

THE NAGALAND PAPER PROJECT

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N.P.P.C. is the first paper mill to come up in the current decade. Initiated in the late sixties it is expected to be on stream by mid-seventies. This integrated 100 t/d unit is expected to expend an investment of about twenty crores with gross return at 9%. Direct employment potential generated would be 1000 hands and indirect ten times of that. Partly based on the utilisation of local reeds and grasses its commissioning would open out new vistas for the utilisation of these forest produced raw materials, so far neglected, on such a large scale. N.P.P.C. is going to be the mills farthest from the capital and in a region yet unindustrialised full of rugged terrain.

INTRODUCTION

Fictions are said to be strangers than facts but at times facts too can be stranger than fictions and the case in sight is that of the Nagaland Pulp & Paper Co. Ltd. Hardly a decade back it was beyond anybody's comprehension to have thought of a project in such a far off and rugged terrain, but today it is a reality. A reality far over shadowing a number of projects which though in the offing for over a decade now with much money expended, hard labour exhumed, in areas abundant in cellulosic raw materials in proximity to consuming centres and viable on all counts, yet remain lingering at the very stage of their initiation. This gloomy picture may be an outcome of man-made excuses and hindrances imbibed as a part and parcel of our system of planning and projecting. The Dandakarnia region in Madhya Pradesh, the vast span of Assam south of the Brahmaputra, the Beas Valley in the north and the Godavari catchment area in the south are a few of such instances. Regional surveys, site inspections, raw material assessments, alienated investigations, feasibility studies, detailed projects reports and what not have not been gone into time and over again and that these regions offer vast potential for large units require no elaboration here. No doubt, all the available regions cannot be ideal from all angles and free from all troubles. Development of the paper industry has come to the stage of challenging job but it has to be accepted as such if the plan targets have to be converted into realities. The places of pudding making have all been exhausted long since. Forest, water, communication and market are the four fundamental ingredients of a healthy location for a paper mill but such locations are now hardly to be seen. Therefore, a reasonable balance between the four has to be struck at to arrive at a viable location.

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In fact, our national policy for the industrialisation of backward areas even vitiates the reasoning. The National Council of Applied Economic Research in their Forest Appraisal Report for Nagaland had suggested the possibilities of a number of forest based industries including one or two pulp and paper units based on the cellulosic potential of the State. This was in 1964.

Forests Surveys & site Selection

In 1964-65, the State authorities undertook the first survey work to ascertain the raw material potential of a compact region in this State rich in cellulosic material and accessible to probably a paper mill site. This survey has since been called the "Pre-investment Survey". Though a rough one based on low percentage of sampling, it showed a promise of more than 3,00,000 tonnes of air-dry cellulosic raw material extractable annually only from the outer sub-montane belt along the north-west border of the State facing Assam and having a linear frontage of about 240 Km. along the main railway track and an all weather road running parallel to it. This report covered a forest area of about 757 Sq. Km. (1,87,000 acres) with the districtwise break-up as follows:—

Kohima Dist.	(W.B. Dimapur)	38,700 acres (12,662 hec.)
Mokokchung Dist.	(W.B. Tuli)	1,07,800 acres (43,627 hec.)
Tuensang Dist.	(W.B. Naginimara)	40,600 acres (16,431 hec.)

The entire area is hilly with elevation ranging between 120 to 1000 metres, but the soil generally deep and fertile. The detailed break-up of the sustained annual cellulosic yield as brought out in the report is as given in Table I, with figures expressed in air-dry tonnes:—

TABLE I.

	Grasses and Reeds	Bamboo	Total
Tuli Block	2,05,740	15,730	2,21,480
Naginimara Block	13,060	41,300	54,360
Dimapur Block	1,01,180	23,490	1,24,670
Total:	3,19,980	80,490	

This bright promise led the State authorities to undertake forthwith second survey based on higher percentage of sampling called the "Detailed Survey". It was completed in April 1967 and the Directorate of the State Forest Department submitted their "Report on the Cellulosic Raw Materials for a Paper Mill in Nagaland" in November 1967. The work under this report was confined to only two blocks of Tuli and Naginimara for the simple reason that a compact area was available there with the probable location of a paper mill at Tuli. Another factor contributing this restricted approach was the line of thinking of setting up an industry based entirely on the utilisation of local grasses—Bhutang and Khagra. The Table II gives the available yearly yield of the cellulosic raw materials in these two blocks.

TABLE II.

Block	Grass and Reeds	Bamboo	Total
Tuli	2,20,326	18,162	2,38,488
Naginimara	4175	24,840	29,015
Total	2,24,501	43,002	2,67,493

The sectorwise break-up of the compact area is as given in Table III:—

TABLE III.

Block	Sector	Area in acres	Remarks
Tuli	1. Tuli-Merangkong-Wamenken	30,231 (12,234 hec.)	Whole section
	2. Asangma-Kuligmen-Longchang	24,317 (9,841 hec.)	Whole section
	3. Changtongiya-Chuchuiyim-long	2,270 (920 hec.)	only bamboo area
	4. Lakhuni.	250 (100 hec.)	only bamboo area
Naginimara.	Naginimara-Golki	10,602	

This second report further states that Tuli and Naginimara blocks can serve as a most suitable compact source of raw material for a paper mill at Tuli and that to feed adequately a paper mill of the capacity of 100 tonnes a day, more than 90,000 tonnes of fibrous raw material will not be required. It further states that even allowing for some safeguards to the extent of 50% (10% for fire hazards, 25% for poorer growth than anticipated, 5% for use in the raw material organisation itself and 10% for contingencies), it will suffice to protect only an area

of 67,600 acres (Table III) to guarantee 1,35,000 tonnes of grasses alone against the requirement of 90,000 tonnes, besides 43,000 tonnes of bamboo, if required. Further, there is a good prospect of another equally suitable raw material namely hard woods in good quantity and Bamboo supply from Dimapur region can always be had.

Suitability of local grasses

Side by side with the above investigation work, the Government of Nagaland also made an approach to the Government of India in 1965 to get the project included in the Fourth Five Year Plan. In December 1966, it was accepted in principle by the Planning Commission and a Committee was set up by the Ministry of Industrial Development to fully examine and ascertain the viability of the project. This led to the determination of the suitability of the grasses for paper making. Sizeable quantities of grasses were flown to Paris where Messrs Celpac in collaboration with Messrs Centre Technique Forestier Tropical carried out exhaustive investigation work both in laboratories and on pilot plants. The findings were encouraging as detailed in the Tables below and subsequently a Detailed Project Report was got prepared. This was in mid 1968. Since the emphasis till then had remained confined to the utilisation of only local grasses and reeds, bamboo was left out of any investigation work and Messrs Celpac instead suggested use of some long fibred pulp if need be along-with grasses pulp. Celpac's findings on the grasses are given in the following Tables:—

TABLE IV.

ANALYTICAL DETERMINATION (WITH ALL FIGURES IN PERCENTAGE)

	Bhutang	Khagra	Bamboo*
Alcohol-benzene extract.	2.14	4.43	1.4—1.43
Extract with water	7.82	6.56	3.75—6.48
Extract with 1% caustic soda	28.90	26.40	12.58—18.97
Magnin (rectified)	22.50	23.30	24.13—28.66
Pentosens	28.40	29.00	15.13—15.18
Cellulose (rectified)	39.30	36.50	62.25—60.05
Ash.	3.90	2.70	0.71—1.87

*Bamboo from Assam and Madhya Pradesh given just for comparison.

TABLE V (figures are in microns)

		Bhutang	Khagra
Fibre length	min.	800	500
	max.	2700	4000
Fibre width	..	16.5	16.0
Fibre wall thickness	..	9.5	11.0
Fibre wall cavity	..	7.0	5.0
felting power	(L/I)	106	92

Process Technology

According to the French experts, the process technology to be inducted was that of kraft batch cooking and Chlorine cum Chlorine-dioxide bleaching. There was to be a single pulping street and one paper machine to manufacture cultural papers. It was further suggested to base entire production on grasses and to project the mill for an annual capacity of 30,000 tonnes of pulp and an equal tonnage of paper.

The predominant grasses in the Tuli region are Bhutang (*Saccharum Procerum*) and Khagra (*Nayraudia Reynaudiana*) and their chemical and physical composition as reported in the Celpac report are given in the following table:

TABLE VI

Plant Composition			
Plant	Stem%	root%	Tops%
Bhutang	79.1	19.0	1.9
Khagra	77.5	20.0	2.5

(N.B. Air-dry weight of cut stems in 110 Kg. and 135 Kg. per cubic metre for Bhutang and Khagra respectively).

Under normal cooking conditions with 16 percent of alkali as Na_2O at 150 degrees centigrade for 150 minutes, the physical characteristics of the two pulps yielded the following results, giving 40% of bleached pulp.

TABLE VII

CHARACTERISTICS OF UNBLEACHED PAPERS AT 40 SR. IN JORKO BEATER

	mts.	mts.
time of beating to 40 SR	3	5
breaking length in m	5000	6500
burst ratio	29	41
tear ratio	78	81
double fold (T=1 kg)	5	11
porosity	18	6
bulk	1.65	1.60
unscreened yield %	45.5	52.8
screened yield %	44.8	51.3
rejects %	1.5	3.0
NaOH g/l in B.L.	12.6	8.0
KMnO ₄ number	13.5	9.5
brightness	35.5	39.5

TABLE VIII

CHARACTERISTICS OF BLEACHED PAPERS AT 40 SR

	Khagra	Bhutang
Breaking length m	4900	6600
burst ratio	26	39
tear ratio	76	74
double fold	9	25
porosity ratio	19	6
bulk	1.55	1.50
opacity	62.64	62.66

Findings of Expert group & N.I.D.C. Consultants

In the Detailed Project Report, project cost estimates were worked out to Rs. 15.5 crores with foreign component at about Rs. 5 crores. But prior to the adoption of the DPR, the Government of India constituted a four-member Appraisal Group of Experts drawn from the paper industry including the author and the concerned Development Officer, with the assignment to scrutinise the DPR and submit suitable recommendations. In December 1969, this group made an on-the-spot inspection, visited a few raw material areas, held discussions with the State and other concerned officers including the State Industries Minister and the Secretaries to the Govt. of Nagaland. In February 1970, the recommendations of the expert team were finalised at a meeting where representatives of the Ministries of Finance and Industrial Development and Government of Nagaland were also present. Because of geophysical, geographical and other considerations associated with Tuli region as also of technical factors connected with the utilisation of local grasses and reeds on such a large scale and that for the first time on a fast paper machine, the author put forth the suggestion of incorporating bamboo as well for pulp making and in the same proportion as that of the grasses and diversify production pattern by installing two medium size paper making units so as to cover the local and surrounding market in a larger way. No doubt, this meant enhanced project cost but it was meant to result in greater flexibility both in operation and production pattern and at the same time taking care of the snags associated with the use of only grasses and reeds. Added to these considerations was the problem of transporting heavy machinery over a rugged terrain of 20 Km. by road, if it were to be a single street plant with one big paper machine. This major deviation from the original planning was accepted by the appraisal group and recommended to the Central Government.

Subsequently, Messrs National Industrial Development Corporation, an Engineering Consultancy firm of the Government of India, were appointed consultants to the Nagaland Pulp & Paper Company Limited. Messrs N.I.D.C. early in 1971 recast the earlier DPR by incorporating the necessary changes on the plant side and revising cost structure on the investment and profitability side. It may be of interest to know at this stage the progress already made towards the implementation of the Project.

Joint State Sector

The Nagaland Pulp & Paper Company Limited is a joint venture in the State sector with equity held between the

Nagaland Government and the Hindustan Paper Corporation in the ratio of one to seven but with equal representation on the Board of Directors. Expenses incurred so far amount to over Rs. 80 lakhs covering preliminary expenses, site development, basic investigations, preparation of DPRs, construction of over three scores of quarters both for officers and junior staff and preliminaries to the development of infra-structure. This 100 tonnes/day integrated paper mill is being located at a place called the Thirteenth Mile on the Amguri-Mokokchung highway, about 20 km. from the Amguri railway station and 60 km. by road from Jorhat. The Thirteenth Mile site is all hilly with little of flat land but abounding in enchanting scenery. Rainfall spreads over the year with lean months from December to March and heavy from May to August. The river Melak, the main source of water intake, flows sideby and is good in perennial water discharge. With detailed site survey complete, planning and projecting is well on its way at the NIDC Headquarters. In fact, selection of plant and machinery and finalisation of the placement of firm orders is just a matter of a few months, scheduled to be over before the year is out.

Employment Potential & Transportation

Though this project is a modest one in size and a precursor to other units to be set up in Central or Centre-cum-State sector, yet it has its own problems and prizes. Utilisation of grasses and reeds on such a large scale—50,000 tonnes a year—has its own problems of collection, transportation and storage, but once done, it would give a lead to the country and infuse confidence so badly needed at the moment in the field of the utilisation of agricultural residue, grasses and straw for paper making. It is a difficult terrain causing difficulties both in the transportation and in the construction but once completed, it will be the first unit in such a rugged region in our country. It will probably be the first big unit in a backward area—a step towards the cherished goal of over-balanced regional economic development.

To those not familiar with any industrial area and its activity, it will be something of an eye opener and an awe inspiring establishment. When in full swing after commissioning, it will offer employment opportunities to over 1,000 hands directly and to more than 10,000 to 12,000 hands indirectly and that too in an area where hardly a score of hands can be seen working in an industry today. Since all material will have to be transported by road only, 150 to 175 truck loads would be moving in and out of the factory every day.

Naturally, the Government of Nagaland and its people have every reason to be proud of for this big step for-

ward towards the industrialisation. When effort is there, success is bound to follow.

The Project at a glance

1. Capacity: 33,000 tonnes of Paper annually.
2. Production Pattern: 13,000 tonnes industrial papers. 20,000 tonnes cultural papers.
3. Raw Material: 50,000 tonnes/year of Bhutang and Khagra reeds new line 40,000 tonnes/year of bamboo.
4. Process Technology: Kraft-Sulphate-Cooking. Chlorine bleaching.
5. Source of water: The River Melak.
6. Daily water intake: 10 m.g.d. (45000 cubic meters)
7. Power: 10,000 KW (own generation)
8. Fuel for Power: Coal
9. Project cost: Rs. 20/21 crores.
10. Annual Sales: Rs. 6.7 crores.
11. Gross return on equity: 15-16%
12. Gross return on investment: 9%
13. Employment: 1,000 direct. 10,000 indirect.
14. Period of implementation: 4 years.

Plant Capacity & Specifications.

- | | |
|---------------------|--|
| Unit: | Integrated Pulp and Paper Mill |
| Plant Capacity: | 33,000 tonnes of Paper/year. |
| Production Pattern: | 20,000 tonnes of writing and printing papers and 13,000 tonnes of MG papers. |
| Raw Materials: | Bamboo — 50%, Khagra and Bhutang reeds — 50%. |
| A. PAPER SECTION: | To comprise of two streets; one for the manufacture of M.F. and |

surface sized papers and the second for M.G. Papers.

Each street to consist of separate modern continuous stock preparation Plant and fine screening.

Preparation of sizing chemicals etc., to be common for total production.

STREET-I

Quality writing and printing M.F./ surface sized papers. Substance range 40 to 110 gsm.

1. Stock Preparation:

3/4 high speed refiners with stainless steel bars.

2—Jordans/disc refiners.

2—Centrifugal vertical primary screens and one secondary.

2 mixing and 2 machine chests each of 75 cu.m. capacity.

Dry Broke Treatment Plant comprising of hydra-pulper, stock pump, deflaker and Broke Chest (75 cu. m.). Wet Broke recovery plant consisting of couch pit with agitator, stock pump and thickener. Fibre recovery plant, preferably disc type.

All auxiliary equipments for dosing dyes, size (2%), alum (6%), and clay (12%).

Kitchen for the preparation of surface size emulsion. (Max. retention in paper—5%). Necessary level and flow indicators and recorders consistency regulators, wherever necessary.

2. Paper Machine:

Conventional Fourdrinier Type:

Guaranteed Performance Capacity: 60 tonnes of finished scale-able paper in 50 gsm. substance in 24 hours of M.F. writing and printing paper or 60 tonnes of finished saleable surface sized paper in 60 gsm. substance in 24 hours.

Wire width: 3300 mm (trim—3000 mm)

Wire length: Preferably 32000 mm. Pressure head box equipped with eveners and distribution perforated rolls.

Conventional fourdrinier wire part with quick wire draped device.

Latest type of Projection slices. Table rolls-cum-foils.

6/7 Vacuum boxes oscillating type. Formation table preferably with double shake.

Motor driven dandy roll preferably 600 mm dia. Suction Couch roll (bronze shell). Forward wire return roll (bronze). Wet sheet vacuum transfer arrangement of the wire to first press.

First suction press: stonite top roll; bottom suction roll (350 P & J). Second press inverse suction type (rolls similar to first press).

Third press ventanip straight through Felt.

Conditioners for wet felts;

Pre-dryers 20, each of 1500 mm dia. Horizontal inclined size press.

After-dryers; one chrome plated and eight ordinary ones, each of 1500 mm dia.

Necessary number of felt dryers in each section.

All dryers to be provided with doctors.

Two cooling cylinders (1500 mm dia.) with doctors.

Two stacks of calenders each of 6 bowls.

Cool air blowers to calenders.

King rolls having oscillating doctor.

Horizontal pope reeler.

12 paper winding shells.

All presses to be operated hydraulically.

Dryer section to be equipped with three stage heating system and well

ventilated latest type of hood.

Driving gears for the dryers to be enclosed/encased type.

All moving rolls to have anti-friction bearings.

Dryer bearings and gears to be provided with common continuous oil lubrication systems.

Pneumatic paper feeding to calenders and in Wet Section.

Paper machine main drive to be of latest mechanical line shaft type with Ward Leonard set or equivalent as the prime mover.

Speed range preferably 100 to 375 m/min.

All pumps, pipings, fittings to be included.

Steam supply to dryer at 4 atm. saturated.

All electrical equipments including motors, starters etc. to be either included or a detailed list with specifications to be supplied.

STREET-II

Quality MG papers: Substance Range 36 to 120 gsm.

3. Stock Preparation:

2/3 High speed refiners.

2—Jordans/disc refiners.

2—Centrifugal vertical primary screens screening and one secondary screening.

2—Machine chests and 2 mixing chests each of 75 cu. m. capacity.

Dry Broke Treatment Plant comprising of hydro-pulper, deflaker and Broke Chest (75 cu. m.)

Wet Broke recovery Plant consisting of couch pit with agitator, pump and thickener.

White water fibre recovery plant preferably disc type.

All auxiliary equipment for dosing dyes, size (2%) and alum (6%).

4. Paper Machine

Fourdrinier cum M.G. type.

Guaranteed Performance Capacity: 40 tonnes of finished saleable paper in 50 gsm. substance in 24 hours. Wire width: 3300 mm (trim—3000 mm)

Wire length: Preferably 32000 mm. Pressure head box with eveners and distribution perforated rolls.

Conventional fourdrinier wire part with quick wire drape in device.

Table rolls-cum-coils.

Latest type of projection slices.

5/6 vacuum boxes oscillating type. Formation table preferably with double shake.

Motor driven dandy roll preferably 600 mm dia.

Suction Couch (bronze).

Forward wire return roll (bronze).

Wet sheet vacuum transfer arrangement from wire to first press.

First suction press.

Second press: ventanip straight through.

Vickery felt conditions for wet felts except for pick-up felt having wangler press.

8 predryers with doctors.

One yankee cylinder of 32500 mm dia. with two touch rolls and three oscillating doctors.

Necessary felt dryers.

Horizontal rope reeler.

12 paper winding shells.

Presses and couch rolls to be operated hydraulically.

Dryer section to be equipped with two stage heating system and well ventilated latest type of hood.

Driving gears for the dryers to be enclosed/encased type.

All moving rolls to have anti-friction bearings.

Dryer bearings and gears with common continuous oil lubrication system.

Paper machine main drive to be of latest mechanical line shaft type with Ward Leonard set or equi-

valent as the prime mover, speed range 75 to 250 m/min.

All pumps, pipings, fittings, etc. to be included.

All electrical equipment either to be included or a detailed list with specifications to be supplied.

5. Paper Finishing Machinery:

One slitter rewriter to take full width of the sheet. Maximum operating speed: 800 m/min. One duplex sheet cutter to take the full width of the sheet. Capacity: 70 t/d in 50 gsm. substance. One simplex cutter of 1500 mm width. Capacity: 25 t/d in 50 gsm.

2 guillotine machines each of 1000 mm width.

One spiral paper-core making machine.

Capacity: 7000 metre/day.

One paper reel wrapping machine for a turn over of 600 reels per 24 hours.

6. Overhead Cranes:

Overhead cranes for both the machines separately.

One of 20 tonnes capacity with 2 Cradles and the other of 5 tonnes capacity with one cradle.

B. PULP SECTION:

This part is to cover the supply of Two Streets of sulphate pulping plants, separately for Bamboo and Bhutang-Khagra grasses, commencing from raw material handling to the production of fully bleached pulp.

STREET-I

Capacity: 50-55 tonnes/24 hrs. of air dry bleached bamboo pulp of 80-85° G.E. brightness.

1. Raw Material handling and Preparation:

Capacity: 175 tonnes of air dry chips/24 hrs.

Belt/Chain conveyor for feeding bamboo to individual chippers from

piles at a distance of approx. 50 metres.

2-3 multi-knife chippers, depending upon size and design with feed-in arrangement and cyclones.

1 latest type of oscillating/vibratory chip screen.

Dust collecting equipment.

Chip washing system.

Chip Conveyor to Silo.

1 Silo of capacity 1000 m³, complete with extraction device.

Chip Conveyor to digesters preferably pneumatic including chip feeding to digesters.

Chip weighing and magnetic trap equipment.

One Rechipper with back feeding system.

One Knife Grinding machine to take one set at a time.

2. Digester House:

Capacity: 60 tonnes/24 hrs. of screened unbleached air dry pulp.

3 cylindrical vertical stationary digestors each of capacity 60 m³. Indirect liquor heating system (outside pre-heaters).

Active alkali as Na₂O on raw materials: 18%.

Yield at unbleached stage 44% approximately.

1 Blow tank with complete heat recovery system, trash trap, bottom agitator, Capacity: 200 cu. m.

1 Brown stock knotter screen of Johnson Vibratory type.

3 Single-stage Brown stock washers with all auxiliaries and liquor tanks. Malone type filter for black liquor etc.

2 stage high consistency centrifugal sand traps.

2 stage centrifugal rotary screens.

1 vacuum pulp thickener.

1 High density pulp storage tower capacity 50 tonnes of Pulp at 10% consistency.

3. Bleaching House:

Chlorination Approximate retention time 90 minutes

at 3.5% consistency.
 Alkali stage: Approximate retention time 60 minutes at 10% consistency.
 First stage hypo: Approximate retention time 240 minutes at 7-8% consistency.
 Second stage hypo: —do—
 Vacuum Washing filters, Screw mixer-cum-conveyors, etc., after every stage of bleaching system.
 2-3 stage multi centricleaners.
 1 Vacuum Pulp Thickener.
 1 High density Pulp storage tower capacity: 50 tonnes of pulp at 10% consistency.
 Chlorine consumption: 10-12% on pulp (60% direct and balance as hypo-chlorite); alkali extraction 2%.

STREET-II

4. Capacity:
 50-55 tonnes/24 hours of air dry bleached Bhutang and Khagra reed pulp of 80-85° G.E. brightness.
 Plant and machinery of this Street is to be similar to that of Street I except that conveyors, chippers (preferably multi-knife drum type), and pulp and chip screens are to be suitable for processing reeds and reed pulps are to be incorporated. There need not be any chip washing system.
 The digesters are to be cylindrical tumbling type.
 There need not be any second stage of hypo-bleaching.

5. Auxiliaries:

The Streets I & II must be complete in all respects, i.e. including liquor and water pumps, drives, storage tanks, foam breaker, consistency, regulators, level indicators as also chlorine gassifier, dozing and continuous calcium hypo preparation and dozing plant.

C. SULPHATE BLACK LIQUOR QUINTUPLE-EFFECT EVAPORATION PLANT

Type: Long Tube

Capacity: Water evaporation: 50-55 M³/hr.

Weak Black Liquor at feed-in point: 70-75 M³/hr. having 13-15% solids.

Black liquor solids of organic to inorganic ratio at 1.6:1.0 (approximately).

Jet condenser alternatively surface condenser.

Mixed feed flow system preferred. Tube cleaning equipment to be incorporated.

Tubes in First two bodies to be in stainless steel.

All auxiliaries to make the plant complete including temperature, pressure and flow control equipments for liquor and steam, drives etc.

D. RECAUSTICISING PLANT:

Continuous recausticising plant of latest type commencing from green liquor clarifier to lime mud washer. Capacity: 450 m³ of clarified white liquor/24 hours of 100-105 grams per litre of active alkali.

All accessories to be incorporated including lime crusher, elevator, silos with lime extraction table.

White liquor storage tank of capacity 450m³.

The equipment are to be based on the availability of lime at 60-65% CaO content and the green liquor feed having the following indicative characteristics:

Temperature: 75°C.

Twaddle: 23°

Titrate alkali as Na₂O 85 g/l

Active alkali as Na₂O 40 g/l

NaOH 21 g/l

Na₂S 30 g/l

Na₂CO₃ 77 g/l

SiO₂ 6-7 g/l

R₂O₃ 0.5 g/l

CaO 0.2 g/l

E. CHEMICAL RECOVERY BOILER WITH VENTURE SCRUBBER AND CYCLONE EVAPORATOR:

The chemical recovery boiler shall

conform to the following approximate parameters.

MCR evaporation 18 tonnes/hr.

Peak evaporation 20 tonnes/hr.

Working pressure at superheated outlet 85 kg/cm²

Final steam temperature at superheated outlet 450°C approx.

Feed water temperature 105°C

Ambient temperature 30°C

Concentration of black liquor feed to venturi Scrubber/cyclone Evaporator. 50% at 85°C

Concentration of black liquor feed to boiler furnace before addition of salt cake. 60%

Dry black liquor solids to be fired per 24 hrs. 180/200 tonnes.

Approximate gross calorific value of dry black liquor solids. 2750 k. Cal/kg.

Salt cake feed 12-15 tonnes. per 24 hr.

Organic/Inorganic matter 1.8/1.0

Auxiliary fuel for start up and maintaining temp. of furnace Furnace oil

The chemical recovery boiler and evaporation system shall be complete with but not limited to the following. The pumps shall be complete with drive motors:

Water and steam drums complete with internals

Boiler tubes and manifolds

Integral pipe works

Valves and fittings

Superheater

Induced draft and forced draft fans.

Revolving oil burners for full generation of steam.

Retractable soot blowing equipment.

Feed water pumps, regulators.

Instrumentation and automatic combustion control.

Galleries and ladders

Special refractories and insulation materials

Venturi scrubber/cyclone type evaporator with Green liquor pumps—(1000 litres/minute at 30 metres head)

Mixing tank

—Black liquor spray gun with spare nozzles.

Smelt Dissolver with level regulators.

Reinjection equipment for Fly Ash recovery

Spares (Itemwise prices to be quoted separately)

Salt cake unit comprising of disintegrator to give 2 mm size salt cake with efficient cyclone and bag filters or trouble free conveyor, 24 hr. capacity salt cake bins with variable speed drive vibrating screen to separate oversize rotary feeder.

F. COAL FIRED BOILERS:

No. of units: 3 (two to operate at a time) Natural Circulation water tube boilers, of brickset design or equivalent suitable for

MCR evaporation — 30 tonnes/hr.

Peak evaporation — 35 tonnes/hr.

Working pressure at superheater outlet .. 65 kg/cm².

Final steam temperature at superheater outlet 450°C approx.

Feed water temperature—105°C

Ambient temperature — 30°C

Approximate fuel specifications (Coal)

Carbon	..	80%
Hydrogen	..	55%
Sulphur	..	5.55%
Nitrogen	..	1.4%
Oxygen	..	8.4%
Ash	..	6-9%
Moistures	..	2.5-3%
Calorific value —	8050.K.Cal/Kg.	

The Boilers shall be complete with but not limited to the following.

The pumps shall be complete with drive motors:

Water and steam drum complete with internals.

Boiler tubes and manifolds

Integral pipe works

Supporting steel works

Valves and fittings

Superheater

Economiser with cleaning equipment.

Economiser recirculating pumps and starters

Soot blowing equipment

Mechanical stoker in case of stoker fired boiler

Secondary air fan

Induced and forced draft fan

Mechanical - cum - Electrostatic dust collector

Dampers

Ducting

Hoppers

Feed water regulators

Remote water level indicators

Instruments and automatic combustion control

Galleries and ladders

Special refractories and insulation materials

Boiler feed pumps

Coal Bunkers (24 hour capacity)

Furnace oil heating equipment and transfer pumps.

Coal handling Plant (common for three boilers) 2 crusher of capacity 50 tonnes/hr. each.

Ash handling plant (common for three boilers)

Boiler House Pipe work and valves.

Water demineralising plant including

Water stabilising equipment (Common for three boilers + 1 chemical recovery boiler).

Analysis of River Water

Total solid 60-550 ppm

Dissolved solids 45-60 ..

Turbidity

(Silizer scale) 22-450 ..

Suspended solids 10-450 ..

Alkalinity as CaCO₃ 42-110 ..

Total hardness as

CaCO₃ 28-56 ..

Calcium (Ca) 7-18 ..

Magnesium (Mg) 2-5 ..

Sulphate (SO₄) Traces ppm

Chloride (Cl₂) Traces ..

Iron (Fe) 1-5 ..

PH 7 ..

Methyl Orange

Alkalinity as CaCO₃ 0-5 ..

Non-Carbonate hardness as CaCO₃ Traces ..

Note: The raw water for steam plant shall be received from clarifurucators and shall have Turbidity of about 50 ppm.

Electrical equipments

Special erection and maintenance tools

Details of chimneys to be installed and recommended method of connection.

Spare parts (Itemwise prices to be quoted separately)

G. TURBO ALTERNATOR:

Single casing combined reaction and impulse type turbine with two regulated extractions conforming to the following general specifications :—

(i) Turbine

Rated output at 0.8 p.f. 10,000 K.W.

Minimum output without steam extraction 4,000 KW

Turbine synchronous

Speed 3,000 rpm.

Steam conditions at turbine inlet 63-65 kg/cm² at 450°C approx.

Regulated extractions	1st stage	2nd stage
Rated pressures	11 kg/cm ²	4.5 kg/cm ²
Adjustability	10-12	4.5

of pressure kg/cm² kg/cm²
 Rated quantity 10-15 35-54
 of extraction tonnes/hr. tonnes/hr.
 Steam to condenser. As little as possible to maintain vacuum.

The turbine shall be complete with but not limited to:

Pressure oil lubricated bearings
 Admission steam valve hydraulically released.

Servomotor operated steam shut off valve.

Centrifugal speed regulator with automatic draw off controller.

Oil circulation system comprising of oil, turbo pumps, oil motor operated pump, oil filters, coolers and tanks etc.

Instrumentation for speed, pressure and temperature.

Insulation with special casing

Special tools for erection and maintenance

Air ejectors and starting ejector.

Condenser with condensate pumps
 Spare parts (Itemwise prices to be quoted separately)

Safety and protective devices providing protection against:

- (a) Over speed
- (b) Lubricating oil pressure drop
- (c) Thrust bearing axial shift
- (d) Vacuum drop
- (e) Regulated extraction pressure rise
- (f) Pressure rise in condenser steam space
- (g) Pressure rise in regulated extraction line

(ii) Alternator

12,500 KVA, 6.6 KV, 3 phase, 50 cycles, 0.8 pf alternator with closed ventilation circuit coupled to the above mentioned turbine complete with, but not limited to the following:—

Starter consisting of welded rolled

steel element.

Pressure oil lubricated bearings.

Air coolers.

Exciter.

Voltage regulation system.

6 current transformers indoor type for differential protection.

3 current transformers for metring, measurement and protection.

3 potential transformers protected by HRC fuses and disconnecting switches.

Note: The basic requirement of process steam and electric power are given below. Alternate offers with modified parameters of boilers, chemical recovery boiler and turbo-alternator meeting with the basic requirement may also be submitted for consideration:

Process steam

1.11 kg/cm² 11-15 tonnes/hr.

3.5 kg/cm² 35-45 tonnes/hr.

Power 10,000 KW.

H. EMERGENCY

DIESEL GENERATOR:

Indoor type Diesel generating set comprising of diesel engine, turbo-charger with air filters, oil cooling and oil filter devices, hydraulic regulation, compressed air starting, instrumentation protective and safety devices, current and potential transformers coupled to alternator per following:

Details:—

Electrical output 1000 KVA

Generator Voltage 6.6 KV

Phases 3

Power factor 0.8 lag

Frequency 50 cycles/sec.

other data

Site altitude 1060 ft (323 meter) to 1150 ft (350 m). above sea level.

Mean ambient temperature

Summer 30°C

Monsoon 32.9°C
 Relative humidity summer 94%
 Monsoon 98%
 Nature of atmosphere Particle laden.

Nature of cooling water: River water turbid but clear after filtering, Sediments 1 part in 10,000 in monsoon.

Starting of generator: Mains failure starting.

Type of generator. Drip, proof, forced air circulation Conventional D. C. excitation.

I. WATER WORKS

Capacity of clarified water: 10 m.g.d. (45000 cubic m)

Capacity of filtered water : 0.5 m.g.d. (2,250 m³)

Raw water intake pumps 3/4 necessary chemical dosing arrangement

Raw water clarifiers 2

Clarified water storage tanks. 0.5 m.g.d.

necessary number of booster pumps

Water filtration plant

Feed water treatment plant for Boilers.