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Expert group meeting on the selection of equipment for the sugar processing industry
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Guidelines for investors when establishing a sugar industry in developing countries

TENDER DOCUMENTS TO BE PREPARED ON THE RESULTS OF A FEASIBILITY STUDY AND TECHNICAL DATA FOR PLANT SPECIFICATIONS IN THE SUGAR INDUSTRY 1/

by

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In order to elaborate standardization guidelines for the establishment of the Sugar industry in developing countries a basic working paper is proposed.

This paper covers the feasibility study, the Tender documents and ends with technical data for plant Specification in regard of beet Sugar industry.

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1. FEASIBILITY REPORT

B. Example of conclusions.

It results from the Agricultural Survey that :

- In the region of the following crops are grown : tobacco, wheat, barley, cotton, rice, etc...
  Surpluses of tobacco are recorded and therefore a new cultivation of high value for the farmer replacing low grade tobacco in the lower plains of the area would no doubt be welcome.

- Furthermore, it appears that the local ecological factors, i.e. climate, soil and water would certainly allow the cultivation of sugar-beets. The report examines and gives the conditions to be met and the actions to be taken in respect of these factors.

- The analysis shows that the introduction of beet cultivation in the area of would be most justified from the social point of view (unemployement) as well as from the economic angle (considering that the low elevation of the area favours particularly beet growing, the area having high crop potential which might possibly be strenghened by the possibility of growing winter beets in some parts of the region in addition to the regular summer crop).

- The estimate of the land available to and suitable for beet cultivation is compatible with water supply and irrigation possibilities.
  The yearly output potential on the basis of 4 year crop rotation has been assessed at 112,50 tons of beets on the average corresponding to the following calculation.

  It should be noted that the above estimate is rather conservative although one cannot expect to reach such yield in the first cultivation years.

- The beet campaign duration cannot exceed 75 days maximum.
  Therefore, the normal daily processing capacity of the sugar plant should be of the order of 2,000 tons of beets.

- The economic and social role of the sugar-beet is also to be emphasied. Evidence is found in the fact that more and more countries turn to it namely in the mediterranean area for the following reasons :

- It requires an important labour force thereby reducing rural unemployment to a great extent.
  It has a very important fodder value influencing animal production and its economic value is comparable to other fodder plants.

- Beet growing requires specific cultivation methods which in turn influence and improve the general agricultural methods of the crops grown in the region where beet is introduced.

- The financial revenu obtained by the farmer thanks to that cultivation favourably compares with income derived from other agricultural productions.

- Beet growing does not exhaust the soils. On the contraty, yields in other crops are always higher in the following years after beet cultivation.

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x x

The conclusions of the following points to a positive recommendation in respect of the introduction of beet growing in

In this connection are also included in the report specific recommendations regarding agricultural action (fertilizers , spreadings, irrigations, sowing, crop rotation) and some comments on the organization to be foreseen in order to make the agricultural efforts and results coincide in due course with the plant requirements by means of an adequate promotion system (experimental stations, etc...)

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The economic study has revealed that :

- The market in a few years'time will reach the 300,000 ton mark. Altough at present the consumption (275,000 tons) is covered to a large extent by imports (225,000 tons) there will be a gap of approximately 60,000 tons to be bridged.

- Taking into account that the supply of beets forecast corresponds to a yearly output of 13,300 tons of white sugar on the average, the question arises to check whether or not the refining of imported raw cane-sugar is warranted to make up for the difference between 60,000 tons and the above figure.

- Owing the fact that :

  - the additional investment for installing the refining equipment is low (less than 10% of the investment cost) and would enable to maintain at work throughout the year the workforce employed in the plant,

  - the depreciation allowances distributed over a such larger volume of production would help ease the pressure exerted on the operation of the plant by too small margin existing between the costs of beets and the sales price fixed for white sugar on the whole market,

  - the considered area could normally absorb the greater part of the total yearly output of the beet department and refinery department estimated at 60,000 tons,

  there is no doubt that the installation of the additional equipment required for the refinery and the corresponding enlargement in the capacity will bring financial equilibrium to the scheme by making it economically viable.

- The location of the factory can be envisaged either in where a site has already been proposed or in the center of the cultivation area. Although it is common saying that a beet sugar plant should be sited in the cultivation area, it appears from the comparison made in respect of both possible locations that there is a slight advantage in favour of the first site.

- The necessary insvestments (which have been estimated in a rather conservative manner to remain on the safe side) including the housing scheme and all additional costs during construction are tabulated. The foreign exchange components have also been assessed and a tentative investment schedule drawn up asuming normal payment terms.

- As requested, the financing of the project has not been dealt with in the study.

- Furthermore, a budget of income and expenditures for the first five years of operation, assuming that the plant will process limited quantities of beets at the outset and in counterpart refine more raw cane-sugar to a certain extent has been materalized under the form of pro-forma balance sheets.

- The calculations made show that a reasonable profit can be expected (7% return on total investment costs and 12,5% on turn over).

  Saving in foreign exchange, although small under existing conditions will also be generated by the project.
  This results from the fact that the level of white sugar quotations adopted to apprcise this particular aspect while corresponding to prevailing trends is nevertheless exceptionnaly low. Furthermore, each additional quantity of white sugar produced from beets in replacement of the same quantity obtained from imported raw sugar implies additional savings in foreign currency.

  Furthermore, the value added in the plant and in the whole scheme to be credited to the project is rather impressive as well as in particular the effect on employment (450,000 working days in the fields and more than 400 jobs in the plant).

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x x

In conclusion, it is clear that the whole project will contribute to create more economic wealth and to further develop the economy of the country within the framework of the industrial national policy and therefore its implementation should be recommended.

1. FEASIBILITY STUDY

C. Typical project Engineering for a 2.000 T/day beet factory + cane raw refinery.

I. MANUFACTURING PROCESS.

The proposed process will combine the equipment intended for the sugar plant and the refinery department so as to reduce as much as possible the additional equipment required for the operation of the latter.

The beets characteristics will be considered for the design and specification of the equipment.

Furthermore, special attention will be paid to efficiency of equipment and process in respect of power consumption as well as consumption materials.

Water requirements for transportation, washing, condensation, cooling, etc..., will be kept to a minimum while ensuring the best operating conditions and a limited discharge of used waters.

The beet juice purification system will enable to treat efficiently the refinery clairces.

General flow-sheets are herewith enclosed for illustration purposes.

1. Quality of sugar to be produced.

The sugar will meet the following requirements :

Polarization : min. 99.8% of sugar
Moisture : max. 0.05 gr % gr. of sugar
Ashes : max. 0.03 gr % gr. of sugar
Colour : max. 0.010 extinction.

2. By-products.

Exhausted pulpswill be molassed, dried and compressed in pellets so as to facilitate handling, storage and transportation.

II. GENERAL DESCRIPTION OF THE EQUIPMENT.

The plant will comprise the following sections :

1. General operating equipment.

1.1 Weighing bridges and reception laboratory

Lorries loaded with beets are weighed at the entrance of the plant. A sample of 20 Kg. is taken and weighed (gross weight), then washed in the beet reception laboratory.

After weighing the washed sample (net weight), the percentage of earth is determined as well as the sugar content by polarization.

1.2 Beet handling and storage.

Beets are then either unloaded to be immediately processed or stored in silos by means of lorry-tilting system and conveyors if they are to be processed during the night or outside normal reception time.

1.3 Conveying of beets to washing.

Beets coming from the unloading point or from the intermediate silos are sent to the washing station via the transportation system.

1.4 Washing of beets.

Beets are brought to the necessary elevation in the channel to the washing station.
This channel is equipped with trash and stone catchers intended to eliminate leaves, straw and stones carried along with the beets.

Water is then separated and flows throug the beet separator whereas beets are washed under high pressure sprays.

1.5 Clean beets are transfered to the beet hopper over the beet slicers. These horizontal cutting disc type slicers will be equipped with the Königsfeld knives giving an accurate slicing, making sugar extraction from the cassettes easier and giving a low draft.

1.6 Beet tails recovery.

This station permits the recuperation of the beet tails after washing and separation of trash an I stone. Then the washed tails are sent to the diffusion plant.

1.7 Continuous diffusion.

Good sugar extraction of the scalding cossettes is achieved by osmosis and diffusion in a continuous diffusion. Methodical circulation of the treated water and the advance of the cossettes from one compartment to the other in the diffuser is in countercurrent flow so that the beet pulps leave the diffuser correctly depleted from sugar.

1.8 Pulp pressing plant.

The pressing of the pulp with high dry matter content serves the purpose to reduce the fuel consumption of the drying station.

The molassed dried pulps will be compressed in pellets.

1.9 Purification by liming and arbonation.

The raw diffusion juice is purified by the liming and the carbonation process.

The chemical purification includes in the first stage, the preliming which achieves the progressive mixing of the raw juice with a proportional quantity of lime at a suitable temperature during an appropriate period ; after follow the main liming and the first carbonation, the limed juice being carbonated in a continuous carbonation plant by CO_2 bubbling in the limed juice in order to precipitate as calcium carbonate all the lime introduced.

The formed insoluble precipitate carry away an important part of the juice impurities and will be separated in the special thickening filters in order to obtain a good clarified juice and on the other side a thick slurry of precipitate.

This thick slurry is again filtered on mechanized press filters.

The cake will be desweetened by methodical water washing on these filters, the desugarising water will be used for the milk of lime preparation.

The cake with high dry matter content will be transported by belt conveyors to the cake storage area.

1.10 Filter plant.

The first filtrated juice from the thickening filters and the press filters will receive further slight addition of milk of lime.

This limed juice will be also carbonated until obtainment of the second carbonation alkalinity and after a certain time of sejourn in a decarbonation tank will be filtered on complete automatic bag-filters.

The corresponding muds will be mixed with the first carbonation muddy juice and desweetened on press-filters.

1.11 Juice decalcification.

A final filtration also in automatic bag-filters will ensure the finition of the second carbonation filtered juice.

A decalcification of this juice by ion exchanging resins will remove the lime salts to a certain extent, preventing scalding in the evaporation tubes.

1.12 Thin juice sulphitation.

The clear thin juice obtained will sulphited by gas action in order to decrease the sugar colouration.

After this treatment, the juice will be heated to the boiling temperature of the first body of the evaporation plant.

1.13 Evaporation plant.

In the multiple-effect evaporation station, the juice is concentrated to reach an average Brix of 65 - 67 at the outlet.

1.14 Syrup treatment.

The sulphitation of thick juice will be provided in order to obtain a supplementary curing and decolourising action.

1.15 Vacuum pans, crystallizers, centrifugals and refining equipment.

The syrup with other sugar products, from feed tanks is sucked in the fisrt strike vacuum pans " A " in which the evaporation continues under vacuum and at low temperature.

The first strike masse-cuite shall be then discharged into the crystallizers located above a group of continuous centrifugals with vertical axis and conical bowl.

In the centrifugal basket, the sugar crystals are clairced with water at 95°C and the "A" syrup will be cooked anew in the vacuum pans "C".

The masse-cuite obtained will be discharged in the low cooling crystallizers so as to continue the exhaust of the syrup.

After centrifuging of this masse-cuite, the sugar "C" and the molasses will be obtained.

We will note here that the Sugar Factory will be equipped with all the material, this is to say vacuum pans, crystallizers and continuous centrifugals necessary for the manufacture of sugar "B" and syrup "B".

This plant will be in permanent operation during the refinery period of raw cane sugar. It could be used with beet sugar if deemed necessary in the case of very high purities of the beet juice and in order to reduce to the maximum the purity of the molasse.

The primings of crystallization, or footing of 1st strike masse-cuite will be obtained by suction of the artificial masse-cuite resulting from the mixture of sugar "C" and syrup "A".

All the sugar "A" obtained will be remelted and recrystallized in two successive strikes.

The masse-cuite will give sugar at 99.8° polarization and two syrups, by centrifuging on the wholly automatic centrifugals. These vertical axis centrifugals, driven by electric motors, will be provided with cylindrical pendulum baskets turning at high velocity and at high number of cycles.

The loading of the masse-cuite, the unloading of the sugar, the claircing with superheated water, the separation of the syrups, the duration of the cycles and the timing of these different operations will be wholly automatic and adjustable by means of control and security panels.

The green syrup of I will be used for the cooking of the white II the wash syrup will be re-introduced in vacuum pans I.

The automatic centrifugals of white II will produce sugar at 99.8° polarization, a green syrup recycled in vacuum pans A and a wash syrup re-introduced in vacuum pans II.

1.16 Sugar dyying and packing.

The sugars I and II will be mixed, dried and cooled in a combined drum-granulator before being packed and stored.

1.17 Pulp drying plant.

This equipment will assume the drying of all pulp coming from the production with 90% of dry matter content.

It will include complete installation for molassing of beet pulps.

The molassed dried pulps will be compressed in pellets.

2. Refining of imported raw sugars.

The raw sugars mixed with the "B" sugars and the affinated syrup so as to form an artificial masse-cuite (magma) will be affinated in continuous centrifugals so as to obtain an affinated sugar and an affinated syrup of which about 2/3 will be recycled for the preparation of the abovementioned artificial masse-cuite and 1/3 exhausted in 3 strikes in the sugar manufacturing equipment.

The affinated raw sugar and the sugar A will be remelted and the claircе will be limed and carbonated in two successive stages in the 1st and 2nd carbonation tanks without intermediate filtration.

The filtration of the carbonated final claircе and the desugarising of the resulting muds will be executed, after a stay in the decarbonation tank, in the mechanized filter-presses.

The filtered claircе will be finaly conveyed towards the decalcification plant of the sugar plant in which the active charge has been substituted by appropriate discolouration resins.

The flow sheet in two strikes of refined sugar is then comparable with that which has been already described in sugar plant.

3. Auxiliary plants.

3.1 The lime kiln and the preparation of lime milk.

The quicklime (CaO), as well as the carbon dioxide 'CO2) will be produced from limestone (CaCO3) decompisition by heat emitted by the combustion of fuel oil.

The lime kiln, of suitable capacity and of good calorific efficiency, will ne equipped with a feeding device for fuel oil and limestone, wholly automatic so as to fill only twice a day the hoppers cotaining the necessary reserve.

The extraction of the quicklime will be also automatic. The storage area for the lime stone will be largely sized.

A mick horizontal drum preparator for the milk of lime, two cyclone purifiers, the pumps and tanks with regulation of the Beaumé will complete the equipment which will be located in a building adjacent to the factory.

3.2 Compressed air.

Two air compressors with tested tanks will meet the needs of the regulation and the pneumatic servo-motors.

3.3 Steam production and motive power production.

Motive power will provided by low steam consumption turbo-alternators which will be feeded by superheated steam, produced by boilers equipped to burn heavy fuel oil.

3.4 Water station.

The processing water will be totally recycled.

The boiler feed water will be purified and an equipment for distribution of drinking water will be foreseen.

III. PLANT LAYOUT.

For illustration purposes, preliminary basic plant layouts are attached hereto. Final palnt layout will be drawn up under the first stage of " Industrial phase ".

Vide :

- Plant layout during beet campaign
- Plant layout during refinery.

IV. BUILDINGS AND THEIR DISTRIBUTION ON THE SITE.

The drawing up of the final layout with arrangements of buildings, road network, sewers, water distribution, power distribution, will be made under the first stage of " Industrial phase " : Setting up of final project.

The whole complex an area of 30 hectares : the total area required is 40 hectares mud settling basins included and constitutes an indispensable minimum allowing for the distribution of the different buildings including the administrative ones, of the various warehouses, workshops, stores and auxiliary services.

Large clearings for vehicle traffic and safety [illegible], have been foreseen.

The possible future increase in capacity of the sugar plant as well as of the refinery and auxiliary installations has also been considered.

The vehicles delivering the beets will be weighed on the weighing bridges located near the road at the entrance of the factory.

Sampling for determining the earth weight and for analysis purposes will take place in adjorning building.

The main building will occupy a central position. The boiler house and the power station are next duor to the main steam and power users.

The lime kiln and the lime slacking station are adjacent to the chemical purification station, in order to reduce the lenght of all the slacking lime pipes and to avoid clogging.

Around the plant, an area for a raw sugar sugar storage the capacity of which can be later brought up to 80,000 tons in two parallel warehouses. The storage intended for white sugar together with the conditioning of white and refined sugar in various packings or under various forms (granulated sugar of loafsugar).

The molassed pulp drying plant and storage, are close to the drying plant the dehydrated alfalfa storage and the storage of fertilizers and phytopharmaceutical products. Farther the molasse tanks. The situation of the drying plant entirely separated from the manufacturing halls has been chosen in order to reduce to a minimum fire risks and to allow for easy venting of steam.

Between the plant and the sugar warehouse the weighing bridge for products to be sold has been installed.

Storage areas relatively distant from the main buildings for products which are unsheltered, dusty or evolving bad odours.

Outside the area intended for the above buildings and activities, an additional area of about 10 hectares must be provided for the construction of settling tanks with possible recycling of settled waters.

V. ASSUMED PRODUCTIVITY.

1. Sugar beet department.

Production :	
Beets to slice	100,000 tons
Sugar content	16.5
Yield in sugar	13.3
Yield in molasses	5 to 5.5
Sugar produced	13.300 tons
Molasses produced	+ 5,500 tons
Dried molassed pulps	6,600 tons

Consumption	
Fuel	4.33 Kg for 100 Kg beets
Fuel for pulp drying	1.8 Kg for 100 Kg beets
Limestones	4 Kg for 100 beets
Fuel for limekiln	265 gr for 100 Kg beets
Water	200 m3/h
Sulphur	0, 03% beets
Bags	jute bags
Slicing days	+ 65
Drinking water	30 m3/h

2. Refinery department working during off season.

Production :	
Raw sugar	51, 700 tons
Pol of raw sugar	+ 96
Yield in sugar	92.5
Yield in molasses	5.5
Sugar produced	48.000 tons
Molasses produced	2, 855 tons

Consumption :	
Fuel	16.4 Kg % refined sugar
Lime	max. 1.5 Kg% refined sugar
Water	35 m3/h process water + 30 m3/h drinking water
Bags	jute bags
Working days	240

VI. ORGANIZATION CHART.

A detailed organization giving the estimated requirements in respect of personnel for the operation of the plant is attached hereto.

A breakdown of needs during beet campaign and during the off season has also been made.

VII. TRAINING OF PERSONNEL.

A detailed table covering the training of personnel and corresponding costs before the entry into operation of the plant is also enclosed.

VIII. FLEXIBILITY OF EQUIPMENT.

Diffusion and purification equipment will be capable of handling important variations in the rate of output.

Equipment will be selected for maximum efficiency in beet extraction and in refining as well.

The drying plant which normally works only during beet campaign can also dry other products and specially alfalfa to produce lucernemeal, a high valuable product among feeds for poultry farms due to its high carotene and protein content.

As alfalfa has been suggested for rotation purposes, the drying station can operate during 6 more months and therefore, more labour can be kept on that station and would be available when the beetcampaign starts.

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86 Warehouse for raw sugar
87 Warehouse for white sugar
88 Molasses tanks
89 Fuel tanks

Section 9 - Administration building, Engineer and Staff facilities and other services, spare parts and supplies.

Sub-section 91 Administration building
92 Social department (Locker-rooms, washing-room, cafetaria, offices and testing laboratory).
93 Spare parts and repair materials, operating supplies and operating materials, start-up supplies).
94 Consulting Engineer'site offices
95 Engineer's housing facilities
96 Transportation facilities.

Section 10 - Yeast Plant alternative

Section 11 - Steffen Plant alternative

Section 12 - Alternatives and addenda.

UNITIES AND SYMBOLS USED IN THE TENDER DOCUMENTS.

1.	Linear measures.	
	Kilometer	km
	Meter	m
	Centimeter	cm
	Millimeter	mm
2.	Surface measures.	
	Square kilometer	km2
	Square meter	m2
	Square decimeter	dm2
	Square centimeter	cm2
	Square millimeter	mm2
3.	Area measures.	
	Hectare	ha
4.	Volume and capacity measures.	
	Cubic meter	m3
	Hectoliter	hl
	Liter	l
	Cubic decimeter	dm3
	Milliliter	ml
	Cubic centimeter	cm3
	Cubic milimeter	mm3
5.	Weight measures.	
	Metric ton	t
	Kilogram	kg
	Gramme	g
	Miligram	mg
6.	Angle measures.	
	Degree	•
7.	Time measures.	
	Day	day
	Hour	h
	Minute	min
	Second	s
8.	Rotation measures.	
	Round per minute	rpm

9. Pressure measures (effective pressure if not otherwise specified).

Kilogram per square meter	kg/m2
Kilogram per square decimeter	kg/dm2
Kilogram per square centimeter	kg/cm2
Bar	b
Millibar	mb

10. Dynamic viscosity measures.

Poise Cm - 1 s - 1	P
Centipoise	cP

11. Cinematic viscosity measures.

Stoke (cm2/s)	St
Centistoke	cSt

12. Temperature measures.

Degree	•
Degree Celsius	°C

13. Power measures.

Megawatt	MW
Kilowatt	kW
Watt	W
Milliwat	mW
Horse power	ch

14. Energy measures

Kilowatthour	kWh
Watthour	Wh

15. Heat quantity measures.

Kilocalorie	kcal
Calorie	cal

16. Electrical Circuit intensity measures.

Kiloampere	kA
Ampere	A
Miliampere	mA

17. Electrical tension measures

Kilovolt	kV
Volt	V
Milivolt	mV

18. Electrical apparent power measures.

Megavoltampere	MVA
Kilovoltampere	kVA
Voltampere	VA

19. Electrical reactive power measures.

Megavar	Mvar
Kilovar	kvar
Var	var

20. Electrical resistance measures.

Megohm	M
Kilohm	k
Ohm	
Microhm	

21. Illumination measures.

Lux	lx

22. Electrical conductivity.

Micro Siemens	S

23. Technological abbreviations.

Dry substance %	D.S.
Refractometric dry substance%	Brix
Apparent purity	Purity
Mean aperture	M.A.
Coefficient of variation	C.V.

2. TENDER DOCUMENTS.

B. General specifications.

1.0 SCOPE OF CHAPTER 1 - GENERAL SPECIFICATIONS.

Scope of chapter 1 General Specifications covers :

1.1 Introduction - Location of the plant - Organization chart - Numbering system - Design priciples - Inventories - Flexibility of the Plant.

1.2 Products and production capacities.

1.3 Guarantees

1.4 Extent of each contract

1.5 Accompanying documents.

1.6 Time limit to be followed by the Contractor.

1.1 INTRODUCTION.

1.1.1. Location of the plant.

1.1.2. Organization chart - Numbering system.

In order to simplify the work of the Tender, an organization chart for the factory has been drawn up to serve for the preparation of the tenders and the execution of the contracts.

The plant is divided into twelve sections :
- the first four cover the sugar manufacturing process
- the following five include the general services, maintenance, power, administrative departments
- the tenth one concerns the yeast plant (optional)
- the eleventh one concerns the Steffen Plant (optional)
- the last one is at the Tenderer's disposal for alternatives and addenda.

Each section has been divided into several sub-sections which are dealt separately in the respective specification sheets in chapter 10.

The material included in each sub-section is divided into several items.

The numbering system shall be used by the Tenderer preparing his quotation when referring to equipment or machinery. Moreover, the Tenderer and Contractor shall use this numbering system to identify the machinery and equipment on all flow sheets and engineering diagram prepared . The number shall appear on all crates and on the exterior of all machinery and equipment and cases to be shipped to the site. All machinery and equipment shall be tagged with this number for identification prupases.

Organisation chart.

0 to 4 - Production department.

Section 0 - Handling of beets and diffusion.

Sub-section	00	Beet reception
	01	Main laboratory
	02	Beet silos and flumes
	03	Hydraulic transport of the beets
	04	Washing plant
	05	Beet slicing
	06	Diffusion
	07	Pulp pressing
	08	Pulp drying and storage

Section 1 - Juice purification.

Sub-section	10	Lime kiln
	11	Preparation of the milk of lime
	12	CO2 handling plant
	13	Raw juice treatment
	14	First stage carbonation and filtration
	15	Second stage carbonation and filtration
	16	Juice decalcification
	17	Thin juice sulphitation.

Section 2 - Evaporation, boiling, massecuites.

Sub-section	20	Evaporation
	21	Syrup treatment
	22	Treatment of first strike massecuite
	24	Treatment of low grade massecuite

Section 3 - General services.

Sub-section	30	Condensation plant
	31	Drain of steam chests (evaporation, heaters)
	32	Water supply
	33	Transmission

34 Piping valves
35 Thermal insulation
36 Control and automation
37 Supports, platforms, staircases and ladders
38 Gutters and chutes.
39 Paintings materials

Section 4 - Operation as a refinery

Sub-section 40.1.A Treatment of refinery massecuites (beet campaign)
B Treatment of refinery massecuites (raw sugar period)
C Treatment of refinery massecuites (Steffen sugar treatment)
40.2 Treatment of affinated sugar
40.3 Sugar drying
40.4 Discolouration plant.
41 Adaptation of machines
42 Modifications of piping
43 Treatment of empty raw sugar bags.

5 to 9 - General services, maintenance, power, administrative departments.

Section 5 - Buildings, transports and handling.

Sub-section 50 Grounds - Site preparation - Temporary works
51 Main manufacturing buildings
52 Yard, fences, settling basin
53 Railway siding
54 Garage for vehicles
55 Sewers
56 Fire equipment
57 Weighing bridges
58 Transport and handling machines

Section 6 - Production and supply of electricity

Sub-section 61 Turbo-alternators room
62 Transformation sub-stations
63 Emergency set
64 Cables and wires
65 Electrical switchboards
66 Lighting
67 Telephones
68 Electrical meters
69 Grounding

Section 7 - Production and distribution of fluids.

Sub-section 71 Boilers
72 Water supply - Pumping station
73 Cooling tower
74 Water treatment plant - Water circuits
75 Water distribution lines in the factory
76 Compressed air supply
77 Fuel oil supply

Section 8 - Workshop and stores

Sub-section 81 Mechanical workshop
82 Carpentry shop and woodstores
83 Mechanical and electrical warehouse
84 Electrical workshop
85 Warehouse for white sugar bags
86 Warehouse for raw sugar
87 Warehouse for white sugar
88 Molasses tanks
89 Fuel tanks.

Section 9 - Administration building, Engineer and Staff facilities and other services. Spare parts and supplies

Sub-section 91 Administration building
92 Social department (Locker-rooms, washing-room and cafeteria) and testing laboratory
93 Spare parts and repair materials, operating supplies and operating materials
Start-up supplies
94 Consulting Engineers' site offices
95 Engineer's housing facilities.
96 Transportation facilities.

Section 10 - Yeast Plant

Section 11 - Steffen Plant

Section 12 - Alternatives and addenda.

1.1.3. Design principles.

The present tender will cover the erection of a 2.000 metric tons of beets per day and up to a capacity of 300 metric tons of raw cane sugar per day.

Moreover a yeast plant and a saccharate molasses recovery will be quoted as alternatives for valorization of molasses.

1.1.4. Inventories.

The factory will be designed with provision of all suitable means for establishing accurately the processing inventories.

Weighing scales and weighing bridges will be supplies with the necessary check weights. These weights have to be certified exact weights.

Tanks hoppers and silos will be numbered and graduated as far as necessary for the inventories. Level indicators or means for measuring the level will be provided.

Suitable means for establishing the input raw sugar and beets as well as the output refined sugar, molasses and pellets will be provided.

1.1.5. Flexibility of the Plant.

Concerning the flexibility of the factory, the whole Plant must be able to work good results between 50 and 100% of the rated capacity.

Moreover, the equipment of sub-sections 03 and 04 will be able to work at 110 % of their rated capacity for allowing the buffer effect of the bin above the beet slicers.

The diffusion installation must be able to work with good results to be guaranteed by the Contractor at any capacity between 50% and 100% of the rated capacity.

The Contractor will indicate the losses at 120% of the rated capacity.

For the Sugar House comprising the vacuum pans, the centrifugals and the driers, the Tenderer will indicate in its Tender, the peak capacity based on individual equipment performance which he has foreseen for reaching the rated capacity of the whole installation.

1.2 PRODUCTS AND PRODUCTION CAPACITIES.

1.2.1. Products to be manufactured.

During the beet campaign.

- Refined granulated sugar from beets (glittering crystals).
- Dried molassed pulp pellets
- Lime saccharate (optional)
- Beet molasses
- Yeast(optional)

During yhe refinery period (all the year round except campaign)
- Refined granulated sugar from raw cane sugar and from beet Steffen-house sugar (glittering crystals).
- Cane molasses.
- Yeast (optional).

1.2.2. Daily output capacities.

During the beet campaign
- Refined granulated sugar :
  the quantity of sugar corresponding to the treatment of 2.000 tons of beets per day and to the sugar recovered in the Steffen plant working at rated capacity. With an average polarization of beets up to 18% and a thick juice purity of 89.
- Dried molassed pulp pellets :
  the quantity of dried pulps corresponding to the total pulp produced from 2,000 tons of beets per day including 30% molasses (cane molasses) on dried product (about 175 t/day).
- Lime saccharate : (optional)
  the finished product for the Steffen Plant will be lime saccharate milk at 30 to 35% D.S. corresponding to the treatment of 65 Metric Tons of molasses per day.
- Beet molasses :
  the quantity of molasses corresponding to the treatment of 2.000 tons of beets per day (about 140 tons per day at 82 Brix and 60 Purity).
- Yeast : (optional)
  one ton dry yeast (90% D.S.) per day under normal operation conditions and 1.3 ton dry yeast (90% D.S.) per day under maximum overload conditions.

During ref inery period.
- Refined granulated sugar :
  285 t/day
- Cane molasses :
  the corresponding quantity to 300 Metric Tons raw cane sugar (about 15 t/day)
- Yeast :
  same as during beet campaign.

1.2.3. Products quality

Refined granulated sugar shall satisfy the following specifications

- Polarization	min 99.9% of sugar
- Conductimetric ash	max 0,012 g% of sugar
- Moisture	max 0,03 g% of sugar
- Reducing sugars	max 0,012 g% of sugar
- Grain size	ranging between 0,4 and 1 mm
- Colour	max 0,010 extinction

Dried molassed pulp pellets.
Pulps will be normally molassed with cane sugar molasses stored during the previous refinery period till the next beet campaign.

Beet molasses may also be used for molassing pulps (for instance during the first campaign when not enough cane molasses will be available).
Maximum moisture content of the finished product : 10%
Molasses content : up to 30% of the finished product.

Lime saccharate.
The minimum apparent '' saccharate purity " will be 90 with input molasses at 60 apparent purity.

Beet molasses.
Apparent purity maximum : 60
The Brix of the molasses will be sufficient to allow for storage over several months.

Cane molasses.
Apparent purity maximum ; 45
The Brix of the molasses will be sufficient to allow for storage up to one year.

Yeast
Dry baker's yeast (minimum 90% D.S.)
Colour : light beige.

1.2.4. Conditioning of finished products.
Refined sugar
- 100% in jute bags of 100 Kg net weight (or in paper bags depending on local conditions)
- 100% in cotton bags of 50 Kg net weight.

Molassed pulp pellets.
- in jute bags (raw sugar bags) of 50 Kg net weight (or in paper bags depending on local conditions).

Yeast
- dry yeast : in 500 grams and 125 grams packings
- wet yeast (alternative) : in 500 grams packing (small percentage).

1.3 GUARANTEES.

1.3.1. Scope.
The tenderer shall furnish guarantees for :

- quality of final and intermediate products,
- throughput and output
- requirements of raw materials, utilities, chemicals, etc...
- operating conditions
- maintenance
- efficiency
- waste matter treatment
- all other performance data.

for each machinery , equipment, etc...as required in accordance with the General Specifications - chapters 3 to 8 - and each Section as required in accordance with chapter 10 " Plant Specifications"

All these items of guara tees shall be completed within the time limit specified and not over the estimated price.

Should the customer as well as other Contractor (s) suffer damages because of the delays in the preparation of the Site, the completion of the Works, or the preparation of start-up, etc..., the responsible Contractor shall pay compensations.

1.3.2. Engineering and design.
The Contractor shall guarantee the basicengineering and planning of each Plant.

The Contractor shall be responsible for and shall pay for any alternations caused in the Works of other Contractor (s) due to any discrepancies, errors or omissions in drawings, data or other particulars supplied by him to enable other Contractor (s) to complete their portion of the Works regardless of wether or not such drawings or particulars, or data have been approved by the Engineer (consultant). The Engineer s used as to represent the consultant group cooperating with the customer.

If any machinery or equipment is found to be incorrect in application, capacity or materials of construction, such machinery or material shall be replaced by the Contractor at his own expense by suitable machinery or materials to the satisfaction of the Engineer. (consultant).

1.3.3. Machinery and Equipment.
The Contractor shall guarantee that all machinery and equipment supplied shall be in accordance with chapters 4,5,6,7 and 8 and, judged by B.S.S. or equivalent international standards, shall be of firstclass workmanship and materials, and that under normal operating conditions at the Site, the machinery and equipment shall show no defect due to faulty design, materials or workmanship throughout the period of guarantee's continuous operation.

The Contractor shall also guarantee that all equipment are of modern efficient design and that all equipment and materials are new and that no second-hand or repaired parts are supplied.

Should the machinery and equipment supplied show defects or fail short of their guarantee from the standpoint of maintenance and operation, the Contractor shall be responsible to correct such faults completely at his own expense until they are to the satisfaction of the Engineer.

1.3.4. Products, quality, capacity.

The quality of final and intermediate products specified in article 1.2.3. shall be guaranteed. Should the products fail to comply with the quality of the products specified, the Contractor shall modify the equipment at his own expense until the quality is satisfactory to the specifications.

The guarantee figures of capacity for final and intermediate products at each department are shown in articles 1.3.5., 1.3.6., and 1.3.7. If the guarantee capacities are not attained, the Contractor shall either replace the machinery and equipment with that of a larger capacity or make additions or alterations in the installations at his own expense and responsability.

As to the consumption of raw materials, auxiliary materials, utilities, chemicals etc..., the figures submitted by the Tenderer under article 1.3.8. shall be considered as guarantee figures. If the guarantee consumptions are not attained, the Contractor shall be responsible to make additions or modifications in the installations at his own expense, untill they are satisfied.

1.3.5. Plant performance data during the beet campaign.

a) The Plant will be guaranteed capable to process 2.000 Metric Tons of beets per 24 hours of the quality specified in chapter 2, article 2.2.1., to produce the quantity of refined sugar of the quality specified in articles 1.2.3. and 1.2.4. hereabove, corresponding to the sugar content of the beets abd to the sugar recovered in the Steffen plant working at rated capacity and to the yields given by the Tenderer as requested hereunder (article 1.3.7.)

The corresponding pulps of 2.000 tons beets per day will be molassed, dried and pelleted to meet the quality specified in articles 1.2.3. and 1.2.4. hereabove.

The corresponding quantity of molasses will be produced of the quality specified in article 1.2.3. hereabove.

The Steffen Plant will be guaranteed capable to process 65 Metric Tons of beet molasses of the quality specified hereabove and to produce the corresponding quantity of li-

me saccharate of the quality specified hereabove in article 1.2.3.

b) The yeast Plant will be guaranteed for a production of one ton dry yeast per 24 hours under normal operating conditions and 1.3 ton dry yeast per 24 hours under maximum overload operating conditions of the quality specified in articles 1.2.3. and 1.2.4. hereabove.

c) The dry unloading and stocking equipment for beets will be guaranteed capable of 200 tons beets per hour.

The beet reception laboratory will be guaranteed capable of determining tare and sugar content of 40 samples per hour.

The diffusion will be guaranteed capable to run with good results, to be specified by the Tenderer, at 50% capacity.

The refined sugar dispatching facilities will be guanrateed capable of 600 bags per hour.

1.3.6. Plant performance data during the refinery period.

a) The Plant will be guaranteed capable to process 300 Metric Tons of raw cane sugar per 24 hours of the quality specified in chapter 2 article 2.2.2. to produce the quantity of refined sugar of the quality specified in articles 1.2.3. and 1.2.4. hereabove, corresponding to the yields guaranteed by the Tenderer as requested hereunder (article 1.3.7.).
The corresponding quantity of cane molasses will be produced of the quality specified in article 1.2.3. hereabove.

This guarantee will be realized during the second five days test-run whilst the Plant is processing raw cane sugar and producing the quantity of refined sugar as indicated in the first paragraph of article 1.3.6. hereabove.

b) The refined sugar dispatching facilites will be guaranteed capable of 600 bags per hour.
The raw sugar handling facilities will be guanrateed capable of piling 600 tons per 24 hours and unpiling simultaneously 300 tons per 24 hours.

1.3.7. Yields.

a) The Tenderer will guarantee the following yields and losses, for the performances during the beet campaign with raw materials as specified in article 2.2 and when producing finished products as specified in article 1.2 - hereabove.
- Total sugar losses % beet including pulp losses, scum-losses and undetermined losses but without molasse-sugar losses.

- Molasse-sugar losses (Sugar content in the molasses % beet) with our without Steffen Plant operation and for different qualities of beet as specified in article 2.2
- The apparent purity of the lime saccharate
- The losses in the Steffen plant.

b) Yeast (optional)
The tenderer will guanratee the yields and losses.

c) During the refinery period, the following yields and losses will be guaranteed :

- Refined sugar yield on raw cane sugar the refined sugar being of the quality specified in 1.2.3. and 1.2.4. hereabove and the raw sugar corresponding to the quality stated in article 2.2.
- Molasse-sugar losses (sugar content in the molasses % raw sugar) of the quality specified in article 1.2.3. hereabove.

1.3.8. Consumptions.
The Tenderer will guanratee during the beet campaign :

a) the fuel consumption for the pulp drying plant
b) the steam consumption for the Steffen Plant.
c) the steam consumption for the yeast plant, as well as other utilities and materials consumptions
d) the fuel consumption for processing sugar from beets excluding the fuel consumption for the lime kiln.
e) the consumption of products for the regeneration of the decalcination plants including replacement of resins.

During the refinery period, the following guarantees have to be given :

f) consumption of fuel for the transformation of raw sugar into refined sugar at the rated capacity of the Plant (production of 285 tons of refined sugar per day)
g) consumption of products for the regeneration of the discolouration plant including replacement of resins at the rated capacity of 285 tons of refined sugar produced per day.

1.3.9. Check up on guarantees.
During the beet campaign the following guarantees will be checked at the same time during one main test-run of seven days :

1.3.5. a) and b)
1.3.7. a) and b)
1.3.8. c) d) and e)

During the beet campaign, the following guanratees will be checked separately, at the contractor's request, during one test, the duration of which will be determined in each case, by the Engineer.

1.3.5. c)
1.3.8. a) and b)

During the refinery period, the following guarantees will be checked at the same time during the main test-runs of 2 x 5 days.
1.3.6. a)
1.3.7. c)
1.3.8. f) and g)

During the refinery period, the following guarantees will be checked separately, at the contractor's request, during one test, the duration of which will be determined in each case by the Engineer.
1.3.6. b).

1.3.10. Modalities for guarantee test-runs.

A. Main test-run during the beet campaign

1) - the capacity of 2000 tons of beets per day will be measured on the cossettes weighing scales.

The beet tails will be weighed together with the cossettes.

- a tolerance of up to 1% will be accounted for the cossettes weighing scales.
- the accuracy of the cossettes weighing scales will be controlled at the begin and at the end of the test-run and, on request of the Engineer at any time during the test-run. A correction factor will be established and the indicated weights will be corrected by that factor.
- the time spent for checking the accuracy of the cossettes weighing scales during the test-run will be deducted for the control of the capacity performance. The necessary equipment for checking the accuracy of the cossettes weighing scales will be supplied and installed.

2) Sugar input determination.
The cossettes samples will be taken with care and at random so as to represent as much as possible an average sample of the total amount of beets entered into the factory including the tails.

In principle, one sample will be taken every hour and this sample will be used for :

- the dugar content determination according to the hot digestion method, or by any other method proposed by the Tenderer and accepted by the Engineer.
- for the purity determination of the pressed juice obtained from this sample.
- the purity will be established from polarization of the pressed juice and from the refractometric Brix.
- the sugar input and white yield coming from the Steffen Plant will be established bye the weight and polarization of the molasses introduced in the Steffen Plant, the Steffen Plant losses and the saccharate purity. The mean average of the analysis over the seven days test-run will be admitted as basis for establishing the quantity of sugar input in the Plant as well as for the quantity of molasse-sugar to be produced.

3) Sugar output determinations.
The refined sugar will be weighed with an accuracy of 1/oo (1/1000). The bags produced during the seven days test-run will be stored separately and carefully so as to allow for easy counting. Inventories of circulation sugar will be established at the beginning and at the end of the test-run. A tolerance of 5% on the difference of circulation-sugar between the beginning and the end inventories will be accounted for.

4) Molasse-Sugar determination.
The determination of the quantity of molasses produced will be done by wieghing or measuring before main storage tanks.
The precision required for the determination of the weight of molasses produced is + 1% (1/100).

5) Sugar quality determination.
- Polarization : conventional method
- Reducing sugars : this determination will be done according to the method of " Knight and Allen " described in " ICUMSA methods of sugar analysis " Elsevier 1964.
The reference graph will be established using pure sucrose to which known quantities of reducing sugar are added under the form of glucose p.a.
The pure sucrose will be obtained by alcoholic precipitation (ethylic alcohol) from a refined sugar solution.
The precipitate is washed with alcohol and dried for 2 hours at 60°C in a vacuum drying cupboard.

- Moisture : this determination will be done by drying for one hour in an ordinary drying cupboard at 105°C a sample of 100 gr of sugar placed in a " Petri " disk of 10 cm diameter.
- Ash : the ash content will be determined by measuring the electrical conductivity at 20°C of a solution containing 5g % ml.
  For the description of the method refer to " ICUMSA methods of sugar analysis " Elsevier, 1964, but with the following precisions :
  - the water used for preparing the solution of sugar will have a conductivity inferior to 2 Scm-1.
  - the reading will be corrected on account of the water used by substracting 0,9 of the value registered for the water.
  - the ash content will deducted from the conductivity by the following relation : g.ash%g = corrected conductivity Scm-1 x 18.10-4.
- Colour : the colour will be measured by the extinction of a sugar solution containing 54 g % ml using a " Lange " colorimeter with a G.B. 5 filter of 1 mm thickness and with 34 mmoells.
  Description of the method " Zucker-techniker Taschenbuch " 7th edition 1966, p 187-188.
  The result will be given by the extinction directly read on the apparatus.
- Grain size : the grain size will be determined bu the method of " Power " described in " ICUMSA method of Sugar analysis" Elsevier, 1964, p 94.

  The following series of screens will be used :

Mesh : 36	opening : 1.0 mm
Mesh : 64	opening : 0.75 mm
Mesh : 100	opening : 0.60 mm
Mesh : 121	opening : 0.54 mm
Mesh : 196	opening : 0.43 mm
Mesh : 256	opening : 0.385 mm

  Screening will last for 8 minutes.

  The results have to satisfy to the following requirements :
  M.A. : between 0,6 and 0,8 mm
  C.V. : less than 25.0
  Moreover the quantity of sugar passing through the 256 mesh screen will be inferior to 1% of the total.

6) "Saccharate purity" determination.
The apparent purity of the saccharate milk will be established by direct polarization and refractometric Brix determination on the carbonated and filtered saccharate solution.

B. Main Test-runs during the refinery period.

1) Two main test-runs will be run and will have a duration of five days each.

- the raw sugar will be weighed on a weighing scale with an accuracy of 2°/.. (2/1000).
- this weighing scale will be checked before and at the end of the test-run and, on request of the Engineer at any time during the test-run. A correction factor will be established and the indicated weights will be corrected by that factor.
- the time spent for checking the weighing scale during the test-run will be deducted for the control of the capacity performance.
- the necessary equipment for checking the weighing scale will be supplied.

2) Sugar input determination.
The raw samples will be taken with care and at random so as to represent as much as possible an average sample of the total amount of raw sugar introduced in the Plant.

It is suggested to calculate the white yield and authorized molasse sugar yield according to the following formulae :

$$Y = Pol - (D.S. - Pol) \times \frac{45}{55} - L$$

$$M.S. = (D.S. - Pol) \times \frac{45}{55}$$

In which :

Y = White Yield percent weight of raw sugar
Pol = Direct polarization of raw sugar
D.S. = Dry substance of raw sugar
L = Undetermined losses % weight raw sugar
M.S. = Authorized molasse-sugar % weight of raw sugar.

for the sugar input from the Steffen Plant the same procedure will be followed as during beet campaign.

3) Sugar output determination.
Same as during beet campaign.

Inventories of circulation sugar will be established at the beginning and at the end of each test-run.
A tolerance of 5% on the difference of circulation sugar between the beginning and the end inventories will be accounted for.

4) Molasse-Sugar determination.
Same as during the beet campaign.

5) Sugar quality determination.
Same as during beet campaign.

General remark.

All the equipment necessary for the control of the a/m guarantees has to be supplied and installed if required.
The equipment will remain the property of the factory.

1.4 EXTENT OF CONTRACTS :

1.4.1. Scope.

The Contracts comprise the design and drafting of the civil engineering works, the contruction, the manufacture, inspection, testing, packing, shipping, transportation, insurance, delivery on site, unloading, erection, Site testing, putting into normal operation, training and submitting of documents, information, drawings, reports, catalogues for spare parts, etc... for the whole Plant.
They comprise, also, the provision for all labour, materials, field equipment, temporary works and everything whether of temporary or permanent nature (including the storage thereof) required in and for such construction protection, completion and maintenance, insofar as the necessity for providing the same is specified in, or can be reasonably inferred from the Contract Documents.

The factory shall only supply the following :

- The Site and access facilities in the conditions as they are.
- The personnel necessary to be trained in Iraq and abroad and the personnel required for strat-up of each Plant as well as the expenses for the above.
- The raw materials (sugar beets, raw sugar, fuel, limestone, molasses as specified in article 1.21 - Contractual Terms.

- Chemicals and all other requirements (including packings and other materials necessary to import for the operation of this Plant) that must be supplied by the as specified in article 1.21 - Contractual Terms. These chemicals and the other requirements are to be specified in detail by the Tenderers and confirmed by the Contractor six months before the completion of the factory, both as regards quality and quantity.

Its is the Contractor's obligation to deliver to the customer the complete work of the whole Plant in its complete required operation form.

1.4.2. Extent.

Unless otherwise specified in the Contract Documents, the Works within the limit of the Sugar Plant shall be executed at the Contractor's own responsability. Each Contractor shall pay special attention to the connection points between works done by himself and another contractor , as to any default or discrepancy.

Site preparation and temporary Works.

The Contractor No. 1 shall have to prepare the ground works for the Site and the temporary works so that all Contractor (s) can carry out their Works sufficiently. At the site preparation, each Contractor shall have to endeavour to minimize the construction of temporary facilities as far as possible.

Specifications for Site preparation and temporary Works are laid down in chapter 3 " Special conditions of Contract ".

Co-ordination.

Each Contractor shall carry out his respective work in good faith without causing inconvenience to the other and shall be responsible for co-operating between themselves in order to erect, construct and operate the whole Plant without any difficulty.

Should the other Contractor (s) suffer damages due to any delay, poor planning, incomplete operation etc... caused by other Contractor, that Contractor shall take the liability for such damages at his own cost.

Contractors no. 2 and 3 shall co-operate with Contractor No. 1.

At the time of Tender, if there exists any overlap or duplication among each Tender, the Engineer shall have the right to adjust the scope of each Tender.

The detailed extent to be executed by each Contractor shall be in accordance with chapter 10 " Plant Specifications ".

The Extent of Contract No.1 is as follows :

- the sugar beets processing department
- the raw sugar processing department
- the molassed pulp drying plant
- the general services, power and administration departments
- the facilities for the Engineer's staff, specified in chapter 10 - " Plant Specifications "
- the treatment of saccharate milk

The extent of Contract No.2 is as follows : (optional)

- the dry bakery yeast department, specified in chapter 10

The extent of Contract No.3 is as follows : (optional)

- the sugar recovery plant from beet molasses, specified in chapter 10

1.4.3. Engineering.

The engineering design work and other engineering services to be carried out by the Contractor shall include complete planning, calculation and design for the erection of the extention of the Sugar Plant. Such planning, calculation and design must be approved by the Engineer and meet the satisfaction of The Contractor must bear in mind the safety of the workers, the prevention of accidents caused defects in machinery and equipment and that the engineering shall be rational and economical so that the Plant can be operated and maintained without difficulty.

The Contractor shall prepare and submit all information, drawings,schedules, lists, documents, reports, spare parts lists and catalogues, etc... required during yhe progress of the Works stated in the Coatract Documents or requested by the Engineer. The Contractor shall also be obliged to submit all operation instructions, maintenance instructions, final drawings and other documents required for the complete operation and maintenance of the Plant.

1.4.4. Machinery and equipment.

The Contractor shall furnish all machinery and equipment required for the whole Plant complete in every respect, readu for operation in accordance with the technical specifications including all special tools necessary for servicing and maintenance.

The quality of the machinery and equipment supplied by the Contractor shall satisfy the specifications shown in the Contract Documents for execution of the Works. For each rotating machine such as pumps compressors, blowers, etc... suitable number and capacity of stand-by shall be supplied.

The number and the capacity of the stand-by shall be specified by the Tenderer.

If the Contractor wishes to make substitution for the machinery and equipment during the progress of the Works, he shall submit full details and reasons for such substitution to the Engineer - in writting for approval, and the decision of the Engineer shall be final.

Flow sheets, equipments layout, equipment lists, etc... shall be supplied. All machinery and equipment required for the complete erection, operation and maintenance of the whole Plant shall be included and considered.

1.4.5. Transportation, packing, and shipping.

The Contractor shall make all necessary arrangements for the delivery of machinery, equipment and all other materials to the Plant Site and shall bear all the cost as of shipping insurance and handling cost involved in bringing the machinery and equipment etc... to the Plant Site.

The Contractor shall be responsible dor determining the best way to ship the machinery, equipment and materials etc... to assure that they arrive at the Site in accordance with the schedule set forth in article 1.6

The Contractor shall pack the machinery and equipment in such a manner adequate to protecting them against weather and damage while in transit.

The Contractor shall be responsible to replace missing or damaged parts at his own cost or to repair them in such a way that the erection and start-up shall not thereby be delayed or incomplete.

On arrival at the Site, the Contractor shall place the machinery, equipment and materials for storage in areas designated by the Engineer. The Contractor shall be responsible for the proper storage of any machinery, equipment, materials etc... delivered to the Site.

1.4.6. Civil engineering works - Buildings.

The Contractor shall be responsible for the complete studies and drafting and the construction of the civil engineering works and buildings.

The Contractor shall supply all the necessary skilled and unskilled labour and supervision for the construction works. The Contractor shall provide all tools, machines etc... as required for the construction works.

1.4.7. Erection and installation.

The Contractor shall be responsible for the complete erection and installation of all machinery and equipment for the complete Plant.

The Contractor shall supply all the necessary skilled and unskilled labour and supervision for the erection of the machinery and equipment. The Contractor shall provide all tools, welding apparatus, machine tools, mobile equipments etc... as required for the erection and installation of the machinery and equipment. The Contractor shall supply all scaffolding, framing and the like required to install the machinery and equipment.

The Contractor shall provide all cranes, trucks, tractors and any and all other mobile erection equipment required for the erection and installation of the machinery and equipment.

The Contractor shall supply all supplies and services such as water, power, compressed air, lighting, office facilities, telephone connections, stores facilities etc... that he requires at the Plant Site, as defined in - Special Conditions of Contract - Contractual Terms, and in Plant Specifications.

The Contractor shall provide protection for machinery, equipment and materials prior to and during installation at all places.

The Contractor shall make known to the Engineer what openings he requires in the buildings and structures in order to carry out the erection and installation of the equipment. If the Contractordesires different or additional openings at a latter date in buildings, structures or civil construction that have already been completed, the Contractor shall make such openings at his own expense and repair the openings at his own cost.

If after the buildings or foundations are completed, the Contractor wishes to make changes, the Contractor shall make the necessary corrections to the buildings and foundations at his own cost after approval of the Engineer.

When a piece of machinery or equipment or a system has been completely checked to see that it is under operating condition and all tests that are required according to the applicable codes and the Technical Specifications have been made and the machinery and equipment have passed all the tests and test certificates have been signed by the Engineer, the Contractor shall clean up and protect the Plant buildings and all machinery, equipment and materials and shall remove all scaffolding, equipment tools, materials and other facilities used for the erection of the machinery and equipment so as to be ready for run-test at any time.

1.4.8. Inspection and testing.

The Contractor shall carry out all tests of the machinery, equipment and materials required by the codes and standards mentioned in the Contract Documents or equivalent ones if decided so upon signing the contract particularly those mentioned in chapters 3, 4, 5, 6, 7 and 8.

In addition, the Contractor shall also carry out all trials and tests that are normal in practice and under some special circumstances where there is some question as to the quality or suitability of a piece of machinery or equipment. The Contractor shall also carry out additional tests in accordance with the instructions of the Engineer.

If Codes and testing procedures are other than those referred to in the Contract Documents, they shall be of the nearest equivalent codes and testing procedures.

The customer, the Engineer or the Inspecting Authority shall have the right to inspect any machinery, equipment or material being supplied by the Contractor ; they shall have free access to the Contractor's premises, and shall have, at all reasonable times, the power to inspect and examine the materials and workmanship of the machinery and equipment being manufactured.

Whether inspection is carried out at the premises of the Contractor or of any other manufacturer, the Contractor shall provide all personnel, labour, materials, electricity, fuel, water, apparatuses and instruments as many reasonably be demanded to carry out such tests as required by the Engineer or the Inspecting Authority.

The Contractor shall give notice that any material or equipment is ready for inspection or testing at the place of manufacturing at least three (3) weeks before the test is carried out, and the Engineer shall decide whether he is to attend such inspection or testing personally or to send the Inspecting Authority.

In case the Engineer or the Inspecting Authority does not attend the inspection, the Contractor shall carry out inspection by himself and the Contractor shall forward to the Engineer (7) certified copies of all inspection reports.

The Contractor shall also supply the Engineer with the analysis and tests of all materials of construction prior to the manufacture of the machinery and equipement of the entire Works.

Before any equipement is packed for shipment, it shall habe to be inspected and all neccessary tests shall habe to be carried out. Such tests carried out before shipment shall not in any way relieve the Contractor of completing satisfactory Site tests and shall not in any way relieve him of this other obligations.

If any special laboratory tests or analysis are required by the Engineer or the Inspecting Authority, the Contractor shall bear the costs of such tests and analysis.

All machinery, equipment and materials delivered to the Site shall be checked and tested before erection under Contractor's responsability and at his own expense.

Before run-test, the Contractor shall carry out all the mechanical and electrical tests of machinery and equipment, pipe-line, electrical systems and instrumentation as called for by the applicable codesn the Contract Documents, or as requested by the Engineer.

When all the equipment and systems of the Plant have been installed and tests completed, the Plant shall be ready for strat-up.

Any spare parts, repair materials, operating materials etc... consumed before the issuance of the P.A.C. shall be replaced immediately and all spare parts, repair materials, operating supplies, operating materials etc... required shall be ready at the Site to be handed over to the customer before start-up.

The customer shall have the right to own all products produced in the Plant before the issuance of Provisional Acceptence Certificate.

1.4.9. Supervision of operation and maintenance.

Once the works are deemed readu for start-up, the Contractor shall be responsible for the start-up and for running the period of guarantee.

The Contractor shall supply a team of skilled technical management and operating personnel to guide and assist the custome.'s qualified workers from the start-up to the end of the period of guarentee. During the period of run-tests and during the period of guarantee, the operators and technical and management staff supplied by the Contractor will train the customers Plant operating staff and workers.

The Contractor shall supply the customer with the names of the technical management and operating staff to be provided by him for the run-test, start-up and supervision of operation and maintenance with summary description of their experiences.

The customer shall have the right to reject the personnel who, in the opinion of the customer do not have sufficient qualifications.

Should , for any reasons, power, raw materials, water or other materials not be avialable for the Contractor's use at the time of the start-up by the responsibility of other Contractor (s) resulting in the delay of the start-up, other Contractor (s) concerned shall be or the extra expense arising from such a delay in the start-up period.

Once the successful period of guarantee has been carried out and the Final Acceptance Certificate has been issued, the cost of any further supervision of operation that may be deemed necessary shall be borne by the customer.

The Contractor shall provide assistance and guidance required at the time of periodical overhaul and repair during the whole period from the commencement of the Contract until the issuance of the Final Acceptance Certificate.

For accidents, occuring after the issuance of the Final Acceptance Certificate and upon request by the customer, the Contractor is obliged to repair such damages at reasonable price.

1.4.10 Personnel plan and training.

The Contractor shall supply a personnel plan required for the complete operation of the whole Plant and shall receive the approval of the customer (with the opinion of the Engineer).

When the customer approves the personnel plan and wishes to adopt the personnel plan, the Contractor shall train the personnel in accordance with the plan, taking into consideration the experience already acquired by the personnel of the present Sugar Factory.

The Contractor shall give thorough training in the operation and maintenance of the equipment supplied by him, to his own local labour and to the staff designated by the staff designated by the customer to later and maintain such equipment.

Such training shall be organized by the Contractor under the supervision of the Engineer and shall be performed by qualified personnel.

The Engineer is authorized to enter freely into the training site in the country or abroad to supervise and to inspect training conditions, if necessary, and the Contractor shall make all required arrangements for the purpose.

The training program shall include the training of operating personnel testers, and laboratory control technicians and maintenance personnel.

In the case of the personnel destined for training as the Plant operators the Contractor shall arrange to place such personnel in suitable positions in plants then currently in operation where such personnel will learn the administrative and operating techniques and acquire skill required in operating a plant.

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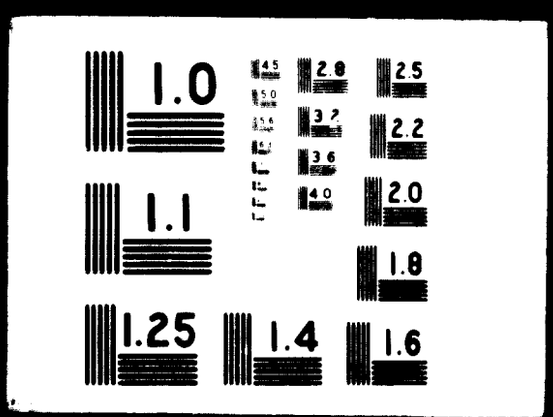


In the case of personnel destined for training in the maintenance of the equipment supplied by the Contractor, the Contractor shall arrange to place such personnel in the shops manufacturing the equipment being supplied by the Contractor.

The training of personnel outside shall continue until the installation of major equipment begins at the Plant Site. At this time, the operating and maintenance personnel working abroad shall return for further training at the Plant Site during the installation of equipment.

Training at the Plant Site shall start with the beginning of erection of major equipment and shall include not only the further training of personnel that was sent abroad, but also the training of the entire staff engaged by the customer to operate the Plant. Training shall continue throughout the period of site testing and until the end of the period of supervision of operations.

The contractor shall co-operate with the customer for the operation and maintenance of the Plant even after the issuance of F.A.C. if requested by the customer. In this case, a separate contract shall be made betwsen the customer and the Contractor for an appropriate price.

The Tenderer shall submit a personnel plan for all required training in the country or abroad and estimated expenses required for the respective training.

All expenses involved in the training of personnel abroad such as those incurred by their travel, their living and other allowances, the cost of special training course, the cost of training them in actually working plants etc... shall be borne by the Contractor.

1.4.11 Other obligations.

a) The Contractor shall carry out all other obligations as specified in Contractual terms, such as the bank reference, establishment of the Contractor's office at the Site and provision of translators, insurance of Works, care of the Works etc... and all other obligations to deliver to the customer the complete Works of the whole Plant perfectly in working order as required by the Contract.

b) Supply of equipment.

The Contractor will consider in supplying equipment to use standards corresponding to the standards used for the present Sugar Factory (DIN standards).

1.5 ACCOMPANYING DOCUMENTS.

1.5.1. Scope.

Each Tender shall be accompanied by the following documents in four (4) copies (original + three (3) typewritten copies).

Each set should be put in separate sealed envelope.

a) The documents specified in article 1.4 - Contractual Terms

b) The lists and lay-out " Field equipment - Facilities "

c) The data required for Temporary Works - Contractual Terms

d) The schedules of Prices

e) The machinery and equipment list and specifications

f) The Plant performances and guarantees

h) The informative documents, drawings and calculations

i) The Time Schedule - chapter 1

j) The information and lists

k) Codes and Standards

The method ob submission shall strictly follow that designated in the Contractual Terms. If this information is not complete or when the contents do not meet said requirements, the Tender shall not be considered.

When the contents of the Tender do not comply with the stated in the Technical Specifications, a covering letter describing the discrepancy and giving reasons therefore, no matter how little the differences are in the process , schedule, mechanical specification etc... shall accompany the Tender. Those contents not given in the covering letter shall be considered and treated as those specified in the Contract Documents.

The Tender and all accompanying documents shall be in English and shall be signed by a responsible of the Tenderer's staff. Other documents which the Tenderer deems necessary for evaluation of his Tender shall also be submitted.

When tendering for two (2) or more contracts and when evaluation may be made separately for each contract, the Tenderer shall submit his Tender and accompanying documents for each contract separately and when evaluation must be made together for all contracts tendered, the Tenderer shall submit said documents together.

ALTERNATIVES TO MACHINERY AND EQUIPMENT, BUILDING, ETC..., WHICH MAY BE STATED IN EACH ARTICLE SHALL BE IN CAPITAL LETTER.

1.6 TIME LIMIT.

1.6.1. General.

The Contractor shall strictly observe the time limits.
Works of this project shall commence from the date of the notice to proceed with the Works.

The Tenderer shall prepare in compliance with this time limit given above, a detailed time schedule.

This document shall include a detailed Time Schedule for each sub-section of the factory and for each category of supply , the duration anticipated for each of the following stages :

- Studies and engineering.
- Execution of the supplies at the Contractor's and/or the Sub-contractors' workshops.
- Transportation of the equipment to the Site.
- Civil engineering works : Site preparation, earth works, concrete works, structural works, sewerage system, painting etc...
- Execution of the equipment
- Tests without load
- Date of start-up
- Date of putting into operation
- Run-tests
- Period of stoppage of the existing installations.

The hereabove mentioned document shall of course be in accordance with the project period of construction and the scheduled date of completion suggested by the customer.

The Engineer may, in relation to other Contractor (s) or other reasons, order to make adjustments or alterations in the above Time Schedule when necessary.

The Tenderer of Contract No.2 and No.3 shall submit to the Engineer the desired data as well as the required number and quantity of utilities. Site preparation, temporary works, etc... which are necessary for the construction works so that Contractor No.1 shall be drawn up with due consideration given to the desires of other Contractor (s) regarding the utilities, Site preparation, temporary works, etc... required for the construction Works.

The time limit for necessary preparations which may have to be made by other Contractor (s) or data which may have to be obtained from others in order to boserve the time schedule, shall be clearly stated. The completion data for the preparation of data that are to be supplied for other Contractor (s) shall also be clearly stated.

Contractor No.1 shall clearly state the date when Contractors No.2 and No.3 can commence work at Site and shall inform the Engineer accordingly.

The date of the putting into operation will be subject for penalities for delay.

1.6.2. Engineering.

The Contractor shall submit :

a) Process and service flow sheets, materials balance sheets, general layout, drawings and wiring diagrams incorporating the equipment for the approval of the Engineer within three (3) months from the day of the signing of the Contract.

b) Outline dimension drawings and specifications of all major and standard equipment elements, within eight (8) months from the day of the signing of the Contract.

c) All other engineering drawings, lists, bills of materials and specifications within ten (10) months from the day of the siging of the Contract.

d) All lists of spare parts and repair materials with description and technical specifications and all manuals, etc... within fourteen (14) months from the day of the signing of the Contract.

e) All lists od operating supplies , operating materials and start-up supplies, within twelve months (12) from the day of the signing of the Contract.

All other documents deemed necessary shall also be submitted according to the afore-mentioned time limit and shall be amply in time for submission.

3. SUGAR TECHNOLOGY

TECHNICAL DATA FOR PLANT SPECIFICATIONS.

1. ENGINEERING DATA.

As a general rule, the equipment will be simple and of best quality in order to insure safety of operation and minimizing the danger of break-downs and the maintenance works.

This involves the use of high quality or stainless steels wherever needed, the introduction of safety coulpings (f.i. hydroflow) where the moving parts are not sufficiently protected by electrical means : the choice of equipment (pumps, valves) with replacable wearing parts instead of needing specialized machining of damaged parts : the adaptation of the sugar factory's workshop's equipments to the maintenance works which will have to be done all by the factory itself.
The maintenance works will also be facilitated by a good accessibility of the equipment and by the installation of lifting equipment, cranes, a.s.o.

All elevators chains will be of marine type with surface treatment hardening : belt conveyors will be supplied iwth synthetic belts (PVC or similar) with imputrescible core, self-centring rollers, scraping, devices, with stadardized driving system and low speed : shape of tanks will be designed so as to avoid stagnation of fermentiscible products overflows of sugar containing tanks will never be connected directly to the sewers bur through inspection tunnels.

The number of equipment will be reduced to a minimum in view of reduction of maintenance works ; by-passes will be foreseen wherever possible, however the necessary stadby equipment will be installed.

2. ACCESSORIES.

All equipments will be supplied complete with :

- columns, framework, gangways, stairs,
- piping, valves,
- the necessary transmissions, coupling, motors and standardized gear-boxes,
- and all usual fittings.

Sub-section 00 : Beet reception

The beets will be delivered to the factory by road. Lorries loaded with beets are then weighed at the entrance of the plant.
Samples of ± 20 Kgs are taken. Their percentage of earth and the sugar content is determined in the beet reception building.

The number of the samples is determined supposing an average load of 5 tons per vehicle.

In order to ensure a factory working capacity of 2,000 tons of beets per day, the factory must receive 7 x 2,000 tons in 6 days or 2,340 t. per day.

On the basis that the reception will work 12 hours a day and considering that the reception capacity should be 130% of the nominal capacity of the factory, in order to take into account traffic irregularities, the installations should therefore be able of receiving $\frac{2340}{12\,h} \times 130\% = 250$ tons

per hour and 50 samples per hour.

All the beets will be sent to the silos in such a manner as to ensure a regulat rotation of the stock.

In the case of a breakdown of the stocking equipment or by necessity if the beets are deteriorated, the beets arriving at the reception will have the possibility of feeding the factory directly at the rate of 100 tons per hour.

Sub-section 02 : Beets silos.

The beets storage capacity must not exceed the factory's maximum slicing rate for 2 days because of climatic conditions.
However the proposed installation can easily be extended should it be necessary when extending the capacity of the factory.
Sheltering of the beet silo by a roof in order to avoid direct sunshine on the beets shall be quoted as alternative proposal.
Ventilation of the beet silos quoted as an alternative proposal.

Sub-section 04 : Washing plant.

A beet washer with high pressure sprays will be installed.
This washing must proceed very fast to avoid sugar diffusion in the wash water.
Before washing the beets are separated from weeds and stones in a special flume.
Tails will be recovered from the waters and after stone and trashseparation in separate tails washer they will join the washed beets to the slicers.
Great care must be taken to separate the most organic matter from the waters as this will lower the solution in the return waters.
Water for washing the beets must be filtered return waters taken back from the settling pans after clorination.

Sub-section 05 : Beet slicing.

The beet slicers must supply the diffuser with a constant supply of good quality slices corresponding to the oroduction rate imposed on the factory.

Normal production : 85 tons of slices/hour.

The cossette weighing machine will adjust automatically the rotation speed of the slicers.

The Tenderers will take into account the fibrous quality of the beets. The attention is drawn to the fact that the beets are sometimes softened by high temperatures and that bridging occurs easily in the slicers bin.

Practical running time of a slicer before changing or cleaning the knives can be sometimes no more than 1 hour.

Practical cleaning time for one slicer : 20 minutes.

Accessories : knife-bloks, bolts, screens, ...
knife washing tank, special tools, ...
Chutes for slicers provided in stainless steel.
Slicers must have automatic knive blowing either wtea.n or air.

Sub-section 06 : Diffusion.

Sugar extraction from the scalded cossettes is achieved in a continuous diffusion complet with automatic regulation and control.

Due to the extremely high fibre content of the beets, the slices might be of bad and variable quality.

It is expected that the plant will not operate at full capacity during the first years. Consequently, the diffuser must be able to operate with guaranteed results at any capacity between 50% and 120% of the nominal output.

Due to the expected coarse cossettes, the installation must be designed for 130% draft.

The pulp press waters reintroduced in the diffuser.

The diffuser will be fed by only one water (press water plus complementary water). The feed water will acidified to run the diffusion at 6 p.H. Special attention for avoiding infection in the diffuser.

Sub-section 07 : Pulp pressing Plant.

The wet pulp from the diffuser will be pressed in high dry substance presses. This dry substance has to be 20 or 22%.
Attention is drawn to the difficulty to press the pulps obtained from fibrous beets.
Main parts of presses must be in stainless steel resisting to corrosion of low pH.
Reference will be given to band conveyors to transport wet and pressed pulp.
Water recovered from the pressed pulp must be screened before going back to the diffuser.

Sub-section 08 : Pulp drying.

From pressed pulp at 20-20% D.S. dried pulp is produced with 90% M.S.
Addition of molasses has to be made before drying (up to 25%).
Pelleting. All dried molassed pulps to be pelleted. Large storage must be provided for storing the dried molassed pulp pellets.
Drier with fuel oil fired furnace.
Alternative proposal : The drying station must be able to dry green fodder (lucerne or grass) in the off season. Also bagged as pellets but without molasses.

Sub-section 10 - Lime kiln.

The lime kiln will be fuel oil fired. The capacity of the lime kiln to be sufficient to allow measured in the main defecated juice.
The guaranteed CO2 concentration will be a minimum of 28% CC2 in the gas.
Highest quality fire bricks will be used to reduce maintenance to a minimum.

Sub-section 11 - Preparation of milk of lime.

This is not strictly necessary when a saccharate plant is intalled.
However the risks involved justify this supplementary installation.
Automatic density regulation for milk of lime must be supplied.

Sub-section 12 : CO2 handling plant.

Water ring gas pumps.
The CO2 gas concentration will only be 28%.
The construction materials will be chosen keeping in mind that the gas contains sulphur compounds. For the same reason the tanks and other materials in contact with the CO2 gas will be treated with a protective coating.
As boiler flue gasses have to be used for the refinery period, this gas has also to be washed.

Sub-section 13 : Raw juice treatment.

The juice drawn off the continuous diffuser will be prelimed in a progressive way at a temperature of 72 during about 20 minutes.
The prelimeat will be chosen in order to ensure the progressive increase in alkalinity.
The juice is the reheated and sent to the main liming at 86°C.
Different juice purifications are existing : having to deal with low purities the best purification is when high alkalinity are avoid before the main bulk of impurities is taken out of the juice. (for ex. the Novisad or the R.T. purification).

Sub-section 14 : First stage carbonation and filtration.

The limed juice will be carbonated in a continuous carbonation plant by CO2 bubbling in the limed juice in order to precipitate as calcium carbonate the lime introduced.

The gas distributors will be adapted to the CO2 as obtained from the oil fired lime kiln.

Performance : The efficiency of the gas distributors and the absorption of the CO2 in the tanks must be sufficient so taht the lime kiln can operate without having to draw off excess lime.

The efficiency will reach a minimum of 65%.

The formed precipitate will be separated in the special thickening filters in order to obtain a good clarified juice and on the other side a thick slurry of precipitate.

This thick slurry is filtered on mechanized press filters.

The cake will be desweetened by methodical water washing on these filters, the desugarising water will be used for the milk of lime preparation.

The cake with high dry matter content will be transported by belt conveyors to the cake storage area.

The continuous carbonation plant is also used during the refinery period.

Sub-section 15 : Second stage carbonation and filtration.

The first filtered juice from the thickening filters will receive a further slight addition of milk of lime.

This limed juice will be also carbonated in the second carbonation and after a certain retention time in a decarbonation tank will be filtered on complete automatic filters.

The corresponding muds will be mixed with the first carbonation muddy juice and desweetened on press-filters.

This second stage will be also in use during the refinery period.

Sub-section 16 : Thin juice decalcification.

A decalcification of the juice by ion exchanging resins will remove the lime salts for preventing scale in the evaporation tubes.

The decalcification of the thin juice by ion exchanging resins and also the discolouration of affinated remelt sugar by strong anion exchanging resins will be foreseen.

Both plants can be regenerated by sodium chloride and part of their equipment will be common.

The installations are based on a lime salt content at the inlet of 150 mg CaO per liter juice and at the outlet of a maximum residual content of 12 mg CaO per liter.

The compressed air will be taken from the central supply.
However the necessary compressed ait tanks have to be supplied.

Sub-section 20 : Evaporation.

Technical data :

Pressure evaporation of a multiple effect.
Heating surfaces will depend on the steam consumption of the heaters boiling pans and all usual utilization.
Inlet steam for the evaporation 2.5 Kg/cm2 and 138°C temperature.
Brass or stainless steel tubes. Special attention to the draining of the steam chests and to the extraction of non condensing gases.
Efficient catchalls must be installed in the evaporation bodies.
A heat balance must be submit for the chose conditions.

Sub-section 22 : Treatment of massecuites.

Most of the equipment is used in beet campaign and in raw refinery period.
Due to low purities in the final thick juice a high quality raw is first boiled, remelted and reboiled as white sugar.
Pans for boiling white sugar would be recommended with stirring device and connected for chemical boiling out.
All pans to be installed with individual vacuum using waterjets.
Discontinuous automatic centrifugals are to be used for white sugar only.
For B or C boilings and for affinating continuous centrifugals will be used.
For final massecuites, continuous crystalization with artificail cooling and final heating before purging. The crystalizers being of the vertical type using less floor space and having no mechanics inside the massecuite.

Sub-section 11 : Molasses Recovery.

Saccharate plant.

xxx Up to 70% of the molasses produced during the beet campaign will be treated to recover the sugar by a continuous saccharate system.

Powdered lime is mixed with diluted molasses, the saccharate precipitate is filtered on a band filter and used after dilution as milk of lime.

The filtrate containing the waste waters is concentrated to 65 - 70 Brix and has a good value as animal foodder.

xxx Use of by-products if often an important item when establishing sugar industry in developping countries. Molasse is a valuable by-product with 50% sugar content. About 90% of this sugar can be recovered as white sugar when using a saccharate process.

Sub-section 34 : Piping-valves.

This sub-section includes all the pipings and valves which are not mentioned in the lists of the equipment, specially those which are necessary for the connection of the various groups of equipment.

All pipelines for juices, syrup and sweet water.
All pipelines for steam and vapour
All pipelines for air and gas.
All pipelines for oil and milk of lime.
All pipelines for cold, hot and drinking waters.
All valves, steam traps, oil separators and the holding devices for the above pipelines.
Pipelines and valves required for the plants in every respect ready for operation.
In view of reducing maintenance and to standardize all valves, diaphragm valves will be supplies up to 100 mm diameter and modern type butterfly valves with appropriated seal rings above 100 mm.
Diaphragms and seal rings are easily replaced.
These valves can be used on clear or muddy water, juices, syrup, massecuites, air, gas, milk of lime and steam.
For steam maximum pressure 2 Kg/cm2
For high pressure steam appropriated valvles will be supplied.
In any case, if valves other than diaphragm or butterfly valves are supplied they will be of such a type and design that their maintenance can be done in the Sugar Factory 's Workshop.

Sub-section 40.3 : Sugar drying.

During the beet and refinery periods the production of Sugar is about the same (290 to 300 tons/24 h).
RI. and RII. sugars will be mixed and dried together.
The drier cooler must have :

- dessication capacity from 1.8/2% water to 0.03 % for an entry temperature of 60°C.
- cooling capacity 15° above outside air.
- the air will be filtered before use.
- the belts for the Sugar conveyors will be made of white material and of quality befitting an alimentary product.

All the precautions will be taken to avoid losses, dust and obstruction of sugar.

Sub-section 55 : Sewers, septic tanks, settling basins, scum yard.

The main sewer shall receive the drained rainwaters and the non polluted water and shall be connected to the river.
A tap to the settling basins shall be foreseen allowing to discharge in.to them the waste water when polluted.

The following general rule has to be strictly followed :
It is prohibited to discharge into the river :

1) any liquid liable to settle in the river,
2) any liquid polluted liable to make river waters unsuitable for animals, for utilization for domestic purposes, for irrigation use and fish preservation.

The main sewer will be designed as follows :
- 2 or 3 main egg-shaped pipe lines laid out according to parallel longitudinal axes to be determined by the Tenderer depending on the number of main roads of the plant, with connections between these main sewer lines, in order to botain a closed circuit.

For the calculation of the sewer network, the following basic data shall be followed :

1. Coefficient of streaming : paved surfaces and roofs : 1 unpaved ground : 0.8
2. Gradient of piping : 1/250 (counterslopes shall not been allowed).

The muddy water supply from the settling tank as well as the polluted water flowing from the processing buildings shall be sent into the settling basins with an overflow discharge returned to the factory. Aerating or treatment with active sludge may be necessary.
The settling basins shall be located at a bottom point of the yard far from the factory taking in consideration the prevailing winds.

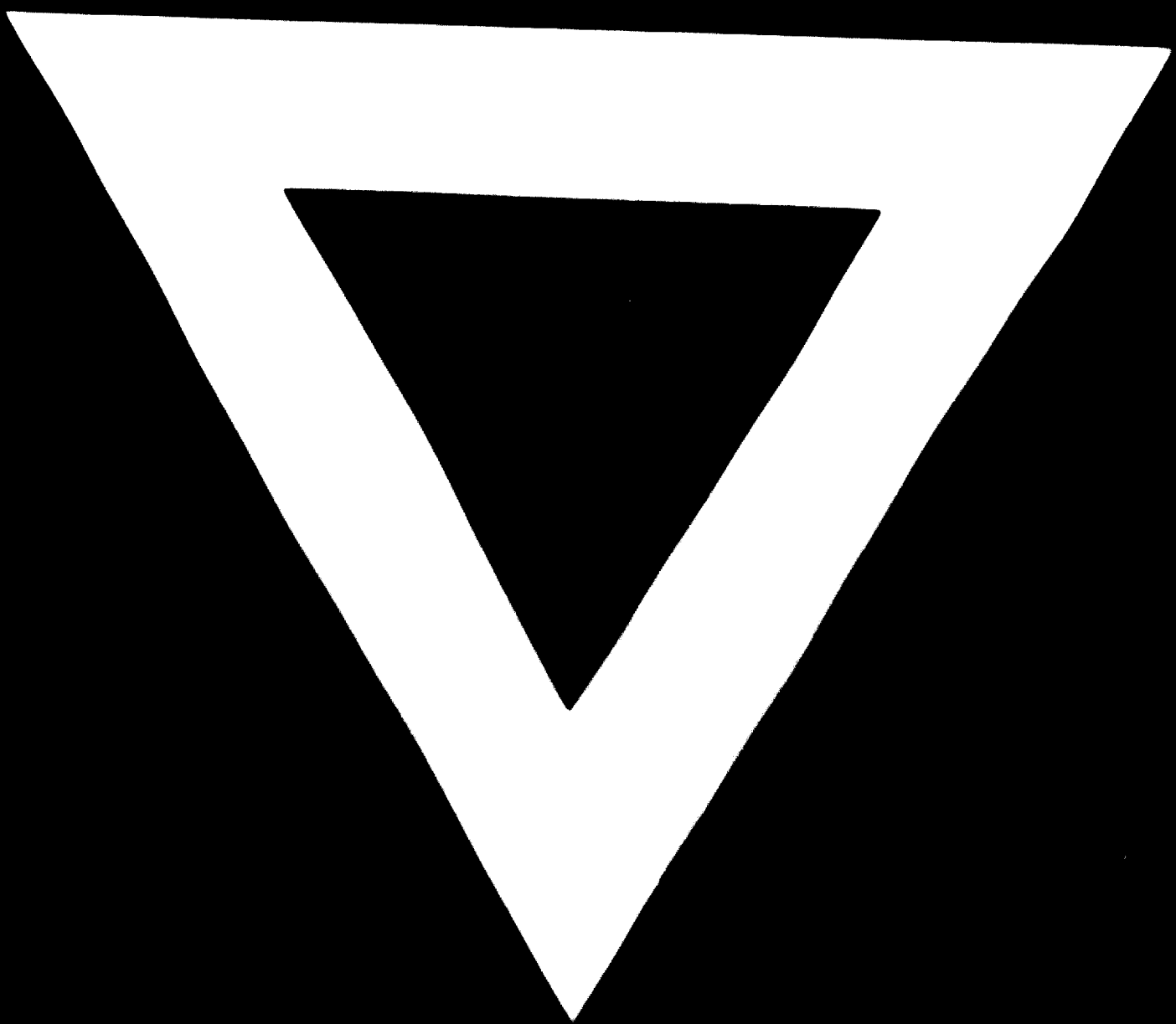
Sub-section 74 : Water treatment plant, water circuits, polution.

Environmental problems are very important in the design of a sugar factory. Even with the fresh water intake a sugar factory -(beet) produces water (77 m3 water in 100 tons of beets). Biggest polution is due to sugar and other organic compounds dissolving in the water washing the beets. All water circuits must be kept separate with cooling devices for reusing the water.
The water to discard to the river should be cleanest of the factory f.e. condensate which is first cooled with spray systems.
Use of waste waters for irrigation could also be foresee.
The raw water shall be delivered to the factory via a main storage water tank of 500 m3.
Fed with raw water the installation shall consist of the necessary treatment for supplying the different consuming points in the factory and general departments with the different qualities of water at the maximum ouiputs necessary

in peak periods during the beet campaign and/or the refinery period.

The flows of the different qualities of water must be calculated and specified by the Tenderer in connection with the manufacturing installation to be supplied.

The Tenderer shall enclose with his tender specific consumption of the different reagents employed.
The fire fighting water shall be taken from the main storage water tank of 500 m3.



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