(1/2)

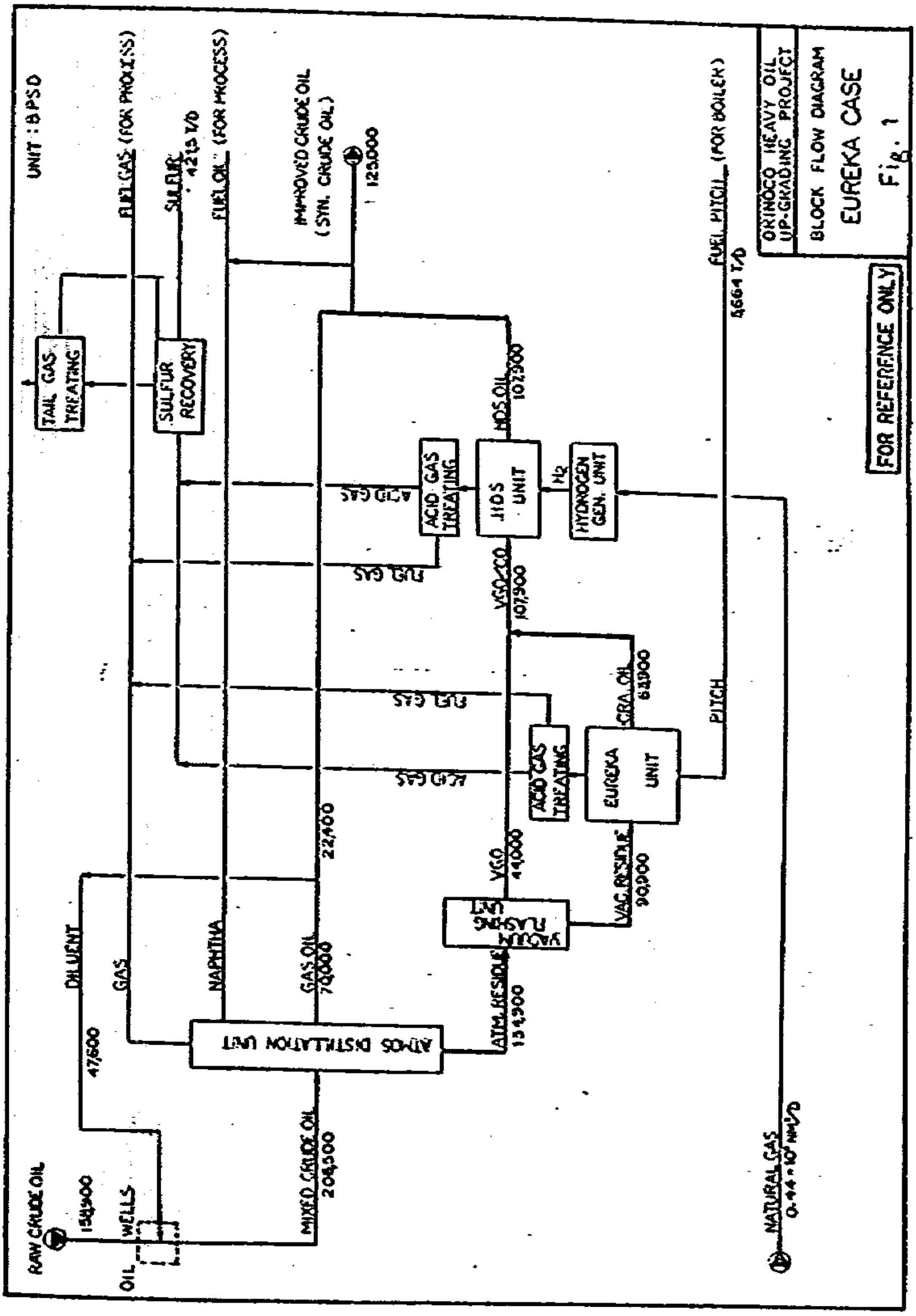
ATTACHMENT TO JICA-2

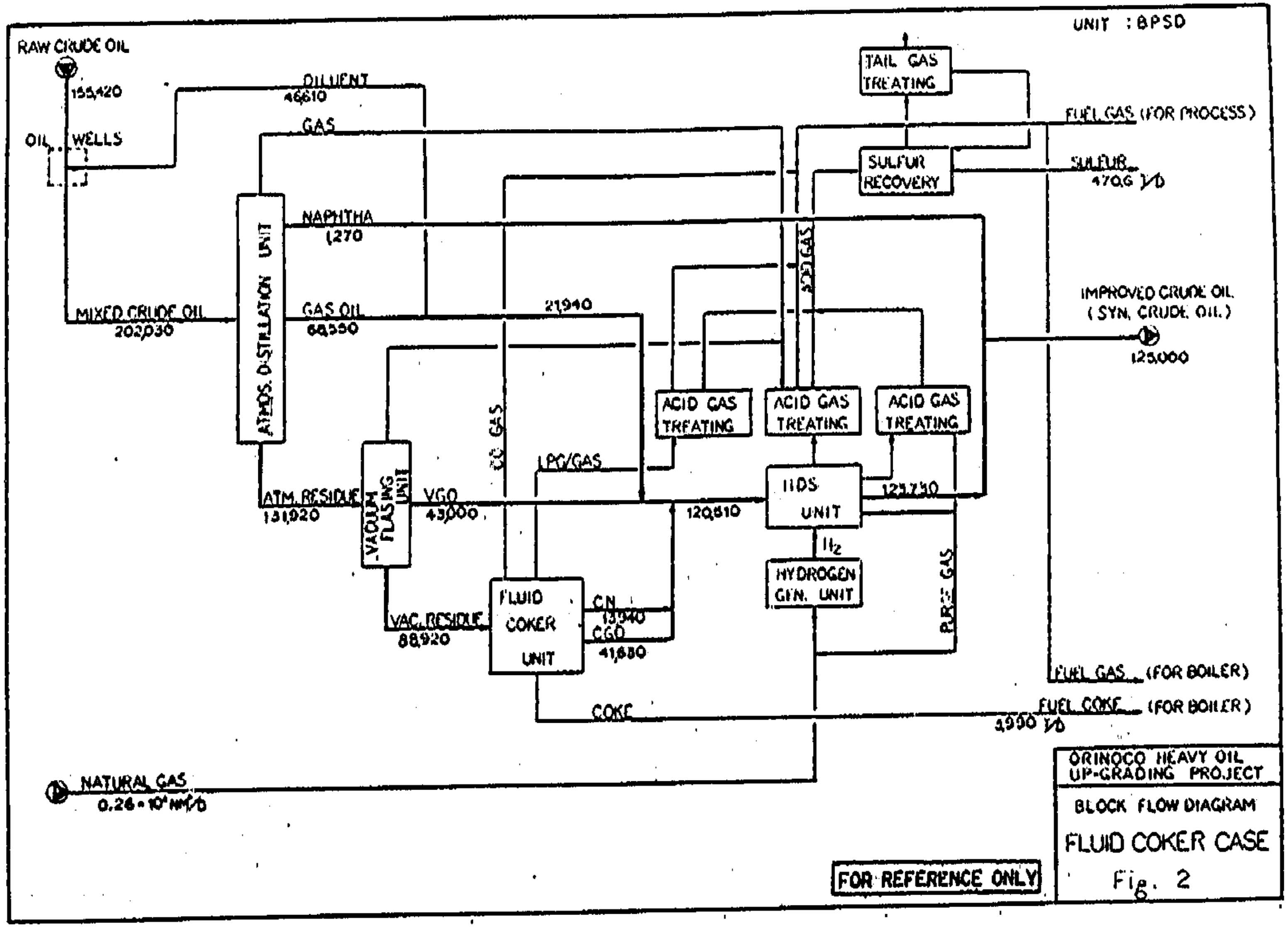
COMPARISON OF FLUIDCOKER VS FLEXICOKER

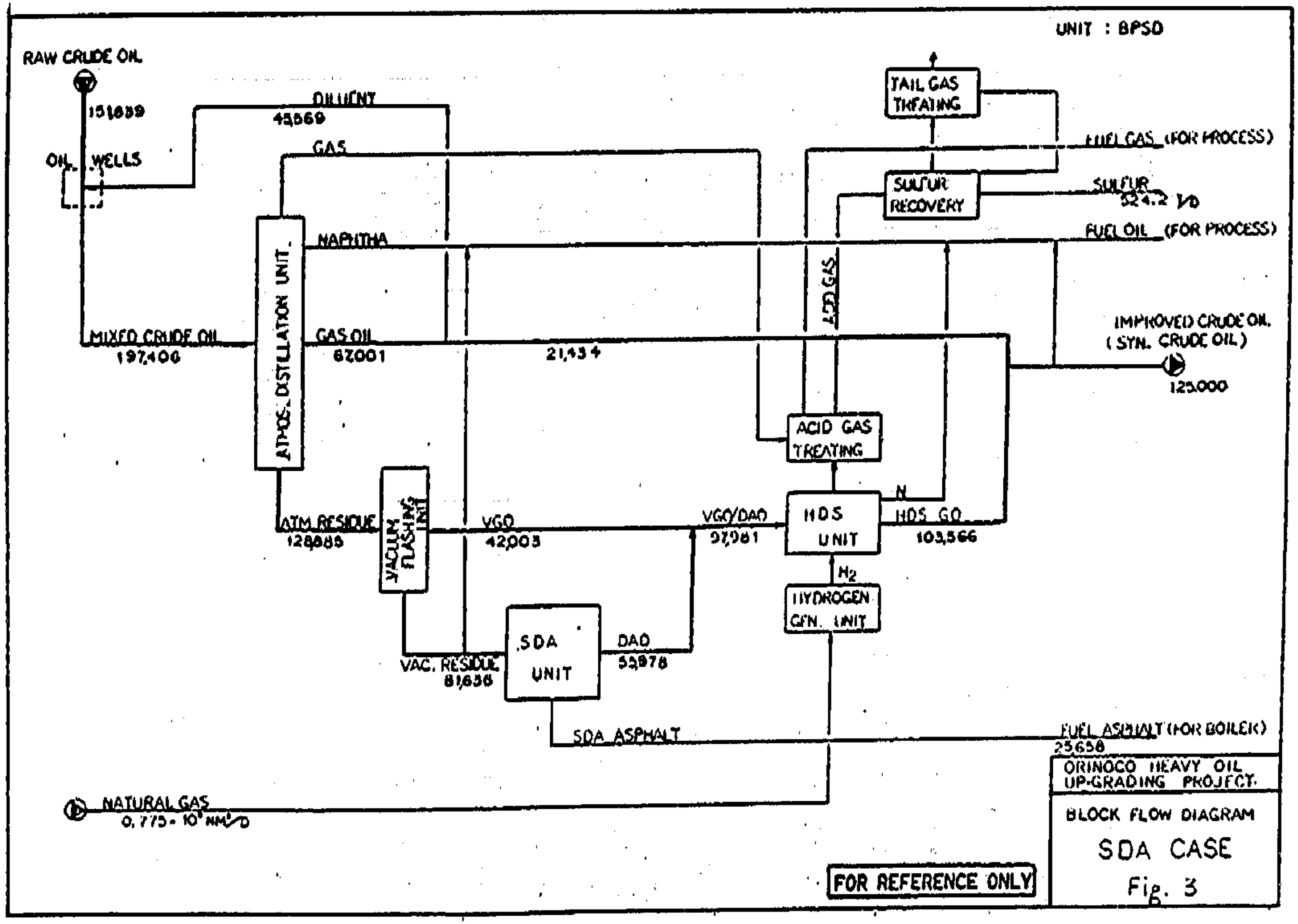
ITEM	FLUIDCOKER	FLEXICOKER
1. By-product	Coke a) Handling is complicated compared with gas. b) Storage is possible. (easy and practical)	Low calorie gas a) Handling is easy. b) Storage is impossible. (not practical)
2. Investment cost	a) Reactor has 2 trains due to limitation of mechanical design. (as 90,000 BPSD capacity) b) Main equipment Reactor Burner Air blower c) Required amount of equipment is small. d) Investment cost is low.	a) Gasifier has 3 trains due to limitation of mechanical design. (as 90,000 BPSD capacity) b) Main equipment Reactor Heater Gasifier Heater overhead system Air blower c) Required amount of equipment is large. d) Investment cost far higher.
3. Coke Handling	a) Main equipment Coke silo for start-up and shutdown Coke silo for fuel Coke grinder for fuel b) Required items of equipment are many. c) Investment cost is higher.	a) Main equipment Coke silo for star-up and shutdown Treating facility for entrained coke from heater overhead system

(2/2)

4. Desulfurization facility for by-product combustion	a) Flue gas desulfurization at boiler b) Electric precipitator	a) Wet system desulfurization of low calorie gas b) No flue gas desulfurization at boiler c) No electric precipitator
5. Operation	a) Time for start-up and shutdown is short. b) Operation is easy c) Boiler is not directly affected by fluctuation of coker operation	a) Time for start-up and shutdown is twice that required for fluid coker. (operators are twice too) b) Operation is complicated. c) Boiler is directly affected by fluctuation of coker operation as the coker gas is burned in the boiler.
6. Maintenance	-	a) Much cost and time for maintenance are required compared with fluidcoker
7. Plot	a) Coke handling area is required.	a) Gasifier area is required.
	(Totally same area)	
8. Fuel efficiency of by-product	a) Total fuel efficiency of the Fluidcoke is higher than that of the Flexicoker gas.	a) Fuel loss for gasification of coke is much.


UNIT : BPSD
RAW CRUDE OIL
158,900
OIL
WELLS
MIXED CRUDE OIL
204,500
47,600
DILUENT
GAS
NAPHTHA
GAS OIL
70,000
ATMOS DISTILLATION UNIT
ATM. RESIDUE
134,900
VACUUM FLASHING UNIT
VGO
44,000
VAC. RESIDUE
90,900
22,400
EUREKA UNIT
ACID GAS TREATING
ACID GAS
FUEL GAS
CRA. OIL
63,900
PITCH
VGO+CO
107,900
HDS UNIT
ACID GAS TREATING
H2
HYDROGEN GEN. UNIT
HDS OIL
107,900
TAIL GAS TREATING
SULFUR RECOVERY
FUEL GAS (FOR PROCESS)
SULFUR 421.5 T/D
FUEL OIL (FOR PROCESS)
IMPROVED CRUDE OIL (SYN. CRUDE OIL)
125,000
FUEL PITCH (FOR BOILER)
4664 T/D
NATURAL GAS
0.44 × 10⁶ NM³/D
ORINOCO HEAVY OIL UP-GRADING PROJECT
BLOCK FLOW DIAGRAM
EUREKA CASE
Fig. 1
FOR REFERENCE ONLY


UNIT : BPSD
RAW CRUDE OIL
155,420
OIL WELLS
DILUENT
46610
GAS
NAPHTHA
1270
GAS OIL
68,550
MIXED CRUDE OIL
202,030
ATMOS. DISTILLATION UNIT
ATM. RESIDUE
131,920
VACUUM FLASING UNIT
VGO
43,000
VAC. RESIDUE
88,920
21,940
CO GAS
LPG/GAS
FLUID COKER UNIT
CN
13,940
CGO
41,680
COKE
120,810
ACID GAS TREATING
ACID GAS TREATING
ACID GAS TREATING
ACID GAS
HDS UNIT
125,750
H_2
HYDROGEN GEN. UNIT
PURGE GAS
TAIL GAS TREATING
SULFUR RECOVERY
FUEL GAS (FOR PROCESS)
SULFUR
470.6 T/D
IMPROVED CRUDE OIL
(SYN. CRUDE OIL)
125,000
FUEL GAS (FOR BOILER)
FUEL COKE (FOR BOILER)
4,990 T/D
NATURAL GAS
0.26 • 10⁶ NM³/D
FOR REFERENCE ONLY
ORINOCO HEAVY OIL UP-GRADING PROJECT
BLOCK FLOW DIAGRAM
FLUID COKER CASE
Fig. 2


UNIT : BPSD
RAW CRUDE OIL
151839
OIL WELLS
DILUENT
45569
GAS
NAPHTHA
MIXED CRUDE OIL
197400
ATMOS. DISTILLATION UNIT
GAS OIL
87001
21,434
ATM RESIDUE
128885
VACUUM FLASHING UNIT
VGO
42003
VAC. RESIDUE
81656
SDA UNIT
DAO
53978
VGO/DAO
97981
HDS UNIT
N
HDS GO
103,566
H2
HYDROGEN GEN. UNIT
ACID GAS TREATING
ACID GAS
SULFUR RECOVERY
TAIL GAS TREATING
FUEL GAS (FOR PROCESS)
SULFUR
324.2 T/D
FUEL OIL (FOR PROCESS)
IMPROVED CRUDE OIL
(SYN. CRUDE OIL)
125,000
SDA ASPHALT
FUEL ASPHALT (FOR BOILER)
25658
NATURAL GAS
0.775・10 NM/D
ORINOCO HEAVY OIL UP-GRADING PROJECT
BLOCK FLOW DIAGRAM
SDA CASE
Fig. 3
FOR REFERENCE ONLY

The material balance of each refinery scheme is summarized in Table 1. (Slide 4)

Table 1 Material Balance of Process Scheme

CASE	Eureka	Fluid Coker	SDA
	BPSD	BPSD	BPSD
1. Feed			
Raw Crude Oil	158,900	155,420	151,839
Diluent Gas Oil	47,600	46,610	45,567
Mixed Crude Oil	206,500	202,030	197,406
Natural Gas	0.44×10^6 Nm^3/SD	0.26×10^6 Nm^3/SD	0.755×10^6 Nm^3/SD
3. Product			
Improved Crude Oil (Synthetic Crude Oil)	125,000	125,000	125,000
Sulfur	421.5 T/SD	470.6 T/SD	524.2 T/SD
Diluent Gas Oil	47,600	46,610	45,567
Excess By-product Fuel (for Boiler)	5,664 T/SD (pitch)	3,990 T/SD (coke) 11,220 FOE (Fuel Gas)	(4,772 T/SD) 25,658 (SDA Asphalt)
Fuel for process Furnace	as required	as required	as required

The properties of the improved crude oil are shown in Table 2. <u>(Slide 5)</u>

Table 2. Properties of Improved Crude Oil

CASE	Eureka	Fluid Coker	SDA
1. Feed (Raw Crude Oil)			
°API	8.5	8.5	8.5
Sulfur, wt%	3.67	3.67	3.67
2. Product (Improved Crude Oil)			
°API	25.8	25.4	25.0
Sulfur, wt%	1.0	0.91	0.4
Component, vol%			
S.R. Naphtha	-	1.0	-
S.R. LGO	17.2	-	17.1
HDS (VGO/CO)	82.8	-	-
HDS (LGO/VGO/CN/CGO)	-	99.0	-
HDS (VGO/DAO)	-	-	82.9

The installed capacity of the process units is summarized in Table 3 for each refinery scheme. (Slide 6)

Table 3. Installed Capacities of Process Unit

Unit \ CASE	Eureka	Fluid Coker	SDA
	BPSD	BPSD	BPSD
Atmospheric Distillation	206,500	202,000	197,400
Vacuum Flashing (2 trains)	134,900	132,900	128,900
Eureka	90,900	-	-
Fluid Coker (2 trains)	-	89,000	-
SDA	-	-	81,600
HDS	107,900	120,500	98,000
Hydrogen Generation (2 trains)	1.93×10^6 Nm^3/SD H_2	1.77×10^6 Nm^3/SD H_2	3.1×10^6 Nm^3/SD H_2
Acid Gas Treating (2 trains)	447.8 T/SD H_2S	500 T/SD H_2S	557 T/SD H_2S
Sulfur Recovery (2 trains)	421.5 T/D S	470.6 T/SD S	524.2 T/SD S
Tail Gas Treating (2 trains)	16.5 T/SD S	18.7 T/SD S	21.0 T/SD S

4. BY-PRODUCT UTILIZATION SCHEME

The by-product utilization scheme is the facilities which utilize the by-products as fuel oil for boiler. The following facilities are included in this scheme:

- storage of by-products
- transportation of by-products
- preparation of by-products fed to boilers
- boilers
- flue gas desulfurization
- hydrogen generation
- sulfur recovery

(1) Basic conditions

(a) 100 kg/cm^{2}G, 500°C steam of 1,000 T/H is produced for electric generation.

100 kg/cm^{2}G, saturate steam is also produced by the remaining fuel.

(b) The boilers are operated 330 days/year, the same as the upgrading refinery.

(c) The total boiler capacities are determined by the fuel quantities which are produced as by-product in the upgrading refinery.

The produced steam from the boilers and the required steam for production of raw crude oil to be charged in the upgrading refinery are not balanced.

(d) 50 MW electric power is supplied from the upgrading refinery for the production of raw crude oil.

(e) It is assumed that natural gases are used for feed and fuel of hydrogen generation unit in the flue gas desulfurization facility.

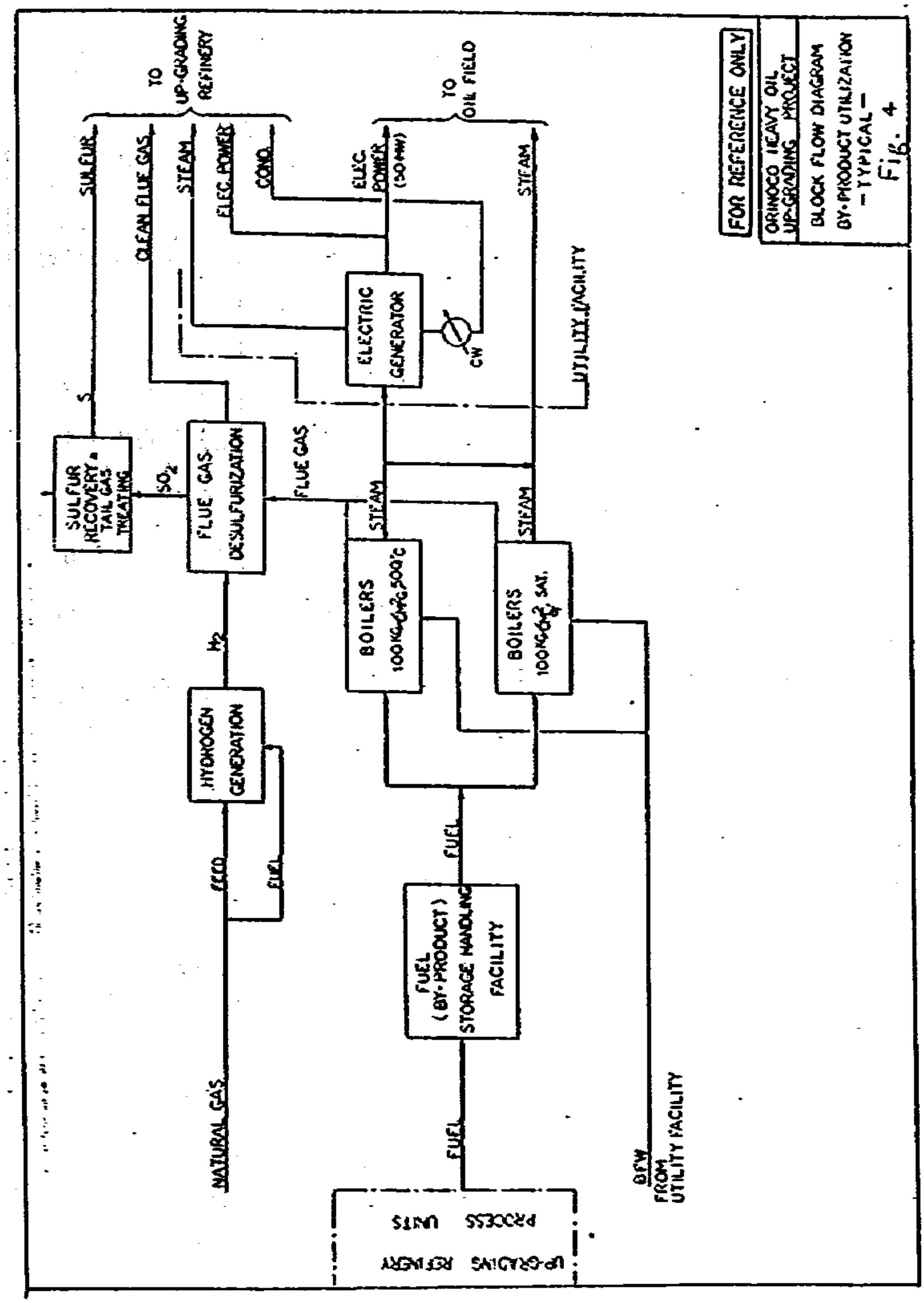
(f) Boiler feed waters for the above boilers are supplied from the utility facility of the upgrading refinery.
However, condensates are not recovered from the injection steam in the oil field.

(2) Boiler scheme

The boiler scheme for by-product utilization is shown in Fig. 4. (Slide 7)
The material balance is shown in Tablel 4. (Slide 8)

Table 4. Boiler Balance

CASE	EUREKA	FLUID COKER	SDA
1. Feed			
(1) By-product Fuel	5,664 T/SD (pitch)	3,990 T/SD (coke) 11,220 FOE BPSD (Fuel Gas)	25,658 BPSD (SDA Asphalt)
(2) Boiler Feed Water	2,550 T/H	2,450 T/H	2,210 T/H
(3) Natural Gas	0.34×10^6 Nm^3/SD	0.22×10^6 Nm^3/SD	0.27×10^6 Nm^3/SD
2. Product			
(1) 100 kg/cm^2G, 500°C Steam	1,000 T/H	1,000 T/H	1,000 T/H
100 kg/cm^2G, Sat, Steam	1,800 T/H	1,880 T/H	1,750 T/H
(2) Sulfur	351 T/SD	230 T/SD	277 T/SD


SULFUR RECOVERY & TAIL GAS TREATING
FLUE GAS DESULFURIZATION
HYDROGEN GENERATION
BOILERS
BOILERS
ELECTRIC GENERATOR
FUEL (BY-PRODUCT) STORAGE HANDLING FACILITY
UP-GRADING REFINERY PROCESS UNITS
SULFUR
CLEAN FLUE GAS
STEAM
ELEC. POWER
COND.
TO UP-GRADING REFINERY
ELEC. POWER (50 MW)
STEAM
TO OIL FIELD
UTILITY FACILITY
CW
S
SO2
FLUE GAS
STEAM
STEAM
H2
FEED
FUEL
NATURAL GAS
FUEL
FUEL
BFW FROM UTILITY FACILITY
FOR REFERENCE ONLY
ORINOCO HEAVY OIL UP-GRADING PROJECT
BLOCK FLOW DIAGRAM BY-PRODUCT UTILIZATION -TYPICAL-
Fig. 4

The installed capacity of the boiler facilities is summarized in Table 5. (Slide 9)

Table 5. Installed Capacities of Boiler Facilities

CASE	EUREKA	FLUID COKER	SDA
By-product Fuel Storage & Handling Facility	5,664 T/SD (pitch)	3,990 T/SD (coke)	25,658 BPSD (SDA Asphalt)
Boiler			
100 kg/cm^2G, 500°C.	500 T/H x 2	500 T/H x 2	500 T/H x 2
100 kg/cm^2G, SAT	530 T/H x 4	540 T/H x 4	440 T/H x 4
Hydrogen Generation	0.80×10^6 Nm^3/D (H_2)	0.52×10^6 Nm^3/D (H_2)	0.63×10^6 Nm^3/D (H_2)
Flue Gas Desulfurization	351 T/SD (S)	230 T/SD (S)	277 T/SD (S)
Sulfur Recovery	351 T/SD (S)	230 T/SD (S)	277 T/SD (S)

5. UTILITY AND OFFSITE FLOW SCHEME

The study of utility and offsite flow scheme is now proceeding.

The facilities of the scheme are organized by utility facilities, storage facilities and general auxiliary facilities which are required for smooth operation of the process units and boiler facilities.

The utility and offsite scheme of each process scheme is different each other. However, a typical scheme for common to each case is described in this part.

(1) Utility Facilities

The following facilities are studied, besides the steam generation facility (boilers) included in the by-product utilization scheme:

Steam distribution facility in the refinery

Electric power generation and distribution facilities

Industrial water intake and desalination facilities

Water treatment facilities

Condensate recovery facility

Sanitary water facility

Cooling water facility

Fuel facility

Air facility

Inert gas facility

The system flow of steam, power and water is shown in Fig. 5. (Slide 10)

The capacity of each facility is not fixed now, but the following intake and output of utilities are assumed in the upgrading refinery:

Industrial Water	5,000 T/H
Brine	1,000 T/H
Steam for well injection	2,000 T/H
Power for Oil production	50 MW

(2) Offsite facility

The tank flow diagram of the upgrading refinery is shown in Fig. 6. (Slide 11)

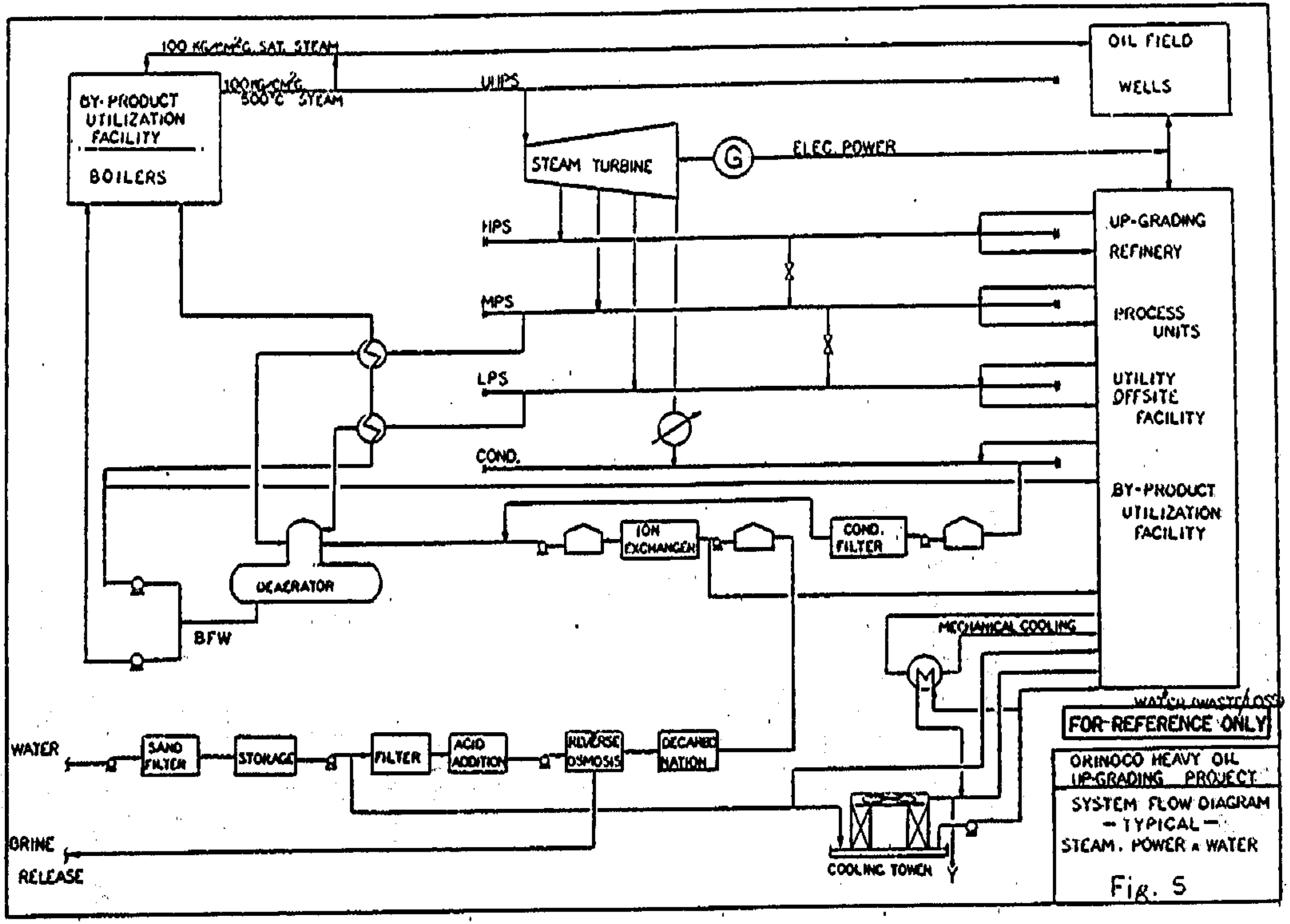
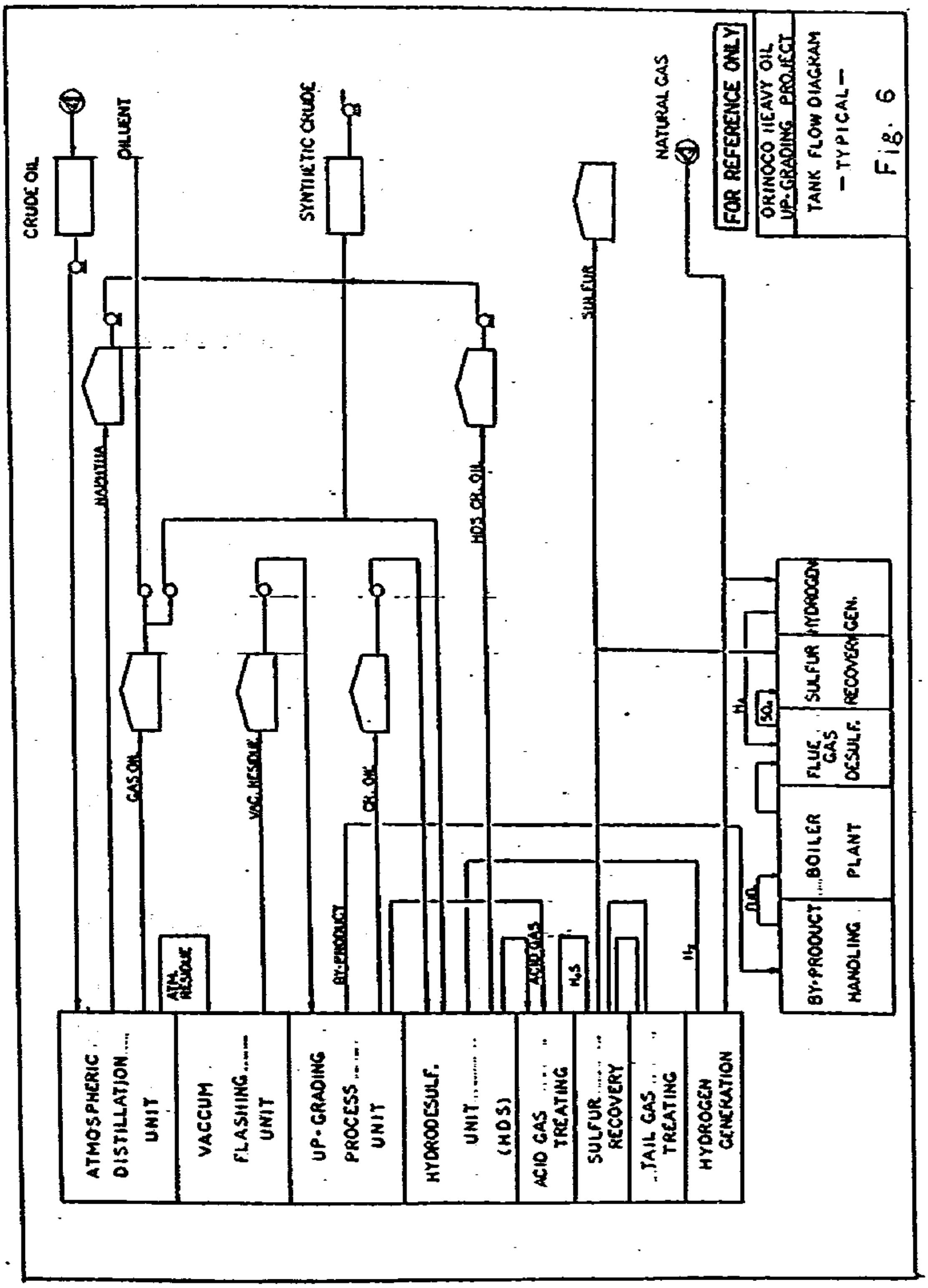

OIL FIELD
WELLS
100 KG/CM²G SAT. STEAM
100KG/CM²G 500°C STEAM
BY-PRODUCT UTILIZATION FACILITY
BOILERS
UHPS
STEAM TURBINE
G
ELEC. POWER
HPS
MPS
LPS
COND.
UP-GRADING REFINERY
PROCESS UNITS
UTILITY OFFSITE FACILITY
BY-PRODUCT UTILIZATION FACILITY
DEAERATOR
BFW
ION EXCHANGER
COND. FILTER
MECHANICAL COOLING
WATER (WASTE/LOSS)
WATER
SAND FILTER
STORAGE
FILTER
ACID ADDITION
REVERSE OSMOSIS
DECARBONATION
BRINE RELEASE
COOLING TOWER
FOR REFERENCE ONLY
ORINOCO HEAVY OIL UP-GRADING PROJECT
SYSTEM FLOW DIAGRAM
— TYPICAL —
STEAM, POWER & WATER

Fig. 5


CRUDE OIL
DILUENT
SYNTHETIC CRUDE
NATURAL GAS
FOR REFERENCE ONLY
ORINOCO HEAVY OIL
UP-GRADING PROJECT
TANK FLOW DIAGRAM
— TYPICAL —
Fig. 6
NAPHTHA
GAS OIL
VAC. RESIDUE
CR. OIL
HDS CR. OIL
SULFUR
ATM. RESIDUE
BY-PRODUCT
ACID GAS
H_2S
H_2
SO_2
ATMOSPHERIC DISTILLATION UNIT
VACCUM FLASHING UNIT
UP-GRADING PROCESS UNIT
HYDRODESULF. UNIT (HDS)
ACID GAS TREATING
SULFUR RECOVERY
TAIL GAS TREATING
HYDROGEN GENERATION
BY-PRODUCT HANDLING
BOILER PLANT
FLUE GAS DESULF.
SULFUR RECOVERY
HYDROGEN GEN.

The storage capacity of the upgrading refinery is smaller than a conventional refinery for the following reasons:

(a) The mixed crude oil before upgrading will be supplied anytime from the outside of the upgrading refinery.

(b) The improved crude oil will be transported by pipeline to storage tanks which will be installed at the port for export tanker.

The following facilities are studied besides the tank facility:

- Waste water treating facility
- Waste material treating facility
- Control room
- Communication facility
- Lighting facility
- Roads and fences
- Flare stack and blow down facility
- Stack for flue gases
- Natural gas intake facility
- Products loading facility
- Buildings
  - Administration office
  - Maintenance shop
  - Warehouse
  - Laboratory
  - Main station and sub-stations
  - Fire station

Dressing room and resting room

Guardhouse

Clinic

Dining room

Other facilities

6. SUMMARY

The main flow of the upgrading refinery organized by the above process units, by-product utilization facilities and utility and offsite facilities is summarized in Fig. 7 (Slide 12)

Main input flow

(a) Mixed crude oil
(b) Natural gas
(c) Industrial Water

Main output flow

(d) Improved crude oil
(e) Sulfur
(f) Steam
(g) Electric power
(h) Waste Water and brine
(i) Diluent oil

The flows are different on each case. The approximate average flow rates are as follows:

(a)	Mixed crude oil	200,000 BPSD
(b)	Natural gas	0.5 - 1 x 10^6 Nm^3/D
(c)	Industrial Water	4,000 - 5,000 T/H
(d)	Improved crude oil	125,000 BPSD
(e)	Sulfur	700 - 800 T/D
(f)	Steam	2,000 T/H

Dressing room and resting room

Guardhouse

Clinic

Dining room

Other facilities

6. SUMMARY

The main flow of the upgrading refinery organized by the above process units, by-product utilization facilities and utility and offsite facilities is summarized in Fig. 7 (Slide 12)

Main input flow

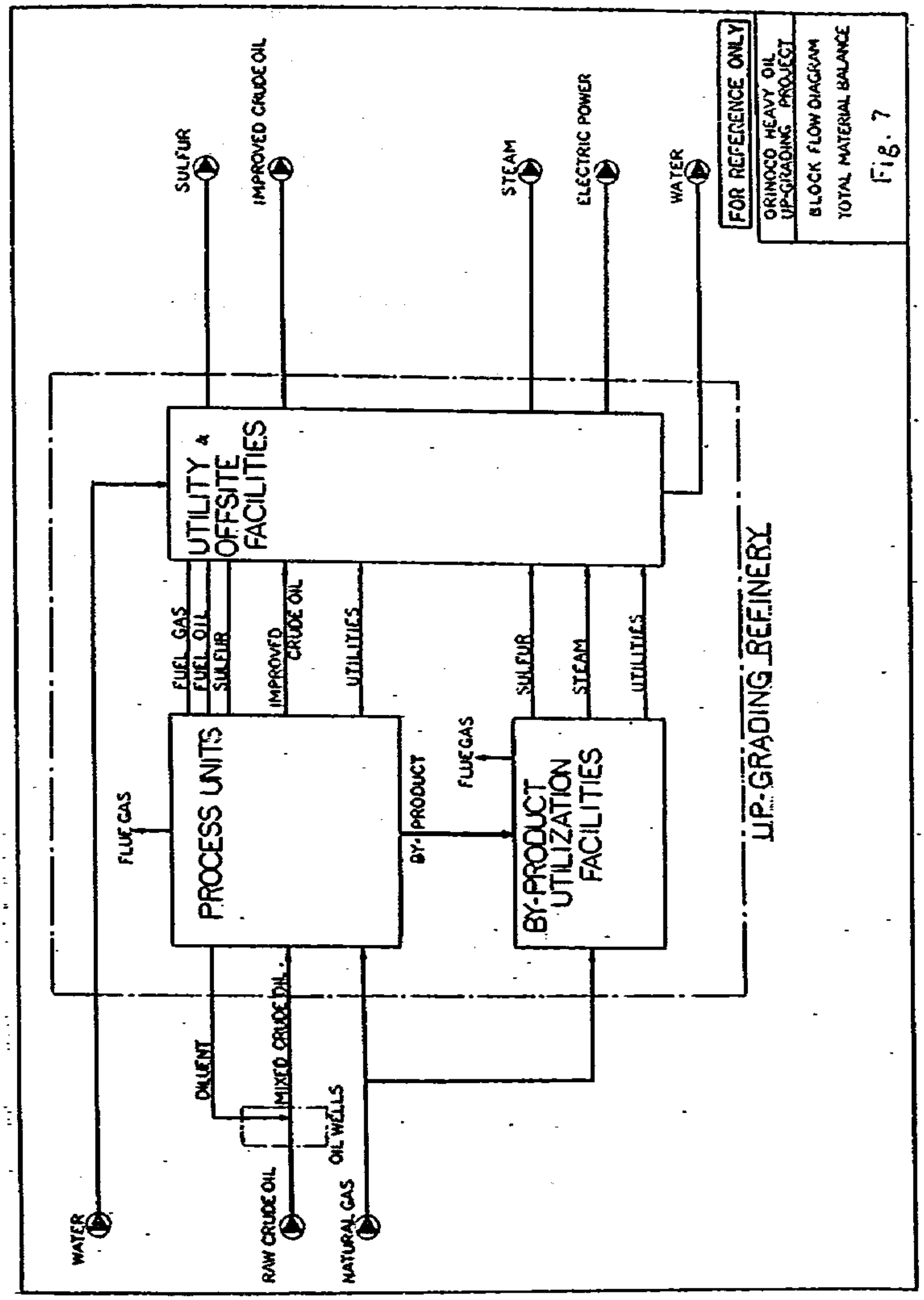
(a) Mixed crude oil
(b) Natural gas
(c) Industrial Water

Main output flow

(d) Improved crude oil
(e) Sulfur
(f) Steam
(g) Electric power
(h) Waste Water and brine
(i) Diluent oil

The flows are different on each case. The approximate average flow rates are as follows:

(a)	Mixed crude oil	200,000 BPSD
(b)	Natural gas	$0.5 - 1 \times 10^6$ Nm^3/D
(c)	Industrial Water	4,000 - 5,000 T/D
(d)	Improved crude oil	125,000 BPSD
(e)	Sulfur	700 - 800 T/D
(f)	Steam	2,000 T/H


FOR REFERENCE ONLY
ORINOCO HEAVY OIL UP-GRADING PROJECT
BLOCK FLOW DIAGRAM
TOTAL MATERIAL BALANCE
Fig. 7
SULFUR
IMPROVED CRUDE OIL
STEAM
ELECTRIC POWER
WATER
UTILITY & OFFSITE FACILITIES
FUEL GAS
FUEL OIL
SULFUR
IMPROVED CRUDE OIL
UTILITIES
SULFUR
STEAM
UTILITIES
PROCESS UNITS
FLUE GAS
BY-PRODUCT
FLUE GAS
BY-PRODUCT UTILIZATION FACILITIES
UP-GRADING REFINERY
DILUENT
MIXED CRUDE OIL
OIL WELLS
WATER
RAW CRUDE OIL
NATURAL GAS

(g)	Electric power	50 MW
(h)*	Waste water and brine	2,000 - 3,000 T/H
(i)	Diluent Oil	45,000 BPSD

* Loss of water is included.

These figures are big values, so that basis of study should be discussed and reconfirmed before the detailed study.

The following few points shall be specially discussed to develop a realistic scheme:

Well water supply
Brine release
Sulfur loading

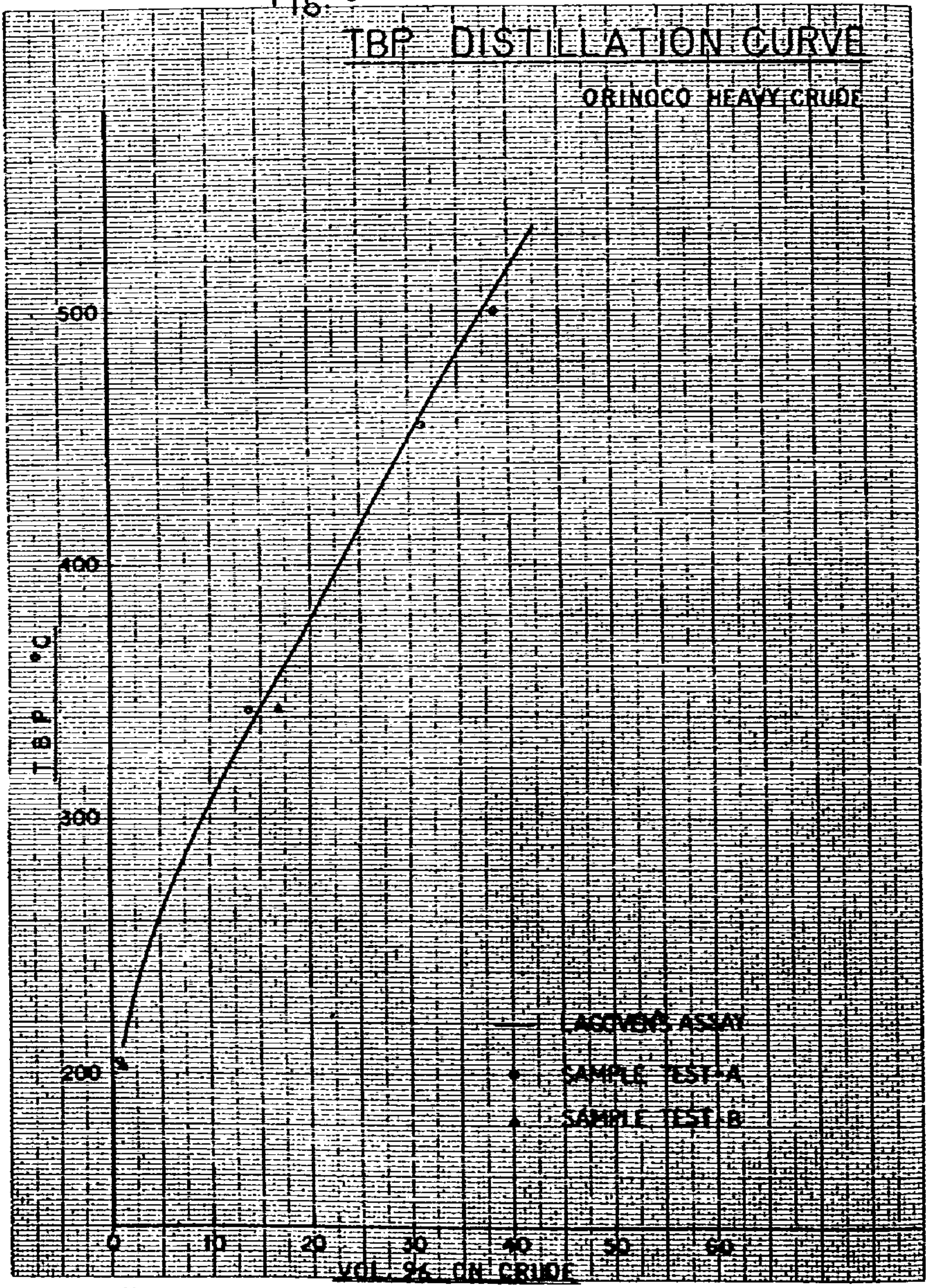
ATTACHMENT

ANALYSIS OF SAMPLE CRUDE OIL

Fig. 8 TBP Distillation Curve (Slide 13)

Table-6 Comparison of Main Analysis Data (Slide 14)

Fig. 8



JIS A4 180×250%

NO. 401 C

TABLE-6 COMPARISON OF MAIN ANALYSIS DATA

SAMPLE	CUT. PT.	TEST	ANALYSIS Sp. Gr (15/4°C)	Sulfur wt.%	CCR wt.%	V w.ppm	Ni w.ppm	Ash wt.%	Na w.ppm	Asphalten wt.%
Crude Oil	-	A	1.019	3.75	18.1	420	110	0.451	840	-
	-	B	1.0199	3.87	17.0	310	120	0.246	1,100	-
	-	ASSAY	1.011	3.67	13.3	392	84	-	-	-
Long Residue	650°F+	A	1.038	3.96	20.60	480	110	0.46	850	-
	650°F+	B	1.0353	4.12	20.40	410	130	0.264	1,002	13.3
	650°F+	ASSAY	1.034	4.04	17.6	484	120	-	-	-
Short Residue	930°F+	A	1.062	4.21	29.50	660	160	0.609	1,190	-
	950°F+	B	1.0514	4.26	-	-	170	0.357	1,500	-
	830°F+	C	1.045	4.14	22.79	559	148	0.3	1,190	-
	995°F+	ASSAY	1.062	4.32	25.7	654	162	-	-	-
	950°F+	ASSAY	1.058	4.26	23.6	616	153	-	-	-
	851°F+	ASSAY	1.049	4.17	20.5	546	135	-	-	-

ATTACHMENT TO JICA-2

②

CONFIRMATION ITEMS OF BASIS

OF

FEASIBILITY STUDY

FOR

THE UPGRADING PROJECT

OF

ORINOCO HEAVY OIL

IN

THE REPUBLIC OF VENEZUELA

APRIL 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Battery limits of the upgrading refinery on the feasibility study (Please refer to the attached Fig. A)

As the feasibility study bases, the upgrading refinery fence is assumed as the battery limits of the following imput and output flows:

(1) Feed oil: mixture of raw crude oil and diluent

The feed oil is dehydrated and desalted in a main station after handling at oil production, gathering and block stations which are excluded from the scope of study. Storage of one week is considered.

(2) Natural gas for feedstock of hydrogen generation.

(3) Diluent (gas oil)

(4) Industrial water

(5) Product sulfur (molten type)

Storage of one week production is considered in the fence.

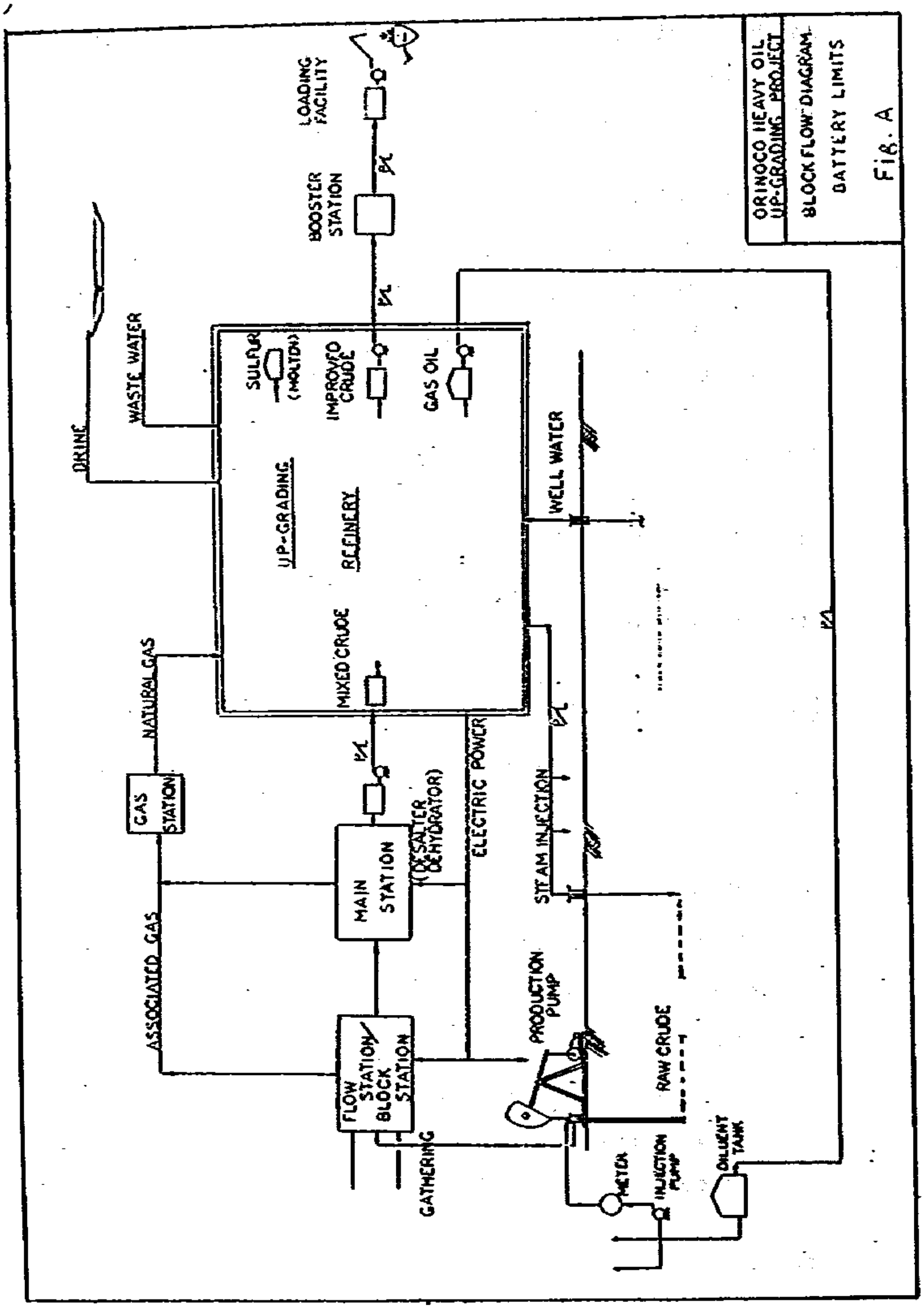
(6) Synthetic crude oil (Improved crude oil)

Storage of one week production and loading pumps of 40 kg/cm^2G discharge pressure are considered in the fence.

Transmission pipeline, booster stations, storage tanks at the port and loading facilities are outside the scope of the study.

(7) Steam

Surplus by-products are used as boiler fuel to produce ultra-high pressure steam.


ORINOCO HEAVY OIL
UP-GRADING PROJECT
BLOCK FLOW DIAGRAM
BATTERY LIMITS
Fig. A
LOADING FACILITY
BOOSTER STATION
WASTE WATER
BRINE
SULFUR
(MOLTEN)
IMPROVED CRUDE
GAS OIL
UP-GRADING
REFINERY
WELL WATER
MIXED CRUDE
NATURAL GAS
GAS STATION
ELECTRIC POWER
MAIN STATION
(DESALTER DEHYDRATOR)
STEAM INJECTION
ASSOCIATED GAS
PRODUCTION PUMP
RAW CRUDE
FLOW STATION/ BLOCK STATION
GATHERING
METER
INJECTION PUMP
DILUENT TANK

Surplus ultra-high pressure steam is exported for well injection.

(8) Electric power

50 MW electric power is exported for well users.

(9) Waste water

Waste water and brine are discharged.

2. Data required

(1) Properties, availability and supply conditions of natural gas.

(2) Properties, availability and supply conditions of industrial water.

3. Information required (Discussion items)

(1) Difference of the data on the crude assay and sample oil
(Please refer to Table 6 and Fig. 8 in the report of preliminary study)

(a) The preliminary study was conducted based on the crude assay.

(2) Specification of improved oil

(a) Specifications of improved oil suggested by MEM are °API gravity and total sulfur content only. However, in a certain case, it is difficut to keep sulfur content at 1.0 wt. percent when gravity is kept at 25 - 28 °API due to the features of the hydrodesulfurization process.

(b) May we understand the high sulfur light gas oil is mixed with the improved oil?

(3) Sulfur

(a) More than 700 Ton/SD sulfur is produced in the refinery.
How to transport the molten sulfur from the refinery to a port, and from a port to market?
Maximum capacity of tanker for molten sulfur will be 2000 ton.

(b) Please kindly give us information on the prevailing restrictions on air pollution.
Is it necessary to recover sulfur from the flue gas?

(4) Desulfurization of boiler flue gas

(a) Molten sulfur production is applied on the preliminary study.
Therefore, hydrogen generation and sulfur recovery units are included in the flue gas desulfurization facilities.

(b) Please kindly give us the following information:

(b-1) demand for sulfur compounds
sulfur, sulfuric acid, sulfite, gypsum, ...

(b-2) availability and price of limestone, magnesium hydrooxide, silica, sand

(b-3) price of gypsum

(5) Boiler feed water

(a) Since the oil well injection steam is not recovered as condensate, a large quantity of fresh water must be produced from underground water, which is assumed to be high in salt content.

(b) For the production of fresh water, a reverse osmosis process is applied, because it is simple and is less expensive compared with other processes such as evaporation process.

(c) Is there a possibility to recover water from the oil well?

(d) Please kindly give us information on the fresh water production system presently used at the oil production field.

(6) Waste water and brine

(a) Discharge point of waste water and brine
(b) Restrictions on water pollution

(7) Operation of boiler and refinery

(a) Operation days of the refinery and boiler facilities are 330 days/year.

(b) Concerning the storage of boiler fuel, the following should be taken into consideration:

(b-1) storage facility of gas fuel for one month consumption is very large and is not practical
(b-2) solid fuel can be stored. However, storage for one month consumption is large. And coke has to be stored indoor.
(b-3) Liquid fuel can be stored. However, since high temperature heating is required, storage of large quantity is undesirable.

(c) Please kindly give us an idea on heating system of the tank presently used for the crude storage.

ATTACH MENT TO JICA-2

③

CONFIRMATION ITEMS OF BASIS

OF

ECONOMIC STUDY

FOR

THE UPGRADING PROJECT

OF

ORINOCO HEAVY OIL

IN

THE REPUBLIC OF VENEZUELA

APRIL 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Schedule

(1) What is the time schedule for the Orinoco heavy crude development and production?

Expected starting time of 150,000 - 160,000 BPSD crude production

(a) 1989
(b) Other (   )

(2) What is the time schedule for the plans for the upgrading plant installation?

Expected operating start-up of the upgrading plant

(a) Early of 1989
(b) Other (   )

(3) How many years should be taken for the project life after start-up operation?

(a) 20 years
(b) Other   years

(4) What should be the stream factor for plant operation?

(a) 1st year [   ] %
(b) 2nd year [   ] %
(c) after 3 year [   ] %

2. Raw material cost and product price

(1) What do you suppose is the cost of Orinoco heavy crude (mixture of raw crude oil and diluent) at the upgrading plant fence?

US$ [   ] /BBL
on [   ] /(Year)

(2) Waht do you suppose is the cost of the diluent at the upgrading plant fence?

US$ [   ] /BBL
on [   ] (year)

(3) What do you suppose is the price of Natural gas at the upgrading plant fence?

US$ [ ] /MMCF (MM Nm^3)

on [ ] (year)

(4) What do you suppose is the price of synthetic crude at the upgrading plant fence?

US$ [ ] /BBL

on the condition of

[ ] °API

[ ] wt.% S

[ ] year base

Syn. crude		Est. price US$/BBL
API	Sulfur (wt%)	at [ ] year
22	1.0	[ ]
24	1.0	[ ]
25	1.0	[ ]
26	1.0	[ ]
28	1.0	[ ]
30	1.0	[ ]
Sulfur premium		[ ] US$/0.1 wt.% S

(5) What is the price of sulfur product at plant fence?

US$ [ ] /ton

(6) What is the price of steam at the plant fence?

US$ [ ] /ton

on [ ] year

at condition of 100 kg/cm^2G saturate

US$ [ ] /ton

on [ ] year

at condition of 100 kg/cm^2G 500 °C

(7) What do you suppose is the supply cost of water of the plant fence?

US$ [ ] /ton

on [ ] year

(8) What is the supply price of electric power at the plant fence?

US$ [ ] /kw
on [ ] (year)

3. Conditions of Cost

(1) What are the inflation factors in Venezuela?

- Construction material [ ] %/year
- Construction labor [ ] %/year
- Raw material, products, [ ] %/year
- Operating labor [ ] %/year

(2) What is the local factor of construction cost compared to US Gulf cost?

- Equipment & materials cost [ ]
- Installation cost [ ]

(3) What are the import duties for import materials & equipment and the income tax of foreign engineers & labor?

[ ] %
[ ] %

(4) What should be considered for working capital?

(a) Land cost

Feed storage
Product storage
Production cost
Product sales

(b) Land

What is the land cost of plant site? [ ]

(c) Oil inventory

What percent full of tank is considered at the end of start-up period? [ ]

(d) Chemical inventory

How many months of supply or how much quantity is required? [ ]

(e) Spare parts

What percent of construction cost is estimated for spare parts? [ ]

(5) What are the salaries including all allowances of operators in the plant?

	US$ /year
- Administrative staff	
- Technical staff	
- Foreman & operator	
- Worker	
at	year

(6) Can you give us a typical organization chart of the existing refinery?

(a) Yes
(b) No

(7) What are the average wages of skilled labor and other?

	US$/Day
Supervisor	
Welder	
Driver (car)	
Driver (crane)	
Driver (truck)	
Mechanic	
Pipe fitter	
Piping worker	
Painter	
Duct worker	
Electrician	
Insulation worker	
Common Labor	
Offie clerk	
Typist	
Accountant	
Engineer	
Draftsman	

(8) What are the costs of construction materials?

	US$/Ton
Cement	
Steel bar	
Gravel	
Concrete	

(9) How many years should be taken for the depreciation period of plant after start-up operation?

(a) 10 year
(b) Other [ ] years

What kind of depresciation method shall be taken?

(a) straight run
(b) Other

(10) How much is taken for salvage value?

[ ]

4. Debt & Equity

(1) What is the ratio of Debt/Equity for investment?

[ ] / [ ]

(2) What is the interest ratio of loan?

for long-term loan
for short-term loan

(a) 8%
(b) 10%
(c) Other [ ] %

(3) How should the interest be handled during construction?

(a) Capitalized
(b) Other

(4) What kind of method for refund of loan should be assumed?

(a) Constant refund
(b) Other

(5) How many years should be assumed for payment of loan?

(a) 10 years
(b) Other [ ] years

(6) How many years are taken as grace period?

[ ] year

And when is a counting point of the period?

[ ]

(7) What is accounting method?

(a) Base account
(b) Mid-year account

5. Taxes

(1) What percent is the corporate tax and what kind of method is selected?

[ ] %

(a) Uniform
(b) Progressive
(c) Other

(2) What percent is the fixed property tax to fixed assets of plants and what kind of method is selected?

[ ] %

(a) Uniform
(b) Progressive
(c) Other

(3) What percent is the insurance for fixed assets of plants?

[ ] %

(4) How much is the royalty for oil production?

[ ]

(5) How many years are considered as tax holiday?

[ ] year

6. Economic Analysis

(1) What kind of analysis method is recommendable?

(a) DCF method
(b) Paid out time method
(c) Other

(2) What is the definition of cash flow?

(a) IRR
(b) NPV

(3) What is the base year?

(a) Start of construction
(b) Completion of construction
(c) Start of operation

(4) Which is a recommendable method of IRR?

(a) ROI
(b) ROE

(5) What sensitivity analysis item shall be calculated?

(a) IRR
- 15%
- 20%
- 25%

(b) Investment Cost
- Base
- +20%
- -20%

(c) Other

(5) What Sensitivity analysis item shall be calculated?

(a) IRR 15%
20%
25%

(b) Investment Cost
Base
+20%
-20%

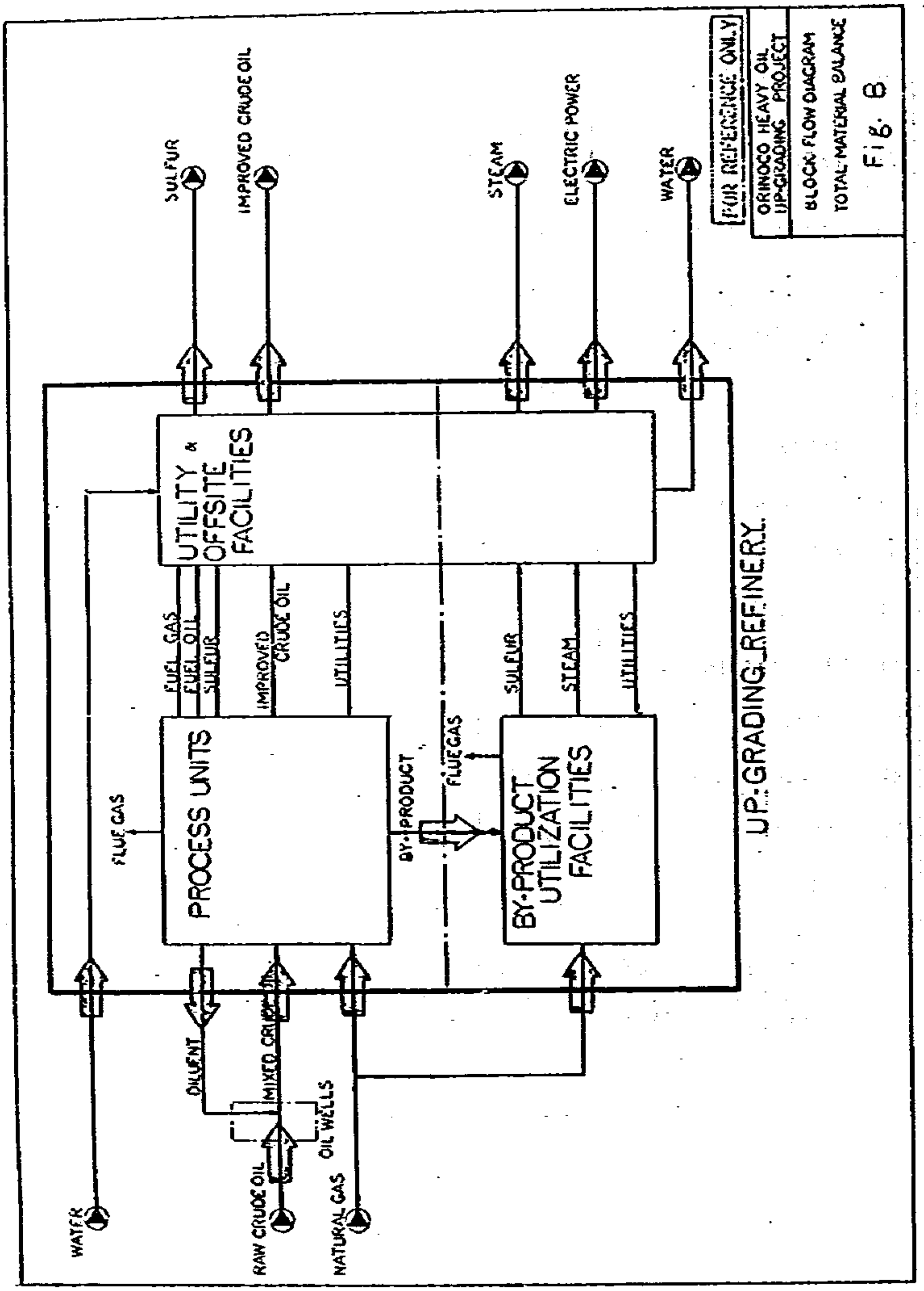
(c) Other

7. Calculation method of Economic analysis

Please refer to the attached Fig. B.

Price/Cost	IN/OUT	Initial Fixed Value	Objective Value (Fixed)	Calculated Value
(a) Mixed crude oil	IN	o		
(b) Raw crude oil	IN	(o)*		
(c) Natural gas	IN	o		
(d) Water	IN			
(e) Diluent	OUT	o		
(f) Improved crude oil	OUT	-		o
(g) Sulfur	OUT	o		
(h) Steam (UHP)	OUT	o		
(i) Electric power	OUT	o		
(j) Water	OUT	o		
(k) By-product fuel	OUT/IN	-		
(l) Utilities	OUT/IN	-		
(m) IRR	-	-	o	

* (b) instead of (a) + (e);
in this case outlet diluent is the same value as inlet diluent.


FOR REFERENCE ONLY
ORINOCO HEAVY OIL UP-GRADING PROJECT
BLOCK FLOW DIAGRAM
TOTAL MATERIAL BALANCE
Fig. 8
UP-GRADING REFINERY
UTILITY & OFFSITE FACILITIES
PROCESS UNITS
BY-PRODUCT UTILIZATION FACILITIES
SULFUR
IMPROVED CRUDE OIL
STEAM
ELECTRIC POWER
WATER
FUEL GAS
FUEL OIL
SULFUR
IMPROVED CRUDE OIL
UTILITIES
SULFUR
STEAM
UTILITIES
FLUE GAS
FLUE GAS
BY-PRODUCT
DILUENT
MIXED CRUDE
OIL WELLS
WATER
RAW CRUDE OIL
NATURAL GAS

ATTACHMENT TO JICA-2

(4)

INFORMATION AND DATA ON CONSTRUCTION PLANNING FOR THE UPGRADING PROJECT OF ORINOCO HEAVY OIL IN THE REPUBLIC OF VENEAUELA

APRIL 1980

JAPAN INTERNATIONAL COOPERTION AGENCY

PORT CONDITION

1. Brief description of dock facilities (Port drawings and harbor charts)

2. Size of ship that can be berthed

3. Maximum size and weight of cargo unloaded at port to date

4. Can vessels be offloaded into sea at port and towed to shore for loading

5. Type and capacities of unloading facilities

Type	Capacity	Quantity
Floating crane		
Crane		
Forklift		

6. Information on unloading extraordinarily large and heavy cargo

   (1) Limitation due to wind, if any

   (2) Effect of tide and height of waves

7. Capacities, available numbers of lighters and any other carriers for cargo

8. Storage capacities

   Shed

   Warehouse

   Bonded warehouse

   Outdoor storage space

9. Port congestion and required period for unloading

10. Harbor permits and regulations

11. Charges, duties and other levies

DATA AND INFORMATION ON SITE

1. Map

(1) Map of country or state showing roads and railroads

(2) Large scale map of site

(3) Contour map of site

2. Geology

(1) Nature of surface soil

Gradation
Color
Acidity
Salt content
Sulfur content
Permeability
Stability under watery condition

(2) Subsoil condition

(3) Soil data

Boring logs
Soil analysis
Laboratory test reports

(4) Elevation above sea level

(5) Flood and tidal data

(6) Elevation of ground water level

(7) Drainage of site

3. Climate

(1) Meteorological records
Clear, cloudy and rainy days
Temperature and humidity
Rainfall
Wind velocity
Earthquake
Record of floods, droughts

4. Obstructions on site

Buildings
Transmission lines
Underground obstructions
Others

5. Utilities required during construction work

Water
Electric power

LOCAL TRANSPORTATION

1. Organization concerned. The country, state, city?

2. Roads

   (1) Distance between site and port

   (2) Buried items

   (3) Width

   (4) Curve radius

   (5) Slope

   (6) Condition and size of side ditches

3. Width and type of bridge

4. Width, height and type of tunnel

5. Limitations relating to above 2, 3 and 4

   (1) Weight

   (2) Length

LABOR CONDITION

1. General

   (1) Governmental authority in charge

   (2) Labor laws and regulations

   (3) Estimated level of local skilled labor compared with that of Japanese

   (4) Working hours and holidays

   (5) Conditions on labor unions

2. Expatriate labors

   Possibility of hiring foreign labors
   (Engineer, technician, skilled and unskilled worker)

3. Contracators for the following works

   (1) Building work

   (2) Civil work

   (3) Steel structure work

   (4) Airconditioning work

   (5) Drainage work

SUBCONTRACTOR

1. Name

   Address

   Telephone No.

   Representative

2. Speciality

3. Experience

   Project, owner
   Site
   Time

4. Equipment owned

5. Number of regular personnel and workers

6. Observation of rubcontractor's jobsites, workshops, construction equipment, office, material yards, etc.

ATTACHMENT-5

Caracas, May 12, 1980

RECORD OF DISCUSSIONS

The Venezuelan authorities concerning with Orinoco Oil development, which are Ministerio de Energía y Minas (hereinafter referred to as "MEM"), Petróleos de Venezuela S.A. (hereinafter referred to as "PDVSA"), LAGOVEN, S.A. (hereinafter referred to as "LAGOVEN") and Instituto Technologico del Petróleo (hereinafter referred to as "INTEVEP"), and the Japanese Second Survey Team for the Upgrading project of Orinoco Heavy Oil in the Republic of Venezuela (hereinafter referred to as "The Team"), sent by Japan International Corporation Agency (hereinafter referred to as "JICA") had meetings.

The schedule of meetings and persons who participated in the discussions are listed in Annex - A and Annex - B, respectively.

Both parties exchanged views and discussed.

The following is a summary of the meetings.

1.- Reporting of the Result of the Preliminary Study
The Team reported the result of the preliminary study based on "Attachment to JICA - 2 ①" included in Annex - D.

2.- Revision of Basic Conditions for the Study in "Record of Discussions" signed by both parties on October 10, 1979.
Both parties agreed to the following items:
  (1) Feed Oil of the Upgrading Refinery
    (a) Name of the raw Orinoco Heavy Oil
    50/50% Cogollar IX and Cerro Negro Crude Oil
    (b) Diluent for the oil production
    Distillate of 380 - 510°F, mainly light gas Oil of the upgrading refinery is recycled.

../..

(c) Analysis Data of Raw Orinoco Heavy Oil for futher study use.
"Crude assay of 50/50% COGOLLAR IX and Cerro Negro (Report No. LV.5C - PC.79)" prepared by LAGOVEN and "Characterization de los residuos (700°F +) y de sus crudos de origen" in the Annex - C are used.

(d) Capacity of the upgrading refinery
To produce 125,000 BPSD minimum of product oil.

(2) Product of the Upgrading Refinery

(a) Properties of product
"Target Yields of synthetic crude" and. "Target key qualities of components" in the Annex - C is to be referred.

(3) By products of the Upgrading Refinery

(a) Use of by - product
Fuel for the generation of electric power for the oil production and the upgrading refinery and the generation of steam for the upgrading refinery.
Excess fuel is piled in the upgrading refinery.

(b) Boiler plant site
One centralized boiler plant for use of by-product is installed in the upgrading refinery.
Field portable boilers for steam injection are installed separately in the field which are excluded from the feasibility study.

(c) Fuel supply for the field portable boiler
Excess fuel gas from the upgrading refinery is supplied.
Main fuel for the boiler is natural gas.

(4) Sulfur Recovery

(a) Recovery Sources
Sulfur in the sour gas of hydrodesulfurization units is recovered as elemental sulfur.
Sulfur of 90 % in the flue gas of boilers is recovered as gypsum or others.

../..

(b) Type of Sulfur

Elemental sulfur is solid.

(5) Steam and Electrical Power Requirements for oil production.

(a) Steam

Steam is not supplied from the upgrading refinery.

(b) Electric Power

150 MW on the basis of the raw crude production of 170,000 BPCD is required for the raw crude oil production.

3.- Items Confirmed

Both parties confirmed the following items:

3.1 Items relating to the "Attachment to JICA - 2 ①"

(1) The further study on the Flexicober case is excluded from the feasibility study.

(2) Fuel for furnace of the upgrading refinery

Shortage of fuel is balanced by vacuum residue.

(3) Feed for hydrogen generation unit

Natural gas is supplied.

(4) Industry water

River water is supplied.

3.2 Items relating to the "Attachment to JICA - 2 ②"

(1) Properties, availability and supply conditions of natural gas

C1	93.1	mol%
C2	1.9	mol%
CO2	3.7	mol%
C3+	1.3	mol%
Total	100.0	mol%
H2S	60	ppm
Mercaptan & COS	10	ppm

Supply pressure 500 psig

Required quantity is available.

(2) Properties, availability and supply conditions of industrial water

"REPORTE DE ANALISIS DE AGUA" in the attachment - C is to be referred.

Required quantity is available.

../..

(3) Waste Water

(a) Discharge point of waste water is the fence of the upgrading refinery.

(b) Restriction of water pollution are not specially considered.

(4) Operation of Boiler and Refinery

(a) Stream days of the refinery units are 330 days/year. And minimum half train of process units during shutdown maintenance is to be opereted continuously.

(b) Boiler and power generating facilities are to be operated continuously for 365 days operation of oil production.

3.3 Items relating to the "Attachment to JICA - 2 ③"

(1) Schedule

(a) Mechanical completion of the refinery = end of 1987
Start-up of the refinery = early of 1988
Full production of crude oil = early of 1989

(b) Project life = 20 years

(c) Operating rate of the refinery =
1988 ...330 stream days/year X 50%
1989 ...330 stream days/year X 100%

(2) Raw Material Cost and Product Price

(a) Raw crude oil = US $ 10/BBL on 1980

(b) Diluent gas oil = No value

(c) Natural gas & fuel gas = US $ 3/MMBTU on 1980

(d) Synthetic crude
"Upgraded Crude Values" in the Annex - C is to be referred.

(e) Sulfur = No value

(f) Industrial water = No value

(g) Electric power = US $ 0.023/KW on 1980

(h) Limestone & gypsum = No value

(i) Escalation of price is not considered for the study.

../..

(3) Condition of Cost

(a) Investment and operating cost are estimated on Venezuela site, 1980 base.
And escalation is not considered for the study.

(b) Oil inventry
Feed crude oil = 50% of 30 days storage capacity
Product = 50% of 7 days storage capacity

(c) Chemical inventry = 2 Months

(d) Spare parts = Standard

(e) Salaries including all allowances of operation persons
= Total average US $ 22/MH on 1980

(f) Typical organization chart of refinery
The refinery is organized by three (3) Department of operation, maintenance and technical.
Other departments are outside of the refinery.

(g) Depreciation period after start-up operation
= 16.6 years (Total average)

(h) Depreciation method = straight line

(i) Salvage value = No

(j) Land cost = No value

(4) Debt & Equity

All equity

(5) Taxes

(a) Corporation tax = 50% ~~→~~ 67%

(b) Method of corporation tax = Uniform

(c) Fixed property tax to fixed assets = No

(d) Insurance for fixed assets = No

(6) Economic Analysis

(a) Analysis method = DCF Method

(b) Definition of cash flow = IRR

(c) Base year = Start of operation (1988)

(d) Method of IRR = ROE

(f) Sensitivity analysis = Investment cost
- 20% & + 20%
Raw Crude Oil
-50% & + 50%

(7) Calculation Method

(a) Fixed value

Raw crude oil, diluent, natural gas, water, sulfur, limestone, gypsum, steam, electric power, waste water, by-product fuel, fuel gas,

(b) Objective fixed value

Improved crude oil

(c) Calculated value

IRR (ROE)

4.- Submission of the Report

The explanation of the report will be made in the middle of September, 1980 as per attached schedule in "JICA - 1" of the Annex - D.

Dr. Arévalo Guzmán Reyes
Director General Sectorial
Ministerio de Energía y Minas

S.Hirose
Senichi Hirose
Chief of the Japanese Second Survey Team for the Upgrading Project of Orinoco Heavy oil in the Republic of Venezuela

c.c.: Petróleos de Venezuela S.A.

c.c.: Lagoven S.A.

c.c.: Instituto Tecnológico Venezolano de Petróleo.

SCHEDULE OF VISIT

DATE	TIME	PLACE
May 6, 1980	14:30 - 17:00	Ministerio de Energía y Minas
May 7, 1980	09:00 - 15:00	Petróleos de Venezuela, S.A.
May 8, 1980	11:45 - 16:00	Lagoven, S.A.
May 9, 1980	15:00 - 16:00	Petróleos de Venezuela, S.A.
May 12, 1980	10:00	Ministerio de Energía y Minas

MEMBERS OF MEETING

DATE: May 6, 1980
PLACE: MEM

Venezuelan side

MEM

Dr. Arévalo Guzmán Reyes	General Director for Hydrocarbons
Dr. Alfredo Essis	Production Planning Advisor
Dr. Ricardo Nuñez	Refining Division Head
Dr. José Méndez Zadato	Exploration Advisor
Ing°Luis Rivas Rodríguez	Chemical Engineer
Dr. Manuel Alayeto	Director Adjusto

Japanese side

The second survey team - Group A

Mr. Senichi Hirose	Chief of the Team (Consultant to JICA)
Mr. Keiichi Goto	Deputy Director, Petroleum Development Division, MITI
Dr. Koji Ukegawa	Senior Scientific Officer, Natural Research Institute, MITI
Mr. Hideo Yasuki	Deputy Director, Industrial Survey DIvision, JICA
Mr. Yasuhisa Hosoya	Mechanical Engineer (Consultant to JICA)
Mr. Terutada Tsukagoshi	Chemical Engineer (Consultant to JICA)

Embassy of Japan

Mr. Katsuhiko Tsunoda	Minister
Mr. Hiroshi Yoshida	First Secretary

MEMBERS OF MEETING

DATE: May 7, 1980
PLACE: Petróleos de Venezuela, S.A.

Venezuelan side

MEM

Dr. Alfred Essis
Dr. Ricardo Nuñez
Ing°Luis Rivas Rodríguez

PDVSA

Dr. Carlos Borregales	Orinoco Oil Belt Coordinator
Dr. Angel Behrends	Coordinator Refinacion
Dr. José Prats	Planning Manager, Refinery Coordination
Dr. Edison Perozo	Pet. Engineer, Manager Orinoco Belt

LAGOVEN

Dr. Humberto Vidal	Coordinator of Cooporate Planning
Dr. Orlando Castillo	DSMA Project Deputy Upgrading Coordination

INTEVEP

Dr. Jerry J. Toman	Economic Technical analysis
Dr. Franzo Marruffo	Evaluation of Project

Japanese side

The second survey team - Group A

Embassy of Japan

Mr. Katsuhiko Tsunoda
Mr. Hiroshi Yoshida

MEMBERS OF MEETING

DATE: May 8, 1980
PLACE: LAGOVEN

Venezuelan side

MEM

Dr. Alfred Essis

Dr. Ricardo Nuñez

Ing° Luis Rivas Rodríguez

PDVSA

Dr. Angel Behrends

LAGOVEN

Dr. Humberto Vidal

Dr. Orlando Castillo

INTEVEP

Dr. Franzo Marruffo

Dr. Jerry J. Joman

Japanese side

The second survey team - Group A

Embassy of Japan

Mr. Hiroshi Yoshida

MEMBERS OF MEETING

DATE: may 9, 1980
PLACE: PDVSA

Venezuelan side

PDVSA
Dr. Carlos Borregales

Japanese side

The second survey team
Mr. Senichi Hirose
Mr. Keiichi Goto
Mr. Hideo Yasuki
Mr. Yasuhisa Hosoya

MEMBERS OF MEETING

DATE: May 12, 1980
PLACE: MEM

Venezuelan side

MEM, PDVSA, LAGOVEN and INTEVEP members

Japanese side

The second survey team - A Group
Embassy of Japan
Mr. Katsuhiko Tsunoda
Mr. Hiroshi Yoshida

TABLA 1
CARACTERIZACION DE LOS RESIDUOS (700°F+)
Y DE SUS CRUDOS DE ORIGEN.

CRUDO	CERRO NEGRO		COGOLLAR		JOBO 2	
TIPO DE MUESTRA	CRUDO	RESIDUO	CRUDO	RESIDUO	CRUDO	RESIDUO
Gravedad específica 59/60	1.0129	1.0306	1.0078	1.0343	1.0113	1.0279
Gravedad, °API	8.2	5.8	8.9	5.3	8.4	6.2
Contenido Sal (PTB)	220.0	210	72.0	65	680	225
Azufre (% peso)	3.28	3.74	3.58	3.80	3.67	4.07
Vanadio (PPM)	418	476	442	475	390	490
Niquel (PPM)	92	115	81	109	106	101
Hierro (PPM)	---	13.7	---	---	---	---
Carbono Conradson (%P)	14.3	15.7	12.9	16.9	11.8	16.4
Asfaltenos (% PESO)	12.55	13.50	15.51	16.57	8.64	10.28
Pour Point (°F)	+ 65	+ 95	+ 55	+ 90	+ 65	+ 85
Viscosidad a 140°F (C.S.)	6252	49342	3726	43286	5537	27681
Viscosidad a 210°F (C.S.)	376.0	1256.0	177.9	1020.0	262.6	941.0
Rendimiento sobre crudo (%Peso)	100	90.74	100	89.37	100	92.27

ANNEX-C (3/5)

TABLE I

TARGET YIELDS OF SYNTHETIC CRUDES

		HDAO	HDAO+C	HC/SHC
C_4	- 375 °F	3	10-25	10-25
375	- 650 °F	16	25 min.	25 min.
650	- 1000 °F	47	40 max.	30 max.
1000 + °F		34	25 max.	0

HDAO : Hydrotreated deasphalted oil.

HDAO+C : HDAO plus conversion. (Hydrocracking)

HC : Hydrotreated (for stability) coker synthetic crude.

SHC : Severely hydrotreated coker synthetic crude.

TABLE II

TARGET KEY QUALITIES OF COMPONENTS

		HDAO	HDAO+C	HC	SHC
C_4 - 375 °F	S, % wt.		0.05 max.	0.05 max.	0.03 max.
	N_2, ppm		2 max.	2 max.	2 max.
375 - 650 °F	S, % wt.	0.2 max.	0.2 max	0.2 max.	0.2 max.
	Cetane #	40 min.	40 min.	35 min.	45 min.
650 - 1000 °F	S, % wt.	0.5 max.	0.5 max.	0.7 max.	0.5 max.
	N_2, % wt. **	0.10 max.	0.10 max.	0.10 max.	0.10 max.
	CCR, % wt.	0.7 max.	0.7 max.	1.0 max.	0.7 max.
	Aniline Point *	( )	( )	( )	( )
1000+ °F	S, % wt.	1.0 max.	1.25 max.	N/A	N/A

* Number to be estimated by contractor

N/A: Not Applicable

** Contractor will look at less severe hydrotreating conditions such that this value is 0.25 maximum.

[illegible]

ANNEX-C (4/5)

[illegible]

REPORTE DE ANALISIS DE AGUA

BALANCE ANALITICO	ppm	%
Calcio	6	12.34
Magnesio	2	4.11
Sodio más		
Potasio	16.3	33.53
Bicarbonatos	6	12.34
Sulfatos	10	20.57
Cloruros	5.3	10.90
Nitratos	3	6.17
pH	6.6	
Conductividad	18	
Temperatura °C	26	
pH Saturación	9.3	

DETERMINACIONES VARIAS	
Turbidez como JTU	14
Total sólidos Disueltos ppm	9.6
Sólidos Suspendidos mg/lt.	225
Dureza Total	0
Alcalinidad Total	6
Hierro Total ppm Fe	2.4
Manganeso ppm Mn	NIL
Silica Soluble ppm SiO_2	6.8
Silica Total ppm SiO_2	14.4
Nitritos ppm NO_2	NIL
Indice de Permanganato ppm O_2	13.7
Dioxido de Carbono ppm CO_2	7
Oxigeno Disueltos ppm O_2	6.7
Aceite Mg/lt.	1.5

Muestra: Agua del Orinoco

Tomada en: Casa Bombas

Fecha: 27-8-75

Compañía: Sidor.

COMENTARIOS: Valores expresados en ppm como $CaCO_3$ si no está indicada otra equivalencia.
Conductividad expresada en: MS^{-1}
pH de Saturación calculado a 50°F
Sodio más Potasio calculado por diferencia.

9.11 Upgraded Crude Values

The values established for the possible synthetic crudes are listed in Table I below along with Tia Juana Medium, the "marker" crude oil. Tia Juana Medium was selected as the "marker" crude because its gravity is very similar to the delayed coker synthetic crude.

TABLE I

1990 Crude Values

	Tia Juana Medium	Fluidcoker HFC	Deasphalter HDAD	Delayed Coker DC	Delayed Coker [illegible]
Gravity, API	26.3	25.2	19.4	24.0	30
Sulfur, wt.%	1.5	0.3	0.4	2.3	0.3
Metals, ppm.	–	3	2	20	2
1978 $/BBL	23.86	24.86	24.86	23.86	25.01
1979 $/BBL	25.53	26.60	26.60	25.53	26.76

These values for the synthetic crudes allow for differences in product qualities; i. e. sulfur level and gravity. Since the qualities in Table I were estimates the following procedure was used to allow for changes in the sulfur levels or gravities of the synthetic crudes as the process selection study progressed. A value of $0.05/API was used for gravity differences. Sulfur levels are more complex therefore the following schedule was used for sulfur differences:

For each 0.1% S in the 650° F+ fraction,

Range	Value
% S less than 0.5	$0.25/B
% S between 0.5 and 1.0	$0.15/B
% S between 1.0 and 1.5	$0.08/B
% S between 1.5 and 2.5	$0.04/B
% S greater than 2.5	$0.02/B

The above method allows calculations of relative values of synthetic crudes based on their API gravity and sulfur level. All calculated values are then escalated to a mid-1979 basis by a seven (7) percent factor.

ATTACHMENT-6

Minutes of Meetings

Caracas, October 16, 1980

The Japanese study team for the Up-grading Project of Orinoco Heavy Oil in the Republic of Venezuela (Hereinafter referred to as "The Team"), sent by the Japan International Cooperation Agency (Hereinafter referred to as "JICA"), presented to the Venezuelan authorities a report entitled "DRAFT FINAL REPORT, THE STUDY ON THE ORINOCO HEAVY OIL UP-GRADING PROJECT FOR THE REPUBLIC OF VENEZUELA".

The following is a summary of the meetings and discussions:

1. Schedule of Meetings and Participants
   The schedule of meetings and participants are listed in Annex-A and Annex-B, respectively.

2. Presentation of the Draft Final Report

   2.1 The Team presented the Draft Final Report which has been prepared based on the objectives, the scope of work, and information described in the following record of discussions:

   - Record of discussions dated October 10, 1979
   - Record of discussions dated May 12, 1980

   The presentation was made by highlighting the features of the study and results.

   2.2 The Venezuelan authorities and the Team exchanged views on the Draft Final Report.

   (1) The Venezuelan authorities expressed satisfaction regarding the dedication and efforts made to complete the study.

   (2) A preliminary review of the Draft Final Report indicates that the contents of the Report are objective.

   (3) The Venezuelan authorities requested the following additions to the Draft Final Report.

- to indicate the properties of fractions of the improved crude oil, as much as possible
- to make clear the bases of informations and data on main up-grading processes and hydrotreating/hydrodesulfurization processes.

(4) The Venezuelan authorities expressed the intention of making questions in order to clarify the contents of the Draft Final Report.

- The Team replied to the Venezuelan authorities that such questions should be made to the Embassy of Japan in Caracas by November 17, 1980. The answers will be made in written form outside the final report.

3. Final Report

The Draft Final Report will be considered as final after completion of the additions mentioned above 2.2 (3).

The Final Report will be submitted to the Venezuelan authorities by the end of November 1980.

Both parties accepted the above.

Dr. Arévalo Guzmán Reyes
Director General Sectorial de Hidrocarburos
Ministerio de Energía y Minas
República de Venezuela

S. Hirose
Senichi Hirose
Chief of the Japanese
Team for the Up-Grading
Project of Orinoco Heavy
Oil in the Republic of
Venezuela

c.c: Petróleos de Venezuela, S. A.
Lagoven, S. A.
INTEVEP, S. A.

SCHEDULE OF MEETINGS

DATE	TIME	PLACE
October 13, 1980	15:30-16:30	Ministerio de Energía y Minas
October 14, 1980	8:30-12:00	Petróleos de Venezuela, S. A.
October 16, 1980	9:00-10:00	Petróleos de Venezuela, S. A.
October 16, 1980	15:00-16:00	Ministerio de Energía y Minas

MEMBERS OF MEETINGS

DATE: October 13, 1980

PLACE: MEM

MEM

Dr. Arévalo Guzmán Reyes	General Director Sectorial for Hydrocarbons
Dr. Enrique Daboin Vera	Director of Hydrocarbons
Dr. Manuel Alayeto	Deputy General Director Sectorial for Hydrocarbons
Dr. Ricardo Núñez	Refining Division Head
Ingº Luis Rivas Rodríguez	Head of Project Evaluation Department

PDVSA

Dr. Carlos J. Borregales	Orinoco Oil Belt Coordinator
Dr. Angel Behrends	Refinery Coordinator
Dr. José Prats	Manager, Refinery Coordination

Japanese side

The Team

Mr. Senichi Hirose	Chief of the Team (Consultant to JICA).
Mr. Toshio Ibi	Deputy Director, Development Division Petroleum Department Agency of Natural Resources and Energy, MITI.
Mr. Hideo Yasuki	Deputy Director, Industrial Survey Division JICA.
Mr. Yasuhisa Hosoya	Petroleum Refinery Engineer (Consultant to JICA).
Mr. Terutada Tsukagoshi	Petroleum Refinery Engineer (Consultant to JICA)

Embassy of Japan

Mr. Katsuhiko Tsunoda	Minister
Mr. Hiroshi Yoshida	First Secretary

MEMBERS OF MEETING

DATE : October 14, 1980
PLACE: PDVSA

Venezuelan Side

MEM

Dr. Ricardo Nuñez

Ing. Luis Rivas Rodríguez

PDVSA

Dr. Angel Behrends

Dr. José Prats

Ing. Armando Herrera — Orinoco Oil Belt Coordination

LAGOVEN

Dr. Humberto Vidal — Manager of Corporate Planning

INTEVEP

Dr. Jerry J. Thoman — Economic Technical Analysis

Dra. Carmen Elvira Alvarez — Process Engineer

Japanese Side

The Team

Embassy of Japan

Mr. Hiroshi Yoshida

MEMBERS OF MEETING

DATE : October 16, 1980
PLACE: PDVSA

Venezuelan Side:

MEM

Dr. Ricardo Núñez
Ing. Luis Rivas Rodríguez

PDVSA

Dr. Angel Behrends
Dr. Carlos J. Borregales
Dr. José Prats

Japanese Side

The Team

Embassy of Japan

Mr. Hiroshi Yoshida

MEMBERS OF MEETING

DATE : October 16, 1980
PLACE: MEM

Venezuelan Side

MEM and PDVSA members

Japanese Side

The Team

Embassy of Japan

Mr. Katsuhiko Tsunoda
Mr. Hiroshi Yoshida