

Revamping Existing Units to Increase Rates, Handle Lighter Feedstocks, and other Issues (Problems)



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Need for Revamps?

**To Make Your FCC Facility*
More Reliable - More Flexible**

- **Operational & Maintenance Reliabilities**
- **Feedstock & Product Flexibilities**
- **Maximize Profits!!!**



Purpose (Objective)

To Present and Briefly discuss:

- **What to Look for in Your FCC Unit /Facility ?**
- **What Can We* Do ?**

*** We Refiner...**



Need for Revamps? When & Why ?

- **When --- Maintenance / Repairs – (Reliability)**
 - **Shutdowns & Turnarounds**
 - **Scheduled & Unscheduled**
- **Why? (Flexibility)**
- **Meet New Specifications - Products, Environmental, Others ?**
- **Different Feedstocks -Different Products**
- **Different Operating Mode**
 - **Distillate Mode + Propylene**
 - **Gasoline Mode + Petrochemical Feedstocks**

Need for Revamps? Why

- **Different Feedstocks**
 - **More Severe HDT**
 - **Less Heavy Crudes /**
 - **Less Resid or (More Resid Heavy Crudes??)**
- **Lighter Feeds –**
 - **Tight Oil**
 - **Condensates**
 - **Naphtha (paraffinic)**
 - **Others??**





Need for Revamps?

- **Change Current Operating Modes & Feedstocks**

To:

- **Gasoline + Alkylate (G&A) - More C3=**
- **More Petrochemicals – Olefins & Aromatics**
Alkylate- Olefins & Aromatics
(30 ppm S Gasoline - May 1st Refcom Gal 19 Pres.)
- **Different Mode – More Distillate + C3=**



Existing Unit Limits ? Pg. 1

Do you know... (Take a GOOD LOOK)

Feedstocks & Products Flexibilities

- **Longer Term Supply**
- **What Crude / Feedstocks Available?**
- **What Potential FS from other process units ?
Cokers, Visbreakers, Hydrotreaters
/Hydrocrackers, Lube Plant, etc.**
- **Potential Feedstocks from the surrounding area?
Chemical Plants, Lube Plants, Power Plants
(Coal), etc.**



Existing Unit Limits ? Pg. 2

Do you know... (Take a GOOD LOOK)

Converter Section Reactor / Regenerator

- **Max. / Min Fresh/ Recycle Feedrates**
- **What Feedstock Qualities & Variability**
- **What Product Slate / Slates ?**



Existing Unit Limits ? Pg. 3

Do you know... (Take a GOOD LOOK)

- **Air Blower Rates / Coke Burning Rates**

- **Min / Max -**

To Increase:

- **Reducing Delta P**
- **O2 Enrichment**
- **Remove/Replace Orifice Chamber With Valves(?)**

Existing Unit Limits ?

Pg. 4

Do you know... (Take a GOOD LOOK)

- **Catalyst Circulation Rates – Limitations / Increase?**
 - **Standpipe Delta P's**
 - **Increase Bed Levels**
 - **Increase/Improve Fluidization**
 - **Aeration Taps**
- **Coke Burning Rates (Regen Locations / 2 Stages)**
- **Stripping / Dispersion Steam Rates**
- **Lift Gas Rates - Riser/ Transfer Lines Standpipe (Even if Possible?)**



Existing Unit Limits ?

Pg 5

Do you know... (Take a GOOD LOOK)

- **Coke Burning**
- **Reactor Cat Stripper**
 - **How Effective.....**
 - **Steam Quantity Entrained to Regen**
 - **Light Feedstocks ?**
 - **Cool Regenerator**
 - **Cut Stripping Steam**
 - **or**

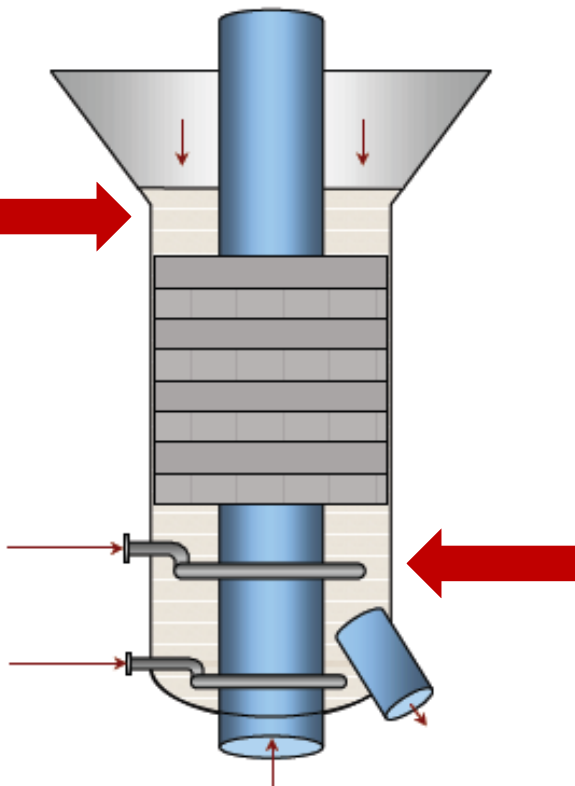


Stripper

Dispersed “Lean Oil” to Rx Stripper for carry over into the regenerator

- **Example**

Stripper Packing Internals



- KFBE™ packing is actually a mixing element
- Full cross-sectional area used (minus blade width is 97% open)
- Much lower flux is achieved, allowing small bubbles to rise
- Small bubbles promote good contacting

Lean Oil Location



Existing Unit Limits ?

Do you know... (Take a GOOD LOOK)

Main Column ... (Heat Removal)

- **Reduce Delta P - (packing)**
- **Improve Fractionation**
 - **Install Product Draws LCG / HCG**
 - **LCO /HCO Product Draws**
- **Install a Second Fractionation Column**
 - **Parallel Column**
 - **Preflash Column**
 - **New Top Section – in Series**



Existing Unit Limits ?

Do you know... (Take a GOOD LOOK)

Main Column ... (Heat Removal)

- **Bottoms / Slurry**
 - **Recycle for Heat Balance / Increase Coke Make**
 - **PREVENT TOWER BOTTOMS COKING**
 - **Slurry Product for Cokers!**



Existing Unit Limits ?

Do you know... (Take a GOOD LOOK)

Gas Concentration

- **Wet Gas Compressor –**
- **Absorbers / Strippers**
- **Treating (Various)**

Product Recovery

- **Splitters –**
 - **Naphtha/Gasoline**
 - **Propylene / Propane**



Existing Unit Limits ?

Do you know... (Take a GOOD LOOK)

Downstream Units

Alkylate Feedstocks --- Butylenes

/Pentenenes ?

FCC Gasoline Hydrotreaters – (Invista – Refcom Gal 2019)

- **Solvent Extraction Technology – Sweetening, & Aromatics**

ANYTHING ELSE ???



Need for Revamps?

More Reliable - More Flexible

- **Operational & Maintenance Reliabilities**
- **Feedstocks & Products Flexibilities**

Maximum Unit Flexibility

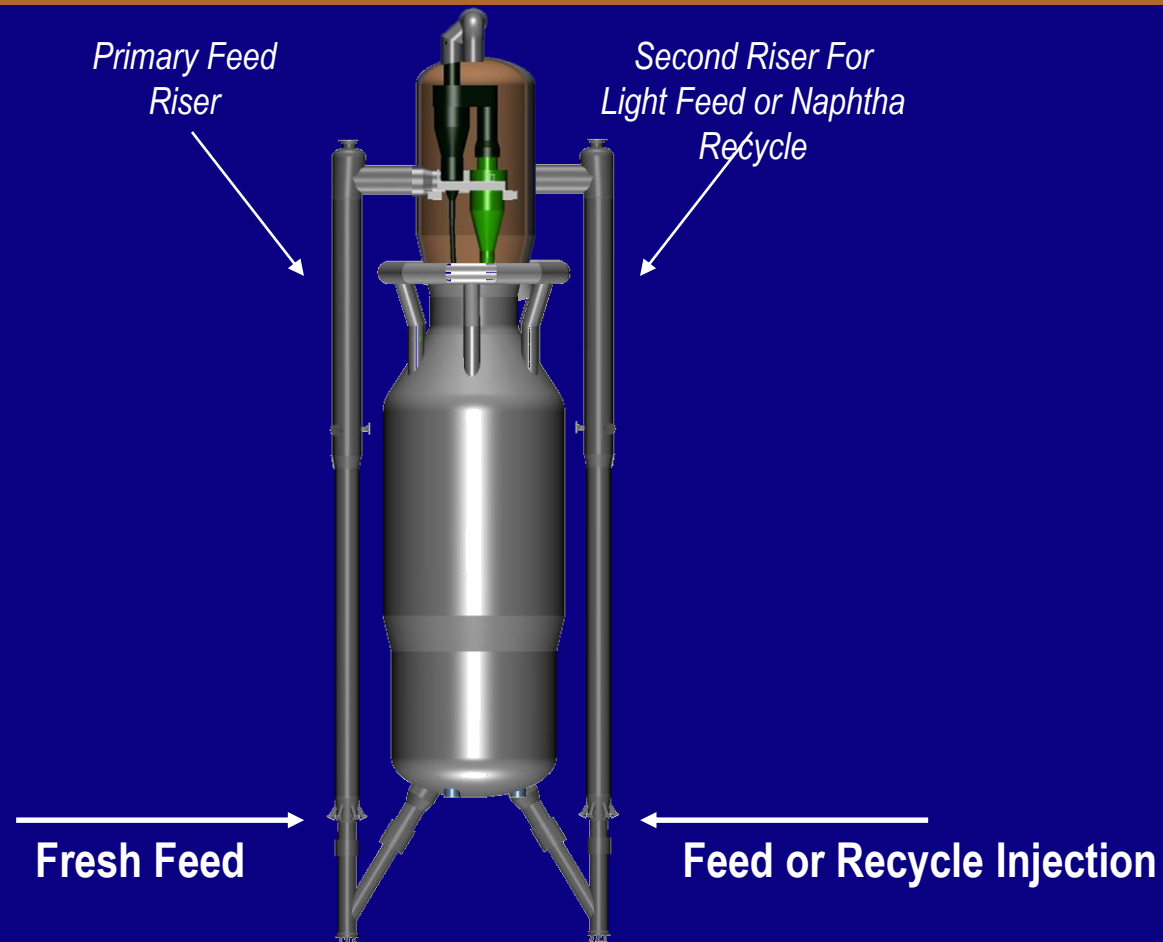
- **Install / Utilize 2nd Cracking Reaction Zone**



Need for Revamps?

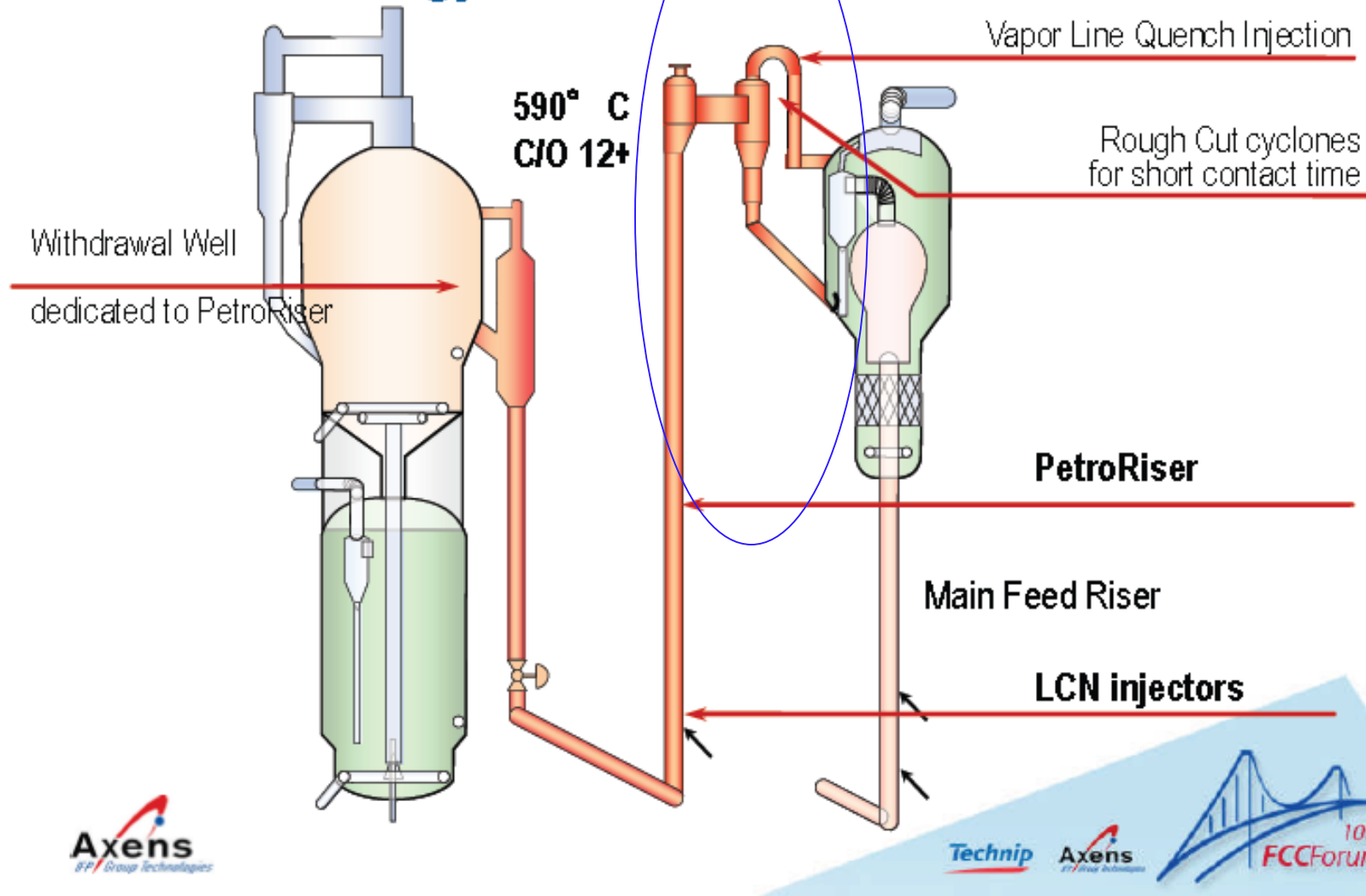
Maximum Unit Flexibility

- **Install / Utilize 2nd Cracking Reaction Zone**
- **Separate (2nd) Reactor Vessel
& Fractionation Sections**

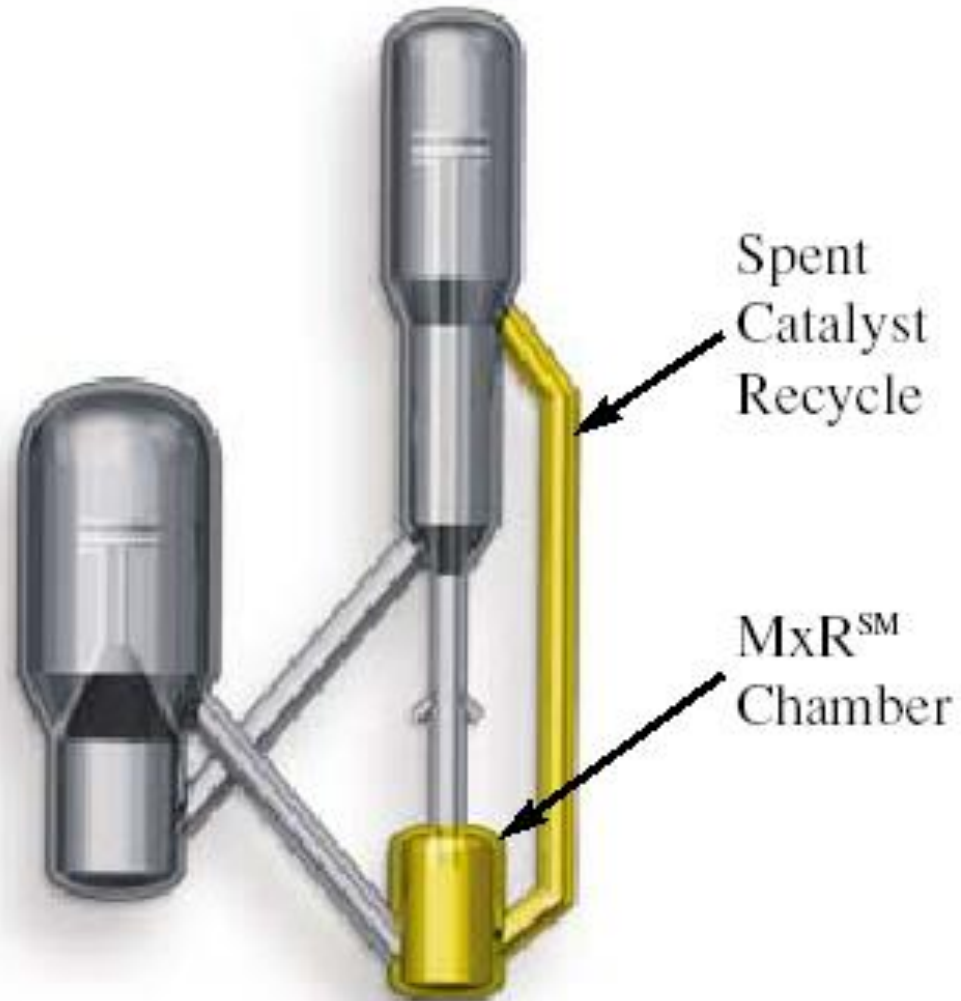


R2P Technology with PetroRiser™

Potential 2nd Rx
Vessel

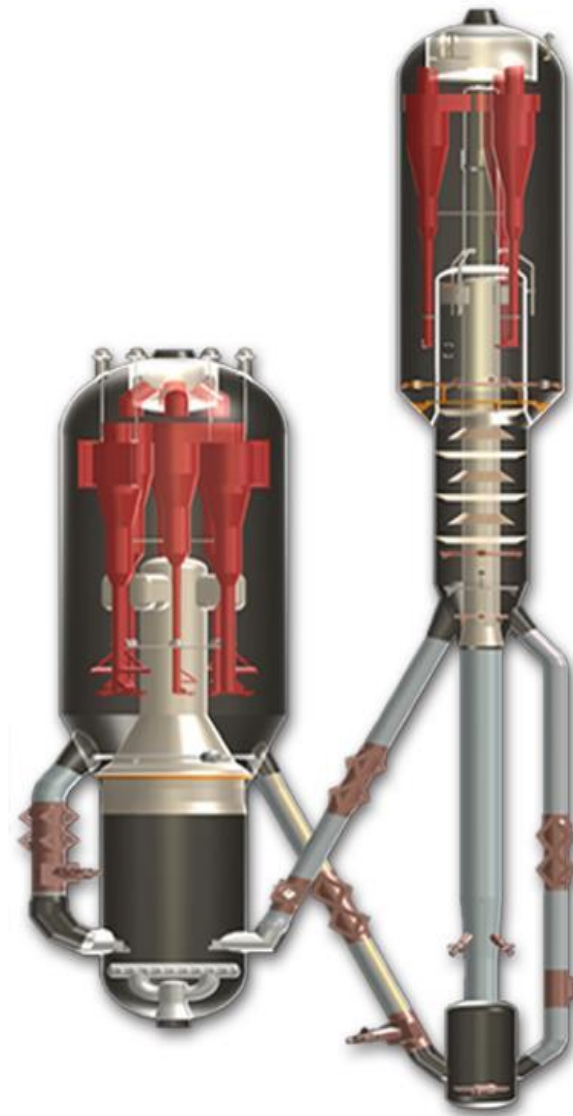


590 Deg C = 1100 Deg F



RxCat Technology Process Design

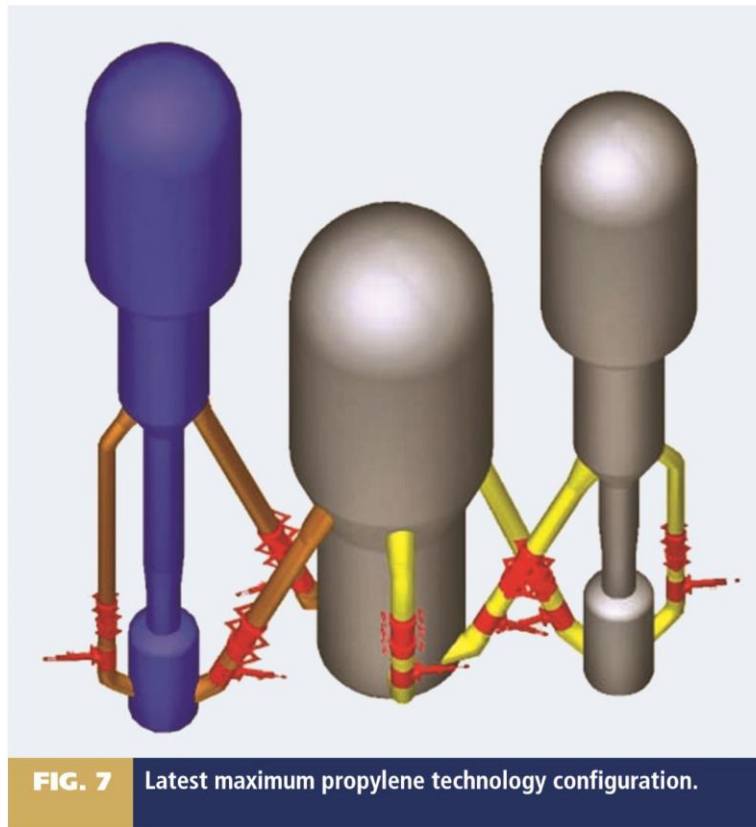
- Increases Regenerator Temperature
- Mixes Spent & Regen in Mixing Chamber at base of Riser



Need for Revamps?

Maximum Unit Flexibility

- Install / Utilize 2nd Cracking Reaction Zone



Maximize propylene
from your FCC unit

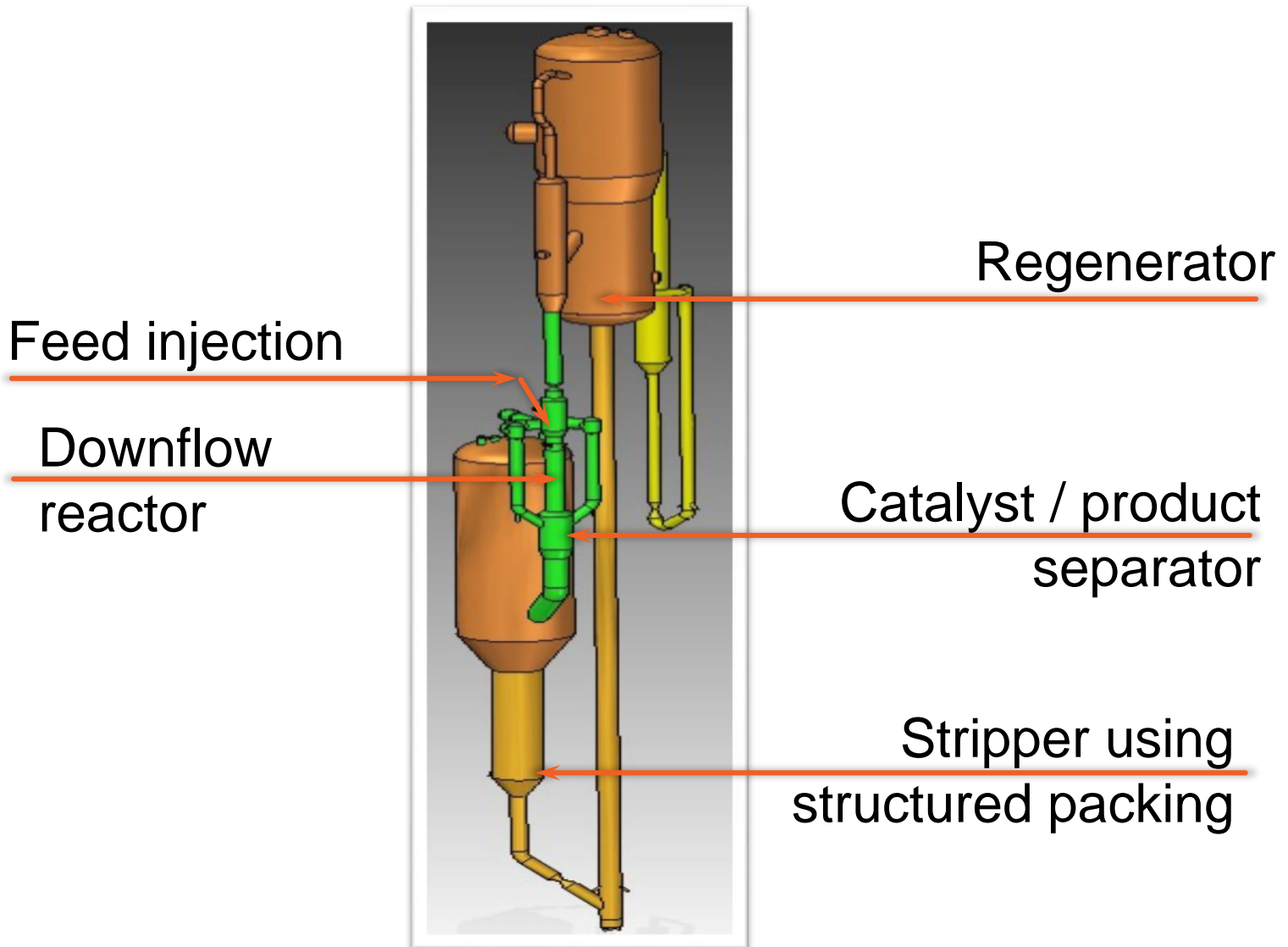
Innovative use of catalyst and operating conditions
increases on-purpose olefin production

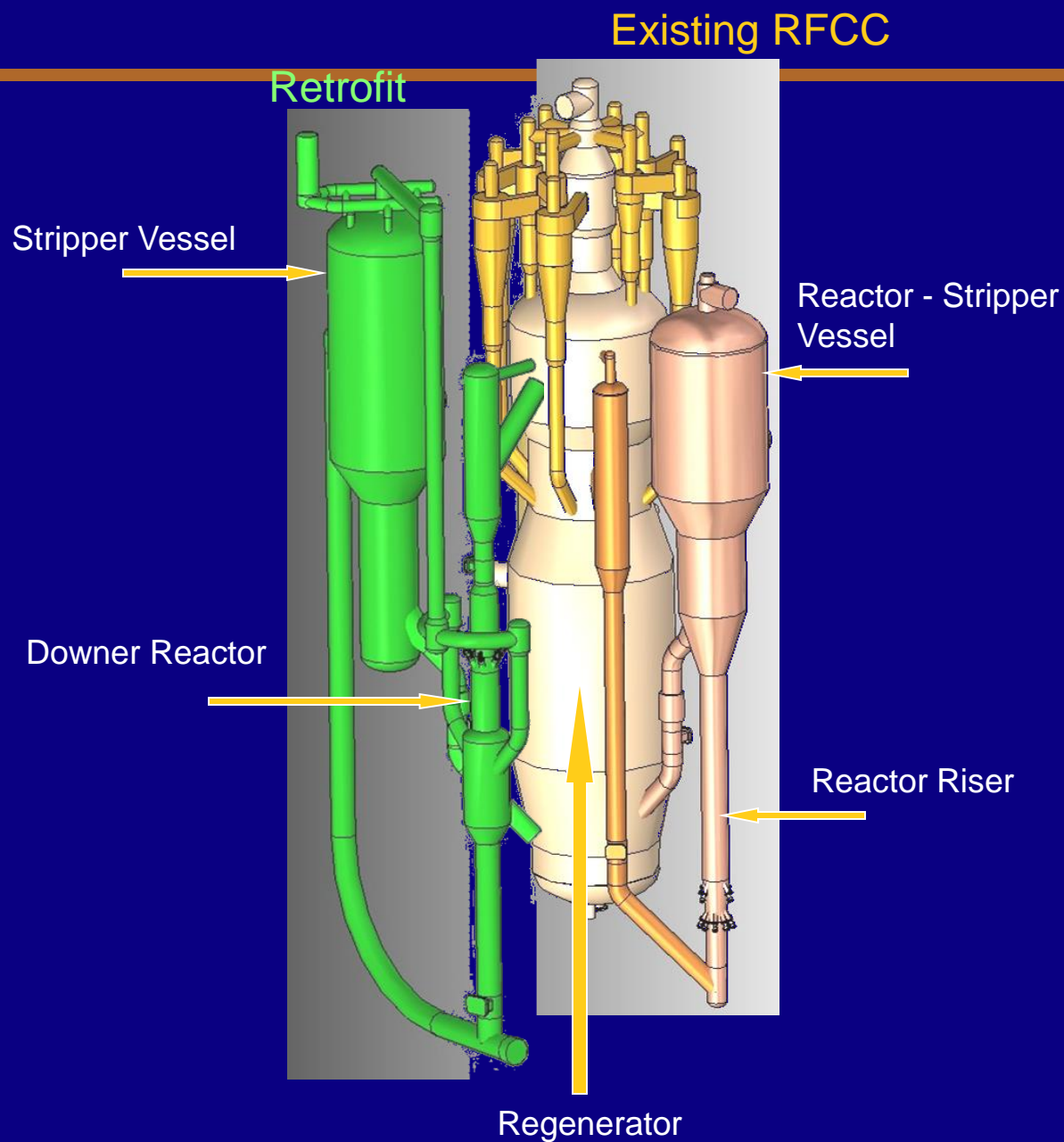
J. KNIGHT and R. MEHLBERG, UOP LLC, A Honeywell Co., Des Plaines, Illinois

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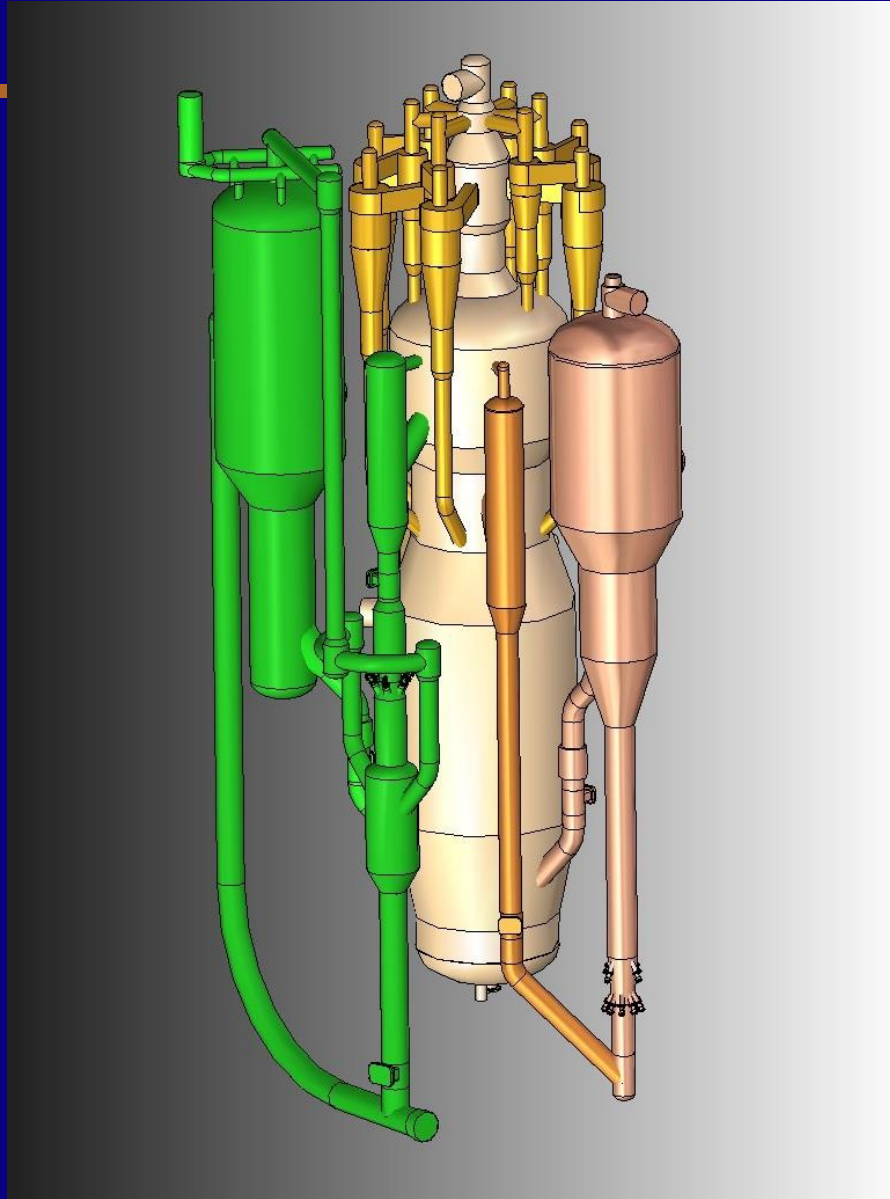
**HYDROCARBON
PROCESSING®**

HS-FCC Key Components





HS-FCC RETROFIT EXAMPLE



Block Flow Diagram

Polymer Grade
Ethylene & Ethane
to Steam Cracker

Refinery Off
Gas
Purification
(ROG)

Quench
Tower
&
Gas Recovery

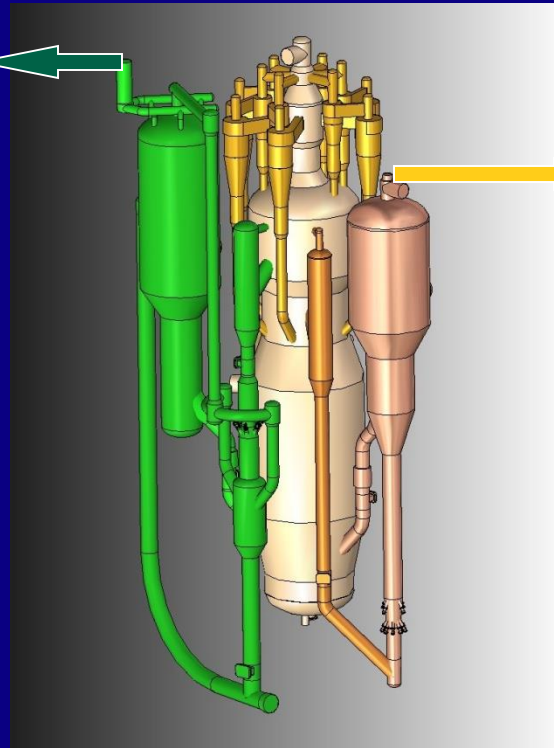
C₃ C₄
Purification
& Separation

Polymer Grade
Propylene & Propane
to Steam Cracker

Fuel Grade Products
to Sales

Fract. Plant
& Gas Recovery

Main Column &
Unsaturate Gas
Plant ; Treating to
produce Fuel
Grade Products





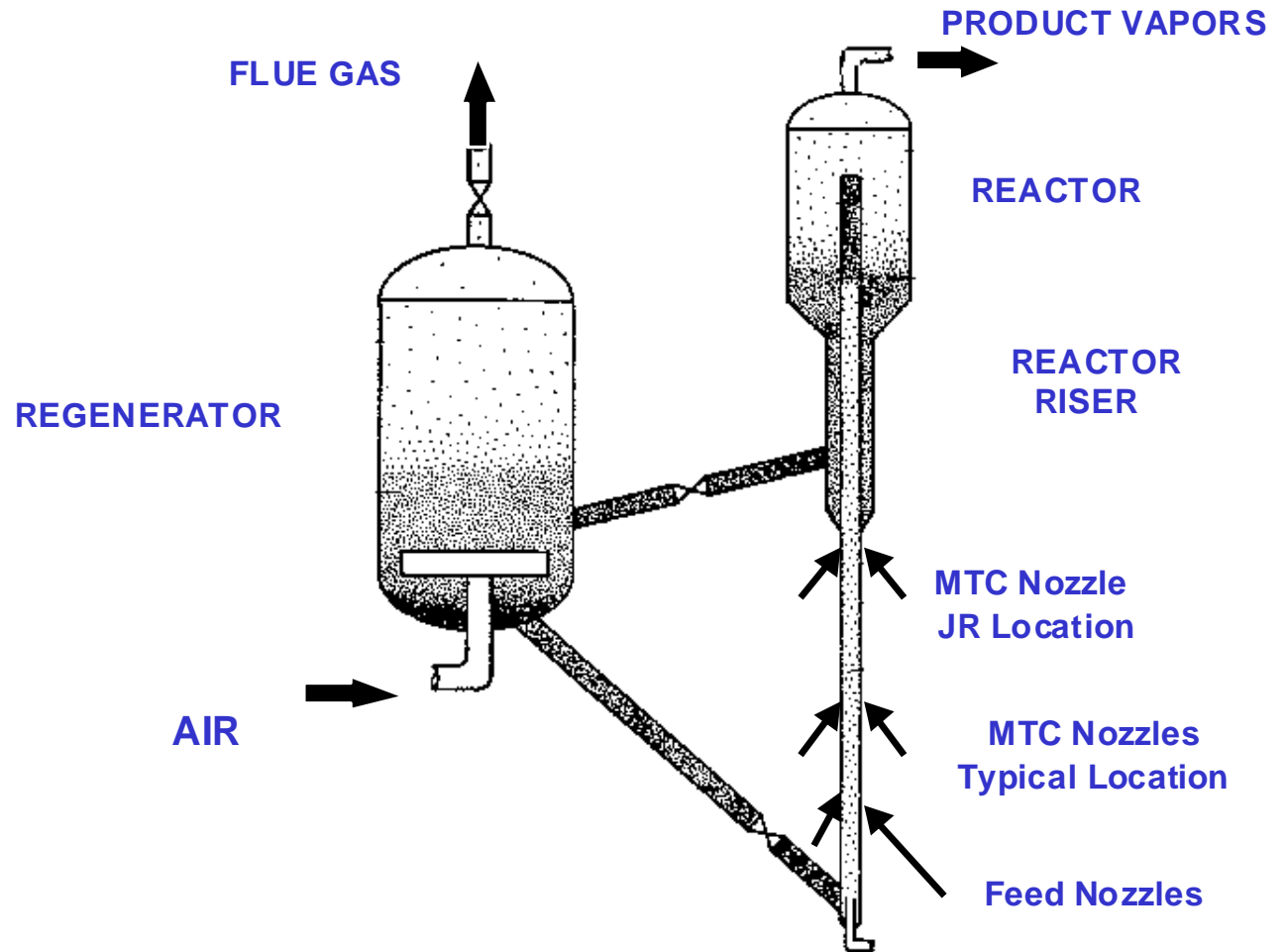
Need for Revamps?

Maximum Unit Flexibility

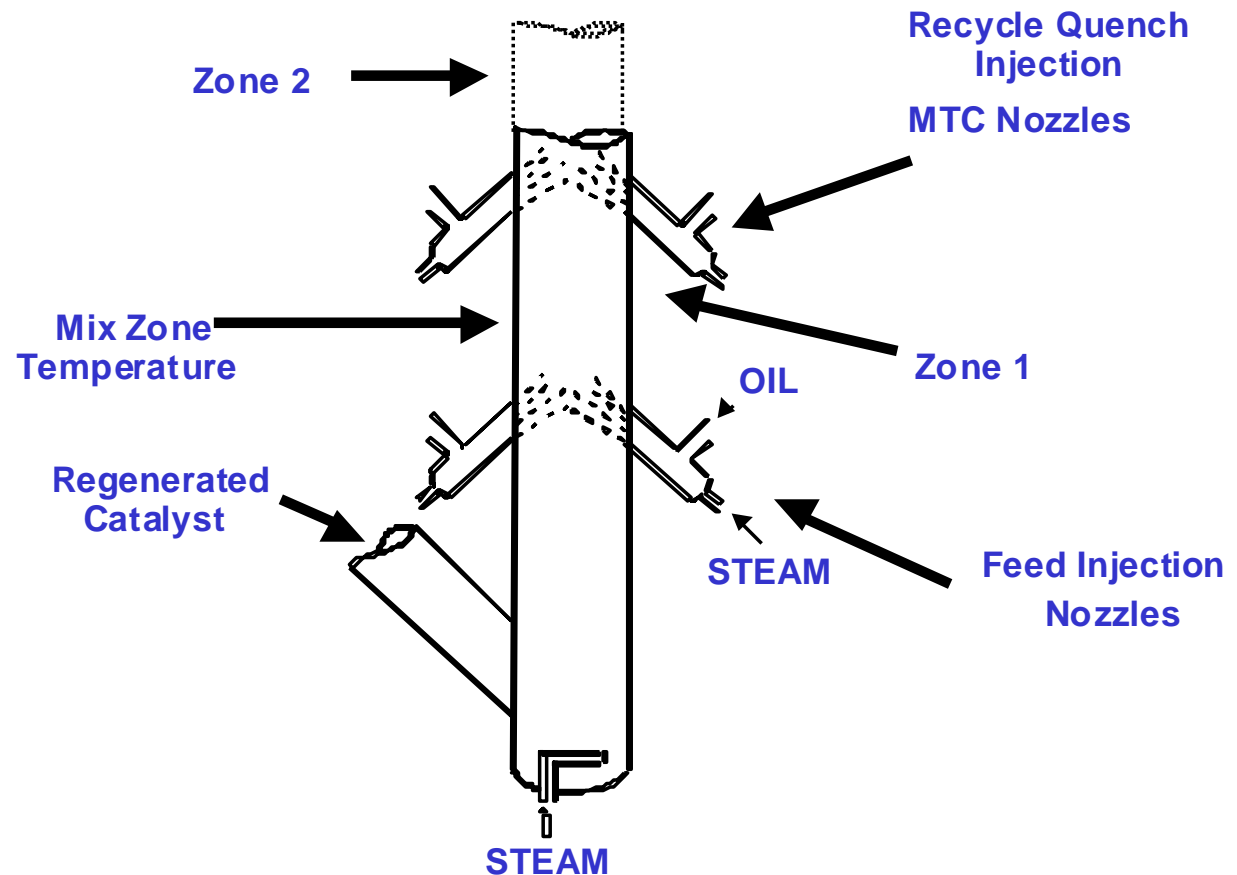
- **Install / Utilize 2nd Cracking Reaction Zone**
- **Separate (2nd) Reactor Vessel
& Fractionation Sections**
- **2 Rx Zone in a Single Riser**

MTC NOZZLE ELEVATION LOCATIONS

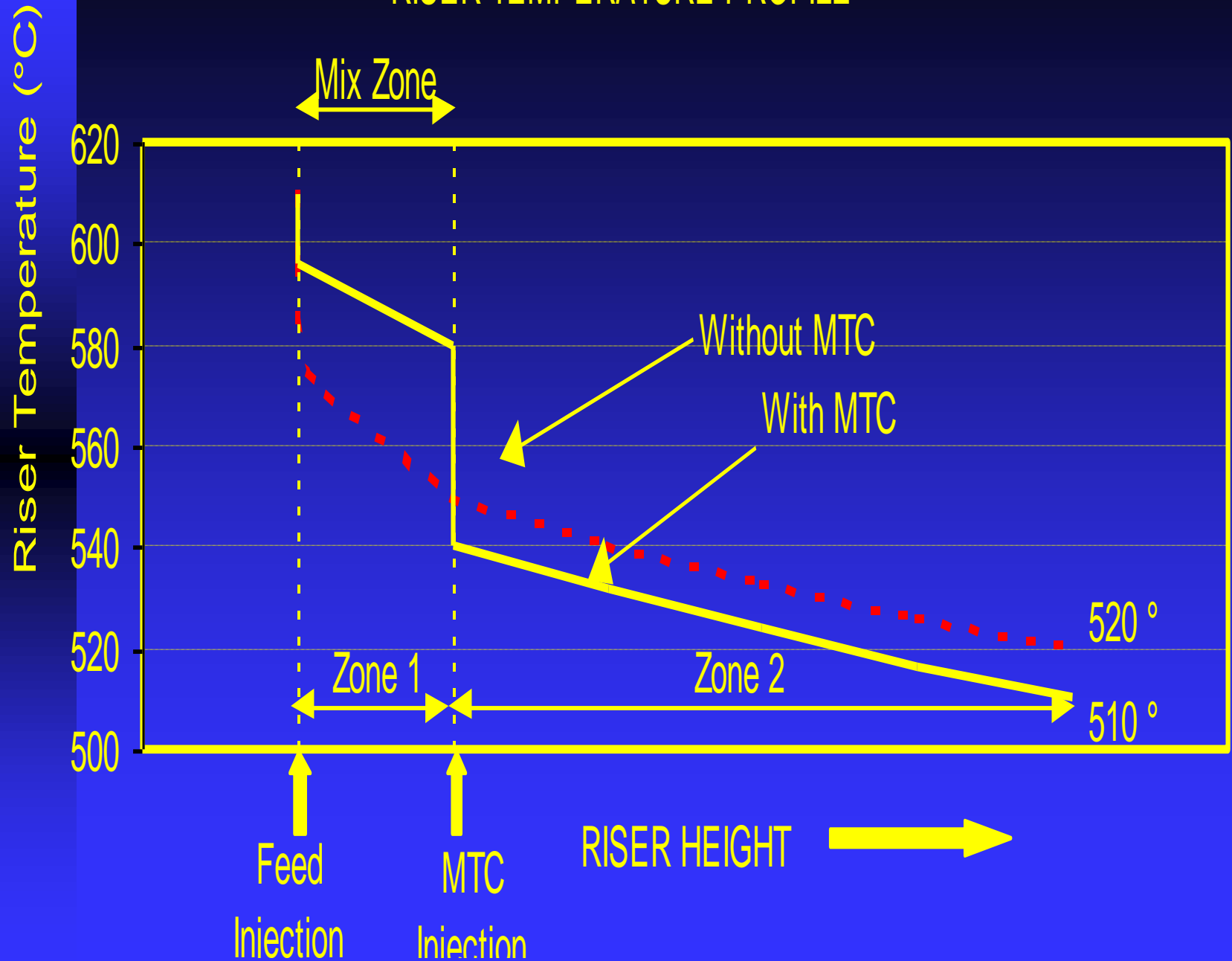
REACTION SECTION



MIX TEMPERATURE CONTROL (MTC)



RISER TEMPERATURE PROFILE





Need for Revamps?

Maximum Unit Flexibility

- **Install / Utilize 2nd Cracking Reaction Zone**
- **Separate (2nd) Reactor Vessel
& Fractionation Sections**
- **PRODUCE PETROCHEMICALS from LIGHT
FEEDSTOCKS - Naphtha / Paraffinic
(LSR/ Condensates, Others)**

Petrochemicals Opportunities

Main Building Blocks ← Produced by Steam Cracking
Ethane & Liquid Feeds
Naphtha Reformers

- **Olefins - Two Main Blocks**

- Ethylene

- Propylene ← Secondary Source Produced by FCC's

- Butylenes ← Co-monomer & ALKY Feedstock

- **Aromatics**

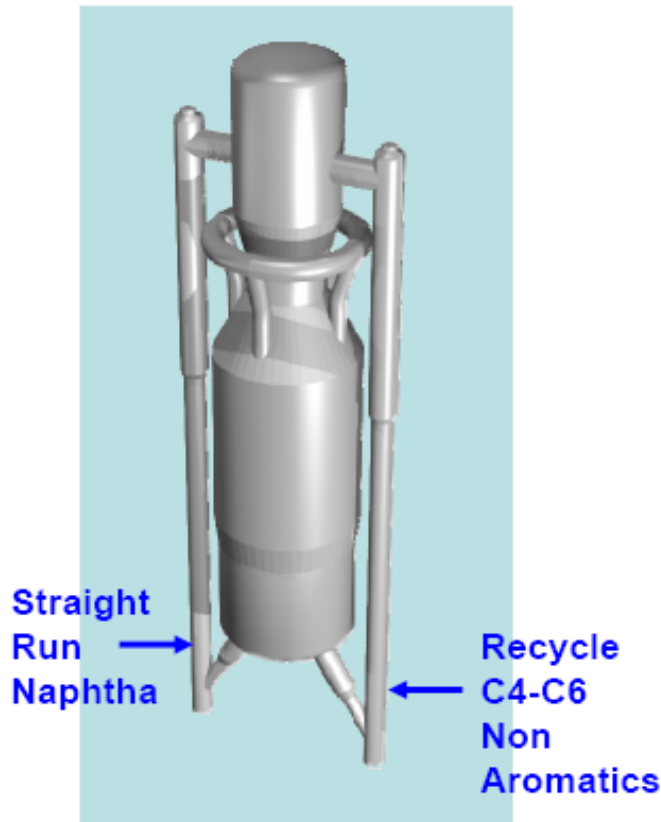
- Benzene

- Paraxylene (other xylenes too)

* High Olefins - FCC (HOFCC) produces C3= and byproducts of other light olefins and aromatics

Advanced Catalytic Olefins (ACO) Process

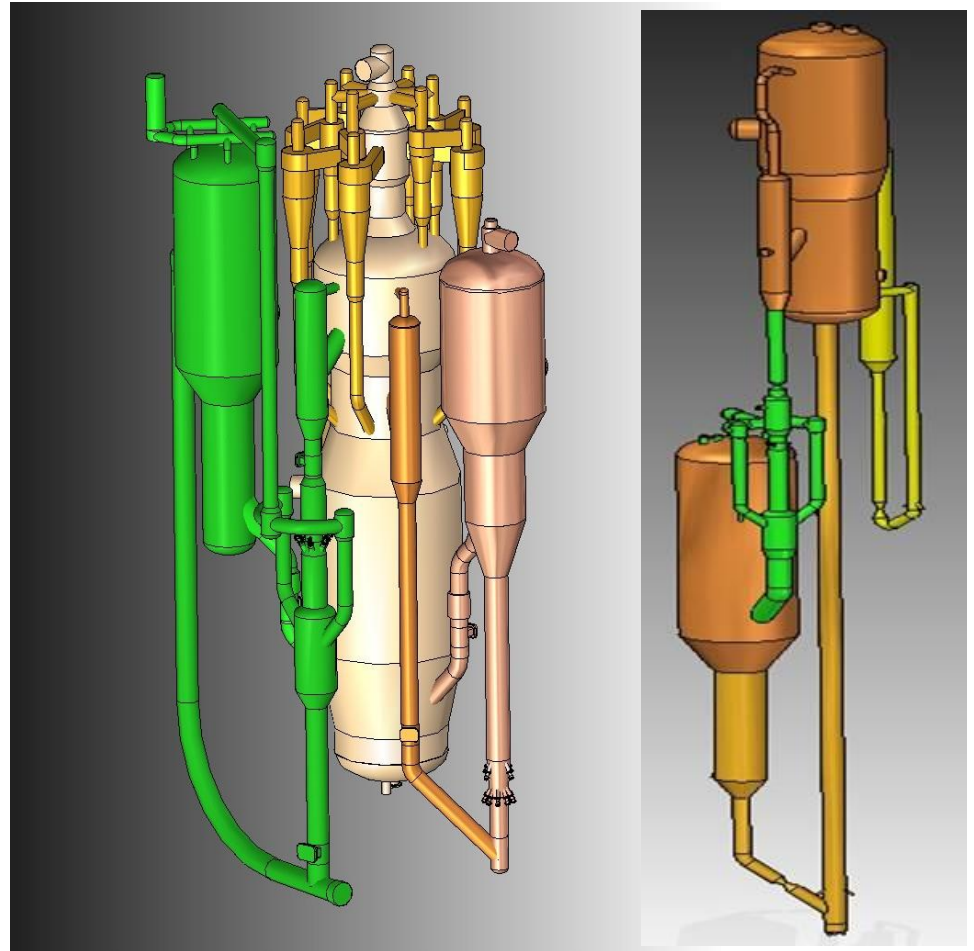
ACO Process Key Features - Reactor



- ◆ Proprietary KBR FCC reactor features
- ◆ Propylene/ethylene (P/E) Product Ratio ~1/1
- ◆ Proprietary catalyst from SK Corporation
- ◆ All proven hardware and processes
- ◆ Robust and flexible, compared to other processes

HS-FCC Naphtha Process

- Retrofit Type to existing FCCU
- Standalone Unit



Naphtha Cracking Fluid Processes

**ACO Commercial
Demonstration Unit
Ulsan, South Korea**



*** HS-FCC Semi-Commercial
Unit Mizushima, Japan
Downer Technology**



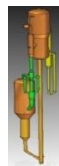
**** Downer Rx. Potential Use**

THANK YOU

The End

Questions - Comments ???

Follow-up Discussions?



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