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Report on the

TJILEGON STEEL PROJECT,

INDONESIA.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

March 4, 1968

REPORT ON THE

T J I L E G O N S T E E L P R O J E C T

INDONESIA

UNITED NATIONS INDUSTRIAL DEVELOPMENT

ORGANIZATION

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A. INTRODUCTION

1. The Tjilegon Steel Project represents the chief development plan for the growth of iron and steel industry in Indonesia and has been assisted heavily by the U.S.A. The other two projects concerning the iron and steel industry in Indonesia are the Lampung iron production plant and the Kalimantan iron and steel project; the former was designed to smelt pig iron from iron ores in the Lampung region and despatch the cold pig iron to Tjilegon to constitute the 10% cold pig and scrap charge for the three 50 tons oilfired open hearth furnaces proposed for the Tjilegon steel project. Whilst references to the Lampung and Kalimantan iron and steel projects will be made in this Report subsequently, it is emphasized at the outset that none of these two Projects has made any headway - no construction work has been taken in hand in either case, no detailed Project Reports have been prepared and the development plan has merely concerned some exploratory work thereon. The latest position is reported to be that optimum grade of iron ore at Lampung represents a deposit of much less than half a million tons and as such, in this Mission's opinion, the Lampung pig iron project has to be scrapped. The Kalimantan iron and steel project is also still very much in the air and very considerable qualitative and quantitative proving of iron ores and coal deposits is called for, besides undertaking coking tests and reducibility studies on the iron ores before the Project plan can even be considered and its feasibility established. The Kalimantan coal deposits are highly bituminous and do not lend themselves to the production of high grade metallurgical coke as shown by tests so far undertaken and as such, the Project could only be based on imported raw-materials which however, will render it totally uneconomic to-day. In view thereof, in the Mission's opinion, there appears to be no

firm ground for Kalimantan iron and steel project unless future exploration and proving of raw materials resources reveal some more promising deposits. Cheap fuel oil, resources of which are abundant in Indonesia, could be considered for some of the proved Direct Reduction processes for the production of sponge iron but their applications can only be adjudged on rigid economic parameters, apart from the necessity of first establishing their metallurgical feasibility. These criteria call for extensive proving and technical investigations and trials in relation to Lampung and Kalimantan iron and steel projects; adjudged however on the present available data, these are regarded as completely unfeasible. In making passing references to these two Projects, it is emphasized that their detailed study or critical examination is outside the scope of the present mission in any case. The cross reference to them is necessitated by the position that the Tjilegon Steel Project has as constituent iron-making plant and the steel-making oil-fired open hearth furnaces of the Tjilegon Steel Plant were to be fed with cold pig iron smelted at Lampung along with the cold scrap charge. In the total absence to-day, of the Lampung iron smelting plant, and its projection or execution in the foreseeable future, the main prop of the steel-making capacity at Tjilegon, it will be conceded, no longer exists. This is apart from the position that for optimum operations, the basic open hearth steel making furnaces are normally fed with hot metal (molten iron) and scrap charge and the process itself is much more a steel-refining process than merely a steel-melting unit.

2. The Soviet Union had prepared the detailed Project Report for the Tjilegon steel complex during 1961 based on the data supplied by the Indonesian authorities and on assumptions and presumptions specified by the latter to be then valid or applicable. As such,

the Russian detailed Project Report for the Tjilegon Steel complex represents a commendable job completed with thoroughness for which the Russian Steel Industry is world-wide renowned and with which the Mission leader, D.N. Vijh was personally closely associated for over a decade in relation to Soviet assisted heavy integrated iron and steel projects in India and which to-day are most efficiently operating and fulfilling high peak-economic productivity parameters. The Indonesian position however, is that the supporting project for iron production at Lampung and corresponding basis for steel production at the Tjilegon steel project are very much in the air than on the ground. And the unhappy but very much real position is that the Indonesian Government has to-day no longer the financial resources and foreign exchange funds in the foreseeable future even to meet the counter-part Indonesian currency Rupiah requirements for the Tjilegon Steel Project, leave alone meeting the foreign exchange expenditure except on a loan or aid basis. The Tjilegon steel project as such to-day stands forlorn, half-erected, some of its constituent units showing only its civil foundations flooded with rain water; most of its heavy electrical and mechanical equipment and machinery lying open in the open, some of it in leaking covered storage sheds at Tjilegon and at the adjoining Merak harbour even while the present Indonesian Government authorities are indeed making most urgent efforts to build effective storage sheds, classify individual equipment crates and prepare an effective inventory and list of the plant and equipment already received and compare it with the comprehensive lists of equipment and machinery originally scheduled to be delivered by the Soviet Union. Whilst the housing, township, unused movie house and the related infra-structure have been completed on schedule, the Tjilegon

steel plant itself presents to-day a very depressing picture of a neglected and highly retarded project, plans for the completion of which are themselves in the melting pot. This then is the background of the Tjilegon steel project. The present Mission's main scope of work is related to the following aspects: -

a. Should the Tjilegon Steel Project be pursued to completion as per its original detailed project report prepared by the Soviets or should it be modified to meet the highly depleted financial situation in Indonesia to-day both of foreign exchange and local Rupiah resources? Should the Tjilegon Steel Project be additionally modified in view of the very much altered basic assumptions and data?

b. If the Tjilegon Steel Project is to be drastically modified, how should it be phased in its plant structure whilst fully mustering available financial resources and ability both in the private and public sectors in Indonesia?

c. Modus-operandi of its implementation should be indicated in the context of current over-all economic plans of the country concerning development of agriculture and industry. Broad guide lines should be formulated to show the infra-structure and supporting plant units, such as the Power House, Merak Port development plans, development of water resources for the steel plant and for irrigation in the region - such infra-structure in the Mission's opinion should be examined and implemented exclusive of the Tjilegon Steel Project itself in view of their direct bearings on the overall economic development of the country. Capital costs of the infra-structure should not be integrated with those of the Tjilegon Steel Plant itself and should be separately provided for.

d. What steps should be taken to meet the financial requirements of the Tjilegon Steel Project and its practical implementation even on a truncated yet phased basis?

e. What alternatives should be considered in the technological processes for the Steel Plant; which of its constituent units should be delayed, indefinitely deferred or altogether given up?

These are the basic and salient questions which the Mission will seek to answer to the best interests of current Indonesian economy.

3. Mr. S.R. Pillai, Senior Industrial Development Adviser in UNIDO started this mission in which Mr. B.P. Abrera, Regional Adviser, ECAFE joined from Bangkok. Initial meetings were held at Bangkok with Mr. A.G.Menon, Chief, Division of Industry and Natural Resources, ECAFE and Indonesian delegation to the Asian Development Council meetings then in session at Bangkok. Our thanks are due to Mr. A.G. Menon, Chief, Division of Industry and Natural Resources, ECAFE for actively taking the lead in sponsoring this Project under the U.N.D.P. through UNIDO. After the initial meetings in Bangkok, the Mission proceeded to Indonesia.

The Mission spent about three weeks in Indonesia visiting Tjilegon and related production centres and had extensive meetings with the Indonesian Government authorities both at Djakarta and Tjilegon etc. The Mission's thanks are sincerely offered to the Indonesian authorities for their co-operation and frankness in discussing their economic difficulties and travail. Last but not the least, the Mission's sincere thanks are offered to the officials of the U.N.D.P. at Djakarta for their co-operation and discussions on the Tjilegon Steel Project. The Mission's thanks are due to all of them for bearing up with the Mission's non-stop queries and answers that inevitably arise when a heavy industry such as the Iron and Steel is projected in a developing country and/or foisted on a still more developing economy for reasons of prestige or

other ise divorced from the absolute techno-economic desiderata and rationale.

B. TJILEGON STEEL PROJECT AS PLANNED BY SOVIET STAFFS

4. It will not be out of place here to give an outline of the Tjilegon Steel Project as detailed in the Detailed Project Report prepared by the Soviet authorities since these data will have a direct bearing on the present status of the steel project to be subsequently outlined in this report and recommendations to be made by the Mission for its implementation or otherwise.

5. The original Tjilegon Steel Project as planned by Soviet authorities comprised basic open hearth steel-making shop; merchant, light sections and wire rod mill; [illegible] rolling mill, repair shop, power house, laboratories, transport, administrative and labour welfare facilities etc.

The open hearth shop comprises of the following:

Three stationary open hearth furnaces of 50 MT capacity each, with total annual steel capacity of about 100,000 annually. Skull breaker and slag yard, coli pig, scrap and bulk materials storage, refractories storage, limestone and dolomite calcination plant etc. The open hearth steel-making furnaces were to be cold charged and oil fired to produce 0.5 ton ingots for rolling light sections, rods, etc. in the merchant mill and 1.7 to 3.2 tons ingots for the sheet mill.

The merchant bar, light sections and wire rod mill consisted of 16 stands viz: one cogging (blooming) stand (650 mm) one 3 high (530 mm roughing stand; two 2 high (370 mm) roughing stands; six merchant

bar stands, finishing four stands; 4 stands (370 mm) and 2 stands (270 mm). The wire rod mill consisted of six wire rod stands (270 mm).

The cold wire drawing section was also attached to this mill.

Other equipment in the merchant bar and wire rod mill contained a continuous heating furnace for ingots, a billet reheating furnace, turntable, tilting and mill tables, turnovers at the roughing stands; crop and dividing shears, runout tables, transfer and flying shears and cooling beds at the merchant and rod stands, besides finishing equipment such as, coilers, roller straightening machines etc. Handling equipment for lifting and conveying raw materials and for the finished products were also provided.

The roughing stand rolls the ingots in 9-13 passes into 60 mm x 60 mm; 80 mm x 80 mm and 100 mm x 100 mm billets respectively 13, 9,9 and 6,4 meters long; these billets after reheating are delivered to the upcut and down cutting shears for cropping and divided into 6,5 m, 6,4 m and 6 m (cropping only) respectively and then conveyed to the rod mill stands.

The cold wire-drawing mill included pickling section; drawing section - - seven, six, four and two hole drawing chains for soft steel wire with 550 mm diameter die blocks, pointing machine, uncoiling devices, coiling machines, butt welders and grinders. Annealing and galvanising sections for wires were included in the schedule of operations.

6. The sheet rolling mill consisted of two departments:

1) A hot rolling mill - 2 stand (1200 mm), one 2 high reversing roughing (600 vertical 900 mm horizontal), coilers in furnaces for rolling strip from up to 3,2 tons slabs without intermediate heating and provided with a continuous hot heating double row furnace and hot shearing line.

2) A reversible cold reducing mill (1,200 mm), continuous pickling line shearing line, hot galvanized line and an

annealing bell type electric furnaces etc. The mills equipment included roll turning lathes, furnace pushers, ingot handling facilities, shearing lines, continuous reheating furnaces and reheating coiler furnaces besides a continuous pickling line, shearing and hot dip galvanising, sheet correcting machine etc. It was however, intimated that steel rolling mills was later excluded from the Tajikcom Steel Project.

7. Repair Shop

The Repair Shop comprises the following sections:

1) Foundry;

2) Forging, Fabrication and Assembling and Electric repair facilities.

8. Foundry

One 1.5 ton electric arc melting furnace; sizing mill, oil-fired non-ferrous melting furnace, gas and oil fired core and mould drying furnace.

9. Forging and Folding

750 - 150 kg pneumatic forge hammer, 50 ton electric, plate bending rolls, press brakes, vertical drilling, flanging machine, welding transformers, etc.

10. Machining and Assembling

Various types of lathes including heavy cutting lathes, boring machinery, planers and shapers, milling machinery, radial drills, surface grinders and tool shop sections.

11. Laboratories

These contained foundry sand control, analytical, chemical and metallographic equipment alongwith their normal auxiliaries.

12. Production Scheme (original)

The original production programme of the Tjilegon Steel Plant was based on the following schedules: -

a. (1) Merchant sections of plain carbon steel:

1. Rounds, squares, hexagons from 10 to 50 mm equivalent diameter (in rods) and flats from 4 to 12 mm thick and from 12 to 125 mm width..23,800 MT annually

2. Angles from 20 x 20 x 3 mm to 80 x 80 x 12 mm, U channels from 50 to 80 mm ..... 5,000 MT annually

3. Loops from 2,0 to 3,5 mm thick, from 20 to 50 mm width (in coils)..... 2,000 MT annually

4. Wire rod from 6,0 to 6,5 mm diameter for the cold wire drawing mill (in coils).....10,200 MT annually

Total merchant sections.....40,000 MT annually

b. Sheets of Plain Carbon Steel

1. Hot rolled black sheets, 500 to 1000 mm width, black pickled sheets (1,6 to 3,0 mm) x 1000 to 4000 mm length ..... 4,000 MT annually

2. Pickled sheets, 2,1 to 5,0 mm, 5000 to 1000 mm width 1000 to 4000 mm length ..... 4,000 MT annually

Total-hot-rolled sheets..... 8,000 MT annually

3. Cold Rolled Sheets from 0,5 to 2 mm x 500 mm to 1000 mm width and 1000 mm to 2000 mm length ..... 12,000 MT annually

4. Pickled - 0,5 to 1,5 mm

500 - 1000 mm width, with 2000 mm length...10,000 MT annually

Galvanized, idem 10,000 MT annually

Total cold rolled sheets including

5000 tons corrugated steel sheets.....32,000 MT annually

Total sheets .....40,000 MT annually

COLD DRAWN WIRE	DIA.	ANNUAL OUTPUT MT
Nail wire	1,2 to 5,0 mm.....	6,000 MT
Galvanized wire for manufactured wire: -		
non-heat treated.....		500 MT
heat treated.....		2,200 MT
Galvanized wire for different purposes -		
from 1,0 to 3,0 mm		
non-heat-treated		300 MT
heat-treated		700 MT
Total (nail wire products)		10,000 MT

The total output of finished products shall be .....30,000 MT per year from a production of 100,000 tons of steel ingots.

Hence, the total production contemplated:

Merchant bars and light sections .....40,000 MT

Hot rolled sheets ..... 8,000 MT

Cold rolled sheets .....32,000 MT

Total .....80,000 MT

The equipment of the rolling mills provided for the possibility of varying the proportion of groups, profiles and dimensions for the rolled products within the specified programme, if required according to market needs.

13. SUMMARY LIST OF EQUIPMENT

The Project Report (Vol.IV) contains the Equipment Specifications. Summarised below is the list of equipment for the Tjilegon Project as follows:

Shops and Facilities		Weight tons original	Percent of total
1.	Open hearth shop	3,543	17,2
2.	Merchant and wire rod mill	5,201	25,9
3.	Sheet rolling mills	9,233	45,9
4.	Repair shop	405	2,1
5.	Laboratory	41	0,3
6.	Gas, steam and power facilities	169	0,9
7.	Water supply and sewerage	605	2,5
8.	Central storage of equipment and materials	53	0,3
9.	Motor and railway transport and plant site maintenance	219	1,6
10.	General Plant Electric and Communication Equipment (communication and signalling, battery charging station, main office, guest house, first aid, lighting of plant premises etc.	630	3,4
	Total	20,150	100

14. Revised List of Technological Equipment supplied for the USSR Tjilegon Steel Project and T.P.A. Technological Equipment (Contract No.030/I dated 5 April 1962).

Facilities	Weight in tons	Delivered	Remainder to be supplied	Remarks (erected as of year 1966)
Steel Plant				
Open hearth	3,360,4	917,4	2,443	
Merchant bar and rod mill	6,068,3	5,392,9	669,4	
Auxiliary shops and facilities	1,719,7	1,641,3	78,4	erected-474,7 MT
Total:	11,154,4	7,957,6	3,196,3	
Thermal Power Station				
Technological equipment	4,082,6	3,481,0	601,6	erected-226.0 MT
Grand Total:	15,237,0	11,438,6	3,798,4	700,7 MT
Percentage of total:	100%	75%	25%	4,6%

Percentage erected of the delivered equipment 6,15%

15. Revised Production Programme

The revised production programme schedules (due to the cancellation of the delivery of the sheet rolling mills by agreement between the USSR and the Indonesian Government) were as follows:

Merchant sections of plain carbon steel:

(a) Rounds, squares, hexagons, from 10 to 50 mm equivalent dia. Flats from 4 to 12 mm thick from 12 to 125 mm width.... 51,000 MT/year

(b) Sections from 20 x 20 x 3 to 80 x 80 x 12 mm and channels from 50 x 30 mm dia; hoops from 2,0 mm - 3,5 mm thick and 20 to 50 mm ..... 18,000 MT/year

(c) Steel wire from 1,0 mm to 5,6 mm dia., galvanized, heat treated and non-heat-treated for nail wire, barbed wire or other purposes ..... 15,000 MT/year

Total production: ..... 84,000 MT/year

The above annual production schedules could be met on the basis of a 6,600 - 7,200 hours/year operation of the plant as follows:

(1) Ingot production (OH)..... .....100,000 MT

50 T/charge per heat

2½ heats per day

300 days per year

(50 x 2,5 x 3 = 375 T/day

375 x 300 working days per year = 100,000 tons per year

(2) (a) Merchant bars (rounds, squares etc.)..... 51,000 MT

(b) Constructional steel shapes, etc.. ..... 18,000 MT

(c) Wire rods required to produce 15,000 MT

of nail wire..... 18,500 MT

Approximate mill capacity 40,000 T/finished bar and rod products for 3,300 hours or about $\frac{40,000}{3,300}$ = 12 tons/hour based on average combined speed of rolling mills.

Assuming the same average production speed for the new part, bar and rod mill, the total operational hours required to produce the annual production of 24,000 tons of finished products would be 6,600 - 7,200 hours.

16. Production Schedule for Phased Implementation of the Tiflis Steel Project as proposed by U.N.I.D.O. Mission

With the recommendations of the UNIDO mission for phased implementation of the Project are discussed in the present chapter of this Report, reference is outline is thereto to be made with.

I. First Phase

1. Operation of cold wire drawing plant;
2. Hours per year (total) = 5000 hours in two "shifts" operation at 3 tons/hour production rate,
3. Imported wire rods in coils (30-35 kg) 5 - 6,5 mm dia.;
4. Annealing and galvanizing on 3 shifts working = 7,200 hrs.
5. Pickling operation - one shift working = 2,500 hrs.

Mill capacity - 5 machines - maximum size drawn to 6,5 mm for 3 machines at 6.5 mm and one machine at 3,2 mm dia.; minimum one machine at 0,75 mm dia.

Capacity of wire drawing on 2 shifts' operations (5000 hours) is estimated at 15,000 tons of wire consisting of:

1. Nail wire at 1,9 mm to 5 mm dia.	9,000 MT/year
2. Galvanized wire for barbed wire manufacture 1.9 mm to 3,0 mm	4,500 MT/year
3. Galvanized wire for various purposes from 1,0 to 3,0 mm dia	1,500 MT/year
Total	15,000 MT/year

Wire rods required for the above yearly production are estimated at 15,500 MT/year
Estimated average production per shift 7,500 MT/year

II. Second phase

Operation of merchant bar, light sections and rod mill

Total number of hours/year..... = 7,200 - 6,600

Number of hours for rolling bars

and shapes ..... = 3,600 - 3,300

Number of hours for rolling wire

rods .... = 3,600 - 3,300

Materials = imported billets (80 mm x 80 mm, 130 mm x 130 mm)

of 4,6 to 6,5 metres in length.

Average production rate of merchant, bar and rod mill = 12 tons/hour.

Total annual production of merchant, bar and light sections from

50,000 tons of imported billets = 43,000 MT/year.

Production of wire rods (5 - 6,5 mm) from 50,000 tons of imported

billets = 43,000 MT/year approximately.

Grand Total Production of:)
merchant mill sections, bars) 86,000 MT/year approximately.
and rods.)

III. Third phase (Steel making)

Either in electric arc melting or open hearth steel making

furnaces depending upon the availability of hot metal/cold pig

and scrap. This subject will be discussed in a later chapter

of this report.

17. ORIGINAL CAPITAL COST OF EL TJILEGON STEEL PROJECT

The original capital cost of the plant equipment including the Thermal Power Station was estimated at 36 million US dollars, which was raised subsequently to 38,5 million US dollars, following revisions to the plant specifications. So far the Indonesian Government has invested in local currency the equivalent of over eight million US dollars in site clearance, township and housing and buildings etc. About 75 - 80 per cent of the overall plant, equipment and machinery (53,000 tons in weight) varying in quantity from one plant unit to the other, has been received reportedly worth about 29,1 million US dollars. The initial design capacity of the Plant is to roll 100,000 tons of steel annually to yield 86,000 tons of merchant light sections, rods, bars, etc. based on the Plant's rolling mill operations, with the Plant's operation also of cold wire-drawing mill for nail wire etc., whilst the open hearth steel furnaces will naturally operate on 3- shift's basis. The merchant light section and rod rolling mill could work on 3 shift's basis (7,200 hours) imported steel billets to roll 150,000 tons of steel billets annually, to yield 129,000 tons of merchant mill sections and steel wire rods, (considering that the steel sheet rolling-mill has been eliminated from the Tjilegon Steel Plant).

The overall plans of Tjilegon Steel Project contain considerable infra- structure and units for regional area development, such as (a) the development of Merak harbour (30 - 35 draft at the wharf) 10 km away from Tjilegon (b) a Thermal Power Plant (36 megawatts) based on coal and oil usage (c) a 40 km water pipe line to be laid from a nearby lake to the steel plant to provide water for the steel plant, thermal power station and also for irrigation purposes in the region.

It is however, felt that the capital and working costs of the Thermal Power Station should not be integrated with those of the steel projects. The Thermal Power Station, in the Mission's considered views, should be completed as an integral part of the overall economic development plans of the country. The Power House should actually sell power to the steel Plant at a suitable economic price structure.

18 Likewise, the cost of water supply system should be divided proportionally between the capital cost of the steel project and regional economic development plans. Similarly, the port development plans, harbour and pier should not be attributed to the steel project. The cost of these infra-structure requirements to complete the steel mill has been estimated at 2,[illegible] million US dollars and Rp. [illegible] billion = 13,3 million US dollars, taking into account losses through pilferage, corrosion damage etc. owing to storage of the plant, equipment and machinery in the open. Some of the latest relevant break-up figures for the plant equipment as contracted and as invoiced are given below, (obtained by the Mission on the basis of the visit to Tjilegon Steel Plant), in terms of capital costs in U.S. dollars.

Equipment	As contracted (U.S. $)	As Invoiced in US dollars (app.)
a. Open hearth equipment	2,[illegible]66,955	2,000,[illegible]46
b. Merchant and wire rod mill equipment	[illegible],696,[illegible]67	7,32[illegible],943
c. Repair shop equipment	650,1[illegible]1	[illegible]6[illegible],310
d. Laboratory equipment	175,393	54,510
e. Gas, steam and Power Facilities	316,792	138,594
f. Water supply and sewerage etc.	956,5[illegible]3	507,636
g. Central storage equipment	63,612	29,304
h. Railway and Motor transport equipment	347,907	503,[illegible]32
i. Equipment instrument and cables General Electric and Communication Facilities	451,131	648,193
j. Cable wire, electric eq. lightning fixture sanitary equipment	34,547	78,996
Building materials	6,615,599	5,528,598
Building equipment	2,[illegible]42,573	2,[illegible]27,602

19. Whilst it is difficult to estimate in the absence of detailed inventory lists which are currently in preparation, the precise details of equipment received for each of the constituent plant units, some ideas thereof will be gained from the above break-up figures. In the case of the Thermal Power Station, the civil works and foundations have been completed whilst the water tube boilers, superheaters etc. have also been received. It will not be premature to make a passing reference to the urgent need of completing the Thermal Power Station, irrespective of the Steel Plant and as a part of the overall economic and industrial growth of the country. The Thermal Power Station, Krak Tor' Development plans, the water pipe line system and reservoirs should be pursued as separate economic development projects and entities which ought to sell their goods and services as if it were, on commercial basis to the steel plant. The steel plant's capital costs should not be loaded on with the capital costs of Power, Water and Port Development systems along with their heavy amortization bills etc. The validity of such a stipulation will be obvious when it is realized that the steel plant as a whole will be using only a part of the 36 megawatt capacity of the Thermal Power Station under installation at Tjilegon.

C. Infra-structure including Power House and Water Requirements etc. for the Tjilegon Steel Project.

20. The original Soviet Project Report has given the details of the infra-structure such as, the Thermal Power House, water requirements and the construction of the 10 km water pipe line to Tjilegon, Port Development Plans etc.; these would be discussed here purely in relation to the recommendation to be elaborated by the Mission in this Report.

21. Water Consumption and scheme of Water Supply

Water consumption figures (rated consumption per second in litres) for the different units of the plant have been estimated as follows: -

Consumption Unit			Total consumption litres / second
1.	Open hearth shop		42
2.	Merchant mills		
	a) clean water recirculating cycle	302	
	b) contaminated water recirculating cycle	119	552
	c) reused water	111	
3.	Cold wire drawing department		17
4.	Sheet rolling mills (at simultaneous operation of the hot and cold rolling mills)		
	a) clean water recirculating cycle		890
	b) contaminated water recirculating cycle		396
	c) reused water		102
5.	Compressor plant		6
6.	Oxygen plant		5
7.	Repair shop		3
8.	Vitriol plant		22
9.	Refrigerating section - reused water		203
	Total:		2,103

including, broken down as follows: -

water of clean cycle	1,237
water of contaminated cycle	395
reused water	421

for merchant bar and rod mill	581
" cold wire drawing mill	17
" oxygen plant	5
" compressor plant	6
" repair shop	3
	612

Plant requirement of fresh water for replenishment to make up the losses of the recirculating cycles and to flush the water supply will amount to about 176 litres per second.

22. Process Water Supply inside the site - water supply scheme

The Tjidamar river originating from and fed by the Rawa Danau lake has been considered as the best source for the continuous process and for the plant and the drinking water supply systems. For process purposes, the water can be delivered without clarifying while for sanitary and drinking purposes it shall be pretreated, chlorinated etc. The water intake works of the river will be located about 39 km from the Tjilegon plant.

Another source envisaged is the Indra river. This river dries out during the dry period but by surplus discharge during the rainy season, this source could be used as the emergency source. The reservoir of a capacity of about 2 to 3 x 10^6 m^3 has been envisaged for construction for this river and generate a fresh water supply (emergency) at about 80 litres per second.

A positive source for process and drinking water at the plant site are the deep wells which produce about 2650 litres per minute or about 40 litres per second. One of these wells produces about 1000 litres per minute or about 17 litres per second.

The steel plant site being remote from the water source, the designed water supply scheme provided for maximum possible recirculation of water. This scheme included two recirculation cycles of process water supply: recirculation of contaminated water and recirculation of relatively clean water. One large pumping station, common for both the recirculation cycles was envisaged.

Contaminated water (recirculation cycle) - Used water from the plant equipment and scale flushing at the rolling mills will go to the scale pits which will serve as primary settlers. Pumping stations will deliver the water partially to be used for scale flushing and partially to secondary settlers for further clarification and from thence to the hot water primary pumping station serving the recirculation system, further on to the ventilation cooling towers and to the cooling chambers of the primary station and finally to the consumers.

23. Recirculation cycle of relatively clean water

A part of the used hot water from the rolling mills, from the open hearth furnace and other shops will go by gravity to the hot water chamber of the primary pumping station of recirculation cycle, wherefrom a set of pumps will deliver it to the cooling water tower of relatively clean water. Another part of the hot water from the rolling mills will come to the cooling water tower under the remaining head.

Water cooled at the tower will go to the cooled water chamber of the primary pumping station where fresh river water will be added to it for replenishing and flushing of the recirculation system. Cooled water will be supplied by pumps to the customers.

24. River Water Requirement of the Plant

The river water requirement of the plant and the electric power station was estimated at 400 litres per second and that of the region including the towns of Merak and Tjilegon at 430 litres per second, or a total of 830 litres per second.

The Tjidanau river as mentioned above, was the major source for river water for industrial and drinking water supply. From the water intake works, the water shall be supplied to the steel plant through a 1000 mm diameter, 39 km long pipe line. This will supply the plant and the region (Merak and Tjilegon) with about 830 litres per second.

The water intended for sanitary and drinking proposed shall be subjected to cleaning at the filtering station. The capacity of the filtering station was about 12,000 cu.m./day. It will cover the requirement of Tjilegon town (7,000 cu.m./day) and that of the town of Merak of about 3,000 cu.m./day. Plant requirements of replenishing water to make up the losses of the recirculating cycles and to flush the water supply system will amount to 613 cu.m./hour or 3,1 per cent of the total consumption.

25. Power Requirements and Thermal Station

The Thermal Power House envisaged in the project report was included basically to cover the electric loads of the steel plant as well as those of Merak Harbour and for regional consumption in the area. It will be of 36 MW capacity.

For this purpose, the Project included the installation of 3-turbo generators each with a capacity of 12 MW. The steam required of the turbo sets will be provided by three boiler units each of 75 tons per hour steam evaporative capacity at 40 atm. absolute at 450° C. One turbo generator and one boiler will be used as standby units. Fuel for the boilers will be coal and oil produced in Sumatra island.

Make-up feed for the boiler and steam and condensate losses and for general steam requirements at the steel plant will be treated in a chemical treatment plant at 40 T capacity. Process water (closed system) will be supplied through the circulating water cooling system in the induced draft cooling towers. 500 cubic meters/hour of river water will be supplied to replenish the circulation system of the Power Plant. The source of water supply (which has not yet been built) will be Tjidana river and reservoir of about 3 x 10^6 m^3 with Bekasi river as the source.

The electric power load will be distributed at 6.3 **KV** at the steel plant and the auxiliaries will feed at 6 KV or 380 V-AC. Direct current will be distributed to shops DC power consumers at 220 V.

The Power facilities incorporate the following : -

(1) electric net work and sub-stations.

(2) signalling and communication system

(3) battery charging station.

(4) compressor plant.

(5) waste heat boilers.

(6) refrigeration station.

(7) oxygen and antogenous facilities.

(8) water supply and sewerage maintenance.

(9) filtering plant.

(10) maintenance of pipe lines.

(11) ventilating system.

Electric Loads

The electric loads in MW were as follows:

(1) steel plant max. .....18 MW

(2) residential site (steel plant)..... 1 MW

(3) Merak Port ..... 2 MW

Total .....21 MW

The rolling mill power equipment consist of the following electric motor drives:

(1) For driving the cogging mill stand (1 unit)
750 V-DC motor - 1800 KW at 75 - 150 RPM motor;

(2) For driving the 530 mm roughing stand -
(1 unit) 750 V-DC motor - 600 KW at 100/125 RPM.
For the 370 mm roughing stand each (2 units) -
450 KW a 160/400 RPM.

(3) For driving the 370 mm - 4 merchant bar stands
(4 units) each - 450 KWH a 160/400 RPM.

(4) For driving the 270 mm rod stands each (2 units)
350 KW a 300/800 RPM.

(5) For driving the 6 wire stands 270 mm (wire rod)
1 unit 750 V-DC. motor - 800 KW a 500/1200 RPM.

The motor generator set consists of: drive induction motor 6,000 V. 1,600 KW, 500 RPM with flywheel and DC generator 750 V. 2000 KW, 500 RPM for the cogging mill DC motor.

The mill motors are controlled by rotary amplifiers to Ward Leonard system.

The main drive motors of the roughing stands are supplied by the Mercury DC Rectifiers with grid control. Ward Leonard control is used for (roll tables, feed rollers, manipulators screw drives, flying shear etc.)

26. <u>Existing Power Supply</u>

Presently electric power is being supplied to the housing and other personnel at the plant site, oxygen plant, repair shop by 4 - 400 KVA diesel driven generators with a total supply of about 1600 KVA. As stand-by units, there are presently installed 2 - 80 KVA diesel driven generator and 2 - 60 KVA diesel driven generator sets. The atmospheric cooling tower

has been installed to supply cooling water to these diesel driven generator sets.

D. Technical Discussions and Recommendations of the Mission

27. It will now be appropriate to have a technical appraisal and critical review of the Tjilegon Steel Project and furnish specific recommendations of the Mission on various aspects of the Project.

The Haematite-magnetite iron ore deposits on which Lampung pig iron-plant was to be based (55,5 per cent Fe., 0,024 per cent P., 0,053 per cent S., 10,0 per cent SiO_2., 6,0 per cent Al_2O_3) has been reported by the Indonesian authorities not to exceed 0,5 million tons. A pig iron smelting complex, however, small and in this case, with a daily output of 100 tons per day cannot be supported by such a small deposit of ore body. It is further emphasized that Soviet Project Report had not included pig iron smelting in the Tjilegon Steel Plant but had relied upon the mixed cold charge of pig iron and scrap to the three 50 tons open hearth steel-making furnaces. The Lampung pig iron project cannot be considered a viable unit and it has to be indefinitely deferred if not scrapped altogether. Considerable ore proving and exploration work will be necessary before venturing upon pig iron smelting in Indonesia. Additionally Indonesian coals are chiefly non-coking in nature. The Kalimantan coals may be able to yield satisfactory low temperature carbonized coke for use in small blast furnaces, provided pilot carbonization trials yield satisfactory results. However, the overall economics and technical feasibility of such low temperature carbonization and iron smelting will need to be worked out after extensive pilot plant scale trials. For the Tjilegon Steel Project, pig iron smelting in Kalimantan area and despatch of cold pig iron to Tjilegon Steel complex is currently totally unjustified. Apart from the high cost of smelting pig iron inherent at Kalimantan and the high

cost of transport of cold pig iron to Tjilegon, there is no project in the offing in Indonesia to-day which can supply cold pig or hot metal to open hearth furnaces at Tjilegon. As such, the operation of the open hearth steel making furnaces at Tjilegon becomes equally problematical. As referred to earlier, the basic open hearth process is essentially a steel refining process based on the use of hot molten metal and cold scrap charges. If simple melting of 100 per cent steel scrap is to be done to make steel ingots, electric arc steel melting can claim to be much superior in many ways to the basic open hearth furnace operation particularly in view of the intermittent and flexible nature of the former in comparison with the continuous operations of the latter. If adequate cheap electric power could be available at Tjilegon after the Thermal Power Station has been commissioned, it would be preferable to set up an optimum electric arc steel melting capacity to feed the steel ingots to the cogging mill of the Tjilegon Steel Plant. This would of-course, need additional dollar and rupiah expenditure which at present is just not possible owing to the most acute financial stringency and shortage of capital funds in the Indonesian economy. In any case, it would be most imperative to keep the open hearth furnace steel-making to the very last-phase. And at the present stage, the following phased operations as indicated in the order of priority should be given over-riding consideration and precedence. Before however, discussing these phased operations, it is emphatically emphasized that most urgent and expeditious action should be stepped-up to move all the heavy electricals, turbo-generators and electrical motors, rolling mill drives and equipment, electric crane motor and drives, steel ropes etc. into covered storage sheds with proper maintenance attention, otherwise, it will no doubt be the case that most of electrical equipment, turbo- generators etc. would be heavily corroded and damaged under Indonesian tropical, humid,

rainy and hot conditions, if not altogether rendered unservicable, needing thereby heavy replacements and still heavier expenditure of foreign exchange. Some steps have been taken in this direction but a visit to the Tjilegon Plant has shown that most urgent and expeditious measures are required to improve the situation. Even at present, it is not possible to assess the actual damage already done particularly to the heavy electrical equipment and machinery.

28. And also there is no ready way or a ready reckoner for assessing the present condition of the plant equipment and machinery which lies in broken wooden crates in the open, unless the equipment is erected, assembled and tried out under plant service conditions. It is also necessary to prepare the up-to-date list of inventories of the plant equipment and machinery to assess the missing items. The commissioning of the 50 cu.mm/hr oxygen plant reported at present to be working at half capacity owing to shortage of oxygen cylinders (despite heavy industrial demands of oxygen) and commissioning of the workshop are steps in the right direction. The foundry sand control and chemical analytical control laboratories are also functioning.

29. Reverting to the open hearth furnace steel-making shop, it also needs to be pointed out that when pig iron smelting becomes economically practicable and metallurgically feasible in Indonesia, it would then be much better adjudged from all angles to set up L.D. oxygen steel-making converters at the pig iron smelting site and despatch the steel ingots or cast billets to the rolling mill at Tjilegon instead of the cold pig iron.

30. In small steel plant operations, it is desirable to reduce capital costs by bottom pouring about 30-40 steel ingots in the teeming plant cast into the billets size and directly rolling the cast-billets in the Merchant and light section mill. Such a sequence will eliminate the

heavy cogging stands or the blooming mill for small steel-making plants. There are several small steel plants working on this basis in different parts of the world, such as in Greece, India etc. where small electric steel melting capacity is coupled directly to a merchant, bar, light section mill for rolling steel rounds, bars, light sections etc. from cast steel billets.

31. In the case of Tjilegon Steel Plant, the billet mill has not been finally included in the Project. As such, the cogging of steel ingots (about 3 tons in weight) becomes redundant. Since also, there would be no steel-making capacity at the Tjilegon Steel Plant in the immediate future as stated earlier, the question of cogging the ingots in the cogging mill stand therefore, does not arise. The following order of priority and phased operations should be established urgently and most expeditiously in the Mission's considered opinion at the Tjilegon Steel Plant: -

32. RECOMMENDATIONS OF THE MISSION

a. First phase:

Start the cold wire drawing mill operations based on imported steel wire rods. This is fully feasible and it has been reported by Indonesian authorities that the rupiah finances for doing so would be available. Adequate power and water resources are also reportedly available at the site and it will not be necessary to await the commissioning of the Thermal Power Plant or the laying of the water pipe line system of 40 km length in order to commission the cold-wire drawing mill. The private sector can be invited by the Government to join in this joint venture. This will create confidence amongst the plant operators. Also the wire output from the cold wire drawing plant can be galvanized

since the galvanizing equipment has also been received from U.S.S.R. at the site.

33. It has further been reported that the imports of unalvanized drawn steel wire alone into Indonesia during 1967 exceeded 2,1 million U.S. dollars. The foreign exchange costs of these imports can be substantially cut down if the steel rods (coils) are imported instead of the finished drawn steel wire. The imported steel rods should be cold drawn in the cold wire-drawing mill at Tjilegon.

34. In the original Soviet Project Report for the Tjilegon Steel Plant, the wire drawing mill was scheduled to operate on two shifts operation. If, however, it is operated on imported wire rods, its working should be extended to three shift's operations, increasing its daily production rate. A current price of C.I.F. 107 US dollars per ton of imported wire rods from Singapore has been quoted. Subject to ensuring regular and proper maintenance of the mill, the latter may well operate on three shift's operation, say for 275 - 300 days in a year, which will substantially raise its production capacity subject of course to the availability of imported wire rods on the one hand and peak maintenance of the mill on the other. The conversion of imported wire rods and their drawing into steel wires of different diameters and the production of galvanized steel wire should mean substantial foreign exchange savings and a boost to the national economy of Indonesia.

35. b. <u>Second phase:</u>

During the second phase, the merchant, rod and light section mill of the Tjilegon Steel Project should be commissioned concurrently with the starting of the Thermal Power Plant. Rupiah resources required for starting this mill should be mobilized with the assistance of the private and public sectors in Indonesia. It is further understood that tube mill

units could be installed in the region to meet the water requirements of this mill which has already been received from Soviet Union. Some tube wells have already been successfully sunk with good results.

36. The operations of this mill will have to be based at present on imported steel billets. In this connection, it is pointed out that during 1967, Indonesia is reported to have imported steel bars, R.C.C. rods and light sections through Hong Kong to the tune of over three million U.S. dollars. This foreign exchange expenditure can be cut down if the steel billets were imported and rolled in the merchant, light section mill at Tjilegon, which has already been received from U.S.S.R. and now needs to be installed, along with the completion of the Thermal Power Station during the second phase. It is to be strongly emphasized that the erection of the Thermal Power Station should be completed and it should be commissioned at the very earliest since it is a Project of considerable economic importance to the national economy of Indonesia. For meeting the financial needs, resources of public and private sectors should be mobilized. The commissioning of the Thermal Power Station should be considered separate (as referred to earlier) of the Tjilegon Steel Plant and for the Power Plant, applications for loan should receive favourable response from the World Bank, Asian Development Bank, International Development Agency, International Monetary Fund, and other International Monetary bodies but a start in this direction will need to be made immediately.

37. c. <u>Third phase:</u>

Having fulfilled these two urgent top priority phases, stock should then be taken of establishing steel-making capacity utilizing basically the internal steel scrap available within the country, supplemented if required by imports of steel scrap (at 35 - 38 US $ C and F per ton), in order to cast steel ingots or billets - the latter will be supplied to the

merchant and light station mill at Tjilegon and the former could be fed to the cogging mill stand of Tjilegon Steel Plant. The casting of steel billets through bottom-pouring technique is widely practised even though the overall yield of the rolled product would be lower compared to large steel ingots and their rolling in a heavy blooming mill - in the case of small cast steel billets, capital expenditure on the heavy blooming mill can be avoided in small steel plants. Another alternative widely gaining ground in developing countries alike, is the continuous casting of steel billets (which ensures very high yield rations) and their rolling directly in a merchant and light section mill. However, in the case of Tjilegon, either of the two alternatives could be considered since the cogging mill stand has already been received from the Soviet Union. Concurrently also; with the commissioning of the cogging mill stand, import of small steel ingots may be considered at lower costs than the import of the billets. The need for establishing an integrated electric arc steel melting capacity would at that stage become unavoidable. With the commissioning of the Thermal Power House, the availability of electric power would also be assured. At that stage, the overall economics of steel refining in the basic open hearth (with a hot molten metal and cold scrap charge) furnace shop in relation to L.D. oxygen steel-making capacity will need to be made, provided in both the cases, hot molten iron is directly available at the site from the blast furnaces. The ultimate comparison of the above processes viz. the open hearth furnace and the L.D. oxygen steel-making with the electric arc steel-making furnaces employing 100 per cent steel scrap charge, would then need to be examined on an integrated basis. In doing so, the site for steel making will have to be examined afresh on a much better basis than what has hitherto been possible, irrespective finally, which of the three steel-making process as finds economic acceptance.

38. In the present context, avenues for the sale of the refractories supplied for the basic open hearth steel shop should be examined and it should not be difficult to get a good price for them provided these are well stocked and preserved. The establishment of the steel-making capacity either at Tjilegon or at another optimum centre should form the subject of another study at the appropriate time. It can however, be recommended, that optimum conservation of steel scrap may have to be introduced at the opportune time, taking into account the scrap already stocked up at Tjilegon.

39. In passing, it is also stated incidentally that in the absence of a co-ordinated coal policy, the Indonesian Government would be well advised to introduce a policy of rehabilitation of Bukit Asam Coal in South West Sumatra, Ombilin in Central Sumatra, and Puluk Pulu coal field in North West Kalimantan. The coal output figures from these mines have steadily fallen to very low standards. These mines do need to be re-activated and rehabilitated even though, to-day there may be no apparent direct linkage of the coal mines with the iron and steel complex. Nevertheless, these factors are highly inter-dependent in up-grading the over-all economy of the country. These coals can meet the export needs of adjacent countries and can be valuable foreign exchange earners which is so vitally needed for the Tjilegon Steel Project.

40. Reverting to the phased implementation of the modified Tjilegon Steel Project, it is pointed out that it may be possible to appoint through the agency of United Nations Technical Assistance Programme (U.N.I.D.O. etc) (subject to funds availability etc.), experienced Technical Experts from the Russian built Bhilai Steel Plant in India of 2.5 million tons annual capacity where identical merchant and light section mills etc. are successfully in full operation for meeting the needs of the Indian markets as also for exports. A number of these experts may possibly be appointed for a period of one to two years to implement the phased execution of the Tjilegon Steel

Project as discussed in the foregoing. These U.N. Experts will also assist in drawing up and checking the inventory lists of plant equipment and machinery and pin-point the missing items and those needing replacements. This is one of the main recommendations of the U.N.I.D.O. Mission for the Tjilegon Steel Plant and steps should be taken to implement it without the least delay. This subject should be taken up at the appropriate level through the agency of U.N.I.D.O. The U.N. Technical Experts will work in the closest possible co-operation with their counterparts in Indonesia to commission the Tjilegon Steel Project on the basis of the "phased" implementation as recommended by this Mission. The Job Descriptions and Project Sheets for these U.N. Experts can be drawn up in due course.

41. In certain quarters, some queries have been raised that the steel plant capacity at Tjilegon can be raised from 100,000 tons to 300,000 tons or even 400,000 tons annually simply by increasing the speed of the motors - this just cannot be done. The speeds of the electric motors are directly related to the rolling of the steel product and the former cannot be unilaterly stepped up beyond limits. The increase in the output of a rolled product from a rolling mill can be accomplished through 3-shift's operations, say up to 275 - 300 days in a year, consistent with efficient mechanical and electrical maintenance of the mill. Also in an integrated iron and steel plant, the steel-making capacity has to be taken into account to match the rolling mill's capacity, unless the steel ingots or billets are to be imported.

42. It should be possible to raise the capacity of the merchant, light section, rod mill to 150,000 tons annually by operating it on 3-shift's basis (upto 275-300 days per year) using imported steel billets. A rolling mill normally has an in-built excess capacity to permit expansion of the plant as a whole. However, there exists no basis whatsoever, to assume

[illegible] realized in the present merchant, light section mill of Tjilegon Steel Project.

43. Reference has been made in some quarters to the setting up of L.D. basic oxygen steel-making converters. It is pointed out that these cannot be set up until and unless molten hot pig iron from an adjoining iron blast furnace is readily available. The LD oxygen steel-making process is essentially a hot molten metal refining process and not basically a scrap based process. The establishment of an iron blast furnace in Indonesia has still a very long way to go and as such, the question of installing the steel making capacity in the country based on L.D. oxygen steel-making process just does not arise at the present time.

44. It is also finally pointed out that there exists no basis whatsoever of establishing a pig iron smelting capacity at Tjilegon; this will have to be based in a region in which iron ore, fuel and flux deposits are optimum adjudged qualitatively and quantitatively and suitably located. Likewise, there also exists no basis for changing the Tjilegon Plant site for rolling mill operations as phased in the Mission's recommendations.

45. At the present stage, there exists no economic or metallurgical basis for establishing an iron-making capacity at Lampung or Kalimantan - the question of pig iron smelting on a commercial scale in Indonesia has to be indefinitely deferred therefore. There may be some auxiliary questions which may now be raised and answered here. The first point concerns the expanding market needs in Indonesia for merchant mill end products, rods, light sections, R.C.C. rounds etc. It has been reported that during 1967, Indonesia imported rolled steel products worth about 5 - 6 million US dollars which the Tjilegon steel rolling mills could supply when in operation. The market needs of Indonesia in an "unrestricted"

market would be much more than 100,000 tons annually of rolled merchant mill products and to that extent, expansion of the Tjilegon rolled steel capacity annually to say 150,000 tons is inherent in the present set up at Tjilegon. The merchant, light section rod mill is scheduled to operate on 2 shifts in the Russian Project Report. If however, imported steel billets are to be used, this mill could well operate on 3 shift's basis (say up to 275 - 300 days per year), subject to adequate mechanical and electrical maintenance of the mill, raising thereby, its annual production capacity to about 150,000 tons of light steel sections, rounds, M.C.C. rods etc. The import of steel billets could be arranged from Europe at the same C and F prices as Singapore does viz. 76 - 80 US dollars per ton (C and F). Alternative supplies of steel billets could also be secured from Japan and India at a suitable price structure.

46. The layout of the Tjilegon Steel Plant was studied. It is adequately integrated to permit future expansion of the steel-making capacity, should the conditions for doing so be optimum at some future date.

47. As touched upon earlier, there exists no basis or justification today for setting up any iron-making capacity at Tjilegon - iron smelting installations in Indonesia can be justified only on the basis of metallurgical suitability and adequate reserves of the requisite raw materials which have still to be extensively explored, investigated and proved. The transport facilities and costs of these raw materials to Tjilegon is a factor to be critically studied if and when requisite raw materials reserves have adequately been proved qualitatively and quantitatively. An iron-smelting complex at Lampung or at Kalimantan is also not justified today following the same reasoning.

48. The import to Indonesia of the iron ore and coke cannot also be considered today in view of the current economic situation and plight involved as these do, foreign exchange expenditure of no mean order. Indonesian coal cannot be used for producing metallurgical grade coke required for iron smelting as revealed by the tests so far conducted.

49. The expansion of harbour and handling facilities at Merak sea-port is a subject which should be independently investigated by technical experts on this subject to assess the capital cost for doing so, both in foreign exchange and in rupiahs.

The shifting of the Tjilegon steel complex to any other site is also currently out of question for economic and technical reasons. And there appears to be no specific advantage of doing so either, considering that smelting of pig iron at any of the alternative sites as also at Tjilegon is out of question at the present time.

50. It would now be in order to define and formulate the future course of action on the basis of the scope of work earlier spelled out. We shall now refer pointedly to the scope of work referred to earlier in this Report and give specific comments thereto in the light and background of the foregoing technical discussion of the Tjilegon Steel Project.

51. Should the Tjilegon Steel Project be pursued to completion as per its original detailed project report prepared by the Soviet or should it be modified to meet the highly depleted financial situation in Indonesia today both of foreign exchange and local Rupiah resources? Should the Tjilegon Steel Plant be additionally modified in view of the very much altered basic assumptions and data?

52. The Tjilegon Steel project has to be phased and implemented on a modified basis as discussed earlier. The following would present its phased execution in the order of priority as outlined below:

1. Commissioning of the cold wire drawing mill utilizing the currently available resources of water and electric power with the joint co-operation and collaboration of the private and public sectors in the country. Wire rods will be imported in the initial stages.

53. 2. Commissioning of the merchant and light section mill based on imported steel billets - this will have to be accomplished concurrently with the commissioning of the Thermal Power Station at Tjilegon and stepping up of the water resources and availability through tube wells sinking operations in the absence of the water pipe installation projected for the Tjilegon Steel Project as a whole and for regional irrigation needs.

54. 3. The establishment of steel-melting capacity at Tjilegon based wholly on cold steel scrap or on cast molten iron plus cold scrap charge or on cold pig plus scrap charge in order to produce steel ingots or directly cast steel billets has to be deferred at this stage as discussed in the foregoing. It may well be necessary to sell off the basic refractories of the open hearth furnaces provided these are well preserved and stored to prevent their deterioration. The entire question of steel-making capacity with or without iron-making installations has to be deferred indefinitely until comprehensive studies and qualitative and quantitative assessment of the raw materials resources in the country have been completed.

55. In this context, urgent efforts should be made to move and store the Tjilegon steel plant equipment and machinery in suitable covered storage sheds and to introduce adequate maintenance facilities so that the heavy electrical and mechanical equipment etc. do not deteriorate and are not damaged beyond repair.

56. If the Tjilegon Steel Project is to be drastically modified, how should it be phased in its plan structure whilst fully mustering available financial resources and ability both in the private and public sectors in Indonesia?

57. The phased implementation of the Tjilegon Steel Project has been referred to above. It stands to reason that when over 38 million dollars investment has been entered into in agreement with the U.S.S.R. on a two and half per cent long term loan basis, the Project as a whole just cannot be written off or dispensed with. In the Mission's opinion, it must be implemented on a phased basis whilst mobilizing all financial resources of private and public sectors within the country. At the same time, loan on suitable terms from IBRD, Asian Development Bank, I.D.A. (International Development Agency), I.M.F. and other International Monetary Bodies should be applied for. It is needless to say that co-operation of friendly countries including U.S.S.R. and others should be actively sought for and obtained both for financial loan agreements and technical implementation of the Tjilegon Steel Complex on a modified and phased basis in accordance with the Mission's recommendations.

58. Modus-operandi of its implementation should be indicated in the context of current overall economic plans of the country concerning development of agriculture and industry. Broad guidelines have to be formulated to separate the infra-structure and supporting plant units, such as the Power House, Merak Port development plans, development of water resources for the steel plant and for irrigation in the region - such infra-structure in the Mission's opinion should be examined and implemented exclusive of the Tjilegon Steel Project itself in view of their direct bearings on the overall economic development of the country. Capital costs of the infra-structure should not be integrated with those of the Tjilegon Steel Plant itself and should be separately provided for.

59. These subjects have been discussed in the foregoing. The commissioning of the Thermal Power Station should receive urgent priority irrespective of the steel plant. Water for the Thermal Power Station

should be obtained through tube well sinkings and reservoir arrangement for storing rain water. The early starting of the Thermal Power Station is highly important to the national economy of Indonesia. IBRD, A.D.B., I.D.A., I.M.F., and other International Monetary Bodies would look favourably upon loan applications for the Thermal Power Project to step up the economic and industrial growth of the region and the country as a whole.

60. The costs of other infra-structure such as, the Merak Port and harbour development, water resources for area development including irrigation etc. should not be added on to the Tjilegon Steel Project. These Projects are related directly to the overall economic growth and development of the region and the country as a whole and as such, should be implemented independent of the Tjilegon Steel Plan Project.

The joint collaboration of the private and public sectors in the country should be effectively mobilized including capital financing and covering foreign exchange requirements.

61. What steps should be taken to meet the financial requirements of the Tjilegon Steel Project and its practical implementation even on a truncated yet phased basis?

62. The subject of mobilization of financial resources to meet the requirements of Tjilegon Steel Project has been discussed in the foregoing. It would be in the short term and in the long run most desirable to seek the full co-operation of Soviet Union for this important steel project over on a fresh basis, clearly bearing in mind that the Soviet Union and Indonesia had in fact entered into a long-term loan and technical agreement for the Tjilegon Steel Project. Other friendly countries should also be invited whilst financial assistance from World Banking and Monetary Bodies, such as I.B.R.D., A.D.B., I.D.A. should be actively obtained. It is also gathered that the private sector in Indonesia may well be able to mobilize

the foreign exchange component of the Project; their active collaboration should be a main theme in the Government plans.

63. What alternatives should be considered in the technological processes for the Steel Plant; which of its constituent units should be delayed, indefinitely deferred or altogether given up?

64. This subject has been comprehensively discussed in the foregoing. Steel-making or steel melting in the basic open hearth furnaces should be indefinitely deferred. The entire subject of iron-making and steel-making in the country needs to be comprehensively examined in depth in relation to available raw-materials resources, their qualitative and quantitative assessment including indigenous iron and steel scrap etc. The installation of scrap-based electric arc steel melting furnaces should receive due consideration and priority subject of course, to the availability of cheap and abundant electric power. The open hearth shop normally does need to be preferably fed with hot molten metal and scrap charges rather than the all-cold charge of scrap and pig iron. In either case, it will need to be directly linked to the iron-making facilities which cannot be established in the foreseeable future in the country owing to reasons already explained. As such, the open hearth steel-making shop will need to be indefinitely deferred at the present time if not altogether dispensed with.

65. However, the Lampung iron-smelting project will need to be totally scrapped and ruled out since there are no adequate iron ore or fuel reserves in the region to feed the project. The scrapping of the Lampung iron-making project is another reason why the open hearth steel-making plant has to be indefinitely deferred if not altogether disposed of through the sale of basic refractories and allied equipment. The other alternatives, such as the direct-reduction processes based on the use of

cheap and abundant oil in Indonesia will have to be separately reviewed, investigated and comprehensively examined vis-a-vis their applications in Indonesia.

66. The choice and development of alternative iron-making sites such as at Kalimantan again require comprehensive study and critical examination of the raw materials resources of the region which have not at all been fully evaluated so far in relation to coal and iron ore deposits. The bituminous coal deposits of Kalimantan should be subjected to exhaustive low temperature carbonization tests to yield low temperature coke for use in small iron blast furnaces and the results studied on the basis of overall and integrated economics of LTC coke production, recovery of by-products and of iron smelting employing the LTC coke.

67. The subject of rehabilitation of coal mines in different parts of the country, such as of Bukit Assam coal deposit in South West Sumatra, Ombilin in Central Sumatra and Pulukan in North West Kalimantan, etc., should be given equal priority.

68. Strictly speaking, the operations of a cold wire drawing plant or/and of a merchant, bar and wire rod mill should not be regarded as that of a steel plant - the former could be better classified as belonging to the status of an En ineering industry. Irrespective, however, of the nomenclature preferred, the need for the wire drawing plant and the merchant, bar and wire rod mill in Indonesia is imperative today. Their successful operations should mean considerable savings in foreign exchange currently used in importing the finished steel wires, light sections and steel rounds, bars etc.

69. There could have been some points left uncovered in the study of a detailed project of the size and complexity of Tjilegon Steel Plant but what is indeed needed is an overall, integrated and powerful approach in lifting the Tjilegon Steel Project from a state of dynamic apathy to one

of animated, co-ordinated and sustained action all around so that the complex steel plant equipment and machinery worth over thirty five million US dollars and the over eight million US dollars already spent by the Indonesian Government at the site are not left waste and barren under the corroding ravages of tropical sun and heavy rains. What is immediately called for is urgent and integrated action before the steel plant's heavy and delicate equipment and machinery are irreparably damaged - the loss to the nation would then be irrevocable and the frustration bound to follow in its wake will thereby be far more immeasurable. U.N.I.D.O will aim to give maximum assistance to the Government of Indonesia in every way possible in converting what is slowly yet steadily turning into a graveyard of valuable steel plant equipment and machinery into a viable invaluable Steel complex throbbing with activity for the national economic growth of the country which indeed the Soviet Union and the Indonesian Government had jointly originally intended the Cilegon Steel Project to be.

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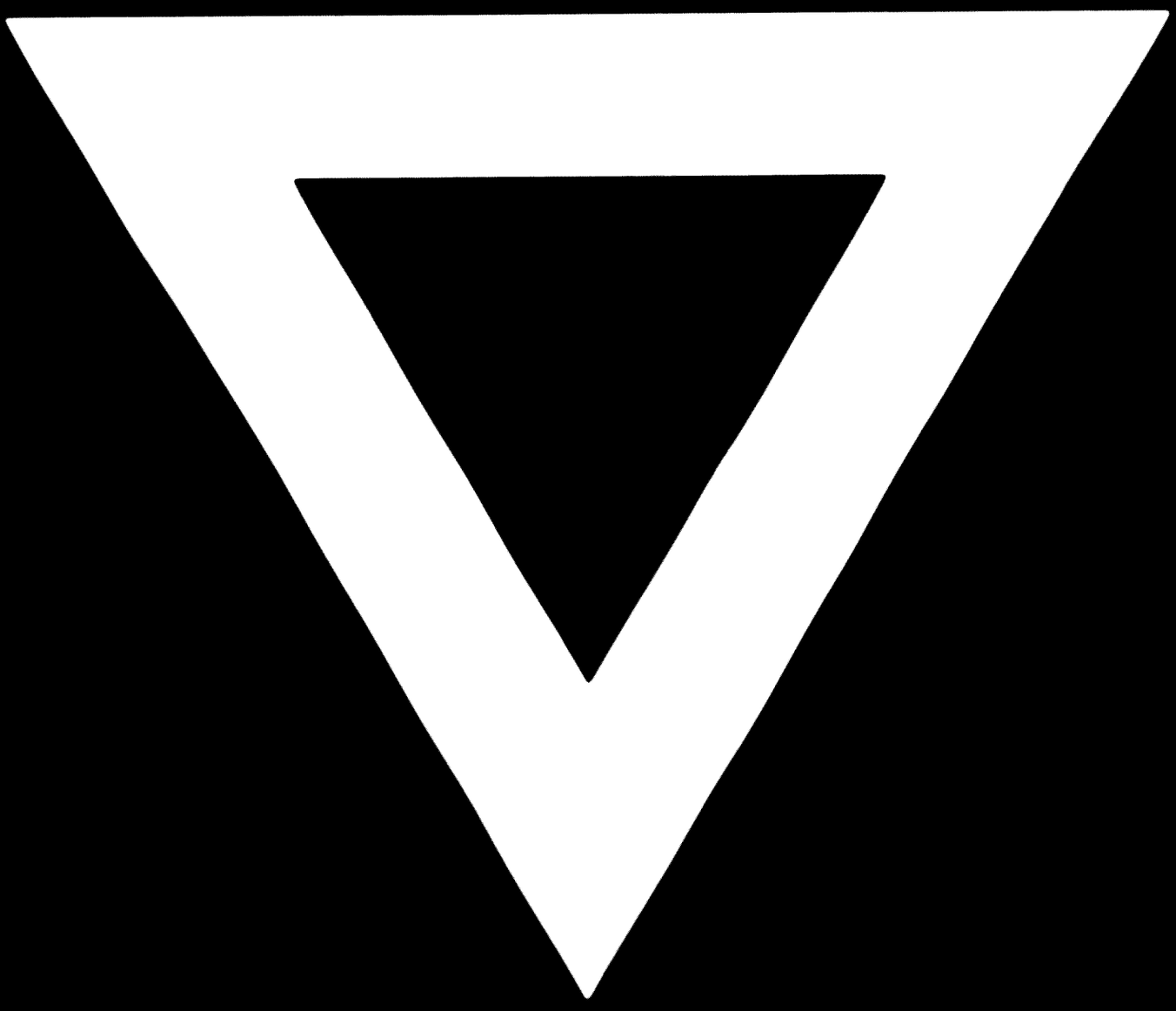

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