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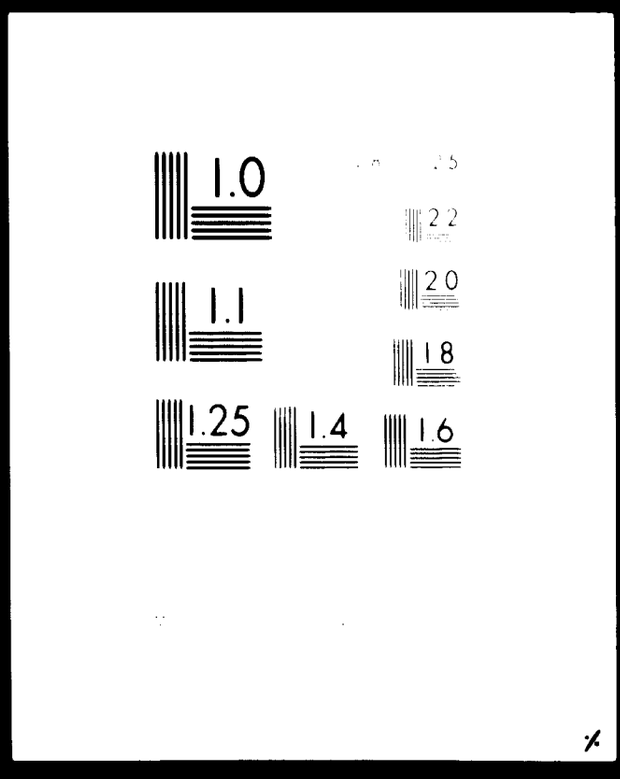

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UNIDO Contract 70/56

Integrated Wood Processing Industry

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UNIDO CONTRACT 70/56

F E A S I B I L I T Y S T U D Y

for the Establishment of an Integrated Wood Processing Industry

in

C Y P R U S

Report for
the United Nations Industrial Development Organisation, Vienna
prepared by

LESNOPROJEKT - BRATISLAVA
POLYTECHNA - PRAHA

Bratislava, January 1971

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C O N T E N T S

SPECIFICATION FOR TENDERS

TABLE OF CONVERSION FACTORS

1. ROUNDWOOD EQUIVALENTS

Product	Unit	Roundwood equivalent-	
		cubic metres	cubic feet
Coniferous sawnwood	1 cubic metre	1.67	59
Broadleaved sawnwood	"	1.82	65
Plywood and blockboard	"	2.30	81
Particle board /650 kg/m^3/	"	1.30	46
Veneer sheets	"	1.90	67

2. GENERAL MEASURES

Length:	1 centimetre	= 0.3937 in.	1 inch	=	2.540 cm
	1 metre	= 3.281 ft.	1 foot	=	0.3048 m
Area:	1 cm^2	= 0.155 sq.in.	1 sq.in.	=	6.452 cm^2
	1 m^2	= 10.76 sq.ft.	1 sq.ft.	=	0.0929 m^2
	1 hectare	= 2.471 acres	1 acre	=	0.4047 ha
Volume:	1 m^3	= 35.31 cu.ft.	1 cu.ft.	=	0.02832 m^3
	1 litre	= 0.2200 gal/imp./	1 gal/imp./	=	4.546 litres
Mass:	1 kilogramme	= 2.205 pounds	1 pound	=	0.4536 kg
	1 metric ton	= 1.102 short tons	1 short ton	=	0.9072 metric ton
Pressure:	1 kg per cm^2	= 14.226 lb.per sq.in.	1 lb.per sq.in.	=	0.070 kg per cm^2
Density:	1 kg per m^3	= 0.06243 lb.per cu.ft.	1 lb.per cu.ft.	=	16.02 kg per m^3

3. OTHER

1 m^3 of Particle board	16 mm	= 62.4 m^2	or	671.4 sq.ft.
1 m^3 of Particle board	8 mm	= 124.8 m^2	or	1.342.8 sq.ft.
1 m^3 of plywood	4 mm	= 249.6 m^2	or	2.685.6 sq.ft.
1 m^3 of veneer	1 mm	= 1.000 m^2	or	10.760 sq.ft.

1 £ = 1.000 mils

1 £ = 2.40 US $, 1 US $ = 0.416 £

1 MWh = 1.000,000kWh,

1 Gcal = 1.000,000 kcal or 1.000.000,000 cal

LIST OF ABBREVIATIONS

CFI Ltd.	Cyprus Forest Industries Limited.
D.B.H.	Diameter breast height
R.W.E.	Round wood equivalent
O.B.	Over bark
U.B.	Under bark
NPV	Net profit value
G.N.P.	Gross National Product
P.B.	Particle board
pcs	pieces
m	meter
m^3 = cu.m.	cubic meter
m^2 = sq.m.	square meter
ha	hectar
m^3 /r/	m^3 roundwood
m^3 /s/	m^3 sawn
MWh	Megawatthour
Gcal	Gigacalorie
t = m.ton	metric ton
s	skilled
ss	semiskilled
us	unskilled
HT Line	High tension Line
M.C.	Moisture content

1. INTRODUCTION

Following the Contract No 70/56 entered into between the UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION /UNIDO/, Vienna and POLYTECHNA, Prague, representing the Engineering and Designing Organization LIGNOPROJEKT, Bretislave, the following experts, Mr. A. Trávník Team leader, Mr. M. Tahy Technologist and Mr. J. Čížek Economist arrived in Nicosia on November 10, 1970 for a stay of three weeks.

The team reviewed the existing studies and background papers and discussed the matter with a number of officials in order to get the up-to-date information on raw material availability and on market potentials. They visited the main forest regions in question, the biggest importers of sawnwood and of wood-based panels as well as the main potential users of products to be manufactured in the proposed integrated wood processing plant.

The team leader attended a meeting of the Board of Directors of "Cyprus Forest Industries Ltd" on November 13, 1970 for a first exchange of views.

After a thorough evaluation of the up-dated information and after discussing various aspects of the project with persons concerned, the team worked out a preliminary assessment of the situation with some tentative recommendations regarding certain changes in the production programme originally planned. Before leaving the Country the team leader submitted the preliminary Report to the Board of directors on November 24, 1970 for consideration and for approval of proposed changes.

The Board of Directors discussed the matters and decided

- to accept the proposed capacities for the sawmill and for the particle board production i.e. a yearly capacity of 10.000 m^3 sawnwood per shift /20.000 m^3 in two shifts/ and 10.000 m^3 particle board in a two shift operation
- to accept the recommendation not to establish a joinery plant for the manufacture of doors and windows, however to install some basic machinary for up-grading of sawn timber according to the proposal
- that the consultants should prepare an economic evaluation of an integrated plant consisting of a sawmill and particle board plant. In view of the doubtful viability of the bruce box plant, technical specification for this production line will be prepared only. It has been decided to postpone the final decision of this matter until the economics of this operation were thoroughly examined.

Acknowledgement: The consultants are greatly indebted to all Organisations

and individuals in Cyprus, who assisted them in the implementation of the Study by providing information, advice and facilities. They appreciate highly the unrestricted support given to their activity in every respect. Without the excellent cooperation of all those engaged in Forestry, Industry, Commerce and Economy, who were consulted by the experts this document could not have been produced.

2. AVAILABILITY OF WOOD RESOURCES

The forests of Cyprus cover some 18,7 % of the total land area of the Island. The breakdown of the forest land according to ownership gives the following picture:

Ownership:	Area in ha:	% of total forest area:
State owned forests	160.000	92,20
Private forests	13.500	7,80
	173.500	100

About 86 % of the State owned forests i.e. 138.000 ha are classified as Main State Forests and include Permanent Forest Reserves and National Forest Parks. The remaining 22.000 ha or 14 % consist of Communal and Municipal Forests and form the "Minor State Forests". The present legislation of Cyprus provides for the classification of State Forests into categories for general management purposes. From the point of view of covering the industrial raw material needs of the Country the most interesting is the category of "Permanent Forest Reserves" which can be intensively managed. The area of Permanent Forest Reserves is estimated to some 60.000 ha.

This figure corresponds to the acreage of State Forests having a canopy density of ground covered over 50 % as may be seen from the following figures:

Canopy density of over 75 %	25.200 ha
Canopy density between 50 and 75 %	34.800 ha
	60.000 ha

It has to be born in mind that in Cyprus a great part of forests have a predominantly protective function to perform and that cuttings in this areas have to be made after careful consideration of the soil conservation and watershed management problems.

It is therefore essential - when planning future development of Forest Industries in Cyprus - to take into consideration as potential raw material resources only those areas, where cutting can be performed without any harm to the ecology.

The forest area of 60.000 ha as proposed by the Forest Department, represents only 34 % of the total forest area and seems to comply with the above mentioned objectives. The respective annual cut under a sustained yield is estimated by the Forest Department to be around 78.000 m^3.

The predominant part of the potentially usable forests is located in the South-West of Cyprus, where the integrated woodprocessing plant is to be sited. The Permanent Forest Reserves of this region have been taken into account in planning the new plant i.e. the forests in the North part of Paphos, in the South part of Paphos, in Adelphi and in Troodos.

From data on growing stock and on estimated increment in those regions it is evident that the following annual yields can be reckoned with:

Forest region:	Annual yield: over bark:	Annual yield: under bark:	Transport distance: to Morphou
North part of Paphos	24.700 m^3	20.250 m^3	38 miles
South part of Paphos	29.200 m^3	24.000 m^3	46 miles
Adelphi Forests	15.600 m^3	12.800 m^3	16 miles
Troodos Forests	6.500 m^3	5.350 m^3	29 miles
	76.000 m^3	62.400 m^3	

In view of the relatively good conditions of the local road network the weighed average transport distance of 36 miles is considered as adequate for an integrated processing plant.

When using the same breakdown into diameter classes for the selected forests as was applied in the official report of the Forest Department /5/ the following picture arises:

Diameter class: DBH in cm	Annual yield over bark in m^3	Annual yield under bark in m^3
5 - 15	4.000	3.000
16 - 25	2.000	1.500
26 - 35	5.500	4.200
36 - 45	11.000	8.800
46 - 55	17.000	14.000
56 - 65	17.200	14.200
66 - 75	12.200	10.300
76 - 85	6.500	5.500
86 - 95	3.100	2.600
96 and over	1.500	1.300
Total volume in diameter exceeding 16 cm	76.000	62.400

In accordance with previous experiences of foresters and local users it is estimated by the Forest Department, Nicosia that from the point of view of suitability for conversion the yield can be subdivided as follows:

- for sawmilling:	58 % i.e.	44.000 m^3 OB or	36.000 m^3 UB
- for box shooks:	31 % i.e.	23.500 m^3 OB or	19.400 m^3 UB
- for mining and agriculture:	11 % i.e.	8.500 m^3 OB or	7.000 m^3 UB
		76.000 m^3 OB	62.400 m^3 UB

The figures mentioned above are to be considered as a rough estimate only; it has to be pointed out that the diameter class of 5 - 15 cm DBH is not included, neither are the volume figures for fuelwood. More reliable data on dimensions and quality of logs will be obtained after a central organisation for logging operation - as proposed in Recommendations of this Study - - has been established.

Conclusion:

It is evident that according to the official figures of the Forestry Department the raw material needed for the operation of the proposed integrated plant is available.

At present the removals are in the range of 50 % of allowable cut.

Table 1

REMOVALS IN m^3 /ROUND/OF INDUSTRIAL TIMBER AND FUELWOOD FOR VARIOUS END USES

FOR THE YEARS 1960 - 1965

		Sawnwood and box sheeks	Round-timber	Hewn-timber	Fuel-wood	Char-coal	Total volume in RWE	Total value in £
		1	2	3	4	5	1 - 5	
1960	1	25.163	1.963	16	11.847	-	38.991	66.114
	2	401	288	47	2.876	7	3.620	2.506
	3	25.564	2.252	63	14.723	7	42.611	68.620
1961	1	32.349	620	6	10.224	2	43.202	96.710
	2	505	217	67	3.070	-	3.861	3.006
	3	32.854	837	73	13.294	2	47.063	99.716
1962	1	36.155	2.701	336	13.114	-	52.318	109.313
	2	953	282	286	3.993	-	5.515	3.561
	3	37.118	2.983	622	17.107	-	57.833	112.874
1963	1	33.573	2.316	688	11.955	-	48.533	115.245
	2	1.087	299	292	5.052	12	6.743	4.544
	3	34.660	2.615	980	17.008	12	55.276	119.789
1964	1	26.624	760	302	8.936	-	36.623	89.951
	2	267	111	233	2.695	-	3.307	1.825
	3	26.891	871	535	11.631	-	39.930	91.776
1965	1	37.393	560	750	11.169	-	49.873	91.869
	2	632	198	270	4.471	-	5.575	1.081
	3	38.026	758	1.020	15.640	-	55.446	94.951

Item 1: Coniferous in m^3

Item 2: Non-coniferous in m^3

Item 3: Total in m^3

Source: Forest Department Nicosia, Cyprus

Table 2

REMOVALS IN m^3 /ROUND/ OF INDUSTRIAL TIMBER AND FUELWOOD FOR VARIOUS END USES

FOR THE YEARS 1966 - 1969

		Sawnwood	Box shooks	Pit-props and other poles	Other ind. wood	Fuel-wood	Total volume in RWE	Total value in £
		1	2	3	4	5	1 - 5	
1966	1	8.840	19.465	2.124	339	13.187	43.957	83.046
	2	482	222	341	253	4.560	5.859	2.751
	3	9.322	19.687	2.465	592	17.747	49.817	85.789
1967	1	9.175	19.246	1.170	246	11.719	41.558	94.100
	2	715	506	119	319	4.404	6.066	3.195
	3	9.891	19.752	1.290	566	16.123	47.524	97.295
1968	1	10.278	20.952	1.216	334	12.549	45.329	107.846
	2	785	799	146	326	3.725	5.782	5.319
	3	11.063	21.751	1.362	660	16.274	51.111	113.165
1969	1	6.965	19.153	1.150	296	10.519	38.085	83.473
	2	553	527	84	409	2.280	3.855	3.698
	3	7.518	19.680	1.234	706	12.799	41.940	87.172

Item 1: Coniferous in m^3

Item 2: Non-coniferous in m^3

Item 3: Total in m^3

Source: Forest Department Nicosia, Cyprus

3. MARKET SITUATION

The market situation has been explored by analyses of Annual Reports of the Forest Department for the years 1960 - 1969 and of the official Statistics of foreign trade for the same period.

From this it appears that export of Forest Products is negligible. The consumption figures deduced from home production and foreign trade balance have been cross-checked by interviewing main importers and users of sawnwood and of wood-based panel products.

For estimates of future trends in consumption no substantial changes are expected as it is evident from general characteristics of the National Economy that:

i/ the per capita GNP in real terms increased within the period of 1966 - 1969 by 7,5 % while for the future an increase of 6 % is expected

ii/ for the rate of growth of investments an increase of 6 - 7 % is expected in comparison with 12,2 % for the past 4 years

iii/ the expected growth in population amounts to 1,3 - 1,5 %/Annum.

As a general guidline it has to be born in mind that the main task of the new integrated plant is not to manufacture a new product to be introduced on the home market, but to substitute imported goods by locally made made ones. Consequently, provided the quality and price of the product remain similar to that of the hitherto imported materiel, no difficulties in marketing are to be foreseen.

3.1 Sawnwood

There are some 75 small bandmills in operation producing box-shooks and 3 sawmills producing in addition to boxshooks a small volume sawnwood as well. The local sawnwood production is insignificant if compared with the total consumption figures, the share being about 10 % for coniferous and some 3 - 4 % for non-coniferous sawnwood as illustrated by the following figures

Coniferous sawnwood:

Local production	1966	1967	1968	1969	1970 estimated
Sawnwood:					
Input m^3/r/	8.840	9.175	10.278	6.965	7.000
Output m^3/s/	4.420	4.587	5.139	3.482	3.500

Local production	1966	1967	1968	1969	1970 estimated
Box shooks:					
Input m^3 /r/	19.465	19.246	20.952	19.153	20.000
Output m^3 /s/	9.732	9.623	10.476	9.576	10.000

Note: in both cases the recovery rate is estimated to be 50 %.

Imports in m^3 /s/	1966	1967	1968	1969	1970 estimated
Redwood				14.600	12.500
Whitewood	27.200	29.000	26.200	17.400	20.000
Total	27.200	29.000	26.200	32.000	32.500

Consumption in m^3 /s/	1966	1967	1968	1969	1970 estimated
Imports	27.200	29.000	26.200	32.000	32.500
Local production					
lumber	4.420	4.587	5.139	3.482	3.500
box shooks	9.732	9.623	10.476	9.576	10.000
Coniferous Sawnwood incl. box shooks total	41.352	43.210	41.815	45.058	46.000

Non-coniferous sawnwood:

Local production	1966	1967	1968	1969	1970 estimated
Sawnwood:					
Input m^3 /r/	482	715	785	553	600
Output m^3 /s/	241	357	392	276	300
Box shooks:					
Input m^3 /r/	222	506	799	527	600
Output m^3 /s/	111	253	399	263	300

Note: in both cases the recovery rate is estimated to be 50 %.

Imports in m^3 /e/	1966	1967	1968	1969	1970 estimated
m^3 /e/	2.100	2.000	20.450	11.920	8.320

Consumption in m^3 /e/	1966	1967	1968	1969	1970 estimated
Imports	2.100	2.000	20.450	11.920	8.320
Local production					
lumber	241	357	392	276	300
box shooks	111	253	399	263	300
Non-coniferous sawnwood incl. box shooks total	2.452	2.610	21.241	12.459	8.920

Prices for imported coniferous sawnwood CIF Famagusta are as follows:

Whitewood /spruce/ .....£ 22/m^3

Redwood /pine/ .....£ 28 - £ 32/m^3

Retail prices for local sawnwood /Pinus brutia/ are £ 17 - £ 20/m^3.

Conclusion:

It may be assumed that an amount of 20.000 m^3 of coniferous sawnwood as proposed for the new plant can be placed on the home market as a substitute for a certain portion of present imports, provided that the retail price differences between the imported spruce/pine on the one hand and the locally produced Pinus brutia sawnwood will remain in the same order of magnitude.

3.2 Joinery

Doors and windows are mainly manufactured by joinery workshops and by carpenters using imported sawnwood and board products. There are at present 295 establishments of this kind working in the Country wherefrom

226 work with less than 5 employed persons
51 work with 5 - 9 employed persons
18 work with 10 - 19 employed persons

It is estimated that the existing capacities of joinery and carpentry workshops can satisfy the expected demands of the Construction Sector for the coming years and consequently there is no justification to establish

a joinery plant integrated to the proposed complex.

Conclusion:

The Board of Directors of Cyprus Forest Industries Ltd. accepted the proposal not to establish a new joinery plant.

3.3 Bruce boxes

The increase in fruit and vegetable exports from the Republic requires big amounts of nailed wooden cases, of bruce boxes and carton boxes as may be seen from the following comparison:

Type of container	1966 /Lewin Report/ pcs	1969/70 Ministry data pcs
Wooden cases	2.357.000	604.350
Bruce boxes	-	1.800.000
Cartons	1.244.000	3.320.750
Trays	935.000	1.052.320
Total	4.536.000	6.777.420
% increase over 1966		49,5 %

Box shooks for wooden cases are manufactured by about 75 small sawmills of the family enterprise type, where overheads are very low.

For the manufacture of bruce boxes a new factory has been established at Zodhia village with two modern production lines using imported sawn slats from beech-wood. The capacity of the plant of 6.000.000 bruce boxes/ /year is used at present to some 40 %, the sales being 2.000.000 pcs for the home market and 500.000 pcs for export to UAR.

It was self-evident to the local authorities to try in the frame of the new integrated plant to produce slats from home-grown wood and thus to substitute the imported slats. This was the reason why logs of Pinus brutia have been shipped to the Forest Products Research Laboratory in Princes Risborough, U.K., for slicing and peeling tests. The tests have shown a promising high recovery figure on produced slats. However, the quality of peeled or sliced slats is inferior in strength if compared with sawn slats.
On the other hand the strong competition of carton boxes calls for an increase in quality of bruce boxes and does not allow to use peeled or sliced slats.

It is of interest to mention that some of the small local sawmillers produced a certain amount of sawn slats from Pinus brutia for the bruce-box factory at Zodhia. They did not succeed and decided to stop the trial production mainly for economic reasons; the yield of acceptable slats was too low due to the knottiness of Pinus brutia.

From the utilisation point of view bruce boxes can be in general compared with carton boxes. In this respect a comparison of prices is instructive:

Bruce boxes	151 mils each
wherefrom the costs of imported beech slats	82 mils
Carton box imported	121 - 132 mils each
Carton box from the new plant in Cyprus	104 - 120 mils each

Conclusion

i/ A further increase in consumption of fruit boxes is to be expected due to the forecasted raise in fruit exports.

ii/ A new factory for carton boxes with a yearly capacity of 6.000.000 boxes per shift has started operating near Famagusta.

iii/ The price relations are clearly in favour of carton boxes. If bruce boxes had to compete with carton boxes their price would have to be cut down at least by 40 mils. A reduction of costs in assembling slats into bruce boxes can hardly be expected as for this operation up-to-date machinery is used. It means that a reduction of costs should be achieved in raw material i.e. in the price of slats, which should be reduced from 82 mils by 50 % to some 40 mils.

iv/ In view of the inferior quality of locally produced slats as well as in view of the fact that in Cyprus a new factory for carton boxes has started production, which is able to cover the needs at lower prices, the future prospects of bruce boxes do not seem to be encouraging.

v/ The Board of Directors decided therefore to postpone the final decision on the realisation of slat production until the economical aspects were more deeply investigated.

vi/ The condition for checking the technical and economic questions are being created within the frame of the proposed technological solution for the new integrated plant. An automatic circular saw with reversible transport for producing sawn slats is envisaged in the re-manufacturing line. Thus it would be possible to obtain a trial production of slats. It is suggested to identify - in cooperation with the Bruce box factory at Zodhia - the lowest quality of slats

admissible /number and size of knots, spiral grain etc./ in order to get information on recovery which could serve as a basis for an economic evaluation.

3.4 Particle boards /Chipboard/

According to official Statistics of foreign trade the following volumes have been imported

		1968	1969	Jan.-Aug. 1970	Estimated 1970
Veneer sheets and sheets for plywood	m^2	26.064	42.547	34.010	42.500
Plywood	m^3	4.380	3.304	2.403	3.000
Blockboard and veneered particle board	m^3	7.645	6.154	7.853	9.820
Reconstituted wood /incl. particle board/	m^3	4.325	4.738	4.958	5.120

The figures mentioned above were cross checked by interviews with the two biggest importers of wood and wood products in the Country, which resulted in the following rough estimates for imports of wood based panels in 1970:

blockboard	5.000 m^3
particle board unveneered	5.000 m^3
particle board veneered	5.000 m^3

Import prices for wooden panels are given CIF Pamagueta as follows:

Blockboard	£ 45 - 56/m^3
Particle board unveneered	
low quality	£ 22 - 29/m^3
high quality	£ 31 - 52/m^3
Particle board veneered	
with beech /low quality/	£ 24 - 31/m^3
with okoumé /OKAL type/	£ 31 - 36/m^3
with Sapeli/khaya	£ 47 - 50/m^3

It is estimated that about 70 % of imported wooden panels are used in construction work /ceiling, partitions etc./ while about 30 % are used in furniture production. At present, consumers give priority to block board in spite of its higher price. For the future, however, it can be assumed that a considerable proportion of blockboard will be substituted by particle board provided, of course, that the locally produced particle board will be of a high grade quality.

The same evolution was facing during the last two decades Western Europe where e.g. in 1951 only 20 % of produced particle board were used in furniture and 76 % for construction purposes while in 1960 the situation changed into opposite and 72 % were used in furniture and only 26 % for construction purposes. This change in pattern of consumption is due to developments in production technology enabling to produce steadily improving qualities of particle board.

As a typical example of this evolution figures for the Federal Republic of Germany may be shown:

	Total consumption of wood based panels in 1.000 m^3	Percentage of total consumption		
		Plywood & blockboard %	Fibre-board %	Particle board %
1959	846	55,5	24,1	20,4
1960	1.943	36,8	22,3	40,9
1965	3.845	21,1	16,8	62,1
1968	4.032	16,3	12,5	71,5
1969	4.691	15,7	11,5	72,8

Note: Figures from paper presented by H. Ollmann to FAO Committee in December 1970

The same trend is confirmed by production figures for blockboard and particle board within the last years:

Production of:		Europe:	Canada and USA
blockboard:	1967	1.187.000 m^3	480.000 m^3
	1968	1.184.000 m^3	469.000 m^3
	1969	1.236.000 m^3	560.000 m^3
particle board:	1967	4.793.000 m.t.	1.488.000 m.t.
		or 7.374.000 m^3	or 2.290.000 m^3
	1968	5.681.000 m.t.	1.876.000 m.t.
		or 8.753.000 m^3	or 2.886.000 m^3
	1969	6.701.000 m.t.	2.245.000 m.t.
		or 10.309.000 m^3	or 3.450.000 m^3

Source: Secretariat paper prepared for FAO Comittee in December 1970.

From thie the remarkable expansion of particle board production is evident which attaine for the period of 1967 - 1969 an increase of some 40 %.

For the period 1969 - 1971 a further increase in production capacity is foreseen for Europe being estimated to about 2.000.000 m.t. per annum.

The big amounte of particle board produced have their impact on the quality of the product. Due to the strong competition on the world markets the quality of particle board to be produced in Cyprus has to have a very high quality bearing in mind the necessity to replace imported particle board and to substitute gradually at least a certain portion of presently imported blockboard as well.

Conclusion:

i/ The proposed capacity of 10.000 m^3 of particle board per annum in a two shift operation is to be considered as fully justified. In view of the relatively high investment costs it is economically unviable to produce particle board operating one shift only.

ii/ A third shift of 5.000 m^3 may be introduced at a later stage according to market development and after the solution of the running-in problems and treining of personnel.

iii/ The proposed production of 10.000 m^3 or 15.000 m^3 respectively does not create any new problem from the marketing point of view since the local market already consums this volume.

3.5 General

Speciel attention must be devoted to the decreasing contribution of local production to the total consumption of wood and wood products. As may be seen from table 3, which has been compiled from Annual Reports of the Forest Department for the years 1961 - 1969, the share of local production in total consumption of timber and of other wood products decreased from 36,8 % in 1961 to 19,0 % in 1969.

These data based on import and consumption figures converted into Round Wood Equivalents do not give an exact picture for mechanically processed wood and wood products as they include paper and paper products as well.

Nevertheless it may be clearly seen, that the local production and sales

of roundwood and fuelwood decreased from 47.053 m^3 in 1961 to 41.960 m^3 in 1969 in spite of the fact that according to official figures of the Forest Department the raw material resources of the Country are presently utilised to less than 50 %.

It is therefore to the interest of the National Economy to promote industrial utilisation of home grown wood species and thus to contribute to an improvement of the Country's balance of trade.

Table 3

COMPARATIVE TABLE OF TOTAL IMPORTS, LOCAL PRODUCTION AND TOTAL CONSUMPTION /IN M³/

Year	Imports m^3	Value of Imports million £	Local Production /sale of logs and fuelwood/ m^3	Total Consumption m^3	Contribution of local production as per cent of total consumption
1961	80.821	1,89	47.053	127.875	36,8
1962	125.325	2,49	57.818	183.144	31,6
1963	126.685	2,50	55.297	181.983	30,4
1964	112.181	2,36	39.943	152.124	26,3
1965	135.779	3,05	55.439	191.218	29,0
1966	130.594	3,18	49.820	180.414	26,6
1967	142.691	3,67	47.620	190.311	25,0
1968	198.498	4,52	51.110	249.608	20,5
1969	177.960	5,08	41.940	219.900	19,0

Source: Forest Department Nicosia, Cyprus

4. PROPOSAL FOR REALIZATION

4.1 Introduction

The technological principles of the plant have to be directed towards a most economical utilisation of Pinus brutia from the Permanent Forest Reserves of the Paphos, Troodos and Adelphi areas.

The proposed processing units take into account the raw material availability described under Chapter 2 of this Study. The products to be manufactured are not considered as new materials which would have to be introduced on the home market. The purpose of the production program is to replace to a substantial extent goods so far imported.

Based on the above considerations it is suggested to establish the following production units:

- sawmill with an annual input of 30.000 m^3 saw logs producing in two shifts 20.000 m^3 sawnwood
- a particle board production line with an annual output of 10.000 m^3 in a two shift operation.

Detailed specification of the equipment recommended is given in Annex "Specifications for Tenders".

4.2 Technology

4.2.1 Sawmill

The climatic conditions on the Island and the existing road network can assure an all year regular harvesting and supply of logs to the central log yards of the Forest Department, where logs will be crosscut, graded and stored throughout the year.

For the log yard at the sawmill itself a storing capacity of 14 days has to be planned i.e. for a total yearly input of 30.000 m^3 of logs the capacity of the yard will be 1.700 m^3 of sawlogs.

Considering theenvisaged further processing it is recommended to store separately three diameter classes i.e. annually:

16 - 35 cm	6.000 m^3/annum
35 - 55 cm	20.000 m^3/annum
55 - 95 cm and over	4.000 m^3/annum

Logs of a diameter up to 65 cm will be debarked on a debarking machine while logs of a bigger diameter have to be debarked manually.

Debarking has to be undertaken in view of the fact that about 35 % of the raw material for particle board production will be obtained from the off-cuts from the sawmill and that the bark content has consequently to be reduced.

Debarked saw logs of a length of 3 - 6 m will be transported by a fork lift truck to the manipulation area in front of the sawmill and then by a chain conveyer to the sawmill where they will be according to their diameter distributed either to the band saw or directly to the frame saw.

The logs of a diameter exceeding 60 cm will be cut on the band headrig into sideboards and flitches which may be cut into the required thickness either on the frame saw or on the band resaw. Logs of a diameter up to 60 cm may be cut directly on the frame saw.

Thus two lines will be working in the sawmill. They may work in parallel but in the case of large logs these will pass through the band mill followed either by the band resaw or gang saw.

The sideboards will then be edged and crosscut. Off-cuts will be transported to the chipping machine to produce chips for the particle board line. The sawn timber will be adjusted longitudinally on the trimmer and by a cross conveyer transported to the sorting places.

In view of the sawn timber further processing and utilisation, a qualitative classification into classes AA, A, B and C is recommended.

At a presumed recovery of 66 % which the team consider to be realistic the yearly sawn timber production will be 20.000 m^3. Taking into consideration the existing studies and experience about 5.000 m^3 /25 %/ of sawn timber will be of a low quality /C - grade/. The other abovementioned classes correspond roughly to the qualities of presently imported sawn timber. It has to be pointed out, that these presumptions will have to be verified by an experimental sawing. After setting the new plant into operation quality standards would have to be reviewed and specified more carefully /depending on the need of further processing/.

For a general orientation it has been estimated that the following proportions of sawnwood in length of 3 - 6 m will be obtained:

Thickness:	22 - 25 mm	19 %
	25 - 50 mm	41 %
	50 - 64 mm	24 %
	64 - 75 mm	14 %
	others	11 %

Width:	less than 120 mm	8 %
	120 to 152 mm	72 %
	152 to 190 mm	6 %
	190 to 220 mm	11 %
	over 220 mm	3 %

Graded sawnwood will be stacked on pallets to enable a complete mechanisation of this section by means of a side lift truck.

The average dimensions of stacked packages will be

width	190 cm
height	180 cm
length up to	6 m

To ensure the proper drying both natural and artificial the individual packages will be composed of planks of an equal thickness.

The average sawn timber storing time will be 20 days, based on kiln drying to 19 % M.C. It means that a stock of 1.600 m^3 will have to exist in the yard.

4.8.2 [redacted]

Interest has been shown by big building contractors in the Country for preserved timber. In compliance with the expected use of preserved timber a small plant for pressure impregnation by water soluble salts such as Copper-Chrome-Arsenic formulation is suggested such as Tanalith, Boliden etc.

The sawn timber has to be air pre-dried afore preservation to at least 30 % moisture content.

4.8.3 [redacted]

To ensure that the sawn timber is qualitatively suitable to replace the imported one, it is necessary to dry it to an average moisture content of 19 %, depending on the envisaged kind of further processing.

It is assumed that 10.000 m^3 of sawnwood per annum at an initial moisture content of about 80 % will be dried.

The drying chambers will have to operate continuously and require measuring and control devices for automatic operation.

The dried sawn timber will be stored under roof, the overall capacity of stock being estimated at [illegible] m³ i.e. a [illegible] day's production.

It is assumed that out of 10.000 m³ of dried timber 4.000 m³ will be sold on local market and 6.000 m³ processed in the remanufacturing plant.

The economics of kiln drying will need to be further investigated. However it must be born in mind that the process will help to eliminate some of the resin content of Pinus brutia and consequently facilitate its marketing.

4.2.4 Remanufacturing plant

For up-grading at least a part of produced sawnwood a wood-working shop is proposed, where 2.000 m³ of dried timber will be processed into semi-products such as flooring boards, pallets etc.

It is suggested that good quality short pieces of sawnwood should be finger-jointed into long length. Moreover this production unit must be equipped with a special multi-blade circular saw for manufacturing slats for bruce boxes on a trial scale. Its experimental operation will enable to verify the yield figures and economics of slat production.

4.2.5 Particle board production

Bearing in mind the consumption of construction boards investigated, their quality and proportions, it is suggested to establish a production line for particle boards. In a 2 shift operation this line should ensure the production of 10.000 m³ good quality particle boards with minimal thickness tolerances and smooth surface, according to the respective DIN Standard 68 761 52. The requirements on quality are [illegible] to the DIN Standard than in the respective B.S. Standard. In [illegible] nd shift would constitute a 30 % reserve for future increase of production in case of particle board consumption growth, as well as for the gradual replacement of blockboards.

The basic raw material will consist of 11.[illegible]00 m³ forest raw material such as fuelwood, branches etc. on the one hand and 6.000 m³ sawmill off-cuts on the other. Thus, the total wood raw material consumption for producing 1 m³ of particle board will be 1,7 m³.

The yard for forest raw material will be planned for a 14 day stock, i.e. for 600 m³.

Sawmill off-cuts will be transported [illegible] in the form of chips. The silo must be [illegible] enough [illegible] stock.

From the log yard the raw material will be transported directly to the department for particle preparation. The raw material will be crosscut to required lengths, and processed into particles which are transported through the drying unit to the applicator of glue and further to the mat forming station and to the press. After pressing the boards must be cut to size, sanded and graded.

The finis oducts will consist of:

9.000	1st class
1.000 m^3	2nd class

Thickness: 4 - 8 mm	10 %
10 - 12 mm	15 %
14 - 16 mm	50 %
18 mm	15 %
up to 25 mm	10 %

Dimensions:

width:	1.830 mm
length:	3.600 - 7.200 mm

The physical properties of the boards such as density, swelling, bending strength, internal bonding strength etc. are specified in DIN 68 761 52. It is assumed that 90 % of products, i.e. 9.000 m^3 will be transported for surface finishing and 9.000 m^3 will be sold from the store without further processing. Consequently a storage room for 800 m^3 of boards is to be planned.

4.2.6 Finishing of particle boards

About 9.000 m^3 of particle boards a year will be finished by veneering in a one day-light heated press. It is assumed that 70 % of the veneered boards will be of a thickness of 14 - 16 mm.

The veneers, mostly from tropical hardwoods, have to be imported and splised and assembled in the plant.

For veneering a short pressing cycle of about 1 minute is suggested.

According to customers requirements other sheets such as melamine laminates or PVC may be used instead of veneers.

4.2.7 Auxiliary facilities

Steam plant

A central boiler house for producing heat energy has to be provided

Installed output: 10 - 12 t of steam/hour
Pressure of steam: 12 at
Fuel: combined oil and wood waste, eventually bark

Maintenance shop

Apart from the usual maintenance shops attacked to the individual production units a central maintenance shop for bigger repairs is proposed. It has to be equipped with main machines for metal processing and welding.

4.2.8 Waste

In the sawmill the following amounts of off-cuts and waste will occur:

Raw material tot l input	30.000 m^3	100 %
Produced sawnwood	20.000 m^3	66,6 %
Off-cuts	6.000 m^3	20 %
Sawdust	3.300 m^3	11 %
Other	700 m^3	2,4 %

The total amount of off-cuts will be chipped for the particle board production.

Sawdust will be used together with fines from the particle boards production as fuel for steam generation.

Besides this a considerable amount of bark will occur:

from logs	6.600 m^3/year
from fuelwood and branches	600 m^3/year
	7.200 m^3/year

which corresponds to about 29 m^3 of bark per day.

It is recommended to discuss with the future supplier of the boilers the possibility of using the bark as fuel for the boiler house.

4.3. Raw material

For timber production:

Saw logs	Diameter	Amount in m^3/annum
	16 - 35 cm	6.000
	35 - 55 cm	20.000
	55 - 95 cm and over	4.000
Total		30.000 m^3/annum
Preservative water soluble salts		110 tons /annum

For Particle board production:

Forest Raw material /fuelwood and branches/	11.000 m^3/annum
Sawmill off-cuts	6.000 m3/annum
Total	17.000 m^3/annum
Urea Resin	900 tons/annum
Wax	60 tons/annum
Veneers	660.000 m^3/annum

4.4. Energies

4.4.1 Power

The estimated installed power and consumption of electrical energy is given in the following table:

	kW	kWh	kWh/D	MWh/annum
Debarking	20	14	110	25
Sawmill:				
Band saw	85	51	815	200
Gang saw	40	24	395	99
Band saw	45	27	430	110
Edger	25	15	240	60
2 Cross cuts	20	12	190	50
Trimmer	4	3	48	12
Cross cut	5	3	48	12
Chipper	40	24	380	90
Grinding machines	5	2	16	5
Dust control & collecting	50	25	480	100
Conveyers	30	20	320	80
Light	16	7	30	10
Total	465	213	3.302	824
Timber Yard /Light/	15	12	50	13
Preservation Plant	8	2	31	10
Kilns	200	150	1.600	900
Remanufacturing Shop				
Surface planer	5	2	32	8
4-side planer	10	5	40	10
Multiblade circular saw	25	13	104	26
Circular saw /for slats/	5	3	24	6
Finger jointing unit	25	12	96	24
Press control & collection	20	15	120	30
Light	5	4	20	5
Total	95	54	436	109
Total timber	703	445	7.529	1.881
Particle board production	550	330	5.300	1.325
Particle board finishing	40	15	150	40
Steam plant	50	25	640	160
Maintenance shop	20	10	80	20
Other	50	20	320	80

SUMMARY:	kW	kWh	kWh/D	MWh/annum
Debarking	20	14	110	25
Sawmill	365	213	1.302	824
Timber Yard	15	12	50	13
Preservation Plant	8	2	31	10
Kilns	200	150	3.600	900
Remanufacturing shop	95	54	435	109
Particle boards	550	330	5.300	1.325
Finishing of PB	40	15	150	40
Steam Plant	50	35	640	160
Maintenance shop	20	10	80	20
Other	50	20	320	80
GRAND TOTAL	1.413	855	14.018	3.506

4.4.2 Steam

The following heat consumption for production purposes is expected:

	kcal/h	t/h	t/day	G cal/annum	t/annum
Particle board	2.510.000	5	80	10.000	20.000
Kilns	1.300.000	2,5	60	7.500	15.000
Total	3.800.000	7,5	140	18.000	35.000

4.5 Man power

4.5.1 Summary of wages /for details see Annex/

	Amount in £/annum
Sawmill	23.600
Preservation Plant	2.000
Kilns	1.900
Remanufacturing	2.800
Management of Timber production	12.700
Particle board production	12.700
Finishing of Particle board	10.700
Management of Particle board production	17.700
	£ 84.100

	Amount in £/annum
	84.100
Steam plant	3.100
Maintenance	5.600
Other	4.200
Administration of Plant	21.200
Integrated Plant Total	£ 118.200

Table 4

4.5.2. PERSONNEL OF THE INTEGRATED PLANT

Production	Workers							Administr./Others				Prod.	Admin.	Grand Total
	Shift			Total	S	SS	US	Shift			Total			
	I.	II.	III.					I.	II.	III.				
Sawmill incl. preservation, kilns, remanufact.	34	22	1	57	14	27	16	3	-	-	3	57	3	60
Particle boards	18	14	-	32	13	10	9	4	-	-	4	32	4	36
Finishing of particle boards	17	13	-	30	4	14	12	-	-	-	-	30	-	30
Steam plant	2	2	1	5	3	2	-	-	-	-	-	5	-	5
Maintenance shop	6	-	-	6	3	3	-	-	-	-	-	6	-	6
Others	4	2	2	8	-	2	6	11	1	1	13	8	13	21
Together	81	53	4	138	37	58	43	18	1	1	20	138	20	158

4.6 Investments

4.6.1 Timber production

SAWMILL

Buildings		Amount in $
Preparation of site	7 - 10 ha	20.000
Log yard	1.400 m	3.000
Debarking station	40 m for PB + Sawmill	500
Sawmill	1.400 m	20.000
Timber yard incl. store for dry timber	3.200 m^2	14.000
Fire protection		5.000
Roads	1.750 m	14.000
Water supply	630 m	2.500
Power supply	1.200 m	6.000
Sewers	240 m	1.200
Fence	1.300 m	1.000
Contigencies		10.000
Total Buildings		$ 97.200

Equipment /for details see Specification for Tenders/

Log Yard	5.000
Debarking station	7.500
Sawmill new equipment	30.000
Power supply	3.500
Water supply	1.400
Removal of existing equipment	6.000
Dust control & collection	5.000
Power installation	15.000
Erection	12.600
Total new equipment	86.000
Existing equipment	28.000
Total equipment	114.000
Grand total investment	211.200
of which new investment	183.200

PRESERVATION PLANT

Buildings	Amount in ₺
Preparation of site 0,7 ha	2.000
Equipment /for details see Specification for Tenders/	
Equipment incl. erection	4.000
Total investments	₺ 6.000

KILNS

Buildings	400 m²	6.000
Steam supply, power supply, roads		3.000
Total buildings		9.000
Equipment /for details see Specification for Tenders/		
Equipment incl. erection		15.000
Total investments		₺ 24.000

REMANUFACTURING OF TIMBER

Buildings	600 m²	8.000
Roads and others		2.000
Total buildings		₺ 10.000
Equipment /for details see Specification for Tenders/ incl. power installation, dust control & collection,& others		15.000
Total investments		₺ 25.000

Total timber production investments	
Buildings	118.200
Equipment	120.000
Total	₺ 238.000

4.6.2 Particle Boards

Buildings		Amount in £
Preparation of site	3 - 5 ha	10.000
Log yard	700 m^2	1.200
Debarking station	40 m^2 for PB + Sawmill	100
Building of particle boards production	3.800 m^2	60.000
Steam supply	200 m	1.000
Power supply	800 m	4.000
Water supply	370 m	1.500
Fire protection		1.500
Roads	750 m	6.000
Sewers	160 m	800
Fence	700 m	500
Contigencies		3.400
Total		£ 106.000

Equipment /for details see Specification for Tenders/

Log yard	2.000
Debarking station	1.500
Main particle boards equipment	230.000
Maintenance	1.800
Steam supply	2.000
Power supply	2.500
Water supply	600
Exhausting equipment	8.000
Power installation	35.000
Installetion of equipment	40.000
Total	£ 323.000

Finishing of particle boards

Buildings	1.800 m^2	28.000
Equipment		
Machinery		25.000
Power installation		3.000
Exhausting		3.000
Installation of equipment		4.000
Total		35.000
Total investment		£ 63.000

Total particle board production	Amount in £
Buildings	134.000
Equipment	358.000
Total	£ 492.000

4.6.3 Steam plant /for details see Specification for Tenders/

	Amount in £
Buildings 200 m^2	3.500
Equipment	30.000
Total	£ 33.500

4.6.4 Maintenance shop, administrative, social facilities and other

	Amount in £
Buildings	5.100
Equipment	35.000
Total	£ 40.100

4.6.5 Designs, engineering, training £ 90.000

Note: Investment costs for substation are subdivided into power installation costs for each of the production units.

4.6.6 Summary of investment costs

		Amount in £	Amount in US $
A. Building - structures			
Preparation of site	10 - 15 ha	32.000	76.800
Log yard	2.100 m²	4.200	10.080
Debarking station	40 m²	600	1.440
Sawmill	1.400 m²	20.000	48.000
Timber yard	2.000 m²	4.000	9.600
Store for dry timber	1.200 m²	10.000	24.000
Preservation plant	500 m²	2.000	4.800
Kilns	400 m²	6.000	14.400
Remanufacturing of timber	600 m²	8.000	19.200
Particle board production	3.000 m²	60.000	144.000
Finishing of particle board	1.800 m²	28.000	67.200
Steam plant	200 m²	3.500	8.400
Fire protection		6.500	15.600
Maintenance shop	150 m²	1.500	3.600
Social facilities + office		2.800	6.720
Power supply	2.000 m	10.000	24.000
Steam supply	300 m	1.500	3.600
Water supply	1.000 m	4.000	9.600
Roads	2.500 m	20.000	48.000
Sewers	400 m	2.000	4.800
Fence	2.000 m	1.500	3.600
Contigencies		32.700	78.480
Total		260.800	629.920
B. Equipment			
Log yard		7.000	16.800
Debarking station		9.000	21.600
Sawmill new equipment		30.000	72.000
Preservation plant		3.600	8.640
Kilns		13.000	31.200
Remanufacturing of timber		11.500	27.600
Particle boards		230.000	552.000
Finishing of particle boards		25.000	60.000
Steam plant		25.000	60.000
Maintenance shop and others		26.900	64.560
Power supply		6.000	14.400
Steam supply		3.000	7.200
Water supply		2.000	4.800
Embedding system		20.000	48.000
Power installation		65.000	156.000
Installation of machinery		56.000	134.400
Total equipment		541.000	1.298.400

Total equipment		[illegible]
Existing equipment		67.000
GRAND TOTAL EQUIPMENT		1.170.000

TOTAL FACTORY

Buildings	[illegible]	US $ [illegible]
Equipment	[illegible]	US $ 1.170.000
Other	[illegible]	US $ 716.000
Total	[illegible]	US $ 2.212.100

9. [illegible]

9.1 [illegible]

			Amount in $
1. **Materials**			
Sawlogs	30.000 m³	à 6,26 $	187.800
Redwood for particle board	11.000 m³	à 1,90 $	16.900
Urea resin	900 t	à 70 $	63.000
Wax	60 t	à 83 $	4.980
Preservatives	110 t	à 282 $	31.020
Veneers	660.000 m²	à 0,05 $	33.000
			$ 336.300
2. **Utilities**			
Fuel oil	1.800 t	à 13 $	23.400
Electric energy	3.906 MWh	à 10 $	39.060
Water	14.000 m³	à 0,02 $	280
			$ 90.940
3. **Wages**			$ 97.000
/Personnel expenditure, total - 110.200/			
4. **Depreciation**			
civil engineering, buildings	4 %		10.432
machinery and equipment	10 %		97.100
preliminary costs	20 %		18.000
			$ 69.532
5. **Maintenance**			
3 % to the cost of machinery			17.130
1 % to the cost of civil eng. and buildings			2.600
			$ 19.730
6. **Insurance**			
1 % of the cost of fixed capital expenditure & stocks			$ 9.175
7. **Plant overhead**			
Personnel expenditure of management			21.000
+ other administrative and office expenses /80 %/			16.800
			$ 38.100

	Amount in £
8. Sales expenses	
2 % of sales of particle boards and 1 % from sales of sawmilling products	£ 12.000
9. Interests	
see table 18	£ 29.949

Table 5

OPERATING COSTS

Productions \ Kind of costs	Material in £	Utilities in £	Per-sonnel expend. in £	Depre-ciation in £	Direct costs in £	Steam in £	Manufact. costs in £	Overhead distr. in £
Sawmill	185.800	8.900	36.300	18.300	290.900	-	290.900	43.879
Preservation plant	31.020	200	2.000	480	33.700	-	33.700	5.091
Kilns	-	9.000	1.900	1.950	12.850	10.122	22.972	4.019
Manufact. of timber	-	1.090	2.800	1.900	5.790	-	5.790	1.007
Particle boards	77.480	14.200	30.480	37.092	159.132	12.490	171.622	61.343
Finishing of particle boards	60.000	480	10.700	4.700	95.880	1.018	96.818	20.893
Steam plant	-	17.380	3.100	3.150	23.630	-23.630	0	-
Administration and maintenance shop	-	170	31.080	18.080	87.882	-	136.992	-
Total	336.300	50.940	118.280	85.532	990.972	0	678.794	136.992

1) Includ. other costs 38.692 £

Table 6

PRICES AND SALES

Production	Price/ in £/m³ Unit	Products in m³	Amount in £
Timber from sawmill			
Unsorted	17,60	15.000	265.000
C - grade	15,00	5.000	75.000
Total	17,00	20.000	340.000
Preservated timber	26,00	5.000	130.000
Dry timber	22,00	10.000	220.000
Remanufactured timber	28,00	2.000	56.000
Particle boards			
1st grade	27,50	9.000	247.500
2nd grade	24,00	1.000	24.000
Total	27,15	10.000	271.500
Finished particle boards	45,00	5.000	225.000

Sales/A

Sawmill	17,00	5.000	85.000
Preservated timber	26,00	5.000	130.000
Dried timber	22,00	8.000	176.000
Remanufactured timber	28,00	2.000	56.000
Total timber	22,35	20.000	447.000
Particle boards	26,00	5.000	134.000
Finished particle boards	45,00	5.000	225.000
Total particle boards	35,90	10.000	359.000
Total factory Timber	22,35	20.000	447.000
Particle boards	35,90	10.000	359.000
Total sales			[illegible]

Table 7

OPERATING COSTS AND SALES

Productions / Units	Unit	Sawmill	Preservation plant	Kilns	Reconditt. of timber	Timber total	Particle board product.	Finishing of particle boards	Particle boards total	Factory total
1. Material	$	197.000	116.000	170.000	44.000	218.000	77.400	174.000	117.400	335.400
2. Utilities	"	8.500	200	10.100	1.000	20.912	25.600	1.438	28.188	57.088
3. Personnel expenditure	"	36.300	2.000	1.000	2.000	43.000	30.400	10.700	41.100	84.100
4. Depreciation	"	28.300	400	1.000	1.900	22.630	37.052	4.700	41.752	64.382
5. Manufact. costs	"	259.000	119.700	182.072	49.700	313.362	171.652	190.838	288.440	541.802
6. Overhead distrib.	"	43.879	5.851	4.000	1.007	54.736	61.343	20.853	82.196	136.992
7. Total costs	"	304.779	126.501	186.881	50.797	368.158	232.965	211.671	370.636	678.794
Total output	"	360.000	130.000	280.000	56.000	447.000	288.000	285.000	359.000	806.000
Sales ex factory	"	85.000	130.000	176.000	56.000	447.000	134.000	285.000	359.000	806.000
Net profit before tax	"					78.842			48.364	127.206
Costs per m^3	"	14,73	26,00	10,00	25,30	18,41	23,30	42,33	31,05	-
Average price per m^3	"	17,00	25,00	22,00	28,00	22,35	27,15	45,00	35,90	-
Output per annum	m^3	20.000	5.000	10.000	2.000	20.000	10.000	5.000	10.000	-
Sales ex factory/annum	m^3	5.000	5.000	8.000	2.000	20.000	5.000	5.000	10.000	-

Table 8

5.2 WORKING CAPITAL

Timber production

1. Current Assets	Amount in ₤
1.1 Saw logs 14 days 1.700 at ₤ 6,26	10.650
Preservatives /2 months/ 19 tons at ₤ 282	5.250
1.2 Parts and supplies for repair and maintenance /1 year/	30.000
1.3 Finished goods /1 month stock/ 1.700 m3 at ₤ 22	37.400
1.4 Other liquid assets	3.000
1.5 Credit to customers /2 month/ 3.400 m3 at ₤ 22	74.800
1.6 Provision for Cash	1.000
Total current assets	₤ 162.200

2 Current liabilities	Amount in ₤
2.1 Suppliers credit for raw material and chemicals	8.000
2.2 Bank credit 50 % of receivables /item 1,5 above/	37.400
2.3 Credit from other suppliers and provisions	1.000
Total current liabilities	₤ 46.400
NET WORKING CAPITAL	₤ 115.800

Table 9

WORKING CAPITAL

Particle boards production

1. Current Assets	Amount in £
1.1 Fuel wood and Branches 14 days stocks 600 m3 at £ 1,5	900
Off-cuts /Chippe/ 2 days stocks 50 m3 at £ 1,0	30
Glue 2 month stocks 96 t at £ 70	6.720
WAX 2 mohths stocks 10 t at £ 83,3	830
1.2 Parts and supplies for repair and maintenance /1 year/	20.000
1.3 Finished goods /1 month/ 890 m3 at £ 28	23.800
1.4 Other liquid assets	2.500
1.5 Credit to customers 3 months 2.500 m3 at £ 28	70.000
1.6 Provision for cash	1.500
Total current assets	£ 126.300

2. Current liabilities	Amount in £
2.1 Suppliers credit for raw materials and chemicals	4.000
2.2 Bank Credit 50 % of receivables /item 1.5 above/	35.000
2.3 Credit from other suppliers and provisions	500
Total current liabilities	£ 39.500
NET WORKING CAPITAL	£ 86.700

Table 10

OPERATING COSTS IN £

/start of operation/

	Operating years		
	1	2	3
1. Materials	235.410	319.485	336.300
2. Utilities	35.660	48.390	50.940
3. Wages	82.450	94.600	97.000
4. Depreciation	85.532	85.532	85.532
5. Maintenance	17.760	19.739	19.738
6. Insurance	9.175	9.175	9.175
7. Plant overhead	36.250	38.160	38.160
8. Sales expenses	12.000	12.000	12.000
9. Interests	55.250	50.947	46.278
10. Total £	569.487	678.027	695.123

Forecast of sales			
Particle boards	251.900	341.350	359.000
Sawmilling products	313.900	425.150	447.000
Total £	565.800	766.500	806.000

Table 11

INVESTMENT COSTS /INTEGRATED PLANT/

	To be paid in		Total	Depre-ciation rate	Annual depreciation in $
	local currency	foreign currency	in $		
Land and site preparation	240.800	20.000	260.800	4 %	10.432
Construction					
Machinery and equipment a/	-	28.000	28.000	10 %	2.800 1)
and b/	25.000	518.000	543.000	10 %	54.300
Erection charges					
Preliminary expenditure and costs of establishment	40.000	50.000	90.000	20 %	18.000
Total	305.800	616.000	921.800		85.532

a/ existing equipment; b/ new equipment

1/ 5 years

CAPITAL REQUIREMENTS

	Payable in		Total
	local currency	foreign currency	in $
Investment costs	305.800	616.000	921.800
Working capital	140.000	62.500	202.500
Total	445.800	678.500	1.124.300

Table 12

FINANCING SCHEDULE

/In $/

Origin of resources:		
Own resources /equity/	500.000	
Long-term loan	350.000	8 years
Medium-term loan	300.000	5 years
Short-term loan	overdraft balance	

SCHEDULE OF INVESTMENT IN $

	1st year of construction	2nd year of construction
Building	156.500	104.300
Equipment	114.200	456.800

Table 13

CALCULATIONS OF INTEREST AND ANNUAL REPAYMENT INSTALMENTS

Loan	Amount £	Rate		Operating year									
				1	2	3	4	5	6	7	8	9	10
Long-term Loan	350.000	8,5 %	Int.	29.750	29.750	29.750	27.003	24.022	20.789	17.280	13.473	9.342	4.885
			Princ.	-	-	32.318	35.065	39.046	41.279	44.788	49.595	52.726	57.183
			Inst.	29.750	29.750	62.068	62.068	62.068	62.068	62.068	62.068	62.068	62.068
Medium-term Loan	300.000	8,5 %	Int.	25.500	21.197	16.528	11.463	5.927					
			Princ.	50.623	54.926	59.595	64.660	70.196					
			Inst.	76.123	76.123	76.123	76.123	76.123					
Aggregate interest			Int.	55.250	50.947	46.278	39.466	29.949	20.789	17.280	13.473	9.342	4.885
Aggregate repayment of principal			Princ.	50.623	54.926	91.913	99.725	108.242	41.279	44.788	48.595	52.726	57.183
Aggregate annual instalment			Inst.	105.873	105.873	138.191	138.191	138.191	62.068	62.068	62.068	62.068	62.068

Table 14

FORECAST OPERATING ACCOUNT

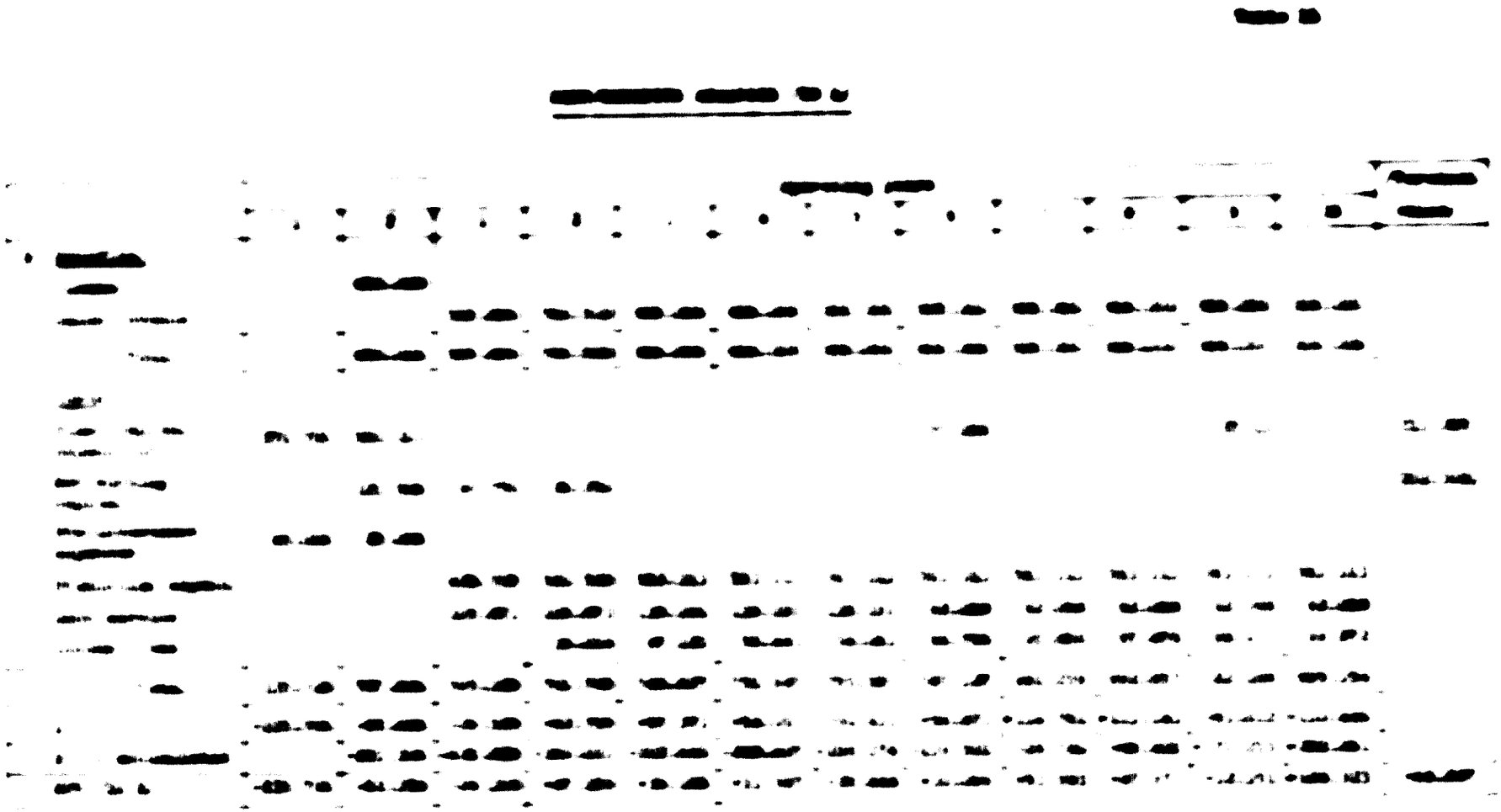
/in $/

	Operating year									
	1	2	3	4	5	6	7	8	9	10
1. Sales	565.800	766.500	806.000	806.000	806.000	806.000	806.000	806.000	806.000	806.000
2. Operating costs	428.705	541.548	563.313	563.313	563.313	563.313	563.313	563.313	563.313	563.313
3. Depreciation	85.532	85.532	85.532	85.532	85.532	64.732	70.447	70.447	70.447	73.162
4. Interest paid	52.250	50.947	46.278	38.466	29.949	20.789	17.280	13.473	9.382	4.865
5. Total expenses	569.487	678.027	695.123	687.311	678.794	648.834	651.040	647.233	643.182	641.340
6. Profit before tax	- 3.687	+88.473	+110.877	+118.689	+127.206	+157.166	+154.960	+158.767	+163.898	+164.640
7. Cumulative profit		+84.786	+195.663	+314.352	+441.558	+598.724	+753.684	+912.451	+1.076.349	+1.240.989
8. Income tax (42,5 %)		36.034	47.123	50.443	54.063	66.796	65.858	67.476	69.657	69.972
9. Net profit	- 3.687	+48.752	+63.754	+68.246	+73.143	+90.370	+89.102	+91.291	+94.241	+94.668
10. Cumulative net profit		+45.065	+108.819	+177.065	+250.208	+340.578	+429.680	+520.971	+615.232	+709.900

Table 15

5.3. [illegible] /10 b/

	Construction		Operating years									
	1	2	1	2	3	4	5	6	7	8	9	10
a [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]										
[illegible]		[illegible]										
[illegible]	[illegible]	[illegible]										
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
b [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



[redacted]

9.4 [redacted]

The economic chapter of the Study [illegible] the production costs and sales for the plant as a whole [illegible] The effectiveness of the [illegible] on enclosed tables [illegible]

i/ For the 5th year of [illegible] attains 10,7 % and the repayment [illegible] 4,1 years.

ii/ Within the 2nd year of operation a net profit is created and dividends are foreseen for the 3rd year of [illegible]

iii/ The net present value of capital is in the credit side at a capital cost of 10 %. The internal rate of return exceeds 10 %.

iv/ An improvement in foreign trade balance is to be expected due to the substitution of imported goods by locally manufactured ones. The sales of products will at 5 % p.a. and thereby the share of imported raw materials needed attains about [illegible]. For comparison it has to be pointed out that the [illegible] foreign currency is estimated to amount to 616.000.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Raw material

i According to official figures of the Forest Department, Dimapur is the evident that the round raw material needed for the operation of the proposed integrated plant is available

ii Actual sales of roundwood from the forests realised during the last years attained not more than 50 % of the potential production. A more intensive utilisation of roundwood for industrial processing has to be therefore promoted

iii It is recommended to change the whole system of logging and selling roundwood from the State forests in order

- to guarantee continuous wood supplies to suit the requirements of the new integrated plant as well as the requirements of other users of roundwood in the Country
- to achieve the highest possible revenue for harvested timber i.e. to create adequately differentiated prices for logs graded according to their species, quality and dimensions

In this respect the existing proposal to create a new organisation to be entrusted with logging, hauling, grading and transport of logs and other removed forest produce is fully endorsed. Present log pricing policies tend to create conditions where to many cases logs of clear long lengths are cross-cut into short lengths for the sheet manufacture which is contrary to the aim of proper raw material utilisation.

The felled logs should be transported to central log ponds where the logs are to be piled in such a way that measuring, grading and sorting can be carried out easily.

The length and diameters of each log are to be measured, thereby the value of different sizes depends on assortments which can be produced from them. Price lists usually show a rise in price for each inch from 6" up to 18" as log diameter. Bigger logs usually are not considered more valuable being often affected by defects.

Deductions are allowed for any defects which may be divided into two main groups:

- quantity defects in length and or diameter which are cropped - whose whole sound cutting or successive edging of the sawn planks are to be taken, short lengths or reduced diameter in centre of the log
- quality defects such as ... Depth of ... affect ...

6.0 [redacted]

i/ The production program for timber and particle board as stated in this Study is to be regarded as fully [illegible] details of input and output for each of the plants as well as basic data on economics are given in enclosed table 18 based on estimates

ii/ Provided that the quality [illegible] the proposed economic parameters will be achieved, [illegible] marketing problems are to be expected as the products proposed for [illegible] are [illegible] part of presently imported goods

iii/ Provisions are made for trial combustion of bruno hog waste to enable a thorough technical and economical evaluation for future decision

iv/ The investments into the site preparation and the transport relations for raw materials and manufactured goods will have a continuous impact on the production costs and hence on the profitability of the whole integrated plant. It is therefore recommended to prepare a new comparative evaluation of the sites based upon the lay-out attached

v/ To enable the call for tenders a specification of machinery and equipment has been carried out which is [illegible] as a basis for the [illegible] this Study. For each of the [illegible] the main technical parameters are stated only to endure a broader possibility of choosing the most suitable offer. The opportunities have to decide how to proceed i.e. whether the whole [illegible] formation will be given to one potential tenderer or subdivided according to individual production units

vi/ The tentative network diagram should serve as a orientation for further steps to be undertaken. In view of the fact that delivery times and the scope of each of the machines will be fixed as a result of negotiations with potential tenderers the network diagram will have to be reviewed

7. LIST OF BACKGROUND PAPERS

1. Forest Industry Development Study, prepared by FORESTAL in October 1965
2. Reports prepared by UNIDO expert Mr. P. Lewin in 1967
   - Assembling an integral appraisal of raw material and market opportunities, Part I
   - Assembling an economic Feasibility Study, Part I - 2
   - Chipboard and pulp, an opportunity analysis
3. Assembling Feasibility Study by UNIDO expert Mr. Alkalaj
4. Annual Reports of the Forest Department, 1960 - 69
5. Paper on raw material availability, prepared by Mr. Polycarpou
6. Paper prepared for Cyprus Forest Industries Ltd. on the Economic Feasibility of Various Alternative Projects August 1969
7. Paper on Logging and Transport Co Ltd., prepared by the Forest Department
8. Statistical Abstract 1969 No. 19, published by the Department of Statistics and Research Ministry of Finance
9. Testing and classification for fruit boxes /P.F.R.I. Princes Risborough/ 1968
10. Particle board from Cyprus grown trees, Tropical Prod. Inst., U.K.
11. Air seasoning of Pinus Brutia /T.P.R.I. Princes Risborough, 1961/
12. Strength properties of kiln-dried Aleppo Pine /T.P.R.I. Princes Risborough, September 1967/
13. Economic Report 1969
14. Tariffs for industrial electricity
15. Statistics of wages, salaries and hours of work, 1969, Ministry of Finance
16. Statistics of Foreign trade, 1969

Table 18

MAIN DATA OF INTEGRATED PLANT /5th YEAR OF PRODUCTION/

Production		Output/A		Input/A		Energy/A		Personnel				Investment in 1.000 $			Prod. costs		Sales/A		Profit
								Shift			Total				in	in $	in	in $	before
Kind	No. shifts	Amount	T-unit	Amount	T-unit	Amount	T-unit	I.	II.	III.	persons	Build.	Equip.	Total	1.000 $ total	per T unit	1.000 $ total	per T unit	tax
Sawmill	2	20.000 [2]	m^3	30.000 [1]	m^3	850	MWh	30	19	-	49	97,2	86 28 [11]	183,2 211,2	294,78	14,73	85,0	17,00	
Preservation of timber	2	5.000 [4]	m^3	5.000 [1] 110 [7]	m^3 tons	10	MWh	2	2	-	4	2	4	6		7,92 [10] 24,92	130,0	26,00	
Drying of timber	3	10.000 [5]	m^3	10.000 [1]	m^3	900 7.500	MWh Gcal	1	1	1	3	9	15	24		2,29 [10] 19,69	176,0	22,00	
Remanufacturing of timber		2.000 [6]	m^3	2.000 [1]	m^3	109	MWh	4	-	-	4	10	15	25		3,39 [10] 25,39	56,0	28,00	
Total timber production	1 - 3	20.000 [3]	m^3	30.000 110 [7]	m^3 tons	1.869 7.500	MWh Gcal	37	22	1	60	126,2	148	266,2	368,16	18,41	447,0	22,35	78.842
Particle b. production	2	10.000	m^3	11.000 [3] 6.000 [4] 860 [7]	m^3 m^3 tons	1.420 9.250	MWh Gcal	22	14	-	36	106	323	429		23,30	134,0	27,15	
Finishing of particle boards	2	5.000 [5]	m^3	5.000 [5] 660.000 [6] 100 [7]	m^3 m^2 tons	40 750	MWh Gcal	17	13	-	30	28	35	63		15,18 [10] 42,33	225,0	45,00	
Total particle boards production	2	10.000 [5]	m^3	17.000 660.000 [6] 960 [7]	m^3 m^2 tons	1.460 10.000	MWh Gcal	39	27	-	66	134	358	492	310,63	31,06	359,0	35,90	48.364
Others [8]	2					177	MWh	23	5	4	32	8,6	65	73,6 90,0 [9]					
Integrated plant	1 - 3			30.000 [1] 17.000 [3] 660.000 [6] 1.070 [7]	m^3 m^3 m^2 tons	3.560 17.500	MWh Gcal	99	54	5	158	260,8	571	821,8	678,79		806,0		127.206

1. Sawlogs
2. Timber
3. Branches and fuelwood
4. Off-cuts
5. Particle boards
6. Veneer
7. Preservative and glue
8. Maintenance, steamplant, transport, admin., and existing equipment
9. Design, engineering
10. Incl. selling prices of material /for ex. preservation costs/ 1 m^3 + sell. price of 1 m^3 timber; 7,92 + 17,00 = 24,92 $/1 m^3 preservated timber/
11. Existing equipment

Annex

MAN POWER SPECIFICATION

1. LIST OF PERSONS EMPLOYED

	Shifts			
Sawmill Production	I.	II.	III.	Total
Log Yard	2	1	-	3
Debarking	2	0	-	2
Sawmill	9	9	-	18
Green chain	5	5	-	10
Chipping offcuts	2	1	-	3
Timber yard	2	2	-	4
Grinding of tools	1	-	-	1
Foreman	1	1	-	2
	24	19	-	43
Preservation plant	2	2	-	4
Kilns	1	1	1	3
Remanufacturing	4	-	-	4
Maintenance				
Electrician	1	-	-	1
Mechanic	1	-	-	1
Helper	1	-	-	1
Total	3	-	-	3
Management				
Manager	1	-	-	1
Bookkeeper	1	-	-	1
Clerk	1	-	-	1
Total	3	-	-	3
Timber production Grand Total	37	22	1	60

Particle board production

Particle board	I.	II.	III.	Total
Preparation of raw material	4	4	-	8
Chipping	2	2	-	4
Glue Mixing	1	1	-	2
Forming machine	1	1	-	2
Press	1	1	-	2
Sizing of panels	1	1	-	2
Laboratory	1	1	-	2
Store	2	2	-	4
Foreman	1	1	-	2
Total	14	14	-	28

Finishing of particle boards

Panel sawing	2	-	-	2
Veneering line	6	6	-	12
Panel sizing	-	1	-	1
Preparation of veneers	4	4	-	8
Preparation of glue	1	-	-	1
Store and transport	2	2	-	4
Foreman	1	-	-	1
Total	16	13	-	29

Maintenance

Electrician	1	-	-	1
Mechanic	3	-	-	3
Helper	1	-	-	1
Total	5	-	-	5

Management

Manager	1	-	-	1
Techn. manager	1	-	-	1
Bookkeeper	1	-	-	1
Clerk	1	-	-	1
Total	4	-	-	4

	Shifts			
	I.	II.	III.	Total
Particle boards production - Total	39	27	-	66
Steam plant				
Boiler operator	1	1	1	3
Helper	1	1	-	2
Total	2	2	1	5
Maintenance shop				
Mechanic	3	-	-	3
Electrician	2	-	-	2
Foreman	1	-	-	1
Total	6	-	-	6
Other services				
Transport and others	4	2	2	8
Administration of plant				
Plant manager	1	-	-	1
Technical manager	1	-	-	1
Sales manager	1	-	-	1
Chief bookkeeper	1	-	-	1
Secretary	1	-	-	1
Clerk	3	-	-	3
Others	3	1	1	5
Total	11	1	1	13

2. WAGES AND SALARIES

Production	No of Persons	Type of work	Cost per Annum in £
1. Sawmill			
Log Yard	1	Grader	700
	2	Operators	1.100
Debarking	2	Operators	1.100
Sawmill	8	Operators	4.800
	10	Assistants	5.000
Green chain	2	Skilled	1.200
	8	Semiskilled	4.400
Chipper	2	Operators	1.100
	1	Assistant	500
Timber Yard	2	Transport	1.100
Maintenance	1	Grinder	600
	1	Mechanic	700
	1	Electrician	800
	1	Assistant	500
Sawmill			23.600
Preservation Plant	2	Operators	1.100
	2	Assistants	900
Total			2.000
Kilns	3	Skilled	1.900
Remanufacturing of timber	4	Skilled	2.800
Administration & Overhead	1	Manager	1.800
	2	Foreman	1.800
	1	Bookkeeper	800
	1	Clerk	600
Total			5.000

Production	No of Persons	Type of work	Cost per Annum in £
Personnal benefits and Insurance			7.700
Total timber production			43.000
Particle boards	8	Log yard & handling	4.800
	2	Chipper operators	1.100
	2	Assistants	900
	2	Glue mixing	1.100
	2	Forming machine	1.200
	2	Press operators	1.400
	1	Saw tender	700
	1	Saw helper	500
	2	Laboratory technicians	1.200
Maintenance	4	Stores	2.600
	1	Mechanic	800
	1	Assistant	500
	1	Electrician	1.000
	1	Assistant	600
Total			18.400
Finishing of Particle Boards	1	Panel Sawing	600
	1	Panel Sawing helper	500
	2	Veneering Line operaters	1.400
	6	Assistants	3.600
	4	Preparation of veneers	2.400
	1	Glue mixing	500
	4	Transport & Stores	2.200
Maintenance	1	Mechanic	700
Total			11.900
Administration & Overhead	1	Manager	2.000
	1	Technical manager	1.500
	3	Foreman	2.400

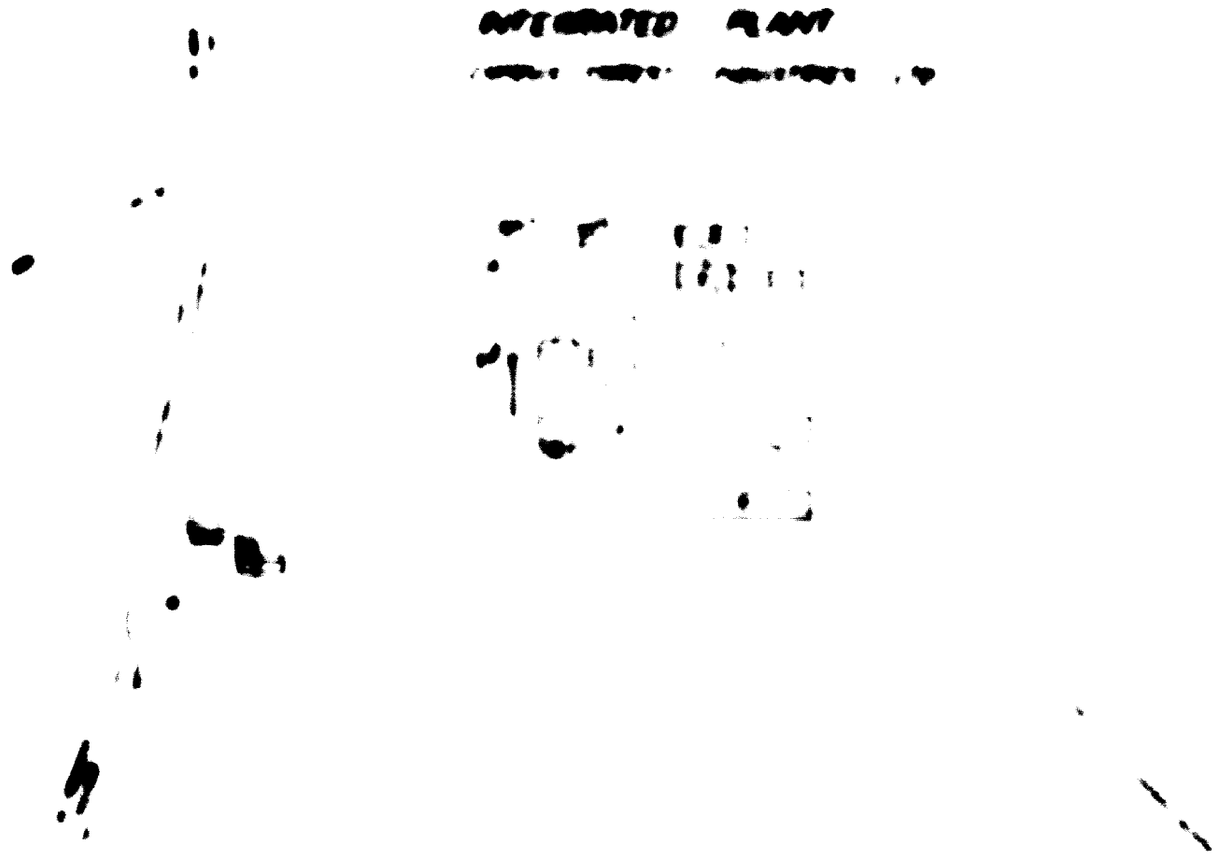
Production	No of Persons	Type of work	Cost per Annum in $
	1	Bookkeeper	800
	1	Clerk	600
Total			7.300
Personal benefits & insurance			3.500
Total particle boards production			41.100
Steam plant	3	Boiler operators	2.100
	2	Boiler helpers	1.000
Total			3.100
Maintenance Shop	3	Mechanics	2.400
	2	Electricians	2.000
Total			4.400
Other services	2	Fire protection	1.200
	6	Transport	3.000
Total			4.200
Administration of Plant	1	Plant manager	3.000
	1	Technical manager	2.900
	1	Sales manager	1.900
	1	Accountant	1.300
	1	Foreman	1.200
	1	Secretary	800
	3	Clerk	1.800
	5	Others /Driver, Typists/	3.000
Administration			19.100
Personal Benefits & Insurance			7.300
TOTAL PLANT			$ 118.200

An increase in wages of 10 % against 1970 has been calculated also for the year 1971

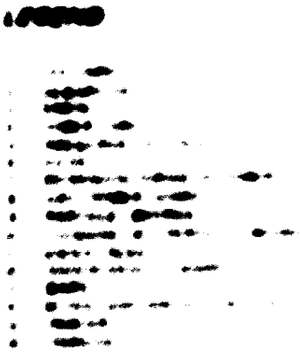
Annual wages include 10 % insurance and % benefits

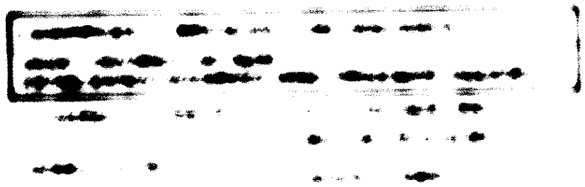
1. [redacted]

	Amount in D.A
Sawmill	81.000
Preservation Plant	8.000
Silos	1.000
Remanufacturing	8.000
Management of fiber production	18.700
Particle boards production	18 700
Finishing of Particle boards	10.700
Management of Particle boards	17.700
Steam Plant	1 000
Maintenance	5.000
Other	4 000
Administration of Plant	81 000
Integrated Plant total	D 110.000



SECTION I





SECTION 7

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[redacted]
for the Establishment of an Integrated Wood Pre
cessing Industry
in
[redacted]

Report for
the United Nations Industrial Development Organization, Vienna
prepared by
[redacted]

[redacted], January 1971

[redacted]

1 [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

2 [redacted]

[redacted]

2.1 [redacted]

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

[redacted]

For Particle board production:

Branches and fuelwood	11.000 m^3
Off-cuts from sawmill suitable for chipping	6.000 m^3
Imported veneer sheets for finishing particle boards	660.000 m^2
Average thickness	1,0 mm
length	1,600 - 2,200 mm

2.2 Main products per annum

Sawnwood for sale without further processing	5.000 m3
Preserved sawnwood	5.000 m3
Dried sawnwood	8.000 m^3
Surfaced finished timber and semi-products	2.000 m^3
Total sawnwood	20.000 m^3
Non-veneered particle board	5.000 m^3
Veneered particle board	5.000 m^3
Particle board total	10.000 m^3

2.3 Estimated Energy and Water Consumption

Power:	kW	1.410
/from HT line/	kWh	855
	MWh/annum	3.506
Steam:	kcal/h	3.800.000
/own production/	Gcal/annum	18.000
Water:	m^3/h	3,3
/from water pipeline/	m^3/annum	14.000

Note:

Working days per annum 250

Number of shifts:	Sawmill	2 shifts
	Remanufacturing plant	1 shift
	Preservation plant	1 shift
	Dry Kilns	3 shifts
	Particle board production	2 shifts
	Finishing of particle board	2 shifts
	Steam plant	3 shifts

The operation of the plant will be dependent on importing:

- adhesives and preservation materials
- veneers and other materials for finishing particle boards

2.4 Siting

The plant will cover an area of 150.000 m^2, including a reserve for future enlargement in the Western region of Cyprus near Morphou.

Road connections, branch circuit of electric energy and water-piping connection will be the responsibility of the investor.

2.5 Time Schedule

According to preliminary estimates the presumed time schedule for the building program has been drawn up in the enclosed Network diagram.

3. GOODS AND SERVICES TO BE TENDERED

3.1 Equipment as specified in Annex 1 - 8

1. Sawmill
2. Preservation plant
3. Kilns
4. Remanufacturing shop
5. Particle boards
6. Finishing of particle boards
7. Steam plant
8. Substation

3.2 Designs

The equipment suppliers will provide as a part of their delivery for each of the production units listed in Annexes 1 - 8.

- a detailed flow sheet of production
- a detailed lay-out of the machinery
- foundation plans for main machines
- input of power
- consumption of heat
- man power needed

- areas and space [illegible]
  list of equipment to be manufactured locally and their designs

Note: Cyprus Forest Industries [illegible] shall be in accordance with the rules for tenders factory safety regulations [illegible] fire protection requirements.

1.1 Training

The suppliers [illegible] covering the training of key workers in existing [illegible] character during the time of operation of the plant so that key personnel would be prepared to ensure the running of production as soon as [illegible] will be put into operation.

The tenderer [illegible] proposals for the number of persons to be trained and [illegible] duration of training.

As a basis for negotiations relating [illegible] for the following key personnel:

[illegible]	[illegible]
[illegible] manager	1
[illegible] operator	
[illegible] and grinding	8
[illegible] for the preservation plant	1
[illegible] for dryers	1
[illegible] manager for [illegible] production	1
1 [illegible] for [illegible] production each	1
[illegible]	1
[illegible] for [illegible] finishing	1
[illegible] plant [illegible]	1

The program of training to be [illegible] has the mentioned amount [illegible]. The proposed periods [illegible] are to be considered as a guideline only. The exact duration of training [illegible] dependent on the qualifications of the personnel [illegible].

1.2 [illegible] of [illegible]

The supplier has [illegible] detailed [illegible] for the installation of all [illegible] and [illegible] the [illegible] of [illegible] manufactured [illegible] bearing [illegible] and [illegible].

[illegible] [illegible] [illegible] [illegible] [illegible] to be [illegible]

units on a turn key basis. The individual machines and equipment will be checked as to their performance and output. Besides this the supplier of machinery has to attain in a trial run the guaranteed output in volume and quality for the sawmill and for the particle board production line. For the sawmill in two 2-shifts operations and for the particle board line in a continuous 24 hours operation.

4. [redacted]

In this part the investor is expected to express his usual conditions as to

- quoting the prices
- guarantees for functioning, capacities, quality of product
- schedule of payments etc.
- force majeure
- delivery dates

Annex 1

SAWMILL

SPECIFICATIONS OF MACHINERY AND EQUIPMENT

In accordance with the basic data specifying the range of the offer as well as technological and economic conditions given in chapter "Invitaiton to Tender", point 1 - 4, the specification of the individual equipments is made more precise followingly:

1. Existing equipment

Existing equipment description

1.1 Bleuer - Type: N 300
Manufacturer: Louis Bronte Belgium
To lift up to three logs with skip & loader, stoping deck and loading arms hydraulically operated complete outfit with its controls, valves, hoses, piping, 15 HP motor, started etc.
This equipment can be used

1.2 Bandsaw headrig - Type: 61" Diameter Pulleys
Manufacturer: Louis Bronte Belgium
Right hand type, carrying 8" wide sawblades with power saw blade tensioning device, power driven running off roller, brake, machine complete with 100 HP motor and starter. This machine is in good condition and can be transferred to the new sawmill

1.3 Log carriage -
Manufacturer: Louis Bronte Belgium
with automatic controls, 20 ft. long, opening of head block across 60", with 4 headstocks, offset device, log tapering device remote controlled at canvore deck close to the heading with two speed motorbs and electro - hydraulic feedworks, complete with motor and starter at camper's deck. Can be used in the new sawmill

1.4 Band saws - Type: [illegible]
Manufacturer: Aktiebolaget AB Bolinders Mariannelund, Sweden
1 pcs 48 Diameter Pulleys right hand machine
one [illegible] blade [illegible]
blade [illegible] the upper guide is
provided with a power [illegible] sing and loosing mechanism
blade [illegible] the upper guide electric [illegible]

selector with individual shrinkage allowance.
Feed rolls, diameter 600 mm,
motor for roll raising,
motor for blade guidance,
motor for dimension selector.
Electric motor ASEA MCRF 22, 60 hk, 1.470 rpm, 415 v D
Automatic star-delta switch KDRF 160 for above motor.
The machine is in good condition.

1.5 Crosscut saw - Type: CSH
Manufacturer: Stenner of Tiverton Ltd. England
- to take a 32" saw, with a nominal capacity of 10" deep by 30" wide. Equipped with hydraulic traversing of the saw carriage and with electric motor drives of 12 1/2 H.P. and 1 H.P. motor for the hydraulic equipment. The speed of cutting can be precisely controlled and is infinitely variable up to 90 feet a minute. It can be used.

1.6 Double edger - Type: C16 vh
Manufacturer: Gebrüder Linck, Oberkirch in Baden, W. Germany
- with hydraulically operated quick adjustment of the saw blades and hydraulically operated gear box. Max width between two saws 22", range of feed infinitely variable 260 ft min, 90 HP motor, star-delta starter with air circuit breaker.
It can be used.

1.7 Two saw trimmer - Type: JV 62
Manufacturer: Mastin AB Bröderna Lindquist, Säter, Sweden
- with four chains, distance sawblades 16 ft., 5 HP motor for saw blades.

1.8 Band saw setting machine - Type Adn v II
Manufacturer: Vollmer Gerbe, Maschinen Fabrik GmbH, 791 Biberach, W. Germany
- for circular-, gang-, and band saws with three phase motor.
Circular saws from 16" to 48" dia.
Gang saws of any length and width.
Band resaws and side band saws of any length and width
It can be used

1.9 Saw sharpening and grinding machine - Type FVG
Manufacturer: Vollmer Gerbe
- for Band Resaws and Log Band saw blades of a width from 3" to 9".
- 3/4 and of any length
For gang saws of any width and length, gauge 21" to for circular saws up to 19" 6" diameter. It can be used

1.10 **Band saw sharpener** - Type Cera

Manufacturer Vollmer Werke

- for wide Band saws of a width from 4" up to 12" and of any length. It can be used

1.11 **Brazing apparatus** Type B A

Manufacturer Elektro apparate bau Grubh, 4780 Lippstadt, B Germany

- for band saws of [illegible] cm width should be replaced by a larger one as [illegible] cm width is not enough

1.12 **Shears** - Type A4

Manufacturer Elektro Apparate Bau Grubh,

- for straight and rectang ular cutting off the ends of the Band saws of up to 2½ cm width. It can be used

1.13 **Electric grinding machine** - Type [illegible] A

Manufacturer Elektro Apparate Bau Grubh

- for grinding off the se tting burr for blades up to 2½ cm width. It can be used

1.14 **Slidelander** - Type [illegible]

Manufacturer Lancers [illegible] Leighton Buzzard, England

- capacity 17.920 lbs at 11" load centre, height of lift 10 ft. Fork length 60". It can be used

1.15 **Log haul chain conveyor**

Manufacturer Ingenieurbüro Berger und Obsterer Dalsenhofen B Germany

- 139 ft long to convey logs from log dump to the sawmill speed 21 ctr. Bin consisting of a drive unit, mounted on steel frame with the main shaft of forged steel height steel 51 ¾, with heavy ball bearings. The sprocket made of cast steel has a diameter of 50 cm driven by a motor reduction gear 11 HP. The Reversing unit mounted on steel frame. The link chain has a breaking load of 11 000 pounds. The dogs are screwed to the chain. Distance from dog to dog 1 foot

1.16 **Log haul feed**

Manufacturer Ingenieurbüro Berger und Obsterer Dalsenhofen B Germany

- with a chain length of 75 ft speed 11 ft p/s. The load allowed [illegible] tons

The driving shaft is made of [illegible] steel bearings and is driven by Duplex [illegible] and operated from a 7 HP motor reduction gear. Opposite the driving a [illegible] there are load stations for [illegible]

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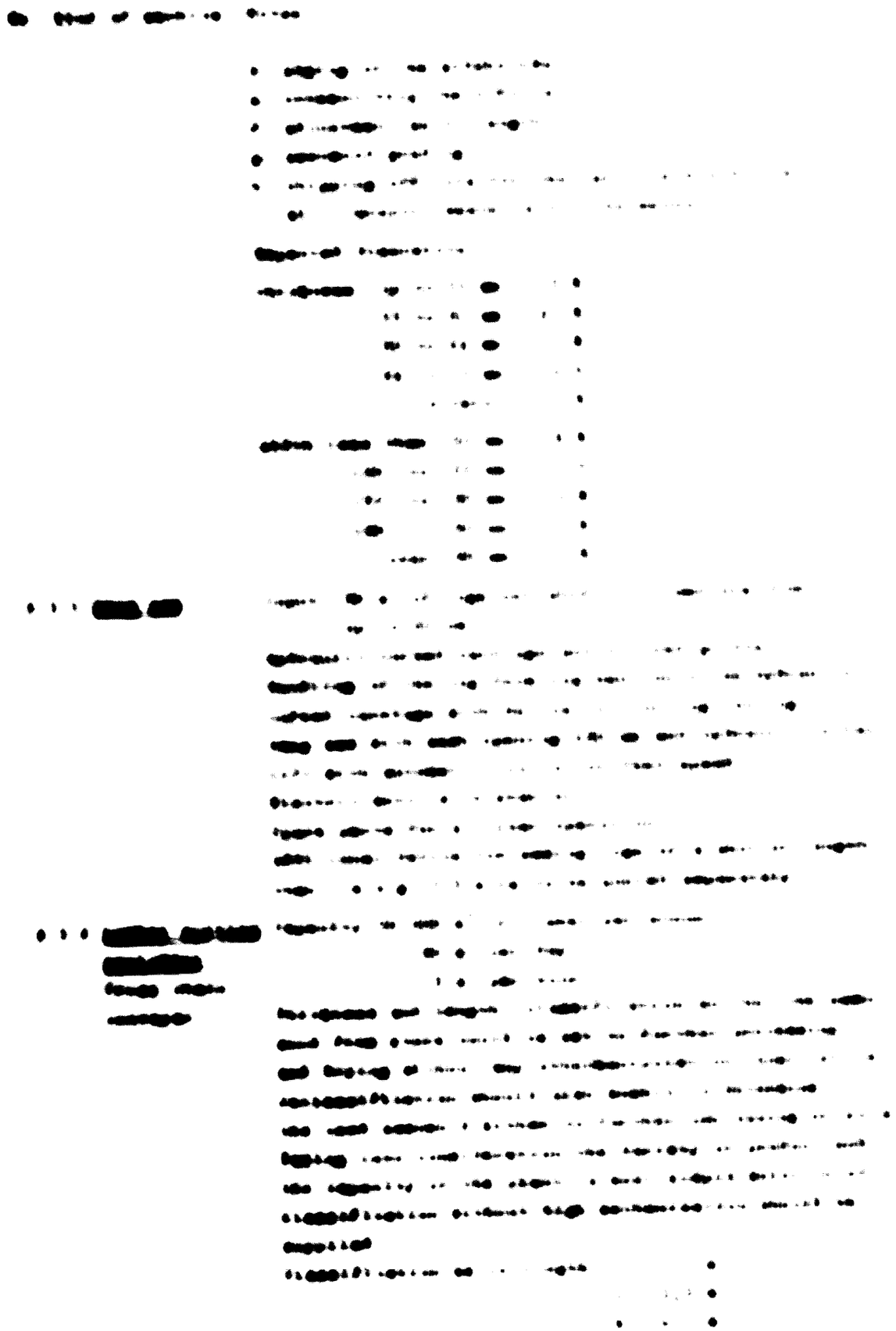

[redacted]

- [illegible]

- [illegible]

[redacted]

[redacted]

[redacted]

[redacted]

Annex 4

REMANUFACTURING SHOP

No	Kind of machine	Notes
		The remanufacturing plant will provide a partial processing of 2.000 m^3 dried sawnwood per annum in one shift, 250 working days. Timber will be up-graded by surface processing and by remanufacturing it into certain semi-products such as pallets etc. This shop will provide the planing of sawnwood and adjusting it to accurate size. Short length will be processed by finger joints into long length boards which will be crosscut to precise sizes. Apart from this the shop will dispose of a space for experimental sawing of slats for bruce boxes. Thus it will be possible to verify the yield, economic and technological conditions in view of an eventual ensuring the mass production in the next stage.
1.	Multiblade circular saw	Maximal dimensions of timber to be sawn: width 350 mm thickness 80 mm capacity 8 - 10 m^3 per 8 hours
2.	Cross cut saw	Maximal dimensions to be cut: width 350 mm thickness 80 mm length 2 - 6 m capacity 10 m^3 per 8 hours at average quality of sawnwood
3.	Four side planing machine	Maximal dimensions to be planed: width 150 mm thickness 80 mm capacity 5 m^3/ 8 hours
4.	Finger jointing line	Maximal dimensions to be jointed: width 250 mm thickness 80 mm minimal length 250 mm capacity 2 - 3 m^3/8 hour shift at an average length of 80 cm

No	Kind of machine	Notes
5.	Surface planing machine	[illegible]
6.	Automatic circular saw bar mat for slide with ball centres for reversible movement	[illegible]

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B-560

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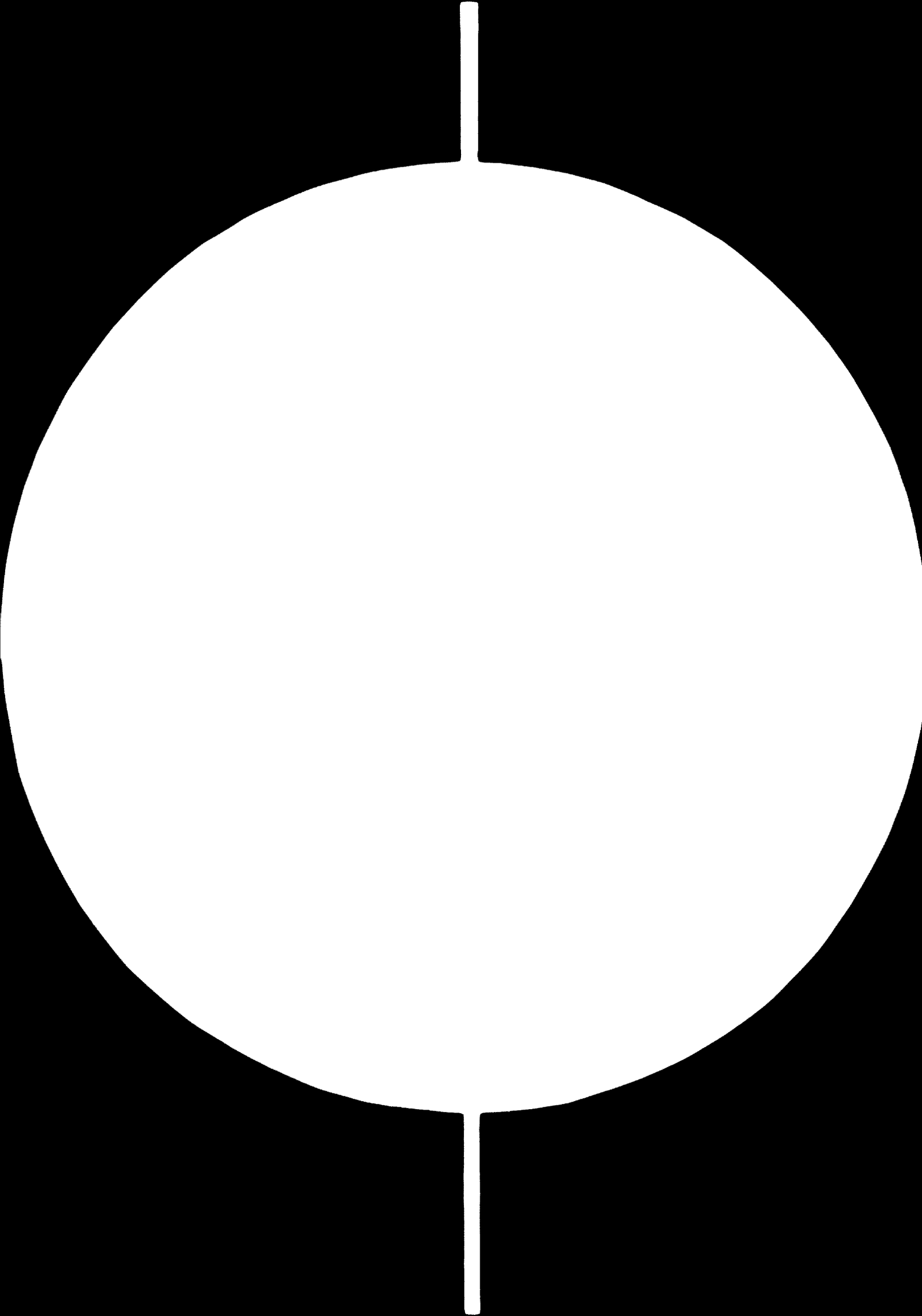
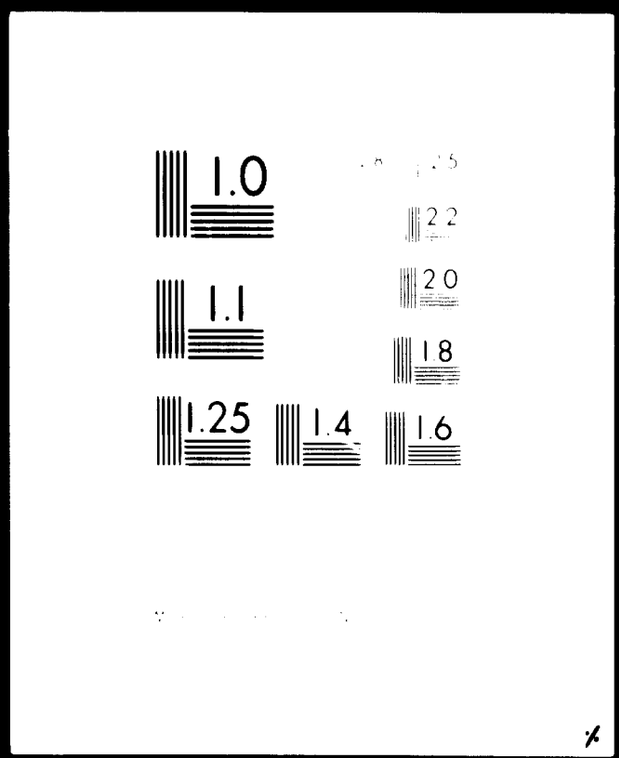




Annex 8

SUBSTATION

Basic data: To transform power from 11 kV to 0,415 kV.

Installed input:

Place of consumption	kW	kWh
Debarking & Sawmill	385	227
Timber yard & preservation plant	23	14
Kilns	200	150
Remanufacturing	95	54
Particle boards production	550	330
Finishing of particle boards	40	15
Steam plant	50	35
Maintenance shop	20	10
Others	50	20
Total	1.413	855

The high tension branch circuit will be connected with the general network 11 kVA.
No electric motor will exceed 90 kW.

It is recommended that the transformer station be provided with two transformers with one extra room for a third one to be installed later.

Within the scope of the offer it is necessary to attach the specification concerning the delivery of transformer station project and specifications for the building project.

The offer for the main switch-control room is also required together with measurement and regulation devices to be supplied.

Prices to be quoted CUF Famagusta on a turn key basis indicating separately costs of erection and running in.

An economic comparison has to be attached whether the bark can be burned in the respective equipment and consequently what the increased investment demands and boiler house attendence may be if bark is to replace part of the fuel oil.

Prices to be quoted CIF Famagusta on a turn key basis indicating separately costs of erection and running in.

Annex 9

PROPERTIES OF RAW MATERIAL

The species to be processed in the proposed integrated plant is Pinus brutia, the properties of which have been investigated by the Tropical Forest Institute in England. The results of this investigation have been compiled in a Report of the Forest Department as follows:

Form: P. brutia is a light demanding species and unless grown in dense stands or in sheltered valleys it does not grow straight. It tends to "curve" in its' upward growth somewhat similar to larch /Larix sp./. Its' form factor varies from 0.4 to 0.6.

Spiral grain: certain individual trees exhibit spiral grain but the defect is not significant.

Knottiness: The number, frequency and size of knots varies between trees considerably. Although this characteristic is genetical, in general, the bigger the tree, the larger the knots. The number of knots is greater and the size of knots larger in trees growing in open stands. Generally the tree produces live knots and dead knots are very few.

Bark: Thick and persistent. The proportion of bark varies between diamete/ /age classes ranging between 26 % in the smaller diameter classes to 16 % in the larger diameter classes, the average being 18 %. Debarking is relatively easy.

Resistance to insect and fungal attack.

The species exhibits good natural resistance to insect and fungal attack probably due to itsresin content. The sapwood is highly susceptible to blue stain. Fire scorched trees are readily attacked by wood-boring insects.

Sapwood/heartwood ratio: The proportion of sapwood and heartwood varies between individual trees but the variation is closely relatedto tree age and size. There is more heartwood in the older trees than in the younger ones. No studies were made of the sapwood/heartwood ration in logs.

Density and resin content: Tests were carried out by the Forest Products Research Laboratory, Ministry of Technology, U.K. For unextracted sapwood the range of densities on the samples tested was 0.371 to 0.614. The highest values were obtained in the outermost layer at the base of the trees while the location of the lowest density material varied from tree to tree. The extractive content was in all cases small, lying between 0.32 per cent

and 2.76 per cent and no clear conclusions could be drawn in this case as to the distribution of the resin within the tree. Certainly, in the sapwood, the resin content is too small to have much effect on the density of timber /0.365 - 0.604 for extracted wood/.

In general, the density of unextracted heartwood was greater than that of sapwood from the same tree, though anomalous results were obtained in a few cases. After extraction, density difference between sapwood and heartwood were less apparent.

The densities of unextracted heartwood were found to be in the range 0.457 to 0.890. The highest densities were recorded in the inner heartwood at the base of the tree and these were always associated with high resin contents. It was shown, however, that even when allowances were made for extractive content, this pattern of density distribution in the heartwood was unaltered.

Wood of high resin content was associated with larger trees /above 40 cms diameter/. Medium-sized trees contained a lower percentage of resin in the heartwood and the small trees /30 cm diameter class/ showed virtually no heartwood and could be considered to be non resinous.

Strength properties: Pinus brutia timber is heavierthan the more common species of pine, the general average being about 36 lbs per cu. ft. /or 556 kgs/m^3/ at 12 per cent moisture content. This is some 20 per cent heavier than Baltic redwood /Pinus sylvestris/. Since density controls the weight of timber and there is great variability in density between size classes, a corresponding variation in weight must also be expected.

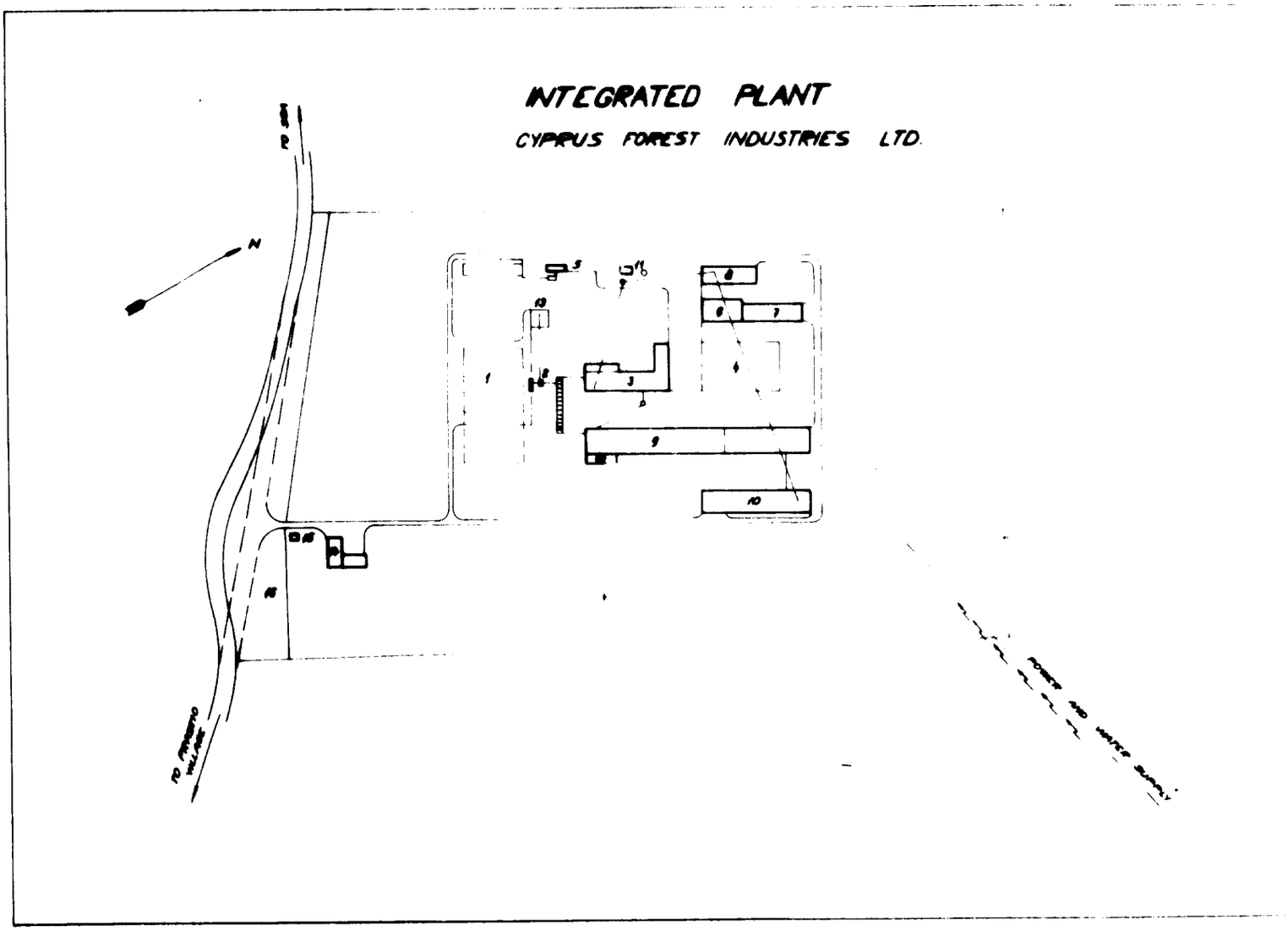
Since P. brutia timber is heavier than P. sylvestris, some of its strength properties are also rather higher than Baltic redwood, the bending and compression strength being about 10 per cent and the shear strength about 20 per cent higher. P. brutia is almost twice as hard as P. sylvestris but in stiffness, resistance to impact bending and cleavage the two timber are roughly equivalent.

More details of the mechanical and physical propertion of P. brutia in the Kiln-dried condition are given in enclosed Table 1.

Table 1

MECHANICAL AND PHYSICAL PROPERTIES OF PINUS BRUTIA IN THE KILN-DRIED CONDITION

Description	Moisture content	Nominal specific gravity	Weight per cubic foot	Static Bending: Maximum bending strength	Static Bending: Modulus of elasticity	Impact: Maximum drop of hammer	Compression: Maximum compressive strength parallel to grain	Hardness: Resistance to indentation on side grain	Shear: Max. shear strength parallel to grain	Cleavage: Splitting: In radial plane	Cleavage: Strength: In tangential plane
	%		lb	lbf/in^2	1000 lbf/in^2	inch.	lbf/in^2	lbf	lbf/in^2	lbf/in width	lbf/in width
Tree No.2	13,6	0.580	40,5	14,470	1.760	30	7.200	1.010	2.050	53	82
Tree No.5	11,3	0.509	35,5	13,400	1.470	24	7.507	850	2.130	43	65
Tree No.6	11,5	0.484	33,8	12,690	1.440	26	7.310	830	2.050	65	70
Tree No.7	11,9	0.497	34,7	12,420	1.370	19	6.860	890	2.030	51	75
Tree No.10	12,1	0.531	37,1	12,800	1.530	24	7.220	990	1.980	49	76
Average of averages	12,1	0.520	36,3	13,160	1.510	25	7.230	910	2.050	52	74 12.1
Standard deviation of individual results		0.555		1,565	245	5,5	618	149	291	10,4	
Number of results		32		32	32	30	32	32	64	31	32
Redwood, Baltic	12,8		30	12,100	1.450	26	6.520	580	1.640	56	62
Scots pine from United Kingdom	12,0		32	12,900	1.450	28	6.870	670	1.840	59	74


INTEGRATED PLANT
CYPRUS FOREST INDUSTRIES LTD.
N
TO PRODROMOS VILLAGE
POWER AND WATER SUPPLY

SECTION 1

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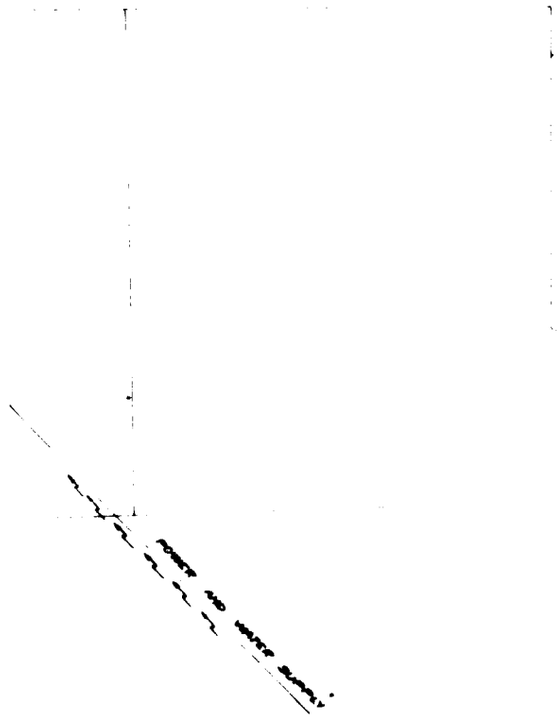


LEGEND:

1 LOG YARD
2 DEBARKING
3 SAWMILL
4 TIMBER YARD
5 PRESERVATION PLANT
6 KILNS
7 REMANUFACTURING OF TIMBER
8 DRY TIMBER STORE
9 PARTICLE BOARDS
10 FINISHING OF PARTICLE BOARDS
11 STEAM PLANT
12 MAINTENANCE SHOP
13 BARK
14 OFFICE AND SOCIAL FACILITIES
15 PORTER
16 PARKING

LIGNOPROJEKT BRATISLAVA CZECHOSLOVAKIA

UNIDO CONTRACT NO 80/56
ESTABLISHMENT INTEGRATED WOOD PROCESSING INDUSTRY

IN CHARGE A TRAVNIK

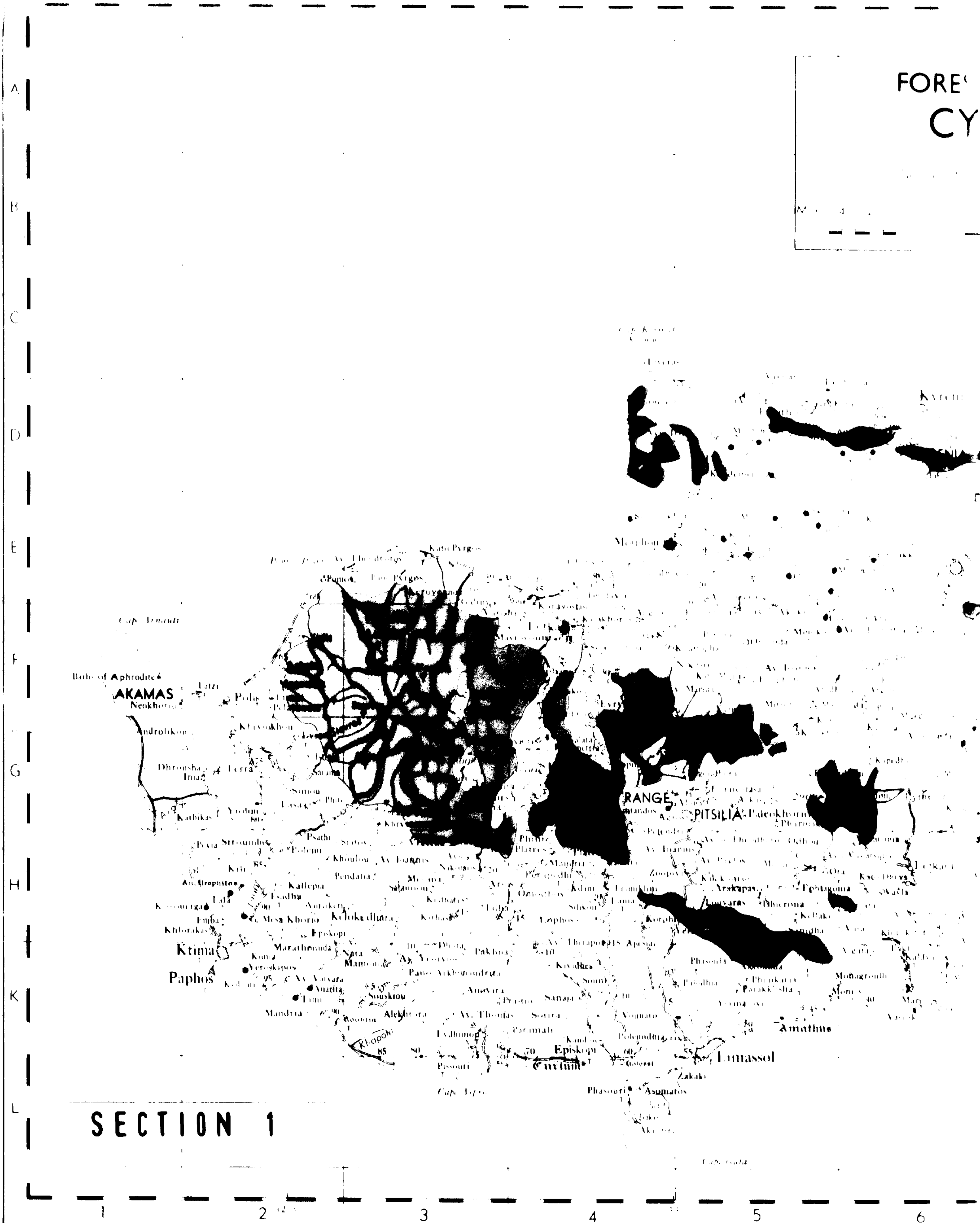
DESIGN M TAHY

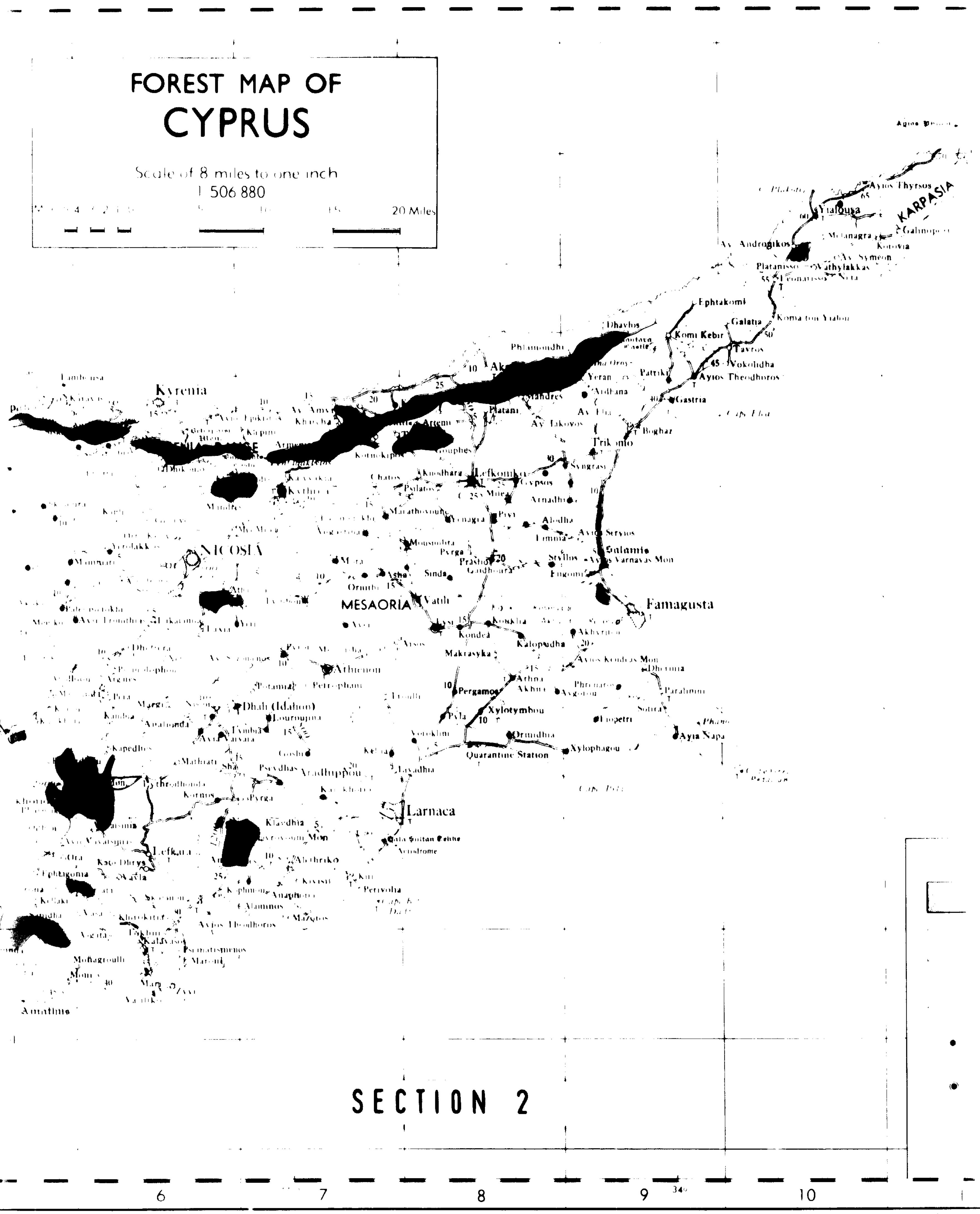
DATA DECEMBER 1980

IECC NR P1 S 66164

SCALE 1 2500

SECTION 2




FOREST MAP OF
CYPRUS
Scale of 8 miles to one inch
1 506 880
20 Miles
KARPASIA
Ayios Thyrsos
Yialousa
Melanagra
Galinoporni
Ay. Andronikos
Ay. Symeon
Platanisso
Vathylakkas
Leonarisso
Ephtakomi
Galatia
Koma tou Yialou
Komi Kebir
Tavros
Vokolidha
Ayios Theodhoros
Dhavlos
Phlamoudhi
Patriki
Gastria
Boghaz
Trikomo
Kyrenia
Lefkoniko
Gypsos
Arnadhi
Piyi
Alodha
Ayios Servios
Salamis
Ayios Varnavas Mon
Famagusta
Styllos
Engomi
NICOSIA
MESAORIA
Vatili
Prastio
Gaidhoura
Kondea
Koukla
Akhyritou
Kalopsidha
Ayios Kendeas Mon
Dherinia
Paralimni
Makrasyka
Athna
Akhna
Avgorou
Pergamos
Sotira
Pyla
Xylotymbou
Ormidhia
Xylophagou
Liopetri
Ayia Napa
Quarantine Station
Athienou
Petrophani
Dhali (Idalion)
Louroujina
Potamia
Margi
Analiondas
Lymbia
Ayia Varvara
Kapedhes
Mathiati
Psevdhas
Aradhippou
Kornos
Pyrga
Klavdhia
Larnaca
Livadhia
Stavrovouni Mon
Alethriko
Kiti
Perivolia
Kophinou
Anaphotia
Alaminos
Mazotos
Ayios Theodhoros
Lefkara
Kato Dhrys
Vavla
Ophtagoma
Khirokitia
Tokhni
Kalavasos
Psematismenos
Maroni
Mari
Zyyi
Monagroulli
Moni
Amathus
Aerodrome
Hala Sultan Tekke
Cape Pyla
Cape Greco
SECTION 2
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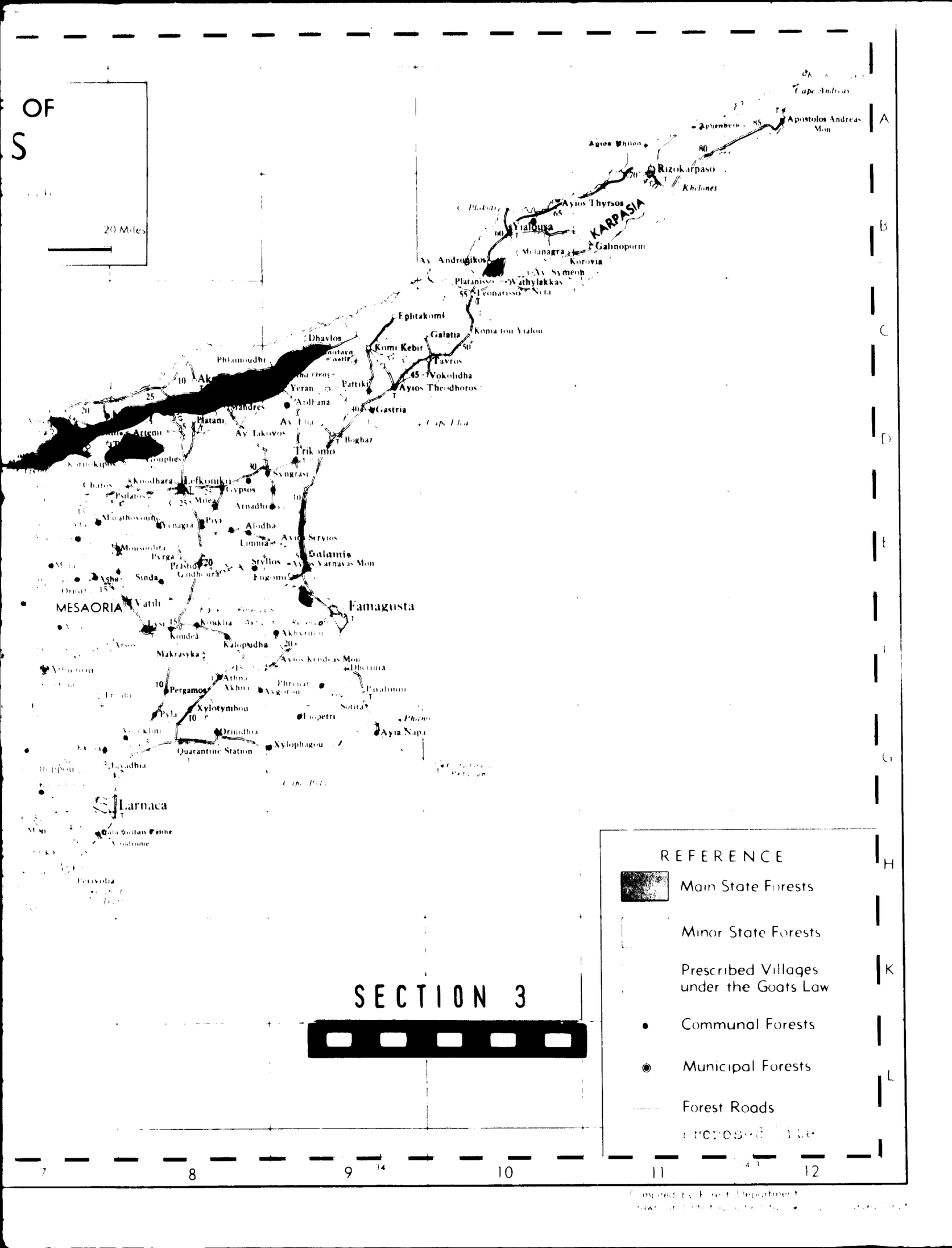
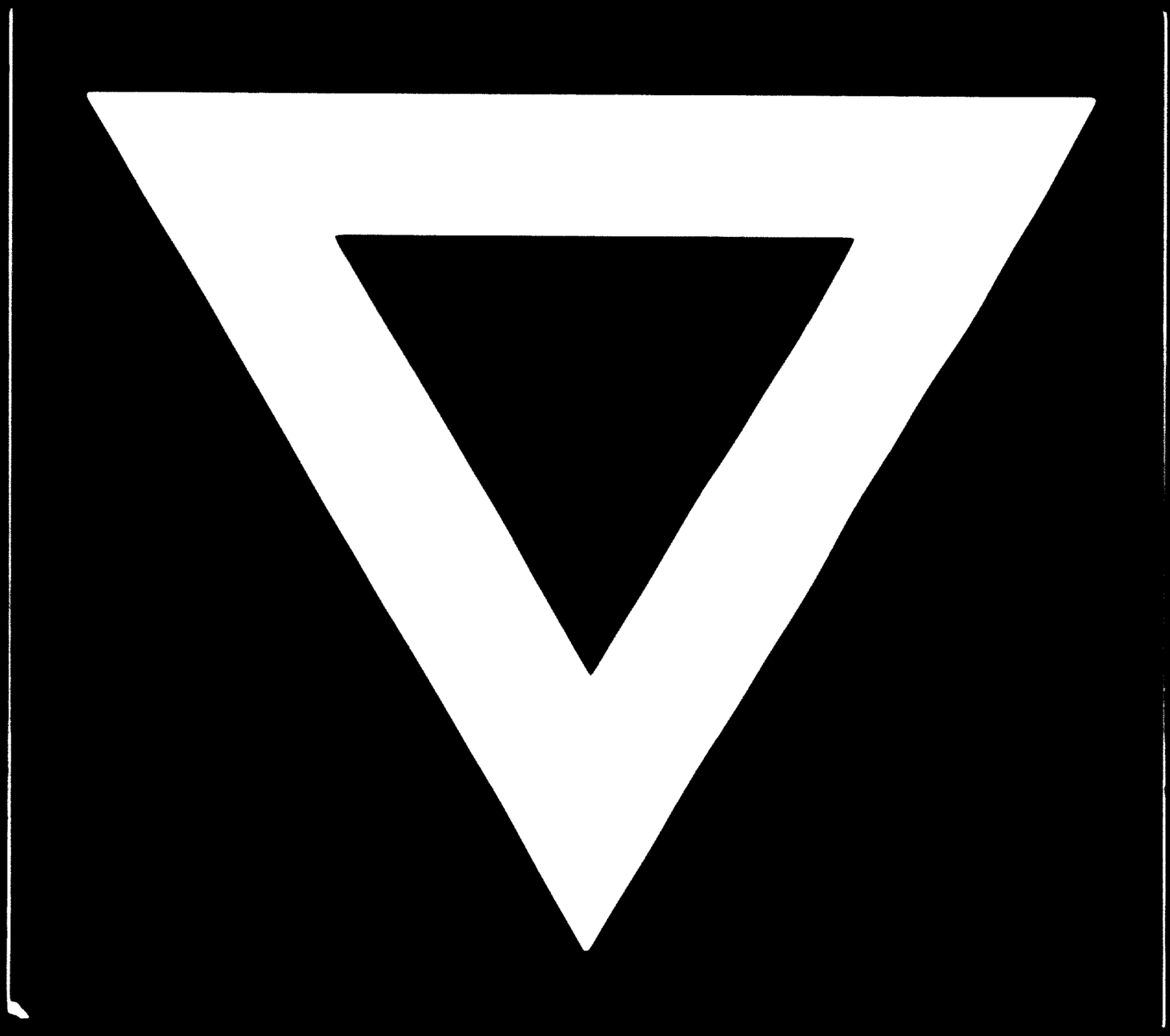
7
8
9
10


OF
S
20 Miles
Cape Andreas
Apostolos Andreas Mon
Agios Philon
Rizokarpaso
Khelones
Ayios Thyrsos
KARPASIA
Vialousa
Galinoporni
Korovia
Ay. Andronikos
Platanisso
Vathylakkas
Ay. Symeon
Trikomo
Eptakomi
Galatia
Komi Kebir
Tavros
Vokolidha
Ayios Theodhoros
Gastria
Dhavlos
Phlamoudhi
Pattriki
Yeran
Ardhana
Mandres
Platani
Ay. Elias
Ay. Loukovos
Boghaz
Artemi
Lefkoniko
Gypsos
Syngrasi
Armadhia
Alodha
Ayios Serylos
Stylos
Sinda
Vatili
MESAORIA
Famagusta
Konkhia
Kalopsidha
Makrasyka
Ayios Kendeas Mon
Athna
Pergamos
Akhuri
Xylotymbou
Orinidhia
Xylophagou
Ayia Napa
Paralimni
Dherynia
Sotira
Quarantine Station
Larnaca
Perivolia
SECTION 3
REFERENCE
Main State Forests
Minor State Forests
Prescribed Villages under the Goats Law
Communal Forests
Municipal Forests
Forest Roads
Proposed Forest Roads
A
B
C
D
E
F
G
H
K
L
7
8
9
10
11
12

B - 560



81.08.26