The MFA Application at CPC Corporation, Taiwan

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NOV. 10, 2008

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Outline

- Introduction
- Mass Flow Analysis in Refinery & Petrochemical Plant
- Application of MFA in Energy Management
- Sulfur Balancing in Refinery
- Forecast

Signification of Mass Flow Analysis

- Tools and Indicators for Efficiency & Performance of Improvement
- Wide Application in Material, Resource and Environmental Management, and Disposal Control
- Well-Defined of the Boundary Condition
- Adequate and Accurate Data Base

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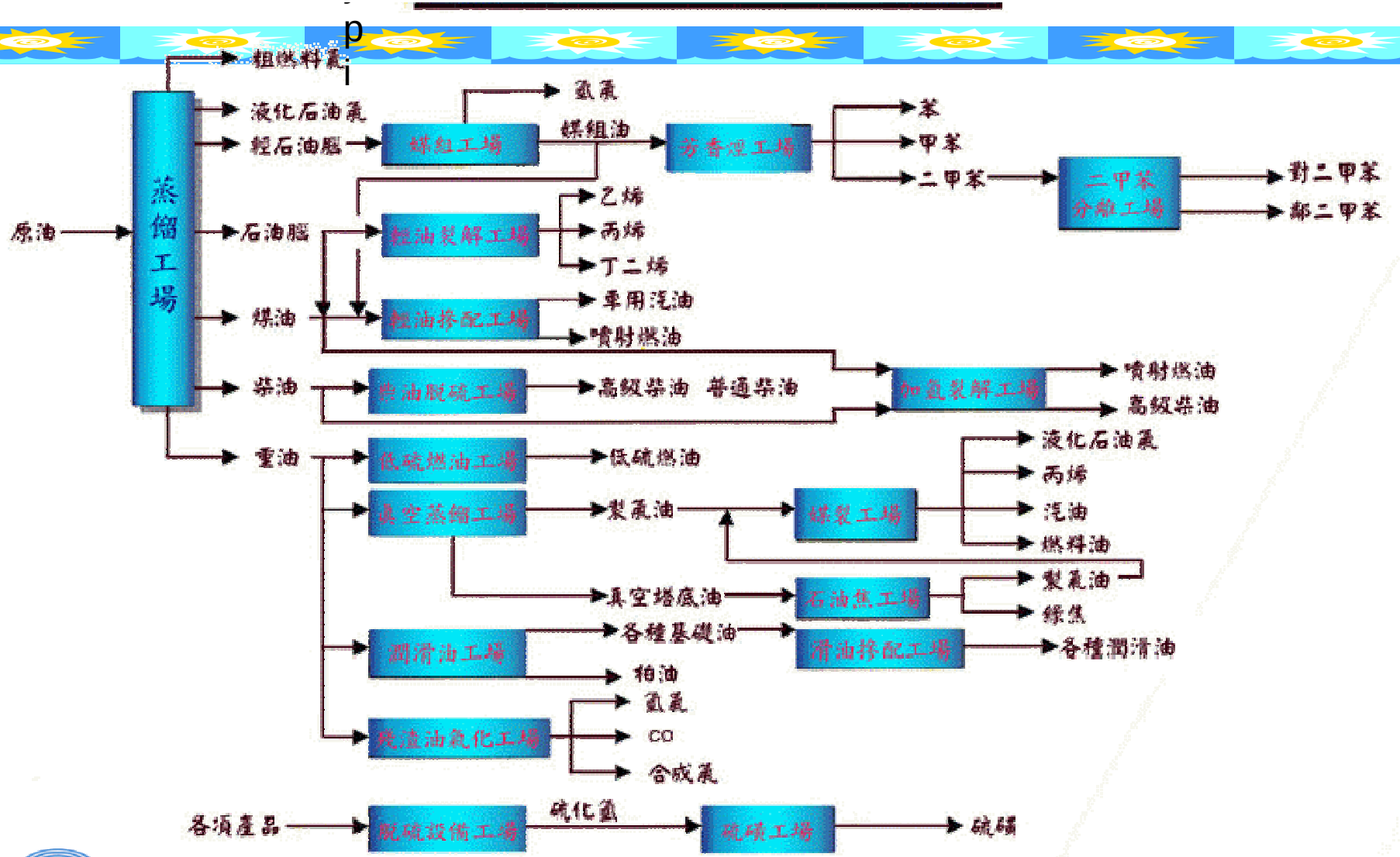
Typical Block Diagram For A Refinery

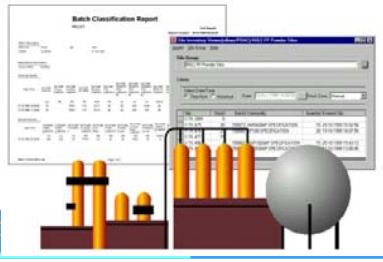


Application of MFA in Refinery

- Strategy Planning for Crude Selection
- Operation Scheduling for Refinery
- Optimization of Processes Operation
- Storage & Piping Operation
- Energy Conservation
- Hydrogen Balancing
- Steam Balancing
- Water Resource Balancing
- Sulfur Balancing
- Carbon Balance and Monitoring of Carbon Emission

Material Flow Anal. for Topping Unit

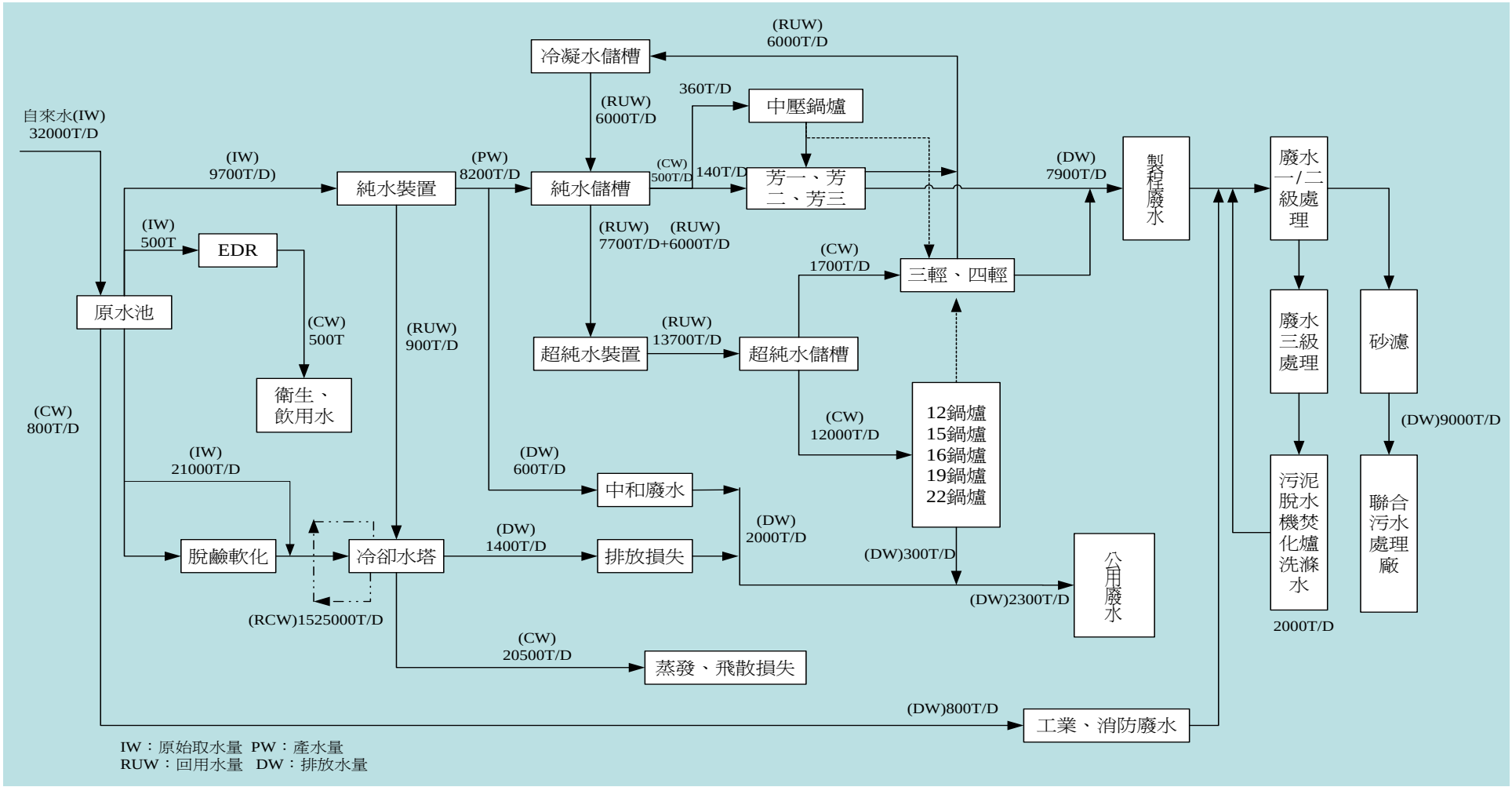
Energy managing for Business Unit



FOE KL

Bussiness Unit	Energy Saving	2,005	2006	2007	2008(3Q)	Total	Achieve
Refining	Target	18,886	27,364	32,878	35,417	114,545	
	Calc.	39,130	45,982	76,327	44,741	206,180	180%
Petro-Chem	Target	3,308	6,598	9,870	13,125	32,901	
	Calc.	13,428	35,597	14,351	18,221	81,597	248%
LNG	Target	152	303	453	602	1,510	
	Calc.	1,466	370	334	1649	3,819	253%
Petro-Sov	Target	97	97	97	97	388	
	Calc.	262	707	395	266	1,630	420%
Explo & Develop	Target	1,563	1,563	1,563	1,563	6,252	
	Calc.	1,565	1,641	1,784	1,389	6,379	102%
Others	Target	240	240	240	240	960	
	Calc.	794	1,226	1,108	1,310	4,438	462%
SUM	Target	24,245	36,164	45,101	51,044	156,554	
	Calc.	56,645	85,523	94,298	67,575	304,041	194%

Water Balancing Diagram for LinYuang Plant



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Recover Rate of Process Water

A.Raw Water Supplied for Plan	**19,257**	**Ton/Day**
B.Reclcling Water＝	**756,000**	**Ton/Day**
1.Recovery of Process Water＝	1,200	Ton/Day
2.Recovery of Cooling Water＝	5,800	Ton/Day
3.Recovery of Acid Water＝	-	Ton/Day
4.Recovery of Back Flush Water＝	-	Ton/Day
5.Recovery of Waste water＝	165	Ton/Day
6.Recovery of others＝	-	Ton/Day
C.Total Recovery＝	**7,165**	**Ton/Day**
Total used＝A+B+C=	**782,422**	**Ton/Day**
R1Recover Rate＝	**97.5**	**%**
R2Recover Rate＝	**27.1**	**%**

$$R_1\left(\frac{\text{總循環用水量}+\text{總回用水量}}{\text{總用水量}}\times 100\%\right)$$

$$R_2\left(\frac{\text{總循環用水量}+\text{總回用水量}-\text{總冷卻水用水量}}{\text{總用水量}-\text{總冷卻水用水量}}\times 100\%\right)$$

Hydrogen Balancing in Refinery

生產	日產量KNM3/D	current value	tagname	生產	日產量 KNM3/D	current value	tagname
第一氫氣	195.16	303.52 KSCFH	1HU--1FI501PV	NC5 H2 to utility	139.94	5.83 KNM3/HR	(FI13046-FC41002)
ROG	0.00	0 NM3/HR	1ROGBFI0603PV	大林廠送回H2	0.00	0.00 KSCFH	1HCC-FR601PV
第三氫氣純化	0.00	0.00 KSCM	1HPU3FIC01DB2				
合計氫氣產量	342.45		1KOR-H2PRODUCTION				

使用	日使用量KNM3/D	current value	tagname	使用	日使用量KNM3/D	current value	tagname
VGO1 FM HU1	132.75	5531.04 M3/HR	1VGO1FI2201PV	RDS2 FM HU1	12.00	0.50 KNM3H	1RDS2FC0016PV
VGO2 FM ROG	1.37	89.21 M3/HR	1VGO2FI2154PV	RDS2 FM ROG	0.00	0.00 KNM3H	1RDS2FC0017PV
VGO2 FM HU1	0.00	0.00 M3/HR	1VGO2FI2150PV	CGOC1 FM CPC	8.60	358.30 NM3/HR	1CGC105FIA078PV
HDS3	26.23		估算值	CGOC2 FM CPC	17.50	729.20 NM3/HR	1CGC215FR004PV
HDS4	0.00		估算值	NC5 START UP	0.00	0.00 KNM3H	1NC5-FI13051PV
HDS7 FM HU1	47.35	1931.99 M3/HR	1HDS7FR732PV	ISO2 FM HU1	32.60	1358.20 NM3/HR	1ISO2FI5270PV
HDS7 FM ROG	0.01	0.35 NM3/HR	1HDS7FR735PV	SRU5	0.00	0.01 NM3/HR	1SR5-FIC4078PV
HDS8 FM HU1	0.00	0.00 NM3/HR	1HDS8FR832PV	SRU7	1.91	79.50 NM3/HR	1SR7-FC5003PV
HDS8 FM ROG	0.00	0.00 NM3/HR	1HDS8FR835PV	HU排flare	0.00	0.00 %	1HCC-5PC91OP
HU FEED (A)	0.42	0.62 KSCFH	1HU--1FC102APV	ROG排flare	0.00	0.00 NM3/HR	(FI0603-FR0601)
HU FEED (B)	10.24	15.07 KSCFH	1HU--1FC102BPV				
HCC	0.00	0.00 MSCFH	1HCC-FC76PV				
合計氫氣消耗量	413.06		1KOR-H2CONSUME				

Monitoring of CO_2 Emission

MONTH	May	June	SUM
Distillation Unit,Real Operation Crude(KL)	1,210,661	**1,198,108**	7,146,468
Distillation Unit,Design Capacity Crude(KL)	1,478,537	**1,430,843**	8,632,750
Operation Rate of Distillation Unit(%)	82%	84%	83%
EDC Capacity(KL)	4,833,910	3,923,016	28,092,657
Configuration Factor(EDC/Crude Oil)	**3.3**	**2.7**	**3.3**
Fuel of Equivalent (FOE, KL)	59,052	57,474	350,303
CO_2 Emission(Ton)	152,808	148,195	901,114
CO_2 / FOE Factor	**2.6**	**2.6**	**2.6**
CO_2 Emission(Kg/BBL Crude Oil)	20.07	19.66	20.05
CO2 Emission(Kg/BBL EDC)	**5.03**	**6.01**	**5.10**

Fuel Data【Whole Plant】

Fuel Data	May	June	SUM
LNG (KS)	7,648	20,797	69,134
Fuel Gas (FG, KS)	13,431	12,984	73,536
Low Calorific Fuel Gas,(KS)	16,706	1,080	78,513
Liquified Petroleum Gas (LPG, KL)	0	0	0
Naphtha feed for H2 Plant (Naphtha, KL)	0	0	0
Fuel Oil (FO, KL)	17,970	15,618	110,690

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Application of MFA in Energy Mnagement

Energy management system

1. **Energy management control system**：
   Energy consumed as fuel oil equivalent (FOE) for each process unit, and Performance Indicator for heavy-duty equipment.
2. **Furnace and Boiler management and Processes Integration**：By DCS of processes unit, Inter-net PI-Process Book & Data Link, and Excel/Access connect to PI-Server to monitoring processes variables and energy cost.
3. **Max. operation rate to improve the efficiency** ：
   Minimize occasional shut down to improve the efficiency of major operation unit.

Base Load Anal. for Each Operation Unit

Operation Unit	Feed	Energy Materials								Total	Unit Energ	Operation Rate
	KL	FO	FG	LNG	HPS	MPS	LPS	CW	POWER	MKCAL		
DC2	28390	0	506	0	7	9636	0	404516	528456	12867	453	38.3
FCC	99266	0	559	28	0	23919	-10185	3131000	1140144	20027	202	80.5
HDS3	8039	0	128	13	0	1062	0	186000	17424	1848	230	65.3
HDS4	47699	0	542	31	0	498	0	558000	85379	4010	84	64.5
HDS7	39730	0	676	0	0	672	0	308450	313640	6152	155	100.9
HDS8	46641	0	532	0	0	1	0	593548	416881	5406	116	47.3
HU	18026	0	0	1485	0	3282	0	558000	932265	47046	2610	41
RDS2	125487	0	1269	0	0	15061	-3480	1488000	7191247	33245	265	65.9
SR7	3665	0	0	174	0	50	3240	620000	1202850	6850	1869	47.2
TP5	181999	1435	2068	206	0	7598	0	1294560	380171	38344	211	73.6
TP6	389200	3045	892	267	0	7445	0	1830000	1419944	47229	121	78.9
TP7	91312	423	594	0	0	1127	0	390600	303343	12139	133	92.6
TP8	424766	2953	1655	236	0	6351	0	1395000	2328028	52807	124	86.1
VGO1	73462	0	719	37	0	2166	0	83700	1243027	8929	122	74.5
VGO2	105299	0	648	6	0	6376	-4137	992000	2354281	11921	113	85.4
VT1	515	0	0	0	0	257	0	0	18200	226	438	2.9
VT3	62949	135	129	534	0	1163	0	86700	307097	7501	119	42.4
VT4	85757	471	277	202	0	360	0	73906	290005	9105	106	57.8
VT5	55816	966	465	0	0	3780	0	954800	423999	18178	326	94.2
SR5	3981	0	163	141	0	2735	-3632	434000	186000	3086	775	64.2
BTX5	44902	0	136	0	0	39003	-1416	1426000	906072	31114	693	45.5
NC5	42445	0	27722	3979	11897	1905	-8903	20615000	5395739	293400	6912	112.9
NC5B	6548	0	0	0	0	19298	466	2635000	1393957	18674	2852	67.3
NC5G	49,561	0	406	0	0	14148	4,730	376,429	1393957	19,888	401	
ROG	6858	0	0	0	2699	2020	-8	3632380	6850485	20410	2976	46.9
ISO2	23155	0	-171	1009	0	7706	4173	1178000	864928	21234	917	45.2
合 計		9428	39915	8348	14603	177619	-11241	45245589.84	37887518.3	751638.127		

Monitoring of Unit Energy Consume Via Product

Oper. Unit	Oper. Quan.	Energy Resources								Others	Total E	Unit E	U E Base	Energy Saving	
	KL/KS/MT	FO	FG	LNG	HPS	MPS	LPS	CW	Power	Coke	MKCal	KKCal/Unit	KKCal/Unit	MKCAL	FOE(KL)
DC2	67,613	-	940	-	-	4,991	17	883,500	972,695		14,778	218.6	**267.5**	3,306	359
FCC	113,876	-	401	230	-	27,536	- 10,717	-	4,033,628		27,295	239.7	**202.5**	-4,235	**-460**
HDS3	13,009	-	104	3	-	755	-	155,000	13,490		1,512	116.2	**146.8**	398	43
HDS7	43,414	-	726	-	-	182	- 559	308,450	303,528		5,611	129.3	**141.5**	530	58
HDS8	70,309	-	718	-	-	-	-	1,240,000	788,316		8,401	119.5	**92.3**	-1,909	**-207**
RDS2	135,761	-	1,555	22	-	14,868	- 11,944	1,302,995	6,712,138		29,433	216.8	**249.7**	4,473	486
TP6	376,099	3,592	1,333	-	-	8,021	-	1,891,000	2,372,823		59,054	157.0	**108.2**	-18,356	**-1,995**
TP7	99,148	102	606	-	-	1,723	-	235,151	461,954		10,538	106.3	**103.7**	-260	**-28**
TP8	449,799	2,526	1,719	748	-	6,628	-	1,249,272	3,042,344		57,519	127.9	**143.8**	7,154	778
VGO1	89,948	-	247	-	-	-	-	103,666	1,275,993		4,865	54.1	**82.6**	2,567	279
VGO2	124,266	-	1,097	1	-	6,846	- 6,268	992,000	1,755,303		12,345	99.3	**115.7**	2,034	221
VT3	88,692	246	842	8	-	2,090	-	184,676	485,747		11,013	124.2	**92.8**	-2,785	**-303**
VT4	88,707	267	552	-	-	2,713	-	194,081	511,448		10,113	114.0	**104.9**	-809	**-88**
VT5	59,927	-	456	-	-	3,821	-	642,973	420,328		9,310	155.4	**170.7**	919	100
BTX5	52,352	-	139	-	-	35,174	- 431	1,426,000	1,007,246		29,229	558.3	**622.3**	3,352	364
NC5	51,388	-	34,276	3,973	17,968	- 13,380	- 4,468	26,350,000	5,258,805		319,916	6,225.5	**6,750.0**	26,953	2,930
NC5B	6,999	-	-	-	-	21,373	589	2,635,000	1,393,188		20,255	2,894.0	**2,595.6**	-2,088	**-227**
NC5G	52,103	-	960	-	-	13,594	928	465,000	1,561,971		21,451	411.7	**345.6**	-3,442	**-374**
ROG	14,990	-	5	-	2,971	2,773	- 267	4,082,799	13,948,223		36,748	2,451.5	**2,738.8**	4,306	468
ISO2	28,046	-	344	88	-	7,025	7,173	1,178,000	946,918		17,396	620.3	**600.0**	-569	**-62**
合計		6,733	47,020	5,073	20,939	146,733	- 25,947	45,519,563	47,266,086	-	706,784		合計	**21,538**	2,341

Energy Conservation Measure

- **Equipment Efficiency improving**

  Improve the Performance of Heat Exchange Net :

  Process energy analysis, Preventing maintenance and rejuvenating of equipment and Acceleration retire for out of date equipment.

  Furnace and Boiler Efficiency Improving :

  Excess oxygen and outlet temperature control for flue gas。

  Air pre-heater, and economizer for heat recovered boiler operation

- **Improvement of Operation performance**

  Minimize Steam & LNG Balance Loss

  Oil & Gas：Recover and reutilization of Flare gas, reduce the VOC emission from equipment element, recover and reutilization of disposing oil from API/CPI/ SLOP system

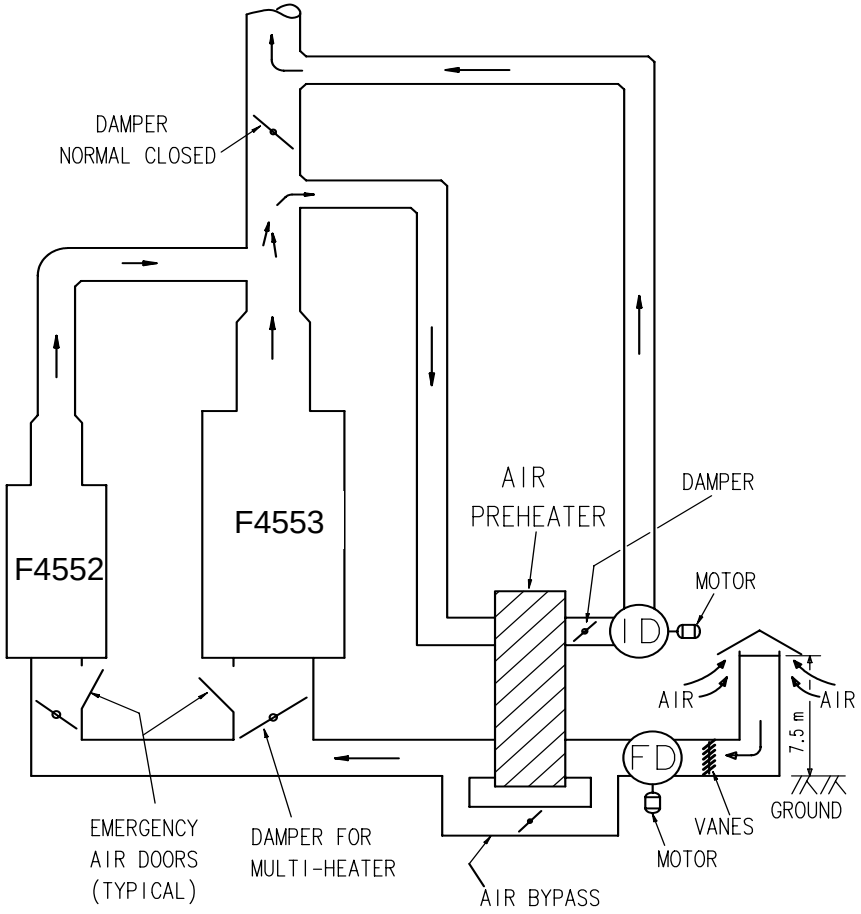
  Water Saving：By water balance, Reutilization of process water, to minimize usage of Primary water

  Cooling Water：Regulate cooling fan and adjust the temperature of chilling water.

Operation Control for Furnace and Boiler

- **Installation and Max. Op. for Air Pre-heater：Reutilization the emission energy of High Temp. Flue Gas.**
- **Min. Outlet Temp. of Flue Gas ：Max. Heat Recovery By Furnace Tube in Convective Zone and Air Pre-heater.**
- **Excess Oxygen control：For Fuel Oil（<4.5%）,Oil & Gas（<3.5%）、Gas（<2.5%）.**
- **Total Efficiency for Furnace & Boiler： For both with Furnace Tube in Convective Zone and Air Pre-heater.(>90%)**
- **Others： Chamber Pressure and Skin Temp; Preventing maintenance for Soot Blower, Exhaust duct, Insulation Material, Instrument and Dialog System.**

Air Pre-Heater Unit for Heat Recover



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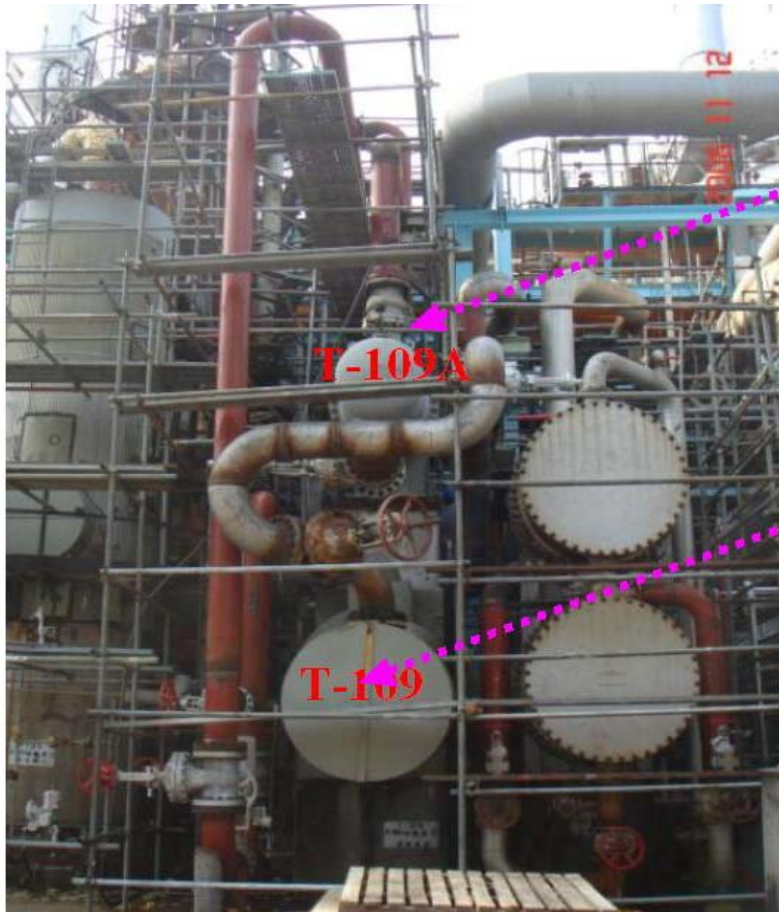
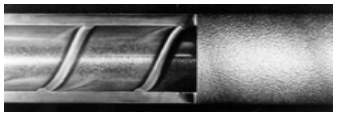
Performance of Heat Exchanger Net



Key Spare parts Replacement

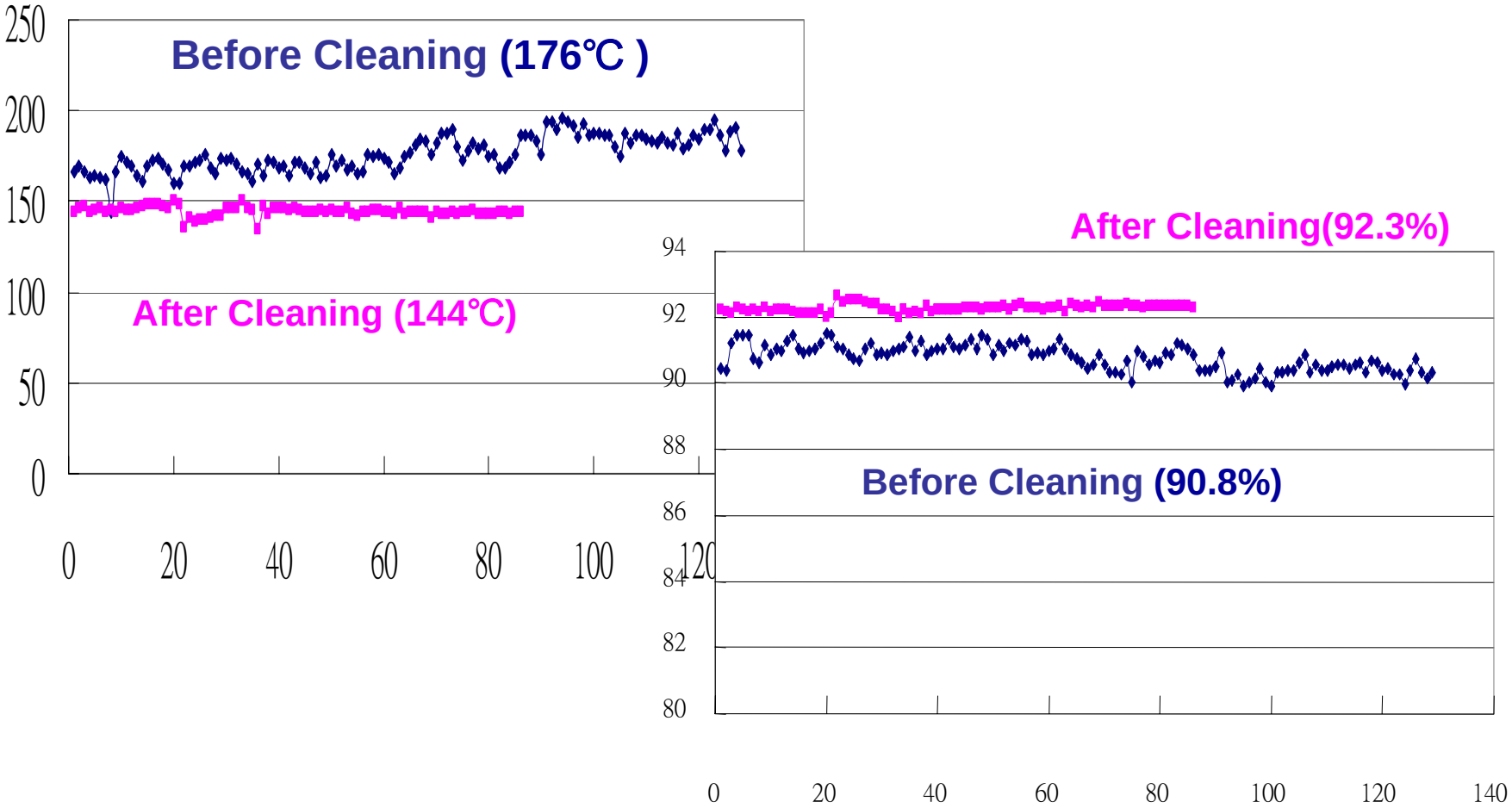
- Furnance Tube of Naphtha Cracker

	800HT	MERT
Shape & Angle	Rifle  75 ^{0}	Mix element  30 ^{0}
Materials	Incoloy800H	KHR45A(43Ni-31Cr)
Max. Temp.	1,093 ℃	1,150 ℃
Manufacture	Forging	Casting

- High efficiency Column Tray

Rejuvenating of Furnace Tube in Convective Zone

Outlet Temp & Boiler Efficiency



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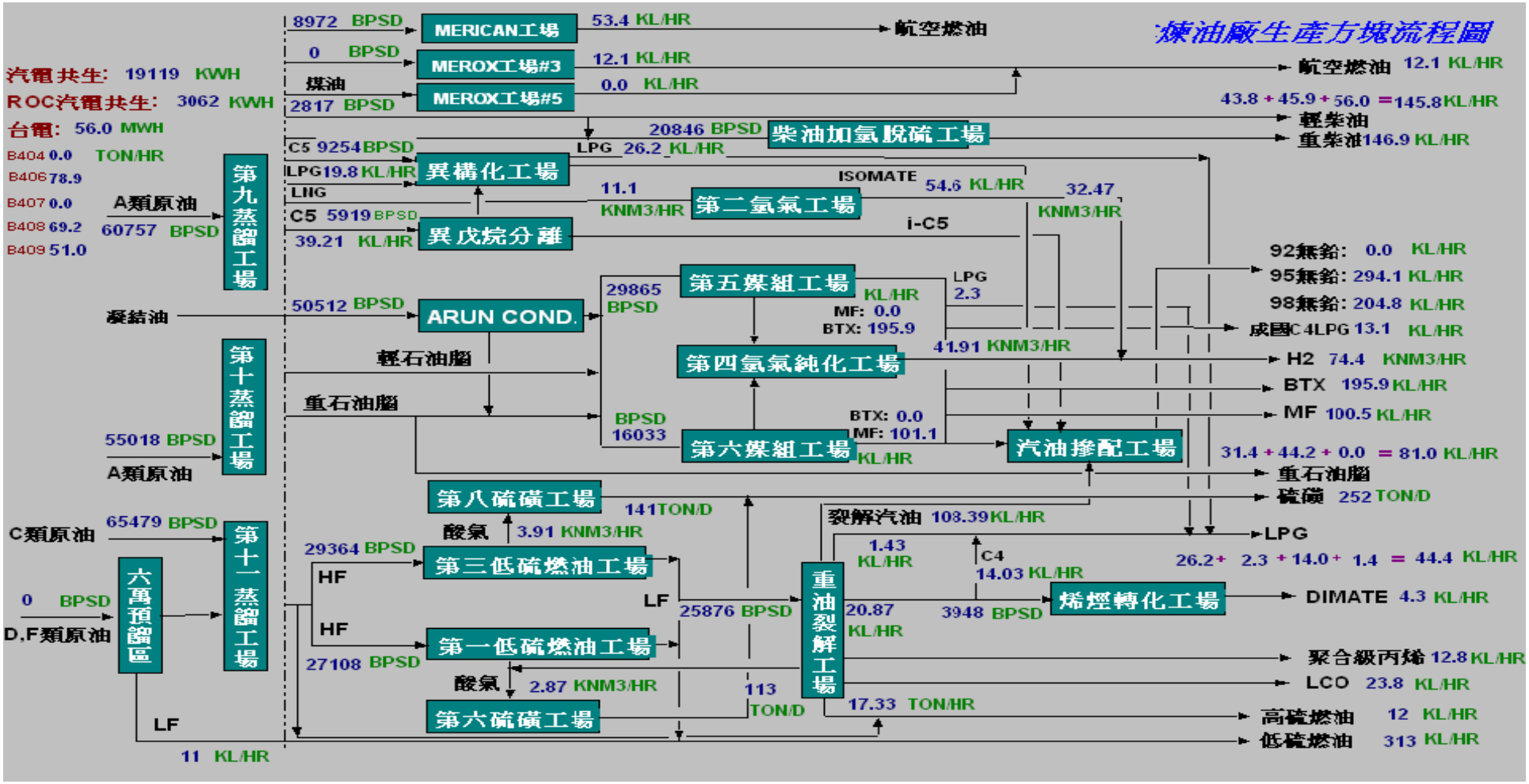
Block Diagram for Typical Refining Matrix



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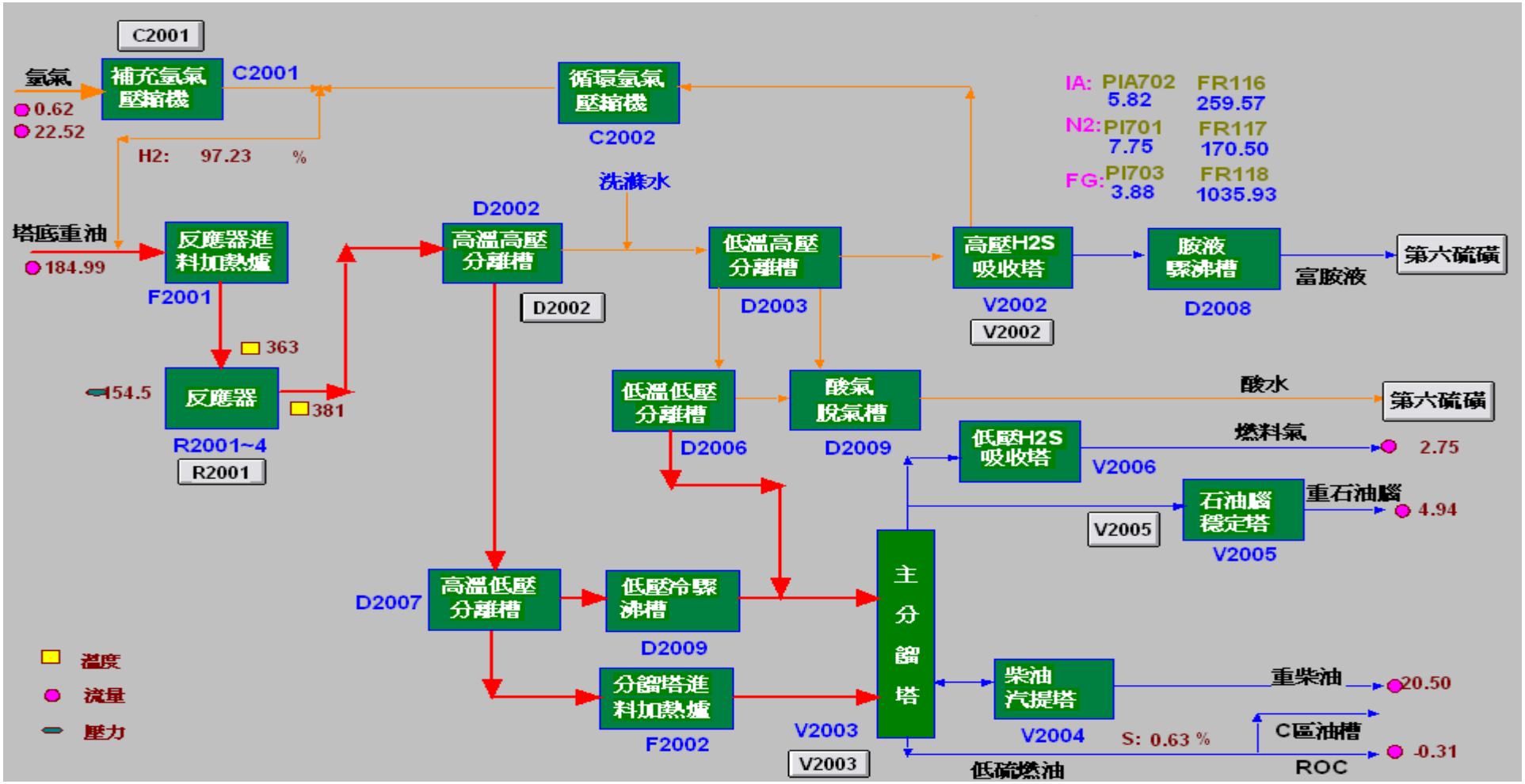
Block Diagram of Residual DeSulfurization



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Sulfur content for HS Crude

Crude	type	S cont.(wt%)	Sp.Gr	Feed (KL)	Sulfur(MT)
	AH	2.91	0.88770389	-	-
	AM	2.79	0.881070984	-	-
	HT	1.57	0.846798324	-	-
	IH	1.72	0.877247365	-	-
	IL	1.52	0.859659781	-	-
	KC	2.38	0.866503368	-	-
	KH	2.9	0.879428216	-	-
	UZ	1.81	0.852923448	-	-
	OM	1.07	0.858095816	-	-
	QM	1.8	0.851896448	-	-
	RI	3.85	0.907633098	-	-
	ave.	2.21090909	0.869905522		

Sulfur content for LS Crude

Crude	type	S cont.(wt%)	Sp.Gr	Feed (KL)	Sulfur (MT)
	CB	0.14	0.862279098	-	-
	GI	0.34	0.86809816	-	-
	DJ	0.25	0.884375	-	-
	AA	0.27	0.888261142	-	-
	ZD	0.26	0.878881988	-	-
	NE	0.18	0.828454333	-	-
	AZ	0.15	0.848830234	-	-
	avg.	0.22714285	0.865597136		

Calc. Sulfur content for Total Feed

96年原油種類		cont.(wt%	Sp.Gr	進料總量(KI capacity (MT	進料硫磺(M
A油	AH	2.91	0.8877		
A油	AM	2.79	0.8811		
A油	HT	1.57	0.8468		
A油	IH	1.72	0.8772		
A油	IL	1.52	0.8597		
A油	KC	2.38	0.8665		
A油	KH	2.9	0.8794		
A油	UZ	1.81	0.8529		
A油	OM	1.07	0.8581		
A油	QM	1.8	0.8519		
A油	RI	3.85	0.9076		
Sub Total				4114439.8	3569134.538	77854.73853
B油	AL	1.93	0.8618	799032.54	688569.4544	13289.39047
C油	CB	0.14	0.8623		
C油	GI	0.34	0.8681		
C油	DJ	0.25	0.8844		
C油	AA	0.27	0.8883		
C油	ZD	0.26	0.8789		
C油	NE	0.18	0.8285		
C油	AZ	0.15	0.8488		
sub Total				4064459.84	3524180.079	8220.780751
total S of (A+B+C)						99364.90928

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Sulfur Contained in Oil & Gas Products

Product	KL	spgr	MT	S cont.	unit	S wt. (MT)
LPG	48,277.91	0.529864	26,861.83	5.995540691	ppmw	0.161051195
Propylene	201,110.80	0.520000	104,577.62	<0.5	ppmw	0.05228881
Propane	115,797.18	0.556400	64,429.55	<0.5	ppmw	0.032214775
92 ULG	631,938.70	0.748086	495,982.48	37.36877612	ppmw	18.53425825
95 ULG	2,706,404.46	0.750869	2,124,144.66	36.3351598	ppmw	77.18113566
98 ULG	194,316.16	0.758746	152,510.70	35.81330435	ppmw	5.461912115
JP-A1	963,634.00	0.797244	775,918.10	392.590295	ppmw	304.6179158
JP-8	30,637.00	0.805123	24,668.91	250	ppmw	6.1672275
Alkylate	9,122.00	0.784873	7,159.61	<0.5	ppmw	0.003579805
SD	1,952,686.20	0.843266	1,646,633.48	27.83839359	ppmw	45.83963092
LCO	157,027.19	0.930589	146,851.83	4577.840909	ppmw	672.2643149
Fuel gas .0	774,366.56	0.940353	728,177.55	4548.921378	ppmw	3312.422424
LCN	14,683.06	0.704519	10,344.50	125	ppmw	1.2930625
Fuel oil	624,775.99	0.932720	582,741.06	**21833**	ppmw	12722.98556
AC1-10	141,925.08	1.023000	145,189.35	5.456	wt %	7921.530936
AC1-20	170,353.51	1.023000	174,271.65	5.456	wt %	9508.261224
slop	1,372.00	0.895569	1,228.72	-	ppmw	-
HD	22,295.67	0.870300	19,403.92	5225	ppmw	101.385482
						34698.19422

Operation Rate for Sulfur Plant

PLANT	SULFUR UNIT	Design Capa.(MT/D)	Product MT	Operation Rate %
Tyoyuan	Sulfur Unit 2	120	10,907	27.5%
	Sulfur Unit 3	200	19,330	29.3%
	Sulfur Unit 5	150	32,362	65.4%
	Sub Total	470	62,599	40.4%
Kaoshiung	Sulfur Unit 4	120	7,350	18.6%
	Sulfur Unit 5	200	47,456	71.9%
	Sulfur Unit 7	250	46,992	57.0%
	Sub Total	570	101,798	54.1%
Ta Lin	Sulfur Unit 6	200	34,204	51.8%
	Sulfur Unit 8	200	47,255	71.6%
	Sub Total	400	81,459	61.7%
Operation Rate:	Base On 330 Day for 1 Year			

Calculation Base for Sulfur Balancing

Feed	Toping, Capacity	Per Day	OP. Rate	Sulfur Unit, MT	Real Prod., MT
1A	100,000	1	0.404		
1C	100,000			470	190.2

Feed	KL	SPGR	Av. S Content	Unit	Total S in Feed, MT
A	15897	0.869906	2.049677015	wt %	283.4475403
C	15897	0.865597	0.227142857	wt %	31.25576044
SUM	31794				314.7033008

Calculation of S Cont. in Flare Emission

By Consumption of Fuel Gas & Fuel Oil

	Comsumption	Total S (MT/Y)	Total S (MT/D)
FO	140811.96 KL	595.704558	
FG	98265.33 KS	94.3347168	
		690.039274	2.091028

Balancing of Total Sulfur Output

Products	Quan.(KL)	VOL%	SPGR	LAB硫含量	UNIT	Total S (MT)	Wt.%
PROPYLENE	201,110.80	2.24	0.52	>0.5	wt ppm	0.0523	0.000
PROPANE	115,797.18	1.29	0.56	>0.5	wt ppm	0.0322	0.000
LPG	48,277.91	0.54	0.53	5.99554	wt ppm	0.1534	0.000
92 ULG	631,938.70	7.04	0.75	37.3688	wt ppm	17.6639	0.018
95 ULG	2,706,404.46	30.15	0.75	36.3352	wt ppm	73.7532	0.074
98 ULG	194,316.16	2.16	0.76	35.8133	wt ppm	5.2750	0.005
JP-A1	963,634.00	10.73	0.80	392.59	wt ppm	301.5914	0.304
JP-8	30,637.00	0.34	0.81	250	wt ppm	6.1665	0.006
Alkylate	9,122.16	0.10	0.78	>0.5	wt ppm	0.0036	0.000
SD	1,952,686.20	21.75	0.84	27.8384	wt ppm	45.8361	0.046
MDO	22,295.67	0.25	0.87	5225	wt ppm	101.3505	0.102
LCO	157,027.19	1.75	0.93	4577.84	wt ppm	668.5263	0.673
LSFO	774,366.56	8.63	0.93	4548.92	wt ppm	3275.9553	3.297
LCN	14,683.06	0.16	0.70	125	wt ppm	1.2848	0.001
HSFO	624,775.99	6.96	0.93	21833	wt ppm	12722.7128	12.804
AC1-10	141,925.08	1.58	1.02	5.456	wt %	7921.5317	7.972
AC1-20	170,353.51	1.90	1.02	5.456	wt %	9480.3773	9.541
SULFUR	34,864.72	0.39		99.8	wt %	62630.9870	63.031
FLARE						599.6352	0.603
TOTAL	8,794,216.35	97.95					
						97852.8884	98.478

Applicatin of Sulfur Balancing

進料	日煉量	天數	設備利用率	硫磺工場日產能，MT	
2A	200,000	1	63%	產能	實際產量
				970	611.1
進料	KL	SPGR	平均硫	單位	進料總硫量, MT
A	31794	**0.87**	2.32	wt %	642.097899
C	0			wt %	0
合計	31794				642.097899
產品	vol %	SPGR	平均硫	單位	產品總硫量, MT
全廠煙囪排放					2.07
PROPYLENE	1.9	0.52	>0.5	wt ppm	0.000157062
C3 LPG	1.03	0.53	>0.5	wt ppm	8.67817E-05
95 ULG	34.8	0.75	10	wt ppm	0.08298234
JP	14.37	0.7972	270	wt ppm	0.983406314
Kerosene	2.68	0.7785	105	wt ppm	0.069651084
超柴(SD)	24.93	0.8432	10	wt ppm	0.066834091
LSFO	16.88	0.93	3000	wt ppm	14.97344789
HSFO	2.15	0.9327	20000	wt ppm	12.75133343
硫磺	1.03				611.1
總計	99.77				642.097899
Over capacity					327.902101

Outline

- Introduction
- Mass Flow Analysis in Refinery & Petrochemical Plant
- Application of MFA in Energy Management
- Sulfur Balancing in Refinery
- **Forecast**

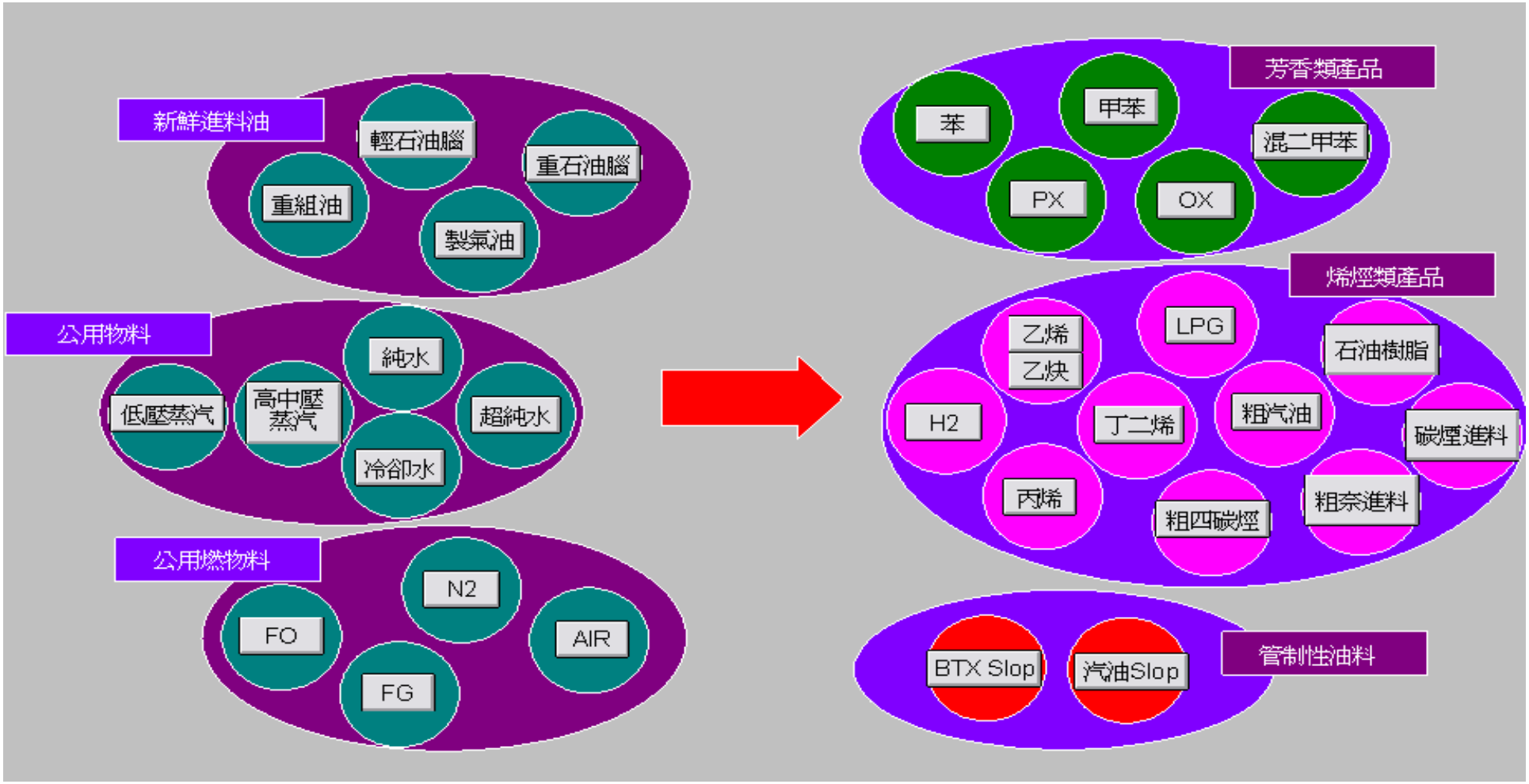
Signification of Mass Flow Analysis

- Tools and Indicators for Efficiency & Performance Improvement
- Wide Application in Material, Resource and Environmental Management, and Disposal Control
- Well-Defined of the Boundary Condition
- Adequate and Accurate Data Base

Forecast

- **Building Environmental Accounting System Base on Mass Flow Anal.**
  (Inclu. Raw Material, Energy and any Resource Input and Output)
- **Life Cycle Assessment for Petro-chemical Product**

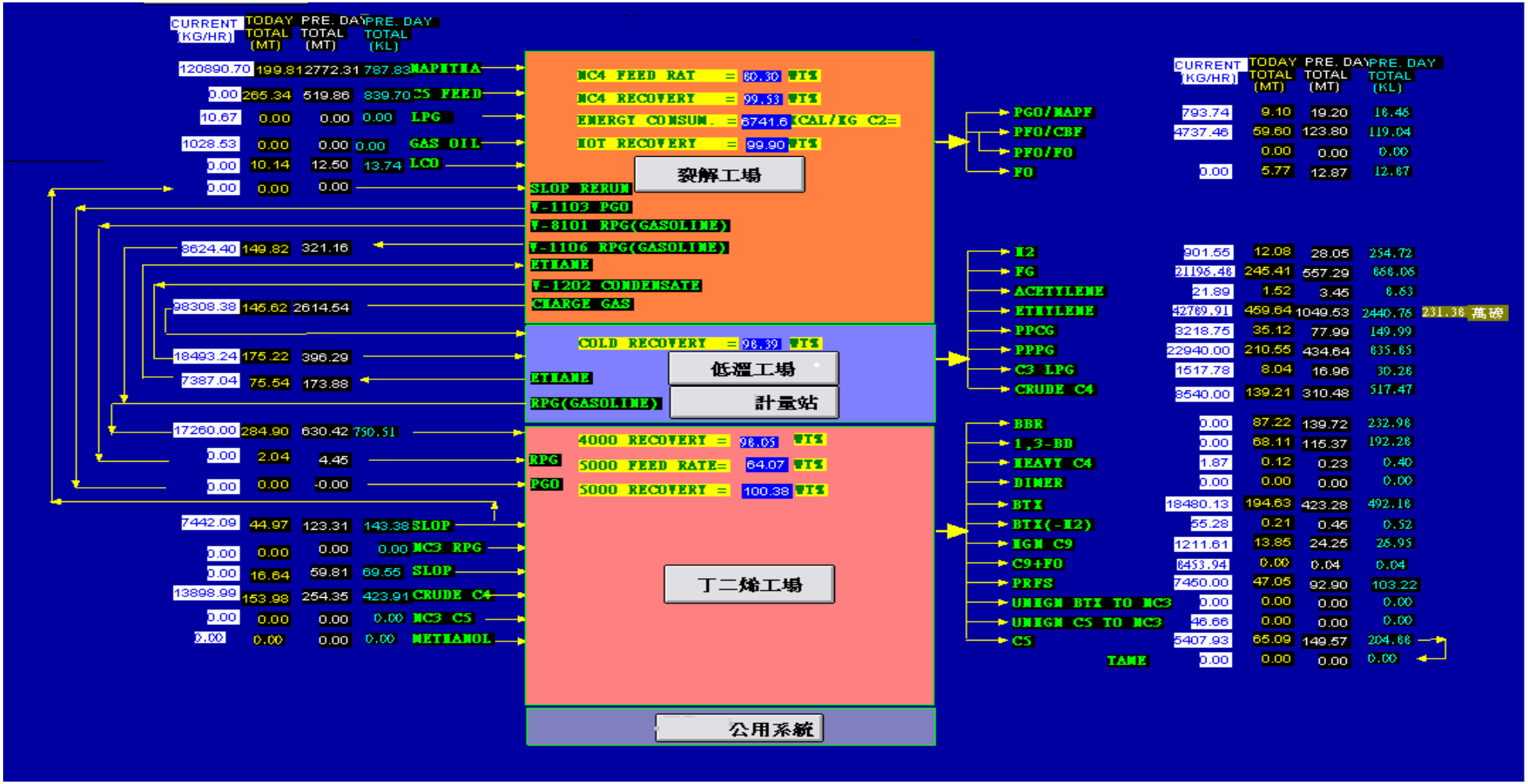
Mass Flow Diagm. of Petrochem Plant



Material Balance of Naphtha Cracking Unit

台灣中油股份有限公司
CPC Corporation, Taiwan

Mass Flow Anal. Of Naphtha Cracking Unit



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Thank You for your Attention !

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