  - Lower RE, UCS
  - Higher Activity
- Recycle cracked naphtha (LCN, FRCN)

Note:

Distillate Mode typically operates to produce enough C4= to meet Alky capacity

Need for Revamps?

- Different Feedstocks
  - More severe HDT
  - Less Resid
  - Lighter Feeds –
    - Tight Oil
    - Condensates
    - Naphtha (paraffinic)

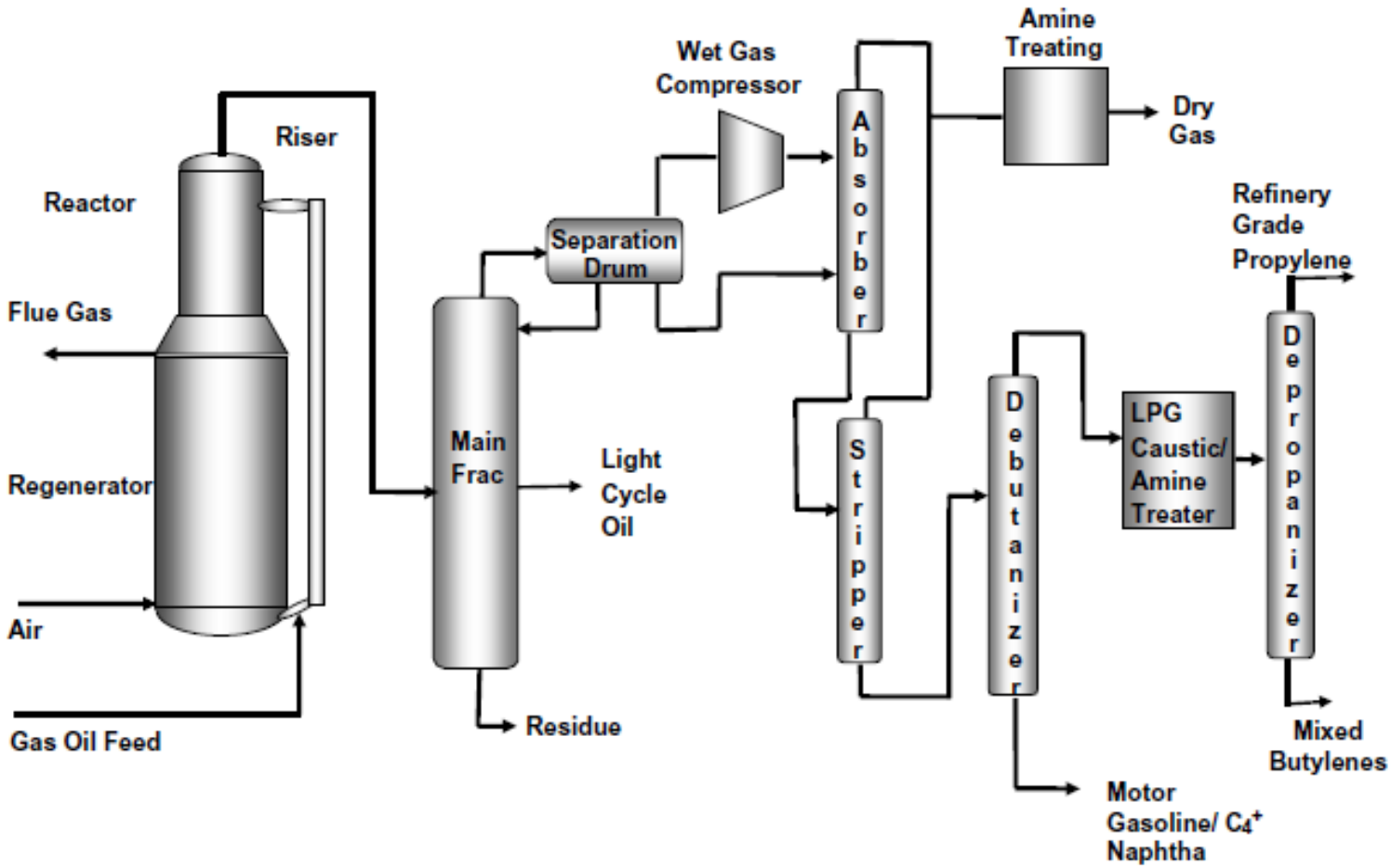
- Distillate Mode + Propylene

Concerns

- Gas Con Changes (More Light Gases)
- Treating & Contaminant Removal
  - Treating Off Gas for C2=&C2
  - Polymer Grade C3=
- Aromatic Gasoline
  - Gasoline Blending
  - Aromatic Extraction

Fluid Catalytic Cracking PFD

KEY PROCESS – FCC UNIT



Hardware Changes for More Propylene (Revamps)

Increase Reaction Time

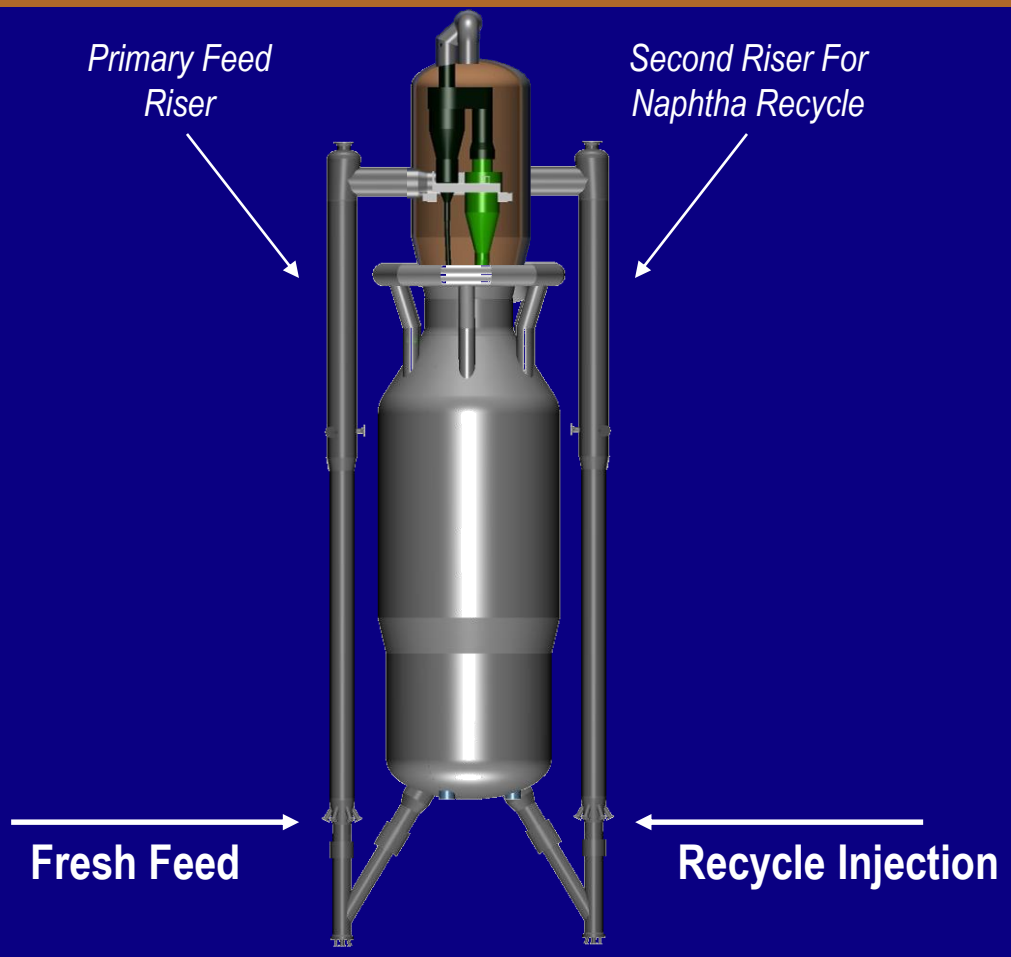
- Additional Reactor Zone
  - 2nd riser terminates in existing Rx. Vessel
  - 2nd riser / downflow rx. terminates in new Rx. Vessel
- Recycle LCN/FRCN to feed or 2nd reaction zone
- More Bed Cracking
- Premix catalysts - spent/regen (RxCat Vessel)

Summary - Licensor Types of HOFCC

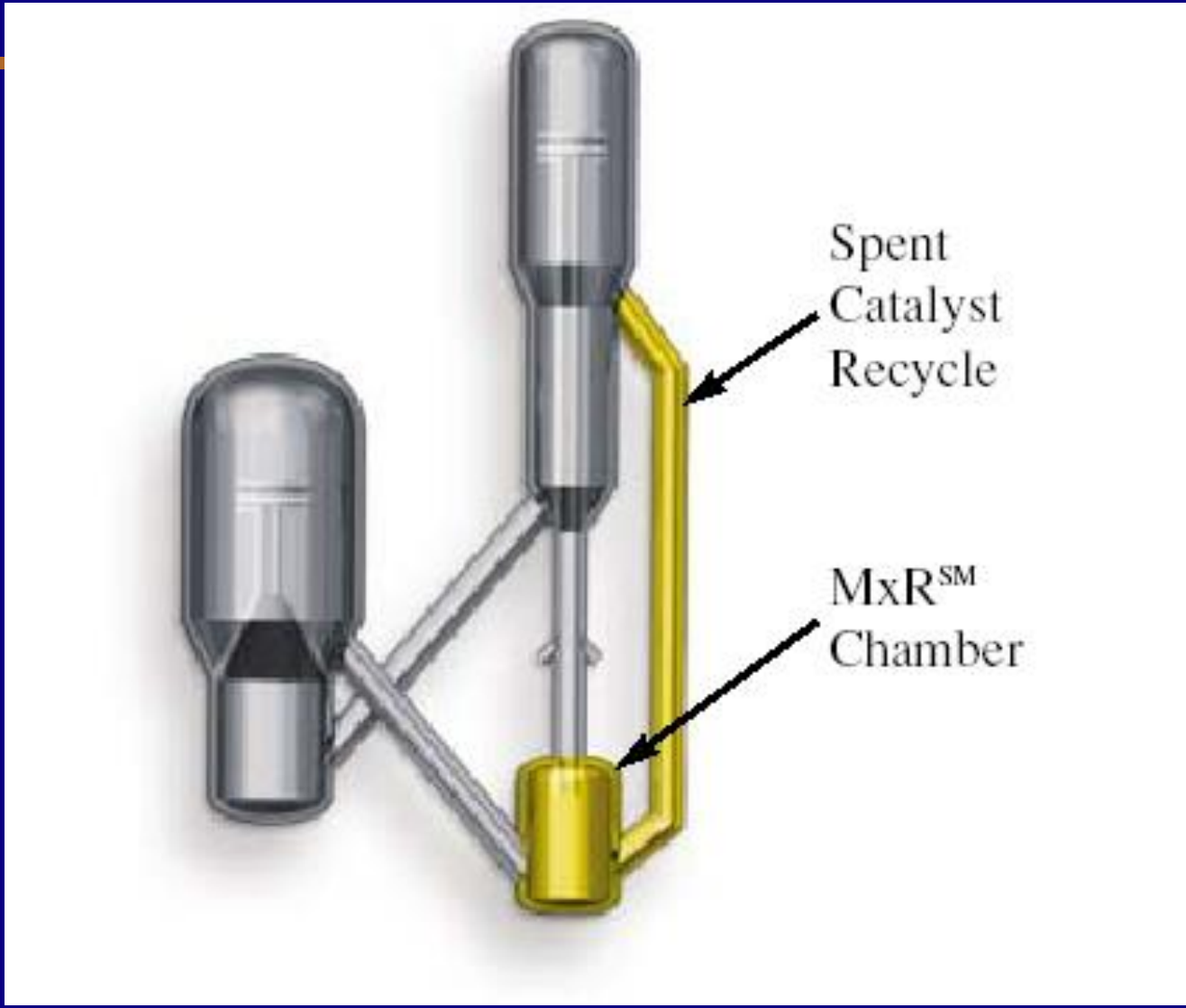
- UOP- PetroFCC
- S&W Deep Catalytic Cracker (DCC) *
- KBR- Maxofin Process- *
- Axens / S&W - High Severity FCC (HS-FCC)*
- ABB Lumus /Indian Oil Company - Indmax *
- Sinopec*
- Others

* Proprietary Catalysts

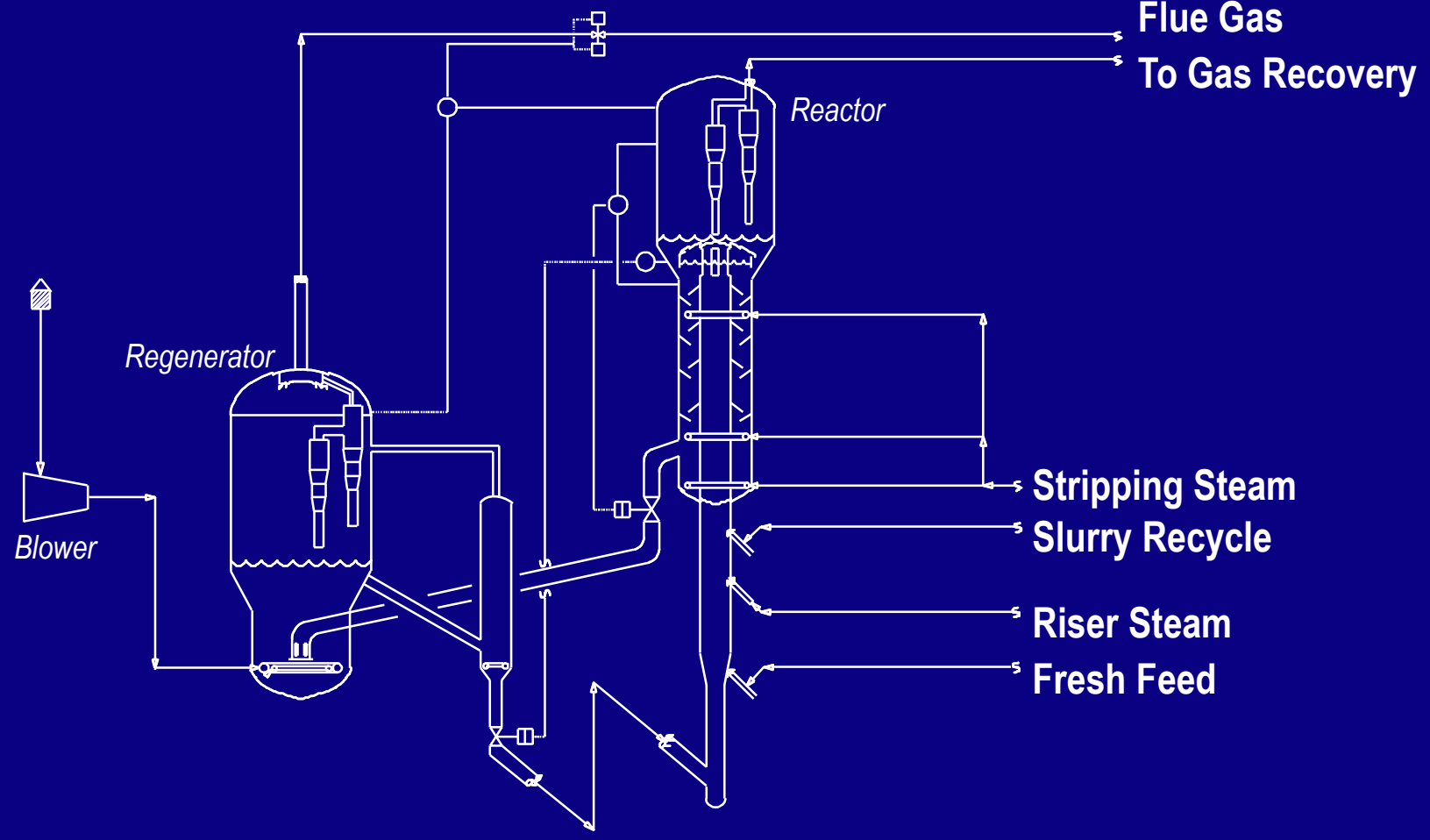
KBR MAXOFIN Process



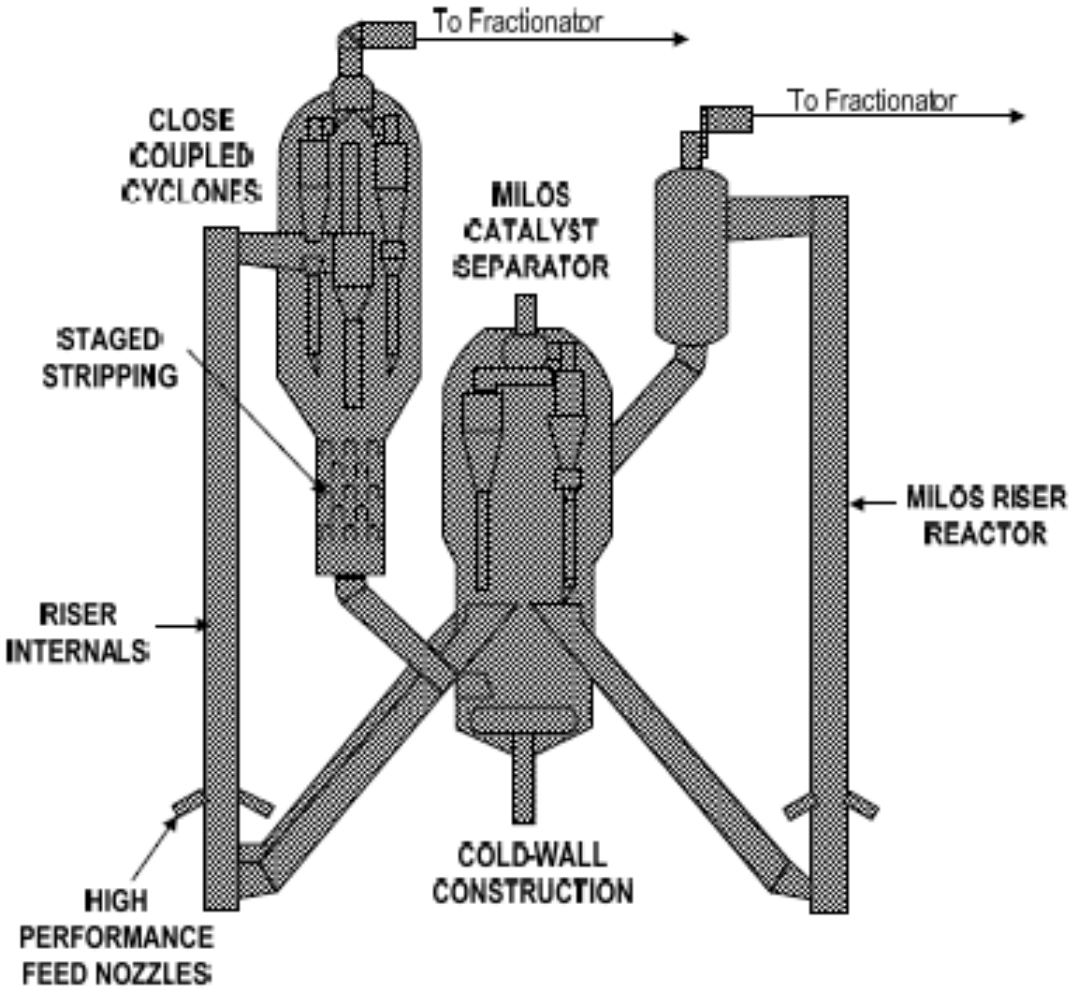
UOP PetroFCC Process



Technip Stone & Webster DCC Process

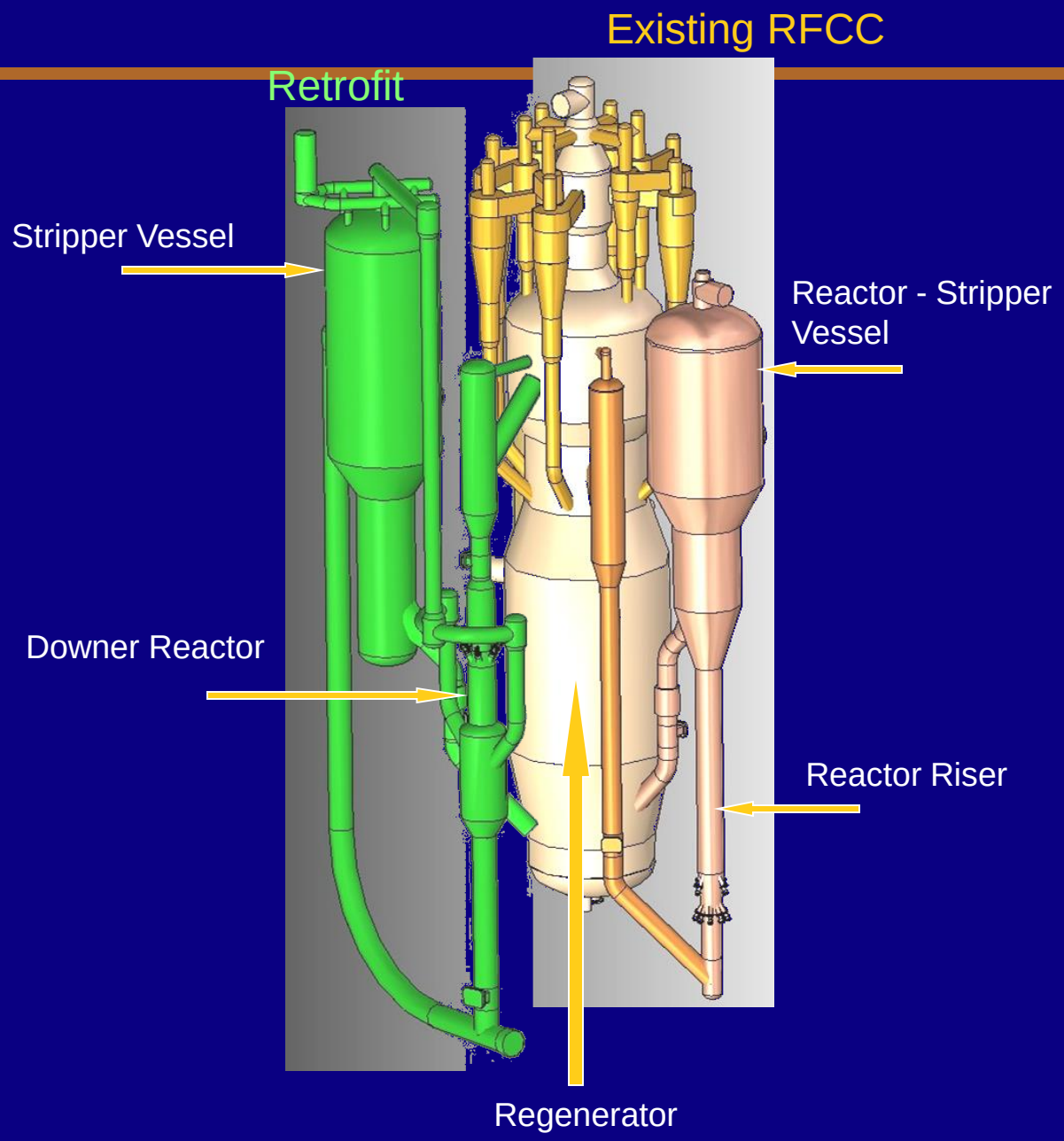


Shell Milos Distillate + Olefins



Source Shell Global Solutions

Retrofit To Axens/Shaw's R2R FCC Unit



Conclusions
More Propylene in Existing FCC Units & Revamps

- Producing More Propylene in existing FCC's is viable for increasing refinery profitability
- Producing More Propylene in Distillate Mode is viable
- Revamps to existing FCC's utilizing HOFCC's Technology and catalysts are being implemented !

THANK YOU

The End

Questions ???

Additional Follow-up discussions during the Revamp Workshop