FLOWSERVE

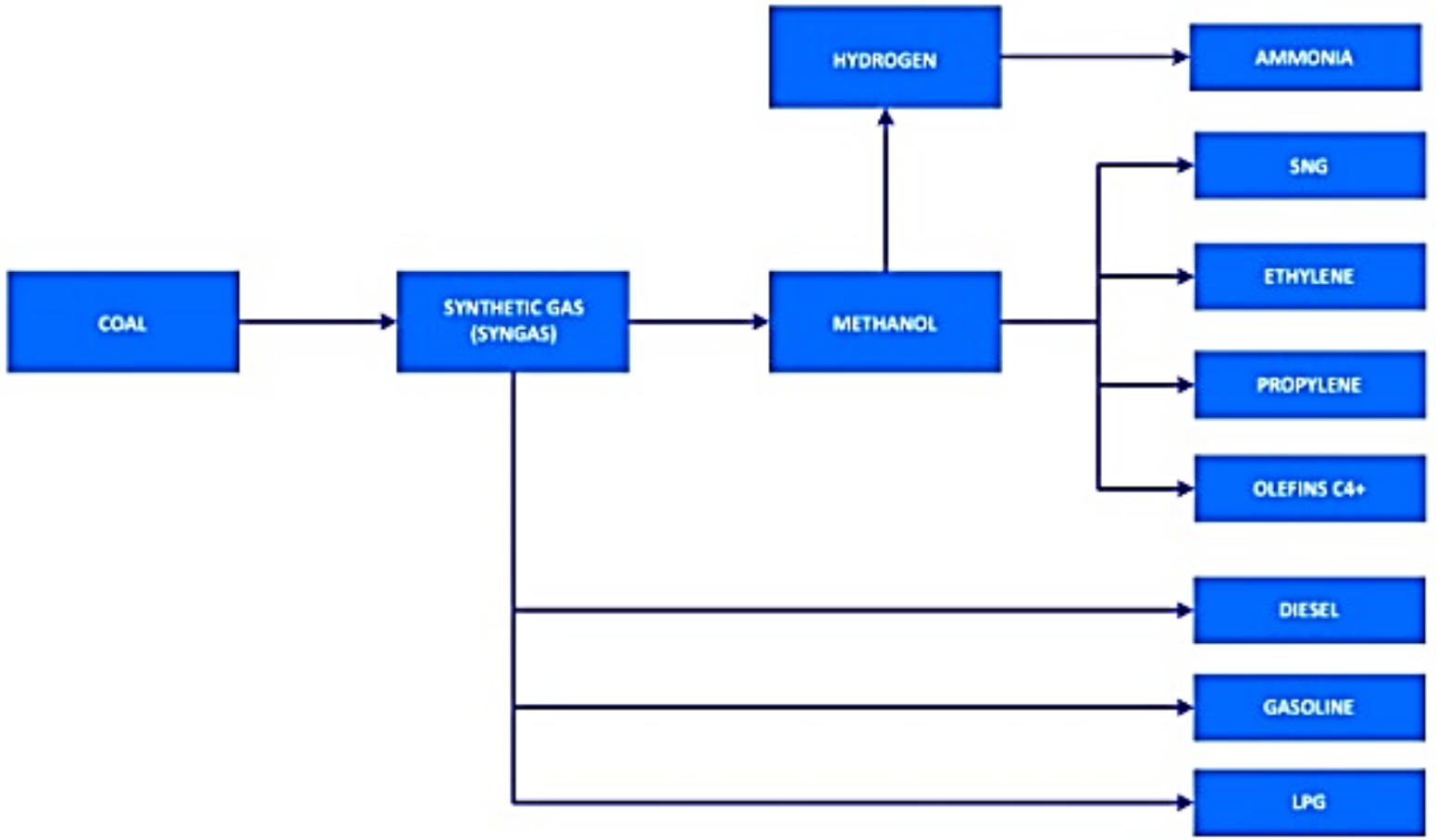
DECEMBER 2019

Process Flow Diagrams

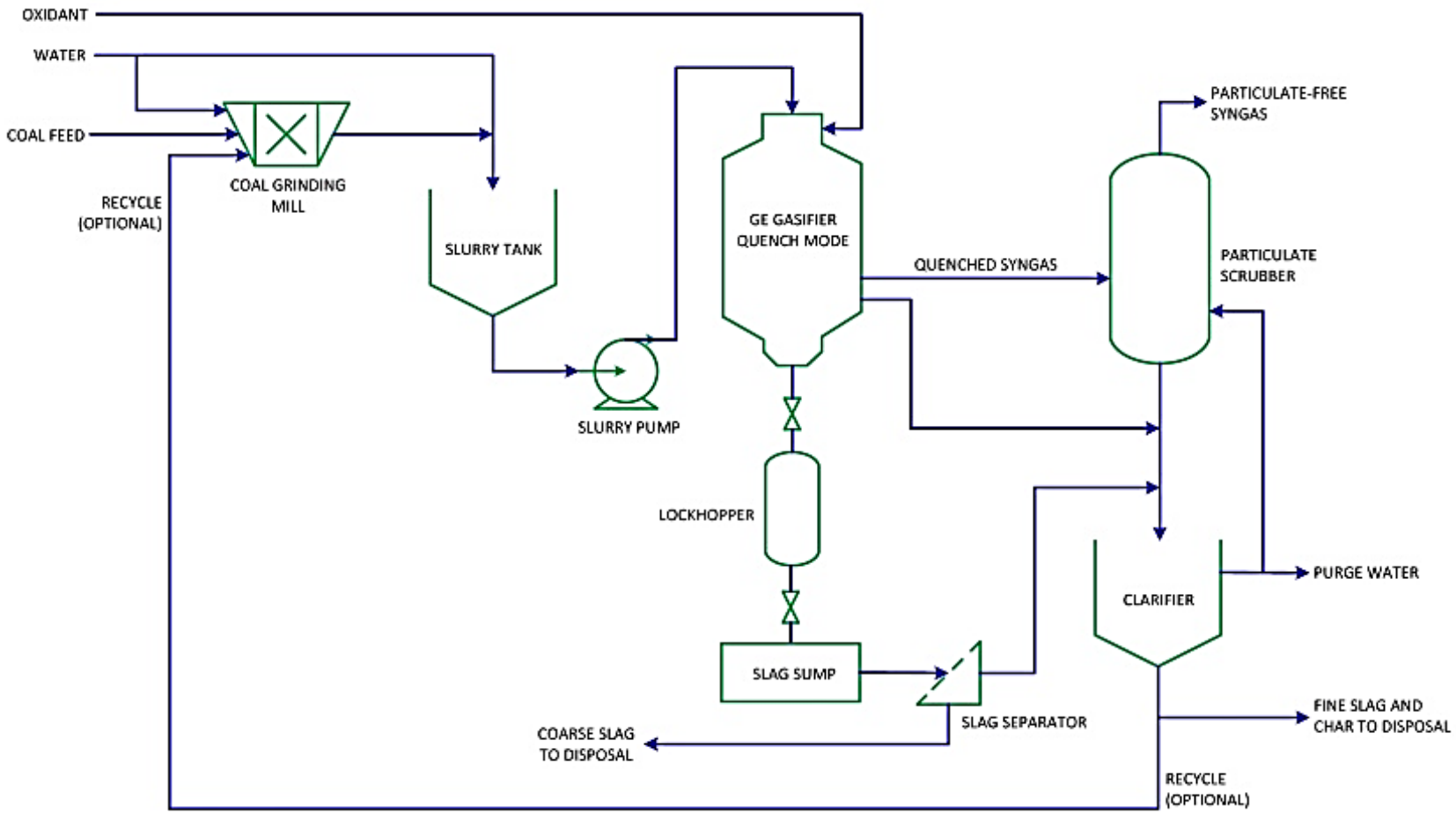
COAL TO OLEFINS (CTO) / METHANOL TO OLEFINS (MTO) API PRODUCTION

Experience In Motion

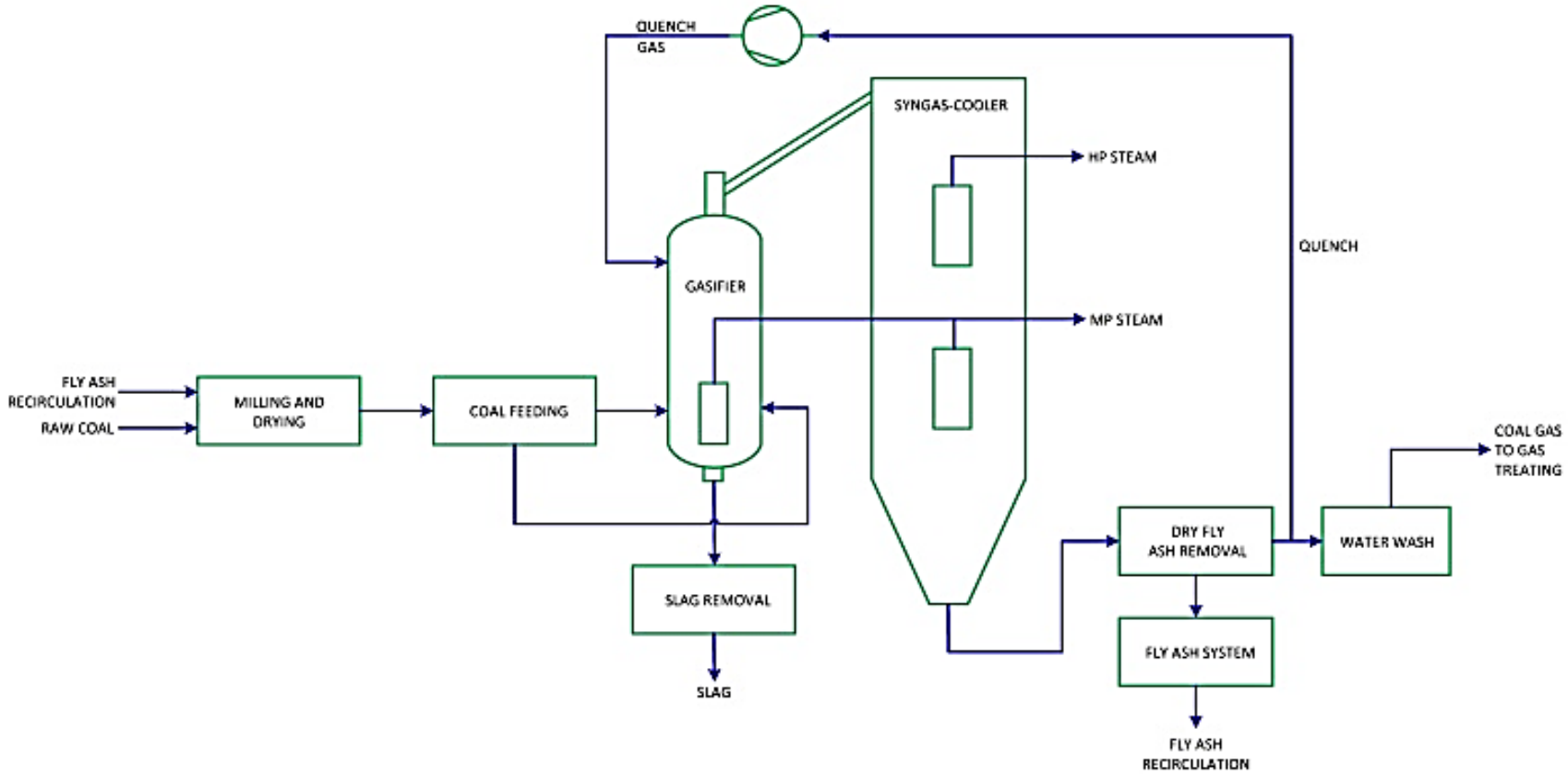
Chemicals Processed From Coal



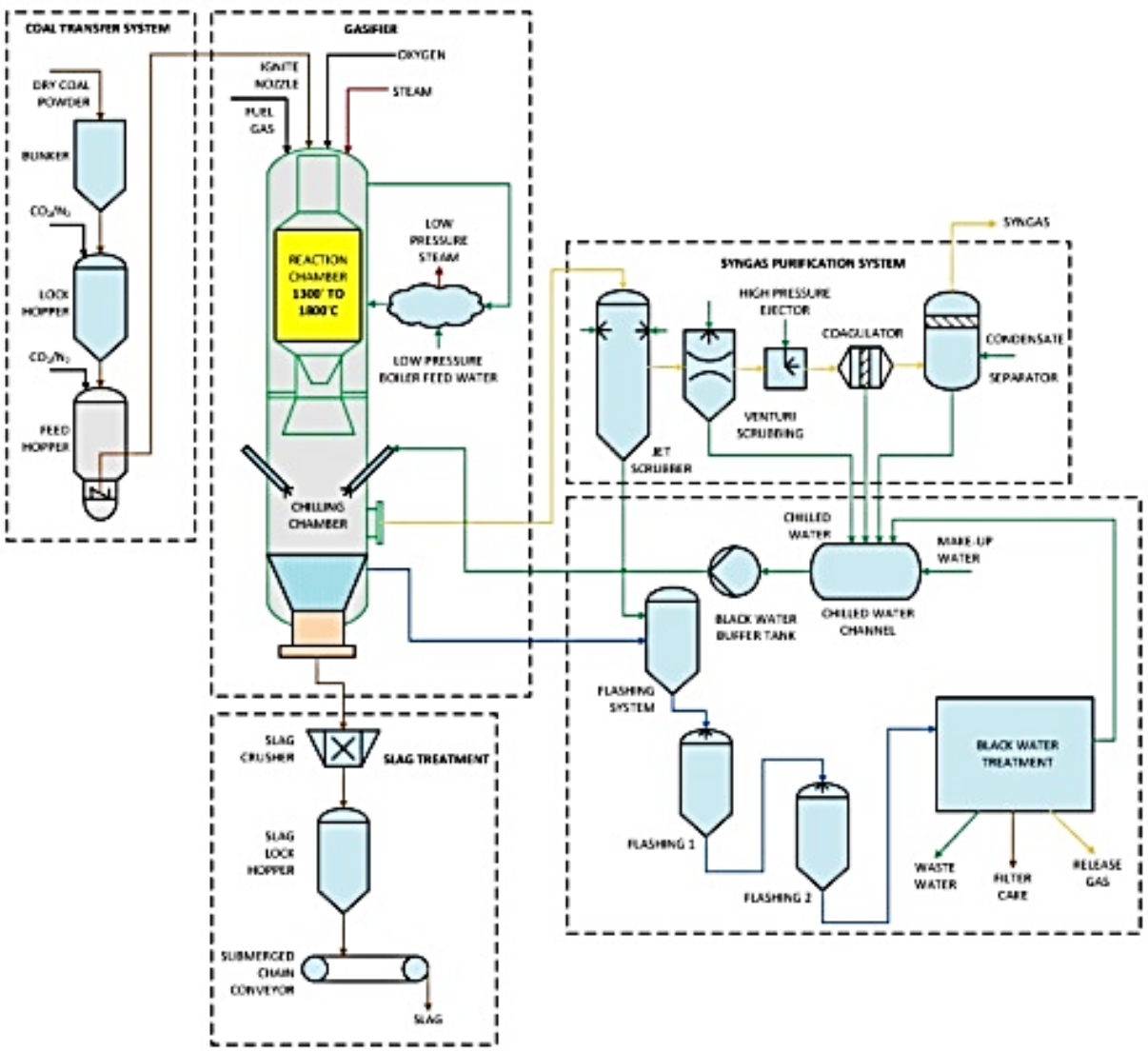
TCGP – Coal, Methanol to Olefin (2)



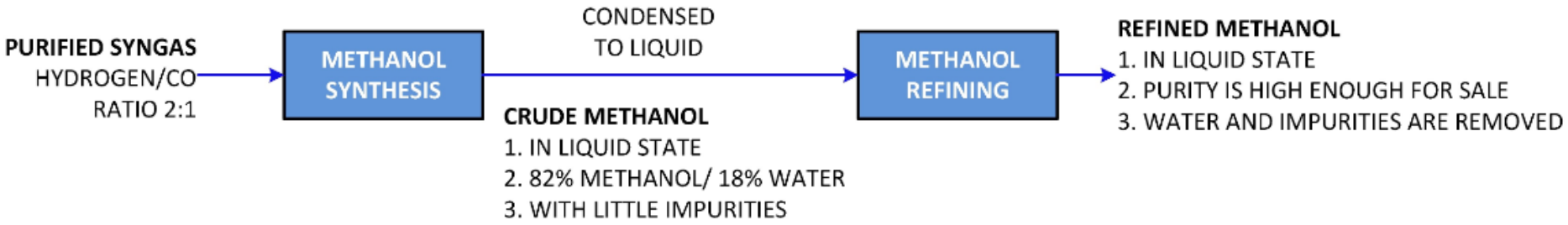
Shell's CGP – Coal, Methanol to Olefin (3)



GSP Gasification Process



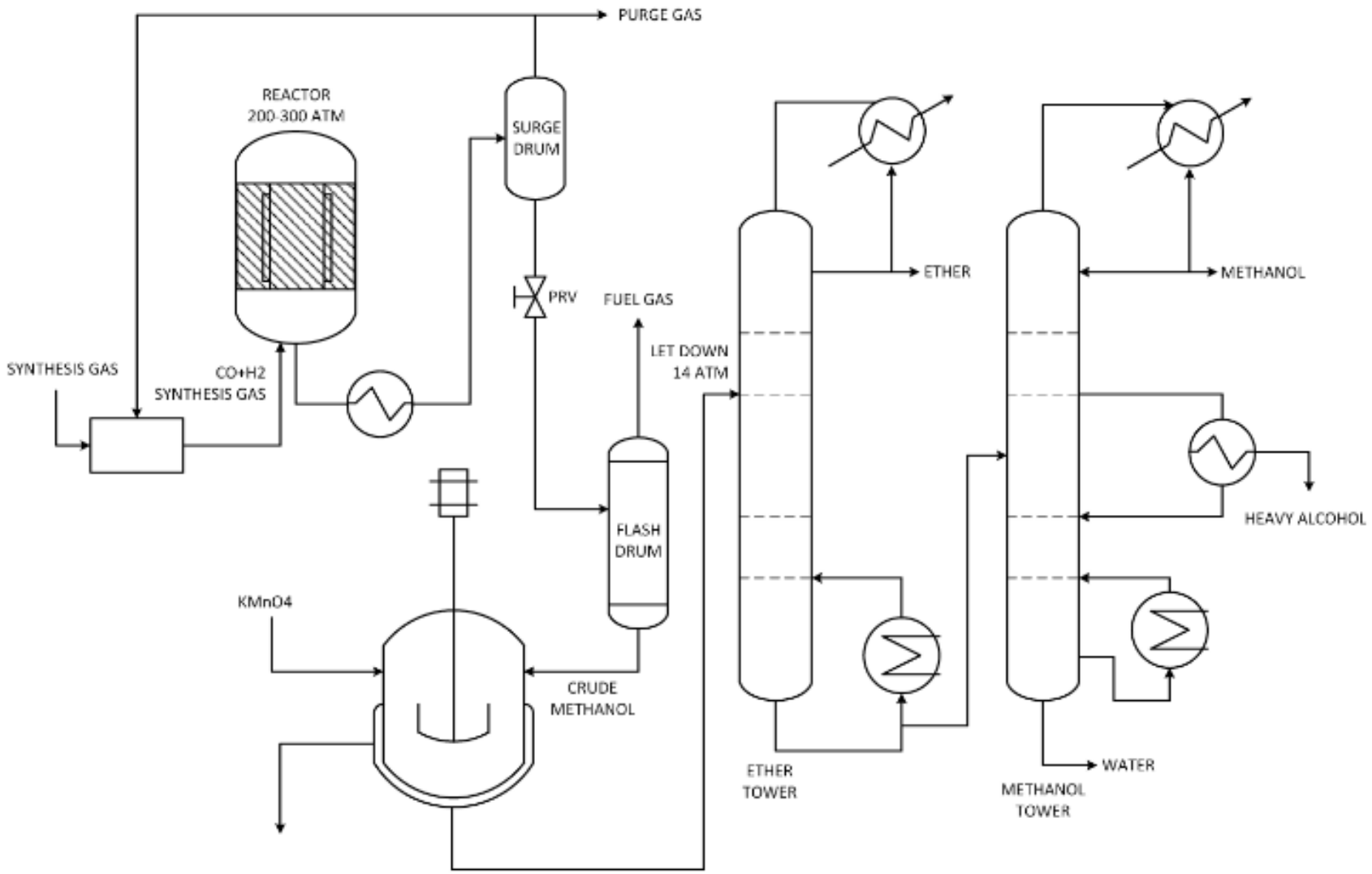
Synthetic Gas to Methanol (1)



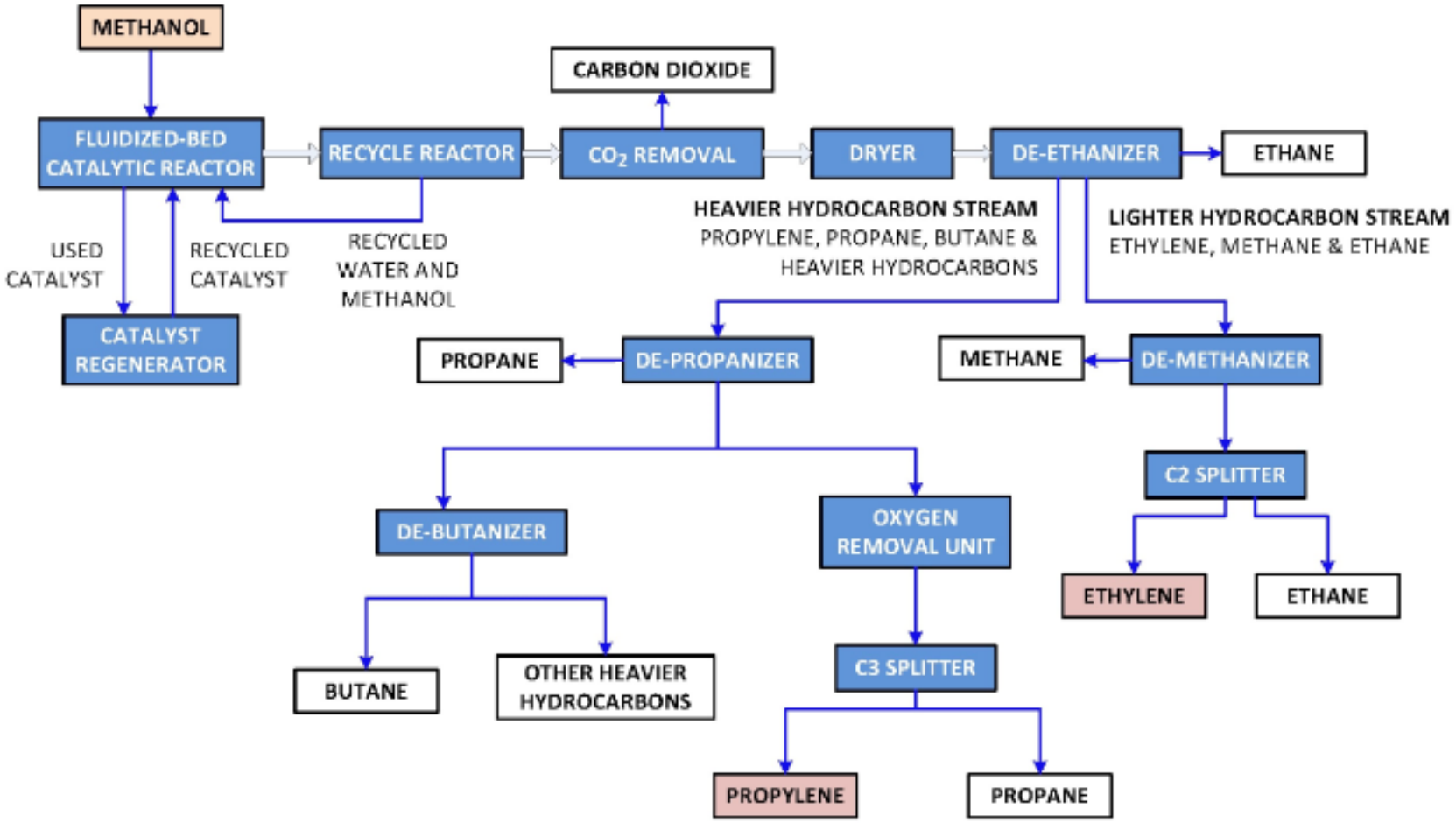
OVERALL REACTION: CARBON MONOXIDE + HYDROGEN < -- > METHANOL + HEAT

CHEMICAL EQUATION: CO (g) + 2 H_2 (g) < -- > CH3OH (g) (EXOTHERMIC)

Synthetic Gas to Methanol (2)



MTO Process – Methanol to Olefin (MTO)

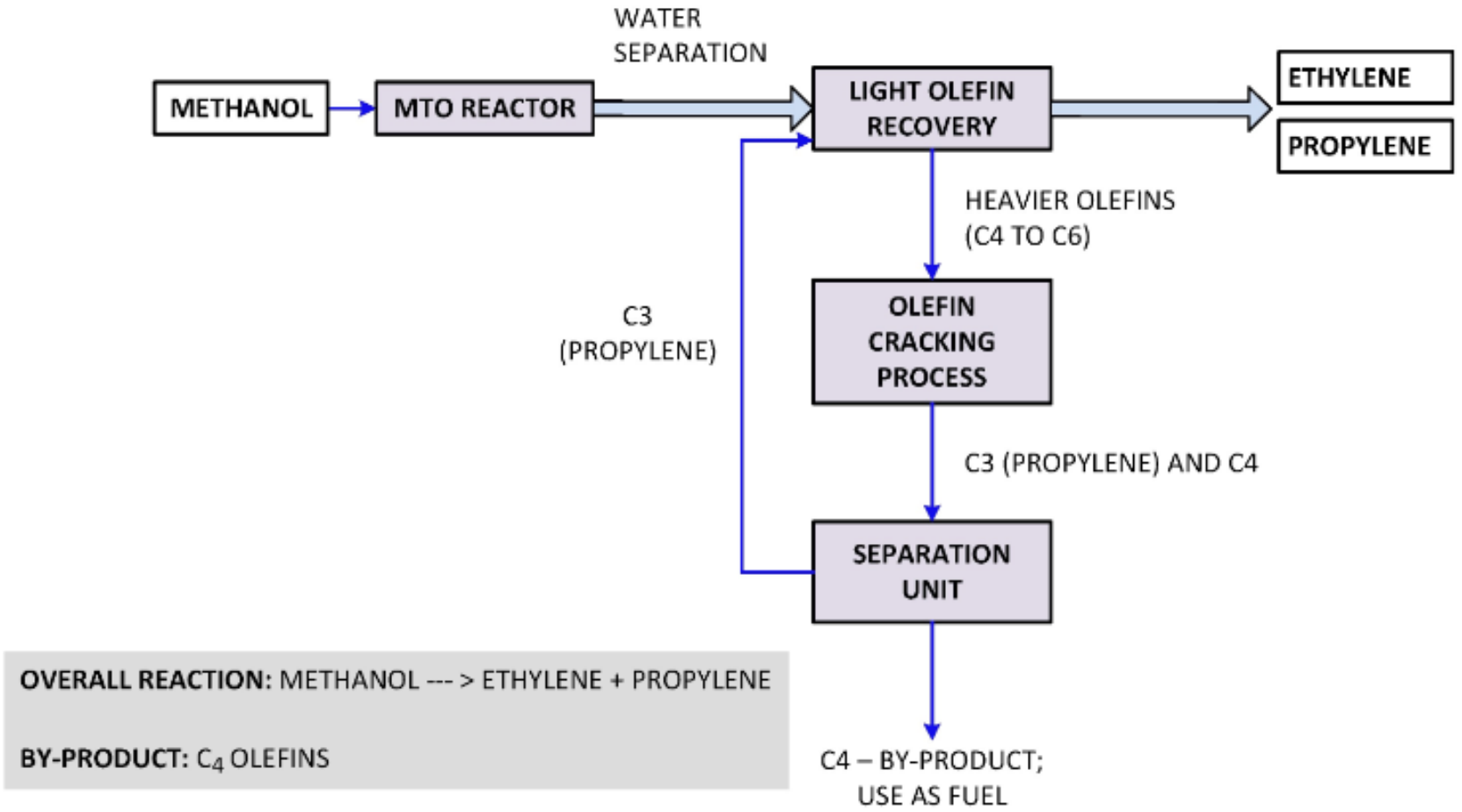


OVERALL REACTION: METHANOL --- > ETHYLENE + PROPYLENE

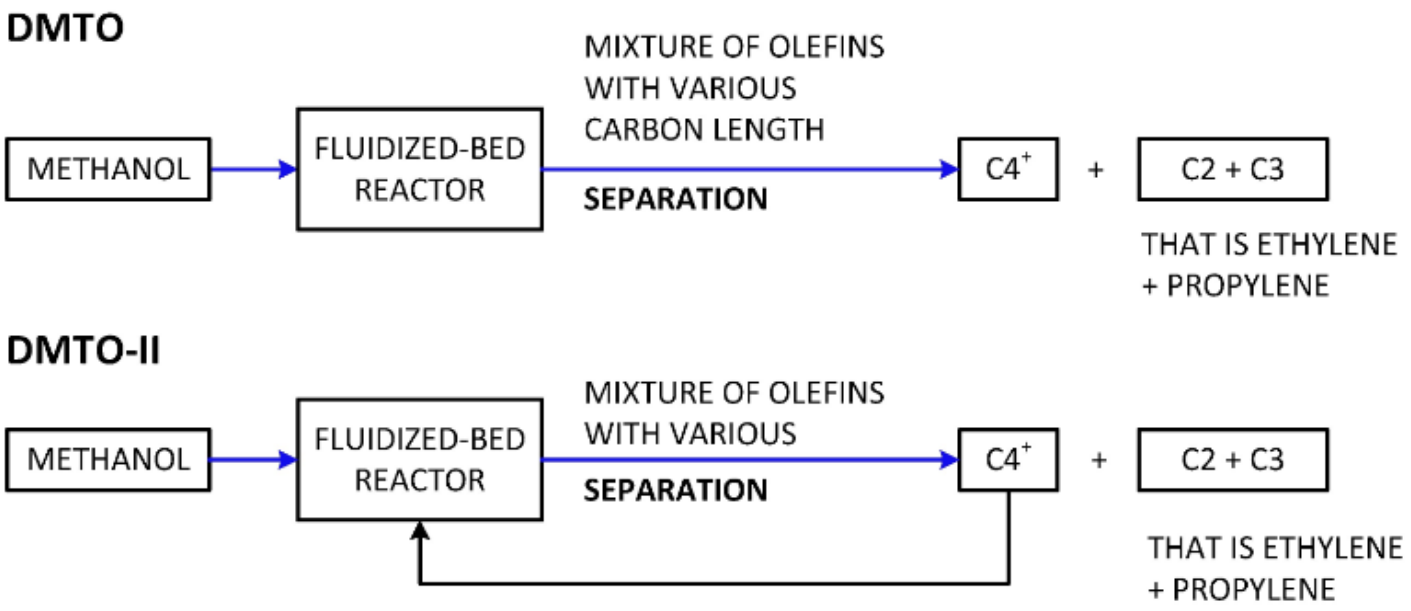
MAJOR BY-PRODUCTS: METHANE, ETHANE, PROPANE, BUTANE & OTHER HEAVIER HYDROCARBONS

CONVERSION YIELD: OVER 80% FOR COMBINED ETHYLENE & PROPYLENE

MTO Process by UOP

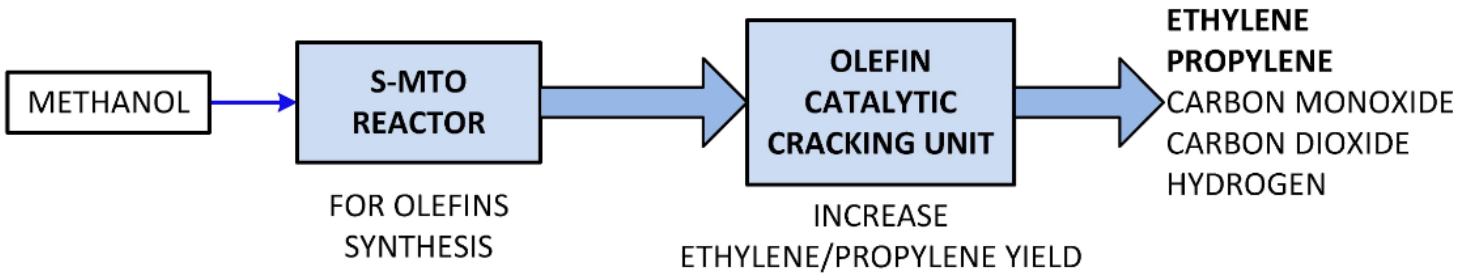


DMTO/DMTO-II



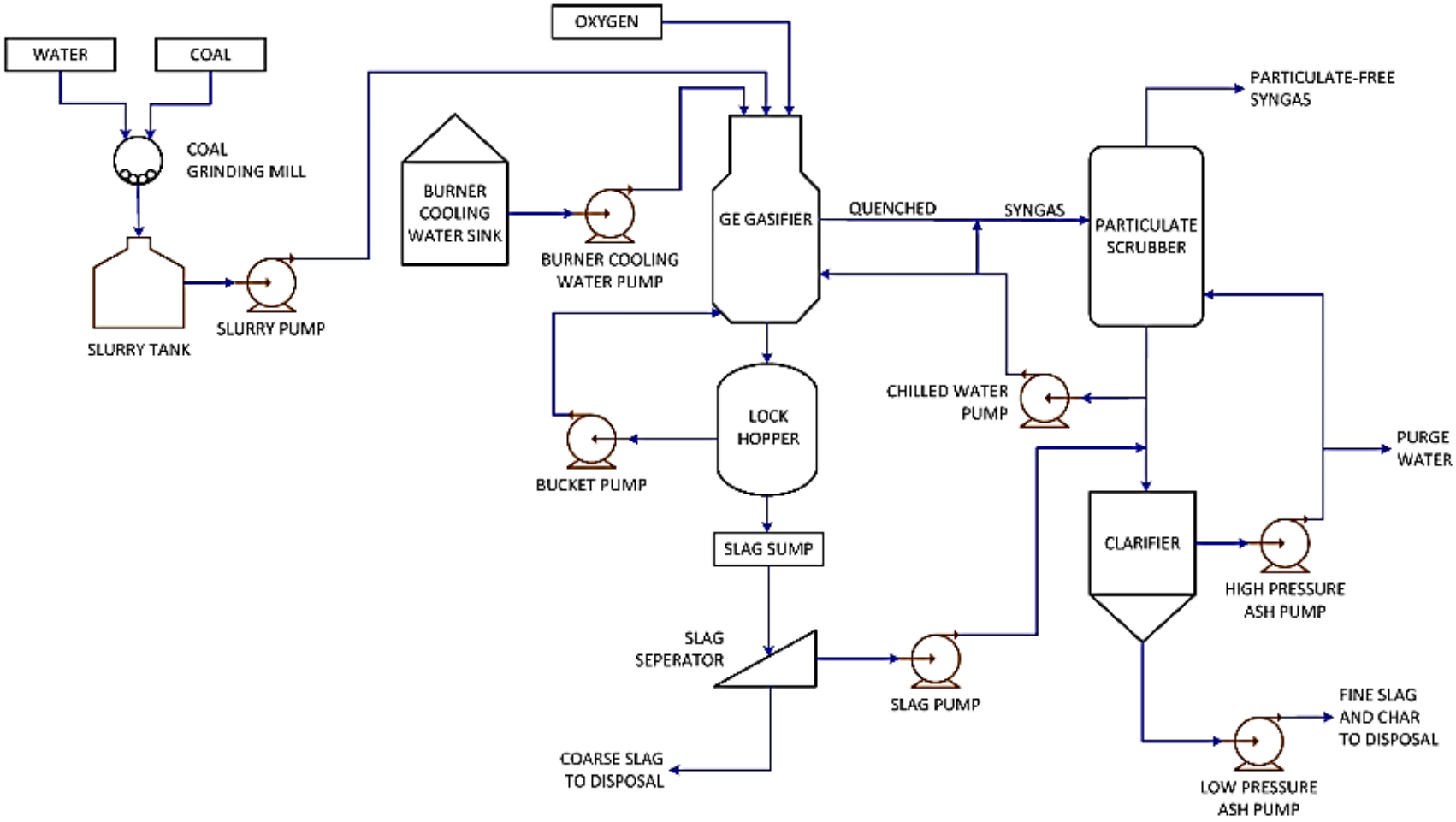
OLEFINS WITH MORE THAN 4 CARBON ATOMS WILL BE SEPARATED, COLLECTED AND FED BACK TO THE FLUIDIZED-BED REACTOR UNTIL C4+ (THE HEAVIER OLEFINS) FINALLY CONVERTS TO C2 (ETHYLENE) OR C3 (PROPYLENE)

S-MTO Process by Sinopec

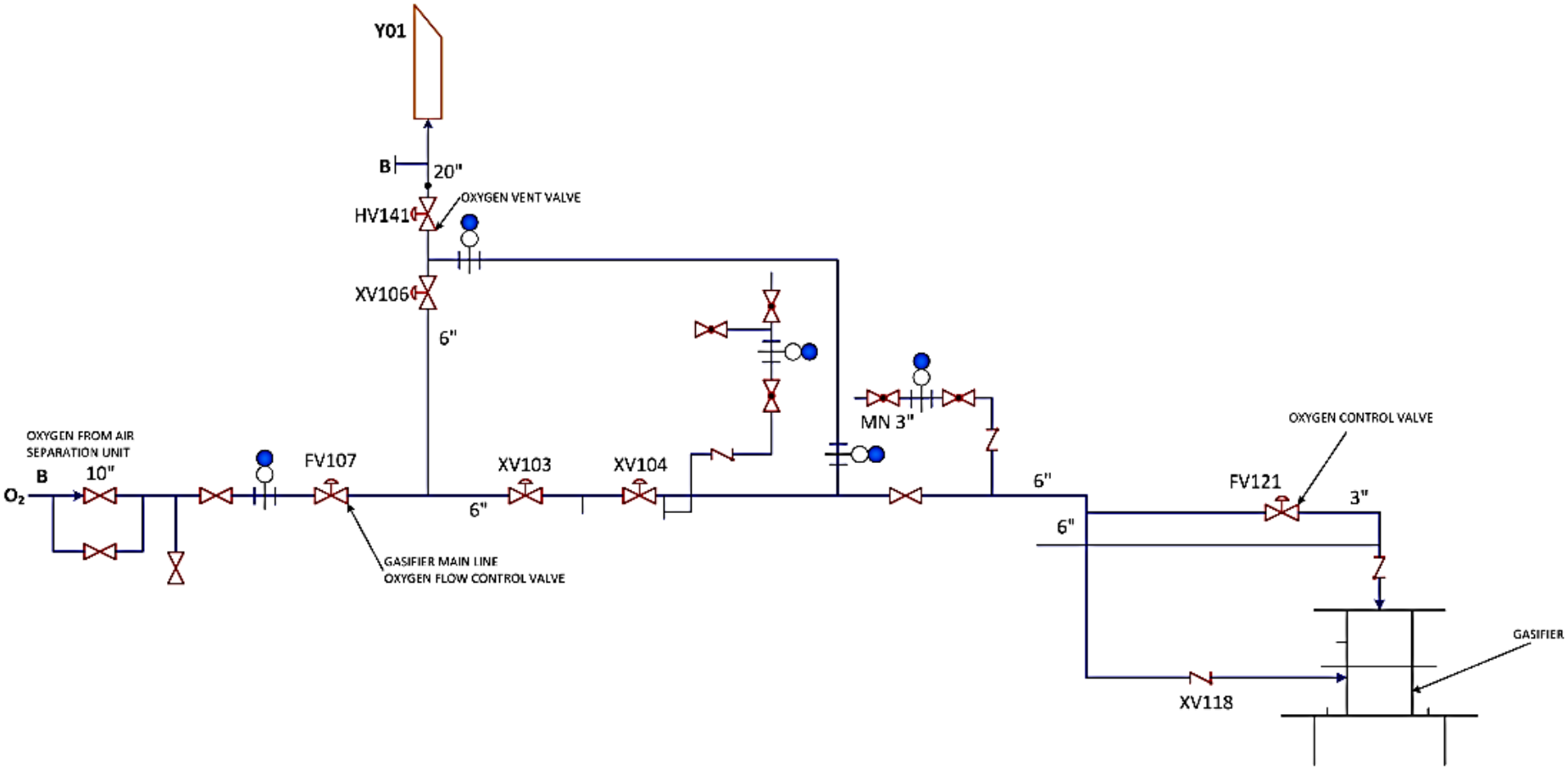


OVERALL REACTION:	METHANOL --- > ETHYLENE + PROPYLENE
BY-PRODUCTS:	CARBON MONOXIDE, CARBON DIOXIDE, HYDROGEN
PRODUCT YIELD:	UP TO 85 – 87% (COMBINED ETHYLENE AND PROPYLENE)

GE Energy Gasification Process (Coal Slurry)



Valve Application in Gasification Process (Coal Slurry)



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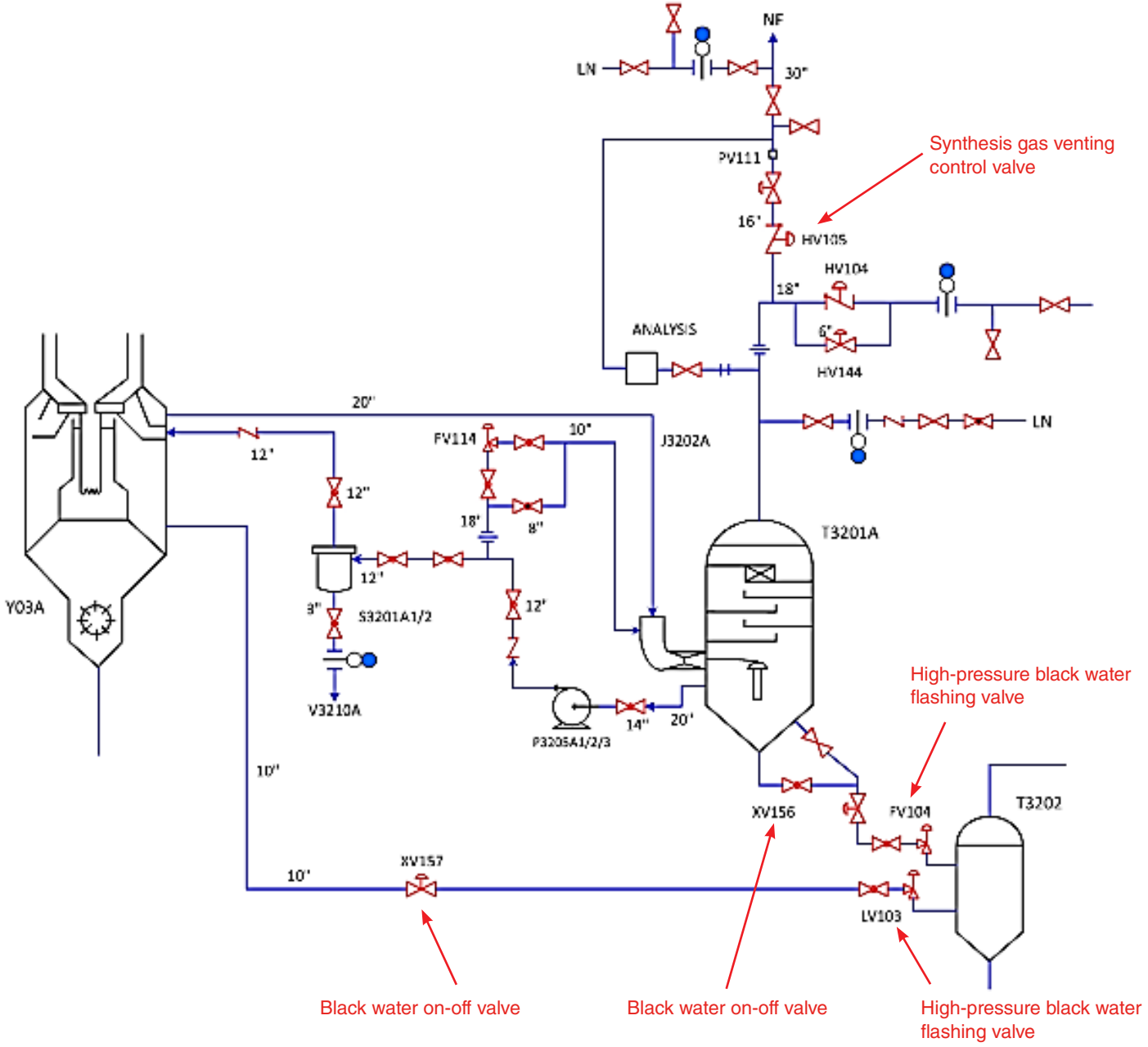
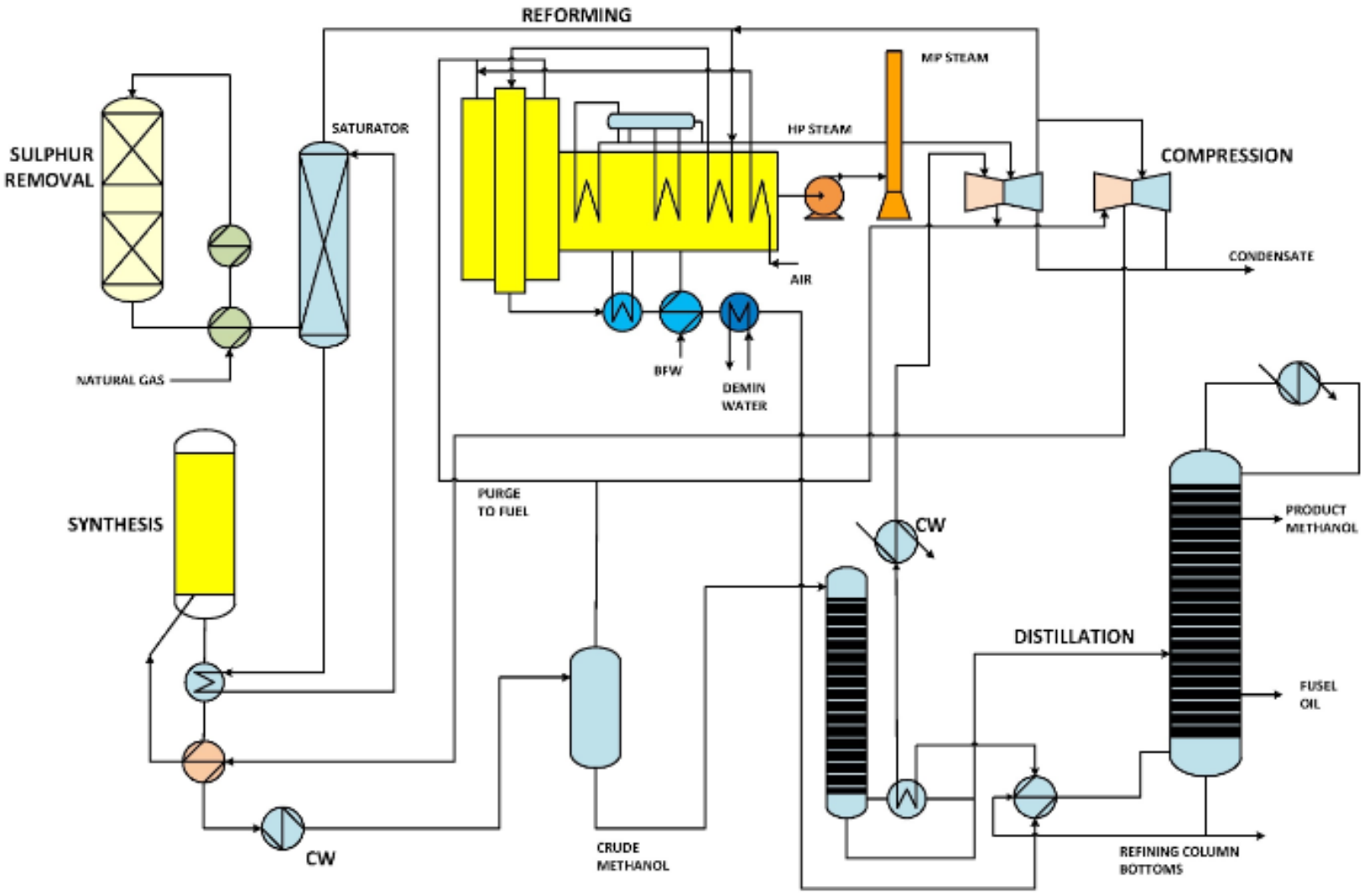
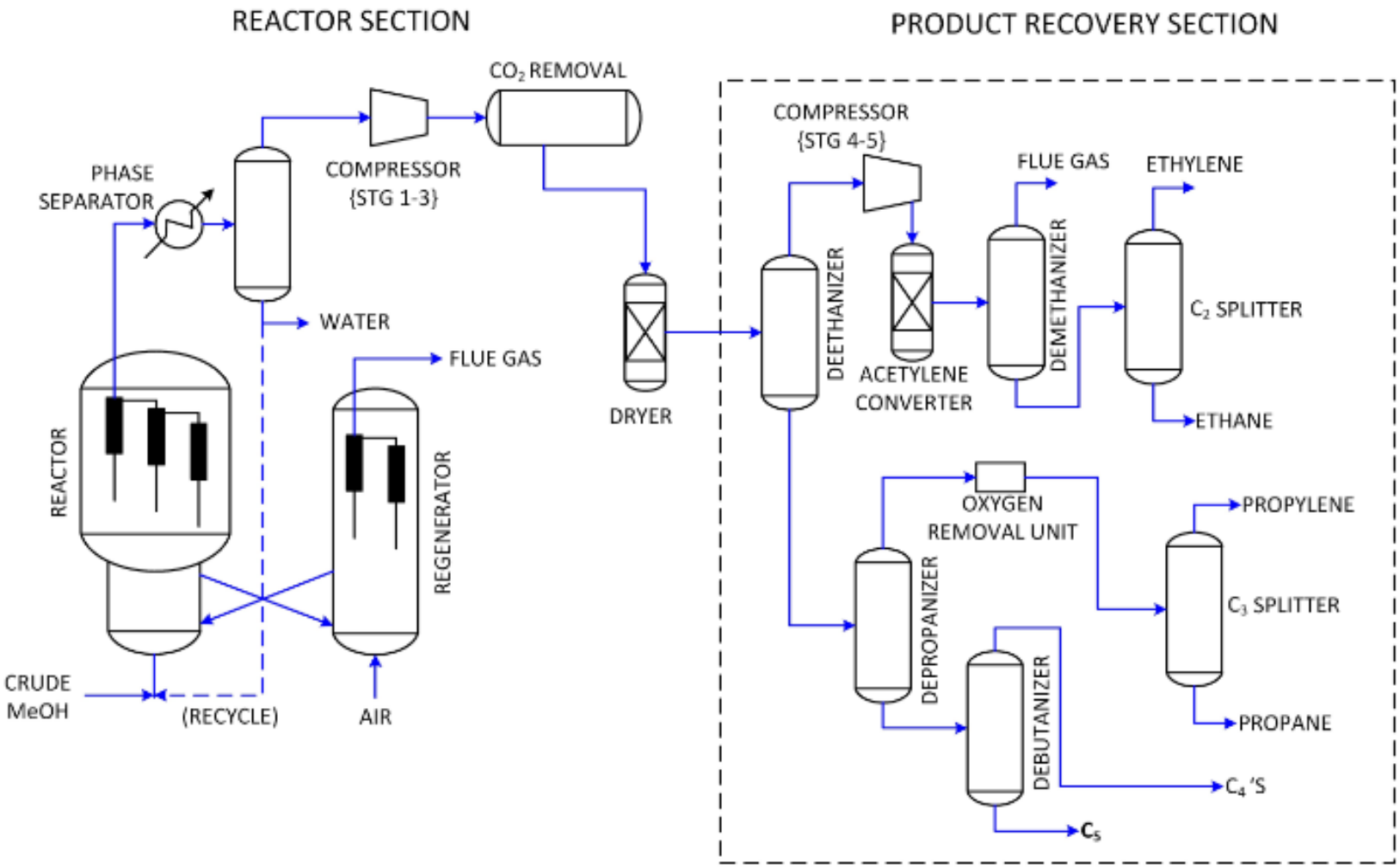


Methanol Synthesis System



UOP-MTO Process



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Experience In Motion