

# **SPECIFICATIONS OF 1250TCD SULPHITATION SUGAR PLANT EXPANDABLE TO 2000 TCD**

**“GUIDELINES” TO SPECIFICATIONS OF CANE SUGAR PLANTS CAPABLE OF CRUSHING 1250 TONNES OF CANE PER DAY AND SUITABLE FOR EXPANSION TO 2000 TONNES OF CANE PER DAY TO PRODUCE DIRECT CONSUMPTION WHITE PLANTATION SUGAR**

## (I) CANE MILLING PLANT

### (a) Cane Handling and Feeding Arrangement

#### (i) Cane Handling

##### ALT - I

For 1250 TCD - One Bridge with one trolley, having sling bar system – Two motion type

For 2000 TCD - Addition of one more trolley only

The crane shall be 2 motion 7.5 tonnes S.W.L. electrically operated overhead unloading crane conforming to Class IV IS specifications and capable of 20 lifts per hour. In each lift, sling shall lift at least 6.0 tonnes of cane. The crane shall be complete with its accessories, attendant platform along the length of the gantry on both sides. It shall be heavy duty type and suitable for continuous outdoor working. The crane span shall be 30 metres.

Design Code - IS. 3177 & 807

All electric motors shall be of crane duty, T.E.F.C. enclosures, suitable for 300 operations per hour with following specifications :

Particulars	Type of Motor	H.P.	Rating	Duty
Hoisting drum drive	Squirrel cage	35	1 hour	S4
Holding drum drive	Squirrel cage	35	1 hour	S4
Cross travel drive	Slipping	10	½ hour	S4

For operation of these motors, push button type panel shall be provided and its location shall be in the cabin attached to the trolley.

The following speeds shall be provided for various motions :

Hoisting	12 meters / minute
Holding	12 meters / minute
Cross travel	20meters / minute

The height of the lift shall be 10 metres. All gear boxes shall be totally enclosed, dust proof, helical type gear and shall be designed with a service factor of 2.0. All couplings shall be flexible gear type, with periodically greasing arrangements. All brakes shall be of electrohydraulic thruster operator type. A suitable shed be provided on the trolley. The structure and bridge should be designed for 2 Nos. Trolleys each of 7.5 T SWL capacity. The bridge shall be of box type construction made of IS:2062.

## ALT - II

For 1250 TCD - One bridge with one trolley, of three motion, having grab system (5 T SWL Capacity).

For

2000 TCD - One additional bridge with one trolley, of three motion with grab system.

The crane shall be of 3 motion electrically operated overhead unloading crane conforming to class IV IS ; specifications and capable of 20 lifts per hour. In each lift, grab shall lift at least 2.5 tonnes of cane. The crane shall be complete with its accessories, gantry columns, attendant plat-form along the length of the gantry on both sides, 2 Nos. stair cases, motors etc. It shall be heavy duty type and suitable for continuous outdoor working. All operations shall be electrically controlled from the operator's cabin. The crane gantry span shall be 22 metres. The crane gantry shall be 30 metres in length with gantry columns 10 metres apart for initial capacity and shall be extended by 10 mtrs. for ultimate capacity. The crane bridge shall be of box type construction made of IS-2062 or equivalent. The gantry columns should have 'L' shape construction but the 4 nos. end columns should have double L construction at 90 deg. The end columns should be provided with tie beams on each end.

If there is more than one bridge, each bridge should have separate down shop leads and separate ACB. The operators cabin shall be provided with fan, ladders, glass panels and windows etc. There should be no open gearing. All wheels shall be provided with 'L' type bearing housing.

The crane columns shall be extended by 2 metres for the shed to be provided at a later date by the purchaser. The structure of the gantry shall be of adequate strength to provide additional crane of identical specifications for expansion to ultimate capacity.

Design Code - I.S. 3177 & 807

All electric motors shall be of crane duty T.E.F.C. enclosures suitable for 300 operations per hour with following specifications :

Particulars	Type of motor	H.P.	Rating	Duty
Hoisting Drum Drive	Squirrel cage	25	1 hour	S4
Holding Drum Drive	Squirrel cage	25	1 hour	S4
Long travel drive	Slipring	10	½ hour	S4
Cross travel drive	Slipring	7.5	½ hour	S4

For operation of these motors push button type panel shall be provided and its location shall be in the cabin attached to the trolley.

The following speeds shall be provided for various motions :

Hoisting	-	12 metres/minute
Holding	-	12 metres/minute
Long Travel	-	20 metres/minute
Cross Travel	-	20 metres/minute

The height of the lift shall be 10 metres. All gear boxes shall be totally enclosed, dust proof, helical type gear and shall be designed with a service factor of 2.0. All couplings shall be of flexible gear type, with periodically greasing arrangement. All brakes shall be of electro hydraulic thruster operated type. The ratio of pulley dia (PCD) to wire rope dia not be less than 20.

A suitable shed shall be provided on the trolley.

(ii) **Feeder Table** : For 1250 TCD - 1 No:

For 2000 TCD - Additional 1 No:

Cane feeder table of minimum 6 metres width and 7 metres in length to be installed at right angle to the cane carrier. The feeder table shall be of all steel construction fitted with 8 strands of 150 mm pitch heavy duty steel drag type chains having breaking strength of minimum 40,000 kgs. The feeder table shall be complete with cast steel machine cut sprocket wheel, shafts, bearings etc. The feeder table shall be driven by a 15 B.H.P., T.E.F.C. squirrel cage motor and coupled to a variable speed drive and a reduction gear so as to provide speed regulation from 1 to 3 mtrs/min. The feeder table shall be suitably supported on steel structure designed to withstand heavy shocks. It shall be installed in a manner so that it is horizontal.

Operator's cabin on a suitable height shall be provided to have a clear view of the loading of the cane carrier. A suitable ladder shall be provided to this cabin.

**Note: Feeder table recommended only in case of unloader with sling arrangement.**

### Cane Carrier and Preparatory Devices:

(b) **Cane Carriers**

(i) **Cane Carrier:**

One cane carrier 1525 mm wide and horizontal loading length 30 mtrs. shall be provided. The length of its inclined portion shall be such that it gives an inclination of 18 deg. for the leveller with a minimum length of 6 metres having a slope of not more 8 deg. before fibrizer. It shall have suitable elevation to suit the installation of fibrizer. It shall have two strands of chains of 150 mm pitch. The breaking strength of the chains shall be minimum 40,000 kgs. The cane carrier and its structure shall be of all steel construction, the slats 6 mm thick shall be as per IS: 8236 and fastened to chain by bolts and nyloc nuts or by bolts and check nuts. The horizontal portion of the carrier shall be arranged below the ground level in such a way so that the sloping sides of the carrier is about 300 mm above the ground level. Space of minimum 750 mm shall be left in the pit on either side of the carrier for inspection and cleaning purpose. Arrangement for adjusting the clearance upto 50 mm between tip of knives and the slats in the cane carrier shall be provided in the inclined portion. The carrier frame work shall not be less than 5 mm thick and mild steel plate extending along the complete length of the carrier except at the place of cane leveller where the thickness should be 10 mm for about 2500 mm length. The frame work shall be adequately

stiffened at the top and bottom by angle iron welded to the side plates. The side plates shall be bolted to and supported by rolled steel 150 mm x 75 mm channels or sections of equivalent strength and be provided with base plate of ample area reinforced by gusset plates or angle plates. Two foundation bolt holes would be provided in each base plate. The columns in the immediate vicinity of the cane knife set shall be 225 mm x 75 mm double channels or sections of equivalent strength. All columns at drive end should be adequately braced by angle cross pieces of heavy section secured by gusset plate and bolts or by welding. Three longitudinal 150 mm ISMB runners with renewable 6 mm thick spring steel wear pads would be bolted on the top side of the cross pieces to support the cane carrier chain rollers. The distance between the adjacent supporting columns should not exceed 3.5 metres. The runners would be lowered slightly where the chain arrives at and leaves the runners. 6 mm x 75 mm flat iron should be tag welded/bolted on the side plates of the cane carrier so that cane carrier slats touch the flat iron only to avoid wearing on side plates.

The return side of the apron can slide on the guide angle runners with 6 mm thick spring steel wear flat provided the slats are equipped with renewable wear pads or alternatively be supported on C.I. idler pulleys having 280mm dia and 60mm width and secured on 75mm dia MS shaft running in G.M. Bushes fitted in C.I. Brackets with grease cups fastened to each set of supporting columns. Side plate be provided inside the columns to guide the slats.

The carrier chain driven by means of cast steel sprockets having machine cut teeth atleast 14 in number and mounted on minimum 170 mm central dia. head shaft of 40 C8 quality or equivalent and shall run in 140 mm size split gunmetal line cast steel plummer block. The head shaft would be driven by machine cut gears of adequate strength. The columns under the head shaft and carrier drive shall be extra heavy section to withstand vibrations. At the non-driving end of the cane carrier, the chain shall be mounted on cast steel sprockets having machine cut teeth on minimum 125 mm central dia tail shaft of 40 C8 quality or equivalent running in minimum 100 mm size gun metal lined cast steel. Housing with slide rails and tension bolts for tightening the chains

The head and tail shafts be hot forged and ultrasonically tested.

Pneumatic steaming arrangement to be provided on the head shaft of cane carrier to clean slats and chain to remove cush cush from the carrier chain.

### **(II) Rake Carrier :**

Rake type conveyor shall be of steel construction having suitable width trough to accommodate 1525 mm rake width and of suitable length to suit minimum feeding height 3 mtrs above top roller of 'new' mill. The inclination of the rake carrier shall be 45 deg. max. and the boot having no horizontal portion. Tail shaft center of rake carrier shall be in line with head shaft centre of cane carrier. The rake carrier and its structure shall be of all steel construction with two strands block type forged chain of 229 mm pitch chain having 60,000 kgs. breaking strength having locking arrangement with nyloc nuts or check nuts. Flights would be made out of 6 mm thick mild steel plate of suitable shape and profile and welded on pipe or box construction beams. These beams shall have suitable arrangement for fitting with the chain attachment at every fourth link with the help of bolts, nyloc nuts or check nuts

The rake carrier should have runners of channels angle iron with 6 mm wear flats and 8 mm thick mild steel bottom trough plate with stiffeners and should be supported on steel channel columns of adequate strength provided with rigid base plate. The columns should be adequately braced to avoid vibrations. The elevator chain shall be driven over two cast steel machine cut sprockets mounted on 130 mm central dia. head shaft of 40 C8 or equivalent quality running in minimum 100 mm size gun metal lined cast steel bearings secured to head shaft columns. The tail shaft of minimum 100 mm central dia. 40 C8 or equivalent quality should have two cast steel

sprockets having machine cut minimum 14 No. of teeth and would run in minimum 90 mm size gun metal lined, cast steel plummer blocks attached to the rake carrier boot. Space of minimum 750 mm on both sides at tail end to be kept.

The portion of the chain below the fibrizer shall be suitably covered to avoid damage due to prepared cane thrown by the fibrizer. The tightening arrangement shall also be provided with tail shaft bearings.

## c) Cane Carrier / Rake Carrier Drive

- (i) Cane carrier - 50 B.H.P.
- (ii) Rake carrier - 25 B.H.P.

Each carrier shall have a constant torque characteristic over operating speed range. The motor to be coupled to electrodynamic variable speed unit and to helical gear box having service factor of 1.7 with open gearing/sprockle drive to provide following apron speed.

- (i) Cane carrier - 3 metres to 10 meters/ minute.
- (ii) Rake carrier - 10 to 25 metres/minute.

## (d) Rake type Intercarrier for zero mill –

Rake type intercarrier, between the future new mill and first mill whose centre distance shall not be less than 8000 mm shall be provided. The width of the carrier trough shall be suitable to accommodate 1525 mm rake width and its cross section suitable for handling bagasse of ultimate crushing rate of ultimate capacity. It shall be similar in construction as described under rake carrier item b (ii).

Rake carrier drive shall consist of the TEFC motor of 25 BHP, 1440 RPM with enclosed helical speed reducer having service factor of 1.7, electrodynamic variable speed coupling, common bed frame and set of open spur gearings / sprockets and chains with guards. The linear speed shall not be more than 25 m/minute. A suitable M.S. fabricated new mill by pass chute shall be provided.

**Note : Alternatively, in place of this carrier, the rake elevator of increased centre distance directly feeding the 1<sup>st</sup> Mill can be considered in which case its drive should be 40 HP instead of 25 BHP.**

## (e) Cane Preparation

### (i) Cane Chopper

One cane chopper set having not less than 24 knives secured to cast steel hubs of IS :1030 grade 280 – 520 W mounted on a forged steel shaft of 140 mm dia. of 40 C8 quality. The dia. over the tips of knives shall not be less than 1400 mm. The knife shaft shall be supported at 120 mm bore, heavy duty self aligning double row spherical roller bearings with adopter/withdrawal sleeve in steel plummer blocks. The knives shall be of special shock resisting steel having hard faced cutting edges, hardness 45 to 48 HRC and tenoned into the hubs eliminating the shear on the bolts which should be of EN8 steel or of equivalent strength with nyloc nuts. The knives shall conform to IS ; 8461. A suitable fly wheel of CI grade, FG 260 IS-210 duly machined and well balanced shall be provided at the outer end of the shaft.

Cane chopper set shall be driven by a continuously rated drip proof/screen protected slipping motor of 75 B.H.P. and 600 R.P.M. synchronous speed at a total slip of 15 percent. It shall be coupled through suitable helical gearbox having 2.0 service factor by means of geared coupling to

get final speed of 300 RPM capable of transmitting 75 B.H.P. continuously. The motor shall be complete with starter and suitable buffer resistance. The starting current should not be more than 300% of rated current. The direction of rotation shall be reverse.

The knife set shall be installed on the horizontal portion of the carrier before leveller and clearance in between the slats and knives tips shall be 850 mm. The knife set shall be totally enclosed by suitably reinforced hood of 10 mm thick and mild steel plate attached to the cane carrier frame work and provided with suitable swing flaps and bolted doors at top of the hood.

## (ii) Cane Leveller :

One cane leveller set having not less than 36 knives secured to cast steel hubs of IS:1030 Grade 280 – 520 W mounted on a forged steel shaft of 200 mm dia. of 40 C8 quality. The dia. over the tips of knives shall be not less than 1400 mm. The knife shaft shall be supported at 150 bore, heavy-duty self-aligning double row spherical roller bearings with adopter / withdrawal sleeve in steel plummer blocks. The knives shall be of special shock resisting steel having hard faced cutting edges, hardness 45 to 48 HRC and tenoned into the hubs eliminating the shear on the bolts which should be of EN8 or of equivalent strength with nyloc nuts. The knives shall conform to IS. 8461. A suitable flywheel of CI grade, FG 260 IS-210 grade duly machined and well balanced shall be provided at the outer end of the shaft.

Cane leveller set shall be driven by a continuously rated drip proof / screen protected slipping motor of 150 B.H.P. and 600 R.P.M. synchronous speed at a total slip of 15 percent. It shall be directly coupled by means of geared type coupling capable of transmitting 150 B.H.P. continuously. The motor shall be complete with starter and suitable buffer resistance.

The knife set shall be installed on the inclined portion of the carrier and be provided with a suitable device for adjusting clearance in between the knives tip and slats from 250 to 300 mm. The knife set shall be totally enclosed by suitably reinforced hood of 10 mm thick and mild steel plate attached to the cane carrier frame work and provided with suitable swing flaps and bolted doors at top of the hood. Provision for identical additional motor drive arrangement with load balancer on other end should be made for ultimate capacity.

## (iii) Swing Hammer Fibrizer

Swing hammer type - located at the head end of carrier, to suit 1525 mm wide cane carrier having not less than 84 hammers. Weight of each hammer shall not be less than 18 kg.

The rotor shaft shall be heavy duty minimum 300 mm dia at the hubs and 220 mm dia. at the bearing journals and shall be 45C8 as per IS 1570. The fibrizer should have detachable type domite type of hammer tips having size 90x90mm. The hammer shank shall be made of special shock resistant alloy steel and secured through 50mm dia SS pins. The hammer shank and fibrizer disc should have GM bushes to suite SS pins The hubs shall be fabricated from minimum 50mm thick MS plates and fitted on rotor shaft.

Anvil plate shall be pocketed design, having wrap angle of 160 deg Minimum. The base plate thickness of the anvil shall be minimum 25 mm. Hard facing on the anvil-working surface shall be having minimum hardness 600 BHN. Anvil plate shall have provision for adjusting the anvil clearance. A suitable guide plate/Floating flap of 20mm thick to be provided, at the entry point of the anvil.

Rotor shall be supported on two heavy duty self aligning double row spherical roller bearings. with adapter/with drawal sleeve in split type C.S. plummer blocks. Tip dia. of hammers shall be 2000mm speed when running at 750 RPM motor speed.



The fibrizer rotor shall be completely covered by reinforced mild steel fabricated hood made out of 12 mm thick plate attached to the cane carrier frame work and will be complete with deflector plate, adjustable mild steel fabricated anvil plate, anvil suspension gear, front adjustable cover, rear chute of 12 mm thick with 2.5 thick SS lining, bolted doors on the top of the hood. Rotor bearing plummer blocks shall be cast steel. Mist/pressure lubricating system for bearings shall be provided. Provision shall be made for adjusting the clearance. Pressure lubrication system should have provision for 2 Nos. Pumps. 2 Nos coolers (one standby) oil reservoir pressure gauge, piping, return line, needle valve fitting etc. And auto starting of stand by pump.

The Fibrizer shall be driven by 1 No. continuously rated 600 HP SPDP slipping motor of 750 RPM synchronous speed at a total slip of 15%. The motor shall be directly coupled to one end of the fibrizer shaft by means of coupling capable of transmitting 600 HP continuously. The other end of the fibrizer shall have provision for installation of additional identical motor by means of flexible gear coupling at later stage for the ultimate capacity. The motor shall be complete with load balancer stator rotor starter and suitable buffer resistance.

## f) AUTO CANE FEED CONTROL SYSTEM

The automatic cane feeding control system shall be installed on cane carriers. The system shall ensure the uniform feed rate to the 1<sup>st</sup> mill with provision to change the feed rate at any time having a variation not more than  $\pm 5\%$  set rate. Primary cane carrier shall follow speed of secondary cane carrier in a fixed ratio. Load of all cane preparation devices shall override the speed signal of each cane carrier. When load of any cane preparation device exceeds 80% of rated load, the speed of that cane carrier shall be proportionately reduced. If load exceeds 100% of rated load, that cane carrier will stop. It will restart automatically when overload condition on that cane preparation device becomes normal. These overload settings shall be adjustable from the control panel. The system shall have the following provisions.

**Sensors** : For load sensing of cane preparatory devices such as chopper, leveller, fibrizer and 1<sup>st</sup> mill, suitable current transformers / two wire electronic analogue pressure transmitters with capacitance sensing technology with 4-20 mADC output and configurable for calibration to the required pressure ranges within the designed pressure span of the transmitter. In addition to this level sensing of prepared cane at Donnelley chute should be provided.

**Control Action** : The system should be provided with two control actions i.e. proportional and ON-OFF control actions. Proportional control as per the 1<sup>st</sup> mill load. ON-OFF control as per the high load settings of the cane preparatory devices and first mill.

**Set Points** : Following settings are to be provided,

- i) For loads of various cane preparatory devices and 1<sup>st</sup> mill motor / turbine, precision load setters of 1 K 10 Turns helipot with dial knobs.
- ii) For average height and feed rate precision 10 K 10 Turns helipot with dial knobs.

**Visual Indication** : Coloured lamp indicators for the high set load values.



## Carrier Speed Adjustments :

The speed of the cane carriers can be adjusted from zero to the rated RPM with the settings provided on the control panel at operators console.

Proportional control at speed of carriers (cane carrier and rake carrier) as per 1<sup>st</sup> mill load, preparatory devices load and blanket thickness of cane carrier shall be provided.

**Indicators** : Analogue load indicators (i.e. current or pressure indicators) and speed indicators.

**Power Supply** : 230 V AC, 50 Hz

## (g) Milling Plant

### (i) Mills :

For 1250 TCD : 4, three roller mills 600mm dia. x 1200mm long, grooved under feed rollers and Donnelly type chutes

For 2000 TCD : Addition of 1 No: 760mm dia. x 1525mm long mill. New mill shall be installed as zero mill.

Each mill roller shall be minimum nominal dia. of 600 mm x 1200 mm length and journals of minimum 300 mm dia x 375 mm length and journal centre distance of minimum 1800. The rollers shall be of coarse grain cast iron having hardness 180 -210 BHN. The composition of the shell material shall conform to IS : and shall be :

Total carbon	-	3.20 to 3.6 percent.
Manganese	-	2.2 to 3.2 percent
Silicon	-	1.2 to 2.2 percent
Phosphorus	-	0.5 per cent Max.
Sulphur	-	0.15 percent Max.

The cast iron shell shall be hot shrunk on forged steel shaft of 40C8 quality conforming to IS: 1570 or equivalent having a minimum tensile strength of 58 kg/mm<sup>2</sup>. All the shaft shall have square ends, not less than 260 mm square. Top roller shall be fitted with stationary collars and juice rings in two halves. The bottom roller shall be provided with juice rings and removable guards to prevent entry of juice into the bearings. The cast steel crown pinions shall have minimum 300 mm face width and 17 No. machine cut teeth conforming to IS :2708 Grade 3, keyed to roller shaft and suitable mild steel guards and troughs.

The headstocks shall be of cast steel as per IS:1030 grade 280/520 W. These will be of king boltless type. Removable hard steel/cast steel/gun metal/fibre wearing plates on feed side as well as discharge side and with lubricating arrangement between top roller bearings and wearing plates shall be provided. The top and side caps shall be of cast steel as per IS:1030 grade 280/520 W and shall be securely locked in position for quick assembly. Stainless steel strip of 8 mm thick shall be provided in the side roller bearing face of the head stock. The eccentricity between top roller bearing centre and hydraulic cap centre shall be kept suitably towards the feed side of the headstock, except in case of inclined headstock.

All rollers shall be coated with surface roughening electrode material and its bearings shall be of cast steel with gun metal / white metal, Gr.6 lined as per IS – 25, 1979 and with water cooling arrangement. The side roller bearing shall be of cast steel housing with renewable gun metal liner as per IS:318

The housing shall have water-cooling arrangement. All top roller bearings shall be interchangeable. Similarly all feed side and discharge roller bearings shall be inter changeable by their respective bearings.

The mills shall be provided with cast steel trash beam as per IS:1030 grade 280 / 520W and supported on heavy steel brackets with pivoted journals fitted in the head stocks and adjustable by means of tie rods and fitted with removable cast steel trash plate as per IS:1030 grade 280/520W, bolted by high tensile bolts and nuts. Top roller scrapers shall be of floating type. Scrapers for top and discharge rollers shall have renewable cast iron tips. Messchaert groove scrapers shall be of spring steel secured on square shaft and supported on cast steel/fabricated steel blocks and provided with lever or other suitable adjusting device. All mechanical parts of mill shall be designed for a crush rate of 2000 TCD.

Each mill shall be provided with hydraulic loading system, consisting of hydro-pneumatic accumulator, one for each of the journal of the top roller, one extra as spare and accessories such as pumping set, receiver tank, gauges, remote control panel and roller movement indicator electronic type . The dia. of the hydraulic ram for top cap shall be minimum 240mm. The hydraulic system shall be designed for a oil pressure of 280 kg/cm<sup>2</sup> g.

One forced feed oil lubricator for each mill having 24 number of points shall be provided so as to have two points for each bearing - one being as standby and spare points for future requirement.

OR

One centralised mill lubrication system having positive displacement pump at about 400 bar pressure having dual delivery lines made of SS 304 x 2mm thick (DIN standard) of 16mm dia for main line on both sides of the mills with changeover valves, relief valves and distributors with delivery adjustment arrangement with feed line of 8mm dia SS x 1mm thick provided to the bearings, complete with control panel pressure gauges and audio/video alarm with suitable timer arrangement for controlling pump operations.

Juice trough under the mills shall be made of 6 mm thick aluminum plates or 5 mm thick SS 409 M. The trough shall be bolted to the headstocks with stainless steel bolts and copper washers. Joint shall be suitably sealed to prevent any juice leakage.

All the mills shall be high set so that no part of the juice tank pumps are situated below floor level. All the mills shall have common gangway on both sides having width not less than 750 mm with chequered plates or gratings and minimum four number staircases one for crusher side, one for bagasse elevator side and two from mill drive platform, along with the cross connections after each mill.

Access from mill platform to rake elevator drive platform with suitable cat ladders shall be provided. All gangways and staircase shall have hand railings.

**ii) Cast iron grooved underfeed roller : 4 nos.**

Cast iron shell hot shrunk fit , grooved inter-meshing type under feed roller of the same material as that of mill roller having minimum nominal diameter 100% of the mill roller nominal diameter. The shaft shall be 40 C8 quality conforming to IS 1570 and of 200 mm central dia. and supported by means of bush bearing of minimum 120 mm bore. The under feed roller shall be

driven by top roller through gears to give surface speed of about 10% higher than the mill roller surface speed. It shall have arrangement to adjust the setting in horizontal & vertical axis by plus-minus 25 mm.

### iii) Donnelly type Chute: - 4 nos.

The Donnelly type chute fabricated out of 6 mm thick of SS 409 M shall be provided. It shall have arrangements to adjust the blanket thickness from front as well as back side. The height of each chute shall not be less than 2.5 metres and its inclination not less than 80 deg. with the horizontal. Side plate of chute shall have full height transparent sheet to see the bagasse level. First mill chute shall have electronic level sensing device to control cane feeding. Suitable indicators shall also be provided to indicate bagasse level in other mill chute. Level sensing device should have on off control of the intermediate rake carrier drives and sequencing interlock.

### iv) Rake type Intermediate Carriers. Three nos.

Rake type carrier, between the mills whose centre distance shall not be less than 8000 mm be provided. The width of the carrier trough shall be suitable to accommodate 1200 mm rake width and its cross section suitable for handling bagasse of ultimate crushing rate with imbibition upto 300% on fibre. It shall be similar in construction as described under rake carrier item Ib(ii).

The rake carriers shall have runners of angle iron / channel with 6 mm spring steel wear flat and 8 mm mild steel bottom trough plate with stiffeners and be supported on steel channel column provided with rigid base plate. The columns shall be adequately braced wherever necessary.

Each rake carrier drive shall consist of the TEFC motor of 20 BHP, 1440 RPM with enclosed helical speed reducer with open gearing, fluid coupling, common bed frame. The linear speed shall not be more than 25 m/minute. The rake carrier chain shall be 229 mm pitch block type chain having breaking strength of minimum 60,000 kgs. driven over two cast steel sprockets having 14 No. cut teeth mounted on 130 mm central dia. head shaft of 40 C8 quality conforming to IS:1570 or equivalent and running in 100 mm size split gun metal lined cast steel bearings secured to head shaft columns. The tail shaft of 100 mm central dia. and of 40C8 quality or equivalent shall have two cast steel or fabricated sprockets having machine cut teeth and shall run in 80 mm size gun metal bush lined cast steel plummer blocks attached to the elevator boot. Its bearing shall be outside the elevator trough. The tightening arrangement shall be provided with the tail shaft bearings. The angle of the rake carrier shall not be more than 45deg. The rake carrier shall be designed for head end discharge of bagasse to the Donnelly type chute.

### (ii) Mill Drive:

#### Four Nos. Thyristor Controlled Variable speed D.C. Drives

Each mill shall be driven by continuously rated 300 HP D.C. electric motor. D.C. motors shall be force cooled with air filters SPDP with class V overload duty S1 continuous. The motor base speed shall be 1500 RPM and shall have constant torque characteristic between 20% to 100% base speed and constant power characteristic between 100 to 110% at base speed.

Detail specifications of motor shall be as below:

Rating (continuous) - 300 HP, 1000 rpm, Class V, Duty S1

Overload duty Class	-	V
Armature voltage	-	460 V
Field voltage	-	220 V
Protection	-	IP 23 (SPDP force cooled with air filters)
Class of Insulation	-	F, Temp. rise limited to class B at continuous rating
Speed (RPM) Base	-	1500
Mounting	-	Horizontal foot mounted
Ambient Temp.	-	45 degree C

The motors shall be designed for variable speed operations, controlled by the thyristor convertor station, and shall have constant torque characteristics down to continuous operating speed of 20% of the rated speed. RTD for temperature detection of motor winding shall be provided. Thermesters shall be provided for thermal protection of the DC Motors. RTD shall be provided for bearings. Necessary thermister relays & RTD scanner with tripping facility shall be provided in thyristor panel.

## FOUR Thyristor Converter Station ( Digital type )

For operation and control of the four D.C. motors,

Convertor cubicals fabricated from 12/14 SWG cold rolled steel sheets, free standing, passivated, and painted with anti-corrosive paints. The cubicle will house all protective switchgear, thyristor modules, regulation circuit, interlocking relays, mounted on passivated plates, the cubicle will conform to IP-30 protection. All necessary indications, annunciations, controls will be neatly arranged on cubicle front door with neoprene gaskets on all edges of panel. Ventilation openings shall be provided at the top of panel and on side covers by louvres suitably covered by fine wire mesh.

The thyristor drive panel shall be as per following specifications:

- a) Armature convertor
  - Rating of DC motor controlled – 300 HP
  - Rated DC voltage - 460 V
  - Incoming AC supply - 415 V, 3 phase, 50 Hz
  - Torque rating - 100% cont. 150% for 2 hours and 200% for 1 min class V constant of rated full speed.
  - Type of Thyristor bridge - 3 ph, 6 pulse fully controlled non regenerative

- Voltage grade of thyristors
- 1500 V PIV (approx)

Panel complete with field convertors, regulators, tacho feedback, safety protection, (electronic thermal overload, electronic instant O/L, Phase seq. ,Phase loss, field failure, over speed, tacho/speed loss, earth fault), indication meters, push buttons, switch gears and controls.

Drive bi - directional in operation with field reversal in the speed range of 50% to 100% of speed at constant torque. Speed regulation will be  $\pm 1\%$  of base speed at base speed by tacho feedback. The panel will have facility to accept 4 to 20 mA signal for speed setting in auto mode. Speed regulation with armature voltage feed back shall operate in case failure of tacho feed back. Auto visual window annunciators will be provided. The pressure ventilation system with electric motor driven blower with filter will be provided for panels. One common control desk with controls shall be provided for each motor to be controlled from this common desk. The thyristor panels to be installed in AC room to be provided by the Purchaser.

## (vi) Mill Gearings:

Each mill drive shall be coupled through flexible gear coupling to enclosed reduction gear and single stage low speed reduction gearing unit capable of transmitting 300 HP continuously under shock load conditions at base speed of the motor. The total reduction ratio of the gearing unit should be such so as to run the mill roller at a surface speed of 11.0 m / min.. when motor is run at its base speed. The enclosed reduction gear boxes shall have hardened and ground internals and shall have minimum service factor 2.0 with FLS system with double cooler, filters and pumps and automatic starting of spare pump. The open spur gearing shall be designed to transmit 300 HP continuously at mill roller surface speed of 11.0 m / min. under shock load conditions and shall conform to IS:4460-1967. The low speed reduction gearing unit shall have pinions and gear with machine cut teeth by gear generating process in both cases. The module of open gearing should not be less than 25. The pinion should be of EN-24 and gear shall be of IS-2708 Gr.III. Hardness of pinion and gear shall be minimum 250BHN and 200BHN respectively.

Suitable bed plates made in sections, mild steel guards for completely enclosing the gears and pinions (low speed), shall be provided. Shafts of these gears shall be of 40C8 quality conforming to IS:1570 or equivalent having minimum tensile strength of 58 kg/mm<sup>2</sup> and supported on cast steel plummer blocks with gun metal bearings provided with self and mechanical lubrication arrangement with needle valves, stand by pumps, reservoir and return pipe line with automatic starting of stand by pump.

The mill top roller shall be connected to transmission gear shaft by means of forged steel tail bar of 40C8 quality conforming to IS:1570 or equivalent and coupling. The length of the tail bar shall not be less than 1200 mm and its size not less than 260 mm square. Two cast steel couplings, one of lesser cross section so as to act as a fuse to safeguard reduction gearing units and drive with provision of greasing shall be provided.

## (h) Imbibition Equipment and Mixed Juice Pump

- (i) **ONE** – Rotary Screen for juice screening- suitable for ultimate capacity.

For separating the crush – crush / fine bagacillo from the mixed juice, generally to the following specifications:

1. Juice handling capacity 105 m<sup>3</sup>/hr.

2. Juice loading per sq.m. screen open area. 105 m<sup>3</sup>/hr. max
3. Drum speed 1 to 1.5 m/sec
4. Drive arrangement Positive through transmission chain and chain wheels or directly coupled, minimum 7.5 HP
5. Material of construction :
  - a. Screen drum Wedge wire screen of SS 304 welded type having slot width 0.35 mm/0.5mm
  - b. Support and thrust rollers Of METALON / Polyvethene/ Carbon steel case hardened supported on antifriction bearings
  - c. All juice wetted parts like juice tray, splash guards, inlet feed box, drum shell at inlet and outlet, cush-cush, discharge chute. SS 409 M
6. Water sparging system For cleaning and sanitation, to spray hot water through jet nozzles during operation with provision of auto on/off at nozzle header min 4 kg/cm<sup>2</sup>.

The Rotary Screen shall be mounted on suitable steel staging, having platforms around the drum at right angles to the mills so as to directly discharge the cush-cush in to the rake elevator.

## **CONTROL PHILOSOPHY FOR OPERATION OF ROTARY SCREEN**

### A) Hot Water Sparging

The screen drum should be cleaned at regular intervals by spraying weighed hot water (80 to 85 deg. C) at adequate pressure (min.4kg/cm<sup>2</sup> at nozzle header) through spray nozzles. The hot water should be pumped by a separate high pressure sparging pump. The starter panel of the pump should be provided with control circuit having timers to 'START' the pump at pre-set time intervals of every 5 to 10 minutes. The pump remains 'ON ' for about 30 to 60 seconds.

### Alternatively

### Screened Juice Sparging

The screen drum should be cleaned at regular intervals by spraying screened juice at adequate pressure (min. 0.5 kg/cm<sup>2</sup> at nozzle header) through spray nozzles. The juice is tapped from screened juice pump delivery line and provided with a solenoid control valve, with control circuit to spray the juice at a pre-set interval for a set time period.



In this case, a separate pipe header is required for sanitising the screen with either hot water (80 to 85 deg C at 1.0 bar pressure from imbibition water system or with exhaust steam (125 deg C at 0.5 to **1.0 bar pressure**) **at least once in a shift for a period of one to two minutes**

### B) Caustic Soda Solution Cleaning

1. In order to clean accumulated scum of gummy, waxy matter, a spray of dilute caustic soda solution (about 20 %), approx. 300 to 500 litres, is applied on to the screen drum once in a week. Caustic soda solution pumped with the help of the same water-Sparging pump. It is necessary to stop the feed juice going to the screen, at this time. Dilute caustic soda solution should be allowed to react on the scum of gummy, waxy matter and later, hot water / screened juice should be sprayed to wash away the loosened scum as well as traces of caustic soda solution. The caustic soda solution is to be re circulated by installing a separate tank by installing a diverter and valve , so that this caustic soda solution does not add alkalinity to the juice.

2. As an additional precaution, screen drum should be inspected and bagacillo, gummy, waxy matter accumulated & hardened in the screen slots over the period of time, should be thoroughly cleaned with brush & caustic soda dilute solution during the regular cleaning shut – down.

### (ii) Juice Tanks and Pumps :

The juice from mill No.3 and 4 shall be collected in individual cylindrical whirler tank with conical bottom of 750 mm dia and 1100 mm height made of 6 mm thick aluminum sheet or 4 mm thick S S 409 M connected to mill juice trough through 6 mm thick . Aluminium or 4 thk. SS 409 M gutter. The juice from mill No.2 and 1 shall be collected from individual mill juice trough to Aluminum / SS 409 M gutters outside the mills and then connected to individual cylindrical whirler tank with conical bottom of 50 HL capacity. All whirler tanks shall be interconnected with gutter and flap at top level. The juice from whirler tanks of mill number 3 and 4 shall be pumped through individual chokeless pump capable of pumping 30m<sup>3</sup> per hour of juice having minimum 50% solids at 10 metres head to imbibition juice distribution trough through a suitable surplus feed back device installed above the level of gangway at the mills to ensure steady and uniform rate of imbibition. The mixed juice from Mill No.1 and 2 shall be collected in individual tank and be pumped through separate chokeless pump with full bore discharge and each capable of pumping 75 m<sup>3</sup> per hour of juice having minimum 50% solids at 12 metres head to rotary screen. All the above pumps shall be designed to operate at about 960 rpm.

The screened juice shall be collected in a 6 mm thick Aluminium / 4 thk SS 409 M cylindrical tank / column of 50 HL capacity. Two strained juice pumps (one as stand by) each of 75 m<sup>3</sup>/hr capacity and 55 mtr head shall be provided for pumping the screened juice.

All juice pumps viz. Imbibition, screened and unscreened to have S.S. bodies and with SS impellers and SS shafts. All the juice pumps should have delivery lines not less than 150mm.

### iii) Hot water meter:

One Orifice type flow meter indicating integrating and recording type suitable to measure upto 60 m<sup>3</sup>/ Hr. at 100 deg C. The water will be discharged in a closed receiving tank of suitable capacity fitted with two imbibition water pumps each of 30 m<sup>3</sup>/hour capacity and 50 m. head (one as standby) capable of handling water upto 100 deg.C. The imbibition water shall be applied before the last mill through gunmetal chokeless type nozzles.



## **(j) Bagasse Elevator and Conveyor**

### **(i) Bagasse Elevator**

One steel slat or rake type bagasse elevator of all steel construction of 1000 mm effective width and suitable length (inclination not to exceed 45 deg. with the horizontal) to carry about 40 tonnes of bagasse per hour and driven by TEFC electric motor of 25 BHP through helical speed reducer with open gearing or worm speed reducer and chain sprockets to give a linear speed of 25 metres/minute shall be provided. It shall have two strands of chains of 150 mm pitch conforming to IS-8466. The breaking strength of chains shall be minimum 40,000 kgs.

The elevator chain shall be driven over two cast steel sprockets with machine cut teeth only mounted on 130 mm dia. mild steel head shaft running in 110 mm size gun metal bearings and secured in cast steel housings. The tail shaft shall have two cast steel sprockets having machine cut teeth mounted on 100 mm central dia. steel shaft running in 90 mm size gun metal bearings secured in cast steel housing. The head and tail shaft shall be of 40C8 quality. The bagasse scrapers would rise on the bottom side of the elevator and discharge by means of mild steel chute bolted to head columns into the bagasse carrier. The trough side and bottom plate shall be of 6 mm thick mild steel duly reinforced with 65mmx65mmx6mm angles.

Easy sliding screens shall be provided on the elevator for screening the bagacillo. The screening area shall be 8.0 m<sup>2</sup>. Each screen shall have a blind portion for sliding it in the elevator portion for cleaning or changing the screens while working. Width of each screen shall not be more than 600 mm. The screen shall have punched conical holes having 6/8 mm dia. size on the surface facing the bagasse elevator. Platform and staircase shall be provided for approaching on both sides of the elevator. Bagasse elevator shall have tightening arrangement at tail end.

### **ii) Return Bagasse Carrier**

One return type self discharge bagasse carrier of 1000 mm effective width and of 50 m length similar in construction as elevator shall be provided.

The conveyor shall be complete with all its structure and be driven by TEFC electric motor of 40 BHP coupled to helical reduction gear unit with open gearing or worm speed reducer and chain sprockets to have linear speed not more than 25 metres/minute. Idler sprockets having machine cut teeth shall be provided wherever there is change in direction. Approach from the ground shall be provided to attend to drive of this conveyor. Horizontal loading 10 m portion of this carrier shall be not more than 300 mm below the ground level. Mild steel guards shall be provided over the horizontal portion of the return bagasse carrier to ensure safety of workman. Return bagasse carrier shall have self tightening arrangement and be interlocked with bagasse elevator. The return bagasse carrier shall be inline with the main bagasse elevator. A gangway with hand railing shall be provided along with whole length of the return bagasse carrier with access staircase from the ground at the drive end and from the top of the boiler furnace and boiler platform. RBC shall have arrangement to feed bgasse to boilers from return portion of the carrier. Individual chute to boiler shall have slide operated diagonally cut doors operating from the working platform of boiler having double pinion and rake type arrangement.

## **k) Mill House Crane and Gantry**

One three motion electrically operated overhead mill house travelling crane conforming to class II IS specifications having one crab of 15.0 tonnes SWL capacity & with box type design and one HOT crab of 2 T SWL capacity with independent trolley complete with crane gantry shall be provided. The crane rail centre distance shall be to suit the mill house building span and length

of travel for Mill House Crane shall cover fibrizer to Bagasse elevator. The specifications for mill house crane shall be as under :

Height of lift	-	9 metres
Main hoist speed	-	2 metres/minute
Long travel speed	-	10 metres/minute
Cross travel speed	-	10 metres/minute
Main hoist motor	-	10 HP TEFC sq. cage., S4 duty.
Long travel motor	-	7.5 HP slip ring TEFC, S4 duty.
Cross travel motor	-	5.0 HP slip ring TEFC, S4 duty.

All the above motors shall be of crane duty.

The supplier will provide the loading data and span details to enable the purchaser to arrange suitable design columns to support the mill houses trusses and the crane gantry.

### **LIST OF ADDITIONAL EQUIPMENT FOR EXPANSION TO 2000 TCD (FOR CANE MILLING PLANT)**

#### **(a) Cane Handling & Feeding Arrangement**

##### **ALT - I**

1 No: Trolley of 7.5 tonnes SWL capacity to be installed on existing bridge.

##### **ALT - II**

1 No: Bridge with one trolley of three motion with grab system.  
1 Lot Extension of gantry by one bay of 10 mtrs.

(b) 1 No: Feeder Table of identical specification size 6 M width x 7 M length with 15 HP variable speed drive for Alternative I.

#### **(c) Donnelly chute for Rake type Intercarrier for new Mill**

1 No: Donnelly type chute in place of ordinary by pass chute shall be provided and height of Donnelly chute shall not be less than 3 mtr. And it shall be similar in construction as described under Donnelly chute g(iii)

#### **(d) Cane Preparation :**

##### **(i) Cane Chopper**

1 no. 75 HP/600 rpm identical motor with gear type coupling to be coupled from other end.

##### **(ii) Cane Leveller**

1 No: 150 HP/600 RPM identical motor with gear type coupling to be coupled from other side. A suitable starter with load balancer for proper operation of twin electric drive shall also be supplied.

(iii) Swing Hammer Fibrizer

1 No. 600 HP/750 RPM identical motor with gear type coupling to be coupled from other side. A suitable starter with load balancer for proper operation of twin electric drive shall also be supplied.

**(e) Milling Plant**

**(i) Mill :** One mill to be installed as zero Mill with under feed roller.

The mill roller shall be minimum nominal dia. of 760 mm x 1525 mm length (30" x 60 " ) and journals of minimum 380 mm dia x 495 mm length and journal centre distance of minimum 2400. The rollers shall be of coarse grain cast iron having hardness 180 -210 BHN. The composition of the shell material shall conform to IS : and shall be :

Total carbon	-	3.20 to 3.6 percent.
Manganese	-	2.2 to 3.2 percent
Silicon	-	1.2 to 2.2 percent
Phosphorus	-	0.5 per cent Max.
Sulphur	-	0.15 percent Max.

The cast iron shell shall be hot shrunk on forged steel shaft of 40C8 quality conforming to IS: 1570 or equivalent having a minimum tensile strength of 58 kg/mm<sup>2</sup>. All the shaft shall have square ends, not less than 300 mm square. Top roller shall be fitted with stationary flanges and juice rings in two halves. The bottom roller shall be provided with juice rings and removable guards to prevent entry of juice into the bearings. The cast steel crown pinions shall have minimum 380 mm face width and conform to IS :2708 Grade 3 with well dressed, properly profiled moulded teeth, keyed to roller shaft and suitable mild steel guards and troughs.

The head stock and crown pinion shall be designed to accommodate rollers of outside diam varying from 770 mm to 840 mm.

The headstocks shall be of cast steel as per IS:1030 grade 280/520 W. These will be of king boltless type. Removable hard steel/cast steel/gun metal/fibre wearing plates on feed side as well as discharge side and with lubricating arrangement between top roller bearings and wearing plates shall be provided. The top and side caps shall be of cast steel as per IS:1030 grade 280/520W and shall be securely locked in position for quick assembly. Stainless steel strip of 8 mm thick shall be provided in the side roller bearing face of the head stock. The eccentricity between top roller bearing centre and hydraulic cap centre shall be kept suitably towards the feed side of the headstock , except in case of inclined headstocks.

All rollers shall be coated with surface roughening electrode material and its bearings shall be of cast steel with gun metal / white metal, Gr. 6 as per IS-25, 1979 lined and with water cooling arrangement. The side roller bearing shall be of cast steel housing with renewable gun metal liner as per IS:318 or renewable steel liner with white metal lining as per I.S. 25.

The housing shall have water cooling arrangement. All top roller bearings shall be interchangeable. Similarly all feed side and discharge roller bearings shall be inter changeable by their respective bearings.

The mill shall be provided with cast steel trash beam as per IS:1030 grade 280 / 520 W and supported on heavy steel brackets with pivoted journals fitted in the head stocks and adjustable by means of tie rods and fitted with removable cast steel trash plate as per IS:1030 grade 280/520 W, bolted by high tensile bolts and nuts. Top roller scrapers shall be of floating type. Scrapers for top and discharge rollers shall have renewable cast iron tips. Messchaert groove scrapers shall be of spring steel secured on square shaft and supported on cast steel blocks and provided with lever or other suitable adjusting device.

The mill shall be provided with hydraulic loading system, consisting of hydro-neumatic accumulator, one for each of the journal of the top roller, one extra as spare and accessories such as pumping set, receiver tank, gauges, remote control panel and roller movement indicator electronic type . The dia. of the hydraulic ram for top cap shall be minimum 300mm. The hydraulic system shall be designed for a oil pressure of 280 kg/cm<sup>2</sup> g.

One forced feed oil lubricator for each mill having 24 number of points shall be provided so as to have two points for each bearing - one being as standby .

Juice trough under the mills shall be made of 6 mm thick aluminium plates or 5 th SS 409 M. The trough shall be bolted to the headstocks with stainless steel bolts and copper washers. Joint shall be suitably sealed to prevent any juice leakage.

The Mill shall be high set so that no part of the juice tank pumps are situated below floor level. The mill shall have common gangway on both sides having width not less than 750 mm with chequered plates or gratings, and shall be suitably connected to existing gangways.

Access from mill platform to rake elevator drive platform with suitable cat ladders shall be provided. All gangways and staircase shall have hand railings.

## ii) Mill Drive: (Zero)

### One No. Thyristor Controlled Variable Speed D.C. Drive

The mill shall be driven by continuously rated 400 HP D.C. electric motor. D.C. motor shall be IP23, force cooled with air filters SPDP with class V overload duty S1 continuous. The motor base speed shall be 1500 RPM and shall have constant torque characteristic between 20% to 100% base speed and constant power characteristic between 100 to 110% at base speed.

Detail specifications of motor shall be as below :

Rating (continuous)	-	400 HP 1500 rpm Class V, Duty S1
Overload Class	-	V
Armature voltage	-	460 V
Field voltage	-	220 V
Protection	-	IP 23 SPDP (forced cooled with air filters)
Class of Insulation	-	F, Temp. rise limited to class B at continuous rating

Speed (RPM) Base	-	1500
Mounting	-	Horizontal foot mounted
Ambient Temp.	-	45 degree C

The motors shall be designed for variable speed operations, controlled by the thyristor convertor station, and shall have constant torque characteristics down to continuous operating speed of 20% of the rated speed.

RTD for temperature detection of motor winding shall be provided.

Thermesters shall be provided for thermal protection of the DC Motors. RTD shall be provided for bearings. Necessary thermister relays & RTD scanner with tripping facility shall be provided in thyrester panel.

## One Thyristor Converter Station ( Digital type )

For operation and control of the D.C. motor

Convertor cubicals fabricated from 12/14 SWG cold rolled steel sheets, free standing, passivated, and painted with anti-corrosive paints. The cubicle will house all protective switch gear, thyristor modules, regulation circuit, interlocking relays, mounted on passivated plates, the cubicle will conform to IP-30 protection. All necessary indications, annunciators, controls will be neatly arranged on cubicle front door with neoprene gaskets on all edges of panel. Ventilation openings shall be provided at the top of panel and on side covers by louvres suitably covered by fine wire mesh.

The thyristor drive panel shall be as per following specifications:

- a) Armature convertor
  - Rating of DC motor controlled – 400 HP
  - Rated DC voltage - 460 V
  - Incoming AC supply - 415 V, 3 phase, 50 Hz
  - Torque rating - 100% cont. 150% for 2 hours and 200% for 1 min class V constant of rated full speed.
  - Type of Thyristor bridge - 3 ph, 6 pulse fully controlled non regenerative
  - Voltage grade of thyristors - 1500 V PIV (approx)

Panel complete with field convertors, regulators, tacho feedback, safety protection, ( electronic thermal overload, electronic instant O/L, Phase seq. ,Phase loss, field failure, over speed, tacho/speed loss, earth fault), indication meters, push buttons, switch gears and controls.

Drive bi - directional in operation with field reversal in the speed range of 50% to 100% of speed at constant torque. Speed regulation will be  $\pm 1\%$  of base speed at base speed by tacho feedback. The panel will have facility to accept 4 to 20 mA signals for speed setting in auto mode. Speed regulation with armature voltage feed back shall operate in case failure of tacho feed back. Auto visual window annunciators will be provided. The pressure ventilation system with electric motor driven blower with filter will be provided for panels. One common control desk with controls shall be provided for each motor to be controlled from this common desk.

The thyristor panels to be installed in AC room to be provided by the Purchaser.

### (iii) Mill Gearings :

The mill drive shall be coupled through flexible gear coupling to enclosed reduction gear and single stage low speed reduction gearing for mills and GRPF capable of transmitting 400 HP continuously under shock load conditions at base speed of the motor. The total reduction ratio of the gearing unit should be such so as to run the mill roller at a surface speed of speed of 12 m / min. The enclosed reduction gear boxes shall have hardened and ground internals and shall have minimum service factor 2.0 with FLS system with double cooler filters and pumps and automatic starting of the spare pump. The open spur gearing shall be designed to transmit 400 HP continuously at mill roller surface speed of 12 m / min. Under shock load conditions and shall conform to IS:4460-1967. The low speed reduction gearing unit shall have pinions of EN24 material having hardness 250 BHN and gear of cast steel IS-2708 Grade III having hardness 200 BHN with machine cut teeth by gear generating process in both cases. Gear module shall not be less than 25.

Suitable bed plates made in sections, mild steel guards for completely enclosing the gears and pinions (low speed), shall be provided. Shafts of these gears shall be of 45C8 quality conforming to IS:1570 or equivalent having minimum tensile strength of 58 kg/mm<sup>2</sup> and supported on cast steel plummer blocks with gun metal bearings provided with self / mechanical lubrication arrangement with needle valve, standby pumps, reservoir and return pipe line with automatic starting of spare pump. The gearing unit shall be complete in all respect.

The mill top roller and GRPF bottom roller shall be connected to transmission gear shaft by means of forged steel tail bars of 40 C8 quality conforming to IS:1570 or equivalent and coupling. The length of the tail bar shall not be less than 1500 mm and its size not less than 300 mm square. Two cast steel couplings, one of lesser cross section so as to act as a fuse to safeguard reduction gearing units and drive with provision of greasing shall be provided.

### (h) Imbibition Equipment and Mixed Juice Pump

#### (i) Juice Tanks and Pumps :

The juice from mill No. 2, 3 and 4 shall be collected in individual cylindrical whirler tank with conical bottom of 750 mm dia and 1000 mm height made of 6 mm thick aluminum sheet or 4 mm thick S S 409 M connected to mill juice trough through 6 mm thick . Aluminium or 4 thk. SS 409 M gutter.

The juice from mill No.zero and 1 shall be collected from individual mill juice trough to Aluminium / SS 409 M gutters outside the mills and then connected to an individual cylindrical whirler tank with conical bottom of 1000 mm dia. All whirler tanks shall be interconnected with gutter and flap at top level.

The juice from whirler tanks of Mill No: 2, 3 and 4 shall be pumped through individual chokeless pump capable of pumping 60 m<sup>3</sup> per hour of juice having minimum 50% solids at 10 metres head

to imbibition juice distribution trough through a suitable surplus feed back device installed above the level of gangway at the mills to ensure steady and uniform rate of imbibition. The mixed juice from new Mill and Mill No. 1 shall be collected in individual whirler tank and be pumped through individual chokeless pump for each mill with full bore discharge and capable of pumping 75 m<sup>3</sup> per hour of juice having minimum 50% solids at 10 metres head so that two pumps shall be in operation and one as standby . All the above pumps shall be designed to operate at about 960 rpm.

The screened juice shall be collected in a 6 mm thick Aluminium / 5 thk SS 409 M cylindrical tank / column. One strained juice pump of 150 m<sup>3</sup>/hr capacity and 60 mtr. head shall be provided for pumping the screened juice to juice heaters through mass flow meter so that two pumps shall be in operation and one as common standby.

All juice pumps (i.e. imbibition pumps, screened juice and unscreened pumps) to have S.S. body with SS impellers and SS shafts. All juice pumps should have delivery line not less than 150mm

### **(ii) Hot Water Imbibition Pump:**

1 No. Identical pump 30M<sup>3</sup>/Hr. capacity and 50M head capable of pumping hot water upto 100 deg C., so that two pumps shall be in operation and one as standby. The imbibition water shall be applied before last mill through G.M. chokeless type nozzles.



## II) CLARIFICATION PLANT (DOUBLE SULPHITATION PROCESS)

### a) JUICE WEIGHMENT

One Mass Flow meter having capacity 100T/hr. Juice flow measuring system shall have computerised, instantaneous and integrated system, to be installed in screened juice line with check weighment arrangement.

Beam scale of 10 ton capacity to be procured for random verification with suitable capacity MS tank to be kept at a height for gravity flow to juice recovery tank.

The filtrate from filter station shall be pumped to Juice Sulphitor.

Specification for mass flow meter is as under:

#### ONLINE MASS FLOWMETER

For the accurate weighment of juice online mass flow meter having following specifications shall be considered.

<b>Type</b>	:	Coriolis Dual U Tube design or single full bore straight tube design.
<b>Wetted Parts and Connection</b>	:	Tube, Manifold, and Process flanges in 316 welded design, enclosure in SS 304 and should fullfill NACE standard.
<b>Accuracy</b>	:	± 0.10% of mass flow rate
<b>Ambient Temp. Effect</b>	:	0.001 % of Nominal flow rate per °C
<b>Repeatability</b>	:	± 0.05% of rate
<b>Inaccuracy in current output</b>	:	None
<b>Core processor</b>	:	It should be microprocessor based with digital communication having meter diagnostic capabilities and multivariable measurement with 4 wire system between the sensor and transmitter.
<b>Outputs</b>	:	<ul style="list-style-type: none"> <li>i) 4-20 mA for mass flow rate</li> <li>ii) 0-1000 Hz frequency for mass flow rate</li> <li>iii) Digital HART for remote configuration</li> </ul>
<b>Power Supply</b>	:	85-250 VAC / 24 VDC
<b>Electrical Connection</b>	:	¾ inch NPT
<b>Electrical Housing</b>	:	NEMA 4X

- Temperature Limits** : 0 to 204 °C
- Indication facilities** :  
i) Flow rate in TPH  
ii) Current hour flow in tonnes  
iii) Last hour flow in tonnes  
iv) Separate display for measured liquid during check weighment.
- Communication Ports** :  
a) RS 232/RS 485 for PC communication  
b) Centronic parallel port for printer

On line calibration facility for check weighment with tank of suitable capacity shall be provided for random checking of juice delivered by the mass flow meter without stopping the crushing. The juice from check weighment tank should be sent to screened juice tank by a pump set.

Suitable arrangement for preparation, storage and pumping of phosphoric acid solution shall be provided. The tank of mild steel with rubber lining and stirrer, piping of PVC, dosing pump of suitable capacity shall be provided.

## b) JUICE HEATERS

Suitable for 1250 & 2000 TCD – 3 Nos.each of 140 m<sup>2</sup> and 2 Nos. each of 200m<sup>2</sup> H.S.

Distribution:

- One for raw juice heating - 200m<sup>2</sup> H.S.A.  
One for clear juice heating - 200m<sup>2</sup> H.S.  
Two for sulphited juice final heating - 140m<sup>2</sup> H.S.  
One, 140m<sup>2</sup> common stand by for raw juice and sulphited juice heating.

The juice heaters to be modified to reduce pressure drop for ultimate capacity.

All vertical tubular juice heaters shall be of multiple circulation type, designed to have juice velocity of 1.5 m/sec. The body shall be constructed from 10 mm thick, tube plate 25mm & cover plates from 30-mm thick mild steel plates with stiffeners.

Multiple passes vertical tubular juice heaters with easy opening device for cover plates, each set consisting of 2 nos. of double beat valves (for RJ and SJ heaters) and one no. for clear juice heaters having a common housing necessary for inter-changeable connections of heating raw juice and sulphited juice, heating by exhaust & vapour bleeding connections with valves and top and bottom venting control by separate valve to atmosphere and vacuum arrangement, and safety valve to calandria. Partition plate for header and header shell not be less than 12.0 mm thick M.S. plate and flexible cord fixing arrangement be made of 30 mm sq. and duly dovetail grooved.

Arrangements shall be provided to drain all juice heaters, drained juice to go to common collection tank along with suitable pump to deliver the drained material to juice sulphitor. The platform shall be provided below the juice heaters for opening the covers, draining and repairs etc. Each juice heater shall have mercury filled 150 mm dial type thermometer in inlet and outlet branch of juice and for the steam chest. One compound gauge shall also be provided in the steam chest. The tightening bolt shall be 'T' type construction or eye type bolt with individual fixing pins having circular pitch not more than 120 mm .

Annealed stainless steel tubes as per 304 grade of 45 mm outside dia. and 1.2 mm thick shall be used. Ligament of the tubes shall be minimum 12 mm. The length of tubes shall be about 4000 mm.

Juice heater shall be provided with individual condensate receiver for exhaust and vapour condensate alongwith a pump of 8m<sup>3</sup>/hr for juice heaters having heating surface of 140m<sup>2</sup> and 10m<sup>3</sup>/hr for juice heaters having heating surface of 200m<sup>2</sup>.

### c) JUICE SULPHITER

For 1250 TCD - One unit of 80H.L. capacity

For 2000 TCD - Replacement of existing by one unit of 120 H.L. capacity

One continuous juice sulphitation unit of 80 HL capacity designed for a crushing rate with 115% juice, retention time not less than 7 minutes and working height of juice column above the gas distribution not less than 2 m. It shall consist of a reaction tank, stack gas recovery tower, one cylindrical receiving tank of 100 HL capacity two centrifugal pumps each of 100m<sup>3</sup> / hour capacity (one as standby) at 60 M. head capable of pumping juice through two juice heaters in series, to the flash tank of the clarifier. The speed of stirrer used shall be around 16 RPM. Design of the unit shall have arrangement for pre sulphitation.

The continuous juice sulphitation unit shall be made from 12 mm thick mild steel plate and be complete with milk of lime proportioning arrangement. SO<sub>2</sub> gas pipe line shall be of C.I. IS 210-1978 and sparger shall be of SS 316 grade or alternatively C.I. crosses & C.I. piping.

For ultimate capacity of 2000 TCD, one no. identical pump shall be added so that two pumps shall be in operation and one will be common standby.

pH Automation for juice sulphiter shall be provided.

### SPECIFICATIONS FOR AUTOMATIC pH CONTROL SYSTEM FOR JUICE SULPHITATION :

The microprocessor based two-loop pH control system shall be considered. Lime dosing into juice sulphitor shall be automatically controlled based on pre-set ratio to juice flow.

Lime flow will be measured to give feed back signal to the lime dosing control loop. pH of treated juice will be measured and signal given to control speed of sulphur dosing pump in case of thin film type sulphur burner option. Combustion temperature of thin film type sulphur burner will be measured and air vent valve will be adjusted to control operation of sulphur burner. The system shall have following specifications.

**Sensor** : (a) Ruggedised industrial grade combined pH electrode with automatic temperature compensation.  
It shall be field repairable type.

: (b) Suitable magnetic flow meter for the measurement of MJ (mixed with filtrate) and MOL

**pH Analyser** : Microprocessor based design with LCD display for pH and temperature value with following facilities:

Output : 4-20 mA dc for recorder/controller  
Power : 230 V AC  
Supply

Mounting : Panel/Field  
 Alarm : High/Low  
 Housing : NEMA 4X  
 Diagnostic : Following Diagnostic features  
 feature shall be provided  
 i)Electronic failure  
 ii)Electrode coating  
 iii)Electrode breakage

**Controller** : Microprocessor based multi loop controller with following main facilities :  
 i) Cascade control and self tuning  
 ii) Communication port  
 a.RS 232 or RS 485 for PC communication  
 b.Centronic Parallel port for printer

**Control Valve`** : Suitable for controlling the flow of lime and SO<sub>2</sub> continuously with proportional control.

**Recorder** : Suitable recorder shall be provided.

**(d) SULPHUR FURNACE - suitable upto 2000 TCD**

One no. automatic continuous sulphur burner of 70kg/hr and one no. film type sulphur burner of 75kg/Hr capacity.

**(i) Automatic Continuous Burner – One no.**

Continuous sulphur furnace shall be suitable for burning 70 kgs of standard quality sulphur per hour. Each burner shall have a minimum of 0.6 m<sup>2</sup> burning area. All sulphur feeding valves spindles and seat shall be of stainless steel. The melting chamber for sulphur shall be made out of 12-mm thick mild steel plate. The combustion chamber shall be 16-mm thick mild steel with refractory lining.

The furnace shall be complete with electric driven stirrer, water jacketed counter current cooling arrangement (material for cooler pipe shall be of schedule 80) for the vertical gas pipe, mild steel water jacketed scrubber of 16 mm thick etc.

Sulphur pipeline from all the furnaces shall be so designed that both juice and syrup could be sulphited from any of the furnaces either singly or jointly. Sulphur pipeline and crosses shall be of cast iron conforming to IS 210-1978. Suitable glass lined rubber diaphragm valves shall also be provided. Temperature indicators for indicating temperature of molten sulphur and SO<sub>2</sub> gas to be provided and automatic control for sulphur furnace shall be provided. The sulphur burner shall have M.S. steel staging

**(ii) Film type burner – One No.**

One thin film type sulphur furnace suitable for burning 75 kgs of standard quality sulphur per hour shall be provided as per following specifications.

**A. Sulphur melter with overflow and underflow dirt separation – One No.**

The melter should be made of 8 mm thick M.S. Plate and should be complete with steam coils, valves and traps etc.

### B. Sulphur Burner

The sulphur burner should be complete with refractory lining, and chequered bricks arrangement with oil burner for pre heating

1. Material for construction - M.S.
2. Thickness of bottom plate - 12 mm
3. Thickness of shell plate - 10 mm
4. Sulphur line - steam jacketed, M.S.
5. Variable speed, plunger type positive displacement pumps - 2 nos. (one as standby )
6. Staging and inter connecting piping shall be provided.

### Instrumentation and Automation System for Thin Film Type Sulphur Burner

Electronic controlled system with digital display shall be provided for the following :

- 1) Variable speed drive for sulphur pump to control the burning rate. The variable speed drive should be compatible to take output from a controller for feed back control of juice flow/pH as and when installed in future.
- 2) To control the supply of primary air to sulphur burner by controlling air vent valve with feed back of temperature.
- 3) Mechanical temp. recorder for SO<sub>2</sub> gas outlet range 0 – 200 deg. C.
- 4) Digital temperature indicator for temperature indication of molten sulphur, burner and final SO<sub>2</sub> gas.

### Performance Parameters

Performance of the sulphur burner will be judged on the following parameters:

1. Rate of sulphur burning - 75kg/hr
2. No sublimation & minimum SO<sub>3</sub> formation with 100% burning.
3. Temperature of final SO<sub>2</sub> gas - 70°C
4. Concentration of SO<sub>2</sub> not less than 7% at 70°C @ 75kg/hr burning of sulphur.
5. Turn down capacity upto 50%.

The sulphur burner shall have M.S. steel staging.

### e) AIR COMPRESSORS

Suitable for 2000 TCD – Two Nos. –400 M<sup>3</sup> / hr. moist free air delivery pressure of 1kg/cm<sup>2</sup>

These air compressor shall be operated to deliver 250 M<sup>3</sup> /hr FAD by change of pulley for initial capacity

Air compressor shall be provided with necessary pipeline, gauges, valves etc. arrangement to supply moisture free air with suitable filter of adequate capacity air receiver with suitable relief valve. All furnaces shall be connected in such a way that any furnace could be worked with either compressor. The air compressors should be vertical type and with water cooling system.

### f) MILK OF LIME PREPARATION

Suitable for 2000 TCD

One lime slaker capable of slacking about 600 kgs of quick lime per hour. A Koran flash tank type lime classifier with grit remover or rake type lime classifier or hydrocyclone type classifier. Two milk of lime storage tanks of about 100 HL capacity each and two pumps (one as standby) either rubber lined rotary or plunger type each capable of delivering 4.0 m<sup>3</sup> per hour of milk of lime at 20 mtrs head and two grit catchers common for both pumps.

The slaker shall be of continuous type, driven by electric motor, through suitable reduction gearing arrangement to give 6 to 8 rpm. The storage tanks shall be made of 6 mm thick mild steel plates and shall be complete with stirrers with independent separate drive for each tank and connected through grit catchers to milk of lime pumps. Separate gutters shall be provided over the milk of lime storage tanks for the milk of lime coming from the slaker and return milk of lime.

Milk of Lime pipe lines shall be provided up to juice sulphitation with return piping and to mud overflow tank and to condenser outlet. MOL station shall be supported on M.S. steel staging.

### g) CLARIFIER

For 1250 TCD - 1 No. 7315 mm. Dia with three compartments each having 1525mm height

For 2000 TCD - Addition of one No. compartment in existing clarifier of 7315 mm dia.

Clarifier shall have separate juice and mud outlet from each compartment.

The flocculating compartment complete with skimmer and feed well shall be installed separately. The clarifier shall be made of mild steel plates having following minimum thickness:

Particulars:

1. Bottom: 8 mm
2. Shell: 6 mm with stiffeners
3. Tray (intermediate): 8mm
4. Tray (Top): 6 mm
5. Top Cover: 6 mm
6. Flocculating Compartment; 6 mm

The continuous clarifier shall be complete with mild steel flash tank; clear juice and mud withdrawal gravity boxes with sleeves, telescope pipes and O-rings, hinge type squeezers, driving mechanism with variable speed drive head with motor consisting of sprocket, chain and drive guards, all inside and outside clear juice piping and mud piping, all valves and pipe fittings etc, and complete with peripheral walkway, angle iron bracket supporting angles, piping for railing, rail support etc; 3 manholes one for each compartment, each manhole to have platform, railing and access ladder, tank with support, insulation material etc. Mud liquidating pump of 25-m<sup>3</sup>/hr. and 30 m. head of C.I. Construction with bronze fittings complete with drive motor shall be provided. Two clear juice centrifugal pumps each of 75 m<sup>3</sup> per hour and not less than 30m. head and C.I. construction with bronze fittings complete with drive motor and suitable column having sight and light glasses shall be provided for pumping juice through clear juice heater to 1st body of evaporator. Provision of re-circulation of juice in the clarifier shall be also provided. Arrangement of preparation and dosing of flocculent to be provided. For ultimate capacity of 2000 TCD, one no. identical pump for clear juice shall be added so that two pumps will be in operation and one will be as common standby.

### (h) Vacuum Filter

For 1250 TCD - 1 No 2.44 M dia. x 4.88 M long

For 2000 TCD- 1 No.2.44 M dia. x 4.88 M. long to be added

Rotary cane mud vacuum filter shall be of 2.44 m dia and 4.88 m long having nominal filtration area of 36 m<sup>2</sup> and installed at a height of 8 meters from factory floor level, shall be complete with 5 mm thick stainless steel 304 grade drum, 8 mm thick stainless steel heads with mild steel structural reinforcement, cast iron trunnions, stainless steel 304 grade piping and decking, stainless steel screens, mild steel trough/agitator, two numbers valves, one on each side consists of bronze/stainless steel 304 grade valve body, bronze/ polypropylene/ Ferro-bestos wear plate, stainless steel pipe, plate wash assembly, scrapper, variable speed drum drive and constant speed agitator drive.

The drum drive shall be of 1.5 kW TEFC motor having means to vary the drum speed from 30 RPH to 10 RPH. The agitator drive shall be of 1.0 KW TEFC motor. Rotary filter shall be complete with two number filtrate receivers fitted with gun metal vacuum release assemblies and copper SS floats/ one number vacuum regulating valve, two number filtrate pumps, one cascade condenser, one entrainment separator with sealing arrangement to discharge the entrained juice, one vacuum pump of 12 m<sup>3</sup>/minute capacity against 500 mm (20") mercury, complete with motor and drive etc. One overflow tank of 45 HL capacity with steam coil and trap one centrifugal blower, one bagasse cyclone suitable for separating bagacillo with mild steel shell adjusting fin, 400 mm dia. inlet connection and outlet through 2-way valve fitted with manually operated flap door, two mud recirculation non-clog centrifugal pumps each of 25 m<sup>3</sup>/hr. capacity at 18 m. discharge head complete with motor drive, one injection water pump of 15 m<sup>3</sup>/hr. capacity at 20 m discharge head complete with motor drive, one cake wash water pump of 10 m<sup>3</sup>/hr. capacity at 30 m. discharge head complete with motor drive etc. The bagacillo blower shall be complete with 400-mm dia blowing pipe from mill house to bagacillo cyclone along with pipefitting etc. One belt conveyor of 450 mm width and suitable length for discharging mud at least 4 m. Outside the filter house complete with motor drive shall be provided.

The feed mixer, mud overflow tank, air blower and cyclone separator, shall be suitable for ultimate capacity.



## (III) EVAPORATION AND BOILING PLANT

### a) Evaporator: - Suitable upto 1250 TCD

#### Vapour bleeding arrangement

From 1<sup>st</sup>. effect - for 'C' vacuum pans. &

2<sup>nd</sup>

sulphited juice heating. Pipe size 450mmΦ and 250mmΦ resp.

From 2<sup>nd</sup>. effect (A)- for A & B vacuum pans, pipe size 650 mmΦ

From 2<sup>nd</sup> effect B – for 1<sup>st</sup> sulphited juice heating, pipe size 250 mmΦ

From 3<sup>rd</sup>. effect - for raw juice heating, pipe size 450mmΦ

Juice heater vapour bleeding connection shall be drawn from respective body with C.I. isolating valve. The two vapour pipe of low and high grade pan shall be inter connected through C.I. isolating valve of 500mm dia. provided in the vicinity of evaporator and exhaust connectin through C.I. valve of 500mm size shall be provided in vapour line to high grade pan.

#### Quadruple effect evaporator set having following heating surfaces:

1st body –1000 m<sup>2</sup> (semi-kestner type) exhaust/vapour pipe size 550mmΦ/650 mmΦ

2nd A body –600 m<sup>2</sup> (Robert type) vapour pipe size 500/600 mmΦ

2<sup>nd</sup> B body – 400 m<sup>2</sup> (Robert type) vapour pipe size 500/600 mmΦ

3rd body – 250 m<sup>2</sup> (Robert type) vapour pipe size 450/550 mmΦ

4th body - 150 m<sup>2</sup> (Robert type) vapour pipe size 350/600 mmΦ

### Evaporator for 2000 TCD

#### Vapour bleeding arrangement

From 1<sup>st</sup>. effect - for 'C' vacuum pans. & 2<sup>nd</sup> sulphited juice heating.

From 2<sup>nd</sup>. Effect (A) - for A & B vacuum pans

From 2<sup>nd</sup> effect (B) – for 1<sup>st</sup> sulphited juice heating.

From 3<sup>rd</sup>. effect - for raw juice heating,

#### **Quadruple effect evaporator**

First body - 1400 m<sup>2</sup> ( Long tube evaporator ) – (New )

- Exhaust/vapour pipe size 600/700 mmΦ

Second A body - 1000 (existing)

Second B body - 600 m<sup>2</sup> - (existing)

Third body - 400 m<sup>2</sup> (existing)

Fourth body - 250m<sup>2</sup> – (existing)

Fourth body spare - 150m<sup>2</sup> – (existing)

Suitable relief valve spring loaded or dead weight lever type shall be provided to ensure that pressure in the vapour space of 2<sup>nd</sup> body of evaporator does not exceed 0.4-kg/cm<sup>2</sup> g. The

bodies shall have a vapour space height between the top tube plate and cylindrical portion of the vapour space shall not be less than 2 times the calandria height, in case of 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> bodies and 2.5 times in case of last body. Suitable arrangement for light and heavy noxious gas removal shall be provided. Boxes shall be provided for easy removal of condensate from calandria. Manhole shall be provided to bottom saucer and vapour space. Suitable connection for soda washing and draining for juice shall be provided. Safety valves shall be provided on calandria of first body.

For bodies having heating surface upto and including 600 m<sup>2</sup>, minimum thickness of mild steel plates for calandria and body shall be 12 mm, bottom saucer 16 mm and tube plates 25 mm & for body above 600 M<sup>2</sup> minimum thickness of mild steel plate of calandria & body shall be of 16 mm., bottom saucer 22 mm. & tube plate 32.mm. The bottom saucer shall be welded to the calandria. The domes of the bodies shall have outward flow centrifugal saveall of suitable design. A suitable external saveall for fitting in the vapour pipe after the last body going to the condenser shall be provided. Each body shall have three sight and one light glasses, lowest sight glass shall not be higher than 1.5 M from the working platform and 250 mm from top tube plate.

Annealed stainless steel tubes confirming to I.S.13316 of 45 mm outside dia. and 1.2 mm thick shall be used and of 2 M. length.in case of Robert effects and 4m in case Semi-kestner. The pitch of the tube shall be such that the ligament is not less than 10 mm.

The placement of the tubes shall provide effective steam distribution arrangement.

The evaporator set shall be complete in every respect with fittings for satisfactory operation, with 8-mm thick mild steel inter connecting vapour pipes suitable for ultimate capacity. The sluice/right angle valves (C.I.) used in exhaust steam and vapour pipelines. Syrup extraction system with suitable columns connected to two-syrup extraction pumps (one as standby) of 30-m<sup>3</sup>/hr. capacity at 30-m. head through S.S. screen grit catchers shall be provided. Continuous syrup sampler and sampling arrangement from each body shall also be provided. Suitable individual condensate extraction pump with suitable size receiver bottles to be provided to all bodies. The RPM of the motor of the Condensate extraction pumps should not be more than 1500. Condensate outlet pipes from various units to have sight glasses at eye level in addition to sight glasses in extracting columns. Test cocks should also be provided at all units individually for testing Condensate water for sugar traces. All the Condensate pumps delivery lines should have suitable size connection with valve to test and to let out the water in the drain as and when sugar traces are found in the Condensate. All inter connecting vapour, juice, hot and cold water and exhaust piping shall be suitable for ultimate capacity. Suitable condensate flash recovery system shall be provided.

For ultimate capacity of 2000 TCD, one identical pump for syrup shall be added so that two pumps will be in operation and one will work as common stand by.

A working platform with staircases from ground level under the bodies for cleaning, repairs and maintenance shall be provided.

For open soda boiling, reduced steam entry at the bottom and vapour outlet to atmosphere at top shall be provided in each body.

Suitable arrangement for preparation of caustic soda solution and pumping the same to the evaporator bodies with recirculation arrangement shall be provided. Capacity of the tank shall be 200 HL., pump capacity shall be 23 L/second against a head of 15 meters.

### **b) Syrup Sulphitation Units**

For 1250 TCD. - 1 No: of 30 H.L. capacity

For 2000 TCD - Replacement of existing sulphitor by one no. of 50 H.L.capacity.

One continuous syrup sulphitation unit of 30 HL working capacity capable to process syrup of 65 deg. Bx., with working height of 1.5 m. of syrup column above the gas distribution, stack gas recovery unit constructed of 10 mm thick mild steel plate complete with SO<sub>2</sub> gas absorption arrangement and all necessary pipelines, valves etc, shall be provided.

Inside SO<sub>2</sub> pipe and sparger shall be of S.S.316 grade Two syrup pumps each of 30m<sup>3</sup>/hr capacity at 30 m. head (one as standby), grit catchers and one sulphited syrup receiver of 450 mm dia. and 1800 mm height with sight and light glasses, inlet, outlet, and equalising connections shall be provided.

For ultimate capacity of 2000 TCD, one identical pump shall be added so that two pumps will be in operation and one will work as common stand by.

### (c) Syrup and Molasses Storage Tanks

For 1250 TCD - 9 tanks each of 150 H.L.

For 2000 TCD - 2 tanks each of 150 H.L.(Additional)

Each tank shall be of 150HL capacity to store syrup, molasses and melt etc. at the pan floor These tanks shall be preferably rectangular. The height of the tanks above the pan floor shall not be more than 1.2m. Each tank shall have level indicating device with SS-304 floating valve.

Two or three tanks shall be arranged in one nest depending upon the material to be stored with the provision of separate nest for syrup, each molasses and melt and each nest to be connected at top. The tanks shall be made of 8-mm thick mild steel plate duly cross braced with 65 x 65 x 6 mm angle at top, bottom and sides and have 4 nos. tie rods at the top. Molasses storage tank shall be provided with steam heating coils with necessary valves and non-return valves, draining arrangement, pipes gutters, valve etc. The wash out connection of each tanks shall be connected by a pipe to juice check weighment tank with proper dilution with water and pumped to juice sulphitation tower with suitable valves. All tanks shall be covered with gratings.

Necessary pipe lines with 100mm dia right angle valves from the tanks to the pans i.e. for syrup, melt, A-light molasses etc. for A-heavy and B light molasses, B-heavy and for C-light molasses shall be provided, for respective A,B and C massecuite pan.

Three Molasses conditioning units complete with inter connecting pipes, valves and sampler shall be provided; one for A-heavy molasses, one for B-heavy and one for C-light molasses. These molasses conditioners will be designed for an ultimate crushing capacity with following percentages of molasses:

A-heavy - 15 percent on cane

B-heavy -8 percent on cane

C-light - 4 percent on cane

**Automatic control of temperature and brix system** shall satisfy the following requirements:

- i) Temp. of conditioned molasses - 70 deg.C
- ii) Brix of conditioned molasses - 70 - 75 deg.
- iii) Conditioned molasses shall contain no fine grains

## AUTOMATIC BRIX AND TEMPERATURE CONTROL FOR MOLASSES CONDITIONER

The automatic brix and temperature control system for molasses conditioner shall be provided. For each molasses conditioner the system shall include two control loops consisting of various control system components as specified.

a. Brix Control System :

- i. Sensor - based on conductivity principle with tefzel body SS 316 electrode and built in temp. element for automatic temperature compensation
- ii. Transmitter - two wire electronic analogue type with 4-20 mA DC output
- iii. Controller - microprocessor based single loop indicating type
- iv. Control valve - suitable for controlling the flow of water in molasses continuously with proportional control

b. Temperature Control System :

- i. Sensor - suitable RTD PT 100
- ii. Transmitter - two wire electronic analogue type with 4-20 mA DC output
- iii. Controller - microprocessor based single loop indicating type
- iv. Control valve - suitable for controlling the flow of steam entering into the molasses conditioner continuously with proportional control

Recorder : Suitable recorder for recording the controlled brix and temp. of the molasses.

### (d) Vacuum Pans

For 1250 TCD - 4 No: pans of 40 tonnes strike capacity.

For 2000 TCD – 2 Nos. each of 40 tonnes strike capacity.

Each pan shall have double tangential steam/vapour entries. The vacuum pans shall be low head rapid boiling calendria type each having normal strike capacity of 40 tonnes (280 HL) massecuite. Gaining volume in each pan shall preferably not exceeding 45 % of strike capacity. Cross section area ratio of all tube I.D. to down take shall be 140%.

The heating surface of each pan shall be so designed that the ratio of heating surface (m<sup>2</sup>) to volume (m<sup>3</sup>) is not less than 6.6. The length of the tube shall not exceed 750 mm.

The tubes shall be of Stainless steel conforming to I.S.13316-92 having 90 mm outside dia. X 1.6 mm thickness. The pitch of the tubes shall be such that ligament is not less than 16 mm. Mild steel tube plates shall be 25-mm thick calendria and body 12 mm, bottom saucer 16 mm. Vapour pipe 8 mm thick. W shape bottom saucer shall be welded to the calendria in which case suitable arrangement for expansion of tubes in the bottom tube plate shall be provided. Bottom saucer shall be of ring supported design of minimum 750mm height.

A vapour space of 2.5 M. shall be provided in the cylindrical portion above the strike level. The pan shall have internal saveall having centrifugal type catchall of efficient design. The vapour pipe dia. going to the condenser shall be 900 mm. Each pan shall have feed-check valve after the feed manifold. Pans shall have 7 Nos. sight and 2 Nos. light glasses- 200mm dia size, light glass with

reflector to illuminate the whole tube plate, calibration scale, vacuum gauge and thermometer in vapour space and a compound gauge and thermometer in the calandria.

Pan shall be complete in every respect with necessary fittings for satisfactory operation including the pneumatically operated discharge valve of ample capacity, various pipe lines (vapour, syrup, high and low grade molasses, movement water, inter connecting cut over pipe lines etc.) key sampler, vacuum and atmosphere venting. Hot water meter cum recorder capable of measuring 15 m<sup>3</sup>/hr of hot water to be provided. Panometer with automatic feed control system and hydraulically operated/pneumatically operated discharge valve shall be provided.

The condensate extraction system shall consist of two closed cylindrical receivers installed at the 3.5 meter level on steel staging. The capacity of exhaust condensate receiver shall be 50 HL and that for vapour condensate receiver 125 HL. These tanks shall be complete with level indicator outside the tank and necessary venting arrangement. The condensate piping shall be such that the condensate from low grade pans could go to either of these tanks whereas condensate from high grade pans could go to vapour condensate receiver. The condensate pipes in these receivers shall lead upto 1/4th height from the bottom of the receiver for sealing purpose. Two pumps (one as common stand by ) each of 30 m<sup>3</sup>/hour capacity and one pump of 15 m<sup>3</sup>/hour capacity against a head of 30 m. shall be provided for pumping the condensate from these tanks to boiler feed water tank/ hot water tank.

These pumps shall have minimum 25 percent leak off to the receivers for maintaining a constant level of the tanks.

Each pan shall have one common vapour inlet valve of 400 mm. Dia. B/C pans shall have common valve for 2 Nos. vapour connection.

### **(e) Seed Crystalliser and Vacuum Crystallisers**

2 Nos. seed crystalliser of 30 tonnes net working capacity and two vacuum crystalliser of 30 tonnes capacity. All the crystallisers shall be fitted with stirrer, coupled to 7.5 HP, TEFC or geared motor and reduction gear unit and necessary fittings. The speed of the stirrer shall be about 60 RPH.

**Alternatively** All the crystallisers should be driven by shaft mounted high efficiency suitable helical planetary drive system. These crystallisers shall be installed on pan floor. Necessary interconnecting pipelines between these crystallisers and pans shall be provided.

The shell of the vacuum crystallisers shall be made of minimum 8-mm thick M.S. plate with necessary stiffeners and the end plates minimum 16-mm thick M.S. plate with stiffeners. The seed crystalliser shell shall be 8 mm thick and end plate 16 mm thick with stiffeners.

Vacuum crystalliser shall have four sight glasses on the side and one light glass with reflector at top. One manhole of 500-mm dia. and arrangement for sight glass washing shall be provided. A ladder shall be provided for the approach of seed and vacuum crystalliser. Cut over valves of this crystalliser shall be operable from the pan floor.

Vacuum crystallisers should be near C – Pans and Seed crystallisers towards A – Pans.

### **(f) Condensers :**

For Evaporator- Suitable for 600 mm dia vapour pipe.

For Vacuum Pans – Suitable for 900mm dia vapour pipe. - for 40 tonnes capacity

### Type of the Condenser – Single water entry type

Each condenser shall be made of 5 mm. thick SS 304 with M.S. hoop rings & tail pipe shall be 3 mm thick of S.S. 304. Suitable platform with railings, access staircase for inspection, repair etc. of the condenser shall be provided. Jet & spray nozzles shall be of gun metal / SS.304/PVC. Condenser shall be so designed that the approach temp. (temp. difference between saturation vapour temp. and tail pipe outlet water temp.) should not be more than 5 deg. C. Injection water line be provided with on line strainer.

#### (g) Injection & Spray water pumps :

Injection pumps:

For 1250 TCD - 900 M<sup>3</sup>/Hr – 22M Head – 3 Nos. (1 No. standby) for single entry condenser

For 2000 TCD - Addition of 900 M<sup>3</sup>/Hr – 22M Head – 1No. For single entry Condensers

Spray pumps:

For 1250 TCD - 900 M<sup>3</sup>/Hr – 15M Head – 2Nos.

For 2000 TCD - Addition of 900 M<sup>3</sup>/Hr – 15M Head

The above pumps shall be of centrifugal type, bronze impeller and fittings and directly coupled to SPDP slip ring induction motor with suitable starter for continuous working. Priming pumps for injection and spray pumps shall be provided. The starting current should not exceed by 300% of full load current.

The injection water pipe connection to condenser should have valve for regulation purpose. A pressure gauge in water line is to be provided. A common header of 500 mm dia and 10 mm thick size shall be provided. Each pump shall have isolating & NRV in delivery line and 2 Nos. drain connection of 100mm dia with blind be provided.

#### (h) Spray Pond:

For 1250 TCD - No. of nozzles – 125.

For 2000 TCD - Addition of No.of nozzles – 100.

The main header of Spray Pond shall be MS construction 900mm $\Phi$  and minimum 10mm thickness. The branch piping 13 Nos. on one side and 12 Nos. on other side each of 150mm dia installed at 5.0 metre centre and fitted with 5 Nos. nozzles of 2.2mt. center shall be PVC/ M.S. with support of RCC pillars. Nozzles shall be of thermo engineering plastic with S.S. insert at throat of nozzle or of cast iron & arranged on the branch piping with single nozzle arrangement. The discharge capacity of each nozzle should be 14.5 M<sup>3</sup>/hr.



The cooling system for the water shall be so designed that at least a drop of 13 deg. C or within 7 deg. C of wet bulb temperature, whichever is less should be achieved.

NOTE: (I) Provision of space in the layout for additional pumps for the ultimate capacity to be kept.

(ii) Spray pond and masonry water channels shall be suitably designed for the ultimate capacity

**Alternatively**, Initially two cell cooling tower each cell suitable to cool 500m<sup>3</sup>/Hr. water shall be provided to cool water from 50°C to 32°C at 27°C WBT. With three feed pumps (one as standby) each of 500m<sup>3</sup>/Hr capacity and suitable head to be installed. For ultimate capacity similar cell with one feed pump to be added.

### (IV) COOLING, CURING AND GRADING PLANT

#### (a) Crystallisers

For 1250 TCD

- (i) Three Nos. air cooled each of 45 tonnes batch type horizontal crystallisers for A massecuite.
- (ii) Two nos. water cooled crystallisers each of 45Ton capacity horizontal batch type for B massecuite.
- (iii) One no. water cooled crystalliser of 45 Ton capacity as receiver for C massecuite.
- (iv) Three nos. water cooled crystalliers each of 45 Ton capacity for C massecuite to work as continuous crystalliser.

**Alternatively**, two nos. each of 55 tonnes capacity and air cooled horizontal type for C massecuite receiver and one no. vertical continuous crystalliers of 150Ton capacity for C massecuite.

For 2000 TCD

#### 1) Air-cooled crystallisers:

(i) One No. 45 tonnes capacity to be added for 'A' massecuite. Plus three nos. each of 45 Ton capacity (existing for A massecuite).

#### 2) Water-cooled crystalliser:

- (i) Existing 4 Nos. each of 45 Ton capacity to be used for 'B' massecuite
- (ii) Existing 2 Nos. each of 45 Ton capacity to be used for C receiver.
- (iii) One no. 250 Ton capacity vertical continuous crystalliser for C massecuite to be added.

The batch crystallizers for 'A' massecuite shall be complete with efficient stirring arrangement of sturdy construction. Air cooled crystallisers shall be driven by electric motor of 10 BHP for continuous working and complete with suitable reduction gear unit designed to give a stirrer speed of not more than 60 RPH.



Necessary cooling surface to be provided in case of "B" massecuite cooling, so that the massecuite temperature is cooled from 65 deg C to 50 deg C when supplied with cooling water at 30 deg C. Horizontal type water cooled crystalliser for 'B' massecuite shall be driven by electric motor of 15 BHP for continuous working, complete with suitable reduction gear unit, to give a stirrer speed of not more than 20 RPH, all worm and worm wheel shall be machined cut and interchangeable duty wise .

In case of C massecuite necessary cooling surface shall be provided so that the temperature of the massecuite is cooled from 65 deg.C to 40 deg.C in 15 hours, when supplied with cooling water at 30 deg.C. Provision in the design shall also be made for a maturing period of 4-5 hours in case of low-grade continuous crystallisers. The cooling surface (m<sup>2</sup>) to volume (m<sup>3</sup>) ratio shall be minimum 2. The heat exchange elements shall be tested at pressure of 6-kg/cm<sup>2</sup> g. complete with suitable reduction gear unit designed to give a stirrer speed of not more than 20 RPH all worm and worm wheel should be machined cut and interchangeable duty wise. For 125 T vertical crystalliser the motor shall be of 15 BHP and for 250 T the motor shall be of 20 BHP.

Alternatively all crystalliser should be driven by shaft mounted high efficiency suitable helical planetary drive system.

The heat exchange elements of vertical continuous crystallisers should be of Boiler quality or heavy-duty ('C' class) MS pipes as per IS-1239 and disc type for horizontal water cooled crystalliser.

The shell of the horizontal crystallisers shall be made of minimum 10 mm thick mild steel plate and end plates 16 mm thick mild steel plate duly reinforced.

For pumping C massecuite from receiver crystalliser to vertical crystalliser and for liquidation of C massecuite from vertical crystalliser: 2 Nos. pumps (1 as stand by) each of 20T /hr capacity and 30 M head shall be provided. In case of outdoor installation of vertical crystalliser separate 1 No: liquidation pump to be provided.

### **(b) Centrifugal Machines: -**

#### I. Fully automatic plough discharge machines

- (i) For 1250 TCD: 2 Nos. fully automatic recycling type flat bottom plough discharge machines each of 1250 kg / charge capacity, (one as stand by).

For 2000 TCD : Both the machines as per requirement will be run.

Each 1250 Kgs / charge capacity machine shall be driven by Digital type D.C. thyristor controlled minimum 20 cycle /hr.

#### II. Continuous Machines:

- (i) For 1250 TCD 2 Nos. Continuous centrifugal machines for 'C' foreworker dia 1100 mm shall be capable to cure 'C' massecuite of minimum 100 brix and 52 purity at a rate of 6T/hour and shall have a minimum gravity factor of 2200

Two Continuous centrifugal machines for 'B' curing and 'C' afterworker dia 1100 mm. capable to cure 12T/hour & shall have minimum gravity factor of 2000

- (ii) For 2000 TCD Additional One machine of dia 1100 mm shall be provided.

All operations of the automatic recycling type machines including charging and discharging, changing the speed, application of superheated wash water, molasses separation, operation, bottom valve closing etc. shall be automatic. Manually operated brakes shall also be provided with process logical control programme such that the plough should not be operated at higher basket speed than ploughing speed of 60 RPM. Manually controlled steaming arrangement of monitor casing to be provided.

Each machine shall have individual switch fuse isolator of suitable rating, an ammeter, and thyristorised/ air break-contactor for operating the machine in manual and fully automatic recycling with a separate selector switch. All operations such as charging, bringing the machine at different speeds, retardation, water wash, pugmill gate opening and closing, syrup separation, cycle over etc. shall be given on control box and indicated by different lamps. All these applications shall also be possible to be applied by push button/rotary switch in manual or automatic position of the selector switch from the control box except bringing the machines at different speeds, retardation and cycle over. Control box shall have speed and supply indicator etc. Necessary arrangement in the panel shall be provided for tripping of the machine in case of high temperature on sensing through ETDs of the motors.

The continuous centrifugal machine shall be complete with mild steel monitor casing designed to provide a sturdy support for all machine elements, separate compartment for sugar and molasses, hinged doors for access to the sugar chamber, sugar sampler and water/steam washing arrangement, stainless steel basket construction, stainless steel inner supporting screen, pure nickel chromium plated working screen, stainless steel accelerating cone, receiving cup, hot water/steam washing arrangement with metering device to measure the wash water, drive arrangement having motor, pulley, V-belts drive and bearings, massecuite feeding device etc.

The angle of basket shall be 30 deg. for 'B' & 'C' massecuite. Screen for 'C' foreworker machines shall have perforations of 0.06 mm and not less than 7% open area. Screen for B and C afterworker machines shall have perforations of 0.09 mm and 9% open area. In case of oil lubricated bearings oil pumpsets are to be supplied with pressure switch (not applicable in case of mist oil lubrication). The bearing lubrication system shall have built in protecting arrangement to trip the machine in case of failure of lubrication system and or bearing temperature rise.

Operator's push button panel shall have provision for operating motor, an ammeter and 'ON' indication.

Incoming panels for both batch and continuous type centrifugal shall be designed for a symmetrical fault level of 35 KA (rms) of one second and suitable for ultimate, capacity of 2000 TCD. at unit load factor. All incoming panels shall consist of an ACB, ammeter, voltmeter with fuse and selector switch and 'ON' indication. Suitable interlocking arrangement shall also be provided in each batch machine panels such that not more than two machines are started at a time.

Monorail with 3 tonnes capacity chain pulley block over the centrifugal machines shall be provided.

Pugmill made out of 6 mm thick mild steel plate and suitable for ultimate capacity and mounted over the machines shall be provided having stirring arrangement, driven by electric motors, coupled to reduction gear unit. The pugmill feed valve shall be operated pneumatically. For low-grade massecuite separate header with transient heater for individual C/F machine shall be provided. All transient heaters should have 16 SWG wall thick AISI 304 grade SS tubes. Pugmill with drive will be provided for 'C' after and 'B' machines. There shall be stand by pumps for suspended wash water and oil pumps for centrifugal machines. The pug mills charging gate to be operated both pneumatically and manually. All the fore-workers and low grade massecuite afterworker machines to discharge directly into the corresponding magma mixer of suitable

capacity and design. The shell of the magma mixers shall be of 6 mm thick mild steel plates having C.I. double beater paddles, coupled to electric drive through suitable reduction gear. The pugmill charging gate are to be operated with pneumatically and manually. A suitable platform should be provided near the pug mills with proper approach from centrifugal platform.

The centrifugal station shall be complete in all respects and shall have necessary accessories namely Air compressor 7 kg/cm<sup>2</sup> with receiver and modern air dryer to supply moisture free air for pneumatic control, mild steel molasses tanks, two of 3 m<sup>3</sup> capacity for A-heavy and A-light molasses and remaining tanks of 2 m<sup>3</sup> capacity each, two molasses pumps of 25 m<sup>3</sup>/hour capacity at 30 meters head for A heavy and light molasses each, four molasses pumps of 10 m<sup>3</sup>/hour capacity at 30 meters head for B-heavy, C-light and final molasses with a standby for final molasses. Three magma pumps of 15m<sup>3</sup>/hour capacity at 30 meters head for B foreworker, C-foreworker and C afterworker magma. Magma pumps shall be of rotary type with cast iron rotor having replaceable gun metal or bronze strips and have by-pass arrangements. All magma and molasses pumps shall have steam connections with non-return valves and suitable size return pipes with valves from their delivery pipes back to the respective tanks. The speed of the magma pumps not to exceed 36 RPM, 192 rpm for A.B. molasses pumps and 144 rpm for C molasses pumps. Size of all molasses pumps shall be 100 mm x 100 mm minimum and magma pumps of 150 mm x 150 mm minimum.

All machines shall be suitably connected to respective molasses tanks for flow of molasses.

### (c) Sugar Melter ( suitable for 2000 TCD )

One continuous sugar melter of 15 tonnes/hour capacity for melting sugar lumps and magma sugars and one melt pump of 20 m<sup>3</sup>/hour at 30 meters head shall be provided.

A magma mixer and magma pump of 10 tons/hr at 30-meter head shall be provided near the grader for taking dry seed for A massequite. Necessary water, steam and other usual connections shall be provided.

### (d) Grass Hopper ( suitable for 2000 TCD )

One single tray grass hopper conveyor of 1.5 M width and 12 M. length shall be installed under the " A" machines to convey the sugar discharged from the machines to the first multitray grass hopper.

Two multi-tray grasshoppers, each of 1.5 m. width and length not less than 12.0 m. shall be driven by 10 BHP TEFC electric motor with hot air blowing arrangement on the first multi-tray unit and cold air blowing in the second shall be provided. The hopper eccentricity shall not be less than 19 mm and its driving shaft speed shall be 300 to 330 RPM. Portion of the hopper where connecting rod is fixed shall be strengthened by 10mm plate, 1 meter wide. The hopper shall not be welded on longitudinal seams. Each hopper shall have two connecting rods. Sugar lump separating unit shall be provided on second hopper. The drying arrangement at hopper should be in such a way that the bagging temperature of sugar should not be more than 42°C when ambient temperature is note more than 36°C.

All drive slats etc. shall be similar and interchangeable.

### (e) Sugar Elevator

For 1250 TCD      15 TON /HR   1 No.

For 2000 TCD      Addition of   1 No. of 15 ton / hr.

One No. Steel cased elevator to deliver 15T sugar per hour from the hopper to the grader fitted with two strand of chain and G.I./SS409 buckets and driven by a TEFC electric motor coupled to enclosed worm reduction gear unit shall be provided. Approximate height of the elevator shall be 11 meters. The speed of elevator not to exceed 25 m/minute.

**(f) Sugar Grader**

**For 1250 TCD 15 TON /HR ONE NO.**

**For 2000 TCD Addition of one No. of 15 tons/hr.**

One no sugar grader of 15 T per hour capacity having fourdecks and each deck capable to sieve minimum 10 tonnes/Hr of sugar of any grade and shall be mechanically/electrically vibrator type capable of screening any grade of sugar according to IS specifications. The grader shall be driven by TEFC electric motor. Magnetic iron separator shall be provided for each chute. One sugar distributor for distributing the sugar over full width of grader screen shall be provided. Screens shall be of SS-304 quality. The grader shall be suitable for filling into 50Kg/HDPE/Jute bags.

Suitable dust catching arrangement shall be provided.

**(g) Sugar Weighing Machine (For 2000 TCD )**

Two nos. pre-determined balance weight type weighing machines each having capacity to handle 50Kg bags shall be provided

**(h) Bag Stitching Machine ( For 2000 TCD )**

2 Nos. electrically operated double row stitch bag stitching machines with one spare head, of conveyor type, each suitable for handling about 200 bags per hour shall be provided. The length of conveyor shall be 4 meters. The bags shall be of 50Kg net capacity.

**(i) Molasses Weighing Scale ( For 2000 TCD )**

One automatic molasses weighing scale of 1.5 tonnes per tip capacity, complete with registering counter and other accessories, weighed molasses receiving tank of 30 HL capacity and two pump sets (one as standby) each of 10 m<sup>3</sup>/hour having 30 meter head for pumping the final molasses to the storage tank at a distance of about 120 m from factory shall be provided. The delivery pipeline shall be raised vertically and the subsequent horizontal portion to have suitable gradient. Provision of check weighment with a suitable tank mounted on platform type scale of 3 Ton shall be provided.

**(j) Final Molasses Storage Tank**

For 1250 TCD . 1 No. tanks of 4000 M<sup>3</sup> capacity

For 2000 TCD . 1 No. addition of 4000 M<sup>3</sup> capacity.

Final molasses storage tank shall be as per IS5521-1980 specifications. Two pumps for recirculation of molasses 10m<sup>3</sup>/hr. and 20 mtr. head shall be provided. An overhead tank of 10 m<sup>3</sup> capacity shall be installed on staging at a height of 5 meters from ground floor with a 300 mm discharge line and valve to supply molasses to the tanker directly by gravity. Molasses pumps supplied for recirculation shall also be used for loading the molasses. Arrangement for spraying water with two pump sets on all sides of the tank shall be provided

**(k) Hot and Cold Water Service Tanks ( 2000 TCD )**

Three rectangular overhead tanks of 6 mm thick mild steel plates with stiffeners and angle frame each having a capacity of 200 HL complete with valves, fittings, pipes shall be provided. Bottom of the tanks shall be atleast 6 meters above Pan floor. Tanks shall be covered. Level indicators to be provided.

Two electric driven centrifugal pumps, each having a capacity of 150 m<sup>3</sup>/hour at 30 meters head complete with pipes and valves NRVs from the pump to the service tanks shall be provided at suitable place.

Two parallel strainers with isolating valves shall be provided in each of the in each of cooling water lines to mill bearings, oil coolers, air compressors, vacuum pumps, etc. so that one will be stand by for periodical cleaning.

- l) **Water conservative recirculation system:** Necessary arrangement be provided for recirculation of cooling water from Power Turbine, Mill bearings, enclosed mill drive gear boxes, crystallisers, air compressor and Sulphur burners etc. All equipments like m.s. fabricated collection tank of suitable capacity, 2 Nos. pumping sets (one as standby), piping, valves etc. be installed at suitable location. This water shall be pumped to raw water reservoir through spray nozzles installed on the reservoir itself to achieve atmospheric cooling.

**(V) TECHNICAL SPECIFICATIONS FOR BOILER**

MCR (Max. Continuous rating)

Evaporation : 35 Tonnes per hour

Quantity : 1 no. for 1250 TCD plant.  
(1 no. to be added for expansion to 2000 TCD)

Peak generation : 110% of MCR for half an hour.

Pressure at superheater

outlet : 45 kg/cm<sup>2</sup> gTemperature of steam at  
superheater outlet: 440 ± 5 deg.C at 60% to 110%MCR  
for 45 kg/cm<sup>2</sup> g pressure boiler.

Feed water temp. at

Inlet of feed water tank : 85 deg.C

Excess air % theoretical air : Not exceeding 35 %

Temp.of flue gases at outlet : 170 deg.C. Max.

Efficiency : 68% minimum\_ on GCV of  
bagasse having 50% moisture with  
bagasse as fuel determined as per  
IS Code 13980-1995/ ASME Code.

Fuel : Bagasse with 50 to 52% moisture.

Installation : Indoor &amp; at factory floor level.

Boiler shall be provided with minimum one steam drum and lower drum both of fusion welded construction. The drum shall be provided with suitable dished ends, manhole doors on each side, fitted with cross-bars, studs and nuts at each end. The steam drum of the boiler shall be provided with primary separators of S.S. steel construction and secondary to promote circulation and ensure high steam purity.

The heating surface of the boiler based on mean dia of tubes shall be minimum 1100M<sup>2</sup> with reference to main bank of boiler tubes, front wall, roof, rear wall and side wall tubes. Tube thickness shall be 4.0 mm thick.

**Boiler Headers :**

Boiler headers shall be constructed in accordance with IBR specifications with flanged ends to promote cleaning and inspection.

**Super Heater:**

The boiler shall be provided with super heater to achieve a final steam temp of 440+/-5 deg.C at 60 to 110% MCR and complete with inter-connected pipelines between the boiler and



superheater, mountings such as safety valves, drain/air vent valves, pressure gauges etc. as per IBR.

The tube elements of the superheater would be 4.0 mm thick constructed from seamless alloy steel tubes specification. The tube elements of the superheater shall be expanded into the steam drum at one end and butt welded/expanded to the outlet manifold at the other end. The superheater manifold shall be fabricated from solid drawn seamless pipes. The manifold shall be supplied complete with branches for main steam take off safety valve, air release connection etc. A thermowell in the outlet manifold shall be provided to measure the temperature of superheated steam. The superheater design should be such that the temperature of steam at superheater outlet should not go above 445 deg.C.

A spray attempertor or heat exchanger attempertor in between primary and secondry coils of superheater to be provided to maintain automatically the temperature of steam at superheater outlet  $440\pm 5^{\circ}\text{C}$  at steam flow rate between 60 to 110% of MCR and tube elements of the superheater shall be constructed from seamless alloy steel tubes of SA 213 T 11 specification or equivalent for primary coils (1<sup>st</sup> stage) and SA 213 T22 specification or equivalent for Secondary coils (2<sup>nd</sup> stage) and of 4.0 mm thick.

### **Furnace :**

Suitable furnace(s) to burn bagasse with 50 to 52 percent moisture with preheated air shall be provided for each boiler. Furnace shall be designed to give maximum continuous rating with bagasse firing only even when furnace chamber(s) are being cleaned. One of the following type furnace with all accessories shall be provided at factory floor level.

Spreader stoker with dumping grate/pulsating grate.

Alternatively furnaces to be designed for burning bagasse and coal/biomass individually or simultaneously if desired by purchaser in which case boiler performance is to be finalized between Purchaser & Seller.

### **Rotary Feeders :**

Suitable number of rotary feeders coupled to individual variable speed drive of positively infinitely variable type for regulating the quantity of bagasse to furnaces shall be provided. The feeders shall have speed variation and maximum speed not to exceed 25 RPM. Suitable bagasse storage bunker (bagasse silo) of ten minutes storage capacity for each feeder shall be provided.

### **Induced draft fan (one no.) :**

The fan shall be of designed for a minimum discharge capacity of  $42\text{M}^3/\text{sec}$ . The shaft of the fan shall conform to 40 C 8 of IS:1570-1978. Renewable hard faced wear pads on the blades shall be incorporated in the impeller. ID Fan shall be driven by TEFC slipring motor directly coupled with rotor resistance starter. The Fan rated speed shall not be more than 750 RPM. The impeller of the fan shall be fabricated out of minimum 6 mm thick mild steel. The fan shall be provided with dampers at the inlet as well as at the outlet.

### **Forced draft fan (One no.) :**



Primary air for combustion shall be supplied by the forced draft fan DEDW type, through air heater and shall be supplied to the furnace underneath the grate. The Fan shall be designed for a minimum discharge capacity of 22M<sup>3</sup>/sec. Variable inlet vane control damper in the suction of the FD fan shall be provided. FD fan shall be driven by TEFC SQ cage motor. The blades of fan rotor shall be fabricated out of minimum 5 mm thick mild steel plates. The rotors of the ID & FD Fans shall be dynamically balanced. The rpm of the FD fan should not be more than 960 rpm. ID fan should be interlocked so that FD runs only when ID fan is running.

### Secondary air fan ( One no. ) :

Secondary air fan of 8M<sup>3</sup>/sec. and 600MM W.G.along with TEFC squirrel cage motor shall be supplied. This will supply air into the furnace as a secondary air at high pressure through heat resisting nozzles for ensuring combustion completeness. The secondary air nozzles shall be installed in the furnace walls. From the same fan air shall be supplied to the pneumatic distributors to distribute the bagasse on to the grate uniformly. The isolating/ controlling damper shall be provided at the fan suction and in the duct at a branching point. The suction of fan shall have provision for cold air as well as hot air from airheater with two separate dampers for hot air and cold air. The rpm of secondary fan shall be not more than 1440rpm.

### Blow down arrangement :

Continuous blow down equipment as per IBR complete with all piping connected to the M.S blowdown tank within 10 metres outside the boiler house. Vapour Recovery arrangement shall be provided for blow down water.

### Soot Blowing equipment :

Steam operated hand controlled soot blowing equipment having minimum 4 nos. soot blowers for boiler at appropriate places to cover bank of boiler tubes and one no. automatic motorised retractable soot blower for superheater elements shall be provided. Additional steam operated hand controlled soot blower(s) shall also be provided for the Economiser.

### Instrumentation and Controls :

The instrument control panel to be totally enclosed in a cubicle for dust free conditions by providing an exhaust fan on the panel. The control panel shall be properly wired, tubed and connected to all field transmitters and instruments as per standard instrumentation practice. It should be housed in A.C. room, suitably sized, designed and constructed by the Purchaser.

- A) The following instrumentation systems are to be provided for measuring the various parameters.
- (i) Steam flow meter of indicating, integrating and recording (in data logger) type
  - (ii) Feed water flow meter of indicating, integrating and recording ( in data logger) type.
  - (iii) Drum water level indicating and recording ( in data logger) type.
  - (iv) Superheated pressure indicating and recording (in data logger) type.
  - (v) Multipoint temperature scanner interface with ' K/J ' type thermocouple and universal temperature transmitters with linear output for each of the following points. All these points to be connected to data logger for recording.
    - a) superheater steam at final superheater outlet and primary superheater outlet.
    - b) Feed water at deaerator inlet.

- c) Feed water economiser inlet.
  - d) Feed water at economiser outlet.
  - e) Flue gas temperature at boiler outlet.
  - f) Flue gas temperature at economiser outlet.
  - g) Flue gas temperature at airheater outlet.
  - h) Flue gas temperature at I.D fan inlet.
  - i) Air temperature at airheater inlet.
  - j) Air temperature at airheater outlet.
  - k) Furnace temperature.
- (vi) Draft gauges for –
- a) F.D fan discharge.
  - b) I.D fan suction.
  - c) Furnace.
  - d) Flue gas at boiler outlet.
  - e) Flue gas at economiser outlet.
  - f) Flue gas at airheater outlet.
  - g) Flue gas at fly ash arrestor inlet.
  - h) Flue gas at fly ash arrestor outlet.
  - i) Air at airheater outlet.
- (vii) CO<sub>2</sub> analyser with signal connection to datalogger.
- (viii) Pressure gauges of size 250 mm diameter with S.S. syphon and isolation valve to be provided at boiler drum, superheater outlet steam and at fire door level for superheater outlet steam.
- Pressure gauges of size 250 mm diameter with S.S. syphon and isolation valve to be provided at economiser inlet, economiser outlet, at each feed water pump outlet and feed water pumps common header.
- (ix) Microprocessor based 24 channel data logger programmable to any type of inputs like current, mv, T/C and digital for recording the following parameters with 80 column dot matrix printer and relay output for 8 channels for annunciation.
- a) Steam flow.
  - b) Feed water flow.
  - c) Superheater steam temperature at primary outlet.
  - d) Superheater steam temperature at secondary outlet.
  - e) Superheater steam pressure at secondary outlet.
  - f) Drum level.
  - g) Deaerator level.
  - h) Deaerator pressure.
  - i) Furnace pressure.
  - j) Air flow.
  - k) Feed water at economiser inlet.
  - l) Feed water at economiser outlet.
  - m) Feed water at deaerator inlet.
  - n) Flue gas temperature at boiler outlet.
  - o) Flue gas temperature at economiser outlet.
  - p) Flue gas temperature at airheater outlet.
  - q) Flue gas temperature at ID fan inlet.
  - r) Air temperature at airheater inlet.
  - s) Air temperature at airheater outlet.

- t) Furnace temperature.
  - u) CO<sub>2</sub>
- B) Microprocessor based annunciator with electronic hooter to be provided for the Following:
- a) Feed water tank level low.
  - b) Deaerator tank level low.
  - c) Deaerator tank level high.
  - d) Drum water level low.
  - e) Drum water level high.
  - f) Superheater steam temperature high.
  - g) I.D fan trip.
  - h) F.D fan trip.
  - i) S.A fan trip.
  - j) Feed water pump trip.
  - k) Bagasse feeder trip.
  - l) Feed water transfer pump trip.
- C) The following auto controllers are to be provided with the boiler.
- i) **Three element drum level control system:** Drum level shall be automatically controlled using the three element control philosophy to ensure quick response of the system. In case of drum level falls below minimum level, the feed water control valve will open fully. In case drum level rises above maximum level, the feed water control valve will close fully.
  - ii) **Deaerator pressure and level control system:** Deaerator pressure shall be maintained by regulating the steam flow to the deaerator so that temperature of boiler feed water is maintained at the desired set value. Deaerator level shall be controlled so as to balance the inflow and out- flow of feed water.
  - iii) Cascaded superheater steam temperature control system based on measuring temperature at outlet of primary superheater header and final superheater header.
  - iv) **Combustion control system:** This will be an integrated control loop for maintaining the steam pressure. According to the steam pressure the master controller will adjust rotary feeder speed to feed more or less fuel to the boiler and FD/ID fan to control amount of primary air/flue gas respectively. To ensure that this adjustment is correct, the signal of CO<sub>2</sub> % in flue gases will be taken in the loop to make the final correction in the combustion air/flue gas flow.
  - v) **Furnace pressure control system:** ID fan speed shall be controlled to maintain draft in side the furnace to – 3-5mm WC.
- D) Two air compressors (one as standby) shall be provided to supply oil and moisture free air through suitable dryer system, for pneumatically controlled instruments. Spare air filtering and drying system shall also be provided along with standby compressor.

OR

## COMPUTERIZED BOILER AUTOMATION :-

The computerized scalable process control system shall be provided to achieve the above referred measurements, control & audio- visual alarms for the safe and smooth operation of the boiler. The system shall have the following features and facilities :-

- a) Data acquisition and monitoring.
- b) Data logging.
- c) Alarm and event logging.
- d) Dynamic trend for 32 channels.
- e) Three dimensional graphic display.
- f) Free format report generation for customized reports.
- g) Online mathematical computation for any physical and virtual channels.
- h) Printer hard copy.
- i) Loop wise scan time selection.
- j) Card replacement without power shutdown.
- k) Latest communication standards like HART/Foundation field bus.

### **Economiser :**

An economiser having adequate heating surface with 4.0 mm thick tubes shall be provided. Economiser shall be complete with coils, supports, thermowells for measuring inlet and outlet water temperature, casing and ducting, soot blower, lagging etc. The economiser shall be designed in accordance with the requirement of IBR. The system should have Bye-pass arrangement for flue gas and water circulation. The rise in temperature of feed water in economiser should be about 60°C less than saturation temperature of the drum water.

### **Air pre-heater :**

Air heater having adequate heating surface to heat the air by flue gases required for combustion shall be provided. Air heater shall be complete in all respects with 10 SWG thick ERW tubes, tube plates, support, dampers, casing and ducting etc. Entry of cold air shall be distributed properly over the length of air heater to avoid condensation of moisture. Tube plates thickness shall be minimum 25mm.

The air heater and economiser shall be designed so as to give final flue gas temp. of max. 170 deg.C. The air outlet temp. should not exceed 220 deg C.

### **Fly Ash Arrestor Electrostatic Precipitator (ESP)**

The ESP should be designed on the following basic parameters :

Gas Flow Rate	=	Corresponding to MCR of the boiler
Temperature of gasses at ESP entry	=	<170°C
Inlet Dust concentration	=	5.0g/Nm <sup>3</sup>
Outlet Emission (concentration) at ESP exit	=	<150mg/Nm <sup>3</sup>
Pressure Drop across ESP for condition gas side	=	<25mm WG

The electrostatic precipitator of suitable capacity shall be designed so that the dust emission at the outlet of the chimney should be limited to 150mg/NM<sup>3</sup> or as prescribed by State Pollution Control

Board. The ESP shall be installed on the suction side of ID fan and shall be complete with rotary air lock valve with drive provided with local and remote push button control and a side manual gate. The minimum elevation of the discharge flange of the rotary air lock valve shall be at +2500mm suitable platform, MS steel staging, ladders, staircases, railing, inspection and packing holes shall be included in the scope of supply. The ESP should be properly insulated with aluminium cladding ESP be provided with indication for ash level, low and high temperature alarm, water washing arrangement ESP Switchgear Control Panels, rectifier control panels complete in all respects. It should be provided with suitable ash handling system.

The general arrangement showing major dimension and clearances for ESP system, ESP foundation drawing for load data, electric single line diagram alongwith detailed drawings should be furnished for approval from the Purchaser.

### **Boiler feed water tank (Suitable for 2000 TCD) :**

One cylindrical closed mild steel tank shall be of 300 HL capacity with inlet connections for condensate, treated water, chemical dosing arrangements, outlets connections, for transfer pumps, overflow connection, air vent connection etc. Feed water tank shall be supported on steel supporting structure. Bottom of the tank shall not be less than 8 metre height from the transfer pump suction. Access ladder and platform around the tank shall be provided. High and low water level alarm shall be provided in the feed tank along with gauge glasses.

Two nos. transfer pumps (one as standby) each of 50 m<sup>3</sup>/hr capacity and 60M head to pump water from boiler feed water tank to Deaerator to maintain 4 kg/cm<sup>2</sup> g pressure at the nozzles of Deaerator shall be provided.

### **Deaerator (Suitable for 2000 TCD) :**

Deaerator mounted on de-aerated water tank of 300 HL capacity and suitable for maximum flow rate of 80 m<sup>3</sup> per hour shall be provided to obtain a temperature rise of feed water from 85 deg.C to 105 deg.C by using exhaust steam at 0.5 - 1.5 kg/cm<sup>2</sup> gauge. The maximum dissolved oxygen in the deaerator water shall not be more than 0.007 ppm. at 105 deg.C. temp. The deaerator tank shall be installed at a height of 8 metres from the feed pump suction and shall have platform around the tank, it shall have high and low level alarm along with gauge glasses.

### **CHEMICAL DOSING EQUIPMENTS (Suitable for 2000 TCD):**

The boiler shall be supplied with chemical dosing systems one for high pressure dosing and other for low pressure dosing. Each system shall consist of chemical proportioning tanks, two nos. positive displacement type dosing pumps, valves and measuring instruments. Each mixing tank shall have rubber linings from inside and shall be fitted with motorised stirrer. The capacity of each tank shall be of 400 litres. The chemical dosing system equipment shall be located near feed water station on the ground floor.

### **Boiler feed water pumps :**

#### **(i) Electrical driven feed pumps :-**

Three pumps (one as standby) each of 25 m<sup>3</sup> per hour capacity against head not less than 675 meters shall be provided.

For 2000 TCD additional one no. pump of 25 m<sup>3</sup> per hour capacity against head not less than 675 m.

Each multistage electrical driven pump shall be suitable for pumping hot water at 105 deg.C. from deaerater to boiler. 2% leak-off connection shall be provided for each pump. Electric motor of TEFC sq. cage type with auto transformer/soft starter shall be provided. The starting current should not exceed the 300% of full load current.

### **R.C.C Chimney (Suitable for 2000 TCD) (Purchaser Scope) :**

One R.C.C chimney of 3.0 meters inside diameter at top and of height as per pollution board norms shall be constructed by Purchaser along with ladder with guard. Besides, refractory lining upto 10m height, lightening arrestor and M. S. frame and necessary ducting shall be provided by Purchaser. Detail of chimney inlet to be furnished by Seller.

### **Boiler Feed Water Treatment Plant (Suitable for 2000 TCD) (Purchaser Scope) :**

A D.M plant with mixed bed of 15 m<sup>3</sup>/hr capacity shall be provided to suit the water requirement of the boiler. A M.S. storage tank of 1500 H.L capacity, shall be included to store the treated water from the treatment plant. Two pumps of 50 m<sup>3</sup>/hr capacity and of 25 meters head shall be provided to pump the water from treated water storage tank to feed water tank. Existing water analysis to be provided by purchaser.

### **High pressure Steam Distribution header(Suitable for 2000 TCD) :**

One no. steam distribution header of 400 mm NB with same size flanged ends on either side and provided with the following flanged tapings for collecting the steam and distribution it to various units to be provided.

- i) One 200 mm inlet opening for boiler with gate valve.
- ii) One 200 mm inlet opening with dummy for future boiler.
- iii) One 150 mm outlet opening with Gate Valve for T.G.Set.
- iv) One 200 mm outlet opening with dummy for future T.G.Set.
- v) One 150 mm opening with globe valve for PRD.
- vi) Two nos. 150 mm openings with dummy.
- vii) Provision for pressure gauge and thermometer.

All High pressure piping shall conform to IBR.

### **Material of construction and general instructions :**

The boiler shall be manufactured in accordance with the requirements of Indian Boiler Rules and Regulations/ISO. The boiler shall be provided with a steel supporting structure from rolled steel sections and designed with adequate strength for the loads imposed by the boiler and associated equipments. The boiler shall be complete with necessary tubes, manifolds, integral pipe works, mountings and fittings with valves, gauges, high and low water alarm, maintenance tools consisting of expander, mandrills, ratchets two grease guns and a set of spanners, water gauges, chemical injection valves etc. The integral pipe work shall consist of blow-off bends, high and low pressure drains, water gauge piping, water and steam connections to the feed water regulator, piping from feed control valve to economiser inlet manifold, feed piping from economiser outlet manifold to the boiler steam drum, pressure gauge piping soot blower steam supply pipe works, safety valves escape pipe work etc. The boiler shall be provided with a three element type automatic feed water regulator of the electric/pneumatic controller type, which shall respond to momentary fluctuations in steam demand upto  $\pm 5\%$  of the rated MCR of the boiler. One hand operated control valve of cast steel (located such that its

operator can see water level in gauge glass) capable of passing the required amount of water shall also be provided. The boiler shall have two water gauge glasses at the top drum independently connected.

Necessary mild steel ducting of 5 mm thick plate in case of air duct and 6 mm thick in case of gas duct with stiffeners shall be provided for the boiler, comprising of cold air ducting extending between the forced draft fan discharge and air inlet of air heater, hot air ducting from the air heater outlet to the furnace, flue gas ducting from fly ash arrestor to the chimney. All ducts of mild steel and above the ground.

Necessary regulating and isolating dampers at suitable points shall be provided for the efficient operation and maintenance of boiler. All dampers will have an effective area not less than the specified for the ducts they control.

Suitable galleries and ladders with grating or open steel flooring for affording access to the essential levels of the boiler plant complete with hand railings, curb angles and supports shall be provided.

All supporting steel work, hangers, thrust brackets and castings for the furnace shall be provided for boiler. All refractory tiles and bricks, adequate quantity of high grade refractory cement, special shaped refractory tiles castable refractory bricks for furnace and high temperature zones shall be as per IS-8 quality. All necessary high grade insulating materials for the exposed portion of the boiler, steam and water drums, integral pipe work from the feed pumps to the boiler, steam piping, gas and hot air ducting shall also be supplied. Reinforcement with wire mesh and supercoated with a hard setting material so as to protect the high grade lagging materials against damage shall also be provided. Red bricks, cement and sand also to be provided by Seller.



## (VI) POWER GENERATING PLANT

### (a) Turbo Alternator Set :

**For 1250 TCD - 1 No: 3 MW at 0.8 P.F.**

**For 2000 TCD - Addition of 1 No: 3 MW at 0.8 P.F.**

One turbo alternator of 3750 KVA ( 3000 KW at 0.8 power factor )

3000 KW turbo set shall be suitable of developing 3375KW at 0.9PF power even when both the overload valves of the turbine are closed.

The steam turbine shall be designed for operation for the following ranges of steam parameters :

Inlet Steam parameters :

For 45 kg/cm<sup>2</sup>g Boiler

Maximum	:	45 kg/cm <sup>2</sup> g.
Normal	:	42 kg/cm <sup>2</sup> g
Minimum	∴	38 kg/cm <sup>2</sup> g

Inlet Steam Temperature :

Maximum	:	440 deg. C.
Normal	:	415 deg. C
Minimum	∴	390 deg. C.

Exhaust Steam Pressure :

Maximum	:	1.5 kg/cm <sup>2</sup> g.
Normal	:	1.0 kg/cm <sup>2</sup> g.
Minimum	:	0.5 kg/cm <sup>2</sup> g

The turbine shall be so designed that it suffers no damage if exhaust pressure occasionally goes down to atmospheric pressure and/or live steam temperature goes upto 445 deg. C.

The turbine shall be horizontal bladed rotor type double pedestal multistage uncontrolled bleed cum back pressure design.

The turbine shall also be capable of developing 3000 KW when steam pressure at inlet stop valve is 38 kg/cm<sup>2</sup>g and temperature 390 deg. C. and both overload valves open. The specific steam consumption at its rated speed and for normal steam operating parameters shall not exceed 8.0Kg/KW/Hr while delivering 3000KW.

The turbine shall be coupled to a suitable enclosed reduction gear box of hardened and ground/nitrided gears designed to transmit 3000 KW continuously at turbine rated speed an ambient temperature of 50 deg. C. with a service factor not less than 1.5. The gear box shall be coupled to the alternator through suitable coupling, capable of transmitting 3000 KW continuously. The gear box shall be designed as per relevant DIN/IS/BS/AGMA standard. Necessary cooling arrangement with standby cooler & oil pumps for the gear box shall be provided.

The speed regulation of the turbine (Droop characteristic) shall not exceed 6 percent at 3000 KW full load of the alternator. The turbine shall be provided with a suitable hydraulic/mechanical governor. The turbine shall be complete with high pressure stop and emergency valve, steam strainer steam traps, sentinel valve, main oil pump, auxiliary electric motor driven oil pump, one steam turbine driven standby oil pump, oil cooling system consisting of two Nos Oil coolers with necessary pipes, pumps and valves so that one of the two coolers can be cleaned when the turbine is working on load, steam and oil temperature and pressure gauges, gauge type spot mounted bearing temperature indicators for turbine and gear box local/direct mounted speedometers and one remote reading thermometer, oil pockets with stem type thermometers in the live steam inlet and exhaust steam outlet lines, steam flow meter for measuring the steam consumption of the turbine. Necessary oil reservoir, duplex micron filter/self cleaning type oil filters, oil strainer, interconnecting oil, water and steam pipe work with valves and non-return valves etc, and arrangement for automatic starting of auxiliary oil pump in case of low oil pressure shall be provided. The following safety devices shall be provided for the turbine :-

- (i) Overspeed trip with audio visual alarm.
- (ii) Low oil pressure trip with audio visual alarm.
- (iii) The turbine should trip when the alternator ACB trips due to differential protection.
- (iv) Remote operated manual trip with audio visual alarm.
- (v) Manual trip knob/handle on turbine.
- (vi) Axial movement trip.
- (vii) High back pressure trip.

Special maintenance tools for the turbine shall be supplied along with the turbine.

The alternator shall be suitable for developing continuously 3750 KVA (3000 KW at 0.8 Power factor) 3-phase, 4-wire, 50 cycles/sec. at a normal voltage range of 400-440 V, and shall conform to IS-4722-1968 specifications. The alternator shall be suitable for 3750 KVA even at 0.9 power factor. The alternator shall be fitted with two RTDs in each phase for thermo-protection of the alternator windings, space heaters, winding air space temperature indicator, dial type spot mounted temperature gauge for alternator bearings etc. The alternator shall be designed for an ambient temperature of 50 deg.C. The rotor as well as the stator of the alternator shall have class F insulation however the temperature rise shall be limited to Class 'B'. The alternator shall be complete with excitor, base frame, couplings, water-cooled radiator with admiralty quality brass tubes, item connecting cabling etc. The alternator shall be provided with two bearings (one at each end). Radiator shall be located at both sides of alternator body. Alternator shall have cylindrical rotor. Alternator shall be brushless type and CACW enclosure. Alternator efficiency shall be not less than 96% at full load. Alternator shall be suitable for taking thyristor ( D.C . ) load of upto 40 % of it's rated KVA.

The following panels shall be provided for the turbo set :-

- (i) Desk control panel for the turbine fitted with temp. and pressure gauges for steam and oil, turbine speed indicator and push buttons/rotary switch (inching type) for raising and lowering the turbine speed, push button for starting of auxiliary oil pump, indicating lamps etc.

- (ii) One battery panel consisting of necessary number of DC storage batteries housed in clean glass or rubber lined containers and complete with trickle charger and AC/DC fuses to supply DC control voltage to the various control panels in the power house. Operational D.C. voltage shall be 24 V D.C.
- (iii) AVR panel consisting of one operating and one standby (with change over rotary switch) automatic thyristor controlled voltage regulators with independent primary and secondary modes and complete with other accessories. An over voltage relay shall also be provided in this panel. Suitable voltmeter and fine adjustment devices shall also be provided. Quadrature droop adjustment shall be provided. Panel shall incorporate safety features viz under / over excitation limit, under/ over voltage, excitation overload etc.
- (iv) Excitation Panel - This shall be fitted with suitable size air circuit breaker or suitable switching device with brushless alternator for the excitation field circuit so that the field current is automatically cut off from the circuit in case the turbine/alternator trips. It shall be fitted with DC Ammeter and DC voltmeter, shunt field regulator for manual operation of the excitor with auto/manual selector switch, winding temp. indicator with selector switch, suitable transformers, field discharge resistance, 'ON-OFF' indicating lamps, fuses, etc.
- (v) Alternator breaker panel - This shall be fitted with 2 Nos. of 4000 Amps. rating for 3000 KW turboset draw-out type air circuit breaker having motorised 'ON-OFF' operation in addition to a handle projecting outside the panel for manual operation. This breaker shall be provided with DC operated shunt trip coil. The breaker shall be designed for a minimum symmetrical short circuit current of 50 KA (RMS) for one second. The breaker shall have suitable number of auxiliary contacts for electrical inter locking with auxiliary power supply breaker. The breaker shall be designed as per IS-2516 to be read along with Part I -1977 and Part II - 1972 specifications. The panel shall be fitted with the following protective devices for the alternator:-
- 3-element differential relay
  - earth fault relay (inverse type) (three element )
  - 3 element over current relay
  - 1 instantaneous over voltage relay
  - 1 under-voltage relay.
  - 1 master tripping relay with necessary relay timers.
  - Reverse power relay
  - Breaker discrepancy relay

(All these relays shall conform to IS-3231-1965 specifications & electromechanical type)

The panel shall be fitted with C.T. operated 3 Nos. ammeter 1 No: voltmeter with selector switch, one no reed type frequency meter, one no. KW meter, one no 3 phase power factor meter, one no KWH meter of integrating type, MDI/KVAH meter, one no. KVAR meter. The meters shall be Class 1.5 percent accuracy and shall conform to IS-1248-1968 specifications. Meters shall be preferably digital type. All meters shall be of square type of 144 mm sq with 90 per cent deflection. The panel shall be fitted with audio-visual annunciator having suitable number of windows and the following indications : -

DC failure trip, earth fault trip, over current trip, over voltage trip, under voltage trip, turbine high speed trip, turbine shut down, turbine governor oil pressure trip, lube oil pressure trip, high winding temperature trip, axial movement trip, high back pressure trip. Suitable

mechanical inter-locking with 2 Nos. spare castle key locks( loose ) shall be provided for interlocking of the main breaker with emergency power supply breaker of grid/DG supply and Bus Coupler can be switched 'ON' only when one incomer is 'ON'. If both incomers are 'ON' then bus coupler must be 'OFF'. 1 No: lock shall be fitted with alternator breaker panel and 2 Nos. loose locks shall be fitted in Main Distribution Panel for grid/DG set incomers. This will be in addition to the electrical interlocking of the same.

When additional alternator is required, synchronising system and bus coupler (rating same as incomer of alternator breaker) shall be provided with necessary meters and relays. Synchronising panel shall have double volt meter, double frequency meter, lamps, synchroscope, P.T. fuses and selector switch etc.

The panel will be fitted with suitable number of indicating lamps.

The alternator shall have neutral isolating air circuit breaker /contactor with interlocking facility and mounted on front side of breaker/bus coupler panel. All the above panels shall be sheet steel fabricated cubicle type made out of 14 SWG cold rolled steel sheets The cubicle shall be of totally enclosed floor mounting type, dust, damp and vermin proof as far as possible and shall be fitted with louvers for air circulation. Suitable size electric grade EC-91E copper bus bars shall be provided with SMC/DMC supports etc.

The alternator breaker panel shall be designed for the ultimate capacity for withstanding symmetrical short circuit current of 50 KA (RMS) for one second. The alternator breaker panel shall be designed for an ambient temperature of 50 deg.C and the maximum operating temperature of bus bars at the ultimate capacity shall not exceed 85 deg.C. The size of the neutral bus bars shall be half of that of the phase bus bars. The earth bus bar shall be located at the bottom and shall be continuous throughout the length of the panel. The panel shall be expandable at both ends.

### (b) Electrical Distribution System

The electrical distribution system shall include bus bar trunking connecting the alternator with the alternator breaker panel, main distribution board in the power house, bus coupler panel (at ultimate capacity) auxiliary panel, main and sub-lighting distribution boards, motor control centres, all electric motors, starters and switches for all electrical motors, power factor improving capacitors, all power, lighting and control electrical cables, earthing system, electrical erection materials etc. It will also include distribution boards, cables and lighting fixtures (without bulbs, tube lights and halogen lamps) for the lighting of the factory building, spray pond and cane carrier loading system.. The entire electrical system and equipment shall conform to the Indian Electricity Act and its Rules. The detailed specifications are as under :

- (i) Bus bar trunking : The bus bar shall be made of electric grade (EC-91E) aluminium The busbar trunking enclosure shall be fabricated out of 50 x 50 x 6 mm angle and folded covers of 2 mm thick aluminium sheets shall be provided on all four sides. The louvers shall be provided on side covers. The flexible copper connections as alternator end and fixed connections at the breaker panel end shall be provided. The bus bar trunking shall be designed for 3750 KVA continuous capacity at 0.9 power factor at an ambient temperature of 50 deg.C. and the maximum temperature of the bus bar shall not exceed 85 deg.C. It shall be designed to withstand a symmetrical short Circuit current of 50 KA (RMS) for one second. Bus bar trunking have a neutral bus bar of half the size of the phase busbars. Similar rating bus trunking and tie trunking with bus coupler identical to is panel shall also be provided for the addition of 2<sup>nd</sup> alternator in future.

- ii) Main distribution panel : This shall be designed for capacity of 2000 TCD at unity load factor for two alternator, one main distribution panel board to be added along with suitable bus coupler so the both alternator sets can be worked in parallel or isolated mode. The panel shall be fabricated from 14 SWG cold rolled sheet steel and shall be totally enclosed floor mounting type, dust, damp and vermin proof. Louvers shall be provided in the panel for air circulation. The panel shall be designed for an ambient temperature of 50 deg.C. and the maximum operating temperature of the bus bar shall not exceed 85 deg.C. The panel shall be designed to withstand symmetrical short circuit current of 50 KA (RMS) for one second. The operating heights of the panels shall be about 2000 mm. The panel doors compartment shall be interlocked in such a way that it shall not be possible to open them when the switch/circuit breaker is in closed on position. The bus bars provided in the panel shall be of aluminum EC-91E grade. The size of the neutral bus bar shall be half of that of phase bus bar. The earth bus bar shall be located at the bottom and shall be continuous throughout the length of the panel. Removable sheet steel gland plates shall be provided at the bottom of the panels for cable entry. The panel shall have individual air circuit breaker for outgoing feeders for motor control centres installed for cane preparation ,boilers and centrifugals. The panel shall also have individual switch fuse unit for outgoing feeders for all other motor control centres. The panel shall also have individual switch fuse unit for feeders for auxiliary panel, and electric oil pump for turbo set. The panel shall also have one bus section coupler consisting of 1600 amp. four pole air circuit breaker connected in such a way that some of the load can be transferred from the turboset supply and be fed from the emergency/other power supply. Coupler and emergency supply incomer breaker shall have four pole, (3 phase, neutral) air circuit breaker or 3 pole air circuit breaker and neutral isolating contactor including an ammeter, volt meter with selector switch fuses of suitable rating and indicating lamps..

One four pole air circuit breaker of 1000 amp. rating shall also be installed in the main distribution panel for feeding the emergency power supply from diesel set/state electricity grid . All these Air circuit breakers shall be interlocked with the alternator breaker panel such that only one source of power supply is fed to the bus bar at a time. The main distribution panel shall be fitted with spare switch fuse unit, one of each size subject to a maximum of three nos. and 2 nos. plugs and sockets, each of 63 amps. control supply of 230 VAC shall be obtained only through phase and neutral. Automatic Power factor correction panel with capacitors and suitable rating ACB as incomer shall be installed near the main distribution panel for automatic improvement of power factor to a minimum of 0.90. Air break contactors with back up switch fuse with ammeter and 'ON' Indicating lamps unit shall be fitted in the APFC panel for connection of about 400 KVAR capacitors. Capacitors shall be APP double layer type suitable for avoiding effects of D.C. harmonics generated by thyristor drives. The balance number of capacitors shall be installed at individual MCC's. The main distribution panel shall have ammeter and ON and OFF indicating lamps for each outgoing feeder. Ammeter, voltmeter and 3 nos indicating lamps shall be provided for incoming emergency supply breaker. All switches and air circuit breakers in the outgoing feeders in the main distribution board shall be designed for a rating of 1.2 times the connected load to each feeder. Each outgoing feeder shall be housed in individual separate cubicle with door interlock.

- iii) Auxiliary Panel : The auxiliary panel shall be provided with following outgoing feeders.

- 1 No: 160 amp switch fuse unit for tube well No: 1
- 1 No: 160 amp switch fuse unit for tube well No: 2
- 1 No: 200 amp SF unit for colony supply
- 1 No: 200 amp SF unit for workshop supply
- 1 No: 160 amp SF unit for factory lighting
- 1 No: 160 amp SF unit for street lighting
- 1 No; 63 amp plug and socket
- 1 No: 200 amp switch fuse unit for lighting auxiliary buildings
- 2 Nos: 160 amp switch fuse units as spare



The auxiliary panel shall be with one incoming 1000 amps switch fuse unit. One 1000 amps. 4 pole changeover switch shall also be provided for auxiliary panel so that it can be fed either from the turbo set supply or from the State Electricity grid supply. Neutral bus bar shall also be provided in the auxiliary panel. Other construction details and fault level etc. of the auxiliary panel shall be the same as the main distribution panel. The auxiliary [panel shall be located in the power house. One ammeter with selector switch, one voltmeter and 'ON' indicating lamps shall be provided in the incomer. Each outgoing feeder shall have an ammeter and 'ON' indication.

- iv) Bus coupler Panel : Bus coupler panel at ultimate capacity shall be added similar in construction i.e rating of ACBs (2x4000Amp) EDO type with ammeter, voltmeter with selector switch, interlocking arrangement mechanical/electrical both etc. Tie trunking for inter connection shall also be provided for 3750KVA at 0.8pf load.
- v) Motor Control Centres (MCC) : Complete plant load shall be divided into 12 to 15 zones, 12 to 15 Nos. MCC's shall be supplied, each zone connected to a separate MCC. Boiler and injection pumps shall have minimum 2 Nos: each MCC's. Also the main centrifugal machine motors shall be provided with minimum 4 no. MCCs/ A separate MCC shall be provided for pug mills, magma mixures, magma and molasses pumps. Also separe MCC shall be provided crystalliser and massecuite pumps. MCCs shall be suitable for 3 Ph. 4 Wire supply system ( MCCs shall have neutral busbar with phase busbars )

Each MCC shall be provided with 1 No: incoming switch of 1.2 times the connected load excluding the standby equipment , an ammeter, a voltmeter with selector switch, 3 phase energy meter and OFF and ON indicating lamps. Each MCC will have individual outgoing feeder for each motor connected to that MCC. For squirrel cage motors, each feeder shall have switch fuse unit, starter with overload protection( bimetallic thermal over load relay ) , an ammeter and on indicating lamp. For slipring motors, each feeder shall have switch fuse unit, contactor and bimetal thermal overload relay , ammeter and on indicating lamp for motor rating upto 160 kw and motors above 160 kw rating MCC shall have switch fuse unit ammeter and separate stator control panel with ACB shall be located near motor alongwith rotor resistance starter.In case of slipring motors starter, rotor starters shall be provided and installed near individual motors. The MCC's shall also have feeders for connection of low loss power capacitors APP double layer type, each feeder having air break contactor with back up switch fuse unit, on indicating lamps, ammeter, ON-OFF push buttoms. Suitable number of similar zones will be added to distribute the additional load coming at the expansion stage of 2000 TCD.

Each feeder in the MCC's shall be housed in separate individual compartments with door interlock.

Each MCC shall be 14/16 SWG cold rolled sheet steel fabricated cubicle type, floor mounted, dust, damp and vermin proof. Each MCC shall be expandable at both ends for additions of switches and starter for the motors if required at any stage. The bus bars shall be made of Electric Grade (EC-91E) aluminum & their shall be busbars for 3 phases and neutral . The earth bus bar shall be located at the bottom and shall be continuous throughout the length of each MCC. The operating height of each MCC shall be 1800 mm. Control supply of 230 VAC shall be obtained only through phase and neutral. However, in centrifugal panel/MCCS control supply of 230 V A.C. shall be obtained through control transformer.

Each MCC shall be designed to withstand symmetrical short circuit current of 35 KA (RMS) for one second. Each MCC shall be designed for an ambient temperature of 50

deg.C, the bus bar operating temperature at the ultimate capacity shall not exceed 85 deg. C Removable sheet steel gland plates shall be provided in each MCC for cable entry.

Each MCC shall be provided with spare switches, one of each size subject to a maximum of three nos. and a plug with socket of 63 amps. All squirrel cage motors upto an including of 40 HP rating shall be controlled with D.O.L. starters. All other squirrel cage motors above 40 HP.rating shall be controlled with air break automatic star delta starters. Each slip ring motor shall be controlled with stator rotor starter.

MCC incomers shall be SFU/ACB with 1.2 times capacity of MCC connected load excluding standby equipments.

Each slipring motor shall be controlled with rotor starters installed near motor, or Slipring motors upto 160 KW rating MCC shall house switch-fuse, contactor ,bimetal overload relay ammeter and ON indication lamp as a stator control panel and motors above 160 KW separate stator control panel with ACB shall be supplied and installed near motor.

Electrical inter-locking of the following electric motor (With arrangement for de-interlocking) shall be provided.

- (a) Cane cutter, cane leveller, fibrizer/ shredder, cane carrier motors so that if any of the cane preparatory device trips, the cane carrier drive shall also trip.
- (b) Bagasse elevator, bagasse carrier and return bagasse carrier motors.
- (c) Sugar elevator with grass hopper.
- (d) All batch type centrifugal machines to be interlocked such that not more than 2 machines accelerate simultaneously.

In addition to these MCC's, one pedestal mounted push button operating station (with ON-OFF push buttons) shall be provided near each squirrel cage motor. Also stop push buttons at the ground floor shall also be provided for bagasse elevator, and return bagasse carrier.ON/OFF push buttons for slipring motors shall also have ammeter alongwith push buttons.

- (vi) Electric Motors : All the electric motors up to 100 HP except ID Fan motors shall be squirrel cage TEFC enclosure induction motors. All motors above 100 HP shall be slipring SPDP enclosure induction motors . Batch type centrifugal machines and mill drive motors shall be of D.C. motors as per specified duty conditions in reference to BS-5000.

All the electric motors shall be suitable for operation at 3 phase, 50 Hz, 415 volts, AC supply and shall conform to IS-325 and IS-4722- specifications.

Motors for batch type centrifugal machines shall be suitable for specified duty as per IS-4722 specifications and shall be designed for an ambient temperature of 50 deg.C and shall be fitted with ETDs in each phase for thermo-protection of motor windings.

Electric motors for cross travel and long travel of cane unloader and mill house cranes shall be slipring TEFC enclosure suitable for S4 duty as per IS-4722- specifications. The electric motors for hoisting/de-hoisting of cane unloader and mill house crane shall be squirrel cage TEFC enclosure suitable for S4 duty as per IS-4722- specifications.

Electric cables : All power, control and lighting electric cables for the entire electrical distribution system shall be supplied.



The power electric cables from the main distribution panel to each MCC and to auxiliary panel shall be suitable for the connected load at unity load factor excluding standby equipments. Suitable derating factor for the cables shall be considered as per the recommendations of IS standards.

All power and lighting cables shall be PVC/XLPE insulated, armoured, suitable for use at 1100 V and shall conform to IS-1554(part I) specifications. All the control cables shall be of copper conductor. The minimum cross sectional area per core shall be 4 mm<sup>2</sup> for aluminum conductor and 2.5 mm<sup>2</sup> for copper conductor. Control cables shall be minimum 1.5 sq.mm. copper conductor.

All the lighting cables from main lighting D.B. to sub lighting D.B. shall be 3. 1/2 cores. Power cables from Main distribution panel in Power house to MCCS shall be 3.1/2 cores. However, from each MCC to individual motors shall be 3 core.

All the cables on the ground shall be laid in trenches on proper racks, suitably spaced and clamped to the racks.

All cable terminations shall be through crimping type cable lugs. Cable glands shall be provided at panels. Starters, motors, push button etc.

- viii) Power Factor Correcting Capacitors: Suitable number and rating low loss power capacitors APP double layer type shall be supplied to improve the plant power factor to 0.90, at 1250 TCD crushing capacity. The capacitor shall be suitable for D.C. load and its harmonics. The power capacitors shall conform to IS-2834 specifications. About 400 KVAR capacitors shall be connected to APFC panel in power house and the balance capacitors shall be connected to the motor control centres and motors of rating 100 HP and above with suitable rating SFD units, contactor and on indication. 400 KVAR ( 4X100 KVAR ) capacitor shall be controlled through auto power factor correction relay and thyristered switching / contactor switching shall be used for capacitors switching .
- (ix) Factory Lighting : The scope of work under this section shall be to provide illumination in main factory building, cane yard, spray pump house / cooling tower with additional two flood lights for illuminating spray pond only, injection water pump house, condenser house, cane preparation house and I.D.fan house. The average illumination levels shall be 50 lux in cane yard, 200 lux in power house and 150 lux in other areas. The lighting system shall be designed for use of fluorescent tubes in combination with HPSV ( sodium vapour ) / HPMV ( mercury vapour ) light fixtures.

However, GLS lamps shall be provided on each light glass for various equipments and at each centrifugal machine. All light fixtures and fittings including tubelight, bulb and sodium/mercury lamps shall be provided.

One main distribution board and about 12 numbers sub-distribution boards for the lighting system fitted with miniature circuit breakers for each circuit shall be provided. The main DB shall be located in the power house The sub-distribution boards shall be evenly spread in the factory area to be illuminated. Each sub-distribution board shall also be fitted with 3 nos. three-pin plug points. The main DB shall have a SFU incomer, ammeter, voltmeter with selector switch and indicating lamps. Each SDB shall have a MCB incomer an ammeter and 14 nos. outgoing MCB feeders. The wiring for complete lighting system shall be done with the help of PVC insulated and armored aluminum conductor cables run on walls, ceilings or underground trenches as required The lighting boards shall be sheet steel fabricated.

- (x) Earthing : Earthing of all electrical installations shall be done as per IS-3043-specifications and the Indian Electricity Act and its rules and approved by the Electricity Authority of the Government.
- (xi) All air circuit breakers shall conform to IS-2516-1 part I. All switch fuse units on cubicle switch boards shall conform to IS-4047 specifications. All switch fuse unit on Industrial Boards shall conform to IS-4064- Part I and Part II specifications.

All ammeters and voltmeters shall be 100 mm size, class 1.5% accuracy and shall confirm to IS-1248. All current transformers shall be class-1% accuracy and confirm to IS-2705. All contactors shall be air breake type with at least 2 nos. + 2 auxiliary contacts shall confirm to IS-2516.

- (xii) Necessary harmonic filters with switch gear panel complete in all respect shall be provided for DC harmonics..

### (c) Diesel Set

2 Nos.: diesel sets of 250 KW rating at alternator terminals at 0.8 power factor. The diesel generating set shall be continuously rated comprising multiple cylinder diesel engine having necessary protections such as low lube oil pressure trip, high engine temperature trip, over speed trip etc. and shall be fitted with speed control knob speedometer, hour meter battery charging meter, oil pressure and temperature gauges, radiator etc. The diesel engine shall be coupled with suitable alternator capable of developing continuously the rated power at 3 phase, 4 wire, 50 Hz at normal voltage of 420 VAC (Alternator to be suitable for voltage range of 400-440 VAC) and conforming to IS-4722- specifications. The alternator shall be fitted with minimum one ETD in each phase for thermo protection of the alternator windings. The alternator shall be designed for an ambient temperature of 50deg. C. The alternator shall be self excited and self regulated.

The diesel set shall be complete with base frame, couplings, one M.S. fabricated, diesel service tank of 10 HL capacity, inter-connecting piping, D.C. storage battery and self starting mechanism for the engine or petrol/diesel engine driven air compressor with receiver for starting the engine.

One 2 mm thick cold rolled sheet steel fabricated floor mounted, dust and vermin proof panel for the diesel set shall be provided. The panel shall be fitted with air circuit breaker , an overcurrent relay, over voltage relay, reverse power relay ,reed type frequency meter, earth fault relay, neutral isolating contactor, three phase 4 wire unbalanced energy meters, KW meter, 3 phase power factor meter, 3 nos. ampere meters, one no. voltmeter with selector switch, ON-OFF indicting lamps. The panel shall have neutral and phase bus bars of electric grade (EC-91E) aluminum and shall be designed to withstand symmetrical short circuit current of 35 KA (RMS) for one second. The panel shall be designed for an ambient temperature of 50 deg.C, the operating temperature of the bus bars shall not exceed 85 deg.C. All the meters shall be class 1.5 per cent accuracy and shall conform to IS-1248- specifications. All the meters shall be square type of 100 mm sq. with 90 per cent deflection Interconnecting electrical cables from the diesel set to the main distribution panel and to the auxiliary panel changeover switch shall be provided. Necessary synchronising panel with double voltmeter, double frequency meter , selector switch , lamps , synchroscope etc. shall be provided suitable rating bus coupler panel with ACB etc. shall also be provided between the two incomer of the DG sets to run the DG sets in parallel/individually as required.

### **(d) Power House Crane**

One hand-operated overhead travelling crane of 20 tonnes S.W.L capacity conforming to Class II of I.S specifications complete with rails, gantry etc, shall be supplied. The crane rail centres shall be to suit power house building.

### (VII) MISCELLANEOUS

#### a) Cane Weigh bridges – (Purchaser Scope)

#### (b) Reducing Valves (Suitable for ultimate capacity of 2000 TCD)

The following shall be supplied along with the machinery items: -

(i) One automatic steam reducing valve to reduce pressure of 25000 kgs of steam per hour from 43-45 kg/cm<sup>2</sup> to 7-8 kg/cm<sup>2</sup> g. pressure with suitable automatic desuper-heating arrangement and regulating system to maintain a steady temperature of 175 deg. plus-minus 5 deg.C. of the reduced pressure steam. There shall be provision for adjusting the down steam pressure at any pre-set valve between 7 to 8 kg/cm<sup>2</sup> g the reduced de-superheated steam shall be connected to a receiver with two branches one to supply 5,000 kgs.of steam per hour to centrifugals, sulphur burners, mills, clarification equipment and boiling house etc.

(ii) The second branch shall be provided with one automatic steam reducing valve to maintain a steady pressure of 1.0 - 1.5 kg/cm<sup>2</sup> g. in the receiver for exhaust steam from the prime movers by injecting steam upto 25,000 kg/hr, after reducing pressure from 7-8kg/cm<sup>2</sup>g. Suitable automatic de-superheating arrangement and relating system to be provided to maintain a steady temperature of 130 deg. C. plus-minus 5 deg.C. in the exhaust steam receiver by automatic de-superheating of the entire exhaust and make-up steam and suitable for ultimate capacity. The de-superheated steam coming out of the exhaust steam receiver shall be dry.

There shall be provision for adjusting the pressure in exhaust steam receiver at any pre-set valve between 1.0 to 1.5 kg/cm<sup>2</sup> g.

(iii) Two pressure pumps (one standby ) with electric drive of suitable capacity with receiver for injecting water in the two reduced pressure steam lines through automatically operated control valves shall be provided for de-superheating.

(iv) All the reducing valves shall be provided with pneumatically/electronically operated pressure controllers designed to maintain steady pressure with down steam flow rate variation from 10% to 100% of the rated capacity with over riding control system. One electric driven air compressor with receiver and piping shall be provided for in case of pneumatic operation of the reducing valves and de-superheaters.

(v) One steam flow meter shall be provided in the high pressure side of the reducing valve system at (b)(i) above .

(vi) One steam pressure recorder capable of recording pressure upto 2.0 kg/cm<sup>2</sup> g. shall be provided in the exhaust steam line near the Evaporator station. A dial thermometer of 200 mm dia and 0-300 deg.C range shall also be provided in the exhaust line. One temperature recorder to record the temperature upto 300 deg.C shall be provided in the exhaust line near the Evaporator station.

(vii) Suitable bypass arrangements as per IBR for each automatic reducing valve to be provided for manual operation. Isolating valves shall be provided to isolate the automatic valve for repairs while working. Steam strainers at upstream side of each reducing valve shall also be provided. The PRDS be supported on M.S. steel staging.

## (c) Bagasse Handling Equipment

One bagasse bailing press to handle 2.5 tonnes per hour of bagasse having 50% moisture and complete with 30 HP slipping induction motor etc. shall be provided.

## (d) Pipelines and Fittings

All hot and cold water,, juice, syrup, magma, molasses, massecuite and bled vapours, live steam, reduced pressure and exhaust steam pipe lines shall be suitable for respective capacities of units/equipments and all headers shall be designed for ultimate capacity. Various pipelines shall be designed so that velocities given below are not exceeded at initial stage.

- (i) Water and juice : Suction 1.0 m/second  
Delivery 1.2 m/second.
- (ii) Condensate : Suction 1.0 m/second  
Delivery 1.20 m/second
- (iii) Syrup : Suction 0.5 m/second  
Delivery 0.75 m/second.
- (iv) Molasses : Suction 0.25 m/second  
Delivery 0.5 m/second.
- (v) Massecuite/ Magma : Suction 0.1 m/second  
Delivery 0.15 m/second
- (vi) Superheated & Saturated steam : 30 m/second  
Exhaust steam : 30 m/second  
Bled vapours : 30 m/second
- (vii) Compressed air/ SO2 : 20 m/second
- (viii) A maximum pressure drop of 2.0 kg/cm<sup>2</sup> g. shall be allowed from boiler S.H. outlet to inlet of T.G. set.
- (ix) Main exhaust header, interconnecting piping at evaporator & vapour piping to pans shall be designed as mentioned elsewhere.

Safety valves to be provided in the steam pipe lines wherever necessary. Blow off pipes shall extend beyond the roof/factory buildings safety valves in the exhaust and reduced pressure lines shall be lever operated. Suitable drains, valves, steam traps etc. shall be provided in all steam lines. High pressure steam manifold of 400 mm shall be provided for ultimate capacity and connections as mentioned at high pressure distribution header shall be provided.

The pipes shall conform to specifications given below :

- (i) Cast Iron Pipes and Fittings :

The pipes shall be class 'B' and shall conform to IS:1537-1976 specifications and integrally cast flanged joints or spun pipes with screwed ends on flanges as per IS:1536-1976 shall be used.

The pipe fittings shall be class 'B' and shall conform to IS:1538 (part I to XXIII) - 1976 specifications. Only flanged joints shall be used. One side of the flanges shall be machined in case all pipe fittings.

(ii) Mild Steel Pipes

All mild steel pipes and pipe fittings used for conveying of air, cold water, to water (except boiler feed water) oil (except oil for hydraulic accumulators), molasses, massecuite, juice, lime, syrup, noxious gases etc. shall conform to IS:1239(part I)-1976 and IS:1239 (part II)-1982 specifications. All juice and syrup piping including imbibition juice piping shall be class 'C' (heavy) and rest of the piping shall be class 'B' (medium). The thickness of mild steel pipes having diameter more than 200 mm shall be 8 mm.

In case of all piping above 25 mm NB only flanged joints shall be used. All flanges to be as per IS:6392-1971.

(iii) Live steam, exhaust steam and boiler feed water piping:

These shall conform to I.B.R. wherever applicable. The thickness of exhaust and vapour steam piping shall be minimum 8 mm in case of 300 mm dia. and above.

The distance between two flanges in straight portion of pipes shall not exceed 6 metres except steam, vapour feed water pipe. In case of bends, flanges shall be provided atleast at one end. All steam expansion bellows shall be of stainless steel tested at 1.5 times the exhaust steam pressure.

Valves shall be provided in each branch line of juice heater,, reduced pressure steam lines, water separator, drain, steam trap etc.

All delivery lines of juice, water and syrup of centrifugal pumps shall have non-return valves except in case of unstrained imbibition juice pump,lime and Mud pumps, Water connections to be provided at each station for cleaning.

All exhaust steam valves for evaporator and pans shall be right angle valves.

All bearing and oil cooling water to be collected in a M.S. fabricated tank which shall be about 10 metres away from the factory building.

**(e) Supporting steel structure**

(i) Factory shall be gravity flow type.

(ii) Necessary M.S. staging for all the machinery including supporting columns, integral floor structure, staircases, railings etc. shall be provided for Mills, mill drive, turbo generator, clarifier and lime slaker. Sulphur furnaces shall be on steel staging with railing with R.C.C. flooring. Other machinery except those on floor level shall have its own supporting steel staging.

Pipelines, mill and power house cranes, condensers, flash tanks, cyclone separators can be supported on building columns. No weight of other machinery or platform shall be transmitted to building columns. Mills to have mild steel chequered or perforated or grating flooring. Centrifugals to have chequered plate floor. In the boiling house chequered plate flooring shall be provided. All gangways, passages, staircases, working platform and railings shall be convenient and chequered plate thickness shall be minimum 5.0 mm.

Staging for additional evaporators to be installed for 2000 TCD shall be provided in the expansion stage. However, space is to be left at the initial stage with inter connecting platform. End columns of pan staging to be similar to intermediate columns to take load of pans to be added.

A clear working platform of atleast 2000 mm. width shall be provided in working front of pans and evaporator bodies. Moving space between pans and evaporators shall be 1200 mm. In case of other units a clear working platform of atleast 1.2 m. width to be provided.

All statutory requirement regarding staging platform staircases, safety devices etc. shall be observed at the design stage.

### (f) General Material Specifications

- i) Gun metal used for bushes and bearings shall conform to IS : 318-1965.
- ii) White metal used for lining of bearings shall conform to IS : 25-1966.
- iii) Phosphor bronze castings shall conform to IS: 28-1975.
- iv) The mill drive pinions shall be made of EN-24 (Forged) and gear wheels cast steel as per IS:2708-1973 Grade III.
- v) Cast iron flexible couplings shall conform to IS:2693-1964.
- vi) Glass wool for vessels and piping shall conform to IS:3690-1974 type 2. Mineral wool shall conform to IS:5696-1970. The thickness shall be to suit the temperature and diameter of pipe.
- vii) Sheet rubber shall conform to type 8 of IS:638-1965. Grades to suit the nature of work.
- viii) Compressed asbestos fibre shall conform to IS:2712-1971.
- ix) Cast iron sluice valves shall conform to IS:780-1969.
- x) Gun metal valves (not used for live steam) shall be heavy duty and shall conform to IS:778-1971.
- xi) Plummer blocks used for roller bearings shall conform to IS:4773-1968.
- xii) The slide rails for electric motors, if of grey cast iron conform to grade 15 of IS:210-1962. The slide rails shall be as per IS:2968-1964.
- xiii) Stirrer shaft for crystallizers, pugmills, magma mixer, lime tanks, sugar melter, juice sulphiter, molasses dilution tank etc. shall conform to 40 C8 of IS:1570-1979 or equivalent, except when mild steel fabricated pipes are used.
- xiv) Mild steel plates shall conform to IS:2062-1969 in case of fabricated headstocks, side caps, mill bearings, gear beds, for mill drive and all fabricated parts subjected to steam pressure higher than 1.5 kg/cm<sup>2</sup>.
- xv) Structural steel and mild steel plates conforming to IS:226-1975 or equivalent shall be used for the fabrication of rest of the machinery and equipment.
- xvi) All brass tubes shall be of 70 : 30 alloy conforming to alloy Number 1 of IS:407-1966.



### (g) General

The Plant and Machinery is to be according to the guide line specifications for 1250 TCD Plant expandable to 2000 TCD finalized by the Government of India and should incorporate the following:

- 1) In designing factory building and engineering layout criterion should be attached to local wind direction to ensure the following. General layout of plant and machinery shall show equipment for ultimate capacity.
  - 1) Effective natural ventilation of Power House.
  - 2) Non contamination of circulating waters by acidic agents.
  - 3) Statutory requirements of pollution preventions.
- 2) The factory floor levels as well as injection channels and spray pond levels shall be decided to suit the topography at the Sugar Plant site.
- 3) Eves height of bagging house to be 18 m to facilitate Sugar bins installation in future.
- 4) Plant and machinery to conform to all State and Central laws.
- 5) All the cranes in the Sugar Plant (including cane unloader) should have box type bridge girders (and not lattice type). All the gear boxes installed on the cranes should be helical type having hardened and ground teeth.
- 6) The O&M manuals, drawings, specifications etc. should be supplied by the Seller to the Purchaser 4 months before the scheduled date of commissioning of the Sugar Plant and should also include the following:
  - i) List of Ball/Roller bearings fitted in the Sugar Plant (equipmentwise stating bearing Nos.)
  - ii) List of all electric motors installed in the Sugar Plant (equipmentwise stating motor type, H.P., RPM etc.).
  - iii) List of all Reduction gear boxes installed in the Sugar Plant (equipmentwise stating gear box type, ratio, H.P., rating, service factor etc.)
  - iv) List of pumps installed in the Sugar Plant (pump type, duty, discharge, total head etc.)
  - v) List of all coupling bushes, oil seals etc. fitted in the Sugar Plant (stating sizewise qty and equipment name where the part is fitted).
- 7) The Sellers shall not make the use of building columns and trusses for lifting weights of machinery during erection. Factory building structure should not be used as staging for any items of machinery and equipment (except mill and power house cranes & piping).
- 8) All the Grit catchers in the Sugar Plant should be 800 mm dia x 1000 mm height – shell 8 mm thick, bottom 10 mm thick, cover plates 20 mm thick. Covers should be hinged and cover holding bolts should be 25 mm dia. The bucket screens should be made of 3 mm thick. AISI 304 quality S.S. and should have sturdy handles for lifting.
- 9) Condensate outlet pipes from various units to have sight glasses at eye level in addition to sight glasses in extracting columns. Test cocks should also be provided for taking out condensate samples.

- 10) Test cocks should be provided in condensate outlets of all units individually for testing water for sugar traces. All the condensate pumps delivery lines should have 50 mm NB connection with a valve to let out the water in the drain, as and when sugar traces are found in the condensate.
- 11) Size of Condensate Receivers for Juice heaters and Evaprotators should be 400 mm dia x 1200 mm height – Shell 8 mm thick, bottom 10 mm thick.
- 12) The RPM of the motor of the condensate extraction pumps should not be more than 1500.
- 13) Heating surfaces of juice heaters evaprotator bodies, pans and boilers shall be calculated on the basis of mean diam and effective tube length with contact of heating fluid.
- 14) All the pumps of juice, lime and syrup should be provided with suitable catchers in the suction side. Also, juice delivery lines should be provided with non-return valves.
- 15) All the centrifugal pumps should have stop and non-return valves in the delivery pipes.
- 16) Centrifugal pumps: The service water pumps, injection and spray water pumps, syrup pumps, melt pumps should be bronze fitted. Otherwise these and other (except at mill house) centrifugal pumps should conform to IS-5659 and IS-5120 specifications.
- 17) All the vapour line of the pans and 4<sup>th</sup> body of the evaporators should be provided with a manhole to enable accessibility inside the vapour lines for cleaning and painting purposes. One 100 mm dia x 150 mm long nipple should be welded in the vapour pipe along with a blind flange to enable water filling of the vapour line.
- 18) The diameter of the pipes for filling water into bodies and calandrias of evaporator and pans should not be less than 100 mm size.
- 19) All the valves for massecuite and magma lines should be of rising spindle type only.
- 20) All massecuite, magma and molasses lines at crystalliser and centrifugal stations should be provided with 20 mm size steaming arrangements along with non-return valves.
- 21) The sluice/right angle valves used in exhaust steam and vapour pipelines should have stainless steel internals and S.S. spindles.
- 22) Suitable capacity steam traps should be provided in the exhaust line for the outlet of the condensate.
- 23) Steam flow meter of indicating, integrating and recording type shall be provided for PRDS.
- 24) Temperature recorders for raw, sulphited juice, evaporator exhaust steam, injection outlet/inlet water and vacuum recorder for last body of evaporator shall be provided at appropriate place.
- 25) For lagging the equipments, pipes and fittings etc. of the sugar plant as per specifications the Sellers scope of supply should be as follows:

All the equipments and pipelines (including fittings as defined under Clause 6 of IS:7413 specifications), surfaces in the sugar plant above 55 deg. C. temperature should be effectively lagged (except where heat dissipation is desirable and the surfaces which become hot intermittently such as steam traps and relief valve outlet pipes, vents, blow-down pipes etc.)

Material to be used:

- i) For lagging: Factory made mattresses of Bonded Glass wool/Rock wool/Mineral wool as per IS:8183 – (latest issue) specifications. The bulk density of the material should be:
- 50 kg/m<sup>3</sup> for hot surface temperatures upto 250 deg. C.
  - 120 kg/m<sup>3</sup> for hot surface temperatures above 250 deg. C. but upto 550 deg. C. (as per clause 3.2 of IS:8183 – (latest issue) specifications)

The thickness of the lagging should be such that the difference between temperature measured (at any time during the maintenance warranty period as per clause 22 of the draft agreement) at any point on the outer surface of the lagging cladding (i.e. protective finish) and the ambient temperature at that time should not exceed 10 deg. C.

- ii) For protective finish:

Material for cladding of all lagging in the sugar plant should be cotton canvas (as per IS:7413 standard specifications) (except as follows).

- The valves and flanges (including the flanges of the equipment) to be lagged shall be provided with openable lagging boxes for valves and fittings of the HP steam lines (including boiler plant) openable boxes shall be out of 18 SWG thick aluminium sheets as per IS:737 designation 31000 condition H3.
- All the turbines lagging should be provided with boxes of 3 mm thick Aluminium sheets. Lifting block should be provided for these boxes.

- iii) Balance materials (not specified above) should be as per IS:7413 specifications.

Application and finishing of the lagging materials, protective coverings etc. should be carried out by the Seller as per IS:7413 (latest issue) specifications.

- 26) Chequered plates shall be provided by the Seller for all floorings for the plant and machinery mentioned in the specifications. However, M.S. Gratings Working Platform to be provided below Juice Heaters and Evaporators.
- 27) All maintenance tools, tube expanders etc. to be supplied by the Seller to the Purchaser as per scope of supply stipulated under this Agreement should be brand new and should not be those used by the Seller for erection and commissioning of the Sugar Plant.
- 28) All nuts and bolts and non-return valves should be as per ISI specifications.
- 29) In cases tensile strength or solidily has been mentioned the supplier shall submit a suitable certificate of the same from original manufacturer/Govt. approved testing laboratories/Govt. Engineering Colleges.
- 30) Suitable arrangements shall be provided for continuous sampling of following
- Primary juice
  - Last mill juice
  - Mixed juice
  - Clera juice
  - Sulphited syrup

## Annexure - I

### PERFORMANCE PARAMETERS OF SUGAR PLANTS FOR 1250 TCD EXPANDABLE UPTO 2000TCD

#### 1. MILLING PLANT

i) The preparation index of prepared cane shall be minimum 88. The preparation index shall be determined by Aldrich / Rayner CCR Australian method.

ii) Whole Reduced Extraction (Mittal) shall be minimum 95.0 at 220% imbibition on fibre.

#### 2. CLARIFICATION PLANT

##### Juice heaters:

Following temperature should be obtained:

- i) Raw juice shall be heated from 20 deg. C to 70 deg. C by vapours bled from 3<sup>rd</sup> body of evaporator.
- ii) Sulphited juice shall be heated from 65 deg. C to 103 deg. C by vapours bled from 2<sup>nd</sup> (B) body and 1<sup>st</sup> body of evaporator.
- iii) Clear juice shall be heated to 115 deg. C by available exhaust steam.
- iv) Milk of Lime preparation, Juice Sulphiter and Clarifier -The clear juice obtained from clarifier should be free from suspended mud particles and thick mud should be obtained. In a sample of one litre muddy juice drawn from the clarifier, minimum 50 grams of dry insoluble solid should be obtained.
- v) Vacuum Filter – Vacuum filter efficiency (mud solids retention) should not be less than 75% based on the average of 6 samples taken under regular working conditions. The bagacillo should be available at the rate of 9Kgs per tonne of cane per hour, pol % filter cake should not be more than 1.5 at wash water of 100% on cake.

#### 2. EVAPORATION AND BOILING PLANT

##### (a) Evaporator

- (a) Minimum vacuum at the last body of evaporator shall be 635 mm at mean sea level.
- (b) The evaporator set should be able to give upto 80% evaporation.

##### (b) Syrup Sulphiter

The syrup sulphiter should be capable of sulphiting the syrup of 5.0 pH.

## (c) Vacuum Pan

- (i) Minimum vacuum at the pan body shall be 635 mm at mean sea level.
- (ii) Total cycle time (full strike level) should not be more than the following:

A massecuite pan	-	2.5 hours
B massecuite pan	-	4.0 hours
C massecuite pan	-	8.0 hours after footing and C – massecuite brix 101 deg.

## (d) Condensers

- (i) Minimum vacuum in the body of the condenser shall be 650 mm.
- (ii) The difference of temperature between vapours to be condensed and tail pipe water temperature shall be less than 10 deg. C.

## (e) Spray Ponds

Minimum drop of 13 deg. C or within 7 deg. C of wet bulb temperature, whichever is less should be achieved for injection water cooling.

## (f) Cooling Tower

Minimum drop of 20 deg C or within 5 deg C wet bulb temp. shall be achieved during season.

## 3. COOLING, CURING, GRADING

### (a) Crystallisers

- (i) Minimum purity drop in C – crystallisers should be 4 units reckoned from C – pan dropping massecuite to over flow of C – continuous crystallisers.
- (ii) B – massecuite should be cooled from 65 deg. C to 50 deg. C in 8 hours when supplied with cooling water at 30 deg. C.
- (iii) C – massecuite should be cooled from 65 deg. C to 40 deg. C in 15 hours when supplied with cooling water at 30 deg. C.

### (b) Rapid Reheating Equipment:

The cooled C – massecuite shall be reheated rapidly from 40 deg. C to 50 deg. C and the final temperature should not exceed more than 52 deg. C.

### (c) Continuous Centrifugal Machines:

The guaranteed capacity of continuous centrifugal machines shall be linked to the following:

- (i) B – massecuite brix 94-96, purity not exceeding 67.0
- (ii) C – massecuite brix 100-102, purity not exceeding 55.0

## Performance Parameters to be obtained from Centrifugal machine:

- (i) Purity of single cured C – sugar shall not be less than 80.
- (ii) Purity of double cured C – sugar shall not be less than 92
- (iii) Purity increase between Nutsch molasses purity ( C – massecuite fed to C – fore workers) and final molasses purity from C – fore worker machines shall not be more than 1.5.
- (iv) Purity of B – single cured sugar shall not be less than 95.0.
- (v) Capacity of A batch machines shall be judged for average cycles during continuous four hours working and for continuous machines for four hours continuous working for successive 7 days respectively.
- (vi) Exhaustion of massecuite shall be minimum 60 per cent.

## Sugar Melter

The brix of the melt should not be less than 55 deg. And melt should be free from sugar crystals.

## (d) Grass Hopper

The temperature of the sugar at the end of the last hopper should not be more than 42 deg. C and moisture should not be more than 0.03% when the ambient temperature is below 36°C.

## (e) Reduced Boiling House Recovery

The reduced boiling house recovery shall not be less than 90% by Gundu Rao formula.

## 4. STEAM GENERATION PLANT

- i) CO<sub>2</sub> in the flue gas should not be less than 14.5% measured after waste heat recovery units (corresponding to 35% excess air) with unburnt gases not exceeding 0.1%.
- ii) The flue gas temperature shall not be more than 170 deg. C. Measured after last heat recovery units.
- iii) Peak generation shall be 110% MCR FOR HALF AN HOUR.
- iv) Efficiency of the steam generation plant shall be minimum 70% on G.C.V. of bagasse having 50% moisture and determined as per IS codes. For every reduction in moisture% bagasse of 1% there shall be rise of 0.5% 13980-1995 in boiler efficiency.

## 5. POWER GENERATION PLANT

- i) Specific steam consumption of the turbine shall not exceed 8.00kg/KW/hr for the conditions given in specifications.
- ii) The power factor of the electrical system shall not be less than 0.9.
- iii) Alternator to sustain a continuous load of 3750 KVA at 0.9 PF.
- iv) The performance of all electrical equipments shall be as per existing IS codes.

At the time of factory performance trials, the factory management should, besides giving assistance as per agreement, also arrange adequate supply of clean cane conforming to the following specifications so that the trial operations are completed smoothly:

1. Fibre % cane : Not more than 16
2. Pol % cane : Not less than 12
3. Mixed Juice Purity : Not less than 80

NOTE: Performance trial to be carried during the period of January to March.



## INSTRUMENTATION AND AUTOMATION

### Statutory Requirements

#### 1. Online Mass Flow meters:

- (iii) Depending upon the plant conditions like size, flow rate, specific gravity, viscosity, vendor shall furnish detail sizing calculations showing mass flow rate accuracy, pressure drop, velocities at 10 operating steps.
- (iv) Weights and measures certification and stamping from regional Weights and Measures authority shall be provided.
- (v) Manufacturer shall have facility for weight calibration of mass flow meter in the flow laboratory as per NIST standards.

#### 2. Automatic pH Control for Juice/Syrup Sulphitation :

Well designed and fabricated sampling system for cooling the juice at 40°C for effective online pH measurement.

#### 3. Online Brix Indicators

- (f) Brix measurement shall be independent of changes in the other process parameters like pressure, temperature additives etc.
- (g) Instrument shall be fully configured, operated and maintained using operators' interface. It shall have large backlit digital display, soft push buttons and easy to operate menu driven screen.

#### 4. Online Conductivity Measurement of condensate water

- (iv) To ensure the compatibility the sensor and transmitter shall be of same make.
- (v) Well designed and fabricated sampling system for each line shall be provided.

#### (iii) Instrumentation Panel

All the panel mounted instruments which are integral part of the following control and measurement systems shall be housed in a well designed, fabricated and wired instrumentation panel.

- (vii) Auto Cane Feed Control System
- (viii) Automatic Imbibition Water Flow and Temperature Control System
- (ix) Online Mass Flow Meter for juice and water
- (x) Automatic pH Control System for Juice Sulphitation
- (xi) Online Brix Indicators
- (xii) Automatic pH Control System for Syrup Sulphitation
- (xiii) Automatic Brix and Temperature Control of Molasses Conditioner & melter
- (xiv) Online conductivity measurement of condensate water
- (xv) Automatic massecuite level control in pug mill
- (xvi) Boiler Instrumentation and Automation
- (xvii) Turbine supervisory system
- (xviii) Massecuite feed control for continuous centrifugal machine.

## 6. Microprocessor based Datalogger

For recording various process parameters like pressure, temperature, flow level etc. at various equipments in the boiling house two numbers  $\mu$ p based 32 channels data loggers specifications with 80 column dot matrix printer/132 column dot matrix printer/inkjet printer having following specifications shall be provided : one at evaporator floor and the other at pan floor.

### Specifications :

1. Input : Universal
  - a) Thermocouple as per DIN 43710 (other than standard on request) (J,K,E,R,S,T,N,B grounded or ungrounded) Input resistance  $\geq 1 \text{ M } \Omega$
  - b) RTD PT - 100 as per DIN 43760 (Excitation current  $\leq 2.5 \text{ mA}$ )
  - c) Electrical signal (0/4-20 mA, 0/1-5 V.DC) Input resistance  $\leq 250 \Omega$  for current input Input resistance  $\geq 500 \text{ K } \Omega$  for voltage i/p
  
2. Display & Internal Scan Time :
  - a)  $3\frac{1}{2}$  digit,  $\frac{1}{2}$ ", 7 segment LED display for process variable.
  - 2 digits,  $\frac{1}{2}$ ", 7 segment LED display for channel no.
  - b) 16 x 2/20 x 2 backlit LCD
  - c) 50 m sec. per channel
  
3. Range & Accuracy : Keyboard configurable for each channel separately with reading accuracy of  $\pm 0.25\%$  of F.S.
  
4. Alarms Facilities : 2 settings (HI & LO) per channel over entire range, alarm output (NC/NO), programmable alarm acknowledgement & alarm status (bicolor LEDs) for each channel shall be provided.
  
5. Broken Sensor : Indicated by displaying error message on display
  
6. C.M.R.R. : 120 db
  
7. Memory : It shall be possible to retain the user interaction memory for more than six months in case of power failure
  
8. Operating Temperature : 0 to  $50^{\circ}\text{C}$  with maximum  $\pm 0.015\%$  / $^{\circ}\text{C}$  drift
  
9. Mains supply :
  - a) 230 V AC,  $\pm 10\%$ , 50 Hz, single phase (Standard)
  - b) 110 V AC,  $\pm 10\%$ , 50 Hz, single phase (Optional)
  
10. Communication Port :
  - a) RS 232 or RS 485 with Modbus RTU protocol for PC communication
  - b) Centronic parallel port for printer (log & print interval shall be user configurable with different print options)

## 7. Documentation

The following documents shall be sent to the Purchasers' Consultant for approval.

- i) Instrumentation hookup diagram.
- ii) P & I diagram.
- iii) Specification of instruments i.e. Range, make etc.
- iv) Orifice plate design calculation data sheet as per BS 1042 for flow meters.
- v) Control valve sizing and Cv calculations.
- vi) Instrument control panel cutout, foundation and panel wiring drawing.
- vii) List and specification of erection material.

\*Impulse tubing shall be of SS316/304 15 NB sch 40 pipewith SS isolating and drain valves.

\*Instrument cables from field transmitters to panel shall be 1.5 mm x 2 core Cu conductor armoured cable.

The following documents shall be submitted in triplicate along with instruments to the end user :

- i) Erection drawing and instrumentation calibration and test reports.
- ii) Operation and servicing manuals.

## 8. Central data acquisition system

It shall be possible to connect all the data loggers to the centralised PC based data acquisition system

## 9. Instrumentation Control Rooms

To achieve the desired working performance of various instrumentation measurement and control system even under extreme conditions like shock, vibrations, humidity, electrical interference installation of instrumentation panel shall be done in well designed and constructed rooms as per the standard instrumentation practices.