FOSTER WHEELER

Residue Upgrading with SYDEC^{SM}

Delayed Coking: Benefits & Economics of Canadian Crudes

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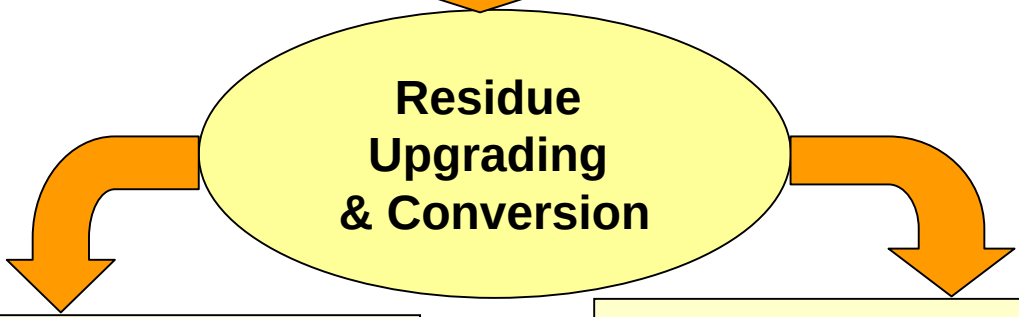
Residue Upgrading – Drivers & Routes

Increasing Light Crude – Heavy Crude Price Spread
Declining Markets for HSFO
Increased Demand for Distillates
Need for Higher Profitability



Catalytic

RFCC
Ebullated Bed Hydrocracking
Slurry Phase Hydrocracking

Non-Catalytic

Delayed Coking
Visbreaking
Solvent Deasphalting
Fluid / Flexicoking
Partial Oxidation

Foster Wheeler: Leader in Delayed Coking

- SYDEC[SM] Technology
- Market Leader
  - Over 2.5 Million BPSD Capacity
  - 52 new units built (5k to 160k BPSD)
  - 29 new units in last 5 years
  - 62 major projects since 1990
- Strong Execution
  - The Standard for execution, schedule and operation; independent benchmarking
  - Continuous work, strong execution teams
  - Operations Support

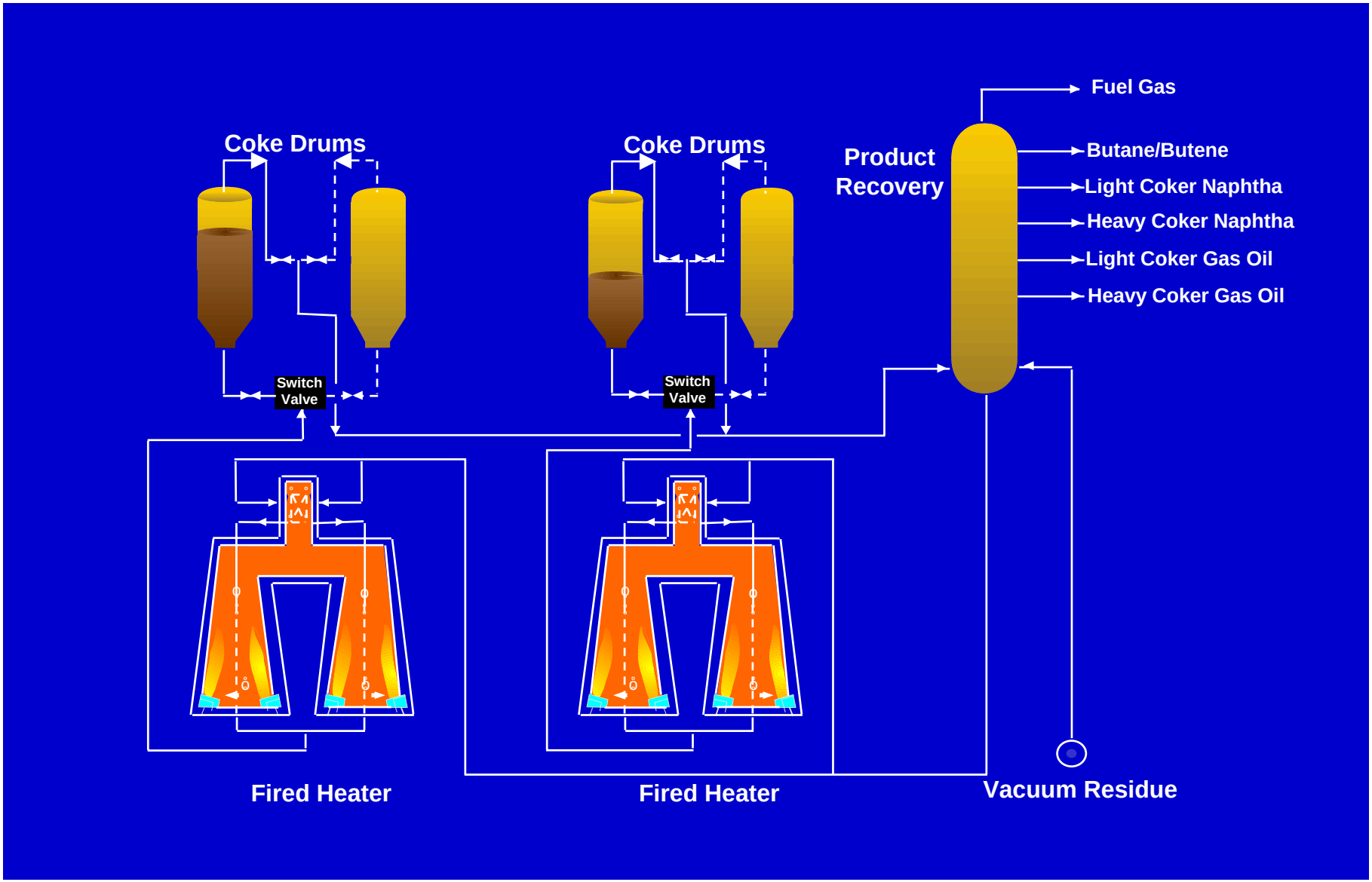
SYDEC^{SM} Delayed Coking – Upgrading Benefits

- **Full Conversion of Resid to Distillates**
  - Full range of lighter products
  - Complete decarbonization of Residue Feed
  - Complete metals removal
- **Cost Effective**
- **Excellent On-Stream Factors**

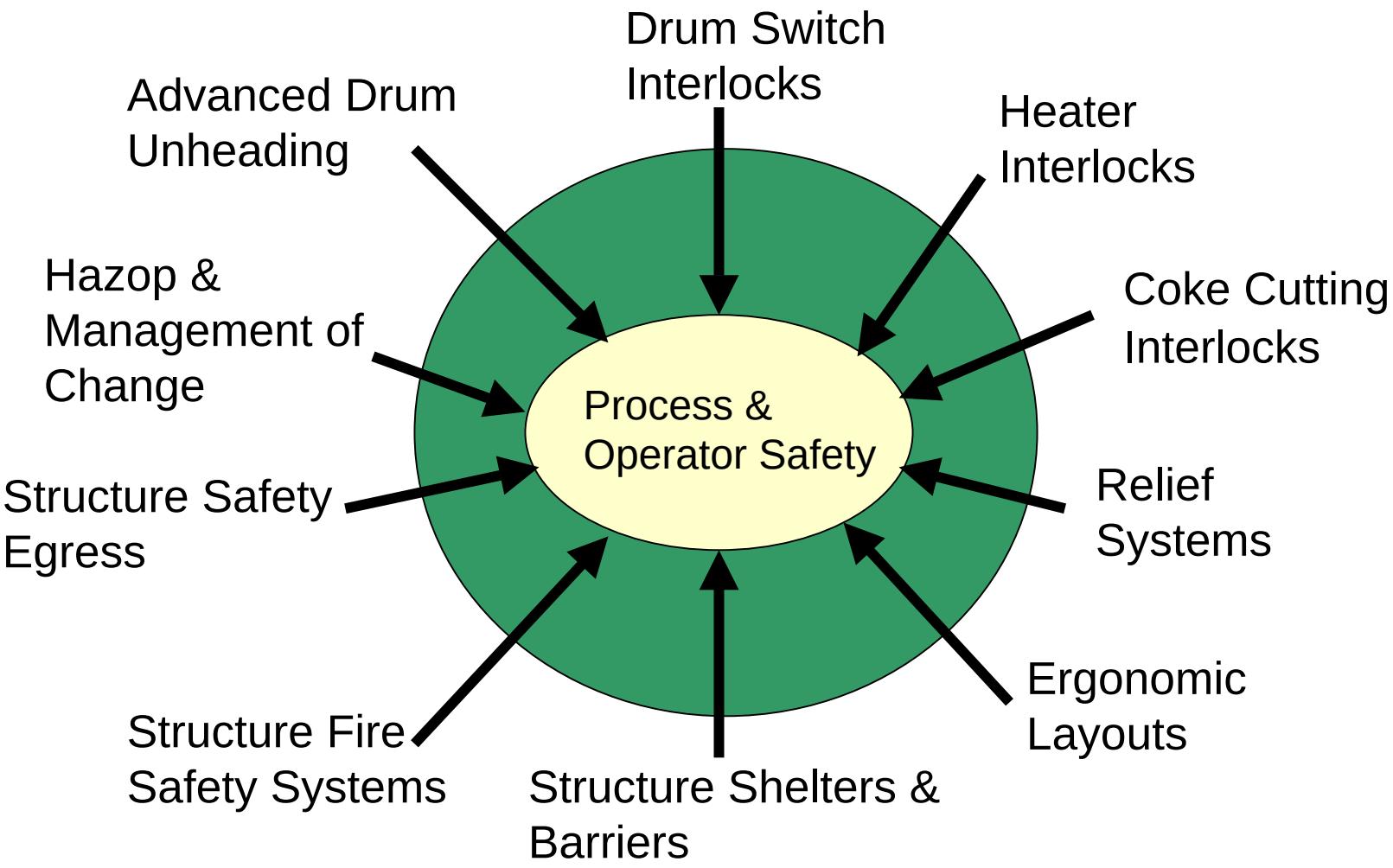
Benefits of SYDEC^{SM} Delayed Coking

- **Proven Technology**
  - Past experience: large available knowledge base on design, operations and maintenance
- **Strong 3rd Party Support Services and Equipment Vendors**
- **Long Turnaround Periods: 5 Years +**
- **Fast Execution of Projects: as low as 28 Months**
  - Short period of negative cash flow
- **Fewer budget surprises: $3000-5000/bbl**
- **Good Margins**
  - Fast realization of project payback
- **Anode Product Coke for Low Sulfur / Metals Feed**

Delayed Coker



SYDEC^{SM} - Design for Safety



SYDEC^{SM} Coke Disposal

- **Fuel Coke**
  - Purchasers include Utility Stations and Cement Calcining Operations. Increasingly: Gasification.
    - High Calorific Value/Low Ash
  - High Sulfur Coke Sold at Discount to Coal
  - Production is over 80 MM MTPA Worldwide
    - Low Compared to Coal
    - Will Continue to Edge Out Coal due to Price Discount
  - Numerous, Competitive Marketing Companies
  - Price is low but the Coker Value is in the Clean Liquid Products and the Conversion of Low Value HSFO.

Economics Of Residue Upgrading with SYDEC^{SM} Delayed Coking – Case Study

- **Base: Fuel Oil Refinery**
  - 150,000 BPSD **West Texas Intermediate**
  - FCC Based VGO Conversion
  - Producing 4.5%S HSFO
- **Upgrade Refinery**
  - 150,000 BPSD **Cold Lake Crude**
  - Add SYDEC^{SM} Delayed Coker Complex
    - Coker, Hydrocracker, DHT Hydrotreater
    - Sulfur Complex, Hydrogen, OSBL, Unit Revamps
  - Exit HSFO Market

Case Study: Key Feed Specifications

Crude	West Texas Int.	Cold Lake
Specific Gravity	0.8289	0.9267
API	39.2	21.2
Sulfur Wt%	0.39	3.69
Visc. @ 104 °F, cSt	3.1	61.6
Visc. @ 122 °F, cSt	2.5	40.1
Nitrogen ppm	880	3520

Case Study: Key US Product Specifications

Gasoline	
Specific Gravity	0.72-0.75
(R+M)/2	87
Sulfur PPM	10
RVP PSI	7
Jet A1	
Specific Gravity	0.8-0.84
Sulfur PPM	3000
Smoke mm	25
Freeze Point C	-46
Diesel	
Specific Gravity	0.82-.876
Sulfur PPM	10
Cetane Index	41
Fuel Oil	
Specific Gravity	0.991 max
Viscosity at 122 F	380
Sulfur wt%	4.5

Case Study: Feed & Product Pricing

WTI $/BBL	72.13
Cold Lake $/BBL	54.21
LPG $/BBL	47.96
Gasoline $/BBL	78.02
Jet A1 $/BBL	89.81
Diesel $/BBL	93.27
Fuel Oil $/BBL	48.25
Fuel Grade Coke $/MT	7.00
Sulfur $/MT	30.00

DOE/EIA week of 25 Aug 2006

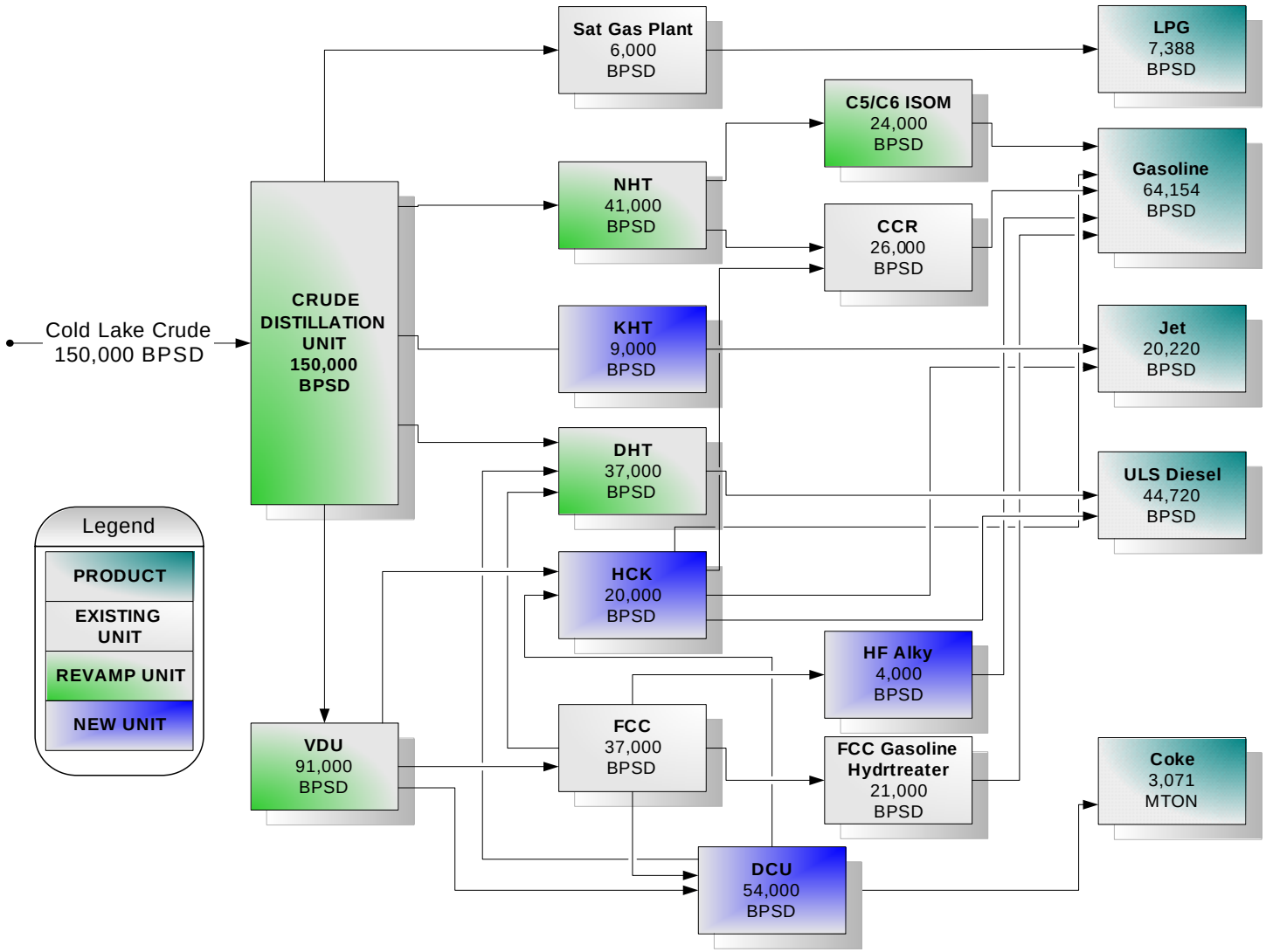
SYDEC^{SM} Yields: Cold Lake Vac Residue

	Cut Point	Yield	Gravity		Sulfur	Nitrogen
	ºF	Wt%	SG 15C/15C	ºAPI	Wt%	ppmw
Dry Gas		5.36				
C3 / C4		3.59				
Naphtha	70 – 360	12.16	0.7363	60.67	2.01	357
LCGO	360 – 680	24.00	0.886	28.14	3.37	1,833
HCGO	680+	21.36	0.997	10.48	5.18	5,310
Coke		33.52			6.03	16,566

Configuration Summary: BPSD or as noted

Unit	Base Case: FCC only	With FCC + Coker Complex	
Crude Distillation	150,000	150,000	Revamp for High Residue Yield
Vacuum Flasher	45,000	91,000	Revamp for High Residue Yield
Naphtha HT	36,000	41,000	Revamp for Coker Naphtha
ISOM	15,000	24,000	Incremental Capacity Revamp
CCR	26,000	26,000	
Kero Treater	38,000	38,000	
Kerosene HT		9,000	New unit
Diesel HT	30,000	37,000	Incremental Capacity Revamp
FCC	37,000	37,000	
FCC Gasoline Treater	21,000	21,000	
Alkylation		4,000	
Sat Gas Plant	6,000	6,000	
SYDEC^{SM} DCU		54,000	New Unit
Hydrocracker		20,000	New Unit
Sulfur (MT)	90	690	New Incremental Capacity
Amine, GPM	590	1,610	New Incremental Capacity
Hydrogen, MMSCFD	16	70	New Unit

Coker Case Refinery



Case Study: Feed & Product Balances

Feed / Product	Base	Coker
WTI BPSD	150,000	-
Cold Lake BPSD	-	150,000
LPG BPSD	13,200	7,388
Gasoline BPSD	54,305	64,154
Jet BPSD	35,332	20,220
Diesel BPSD	29,772	44,720
Fuel Oil BPSD	17,762	-
Sulfur MTPD	81	692
Coke MTPD	-	3,071

Case Study: Economic Benefit of Coker Based Residue Upgrader

Capital Cost for Residue Upgrader: $1,153 MM
Delta Operating Cost: $99.9 MM/yr

Upgrader Benefit	Base	Coker	delta
Gross Margin, $/bbl	6.94	23.60	16.66

Upgrader Benefit	No Tax	Taxes @ 35%
Payout period, yrs	1.5	2.3
IRR, %	49	34
NPV @ 10%	$3.5 billion	$2.0 billion

Closing

- SYDEC^{SM} is the prominent Delayed Coking Technology in the market today
- SYDEC^{SM} delayed coking is reliable, safe, environmentally responsible and economic to implement
- Coking can eliminate HSFO production
- Economics of coking are attractive esp. when switching to less costly heavy crude
- SYDEC^{SM} Delayed Coking is the optimal solution for Bottom-of-Barrel upgrading & Residue conversion

Foster Wheeler SYDEC^{SM} Delayed Coking New U.S. Plant

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