REPORT ON THE COGEN MISSION
PALM OIL MILL PROCESS AUTOMATION

02/09/91 to 08/09/91

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Technology Division

Doc No. 2404
January 1992

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02/09/91 to O8/09/91

The aim of the mission was twofold:

- visit already automated mills, to analyze their operations,

- meet the partner (SOCFIN), define objectives, visit the site chosen for possible installation of a process automation system and determine the main technical characteristics.

Mission schedule

In Malaysia:

02/09/91: Trip to Kluang (Johor)
Tour of the PAMOL mill (UNILEVER PLANTATIONS GROUP)
03/09/91: Meeting with J.M. Mougins, SOCFIN Secretary General, and with P. Girard (COGEN Deputy Coordinator)
Definition of aims
Organization of visits
04/09/91 Trip to Minyak Estate
Tour of mill
05/09/91 Trip to Johore Labis
Tour of mill
06/09/91 Working session and lunch with J.M. Mougins and P. Girard

In Singapore:

10/09/91 Dinner with Andrew Tay, COGEN representative in Singapore
11/09/91 Tour of SISIR
Meeting with Andrew Tay

People met:

PAMOL Plantations SDN. BHD

Peter Yee : Technical Director
N.B. Sudhakaran : Maintenance Engineer

SOCFIN

Jean-Michel Mougins	: Group Secretary General
Robert	: Estate Manager, Minyak Estate
Lim	: Factory Manager, Minyak Estate
Selvarag	: Production Costs manager at Minyak
Sat	: Head of the central laboratory at Minyak Estate
Ong Tat Teik	: Estate Manager, Johore Labis
Pala Santhiran	: Factory Manager, Johore Labis

SISIR

Cheong Soo Chin	: Manager, Electronics and Computer Applications

SUMMARY AND CONCLUSIONS

Automation of the Jahore Labis site, a palm oil mill with a capacity of 50 tonnes/hour belonging to the SOCFIN Malaysia Group, would require investment amounting to around M$ 2.5 million.

The operating savings that could be expected from this operation would amount to less than M$ 200,000 per year under optimum conditions, with a return on investment after more than 13 years.

The project would therefore not be profitable under current economic conditions, as the performance of the SOCFIN Group's palm oil mills is excellent, especially as regards production staff numbers and extraction yield.

Nevertheless, it would be worthwhile continuing the study of automation of the palm oil extraction process, and profitable applications could no doubt be found for it, particularly in Indonesia or Africa, where the mastery of industrial production facilities is no doubt less than in Malaysia.

MILL BELONGING TO PAMOL PLANTATIONS SDN. BHD.

The PAMOL mill, which belongs to the UNILEVER PLANTATIONS Group, is located in Kluang, Johor State, about four hours from Kuala Lumpur by road.

Due to the limited time available, Peter Yee, the Technical Director, took us on a quick tour of the installations. Most of the information was obtained during lunch with N.B. Sudhakaran, the Engineer responsible for mill maintenance.

The mill was built in 1963 and renovated in 1984, primarily in the following areas:

- central boiler house where boilers with a capacity of 25 tonnes/hour at 20 bar were installed and the turboalternator units were replaced.
- the press shop, with the installation of UDW P15 type presses.
- clarification, with the installation of 3-phase decantors.

At that time, Peter Yee was made responsible for carrying out a study of and implementing integral automation of the production process. Two years later, the installation was brought on stream and has been working satisfactorily since then.

In theory, the mill can operate without staff, apart from certain work stations such as sterilization. In practice, a very small number of workers are involved in monitoring at the mill, though no precise figures were available on this point.

The automation system consists of:

* Sensors for:

    - flow rate
    - pressure
    - temperature
    - levels

* a data processing unit with:

    - analogue/digital converters
    - central processing unit and peripherals (screen, keyboard and printer)
    - control interfaces

* remote controlled equipment, mainly consisting of motors, electro-magnetic sluice gates, adjustment valves, speed regulators, etc.

Apart from the remote controlled equipment and the sensors, all the automation equipment is contained in two air-conditioned rooms, where two people monitor and totally control production.

Description of the management system

The system comprises two main sub-units:

- M.I.S. : Management Information System

This unit memorizes all the events occurring along the production line. In particular, it manages:

- technical daily production reports
- incident reports

It also provides an instant display of all the parameters recorded. The pressure curve for the boilers or the steam vessel, or a graphic representation of power consumption changes for an item of equipment during the day can be brought up on the screen.

- M.C.S. : Management Control System

This unit is used to control all the remote controlled equipment in real time from the console.

Based on a general block diagram, it is possible to home in to a single item of equipment and display its status, along with all its control parameters. In addition, these parameters can be modified directly from the console. For example, it is possible to carry out real time correction of the minimum and maximum pressure thresholds beyond which the automation system will open or close the corresponding remote controlled valve.

Of course, the automation of the entire system and of each individual item of equipment can be overridden.

Users' remarks:

From a purely technical point of view, automation of the Kluang oil mill is considered to be a total success. System reliability is excellent and real time technical monitoring of the mill has made it possible to improve daily management of the production unit.

The daily production reports are particularly comprehensive and mill Management has a log available, which is all the more useful in that it is available on a daily basis. In addition, equipment maintenance is greatly simplified, since the system records each operating fault.

As regards overall mill performance - improved milling capacity, fewer losses - we were unable to make any

significant comparisons. However, although the people we spoke to confirmed that operation of the mill in general and of the boiler room in particular was more regular, they acknowledged that the improvements in performance were only marginal.

To conclude the purely technical aspects, the only problems encountered involved sensor reliability in dusty and greasy surroundings.

From an economic point of view, the project promoters acknowledge that amortization of investment has been less rapid than expected. This is mostly due to:

- a smaller increase in the cost of manpower than that expected when the decision was taken to invest
- a smaller reduction than originally expected in the number of work posts; in fact, although workers are theoretically superfluous, certain people have been kept on as security staff. Furthermore, system installation and maintenance required the recruitment of highly qualified staff to run the control centre.

To conclude, Mr. Peter Yee acknowledged that the cost-effectiveness of this investment was marginal and that such a project probably would not have seen the light under current economic conditions.

THE SOCFIN MALAYSIA GROUP: IDENTIFIED USER

The rundown of the SOCFIN Malaysia Group was given by Jean Michel Mougins, the Secretary General. The activities of the Group, which is of French origin, primarily concentrate on rubber and oil palm. Since it was founded, its results have always been positive, even over recent years in an unfavourable economic climate.

Jean Michel Mougins pointed out that, in the past, SOCFIN had always endeavoured to remain in the forefront of raw material processing technology, which is why the Group is potentially interested in automating its palm oil mills.

Generally speaking, SOCFIN looks to obtain a return on its investments within 3 years. However, J.M. Mougins felt that a return on investments after 5 years would be acceptable in the case of the automation project, given its innovative nature.

SOCFIN has 3 oil palm complexes:

- Minyak, with a capacity of 25 to 30 tonnes of bunches/hour
- Johore Labis, with a capacity of 50 to 60 tonnes/hour
- Lima Blas, with a capacity of 25 to 30 tonnes/hour

The first two oil mills were visited and we were able to obtain all the technical and economic data required from SOCFIN services.

Minyak Estate

This oil mill uses the standard process. Its maximum capacity is 30 t FFB/hr, with a practical capacity of 25 t FFB/hr.

- Bunch reception

Consists of 12 unloading hoppers, with a total capacity of 120 tonnes of bunches. There are forty-four 2.5-tonne sterilization cages. Two workers are employed in bunch reception.

- Sterilization

The mill was originally equipped with two 6-cage sterilizers, which were replaced by two 9-cage units in 1991, with automation of the sterilization cycle.
Three workers supervise sterilization.

- Stripping

The double stripping system installed did not result in the improvements expected, so it was not extended to the Group's other oil mills.
One worker supervises stripping and another inspects empty bunches to check that they have been properly stripped.

- Digester-presses

3 WECKER P9 type digester-press units, with a capacity of 10 t FFB/hr, have been installed.
One worker is in charge of loading the digesters and another supervises press operation.

- Kernel recovery station

Comprising:

- two 36 tonne nut silos
- two nut crackers
- a conventional dust removal installation
- a clay-bath separator
- two kernel silos, with a capacity of 12 tonnes each

Storage is in bulk in the silos, so lorries can be gravity loaded.
Two workers are employed in this section.

- Clarification

This section is conventional with:

- a crude oil sieve
- a continuous primary settling tank
- a sludge tank and a sludge pit
- an oil tank and a purifier centrifuge
- a vacuum dryer feeding a 500-tonne storage tank

One worker supervises the levels in the primary settling tank and in the different tanks on the upper catwalk, and another supervises the operation of equipment at ground level, i.e. primarily the centrifuges.

- Main Boiler Room

- two FRASER boilers with a capacity of 12 tonnes/hr, operating at 20 bar with superheating to 260°C.
- two turboalternators, 400 kW three-phase, 50 Hz at 420 V.
- a steam vessel, at 3 bar, fed by the turboalternator exhausts.

There are two workers in the boiler room, a boilerman and his assistant, along with an operator supervising the electricity generators.

The boilers are fitted with a system for dust removal from the smoke emitted and the mill has no empty bunch incinerator.

- JOHORE LABIS

The Johore Labis mill is very similar to the Minyak mill as far as the process is concerned.

Its 50 to 60 t FFB/hr capacity is achieved by doubling the installations found at the Minyak mill, apart from a few exceptions.

- Sterilization

Five 6-cage sterilizers with a capacity of 2.5 tonnes are being replaced with three 12-cage sterilizers. The cycle will be controlled automatically.

- Central Boiler Room:

Comprising:

- two FRASER boilers with a capacity of 15 t/hr
- a BABCOCK VICKERS boiler with a capacity of 20 t/hr operating at 25 bar, superheated to 280°C
- two 500 kW turboalternators
- two 352 kW turboalternators.

As regards production staff, Mr. Palasanthiran, the Mill Manager, informed us that staff numbers were currently too high and the aim was to reduce numbers to 17 per shift, as at Minyak, where Mr. Palasanthiran was Manager before.

ECONOMIC AND TECHNICO-ECONOMIC DATA

STAFF COSTS

The following costs were given to us at Minyak for unskilled personnel:

Salary: $15.60/day over 300 days	4,680
Water : $10/month	120
Medical costs: $20/month	240
Electricity: paid by employee ($8/month)	
Housing maintenance	50
Housing amortization: $12,000 over 10 years, i.e.	1,200
Annual total	6,290

We shall therefore work on the basis of an annual cost of M$ 6,500.

SOCFIN PRODUCTION COSTS

We were informed of palm oil production costs at SOCFIN. For reasons of confidentiality, we shall not indicate these costs in detail. They are more or less the same for the Group's three agro-industrial complexes.

We shall merely mention milling costs, which break down as follows:

- Direct production costs		4.71
- Equipment maintenance		5.85
- Building maintenance		0.42
Total	M$/tonne FFB	10.98

Spare parts for the presses account for around 1/3 of the equipment maintenance budget and the annual maintenance costs for the boilers and turboalternators amount to M$ 35,000 per year on average at the Minyak Estate.

PRODUCTION OUTPUT

At the Group's three mills, the extraction yield, expressed as the oil produced over the potential oil contained in the bunches varies from 92 to 93%, which is excellent.

ESTIMATED COST OF PALM OIL MILL AUTOMATION

We estimated the cost of automating the Johore Labis mill, with a capacity of 50 to 60 t FFB/hr, on the basis of 200 monitoring and remote control points for the two production lines.

The system would be installed jointly by:

- SPEICHIM (France) for:

  * definition of automatic devices
  * definition of sensors
  * definition of control devices
  * supply of control devices
  * supply of a fuel storage system, which is essential for guaranteeing regular boiler operation and which does not exist at the mills visited.
  * supervision of installation work and start-up of equipment.

- SISIR (Singapore) for

  * supply of sensors
  * supply of control interfaces
  * supply of a complete central processing unit + printer
  * development of remote control software for the installations, based on recommendations made by SPEICHIM
  * installation wiring
  * start-up and final adjustments on the computerized aspects of the system.

A local company would be called in to install the control devices and the fuel storage system.

The corresponding cost estimates for these services are as follows:

- SPEICHIM FFrs 3,800,000 i.e.	US$ 690,000
- SISIR S$ 380,000, i.e.	US$ 230,000
- Local installation firm estimated at	US$ 30,000
Total	US$ 950,000

The estimates of costs supplied by SPEICHIM seem to be high and would probably be revised downward once the Company has studied the project in more detail. As a precaution, however, we shall keep to the figure of US$ 950,000, i.e. M$ 2.5 million.

COMMENTS AND CONCLUSIONS

Taking an expected investment of M$ 2.5 million, and a return on investment limited to 5 years, automation of the Johore Labis oil mill would need to lead to reductions in production costs amounting to M$ 500,000 per year at this site.

This target seems to be totally unrealistic, given the excellent results already obtained by oil mills in the Group.

In fact, the direct advantages that should be expected from production process automation are as follows:

- Improvement of mill efficiency

The Group's mills have an extraction yield ranging from 92 to 93%. This result is already excellent and it does not seem that it could be substantially improved by installing an automatic system.

The fact that no noteworthy yield improvements were seen at PAMOL after installation of an automatic system merely serves to bear out our opinion.

- Reduction in equipment maintenance costs

Automation should result in more regular equipment operation, especially the boilers. Consequently, lower maintenance costs can be expected.

Extrapolating maintenance costs at Minyak (M$ 35,000/yr for the boilers and turboalternators) to those at Johore Labis, which we consider at first glance to be double those at Minyak, a possible saving of M$ 35,000 could be made per year.

- Increase in production capacity

In theory, automation results in an improvement in the mill's true production capacity, for the following two reasons:

* improved regularity of throughput, hence a reduction in milling downtime.

* easier preventive maintenance of equipment and reduction in downtime due to breakdowns.

It is difficult to put a figure on this technical advantage, but the Johore Labis mill would seem to have a sufficient milling capacity to process all the bunches delivered to it, even in peak periods.

- Reduction in Staff costs

We noted that staff reductions at PAMOL had been less than expected.

Moreover, some of the oil mills in the SOCFIN Group are currently cutting, or have already cut staff numbers to the strict minimum, as at Johore Labis, i.e. 17 workers/shift/production line (There are currently 51 workers/shift on the two production lines at Johore Labis).

No staff cuts can be made at bunch reception or on the sterilizers, where handling operations will remain essential.

Staff cuts can be considered for extraction, clarification and in the boiler room.

Compared to the optimum number of staff (17/shift/production line), we shall put forward the hypothesis of a reduction to 12 workers. We shall therefore be able to make 20 staff cuts, on average, for the two production lines working on two shifts throughout the year.

As the annual cost of a worker is M$ 6,500, the potential savings would consequently amount to M$ 130,000/year. To be more precise, only direct manpower costs should be considered, excluding amortization costs for existing housing. Under these conditions, the savings made would drop to M$ 106,000/year.

By cumulating the savings made in the best case, we do not reach M$ 200,000 per year, which means a return on investment of almost 13 years.

We can obviously only conclude that it is impossible to recommend such an investment to the SOCFIN Group.

ADDENDUM

Automation of the oil mills in the SOCFIN Group would not be cost-effective under current economic conditions, primarily because the performance of the Group's industrial facilities is excellent.

However, the automation project could find more promising applications in oil mills in Indonesia, where staff numbers are much higher, though manpower is currently cheaper, and, more to the point, where the performance achieved is generally less impressive.

Take the example of an oil mill processing 150,000 tonnes FFB per year with a milling yield of 90%:

On the basis of a mean extraction rate of 20%, palm oil production would be 30,000 tonnes per year with a 90% milling yield. With 92.5%, production would increase to 30,830 tonnes, i.e. an extra 830 tonnes.

Taking a very cautious value of US$ 250 per tonne of oil at the mill gate, the added value would be US$ 207,500, i.e. M$ 565,000.

Under these conditions, a return on investment of around 4 years would be feasible, which is perfectly acceptable.

SPEICHIM

IRHO
avenue du Val de Montferrand
BP 5035
34032 MONTPELLIER CEDEX

BYO 030/JAE/L.120098
Yr. Ref.: DT 194/91

Cergy, 8th January 1992

For the attention of Mr. Jean Marc NOEL

Re: Palm Oil Mill automation

Dear Sirs

Please find enclosed our cost estimate for carrying out a study and supplying eguipment for the automation project.

Our services would include:

- definition of automatic devices
- definition of sensors
- definition of control devices
- supply of control devices
- supply of a fuel storage system (essential for guaranteeing regular operation of the boilers)
- supervision of installation and start-up of the above equipment.

We estimate the overall cost for the above at:
FFrs 3,800,000 (THREE MILLION EIGHT HUNDRED THOUSAND FRENCH FRANCS).

This figure does not include assembly and start-up, which could be entrusted to a local company.

Additional information on the existing installation, in particular layout drawings and diagrams, would be necessary to proceed with the study.

We hope this information will enable the feasibility study to be completed.

Yours faithfully

C. BLAYO

1 Science Park Drive, Singapore 0511, Fax: (65) 778 3951, Telebox: GVT 325, Telex: RS 28499 SISIR
Electronics & Computer Applications Division

FACSIMILE TRANSMITTAL SHEET

SINGAPORE INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH

Date	:	10 October 1991
No. of pages	:	1 (including this page)
Fax Ref No.	:	MOF535
Message To	:	Mr Jean-Marc Noel
Organization	:	Institut De Recherche
Fax No	:	(33) 67615792
Message From	:	Cheong Soo Chin

(If the following message is not well received, please notify me at telephone no. 779-5233)

Dear Mr Noel

Thank you for your fax dated 8 Oct 91.

It is difficult to give you an estimate especially for projects in a foreign country because the information is so little. I will try my best.

The sensors you mentioned cost between Singapore Dollars $200 to $400. For budgetary estimates I use the figure of $400. Normally we use brands like Omron, Ashcroft, MAMC, Yokogawa etc.

The rough estimates are therefore as follows:

a.	200 numbers of sensors	200 x 400	$ 80,000
b.	Wiring costs	100 x 400	$ 40,000
c.	5 numbers of control panels	5 x 12,000	$ 60,000
d.	386 PC and printer		$ 20,000
e.	Central software and application development		$100,000
f.	Transportation, training, testing etc.		$ 80,000
		Total	$380,000

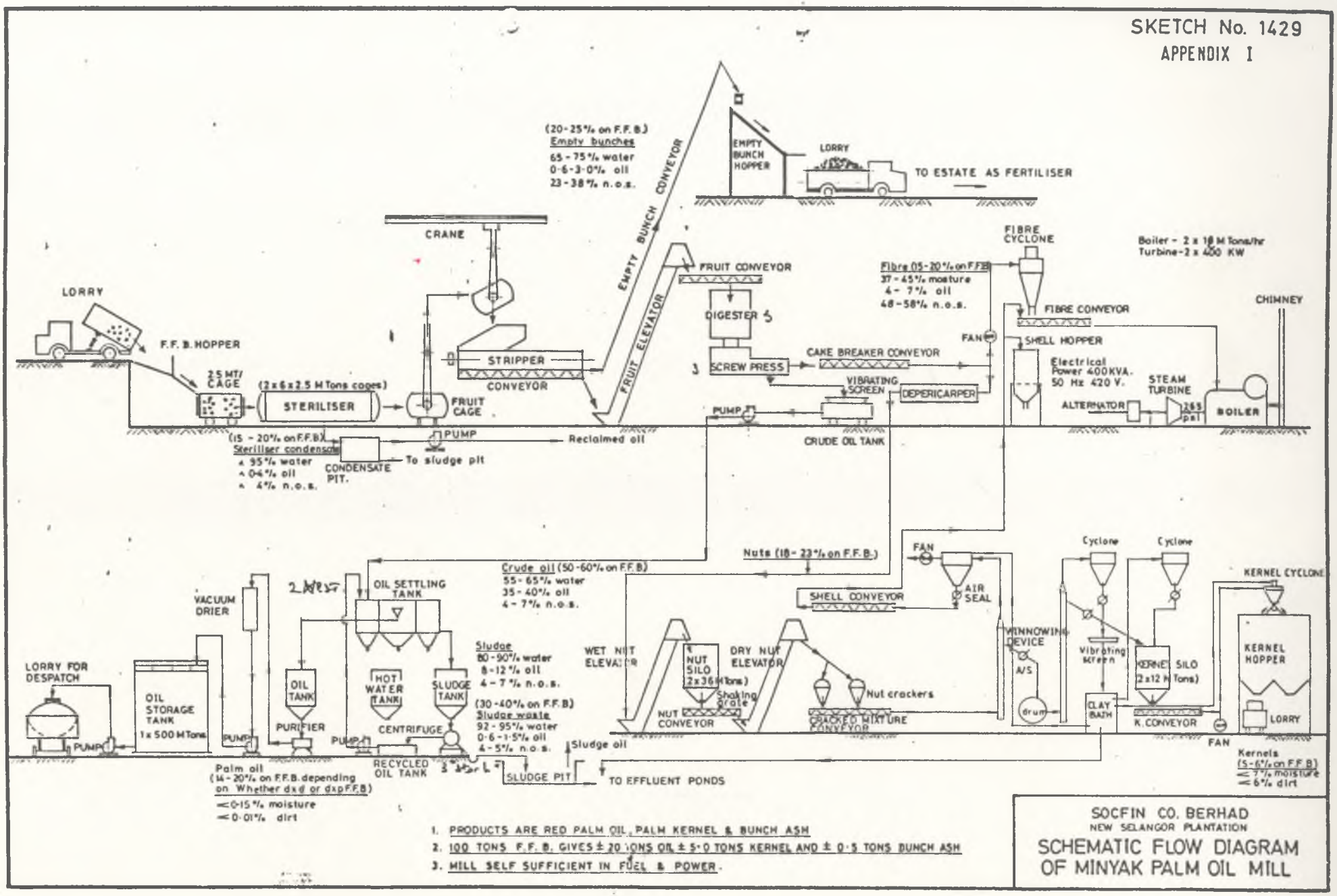
The above estimates do not include prices for valves and motors.

Please advise if Specichim or you want SISIR to look for a palm oil plantation willing to go for automation.

Best regards.

End of message

SKETCH No. 1429
APPENDIX I

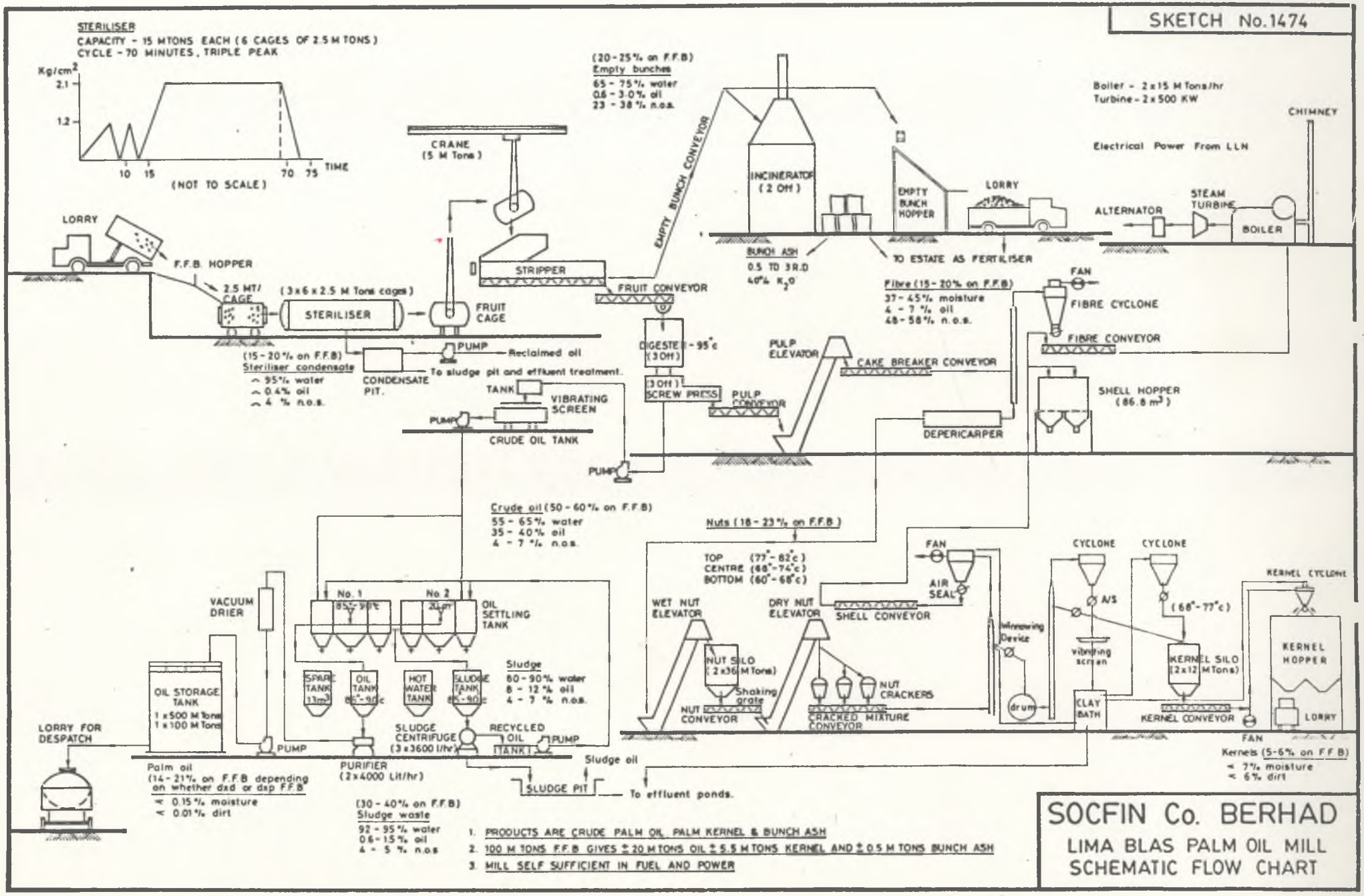


1. PRODUCTS ARE RED PALM OIL, PALM KERNEL & BUNCH ASH
2. 100 TONS F.F.B. GIVES ± 20 TONS OIL ± 5·0 TONS KERNEL AND ± 0·5 TONS BUNCH ASH
3. MILL SELF SUFFICIENT IN FUEL & POWER.

SOCFIN CO. BERHAD
NEW SELANGOR PLANTATION

SCHEMATIC FLOW DIAGRAM OF MINYAK PALM OIL MILL

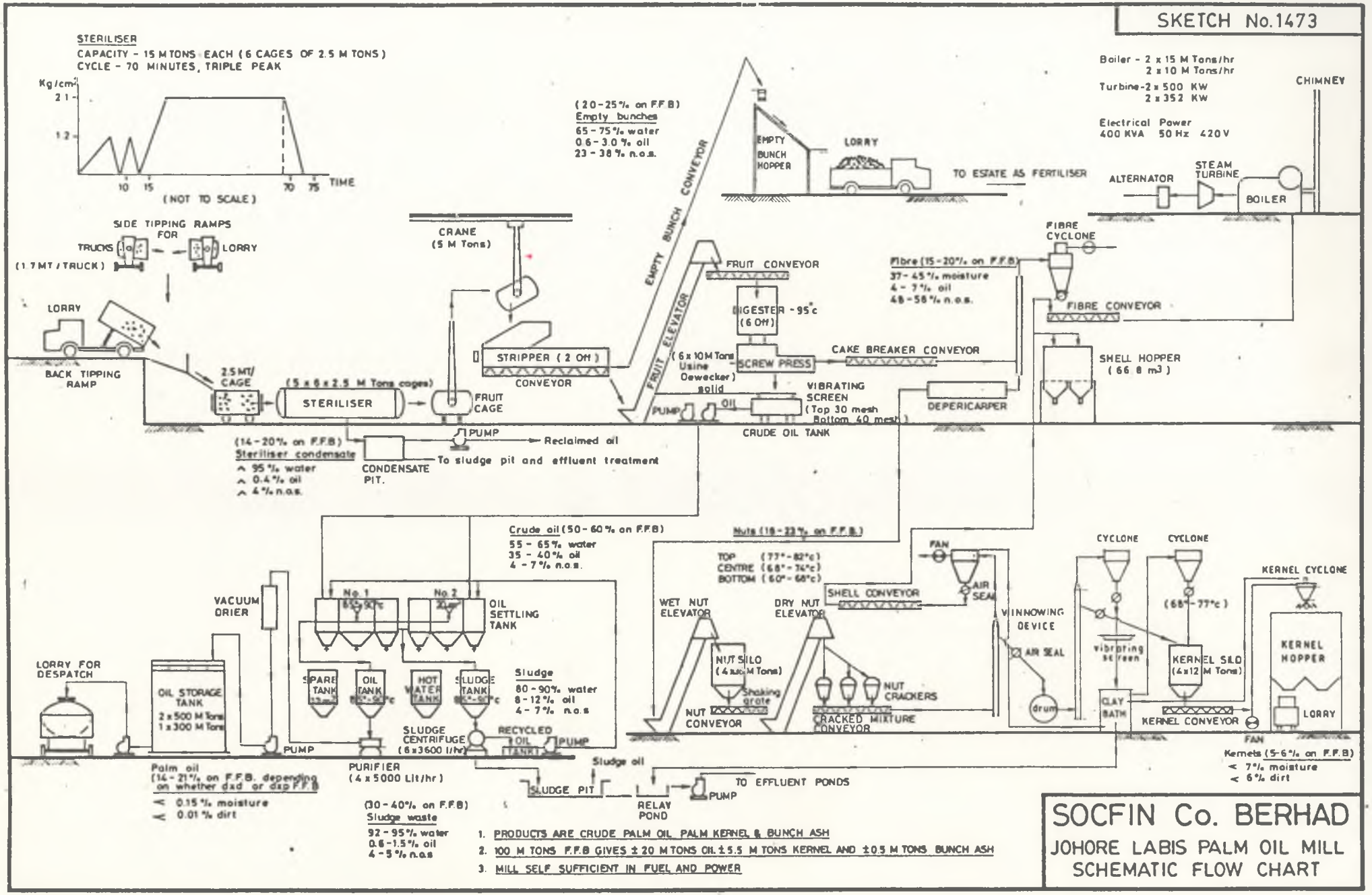
SKETCH No.1474



1. PRODUCTS ARE CRUDE PALM OIL, PALM KERNEL & BUNCH ASH
2. 100 M TONS F.F.B GIVES ± 20 M TONS OIL ± 5.5 M TONS KERNEL AND ± 0.5 M TONS BUNCH ASH
3. MILL SELF SUFFICIENT IN FUEL AND POWER

SOCFIN Co. BERHAD

LIMA BLAS PALM OIL MILL
SCHEMATIC FLOW CHART


SKETCH No.1473
STERILISER
CAPACITY - 15 M TONS EACH (6 CAGES OF 2.5 M TONS)
CYCLE - 70 MINUTES, TRIPLE PEAK
Kg/cm²
2.1
1.2
10
15
70
75
TIME
(NOT TO SCALE)
SIDE TIPPING RAMPS FOR
TRUCKS
LORRY
(1.7 MT / TRUCK)
LORRY
BACK TIPPING RAMP
2.5 MT/ CAGE
(5 x 6 x 2.5 M Tons cages)
STERILISER
CRANE (5 M Tons)
STRIPPER (2 OH)
CONVEYOR
FRUIT CAGE
(20 - 25 % on F.F.B)
Empty bunches
65 - 75 % water
0.6 - 3.0 % oil
23 - 38 % n.o.s.
EMPTY BUNCH CONVEYOR
FRUIT ELEVATOR
EMPTY BUNCH HOPPER
LORRY
TO ESTATE AS FERTILISER
Boiler - 2 x 15 M Tons/hr
2 x 10 M Tons/hr
Turbine - 2 x 500 KW
2 x 352 KW
Electrical Power
400 KVA 50 Hz 420 V
CHIMNEY
ALTERNATOR
STEAM TURBINE
BOILER
FRUIT CONVEYOR
DIGESTER - 95°c (6 OH)
(6 x 10 M Tons Usine Dewecker) solid
SCREW PRESS
CAKE BREAKER CONVEYOR
VIBRATING SCREEN (Top 30 mesh Bottom 40 mesh)
PUMP
OIL
CRUDE OIL TANK
DEPERICARPER
Fibre (15 - 20 % on F.F.B)
37 - 45 % moisture
4 - 7 % oil
48 - 58 % n.o.s.
FIBRE CYCLONE
FIBRE CONVEYOR
SHELL HOPPER (66.8 m³)
(14 - 20 % on F.F.B)
Steriliser condensate
≃ 95 % water
≃ 0.4 % oil
≃ 4 % n.o.s.
CONDENSATE PIT.
PUMP
Reclaimed oil
To sludge pit and effluent treatment
Crude oil (50 - 60 % on F.F.B)
55 - 65 % water
35 - 40 % oil
4 - 7 % n.o.s.
Nuts (18 - 23 % on F.F.B)
TOP (77° - 82°c)
CENTRE (68° - 74°c)
BOTTOM (60° - 68°c)
FAN
AIR SEAL
SHELL CONVEYOR
WET NUT ELEVATOR
DRY NUT ELEVATOR
WINNOWING DEVICE
AIR SEAL
CYCLONE
CYCLONE
(68° - 77°c)
KERNEL CYCLONE
VACUUM DRIER
No. 1
No. 2
OIL SETTLING TANK
NUT SILO (4 x 20 M Tons)
Shaking grate
NUT CRACKERS
NUT CONVEYOR
CRACKED MIXTURE CONVEYOR
vibrating screen
KERNEL SILO (4 x 12 M Tons)
KERNEL HOPPER
CLAY BATH
drum
KERNEL CONVEYOR
FAN
LORRY
LORRY FOR DESPATCH
OIL STORAGE TANK
2 x 500 M Tons
1 x 300 M Tons
SPARE TANK
OIL TANK
HOT WATER TANK
SLUDGE TANK
Sludge
80 - 90 % water
8 - 12 % oil
4 - 7 % n.o.s
SLUDGE CENTRIFUGE (6 x 3600 l/hr)
RECYCLED OIL TANK
PUMP
PUMP
PURIFIER (4 x 5000 Lit/hr)
Palm oil (14 - 21 % on F.F.B. depending on whether d.x.d or d.x.p F.F.B
≤ 0.15 % moisture
≤ 0.01 % dirt
Sludge oil
SLUDGE PIT
RELAY POND
PUMP
TO EFFLUENT PONDS
(30 - 40 % on F.F.B)
Sludge waste
92 - 95 % water
0.6 - 1.5 % oil
4 - 5 % n.o.s
Kernels (5 - 6 % on F.F.B)
≤ 7 % moisture
≤ 6 % dirt
1. PRODUCTS ARE CRUDE PALM OIL, PALM KERNEL & BUNCH ASH
2. 100 M TONS F.F.B GIVES ± 20 M TONS OIL, ± 5.5 M TONS KERNEL AND ± 0.5 M TONS BUNCH ASH
3. MILL SELF SUFFICIENT IN FUEL AND POWER
SOCFIN Co. BERHAD
JOHORE LABIS PALM OIL MILL
SCHEMATIC FLOW CHART