OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

22558

Verbundplan

DIPL-HTL-ING. REINHARD ENZENEBNER
DIPL.-ING. CARLOS HENAO

UNIDO

UNIDO-CONTRACT P.2000/220-12.10.2000

Integrated Program to Support the National Strategy on Industrial Competitiveness in Cuba

Table of contents:

PLEASE BE AWARE THAT
ALL OF THE MISSING PAGES IN THIS DOCUMENT
WERE ORIGINALLY BLANK

Date : **October 18 – Nov 2 2000**

Ort: **Havanna, Cuba.**

Paticipants : **...**

VPL Dipl. Ing. Carlos A. Henao
Dipl. Ing. Reinhard Enzenebner

1. SUMMARY

1.1 Summary in Spanish

Con el propósito de analizar el uso de la energía en la industria de alimentos cubana, se realizó una “fact finding mission” en La Habana, durante la cual fueron analizadas cuatro industrias representativas de diferentes sectores y, conjuntamente con su personal, se analizó el uso de sus portadores energéticos

Las fábricas visitadas fueron:

1.1.1 Alimentos cárnicos El Miño

Esta planta corresponde a una antigua fábrica de alimentos recientemente remodelada, la cual se encuentra actualmente en la fase de ajuste de su proceso productivo.

Los mayores problemas encontrados están representados por la necesidad de transportar en camiones el agua de aseo y de proceso, los altos niveles de tensión del alimentador, los cuales causan daños en el equipo eléctrico y la operación irregular del compresor de aire.

1.1.2 Cereales Turcios Lima

Esta planta se dedica al descargue y almacenamiento de trigo y a la molienda del mismo para la producción de harina

Los principales aspectos encontrados en esta planta fueron la ausencia de partes de repuesto para el mantenimiento del sistema eléctrico, la ineficiencia de las grúas de descargue, que ha forzado incluso a retirar una de ellas de servicio y el alto nivel de tensión en el alimentador proveniente de la empresa de energía.

1.2.3 Productos lácteosBalkan

La fábrica se dedica a la recolección y procesamiento de leche cruda, para convertirla en leche concentrada, queso y yogurt

Los mayores problemas encontrados en esta planta se relacionan con el excesivo consumo de combustibles en el equipo de transporte, la alta ineficiencia del equipo de pasteurización, acompañado de una doble realización de este proceso, y en general el envejecimiento de los equipos, su baja eficiencia y la carencia de partes de repuesto.

1.2.4 Cervecería La Polar

Esta planta se dedica a la producción de cerveza y a la elaboración de bloques de hielo. Sus instalaciones básicas datan del año 1911.

Los mayores problemas encontrados en esta fábrica se relacionan con la producción de vapor y su distribución a lo largo de la planta, la producción de hielo con equipos verdaderamente obsoletos y la ausencia de partes de repuesto para casi todos los equipos.

1.2 Summary in English

With the purpose of analyzing the use of the energy in the Cuban food industry, a fact finding mission was carried out in Havanna, during which four

representative industries of different sectors were visited, and jointly with their personnel, was analyzed the form of use of the power carriers.

The visited factories were:

1.2.1 El Miño Meat Factory

This plant corresponds to an old meat factory recently renewed, and is currently in its final adjustment phase of the productive process.

Their main problems are represented by the necessity to transport in trucks the process and the cleaning water; the high voltage level of the feeder, which causes damages in the equipment, and the irregular operation of the air compressor .

1.2.2 Cereales Turcios Lima

The plant dedicates to the unloading and storage of wheat and the milling of the same one for the flour production.

The main aspects found in this plant, have to do with the absence of spare parts for maintenance of the electrical system, the high inefficiency of the unloading cranes, that had forced the service retirement of one of them, and the high voltage level received from the utility.

1.2.3 Balkan Dairy Products

The factory dedicates to the collecting and processing of milk, to convert it into concentrated milk, cheese and yogurt.

The biggest problems founded in the plant are the excessive fuel consumption presented in the transport equipment, high inefficiency in the pasteurization equipment and double accomplishment of this process, and in general old equipments with low efficiency and absence of spare parts.

1.2.4 Brewery La Polar

This factory brews beer and produces ice blocks. It poses a very old installation, dated from 1911.

The main problems are the steam production and its distribution along the plant, the ice production with obsolete containers and the absence of spare parts for almost all equipment.

2. INTRODUCTION

Many of the existing systems for power distribution and industrial applications in Cuba, shown a substantial run-out of service life time. The applicable technical standards for operation and maintenance of the equipment don't fulfill the present international state of the art. In order to look for a better performance as well as higher availability and efficiency of the overall power system, the significant weak points were to be identified and evaluated.

As result of the investigations at industrial plants, this report describes the facts of energy consumption, waste of energy carriers, and suggest proposals for useful improvements

By means of this document, further detailed analysis and optimization of condition for investigated systems can be performed, according to industrial economical management practice, within a second step of improvements.

2.1 Goals.

The task of the Energy Saving Concepts for Cuban enterprises has been the preparation of a report as detailed background information for good house-keeping of energy at these chosen Cuban plants, indicating the relevant weak points, and offering recommendations for useful improvements and further sensible measures.

Consequently, rehabilitation and maintenance strategies on the basis of good international engineering practice are been suggested.

2.2 Fact Finding Mission

In order to make the collecting of requested data, a fact finding mission was carry out in Havana, during which, the personnel from the food industry ministry (MINAL Ministerio de la Industria de alimentos) was contacted, to identify the industries to be analyzed, and to obtain the first information.

Each one of the industries was visited with the purpose of obtaining the necessary data by our own impressions and by means of the discussions with the local experts as well as with the production and power administration personnel at the factories.

With the purpose of unifying the evaluation criteria, all the meetings in these industries were carried out following a questionnaire previously directed to each one, which is attached in the Annex A.

3. DESCRIPTION of ENTERPRISES

3.1 El Miño meat factory

El Miño meat factory belongs to the Compañía Cárnica El Miño, and is located in Ayestarán #361 - Cerro- Habana/Cuba. This factory is dedicated to processing different classes of meat products.

Its Organizational structure can be seen in the attached Organizational chart, at the end of this chapter.

The factory has currently the following personnel:

4 Directives
4 Technicians
5 Administrative personnel
6 Servicemen
40 Workers

Although the factory has existing for a long time, it was modernized completely throughout 1999 and was commissioned again at the beginning of the 2000, being still the initial production phase, not reaching till now its total planned capacity

3.2 Cereales Turcios Lima

The company "Cereales Turcios Lima" is located in the port of Havana and it is dedicated fundamentally to the unloading, storage and milling of wheat. Its facilities are made up basically by the unloading zone on the peer, unloading cranes, conveyor belts to mobilize the grain, the storage silos, the mill for the flour production and the administrative dependencies.

Currently, the plant has a total 200 workers, 32 of which are engaged with the silo and 35 are working in the mill (20 in packing and 15 in the direct operation of the mill) The attached Organizational Chart shows the different departments of the company.

3.3 Balkan dairy products

The dairy plant Balkan process mainly fluid milk, yogurt, cream and cheese. They collect the row milk from the milk farmers, located in a radio of about 150 km away from the factory, process it and supply the production mainly to hospitals, schools and hotels.

At the present time, they have 187 workers, from which 17 people are engaged in administrative labors and 170 in the production process. This shows the total absence of automation in the production process. The attached Organizational Chart shows the different activities of these workers.

3.4 Bewery La Polar

The Miguel A. Oramas Enterprise, most known as "La Polar" is an old Brewery located in La Habana. Currently they have a total of 337 workers, distributed as follows:

Leading Personnel	37
Administrative personnel	20

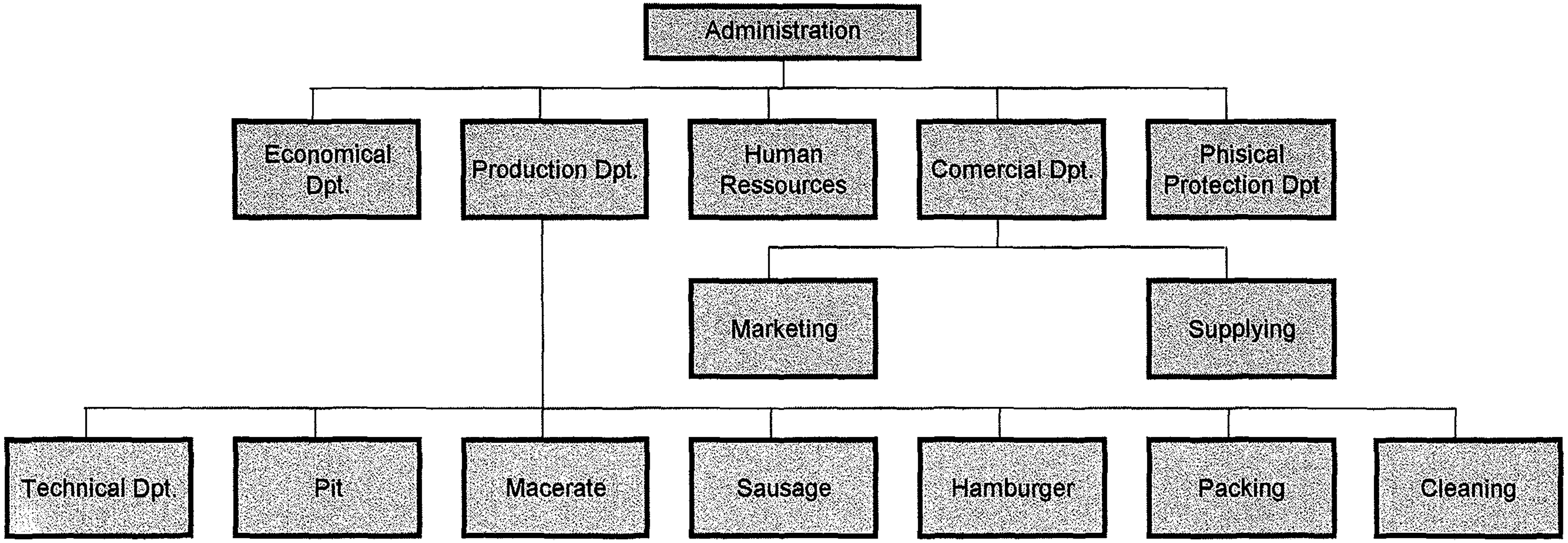
Technical workers	53
Services	27
Workers	200
Total	337

The attached Organizational Chart shows the different responsibility levels in this company.

INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS

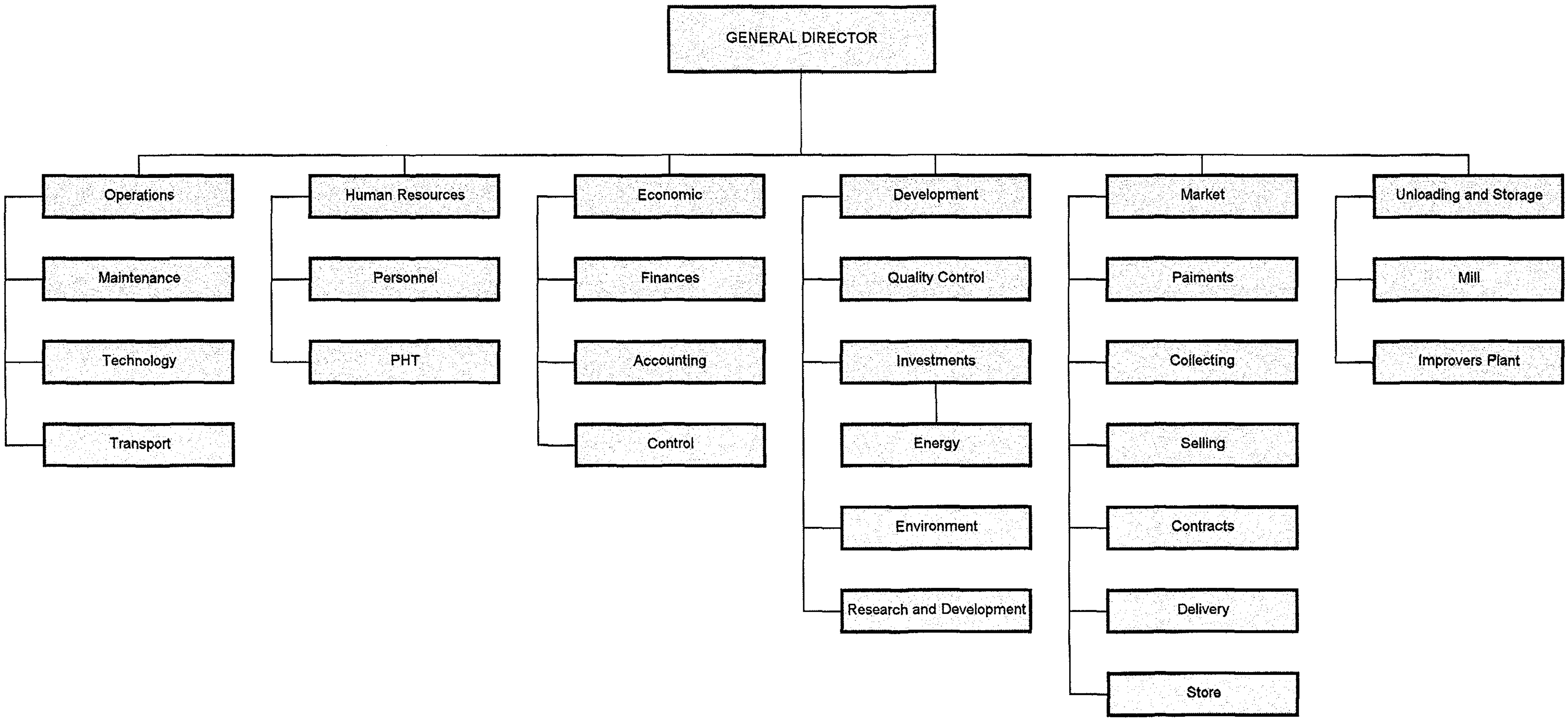
El Miño Meat Factory

Organizacional chart

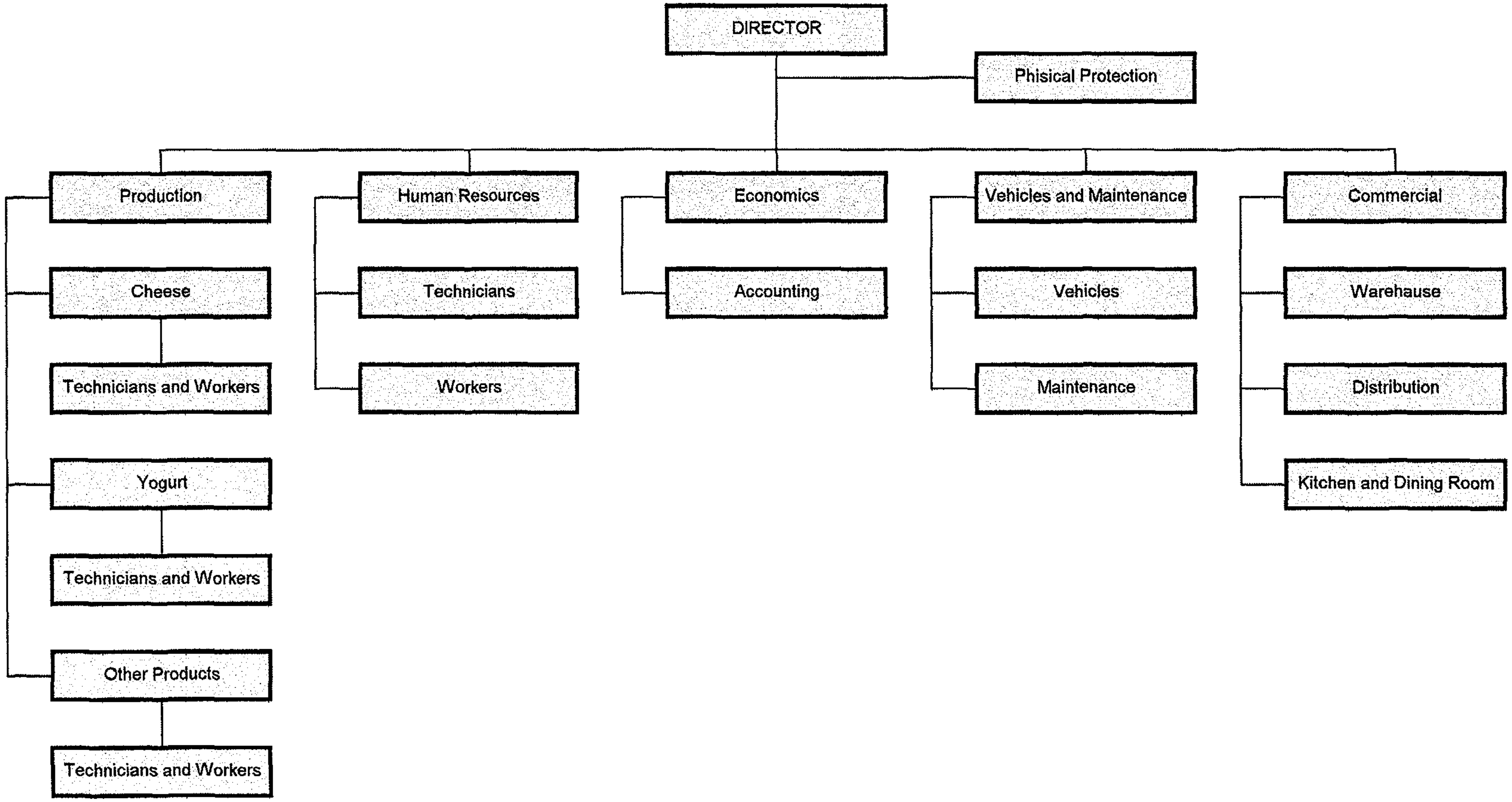


INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS

CEREALES TURCIOS LIMA
Organizational Chart



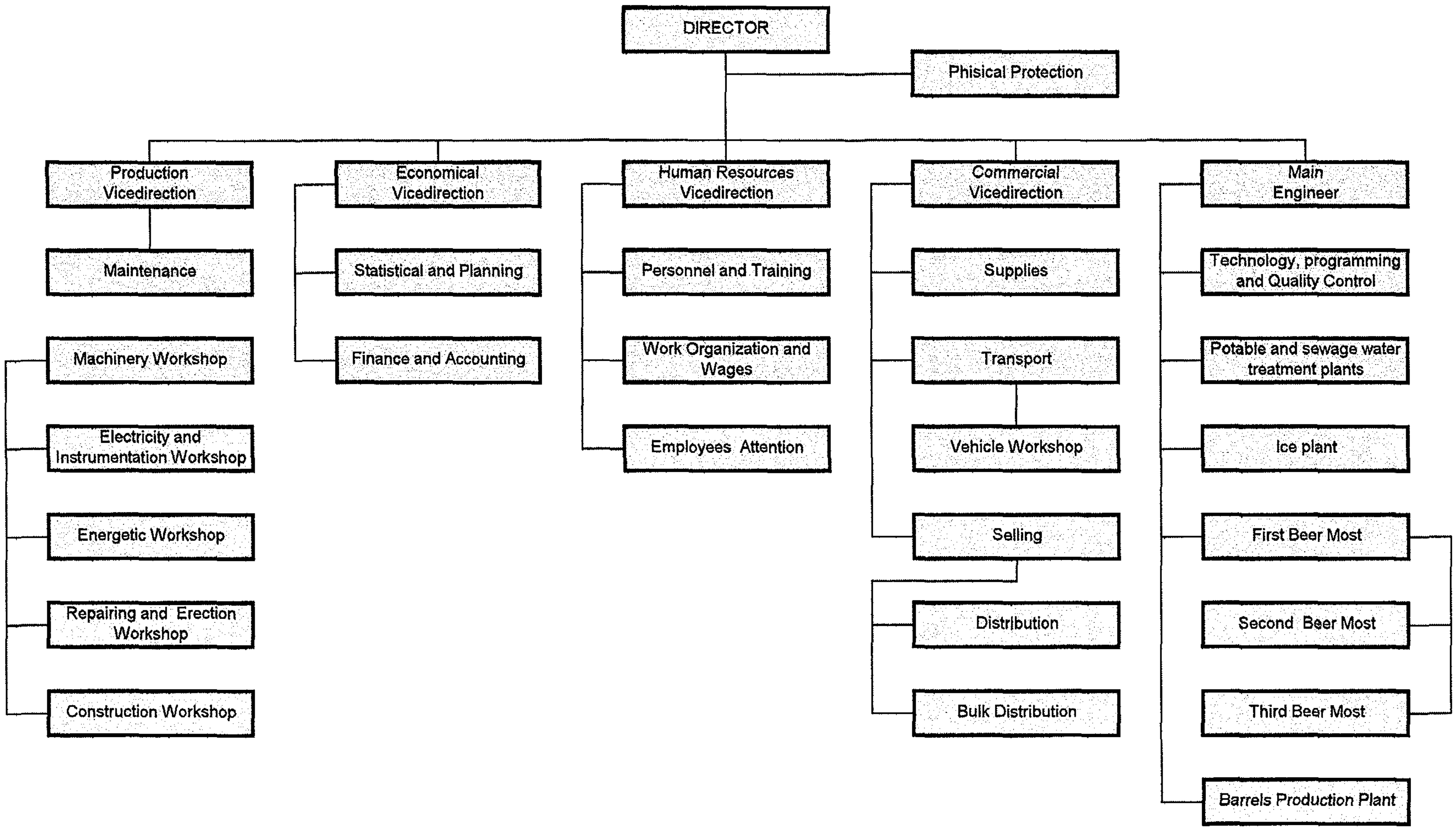
BALKAN DAIRY PRODUCTS
Organizational Chart



INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS

BREWERY "LA POLAR"

Organizational Chart



4. FACT FINDING MISSION AT ENTERPRISES

4.1 El Miño meat factory

On October 27/2000 was realized a visit to El Miño meat factory. In this visit it was reviewed the facilities plant disposition, the process flow chart and the single line diagram of the installation, which are enclosed to this document.

Figure 4-1 Meeting at El Miño meat Factory

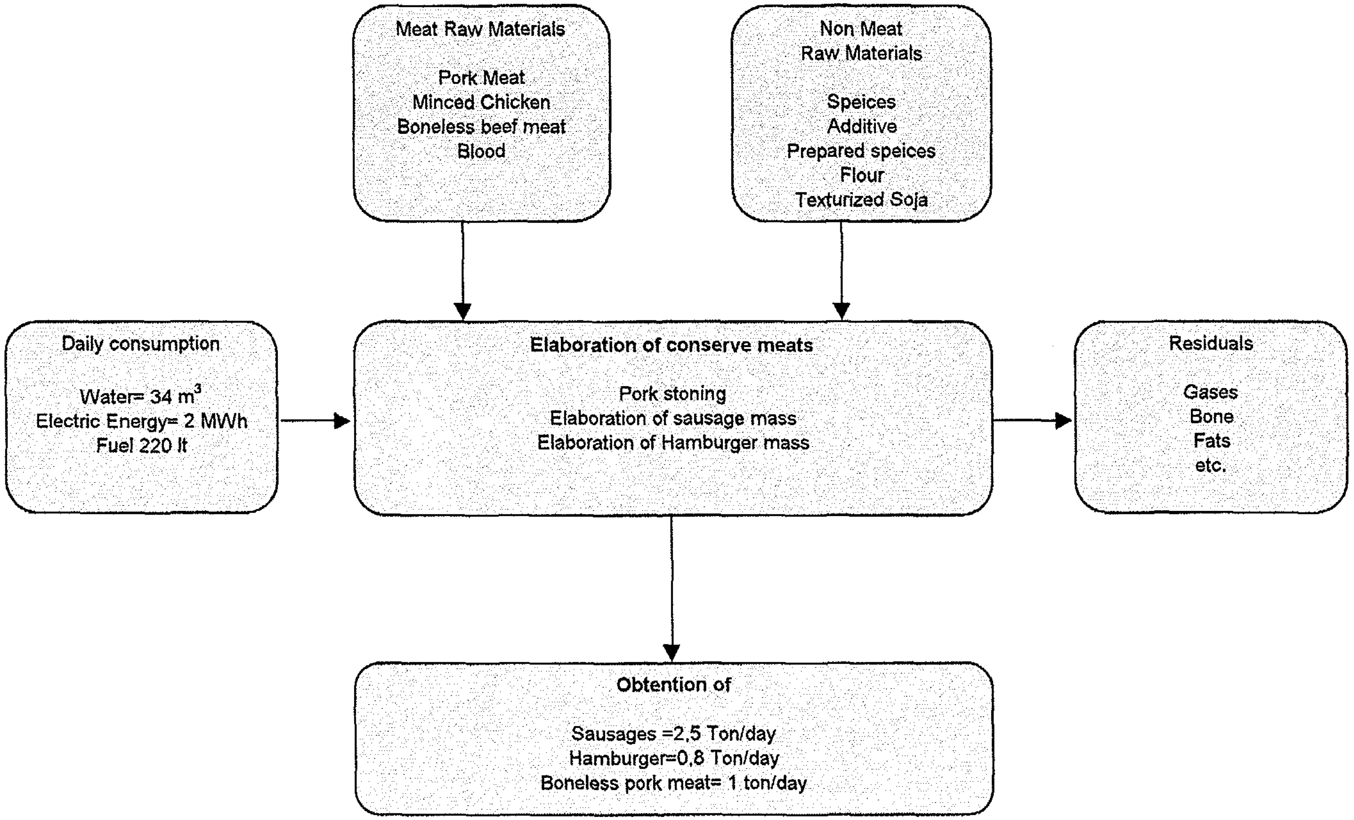
For the production process, they was daily receiving 5 ton of meat, to produce 3.5 ton of meat products and 1.5 ton remainders, represented fundamentally in fats and bone. These remainders are dispatched to other companies, where they are again used as raw materials.

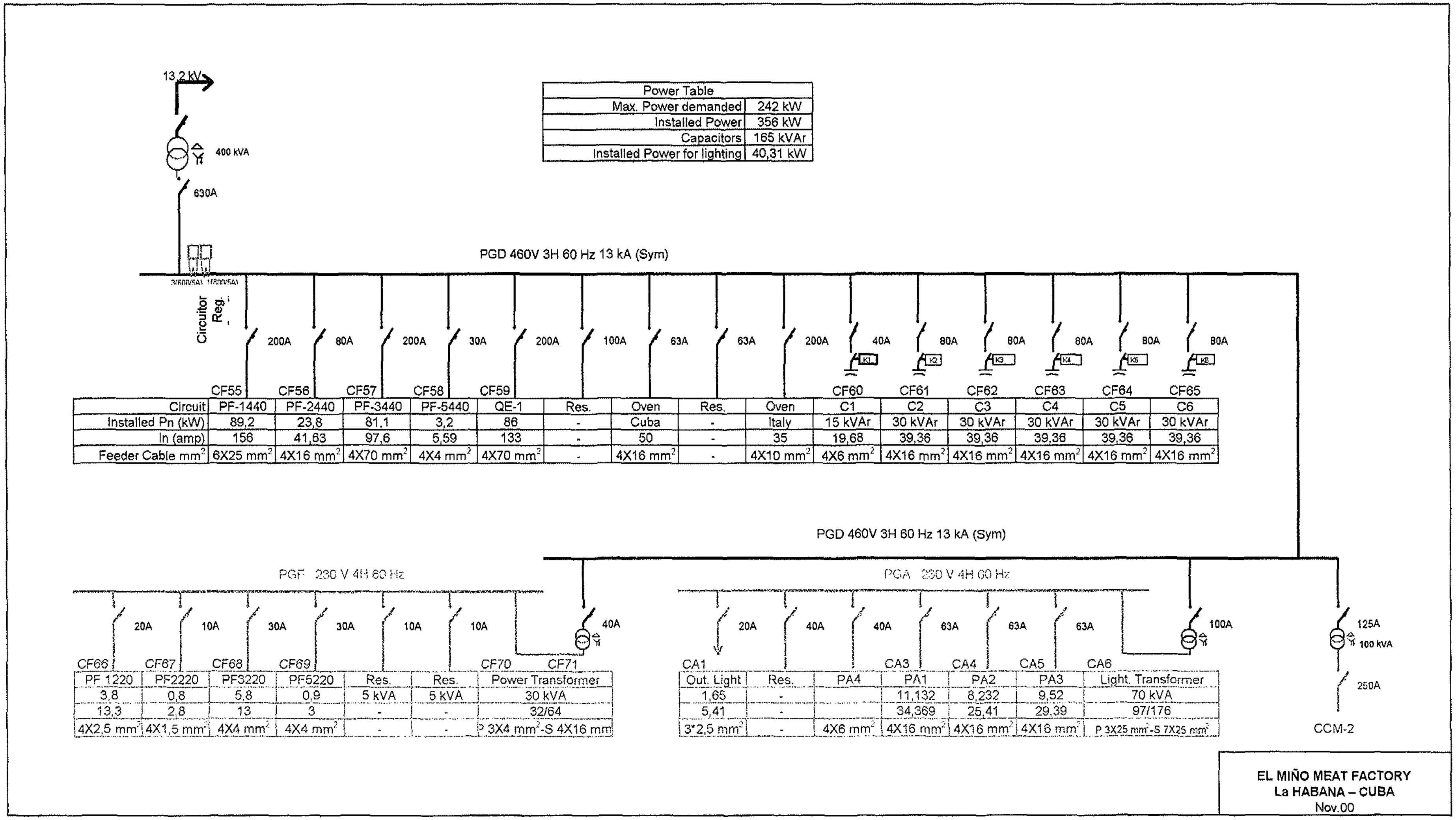
The water is transported to the factory by means of cistern trucks (pipas), with a capacity of about of 1.200 gallons each one, because in the zone where the plant is located the aqueduct system is older than 100 years and presents great deficiencies. Also, boring of wells for water extraction is not allowed in this area, because of proximity to military installations.

INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS

EL MIÑO MEAT FACTORY
LA HAVANNA - CUBA

Production Process Flow Diagram





Power Table	
Max. Power demanded	242 kW
Installed Power	356 kW
Capacitors	165 kVAr
Installed Power for lighting	40,31 kW

	CF55	CF56	CF57	CF58	CF59					CF60	CF61	CF62	CF63	CF64	CF65
Circuit	PF-1440	PF-2440	PF-3440	PF-5440	QE-1	Res.	Oven	Res.	Oven	C1	C2	C3	C4	C5	C6
Installed Pn (kW)	89,2	23,8	81,1	3,2	86	-	Cuba	-	Italy	15 kVAr	30 kVAr	30 kVAr	30 kVAr	30 kVAr	30 kVAr
In (amp)	156	41,63	97,6	5,59	133	-	50	-	35	19,68	39,36	39,36	39,36	39,36	39,36
Feeder Cable mm²	6X25 mm²	4X16 mm²	4X70 mm²	4X4 mm²	4X70 mm²	-	4X16 mm²	-	4X10 mm²	4X6 mm²	4X16 mm²	4X16 mm²	4X16 mm²	4X16 mm²	4X16 mm²

CF66	CF67	CF68	CF69			CF70 CF71
PF 1220	PF2220	PF3220	PF5220	Res.	Res.	Power Transformer
3,8	0,8	5,8	0,9	5 kVA	5 kVA	30 kVA
13,3	2,8	13	3	-	-	32/64
4X2,5 mm²	4X1,5 mm²	4X4 mm²	4X4 mm²	-	-	P 3X4 mm²-S 4X16 mm

CA1			CA3	CA4	CA5	CA6
Out. Light	Res.	PA4	PA1	PA2	PA3	Light. Transformer
1,65	-		11,132	8,232	9,52	70 kVA
5,41	-		34,369	25,41	29,39	97/176
3*2,5 mm²	-	4X6 mm²	4X16 mm²	4X16 mm²	4X16 mm²	P 3X25 mm²-S 7X25 mm²

EL MIÑO MEAT FACTORY
La HABANA – CUBA
Nov.00

The factory has a fuel-oil boiler, which works between 3 and 5 hours every day.

From year 2001 onwards, the costs of the energy carriers will be paid in US Dollar.

The present daily work schedule, represents 7 hours of production and one hour of cleaning, working approximately 22 days per month.

The demand of energy carriers for the year 2000 is showed on the next table. On the year 1999, the factory was in remodelation, then no data were available.

El Miño Meat Factory - Energy and Water Consumption

Month	Phisical Production (ton)	Electrical Energy (MWh)	Fuel Oil 1000 Liter	Water (m3)	Electrical Energy MWh/Ton	Fuel Oil Liter/ton	Water M3/ton
		Consumption			Efficiency (*)		
Jan	16,6	32,2	3,9	881	1,94	234,94	53,07
Feb	ND	32,2	3,9	811			
Mar	33,02	36	4,8	635	1,09	145,37	19,23
Apr	52,7	36,8	2,64	773	0,70	50,09	14,67
May	129	32	4,804	800	0,25	37,24	6,20
Jun	23,9	36	3,448	800	1,51	144,27	33,47
Jul	36,9	33	3,298	616	0,89	89,38	16,69
Aug	52,2	36	2,3	1008	0,69	44,06	19,31
Sep	55,6	36	2,2	1008	0,65	39,57	18,13

(*) The Efficiency indicators were calculated from the production and consumption supplied values

The distribution of electrical energy was analyzed considering the single line diagram. This electrical diagram shows information about each one of the elements, the circuit to which is connected and the load installed. Also, the disposition of the measuring equipment for active and reactive energy was analyzed.

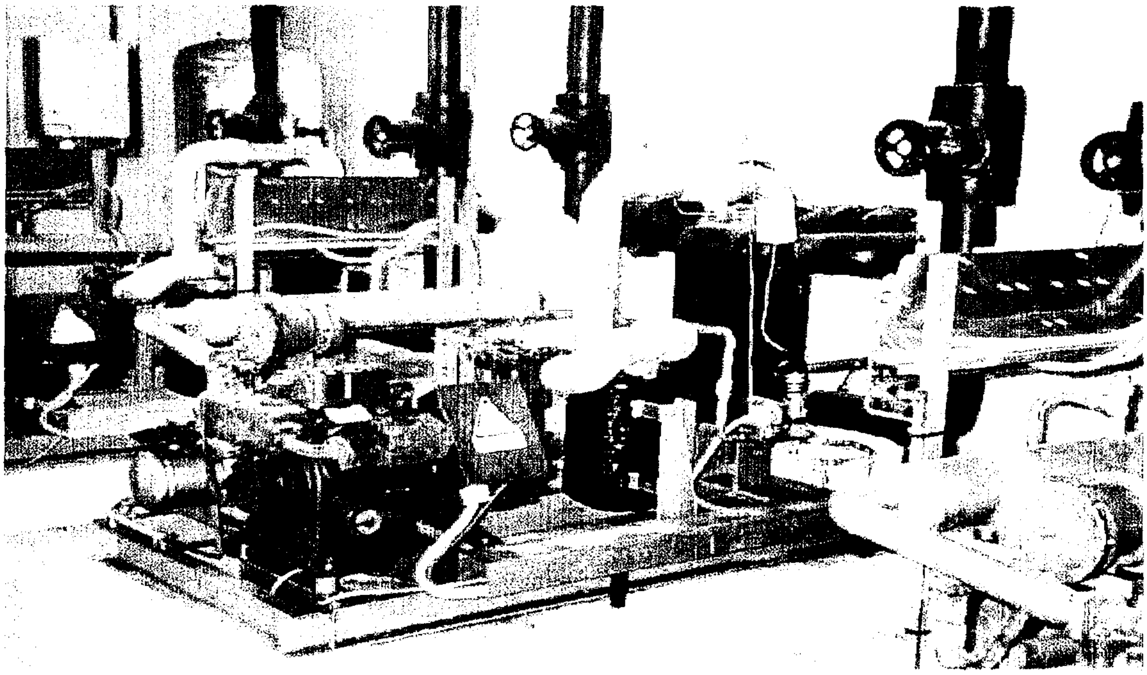


Figure 4-2 Compressors set for the cooling system

The feeding voltage supplied by the utility to the factory is higher as normal, and this situation has caused the burning out of two motors for the cooling system; at the moment of the visit, from three cooling compressors installed in the factory, only one was running, the other two were damaged by overvoltages; it should be noted that without this compressor the whole factory's cooling system is out of service.

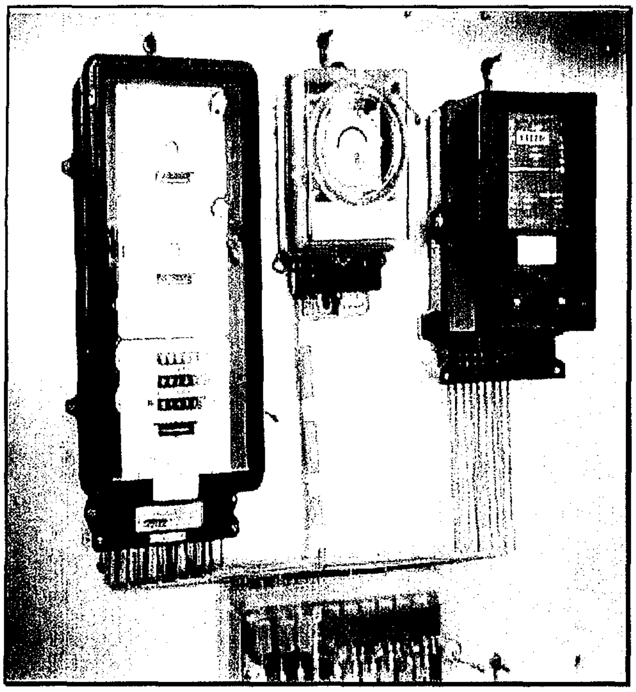


Figure 4-3 Measurement equipment at utility feeder

According to the Cuban electric system, in the factories with a peak power above 50 kW the reactive energy must be measured and evaluated. If the power factor lays under 0.9, the factory receives a penalty; if the power factor lays between 0.9 and 0.94, the factory receives a bonus; power factors over 0.94 aren't stimulated.

Particularly in El Miño, the installation of condensers was also necessary, in order to adjust the power factor, avoiding the penalties granted by the utility .

The electrical energy and fuel oil bills were not provided, because they weren't available in the factory; these values are canceled directly by the Company to the Utility. Here it's necessary to explain that in the Cuban industrial organizational system, a Company means the overhead group and a Factory means the production plant itself.

4.2 Cereales Turcios Lima

On October 30/2000 was realized a visit to "Cereales Turcios Lima". During this visit, the electrical distribution system was analyzed means a single line diagram skizzed during the meeting. No electric drawings were available at the visit.

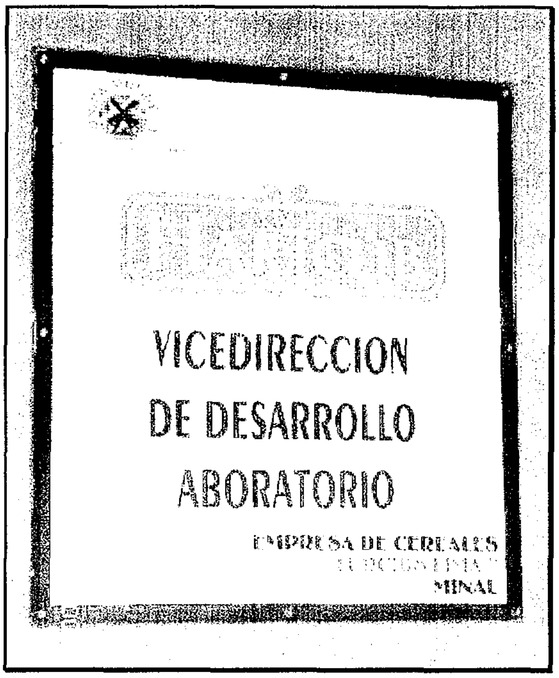


Figure 4-4 Company Identification

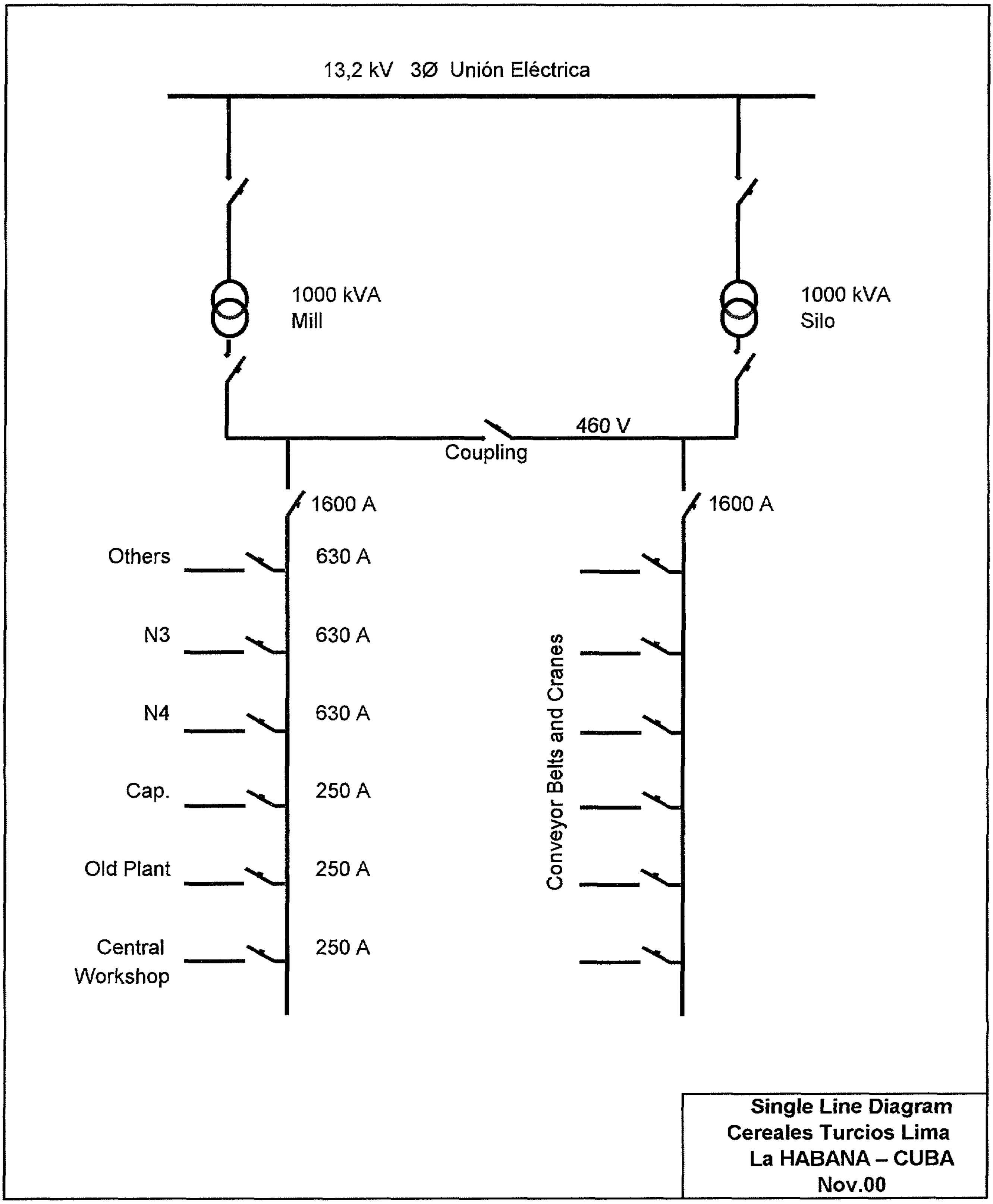
This plant depends 100% on electrical energy, for this reason no other energy carriers were analyzed.

A description of the electric power system and the process, are shown in the attached Single Line Diagram and Production Process Flow Diagram.

Currently, they are planning a new installation, together with a Mexican Company, but our visit was limited to the old installations, and no attention was put to the new ones, because they belong to private investors.

The electrical feeding is carried out at 13,2 kV. For the future installation they plan to have a feeder 13.8 kV 1250 kVA. The low voltage side will have 460 V

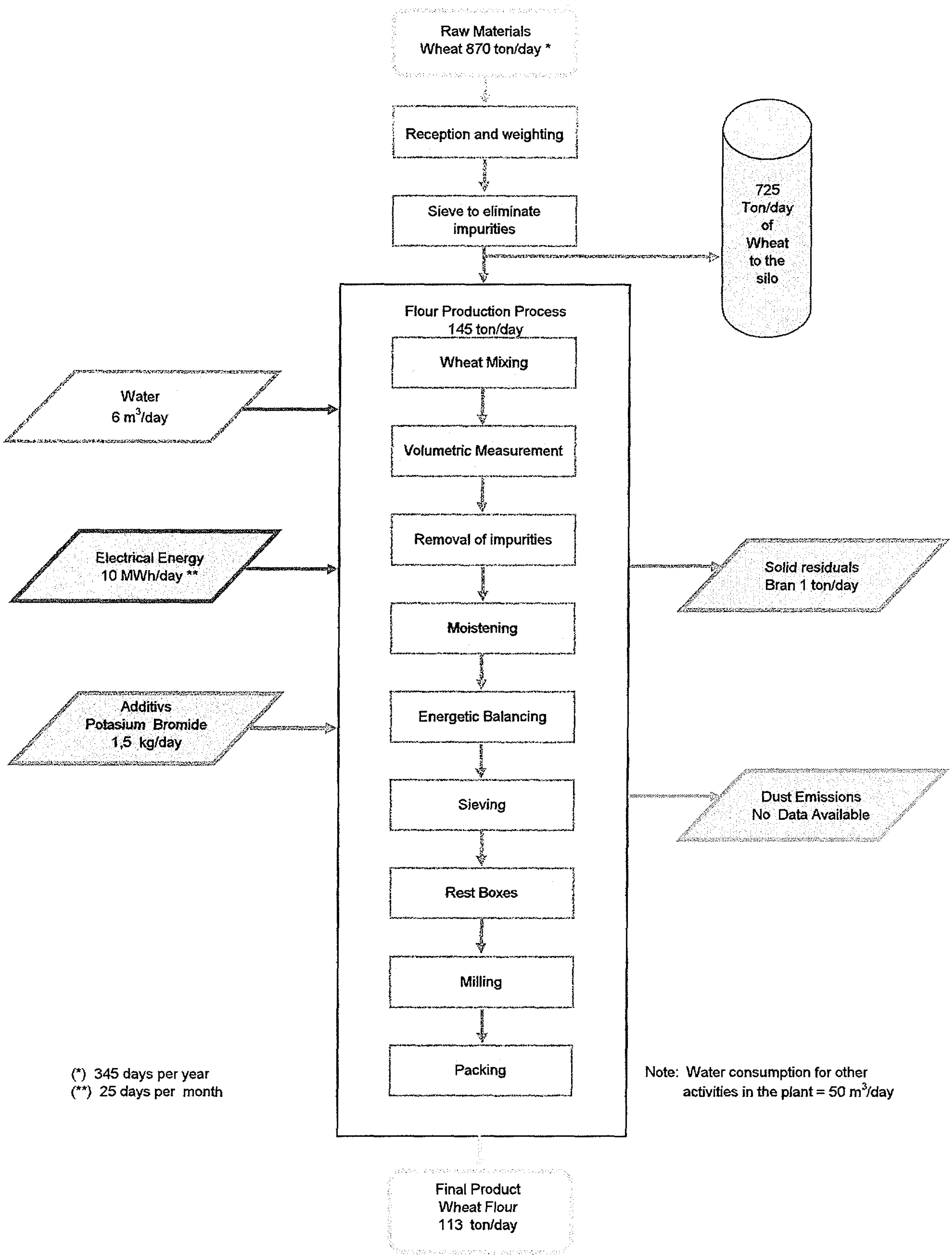
INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS



INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS

CEREALES TURCIOS LIMA

Production Process Flow Diagram



(*) 345 days per year
(**) 25 days per month

Note: Water consumption for other activities in the plant = 50 m^3/day

At the present, only the Belgian VIGAN crane is still in operation; the other crane (ORIM from Spain) was took out of service, due to economical reasons.

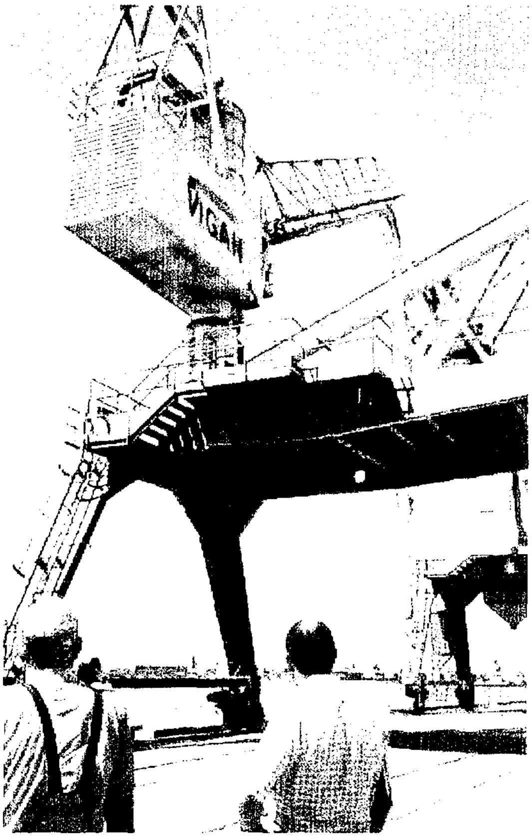


Figure 4-5 Operative Crane

The available crane capacity, demands approximately 10 days to unload a 30,000 tons vessel; this duration lays within the time agreed for its accomplishment. In case of extending this unloading process, they are forced to cancel the sum of US$7.000 per day as sanction, whereas if they shorten the unloading time, they receive the amount of US$ 3,500 per day as bonus.

Currently they have programmed to unload between 18 to 20 vessels per year (approximately 300.000 ton year).

The mill, has a nominal capacity of 180 ton, but currently, they are processing approximately 140 ton. daily, working 24 hours.

From the 300.000 ton that are they unloading yearly, approximately 50.000 ton are processed in the mill, and the rest is stored in the silos to be later delivered to other companies.

Energy Consumption:

The electric energy is used as follows in the plant (this information was gattered when the two cranes were still working):

Cranes				
Parameter	Unity	Crane VIGAN	Crane OCRIM *	Total (Average)
Installed Capacity	kW	200	300	500
Load Coefficient	%	75	75	75
Hourly average consumption	kW	150 (**216)	225	375
Unloading capacity	Ton/hour	125	80	205
Consumption index	KWh/ton	1.2	2.8	1.83

* This crane is currently out of service. This crane has a consumption index of 2.8 kWh per ton. While the other crane has an index of only 1.2 kWh/Ton.

** Hourly estimated consumption if this crane works alone to unload 180 ton/hour.

***Recycling will be denominated the wheat transport process between the silos.

Conveyor belts		
Total installed power	350 kW	Load Coefficient = 75%
Power unloading equipment	226 kW	170 kW
Power recycling equipment ***	140 kW	105 kW
Power for wheat transport to the mill	32 kW	24 kW

To filling the mill with a quantity enough to work 48 hours, they need to work 5 hours with the conveyor belts.

If 3.000 ton/day of transport are considered, to be carried out in 20 hours, then:

Transport consumption = 170 + 105 + 32 = 307 kW
Daily energy = 307 kW X 20 Hours = 6.140 kWh/day
Consumption Index = 6.140 kWh / 3000 Ton = 2.05 kWh/ton

When the two cranes were working, the consumption of energy for transport until the silos was = 375kW (unloading cranes) + 170 kW (conveyor belts to the silos) = 545 kW

For journeys of 20 hours daily = 545 X 20 = 10,900 kWh per day, which were consumed as follows: 9 MWh in day and at dawn (prices = 0,04 US$/kWh) and 1,5 MWh in peak hour (Tariff = 0,11 US$/kWh)

For the estimated 3.000 ton daily, it was obtained = 10.900/3000 = 3.6 kWh/ton

Mill 180 Ton		
Hourly consumption	KWh	386
Daily consumption (24 hours)	KWh day	9265
Flour Production	Ton/hour	6
With an efficiency of	%	75
Total Flour Production	Ton/day	140
Consumption index	KWh/ton	65

According to information received from operative personnel, this indicator of 65 kWh/ton lays between the modern mills standards. They inform additionally, that the monthly consumption reaches 270 – 280 MWh, which cost is approximately 30.000 pesos monthly. (Silo 75,3 MWh, Mill 180 MWH, auxiliary building 18 MWh, diverse 1 MWh)

Water consumption

The plant has a daily consumption of 56 m3, for a flour production of 140 ton/day, that means an index of 400 l/ton.

Energy costs and efficiency

The company has they own condensers to produce the reactive power; they receive a bonus (between 600 and 800 pesos/month) caused by a high power factor.

All discharge and transporting process are carried out in a manual way; only the mill works fully automated, means a BUEHLER electronic system. In order to automates the conveyor belts in the silos, it should be necessary to install all the corresponding instrumentation too.

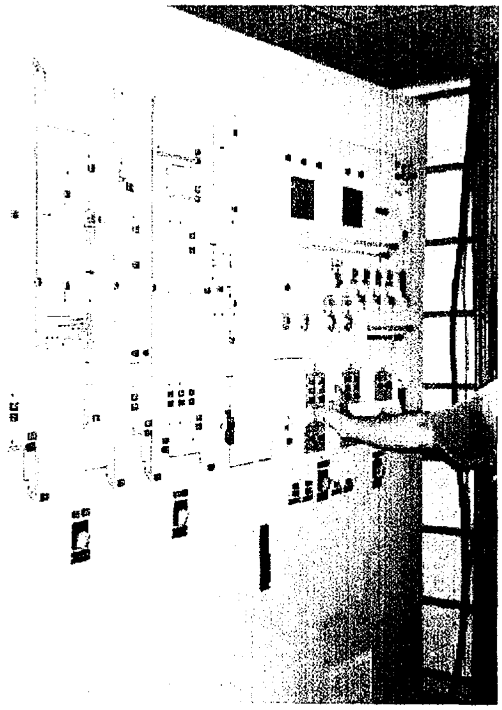
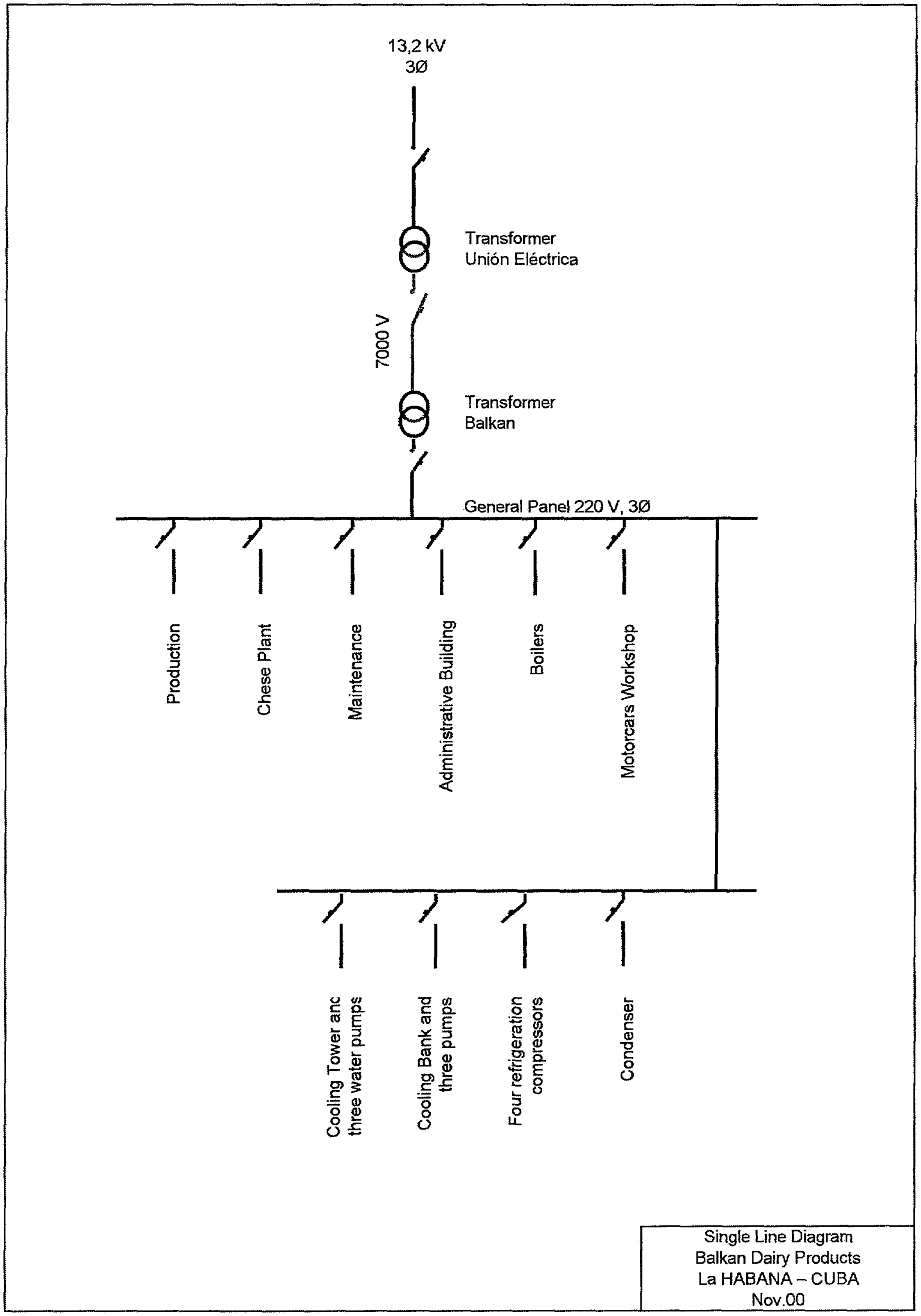


Figure 4-6 Automatic control system for the mill

It is necessary to carry out the maintenance to the main transformers; they are two Siemens transformers, built in 1976. Till now, those transformers had shown no technical problems but the only maintenance received consists of physical cleaning and oil level measurement

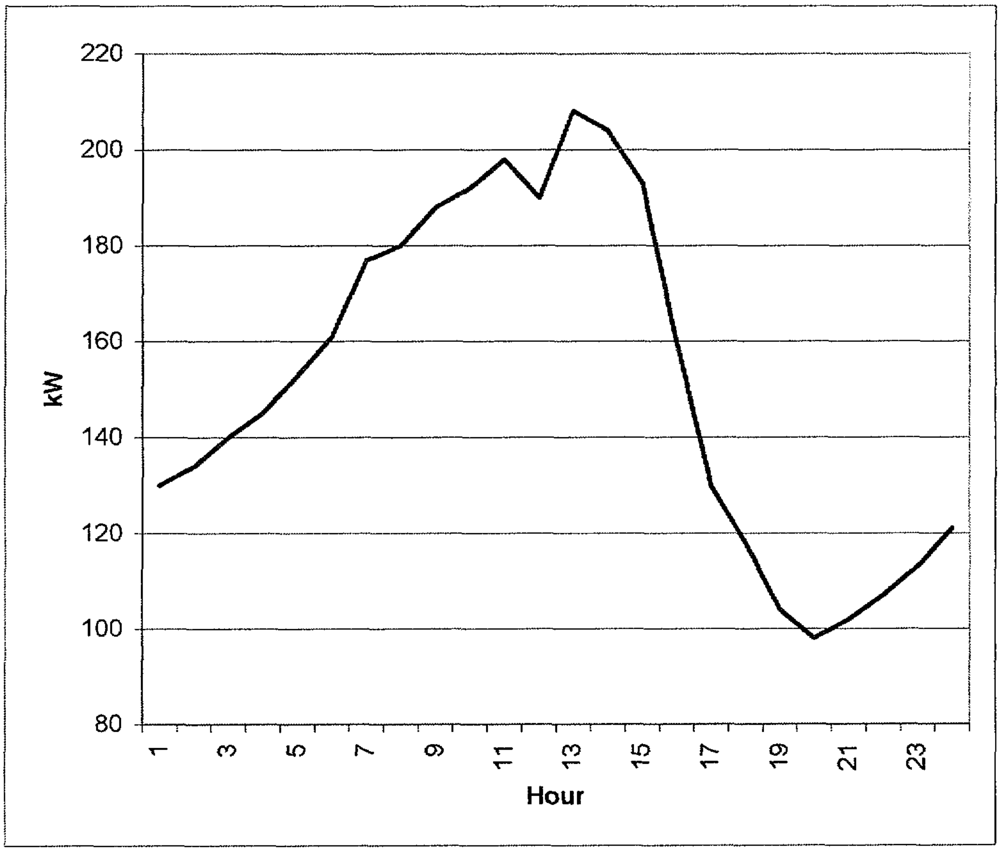
4.3 Balkan dairy products

On October 31/2000 was realized a visit to the Balkan dairy plant. In this visit, the electrical distribution system was analyzed means a single line diagram skizzed during the meeting, and the other energy carriers were analyzed. No electric drawings were available at the visit. See the attached single line diagram and a typical load curve.


13,2 kV
3Ø
Transformer
Unión Eléctrica
7000 V
Transformer
Balkan
General Panel 220 V, 3Ø
Production
Chese Plant
Maintenance
Administrative Building
Boilers
Motorcars Workshop
Cooling Tower anc three water pumps
Cooling Bank and three pumps
Four refrigeration compressors
Condenser
Single Line Diagram
Balkan Dairy Products
La HABANA – CUBA
Nov.00

BALKAN DAIRY PRODUCTS

Load Curve



Time		kW
1:00	AM	130
2:00	AM	134
3:00	AM	140
4:00	AM	145
5:00	AM	153
6:00	AM	161
7:00	AM	177
8:00	AM	180
9:00	AM	188
10:00	AM	192
11:00	AM	198
12:00	AM	190
13:00	PM	208
14:00	PM	204
15:00	PM	193
16:00	PM	160
17:00	PM	130
18:00	PM	118
19:00	PM	104
20:00	PM	98
21:00	PM	102
22:00	PM	107
23:00	PM	113
0:00	PM	121

The delivered milk is collected, cooled down, pasteurized, provided with additives, concentrated, and prepared for the sale. The concentration process consists of elimination of water, in that way they produce one liter concentrated milk from more or less two liter row milk.

The final products from Balkan are: Milk for children under 7Jahre, yogurt for the children in the schools, and cheese; as well as special quality yogurt and cheese to be delivered to hotels and restaurants.

They receive approximately 24.000 liter milk every day, and produce between 12.000-13.000 liter of milk. Additionally, they produce monthly 22 or 23 ton. of natural Yogurt and 40-46 ton. of Yogurt class tourism.

In order to maintain the production over the regulated quality standards, all products are constantly examined in a company-owned laboratory.

Technical Information:

Electrical Installed capacity:	300 kW
Daily consumption:	3260...3270 kWh/Day
Power Factor:	between 0,92 and 0,93
Work schedule:	24h/Day, 7 days/week
Steam consumption:	1 t/hour at 5 bar
Diesel consumption:	0,584 t/Day for Steam production
Water:	17 l/sec, 2 bar

In October 2000 the gasoline price was 269.1 Pesos/ton and for Diesel 225 Pesos/ton.

The water cost is 0,1 $/m³ +5508 Pesos/Month; they take it from own water wells. Not water measuring equipment was shown.

The transport equipment has following consumption:

13 Trucks	407 liter gasoline/day	For distribution
8 truck	390 liter Diesel/day	For collection
	152 liter gasoline/day	For collection
Other cars	132 liter gasoline/day	Administration

Additionally, there is a Diesel tow truck. All transport costs are paid by Balkan

Steam consumption: 112 ton/Week. Steam production is carried out in two J.Thomson boilers, built in 1970, firing Diesel

Energy price: Currently 2,9 pesos/kWh and peak (18-22h) 8,7 Pesos/kW. From the year 2001 onwards, they must pay the energy bills in foreign currency.

Diesel: 225,10 Pesos/t
Gasoline : 269,12 Pesos/t
Water: 0,1 $/m³ + 5508 Pesos/Month
These elements should be paid in foreign currency too.

The biggest energy consumer is the cooling system; the compressors are used to comprise NH_3 to supply cooling media to the plate heat exchangers.

4.4 Brewery La Polar

On November 01/2000 was carried out a visit to the Brewery "La Polar". In this meeting the single line diagram and the energy flow chard were analyzed, and are here attached

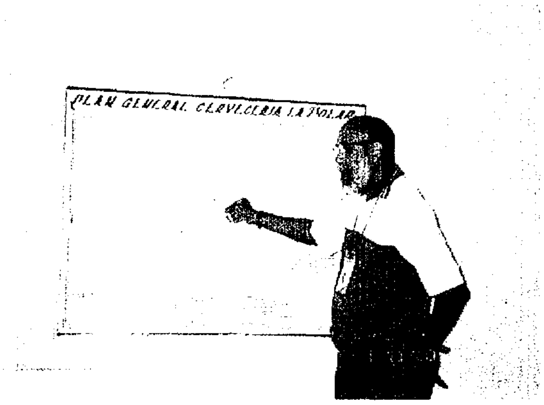


Figure 4-7 Presentation of the company

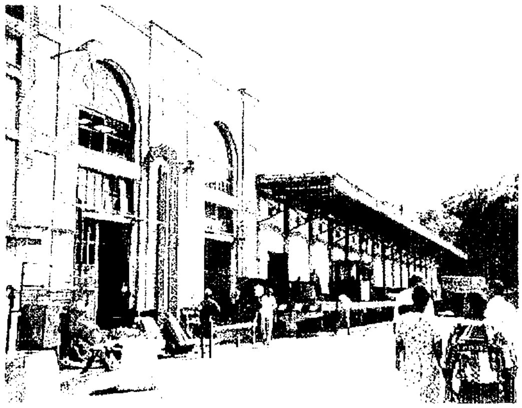


Figure 4-8 General view of the installations

The brewery belongs to an association that is in charge to make all the administrative activities corresponding to the 6 breweries they own, and works as a savings bank handling the foreign currencies they use to seel the beer.

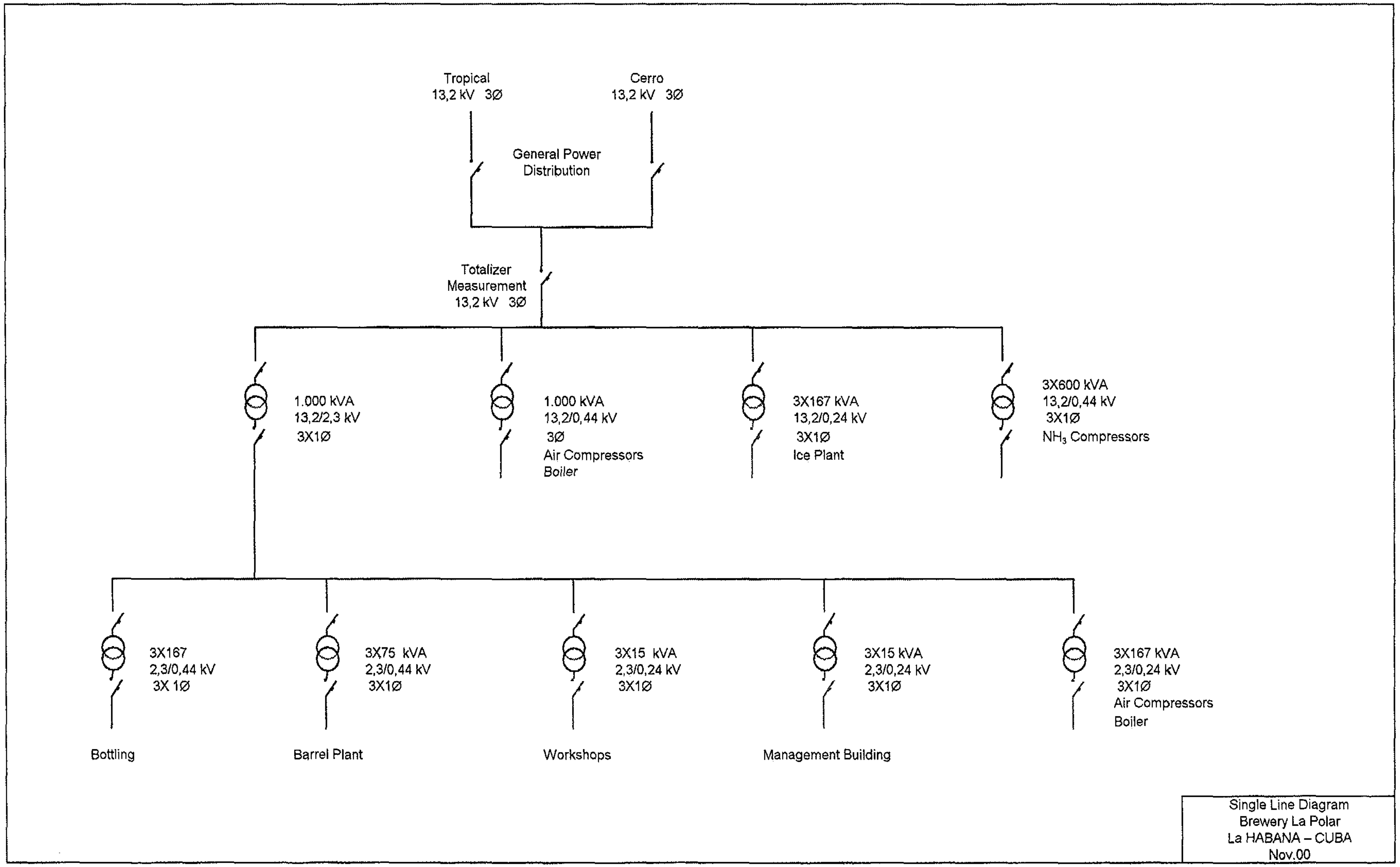
The Bottling department was closed in 1998, due to economical reasons but they maintain the filling of barrels; filling in cans and bottles is carried out in other brewery.

The energy consumption is paid in US$.

Energy Consumption:
The energy and water consumption are as follows

Active energy:

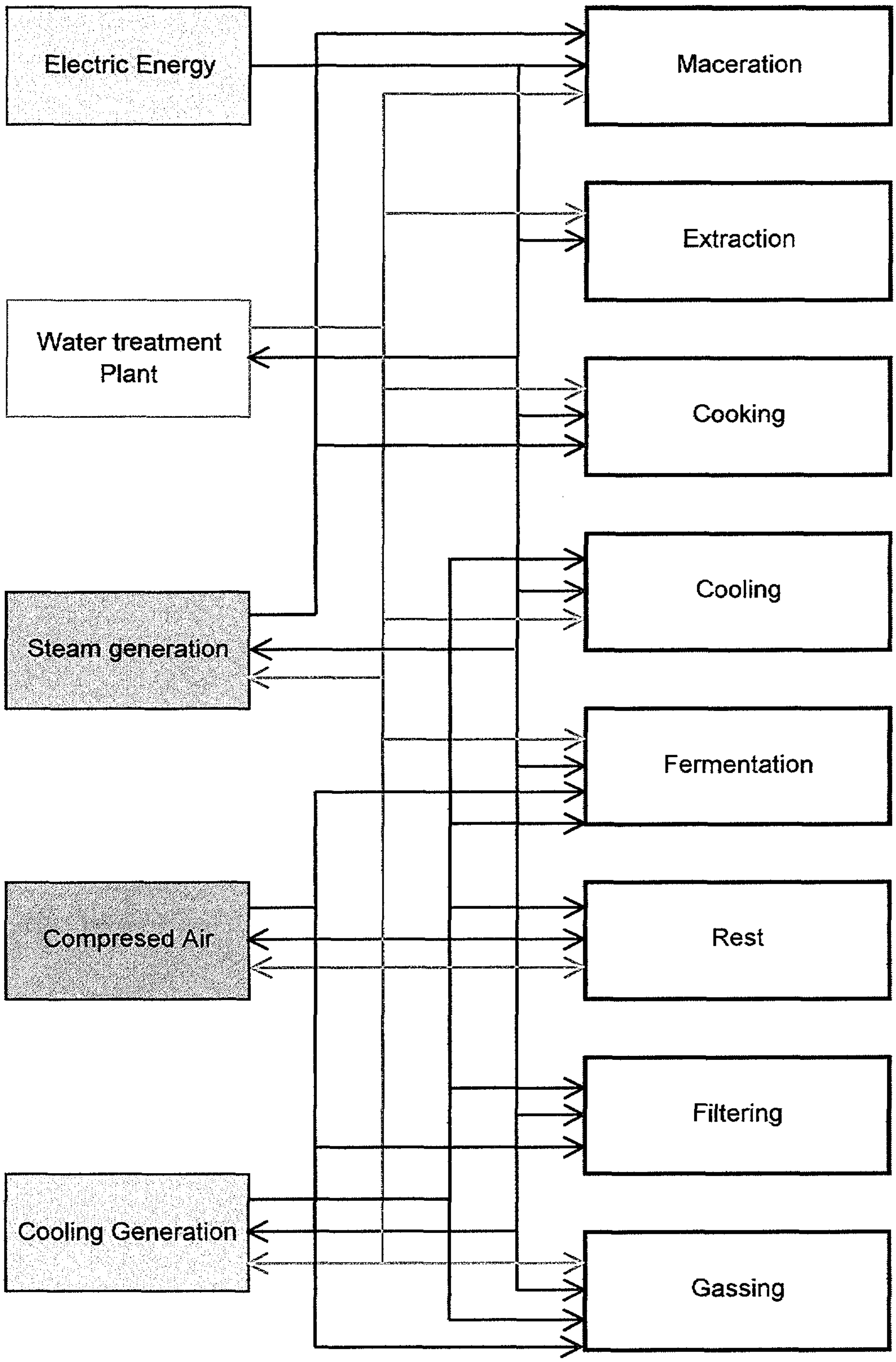
INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS



INTEGRATED PROGRAMME TO SUPPORT THE CUBAN NATIONAL STRATEGY ON INDUSTRIAL COMPETITIVENESS

Brewery La Polar

Energy and Water Flow Diagram



Daily	8 Mwh
Weekly	56 MWh
Yearly	3.000 MWh

Reactive Energy

Daily	0,6 MVArh
Weekly	4,2 MVArh
Yearly	372 MVArh

Fuel Oil for Steam Production

Daily	4 Ton
Weekly	28 Ton
Yearly	1.200 Ton
Steam consumption	4,2 ton/hour

Water Consumption

Daily	32,4 m^3
Weekly	194,4 m^3
Yearly	9723 m^3

Energy Costs:

The energy costs were taken from a four month period as follows:

Time schedule	Price US$/ kWh	Consumption MWh	%	Amount Paid *	%
22:00-06:00	0,03	24,00	29,83%	9573,95	19,04%
06:00-18:00	0,04	400,94	53,39%	24611,81	48,95%
18:00-22:00	0,09	126,2	16,78%	16098,14	32,01%

* The amount paid is a function of consumption, price and a special factor (currently between 1.3 and 1.6 according to oil prices)

For the Tariff 36, that means a demand between 1000 and 2999 kW they pay also 3,3 US$/kW.

It should be considered that they have a consumption of only 16,78% on the peak time, but they pay for it 32,01% of the total electrical energy costs.

According to information received from the personnel at the factory, they received in year 2000 credit notes caused for power factor above 0,9 as follows:

Month	Power Factor	credit note US$
January	0,94	516,89
February	0,94	187,05
March	0,94	242,74
April	0,94	374,47

In budget, they planed a consumption in worth US$81 827.4, but they paid only US$ 65411,3, that means US$ 16416.07 in savings.

In consumption, they planned 1364.7 MWH, but they consumed only 783.04 MWh, that means they consumed only 57.3% of the planned MWh. In 1999 they consumed 1354.6 MWh, then in year 2000 they consumed only 57% from previous year. There was no information about the beer and ice production in order to analyze the consumption per Hlt/beer or per ton/ice.

The consumption of Diesel and gasoline for transportation were no discussed. The prices supplied for the other energy carriers are:

Fuel Oil	144 US$/ton
Diesel	230 US$/ton
Gasoline	479 US$ ton
Water	0,3 US$ m3 from aqueduct (40% of Consumption)
	0,1 US$/m3 from own wells (60% of consumption)

A set of typical production values were obtained from the days October 23 and 24, as follows:

Production on 23.10.00

Beer Production				
	Unit	Programmed	Actual	%
Brewed Beer	Hlt	226,38	521,00	230,1%
Electric Energy	MWh	4,23	2,50	59,1%
Conventional Fuel	TCC	6,48	5,48	84,6%
Conversion Index	MW/MHlt	18,69	4,80	25,7%
Energetic Efficiency	TCC/MHl	28,62	10,52	36,7%
Ice Production				

Ice	Blocks	400	368	92,0%
Electric Energy	MWh	8,46	5	59,1%
Conventional Fuel	TCC	3,07	1,81	59,0%
Conversion Index	MW/Mblock	21,15	13,59	64,2%
Energetic Efficiency	TCC/Mblock	7,68	4,92	64,1%
Combustible Consumption				
Fuel Oil	Ton	4,3	4,26	99,1%
Gasoline	Ton	0,26	0,15	57,7%
Diesel	Ton	0,35	0,16	45,7%

Production on 24.10.00

Beer Production				
	Unit	Programmed	Actual	%
Brewed Beer	Hlt	763,10	711,00	93,2%
Electric Energy	MWh	4,23	1,83	43,3%
Conventional Fuel	TCC	6,48	0,78	12,0%
Conversion Index	MW/MHlt	5,54	2,57	46,4%
Energetic Efficiency	TCC/MHl	8,49	1,10	12,9%
Ice Production				
Ice	Blocks	400	319	79,8%
Electric Energy	MWh	8,46	3,66	43,3%
Conventional Fuel	TCC	3,07	1,32	43,0%
Conversion Index	MW/Mblock	21,15	11,47	54,2%
Energetic Efficiency	TCC/Mblock	7,68	4,14	53,9%
Combustible Consumption				

Fuel Oil	Ton	4,3	0	0,0%
Gasoline	Ton	0,26	0,09	34,6%
Diesel	Ton	0,35	0,02	5,7%

For the energy distribution in this plant , see attached Energy and Water Flow Diagram as well as the single line diagram

The biggest consumer inside this plant is ice factory; it needs more or less twice energy as the brewery.

The power factor regulation is a problem in this company. At the beginning, in 1911, there were installed reciprocate compressors drived by synchronic motors, and with this motors they could control the power factor. Currently those compressors are out of service, an were replaced by screw compressors, drived by induction motors with condenser banks in order to correct the power factor.

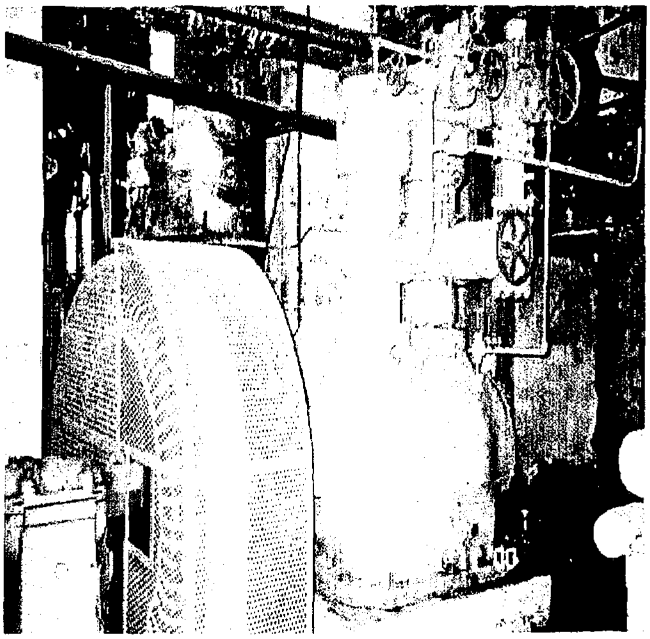


Figure 4-9 Old compressors drived by synchronous motors

5. SHORT DESCRIPTION OF THE MAIN ENERGY PROBLEMS

5.1 El Miño meat factory

Due to the necessity to transport the process and cleaning water, the factory el Miño must assume the water transport costs, situation that would be different if somehow water provision could be obtained by means of an aqueduct. It is necessary to note that from Nov. the 2000 costs of water transport must be assumed in foreign currency.

For the cleaning it is required to use water in different temperatures, which are obtained mixing hot water with cold water; the problem consists that the water provision takes place with different pressures, because while the hot water (85 °C) is 6 bar, the cold water from the storage tank (20 °C) has only 2 bar, when they try to mix them, the hot water invades the cold water pipe until overflow in the storage tank

Figure 5-1 Available water mixer

The provision of electrical energy in the zone is made in a regular way and at the present time power shutdowns are no frequent, only the packing machine is affected during these brief interruptions. Also, the fuel provision to operate the boiler is made without greater difficulties.

In opinion from the operative personnel, at the present time is difficult to make an energy optimization, because this is a new installation that first must reach the production goals that were established during their planning phase; after that an optimization can be undertaken.

About the lighting system, in the zone of production fluorescent lamps have installed, which are turned on and of by the operative personnel according with their necessities. During the visit time, light waste was not established.

Compressed air system. The compressor is working at the moment in very short cycles, reason for which its operation is almost permanent. It´s technical characteristics are:

Model	COMPAIR Cyclon 222 F 165/2388
Year	2000
Max Pressure	8,2
	3,49m³/min
KW	26,1
Motor RPM	3550
	440 V/3/60

It was working as follows:

6 sec ON. The pressure rises from 7,6 to 8,1 bar
23 OFF. The pressure fail from 8,1 to 7,6 bar
The packing machine consumption reaches 1,2 m³/min

Figure 5-2 Air Compressor

As it can be seen, the compressor operation pressure fall near the consumption of the plant, and for this reason its operation becomes very frequent. It would be possible to use an additional storage tank, available in the factory, by means of which, although the times of load of the compressor are extended a little, the pauses of the same one would be also much greater, unloading this the electrical system per longer periods.

It is possible to think about recovering the heat produced by this compressor and by the cooling tower of the refrigeration system and to use this heat to preheat the fed water to the boiler. To have a better idea about the actual heat, it is necessary to much carry out a measurement by several days at the compressor and at this cooling tower, and with the true values of registered thermal energy, evaluate the economic effect of this recovery.

Although the single-wire diagram shows the installed load values of for each circuit, it is worth to carry out a registry of the true consumption of each one during complete production cycles, and to generate consumption indicators by process unit (for example. kW /Processed ton.)

It was not established loss of process water during the visit

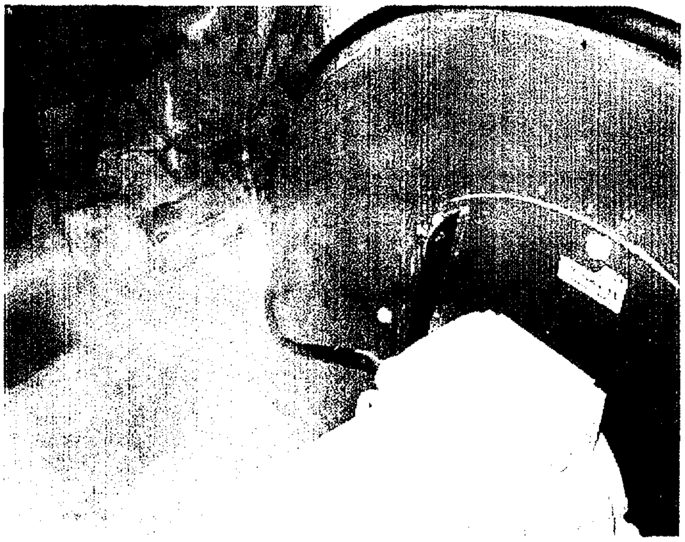


Figure 5-3 Steam losses

There are small steam losses in some seals and valves, caused mainly by lack of spare parts.

There are small losses of compressed air in some seals and valves, caused mainly by lack of spare parts.

The power factor lays between the established range, and then the losses in the electric circuits are maintained at minimum values.

5.2 Cereales Turcios Lima

Energy or production losses

The plant is feed from the same circuit as the refinery located at the end of the feeder; for this reason the voltage is adjusted very high in the substation by the utility, in order to maintain the nominal voltage in the refinery. But in the mill, the distribution voltage reaches 470 – 480 Volt and the transformers are setted at the end of the tap changer. As technical solution new transformers with larger range of control on the LV page were suggested.

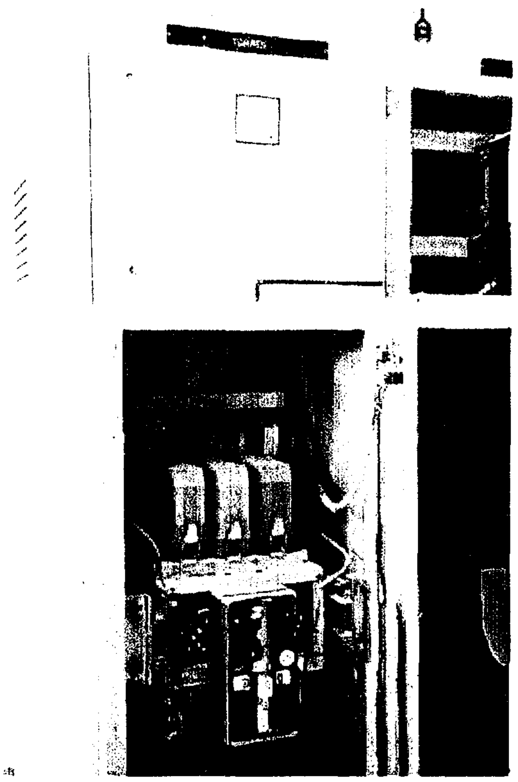


Figure 5-4 Circuit Breaker Cell

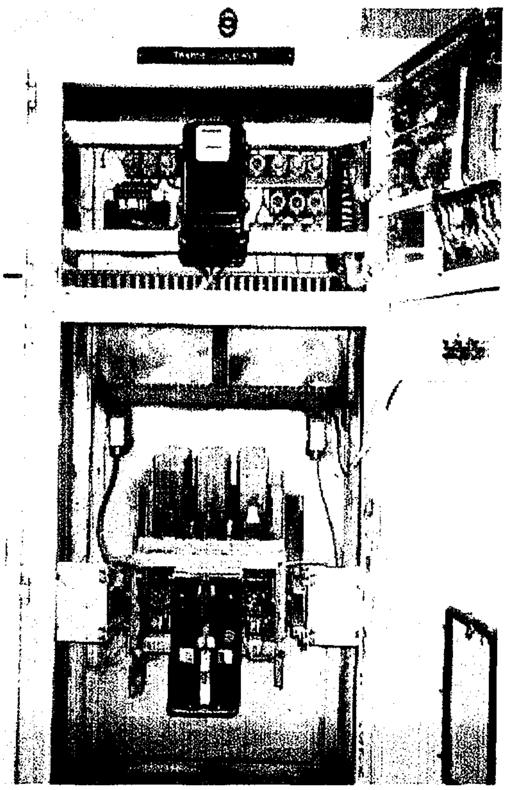


Figure 5-5 View of main Circuit Breaker

For the new installations, they have already ordered all equipment adequate for 480 V, but for the old installation the problem remains.

The protection device of the LV circuit-breakers is out of function. A bus bar was recently destroyed, since no protection disconnection had taken place, when a short circuit was appeared.

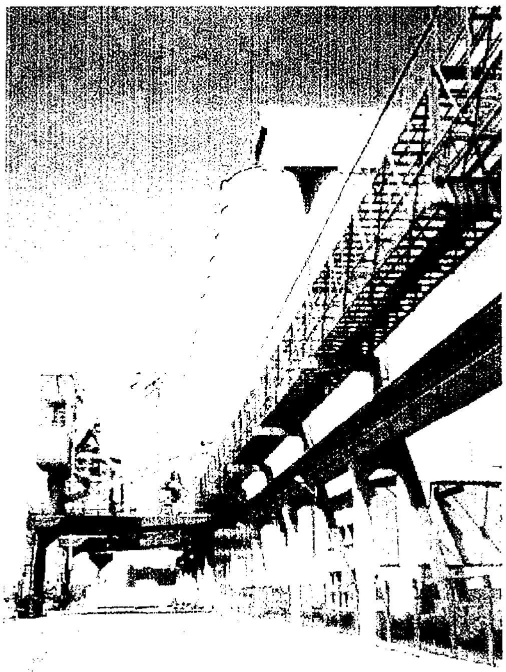


Figure 5-6 The crane feed busses were burn out when a short circuit appeared and the circuit breaker protection remained inoperative

The LV switchgear has an age of approx. 25 years; due to absence of spare parts a maintenance of the system is impossible. It is necessary an immediate maintenance for safety reasons. The technical data of the circuit breaker are: Supplier METRON (splinter); Nominal voltage: 500V; Nominal current: 1600A; Nominally frequency 50/60Hz; disconnection time 30-35 ms, three pole.

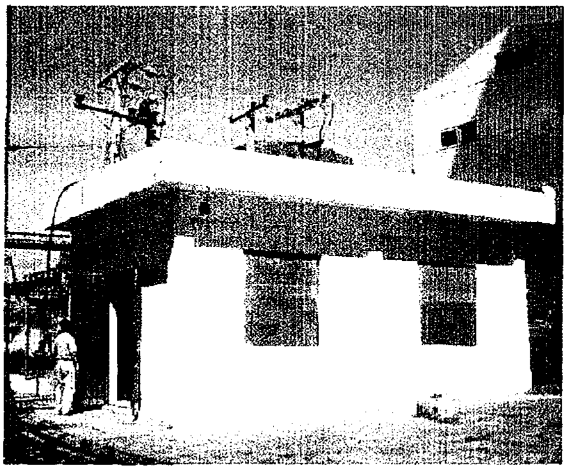


Figure 5-7 Works carried out on the feeding line

They haven't identified loss of energy but they have loss of production caused by disconnections, because the production in all areas depends 100% from electrical supply. Birds produce short circuits in 13.8kV feeder which causes big damages on the feeding lines, that should be repaired by them or by the utility.

Saving Measurements suggested by the Company´s personnel

It should be bought a set of measuring instruments for active and reactive energy (Estimated cost US$10.000) .

It should be purchased a water measuring instrument (Estimated value US$1.200)

They want to do some improvement in the maintenance workshops, but there are no information about scope and costs.

In order to save energy, they plan to carry out the following measurements:

Measurement Description	Estimated yearly saving MWH
To carry out the recycling operations and the mill feeding only at the dawn.	15.6
Not beginning the unloading operations during the peak.	24
At evening, maintain only the necessary illumination, and during the day all luminaries must be out	1.6
Increase in 1% the mill efficiency.	72.2
Maintain a strict control over the lighting system and the air conditioning equipment.	2.8
Total savings estimated	116.2

Measurement of energy flow and other parameters.

Losses

There is no information available over energy or water losses.

According to information obtained from the personnel, the equipment aren't covered for any insurance.

The packing installation has a low efficiency, they are currently working on it in order to put it on a better condition

5.3 Balkan dairy products

Energy or production losses:

The present pasteurization equipment consists of a plate-type heat exchanger for 50.000 lt., but it's current production is only 20.000 lt. That means it works with a very low efficiency. A Plate-type heat exchanger with 10.000 lt capacity is available, but to put it again in service some small components should be bought (a pump about US$ 6.000 and some accessories about 1.200) Additionally, according to the current production process, they are carrying out a double pasteurization process, once when they receive the row milk and again at the end of the whole process.

Supply of cold water:

It is only one station for ice production in operation which works with cold water; in case of failure the entire delivered raw milk must be translated from this plant to another factory. The second ice maker station is out of service, the repair costs amounted to approx. 2.000$.

Transport:

There are big transportation problem in this factory. The efficiency of the Diesel trucks is very low (they reach only 1.8 km/lt.) and the reliability of all trucks is very bad, the additional tow truck is working almost daily going to pick up damaged trucks loaded with row milk or final products, which are exposed to the high existing temperatures without refrigeration.

Steam boiler burners.

Both boilers are approximately 28 years in service and their burners have a very low efficiency; additionally no spare parts are available. A new burner costs US$12.000 approximately

Water supply.

The water supply system consists of two 22 kW pumps (one as reserve) that feed a tank practically at floor level. At the present time its operation is permanent to avoid the frequent start and stop of the pumps, that caused mechanical problems on them, the excess water is returned to the well where it was extracted, with the consequent losses of energy on this process.

Lack in automation:

All activities in this factory must be carried out per hand because there isn't any kind of automation.

Lack in financing:

Formerly, the operation of this plant depended from the Ministry MINAL; today they reached larger independence for operation, that means they should resolve by themselves the finance problems caused when they need to buy row material in foreign currency (packing, spare parts, etc.) for products that they must to sell in their own currency

Water recycling

The cleaning of the containers and process equipment demands an enormous amount of water, which is currently not recycled, at least partially.

Waste water:

In the next three years, they need to build and operate a waste water treatment plant. Currently they are in planning phase, but the financial questions are not resolved.

Consumption in the peak time:

Analyzing the load curve and taking into the consideration the electric energy prices (2,9 pesos/kWh and peak (18-22h) 8,7 pesos/kW), the peak time costs:

Hour			
From	To	Consumption kWh	Value in Pesos
18:00	19:00	118	1026,6
19:00	20:00	104	904,8
20:00	21:00	98	852,6
21:00	22:00	102	887,4
Total cost energy consumed in peak time Daily			3671,4
Total cost energy consumed in peak time Yearly			1,3 Million

5.4 Brewery La Polar

Energy and production losses

The main problems lay by the steam generation and distribution.

The Boiler No. 1 (from Spain) was built in 1996 and uses fuel oil and treated water; a water treatment plant was installed in 1958 and is still in operation. This boiler supplies 10t/h steam with 7 bar steam pressure; the maximum steam pressure reach 10 bar. The efficiency of the steam boiler is not well-known.

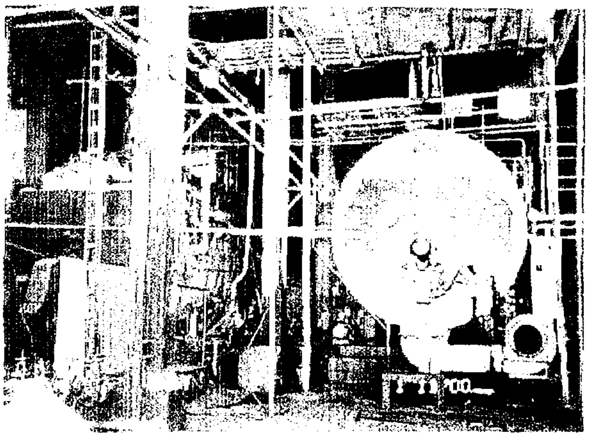


Figure 5-8 Available boiler

The boiler No. 2 (TPK from Yugoslavia) was build in 1978 and at the present is out of service, because of aging reasons and missing spare parts (ceramic isolation blocks, rotary burner, programmable control and instrumentation). They estimate in US$40.000 the necessary amount for components to re-commissioning this boiler.

The condition of the steam and condensate pipes isolation is extremely bad, at present in some small places they are working on renews.

The pipes of the cooling system doesn't have the correct thermal isolation, that losses aren't quantified until now.

The condensating pressure is over 13 ATM, it could be lower if the piping system worked properly.

Some parts of the steam distribution system are being relocated but using the same materials retired from the system.

Approximately 80% of the condensations are led back at present into the steam generation cycle. The remaining 20% goes lost, losing heat and light water with him

The production equipment and beer feeding system in the barrels plant are very old, and of course, they posses very low efficiency levels.

In this factory there is an Ice maker plant, built in 1911, whose containers have big leakages, causing that the clean water mixes the cooling media. Currently this plant produces 375 ton/turn, but it should produce between 500 to 600 ton/turn

Saving measurements Suggested by the Company's personnel:

Carry out the programmed maintenance to the boilers
Improve the boiler's efficiency
Carry out the combustion gas analysis
Take control over the steam pressure in the system.
Insulate all the steam, cold and condense pipe systems
To gauge all the storing pools and tanks
Concentrate the productions

Losses

According to information held in Polar:

Heat losses	463,2 W/m^2
Cold losses	120 W/m
Compressed air losses	1 m^3/h

Those figures were given as approximate values, without the corresponding support. It was no possible to establish the exact value of the energy losses, because there was no equipment to measure the different points where they thing they have the big losses. This is one of the next activities to do in the next time

Power cuts.

The brewery don't have significant problems with power cuts because they posses a double feeding electrical system, but some "administrative " circumstances had caused problems wit electrical energy supply, for example, in October 2000 the supply was cut off because the company don't paid the energy bill. They are paying the bill in foreign currency right now.

Additionally, the leak in spare parts causes delays in the maintenance programs.

There are no problems identified with Fuel supply.

6. RENEWABLE ENERGIE SOURCES FOR ENTERPRISES

6.1 El Miño meat factory

For a plant of this size, located in the urban zone, it is difficult to think about the use of non conventional energy sources. The emphasis must be centered in the diminution of the consumption of power carriers and in the analysis of possible sources of recovery.

So it is the case of the recovery of the heat dissipated in the cooling tower of the cooling system and in the compressor. In that respect, it is recommendable a measurement of the dissipated energy in the mentioned elements towards an evaluation to use this heat for the preheating of the water that feeds the boiler.

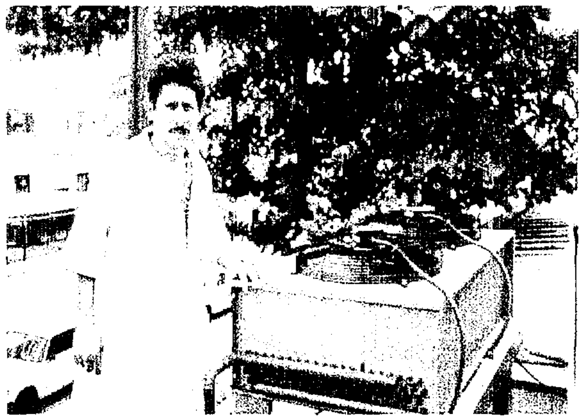


Figure 6-1 Cooling tower

It could be useful to realize a measurement of the sun power and it's daily duration, in order to evaluate the feasibility of introduce a sun heating system to preheat the boiler's water.

6.2 Cereales Turcios Lima

As explained for El Miño, for a plant of this size, located in the urban zone, it is difficult to think about the use of non conventional energy sources; additionally they uses 100 Electrical energy. The emphasis must be centered in the diminution of the power consumption, and perhaps together with the new installation could be useful in the near future to rethink about this concern

6.3 Balkan dairy products

The location of this plant is ideal to install a water heating system with sun energy, to preheat the fed water to the boilers, and a wind drived pump to rise the water to the tank.

For both above mentioned systems is necessary to carry out measurements about the sun and wind power in this place, in order to evaluate the feasibility to use this renewable power sources.

6.4 Brewery La Polar

The energy consumption in this brewery is high and requires a continuos supply, those are hard conditions for a renewable energy source in an urban installation. Although, a sun heating system could be meaningful to preheat the fed water to the boilers, at least during the day. In order to make a detailed evaluation, the sun power and daily duration should be measured

According to information received from plant personnel, It should be considered that in the brewery neighborhood will be soon produced bio-gas that could be used for the new burner together with fuel oil.

7. CONCLUSSIONS AND RECOMMENDATIONS

Generally speaking, it is possible to said that the subject "energy saving" has been working in the industry for some years, having itself obtained until the moment some important results as in the case of the brewery "La Polar", whose reduction as much in kW consumed as in money paid by concept of energy bills is quite significant. In a generalized way, exists the conscience on the necessity of saving, and in an institutional way, diverse plans have been carried out, that have thrown the results before mentioned. Here is important to mention the high interest showed for the personnel from MINAL and from the factories, whose collaboration was very useful in this Fact Finding Mission.

The previous ideas contrasts strongly with the existing possibilities in the different industries, where leak of money prevents to undertake important actions of energy saving; aging of the facilities prevents to reach minimal efficiency levels; the instrumentation deficiency prevents a detailed measurement of the involved variables and with it a pursuit and control on the same ones, and the operation conditions sometimes prevent one better use of the power.

Although for each one of the analyzed companies individual conclusions and recommendations will follow in this chapter, to almost all of them applies in a certain extent some general criteria about the operation of their boilers, and for this reason, we have enclosed in Annex B a compiled Check List about "Measures for Energy Conservation in Boilers". Additionally, an "Energy Audit Model" enclosed in Annex C can help the MINAL to plan their power audits, considering criteria used in developed countries.

On the other hand and taking in mind the availability of the recording equipment provided by UNIDO to MINAL, it could be useful to consider a qualification about his use, so that the personnel in charge carry out the integral diagnoses of power, obtains the greater benefit of his use

7.1 El Miño meat factory

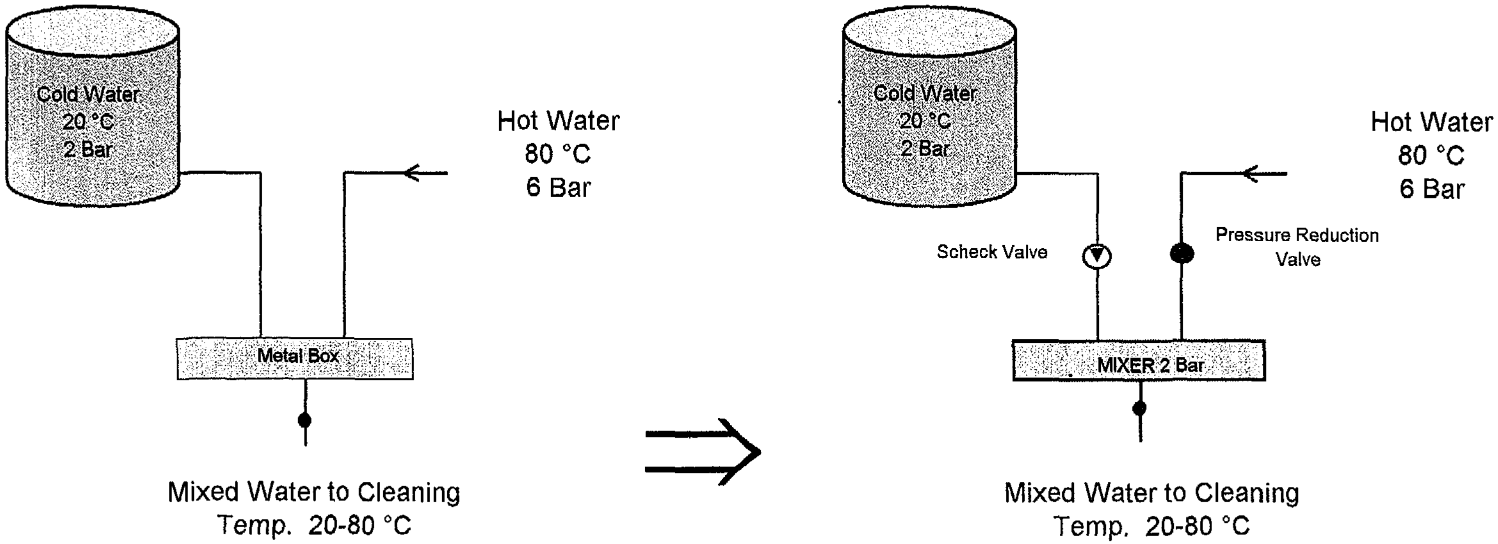
This is a new installation, build with modern technology and hat not yet reached the whole production capacity, for this reason is difficult to evaluate the general plant efficiency; although, it's convenient that the directives in the factory take a direct control about all energy carriers, and develop some efficiency indicators as kWh/production in ton, lt. Water/production, tec.

With the purpose of correcting the water losses due to mixing water with different pressures, it is necessary to introduce in the hot water line a reducing pressure valve and carry out the mixture by means of a mixer in the zone of 2 bars, as shown is in the attached diagram. It is worth to consider the installation of a directional valve (Check Valve) in the supply line of the cold water, with the purpose of eliminating any possibility of return by this conduction and eliminating therefore the losses of water by overflow of the tank

The comment problems about small losses of compressed air and steam should be soon eliminated. Although this installation was re-build a year ago, the pipe insulation shows how was attacked by the humidity caused by these steam leakages.

EL MIÑO MEAT FACTORY

LA HAVANNA - CUBA



Correction to Water Cleaning System

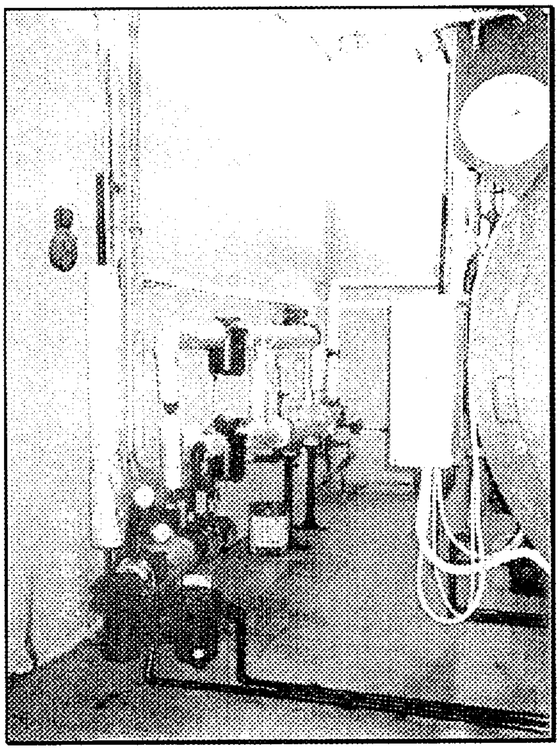


Figure 7-1 Steam Piping isolation

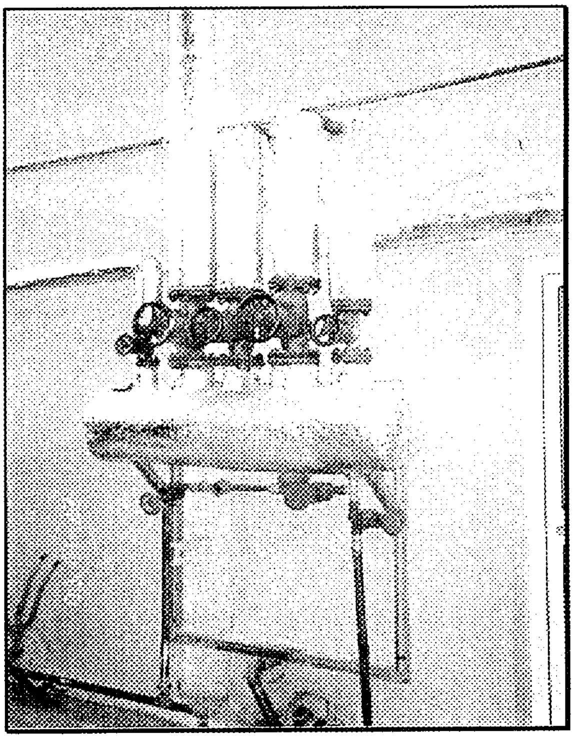


Figure 7-2 Steam Piping isolation

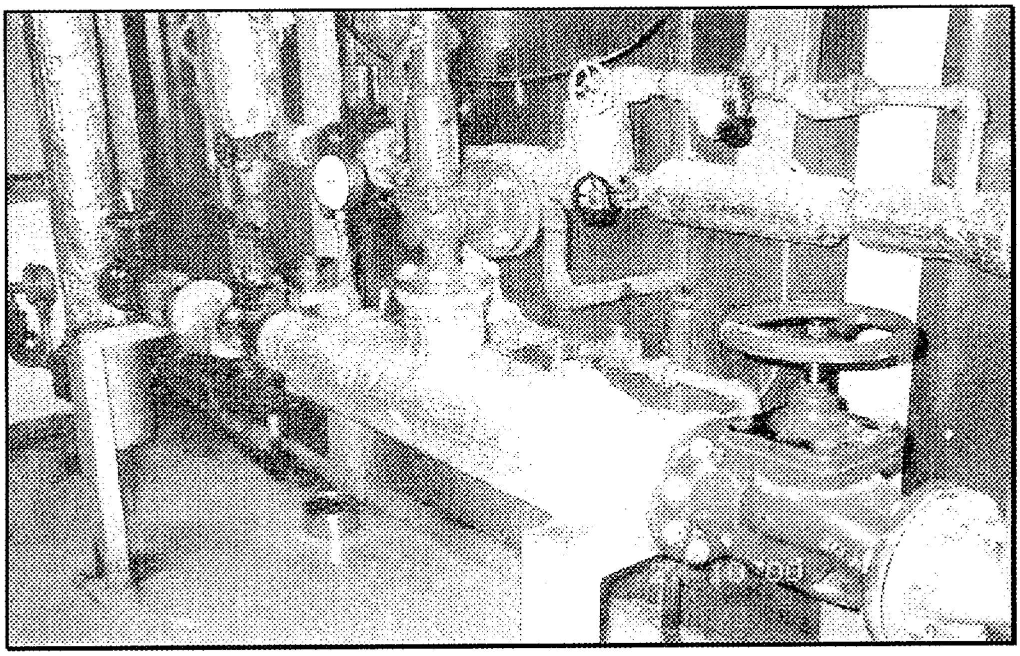


Figure 7-3 Damages caused by steam losses

The company El Miño should insist against the regional authority, represented in the zone of the popular power in El Cerro Area (el Poder popular en la zona de El Cerro), with the purpose of analyzing the possibility of constructing an own well that allows to eliminate the water transport costs.

Additionally, they should go in contact with Unión Eléctrica, who as utility should respond for the adequate voltage level on it's circuits.

7.2 Cereales Turcios Lima

The processes in this plant can be divided in three main groups: unloading, transport and milling.

In the unloading process they have a bottle neck when they are working with only a crane, because the other one is very old an inefficient, it should be replaced with a modern one, whose velocity permits to diminish the unloading time and receive the bonus more frequently. For example, if they had a new unload crane with better capacity, according to the conveyor belts (500 ton/hour), the unloading costs would be reduced substantially. With this capacity, they could unload a 30.000 ton. Vessel in three days, working 20 hours per day (time out of peak price), and the free time could be sold to unload grains for other companies. Additionally, the high efficiency from a new crane contributes to save energy and diminish the bills in order to pay the investment on itself. An economical analysis should be carried out, with real figures about consumption, production and costs, in order to establish it's feasibility.

The conveyor belts for transport are in good condition and work without problem. It's operation is simple and is carried out per hand. An automatically control system could be used, looking for reliability and energy savings because it can set the consumed power in the conveyor belts according to the weight of the transported material, and taking in consideration that the current system is a big consumer.

The milling plant is a new one and works with high automation level reaching a good efficiency level

The spare parts for protection system for the main circuit breakers should be obtained and installed, in order to prevent big problems caused in case of an electrical failure.

The input voltage, current, power factor and water consumption of the different installations should be measured and registered over a longer period of operation. The available information was read from the equipment name plates, which represents only the nominal condition

7.3 Balkan dairy products

The pasteurization process is one of the most inefficient processes in this plant. It's efficiency should be enhanced, repairing and taking again in service the other pasteurizing unit. Additionally, it is necessary to review the whole production process, in order to eliminate the double pasteurization step carried out in the current process.

The current pressure in the cooling system is 12 Bar, it was reduced from 16 to 12 bar reducing the resistance in the conduction with maintenance works. According to the personnel in the factory, it is possible to reduce this pressure to 10 Bar with additional maintenance works. This additional maintenance works should be evaluated and planned, in order to save the corresponding energy.

From the load curve analysis carried out under numeral 5.3 above, it is possible to think in reduce the power consumption at the peak time, stopping the water pumps (two units 22 kW each one), reducing the pressure in the NH3 system and perhaps shutting down some compressors. The peak consumption analyzed costs approximately 1,3 million pesos per year, wit a reduction in this value could Balkan undertake some investments in order to enhance some processes.

An automatic control system with smooth start should be installed to the water supply circuit in order to pump only he water necessary to the process. The start system must guarantee the smooth running of the pumps avoiding mechanical problems

It could be meaningful to buy at least two new trucks with a capacity of 6-7 ton each one, and to plan a general renovation of the trucks for the next five years.

7.4 Brewery La Polar

There is a lack of measuring instruments in the plant, which means they don't know exactly the exact consumption of each equipment/system/process. A set of permanent instruments should be settled in some points of the process (brewing, cooling, ice making, water feeding, etc.) in order to have a permanent control of the energy carriers consumption.

Figure 7-4 Current condition of the electric panels and it's instrumentation

Similarly, it should be useful to measure the boiler's efficiency. They have an estimation of 10 Ton/hour with 9,5 fuel oil and are planning to reduce to 10 Ton/hour with 7,0 fuel oil, but they need the exact instrumentation to measure the involved parameters.

The steam piping isolation and the cooling system piping should be measured, in order to establish priorities which part should be first repaired/renewed.

Because only one boiler is working, the steam generation and distribution system constitutes a narrow bottle neck for this brewery, without it the factory cannot produce any liter of beer. A new boiler should be installed or the old one should be repaired in order to have a reserve for maintenance purposes and for emergency situations.

About the ice plant, here is no information about ice sell prices, but internally should be analyzed the productivity of this ice plant in order to maintain the production or take this part of the plant out of service.

Annex A: Questionnaire used to steering the meetings

Nr.	Tema
1	**Diagrama de flujo de la energía**
2	**Diagrama de flujo del proceso**
3	**Demanda de energía (activa, reactiva, vapor, agua)**
3.1	*Necesidad diaria de energía
3.2	*Necesidad semanal de energía
3.2	*Necesidad anual de energía
4	**Distribución de energía en la planta**
5	**Costos de energía y eficiencia- Costos de la Energía activa y reactiva**
6	**Causas conocidas de las pérdidas de energía/producción**
7	**Sugerencias del cliente**
8	**Recolección de datos sobre los flujos de energía**
9	**Pérdidas**
9.1	Descarga de aguas
9.2	Pérdidas de calor
9.3	Pérdidas de vapor
9.4	Pérdidas de aire comprimido
9.5	Pérdidas originadas por energía reactiva (cos Ø)
9.6	Valoración de las pérdidas
10	**Valoración de acuerdo con los costos de energía**
11	**Medidas a implementar**
11.1	Propuestas y valoración de las soluciones
12	**Seguimiento a las medidas implementadas**
12.1	Comparación de la demanda (antes y despues de las medidas)
12.2	Aumento de la eficiencia en la planta

13	**Resumen del balance energético en las plantas**
13.1	* Uno para energía eléctrica
13.2	* uno para los demás combustibles
14	**Breve descripción de los mayores problemas energéticos que se han presentado en los últimos 12 meses**
14.1	*cortes de energía
14.2	*suministro de combustible?
14.3	*pérdidas de calor?
14.4	*facturación de la energía?
15	**Cuál sería la fuente de energía renovable que contribuiría de mejor manera a la reducción de los problemas y qué se necesita para implementarla?**
15.1	* Bagaso
15.2	* Biogas ?
15.3	* Solar ?

Annex B: Measures for Energy Conservation in Boilers

Load Reduction

Insulation of steam lines and distribution system

Insulation of condensate lines and return system

Insulation of heat exchangers

Insulation of boiler or furnace

Repair steam leaks

Repair failed steam straps

Return condensate to boiler

Reduce boiler blowdown

Improve feed water treatment

Repair condensate leaks

Shut off steam tracers during the summer

Shut off boilers during long periods of no use

Eliminate hot standby

Reduce flash steam loss

Install stack dampers or heat traps in natural draft boilers

Replace continuous pilots with electronic ignition pilots

Waste Heat Recovery

Utilize flash steam

Preheat feed water with an economizer

Preheat make-up water with an economizer

Preheat combustion air with a recuperator

Recover flue gas heat to supplement other heating system, such as domestic or service hot water, or unit space heater

Recover waste heat from some other system to preheat boiler make-up or feed water

Install a heat recovery system on incinerator or furnace

Install condensation heat recovery system with indirect contact heat exchanger

Install condensation heat recovery system with direct contact heat exchanger

Efficiency Improvement

Reduce excess air

Provide sufficient air for complete combustion

Install combustion efficiency control system with constant excess air control

Install combustion efficiency control system with minimum excess air control

Install combustion efficiency control system with optimum excess and CO air control

Optimize loading of multiple boilers

Shut off unnecessary boilers

Install smaller system for part-load operation (for summer loads)

Install smaller system for part-load operation (satellite boiler for remote loads)

Install low excess air burners

Repair or replace faulty burners

Replace natural draft burners with forced draft burners

Install turbulators in firetube boilers

Install more efficient boiler or furnace system (high-efficiency, pulse combustion, or condensing boiler or furnace system)

Clean heat transfer surfaces to reduce fouling and scale

Improve feed water treatment to reduce scaling

Improve make-up water treatment to reduce scaling

Fuel cost reduction

Switch to alternate utility rate schedule (interruptible rate schedule)

Purchase natural gas from alternate source, self procurement of natural gas

Fuel switching - switch between alternate fuel sources

Fuel switching - install multiple fuel burning capability

Fuel switching - replace electric boiler with a fuel-fired boiler

Switch to a heat pump - use for supplemental heat requirements

Switch to a heat pump - use for baseline heat requirements

Other opportunities

Install variable speed drives on feed water pumps

Install variable speed drives on combustion air fan

Replace boiler with alternative heating system

Install more efficient combustion air fan

Install more efficient combustion air fan motor

Install more efficient feed water pump

Install more efficient feed water pump motor

Install more efficient condensate pump

Install more efficient condensate pump motor

Dipl. Ing. Reinhrad ENZENEBNER
Dipl. Ing. Carlos HENAO

ANNEX C ENERGY AUDIT

SITE :____________________________ **DATE:**__________

AUDITOR:____________________________

Fundamental issues shaded, these have to be graded 1 or higher to pass

1. ENERGY USE IN THE BUILDING AND IN PRODUCTION

	Audited issue	*Best practice*	*Good practice*	*Minimum practice*	*Failure*	Grade	Weighting factor	
	Building characteristics	3	2	1	0			
1	Measures have been taken to minimize uncontrolled ventilation (tightness of building envelope)	Measures have been taken to a reasonable extent to minimize uncontrolled ventilation	Measures are being planned to minimize uncontrolled ventilation	Some attention has been paid to uncontrolled ventilation	No attention has been paid to uncontrolled ventilation		1	
2	Measures have been taken to minimize heat loss through structures (insulation level of building envelope) Energy using systems, production and activities	Measures have been taken to a reasonable *extent to* minimize heat loss	*Measures are* being planned to minimize heat loss	Some attention has been paid to heat losses through the building envelope	No attention has been paid to even remarkable heat losses through the building envelope		1	
3	The maintenance for HVAC and electrical and production supply systems is regular and systematic	Systematic and regular maintenance in use, maintenance activities are documented	Systematic and regular maintenance in use	Systematic maintenance in use, activities not regular	No systematic maintenance, only repairing activity		2	

4	The maintenance for the production machinery is regular and systematic	Systematic and regular maintenance in use, maintenance activities are documented	Systematic and regular maintenance in use	Systematic maintenance in use, activities not regular	No systematic maintenance, only repairing activity		2	
5	Energy saving rneasures suggested in the energy audit report have been Implemented	Even energy saving investments have been made	All no-cost energy saving measures have been implemented	Some no-cost energy saving measures have been implemented	No energy saving measures implemented		3	
6	The staff is familiar with the principles of energy efficient operation	The staff is well familiar with the principles of energy efficient operation	The staff is somewhat familiar with the principles of energy efficient operation	The staff knows something about the principles of energy efficient operation	The staff knows nothing about the principles of energy efficient operation		2	
7	The maintenance staff is familiar with the principles of the HVAC and electrical systems	The staff is well familiar with the principles of the HVAC and electrical systems	The staff is somewhat familiar with the principles of the HVAC and electrical systems	The staff knows something about the principles of the HVAC and electrical systems	The staff knows nothing about the principles of the HVAC and electrical systems		3	
8	The maintenance staff monitors the heating and ventilation systems regularly	Monitoring is regular and unusual operating values are dealt with Immediately	Monitoring is regular	Monitoring is irregular	Only faults are repaired, no monitoring activity		1	

9	The method for heat production has been optimized	The present heat production Method is the optimal solution	Comparing calculations have been made, no actions taken	The matter has been recognized, no actions taken	No attention has been paid to heat production		1	
10	The electricity purchase has been Optimized	Electricity purchase has been Optimized	Alternatives for tariffs have been studied	The present tariff and its components have been studied	No actions taken		2	
11	The losses of heat production and distribution have been minimized in the present heating system	All possible actions have been taken to minimize the losses of the present system	Actions are being planned to minimize the losses of the present system	The matter has been recognized, no actions taken	No attention has been paid to the losses of the present system		2	
12	The indoor climate is appropriate for the activity and production in the building	The indoor climate is appropriate for the activity and production in all areas	One minor defect	One major defect or several minor defects	The indoor climate is improper for the activity and production in large areas		3	
13	The ventilation systems are appropriate for the activity	The ventilation systems are appropriate for the activity	Actions have been taken to improve the present system	The matter has been recognized, no actions taken	The ventilation system is not appropriate for the activity		2	

14	The ventilation operating times are in control (time switches or systematic procedure)	The operating times are in control and correspond to actual need	The operating times are mainly in control but there is some need for improvement	The uncontrolled operating times have been recognized and improvements are being planned	The operating times are not in control, there is no responsible person of systematic procedure		2	
15	The capacity of the ventilation systems is controlled according to actual need	The ventilation capacity always corresponds to actual need	Improvement of the capacity control has been started	The need for improving the capacity control has been recognized	There is no possibility for capacity control in the ventilation System		2	
16	The operating values (temperature, air flow, pressure, humidity) of the ventilation systems are appropriate and in control	The operating values of the ventilation systems are appropriate and correspond to actual need	The operating values are mainly in control but there is some need for improvement	The uncontrolled operating values have been recognized and Improvements are being planned	The operating values are not in Control		2	
17	Room temperatures are appropriate when production is running and when production is off	Room temperatures are appropriate	Room temperatures are mainly in control but there is some need for improvement	The uncontrolled room temperatures have been recognized and improvements are being planned	Room temperatures are not in control, there are great variations in all conditions (production on and off)		1	
18	Temperatures are measured and monitored regularly	Temperatures are measured regularly and unusual values are dealt with immediately	Measuring and monitoring of temperatures is regular	Temperatures are measured occasionally	Temperatures are not measured of monitored		1	

19	The production supply systems correspond to actual need	The supply systems are appropriate for the need	Improvement of the supply systems has been started	The need for improving the supply systems has been recognized	The supply systems are not A adequate of technically suitable for the present need		1	
20	The maintenance staff monitors the production supply systems and their use regularly (compressed air, steam, etc)	Monitoring is regular and unusual operating values are dealt with immediately	Monitoring is regular	Monitoring is irregular	Only faults are repaired, no monitoring activity		1	
21	The water consumption is in control and there are no leaks or uncontrolled use	Water consumption is in control and there are no leaks	Excessive use of water has been dealt with but there is some need for further improvement	The uncontrolled use of water has been recognized and Improvements are being planned	No attention paid to the use of water		2	
22	The water using equipment and fittings are maintained regularly	Systematic and preventative maintenance in use	Leaks and faults are repaired immediately	Leaks and faults are repaired when time allows	No reaction to leaks or faults		1	
23	Additional electrical heating is used only where needed	Additional electrical heating is not used or used only where needed	Some measures have been taken to reduce the use of additional heating	The uncontrolled use of additional heaters has been recognized and improvements are being planned	No attention paid to the use of additional electric heaters although there are more economic means for heating		1	
24	The lighting levels are sufficient for the activity in the building	The lighting levels are appropriate for the activity and production in all areas	One minor defect	One major defect of several minor defects	The lighting levels are improper for the activity and production in large areas		3	

25	The lighting systems (lamp types and lighting controls) are appropriate for the activity and production	The lighting systems are appropriate for the need	Improvement of the lighting systems has been started	The need for improving the lighting systems has been recognized	The lighting systems are not adequate or technically suitable for the present need		2	
26	The use of lighting and the lighting Levels correspond to actual need	The use of lighting and the lighting levels always correspond to actual need	Improvement of the use of lighting and lighting controls have been started	The need for improving the use of Lighting and lighting control has been recognized	The use of lighting and the lighting levels are not in control		2	
27	The production machinery is energy efficient	Attention has been paid to the machinery when new equipment is purchased, energy metering has been installed	Energy use for production is monitored	Some attention has been paid to the subject	Old equipment not energy efficient, the consumption for production has not been monitored		2	
	The weighting factor describes the importance of the issue in terms of energy use, regarding also the effects on indoor conditions and environment 1 = quite important issue; 2 = important issue; 3 = very important issue The Issues are marked with Index letters and running numbers. F = fundamental issue which has to be graded with a 1, E = energy reiated issues, M = energy and environmental management issue							

2. ENERGY AND ENVIRONMENTAL MANAGEMENT							
	Audited issue	*Best practice*	*Good practice*	*Minimum practice*	*Failure*	Grade	Weighting factor
	Principles for management	3	2	1	0		
1	Policy: Continuous improvement is the target in energy and environmental issues	Continuous improvement leads the activities in the company	The principle of continuous improvement is included in company policy but does not lead to actions	The principle of continuous improvement has been recognized, first steps have been taken	The principle of continuous improvement has not been recognized		3
2	Targets: the company has set approved targets for energy use and environmental issues	Systematic procedures for energy and environment exist	Systematic procedure exists either for energy or for environment	Individual activities have been made for improving energy efficiency and environment	Targets exist but no systematic procedures have been drafted		1
3	Program: a systematic program is followed in order to reach the targets	Systematic procedures for energy and environment are in use in every day activities	Systematic procedures are followed with exceptions	Systematic procedures are being planned	No systematic procedures exist		2
4	The company has all the environmental permits and licenses required for its production and operation	The company obeys its environmental permits, environmental reporting works	The company obeys its environmental permits, environmental reporting is being developed	The company does not know environmental responsibilities or its the license has not yet been granted	Environmental licenses are not valid or the activity does not correspond to the existing licenses		2

5	The company operates following the environmental laws Organization and staff	The company obeys the environmental laws	The company is working to fulfil all items in the environmental law	The company knows the contents of the environmental laws	The company does not know the of contents of the environmental laws		2
6	There is a responsible person for energy issues	A responsible person has been appointed and he takes care of his duties	A responsible person has been appointed but his duties are not clear	Some attention has been paid to the issue, no responsible person appointed vet	No responsible person appointed		3
7	There is a responsible person for environmental issues	A responsible person has been appointed and he takes care of his duties	A responsible person has been appointed but his duties are not clear	Some attention has been paid to the issue, no responsible person appointed vet	No responsible person appointed		2
8	*There is* a responsible maintenance person for the HVAC, electrical and production supply systems, taking care of the operation, functioning and regular maintenance of the systems	A responsible person has been appointed and he takes care of his duties	A responsible person has been appointed but his duties are not clear	Some attention has been paid to the issue, no responsible person appointed yet	No responsible person appointed		2
9	The responsible persons for energy and environmental issues know their tasks and follow orders and instructions given	Responsible persons have been appointed and they follow the given instructions	Responsible persons and instructions exist, the activity has just been started	Responsible persons have been appointed and their instructions are being developed	Responsible persons have been appointed but there are no instructions yet		3

10	The staff is trained systematically in energy and environmental issues Information activities	Training is systematic	Training is irregular	Training is negligible and irregular	There is no training		2
11	Information about energy and environmental issues is given systematically inside the company	Informing is systematic	Information is irregular	Information is negligible and irregular	Information is not given		1
12	Information about energy and environmental issues is given systematically to the public	Informing is systematic	Information is irregular	Information is negligible and irregular	Information is not given		1
13	Instructions have been given for activities and operations related to energy use	There are written instructions for all energy using activities in the company	Separate instructions on different activities are being collected into a handbook	Instructions have been made for the most important energy using activities	There are no instructions for any energy using activities		2
14	Instructions have been given for activities and operations with environmental impacts	There are written instructions for all environment related activities in the company	Separate instructions on different activities are being collected into a handbook	Instructions have been made for the most important activities with environmental impacts	There are no instructions for any activities with environmental impacts		2

15	A rough energy balance has been Made for the company	A rough energy balance has been made in an energy audit	An energy balance is being done	The importance of an energy balance has been recognized and the matter is being worked on	No attention has been paid to the energy balance		2
16	Monitoring of consumptions and production characteristics is systematic	Monitoring is regular and unusual values are dealt with immediately	Monitoring is regular	Consumption figures are recorded irregularly	There is no monitoring for energy use		3
17	Monitoring of waste and emissions is systematic	Monitoring and reporting is regular and unusual values are dealt with immediately	Monitoring is regular, reporting on monthly basis	Monitoring is regular, reporting on yearly basis	There is no monitoring for waste or emissions		1
18	Environmental laws, permits and reports are filed systematically and can be found easily	Environmental laws, permits and reports are filed systematically	Filing system for environmental laws, permits and reports is being improved	Permits and reports have to be collected from various sources and places	No filing of environmental data		2
19	Monitoring information (energy, waste, emissions and production) is filed, updated and processed systematically	Monitoring information is filed, updated and processed systematically	Monitoring information is filed systematically	Monitoring information is filed, updated and processed irregularly	No systematic procedures exist for filing monitoring information		2

20	Drawings and technical documents are filed and can be found easily	Drawings and technical documents are filed and can be found in the company	Most important drawings and technical documents are filed and can be found in the company	Drawings and technical documents have to be collected from various sources and places	No documents or drawings available		1
Management of emergency situations							
21	Instructions exist in case for a sudden fire or environmental accident	Written instructions exist and the staff has been trained	There are written instructions for some accidents	Written instructions are being made	No instructions exist		1
22	Near-miss-situations with environmental impacts are analyzed and documented for future improvements	Situations are documented and analyzed and improvements made to prevent similar accidents in future	Situations are documented and Improvements looked for	The procedure is being developed	No procedure for near-miss- situations, only accidents documented		2
Waste management							
23	Sorting of waste is in use (metal, glass, Paper, cardboard, etc)	Sorting of waste is in use and works efficiently	Sorting of waste works on a rough level	Hazardous waste is sorted	No waste sorting		1

24	Hazardous waste is handled, sorted, stored and disposed of according to regulations	Hazardous waste is handled according to regulations	Hazardous waste is mainly handled according to regulations, improvements are possible	Problems related to hazardous waste have been recognized, procedure is being developed	Hazardous waste is not handled according to regulations		2
25	Dangerous chemicals and other materials are handled and stored according to regulations	Dangerous chemicals and other materials are handled according to regulations	Dangerous chemicals and other materials are handled according to regulations, improvements are possible	Problems related to dangerous materials have been recognized, procedure is being developed	Dangerous chemicals and other materials are not handled according to regulations		2
	The weighting factor describes the Importance of the issue In terms of energy use, regarding also the effects on indoor conditions and environment 1 = quite Important issue.; 2 = important issue; 3 = very important issue The Issues are marked with Index letters and running numbers. F = fundamental issue which has to be graded with a 1, E = energy related issues, M = energy and environmental management issue						