PD-ABP-529

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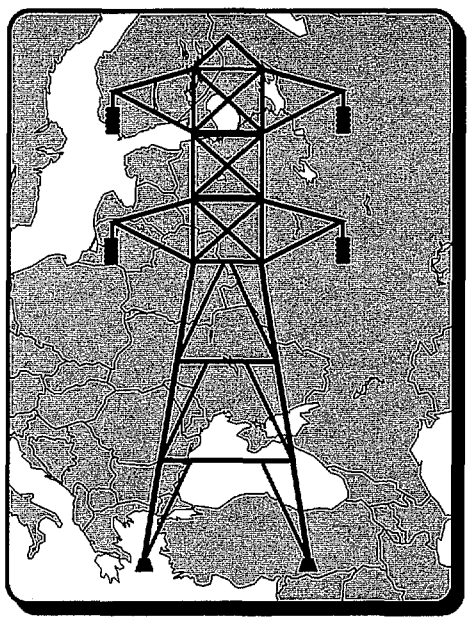
Central and Eastern Europe Regional Energy Efficiency Project EUR-0030-C-00-2053-00



Energy Pricing, Energy Efficiency, and Energy Sector Restructuring Component

Final Report
December 1996

Volume XV

Prepared for:
U.S. Agency for International Development
Bureau for Europe and NIS
Office of Environment, Energy, and Urban Development
Energy and Infrastructure Division

Prepared by:
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CONTENTS

Volume I
Baltics: Assistance to EBRD on Project Development
Baltics: Lithuania DSM/IRP
Baltics: Equipment Procurement

Volume II
Baltics: Electric Power Contracting and Pricing
Regional: Invitational Travel and AEE Conference - 1992
Regional: Invitational Travel and AEE Conference - 1993

Volume III
Regional: Invitational Travel and AEE Conference - 1994
Regional: Invitational Travel and AEE Conference - 1995

Volume IV
Regional: Invitational Travel and AEE Conference - 1996
Regional Energy Efficiency Conference Hungary, 1995

Volume V
Follow-Up to Emergency Industrial Energy Efficiency
Regional Support to AEE Chapters

Volume VI
Regional: CEM Training Program
Poland: Energy Restructuring

Volume VII
Poland: DSM

Volume VIII
Poland: Private Power/Legal
Poland: Electricity Tariffs
Poland: IRP
Poland: Power Pricing

Volume IX
Poland: World Bank Support
Bulgaria: Electricity Action Plan

Volume X
Bulgaria: Energy Efficiency Market Development

Volume XI
Bulgaria: Equipment Procurement
Bulgaria: Private Power
Bulgaria: Energy Legal/Regulatory
Slovakia: ESCO Development & EPC Financing

Volume XII
Hungary: Energy Efficiency Market Development

Volume XIII
Hungary: Energy Office
Hungary: Equipment Procurement

Volume XIV and Volume XV
Romania: Energy Efficiency Market Development

Volume XVI
Romania: Equipment Procurement
Macedonia: Industrial Energy Efficiency
Macedonia: Private Power

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT- ROMANIA

ENERGY EFFICIENCY MARKET DEVELOPMENT

VOLUME II

FINAL ENERGY AUDIT REPORTS

Prepared by:

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4

FINAL ENERGY AUDIT REPORTS -ROMANIA

TABLE OF CONTENTS

TAB 1	Borsa City Hospital	Vasile Grasin, Georgeta Padureanu, ECO-ERG Tehnologie Service, S.R.L.
TAB 2	Danubiana, S.A.	Florin Mihailescu, Camigo, S.R.L.
TAB 3	Matizol, S.A.	Mihail Zdravcu, Arcon, S.R.L.
TAB 4	Mobins, S.A.	Florin Mihailescu, Camigo, S.R.L.
TAB 5	Muha, S.R.L.	Haralambie Pavel, Invest Proiect, S.R.L.
TAB 6	Stirom Glass Factory	Mihail Zdravcu, Arcon, S.R.L.
TAB 7	Terapia, S.A.	Vasile Grasin, Georgeta Padureanu, ECO-ERG Tehnologie Service, S.R.L.
TAB 8	Vega, S.A.	Simona Parvu, Automatizari Orion, S.R.L.

1. INTRODUCTION

The Energy Efficiency Market Development (EEMD) project has been implemented in Bulgaria, Hungary and Romania as part of the USAID's Regional Energy Efficiency Project. Its primary objective has been to encourage the development of a market for an energy efficiency industry in these countries, and to foster the development and capabilities of local private firms to serve this market. This project has included training for private energy efficiency entrepreneurs, demonstration projects, and support to the development of technical and commercial ties between the US and Eastern Europe.

2. ACTIVITIES

2.1 Training of Energy Services Firms

Local private sector energy service companies went through a competitive selection process based on the criteria of entrepreneurial spirit and commitment to the private sector; interest in energy efficiency consulting; technical expertise; and, regional diversity. They were provided a 3-4 week training program which included topics of energy auditing, energy efficiency technology, industrial production quality programs, financial analysis and business practices for consultants. They were also administered the AEE Certified Energy Manager examination (CEM) by AEE representatives, and are now certified.

2.2 Energy Audits

The local CEMs marketed in each country their services to industrial companies. The USAID program then selected 8-10 plants in each country that had agreed to sign a contact with the local consultants and pay these consultants a market-based fee for an energy audit. The plant selection criteria also required the plants to be willing to cost-share the installed equipment, to provide installation and to make the results of the demonstration project available. Replicability of potential measures to other plants in the same industry and to other industries was also considered. Hagler Bailly consultants spent about one week in each plant to train the CEMs in energy auditing techniques, provide advice, and decide on a package of equipment for the demonstration projects. Assistance continued on subsequent visits to finalize the equipment specifications.

2.3 Demonstration Projects

Based in part on the recommendations of the energy audits, some projects were selected as demonstrations. Competitiveness was also part of the selection, based on a criteria including payback, replicability, and the ability to showcase US equipment. US-made energy efficiency equipment was provided to the participating industrial plants. These plants were responsible for providing ancillary local equipment, installing and commissioning the equipment. The local consultants also designed and implemented monitoring and evaluation programs to assess the actual costs and benefits of the demonstration projects.

3. DOCUMENTS

3.1 Advisory Reports

The energy audit advisor reports assembled in Volume I represent work Hagler Bailly Consulting energy efficiency experts conducted as advisors to the local consultants.

3.2 Final Audit Reports

Volume II contains the final audit reports which represent the work conducted by the local consultants.

3.3 Monitoring Reports

Volume III contains the monitoring and evaluation reports prepared by the local consultants.

7

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- ROMANIA

FINAL ENERGY AUDIT REPORT

for work at

Borsa City Hospital

by

Vasile Grasin, CEM

Georgeta Padureanu, CEM

ECO-ERG Tehnologie Service, S.R.L.

for

Hagler Bailly Consulting, Inc.

8

ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	BORSA CITY HOSPITAL
Address	1, FLOARE DE GOLT STREET
	BORSA CITY, MARAMURES DISTRICT
	ROMANIA
Telephone	40-(0) 62-433916
Fax	40-(0) 62-433916
Contact Person	DR. DANIEL BARGAN
Title	GENERAL MANAGER
Telephone	40-(0) 62-433916

2. Energy auditor information

Dates - audit started: OCTOBER 1993 audit completed: Jan.-Febr.1994

Energy audit company	S.C. "AGO-ERG" TEHNOLOGIE SERVICE S.R.L.
Energy audit team leader	DIPL. ENG. VASILE GRASIN, C.E.M. NUCL. PHYS. GEORGETA PADURSARU, C.E.M.
Address	26, ANTON PANN STREET
	3400 CLUJ NAPOCA ROMANIA
Telephone	40-(0)64-194208
Fax	40-(0)64-194208

9

3. Energy audit information

Energy audit focus - describe the major tasks, or areas of the plant, which were investigated during the energy audit:

THE ENERGY AUDIT WAS FOCUSED ON THE PRODUCTION, DISTRIBUTION AND UTILIZATION OF THE THERMAL AND ELECTRICAL ENERGY, AS "BASE LINE" FOR THE ENERGY DIAGNOSIS AND TO IMPROVE THE ENERGY EFFICIENCY.

Energy efficiency - in the energy auditor's opinion, what were the most significant findings of the energy audit:

- IN THE BOILERS'HOUSE THERE ARE NO FUEL METTERS AND THERMAL ENERGY METTERS
- INFFICIENT BURNING OF THE STEAM BOILERS AND HOT WATER BOILERS DUE TO THE ABSENCE OF A GAS ANALYZER IN THE BOILERS'HOUSE
- LOW EFFICIENCY OF THE BOILERS DUE TO THE FACT THAT THE FUEL IS NOT PREAHEATED AND THE QUALITY OF THE FUEL IS DIFFERENT IN TIME, EVEN WHEN PROVIDED BY THE SAME SUPPLIER
- LOW EFFICIENCY OF THE STEAM BOILERS DUE TO THE FACT THAT ALL THE CONDENSATE IS WASTED AND THE FEED WATER FOR STEAM BOILERS IS NOT PREAHEATED
- THERE ARE A LOT OF THERMAL ENERGY WASTED BY THE BUILDING DUE TO UNINSULATED WALLS AND WINDOWS
- MONEY LOSSES DUE TO AN INEFFICIENT SYSTEM OF ELECTRICAL ENERGY METTERING SYSTEM
- AN INFFICIENT LIGHTING SYSTEM

New experience - in the energy auditor's opinion, what were the most significant lessons learned during the energy audit:

- SYSTEMS AND EQUIPMENTS FOR CONDENSATE RECOVERY
- THE WAY TO QUANTIFY THE WASTED ENERGY AND TO ESTABLISHE THE S.P.P.(SIMPLE PAYBACK PERIOD)
- THE WAYTO WORK WITH PERFORMANT MEASUREMENT INSTRUMENTS
- THE WAY TO WORK WITH STATISTICAL DATA
- NEW TECHNOLOGIES FOR WALLS AND WINDOWS INSULATIONS
- NEW POSSIBILITY TO IMPROVE THE BURNING EFFICIENCY (EKOBIK SYSTEM)
- NEW LIGHTING SYSTEMS

10

4. Energy savings

List the energy efficiency measures ALREADY IMPLEMENTED, during the course of the audit (if any): FUEL PRICE AT ACHIEVEMENT DATE

Description of measure	Fuel saved	Savings/units	Payback
1. THE IMPROVEMENT OF BURNING	10,689 l/y	2.245 mill. lei /year	0.93 years
EFFICIENCY BY EQUIPING ABA BOILER WITH A FUEL ECONOMIZER TYPE EKA		/year	years
0.5G(ECONOMIZER PRICE 2,100,000lei)		/year	years
1.221 $.THE ECONOMIZER IS IN THE FIRST 1,000 HOURS OF FUNCTION ,IN THIS PERIOD OF TIME THE ECONOMIZER HAVING AN IMPORTANT ROLE IN THE SELF CLEANING OF FIRE TUBES		/year	years
REDUCING IN THIS WAY THE MAINTENANCE COST.		/year	years
2. BORSA CITY HOSPITAL BOUGHT THE RUBBER INSULATION FOR WINDOWS,		/year	years
HALF OF ALL NECESSARY,IN FUNCTION OF THEIR BUDGET.		/year	years
3. BORSA CITY HOSPITAL BOUGHT ONE FLO RITE TEMP. MODEL 535 TYPE ARMSTRONG, TO PREPARE HOT DOMESTIC WATER FOR ONE SECTION OF THE HOSPITAL.			

11

4. Historical production and energy consumption

1. Summarize the recent production and energy consumption at the plant in physical units (also list the type of units per year, i.e. tons/year, kwh/year, etc.):

YEAR	1990	1991	1992	1993	UNITS
PRODUCTION:					
STEAM	-	-	-	9,904.533	GJ/Y
DELIVERED HEAT	-	-	-	10,632.4	GJ/Y
ENERGY					
HEAVY FUEL OIL:	942,000	827,700	920,500	780,475	l/Y
ELECTRICITY:	791.2	770	894	934	MWh/Y

5. Historical energy costs

Summarize the recent energy cost at the plant, for the base year of the audit and following years, in terms of money per year:

Year:	lei/ 1990	lei/ 1991	lei/ 1992	lei/ 1993	lei/ UNITS
heavy fuel oil:	131,880,000	115,878,000	128,870,000	109,266,500	140 lei/l (3 = 0.922
diesel fuel oil:					
natural gas:					
coal:					
electricity:	54,579,000	53,130,000	61,689,000	64,446,000	69 lei/kwh
steam:					
other (describe):					

6. Previous actions

Describe any other projects which resulted in improved energy efficiency that have already been implemented (or are already funded and in-progress), but which were not identified in the energy audit. Describe the project, the source of the idea, the approximate cost of implementing the project, and the source of funding:

1. It is necessary to improve the energy efficiency by using U.V. sterilization recirculation pumping systems for the swimming pool -to save the energy which is necessary to heat this water. The source of idea was AQA ~~DEA~~ an italian company, who works under USA licence. The energy efficiency is due by the fact that the water is not changed periodicly and heated (daily), only recirculated to be sterilized.
2. To get a proper source to reduce the cost of water needs.

13

7. Detailed forms - required

Complete and attach the following forms:

Fuel, steam, or heat energy consumption - 12 month audit period
(complete for each major fuel type for areas studied)

Steam generation - 12 month audit period (if plant has boiler)

Energy balance - fuel, steam or heat

Electric energy consumption - 12 month audit period

Electric energy generation - 12 month audit period (if plant has generator)

Energy balance - electrical

Action plan - summary of energy efficiency project opportunities

Recommended action - energy efficiency opportunity
(complete one for each recommended action)
(attach additional details if required to justify project)

8. Narrative

Provide any other information which would be useful to USAID and RCG/Hagler Bailly:

The romanian so called heavy fuel has varying characteristicsfor,even when provided by the same supplier,because it is not possible to analyse the fuel composition at the reception of the charge.Only the supplier emits the so called "qualitate certificate",in which the composition of the fuel is mentioned,but in reality this composition varies.

8.1. OBSERVATIONS : REFERING TO STEAM GENERATION

1. Bor City's Hospital Boilers' House has not any fuel metters
2. The Physical Consumption is just estimated to be use for preparing the so call "technological" steam
3. The steam consumption is considered to be a daily constant (it is used aprox. 10 hours daily)
4. Simillary, the fuel consumption is considered to be a daily constant (with aprox. 89 kg/h = 96.5 l/h average fuel consumption)
5. We estimated the hesteontent of fuel considering the monthly fuel consumtion and the physical heat content of fuel added to the chemical heat content of fuel (for ex. $Q_{phys} = 89 \times 1.74 \times 21 = 3252.06$ kJ/h

   $Q_{chem} = 89 \times 39{,}152.55 = 3{,}484{,}576.9$ kJ/h

   $Q_{phys} + Q_{chem} = 3.4878$ GJ/h)
6. We estimated only the cost of fuel consumption for steam generation, because we did not found relevant statisticals informations refering to others costs (for trated water, water price,...)
7. The cost of fuel is calculated at the price of 140 lei/l, as it was at the tim corresponding to the end of audit
8. The production index presented is the specific heat consumption for one tone steam produced by ABA boiler
9. The steam boiler efficiency was calculated and has an average value η_t =76.9
10. The estimated average value for steam generation is 986 kg/h at 5.5 bar, with an average corresponding enthalpy 2,752.1 kJ/kg
11. The whole generated steam it is use like "technological" steam by Hospital, for sterilization, hot-tables for food, laundry...)
12. All the condensate is wasted
13. The fuel is not preheated (the fuel temperature is 21°C)
14. The feed water is not preheated (the feed water temperature is max.11° C)
15. The Boilers' House has not any combustion analyzer and that's the reason why there are energy losses with burnt gases and a low burning efficiency (the losses with burnt gasese are aprox. 23.4% from the entire thermal energy entered in energy balance)

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15

16. In the Boilers' House there are two steam boilers type ABA 1t/h (one in function and one is reserve).

17. We proposed some measures to reduce energy losses and, in the same time to improve the boiler's efficiency:

17.1 To improve burner efficiency it is necessary to have and to use a combustion analyzer

17.2 It is necessary to preheat the fuel with a fuel preheater

17.3 It is necessary to recover the condensate by using performent steam traps and to return the condensate to the Boilers' House, to be use like feed water for the steam boiler

17.4 To reduce the fuel consumption and the cost of maintenance we recommended to use a fuel economizer, an EKOBIK system

17.5 We recommended to equip each ABA boiler with fuel metters, for a good adjustment of consumption and boilers' load

17.6 It is necessary to moniterize the fuel consumption

17.7 It is necessary to moniterize the steam production and consumption

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1. Borşa City Hospital Boilers' House does not have energy metter for hot water mettering

2. The fuel consumption to prepare the hot water with a CIMAC type hot water boiler is estimated usingg the datas from the audit report

3. The thermal consumption is refering only to the estimated heat content of fuel

4. The fuel consumption is considered to be like an hourly average consumption (399 kg/h = 432.75 l/h)

5. We estimated the heat content of fuel considering the physical heat content of fuel added to the chemical heat content of fuel (for ex. :

Q_{phys} = 399 x 1.74 x 21 = 14,579.46 kJ/h

Q_{chem} = 399 x 39,152.55 = 15,621,867.45 kJ/h

$Q_{phys} + Q_{chem}$ = 15.636 GJ/h)

6. The fuel consumption (or the heat content of fuel) does not cover the heating demand (needs) of this hospital,because Borşa City's Hospital budget was to small to cover the whole demand (needs) of this Hospital

7. We estimated only the fuel cost (for heating) for the sames reasons like for the fuel cost for steam,at the same price (140 lei/l)

8. The delivered heat by Boilers' House,for heating, was established considering an average value for recirculated water (135 t/h),with an average value of $\Delta t = 19^{\circ}C$ corresponding to ΔH = 79.54 KJ/Kg and considering the monthly hot water boiler's hours of function (for expl:

The delivered util heat ,Q_u, is:

135,000 kg/h x (318.13 -238.54) kJ/kg= 10,744,650 kJ/h = 10.745 GJ/h

The monthly estimated delivered heat is Q_u x monthly hours)of function (t_f)

9. Hospitals real heating demand is 9,185 GJ/h added to 4.93 GJ/h for make up water (14.115 GJ/h compared to 10.745 GJ/h generated by the CIMAC boiler)

10. For money economy reasons,and budgeterism,the hot water boilers are working at aprox. half (1/2) of nominal heating capacity (10.745 GJ/h compared to 12.56 GJ/h)

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11. The hot water boiler efficiency (estimated average value is $\frac{10,632.4}{15,472.6} \times 100 =$ 68.72% ,compared to 88% nominal boiler efficiency

12. The fuel is not preheated

13. We established that the walls,doors and windows do not have insulations

14. We proposed some measures to improve boiler's efficiency:

14.1 It is necessary a heat energy metter to adjust the boiler's load

14.2 It is necessary to equip the boiler with two fuel metters,one on the turn of fuel piping system,and another one,on the return of fuel piping system

14.3 We recommended to equip each boiler with a fuel preheater

14.4 To improve boiler's efficiency it is necessary to use a combustion analyzer

14.5 To reduce the fuel consumption and the cost of maineneance it is necessary to equip the boiler with a fuel economizer (EKOBIK system)

14.6 To reduce the thermal energy losses it is necessary to improve the walls, doors and windows insulations

14.7 It is necessary to monitorize the fuel consumption and the delivered heat

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8.3 OBSERVATIONS REFERING TO ALECTRIC ENERGY AUDIT

1. Is very difficult to follow the daily electric consumption due by the fact that all electric energy metters are RENEL's property. The electric energy metters are in a closed place and the Hospitals employees have no acces without RENEL's empoyees

2. The losses in electric meters are great due by the fact that the maintenance operations are not done just in time (the maintenance operations are refering to the electric meters' and actionated equipments' maintenance).
There are not used the recommended lubricants and there is not used ,in time, the replacement of used pieces with new ones.

3. The lighting systems are not efficient due by the fact that in use are more incandescent lamps,with 75W and a lot of functions hours.

4. We proposed a few measures to improve the electric energy efficiency :

4.1. To change the actual system of billing by changing the actual contract with electricity supplier (RENEL BAIA_MARE) with an other,better one,based on the monitorizing energy consumptions.

4.2 To replace the actual energy metters with other performant systems ,equiped with time switcher and data logging,to permite monitorize the electric consumptions.

4.3 To replace the actual lighting systems (incandescent and fluorescent) with performant lighting systems.

4.4 To improve the maintenance activity,beeing known that is one way to reduce th mechanical losses in meters.

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19

FUEL, S[illegible] OR HEAT ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
ENERG[illegible]E: STEAM produced by ABA steam boiler (fuel typ[illegible]03)
Prepared for USAID and RCG/Hagler Bailly

Plant name: Berş a City Hospital, Maramureş District, Romania
Address: 1, Floare de Colţ Str.

Auditor's name: S.C. "ECO-ERG" Tehnologie Service S.R.L.

Report date:

Supply contract terms:

Fuel or [illegible] supply company's name	Ploieşti Refinery
Contract maximum demand:	
Minimum charge (cost):	
Other:	

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM):

Bills Reading Mo/day/yr	Physical Consumption units = l/month	Thermal Consumption GJ	Total Cost lei/month	Fuel estim. for steam generation	Fuel heat content for steam	Estim. cost of fuel for steam gen.	Degree-Days HDxGJ	Util steam heat cont. Q u	Heating Index GJ/HDD	Product. Index GJ per: tone of steam	Notes on plant conditions and changes
Jan/31/93	29,915	1,081.218	4,188,100				841.207			3.537	
Feb/28/"	27,02	976.584	3,782,800				759.8			-"-	
Mar/31/93	29,915	1,081.218	4,188,100				841.207			-"-	
Apr/30/93	28,95	1,046.34	4,053,000				814.071			-"-	
May/31/93	29,915	1,081.218	4,188,100				841.207			-"-	
Jun/30/93	28,95	1,046.34	4,053,000				814.071			-"-	
Jul/31/93	29,915	1,081.218	4,188,100				841.207			-"-	
Aug/31/93	29,915	1,081.218	4,188,100				841.207			-"-	
Sep/30/93	28,95	1,046.34	4,053,000				814.071			-"-	
Oct/31/93	29,915	1,081.218	4,188,100				841.207			-"-	
Nov/30/93	28,95	1,046.34	4,053,000				814.071			-"-	
Dec/31/93	29,915	1,081.218	4,188,100				841.207			-"-	
TOTAL 93	352,225	12,730.47	49,311,500				9,904.533				

US$

Note: Heating degree-days based on reference temperature of ____C

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PE.7

20

COMMENTS:

Fuel characteristics $0.912 < \rho < 0.924$ kg/dm^3 (density)

for $\rho = 0.922$ kg/dm^3 the specific heat constant, C_{pc},

$C_{pc} = 1.74$ KJ/Kg°C

Fuel composition : carbon, $C^i = 87.02$ %

hydrogen, $H^i = 9.5$ %

sulphur, $S^i = 0.98$ %

oxygen, $O^i = 2$ %

humidity, $W^i = 0.5$ %

$H_i = 39,152.55$ KJ/Kg

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FUEL, S[illegible] OR HEAT ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
ENERG[illegible]E: HOT WATER prepared by CIMAC type hot water boil[illegible]
Prepared for USAID and RCG/Hagler Bailly

Plant name: Borşa City Hospital
Address: 1,Floare de Colţ Str.,Borşa City,Maramureş District,Romania

Auditor's name: S.C."ECO-ERG" Tehnologie Service S.R.L.

Report date:

Supply contract terms:

Fuel or heat supply company's name ~~xxxx~~	Ploiesti Refinery
Contract maximum demand:	
Minimum charge (cost):	
Other:	

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM):

~~Meter Reading~~ Mo/day/yr	Does not exist ~~xxxx~~ Physical Consumption units =1/month	Fuel estim. for heating content (used) Thermal Consumption GJ	Fuel cost (estim.) for heating Total Cost lei/month	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index GJ per util GJ	Q u (util GJ)	Notes on plant conditions and changes
Jan/31/93	63,564	2,296.7	8,898,960	688	3.338	1.455	1,578.2	
Feb/28/93	63,657	2,300.1	8,911,980	689	-"-	-"-	1,580.6	
Mar/31/93	49,151	1,775.7	6,881,140	532	-"-	-"-	1,220.2	
Apr/30/93	38,342	1,385.4	5,367,880	415	-"-	-"-	952	
May/31/93	34,092	1,231.8	4,772,880	369	-"-	-"-	846.5	
Jun/30/93	-	-	-	182	-	-	-	
Jul/31/93	-	-	-	101	-	-	-	
Aug/31/93	-	-	-	26	-	-	-	
Sep/30/93	26,701	964.8	3,738,140	289	-"-	-"-	663	
Oct/31/93	42,684	1,542.2	5,975,760	462	-"-	-"-	1,059.8	
Nov/30/93	45,179	1,632.5	6,325,060	489	-"-	-"-	1,121.8	
Dec/31/93	64,858	2,343.4	9,080,120	702	-"-	-"-	1,610.3	
TOTAL 93	428,228	15,472.6	59,951,920	4,944			10,632.4	
				412 average value				

Note: Heating degree-days based on reference temperature of 18C

Page 8

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22

STEAM GENERATION – 12 MONTH AUDIT PERIOD
Prepared for US[redacted]RCG/Hagler Bailly

Plant name: 1[redacted] City Hospital
Address: ,Floare de Colt Str,Borşa City,Maramureş District,Romania
Auditor's name: S.C. "ECO-ERG" Tehnologie Service S.R.L.
Report date:

Boiler characteristics:

	Steam boiler	Hot water boiler		
Name/number	ABA 1/2 rezerve	CIMAG 5		
Manufacturer	Termorom Cluj			
Type (firetube/watertube)	fire tube			
Type (saturated/superheated)	saturated			
Capacity (tons/hour)	1 tone/hour	3 GCal/hour		
Year installed:	1984			
Nominal efficiency Year last major overhaul:	90%	88%		
Operational? (yes/no)	Y	Y		
Steam pressure:	nominal 8 bar working 5.5 bar			
Steam temperature:	155°C	hot water temp. 115°C		
Stack temperature, after economizer:	222°C	152°C		
Stack gas analysis: percent O2	8.6%	11.8%		
Combustion efficiency: burning eff.	87.6%	88.6%		
Blowdown analysis: dissolved solids PPM	1,200			
Nominal fuel consumption	70.9kg/h	360 kg/h		

STEAM GENERATION DATA FOR 12-MONTH AUDIT PERIOD:

	STEAM GENERATION BY PLANT					IMPORTS	STEAM SALES AND DISTRIBUTION TO CONSUMERS:							NOTES
Meter Reading Mo/day/yr	Fuel Consumption GJ	Steam Generation tons	Steam Generation GJ	Monthly Efficiency %	Steam Purchased GJ	GJ	GJ	GJ	GJ	GJ	GJ	Losses & Unaccounted GJ	Unusual Operating conditions
Jan/ 3193	1,081.22	305.66	841.21	77	–	841,207							
Feb/ 2803	976.6	276.08	759.8	–"–		759.8							
Mar/ 3193	1,081.22	305.66	841.21	–"–		841.207							
Apr/ 3093	1,046.34	295.8	814.07	–"–		814.071							
May/ 3193	1,081.22	305.66	841.21	–"–		841.207							
Jun/ 3093	1,046.34	295.8	814.07	–"–		814.071							
Jul/ 3193	1,081.22	305.66	841.21	–"–		841.207							
Aug/ 3193	1,081.22	305.66	841.21	–"–		841.207							
Sep/ 3093	1,046.34	295.8	814.07	–"–		814.071							
Oct/ 3193	1,081.22	305.66	841.21	–"–		841.207							
Nov/ 3093	1,046.34	295.8	814.07	–"–		814.071							
Dec/ 3193	1,081.22	305.66	841.21	–"–		841.207							
TOTAL 93	12,730.47	3,598.9	9,904.533			9,904.533							

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23

ENERGY TYPE: STEAM

Prepared for USAID and RCG/Hagler Bailly

Plant name: Borşa City Hospital

Address: 1,Floare de Colţ Str.,Maramureş District,Romania

Auditor's name: S.C."ECO-ERG" Tehnologie Service S.R.L.

Report date:

Item No.	Equipment or Process Description	Nominal Maximum Load units: tone/h	Average Load units: tone/h	Load at Peak Demand units: tone/h	Energy Consumption units: GJ /year (BY HEAT CONTENT OF GENERATED STEAM)	Total Energy Cost LEI /year (ONLY THE FUEL COST)
1	STEAM BOILER TYPE ABA 1tone/hour (2 pieces; 1in function,1 reserve)	1	0.79	0.98	9,904.533	49,311,500
TOTAL PEAK DEMAND						
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)						

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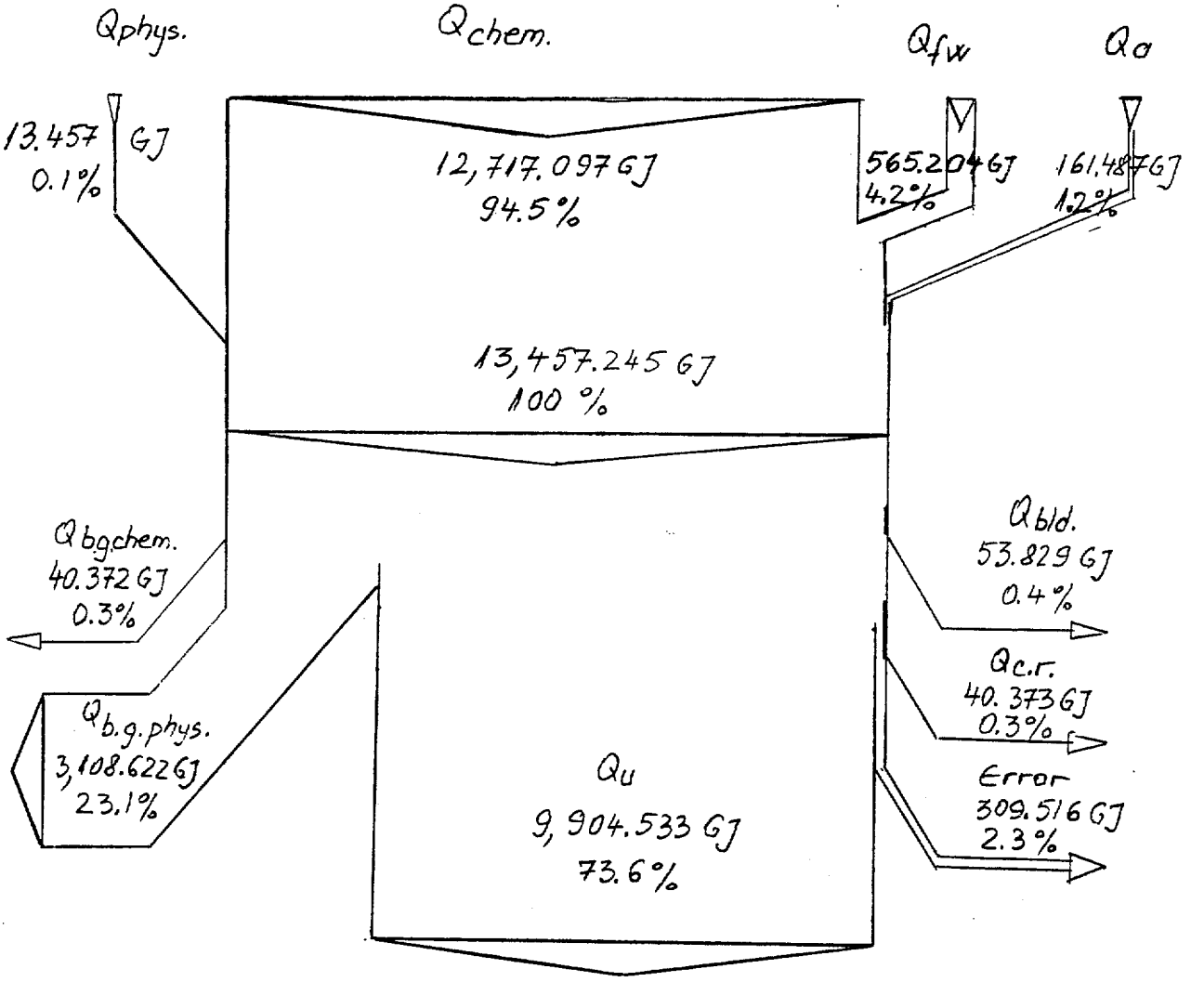
ENERGY BALANCE FOR STEAM GENERATION BY FOS STEAM BOILER
(ESTIMATED FOR 1993)



LEGEND: Qphys. – Fuel's physical heat content
Qchem. – Fuel's chemical heat content
Qf.w – Feed water's heat content
Qa – Combustion air's heat content
Qb.g.chem. – Burned gases' chemical heat content
Qb.g.phys. – Burned gases' physical heat content
Qu – Generated steam's heat content (util heat)
Qbld. – Blowdown's heat content
Qc.r – Heat losses due to convection and radiation

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25

ENERGY TYPE: HOT WATER

Prepared for US[redacted] RCG/Hagler Bailly

Plant name: B[redacted] City Hospital

Address: 1,Floare de Colț Str.,Borșa,Maramureș District,Romania

Auditor's name: S.C."ECO-ARG" Tehnologie Service S.R.L.

Report date:

UTIL HEAT CONTENT OF HOT WATER

ONLY THE FUEL COST

Item No.	Equipment or Process Description	Maximum Load units: GJ/h	Average Load units: GJ/h	Load at Peak Demand units: GJ/h	Energy Consumption units: GJ /year	Total Energy Cost LEI /year
1	HOT WATER BOILER TYPE CIMAC (2pieces: 1 in function and 1 reserve).In addition there exist an other hot water boiler type C5D,which is not in use,due to his very low efficiency.	12.56 (3GCal/hour)	10.745 (2.57 GCal/h)	12.56 (3GCal/hour)	10,632.4	59,951,920
TOTAL PEAK DEMAND						
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)						

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Pg.11

BOILER (ESTIMATED FOR 1993)

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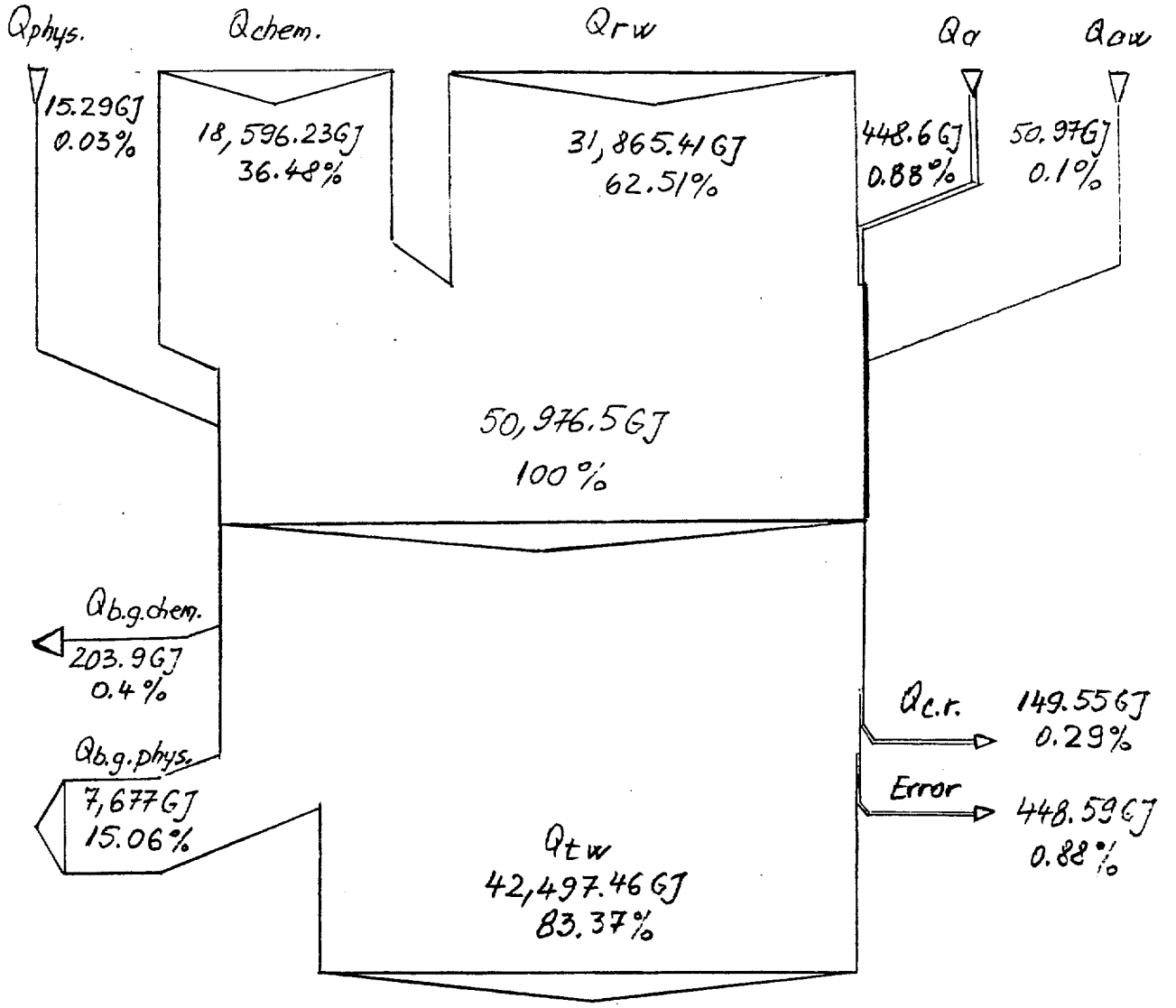

LEGEND:

- $Q_{phys.}$ – Physical heat content of fuel
- Q_{chem} – Chemical heat content of fuel
- Q_{rw} – Returned (recirculated) water heat content
- Q_a – Heat content of combustion air
- Q_{aw} – Added water heat content
- $Q_{b.g.chem.}$ – Burned gases chemical heat content
- $Q_{b.g.phys.}$ – Burned gases physical heat content
- Q_{tw} – Generated hot water (turn water) heat content
- $Q_{c.r.}$ – Heat losses due to convection and radiation
- $Q_u = Q_{tw} - Q_{rw}$ (util heat)

ELECTRIC ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
Prepare SAID and RCG/Hagler Bailly

Plant name: Borşa City Hospital
Address: 1, Floare de Colţ Str., Borşa, Maramureş District, Romania

Auditor's name: S.C. "ECO-ING" Tehnologie Service S.R.L.

Report date:

Electricity contract terms:

Electricity supply company's name	RENEL BAIA-MARE
Contract maximum demand (kW):	120
Minimum charge (cost):	
Other:	

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD:

Meter Reading Mo/day/yr	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Power Factor cos 0	Load Factor	Total Cost	Product. Index kWh per:	Notes on plant conditions and changes
Jan/ 3193 / /	100,000	defect reactive power meter	120	–	–		6,900,000		
Feb/ 2893 / /	80,000		–"–	–	–		5,520,000		
Mar/ 3193 / /	98,000	20,000	–"–	–	0.98		6,762,000		
Apr/ 3093 / /	76,000	34,000	–"–	–	0.91		5,244,000		
May/ 3193 / /	68,000	30,000	–"–	–	0.91		4,692,000		
Jun/ 3093 / /	76,000	34,000	–"–	–	0.91		5,244,000		
Jul/ 3193 / /	64,000	defect reactive power energy meter	–"–	–	–		4,416,000		
Aug/ 3193 / /	40,000		–"–	–	–		2,760,000		
Sep/ 3093 / /	72,000	38,000	–"–	–	0.88		4,968,000		
Oct/ 3193 / /	82,000	32,000	–"–	–	0.93		5,658,000		
Nov/ 3093 / /	84,000	32,000	–"–	–	0.92		5,796,000		
Dec/ 3193 / /	94,000	40,000	–"–	–	0.92		6,486,000		
TOTAL	934,000	260,000					64,446,000		

Peak demand during audit period (kW): –

pg. 2

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28

ELECTRIC ENERGY GENERATION – 12 MONTH AUDIT PERIOD
Prepared for U[illegible]nd RCG/Hagler Bailly

Plant name: B[illegible] City Hospital
Address: 1,Floare de colt Str.,Borşa,Maramureş District,Romania

Auditor's name: S.C."ECO-ERG"Tehnologie Service S.R.L.

Report date:

Generator characteristics:

Name/number	GTA 125/400TS/1	It is installed just for emergency situations.In 1993 it was not necessary to be used.		
Manufacturer	POLAND			
Capacity (kW):	125			
Year installed:	1 984			
Year last major overhaul:	–			
Drive type (steam, gas, diesel)	DIESEL			
If steam – Condensing/extraction/backpressure	–			
Operational? (yes/no)	Yes			

GENERATION DATA FOR 12-MONTH AUDIT PERIOD:

	SELF-GENERATION BY PLANT				SOLD TO OTHERS:				PURCHASED FROM OTHERS				NOTES
Meter Reading Mo/day/yr	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Unusual Operating conditions
Jan/__/__													
Feb/__/__													
Mar/__/__													
Apr/__/__													
May/__/__													
Jun/__/__													
Jul/__/__													
Aug/__/__													
Sep/__/__													
Oct/__/__													
Nov/__/__													
Dec/__/__													
TOTAL													

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Prepared [redacted]ND and RCG/Hagler Bailly

Plant nam[redacted]orşa City Hospital

Address: 1,Floare de Colţ Str.,Borşa,Maramureş District,Romania

Auditor's name: S.C."ECO-ERG"Tehnologie Service S.R.L.

Report date:

Item No.	Equipment or Process Description	Connected Load kW	Maximum Load kW	Average Load kW	Load at Peak Billing Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost lei/year
1	All electric consummers are connected to a distribution point ,located in the area of the Hospital,equiped with two transformers:	530.4	220	112.5	-	934,000	64,446,000
	- 630 KVA 20/0.4 KV - in function						
	-400 KVA 20/0.4 KV - in reserve						
2	The main electric consummers are:						
	- electric meters	234.3					
	- medical equipments	228.4					
	- lighting	67.7					
3	Energy balance for the electric consummers:						
	3.1 USEFUL ELECTRIC ENERGY: 704,236 KWh 75.4%						
	3.1.1 in meters : 259,652 -"- 27.8%						
	3.1.2 medical equipment : 233,500 -"- 25.0%						
	3.1.3 lighting : 211,084 -"- 22.6%						
	3.2 ELECTRIC ENERGY LOSSES: 229,764 -"- 24.6%						
	3.2.1. in cables : 2,802 -"- 0.3%						
	3.2.2. in meters copper : 23,350 -"- 2.5%						
	3.2.3. mechanics and ferrous losses of meters : 203,612 -"- 21.8%						
	TOTAL YEARLY electric consumption : 934,000 -"- 100.0%						
TOTAL PEAK DEMAND (equals maximum billing demand)							
TOTAL ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)						934,000	64,446,000

(69lei/kWh

ACTION – SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES
Prepared by: AID and RCG/Hagler Bailly

Plant name: BAIA CITY HOSPITAL
Address: 1, FLORAR DE GOLT STR., MARAMURES DISTRICT

Auditor's name: S.C. "ASO-ENG" TEHNOLOGIE SERVICE S.R.L.

Report date:

BASELINE – EXISTING CONDITIONS

NO METERING SISTEMS FOR ELEC AND HEAT CONSUMPTIONS	FUEL Consumption l/y	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost $ /year
BASE CASE	780,453				934,000	122,112

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS:

Action No.	Action Description	FUEL Consumption l/y	FUEL NET reduction l/y	Water net reduction m³/y	Electric Peak Demand kW	Electric Energy Consumption kWh/year	El. en. net reduct kwh/y	Total Energy Cost $ /year	Action Project Cost	Action Payback Period (years)	Net energ. reduct $/y	%
1.	To adjust the steam and hot water boilers' burning efficiency by a combustion analyzer	755,999	24,454			934,000		120,122	1,250	0.65	1,990	1.63
2.	To change the steam trays and to return the condensate to the steam boilers	730,307	25,692	2,555		934,000		118,031	1,541	0.73	2,091	1.71
3.	To equipe the boilers' house with metering systems as: fuel meters for steam boilers, fuel meters for hot water boiler, steam meter for steam production, hot water meter for hot water boiler	606,020	124,287			934,000		107,915	11,070	1.14	10,116	8.28
6.	To install a fuel preheater for steam boiler	591,420	14,600			952,250	(18,150)	106,870	1,965	2.2	1,045	0.86
7.	To equipe the hot water boiler with a fuel preheater and a fuel economizer	561,444	29,976			970,052	(17,802)	103,848	14,842	0.9	3,022	2.48
8.	To change the generation system of hot domestic water with ARMSTRONG FLORITE SYSTEM	304,557	256,887			970,052		71,153	30,164	0.94	32,695	26.78
4.	To replace the actual lighting systems(incandescent ones)	~~304,557~~	~~256,887~~			898,414.3	71,637.7	68,279	5,168	1.15	2,874	2.35
5.	To monitorize the electric energy consumptions and to change the actual billing system	~~304,557~~	~~256,887~~		122,826	775,579.3	122,835	57,459	4,092	0.4	10,820	8.86
	TOTAL	304,557	475,896	2,555	122,826	775,579.3	194,472.7	57,459	70,092	1.08	64,653	52.95
TOTAL SAVINGS			475,896				194,472.7	57,459	70,092	1.08		
SAVINGS AS PERCENTAGE OF BASE CASE			41.74				11.21					

Note: Assumes that the actions are taken in order of best payback period first, in order to take into account the interaction between the various measures

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 1

Plant name: Borşa City Hospital
Address: 1,Flearo de Colţ Str.,Borşa,Maramureş District,Romania

Auditor's name: S.C."ECO-ERG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: ADJUSTMENT OF BURNING EFFICIENCY

AREA OF THE PLANT AFFECTED: BOILERS' HOUSE

FINDINGS CONCERNING EXISTING CONDITIONS:

IT DOES NOT EXIST COMBUSTION ANALYZER

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

- To achieve a combustion analyzer (type FYRITE II) for Boilers' House
- To instruct the operators to work with this type of analyzer and to make daily adjusments of burning efficiency

A. ABA boiler's yearly fuel consumption : 352,225 l/y
ABA steam Boiler's efficiency (as it was at 9/02/94);87.6% (measured with gas analyzer type Bacharach model 300)
ABA steam boileradjusted burning efficiency : 91%

B. CIMAC hot water boiler's yearly consumption : 428,228 l/y
CIMAC hot water boiler's burning efficiency (as it was at 9/02/94) : 88.6%
CIMAC hot water boiler's expected burning efficiency :91%

C. Fuel cost : 140 lei/l

D. Expected fuel economy : 1. for ABA steam boiler: $352,225 \times \frac{91 - 87.6}{91} \times 140 = 1,842,408$ lei/y
2.for CIMAChot water boiler: $428,228 \times \frac{91-88.6}{91} \times 140 = 1,581,150$ lei/y
3.Total fuel economy:3,423,560lei/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam total l/y	Fuel ABA l/y	Fuel CIMAC l/y	FUEL Total cost Mill. lei/year
Baseline –existing conditions for ABA&CIMAC boilers			780,453	352,225	428,228	109.263
After recommended action			755,999	339,065	416,934	105.840
Net reduction			24,454	13,160	11,294	3.423 aprox (a) 1,990$

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE.	Cost (million lei)	Notes
Engineering design	–	
Equipment procurement	2.150 (1,250 $ x1,720 lei/$)	
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	2.150 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	0.1 (c)	

PAYBACK PERIOD:

$$\frac{b: 2.150}{a: 3.423 - c: 0.1} = 0.647 \text{ years} = 7.8 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

32

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 2

Plant name: Borşa City Hospital
Address: 1,Floare de Colţ Str,Borşa, Maramureş District,Romania

Auditor's name: S.C. "ECO-ERG" Tehnologie service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To change the steam traps,to recover and to return the condensate

AREA OF THE PLANT AFFECTED: The Hospital and the Boilers' House

FINDINGS CONCERNING EXISTING CONDITIONS: The existing steam traps are not in use and the condensate recovering system is not in function.All the condensate is wasted.

RECOMMENDED ACTIONS: To replace the existing steam traps with Armstrong steam traps
To put in function the condensate recovering system
To insulate the condensate pipelines and condensate tank

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

A. ABA steam boiler yearly fuel consumption:352,225 l/y;Fuel price:140 lei/l yearly hours of function:3,650 h/y;feed water consumption: 990l/hx3,650h/y=3,613.5te/y feed water temperature:11°C;heat content of generated steam:9,904.533GJ/y; fuel heat content(chem &phys) : 12,730.47 GJ/y;feed water heat content: 166.415 GJ/y;ABA steam boiler thermal efficiency: $\frac{9,904.533}{12,730.47-166.415}$ x100 =78.83 %

B. Insalling the steam traps the expected condensate return rate,considering to be more than 12 % normal wastes (aprox. 29%)is: 990 l/h -290 l/h= 700l/h =.7 te/h at 90°C with 381.15 KJ/Kg enthalpy; Expected feed water heat content will be: 290 kg/hx3,650h/yx11°C x 4.1876 KJ/Kg°C + 700 Kg/hx3,650 h/y x 381.15 KJ/Kg = 1,022.586 GJ/y;Expected ABA stea boiler efficiency (thermal) : $\frac{9,904.533}{12,730.47-1,022.58}$ x100= 84.58 %

C. Expected fuel economy:
$352,225 \frac{84.58-78.83}{78.83}$ =25,692l/y x140lei/l=3,596,880 lei/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	FUEL l/y	WATER te/y	million lei/year
Baseline –existing conditions			352,225	3,613.5	49.6945
After recommended action			326,533	1,058.5	45.8268
Net reduction			25,692	2,555	3.8677 (a)

COST–BENEFIT ANALYSIS: million lei

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design (based on existing design)	–	
Equipment procurement	2.05	(1.45 steam traps + 0.6 insulletion)
Equipment installation	0.5	
Equipment commisssioning	0.1	
TOTAL INSTALLED COST	2.65 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	0.25 (c)	

PAYBACK PERIOD:

$$\frac{b: 2.65}{a: 3.8677 - c: 0.25} = 0.73 \text{ years} = 8.8 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

D. Water price; 106 lei/te; expected water money economy: 0.7 te/h x 3,650 h/y x 106 lei/t = 270,830 lei/y ;

E. TOTAL EXPECTED MONEY ECONOMY (FUEL & WATER) 3,596,880 + 270,830 = 3,867,710 lei/y

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 3

[illegible] name: Borşa City Hospital
[illegible]dress: 1,Floare de Colţ Str.,Borşa,Maramureş District,Romania
Auditor's name: S.C."ECO -RAG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To equipe Boilers'House with metering systems :Fuel meter for ABA steam boiler and for Cimac hot water boiler,steam meter for Aba Boiler,hot water meter for Cimac hot water boiler.

AREA OF THE PLANT AFFECTED: Affected area : Boilers' House

FINDINGS CONCERNING EXISTING CONDITIONS: There it not exist metering systems.It is known that the metering it's self,does not produce in direct way energy economy,but indirectly,by helping to monitorize the fuelconsumption,the steam and heat production,will allow a more rational usage of what is produced. These metering systems will permit to monitor the savings created by other measures.The base line for ABA steam boiler is considered to be the thermal efficiency 78.83 %.We do estimate to rase up the thermal efficiency with:5.75% due to ~~RECOMMENDED ACTION TO IMPROVE EFFICIENCY~~ excondensate recovery system, 3% due to fuel preheating and 2% using the fuel economizer. In this way we estimate to improve ABA steam boiler's thermal efficiency to 89.58 %. For ABA steam boiler,the estimated fuel economy will be:

$352,225 l/y \frac{89.58 - 78.83}{89.58} = 42,269$ l/y and money economy: 42,269 l/y x140 lei/l=5,917,660lei/

The base line for GIMAC hot water boiler is it's thermal efficiency : 68.72 %.We do estimate to improve boiler's thermal efficiency with: 3 % using a fuel preheater, 2% using a fuel economizer and 11.28 % by udjusting the thermal boiler load.For GIMAC hot water boiler the estimated fuel economy will be: $428,228 l/y \frac{85\% - 68.72\%}{85\%} = 82,018$ l/y and fuel money economy: 82,018 l/yx140 lei/l= 11,482,520 lei/y (the estimated improvement for CIMAC hot water boiler beeing ,in total, 85 %).The total fuel economy for ABA steam boiler and for CIMAC hot water boiler will be : 42,269 l/y + 82,018 l/y = 124,287 l/y and [illegible]el money economy: 5,917,660 lei + 11,482,520 lei = 17,400,180 lei/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity: Peak kW	Electricity: Energy MWh/year	Fuels, heat and steam: FUEL l/y	Total cost million lei/year	
Baseline – existing conditions			780,435	109,260,900	= 63,524 $
After recommended action			656,148	91,860,720	= 53,408 $
Net reduction			124,287	17,400,180	= (a) 10,116$

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		(~~430 $- fuel meter for ABA boiler~~
Equipment procurement	10,570 $	2,600$- steam meter for ABA boiler
Equipment installation	500$	2,040$- 2x1,020$ fuel meter for CIMAC ~~hot water boiler~~
Equipment commisssioning		5,500$- hot water meter for CIMAC hot water boiler)
TOTAL INSTALLED COST	11,070$ (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	400$ (c)	

PAYBACK PERIOD

$$\frac{b: 11,070\ \$}{a: 10,116\$ - c: 400\ \$} = 1.14 \text{ years} = 14 \text{ month}$$

[illegible]MMENDED IMPLEMENTATION SCHEDULE:

34

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 4

Plant: Borşa City Hospital
Address: 1, Moara de sol+ Str. Borşa, Maramureş district, Romania
Auditor's name: S.C. "ECO_ERG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To replace de actual lighting systems(incandescent ones)

AREA OF THE PLANT AFFECTED: Hospital's area.

FINDINGS CONCERNING EXISTING CONDITIONS:
- 100 pieces/60 W incandescent lamps
- 120 pieces/75 Wincandescent lamps
- 13 pieces/100 W incandescent lamps

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: - To change 60 W incandescent lamps with FD9 lamp (Tungsram -G.E.) and adapters for them (to 6 lamps 1 adapter)
- To change 75 W incandescent lamps with FD 11 lamps (Tungsgram-G.E.) and adapters for them (1 adapter/6 lamps)
- To change 100 W incandescent lamps with M4F82 lamps (with electronic balast). Manufacturer Tungsram G.E.

Base line(actual conditions): $(1x60Wx2,220\ h/yx10^{-3})x100$pieces + $(1x75\ W.x7,680\ h/y)10^{-3}x$ 120 pieces + $(1 \times 100\ W \times 1,692\ h/y \times 10^{-3})x13$ pieces = 84,640 KWH/y
Electricity cost: 84,640 KWh/y x 69 lei/kWh = 5,840,160 lei/y : 1,720 lei/$ = 3,396 $
After recommended action: $(1x\ 9W_{-}x2,220\ h/y \times 10^{-3}) \times 100 + 1\ x11\ W \times 7,680\ h/y\ x10^{-3}) x120 +$ $+ (1 \times 20_{-}\ W \times 1,692\ h/y \times 10^{-3}) \times 13$ for lamps + $(2W \times 2,220\ h/y \times 10^{-3}) x17 + (2W\ x7,680$ $h/y \times 10^{-3}) \times 20 + (2W \times 1,692\ h/y \times 10^{-3}) \times 13$ for adapters and balasts = 12,575.6 kWh/y for lamps + 426.7 kWh for adapters and balasts = 13,002.3 kWh/y
Electricity cost: 13,002.3 kWh/y x 69 lei/kWh = 897,159 lei/y :1,720 lei/$=522 $

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	adapt&bal. kWh/y	Total KWh/y	million lei/year
Baseline –existing conditions		84,640		84,640	5.840
After recommended action		12,575.6	426.7	13,002.3	0.897
Net reduction		72,064.4	426.7	71,637.7	4.943 (a)

COST–BENEFIT ANALYSIS: million lei

PROJECT COST ESTIMATE:	Cost	Notes	lei
Engineering design	–	FD9 100 pieces x 16,446 lei/p=	1,644,600
		adapt.17p.x39,305 lei/p=668,185	
Equipment procurement	5.684,79	FD11 120 p x 17,068 lei/p =	2,048,160
Equipment installation	–	adapt. 20p x 39 ,305 lei/p =	786,100
		M4F82 13 p x 41,365 lei/p =	537,745
Equipment commisssioning	–		
		Total = 5,684,790 lei	
TOTAL INSTALLED COST	5.685 (b)		
Estimated increase in annual (non–energy) operations and maintenance cost	– (c)		

(average life time = 10,000 h) PAYBACK PERIOD:

$$\frac{b: 5.685}{a: 4.943 - c: 0.0} = 1.15 \text{ years} = 14 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

35

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 5

Plant name: Borşa City Hospital
Address: 1,Floare de Colţ Str. , Borşa, Maramureş district,Romania
Auditor's name: S.C. "ECO-ENG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To monitorize the electric energy consumptions and to change the actual system of billing (to change the electricity contract with RENEL)

AREA OF THE PLANT AFFECTED: Hospital's area

FINDINGS CONCERNING EXISTING CONDITIONS:

1. The actual billing system for electric energy consumption is 69 lei/kwh for active power and it is not billed the reactive power due to the fact that cos $\varphi > 0.92$
2. It does exist the possibility to monitorize the whole energy consumptions (electric and thermal) due by the existance of a lculation office,wherexist P.C. 486 and 386 (MS DOS 5.0 operating system)

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. To replace the actuall (existing) electric energy meters (active,reactive),with other,performant ones,having analog outputs, to put a time switcher.
2. To install a data logging and to put in line with P.C. ,to monitorize the electric consumptions.
3. To change the actual system of billing with other one, based on a new contract with the electric energy supplier (RENEL BAIA – MARE).In this case ,the cost of electric energy at peak is 124 lei/kwh,while for the other consumpitons hours the electric energy price is 46 lei/kwh.The average energy consumption is 106.62 kw/h.
   The actuall consumption (base line,at the time of energy audit) is:
   365 days/y x 24 h/day x 106.62 kw x 69 lei/kwh: 1,100 lei/$ = 58,587 $/y (the rate change at electric energy price of 69 lei/kwh was 1$=1,100 lei)
   Estimate consumption at peak: 1,152 h/y x 106.62 kw x 124 lei/kwh : 1,100lei/$=13,846 $/y
   Estimate consumtion without peak:7,608h/yx106.62kwx46lei/kwh:1,100lei/$=33,921$/y
   Total estimated consumptions: 13,846 $/y + 33,921 $/y= 47,767 $/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak MW/y	Electricity Energy MWh/year	Fuels, heat and steam: new cost lei/kwh	Fuels, heat and steam: new cost at peak lei/kwh	Total cost $/year	
Baseline – existing conditions		934	69	–	58,587	
After recommended action	122.826	811.165	46	124	47,767	
Net reduction					10,820	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE.	Cost in $	Notes
Engineering design	727	
Equipment procurement	3,365	(data logging-2,000$;soft-910$;cables-455$)
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	4,092	(b)
Estimated increase in annual (non–energy) operations and maintenance cost	455	(c)

PAYBACK PERIOD:

$$\frac{b: 4,092}{a: 10,820 - c: 455} = 0.4 \text{ years} = 5 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 6

Plant name: Borşa City Hospital
Address: 1,Floare de Colt Str.,Borşa,Maramureş district,Romania
Auditor's name: S.C. "ECO-ERG"Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To install a fuel preheater for ABA steam boiler

AREA OF THE PLANT AFFECTED: Boilers' House

FINDINGS CONCERNING EXISTING CONDITIONS:
The fuel is not preheated

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: The fuel preheater is manufactured by S.C.EKOBIK S.A. Bucharest.The installed power of recommanded fuel preheater is 5kW,and the fuel may be heated from 25°C to 95°C. The warrantied fuel economy is 4- 4.5 % .ABA steam boiler's, with unpreheated fuel,consumption is : 96 l/h (96.5 l/h)
The aprox. warrantied fuel economy is: 4.2 % x 96 l/h = 4l/h
By changing the actual system of electric billing consumption,based on a new contract with electric energy supplier,in which case the paymentis 46 lei/kwh (that was at the data of mix electric energy audit-the base line for ours'estimations),the electricity consumption price will be 5 kw x 49 lei/kwh x 3,650 h/y :1,100 lei/$ =813 $/y
Expected fuel money economy : 4l/h x 140 lei/l x 3,650 h/y x: 1,100 lei/$ = 1,858 $/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost $ /year
Baseline –existing conditions	96l/hx3,650h/yx140lei/l:1,100lei/$= 44,596 $/y			44,596
After recommended action	92l/hx3,650h.yx140lei/l:1,100lei/$= 42,738 $/y			42,738
Net reduction	electricity cost:813$/y(net reduction:1,858 $/y-813$/y=1,045$/y)			1,045 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:	Cost $	Notes
Engineering design	150	
Equipment procurement	1,815	
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	1,965 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	150 (c)	

PAYBACK PERIOD:

$$\frac{b:1,965}{a:1,045 - c:150} = 2.2 \text{ years} = 26 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 7

[redacted] name: Borş a City Hospital
Address: 1,Flearo de eplţ Str., Borşa,Maramureş District,Romania
Auditor's name: S.C."ECO-ERG"Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: Teequipe the CIMAC hot water boiler with a fuel preheater and fuel economizer

AREA OF THE PLANT AFFECTED: Boilers' House

FINDINGS CONCERNING EXISTING CONDITIONS: It does not exist fuel preheater and fuel economizer.
Therecommended fuel preheater and fuel economizer are manufactured by S.C. EKOBIK S.A.-Bucharest.The fuel preheater has an installed power of 18 kW.The warrantied fuel economy is 4 - 4.5 % ,by heating the fuel from 25°C to 95°C.
The recommended fuel economizer is EKS 0.5M type.The Warrantied fuel economy is: 1.3-3.1%.
The CIMAC hot water boiler operating hoursfor 1993 were:989 h/y.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
Warrantied economies:
1. Preheater : 0.04 x 4331/h x 989 h/y x 140 lei/l : 1,100lei/$ = 2,180 $/y
2. Fueleconomizer: 0.03 x 4331/h x 989h/y x 140 lei/l :1,100 lei/$ = 1,635 $/y
3. Maintenance economies due to fuel economizer: aprox. 1,636 $/y
4. Fuel economies due by reducing the operating hours to set on/off(by reducing the fuel consumption to enter in thermal charge): min. 2h/day x 4331/h x 110 day/y x 140 lei/l : 1,100 lei/$ = 12,124 $/Y.
   Estimated economies (1+2+3+4): 2,180 $/y + 1,635 $/y + 12,124 $/y + 1,636 $/y = = 17,575 $/y
5. Electricity cost for fuel preheater: 18 kW x 989 h/y x 49 lei/kWh :1,100 lei/$=793$/y
   Expected economy: 17,575 $/y - 793 $/y = 16,782 $/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost $ /year	
Baseline –existing conditions					
After recommended action					
Net reduction (1+2+3+4) - 5				16,782	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineering design	150	
Equipment procurement	14,492	(fuel preheater - 7,960 $; fuel economizer 6,480 $; estalizer - 52 $)
Equipment installation	200	
Equipment commisssioning	-	
TOTAL INSTALLED COST	14,842	(b)
Estimated increase in annual (non–energy) operations and maintenance cost	200	(c)

PAYBACK PERIOD:

$$\frac{b: 14{,}842}{a: 16{,}782 - c: 200} = 0.9 \text{ years} = 11 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:
OBS. The boiler's operating hours is depending on hospital's budget. The real operating hours (minimum) is aprox. 5,253 h/y,depending on external temperature(HDD).Considering the rea l operatings hours ,the payback period would be very short.

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 8

[redacted] name: Borşa City Hospital
Address: 1,Floare de Colţ Str., Borşa,Maramureş Districtăromania
Auditor's name: S.C."ECO-ERG"Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To change the preparation of hot domestic water generated with the CIMAC hot water boiler and two heat exchangers,with FLO RITE TEMP. system

AREA OF THE PLANT AFFECTED: Hospital's area.

FINDINGS CONCERNING EXISTING CONDITIONS: The hot domestic water is prepared with a CIMAC hot water boiler at nominal charge of 3 GCal/h,and two water-water heat exchangers.Hot water's exit temperatt is 76°C and the entering water's temperature is 57°C.The domestic hot water is prepared and delivered 5 hours daily,at 50% of nominal charge (1.5 Gcal/h).The measured thermal efficiency was 68.72 %,and the max. thermal efficiency for the heat exchangers is not more than70 %. The average fuel consumption,at 50 % of nominal charge is 360 l/h. The prepared domestic water's temperature is max 53°C,min. 49°C.The feed water's temperature is approx.4-6°C.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: To install 2 (two) FLO-RITE TEMP. equipments,535 model40F/120F,2x45 GPM/15psig,replacing the actuall domestic hot Water preparation.It must to be mentimned,that in actual system, the CIMAC hot water boiler (3 GCal/h) is used to prepare hot water for heating ,and in other period of time is used to prepare the hot domestic water.The boiler's operation hours depend on hospital's budget located to fuelsupply.

1. The actual specific fuel consumption for CIMAC boiler is: $\frac{360\ l/h}{1.5\ GCal/h \times 0.7 : \cancel{1.49}\ 6}$ (nominal; actual efficiency)

   $= \frac{360}{23,333}\ l/h \times h/l = 0.0154\ lF/lW$

2. The expected specific fuel consumption for one (1) FLO RITE TEMP,535 model,which has 883 kg steam at 15 psig is: 883 kg/h0.09 kg/kg:0.922kg/l = 0.0085 lF/lW(the specific consumption for ABA steam boiler 10,200 lW/h beeing:0.09 kgf/kg steam).
   Expected money economy: (0.0154 – 0.0085)lF/lW x 2 x 170 lW/min x 60 min/h x 5 h/day x x365 day/year x 140 lei/lF : 1,100 lei/$= 32,695 $/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost /year
Baseline – existing conditions	0.0154 lF/lW x20,400lW/h x 5h/day x365 day/y x 140 lei/lF:1,100 lei/$=			72,971 $/y
After recommended action	0.00851F/lWx20,400lW/hx5h/dayx365day/yx140lei/lF:1,100lei/$=			40,276 $/y
Net reduction			32,695$/y	32,695 $/y

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineering design	600	
Equipment procurement 2xFLO RITE TEMP 535 model (40F/12 0 F-45GPM/15psig)ARMSTRONG INT.	28,200	
Equipment installation	1,364	
Equipment commisssioning	–	
TOTAL INSTALLED COST	30,164 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	456 (c)	

PAYBACK PERIOD:

$$\frac{b: 30,164}{a: 32,695 - c: 456} = 0.94\ \text{years} = 11\ \text{month}$$

[redacted]MMENDED IMPLEMENTATION SCHEDULE: The technical assistant is required!
The FLO RITE TEMP system is recommended,in the same time for health care reasons!(due by reducing thediseases produced by "legionella pneumonella")

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- ROMANIA

FINAL ENERGY AUDIT REPORT

for work at

Danubiana, S.A.

by

Florin Mihailescu

Camigo, S.R.L.

for

Hagler Bailly Consulting, Inc.

40

ENERGY AUDIT REPORT FOR DANUBIANA SA BUCHAREST

JUNE/JULY 1995

BENEFICIARY : DANUBIANA SA BUCHAREST

Adress: Str. OLTENITEI 181 sector 4

Phones: 401- 6835775,6834140,6832734

Fax : 401- 3122034

General Manager : Cristian Zurini,engineer
Tehnical Manager : Dan Stoica,engineer

PREPARED by: CAMIGO Ltd Bucharest

Adress: Str.Doctor Anibal Teohari 21 sector 5
Bucharest ROMANIA

General Manager : Florin Mihailescu

Phone/Fax : 401-7813353

Energy audit for DANUBIANA

1. EXECUTIV SUMMARY

1.1. OBJECTIVES,GOALS,RESULTS

The objectives of the audit are:

-To evaluate energy consumption at the plant.
-To identify the waste of energy.
-To identify low-cost tuning,operational and maintenancwe recommendations.
-To recommend long-range solutions to energy analysis and process energy management issues.
-To identify instrumentation and low-cost equipment nedeed by the plant to implement the more attractive energy consumption actions.

The goals are the diminution of energy consumptions and specific energy consumption in production process with better quality,productivity,ecology and safety.

This report presents the results from a preliminary energy audit carried out by a team of engineers from CAMIGO Ltd ROMANIA.

1.2 PLANT DESCRIPTION

The DANUBIANA is a business entity,which is in process of privatisation trough the MEBO metod,reprezentative in the branch of furniture production tyres for trucks and wheel tractors,especially for export.
MEBO is one of the privatisation methode,through the employeds buy in time(5-8 years) the plant from the stat.
DANUBIANA is very interested in the production process modernization productivity growth, and diminution of energy consumptions in the thermal unit,heat and hot water distribution,consummers of the production section.
Danubiana is the only producer from Romania of tractors and trucks tyres.
The tyres manufactoring process is consist of the making in the mixers section of a syntectic and natural(from import) rubber composition, which is impregnating with tissue in the calender section.
After that, the composition is modeladed in the volcanisation presses section.
The thermal of this process is the steam and warm water,which are furnised by the own thermal unit.

1.2.1. PLANT INFRASTRUCTURES AND UTILITY SYSTEMS

DANUBIANA is a well organised plant with:
-Production departament
-Energy,electrical departament
-Mecanical section
-Maintenance
-Comercial departament
-Financial departament

The plant has been made in 1962, and in present has almost 4800 employeds from:
-production departement.....2000
-mecano-energy departement(maintenance,design,transport)...2200
-energy division(utilities,labs,etc.).....500
The plant has a general manager and 4 directors.

Utility systems:

1.2.2. ELECTRICAL SYSTEM

The plant is suplied from the national 110 kV grid through a 110/ 6kV by 2 couplings :
-Coupling 6 Kv with 2 transformers 25 MVA;110/6kV
-Coupling 110 kV with a station (SRA) 2X25 MVA
Power max. absorption = 17 Mw

The principal consummers are: own services CET,air compressors station thermic utilyties central CUT.
Danubiana produce electric energy with 3 turbines:
- 1 turbine type AKTP-4 , 4 MW
- 1 turbine type AKTR-4 , 4 MW
- 1 turbine type AKTR-6 , 6 MW

CATEGORY	1990	1991	1992	1993	1994
Annual electric consumption[MWh]	4000	3980	3440	3340	3310
Annual electric energy production[MWh]	8534	11013	5969	6841	11810

The big variation in annual production,it is because Danubiana haven'tgot any constant beneficiary,wich to sale electric and thermal energy and own consum is determinated by the extern contracts, which had been different as value.

1.2.3. THERMAL SYSTEM DATA

Danubiana has an own thermic station with 6 boilers :

-3 steam boilers type CR-03,manufacter VULCAN BUCHAREST,fuel gas
capacity .....50 to/h
steam pressure.....40 bar
steam temperature.....450 °C

-3 steam boilers type CR-12 C,manufacter VULCAN BUCHAREST,fuel gas and heavy oil:
capacity.....50 to/h
steam pressure.....36 bar
steam temperature.....450 °C

Energy audit for Danubiana

CATEGORY	1990	1991	1992	1993	1994
Annual thermic consumption[Gcal]	62470	61100	54400	52450	50600
Annual therm.energy production[Gcal]	601703	588246	524062	505164	487370
Annual heavy fuel oil consumption[to]	946	8446	8022	5866	6665
Annual fuel gas consumption[th.m.cub]	86236	73404	69832	77151	60913
Annual air compress consump[th.m.cub]	8067	7886	7095	7033	6534
Annual demineralise. water[th.m.cub.]	1530	1500	1348	1259	1190

The steady decline in energy consumption it is because,the thermal unit didn't work to nominal capacity,from the absence with the contracts with the beneficiaries.
Also, a part from Danubiana's beneficiaries,because of the growingness of the thermal agent price, had been deconected and build thermal unit of their own.

1.2.4 ENERGY CONSUMPTION BASE YEAR 1994 BY MONTH

	ELECTRICITY		THERMAL		AIR COMP.	GAS	OIL	COOL WATER	DEM.WAT
MONTH	* A	B	A	B					
	MWh		Gcal		Th.m.c	Th.m.c	To	Th.m.c	Th.m.c
JANUARY	290	-	6255	54939	536	4599	2500	15	116
FEBRUARY	289	-	5615	55329	563	4782	2110	14	110
MARCH	273	-	5068	49499	581	5704	800	15	106
APRIL	274	797	3821	36889	485	5097	-	46	96
MAY	220	1372	3413	31827	503	4586	5	69	97
JUNE	243	1631	3698	35103	577	5200	-	80	99
JULY	280	1604	3648	31811	543	4368	-	78	98
AUGUST	280	1727	3476	33438	642	5200	-	84	100
SEPTEM.	292	1705	2831	28967	553	4855	-	83	99
OCTOB.	312	426	3171	33129	551	5060	60	31	97
NOV.	307	1713	4847	47762	620	6052	340	83	97
DEC.	310	835	4757	48677	380	5428	850	48	75

* Note:

A- Own consume CET
B- Produced in CET

ELECTRIC ENERGY GENERATION - 12 MONTH AUDIT PERIOD
Prepared for USAID and Hagler Bailly Consulting, Inc.

Plant name: DANUBIANA SA
Adress: Road Oltenitei 181, sector 4, BUCHAREST, ROMANIA
Auditor's name: CAMIGO Ltd.
Report date: 1995

Generator characteristics:

Name/number		AKTP-4	AKTR-4	AKTR-6
Manufacturer		UM RESITA	UM RESITA	IMG BUCHAREST
Capacity (kW)		4 MW	4 MW	6 MW
Year installed		1964	1965	1994
Year major overhaut		1983	1992	-
Drive type (steam,gas,diesel)		Steam	Steam	Steam
If steam - Condension/extracion/backpressure		35 ata	35 ata	35 ata
Operational? (yes/no)		yes	yes	yes

GENERATION DATA FOR 12 - MONTH AUDIT PERIOD:

	SELF-GENERATION BY PLANT				SOLD TO OTHERS:				PURCHASED FROM OTHERS				NOTES
Meter Reading Mo/day/yr	Energy Active Mwh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Energy Active kWh	Energy Reactive kWh	Max Demand kW	Max Demand kVA	Energy active kWh	Energy Reactive kWh	Max Demand kW	Max Demand kVA	Unusual Operating conditions
Jan/31/94	-				-								
Feb/28/94	-				-								
Mar/31/94	-				-								
Apr/30/94	797	1500	2.0	3.0	-								
May/31/94	1372	2250	3.0	4.5	-								
Jun/30/94	1631	2600	3.5	5.2	-								
Jul/31/94	1604	2550	3.5	5.2	-								
Aug/31/94	1727	2800	3.5	5.6	-								
Sep/30/94	1705	2700	3.7	5.6	-								
Oct/31/94	426	750	1.0	1.5	-								
Nov/30/94	1713	2750	3.7	5.6	-								
Dec/31/94	835	1600	2	3.0	-								
TOTAL	11,810	19,500											

ELECTRIC ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD
Prepared for USAID and Hagler Bailly Consulting Inc.

Plant name :**Danubiana SA**
Adress :**Road Oltenitei 181, sector 4, Bucharest, Romania**
Auditor's name :**Camigo Ltd**
Report date :**1995**

Electricity contract terms:

Electricity supply company's name	**RENEL**
Contract maximum demand (kw)	
Minimum charge (cost):	

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD

Meter Reading Mo/day/year	Energy Active MWh	Energy Reactive MVARh	Max Demand MW	Max Demand MVAR	Power Factor cos ø	Load Factor	Total Cost millions lei	Product Index kWh per:	Notes on plant conditions and changes
Jan/31/94	6530	6594	14.8	13.1	0.71		476.1		
Feb/28/94	7200	4743	14.5	12.7	0.84		520.3		
Mar/31/94	7908	6432	16.9	15.9	0.78		533.0		
Apr/30/94	5880	5832	8.1	7.9	0.71		550		
May/31/94	3759	3942	11.6	11.4	0.7		378		
Jun/30/94	6000	5835	13.1	12.5	0.72		440		
Jul/31/94	4696	4557	9.8	10.5	0.72		429		
Aug/31/94	5351	5238	10.9	11.0	0.72		503		
Sep/30/94	5300	4896	13.9	12.7	0.74		530		
Oct/31/94	6092	5334	12.1	11.4	0-.76		608.8		
Nov/30/94	5660	5517	11.4	10.4	0.71		633.6		
Dec/31/94	5242	5148	15.7	14.4	0.71		590.3		
TOTAL	**69568**	**64068**					**6191.3**		

Peak demand during audit period(KW) 16900

46

ENERGY BALANCE - ELECTRICAL
Prepared for USAID and Hagler Bailly Consulting,Inc.

Plant name :**Danubiana SA**
Adress :**Road Oltenitei 181, sector 4, Bucharest, Romania**
Auditor's name :**Camigo Ltd**
Report date :**1995**

Item No.	Equipment or Process Description	Connected Load Kw	Maximum Load Kw	Average Load KW	Load at Peak Biling Demand KW	Electric Energy CKwh/yearon sumption	Total Energy Cost/ Year
1	Steam boiler - CET	360	280	238			
2	Air compressors	5100	3600	3366			
3	Volcanisation Presses	5274	3165	2110			
4	Mixers	13600	8400	5440			
TOTAL PEAK DEMAND(equals maximum biling demand)							
TOTAL ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)							

STEAM GENERATION - 12 MONTH AUDIT PERIOD
Prepared for USAID and Hagler Bailly Consulting,Inc.

Plant name :**Danubiana SA**
Adress :**Road Oltenitei 181, sector 4, Bucharest, Romania**
Auditor's name :**Camigo Ltd**
Report date :**1995**

Boiler characteristics:

Name/Number	Nr.1/CR-03	Nr.5/CR12C		
Manufacturer	VULCAN Bucharest	VULCAN Bucharest		
Type (firetube/watertube	aquatubbular	aquatubbular		
Type (saturated/superheated)	superheated	superheated		
Capacity (tons/hour)	50	50		
Year installed	1962	1978		
Very last major overhaut	1984	1992		
Operational (yes/no)	Yes	Yes		
Steam pressure	40	36 bar		
Steam temperature	450°C	450°C		
Stack temperature,after economizer		160-190°C		
Stack gas analysis:percent O2		8.2%		
Combustion efficiency		85-89%		

STEAM GENERATION DATA FOR 12-MONTH AUDIT PERIOD

STEAM GENERATION BY PLANT					IMPORT	SALES AND DISTRIBUTION TO CONSUMERS:	
Meter Reading Mo/day/year	Fuel Consumption N.gas/H.oil Th.Nmc/To	Steam Generation tons	Steam Generation Gcal	Monthly Efficiency %	Steam Purchased GJ	Gcal	Unusual Operating conditions
Jan/31/94	4599/2500	77370	54939	85		6722	
Feb/28/94	4782/2110	77900	55329	85		7565	
Mar/31/94	5704/800	69700	49499	86		6972	
Apr/30/94	5097/ -	51900	36899	86		3495	
May/31/94	4586/5	44800	31827	86		1396	
Jun/30/94	5200/ -	49400	35103	83		1104	
Jul/31/94	6368/ -	44800	31811	85		1372	
Aug/31/94	5200/ -	47000	33438	80		1573	
Sep/30/94	4855/ -	40800	28967	80		1532	
Oct/31/94	5060/60	46600	33129	80		1086	
Nov/30/94	6052/340	67200	47762	86		3852	
Dec/31/94	5428/850	68500	48677	87		4117	
TOTAL	60913/6665	685970	487370	85		40786	

58

FUEL STEAM OR HEAT ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD
ENERGY TYPE : STEAM
Prepared for USAID and Hagler Bailly Consulting, Inc.

Plant name : Danubiana
Adress: Road OLTENITEI 181.sector 4, Bucharest, Romania
Auditor's Name : CAMIGO LTD
Report date : 1995

Supply contract terms

Fuel or heat supply company's name : RGAB, PECO
Contract maximum demand :
Minimum charge (cost) :
Other :

CONSUMPTION OR FILLING DATA FOR 12 - MONTH AUDIT REPORT

Meter Reading Mc/day/yr	Physical Consumption units - Th.N.mc/To N.gas/H.oil	Thermal Consumption Gcal	Total cost mill lei N.gas/ H.oil	Monthly Heatind Degree-Days HDD	Heating Index Gcal/ HDD	Product index GJ per:	Notes on plant conditions and changes
Jan/31/94	4599/2500	54939	451.8/357.5	556	98.8		
Feb/28/94	4782/2110	55329	512.6/301.7	365	151.58		
Mar/31/94	5704/800	49499	610.7/114.4	217	228.1		
Apr/30/94	5097/ -	36889	612.6/ -	29	1272		
May/31/94	4586/5	31827	559.4/0.76	0			
Jun/30/94	5200/-	35103	634.6/ -	0			
Jul/31/94	4368/-	31811	533.4/ -	0			
Aug/31/94	5200/-	33438	635.4/ -	0			
Sep/30/94	4855/-	28967	591.9/ -	10			
Oct/31/94	5060/60	33129	616.2/10.14	30	1104.3		
Nov/30/94	6052/340	47762	735.4/57.46	211	226.36		
Dec/31/94	5428/850	48677	654.6/143.65	405	120.19		
TOTAL	60913/6665	487370	7148.6/995.61	1813	262.85		

Note: Heating degree-days based on reference temperature of 12°C

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49

ENERGY BALANCE - FUEL, STEAM OR HEAT
Prepared for USAID and Hagler Bailly Consulting, Inc.

Plant name :**Danubiana SA**
Adress :**Road Oltenitei 181, sector 4, Bucharest, Romania**
Auditor's name :**Camigo Ltd**
Report date :**1995**

Item No.	Equipment or Process Description	Maximum Load t/h	Average Load t/h	Load at Peak Demand	Energy Consumption t.c.c/year	Total Energy Cost/ Year
1	Steam to hot water heat exchangers	300	186		79.000	8134.2
2	Volcanisation presses	240	150		63.200	6505
TOTAL PEAK DEMAND(equals maximum biling demand)						
TOTAL ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)						

ACTION PLAN - SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES
Prepared for USAID and Hagler Bailly Consulting

Plant name: DANUBIANA S.A.
Adress: Road OLTENITEI 181, sector 4 BUCHAREST, ROMANIA
Auditor's name: CAMIGO Ltd.
Report date: 1995

BASELINE - EXISTING CONDITIONS

	Thermal consumption Gj/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Cost mill/year
BASE CASE				

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS:

Action No.	Action Description	Thermal consumption Gcal/year	Fuel/To Nat. Gas/Nm³	Electric Energy Consumption MWh/year	Total Energy Cost mill lei/year	Action Project Cost mill lei	Action Payback Period (years)
1	Improvement of the illuminating system			938	80.6	16.0	0.2
2	Energy consumption decrease for compressors			150	12.9	4.7	0.37
3	Firing automatic control for one steam boiler		549/625		202.3	126	0.62
6	Automatic control of the oil temperature	112	15.9/ -		4.62	4.1	0.97
4	Installation on the presses, by performant steam traps	1119.11	158/-		43.02	53.05	1.4
5	Recovery under pressure of the warm drainage	7.683	1.09/-	6.95	300.29	774.8	3.15
TOTAL SAVINGS		1239	725/625	1095	643.73	978.65	
SAVINGS AS PERCENTAGE OF BASE CASE					11.75		

NOTE:Assumesthat the actions are taken in order of best payback period first, in order to take into account the interaction between the various measures

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly **Action nr. 1**

Plant name: DANUBIANA S.A. BUCHAREST
Address: Str. OLTENITEI 181 sector 4
Auditor's name: CAMIGO S.R.L. BUCHAREST
Report date: APRIL 1995

ACTION NO. AND BRIEF DESCRIPTION: Illumination system improvement
AREA OF THE PLANT AFFECTED: Power department

FINDINGS CONCERNING EXISTING CONDITIONS:

The illumination system consist of lamps with mercury vapors of 400 W/lamp.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Replacement of these by lamps with high pressure sodium of 250 W/lamp.
Note: It has been taken into account the expenditures for the first action of modernization

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels,heat and steam			
	Peak kW	Energy MWh/yr				Total mill. cost/yr lei
Baseline-existing conditions		2500				215.0
After recommended action		1562				134.37
Net reduction		938				80.63 (a)

COST-BENEFIT ANALYSIS PROJECT COST ESTIMATE	Cost		Notes
Engineering design	1.00		
Equipment procurement	10.00		Danubiana
Equipment installation	5.00		Danubiana
Equipment commissioning	-		
TOTAL INSTALLED COST	16.00	(b)	
Estimated increase in annual (non-energy) operations and maintenance cost:	1.2	(c)	

PAYBACK PERIOD: $\frac{b:16.00}{a:80.63 - c:1.2} = 0.2$ years

RECCOMENDED IMPLEMENTATION SCHEDULE

52

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly **Action nr. 2**

Plant name: DANUBIANA S.A. BUCHAREST
Address: Str. OLTENITEI 181 sector 4
Auditor's name: CAMIGO S.R.L. BUCHAREST
Report date: APRIL 1995

ACTION NO. AND BRIEF DESCRIPTION: Compressors power consumption diminution

AREA OF THE PLANT AFFECTED: Compressor's department

FINDINGS CONCERNING EXISTING CONDITIONS:

There is no system of measurement of power consumption correlated with the losses of air

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Installation of measurement apparatus of electric power with max. detectors and of the adjusting apparatus of air consumption function of the technologic consumptions.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels,heat and steam			
	Peak kW	Energy MWh/yr				Total ths. cost/yr lei
Baseline-existing conditions		2,000				172,000
After recommended action		1,850				159,100
Net reduction		150				12,900 (a)

COST-BENEFIT ANALYSIS PROJECT COST ESTIMATE	Cost	Notes
Engineering design	1200	
Equipment procurement	2000	Danubiana
Equipment installation	1000	Danubiana
Equipment commissioning	500	ESCO
TOTAL INSTALLED COST	4700	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	7.05	(c)

PAYBACK PERIOD: $\frac{b:126}{a:12.900 - c:7.05} = 0.37$ years

RECCOMENDED IMPLEMENTATION SCHEDULE

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly **Action nr. 3**

Plant name: DANUBIANA S.A. BUCHAREST
Address: Str. OLTENITEI 181 sector 4
Auditor's name: CAMIGO Ltd.
Report date: 1995

ACTION NO. AND BRIEF DESCRIPTION: Firing automatic control plant for the steam boiler

AREA OF THE PLANT AFFECTED: Energetic division

FINDINGS CONCERNING EXISTING CONDITIONS:

For the time being in the firing control is made on manual, that results in increased fuel consumption on direct consecuequences in the economical running of the boiler
*The consumption are on average value, because there isn't a technical possibility for the measurement of each boiler.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Implementation of a trying automatic control plant in order to save the fuel (natural gas + heavy fuel oil
The estimated fuel savings is of 3.59 %

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels,heat and steam			
	Peak kW	Energy MWh/yr	H Fuel (to)	Natgas Nmc	Total cost/yr	mill. lei
Baseline-existing conditions			*1904	*17403		
After recommended action			*1809	*16533		
Net reduction			549.2	624.57	202.3	(a)

COST-BENEFIT ANALYSIS PROJECT COST ESTIMATE	Cost	Notes
Engineering design	12.0	
Equipment procurement	101.0	
Equipment installation	8.0	
Equipment commissioning	5.0	
TOTAL INSTALLED COST	126.0	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	2.1	(c)

PAYBACK PERIOD: $\frac{b:126}{a:202.3 - c:2.1} = 0.62$ years

RECCOMENDED IMPLEMENTATION SCHEDULE

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly **Action nr. 4**

Plant name: DANUBIANA S.A. BUCHAREST
Address: Str. OLTENITEI 181 sector 4
Auditor's name: CAMIGO Ltd.
Report date:

ACTION NO. AND BRIEF DESCRIPTION:	Installation on the vulcanization presses of performant steam traps
AREA OF THE PLANT AFFECTED:	Vulcanization tyros department

FINDINGS CONCERNING EXISTING CONDITIONS:

The presses have the old thermodynamic steam traps, used, which produce big steam consumers and leaks

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Install a new efficient steam trap.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity	Fuels,heat and steam				
		Thermal energy	H fuel oil	Demin water	Total cost mill. lei /year	
Baseline-existing conditions		11196.11				
After recommended action		10.077				
Net reduction		1119.11	158.74	2356	43.02	(a)
		Gcall/y	To/y	mc/y		

COST-BENEFIT ANALYSIS PROJECT COST ESTIMATE	Cost	Notes
Engineering design	3.0	
Equipment procurement	50.05	Danubiana
Equipment installation	-	Danubiana
Equipment commissioning	-	
TOTAL INSTALLED COST	53.05	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	5.33	(c)

PAYBACK PERIOD: $\frac{b:53.05}{a:43.02 - c:5.33} = 1.4$ years

RECCOMENDED IMPLEMENTATION SCHEDULE

55

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly **Action nr. 5**

Plant name: DANUBIANA S.A. BUCHAREST
Address: Str. OLTENITEI 181 sector 4
Auditor's name: CAMIGO Ltd.
Report date: 1995

ACTION NO. AND BRIEF DESCRIPTION: Recovery under pressure of the warm drainages, originating from the hot water for tyre vulcanization

AREA OF THE PLANT AFFECTED: Tyre vulcanization department

FINDINGS CONCERNING EXISTING CONDITIONS:

As the end of tyre vulcanization with hot water, the volume of water at 18-19 bar and 175 - 180°C from tyre's diaphragms is evacuated through pipes to the termic station -cut. in reservoirs at atmospheric pressure.Thus the secondary steam resulted from hot water (warm drainage's) expansion is lost in the atmosphere conducting to losses of termic energy and soft water

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

It is recommended to recover the hot water from presses diaphragms (warm drainage) under pressure, at 3-5 bar.a. in closed expansion receptacles.The warm drainage from the expansion receptacles is taken by the pumps (from 3-5 bar.142-151°C) and introduced in the bar of 3-5 bar.a. where from there are supplied different consumers at low pressure. The warm drainage from the expansion receptacles is taken by the pumps (from 3-5 bar, 142-151°C) an introduced back in the circuit of hot water (approx 18 bar).

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity	Fuels,heat and steam			
	Energy Mwh/yr	Thermal energy	H fuel oil	Demin water	Total cost mill. lei /year
Baseline-existing conditions					
After recommended action	6.958	7.683	1.090	15.820	300.293 (a)
Net reduction					
		Gcall/y	To/y	mc/y	

COST-BENEFIT ANALYSIS PROJECT COST ESTIMATE	Cost mill lei	Notes
Engineering design	70.0	
Equipment procurement	287.8	
Equipment installation	417.0	
Equipment commissioning	-	Danubiana
TOTAL INSTALLED COST	774.8	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	54.62	(c)

PAYBACK PERIOD: $\frac{b:774.8}{a:300.293 - c:54.62} = 3.15$ years

RECCOMENDED IMPLEMENTATION SCHEDULE

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly **Action nr. 6**

Plant name: DANUBIANA S.A. BUCHAREST
Address: Str. OLTENITEI 181 sector 4
Auditor's name: CAMIGO Ltd.
Report date: 1995

ACTION NO. AND BRIEF DESCRIPTION: Automatic control of the heavy oil temperature in the tanks

AREA OF THE PLANT AFFECTED: Reservoir aboveground fuel oil.

FINDINGS CONCERNING EXISTING CONDITIONS:

-The oil temperature in the tanks is not controlled
-The steam traps are old, having steam leaks

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

-Install automatic valves for controlling steam flow
-Install a new efficient steam traps

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity	Fuels,heat and steam			
	Energy Mwh/yr	Thermal energy	H fuel oil	Demain water	Total cost mill. lei /year
Baseline-existing conditions		267.875			
After recommended action		167.335	1.090	15.820	300.293
Net reduction		112.0	15.9	230	4.624 (a)
		Gcal/y	To/y	mc/y	

COST-BENEFIT ANALYSIS PROJECT COST ESTIMATE	Cost mill lei	Notes
Engineering design	0.35	
Equipment procurement	3.251	
Equipment installation	0.5	
Equipment commissioning	-	Danubiana
TOTAL INSTALLED COST	27.101	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	0.412	(c)

PAYBACK PERIOD: $\frac{b:4.101}{a:4.624 - c:0.412} = 0.97$ years

RECCOMENDED IMPLEMENTATION SCHEDULE

ACTION No.1

IMPROVEMENT OF THE ILLUMINATING SYSTEM

1. Current situation

The illuminating system in the tire factory consists in two parts: the external illuminating system and the internal illuminating system for all the sections.

The illuminating system of the factory is realized with Hg fluorescent lamps having a nominal power of 400 W. The entire power installed is 700 kW and the mean annual energy consumption is 2.500 MWh.

2. Recommended action

We suggest the replacement of the existing lamps with high pressure Na lamps which have a lower consumption (250 W). This will lower the annual energy consumption to 1512 MWh, realizing a 938 MWh annual saving.

The external illuminating system which represents 30% of the total energy consumption for illumination can be optimized to obtain a decrease of 10% of actual energy need.

3. Technico-economical analisys of suggested sollution

In order to obtain a reduction in energy consumption for the illumination of the factory is necessary to change the structure of illuminating system both for inside and for the outside and also to change the type of lamp.

The changing of the lamps implies in certain zones also the changing of the existing installation which in turn leads to supplemental expenses. Although, we consider that these expenses will be covered by the lower cost of the sodium lamp.

In these conditions it will be obtained a decrease in energy consumption estimated to 338 MWh which corresponds to 80.660.000 lei/year.

4. Savings computations

We consider the following costs:

- electricity 86.000 lei/MWh

Results: The annual energy savings 2500-1512 = 938 MWh/yr.
938 MWh x 86.000 lei = 80.668.000 lei

5. Investment value computation

The calculation is made by using a exchange course of 2.000 lei for 1 USD

Designing: 1.00 million lei

Equipment: 10.0 million lei

Equipment installation: 5.0 million lei

Technical assistance for installation and testing: --

Total 16.0 million lei

6. Evaluation of savings and investment recovery time

Recovery time: 16.0 / 79.4 = 0.2 years

7. Conclusions and recommendations

Considering the results of the economical analysis following the improvement of the illuminating system which show that the investment recovery time from the net savings is very short, the suggested action shows to be very efficient.

ACTION No.2

ENERGY CONSUMPTION DECREASE FOR COMPRESSORS

-COMPRESSOR SECTION-

1. Current situation

The energetic section is equipped with 3 compressors, each of them having an installed power of 1.700 kW. From the information available at the energetic department results a mean annual energy consumption of about 2.000 MWh/year.

At this moment, there is no measuring system correlated with the air losses from the entire system, the compressors functioning a much longer time than necessary.

So, there is no strict control of the functioning time for the compressor, correlated with the necessary air consumption for the technological process.

2. Recommended action

We suggest reorganizing the compressor section by installing measuring devices, controlling the energy consumption with a sensor for the upper limit and adjusting the air consumption to the needed level.

Verifying the relation P_u/P_{nom} for the compressor motors, it becomes obvious that an optimal selection of these motors can lead to decrease in the energy consumption.

The continuous correlation between the functioning of the compressor and the other technological parameters is also suggested.

All these suggested procedures will lead to a decrease in energy consumption from 2.000 MWh to 1.850 MWh

3. Technico-economical analisys of suggested sollution

Through the measures recommended in the previous chapter it is possible to obtain a decrease in energy consumption of 150 MWh coresponding to a value of 12.900.000/year.

4. Savings computations

We consider the following costs:

- electricity 86.000 lei/MWh

Results: The annual energy savings 150 MWh/yr.

150 MWh x 86.000 lei = 12.900.000 lei

Note: In this calculation was not considered the difference in price for the energy in the peak period.

5. Investment value computation.

The calculation is made by using a exchange course of 2.000 lei for 1USD

Designing: 1.200 thousands lei

Equipment: 2.000 Th. lei

Equipment installation: 1.000 Th. lei

Technical assistance for installation and testing: 500 Th. lei

Total: 4.700.000 lei

6. Evaluation of savings and investment recovery time

The annual supplementary costs are:

-depreciation 4.700.000 x 0.1%=4.700 lei

-maintenance 4.700.000 x 0.05%=2350 lei

Recovery time: 4.700.000/(12.500.000-7.050)=0.37 years

7. Conclusions and recommendations

Considering the results of the economical analysis which show that the investment recovery time from the net savings is shorter than 1 year, and also considering that there is no need for personnel training, the suggested action shows to be efficient.

ACTION NO.3

REDUCTION OF FUEL CONSUMPTION THROUGH AUTOMATICALLY GUIDED BURNING

1.CURRENT SITUATION

1.1. Tennical characteristics of the boilers

The DANUBIANA thermal power station is currently equipped with 6 steam boilers:
- 3 boilers-CR03-50 to/hr;40 bar;450°C;fuel natural gas,which are almost worn out,there exist already some researches for their remplacement in the moment when there will be available adequate financial resources.
- 3 boilers-CR12-C-50 to/h;40 bar;450 °C;fuel heavy oil and natural gas.

Since the autommatically guided burning equipment will be installed on a CR-12 boiler,there will be presented its main technical charateristics,registred at the homologation:

-Capacity [to/h].....50
-Pressure in drum [kgf/cm2].....40
-Steam pressure [kgf/cm2].....36
-Temperature superheated steam[°C].....450
-Fuel: heavy oil/natural gas
-Consumption heavy fuel oil[kg/h].....3647
-Consumption natural gas[Nmc/h].....4150

a)Work with heavy fuel oil :

-Analyse fired gas in the end of focus/capacity 50 t/h :
-CO2%.....14,05
-O2%.....2,54
-CO%.....0
-Air excess,in the end of focus :
-designed.....1,12
-measured.....1,137

-Analyse fired gas in the stack/capacity 50 to/h :
-CO2%.....10,87
-O2%.....6,72

-Air excess in the stack :
-designed.....1,46
-measured.....1,477

b)Work with natural gas :

-Analyse fired gas in the end of focus :
-CO2%.....11,7
-O2%.....0,35

-CO%.....0
-Air excess in the end of focus :
-designed.....1,14
-measured.....1,016

-Analyse fired gas in the stack:
-CO2%.....10,53
-O2%.....2,64
-CO%.....0

-Air excess in the stack:
-designed.....1,40
-measured.....1,40
-The thermic efficiency of the boiler obtained at the homologation at functioning on oil fuel and natural gas :
-direct method.....89,14%-92,374%
-indirect method.....91,93%-93,01%
-Losts of heat measured at the stack:
on fuel oil at 50 to/h.....6,38%
on natural gas.....5,37%

The CR 12 boiler is of the radiant type,aquatubullar,with natural circulation,being equipped with 2 packets of air preheating.
The focus is screened.Between those 2 air preheaters there is placed the injector of own condense,that is necessary for temperature adjustement of the superheated steam.The burning of the fuel is carried out in 4 burners.
The burning gases are absorbed by a centrifugal ventilator(200KW) and refuleted to the stack.The necessary air for burning is introduced into the boiler by a centrifugal ventilator(160KW).

1.2.Problems regarding control of burning

Currently,the control of burning is carried out periodically through its testing with a BACHARACH 300 analyser.
In the during of energy audit on a CR -12 boiler functioning with fuel oil,there were observed the following aspects:
-the oxygen quantity at the end of the focus variate btw.5,8-9,2%,and the air excess coeficient btw.1,36-1,74%
After that it is registred a continuuos growth of these reading,to come to the stack at values of:
-O2 = 12,1-14,6%
-Air excess= 2,29-3,18% .The cause is the air infiltrations.
The value for CO are practically negletable,tending to zero,and NO and SO apear within the normal limits,depending on the fuel oil used at a given moment.
From the comparison of the results measured with BACHARACH 300,even if it is considered that there exist some measuring errors,with those registred at the homologation of this type of boiler,there may be observed important diferences regarding the air excess which have as a consequance the growth of losses of heat with gases evacuation to the stack,and consequantly decrease of efficiency of the boiler and the increase of fuel consumption.

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-Computation

Elementary analysis of the fuel oil :
C+H+O+N+S+A+Wt= 100[%]
86,5+11,3+0,2+0,5+1+0,2+0,3= 100[%]

-Theoretic volume of fired gas:

Vga °=Vgn °+VH2O °=VR2O °+VN2°+VH2O °,where:

VR2O°=VCO2°+VSO2° =1,867(C+0,375S):100=1,62 Nmc/ kg fuel
VN2° =0,79Va°+0,8N:100 =8,48 Nmc/kg fuel where:
Va° -theoretical volum of fire gas
Va° =10,73 Nmc/kg fuel-calculeted
VH2O°=1,44Nmc/kg fuel ,, ,,
Vga° =11,54 Nmc/kg fuel ,, ,,

The real calculeted volume of fired gas is:
Vga° =13,03 Nmc/kg fuel
Pci =9400 kcal/kg-inferior caloric energy of the fuel oil
α =1,137-coef. of air excess in the end of focus,measured to homc-logation
In the case of measured air excess,there results;
α = 1,7
O2 =8,2%
Vga =11,54+(1,7-1)X10,9 =19,17 Nmc/kg fuel
-Efficiency decrease owed to increase of burning gases volume,resulted through air usage in excess at burning,can be computed by formula:

$$n = \frac{VgaxCmedxt°stack}{Pci} x100[\%] \text{ where:}$$

Vga =19,17-13,03=6,14Nmc/kg fuel
Cmed =0,324 kcal/mc°C -calculeted
t°stack=160-190°C -measured by BACHARCH 300 So,
n = 3,59%
-This lost from boilers efficiency imply a suplementary of fuel
-Similar computation can be made for usage of fuel of fuel under the form of natural gas.
-Boilers efficiency measured by BACHARACH has values btw. 85-89%

1.3. Computation suplementary consumption of fuel

-Hourly suplementary consumption:

$$Bh=\frac{D(Iab-Iaa)}{Pci}\left(\frac{1}{nmea} - \frac{1}{nmea+\delta}\right) [kg/h] \text{ where :}$$

D=50000 kg/hr.....steam capacity
Iab=796,4 kcal/kg.....superheated steam enthalpy
Iaa=151 kcal/kg.....feedwater enthalpy
Pci=9400 kcal/kg
nmea=0,86.....measured efficiency by BACHARACH 300
δ =0,0359.....lost efficiency, So:

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Bh= 137,3 kg/h
-Yearly suplementary consumption:
Byear= 4000 hr/yearx137,3 =549,200 kg/year heavy fuel oil

1.4 Suplementary costs

C = ByearxP_p [lei/year] , where :
P_p = 254,690 lei/to - the current heavy fuel oil(s<1%) price
C = 139,875,742 lei/year
Taking into account the minimal economy for the functioning with natural gas,the suplementary costs are: 62,457,142 lei
Ctot = 202,332,884 lei- the total suplementary costs

2. Recommended solution

2.1. Automatically guided burning equipment

These suplementary expences can be deleted through the utilisation an installation of automatically guided burning process of the boiler, type BAILEY- ICCS, or an other similary.
This equipment has been used in ROMANIA at NITRAMONIA SA FAGARAS,on a similary boiler.
The program of measurement was elaboreted with the registration and computation of the main parameters of the functioning boiler in the following regims:
-Boiler's functioning with classical automatization with burning adjustment with a fixed ratio element,but optimized according to indications given by ICCS being is a regime of a monitoring(analysing regime,without ICCS adjusting)
-The functioning of the ICCS boiler in a completely automatic regime with parameters registration in real time and sequential improvement of the adjustement of regulators(classical and ICCS) to optimal values.
Thus there were obtained savings of specific average consumptions btw 3-8%.

Conclusion

This type of equipment can be used at DANUBIANA.
The combination of the automatically guided burning process,with reduction of air excess along the whole route,with the provision of some execution elements for adjustments implementation guided by processor,can conduct to efficiency and increase by 2-3%

2.2 PROJECT COST ESTIMATE

-Engineering design.....12 mill.lei
-Equipment procurement.....101 mill.lei
-Equipment instalation.....8 mill.lei
-Equipment commisioning.....5 mill.lei
-Net reduction.....153,2 mill.lei (a)
-Total installed cost.....126 mill.lei (b)
-Estimated increase in annual(non-energy) operations and maintenance cost.....2,1 mill.lei (c)

$$\text{PAYBACK PERIOD:} \frac{b}{a-c} = \frac{126}{202.3-2.1} = 0.62 \text{ year}$$

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65

ACTION No.4

EQUIPPING THE VOLCANIZATION PRESSES WITH ADEQUATE CONDENSATION POTS FOR CONDENSE EVACUATION FROM THE DOME OR SCALES

1. CURRENT SITUATION

The volcanization departments from DANUBIANA are equipped with tyre volcanization presses of the following sizes:

- 40" - 42" with dome or scale for tyre volcanization for cars or tractors' front wheel tyre
- 55" BOM type with dome for trucks tyre volcanization
- 75" with dome for tyre volcanization for tractors' rear wheel

The 40" - 42" and 55" presses have 2 volcanization units each, and the 75" one has a single unit.

During the volcanization period the materials are heated through 5 bar steam introduction into the dome, the condense being eliminated at the saturation temperature through the steam traps - 1 for each volcanization unit. The steam traps are of the thermodynamic type, with relative reduces features, with registrations of defective functioning that causes greater steam consumptions than those indicated in the technical specifications of the machines, according to the technologic process.

DANUBIANA always cared for reduction of steam consumption for domes and scales heating. Thus there were adopted technologies that eliminated the cooling of the dome at the end of the volcanization cycle (at aprox. 80 C according to the old technology)

An important measure for reduction of this consumption is the equipping of the presses with adequate steam traps that would reduce the skip of uncondensed steam to the equipment of condense recover, it is well known that the thermodynamic steam traps even in the case of a proper functioning can admit skipings of steam for 3 - 10 %, especially in situations of intermittent functioning similar to those presses.

According to practical data of exploitation in different equipment through replacement of thermodynamic steam traps with traps of bell type, floater type, thermostatic, or with bimetal there result a reduction of steam consumption by 10-20 %.

To establish the efficiency of equipping presses with adequate steam traps we shall base our computations on the following data:

1. Minimal plan for tyre production:
   - 360,000 pieces/year of tyres for cars or front tractors volcanized on 40" - 42" presses
   - 386,000 pieces/year of truck tyres volcanized on 55" presses
   - 154,000 pieces/year rear tractor tyres volcanized on 75" presses

2. The necessar amount of presses utilized for production
   - 16, 40" - 42" presses
   - 50, 55" presses
   - 40, 75" presses

3. Consumptions of heat for a volcanization cycle established according to the thermal balance for each press type is as follows:
   - 40" - 42" press: q1 = 10,692 kcal/cycle/press
   - 55" press: q2 = 32,695 kcal/cycle/press
   - 75" press: q3 = 19,230 kcal/cycle/press

COMPUTATIONS

1. Total consumption of heat in presses's dome, for production:

$$Qtot = q1*n1 + q2*n2 + q3*n3 \quad kcal/year$$

where n1, n2, n3 are the number of cycles of press for tyre production.

$$n1 = \frac{360,000}{m} = \frac{360,000}{2} = 180,000 \text{ cycles for 40" - 42" presses}$$

$$n2 = \frac{386,000}{m} = \frac{386,000}{2} = 193,000 \text{ cycles for 55" presses}$$

$$n3 = \frac{154,000}{m} = \frac{154,000}{1} = 154,000 \text{ cycles for 75" presses}$$

where m is the number of volcanization units per press

m = 2 for 40" - 42" and 55" presses
m = 1 for 75" presses

$$Qtot = (180,000 * 10,692) + (193,000 * 32,695) + (154,000 * 19,230) \quad kcal/year$$

$$Qtot = 11,196,115,000 \text{ kcal/year}$$

2. Fuel savings obtained through equipping of the presses with new adequate condensation pots

It is estimated a reduction of steam consumption, respectively of heat, by 10 %, that is at the lower limit of some data obtained from testing carried out in different equipment.

$$Qec = .1 * Qtot = 1,119,115*10^6 \text{ kcal/year}$$

Considering a net annual average efficiency for thermic energy production at the power station of 75 %, there results a saving of fuel oil of Pci = 9,400 kcal/kg

$$Bec = \frac{Qec}{\eta * Pci} = \frac{1,119,115*10^6}{.75*9,400} = 158,740 \text{ kg/year}$$

The price of 1%S fuel oil is (incl. VAT): C = 254,690 lei/to

There results savings of

$$\Delta Ci = Bec*C = 158.74 * 254,690 = 40,429,490 \text{ lei/year.}$$

3. Savings of demineralized water at the power station through reduction of steam consumption

The resulting condense from the dome of the presses is an impurified condense which is utilized at the station of thermic utilities - CUT - as soft water to be added to the circuit of hot water for tyre volcanization, ie for steam production at the power station there will be used the demineralized water.

The 5 bar steam quantity equivalent to the saved heat is:

$$Gab = \frac{Qec}{r} = \frac{1,119,115*10^6}{504.2} = 2,219,585 \text{ kg/year}$$

Considering an efficiency of steam transportation from the power station to the consumption place of 97% and a continuous drain of 3 %, there results the consumption of demineralized water at the power station of:

$$Gad = \frac{Gab}{.97} * 1.03 = 2.356.879 \text{ kg/year} = 2,356 \text{ cubic m/year}$$

SInce the condense from the presses is used as soft water at the CUT, the valoric savings will result from the price difference for demineralized water - 2,500 lei/cubic m, and for soft water - 1,400 lei/ cubic m

$\Delta C2$ = Gad*(Cad - Caded) = 2,356*(2,500 - 1,400) = 2,591,600 lei/yr

4. Total savings

$\Delta C = \Delta C1 + \Delta C2$ = 40,429,490 + 2,591,600 = 43,021,090 lei/year

5. Evaluation of investments and annual expenses

It is considered the equipping of the presses with 1 filter each, and 1 thermostatic condensation pot without filter for each volcanization unit (2 for 40" - 42" and 55" and 1 for 75" presses):

Thus there necessary:
- filters : (16 + 50)*2 + 40*1 = 172 piecies + 8 spares = 180 pcs.
- pots : (16 + 50)*2 + 40*1 = 172 piecies + 8 spares = 180 pcs.

Prices: - filters : Du15 - 60,000 lei/piece - domestic
- pots : Du15 - DM 120/piece - imported

DM 120 * 1,400 lei/DM = 168,000 lei
Customs: 10 %
VAT: 18 5

Franco cost beneficiary: 168,000 * 1,1 * 1,18 = 218,064 lei/buc

Total costs for equipment purchase:
C3 = 180*(218,064 + 60,000) = 50,051,520 lei

Investment evaluation:

- Design	3,000,000 lei
- Equipment purchase	50,051,520 lei
- Equipment installation	*
- Tests + PIF	*
TOTAL Itot =	53,051,520 lei

* NOTE: It has been considered that the installation, tests, and PIF will be carried out by DANUBIANA.

Maintenance and depreciation cost: .05 % of investment + .1 % of investment.

$$Cia = \frac{.05*53,051,520}{100} + .1*53,051,520 = 5,331,678 \text{ lei/year}$$

6. Investment recovery period

$$\tau_{rec} = \frac{I_{tot}}{C - C_{ia}} = \frac{53,051,520}{43,021,090 - 5,331,678} = 1.4 \text{ years}$$

CONCLUSIONS

Generally an investment in the energetic sector is considered efficient if it is recovered in maximum 5 year.

From this point of view the action of equipping of presses with adequate condensation pots is very efficient even in the case when the savings of energy will be of 5 % only against the computed 10 %.

A possible reduction of the investment recovery period can be done through an attentive investigation of the market at the moment of aquisition of condensation pots from import.

ACTION No.5

RECOVERING UNDER PRESSURE OF WARM DRAINAGE FROM THE HOT WATER FOR TYRE VOLCANIZATION, IN THE OLD VOLCANIZATION DRAINAGE

1. CURRENT SITUATION

Tyre volcanization is done in interior with hot water under pressure of 19 - 21 bar and temperature of 180 - 185 °C. The volcalization with hot water is done in the 2 ways continuous circulation through the diaphragms of the volcanized tyres and contains the following main phases:

- filling the diaphragms with hot water
- 2 way circulation of hot water through the diaphragms
- stopping the circuit and evacuating the water from the diafragms.

The hot water in the 2 way circuit at 185/175°C is assured by the station of thermaic utilities - CUT -, through pipes installed in thermic canals of the presses series from the volcanization department. In the CUT there are recovered the drainage from the presses, and after degasation - they are introduced reheated through pumping in the hot water circuit. According to some old technologies the evacution of the warm drainage from the presses at the end of the volcanization period was simultaneously with the introduction of cold water under pressure for the inside cooling of the tyres. In order to reduce the consumption of thermic energy DANUBIANA made experiments and adopted a technology which delete the inside tyre cooling phase.

Regarding the phase of evacuation of the warm drainage from the diaphragms there can be said the following:

- regardless the way of evacuation, respectively with cooling water or without cooling water the drainaige are evacuated through pipes, through free leakage into the atmospheric reservoirs in the CUT, in the basement under the quote of placement of the presses from the volcanization department;
- a very important share of heat contained in these drainage is lost:

a. through expanding of hot water (drainage) evacuated from diaphragms from 175 - 180 C to 100 C (atmospheric pressure) with the lost in the atmosphere of the secondary steam from expansion in the case when there is no interior cooling;

b. through expansion and mixing with cooling water in the case when the interior cooling is done. Here the temperature in the drainage reservoirs from the CUT comes down to 80 - 85 C.

It must be noted that these drainages from the hot water from the 2 way volcanization circuit must be heated up to 180 - 185° C and introduced through pumping at aprox. 18 - 19 bar in the circuit of hot water, as suplementary water for compensation of losses under the form of drainage.

2. SUGGESTED SOLUTION FOR REDUCTION OF LOSSES

It is obvious that the losses reduction through recovering of the heat of these drainage conducts to reduction of consumptions of thermic energy at the CUT thet are necessary for preparation of volcanization hot water.

Thus it is recommended the recuperation under pressure of the warm drainage proceeded from the presses at the end of volcanization. This action is subjected to implementation of the following sequence of functioning of the presses and a recovering scheme:

a. Design an evacuation sequence of the drainage under pressure through an automatic valve from the press, through a pipe that would direct the drainage to a closed expansion vessel, where there will take place the expansion to 3-5 bar
In this case the evacuation of the drainage from the presses diaphragms will be done through own created pressure in the diaphragm the steam forming through expansion from 175-180°C (saturation pressure 9-10 bar) at 3-5 bar.pressure from the recovery circuit.

b. Recovery of the secondary 3-5 bar.a steam resulted from the expansion of drainage in the recovery reservoir and its introduction in the steam network of 3 - 5 bar.a from the section, where from there are supply different customers of low pressure stream.

c. Taking over of the warm drainages after expanding from the recovery reservoir and their pumping from the pressure of 3 - 5 bar.a (T=142 -151°c), in the hot water circuit, to the pressure of 18 - 19 bar (in the returning pipe from the presses).

NOTE: Due to the constructive system of the evacuation circuits of the drainages through the presses, there is no possibility to evacuate more than 85 - 90 % of the total water contened of the diaphragms.

- After drainage evacuation under pressure, the cycle may be continued with the evacuation in the drainage without pressure of the remaining water in the diaphragm, or with interior cooling with evacuation in the returning circuit of cooling water(cold drainages)

- In the case when interior cooling is not carried out, there is no necessity to install an automatically guided valve for warm drainage evacuation under pressure, with the possibility to use the existing valve for cold water.

- Establishing the investment values it should be taken into account the equipping of each press with an automatically guided pneumatic valve for evacuation and a retaining dumper for each volcanization unit of the press, that constitutes the maximum equipping value, in the case when there is no possibility to use one of the valves for interior cooling water.

3. COMPUTATIONS HYPOTHESIS

3.1. Tyre production plan for old volcanization section

- 360,000 pcs/year car and front tractor tyres volcanized on 40" - 42" presses
- 386,000 pcs/year truck tyres volcanized on 55" presses
- 100,000 pcs/year rear tractor tyres volcanized on 75" presses

3.2. Number of presses utilized for production process

- 16 - 40" - 42" presses with 2 volcanization units
- 50 - 55" presses with 2 volcanization units
- 40 - 75" presses with 1 volcanization unit

3.3. Diaphragm water volume per unit and per press type

- 40" - 42" press - 83.5 l/dph respectively 167 l/press
- 55" press - 170 l/dph respectively 340 l/press
- 75" press - 500 l/dph respectively 500 l/press

4. COMPUTATIONS

4.1. Verification computations regarding drainages evacuation from presses, under pressure created through expansion of hot water from the diaphragm.

- Innitial parameters of hot water in diaphragms (at the beginning of the drainage evacuation from presses' diaphragms.

$p1 = 19$ bar, $t1 = 175^{\circ}C$ (min), $i1' = 177$ kcal/kg, $\gamma 1 = 892$ kg/cub m

- Final parameters of the hot water at the end of evacuation

$p2 = 5$ bara, $t2 = tsat = 151^{\circ}C$, $i2' = 152{,}1$ lcal/kg,

$v2'' = .3817$ cub m/kg, $r2 = 504.2$ kcal/kg

- We shall find out the the quantity of water at $175^{\circ}C$ that would be sufficient to expand to $p = 5$ bar.a ($ts = 151$ C) to creat the necessary volume of steam that would replace the water from the diaphragm.
The steam quantity resulted from 1 liter of drainage of $175^{\circ}C$ from the press:

$$G_{ab}^{5\,bar} = V * \gamma 1 \frac{i1' - i2'}{r2} = .001 * 892 \frac{177 - 152.1}{504.2} = .04405 \text{ kg/}\ell$$

$$V_{ab} = .04405 * V2'' = .04405 * 0.3817 = .0168 \text{ cub m/}\ell$$

Quantity of water necessary to expand to fill the diaphragms with expanded steam, through drainage evacuation:

- For 40"-42" press: $V_a = \frac{V_{dph}}{V_{ab}} = \frac{.0835}{.0168} = 4.97\ \ell < 83.5\ \ell$

- For 55" press: $V_a = \frac{V_{dph}}{V_{ab}} = \frac{.17}{.0168} = 10.12\ \ell < 170\ \ell$

- For 75" press: $V_a = \frac{V_{dph}}{V_{ab}} = \frac{.5}{.0168} = 29.8\ \ell < 500\ \ell$

There results that through expanding of hot water from diaphragms there is created a sufficient quantity of steam to evacuate under the pressure created by it, of the warm drainages from diaphragms.

4.2. Computations of savings of thermic energy, electricity, and adding soft water obtained from recovery of the warm drainages under pressure.

4.2.1. The total quantity of drainages resulted at tyre volcanization:

- from 40" - 42" presses :360,000 pcs/year * 83.5 ℓ/dph = = 30,600 cub m/year
- from 55" presses :386,000 pcs/year * 170 ℓ/dph = = 65,620 cub m/year
- from 75" presses :100,000 pcs/year * 500 ℓ/dph = = 50,000 cub m/year

TOTAL V_{dcp} = 146,220 cub m/year

Considering a recovery of 85 % of the warm drainage under pressure there results the annual total quantity that could be recovered:

$$Gdcp = V\ dcp * \gamma 1 * Kr = 146{,}220 * 892 * .85 * 10^{-3}\ t/year$$

$$Gdcp = 110{,}864\ t/year$$

4.2.2. Savings of thermic energy obtained through re covery under pressure of the warmdraiages:

Currently during the recovery of the drainages in reservoirs at atmospheric pressure there is produced a loss of steam resulted from expansion, respectively:

$$Qes = Gscp(i1' - i2')*10^{-3}\ Gcal/year$$

$$Qes = 110{,}864(177 - 100) * 10^{-3} = 8{,}536.5\ Gcal/year$$

$$Ges = \frac{Qes}{r} = \frac{8{,}536.5*10^{3}}{539.6} = 15{,}820\ t/year$$

In the case of recovering of warm drainages under pressure, this lostis eliminated, ie there is a saving. Assuming a recovery efficiency of 90% there results a net saving of of:

$$Qec = .9*Qes = .9*8536.5\ Gcal/year = 7{,}682.9\ Gcal/year$$

With a net average annual efficiency of production and transport of thermic energy from the power station to the consumption department of 75%, there results a saving of (1%S fuel oil, Pci = 9400 kcal/kg):

$$Bec = \frac{Qec}{\eta * Pci} = \frac{7{,}682.9*10^{3}}{.75*9{,}400} = 1{,}089.8\ t/year$$

The fuel oil price (inclusive VAT) is Cb = 254,690 lei/to.

There results a saving of:

$$C1 = Bec*Cb = 1{,}089.8*254{,}690 = 277{,}553{,}400\ lei/an.$$

4.2.2. Current savings of adding soft water from elimination of losts in the atmosphere of steam from expansion at atmospheric pressure.

The price of soft water is Cad = 1400 lei/cub m (1400 lei/t)

The resulting saving is:

$$\Delta C2 = Ges*Cad = 15{,}820\ t/year*1400\ lei/t = 22{,}148{,}000\ lei/year$$

4.3.3. The savings of electric energy resulted from the fact that the warm draiages recovered under pressure are repumped into the hot water circuit from the recovery pressure of (p = 5 bar.a) to the pressure of 18 bar from the hot water circuit; on the contrary, currently the drainages are pumped from the atmospheric pressure to 18 bar.

a. Current situation:

$$Gdfp=(Gdc-Ges)*\frac{1}{\gamma a^{100c}} = (110,864 - 15,820)*\frac{1}{.958} = 99,210 \text{ cub m/yr}$$

Δpp = 18 bar; ηp = .65 avg annual pumping efficiency

$$Hp = 18*10*\frac{1}{\gamma} = \frac{180}{.958} = 188 \text{ cub m}$$

Pumping energy:

$$Ep1 = \frac{Qdfp*H*\gamma}{367*\eta p} = \frac{99,210*188*.958}{367*.65} = 74,903 \text{ kW*h/yr}$$

b. Situation of recovering the warm drainage under pressure:

Through the DCP expansion at p2 = 5 bar.a there results the quantity of the recovered steam:

$$Grec = \frac{110,864*10^3 \text{ kg/yr}(177-152.1) \text{ kcal/kg}}{504.2} * .9$$

Grec = 4,927.5 t/yr

The warm drainage recovered at p=5 bar.a which will be repumped in the circuit is:

$$Gdcp = 110,864 - 4,927.5 = 105,936.5 \text{ t/yr} \quad \gamma^{5bar.a} dcp = 916 \text{ kg/cub m}$$

$$Qdcp = \frac{Gdcp}{\gamma 151} = \frac{105,936.5}{.916} = 115,651 \text{ cub m/yr}$$

$$pp = 18 - 4 = 14 \text{ bar} = \frac{14*10}{.916} = 153 \text{ cub m}$$

Pumping energy:

$$Ep2 = \frac{Qdcp*H*\gamma}{367*\eta p} = \frac{115,651*153*.916}{367*.65} = 67,945 \text{ kW*h/yr}$$

c. Savings of energy for pumping:

$$E = Ep1 - Ep2 = 74,903 - 67,954 = 6,958 \text{ kW*h/yr}$$

Average price of electric energy: Ke = 85 lei/kW*h
Resulting savings:

$$C3 = E*Ke = 6,958*85 = 591,430 \text{ lei/yr}$$

4.3.4. Total savings resulted from warm drainages recovery under pressure:

$$\Delta C = \Delta C1 + \Delta C2 + \Delta C3 = 277,553,400 + 22,148,000 + 591,430$$
$$C = 300,292,830 \text{ lei/yr}$$

5. EVALUATION OF INVESTMENTS AND ANNUAL SAVINGS

5.1. Investments for presses equipping:

It is necessary to equip every volcanization unit with:

- Pneumatic valve for DCP evacuation	- 500,000 lei/pce
- Guiding electromagnetic tap	- 300,000 lei/pce
- Closing tap	- 100,000 lei/pce
- Retaining tap	- 80,000 lei/pce
- Electric cables	- 15,000 lei/unit
- Pipes and AMC	- 45,000 lei/unit
PURCHASE TOTAL	1,040,000 LEI/UNIT

Total volcanization units:

16 40" - 42" presses	* 2 units/press	= 32 units
50 55" presses	* 2 units/press	= 100 units
30 75" presses	* 1 units/post	= 30 units
	TOTAL 1	= 162 UNITS
	RESERVE	8 UNITS
	TOTAL	= 170 UNITS

Total investments for presses' equipping:

Purchase: 170 * 1,040,000 = 176,800,000 lei
Installation: 2,000,000 lei

TOTAL: 178,800,000 lei

5.2. Pipes, AMC, insulations in the volcanization dept.

- Pipes, Dn 100 lateral canals: 800 m	- 8,800 kg
- Pipes, Dn 200 magistral canal: 310 m	- 13,100 kg
- Pipes, Dn 25 - to presses: 850 m	- 2,000 kg
- AMC	- 1,500 kg
- Metalic structures, supports	- 1,600 kg
TOTAL :	27,000 KG

Purchasing price and installation: 5,000,000 lei/t

- Pipes, AMC 27 t * 5,000,000 =	135,000,000 lei
- Pipes and AMC insulation	100,000,000 lei
TOTAL :	235,000,000 LEI

5.3. Investments for the recovery equipment of the warm drainages under pressure in the hot water station - CUT.

- Purchase of DCP reservoirs	- 25,000,000 lei
- Purchase of pumps	- 36,000,000 lei
- Purchase of AMC equipment	- 50,000,000 lei
TOTAL EQUIPMENT PURCHASE	111,000,000 LEI
- Equipment installation	10,000,000 lei
- Pipes and AMC	40,000,000 lei
- Materials and AMC equip. inst.	30,000,000 lei
- Eqpt. and pipes insulation	50,000,000 lei
- Constructions	50,000,000 lei
TOTAL INSTALLATION	180,000,000 LEI
TOTAL CUT INVESTMENT	291,000,000 LEI

5.4. REVISING INVESTMENTS

- Design:	70,000,000 lei
- Equipment purchase	287,800,000 lei
- Installation	417,000,000 lei
TOTAL INVESTMENT	774,800,000 LEI

NOTE: The testing and the PIF are considered to be carried out by the beneficiary.

5.5. ANNUAL COSTS FOR MAINTENANCE AND DEPRECIATION

- Maintenance: .05% of investment
- Depreciation: 7% of investment (avg value)

$$Kia = \frac{.05*774,800,000}{100} + .07*774,800,000 = 54,623,400 \text{ lei/yr}$$

6. INVESTMENT RECOVERY PERIOD

$$\tau rec = \frac{Itot}{C - Kia} = \frac{774,800,000}{300,292,830 - 54,623,400} = 3.15 \text{ yrs}$$

τrec = 3,15 years

CONCLUSIONS

The 3.15 years recovery period is shorter than 5 years that is considered to be an efficient recovery period for an investment in the power sector.

In the case when there are utilized volcanization cycles without the interior cooling phase, for the warm drainages evacuation under pressure from the presses there can be utilizes automatic valves from the cooling circuit. This conduce to a reduction of the total investment by 200,000,000 lei and correspondingly the investment recovery period by 2.2 years.

The efficiency growth for DCP recovery, respectively the reduction of the investment recovery period can be carried out also through the increase of the recovery rate of the volume of the drainages from the diaphragms from 85%, that was considered in the computations, to 90-95%.

The efficiency increase can be also done through execution by the beneficiary of some works of construction and installation.

The recovery efficiency will be greater if the tyre production increases.

To ease the investment effort the works can be planned a trunks. Thus there can be observed that the maximum efficiency is obtained from the recovery of the warm drainage under pressure from the 75" and 55" presses, because at the same expenditures for equipping the presses with the necessary equipment, the quantity of the recovered drainageis much greater compared to the 40" - 42" presses. Taking into account this idea, the DCP recovery will have to begin from the 75" and 55" presses. However, it must be noted that the production program for different tyre sizes.

The reduction of the investment values is possible through the installation of the warm drainages recovery under pressure even in the volcanization department, next to the presses. Thus it is possible to reduce the length of the DCP pipe to the CUT, and additionally the losts of heat are reduced correspondingly.

ACTION No.6

REDUCTION OF THE STEAM CONSUMPTION AT THE FUEL OIL RESERVOIRS 2000 CUBIC M

1. CURRENT SITUATION

At the DANUBIANA S.A. there exist 3 aboveground fuel oil reservoirs of 2,000 cubic m each and 1 reservoir of 1,000 cubic m. The reservoirs are insulated and are designed with heating coils which maintain the deposited fuel oil at approximately 70°--80°C. The heating thermal agent is the 3 bat.a steam, and the condenseis not recovered, being directed to the canal. The reservoirs are not designed with taps for steam debit control introduced into the coils for maintaining at a constant temperature. The condense evacuation is done through thermodynamic steam traps. The reservoirs have temperature detectors which signal the temperature exceed over 100°C, which is the temperature of fuel oil flamation.

Since there isn't any automatic control of fuel oil deposit temperature, the steam consumption is higher than the strictly necessary one depending on the temperature of the exterior. There has been registred defective functionings of the condesation traps, especially owed to the low steam pressure, which conducts to values of pressure behind the trap of 50% greater than the steam pressure, values at which the thermodynamic steam traps do not function properly, and steam evacuations occure frequently.

2. PROPOSED SOLUTION FOR REDUCTION OF STEAM CONSUMPTION

It is suggested that the aboveground reservoirs to be supplied with:

- 1 automatic valve for steam debit control introduced into the coil depending on the temperature of the fuel oil in the reservoir, which will be maintained at the constant value of 70°C.

- 1 corresponding steam trap capable of proper functioning at variations of steam pressure.

3. COMPUTATION HYPOTHSES

To establish the efficiency of proposed measures for steam consumption reduction we shal make computations for a 2,000 cubic m reservoir - cylindrical, vertical, insulated with mineral wadding:

Reservoir's characteristics:

- Φ = 15.270 mm
- H = 11.775 mm
- δ_1 = 10 mm - width of the wall
- δ_{iz} = 100 mm - width of the insulation
- λ_{iz} = .0628 W/m°C - mineral wadding
- degree of filling with fuel oil - 90%

We shall use for computations annual average temperatures in the Danubiana area:

- air avg temperature: +11.5°C
- ground avg temperature: + 5 °C

Computation parameters for steam and fuel oil:

t_p = 70°C - fuel oil temperature in reservoir
p_{ab} = 3 bar·a, tsat = 133°C

4. COMPUTATIONS.

4.1. Based on the geometric characteristics of the reservoir it is computed:

- the exterior surface of the insulated reservoir for the area in contact with the fuel oil:

$H_p = .9 \cdot H_{rez} = .9 \cdot 11.775 = 10.6$ m - height of the reservoir in contact with the fuel oil;

$S_1 = \pi \cdot D_{eiz} \cdot H_p = \pi \cdot 15.47 \cdot 10.6 = 515$ m²

- the surface of the reservoir that isn't in contact with the fuel oil (cylindrical area + lid):

$$S_c = \frac{\pi \cdot D^2_{eiz}}{4} + \pi \cdot D_{eiz} \cdot [(H_{rez} + \delta_{iz}) - H_p] = \frac{\pi \cdot 15.47^2}{4} + \pi \cdot 15.47 \cdot$$

$$\cdot [(11.775 + .1) - 10.6] = 250 \text{ m}^2$$

- the surface of the reservoir bottom:

$$S_r = \frac{\pi \cdot D_{erez}}{4} = \frac{\pi \cdot 15.27^2}{4} = 183 \text{ m}^2$$

4.2. Equation for heat transfer from the fuel oil to exterior environment:

$Q = KS \cdot (tp - to)$ [W]

to - average weighted exterior temperature

$$to = \frac{(S_1 + Sc)\ tair + Sf \cdot tsoil}{S_1 + Sc + Sf} = \frac{(515+151) \cdot 11.5 + 183 \cdot 5}{515 + 151 + 183} = 10,2°C$$

$KS = k_1 \cdot S_1 + kc \cdot Sc + kf \cdot Sf$ [W/°C]

k_1 - global coeficient of thermal transfer through the S_1 surface (from the fuel oil to the exterior through the metalic wall and insulation)

$$k_1 = \frac{1}{\frac{1}{\alpha_1} + \frac{\delta_1}{\lambda_1} + \frac{\delta iz}{\lambda iz} + \frac{1}{\alpha 2}}$$

α_1 = 21 W/m²°C - fuel oil - metalic wall
λ_1 = 57 W/m°C - coeficient of thermaic conductability for metalic wall
$\alpha 2$ = 23 W/m²°C - insulation surface - exterior air

$$k_1 = \frac{1}{\frac{1}{21} + \frac{.01}{57} + \frac{.1}{.0628} + \frac{1}{23}} = .6\ W/m^2°C$$

kc - global coeficient of thermal transfer from the fuel oil to the exterior air through the reservoir area that is not in contact with the fuel oil

$$kc = \frac{1}{\frac{1}{\alpha 3} + \frac{1}{\alpha 4} + \frac{\delta_1}{\lambda_1} + \frac{\delta iz}{\lambda iz} + \frac{1}{\alpha 2}}$$

$\alpha 3$ = 7.22 W/m²°C - fuel oil - interior air at the fuel oil surface

$\alpha 4$ = 2.93 W/m²°C - interior air - reservoir metalic wall

$$kc = \frac{1}{\frac{1}{7.22} + \frac{1}{2.93} + \frac{.01}{57} + \frac{.1}{.0628} + \frac{1}{23}} = .473\ W/m^2°C$$

kf = .14 W/m²°C - global coeficient of thermic transfer from the fuel oil to the soil through the bottom of the reservoir.

Quantity of heat lost in the exterior.

$Qp = ks\ (tp - to) = (k_1 S_1 + kcSc + kf \cdot Sf)(tp - to)$ [W]

$Qp = (.6 \cdot 515 + .473 \cdot 250 + .14 \cdot 183)(70 - 10.2) = 27.082$ w

Qp represents the annual average value losts per hour of heat from the reservoir to the exterior when the temperature of the fuel oil in the reservoir is maintained costant at 70°C.

4.3. Thermic capacity of the reservoir's coil

The reservoir is designed with a coil having an Ss = 40 m²
For tp = 70°C
tab = 133°C (p=3 bar·a)
ks = 81.4 W/m²°C - global coeficient of thermic transfer from the steam to the fuel oil through the coil

There results the thermic capacity of the coil:

$Q(coil) = ks \cdot Ss(tab - tp) = 81.4 \cdot 40(133 - 70) = 205.128$ W

It can be observed that we have:

$Q(coil) > Qp$

In this situation the temperature of the fuel oil will increase till the value at which the thermic flux from the steam to the fuel oil (through the coil) with the thermic flux from the fuel oil to the exterior.

Thus, we shall have:

$(k_1 S_1 + kc \cdot Sc + kf \cdot Sf)(tp - to) = ks \cdot Ss(tab - tp) = ks(tp - to)$

$ks = k_1 \cdot S_1 + kcSc + kfSf = .6 \cdot 515 + .473 \cdot 250 + .14 \cdot 183 = 452.87$ w/°C

There results tp:

$$tp = \frac{ks \cdot Ss \cdot tab + kSto}{kS + ks \cdot Ss} = \frac{81.4 \cdot 40 \cdot 133 + 452.87 \cdot 10.2}{452.87 + 81.4 \cdot 40} = 118\ °C$$

I.e. in the case when there is no adjustment of steam in the reservoir coil the annual average value of the fuel oil temperature in the reservoir will be much greater than the necessary one, cosequently the losses in the exterior will be greater.

4.4. Computations for savings of thermal energy

Note: For saving computation we shall consider that by the interference of the personnel of exploitation the (annual average) temperature of the fuel oil will be limited to 100 °C against 118°C

In this situation the heat loss to the exterior will be:

$Q'p = ks(tp - to) = 452.87(100-10.2) = 40.667$ W/h or 34.973.62 kcal/h

For a depositing period of 8,000 h/year, through the adjustment of fuel oil temperature in the reservoir there are saved:

$Qec_1 = (Q'p - Qp)\cdot\tau = (40.667-27.082)x8.000=108.680$ kw/year

$Qec_1 = 93.464$ Gcal/year

By designing an adequate steam trap there is estimated a reduction by 10% of consumption through elimination of steam losses through current traps.

$Qec2 = .1\cdot Qp\cdot\tau = .1x27.082x8.000x10^{-3} = 21.665.6$ kw/year

Qec2 = 21.665.6 kw/year =18.632 Gcal/year

Total savings of thermic energy:

$Qec = Qec_1 + Qec2 = 83.807 + 16.733 = 112.096$ Gcal/year

With an annual average efficiency rate of 75 % of production and transport of thermic energy there result savings of fuel oil of 1% S

$$Bec = \frac{Qec}{\eta\cdot Pci} = \frac{112.096\cdot 10^9}{.75\cdot 9,400} = 15.9 \text{ t/year}$$

Price of 1% S fuel oil is 254,690 lei/t incl. VAT

$\Delta C1 = Bec\cdot cp = 15.9x254\ 690=4.049.571$ lei/year

4.5. Computation for savings of demineralised water

Corresponding to savings of thermic energy there results a reduction of steam consumption :

$$G_{ab} = \frac{G_{ab}}{i\ 9\ bar\cdot a} \cdot \frac{112.096 \cdot 10^{9}}{0.97 \cdot 0} = 216,69\ t/year$$

Considering an efficiency of 97% of steam transportation from the power station to the reservoirs and a blowdown of 3% at boilers, there results a reduction of consumption of demineralized water, at the power station:

$$G_{ad} = \frac{G_{ab}}{.97} \cdot 1.03 = 230\ t/year \approx 230\ m^3/year$$

Price for demineralized water: C_{ad} = 2500 lei/m³
There result savings of.

$$\Delta C_2 = 230 \times 2.500 = 575.000\ lei/year$$

4.6. Total savings

$$\Delta C = \Delta C_1 + \Delta C_2 = 4.049.571 + 575.000 = 4.624.571\ lei/year.$$

5. INVESTMENTS EVALUATION

5.1. Purchase of equipment

- Direct temperature adjuster		3,000,000 lei
- Thermostatic steam trap DM140·1400lei/DM =	196,000 lei	
VAT - 18 %		35,280 lei
customs - 10 %		19,600 lei
Total		250,880 lei
TOTAL EQUIPMENT		3,251,000 LEI

5.2. Investment evaluation:

- Design	350,000 lei
- Equipment design	3,251,000 lei
- Installation	500,000 lei
- Probes + PIF*	-
Itot	4,101,000 lei

*DANUBIANA

5.3. Maintenance and reparation costs

-Maintenance	.01 % of Itot
-Depreciation	10 % of Itot

$$cia = \frac{.05 - 4,101,000}{100} + .1-4,101,000 = 412,150 \text{ lei/year}$$

6. INVESTMENT RECOVERY PERIOD

$$drec = \frac{Itot}{DC - cla} = \frac{4,101,000}{4,624,571 - 412,150} = 0.97 \text{ years}$$

CONCLUSIONS

- The investment in efficient since it has a short recovery period compared to the accepted value of 5 years for the energy sector.

- The provision of the reservoirs with automatic temperature adjusters and with adequate steam traps conducts to temperature maintenance below the value of inflammation - a procedure prescribed by standards.

- The provision of reservoirs with automatic adjusters allows temperature adjustment of the fuel oil at values below 70°C in periods when the reservoir is not in the fuel oil load-consumption circuit, but only in state of depositing, with the reduction of steam consumption.

- In any case the replacement of steam traps in absolutely necessary because of the reasons described above (this type of thermodynamic trap is not adequate for functioning with contrapressure greater than 50% of steam pressure.

- Adjustment of fuel oil temperature in reservoirs is strictly necessary in situations when the reservoir in the circuit of fuel oil consumption and it is returned back to it fuel oil of a higher temperature (180-130°C) from the burners of the boilers. Temperature adjustment reduces steam consumption and reduces the possibility of fuel oil inflammation.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- ROMANIA

FINAL ENERGY AUDIT REPORT

for work at

Matizol, S.A.

by

Mihial Zdravcu

Arcon, S.R.L.

for

Hagler Bailly Consulting, Inc.

87

ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	**MATIZOL** S.A.
Address	PLOIEŞTI
	Sos. CENTURA PLOIESTI-EST
Telephone	401 - 044 - 125400
Fax	401 - 044 - 144541
Contact Person	**Petru VEIGANG** and **Dan IONESCU**
Title	Technical Director Energy Manager
Telephone	401 - 044 - 125400

2. Energy auditor information

Dates - audit started: March 1994 audit completed: April 1994

Energy audit company	**ARCON** SRL
Energy audit team leader	**Mihail ZDRAVCU**
Address	Str. Odobeşti 1, Bl. Z2, Sc. 5, ap. 59
	Bucureşti, ROMANIA
Telephone	401 - 673.60.81
Fax	401 - 673.60.81

88

3. Energy audit information

Energy audit focus - describe the major tasks, or areas of the plant, which were investigated during the energy audit:

- To evaluate energy consumption at the plant
- To identify energy conservation actions or opportunities
- To identify instrumentation and low-cost equipment needed by the plant to implement the more attractive energy conservation actions
- Areas of the plant which were ivestigated are:

a) Bitumen treated glass fibre felt process line
b) Bitumen treated glass fibre fabric process line
c) Bitumen coated cardboard process line and Oxidation plant
d) Mineral Wool process line
e) Air compressor house
f) Utility facilities: electricity, steam, water
g) Head office, mechanical and electrical workshops

Energy efficiency - in the energy auditor's opinion, what were the most significant findings of the energy audit:

a) Consumption efficiency at 8 gas fired for glass sticks and Mineral wool fabrication
b) Reduction of the heat loss
c) Reduction of compressed air losses
d) Energy management
e) Conviction of the management of the factory to implement a Energy management plan for reduction of the specific consumptions

New experience - in the energy auditor's opinion, what were the most significant lessons learned during the energy audit:

- Simplicity of the portable testings methods with combustion efficiency analyser (O_2, CO_2, excess air and stack loss), infrared pyrometer and portable ultrasonic testers

4. Energy savings

List the energy efficiency measures ALREADY IMPLEMENTED, during the course of the audit (if any):

Description of measure	Fuel saved	Savings/units	Payback
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years

40

4. Historical production and energy consumption

1. Summarize the recent production and energy consumption at the plant in physical units (also list the type of units per year, i.e. tons/year, kWh/year etc.):

Year:	1990	1991	1992	1993	UNITS
Production:					
a. Bit.Cardboard				$19,445 \times 10^3$	m^2
b. Mineral Wool				6,598	t
c. Glass fibre felt				$9,000 \times 10^3$	m^2
d. Glass fibre fabric				$4,300 \times 10^3$	m^2
e. Glass sticks				3,092	t
Energy:					
heavy fuel oil:					
diesel fuel oil:			13.27×10^6	16.16×10^6	Nm^3
natural gas:					
coal:					
electricity:			21,312	21,494	MWh
steam:					
other (describe):					

Energy/Production index:

	a	b	c	d	e
thermal	6.7 $GJ/10^3m^2$	25.56 GJ/t	10.20 $GJ/10^3m^2$	7 $GJ/10^3m^2$	29 GJ/t
electrical	0.122 $MWh/10^3m^2$	0.2 MWh/t	0.2 $MWh/10^3m^2$	0.6 $MWh/10^3m^2$	0.46 MWh/t

91

5. Historical energy costs

Summarize the recent energy cost at the plant, for the base year of the audit and following years, in terms of money per year:

Year:	1990	1991	1992	1993	UNITS
heavy fuel oil:					
diesel fuel oil:					
natural gas: Avg	89.426 USD/1000 Nm^3			2.67 USD 2.14 USD	GJ imported 70% GJ local 30%
coal:					
electricity:	0.05 USD/kWh			0,034 USD 0.131 USD	kWh kWh demand
steam: (saturated)	10.94 USD/t			3.97 USD	GJ
other (describe):					

6. Previous actions

Describe any other projects which resulted in improved energy efficiency that have already been implemented (or are already funded and in-progress), but which were not identified in the energy audit. Describe the project, the source of the idea, the approximate cost of implementing the project, and the source of funding:

a) Providing of a tub head recuperator at 3 glass stick furnaces and reduction of the stack temperature from 1200°C to 350°C. Investment from own resources.

b) Burners changing 100×10^6 Nm^3/yr - 1.5 million lei/yr

c) Convertors 100 mWh/yr - 3 million lei/yr

92

7. **Detailed forms - required**

Complete and attach the following forms:

Fuel, steam, or heat energy consumption - 12 month audit period
(complete for each major fuel type for areas studied)

Steam generation - 12 month audit period (if plant has boiler)

Energy balance - fuel, steam or heat

Electric energy consumption - 12 month audit period

Electric energy generation - 12 month audit period (if plant has generator)

Energy balance - electrical

Action plan - summary of energy efficiency project opportunities

Recommended action - energy efficiency opportunity
(complete one for each recommended action)
(attach additional details if required to justify project)

8. **Narrative**

Provide any other information which would be useful to USAID and RCG/Hagler Bailly:

_____

_____

_____

_____

_____

93

ELECTRIC ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
Prepared for USAID and RCG/Hagler Bailly

Plant name: MATIZOL
Address: Ploieşti – Romania

Auditor's name: Mihail ZDRAVCU

Report date: March 1994

Electricity contract terms:

Electricity supply company's name National Grid 110/6kV

Contract maximum demand (kW): 3000

Minimum charge (cost): 0.034 USD/kWh

Other: Winter 0.0532 USD/kWh; Summer 0.0468 USD/kWh
Arg 0.05 USD/kWh

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD:

Meter Reading Mo day/yr	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Power Factor cos 0	Load Factor	Total Cost USD	Product. Index kWh per:	Notes on plant conditions and changes
Jan /93	1441200	547656	1937	2083	0.93	0.65	76672		
Feb /93	1624800	617424	2507	2696	0.93	0.84	86439		
Mar /93	1632900	620502	2268	2439	0.93	0.76	86870		
Apr /93	1704900	647862	2292	2465	0.93	0.77	79244		
May /93	2142600	814188	2977	3201	0.93	1.00	99588		
Jun /93	1976400	751032	2656	2856	0.93	0.89	91863		
Jul /92	1586100	602718	2203	2369	0.93	0.74	73722		
Aug /92	1809000	687420	2431	2614	0.93	0.81	84082		
Sep /92	1721400	654132	2391	2571	0.93	0.80	80012		
Oct /92	1796700	682746	2415	2597	0.93	0.81	95584		
Nov /92	1899300	721734	2638	2837	0.93	0.87	101043		
Dec /92	1668300	633954	2242	2411	0.93	0.75	88754		
TOTAL	21,000,000	7,981,368	2977	3201	0.93	1.00	1,043,280		

Peak demand during audit period (kW): 2415

FUEL, STEAM OR HEAT ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
ENERGY TYPE: Steam
Prepared for USAID and RCG/Hagler Bailly

Plant name: MATIZOL
Address: Ploieşti - Romania

Auditor's name: Mihail ZDRAVCU

Report date: March 1994

Supply contract terms:

Fuel or heat supply company's name PETROTEL PROIESTI

Contract maximum demand:

Minimum charge (cost): 3.97 USD/GJ, 10.94 USD/t

Other:

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM):

Meter Reading Mo/day/yr	Physical Consumption units = to	Thermal Consumption GJ	Total Cost USD	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index GJ per:	Notes on plant conditions and changes	F... G...
Jan/__/93	12423	34490	136925.3	558	61.81			
Feb/__/93	10289	28565	113403.0	364	78.47			
Mar/__/93	13885	38549	153039.5	217	177.65			
Apr/__/93	11790	32733	129950.0	30	1091.10			
May/__/93	10740	29817	118373.5	0	-			
Jun/__/93	10500	29151	115729.4	0	-			
Jul/__/92	6492	18024	71555.3	0	-			
Aug/__/92	8749	24290	96431.3	0	-			
Sep/__/92	10650	29568	117384.9	0	-			
Oct/__/92	13362	37097	147275.1	31	119.65			
Nov/__/92	13870	38507	152872.8	210	183.37			
Dec/__/92	10874	30189	119850.3	403	74.91			
TOTAL	133,624	370,980	1,472,791	1,813	204.62			

Note: Heating degree-days based on reference temperature of 12°C

FUEL, STEAM OR HEAT ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
ENERGY TYPE: Natural Gas
Prepared for USAID and RCG/Hagler Bailly

Plant name: MATIZOL
Address: Ploieşti - Romania

Auditor's name: Mihail ZDRAVCU

Report date: March 1994

Supply contract terms:

Fuel or heat supply company's name: National Grid

Contract maximum demand:

Minimum charge (cost): 2.67 USD/GJ imported 70%; 2.14 USD/GJ local 30%

Other: Arg 2.51 USD/GJ, 89.426 USD/1000 Nm^3

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM):

Meter Reading Mo/day/yr	Physical Consumption units = Nm^3	Thermal Consumption GJ	Total Cost USD	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index GJ per:	Notes on plant conditions and changes
Jan/__/93	650000	23127	58072	558	41.45		
Feb/__/93	767000	27290	68525	364	74.97		
Mar/__/93	913000	32485	81570	217	149.70		
Apr/__/93	1276000	45400	113999	30	1513.33		
May/__/93	1488000	52943	132940	0	-		
Jun/__/93	1480000	52658	132224	0	-		
Jul/__/92	986000	35081	88088	0	-		
Aug/__/92	1252000	44546	111855	0	-		
Sep/__/92	1295000	46076	115697	0	-		
Oct/__/92	1166000	41486	104171	31	1338.26		
Nov/__/92	1074000	38213	95953	210	181.97		
Dec/__/92	833000	29638	74421	403	73.54		
TOTAL	13,180,000	468,943	1,177,516	1,813	258.66		

Note: Heating degree-days based on reference temperature of 12°c

ACTION PLAN – SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES
Prepared for USAID and RCG Hagler Bailly

Plant name: MATIZOL
Address: Ploieşti - Romania

Auditor's name: Mihail ZDRAVCU

Report date: March 1994

BASELINE – EXISTING CONDITIONS

	Thermal Consumption GJ/year	Nat.Gas Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost USD /year
BASE CASE	370980	468943	-	2977	21.510^6	3,693,587

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS

Action No	Action Description	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost USD /year	Action Project Cost USD	Action Payback Period (years)
A1	Put energy eff.teams in action to reduce en.loss	15380	-	-		430000	73346	50000	0.68
A2	Reduce compressed air losses					1386000	69300	30000	0.43
A3	Reduce heat loss on gas-fired furnaces and polimerisation tunnel		9378.86				25000	25000	1
B1	Improve heating system of Plant Buldings	14200					56374	20000	0.35
B2	Improve combustion eff. at gas fired furnaces for mineral wool and glass sticks		119000				317730	312000	1
B3	Improve combustion eff. at gas fired furnaces for bitumen and oil heating at Oxidation Plant		6540				17462	28000	1.6
TOTAL SAVINGS		29580	134918			1816000	559212		
SAVINGS AS PERCENTAGE OF BASE CASE		7.97	28			8.4	15.14		

Note: Assumes that the actions are taken in order of best payback period first in order to take into account the interaction between the various measures

- ENERGY EFFICIENCY OPPORTUNITY
3/Hagler Bailly

ACTION NO. A1

ZOL
entura Ploieşti Est
il ZDRAVCU
1994

ESCRIPTION: **A 1 - REDUCE ENERGY LOSSES**

ECTED: **MATIZOL PLANT**

EXISTING CONDITIONS: During audit the Team observed breack downs in electrical m - power cables about 600 motors/yr where rewinded the condensate is ned to supplier only 30%, same steam leacks, valves not insulated, compressed eackage.

TO IMPROVE EFFICIENCY: 1) MATIZOL shall form Energy Efficiency Teams for electric s, steam, air compressors.

- Develop an inventory of the uses of steam in the plant and survey of itions of steam pipe insulations in the plant
- Check the operation of steam traps - repair or replace leacking s as found
- Replace motors with excessive reactance and develop a plan for duction of high efficiency motors
- Reduction of air compressed consumption Action A1.1

2) Provide equipment as per list 1 (USAID) pos.4 Qty: 2 pcs; , Qty 80 and pos. 7 Qty: 3

- Make proposal for a larger equipment cost LIST 2 (USAID) pos. 6 Qty 14 Action A1.2

EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: TJ/yr	Total cost USD /year	
ons	21000		370.98	2,516071	
n	21,070		353.60	2,442725	
	430		17.38	73,346	(a)

(a)

IS.

IMATE:

	Cost USD	Notes
	-	-
ent	50,000	
n	-	
sioning	-	

COST (b) 50,000 USD

nual (non-energy) operations and maintenance cost (c) -

PAYBACK PERIOD

$$\frac{b: 50,000}{a: 73346 - c: 0} = 0.68 \text{ years}$$

MENTATION SCHEDULE.

98

ACTION PLAN – SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES
Prepared for USAID and RCG/Hagler Bailly

Plant name: MATIZOL, PLOIESTI, ROMANIA
Address:

Auditor's name: Mihail Zdravcu
Report date: March, 1994

BASELINE – EXISTING CONDITIONS

	STEAM Thermal Consumption GJ/year	HOT GAS Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	USD Total Energy Cost /year
BASE CASE	37098	458943		2977	21,5x10^6	3693587

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS (USAID)

Action No.	Action Description	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost USD /year	Action Project Cost	Action Payback Period (years)
	LIST NO 1								
A1.1	Reduce Energy Losses	957				12800	4440	2460	0,55
A2.1	Reduce Compressed Air Losses					20000	1000	500	0,5
A3.1	Reduce Heat Losses on Gas Fired Furn.		996				2500	2500	1.
B2.1	Improve Comb. Eff. at Gas Fired Furnaces		3585				9000	4500	0,5
	Total Savings	957	4581			32800	16940	9960	0,6
	Savings as % of base case	0,2	0,97			0,37	0,45		
	LIST NO 2								
A1.2	Reduce Energy Losses	8950					29000	29000	1
A2.2	Reduce Compressed Air Losses					80000	4000	4000	1
A3.2	Reduce Heat Losses on Gas Fired Furnaces		2390				6000	6000	1
B2.2	Improve Comb. Eff. at Gas Fired Furnaces		16733				42000	28000	0,62
	Total Savings	8950	19123			80000	81000	67000	0,82
	Savings as % of base case	0,24	4,07			0,37	2,19		
TOTAL SAVINGS		9907	23704			112800	97940	76960	0,78
SAVINGS AS PERCENTAGE OF BASE CASE		2,67	5,05			0,52	2,65		

Note: Assumes that the actions are taken in order of best payback period first in order to take into account the interaction between the various measures

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO A1.1

ant name: MATIZOL
idress: Sos. Centura Ploieşti-Est

Auditor's name Mihail ZDRAVCU

:port date: March 1994

ACTION NO. AND BRIEF DESCRIPTION A1.1. REDUCE ENERGY LOSES - LIST 1: Pos. 4, 6, 7

REA OF THE PLANT AFFECTED MATIZOL PLANT

FINDINGS CONCERNING EXISTING CONDITIONS PLANT have many values not insulate, steam traps are not working properly, V-belts have only up to one year life, low eff.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY : Provide on List no. 1 - USAID:

Pos.4 Soft cover steam value body insulation for 5 bar at 180°C
1 pc for 100 mm value cost 250 USD SAV 500 USD
1 pc for 50 mm value cost 150 USD SAV 300 USD

Pos.6 Cog belts (matched sets for use on standard V-belt sheves
80 belts cost 560 USD, SAV 640 USD

Pos.7 Steam traps for cardboard machine 10 bar, 240°C, 20 mm line
3 units for 1 TPH each cost 1500 USD, SAV 3000 USD

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: TJ	Total cost USD /year	
Baseline – existing conditions		21,000	370.980	2,516071	
After recommended action		20,987.2	370.023	2,511631	
Net reduction		12.8	0.957	4440	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE.	Cost USD	Notes USAID, LIST 1, Pos.4,6,7
Engineering design	–	
Equipment procurement	2460	
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 2460	
Estimated increase in annual (non–energy) operations and maintenance cost	(c) –	

PAYBACK PERIOD:

$$\frac{b: 2460}{a: 4440 - c: -} = 0.55 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

180

..ECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO A1.2

ant name: MATIZOL
ddress: Sos. Centura Ploieşti Est

Auditor s name Mihail ZDRAVCU

eport date: March 1994

ACTION NO. AND BRIEF DESCRIPTION A1.2. REDUCE ENERGY LOSSES

REA OF THE PLANT AFFECTED MATIZOL PLANT

. INDINGS CONCERNING EXISTING CONDITIONS Plant's energy management Program can't be implemented due to lak of flow-metters. Calculations of the specific consumptions must be more acurate for gas and steam

ECOMMENDED ACTION TO IMPROVE EFFICIENCY: Provide on List nr. 2 - USAID:

Pos.6: FLOW-METERS FOR

a) Natural gas, 1 bar, 250 mm Ø, Q = 3000 Nm^3/h, Qty: 1
b) Natural gas, 0.5 bar, 100 mmØ , Q = 500 Nm^3/h, Qty: 6
c) STEAM, 10 bar, 240°C, 450 mm Ø, Q = 30 t/h, Qty: 1
d) STEAM, 5 bar, 180°C, 100 mm Ø, Q = 5 t/h, Qty: 6

TOTAL COST: 20,000 USD, SAVINGS: 29,000 USD

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: TJ	Total cost USD /year	
Baseline – existing conditions			370.98	1472791	
After recommended action			362.03	1443791	
Net reduction			8.95	29.000	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE.	Cost USD	Notes USAID, List 2, Pos.6
Engineenng design		
Equipment procurement	29,000	
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 29,000	
Estimated increase in annual (non–energy) operations and maintenance cost	(c) –	

PAYBACK PERIOD:

$$\frac{b: 29,000}{a: 29,000 - c: -} = 1 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

101

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO A2.1

int name: MATIZOL
dress: Sos. Centura Ploieşti-Est

Auditor s name: Mihail ZDRAVCU

port date: March 1994

ACTION NO. AND BRIEF DESCRIPTION: A2.1 REDUCE COMPRESSED AIR LOSSES

REA OF THE PLANT AFFECTED: MATIZOL PLANT

NDINGS CONCERNING EXISTING CONDITIONS:
Compressed air system hase high losses (Avg.40%)

ECOMMENDED ACTION TO IMPROVE EFFICIENCY:
Provide on List no. 1 - USAID
Pos. 3 - 1 pc ULTRASONIC LEAK DETECTOR FOR COMPRESSED AIR LEAK DETECTION EQUIVALENT TO MODEL ULD-100
Cost 500 USD, Sav. 1000 USD

EXPECTED RESULTS – EFFECT OF RECOMMENDATION

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam	Total cost USD/year	
Baseline – existing conditions		21000		104328 0	
After recommended action		2098 0		104228 0	
Net reduction		20		1,000	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost USD	Notes USAID List 1, pos.3
Engineering design	–	
Equipment procurement	500	
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	(b) 500	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD

$$\frac{b: 500}{a: 1000 - c:} = 0.5 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

102

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly

ACTION NO A3.1

Plant name: MATIZOL
Address: Sos. Centura Ploieşti-Est
Auditor's name: Mihail ZDRAVCU
Report date: March 1994

ACTION NO. AND BRIEF DESCRIPTION: A3.1 - REDUCE HEAT LOSS ON GAS FIRED FURNACES AND POLIM. TUNNELS

AREA OF THE PLANT AFFECTED: MATIZOL PLANT

FINDINGS CONCERNING EXISTING CONDITIONS: Substantial heat is wested from a wide range of heating and combustion equipment troughout the MATIZOL facility

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Provide temperature testing equipment on List 1 - USAID

Pos. 1 - 1 pc. I.R. Pyrometer, non-contact surface measurement. Temperature range 400°C-3000°C (Min.1600°C), accy ±1% of readings. Cost 2000 USD, sav. 2000 USD

Pos. 5 - 1 pc. I.R. Temperature thermometer for -20°C to +500°C for measuring on steam lines and exterior of refractory and polimerisation tunnels equivalent to DK 1164198 DAVIS Catalog. Cost 500 USD, saving 500 USD

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: TJ	Total cost USD/year
Baseline – existing conditions			468.943	1,177,516
After recommended action			468.942,01	1,175,016
Net reduction			0.996	2,500 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:	Cost USD	Notes USAID - List 1 - Pos.1 and 5
Engineering design		
Equipment procurement	2500	
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 2500	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD:

$$\frac{b: 2500}{a: 2500 - c: 0} = 1 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO A3.2

ant name: MATIZOL
idress: Sos. Centura Ploieşti-Est

Auditor s name: Mihail ZDRAVCU

eport date: March 1994

ACTION NO. AND BRIEF DESCRIPTION: A3.2 - Reduce heat loss on gas fired owens

REA OF THE PLANT AFFECTED: Drying fiber glass felt

FINDINGS CONCERNING EXISTING CONDITIONS: Polimerization and drying glass fiber felt has 2 low efficiency burners

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Provide on List no. 2 - USAID:

Pos. 4 - High efficiency burner for drying fiber glass felt complete with air fan and instrumentation for combustion optimization 35 Nm^3/h gas, 500 mm WC; Qty:2; Cost: 6000 USD; savings: 6000 USD

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: TJ	Total cost USD /year	
Baseline – existing conditions			468.943	1177516	
After recommended action			466.553	1171516	
Net reduction			2.39	6,000	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost USD	Notes USAID, List 2, Pos. 4
Engineering design	–	
Equipment procurement	6,000	
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	(b) 6,000	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD:

$$\frac{b: 6,000}{a: 6000 - c:} = 1 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

104

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly

ACTION NO B2.2

Plant name: MATIZOL
Address: Sos. Centura Ploieşti-Est
Auditor's name: Mihail ZDRAVCU
Report date: March, 1994

ACTION NO. AND BRIEF DESCRIPTION: B2.2 IMPROVE COMBUSTION EFFç AT GAS FIRED FURNACES

AREA OF THE PLANT AFFECTED: MATIZOL PLANT

FINDINGS CONCERNING EXISTING CONDITIONS:

Combustion at the moment has excess air very high, 10 - 11% O_2

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Provide on LIST No. 2, USAID:

Pos. 1 - Digital controllers for min. 8 channels provide continuous PID with 4-20 mA, input/output capable to communicate to RS-232C computer plus computer 486 microprocessor 33 MHZ with 4 MB RAM and 170 MB hard drive to include 2 floppy drives (2.5" and 5.25") and super VGA monitor. Cost 6000 USD, sav. 6000 USD, Qty: 1pc.

Pos. 2 - I.R temperature measurement, model OMEGA OS 1200 has one standard head, temp. range 400-3000°C, output 4-20 mA and one electronics box, with sensing heads IP65, with W.COOLER SHELL WC, sighting viewer OS 1000 SV, air purge collar OS 1000-2 fans connection cable 50 Ft.C50, 220 V, 50 Hz, Qty: 1 pc. Cost 4000 USD, savings: 4000 USD

Pos. 3 - High eff. Burner Glass Furnace 14 m² Eqv: KORTING, 150 Nm³/h gas, each, 500 mm WC compete eq.for a proper comb. Qty:2, cost 12000 USD,sav.32000 USD

EXPECTED RESULTS – EFFECT OF RECOMMENDATION

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam TJ	Total cost USD /year	
Baseline – existing conditions			468.943	1177516	
After recommended action			452.21	1135516	
Net reduction			16.733	42,000	(a)

COST – BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost USD	Notes USAID, LIST 2, pos.1,2,3
Engineering design		
Equipment procurement	22,000	
Equipment installation	5,000	
Equipment commisssioning	1,000	
TOTAL INSTALLED COST	(b) 28,000	
Estimated increase in annual (non-energy) operations and maintenance cost	(c)	

PAYBACK PERIOD

$$\frac{b\ 28,000}{a\ 42,000 - c} = 0.67 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

105

ENERGY EFFICIENCY AUDIT REPORT
MATIZOL WATERPROOFING, HEAT and INSULATING MATERIALS PLANT

PLOESTI, PRAHOVA, ROMANIA
MARCH 1994

Prepared by: ARCON-SRL
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106

CONTENT

		Page
	EXECUTIVE SUMMARY	3
I.	INTRODUCTION	10
II.	ENERGY CONSUMPTION AND PRODUCTION ANALYSIS	12
III:	RECOMMENDATIONS FOR ENERGY EFFICIENCY IMPROVEMENTS	
	A.1 - Put energy efficiency teams in action to reduce energy losses	14
	A.2 - Reduce air compressed losses	22
	A.3 - Reduce heat loss on gas fired furnaces	23
	B.1 - Improve heating system of the Plant's Buildings	24
	B.2 - Improve combustion efficiency at gas fired furnaces	26
	B.3 - Improve combustion efficiency at 5 furnaces - Oxidation Plant	33
	C.1 - Revamp Plant to improve design	34

APPENDICES

1. Plant Energy Consumption
2. Monthly Production 1993
3. Production vs. Energy Consumption 1993
4. Natural gas savings available by reducing oxygen to optimum
5. One line diagram of Energy System
6. Annual Energy Cost for steam leak
7. 30 Guidlines for designing and operating compressed air system
8. Steam System Audit
9. Steam Trap Losses
10. Efficiency of the COG-Belts
11. Annual Energy Profile Year1993
12. Annual Energy Profile Year 1992
13. LIST NO 1 Of equipment Approved by MATIZOL's Management

137

EXECUTIVE SUMMARY

This report presents the results from a preliminary energy audit carried out by a team ef engineers from RCG/Hagler, Bailly, Inc. and ARCON SRL at MATIZOL - Ploiesti - Romania.

The objectives of the audit were to work with the plant staff to: evoluate energy consumption at the plant; determine the level of energy management practiced; to identify energy conservation actions or opportunities ; and identify instrumentation and low--cost equipment needed by plant to implement the more attractive energy conservation actions

Primery products of the plant are bitumen treated glass fibre felt, bitumen treated glass fibre fabric, bitumen coated cardboard, mineral wool mattreses, mineral woll felt, glass rods (sticks) all waterproofing, heat and sound insulating materials for use in construction.

A summary of the primary energy consumption at the plant based on 1993 data estimates annual energy costs is given below

	Energy Distribution			Cost Distribution	
	actual units	TJ	%	USD	%
Electricity	21,000 MWh	75.6	8	1,050.000	28.2
Natural gas	13,180 mil.Nm^3	468.943	51	1,178,636	31.8
Steam saturated	133.624 to	370.98	41	1,473.204	40.0
		915.52	100%	3,701,838	100%

Notes:

1. - A TJ (terajoule) is 10^{12} Joules; a GJ is 10^9 Joules; 3.6 GJ/MWh; one Nm^3 gas hc.se 0.o3558 GJ; steam (saturated 180° C, 8 bar) = =2.7763 GJ/tonne
2. Electricity, natural gas and steam are purchased from outside of the Company
3. Prices are as per table "Unit Energy Costs)

TABLE

UNIT ENERGY COSTS

1. STEAM	10,94 USD/To; 3,97 USD/Cj
2. ELECTRICITY	0,05 USD/KWh Including demand (Ex: 0,0532 USD/KWh winter 0,0464 USD/KWh imported sumer)
3. GAS	2,51 USD/Gj; 89,426 USD/1000 Nm^3, 2,67 USD/Tj
4. COMPRESSED AIR	5,67 USD/1000 Nm^3; 0,094 KWh/Nm^3, 0,05 USD/KWh

MATIZOL has some energy efficiency efforts already in progress. In addition, detailed energy consumption and production records are maintained for each departament.

During the brief preliminary energy audit on site, MATIZOL staff worked with the audit team to identify additional energy efficiency measures. Based on the discussions with management, production and technical staff, inspection of equipement and operating procedures, analysis of plant energy and production data and measuremens of certain process parameters,ARCON estimates the potential for enrgy efficiency improvements at the MATIZOL Plant as 18,89% without process changes.

Short-term, low-cost energy efficiency and productivity improvement, projects (a financial paybackof less than one year each), which is implemented, will enable MATIZOL to achieve a financial benefits of 559,200 USD per year. The total cost to achive these benefits is less than 465.000 USD. These measures are summarized on the following page

ARCON recomends the following procurement budget for MATIZOL; sugject to RCG/Hagler, Bailly recommendation and to final approval by USAID (See LIST NO 1 and LIST NO 2).

LIST NO. 1 FOR MATIZOL

Item No.	Cost	Savings	Paybac	Actio
1. IR Pyrometer, Non-Contact Surface Measurement. Temperature Range 400°C-3000°C (Min. 1600°C). Accuracy ± 1% of Reading	$2,000	$2,000	12 mos.	A3.1
2. Combustion Analyzer, Equivalent to Bacharach Model 300, 24-8111 Sigert Fuel Eqns, Battery, Printer, 220 Vac 50 Hz, RS-232, Charger, High Temperature Probe to 1060°C, 48" Probe	4,500	9,000	6 mos.	B2.1
3. Ultrasonic Leak Detector for Compressed Air Leak Detection. Equivalent to Model ULD-100	500	1,000	6 mos.	A2.1
4. Soft Cover Steam Valve Body Insulation for 5 Bar at 180°C				
1 PC for 100mm Valva	250	500	6 mOs.	A1.1
1 PC for 50 mm Valve	150	300	6 mos.	A1.1
5. IR Temperature Thermometer for -20°C to +500°C for Measuring Steam Lines and Exterior of Refractory. Equivalent to Dickson IR550	500	500	12 mos.	A3.1
6. COG Belts (matched sets) for use on Standard V-Belt Sheves (Budget Price $7/Belt)	560	640	10.5 mos.	A1.1
(1) 12 sets x 3 belts/set, 5.5 KW motors Size: 13 mm x 8 mm x 1500 mm, 36 belts				
(2) 11 sets x 4 belts/ set, 7,5 KW motors Size: 17 mm x 11 mm x 1700 mm, 44 belts				
7. Steam Traps for Cadboard Machine Conditions: 10 Bar, [illegible] 240°C, 20 mm Line 3 Units for 1 TPH Each	1,500	3,000	6 mos.	A1.1
	$9,960	$16,940	7 mos (Avg.)	

LIST NO. 2 FOR MATIZOL

Item No.	Cost	Savings	Paybac	Actior
1. Digital Controllers for 8 Channels to Provide Continuous PID with 4-20 mA; Input/Ouput Capable to Communicate to RS-232C Computer 5 Loops for Gas Flow 1 Loop for Gas Air Ratio 2 Loops for Draft Pressure Computer 486 Microprocessor 33MHZ with 4 MB RAM and 170 MB Hard Drive to Include 2 Floppy Drives (2,5" and 5,25") and Super VGA Monitor				
TOTAL	$6.000	$6.000	12 mos.	B2.2
2. Infrared Temperature Measurement; Model Omega OS1200 HAS, Standard Head, Temperature Range 400-300°C. Subranges 8,Output Types Current 4-20 MA and One Electronics BOX. Environmetal Rating 0-50°C, IP52+1 Sensing Header;Environmetal Range 0-175°C, IP65 with Water Cooler Shell Type WC, Sighting Viewer OS1000SV,Air Purge Collar OS1000-2F and Connection Cable 50 Ft., C50 for Sensing Head; **Power 220 V,:50^Hz PC = 1**				
TOTAL	$4.000	$4.000	12 mos.	B2.2
3. High Efficiency Burner Class Furnace; 14 M^2 Units (Equivalent to Körting), Gas 150 Nm^3/h Each, LHV=8300 Kcal/Nm^3 to Obtain Total Flow 300 Nm^3/h, 1500°C in Fournace with Complete Equipement for Combustion, 500 mm WC Total Production of the Fournace 12 tons /day Total Cost - 2 x $8.000 =	$16.000	$32.000	6 mos.	B2.2

112

Item No.	Cost	Savings	Paybak	Action
4. High Efficiency Burner for Fiber Glass Felt, Complete with Air Fan and Instrumentation for Combustion Optimization, 35 Nm^3/h Gas, 500 mm WC. Quantity: 2				
TOTAL	$6.000	$6.000	12 mos.	A3.2
5. Ultraprobe Ultrasonic Tester 2000 220V, 50 Hz Plus Accesoires - Quantity: 1				
TOTAL	$4.000	$4.000	12 mos.	A2.2
6. Annubar Flow Meters for:				
a. Natural Gas, 1 Bar.250mm Q =3006 m^3/h - Quantity: 1				
b. Natural Gas, 0,5, 100mm Q = 500 m^3/h Quantity: 6				
c. Steam, 10 Bar, 240°C, 450 mm Q = $30^t/h$ - Quantity: 1				
d. Steam, 5 Bar, 180°C, 100mm Q = $5^t/h$ - Quantity:6				
TOTAL	$29.000	$29.000	12 mos.	A1.1
TOTAL COST LIST 2:	$65.000	$80.000	10 mos. (Avg.)	

13

MATIZOL Ploiesti Plant

Summary of energy efficiency and productivity projects

RECOMMENDATIONS AND ESTIMATED BENEFITS

	Energy Savings TJ/yr	Energy Savings MUSD/yr	Financial MUSD/yr	PB
A. General and Energy Management				
A.1. Put energy efficiency teams in action to reduce energy costs	18,94	0,073346	0,050	
A.1. Reduce compressed air losses	4,99	0,0693	0,030	
A.3. Reduce heat loss on gas fired furnaces and polimerisation tunnels	9,38	0,025	0,025	
B. Short - term Low - Cost Efficiency Improvements				
B.1. Improve heating system of the Plant Buildings	14,2	0,056374	0,020	
B.2. Improve combustion efficiency at gas fired furnaces for mineral woll and glass sticks	119	0,317730	0,312	
B.3. Improve combustion efficiency at gas fired furnaces for bitumen and oil heating (Oxidation Plant)	6,54	0,017462	0,028	
	173	0,5592	0,465	0,83Jr

114

I. Introduction

1.1 General Plant Description

The MATIZOL Plant deals withwaterproof, heat and insulating materials for use in construction, made mainly from glass and mineral fibre.

The products are:

.Bitumen treated glass fibre felt
.Bitumen treated glass fibre fabric
.Bitumen coated aluminium folis
.Bitumen coated cardboard
.Wateproofing shingles
.Mineral wool plates
.Mineral wool shells
.Glass rods (sticks)
.Glass pallets
.Mineral wool mattresses
.Mineral wool felt

In addition to supplying markets in Romania MATIZOL exports products with a value of over 1/3 per year.

1.2. Energy supplied

The Plant is supplied with electricity, steam and natural gas by the national systems.

The Plant needs about 21.000 MWh/yr, 13.18. 10^6 Nm^3/yr gaz and 133624 t/yr saturated steam.
The total cost of the electricity is 1mil. USD, natural gas 1.117 mil USd and steam 1.472 mil USD per year.

1.3. Energy Audit activities

Ateam of senior engineers from ARCON and RCG/Hogler, Bailly,Inc. carried out site activities at MATIZOL to work together with MATIZOL staff to identify improvements to energy efficiency.

The project manager for the efforts was Mr. Dan IONESCU, Manager of Power and Energy at MATIZOL, reporting to Mr. Perte VEIGANG, Technical Director. The ARCON team consisted of Mihail ZDRAVCU, ARCON Director (CEM), Dragos SIMULESCU (Electrical engineer), Radu STROESCU (Thermotechnical engineer).

115

The RCG/Hogler, Baily Inc, team consisted of Michel ELLIS, Manager, Lourent POMMIER, Project Manager, and Walter SMITH (ETSI).

Based on agreement with the management of MATIZOL, the audit team focused their efforts in the short time available on Mineral wool and Glass rods furnaces. Some of the other parts of the plant were briefly inspected by the team.

One objective of the audit was to measure the combustion efficiency of the furnaces in the Plant. For this purpose, Orsat and the digital combustion analyzer (which measures O_2 , CO, CO_2) was used.

The team identifies nocost and low-cost improvements which could save energy and increase productivity and to develop estimates of the benefits which could be obtained from such projects.

By the end of the audit, MATIZOL has already begun implementing new management objectives for setting, where is possible, the combustion on furnaces, providing on two furnaces, Combustion air preheaters bringing down the stick flue flue gas temperature from 1200°C to 350°C insulating steam pipes etc.,achieving a significant improvement in energy efficiency.

The ARCON presented its recommendations to Mr. Petre VEIGANC and Dan IONESCU and it was decided to start elaborating a drawing by ARCON for one furnace automation.

The ARCON recommended , and MATIZOL agreed that portable combustion analyzers should be procured under USAID energy program RCG/Hogler, Bailly, agreed.

The ARCON team observed that the standard of management and engineering expertise already in place at MATIZOL is satisfactory.

Technical staff is very knowlegeable about energy conservation in general and that with this staff, with a some modifications to procedures and few additional instruments, tools and equipement will fully capable of making signifiant improvements to energy efficiency

II. Energy consumption and production analysis

A graphical presentation prepared by ARCON of basic data received from MATIZOL is presented in Appendices 1 to 3.

The graphs in Appendix 1 provide an overall view of energy consumption showing signifiant month by variations at MATIZOL over the last two years. Appendix 2 presents data from the Plant for Production in 1993, showing significant monthly variations for each type of product.
Appendix 3 presents data on energy consumption versus production in 1993.

The graphs are provided for use by MATIZOL in identifiying variations in energy efficiency. The analysis is a tool to point the way for more detailed investigations. The detailed investigations are beyond the scope of the current study, but several points are evident from the analysis. The main points arising from the analysis which were used to develop specific recommendations regarding the operation of the Plant are as follows:

a) Energy efficiency of MATIZOL Plant is increased substantially at higer production rates. Above about 1 mil. USD production/Mo (1,6 Bilion lei/Mo) energy consumption (steam, gas, electricity) increases little for additional production (Bitumenised cardboard, etc.).

b) There is a very high level of energy consumption which is production unrelated and we are recommending futther studies shall be made todecrease this level.

III. Recommendations for energy efficiency improvements

RCG/Hogler, Bailly, Inc. and ARCON's recommendations for energy management and efficiency improvement have been grouped in three categories:

A. General and Energy Management

These projects are opportunities which are recommended for immediat action, and require little or no expenduire. These projects affect management system and techniques, rather than process equipment . These projects are Primary focus of the USAID Program for Romania.

B. Low-cost, Short-term Efficiency Improvements

These projects are low-cost improvements to process plant and equipment which are recommended for implementation in the short-term. Because of the low-cost and quik paybak (less than one year), these projects couod be implemented from the Company's annual maintenance budget. Some of these projects may be of interest to the USAID Program for Romania (See List No.2).

MATIZOL - PLOIESTI ENERGY EFFICIENCY AUDIT

A. General and Energy Audit

Energy and utilities

MATIZOL Action A.1.

Put energy effiency teams in action to reduce energy losses

Existing conditions:

During the audit the team observed breack downs in electrical system, power cables, about 600 motors/yr where rewinded (30%), the condensate is returned to Petrotel Power House only 30% VS 90% is (as per contract signed annually),many technical and mechanical equipment is out of life date, same steam leaks and valves not insulated.

Recommended action to improve efficiency

The Consultant ARCON SRL recommends that MATIZOL form "Energy Efficiency Teams" for electric motors, steam and compressed air. personnel for this team should be drawn from MATIZOL staff and this exercise should become a continous part of plant operations and maintenance. The organization of such a team furnaces,electrical, condensate,steam and air distribution systems was already under way at the time of the audit.

The Steam Efficiency Team would responsable for the identification and repair of leaks in steam systems, ispection and replacement or repair of steam traps and repair inadequate thermal insulation.

The Steam Efficiency Team should have fooling tasks:

- Develop an inventory of the used of steam in the plant;
- Carry out a survey of the conditions of steam pipe insulations in the plant, using I.R. PIROMETER and other temperature indicators;
- Develop an inventory and chech the operation of all steam traps in the plant on a monthly basis, using the temperature or ultrasonic testing techniques, or visual observation where possible .

119

Repair or replace leaking traps as found.

- Carry out a survey of steam leaks on a monthly basis. For each leak found, calculate the cost of the leak (using the Steam Leak chart on the following page) and estimate the cost to repair the leak. If the payback period is less than 1 year recommend the repair of the leak. Develop a log to keep track of the growth of leaks from month-to-month. Develop a monthly plan for repirs.
Steam pressure shall be set at each unit as per process requirement.

The Electric Motors Effieiency Team would be responsable to survey electric motor load and effiency, chek and clean motors with excessive reactance and develop a plan for introduction of high efficiency motors. The Team will have the following specific tasks:

- Based on nameplate and avaible meters make a complete inventory of all motors over 10 kW which identifies the motor number, rating (kW), location, age, voltage, rot/min, running amperes, expected annual energy consumption, description of use.

- Obtain curves of efficiency VS precentage load and power factors from MATIZOL major suppliers of motors families, of motors now installed in the Plant.

- Develop specifications for new procurement of new motors for the Plant, for new applications. Optain manufacturers data on price, effiency and power factor for alternative lines. In same cases high efficiency motors which reduce energy consomption by 3-10% for the same applications especially under 50 kW, since large motors are relatively efficient, but cost of this motors is obout 50% higer. For over 4000 h/yr running this type of motors can recover the cost in maximum one year or less.

-After carrging out the analysis and developing the new high efficiency specifications for new motors consider the possible replacement of existing motors with high efficiency motors on a plan basis. One way to implement this policy would be to buy a quantity of high efficiency motors, instead of rewinding them. Often, rewound motors have lower efficiency than new motors, as the magnets can suffer reduced flux if they are overheated in the process.

Effiecieny less can also result because rewindings usualy done to lower quality standars than new manufacturing, so increased friction can result from slight misalignement. Finally, if wire of smaller diameter or higher resistivety is used in the rewind job, resistive losses will increase. It is the RCG/Hogler, Bailly and ARCON tem's experience that a rewound motor has an efficiency 1 - 5% less than a new motor and rewinding costs 50% or more of the cost of a new motor;

- With portable volt-ammeter, cosØ meter, carry out an electric motor load survey. The load (kW, kVAR, CosØ) voltage an each phase, and efficiency of all motors over about 10 kWshould be cheked using a systematic procedure;

- Carryout power demand survey (kW, kVAR, metered kW demand and kW/shift) for load centres and factory. Based on this data, develop a power a demand balance for the plant, under various operating conditions;

- Based on result of power demand survey, with process personnel work to investigate ways to reschedule operations to reduce peak demand and to shift consumption from peak to off-peak (mechanical workshop)

- If motors with excessive reactance are identified, they should be out of service for rewinding or replacement;

- Institute a monthly policy of motor maintenance check that bearings are getting proper lubrication. Electrical connections should be checked and tightend if necessary. The housing and ventilation air intake on all motors should be cleaned to improve cooling and efficiency. Dust and dirt from internal parts of the motors shall be blow out with compressed air (air should be dry and less than 4 bar pressure to avoid damaging insulation).
The motor and its drive system should be checked for proper alignement, proper belt tension, and proper lubrication. Insulation should be tested with meghommeter and a logbook should be kept of these readings so that comparisons can be made from month-to-month. Check for excesive vibration.
- As underloaded motors are identified by the survey, should be changed for motors appropriately sized for the job. The inventory

(developped above) should serve as the basis for moving motors from one location to another within the plant to match sizes to loads. If properly sized motors are available from spares or stocks, replacements of a given kW rating should prioritized on the basis of the possible effciency improvement (degree of underloading and operating hours per year).

- If phase-to-phase voltage unbalance is foud (over 2%), then adjustment should be made to correct the problem. For every 2% variation in phase-to-phase voltage, a motor losses about 1% efficiency. For the 0.4 kV system, the phase voltages should be equal within ± 5 Volts, otherwise efficiency is reduced. Voltage unbalance can be caused by losse or corroded connections at bus bars, starters terminals, fuses, or the motor it self. If the problem is caused by single-phase loads which are attached one of the phases these loads should be more equal or distributed among the phases, or else the transformer should be retapped.

The Power Cable Team

A team specialized in power and control cables shall check all cables and will record all cables with break downs making proposals for replacement with new cables.
Many break downs of 0.6/1 kV cables were founded during audit which are causing serious production losses. All 6 kV of main feeders must be replaced being to old and with to manny cable joints.

The Compressed Air Efficiency Teah Should have the following tasks:

- Based on design data make an inventory of all uses of compressed air;
- On a monthly basis, carry out an analysis of air compressors efficiency and record on logbook. If less than design investigate the causes (See Appendix 7 with 30 ways to save A.C.)
- Carry out survey of the plant every month to identity compressed air leaks and record them in a logbook. Measure the flow of leaks using a velometer and prepare a report, with the monthly cost of each leak cleary indicated. Develop a plan for leak repair, based on priority.

In TABLE A1.1 are listed ideas brainstormed jointly with MATIZOL's technical staff to save energy with NO COST

Ideas to save energy - NO COST	A1.1

1. "Fix" Steam Traps Not Needing New Parts in Trap Program
2. Instal COG Belts (See List No. 1)
3. Implement Periodically an In-Depth Compressed Air Audit to Reduce Air Use by Changing How and Why Air is Used in the Technologies
   See Appendix 7 - 30 GUIDELINES FOR DESIGNING AND OPERATING COMPRESSED AIR SYSTEMS
4. Implement Periodically "A Steam Survey to Reduce Steam Use by Changing How and Why Steam is Used in the Technologies (at Point-of-Use)
   See Appendix 8 - STEAM AUDIT
5. Train Supervisors and Employees on Each Shift the Importance of Energy Conservation to their Jobs
6. Study How to Increase Production Rates to Lower Fixed Energy Costs
7. Locate Burners at Optimum Position and Flame Lenght
8. Have Energy Accountability for Each Product
9. Visit TUNGSTRUM - HUNGARY to See New Technologies
10. Reduce Pressure of Compressed Air at Air Compressors
11. Use USAID Combustion Analizer to Measure Efficiency of Furnaces and Adjust to Maximum Level at Optimum O_2, etc.
12. Repair all Instruments that do not Work or are out of Calibration
13. Control Temperature of H.W from Heat Exchanger
14. Provide Pressure Indication for Air and Gas to Furnaces
15. Close Doors Now Open on Furnace to Recover More Waste Heat
16. Evaluate Economics of Using HW from H.R Instead of Buying Steam to Make HW part of the Year
17. Organize Furnace Repair Material Prior to Shutdowns
18. Test Fans for Optimum Performance

In TABLE A1.2 are listed ideas brainstormed jointly with MATIZOL's technical staff to save energy with Some Cost

Ideas to Save Energy with Some Cost	A1.2

1. Repair Traps with New Parts and/or Replace Steam Trap
2. Purchase and Install Soft Cover Valve Insulation (See List 1, pos.4)
3. Repair Refractory at furnaces.
4. Better Utilize Waste Heat from Furnaces and produce Heated Water
5. Purchase High Performance Refractory Materials
6. Install Low Cost Burners
7. Evaluate Economics of New Boilers at Power House
8. Provide the Energy manager the Necessary Tools to Do His Job
9. Use Correct Refractory in Crown of Furnace. Redessigne the Refractory of the Furnaces
10. Install IP 54 Enclosure (Dust Proof) for all Instruments
11. Replace Failed Motors with New Motors or/and with High Efficiency Class B insulation Type
12. Output, set at Lowest Possible Point
13. Automate/close-Loop Control Furnace (See List 2, pos. 1)
14. Optimize Excess Air With O_2 Controls
15. Install VFD (Variable Frequency Drive) on small Motor of Combustion Air Fan or Replace Sheve
16. Use New Technology for Glass Furnace
17. Replace all Circuit Breakers and Cables in Bad Condition
18. Add Seals in Water Pump System
19. Replace Mercury Vapor with HP Sodium and Electronic Ballast
20. Maintain 500 mm Pressure on Gas to the Burners
21. Insulate Low Temperature System with MATIZOL Insulation
22. Identify all Furnace Problems and Provide Engineering Selections for Major Turnarounds

Expected Results:

The ARCON team estimated that the potential savings of an improved maintenance program based on the procedures is 2% of the plant's electric enrgy consumption, minimum 2% of steam energy consumption and 53,000 t/yr condensate returned to Power House (40% in addition to 30% existing).

The savings are estimated at aproximately USD 73.346 annualy, as follows:

Electical

0.o2 x 21,500MWh/yr x 0,05 USD/kWh . 10^3 = 21.500 USD/yr

Thermal steam

0.2 x 370.98 TJ/yr x 3970 USD/TJ = 29,456 USD/yr

Condensate

53,000 t/yr x 188 . 10^{-6}TJ/t x 3970 USD/TJ=22,390 USD/yr

Total 73.346 USD

Total anergy savings in TJ/yr

		(430 MWh/yr)
Electrical	0.02 x 21,500 MWh/yr x 3.6 . 10^{-3}TJ/MWh =	1.54 TJ/yr
Thermal steam	=	7.42 TJ/yr
Thermal condensate	=	9.96 TJ/yr
Thermal steam and condensate	Total	17.38 TJ/yr

The maintenance program will increase motor life, therby reducing replacement and rewinding costs over the long run. The maintenance and monitoring program will also reduce the frequency of shutdowns in production operation because of motor failures,therby having a productivity benefits. The benefits are not estimated in this report.

Equipement required:

A. Equipement Enssured by MATIZOL

. 1 pc Digital strobe tachometer

. 1 pc Digital multimeter/megohmeter with current clamp and power factor meter

. 1 pc Velometer

B. Equipement enssured by USAID (See List No. 1 for MATIZOL)

125

The ARCON and RCG/Hagler, Bailly estimates that MATIZOL should budget approximately 50,000 USD/yr (about 84 milion lei) for additional incidental equipment and repairs (additional maintenance) such a Steam Traps, Insulation, Motors, Refractory at Furnaces, Burners and the like.

LIST no. 1 will have the following schedule:

TASK 1 - ARCON and RCG/H-B prepares specification for approval by USAID
Milestone: April 15, 1994

TASK 2 - USAID provides final approval for procurement
Milestone: Mai 20, 1994

TASK 3 - ARCON/MATIZOL issues purchase order for equipment
Milestone: Mai 30, 1994

TASK 4 - Equipment delivery to ARCON/MATIZOL
Milestone: August 15, 1994

TASK 5 - Equipment installed into the plant and MATIZOL completes development of operating procedure for use of equipment
Milestone: September, 1994

TASK 6 - Equipment fully operational and in use, monitoring begins by MATIZOL
Milestone: October, 1994

LIST no. 2 will be taken in consideration by ARCON/RCG/H-B only in case that additional fundings is available from USAID at a later date for a larger equipment package for implementation at MATIZOL of a New Energy Saving Technologies.

FINANCIAL ANALYSIS:

Based on a cost of 50,000 USD/yr and a net savings of 73,346 USD/yr, the project payback period is approximately 0.68 yr

ACTION A1.1

In order to succeed the task of Action A1 under USAID LIST no.1 pos. 4, 6 and 7, ARCON and RCG/Hagler, Bailly and MATIZOL have finalised the equipment required of course MATIZOL have to make efforts (management and financial) to achieve the major tasks.

ACTION A.1.2

In LIST no. 2 post 6, ARCON and RCG/Hagler, Bailly proposed flowmeters required to count the energy (Gas and Steam).

126

A. General and Energy Management

Air Compressed plant

MATIZOL action A 2

Reduce air compressed losses.

Existing conditions:

The Plant hase:

Station nr. 1 with 4 reciprocating air commprssors 3V45/7, 7bar, 300 kW and station nr 2 with 2 reciprocating compressors 1V15/7,7bar 100 kW

Total annual production 3,760,000 Nm^3/mo x 12 mo/yr = =45.9 x $10^6 Nm^3$/yr Losses are 46%

Recommended actions:

. The Consultant recommends that MATIZOL caryy out a general cheking and to seal the valves eliminate likeages at gaskets, weldings and every where it apears.

Recommended actions are:

- Providing a new compressor with 3 bar or a blower of 2 bar, 18 kW; 258 Nm^3/h (0,074 kWh/Nm^3)
- Providing of flowmeters for each unit, manometers etc.

Reducing of production with 10%

Expected results

. The Consultant estimates that an average annual savings of

- 10% loss reductions

45,9 .$10^6 Nm^3$/yr x 0,1 x 0,112 kWh/Nm^3 = 514.080 kWh/yr

514.080 kWh/yr x 0.05 USD/kWh = 25,704 USD/yr

- Instalation of a new air compressor of 2-3 bar 18kWh. 258 Nm^3/h

(0.112-0,07)kWh/Nm^3 x 1,73 .. 10^6, Nm^3/mo x 12 mo/yr = 871.920 kWh/yr

871.920kWh/yr x 0,05 USD/kWh = 43596 USD/yr

Total savings: 1.386.000 kWh/yr; 69.300 USD/yr

Total cost of a new air compressor and instruments required at air lines 30.000 USD

Financial analysis:

Based on a cost of 30.000 USD and a net sevings of69.300 USD/yr, The project payback period is approximately of 0,43 yr.

Plant Management

MATIZOL Action A 3

Reduce heat loss on gas fired furnaces, polimerisation tunnels etc. - use portable infrared thermal imaging device to monitor heat loss.

Existing conditions:

Substantial heat from a wide range of heating and combustion equipment throughout the MATIZOL facility. This equipment ranges from refractory lined Mineral Wool and Glass Stick furnaces (5 + 4 furnaces), Polimerisation tunnel and heating furnaces (7 furnaces) for Oxidation Plant.

While maintenance on insulation and refractories is routinely performed generally during shutdowns for capital repairing MATIZOL does not currently have a good practice of monitoring all this equipments for heat leaks and hot spots due to wear or deterioration of the insulatio or refractory.

Recommended action:

. The ARCON team recommends that MATIZOL adopt a new procedure for monitoring the condition of insulation and refractories, based on temperature readings from an infrared thermal imaging device (to be procured under Action A 3.1.). This device can locate hot spots and damaged refractory of the anvelop so that repairs can be performed during scheduled maintenance shutdowns.

The device should be used in conjunction with a logbook drawn up for this purpose. The log should contain a complete inventory of thermal equipment, to require the operators of the thermal imager to enter readings for each equipment.

These checks should be performed approximately 3 times per year for each major piece of equipment. A repair order should be prepared for each problem identified.

The thermal imager should be specified to give a mono-chromatic image of the surface of the furnaces or other equipment. The temperature readout should be capable of 0 - 1600°C (minimum).

128

Ecxpected rezults:

Typically the careful use of a termal imaging device can provide savings of 0.5 to 3% of thermal energy used. The ARCON estimates that the use of the thermal imager, toghete with revised maintenance procedures to optimize refractory and insulation maintenance procedures to optimize refractory and insulation replacement, can reduce annual fuel consumptions throughout the MATIZOL furnaces and polimerization tunnel etc. with gas fired, by approximately 2%. At the current consumption rate of gas, the energy saving are estimated as follows:

0.2 x 468.943 TJ x 2670 USD/TJ = 25,000USD/yr

The Consultant based on a cost of refractory materials estimates an additional maintenance budget of 50,000 USD/yr, to allow for shutdowns an refractory, will be required.

Action A3,1. Provide on List No.1, Pos.1 and 5 Temperature testing equipement .

Action A3.2 Improve the combustion on Tunnel for Drying of Fiber Glass Felt burners with high efficiency

B. Low-cost, short-term improvements

MATIZOL Action B 1

Improve Heating system of the Plant's buildings

Existing conditions

Heating system in buildings of Mineral Wool, Glass Wool and Glass fibre felt and Glass fibre fabric, Mechanical and Electrical workshop is performed with saturated steam 180°C. , 4-5 bar.
The total steam consumption is about 26,000 t/yr x 2756 .10^{-6}TJ/t 0 = 71 TJ/yr

Recommended action:

The ARCON recommends that heating agent to be heated water 120/90°C. In each building or in existing Power House building the heat exchangers shall be provided (steam/water) to produce heated water. In addition heat recovery from flue gas to the staks producing more heat water.

Expected results :

Heat saving and labor protection is realised, as following:

- The heat savin is 20% x 71 TJ/yr = 14.2 TJ/yr

  14.2 TJ/yr x 3970 USD/TJ = 56,374 USD/yr

The cost of the instalation is about 20,000 USD/yr (33,4mil. lei at 1670 lei/USD).

Financial analysis:

Basgd an a cost of 20,000 USD and net sevings 56,374 USD/yr, the paybak period is about 0.35 yr.

MATIZOL Action B 2

Gas fired furnaces at Mineral Wool and Glass fibre feld and Glass fabric Plants

Improve combustion efficiency at gas fired furnaces

Existing conditions

Mineral Wool Plant Line I has furnaces (C1 and C2); Line II three furnaces (C1, C2, C3), Glass fibre felt and fabric four fournaces (C1, C2, C3, C4) out of wich one (C2) is stopped and will be restarted after capital repearings.

The instrumentation of the above furnaces and operation procedures are poor.

The control of the air to fuel ratio at presently done based on manual settings of dampers and sometimes are inexistent.

The operator sets the damper position based on readings taken with Orsat oxygen analyser.

Parameters (ones in 1 - 2 months) measured were fuel input, O_2, stack temperature. Later combustion savings were calculated based on LHV on a curve "Natural Gas savings available by reducing oxygen to optimum assumed 2%". Appendix 4 and 4a.

Based on these calculations gas savings were estimated (see following pages).

On the future with portable combustion analyser (USAID) and infrared thermal imager (USAID) new testings were performed in order to recheck the results.

Recommended action:

The Consultant recommends that MATIZOL should hove portable equipment for gas analyser to monitor weekly O_2, CO_2, and flue gas temperature on the stack each furnace.

Combustion air should be regulated to give the minimum amount of excess air to the burners actually which is required for complete combustion.

The Consultant recommends:

A. Full automation with optimisation of the combustion system

B. Feeder redesigning for an uniform heating of the outgoing glass sticks. Saving on each furnace 12 Nm^3/h natural gas = = 36 Nm^3/h (288,000 Nm^3/yr or = 10 TJ/yr).

C. Providing High efficiency burners

Expected results:

The measurements and calculation made at MATIZOL's Mineral Wool and Glass sticks furnaces demonstrates that significant energy savings are possible in the operations of the air to fuel ratio. The savings due to optimization of the combustion process are estimated as 109 TJ/yr of fuel gas energy, as summarized in table B 2.1.

Based on this recommendations (new instrumentation of the each furnace and new process procedures) gas savings will be about 109 TJ/yr and 109 TJ/yr x 2670 USD/TJ = 291,030 USD/yr in gas cost.

Redesigning of the feeder of the furnace we can save 12 Nm^3/h x 3 Glass sticks furnaces about 10 TJ/yr and 26,700 USD/yr.

Total saving in natural gas is 317,730 USD/yr.
The cost of implementing of this recommendations would be approximatel 39,000 USD x 8 = 312,000 USD calculated as follows:

A/B Instrumentation and feeder redisigning for one furnace

-(1 PC)Digital controllers for 8 chanels to provide continous PID with 4-20 mA, input/ouput capable to communicate to RS-232C computer;
5 loops for gas flow
1 loop for gas to air rates
2 loops for draft pressure
Computer 486 microprocessor 33 Mhz with 4 MB RAM and 170 MB drive to include 2 floppy drives (2. 5" and 5,25") and super VGA monitor (USAID for one furna ce — 5000 USD

-Additionequipment for loops — 6000 USD

-(1 PC)Control cabinet — 3000 USD

- Erection works (labor looks, commis-sining feeder modernisazion) — 5000 USD

-(1PC) Infrared temperature measurement;
model Omega OS1200 HAS , standard head temperature range 400-3000°C. Subranges 8 ouput types current 4-20 mA and one elec tronics box, envirometal rating 0-50°C, IP52;
1 sensing head , envirometal range 0-175°C IP65 with Water Cooler Shell Type WC; sighting viewer OS100SV; air Purge Coollar OS1000-2F and Connection Cable 50 Ft, C50 for sensing head.
Power 220V, 50Hz — 4000 USD

Total cost — 23000 USD

133

C. High Efficiency Burner Glass Furnace
14m² units (equivalent to Körting),
150 nm³/h gas each to obtain total flow
300 Nm³/h, 1500°C furnace with complete equipment
for combustiom , 500 mm WC (2 x 8000) 16000 USD

TOTAL COST FOR ONE FURNACE 39000 USD

Financial analysis:

Based on a total installed cost 312.000 USD and a saving of 317.730 USD/yr, the payback period is 12 months,

MATIZOL Plant Mineral Wool (line I and II) and Glass sticks
FURNACES COMBUSTION EFFICIENCY

PLANT	Measurements						SAVINGS		PRODUCTION CAPACITY	
	O_2	Stack Temperature		Fuel Consumption						
	%	°C	°F	Nm^3/h	$Nm^3/yr \times 10^6$	TJ/yr	%	TJ/yr	kg/h	To/yr
1	2	3	4	5	6	7	8	9	10	11
Mineral Wool										
Line I										
Furnace C1										
. before	10	700	1294	464.85	3.718	132.3				
. after	2	700	1294				23	30.43	678	5424
Furnace C2										
. before	10	715	1310	420.45	3.364	119.7				
. after	2	715	1310				23	27.52	646	5168
Line II										
Furnace C1										
. before	11.5	640	1184	193.6	1.548	55.1			412	3296
. after	2	640	1184				24	13.22		
Furnace C2										
. before	10.8	640	1184	185.8	1.486	52.89			355	2840
. after	2	640	1184				23.5	12.42		

Table B2.1 Pg 2/2

1	2	3	4	5	6	7	8	9	10	11
Furnace C3										
. before	11.5	640	1184	201.6	1.612	57.38			429	3432
. after	2	640	1184				24	13.77		
Glass Sticks										
Furnace C1										
. before	10	350	662	241.7	1.933	68.77			357	2856
. after	2	350	662				11	7.56		
Furnace C3										
. before	5	350	662	194.7	1.557	55.42			221	1768
. after	2	350	662				2.5	1.39		
Furnace C4										
. before	5.2	500	932	222.5	1.78	63.33			254	2032
. after	2	500	932				4.7	2.98		
TOTAL						**604.89**		**109**		

NOTES: For savings see APPENDIX Natural Gas Gas Savings Avaible by Reducing to Optimum (assuring 2%)

B. Low-cost short term improvements

Action B2.1 - Provide on LIST No. 1 USAID, Pos. 2, a Combustion analyser

Action B2.2 - Specify on LIST No. 2 USAID, Pos. 1 and 3, Equipment needed to increase the efficiency of gas consumption.

Bitumen Oxidation Plant

MATIZOL Action B 3

Improve combustion efficiency at 7 furnaces

Existing conditions:

MATIZOL has a Bitumen Oxidation Plant which is preparing row material (heated bitumen) for Bitumen coated cardboard, bitumen treated glass fibre felt and bitumen treated glass fibre fabric. The Plant has seven furnaces (5 for bitumen heating and 2 for oil heating).

Using a Orsat, O_2 was measured and stack flue gas temperature with thermometer.

Based on these readings, combustion efficiency calculation were made.

Furnace	$\%O_2$	Stack temp.		Fuel consumption			Eff. is		
		°C	°F	Nm^3/h	Nm^3/yr	TJ/yr	HHV %	LHV	Eff. h/yr
1									
. before	10	130	266	167	1.33×10^6	47.32	83	92.22	8000
. after	2	130	266				86	95.55	
Fuel savings (4 furnaces work)				23	184,000	6.54	dif	3.33	save 3.45%

Recommended action:

The Consultant recommends that MATIZOL shall provide new liquid fuel oil burners, with onw fan and electronic equipment.

Expected results:

. Use the natural gas during shortage period on Glass sticks furnaces where cost of the production is higher (3 - 4 months). Annual reductior of Nat.gas 23 x 8000 = 184,000 Nm^3/yr x 35.58 . 10^{-6} = 6.54 TJ/yr and savings 6.54 TJ/yr x 2670 USD/TJ = 17462 USD/yr for four furnaces in work.

. Out of 7 furnaces: three are working for bitumen heating and one for oil heating

. The cost of implementing of this recommendation is
7 burners x 4000 USD = 28,000 USD

Financial analysis:

Based a total installed cost 28000 USD and a savings of 1742 USD/yr the payback period is 19 months.

C. CAPITAL INVESTEMENT

MATIZOL PLANT

Action C 1 Provide a New Plant for Mineral Wool 6 t/24 h

Existing conditions:
The existing Plant is a standard design plant. Many improvements to the basic installed

Recommended action:
ARCON and RCG/Hogler, bailly recommend that MATIZOL develop a plan for the retrofit of Mineral Wool Plant tacking in consideration a production with higher energy efficiency equipment.

Action C 2 Provide a new Plant for Ceramic Wool and Ceramic Bricks - 6 t/24 h

Action C 3 Provide a new Plant for Glass fibre felt 6 t/24 h
Ditto, action C 1

Action C 4 Provede a new Plant for Glass Fibre Fabric
Ditto, action C 1

Action C 5 Provide a new air compressor house.

Exixting conditions:
It is necessary to redesign air compressor house tacking into consideration the actual conumption and required pressure. The existing compressors are out of life duration with low efficiency.

Recommended action:
Two new compressors or three new compressors can be installed
Action C 6 Provide to all furnaces (Mineral Wool and Glass Sticks) by one recuperator in such a may that flue gas temperature not to be more than 250°C.
Existing condition:
At Mimeral Wool furnaces , flue gas temperature is 650°C at Glass Sticks furnaces about 350°C - Recuperators are tube type.
Recommended action:
Modern design heat recuperator shall be provided in order to increase combustion efficiency by fabricating of HW for heating and shawers.

ENERGY EFFICIENCY AUDIT REPORT
MATIZOL WATERPROOFING, HEAT AND INSULATING MATERIALS PLANT

PLOIEŞTI, PRAHOVA, ROMANIA

March 1994

PREPARED BY: ARCON - SRL
and
RCG/HAGLER,BAILY, Inc.
ARLINGTON, VA, USA

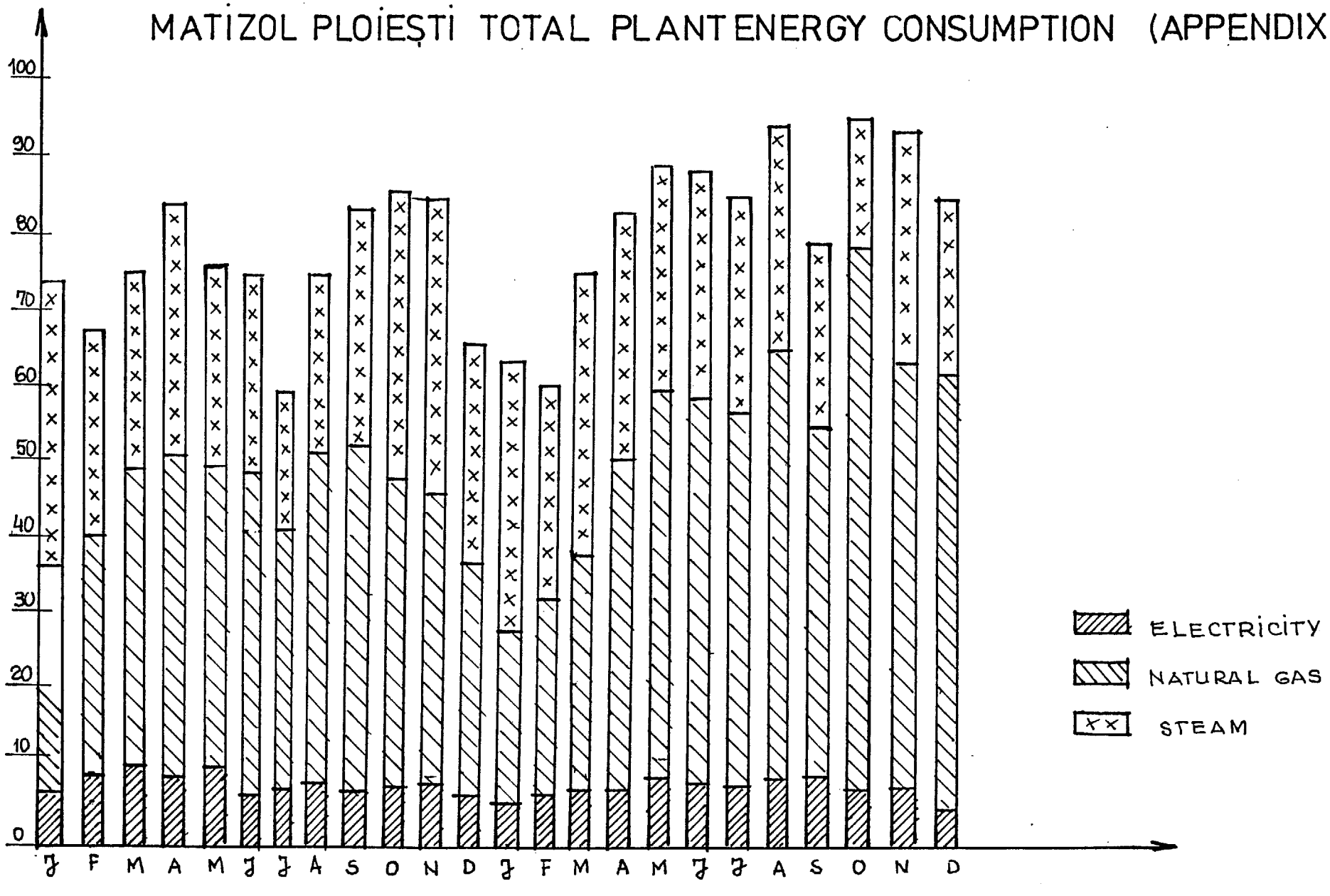
APPENDICES

U.S. EMERGENCY ENERGY PROGRAM FOR EASTERN AND CENTRAL EUROPE

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
BUREAU FOR EUROPE
WASHINGTON, D.C. 20253

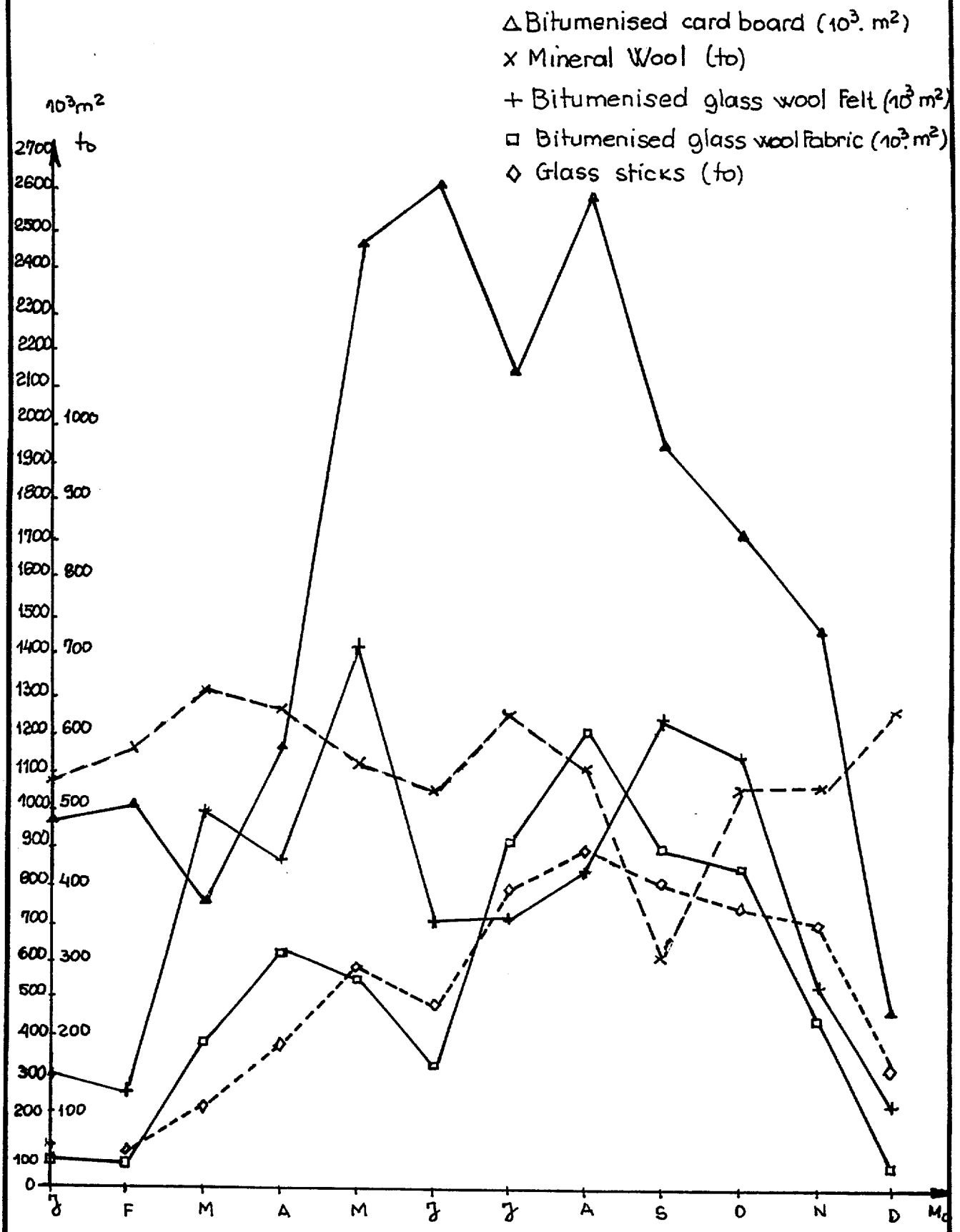
140

MATIZOL PLOIEŞTI TOTAL PLANT ENERGY CONSUMPTION (APPENDIX 1)

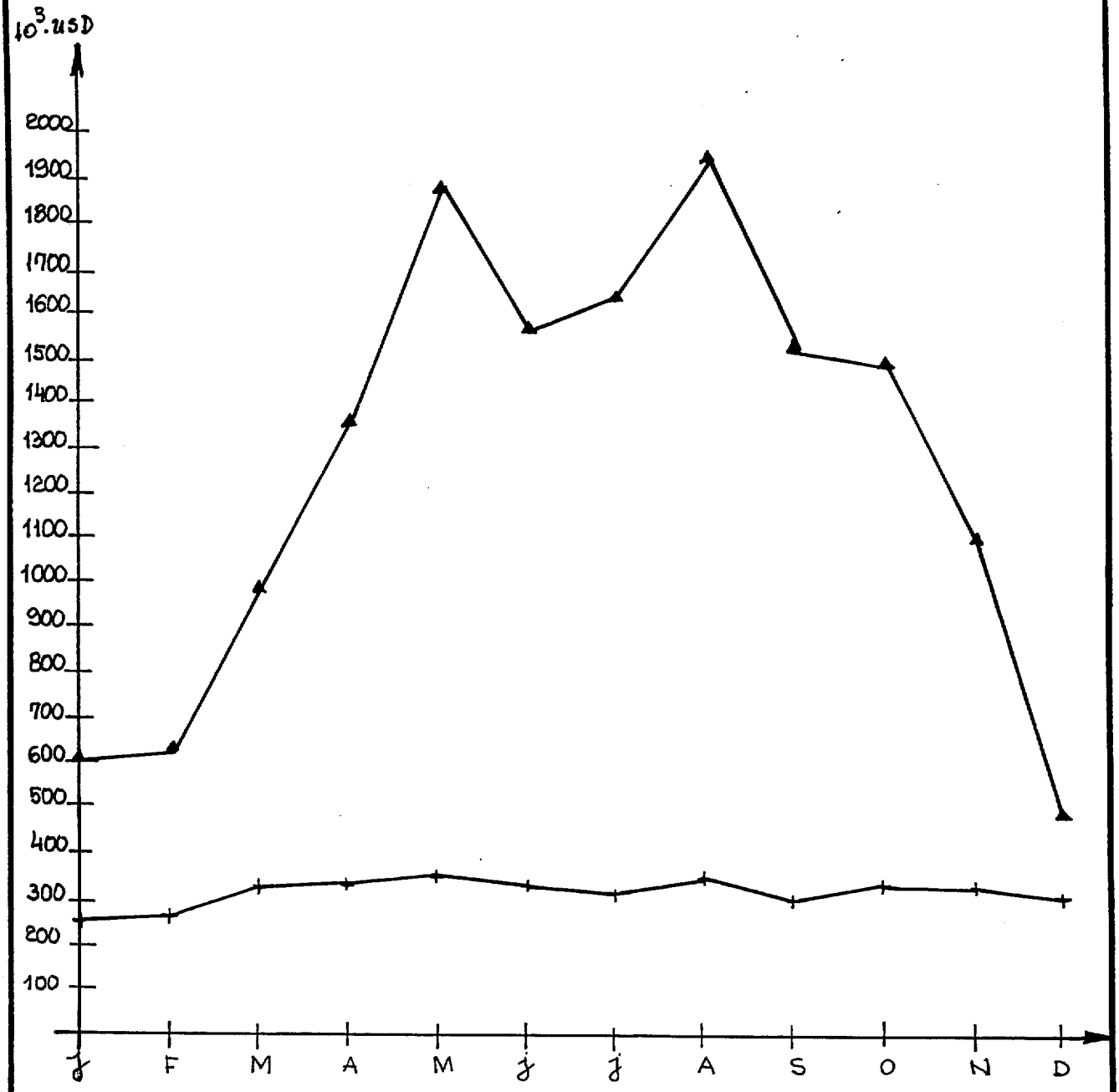


MATIZOL PLOIESTI MONTHLY PRODUCTION 1993

(Appendix 2)



MATIZOL PLOIESTI PRODUCTION VS ENERGY CONSUMATION 1993 (Appendix 3)



▲ Production in USD

+ Energyconsumption in USD

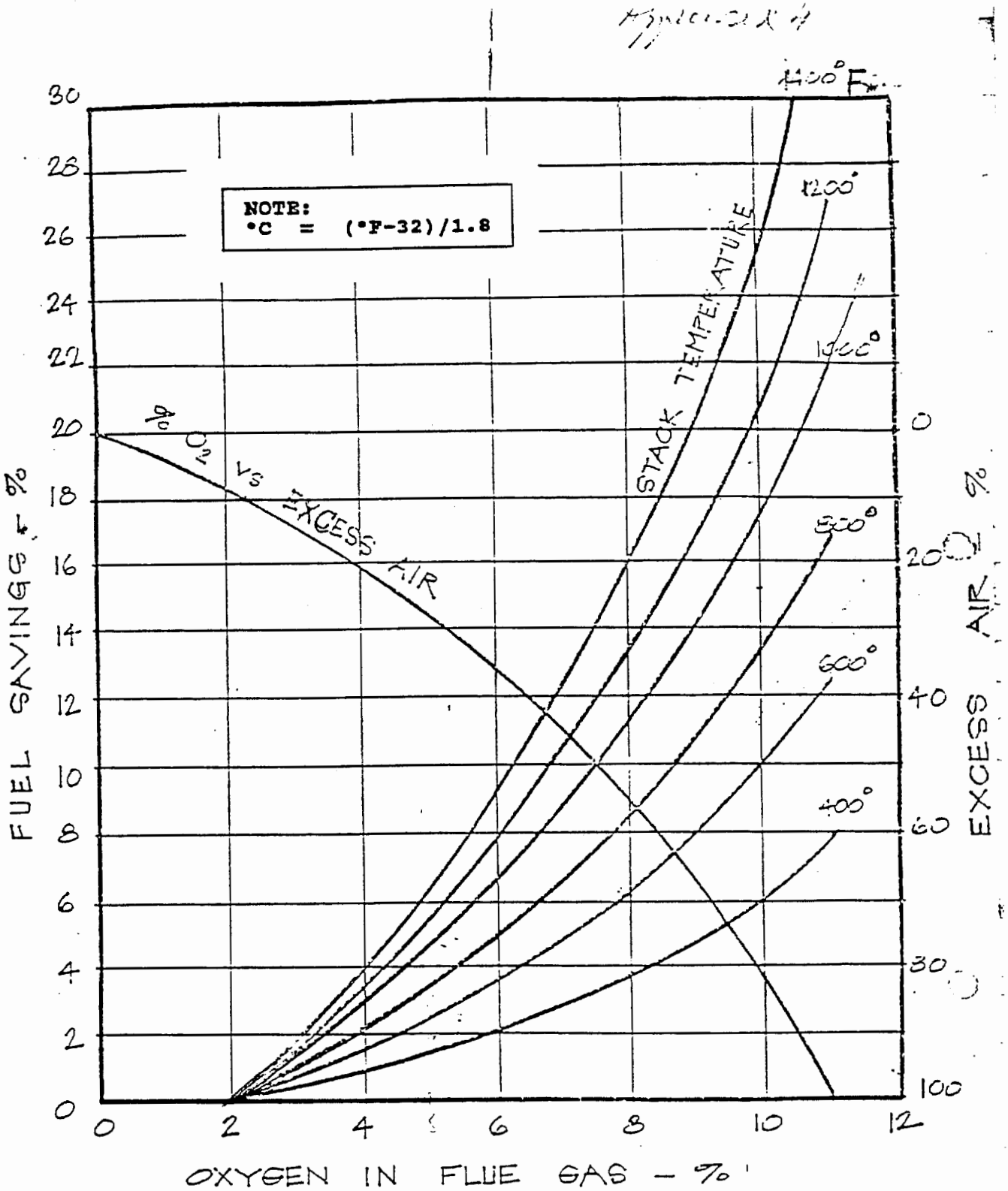
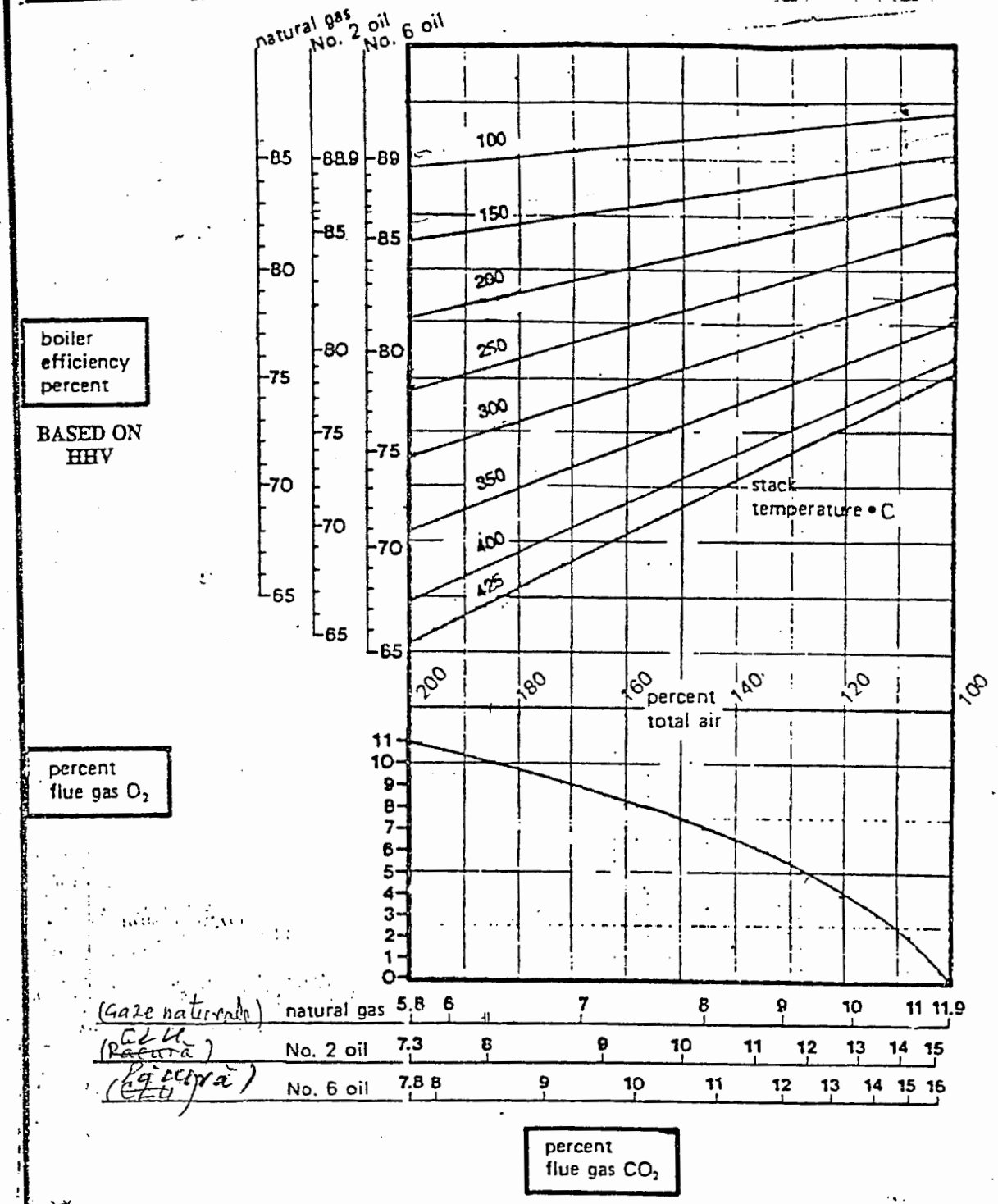


FIGURE — NATURAL GAS SAVINGS AVAILABLE BY REDUCING OXYGEN TO OPTIMUM
(assumed 2%)

Efectul compoziţiei gazului de ardere şi a temperaturii asupra eficienţei cazanului/ cuptorului.



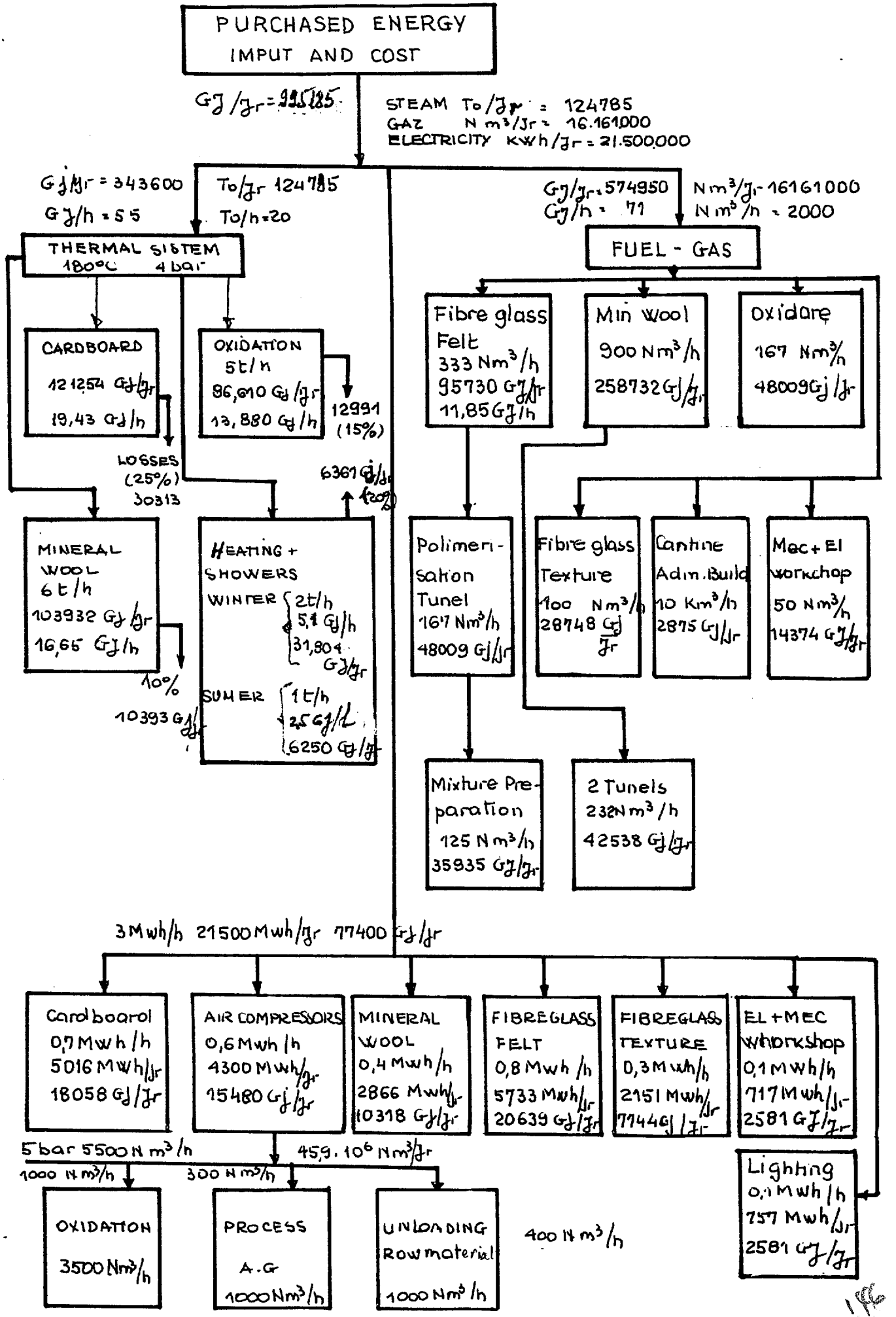
EFFECT OF FLUE GAS COMPOSITION AND TEMPERATURE ON BOILER EFFICIENCY

(Adapted from: Guidelines for Saving Energy in Existing Buildings – Engineers, Architects, and Operators Manual, ECM-2)

Note: Use the following equation to convert from EFF_{HHV} to EFF_{LHV}

$$EFF_{LHV} = \frac{EFF_{HHV}}{K}$$

where
K = 0.9 for natural gas
K = 0.93 for light fuel oil
K = 0.96 for heavy fuel oil


PURCHASED ENERGY
IMPUT AND COST
GJ/Jr = 995185
STEAM To/Jr = 124785
GAZ N m³/Jr = 16.161000
ELECTRICITY KWh/Jr = 21.500.000
GJ/Jr = 343600
GJ/h = 55
To/Jr 124785
To/h = 20
GJ/Jr = 574950
GJ/h = 71
Nm³/Jr 16161000
Nm³/h = 2000
THERMAL SISTEM
180°C 4 bar
FUEL - GAS
CARDBOARD
121254 GJ/Jr
19,43 GJ/h
OXIDATION
5t/h
86,610 GJ/Jr
13,880 GJ/h
12991
(15%)
LOSSES
(25%)
30313
6361 GJ/Jr
(20%)
Fibre glass
Felt
333 Nm³/h
95730 GJ/Jr
11,85 GJ/h
Min Wool
900 Nm³/h
258732 GJ/Jr
Oxidare
167 Nm³/h
48009 GJ/Jr
MINERAL
WOOL
6 t/h
103932 GJ/Jr
16,65 GJ/h
10%
10393 GJ/Jr
HEATING +
SHOWERS
WINTER
2t/h
5,1 GJ/h
31,804
GJ/Jr
SUMER
1 t/h
2,5 GJ/h
6250 GJ/Jr
Polimeri-
sation
Tunel
167 Nm³/h
48009 GJ/Jr
Fibre glass
Texture
100 Nm³/h
28748 GJ
Jr
Cantine
Adm. Build
10 Km³/h
2875 GJ/Jr
Mec + El
workchop
50 Nm³/h
14374 GJ/Jr
Mixture Pre-
paration
125 Nm³/h
35935 GJ/Jr
2 Tunels
232 Nm³/h
42538 GJ/Jr
3 Mwh/h 21500 Mwh/Jr 77400 GJ/Jr
Cardboard
0,7 Mwh/h
5016 Mwh/Jr
18058 GJ/Jr
AIR COMPRESSORS
0,6 Mwh/h
4300 Mwh/Jr
15480 GJ/Jr
MINERAL
WOOL
0,4 Mwh/h
2866 Mwh/Jr
10318 GJ/Jr
FIBREGLASS
FELT
0,8 Mwh/h
5733 Mwh/Jr
20639 GJ/Jr
FIBREGLASS
TEXTURE
0,3 Mwh/h
2151 Mwh/Jr
7744 GJ/Jr
EL + MEC
whorkshop
0,1 Mwh/h
717 Mwh/Jr
2581 GJ/Jr
5 bar 5500 N m³/h
45,9 · 10⁶ Nm³/Jr
1000 N m³/h
300 N m³/h
OXIDATION
3500 Nm³/h
PROCESS
A.G
1000 Nm³/h
UNLOADING
Row material
1000 Nm³/h
400 N m³/h
Lighting
0,1 Mwh/h
757 Mwh/Jr
2581 GJ/Jr

IEES Energy Tips

Energy management suggestions from the Industrial Energy Extension Service
a joint service of the Georgia Office of Energy Resources and Georgia Tech's Engineering Experiment Station.

ENERGY TIP NO. 2

ELIMINATE STEAM LEAKS

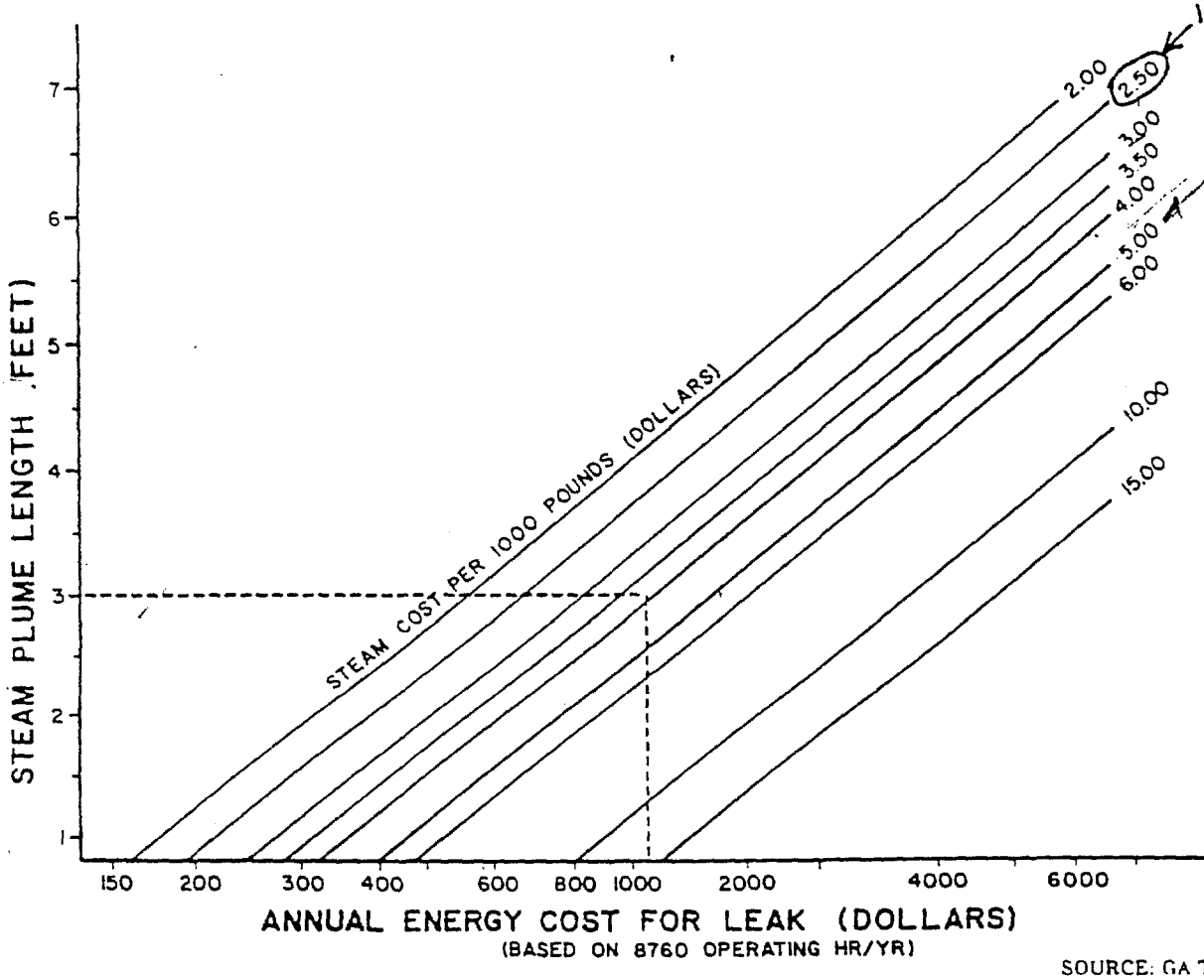
A conspicuous waste of energy are the numerous steam leaks at pipe joints, valves, unions, etc. Until the cost of energy skyrocketed, it was generally thought that small leaks should be tolerated and that fixing them was not worth the time or cost.

The graph below is a rough approximation of what a steam leak costs in terms of annual fuel expense. To use the graph, determine the leak's "Blow Length" by measuring the length of the steam plume or the approximate distance at which water condenses out of the stream onto your hand (usually beyond the visible plume). Enter the graph with the blow length and move across to the corresponding cost of steam line determined by using the "Steam Cost" chart, Energy Tip No. 1. Read the annual energy cost at the bottom of the graph.

EXAMPLE

A survey of a plant's steam distribution system reveals a steam leak at an equipment connection flange. The plume length of the leak is approximated at 3 ft. What is the energy cost of not fixing the leak?

Using the graph and a steam cost of $4.00/1000 lbs determined from Energy Tip No. 1, the annual cost is $1200.



N/A approx. cost of steam

Hatizol

SOURCE: GA TECH EES

GUIDELINES FOR DESIGNING & OPERATING COMPRESSED AIR SYSTEMS

I. ESTABLISH SYSTEM STATUS/REQUIREMENTS

1. EXECUTE A DETAILED COMPRESSED AIR AUDIT
2. TRAIN OPERATING AND TECHNICAL STAFF
3. CALCULATE AND UPDATE REGULARLY COMPRESSED AIR OPERATING COSTS ($/YR., ¢/1000 CF, TOTAL AND VARIABLE)
4. DEVELOP ONE-LINE COMPRESSED AIR BALANCE
5. EVALUATE THE MANUFACTURING PROCESSES AND OPERATIONS FOR END USER REDUCTION
6. AGGRESSIVELY PURSUE A LEAK REDUCTION PROGRAM

WPS/9-91

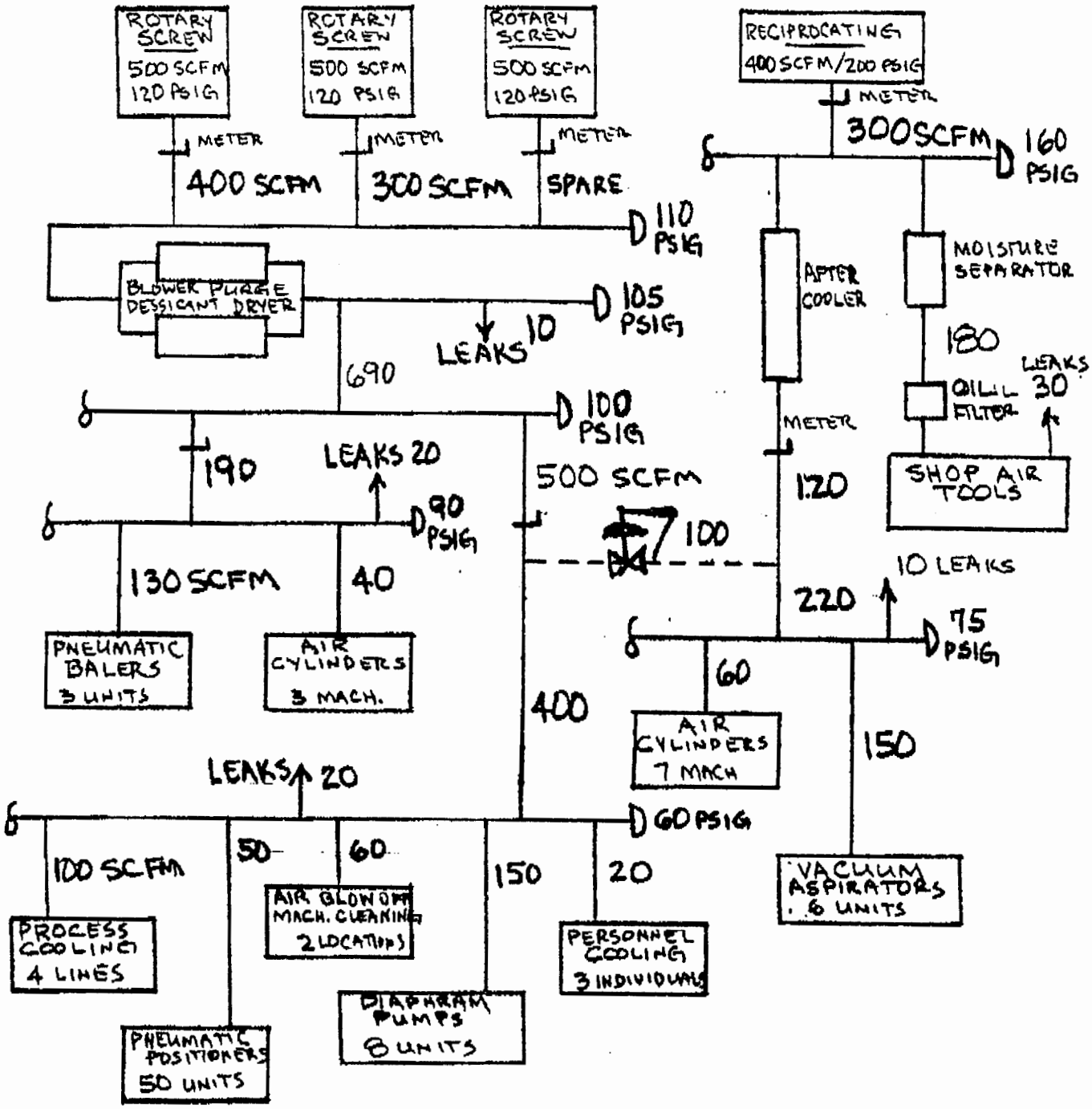
SINGLE LINE COMPRESSED AIR BALANCE

- SHOWS COMPLETE SYSTEM
  - GENERATION ... INDIVIDUAL UNITS
  - DISTRIBUTION ... PRESSURE LEVEL
  - USERS ... INDIVIDUAL LOADS
- INDICATES FLOW RATES
  - SCFM (14.696 PSIA, 60°F)
  - ACTUAL FLOWS NOT DESIGN
  - ANNUAL OR MONTHLY AVERAGE
- ACCOUNTS FOR 100% GENERATED
  - TOTAL GENERATED
  - LOSSES AT COMPRESSOR (BLOW-OFF)
  - LEAKS IN DISTRIBUTION
  - CONSUMPTION AT LOADS
  - LOSSES, LEAKS AT LOADS
- INDICATES TYPE OF USER
  - CONTINUOUS (100% USE FACTOR)
  - INTERMITTENT (<100% USE FACTOR)
  - BATCH, REPETITIVE (<100 USE FACTOR)
- USE SINGLE LINE C.A. BALANCE TO:
  - IDENTIFY INEFFICIENCIES
  - QUESTION OPERATING PRACTICES
  - CHALLENGE PROCESS USE/USERS

WPS/8-91

ONE-LINE COMPRESSED AIR BALANCE

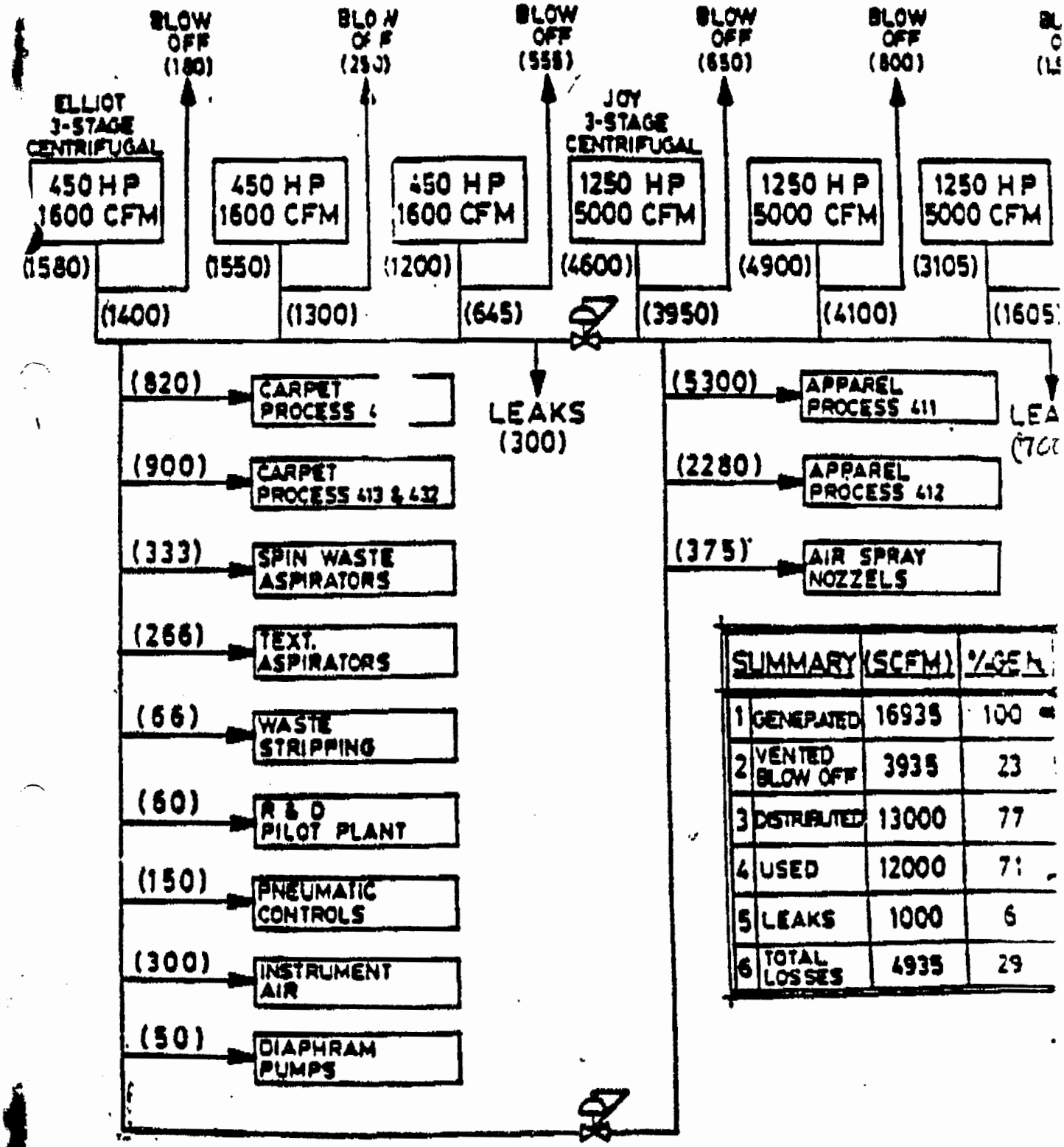
- WHERE DOES IT COME FROM?
- HOW DOES IT GET THERE?
- WHO USES IT AND HOW?



WPSMITH / 9-91

SINGLE LINE UTILITY DIAGRAM

ONE-LINE COMPRESSED AIR SYSTEM (S.C.F.M.)



SUMMARY		(SCFM)	%GEN
1	GENERATED	16935	100
2	VENTED BLOW OFF	3935	23
3	DISTRIBUTED	13000	77
4	USED	12000	71
5	LEAKS	1000	6
6	TOTAL LOSSES	4935	29

151

GUIDELINES FOR DESIGNING & OPERATING COMPRESSED AIR SYSTEMS

II. DESIGN/SPECIFYING

7. EVALUATE CENTRAL VERSUS DECENTRALIZED SYSTEMS
8. OPTIMIZE UNIT SIZING TO FACILITY NEEDS
9. CONSIDER ALTERNATIVES TO MOTOR DRIVES
10. BUY MOST ENERGY EFFICIENCY COMPRESSOR OPTIONS
11. SUPPLY COOLER (OUTSIDE) AIR TO INTAKE

GUIDELINES FOR DESIGNING & OPERATING COMPRESSED AIR SYSTEMS

II. DESIGN/SPECIFYING -- CONTINUED

12. METER AND SUBMETER FOR ACCOUNTABILITY
13. SPECIFY THE RIGHT DRYERS
14. ADEQUATELY SIZE COMPRESSED AIR SURGE TANK
15. EVALUATE STAINLESS VERSUS MILD STEEL PIPING
16. DETERMINE BEST CONTROL STRATEGY
17. EVALUATE (PRIOR TO BUYING) OWNING AND OPERATING COST FOR EACH COMPRESSOR TYPE

GUIDELINES FOR DESIGNING & OPERATING COMPRESSED AIR SYSTEMS

III. OPERATING CONDITIONS/PRACTICES

18. TIE MULTIPLE PRESSURE SYSTEMS TOGETHER

19. BALANCE OUTPUT OF MULTIPLE UNITS

20. MONITOR AND ALARM FOR PERFORMANCE AND RELIABILITY

21. OPERATE AT LOWEST ACCEPTABLE DISCHARGE PRESSURE

22. FLOAT OUTPUT PRESSURE TO SATISFY HIGHEST PRESSURE USER

23. RUN AS FEW UNITS AS POSSIBLE

24. MINIMIZE VENTING (BLOW-OFF) ON CENTRIFUGALS

GUIDELINES FOR DESIGNING & OPERATING COMPRESSED AIR SYSTEMS

III. OPERATING CONDITIONS/PRACTICES -- CONT.

25. OPERATE WITH CLEAN INLET FILTERS
26. PROVIDE LOWER TEMPERATURE INTERCOOLER WATER
27. USE SPECIALIZED SOFTWARE AND CONTROL SYSTEMS
28. CONSIDER USE OF SYNTHETIC LUBRICATION OIL
29. MAINTAIN CONDENSATE TRAP SYSTEMS
30. MAINTAIN OIL SEPARATOR SYSTEMS

155

TEN MOST PRODUCTIVE ENERGY AUDIT QUESTIONS

COMPRESSED AIR (C.A.) SYSTEMS (CONT.)

7. WHAT CONTROL STRATEGY IS CURRENTLY USED FOR INDIVIDUAL COMPRESSORS AND THE SYSTEM AS A WHOLE?

8. IS THERE A FORMAL, SITE-WIDE LEAK REDUCTION PROGRAM (L.R.P.) AND IS THERE A COMPREHENSIVE C.A. PREVENTATIVE MAINTENANCE PROGRAM (P.M.P.)?

9. DO THE AUXILIARY C.A. SYSTEMS (COOLING WATER SUPPLY, INTERCOOLERS, OIL COOLERS, AFTER COOLERS, DRYERS, CONDENSATE TRAPS, ETC.) FUNCTION AS THEY SHOULD?

10. HAVE THE OPERATIONS AND PROCESSES WHICH CURRENTLY CONSUME C.A. BEEN QUESTIONED AND CHALLENGED AS TO HOW CONSUMPTION CAN BE REDUCED AT THE POINT-OF-USE?

REFERENCES:

- *COMPRESSED AIR ENERGY CONSERVATION OPPORTUNITIES, W. SMITH, 4-92.*
- *GUIDELINES FOR DESIGNING & OPERATING C.A. SYSTEMS, W. SMITH, 9-91.*
- *THE INDUSTRIAL/COMMERCIAL ENERGY AUDIT, W. SMITH, 3-92.*
- *COMPRESSED AIR CONSERVATION (TECHNOLOGY: JAHRESTREFFEN '92), W. SMITH, 6-92.*
- *COMPRESSED AIR AUDIT: HILADOS FLEXILON, W. SCALES, W. SMITH, 5-92.*

WPS/Sept92

156

TEN MOST PRODUCTIVE ENERGY AUDIT QUESTIONS

COMPRESSED AIR (C.A.) SYSTEMS

1. IS THERE A FORMAL C.A. CONSERVATION PROGRAM WITH WELL-DEFINED OBJECTIVES, GOALS, AND PLANS?

2. WHAT IS THE ANNUAL OPERATING COSTS OF THE C.A. SYSTEM (VARIABLE AND FIXED, AVERAGE AND INCREMENTAL)?

3. WHAT IS THE TOTAL ECONOMIC IMPACT (T.E.I.) OF THE C.A. SYSTEM PERFORMANCE ON THE SITE'S PERFORMANCE?

4. HAS A DETAILED, SITE-WIDE COMPRESSED AIR AUDIT BEEN DONE WITHIN THE LAST THREE YEARS?

5. HOW MUCH COMPRESSED IS PRODUCED? WHERE DOES IT ALL GO? HOW DOES IT GET THERE? IS THERE AN UP-TO-DATE "ONE-LINE COMPRESSED AIR BALANCE" SHOWING SCFM (OR M^3/HR) FROM ALL COMPRESSORS, THROUGH THE DISTRIBUTION SYSTEM TO ALL MAJOR END USERS?

6. WHAT IS THE SPECIFIC EFFICIENCY (M^3/KWH OR BHP/100 CFM) OF EACH MAJOR AIR COMPRESSOR?

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A SEVEN-STEP APPROACH TO ENERGY AUDITS

EXAMPLE: COMPRESSED AIR PRODUCTION AND USE

TOPIC OUTLINE

Step One	Business Economics of Compressed Air
Step Two	Facility Personnel Input and Guidance
Step Three	Analysis of Supply, Distribution and End-Users
Step Four	Survey of System Performance
Step Five	Analysis of Process Use of Compressed Air
Step Six	Developing "Preliminary" Recommendations
Step Seven	Deliverables: Wrap-Up Meeting, Report and Follow-Up

Summary, Conclusions: The Value of a Comprehensive Approach

WPS/1-93

STEAM SYSTEM AUDIT

1. Objectives

A. **Generation system** (supply side)

. Optimize fuel supply options
. Increase generating efficiency
. Improve system
. Other

B. **Distribution system** (supply - demand)

. Reduce heat losses in system
. Decommission idle steam lines
. Minimize steam system leaks
. Optimize steam trap performance
. Improve system reliability
. Other

C. **Process systems** (demand - side)

. Implement a steam management program
. Identify and quantify major users
. Characterize load profits
. Reduce process loands at point-of-use
. Modify process to use less
. Charge operating methods
. Examine practices and procedures
. Challenge old, outdated process
. Consider New Process Technologies

Constrains: Recommendation must result in equal or greater overall system reliability, productivity, quality and safety ... with 6 to 30 month simple payback

2. Goals, anticipated results (measurable)

A. **Generation system** (supply)

. Increase fuel utilisation by 2 - 4%

. Decrease unscheduled outages by 20%

B. **Distribution system** (supply)

. Reduce heat losses by 20 - 30%

. Eliminate 5-15% of steam piping runs

. Reduce trap losses by 20-40%

. Reduce steam leacks by 40-60%

C. **Process system** (demand)

. Reduce process loads by 20-40%

. Improve reliability, productivity, quality, etc. by 50-100%

Overall goal: reduce annual consumption of 20%

Reality: Recognize the difference between "potential" and "achievable"
(priorities, funding, manpower, etc.)
Bottom-line results must be measurable.

3. Scope of work (Apply 80:20 rule)

A. **Steam generation systems**

. Thermo-economic analysis, unit cost

. Fuel analysis

. Water treatment

. Deaerator performance

. Combustion efficiency

. System losses

. Individual unit realiability

. Operating Practices and Procedures

. Other (heat recovery)

b. **Steam distribution systems**

. Assessment of operating costs

. Loads on individual heaters

. Steam leak conditions

. System losses, insulation

. Maintenance and operating practices

. System realiability and life expectancy

. Steam trap performance
. Condensate return system
. Other/prv's

C. **Process steam reduction**
. Introduce "Program for energy reduction" concepts
. Develop steam balance to and iside individual process
. Identify the steam intensive processes and analyse
. Asses opportunities to reduce loads by changing procedures
. Identify load factor peaks
. Challenge old ways and old technologies
. Other

4. Schedule, milestone

A. **Review draft proposal**	(1 day)
B. **Finalize objective, goals, scope, etc**	(1 day)
C. **Initiale audit process**	(3 days)

1. Task assignments
2. Review schedule
3. Data collection and analysis
4. Field studies
5. Identify specific recommendation
6. Develop (quantify) projects

D. **Audit progress review**	(3 days)
E. **Conclusions, recommendations on generation**	(10 days)
F. **Conclusions, recommendations on distribution**	(15 days)
G. **Conclusions, recommendations on process reductions**	(15 days)
H. **Final documentation and impementation plan**	(15 days)
1. Presentation to management	(1 day)

5. Resources

A. **Audit team**	Proposed Man.hours
. Leader	-
. Specialists	-
.	-
.	-
.	-
.	-
TOTAL	

6. Approach, work plan

A. **Meeting team effort, commitment**
B. **Review audit results of .....**
C. **Review sirrine steam study, other**
D. **Establish priorities, focus the effort**(target specific areas and issues)
E. **Initiate the audit process**
F. **Emphasize NO-COST, LOW-COST recommendation**
G. **Quantify (economics) all major recommendations**
H. **Group projects as expense versus capital**
I. **Provide an implementation plan**
J. **Document results with summary report**

7. Implementation plans, commitment

. Implement via plant energy team(s)
. Identify LOW-RISK, fast payback projects
. Assign recommendations and projects priorities
. Develop a phase program schedule
. Act quickly on LOW-COST, expense recommendation
. Credit projects with legitimate corollary benefits
. Fit program into capital speding plan
. Secure management support commitment

8. Presentation to management

. Objectives, goals
. Scope and schedule
. Summary of mager recommendations
. Implementation plans
. Summary, conditions (commitment)

APPENDIX 10

STEAM TRAP LOSSES

Plant has 117 traps in fonction out of which 67 work and 50 not work.
Assuming an of size 1/11 Fand T type, 10 bar 240°C, 200 kg/h flow rate.

Condensate flow rate in kg/h: 50 x 200 = 10000 kg/h

Steam loss (10% of condensate flow assumed) . 10000 kg/h

Annual cost from steam loss:
1t/h x 8500 h/yr x 0.7 x 11 USD/t steam = 65450 USD/yr

Cost of steam traps (Armstrong):

117 x 500 USD/trap = 58500 USD

$$PB = \frac{58500}{65450} = 0.9 \text{ yr}$$

TOTAL COG GELTS	1216 Pcs
TOTAL COST	14179 USD
KW OF MOTOR	1794,3 KW

SAVINGS = 1794,3 Kwh/H x 8760 H/yr x 0,7 x 0,0153 Sav x 0,05 USD/KWh + +14179 USD = 8225 + 14179* = 22404 USD/yr

$$PB = \frac{COST}{SAV} = \frac{14179}{22404} = 0,63 \text{ yr}$$

Remarks:

0,7 Load factor

0,015 Savings

$$Sav = \frac{Enew-Exist}{Enew} 100 = \frac{0,975-0,96}{0,875} =$$

$$= 1.53\%$$

* double life

ENTERPRISE ANNUAL ENERGY PROFILE YEAR 1993 FACILITY MATIZOL PLANT

MONTH	HEATING	COOLING	ELECTRICITY			FUEL GAS			OTER STEAM			TOTAL ENERGY	
	DEG DAYS	DEG DATS	QUANTITI KWH	COST USD	QUANTITY TJ	QUANTITY M3(100)	COST	QUANTITY TJ	TJ	QUATITY To	COST USD	TJ	COST USD
IANUARY	5580	-	1441200	76671	5,188	650	58126	23,12	34,48	12423	13696.3	62,788	271760
FEBRUARY	364	-	1624800	86439	5,849	767	68589	27,28	27,71	9984	110073	60,839	265101
MARCY	217	-	1632900	87029	5,878	913	81645	32,48	38,54	13885	153082	76,898	321756
APRIL	30	-	1704900	79293	6,137	1276	114107	45,40	32,73	11790	129984	84,267	323334
MAY	0	-	2142600	99588	7,713	1488	133065	52,94	29,81	10740	118408	89,803	351061
IUNE	0	-	1976400	91863	7,115	1480	132350	52,65	29,15	10500	115762	88,915	339975
IULY	0	-	1922400	89353	6,920	1442	128952	51,30	27,39	9866	108772	85,610	327077
AUGUST	0	-	2101500	97677	7,565	1612	144154	57,35	28,64	10318	113755	93,555	355586
SEPTEMBER	0	-	1852500	86104	6,669	1378	123229	49,02	23,59	8500	93712	79,279	303045
OCTOBER	31	-	2135700	113619	7,688	2004	179209	71,30	16,10	5800	63945	95,008	356773
NOVEMBER	210	-	1790700	95265	6,446	1563	139772	55,61	29,95	10790	118959	92,006	353996
DECEMBER	403	-	1168800	62180	4,207	1588	142008	56,50	25,51	9190	101319	86,217	305507
ANUALTOTAL	1813	-	21494400	1065031	77,375	16161	1445126	574,95	343,6	124785	1364734	995,185	3.874.977
ANNUALAVERAGE	151	-	1791200	88752	6,44	1346	120433	47,91	28,63	10398	113727	82,93	322,914

NOTES/CONVERSION FACTORS:
0,0036 GJ/kwh
winter = 0,0532 usd/kwh
sumer = 0,04648 usd/kwh

Electricity:
0,05 USD/kwh
Avg

Natural Gas
35,58 GJ/1000 Nm³
2,513 USD/GJ
89,426 USD/1000 Nm³

steam
0,653 Gcal/to — 3,97 USD/GJ
2,7763 GJ/to — 16,62 USD/Gcal
4,186 GJ/Gcal — 10,94 USD/to

ENTERPRISE ANNUAL ENERGY PROFILE YEAR 1992 FACILITY MATIZOL PLANT

MONTH	HEATING	COOLING	ELECTRICITY			FUEL GAS			OTHER STEAM			TOTAL ENERGY	
	DEG DAYS	DEG DAYS	QUANTITY KWH	COST USD	QUANTITY TJ	QUANTITY M3 (1000)	COST USD	QUANTITY TJ	TJ	QUANTITY To	COST USD	TJ	COST USD
JANUARY	558	-	1628100	86615	5,861	833	74491	29,63	37,48	13.500	148837	73,29	309943
FEBRUARY	364	-	1965900	104585	7,077	937	83792	33,33	26,93	9700	106942	67,33	295319
MARCH	217	-	2065800	109900	7,436	1162	103913	41,34	25,68	9250	101981	74,45	315794
APRIL	30	-	1945800	90440	7,004	1252	111961	44,54	31,64	11400	125685	83,18	328086
MAY	0	-	2205500	102511	7,939	1253	112050	44,58	25,17	9069	99985	77,68	314546
JUNE	0	-	1526100	70933	5,493	1225	109546	43,58	26,07	9391	103535	75,14	284014
JULY	0	-	1586100	73721	5,709	986	88174	35,08	18,02	6492	71574	58,80	233469
AUGUST	0	-	1809000	84082	6,512	1252	111961	44,54	24,28	8749	96457	75,33	292500
SEPTEMBER	0	-	1721400	80010	6,197	1295	115806	46,07	25,56	10650	117416	81,82	313232
OCTOBER	0	-	1796700	95584	6,468	1166	104270	41,48	37,06	13362	147316	85,00	347170
NOVEMBER	210	-	1899300	101042	6,837	1074	96043	38,21	38,50	13870	152916	83,54	350001
DECEMBER	403	-	1668300	88753	6,005	833	74491	29,63	30,18	10874	119885	65,81	283129
ANNUAL TOTAL	1813	-	21818000	1088176	78,538	13268	1186498	472,01	350,57	126307	1392529	901,37	3667203
ANNUAL AVERAGE	151	-	1818166	90681	6,54	1105,6	98874,8	39,33	29,21	10525	116044	75,11	305600

NOTES:

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- ROMANIA

FINAL ENERGY AUDIT REPORT

for work at

Mobins, S.A.

by

Florin Mihailescu

Camigo, S.R.L.

for

Hagler Bailly Consulting, Inc.

167

ENERGY AUDIT REPORT FOR MOBINS SA

MARCH/APRIL, 1995

BENEFICIARY: MOBINS SA BUCURESTI

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168

1.EXECUTIVE SUMMARY

1.1. OBJECTIVES,GOALS,RESULTS

The objectives of the audit are:
-To evaluate energy consumption at the plant;
-To identify the energy efficiency opportunities;
-To identify low-cost tuning,operational and maintenance recommendations;
-To recommend long-range solutions to energy analysis and process energy management issues;
-To identify instrumentation and low-cost equipment needed by the plant to implement the more attractive energy consumption actions.

The goals are the diminution of energy consumptions and specific energy consumption in production process with better quality,productivity,ecology and safety.

This report presents the results from a prelimimary energy audit carried out by a team of engineers from CAMIGO Ltd.

At the request of the beneficiary according to the signed contract the Energy Audit has reffered to the drying section only of the MOBINS S.A. Bucharest.

1.2. PLANT DESCRIPTION

The MOBINS S.A. Bucharest is a business entity,that was entirely privatisated through the MEBO method in 1994, representative of the branch of furniture production from large wood elements for dinning rooms, dormitories, offices, etc, especially for export (90%).

MOBINS is very interesed in the production process modernization,productivity growth,and diminution of energy consumptions.

For this purpose MOBINS acquired from import a brand new finishing section and computer guided high performance devices for wood treetment with diminished energy consumption.

1.2.1 PLANT INFRASTRUCTURES AND UTILITY SYSTEMS

MOBINS is a well organized plant with:
-Production departament
-Mechanical,electrical,and energy department;
-Design section;
-Maintenance
-Commercial department;
-Financial department.
The plant has a general manager and 2 directors.

UTILITY SYSTEMS:

1.2.2. ELECTRICAL SYSTEM

The plant is supplied from national 110 kV grid through a 110/6 KV RENEL station and 6/0.4 kV transformers.

CATEGORY	1990	1991	1992	1993
Annual Consumption (WH*h)	2640	2660	2880	3301
Connected load (kW)	605	605	630	810
Average power indice (cos Ø)	0.87	0.88	0.90	0.92
Energy charge (per kW*h)	670	680	700	720
Demand charges per kW)	670	680	700	720
Time-of-use-rate (hour/day)	16	16	16	16
Electrical distribution (%)				
-engines	88	88	86	85
-lights	8	8	10	12
Self generation capacity	-	-	-	-

-Main electric power consumers/load:
Drying rooms.....132 kW
Thermal power station.....110 kW

1.2.3. THERMAL DATA

CATEGORY	1990	1991	1992	1993
Annual consumption				
-steam (Gcal)	10230	10565	15619	25830
-hot water (Gcal)	9653	9898	9404	10450
Annual billing (in local currency) average price				
-steam lei/ /Gcal) /costs th lei	462/4726	6685/70627	12200/190552	22500/581175
-hot water(lei/Gcal)/cost th lei	585/5647	1950/19301	14300/134477	25650/268043

*The number of working hours at peak hours are considered as follows:
-December-March = 5 hours
-April and November = 3 hours
-May and September = 1 hours
-June and September = 1 hour
-July and August = 0 hours

ENERGY AUDIT FOR MOBINS S.A.

STEAM GENERATION EQUIPMENT	PRESSURE RATING	CAPACITY	AGE	FUEL
BOILER CIR 2.5 t/h type	8 bar	2.5 t/h	10 years	wood waste
Steam generation accesories	manual	automated		
Stock gas monitoring	-	-		
Boiler blow down	yes	-		
Combustion control	-	-		
Pre-heated comb. air	-	-		
Fuel pre-heating	-	-		
Waste heat recovery	**-**	**-**		
Economizer	**yes**	**-**		

Main consumers of steam/load:
-furnitures presses.....0.2 Gcal/h
-drying rooms.....0.8 Gcal/h

The quantity of steam buyed from outside during 1 year is 25830 Gcal/1993 and 21407 Gcal/1994,however it cannot be determined exactly due to the incorect functioning of measure apparatures with which MOBINS operates.

1.3. ENTERPRISE'S ANNUAL ENERGY PROFILE FOR 1993

MONTH	HEATING DAYS DEG	COOLING DAYS DEG	ELECTRICITY QNTY MW	ELECTRICITY COST TH LEI	WOOD QNTY TONE	WOOD COST THS.LEI
IANUARY	-	-	228	5262	578	2132
FEBRUARY	-	-	326	7893	505	1862
MARCH	-	-	346	7800	536	1977
APRIL	-	-	297	6466	473	1744
MAY	-	-	280	7018	410	1512
JUNE	-	-	289	8021	230	848
JULY	-	-	114	3542	RK	-
AUGUST	-	-	270	1325	RK	-
SEPTEMBER	-	-	260	1354	RK	-
OCTOBER	-	-	269	1427	RK	-
NOVEMBER	-	-	347	2662	RK	-
DECEMBER	-	-	275	1574	RK/260	959
ANNUAL	-	-				
TOTAL			3301	54344	2992	11034

NOTES:
-From June till December, 1994 the steam boiler has been under capital reparation (RK).
-The weekly steam consumption and costs cannot be precisely determined since the payment of consumptions is made under a system agreed with the supplier.
-The costs has been determined by the following relationships:
1 MV*H = 3.6 GJ; US$ 27,12/MV*h
1 tone of wood waste US$ 8

1.4.ENTERPRISE'S ANNUAL ENERGY PROFILE FOR 1994

YEAR	ELECTRICITY Quantity Mwh	ELECTRICITY Cost th lei	THERMAL Gcal	THERMAL Cost th lei
1994	3210	346952	21047	512034

2. DESCRIPTION AND ANALYSIS OF ENERGY SYSTEMS. RECOMMENDATIONS.

2.1. GENERAL ISSUES

This report of power diagnosis carried out by the CAMIGD SRL BUCURESTI, represents the beginning of the implementation of fuel and energy saving measures, being a part of the U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) technical assistance program entitled "ROMANIA ENERGY EFFICIENCY MARKET DEVELOPMENT".

After the studies of power consumers, steam and hot water, ventilation and pneumatic transportation systems, distribution and utilization of electric energy for force and illumination, which has been assisted by Mr. LAURENT POMMIER, the representative of the RCG/Hagler Bailly, Inc. (USA), there were identified the following energy problems that could be improved.

The general auditing of possibilities of energy savings does not make part of the signed contract with the MOBINS, however the following recommendations are the guidelines offered to MOBINS for further evaluations.

2.2. DRYING DEPARTMENT

- Currently, the drying process management is carried out manually according to the pshirometric measurements and temperatures, implementing a maneuvre of the valves from the circuits of steam injection alimentation and of the air closing damper from the ventilation circuit of the drying rooms.

This management way, along the disfunctionalities associated to the absence of immediate correction possibilities, in function to the answer of the system; has also the disadvantage of the wood humidity measurement in one point only and in time intervals that allow a more rapid installation of superficial drying, that negatively influences the quality of the product (rejects, waste).

- The drying rooms ventilation system works manually, being possible the consumption diminution throuth the redimensionalization and automatization of the process.

- The condense recovery system does not function adequately, the condense traps, being defective, present omissions.

- The air ventilators' electric engins represent a wide range of powers from 1.5 to 3 kW; a part of them have not worked or have worked in a regime of high electric consumption.

The transmission system is out of date, the connection belts were not tightened appropriately, working with slipings, that imply suplementary electric power consumption.

- The recommended course of action to follow for the process efficiency growth and power consumptions diminution is the automatization of the drying process throgh the mount of the KIL-MO-TROL PLUS (USA) timber humidity control system and the devices indicated on the attached EQUIPMENT LIST, commonly agreed by the CAMIGO SRL anb MOBINS SA, and through the kindness of the RCG/Hagler Bailly, which assured technical assistance.

2.3. THERMIC AGENT SUPPLY

Currently the MOBINS SA acquires the steam mainly from suppliers, there existing no possibility for an exact count and real control over the supplied quantities.

The mount of some specific counters (debitmeters) of high precision would create the possibility of correct control and savings.

2.4. THE (OLD) FINISH DEPARTMENT

- The current ventilation system is inefficient, creating precarious working environment, implying a reconsideration of the system's functions according to the current working conditions.

- The fan transport load is high, there existing no air recirculation system.

- The mount of an automatic inside temperature control system or of some temperature indicators would create a sure possibility of important energy savings.

2.5. VENTILATION AND HEATING SYSTEM

- There is a great variety of ventilation and heating conditions through different inside areas, there existing also non-recommended polluted air transfers from the finish area, unrecovered heated air, etc.

- Inexistence of a control system of inside spaces heating implies energy losses and overhead costs.

- The heat-exchangers system analysis implied the necessity of their re-dimensionalization in function of actual conditions.

- The recommended action to be considered for consumptions diminution would be the mount of a control system (thermostats or taps) for the limitation of temperature excess in the spaces where it exceed the normal habitual values.

2.6. PNEUMATIC TRANSPORT SYSTEM

- The pneumatic transport system is a great power consumer, for example, the first 5 primar transport fans from the production department cost over $ 4,000 $ /year/electricity.

- The re-dimensionalization of the pneumatic transport system according to the introduced new equipment in the production line in co-relation with the trasport velocity, is an action that would reduce the power consumptions.

- The assu rance of transport circuits to be hermetic and the elimination of fals air penetration, may create the possibility for consumptions reductions.

- The mount of some specific systems of heat recovery from the exhausted air.

- Check and reparation of transmission systems, replacement of the worn out belts, air ventilators' bearings, would result in 1-2% savings.

2.7. ELECTRIC ENERGY DISTRIBUTION AND UTILIZATION

MOBINS SA electric consumers' costs, exceed 50% of the total value; to reduce consumptions it is recommended the following course of actions:

Analysis of electric consumptions factors structure for the precise determination of the influence and the exact values for:

- Power factor (cos φ), penalties and taxation kVA
- Real load of kVA, according to the contract value
- Determination of the optimum utilization time of electric equipment
- Analysis of invoices and taxes paid for electric energy
- Check the tension of electric circuits
- Check the functionality of power transformers and measure devices (ampermeters, voltmeters, cosphimeters, etc)

The drawing of an electric energy balance to highlight the non-economic consumptions.

2.8. ILLUMINATION SYSTEM

- The economic analysis of the current illumination system with fluorescent lamps and the possibility of replacement with a system of lamps with pressurized sodium.

- The analysis of consumptions diminution possibilities through mount of some local and central control systems, which would allow the interruption of energy supply when it is not necessary (for example in the 1st shift).

- The mount of a photo-electric cells on/off system where the illumination is on more than it is necessary.

2.9. ELECTRIC ENGINES

- The economic analysis of engins' functionablity from the view point of power factor ($\cos\varphi$).

- Replacement of the worn out transmission belts which produce slippage, with V - toothed trapezoidal belts.

- Replacement of engines that work in a regime of unload (less than 50%), with engines of inferior power.

2.10. COMPRESSED AIR SYSTEM

- The compressed air production and distribution system is worn out; the compressors are old, working at a low efficiency.

- Reconsideration of the maintenance system of the compressed air equipment, check of the circuits to be hermetic and the functionability of local closing taps, is an action that would conduct to consumptions diminutions.

- Economic analysis of introduction of a water cooling system.

2.11. THERMAL STATION

- The CIR 2.5 t/h type steam boiler, which uses wood waste as fuel, works having a manual supply with fuel, a situation when the efficiency is low since there is no burning control, that conduct to an inefficient and non-economic work.

- The modernization of the thermal station may cause great savings, utilizing with maximum efficiency the caloric power of the wood fuel, through the following actions:

* Design and mount of an automated transport, dosage, and alimentation installation for the boiler with fuel;

* Design and mount of an automated burning installation, utilizing injected air for the fuel complete burning;

* Reevaluation of the burnt gas exhaust system, taking into account the possibility for mount of an efficient exhaust installation;

* Reevalution of the ash exhaust from the burning gas for an efficient burning.

In the following pages, there will be presented the opportunity of automatic management of the timber drying department taking into account the obtained energetic savings, since MOBINS SA demanded a report of energy audit of the drying process.

3. ENERGY AUDIT REPORT TIMBER DRYING SECTION

3.1. CURRENT SITUATION

The MOBINS' current timber demand is estimated according to the data supplied by the beneficiary at 4250 cub. m/year as follows:

- poplar and resins	2880 cub. m/year	Ui=80%	Uf=6%

The 6% final humidity is necessary to avoid the growth of the humidity over 8-10% during the period of work on the dry material.

- beech	420 cub. m/year	Ui=35%	Uf=8%
- oak	950 cub. m/year	Ui=35%	Uf=8%

The works schedule is 330 day * 24 hours = 7920 hours/year
Ui - initial humidity
Uf - final humidity

To dry these quantitiies of timber, MOBINS SA has 10 units of BA 12.5m type drying rooms.

The drying process is manually guided, the parameters of the drying environment being supervised from local devices every hour.

The humidity diminution is supervised by the witness test, one per each room, the proof being introduced into the stack of the 3rd timber transportation truck to the drying room, to the edge of the drying room exterior.

The checking through weighting of the witness proof in intervals that depend on the timber's thickness.

The maneuvre of the steam admission ventiles to the heating bateries of the drying rooms, of the steam admission ventiles to the air humidifier pipes and the exhaust damper, and of the fresh air admission is manually guided.

This management way of the drying process, along the disfunctionalities associated to the absence of immediate adjusting possibilities according the answers of the system resulted from the undertaken maneuvres, has also the disadvantage that creates the possibility of installation of superficialy drying of the pieces, faster than the average decrease of their humidity, that may lead to, in the absence of well experinced personnel to supervise the process, to material's deformation, cracks, etc.

3.2. RECOMMENDED ACTION

For diminution of the consequences connected with the control of wood humidity in a single point and at large time intervals, it is suggested to mounth KIL-MO-TROL type control and humidity measurer system for all those 10 rooms.

At the same time is suggested that, for beggining in one of the drying rooms (no.10), it should be mounted an automatically guided drying equipment according to the pshirometric difference, followed by the extension of the system to all those 10 rooms.

To avoid greatly the apperance of drying deffects, it is recommended to switch from steam humidification to pressurized water spray humidification.

It has been done an economic analysis for the option of introducting continuous humidity controllers in all those 10 drying rooms, introducting of pressurized water spray humidification in the room no.10, and introduction of automatically guided system for the room no.10

There will be made references to the influence caused by the introduction of pressurized water spray humidification and the automaticallly guided systems for all those 10 drying rooms.

3.3. SOLUTION'S TECHNICAL & ECONOMICAL ANALYSIS

3.3.1. DRYING PERIODS,EVAPORED WATER QUANTITIES, THERMAL, ELECTRIC AND FUEL SAVINGS ANALYSIS

According to the resulting data from the executed computation the standartized drying cycle lenght, related to the linear and logarithmic drying lenghts, under the utilization of species and humidities mentioned in chapter 1, and for the standard thickness of 40 mm, are:

*Note
The data which notes the savings for the linear and logarithmic methods are determined in concordance with standard STAS 10349/1-87

POPLAR

Linear drying	69	hours
Logarithmic drying	119	hours
Cycle's total length	215	hours

BEECH

Linear drying	54	hours
Logarithmic drying	110	hours
Cycle's total length	192	hours

OAK

Linear drying	105	hours
Logarithmic drying	129	hours
Cycle's total length	267	hours

The dry wood volume in 1 drying cycle is:

- For hemstitched timber	18.24	cub. m
- For unhemstitched timber	13.44	cub. m

The evaporated water quantity during the linear and logarithmic drying periods, the drying cycle heat savings and those annually obtained through the automatically guided drying process are highlighted in the table below:

SPECIFICATIONS	LIN. DRY.	LOG. DRY.	1.	SAVINGS					
				THERMAL ENERGY			7.		6.
				1 DR		2.	4.	5.	10 DR
	kg/h	kg/h	cm/yr	Gcal/cyc	Gcal/yr	3.	MWh/y		%
hemstitched poplar	59	14.74	672	3.47	127.8	677	37	64	5-6
unhemstitched poplar	43.6	10.7	495	2.58	95.04				
hemstitched beech	25.3	10.9	752	1.04	42.9				10-12
unhemstitched beech	18.6	8	554	.77	31.6				
hemstitched oak	14.8	10.76	541	.34	9.79				12-14
unhemstitched oak	10.8	7.93	399	.24	7.12				

1. annual drying capacity
2. 10 drying rooms
3. Gcal/year
4. 1 drying room
5. 10 drying rooms
6. wood cons.
7. electricity

1 DR - 1 drying room

The annual capacity of a drying room, working under automatically guided control of the process, is:

	POPLAR		BEECH		OAK	
	HEMST. cub.m	UNHEM. cub.m	HEMST. cub.m	UNHEM. cub.m	HEMST. cub.m	UNHEM. cub.m
CAPACITY	672	495	752	554	541	339

Analysing the drying capacities according to different species it results that for poplar timber drying tHere are necessary 4-6 rooms, for beech timber - 1 room, and for oak timber - 2-3 drying rooms.

Under these circumstances it is recommended the introduction of automatic adjusting in drying rooms for poplar drying. Under humidity continuous control in drying rooms utilizing qualified operators, the timber savings made through drying defects reduction are:

POPLAR 5 - 6 %
BEECH 10 - 12 %
OAK 12 - 14 %

If the continuous control system will be mounted, the quantities of dry timber will be:

POPLAR 2880 * .95 = 2736 cub. m
BEECH 420 * .9 = 378 cub. m
OAK 950 * .88 = 836 cub. m

Taking into account the fact that the laboratory drying evidences of the MOBINS SA, it results that the average drying cycle for beech is 255 hours, and for oak - 280 hours, under the circumstances when the automatically guided drying process is not applied in all rooms, functioning period of the drying rooms' ventilators in the current regime is negative for the timber:

(2880 * 210 + 420 * 255 + 950 * 280) : 13.44 = 72,761 hours

Under introduction of humidity continuous control, the ventilators' functioning period will be:

(2736 * 210 + 378 * 255 + 836 * 280) : 13.44 = 67,339 hours

The nominal power of a ventilator being 1.5 kW, and the number of ventilators / drying rooms will be 6, there results that the absorbed power by the drying room is:

Pa = 1.5 * 6 * 0.75 = 6.75 kW (0.75 - load factor)
The savings of electric energy which will be obtained from continuous control system introduction will be:

E = (72,761 - 67,339) * 6.75 = 36,599 kW*h, i.e. aprox. 37 MW*h/year

If the automatically drying system will be introduced in all rooms,the drying period will approach the theoretical one and the ventilators' functioning period will be:

(2,736 * 210 + 378 * 187 + 836 * 246) : 13.44 = 63,331 hours
In the case when the drying process is rapid at the poplar, there exist the possibility of humidity reinstallment, with undesirable consequences regarding the quality of the material
Electric energy savings in this case will be:

E= (72,761 - 63,331) * 6.75 = 63,788 kW*h, i.e. aprox. 64 MW*h/year

Specific heat consumption under current conditions is :

POPLAR	0.478 Gcal/cub. m
BEECH	0.253 Gcal/cub. m
OAK	0.32 Gcal/cub. m

Considering that the automatically guided drying system is applied in 1 room that works with poplar, the annual heat savings will be:

Q = (2,880 - 2736) * 0.478 + (420 - 378) * 0.253 + (950-838) * 0.32 + 95.04 = 210 Gcal/year

If the automatically drying systems are applied in all drying rooms, the thermic energy savings will be:

Q = (2,880 - 2736) * 0.478 + (420 - 378) * 0.253 + (950 - 836) * 0.32 + (2736 * 2.58 + 378 * 0.77 + 836 * 0.24) : 13.44 = 677 Gcal/year

3.4. GROSS SAVINGS VALUES COMPUTATION

Consider the following costs:

-electric energy	100 ths lei/MW*h
-thermic energy	35 ths lei/Gcal
-poplar timber	120 ths lei/cub.m
-beech timber	180 ths lei/cub.m
-oak timber	300 ths lei/cub.m

Annual gross savings, in the case of introduction of continuous humidity control system in all rooms will be:

182

Eb=(2,880 - 2,736) * 120 + (420-378) * 180 + (950-836) * 300 + 37 * 100 = 62,740 ths lei

In the case when the automatically guid system is used in all rooms,the gross savings value will be:

Eb= (2,880-2,736) * 120 + (420-378) * 180 + (950-836) * 300 +64*100 +677 * 35 = 89,135 ths lei

Considering also the savings from personell salaries:

1.3 * 150 * 12 *3 = 7,020 ths lei

Total=96,155 ths lei

The total costs of annual electric and thermal energy in 1994 noted in 1.4, was 859,786 ths lei, so the total savings are aprox. 11,7% (the wood consumption are not considered because Mobins use the waste wood which result from furniture manufacturing.

3.5.NECESSARY INVESTMENTS COMPUTATIONS

3.5.1. ACTION NO.1 : THE CASE OF CONTINUOUS HUMIDITY CONTROL AT ALL THOSE 10 DRYING ROOMS

Note: The computation are made at an exchange rate of 1 US$ = 2000 lei.

(In thousand lei)

-design		4,000
-continuos humidity		9,500
-water injection equipment		9,000
-drying room modifications		15,000
ACQUIRING TOTAL		37,500
-mount	0.2 * 37,500	7,500
-PIF + tests	0.3 * 37,500	11,250
INSTALLATION TOTAL COST		56,250

3.5.2 ACTION NO.2: THE CASE OF AUTOMATICALLY GUIDED SYSTEMS AT ALL THOSE 10 DRYING ROOMS

(In thousand lei)

-design	8,000	
-automatically guided system	70,000	
-water injection equipment	9,000	
-drying room modification	10*2,500	25,000
ACQUIRING TOTAL	112,000	
-mounth	0.2 * 112,000	22,400
-PIF + tests	0.3 * 112,000	33,600
TOTAL INSTALATION COST		168,000

3.6. NET SAVINGS AND PAYBACK PERIOD COMPUTATION

3.6.1 THE CASE OF CONTINUOUS HUMIDITY CONTROL IN ALL DRYING ROOMS

The annual overhead costs incured from investment recovery are:

-depreciation 56,250 ths * 0.1	5,625 ths lei/year
-maintenance 56,250 ths * 0.5	2,812 ths lei/year
-salary raise for qualification increase	2,800 ths lei/year
TOTAL OVERHEAD COSTS	11,237 ths lei/year

Thus,the investment recovery period is 56,250 : (89,130 - 11,237) = 0.72 yrs, respectively 11 months

3.6.2. THE CASE OF AUTOMATICALLY GUIDED SYSTEMS IN ALL DRYING ROOMS

Thus, the investment recovery period is 56,250 : (89,130 - 11,237) = 0.72 years, respectively 11 months

3.6.2. THE CASE OF AUTOMATICALLY GUIDED SYSTEMS IN ALL DRYING ROOMS

The annual overhead costs are:

-depreciation	168,000 ths * 0.1	16,800 ths lei/yr
-maintenance	168,000 ths * 0.05	8,400 ths lei/yr
	TOTAL	25,200 ths lei/yr

The investment recovery period is:
168,000 : (96,155-25,200)=2.37 years

From the separation of actions of energetic consumptions diminution at drying, respectively, the continuous humidity supervision (DELMHORST) and the automatic control of the drying process, there don't occure significant differences because:
-The BA 12.5 m dryers are technicaly and constructively worn out, working with inferior efficiency, requiring in a subsequant period an important investment for their replacement with other performant equipment, a situation when the automatic equipment would be efficient.

The Delmhorst system can control the quality of the final product, indirectly adjusting thus the paramenters of the drying process. The resulting savings of hand-work from the introduction of automatization in the drying rooms, are not significant here.

4. CONCLUSIONS AND RECOMMENDATIONS

Talking into account the results of the economic analysis, there is implied that the investment recovery from net savings will last less than 2.5 years in both analysed cased, and considering the difficulties connected with formation of qualified technical personnel in drying process guiding it is recommended therefore a truncated implementation of the second option, i.e. the continuous humidity control in all drying rooms,and the intruduction of automatically guided drying systems in all drying rooms, beginning with one to be used for poplar drying.

ANEXES:
-annexe I -Recommended action-Energy Efficiency Opportunity(2 pag)
-annexe II -Principle scheme
-annexe III -Equipment list no.1 for MOBINS SA
-annexe IV -Equipment list no.2 for MOBINS SA
-annexe V -Fuel, steam or heat energy consumption, energy
-annexe VI -Electric energy consumption
-annexe VII -Steam generations
-annexe VIII-Summary of energy efficiency project opportunities.

FLORIN MIHAILESCU,engineer

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.1
Prepared for USAID and RCG/Hagler Bailly

Plant name: MOBINS S.A.
Address: BUCHAREST, 26, St. Valea Cascadelor Sect.6 ROMANIA PC 77563
Auditor's name: FLORIN MIHAILESCU, CAMIGO Ltd
Report date: 08.01.1995

ACTION NO. AND BRIEF DESCRIPTION: Control wood moisture process

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AREA OF THE PLANT AFFECTED: Drying section-for 10 chambers BA12.5m

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FINDINGS CONCERNING EXISTING CONDITIONS:
In existing conditions, control wood moisture is manual
No exists corections posibility of system.
The measurements wood moisture in one point is relative, existing error posibility.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
-Install a DELMHORST SYSTEM, for measurement wood moisture for one drying chamber
-Install a condensate return piping system
-Install a pump for umidification air in the drying chambers

EXPECTED RESULTS-EFFECT OF RECCOMANDATION	Electricity		Fuels, heat and steam:		Total
	Peak kW	Energy MWh/year	Thermal energy Gcal/y	Wood Cons. m.c/y	Milions (lei) per year
Baseline-existing conditions		492	7936	4250	818
After recommended action		455	7258	3950	728,87
Net reduction		64	677	300	89,13(a)

COST-BENEFIT ANALYSIS: PROJECT COST ESTIMATE:	COST mil lei	NOTES
Engineering design	4,0	
Equipment procurement	33,5	incl. thermomechanic equipment
Equipment instalation	7,5	
Equipment commisioning	11,25	incl.technologic probe
TOTAL INSTALLED COST	56,25	(b)

Estimated increase in annual (non-energy) operations and maintenance cost: 11,237 (c)

$$\text{PAYBACK PERIOD: } \frac{b}{a-c} = \frac{56,25}{89,13-11,237} = 0,72 \text{ years}$$

186

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.2
Prepared for USAID and RCG/Hagler Bailly

Plant name: MOBINS S.A.
Address:BUCHAREST,2G,St.Valea Cascadelor Sect.6 ROMANIA PC 77563
Auditor's name: FLORIN MIHAI ESCU,CAMIGO Ltd
Report date: 09.01.1995

ACTION NO. AND BRIEF DESCRIPTION:Control wood moisture process

AREA OF THE PLANT AFFECTED:Drying section-for 10 chambers BA12.5m

FINDINGS CONCERNING EXISTING CONDITIONS:
In existing conditions,control wood moisture is manual
No exist corections possibility of system.
The measurements wood moisture in one point is relative,existing error posibility.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
-Install a condensate return piping system
-Install a pump for umidification air in the drying chambers
-Install a automatic progrmable for control drying process

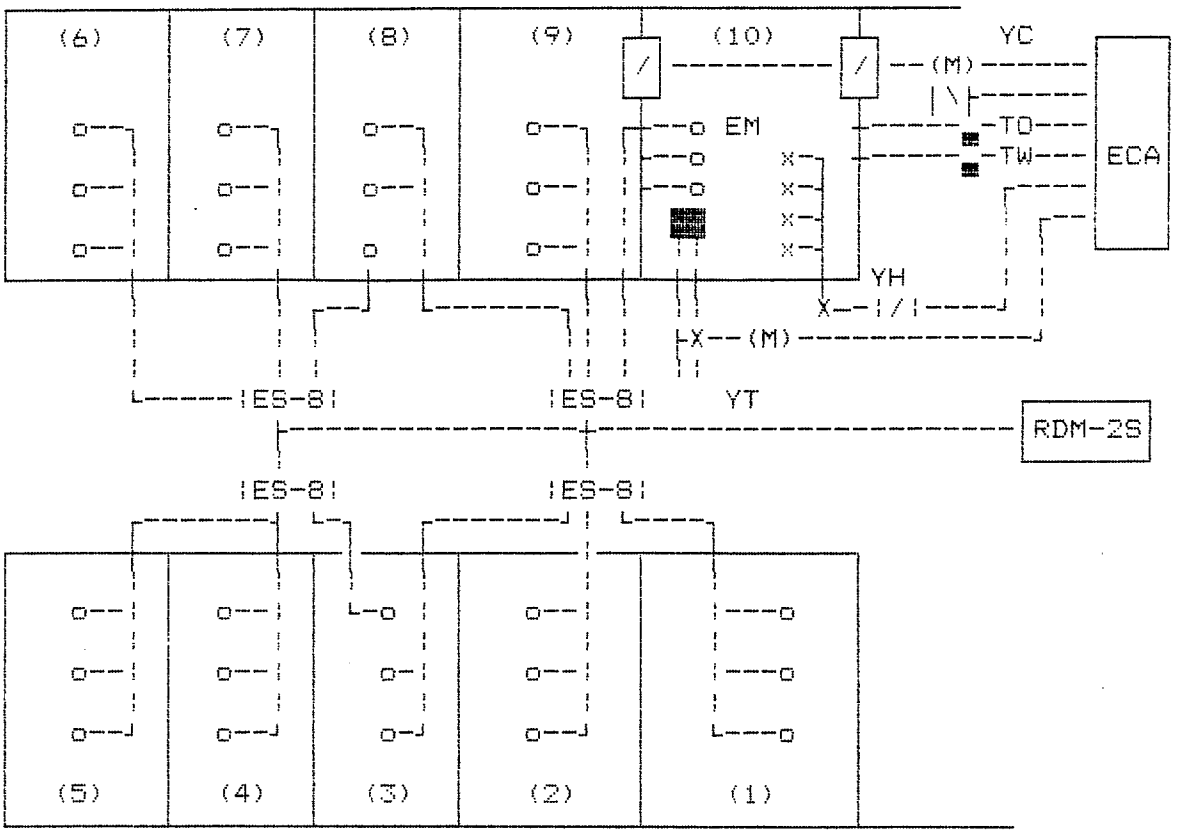
EXPECTED RESULTS-EFFECT OF RECOMMENDATION:

	Electricity		Fuels,heat and steam:		Total
	Peak kW	Energy MWh/year	Thermal energy	Wood Cons.	Milions (lei) per year
Baseline-existing conditions		492	Gcal/y 7936	4250	818
After recommended action		428	7258	3950	721,85
Net reduction		64	677		96,15(a)

COST-BENEFIT ANALYSIS: PROJECT COST ESTIMATE:	COST mil lei	NOTES
Engineering design	8,0	
Equipament procurement	96	incl. thermomechanic equipament
Equipament instalation	22,4	
Equipament commisioning	33,6	incl.technologic prose
TOTAL INSTALLED COST	168,0	(b)

Estimated increase in annual (non-energy) operations and maintenance cost 25,20 (c)
PAYBACK PERIOD = b/(a-c) =168.0/(96.15-25.20) = 2,37 years

187



LEGEND:

ECA	-automat progamable
YC	-air intake motor
YT	-heating motor
YH	-moisture electric valve
TO	-dry thermometer
TW	-moist thermometer
RDM2S	-moisture meter
ES8	-electronic switch box
EM	-pins
(1)-(10)	-drying rooms

PRINCIPLE SCHEME

EQUIPMENT LIST NO.1 FOR MOBINS S.A BUCHAREST

****

DELMHORST INSTRUMENT CO.

QTY	ITEM/DESCRIPTION	PRICE	EXT. PRICE
One portable wood multiple measurement moisture meter system.			
1	RDM-2S/PKG Including : (1) RDM-2S Moisture Meter DC/AC (1) 26-ES Electrode,2 Pin (10)496 Pin, Contact (1) 2407/2439 Nicad Charger 220 V (1) AP-1 Aplication Program (1) 2405-25 25-Pin PC Cable	900.00	900.00
4	SS-12W/# 670 Cable	160.00	640.00
3000 FT	M-166 3-Conducter Coated Cable	.60	1800.00
45	#671 Load Cable w/"shell" Pin	25.00	1125.00
135	#2326-1 core pins	3.50	472.50
135	#2326-2 core pins	3.50	472.50
30	C-131 Female Connector	3.50	105.00
2	1648 Drilling Kit	25.00	50.00
50	L-328 Washer,Ruber.125ID	.20	10.00
50	#786 Spring (B)	.30	15.00
2	#670 Extractor,Pin KMT(B)	25.00	50.00
1	N-317 Silicone Sealant for C-131 Solder Joints	15.00	15.00
2	N-231 Silicone Compound for solder contacts on 671 Load Cables	20.00	40.00

Subtotal $5705.00
with VA taxes $5961.73

FUEL STEAM OR HEAT ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD
ENERGY TYPE : STEAM
Prepared for USAID and Hagler Bailly Consulting Inc. **ANNEXE V**

Plant name : **Mobins S.A.**
Adress : **Valea Cascadelor 26 sector 6 BUCHAREST ROMANIA**
Auditor's Name : **CAMIGO LTD**
Report date : 1995
Supply contract terms

Fuel or heat supply company's name : RENEL
Contract maximum demand :
Minimum charge (cost) :
Other :

CONSUMPTION OR BILLING DATA FOR 12 - MONTH AUDIT REPORT
FOR : (NAME OF ENERGY FORM):

Meter Reading Mo/day/yr	Physical Consumpt units =	Thermal Consumption Gcal	Total cost mill lei	Monthly Heatind Degree-Days HDD	Heating Index Gcal/HDD	Product Index Gcal per:	Notes on plant conditions and changes
Jan/31/94		2391		556	4.3		
Feb/28/94		1719		365	4.7		
Mar/31/94		2030		217	9.35		
Apr/30/94		1808		29	62.3		
May/31/94		1527		0			
Jun/30/94		1659		0			
Jul/31/94		819		0			
Aug/31/94		2304		0			
Sep/30/94		1508		0			
Oct/31/94		1806		30	60.20		
Nov/30/94		2116		211	10.02		
Dec/31/94		1360		405	3.22		
TOTAL		21047	512,834	1813	11.60		

Note:Heating degree-days based on reference temperature of 12°C

ANNEXE VI

ELECTRIC ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD
Prepared for USAID and Hagler Bailly Consulting Inc.

Plant name :**Mobins S.A.**
Adress :**Str, Valea Cascadelor 26,sector 6,BUCHAREST,ROMANIA**
Auditor's name :**Camigo Ltd**
Report date :**1995**

Electricity contract terms:

Electricity supply company's name	**RENEL**
Contract maximum demand (kw)	
Minimum charge (cost):	

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD

Meter Reading Mo/day/year	Energy Active kWh	Energy Reactive kVARH	Max Demand kWh	Max Demand kVA	Power Factor cos ø	Load Factor	Total Cost millions lei	Product Index kWh per:	Notes on plant conditions and changes
Jan/31/94	323,313	243,778			0.80				
Feb/28/94	304,625	229,687			0.80				
Mar/31/94	327,038	246,587			0.80				
Apr/30/94	292,562	220,592			0.80				
May/31/94	305,688	230,489			0.80				
Jun/30/94	257,450	194,117			0.80				
Jul/31/94	63,173	47,632			0.80				
Aug/31/94	222,213	167,549			0.80				
Sep/30/94	245,813	185,343			0.80				
Oct/31/94	286,800	216,247			0.80				
Nov/30/94	324,263	244,494			0.80				
Dec/31/94	257,062	193,828			0.80				
TOTAL	**3,210,000**						346,952		

Peak demand during audit period

STEAM GENERATION - 12 MONTH AUDIT PERIOD
Prepared for USAID and Hagler bailly Consulting, Inc.

ANNEXE VII

Plant name : **MOBINS S.A.**
Auditor's name : **CAMIGO Ltd.**
Adress : **Str. Valea Cascadelor 26, sector 6, BUCHAREST, ROMANIA**
Report date:
Boiler characteristics:

Name/Number	CIR 2.5	Operational? (yes/no)	YES
Manufacturer	CUG-CLUJ	Steam pressure	16 BAR
Type (firetube/watertube	Fi retub	Steam temperature	+205°C
Type (saturated/superheated)	Saturate	Stack temperature, after economizer	
Capacity (tons/hour)	2.5	Stack gas analysis : percent O^2	
Year installed	1985	Combustion efficiency	
Very last major overhaut	1993	Blowdown analysis : dissolved solids PPM	

STEAM GENERATION DATA FOR 12-MONTH AUDIT PERIOD

STEAM GENERATION BY PLANT					IMPORT	SALES AND DISTRIBUTION TO CONSUMERS:	
Meter Reading Mo/day/year	Fuel Consumption Wood/tons	Steam Generation tons	Steam Generation GJ	Monthly Efficiency %	Steam Purchased GJ	Losses&Unaccounted GJ	Unusual Operating conditions
Jan/31/94	1565	41.3					
Feb/28/94	1610	42.8					
Mar/31/94	1315	36.3					
Apr/30/94	1284	34.3					
May/31/94	1015	28.5					
Jun/30/94	785	21.2					
Jul/31/94	368	9.8					
Aug/31/94	393	9.2					
Sep/30/94	815	22.4					
Oct/31/94	1012	27.2					
Nov/30/94	1418	38.8					
Dec/31/94	1623	44.4					
TOTAL	13,203	356.2					

ANNEXE VIII

ACTION PLAN - SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES

PREPARED FOR USAID and HAGLER BAILLY CONSULTING INC.

PLANT NAME :MOBINS S.A.
ADRESS : Str Valea Cascadelor 26,sector6,Bucharest,ROMANIA
AUDITOR'S NAME:CAMIGO Ltd
REPORT DATE :1995

BASELINE-EXISTING CONDITIONS

	Thermal Consumption Gcal/year	Thermal Consumption Gcal/year	Thermal Consumption Gcal/Year	Electric Peak Demand MW/year	Electric Energy Consumption kWh/year	Total Energy Cost millions lei /year
BASE CASE	7936			492		818

Action No.	Action description	Thermal Consumption Gcal/Year	Thermal Consumption Gcal/Year	Thermal Consumption Gcal/Year	Electric Peak Demand KW	Electric Energy Consumption kWh/year	Total Energy cost /year	Action Project Cost	Action Payback Period (years)
1.	Control wood moisture process	7258			455		728.87	56.25	0.72
2.	Control automatic wood moisture	7258			428		721.85	96.15	2.37
Total savings		678			64		96.15		
Savings as percentage of base case		8.54			13.0		11.75		

Note:Assumes that the actions are taken in order of best payback period first,in order to take into account the interaction between the various measures

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

Muha, S.R.L.

by

Pavel Haralambie

Invest Proiect, S.R.L.

for

Hagler Bailly Consulting, Inc.

194

ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	S.C. "MUHA" S.R.L. SUCEAVA
Address	Calea Unirii f.n. 5800 SUCEAVA - ROMANIA
Telephone	40 - (0)30 - 257521
Fax	40 - (0)30 - 520601
Contact Person	DORU MUHA
Title	General Manager
Telephone	40 - (0)30 - 257584

2. Energy auditor information

Dates - audit started: March 1994 audit completed: June 1994

Energy audit company	S.C. INVEST PROIECT S.R.L. SUCEAVA
Energy audit team leader	HARALAMBIE PAVEL
Address	str. Dimitrie Cantemir Bloc I4, Et.III,
	ap.14, 5800 SUCEAVA - ROMANIA
Telephone	40 - (0)30 - 217208
Fax	40 - (0)30 - 217208

195

3. Energy audit information

Energy audit focus - describe the major tasks, or areas of the plant, which were investigated during the energy audit:

The purpose of the audit was to achieve the reduction of heating and electrical energy. The audit investigated the boiler room, the natural and artificial drying process for the timber and the electrical consumption in all the plant.

Energy efficiency - in the energy auditor's opinion, what were the most significant findings of the energy audit:

The most significant findings of the audit were:

-the possibility of reducing the heating energy in the timber drying room by automatic monitoring of the process;

-the reduction of fuel consumption and polution by installing burners in the boiler room;

-the possibility to reorganise the programmes of some activities to reduce the cost of the electrical energy consumed.

New experience - in the energy auditor's opinion, what were the most significant lessons learned during the energy audit:

The need to improve the programme of activities to reduce the cost of electrical energy. The automation of some of the technological processes. Adequate control of the burning process in the boiler room by regular monitoring of the waste gases. Improve control of the natural drying process of the timber until the humidity of 24% is reached - there by reducing the artificial drying period.

4. Energy savings

List the energy efficiency measures ALREADY IMPLEMENTED, during the course of the audit (if any):

Description of measure	Fuel saved	Savings/units	Payback
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years

197

4. Historical production and energy consumption

1. Summarize the recent production and energy consumption at the plant in physical units (also list the type of units per year, i.e. tons/year, kWh/year etc.):

Year:	1990	1991	1992	1993	UNITS
Production:					
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
Energy:					
heavy fuel oil:	_____	_____	_____	_____	_____
diesel fuel oil:	_____	_____	_____	_____	_____
natural gas:	_____	_____	_____	_____	_____
coal:	_____	_____	_____	_____	_____
electricity:	_____	_____	_____	180,0	MWh/year
steam: hot water 95/75°C	_____	_____	_____	3731,84	Gcal./year
other (describe):					
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
Energy/Production index:					
thermal	_____	_____	_____	_____	_____
electrical	_____	_____	_____	_____	_____

198

5. Historical energy costs

Summarize the recent energy cost at the plant, for the base year of the audit and following years, in terms of money per year:

Year:	1990	1991	1992	1993	UNITS
heavy fuel oil:					
diesel fuel oil:					
natural gas:					
coal:					
electricity:				25704000	lei/year
steam:				55977600	lei/year
other (describe):					

6. Previous actions

Describe any other projects which resulted in improved energy efficiency that have already been implemented (or are already funded and in-progress), but which were not identified in the energy audit. Describe the project, the source of the idea, the approximate cost of implementing the project, and the source of funding:

This energy audit is.the first one on the "MUHA" plant which is analysing the possibilities of reclaining the energy from the varios parts of the plant.

199

7. **Detailed forms - required**

Complete and attach the following forms:

Fuel, steam, or heat energy consumption - 12 month audit period
(complete for each major fuel type for areas studied)

Steam generation - 12 month audit period (if plant has boiler)

Energy balance - fuel, steam or heat

Electric energy consumption - 12 month audit period

Electric energy generation - 12 month audit period (if plant has generator)

Energy balance - electrical

Action plan - summary of energy efficiency project opportunities

Recommended action - energy efficiency opportunity
(complete one for each recommended action)
(attach additional details if required to justify project)

8. **Narrative**

Provide any other information which would be useful to USAID and RCG/Hagler Bailly:

The "MUHA" plant is buying the electricity from the National Generating Sistem. The heating is currently produced in the MUHA's boiler room as hot water at 75/95°C. A second boiler is ready to be commissioned to produce steam at o.7 bar.

To fulfil the heating requirements of the plant, it is necessary for both boilers to run on wood waste and light oil

200

FUEL, STEAM OF \T ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
ENERGY TYPE: . , water 95/75°C
Prepared for USAID and RCG/Hagler Bailly

Plant name: S.C."MUHA" S.R.L.
Address: Calea Unirii f.n. 5800 SUCEAVA

Auditor's name: HARALAMBIE PAVEL

Report date: May 1994

Supply contract terms:

Fuel or heat supply company's name own boiler room

Contract maximum demand:

Minimum charge (cost):

Other:

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM):

Meter Reading Mo/day/yr	Physical Consumption units =	Thermal Consumption Gcal. GJ	Total Cost lei	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index GJ per:	Notes on plant conditions and changes
Jan/30/93		342,64	5139600				
Feb/28/93		342,64	5139600				
Mar/30/93		342,64	5139600				
Apr/30/93		280,00	4200000				
May/30/93		280,00	4200000				
Jun/30/93		280,00	4200000				
Jul/30/93		280,00	4200000				
Aug/30/93		276,00	4140000				
Sep/30/93		280,00	4200000				
Oct/30/93		342,64	5139600				
Nov/30/93		342,64	5139600				
Dec/30/93		342,64	5139600				
TOTAL		3731,84	55977600				

Note: Heating degree-days based on reference temperature of ____C

ENERGY BALANCE
ENERGY TYPE: H water 95/75°C
Prepared for USAID RCG/Hagler Bailly

Plant name: S.C."MUHA" S.R.L.
Address: Calea Unirii f.n. 5800 SUCEAVA
Auditor's name: HARALAMBIE PAVEL

Report date: May 1994

Item No.	Equipment or Process Description	Maximum Load units: Gcal/h	Average Load units: Gcal/h	Load at Peak Demand units	Energy Consumption units: Gcal /year	Total Energy Cost lei /year
1.	Timber drying room	0,300	0,240		1728,00	25920000
2.	Furniture factory	0,606	0,430		1856,96	27854400
3.	Mechanical workshop	0,029	0,011		47,52	712800
4.	Administration block	0,058	0,023		99,36	1490400
TOTAL PEAK DEMAND						
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)					3731,84	55977600

ELECTRIC ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
Prepared for USAI' ' RCG/Hagler Bailly

Plant name: S.C."MUHA" S.R.L.
Address: Calea unirii f.n. 5800 SUCEAVA

Auditor's name: HARALAMBIE PAVEL

Report date: May 1994

Electricity contract terms:

Electricity supply company's name National Generating System

Contract maximum demand (kW): 410

Minimum charge (cost):

Other:

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD:

Meter Reading Mo/day/yr	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Power Factor cos 0	Load Factor	Total Cost	Product. Index kWh per:	Notes on plant conditions and changes
Jan/__/93	40000				0,8	250,0	5712000		
Feb/__/93	38000				0,7	237,5	5426400		
Mar/__93	42300				0,82	264,3	6040440		
Apr/__93	42000				0,8	262,5	5997600		
May/__93	50000				0,75	312,5	7140000		
Jun/__93	63800				0,8	398,7	9110640		
Jul/__/93	65000				0,85	406,2	9282000		
Aug/__93	65600				0,9	410,0	9367680		
Sep/__93	45600				0,75	285,0	6511680		
Oct/__93	43200				0,8	270,0	6167968		
Nov/__93	38600				0,85	241,2	5512080		
Dec/__93	37500				0,7	234,3	5355000		
TOTAL	571600						81623488		

Peak demand during audit period (kW): 410

ENERGY BALANCE – EI[illegible]
Prepared for USAID and Hagler Bailly

Plant name: S.C."MUHA" S.R.L.
Address: Calea Unirii f.n. 5800 Suceava

Auditor's name: HARALAMBIE PAVEL

Report date: May 1994

Item No.	Equipment or Process Description	Connected Load kW	Maximum Load kW	Average Load kW	Load at Peak Billing Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost /year
1.	Concrete mixing station	151,65	151,65	140	160	242640	34648000
2.	Furniture factory	101,1	101,1	190	120	160000	22848000
3.	Mechanical workshop	37,1	37,1	30	40	57600	8225280
4.	Timber factory	55,0	55	40	60	76800	10967040
5.	Timber drying room	11,2	11,2	10	15	19200	2741760
6.	Administration block	10,0	10	8	15	15360	2193408
	TOTAL PEAK DEMAND (equals maximum billing demand)				410		
	TOTAL ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)					571600	81623488

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 1.

Plant name: S.C."MUHA" S.R.L.
Address: Suceava, Calea Unirii f.n.
Auditor's name: HARALAMBIE PAVEL
Report date: 05.04.1995

ACTION NO. AND BRIEF DESCRIPTION: Automatic control of the technological drying process o: the lumber.

AREA OF THE PLANT AFFECTED: The drying room

FINDINGS CONCERNING EXISTING CONDITIONS: Presently the control of the technological drying process of the lumber is made by manual driving of the valvs from the heating and water pipes and of the air-admition and evacuation valvs

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: It is recommended the acquisition of portable and fixed devices that will ensure the automatic regulation of humid and dry temperature as well as the air admision and evacuation from the drying roor By the automatic control of the drying process it is reduced the thermical energy consume and lumber waste.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION: Lumber

	Electricity		Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	Gcal./year	m³/year	thousand lei/year
Baseline – existing conditions	11,2	82,25	1260	4200	315204
After recommended action	11,2	59,77	858	3577	265222
Net reduction	0	22,48	402	623	49,982 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE.	Cost	Notes
Engineering design	5500	thousand lei
Equipment procurement	27200	"
Equipment installation	3000	"
Equipment commisssioning	8000	"
TOTAL INSTALLED COST	43700 (b)	"

Estimated increase in annual (non–energy) operations and maintenance cost 7400 (c) thousand lei/year

PAYBACK PERIOD:

$$\frac{b: 43700}{a: 49982 - c: 7400} = 1,02 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: Equipment procurement. Equipment installation. Activating the equipment.

205

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 2.

Plant name: S.C. "MUHA" S.R.L.
Address: Syceava, Calea Unirii f.n.

Auditor's name: HARALAMBIE PAVEL

Report date: 05.04.1995

ACTION NO. AND BRIEF DESCRIPTION: The procurement and assembly of burning installations for light oil

AREA OF THE PLANT AFFECTED: The boiler house

FINDINGS CONCERNING EXISTING CONDITIONS: Right now, to feed the existing boilers we consume 1398 tons/year of solid fuel. Counting the total time available for one person which is 1870 hours/year, for the feeding of the boilers for a whol year, 5 people would be needed. Also, we must take into account powder emissions (soot) for enviromental purposes. The beneficiary should install a purifying assembly for the gases given off from burning.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: To avoid the pollution of the enviromment with powders and to reduce the consumption of fuel and to increase the efficier cy of the boiler, it is recommended that burning installations for light oil is procured and installed and the now disposable wood waste is sold tc the population.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	tcc/year	staff	thousand lei /year
Baseline – existing conditions	2,2	14,034	514	5	75028
After recommended action			408	–	59600
Net reduction	2,2	14,034	106	5	15428 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE.	Cost	Notes
Engineering design	2500 thousand lei	
Equipment procurement	24000 "	
Equipment installation	1500 "	
Equipment commisssioning	1500 "	
TOTAL INSTALLED COST	29500 thousan lei (b)	

Estimated increase in annual (non–energy) operations and maintenance cost 810 thousand lei/year (c)

PAYBACK PERIOD:

$$\frac{b: 29500}{a: 15428 - c: 810} = 2,01 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: The procurement of the burning installations for light oil, the installation of the boiler and its activation. The installa tion of the burning assembly for light oil can be set to work within 30 days of receiving it.

206

Refering to action no .2 about the procuremment and installatior of the light oil burning equipment, here you have the following delails:

- the boiler's burning room dimensions are: -lenght 2,0 m
  -breadth 1,1 m
  -height 1,2 m;
- the depression in the focus: -2 ÷ -5 mm H_2O;
- the fuel need to be warm up to +20°C before the injection;
- it is recomended that the warming sistem of the fuel to be integrate in the apparatus;
- the light oil burner need to be install in the working front of the boiler and it need to provide a heat flow of 150000 ÷ 800000 Kcal./h;
- the boiler is working with natural draught through the stove pipe;
- the feeding with fuel is done from the heating room's reservoir through free fall;
- the fuel characteristics are:
  -the relative density at 20°C max. 0,935;
  -the viscousity at 20°C is 4,5 E°max.;
  -the inflamability M 55°C;
  -the water o,5%;
  -the cinders (ashes) 0,15%;
  -sulphur 2%;
  -the freezing point - 8°C.

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 3

Plant name: S.C."MUHA" S.R.L.
Address: Suceava, Calea Unirii f.n.

Auditor's name: HARALAMBIE PAVEL

Report date: 05.04.1995

ACTION NO. AND BRIEF DESCRIPTION: Separate metering of the electrical energy consumption during the day, at night and weekends.

AREA OF THE PLANT AFFECTED: Whole of the factory

FINDINGS CONCERNING EXISTING CONDITIONS: At present the electricity is supplied from the National Electricity System and is charged at one tarrif even if night or day or weekends.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: It is recommended that an electrical meter (type 3 phase, 50 Hz, 3x380/220V, 3x5A) is purchased and installed which will be able to measure the separate consumption of the energy used between 06,00-22.00; 22.00-6.00 and weekends. This will enable the electric energy to be reduced since the night and weekends tarrif is approximately 1/2 the day time tarrif. By reprogramming some of the activities in the factory to night and weekends periods we should achive teather savings.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam	Total cost thousand lei /year
Baseline – existing conditions		180		25704
After recommended action		180		20642,4
Net reduction				5061,6 (a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost thousand lei	Notes
Engineering design	500 "	
Equipment procurement	6500 "	
Equipment installation	1500 "	
Equipment commisssioning	500 "	
TOTAL INSTALLED COST	9000 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	540 (c)	

PAYBACK PERIOD:

$$\frac{b\ 9000}{a\ 5061,6 - c\ 540} = 1,99 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: To pourchase and instal the new meter. Setting to work and training of staff. It is estimated that the meter can be installe and set to work in 30 days after delivery.

208

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 4

Plant name: S.C."MUHA" S.R.L.
Address: Suceava, Calea Unirii f.n.

Auditor s name: HARALAMBIE PAVEL

Report date: 05.04.1995

ACTION NO. AND BRIEF DESCRIPTION: Periodical burned gas analysis in order to determin: NO_x, SO2, CO, O2, air-excess, gas-waste, yield.

AREA OF THE PLANT AFFECTED: The boiler house

FINDINGS CONCERNING EXISTING CONDITIONS: Presently, the boiler house does not possess any equipment for burned gas analysis, practically this operation is not executed.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: It is recommended the acquisition of a device for burned-gas analysis with which to be determined the content of NO_x, SO2, CO, O2, air-excess, the content of solid wastes (soot) and burning yield. With the aid of this device, it will be improved the burning yield of the fuel and it will be avoided the environment pollution.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: tce/year	Total cost thousand lei/year
Baseline – existing conditions			257	37514
After recommended action			180	26294
Net reduction			77	11207 (a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost	Notes
Engineering design	500	thousand lei
Equipment procurement	12000	"
Equipment installation	500	"
Equipment commisssioning	3600	"
TOTAL INSTALLED COST	16600 (b)	

Estimated increase in annual (non–energy) operations and maintenance cost: 1000 thousand lei

PAYBACK PERIOD:

$$\frac{b: 16600}{a: 11207 - c: 1000} = 1{,}62 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: Equipment acquisition; staff training regarding know-how operating-techique.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- ROMANIA

FINAL ENERGY AUDIT REPORT

for work at

Stirom Glass Factory

by

Mihial Zdravcu

Arcon, S.R.L.

for

Hagler Bailly Consulting, Inc.

210

ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	STIROM
Address	STR. THEODOR PALLADY NO.45
	BICHAREST SECTOR 3
	ROMANIA
Telephone	4-01-630 20 45
Fax	4-01-312 90 23
Contact Person	ENG. ANDY ICLEANU
Title	COOPERATION MANAGER
Telephone	4-01-630 20 45 EXT. 142

2. Energy auditor information

Dates - audit started: 25 MARCH, 1994 audit completed: APRIL., 1994

Energy audit company	ARCON SRL
Energy audit team leader	ENG. MIHAIL ZDRAVCU (CEM)
Address	STR. INTR. ODOBESTI NO.1,Bl.Z2,AP.59
	CP74578, BUCHAREST, SECTOR 3, ROMANIA
Telephone	4-01-673 60 81
Fax	4-01-673 60 81

211

3. Energy audit information

Energy audit focus - describe the major tasks, or areas of the plant, which were investigated during the energy audit:

1. FURNACE C-1, C-2 AND ROW MATERIAL MIXTURE STATION
2. ELECTRICAL SYSTEM, COMPRESSOR HOUS, PUMPING STATION
3. GAS STATION

Energy efficiency - in the energy auditor's opinion, what were the most significant findings of the energy audit:

1. REDUCTION OF COMPRESSED AIR LOSS
2. ELECTRICAL ENERGY CONSUMPTION REDUCTION
3. REDUCTION OF HEAT LOSSES IN AIR ON GAS FIRED FURNACES
4. IMPROVING COMBUSTION EFFICIENCY AT GAS FIRED FURNACES PROVIDING HIGH EFF. BURNERS
5. OPTIMISATION OF COMBUSTION AT GAS FIRED FURNACES

New experience - in the energy auditor's opinion, what were the most significant lessons learned during the energy audit:

1. EFFICIENCY OF INFRARED NON-CONTACT THERMOMETERS AND PYROMETER
2. EFFICIENCY OF GAS ANALYSER
3. THE AUDIT SYSTEM

212

4. Energy savings

List the energy efficiency measures ALREADY IMPLEMENTED, during the course of the audit (if any):

Description of measure	Fuel saved	Savings/units	Payback
1. NEW BURNERS AT FURNACE C-2	15%	_____/year	_____years
2. COMBUSTION OPTIMIZATION	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years

23

4. Historical production and energy consumption

1. Summarize the recent production and energy consumption at the plant in physical units (also list the type of units per year, i.e. tons/year, kWh/year etc.):

Year:	1990	1991	1992	1993	UNITS
Production:					
FINISHED GLASS ITEMS				149468	TØ/YEAR
Energy:					
heavy fuel oil:					
diesel fuel oil:					
natural gas:		60925	52555	57113	M3x1000/YEAR
coal:					
electricity:		45254	48739	47925	MWH/YEAR
steam:					
other (describe):					
H.W				1,5	GJ/H
Energy/Production index:					
thermal				4	GJ/M
electrical					

24

5. Historical energy costs

Summarize the recent energy cost at the plant, for the base year of the audit and following years, in terms of money per year:

Year:	1990	1991	1992	1993	UNITS
heavy fuel oil:	_____	_____	_____	_____	_____
diesel fuel oil:	_____	_____	_____	_____	_____
natural gas:	_____	_____	_____	0,0893	USD/NM3
coal:	_____	_____	_____	_____	_____
electricity:	_____	_____	_____	0,05	USD/KWH
steam:	_____	_____	_____	_____	_____
other (describe):					
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

6. Previous actions

Describe any other projects which resulted in improved energy efficiency that have already been implemented (or are already funded and in-progress), but which were not identified in the energy audit. Describe the project, the source of the idea, the approximate cost of implementing the project, and the source of funding:

_____

_____

_____

_____

_____

215

7. **Detailed forms - required**

Complete and attach the following forms:

Fuel, steam, or heat energy consumption - 12 month audit period
(complete for each major fuel type for areas studied)

Steam generation - 12 month audit period (if plant has boiler)

Energy balance - fuel, steam or heat

Electric energy consumption - 12 month audit period

Electric energy generation - 12 month audit period (if plant has generator)

Energy balance - electrical

Action plan - summary of energy efficiency project opportunities

Recommended action - energy efficiency opportunity
(complete one for each recommended action)
(attach additional details if required to justify project)

8. **Narrative**

Provide any other information which would be useful to USAID and RCG/Hagler Bailly:

_____

_____

_____

_____

_____

216

ELECTRIC ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
Prepared for USAID and RCG/Hagler Bailly

Plant name: STIROM
Address: str: THEODOR PALLADY 45 BUCHAREST ROMANIA
Auditor's name: MIHAIL ZDRAVCU
Report date: MARCH,1994

Electricity contract terms:

Electricity supply company's name	RENEL
Contract maximum demand (kW):	6000
Minimum charge (cost):	
Other:	0,05 USD/KWH

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD: 1993

Meter Reading Mo/day/yr	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Power Factor cos 0	Load Factor	Total USD Cost	Product Index kWh per:	Notes on plant conditions and changes
Jan/__/__	3856000	1472992	5182	5573	0,93	0,86	192800	341,0	
Feb/__/__	3640000	1390480	5617	6039	0,93	0,93	182000	299,6	
Mar/__/__	4300000	1642600	5779	6214	0,93	0,96	215000	300,8	
Apr/__/__	4235000	1617770	5882	6324	0,93	0,98	211750	308,6	
May/__/__	4336000	1656352	5828	6266	0,93	0,97	216800	324,7	
Jun/__/__	4135000	1579570	5743	6175	0,93	0,95	206750	309,0	
Jul/__/__	4086000	1560852	5492	5905	0,93	0,91	204300	302,6	
Aug/__/__	3930000	1501260	5282	5679	0,93	0,88	196500	335,0	
Sep/__/__	3755000	1434410	5215	5607	0,93	0,86	187750	367,8	
Oct/__/__	3961000	1513102	5501	5915	0,93	0,91	198050	345,0	
Nov/__/__	3900000	1489800	5323	5724	0,93	0,88	195000	327,7	
Dec/__/__	3784000	1445488	5416	5824	0,93	0,90	189200	302,9	
TOTAL	47,925,000	18,307,350	5470	5882	0,93	0,91	2,395,900	320	

Peak demand during audit period (kW): 5780

L ... M OR ... CONS ION MONT IIT PE

RGY TYPE: NATURAL GAS

pared for USAID and RCG/Hagler Bailly

t name: STIROM

ess: BUCHAREST ROMANIA

tor's name: MIHAIL ZDRAVCU

ort date: MARCH, 1994

ply contract terms:

Fuel or heat supply company's name	RAGM
Contract maximum demand:	5,5x10^6 NM3/MO
Minimum charge (cost):	2,14 USD/GJ
Other:	Avg.2,51 USD/GJ; 89,3 USD/1000NM3

SUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD 1993
(NAME OF ENERGY FORM): NATURAL GAS

Meter Reading Day/yr	Physical Consumption units = x10^3 NM3/MO	Thermal Consumption GJ	Total Cost USD	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index GJ per: TO	Notes on plant conditions and changes
/_	5019	178576	448197	558	320	15,79	
/_	4641	165126	414410	364	453	13,59	
/_	4845	172385	432659	217	794	12,06	
/_	4892	174057	436856	30	5801	12,68	
/_	5099	181422	455341	0	0	13,62	
/_	4799	170748	428577	0	-	12,76	
/_	4949	176085	441946	0	-	13,04	
/_	4839	172172	432123	0	-	14,67	
/_	3700	131646	330410	0	-	12,89	
/_	4798	170713	428461	31	5506	14,86	
/_	4688	166799	418638	210	794	14,01	
/_	4844	172350	432569	403	427	13,79	
L	57,133	2032079	5100192	1813	1120	13,59	

Note: Heating degree-days based on reference temperature of 12 °C

218

ON PLAN – SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES
ared for USAID and RCG/Hagler Bailly

name: STIROM BUCHAREST
ess: Str. THEODOR PALLADY 45
or's name: Mihaîl ZDRAVCU
ort date: MARCH, 1994

LINE – EXISTING CONDITIONS

	Nat. Gas Thermal Consumption GJ/year	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost USD /year
E CASE	203279			5882	4792500	749692

MARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS

ction No.	Action Description	Nat. GAS Thermal Consumption GJ/year	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost USD /year	Action Project Cost USD	Action Payback Period (years)
A1	Put Energy Team in action to reduce Energy Losses					407363	20368	1517	0,07
A2	Reduce Comressed Air Losses					1212000	60600	59900	0,988
A3	Reduce Heat Losses on Gas Fired Furnace and Annealing Tunels	96930					48000	43000	0,9
B1	Improve Heating System of Plant Buil	115700					62329	13000	0,2
B2	Improve Combustion Eff. at Gas Fired Furnaces	497759				200000	566516	119000	0,21
AL SAVINGS		610389				1819363	757813	236417	
INGS AS PERCENTAGE OF BASE CASE	%	30				3,79	10,1		

Note: Assumes that the actions are taken in order of best payback period first, in order to take into account the interaction between the various measures

219

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
epared for USAD and RCG/Hagler Bailly

ACTION NO. A1

ant name: STIROM
Address: BUCHAREST ROMANIA

ditor's name: MIHAIL ZDRAVCU

eport date: MARCH,1994

ACTION NO. AND BRIEF DESCRIPTION: AlPut Energy Eff.Teams in action to reduce Energy Losses

REA OF THE PLANT AFFECTED: PLANT STIROM

FINDINGS CONCERNING EXISTING CONDITIONS:

Some Electric Motors are underloaded and rewinded. Power factor is 0,93. Transformers are 50% loaded. Breakers and contactors are old. 6kV cables at main feeders are out oflife date and with many joints. Power factor is compensated basicly with capacitors and two sincronuos motors 6kV.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Elaborate a maintenance program.

Use COG Belts on V-Belts Drive. Replace failled motors with high Efficiency Motors, Replace underloaded motors. Check all electric system (contactors,breakers,capacitors, electric contacts tightening,etc) Replace 6kV cables at main feeders.Total savings achiveable through no cost maintenance program 2% out of total electrical consumption excluding compressed air.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam	Total cost
	Peak kW	Energy MWh/year		USD/year
Baseline – existing conditions		47925		2395900
After recommended action		47517.637		2375532
Net reduction		407.363		20368 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost USD	Notes
Engineering design	–	
Equipment procurement	1517	
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	(b) 1517	
Estimated increase in annual (non–energy) operations and maintenance cost	(c) –	

PAYBACK PERIOD:

$$\frac{b:1517}{a:20368 - c:-} = 0,07 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

220

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. A2

Plant name: STIROM
Address: BUCHAREST ROMANIA
Auditor's name: MIHAIL ZDRAVCU
Report date: MARCH,1994

ACTION NO. AND BRIEF DESCRIPTION A2 Reduce Compressed air Losses

AREA OF THE PLANT AFFECTED. PLANT STIROM

FINDINGS CONCERNING EXISTING CONDITIONS

PLANT HASE A LARGE COMPRESSED AIR HOUSE COMPOSED FROM % COMPRESSORS. PRODUCTION 37700 NM3/H. ELECTRIC ENERGY CONSUMPTION IS HIGH(0,105KWH/NM3) LOSSES ARE AVG.14%.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY

INSTALL ANUBAR FLOWMETERS ON MAIN HEADERS.

MAKE AN INVENTORY OF ALL USERS AND TAKE MEASURES AS PER PROCEDURE H-OVER.

REPLACE OLD I.S MACHINES AND CYLINDERS. PROVIDE:

(1)ULTRASONIC LEAK DETECTOR FOR COMPRESSED AIR

(1)ANUBAR FOR 30000NM3/H FLOW

(1)ULTRAPROBE FLOW METER 2,5BAR,500 mmQ,25000NM3/H

(1)ANUBAR FLOW METER FOR C.AIR 6BAR,200 mmQ,3600 NM3/H

(1)COMPRESSED AIR CONTROLL SYSTEM TO MAXIMIZE EFFICIENCY OF I.RAND UNITS TO MINIMIZE VENTING

EXPECTED RESULTS – EFFECT OF RECOMMENDATION.

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost USD /year	
Baseline – existing conditions		47925		2395900	
After recommended action		46713		2335300	
Net reduction		1212		60600	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost USD	Notes
Engineering design	2900	
Equipment procurement	55000	
Equipment installation	1500	
Equipment commisssioning	500	
TOTAL INSTALLED COST	(b) 59900	
Estimated increase in annual (non–energy) operations and maintenance cost	(c) –	

PAYBACK PERIOD

$$\frac{b\ 59900}{a\ 60600 - c\ -} = 0,988 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Pr—ared for USAD and RCG/Hagler Bailly

ACTION NO. A3

Pl : name: STIROM
Address: BUCHAREST ROMANIA

At tor's name: MIHAIL ZDRAVCU
ort date: MARCH,1994

ACTION NO. AND BRIEF DESCRIPTION A3 REDUCE HEAT LOSSES ON GAS FIRED FURNACES

A EA OF THE PLANT AFFECTED: PLANT STIROM

FINDINGS CONCERNING EXISTING CONDITIONS:

SUBSTANCIAL HEAT IS WASTED IN AIR FROM A WIDE RANGE OF FURNACE C-1,C-2 ETC.SHELL,HEAT TREATMENT(ANEALING).

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

-PROVIDE INSULATION BLANKET FOR CROWN OF GLASS FURNACE C-1,AND C-2.
OST: 30000 USD, SAVINGS: 30000 USD.

-PROVIDE ONE SUIT FOR HOT WORK AT TEMPERATURE 1000°C and 15 MIN.
OST: 8000 USD, SAVINGS: 8000 USD.

-PROVIDE I.R. DEVICE -45°C TO +550°C. CDST:500USD,SAVINGS:1000 USD.(SEE A3.1)

- ROVIDE I.R. NONCONTACT PIROMETER FOR TEMPERATURE MEASUREMENT 400 TO 3000°C ON GLASS FURNACE WORK.COST:4500 USD,SAVINGS:9000USD.(SEE A3.1)

XPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:	Total cost
	Peak kW	Energy MWh/year	TJ	USD/year
Baseline –existing conditions			2032	5100192
er recommended action			1935.07	5052192
Net reduction			96.93	48000 (a)

OST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:	Cost USD	Notes
Engineering design	1000	
Equipment procurement	41000	
Equipment installation	1000	
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 43000	
estimated increase in annual (non–energy) operations and maintenance cost	(c) –	

PAYBACK PERIOD:

$$\frac{b: 43000}{a\ 48000 - c: -} = 0,9 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

222

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. B1

Plant name: STIROM BUCHAREST ROMANIA
Address:

Auditor's name: MIHAIL ZDRAVCU

Report date: MARCH,1994

ACTION NO. AND BRIEF DESCRIPTION: B1,IMPROVE HEATING SYSTEM OF PLANT BUILDINGS

AREA OF THE PLANT AFFECTED: STIROM PLANT

FINDINGS CONCERNING EXISTING CONDITIONS:
PLANT HASE A HEATING SYSTEM FOR PREPARING HOT WATER REQUIRED FOR DOMESTIC HW AND FOR BUILDING HEATING . PLANT HEASE AN OUTSIDE HW CONNECTION OF 1,5 GCAL/H AS A SPARE SUPPLY.TOTAL CONSUMPTION IS :4GCAL/H FROM HEAT RECOVERY SYSTEM AND 1,5 GCAL/H FROM OUTSIDE.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
- IMPROVE DESIGN OF RECUPERATORS
- REDUCE 50% HEAT CONSUMPTION FROM OUTSIDE THE PLANT
- PROVIDE HEAT FLOW MEATERS(ULTRASONIC TYPE) ON:a)MAIN PIPE OF THE OUTSIDE SUPPLY;b)MAIN PIPE OF THE OUTSIDE OF RETURN PIPE;c)MAIN PIPE OF THE HEAT+ RECOVERY SYSTEM.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:	Total cost
	Peak kW	Energy MWh/year	TJ	USD/year
Baseline – existing conditions			2032.00	5100192
After recommended action			2016.3	5037863
Net reduction			15.7	62329 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost USD	Notes
Engineering design		
Equipment procurement	13000	
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 13000	
Estimated increase in annual (non–energy) operations and maintenance cost	(c) –	

PAYBACK PERIOD:

$$\frac{b: 13000}{a: 62329 - c: -} = 0,2 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. B2

Plant name: Address: STIROM BUCHAREST ROMANIA

Auditor's name: MIHAIL ZDRAVCU

Report date: MARCH,1994

ACTION NO. AND BRIEF DESCRIPTION: B2, IMPROVE COMBUSTION EFFICIENCY AT GAS FIRED FURNACES

AREA OF THE PLANT AFFECTED: FURNACE C-1, C-2

FINDINGS CONCERNING EXISTING CONDITIONS:

STIROM HASE 10 GAS FIRED FURNACES FOR GLASS MELTING.FURNACE C-1 and C-2 ARE THE BIGGEST AND 27 YEARS OLD. ROW MATERIAL IS PREPARED BY AN AUTOMATIC STATION. PROCESS IS FULLY AUTOMIZED BUT WITHOUT PC IN LINE. RATIO AIR/FUEL AND TEMPERATURES ARE AUTOCONTROLLED.BURNERS ARE ON C-1, 27 Years OLD.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

- RECOVER WASTE HEAT FROM EXHAUST; PREHEAT COMBUSTION AIR(PRIMERY) AND CULLET WITH WASTE HEAT FROM FLUE GAS.
- INSTALL NEW HIGH EFF. BURNERS ON ALL FURNACES
- OPTIMIZE COMBUSTION EFFICIENCY
- OPTIMIZE COMBUSTION REVERSING CYCLE OF REGENERATORS
- INSTALL VARIABLE FREQUENCY DRIVE ON F.D.FAN C-1 and C-2.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: TJ	Total cost USD /year
Baseline – existing conditions		47925	2032	7496092
After recommended action		47725	1534.241	6929576
Net reduction		200	497.759	566516 (a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost USD	Notes
Engineering design	5000	
Equipment procurement	112000	
Equipment installation	2000	
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 119000	
Estimated increase in annual (non–energy) operations and maintenance cost	(c) –	

PAYBACK PERIOD

$$\frac{b: 119000}{a: 566516 - c: -} = 0,21 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

:TION PLAN – SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES
epared for USAID and RCG/Hagler Bailly

ant name: STIROM, Bucharest, Romania
ddress:

ditor's name: Mihail Zdravcu
port date: March, 1994

SELINE – EXISTING CONDITIONS

	Nat. Gas Thermal Consumption GJ/year	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost /year
ASE CASE	2032079			5882	47925000	7496092

MMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS (USAID)

Action No.	Action Description	Nat Gas Thermal Consumption GJ/year	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	USD Total Energy Cost /year	Action Project Cost	Action Payback Period (years)
	LIST NO 1								
1.1	Reduce Energy Losses at no cost and	COG Belts				26400	1320	600	0,45
2.1	Reduce Compressed Air Losses					60000	3000	2400	0,8
3.1	Reduce Heat Losses	4000					10000	5000	0,5
2.1	Improve Combustion at Gas Fired Furn.	800					2000	2000	1.
Total Savings		48000				86400	16320	10000	0,6
Savings as per % of base case		0,2				0,1	0,2	–	–
	LIST NO 2								
12.2	Reduce Compressed Air Losses					1152000	57600	57600	1
13.2	Reduce Heat Losses	15139				–	38000	38000	1
32.2	Improve Comb. Efficiency	45420				200000	124000	910000	0,7 3
Total Savings		60559				1352000	219600	1866000	0,85
Savings as per% of base case		2,98				2,82	2,93	–	–
TAL SAVINGS	LIST NO 1+ LIST NO 2(USAID)	65359				1438400	235920	1966000	0,83
VINGS AS PERCENTAGE OF BASE CASE		3,2				3	3,15		

Note: Assumes that the actions are taken in order of best payback period first, in order to take into account the interaction between the various measures.

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. A1.1

Plant name: STIROM Bucharest, Romania
Address:

Auditor's name: Mihail Zdravcu

Report date: March.1994

ACTION NO. AND BRIEF DESCRIPTION: A1.1 Reduce Energy Loss

AREA OF THE PLANT AFFECTED: STIROM PLANT

FINDINGS CONCERNING EXISTING CONDITIONS:

Plant has a big amount of V-Belts for drives with short life and low efficiency.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Provide:

At first stage install 20Pcs of COG Belts which have double life for Deduster Drives.

5 Belts/Drivex4Drives=20Belts on 55kW Motors. Cost 600 USD

Savings: 55kWx4x8000 h/yearx0,05USD/kWhx0,015=1320 USD/Year

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost USD /year	
Baseline – existing conditions		47925		2395900	
After recommended action		47898.6		2394580	
Net reduction		26.4		1320	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost USD	Notes
Engineering design	–	
Equipment procurement	600	
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	(b) 600	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD:

$$\frac{b: 600}{a: 1320 - c: -} = 0.45 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. A2.1

Plant name: STIROM Bucharest, Romania
Address:

Auditor's name: Mihail Zdravcu

Report date: March, 1994

ACTION NO. AND BRIEF DESCRIPTION: A2.1 REDUCE COMPRESSED AIR LOSSES

AREA OF THE PLANT AFFECTED: STIROM PLANT

FINDINGS CONCERNING EXISTING CONDITIONS:

Plant has 27 years old I.S.Machines with high consumption of compressed air. Plant has 71,5% from Electric Consumption for production of compressed air.Many leaks on C.A.System.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Reduce compressed air leaks by elaborating a maintenance program.
Install on compressed air headers flowmeters to monitor consumptions.
Provide an ultrasonic leak detector to lokate air leaks.
Equipment: Flowmeters...1900 USD
Leak detector ... 500USD

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost USD /year	
Baseline –existing conditions		26718		1335900	
After recommended action		26658		1332900	
Net reduction		60		3000	(a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:	Cost USD	Notes
Engineering design	–	
Equipment procurement	2900	
Equipment installation	200	
Equipment commisssioning	–	
TOTAL INSTALLED COST	(b) 2400	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD

$$\frac{b: 2400}{a: 3000 - c: -} = 0,8 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. A3.2

Plant name: STIROM, Bucharest, Romania
Address:

Auditor's name: Mihail Zdravcu

Report date: March, 1994

ACTION NO. AND BRIEF DESCRIPTION: A3.2 Reduce heat losses

AREA OF THE PLANT AFFECTED: STIROM PLANT

FINDINGS CONCERNING EXISTING CONDITIONS:

Factory has 10 furnaces. Maintenance during operation of the furnaces is performed with dificulties due to lack of proper equipment for hot works. Heat losses on air are high due to outside temperature of shels Avg. 350 °C.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Improve maintenance procedures at furnaces by:

- providing a suit for hot work to protect operator against close work at temperature of 1000 °C, about 15 minutes.
- improve actual designe on furnaces by providing insulation blankets of the glass furnace on crown.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: TJ	Total cost USD/year	
Baseline – existing conditions			2032.000	5100192	
After recommended action			2016.861	5062192	
Net reduction			15.139	38000	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost USD	Notes
Engineering design	1000	
Equipment procurement	37000	
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 38000	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD

$$\frac{b: 38000}{a: 38000 - c: -} = 1/ \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

228

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. B2.2

P it name: STIROM, Bucharest, Romania
Address:

A itor's name: Mihail Zdravcu

ort date: March, 1994

ACTION NO. AND BRIEF DESCRIPTION: B2.2 Improve combustion efficiency at gas fired furnaces

EA OF THE PLANT AFFECTED: Furnace C-1 and C-2

FINDINGS CONCERNING EXISTING CONDITIONS:

Burners on C-1 are 27 years old, Ratio AIR/GAS is not controlled by an IN-LINE Computer and Digital Controllers, F.D.FAN is driven with an asyncronous Motor with fixed speed and Flow Regulation Controll Valve on exit.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

AUDIT TEAM come to the conclusion that Burning System along with Melting Bath on furnace C-1 has to, be changed and combustion control shall be improved providing:

(16) High Eff. Burners for 1500 Nm3/h, LHV=8300 kCal/Nm3 to obtain 1580 °C in furnace with aa optimum combustion and at least 180 To/Day Production.

(1set) Digital Multichanel Controller(8Chanels min.) to provide continuous PID with 4-20 mA Input/Output capable to comunicate with RS232C including Computer as in line in a gas fired furnace+soft.

(2) Variable Frequency Drive for F.D.FANS 22kW/C-1 and 15kW/C-2 furnace.

XPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:	Total cost
	Peak kW	Energy MWh/year	TJ	USD /year
Baseline – existing conditions		47925	2032	7496092
ter recommended action		47725	1986.58	7372092
Net reduction		200	45.42	124000 (a)

OST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:	Cost USD	Notes
Engineering design	3000	
Equipment procurement	86500	
Equipment installation	1500	
Equipment commisssioning		
TOTAL INSTALLED COST	(b) 91000	
estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD.

b: 91000 / (a: 124000 - c: -) = 0,73/ years

RECOMMENDED IMPLEMENTATION SCHEDULE:

229

ENERGY EFFICIENCY AUDIT REPORT
STIROM GLASS FACTORY
BUCHAREST, ROMANIA
MARCH/APRIL 1994

Prepared by: ARCON-SRL
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230

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

1.1 Objectives,goals,results
1.2 Recomandation with economics

2.0 INTRODUCTION

2.1 Background
2.2 Purpose
2.3 Expectations

3.0 AUDIT STRATEGY,ORGANISATION AND PLAN

3.1 Audit Team Concepts
3.2 Focus and Target Areas
3.3 Audit plan and Schedule

4.0 DATA COLLECTIONS,AVAILABLE SOURCE

4.1 Annual Energy Consumption and Cost
4.2 Unit Energy Costs
4.3 Plant Infrastructure and Utility Systems
4.4 Energy distribution Systems
4.5 Manufacturing Processes,Technologies

5.0 DATA COLLECTION,FIELD WORK

5.1 Tour of Energy Systems
5.3 Observations,Field Notes
5.4 Preliminary Identification of ECO's

6.0 ENERGY ANALYSIS:SUPPLY,DISTRIBUTIONS,USERS

6.2 Pie Charts of Energy Supply and Cost
6.2 Unit Cost-Basis-of-Savings (CBOS)
6.3 One-Line Utility Balances
6.4 Block Process Flow Diagram (Technologis)
6.5 System Performance:Efficiency Plus Reliability
6.6 Non-Energy Issuses:Constraints and Problems
6.7 Weakness Analysis

7.0 DEVELOPMENT OF RECOMMENDATIONS FOR ENERGY EFFICIENCY IMPROVEMENT

7.1 Identifying ideas to save energy (BRAIN STORMING)
7.3 Converting ideas into recommendation actions
A1. Put efficiency teams in action to reduce energy losses
A1.1 Reduce energy losses by cogbelts (USAID)
A2. Reduce compressed air losses
A2.1 Reduce compresses air losses with ultraprobe tester,ultraprobe,comp. air control system of 1.Rand compressors and providing anubar flowmeters

231

A3. Reduce heat losses on gas fired furnaces and heat treatment owens

A3.1 Reduce heat losses with I.R. non.contact thermometers -45 to 550oC and I.R. pyromete 600-3000oC (USAID LIST1)

A3.2 Reduce heat losses by repairing refractory work by work by a suit for not work and by providing insulation blanket for crown of glass furnace

B1 Improve heating systems of thr plant buildings

B2 Improve combustion efficiency at gaz fired furnaces

B2.1 Improve combustion eff. at gas fired furnaces providing instruments calibration (USAID LIST 1)

B2.2 Improve combustion eff. at gas fired furnaces providing high eff burners,digital controllers with PC computer and variable FR. drive on furnace FD.Fane.(USAID-LIST2).

8.0 IMPLEMENTATION PLAN

8.1 Responsability for Results

8.2 Implementation Schedule

9.0 CLOSING MEETING WITH PLANT (Preliminary Results)

9.1 Presentation of Initial findings

9.2 Major Recomadations and Preliminary Economics

9.3 Securing Management Commitment and Follow-up

10.0 APPENDICES

10.1 3o Guidlines for designing and Operating compressed air systems

10.2 Figure- Natural gas savings available by reducing Oxygen to optimum (assumed 2%)

10.3 Effect of flue gas composition and temperature on Boiler Eff.

10.4 Blanket specification for Reducing of heat losses on furnaces C-1 and C-2, (WALTER's SMITHS FAX).

10.5 Ceramic fibre plates for blanketing of walls of furnaces C-1 and C-2, supplyier PROCEMA, Bucharest.

10.6 Specification for redisignig of glass melting furnace C-1 at STIROM Plant.

10.7 LIST NO 1 of Equipment for STIROM.

10.8 LIST NO 2 of Eguipment for STIROM.

10.9 LIST NO 1 approved by STIROM Management.

10.10 Readings from electrical system.

232

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RCG/HAGLER,Bailly,Inc. and ARCON SRL gratefully aknoledge the assistance and hospitality provided by the staff of STIROM-BUCHAREST.Particular thanks for techinical cooperation are due to:

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CRISTIAN IORDACHE - FURNACE DEPARTAMENT
MIRCEA DUMITRESCU - CHIEF ENERGY Dept.
GHEORGHE STANGA - ELECTRONIC Dept.
CRISTIAN SANDA - Energy Dept.

1. EXECUTIVE SUMMARY

1.1 OBJECTIVES,GOALS,RESULTS

The objectives of the audit are:

-To increase the skills of STIROM STAFF to "SEE" ENERGY WASTE!

-To identify Low-Cost Tuning,Operational and Maitenance Recommendattions.

-To Quantify major energy conservation opportunities (ECO'S),

-To recommend Long-Range solutions,to energy analysis and process energy management issuses.

-To focus especially on energy issuses energy improvement.

-To identify instrumentation and low-cost equpament needed by the Plant to implement the more attractive energy conservation actions.

The goals are to reduce energy consumption and specific energy consumptions in production process with better Quality ,productivity,Ecology and safety.

The report presents the results from a preliminary energy audit carried out by a team of engineers from RCG/HAGLER,Bailly,Inc,and ARCON-ROMANIA.

1.2 RECOMANDATION WITH ECONOMICS

STIROM has some energy efficiency efforts already in progress.In adittion,detailed energy consumption and production records are maintained for each department.

During the brief preliminary energy audit performed at site,STIROM staff worked with the audit team to identify additional energy efficiency measures.Based on the discussions with management,production and technical staff,inspection of equipament and operating procedures,analisysis of plant energy and production data and measurement of certain process parameters,ARCON estimates the potential for energy efficiency improvements at the STIROM Plant as 28% without process changes.Short term,low-cost energy efficiency and productivity improvement projects (a financial payback of les than one year each),which if implemented,will enable STIROM to achieve a financial benefits of 757813 USD per year.The total cost to achieve this benefits is less than 236417 USD.This Actions are summarized on the Table 1.2.1.RCG/HAGLER,BAILY and ARCON recommends the following procurement budget for STIROM,subject to final approval by USAID:

LIST No1 For STIROM

ITEM1 Universal Digital Measurement KIT SUPERCALL II Multifunctional for process equipament,temperature oC,mV,mA,OHMS, similar with DAVIS INSTRUMENTS MD21215,Catalog No RS 120101,Model CL4500,COST:2000 USD

ITEM2 Infra Red Non contact PYROMETER,-45oC to 550oC similar to DAVIS Catalog DK 1164198 or Wahl DHS-5x,COST:500 USD

ITEM3 Infra Red non contact PYROMETER similar wiith Wahl Type DHS-53 Range 600 to 3000oC plus L-50 Close-Up Lens for DHS-53;COS:4500 USD

ITEM4 COG BELTS

5 Belts/Drive x 4 Drives=20 Belts type BX 116;COST=600 USD

234

ITEM5 Ultrasonic Leak Detector for Compressed air Equivalent to ULD-100 (Scale);COST 500 USD
ITEM6 Anubar for compressed Air Flow:3.4Bar,600 mm Ø,Maximum 30.000 Nm3/h.Minimum 6000 Nm3/h;COST 1900 USD

TOTAL 10.000 USD

*The cost of items 1 to 6 are estimated

IN CASE OF ADDITIONAL FUNDING IS AVAILABLE RCG/HAGLER BAILLY AND ARCON ELABORATED LIST NO2 WITH LARGER EQUIPMENT NECESSARY TO IMPROVE ENERGY EFFICINCY.

235

LISTA NO.2 FOR STIROM

ITEM No.		COST	SAVINGS	PAYBACK
1.	High Efficiency Burners for Glass Furnace C-1 (16 units) - equivalent to Kårting; GAZ=Total Flow 1500 m3/h,8300 Kcal/m3 (LHV) 16 burners to obtain 1580oC in Furnace with Complete Combustion.Out of 16 burners,8 must be working and 8 not operating (cooling conditions) at total production of 180 tons/day. Similar to Kårtining Hannover.	67,000	100,000	8 mos.
2.	Digital Controllers for 8 Channels to provide Continuos PID with 4-20 MA input/output capable of communicating with RS232C computer.			
	5 Loops for Gas Flow) 1 Loop for Gas to Air Ratio) 2 Loops for Draft Pressure)			
	Computer 486 Microprocessor,33 Mhz with 4 MB RAM and 170 MB HD. To include 2 floppy drives (3.5" and 5.25") and SVGA monitor.	14,000	14,000	12 mos.
3.	Insulation Blanket for Crown of Glass Furnace C-1 to Include	30,000	30,000	12 mos.
4.	Variable Frequency Drives			
	A. 22 KW F.D.Fan on C-1 380 V, 50 HZ,1500 RPM	6,000	6,000	12 mos.
	B. 15 KW F.D.Fan on C-2 380 V, 50 HZ,1500 RPM	4,000	4,000	12 mos.
5.	Ultra Probe 2000,220 V with Accessories	4,000	4,000	12 mos.
6.	Annubar Flow Meter for Compressed Air			
	A. 20.5 Bar,500 mm ø,Nm3/h Max Flow 25,000,min 5000 Nm3/h	1,800	1,800	12 mos.
	B. 6.0 Bar,200 mm ø,Nm3/h Max Flow 3,600,min 1200Nm3/h	1,800	1,800	12 mos.

Including indicators in Nm3/h for each.

236

LISTA NO.2 FOR STIROM

ITEM No.		COST	SAVINGS	PAYBACK
7.	Suit for hot work to provide protection against close work at temperature of 1000oC,15 Min.	8,000	8,000	12 mos
8.	Compressed air control system to maximize efficiency of IR units and to minimize venting	50,000	50,000	12 mos.
		$186,600	$219,600	10 mos. (Avg.)

* Subject to USAID approval

231

STIROM - BUCHAREST PLANT Table 1.2.1

RECOMMENDED ACTIONS AND ESTIMATED BENEFITS

ACTION	BRIEF DESCRIPTION	ENERGY SAVINGS Mwh/Jr	TJ/Jr	USD/Jr	FINANCIAL USD	USAID En Savings Mwh/Jr	TJ/JR	USD/Jr	COST USD
A	General energy management								
A1	Put energy efficiency team in action to reduce energy losses	407,313	-	20368	1517	-	-	-	-
A1.1	Reduce energy losses by COB Belts (LIST 1)	-	-	-	-	26,4	-	1320	600
A2	Reduce compressed air losses	1212	-	60600	59900	-	-	-	-
A2.1	Reduce compr. air losses with leak detector and Anubar Flow-Meters (LIST 1)	-	-	-	-	60	-	3000	2400
A2.2	Reduce compr. air losses with ultraprobe tester compr. air control sys. of ing. rang compress. and provi- ding anubar flow-mtrs.	-	-	-	-	1152	-	57600	57600
A3	Reduce heat losses on gaz fired furnaces and heat treatment owens	-	96,93	48000	43000	-	-	-	-
A3.1	Reduce heat losses with I.R. non-contact thermometer -45 to 550 oC and I.R. Pyrometer 600 to 3000oC (LIST1)	-	-	-	-	-	4	10000	5000
A3.2	Reduce heat losses by repairing refractary work by a suit for hot work and by providing insulation blanket for crown of glass furnaces (LIST 2)	-	-	-	-	-	15,139	38.000	38.000

238

ACTION	BRIEF DESCRIPTION	ENERGY SAVINGS Mwh/Jr	TJ/Jr	USD/Jr	FINANCIAL USD	USAID Sn Savings Mwh/Jr	TJ/JR	USD/Jr	COST USD
B	Short-term, low-cost efficiency improvements								
B1	Improve heating system of the plant building	-	15,7	62329	13000	-	-	-	-
B2	Improve combustion efficincy at gaz fired furnaces	200	497,759	566516	119000	-	-	-	-
B2.1	Improve comb. eff. at gaz fired furnaces providing instruments calibration	-	-	-	-	-	0,8	2000	2000
B2.2	Improve combustion efficincy at gaz fired furnaces providing high eff. burners, digital controllers with PC comp. and var.freq. drive on furnace FDFAN (LIST 2)	-	-	-	-	200	45,42	124000	91.000
	TOTAL	1819,363	610,389	757813	236417	1438,4	65,359	235920	196600
	PAYBACK YEARS	0,3				List TOTAL: 0,83		LISTS: 1: 10000/16320 = 0,6 2: 186600/219600 = 0,85	

239

2.0 Introduction
2.1 Background
2.1.1 Origin of project

This project was funded by the United State Agency for International Development (USAID-Industrial Energy Efficiency) as part of humanitarian and techinical assistance from the people of the United States to the people of Romania.

The prime contractor for implementation of the project is RCG/HAGLER,Bailly,Inc.,of Arlington,Virginia,under USAID contract No-0030-C-00-2053-09.

The consultant in Romania ARCON has a contract with ~~with~~ the Plant "STIROM"-Bucharest No 2215/28.03.1993 to performe a "Energy Audit" under USAID programe.

2.1.2 General plant description

STIROM Bucharest ROMANIA is a stat glass factory products being glass cups,bottles for vine vegetabls oil,beer and PEPSI COLA etc.

Plant has 10 gaz fired furnaces,a large air station.All row material are from local market,energy required (natural gaz and electricity) is enssured from natural grid.

Water is pumped from own wells and that water 70/90oC is fabricated from stack heat recovery recuperators.

Plant is one of biggest automatized glass factory,from Romania and is sharing about 40% from interior marked export about 5-10% from the production.

2.1.3 The scop of the audit as per ARCON-STIROM contract is:

1.Furnace C-1 and C-2 full energy audit (gaz and electric energy including process and equipment of furnace C-1,C-2,feeder, IS machines,H.T.owens,sorting lines,fans,combustion,cooling fans, transporting escalators).

2.Electric distributions 6 KV and MCC-0,4/0,23KV,compressor house and water pumping station.

3.Natural gaz installations from central distribution to the furnace panels.

2.2 Purpose

This energy audit will serve as a practical training session to complement the classroom training already received by the consultant (ARCON),and will save as a catalyst to faster the development of market oriented energy services designed to improve industrial energy efficiency in Romania,especially in the short term.

A 15-40% reduction in energy with better quality,higher productivity,ecology and safety.

2.3 Expectations

2.3.1 A dramatic,competitive advantage producing more product with higher selling price at lower manufactoring cost.

2.3.2 Implementing in Plant a more efficient energy management.

3.0 Audit strategy,organization and Plan

In audit period following teams were organized:
-Electrical energy system,compressor house and C.Air system ,cooling tower and H.W. system for heating and showers.
-Natural gaz system
-Furnace and pertaining process including combustion optimization and heat losses .

3.2 Focus and target areas

As per scop of wark and Plant's management with the audit teams were focused on furnace C-1 and C-2,electrical,natural gaz-heat recovery and compressed air systems areas.The target was energy conservation oportunities (ECO'S)

Audit plan and schedule.

The audit started at 25 March and closed at 1 April 1994.Closing heating was with audir teams and STIROM general manager.
The schedule of energy audit:

A)Audit at plant 25 March-1 April 1994

B)Glass furnaces April-May 1994
1.Optimize reversing
2.Measure refractry temperatures
3.Other (see Idea list)

C)Compressed air May 1994
1.One-line diagram
2.Compressor efficiency
3.Leak identification and repair
4.End use reduction
5.Optimize I.R. compressor

D)Audit report
1.To RCG/Hagler,Bailly 30 June
2.To plant 15 July

E)Equipament Use/Installation
1.List 1 15 June/Oct 1994
2.List 2 December 1994

241

ENTERPRISE ANUAL ENERGY PROFILE YEAR:1993 FACILITY:STIROM BUCHAREST **Table 4.1.1**

MONTH	HEATING DEGDAYS	COOLING DEGDAYS	ELECTRICITY MWH	ELECTRICITY GJ	COST USD	FUEL GAZ QUANTITY	FUEL GAZ GJ	FUEL GAZ USD	TOTAL ENERGY GJ	TOTAL ENERGY USD	PRODUCTIVITY * To	PRODUCTIVITY * MUSD COST
JANUARY	558	-	3856	13882	192800	5019	178576	448197	192458	640997	11304	3,66
FEBRUARY	364	-	3640	13104	182000	4641	165126	414441	178230	596441	12149	3,946
MARCH	217	-	4300	15480	215000	4845	172385	432659	187865	647659	14293	4,63
APRIL	30	-	4235	15246	211750	4892	174057	436856	189303	648606	13721	4,44
MAY	0	-	4336	15610	216800	5099	181422	455341	197032	672141	13312	4,31
JUNE	0	-	4135	14886	206750	4799	170748	428551	185634	636301	13379	4,33
JULY	0	-	4086	14710	204300	4949	176085	441946	190765	646246	13500	4,37
AUGUST	0	-	3930	14148	196500	4834	172172	432123	186320	628623	11729	3,80
SEPTEMBER	0	-	3755	13518	187750	3700	131646	310410	145164	518160	10208	3,3
OCTOMBER	31	-	3961	14260	198050	4798	170713	428461	184973	626511	11481	3,72
NOVEMBER	210	-	3900	14040	195000	4688	166799	418638	180389	613638	19900	3,85
DECEMBER	403	-	3784	13622	189200	4844	172350	432569	185972	612769	12492	4,05
ANUAL TOTAL	1813	-	47925	172506	2395900	57113	2032079	5100192	2204585	7496092	149468	48,4
ANUAL AVERAGE	151	-	3994	14376	199658	4759	169340	425016	183715	624674	12455	4,03

NOTES/CONVERSION FACTORS

ELECTRICITY: 1 Mwh=3,6 GJ,50 USD/Mwh;13,89 USD/GJ

NATURAL GAZ: 35,58 GJ/1000Nm3; 0,0893 USD/Nm3; 2,51 USD/GJ; 95 USD/1000 Nm3 - 70% imported; 76 USD/1000 Nm3 - 30% local

* 324 USD/TO PRODUCTION

UNIT ENERGY COST

1.	ELECTRICITY	0,05 USD/kWH 1)
2.	NATURAL GAS	2,51 USD/GJ 2)
3.	COMPRESSED AIR	5,25 USD/ 1000 Nm3

---

1) Including Demand (Winter: 0,0532 USD/kWH; Summer: 0,0464 USD/kWH; Avg. 0,05 USD/kWH)

2) 89,426 USD/1000 Nm3; 2,67 USD/TJ Imported.

3) 0,105 kWH/Nm3; 0,05 USD/kWH.

4.0 Data collection,available sources.

4.1 Anual energy consumption and cost,see table 4.1.1

-Electricity connected Mw:16
demand kWh:5480
Kwh/Jr 47925000

-Natural gaz Nm3/Jr 57,113,000
(8500 Kcal/Nm3)
-Total energy consumption TJ 2.205
-Total h/Jr 8760

4.2 Unit Energy,cost see 6.2 and Table 4.1.1

4.3 Plant Infrastructurs and utility systems

STIROM is a well organized plant with:
-Production departament
-Furnace division
-Laboratories,physical-chemical,electrical,instrumentation mechanical
-Maitenance
-Mechanical and energy departament with development section
-Electrical ,compressor house,pumping house and cooling tower division
-Design section
-Comercial departament
-Financial departament
Plant has a general manager and 2 directors

Utility system:

-Electrical system:Plant is supplyied from national 110 KV grid through a 110/6 KV station-Renel with two cable feeders.Main 6 KV distribution is supplying all transformers 6/0,4/0,23 KV and 6 KV Motor Compressors.

Motor control centers are supplying 0,4 KV motors,lighting 220 V through a LV cable ntework,cos t ≃ 0,93.

Local equipament (starters,signaling and fuse boxes) are dust proof.

Cooling tower has single speed Fan drivers.71,9% out of electrical consumption is for compressed air(19% Power,9,5% lighting).

-Gaz system:Plant is supplyied from National grid.STIROM is biggest gaz consumer from Bucharest (at the moment).Plant has a well develloped gaz pipe network from main station up to each local distribution stations.

Incoming grid medium pressure is 2 To 6 Bar.
Normal required pressure:1.7 Bar
Pressure variation:0,3 to 6 Bar
Consumption of furnace C-1 21% → out of total
C-2 13% → plants consumption

4.4 Energy distribution systems

244

4.4.1 Electrical one-line diagram:fig 4.4.1

4.4.2 Natural gaz one-line diagram:fig 4.4.2

4.4.3 Compressed air one-line diagram:fig 4.4.3

4.4.4 Hot water and heat recovery system:see fig 4.4.

4.5 Manufacturing Process,Technologies:see fig 6.4

5.0 Data collection,field work

5.1 Tour of energy system and process technologies

A team of senior engineers from ARCON and RCH.Hagler,Bailly carried out field activities at STIROM to work together with Plant's staff to collect the data and to identify improvements to energy efficiency and preliminary identification of ECO'S.

The project manager for the eforts was Mr. Andy Icleanu which has reporting direct to chief engineer Niculescu and general manager Mihail Popescu and Mr. Nicolaie Manica and Cristian Iordache for furnace C-1 and C-2;Mr Mircea Dumitrescu - chief of energy departament;Mr Gheorghe Stanga chief of Electronic Instumentation Departament and Mr.Cristian Sanda manager of Natural gaz,Compressed air and Hotwater Systems.

The ARCON team consisted from Mr.Mihail Zdravcu(CEM) general manager and associates Mr.Dragos Simulescu (Electrical),Radu Stroescu and Carmen-Felicia Mihail (Thermotechnical and HVAC).

The RCG/Hagler,Bailly,Inc.Team consisted of Mr. Laurent Pommier and Michael Ellis project managers and Walter Smith (CEM)- Principal ETSI-Energy Techology Services International Consultant.

As per scop of work the audit team focused their efforts in the short time avaible on furnace C-1 and C-2,Row-material Section.Compressor House,Electrical system,etc.

The important objectives of the audit was to measure with I.R. Temperature Non-Contact Thermometer and Pyrometer Furnaces exterior temperature of refractory (mop).

Combustion on furnace C-1,C-2 with combustion analyzer measuring O2,CO,CO2 and flue gas temperature after regenerator with portable clamp ammeter amperage on FD fan was measured and evaluation of USD.

The technical optimization of reversing cycle time (non) rutinely set at 20 minutes regardeless of furnace size,regeneration performance,furnace charge,furnace age,etc.

Estimation of compressed air leaks at I.S. machines on C-1 and C-2 furnaces,etc and chalengening the process itself.

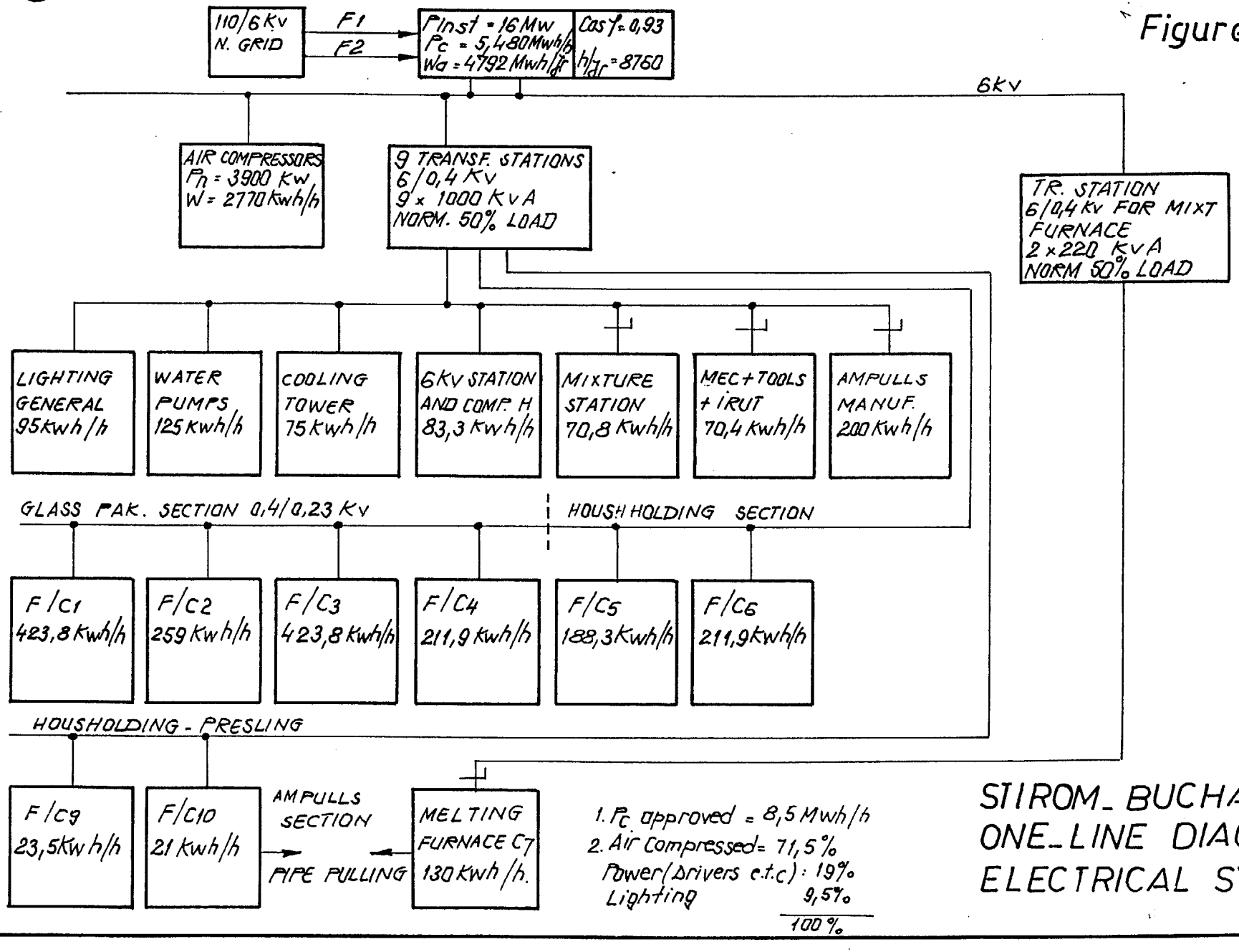
5.2 Field notes were taken for:

-COG Belts,application on V-Belts Driven motors of the Fans,etc.

-Heat recovery by providing insulation blanket on Refractary on Crown of C-1 and C-2 furnaces.

245

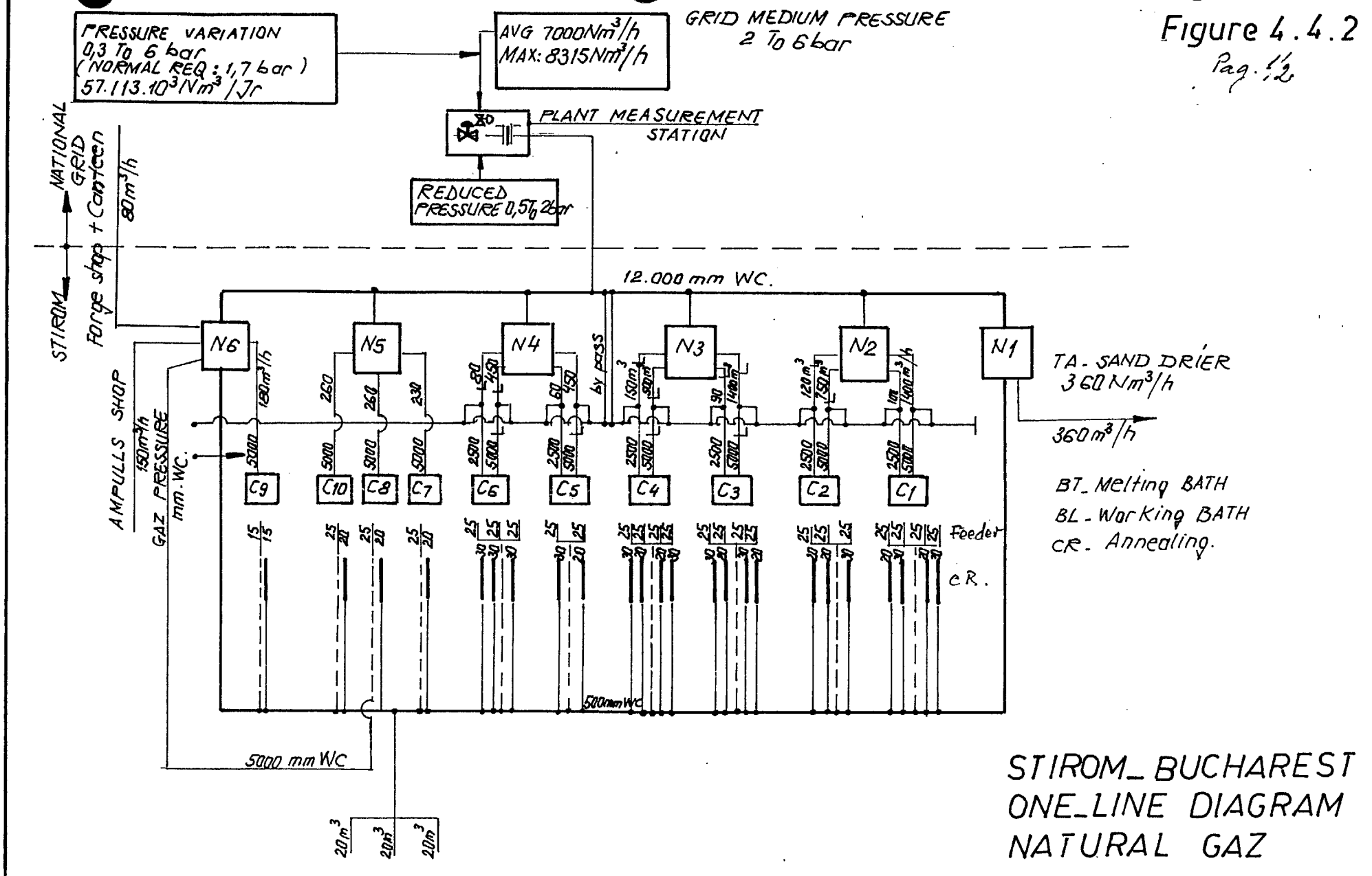
Figure 4.4.1



STIROM_BUCHAREST
ONE_LINE DIAGRAM
ELECTRICAL SYSTEM

Figure 4.4.2

Pag. 1/2

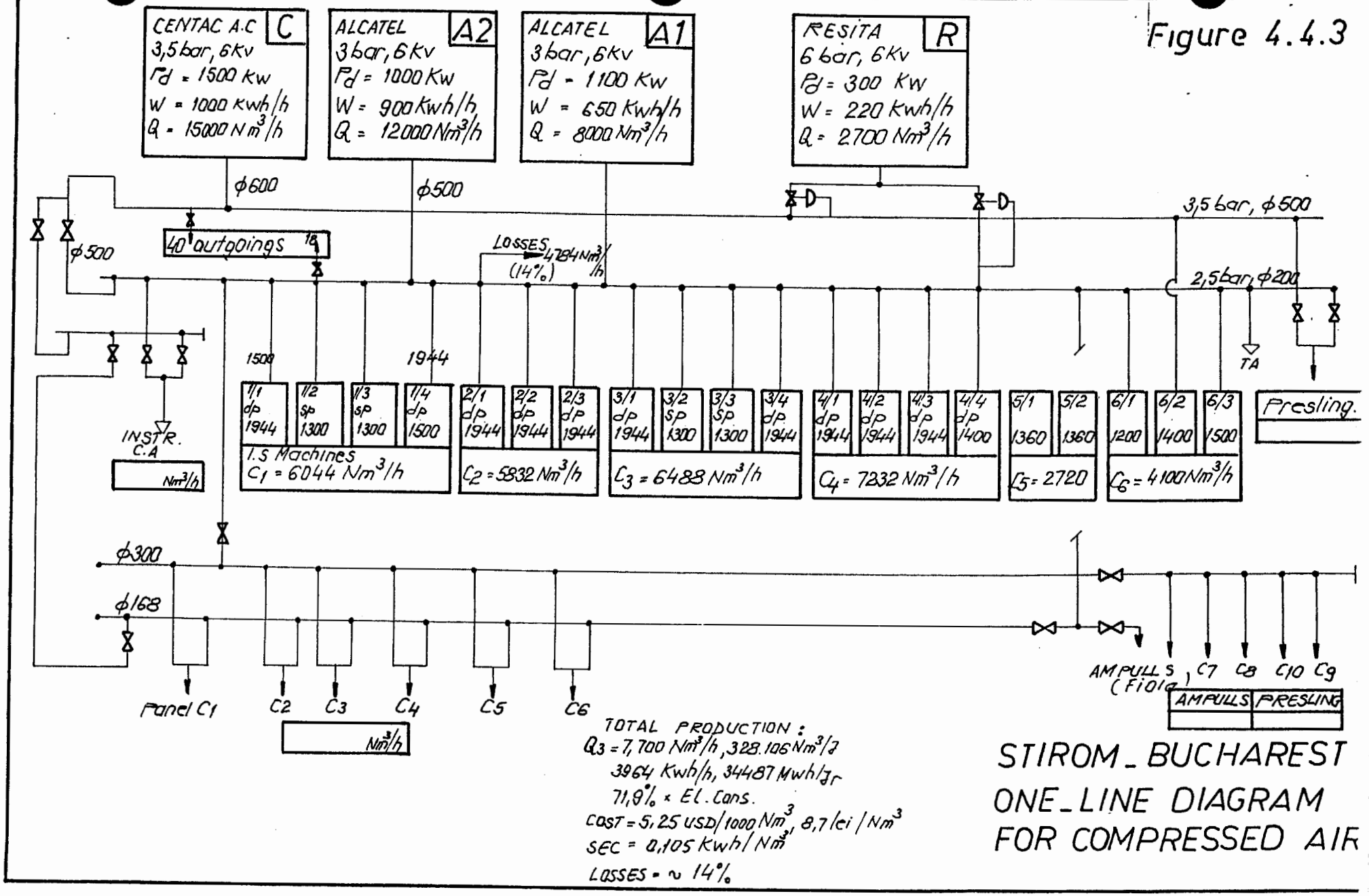


STIROM_ BUCHAREST
ONE_LINE DIAGRAM
NATURAL GAZ

Furnace	Melting Bath Nm^3/h N / Actual	Working Bath Nm^3/h N / Act	Feeder Pe x Nm^3	Annealing Pe x Nm^3	Supply pipe ϕ mm Melting Bath	Supply pipe ϕ mm Working Bath	FURNACE $S\ m^2$
C1	1400/1350	100/90	4 x 25	2 x 30 2 x 20	150	80	92
C2	750/680	120	3 x 25	2 x 20 1 x 30	100	80	50,5
C3	1400/1280	90	4 x 25	2 x 20 2 x 30	150	80	73
C4	500/450	150/140	4 x 25	2 x 30 2 x 20	100	80	35
C5	450/380	60	2 x 25	1 x 30 1 x 20	100	80	28
C6	450/410	80/60	3 x 25	3 x 30	100	80	28
C7	230/200		1 x 25	1 x 20			8
C8	260/220		1 x 25	1 x 20			8
C9	180/100		1 x 25	1 x 15			5
C10	270/260		1 x 25	1 x 20			12
Ampulls shop	150						
Forge + Can. Teen	80						
TA. sand Drier 2pes	360						
Decorativ Reb. owen	–	–	–	3 x 20			
TOTAL	6480/5920	600/560	590	645			

AVG : 7000 Nm^3/h

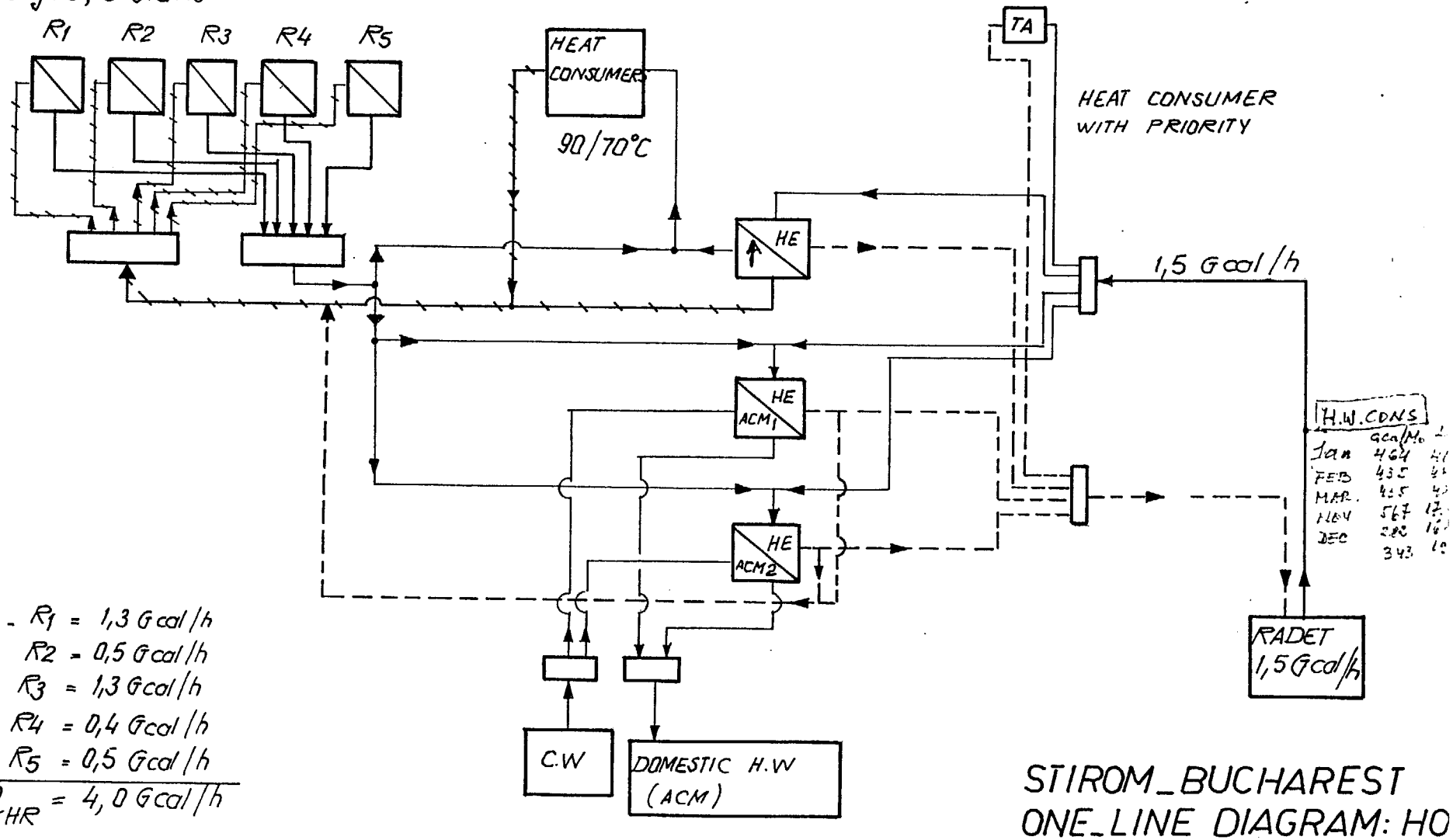
Figure 4.4.3


CENTAC A.C C
3,5 bar, 6Kv
Pd = 1500 Kw
W = 1000 Kwh/h
Q = 15000 Nm³/h
ALCATEL A2
3 bar, 6Kv
Pd = 1000 Kw
W = 900 Kwh/h
Q = 12000 Nm³/h
ALCATEL A1
3 bar, 6Kv
Pd = 1100 Kw
W = 650 Kwh/h
Q = 8000 Nm³/h
RESITA R
6 bar, 6Kv
Pd = 300 Kw
W = 220 Kwh/h
Q = 2700 Nm³/h
φ600
φ500
40 outgoings
LOSSES 4784 Nm³/h (14%)
3,5 bar, φ500
2,5 bar, φ200
TA
Presling.
INSTR. C.A
Nm³/h
1500
1944
1/1 dp 1944
1/2 sp 1300
1/3 sp 1300
1/4 dp 1500
I.S Machines
C1 = 6044 Nm³/h
2/1 dp 1944
2/2 dp 1944
2/3 dp 1944
C2 = 5832 Nm³/h
3/1 dp 1944
3/2 sp 1300
3/3 sp 1300
3/4 dp 1944
C3 = 6488 Nm³/h
4/1 dp 1944
4/2 dp 1944
4/3 dp 1944
4/4 dp 1400
C4 = 7232 Nm³/h
5/1 1360
5/2 1360
C5 = 2720
6/1 1200
6/2 1400
6/3 1500
C6 = 4100 Nm³/h
φ300
φ168
Panel C1
C2
C3
C4
C5
C6
Nm³/h
AMPULLS (Fiole), C7 C8 C10 C9
AMPULLS
PRESLING
TOTAL PRODUCTION:
Q3 = 7,700 Nm³/h, 328.106 Nm³/a
3964 Kwh/h, 34487 Mwh/an
71,9% x El. Cons.
COST = 5,25 USD/1000 Nm³, 8,7 lei/Nm³
SEC = 0,105 Kwh/Nm³
LOSSES = ~ 14%
STIROM_BUCHAREST
ONE_LINE DIAGRAM
FOR COMPRESSED AIR

HEAT RECOVERY HW= 4G.cal/h

Furnace
Flue gaz, 3 staks

Figure 4.4.4



Recup - R_1 = 1,3 Gcal/h
R_2 = 0,5 Gcal/h
R_3 = 1,3 Gcal/h
R_4 = 0,4 Gcal/h
R_5 = 0,5 Gcal/h

Q_{HR} = 4,0 Gcal/h

Total $Q = Q_{HR} + Q_{RADET} = 5,5$ Gcal/h

STIROM_BUCHAREST
ONE_LINE DIAGRAM: HO
WATER AND HEAT
RECOVERY SYSTEM

-Introduction of digital Controllers and PC computers on furnace C-1 and C-2
-Compressed air leaks
-Measuring of Flow on natural gaz,compressed air,etc.
-Burners on C-1 and C-2

5.3 Preliminary Identification of ECO'S

-Optimization of combustion on C-1 and C-2
-Providing proper burners on C-1 and C-2
-Providing insulation Blankets on C-1 and C-2
-Establishing of proper reversing cycle time on Regenerator's C-1 and C-2
-Reducing compressed air leaks
-Preheat of Primer Combustion air on burners on C-1 and C-2

5.4 Energy measurements of ECO'S

-Oxigen O2,CO and CO2 and flue gaz temperature was measured on C-2.Findings were:
(6,8-7)% O2,T=750oC,7,6% CO2 ; Excess air=55%
-It was decided to make more measurements and to optimize combustion
-Refractary map (izothermic) temperature on C-2 furnace 100 m2,350-400oC and it was decided to try a Blanket Insulation to reduce up to 100oC
-Glass cullets Avg. 30%
-All datas of C-1 and C-2 furnaces (Row material,energy consumptions,base line) see table 5.4.

6. Energy Analysis:Supply,Distribution,Users

6.1 Pie Charts of Energy cost.

Gaz - 91,8%
El energy - 7,8%
TOTAL:2204 TJ,7496 MUSD
GAZ: 2032 TJ,5,100 MUSD
EL: 172,5 TJ,2,3959 MUSD

COST
Gaz - 68%
Electric energy cost- 32%

E-P
Energy - 15,5%
Production - 84,5%

6.2 Unit cost basis-of-saving

El.Energy - 0,05 USD/kWh;13,89 USD/GJ
Gaz - 2,51 USD/GJ
Production- 324 USD /To finished glass

6.3 One-Line utility balance

See fig.4.4.1,4.4.2,4.4.3,4.4.4

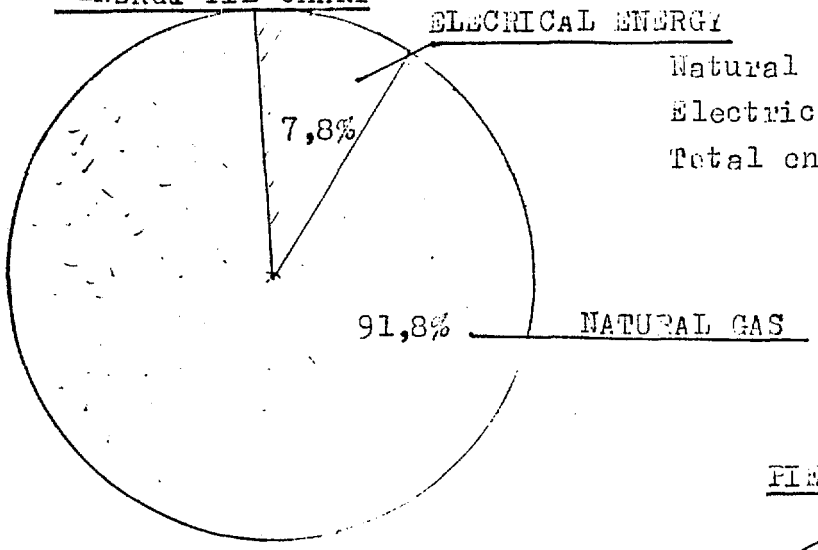
6.4 Block process flow diagram (Technologies)

251

Block process flow diagram for furnace C-1 and C-2

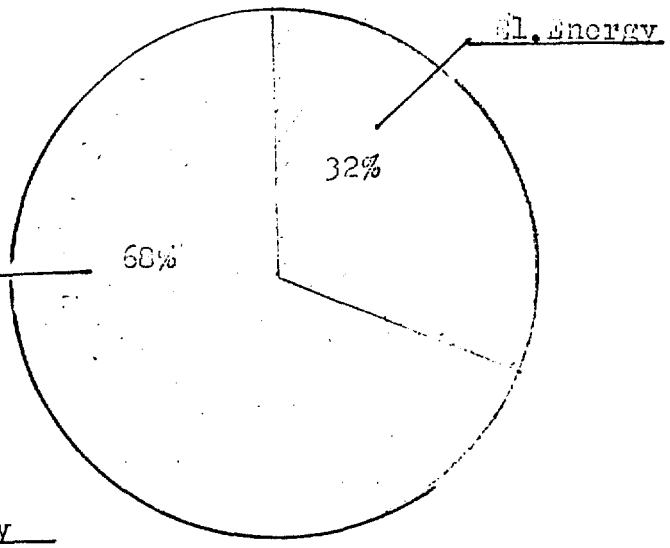
```
+-------+    +----------+    +-----------+    +--------------+
|STEP-1 |    |STEP-2    |    | STEP-3    |    |STEP-5        |
|STATION|  > |MELTING   |  > |I.S.Machines|  > |TAKE-UP       |
|DOZING |    |IN FURNACE|    |Forming    |    |GLASS FINISHED|
+-------+    |BATH      |    +-----------+    +--------------+
             +----------+
```

ENERGY PIE CHART



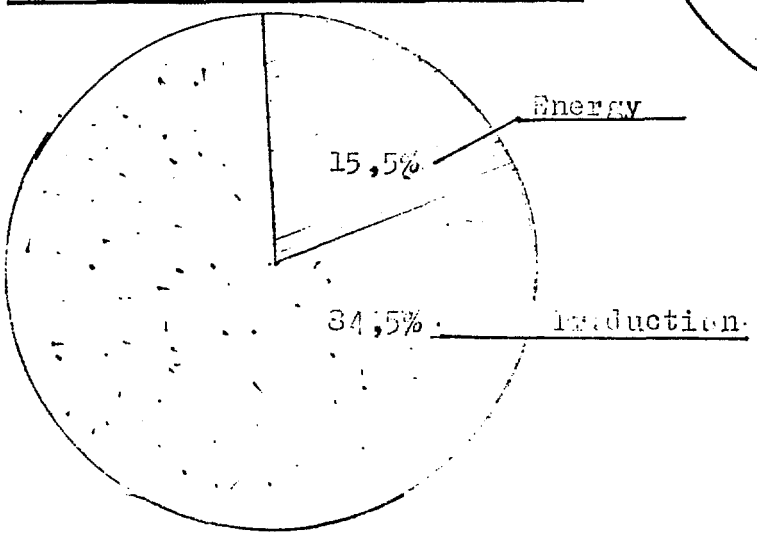
Natural gas: 2032TJ/Year
Electric energy: 172.5 TJ
Total energy: 2204 TJ/Year

PIE CHART OF ENERGY COST



Natural Gas cost: 5.100 MUSD
Electrical energy: 2.3959 MUSD
Total energy cost: 7.496 MUSD/Year

PIE CHART OF ENERGY-PRODUCTION



To/Year Production: 149468/'93
MUSD Year Prod.: 48.4
MWH/Year: 47925; MUSD: 2.3959
Gas TJ/Year: 2032; 5.1 MUSD/Y
Year: 1993

Table 5.4

Data collection for furnace C-1 and C-2

	Denomination	Any value C-1	Any value C-2	Meas.place	Meas.Equip.
	Primery Fuel Natural gaz				
	-Flow melting Nm3/h	1350	680	Supply pipe	Flowmeter
	-Flow working Nm3/h	90	120	"	"
1	-Flow feeder Nm3/h	4x25	3x25	"	"
	-Flow rebanking owen	2x30,2x20	2x20,1x30	"	"
	-LHV natural gaz Kcal	8500	8500	"	"
	-Temperature oC	15	15	Ham station	Thermometer
	Combustion air	14500	7400		
	-Melting tank Nm3/h	16	16		
2	-Temperature oC	700	500		
	-Working tank Nm3/h	15	15		
	-Temperature oC				
3	Flue gaz temperature	(1250)	(1280)		
	Chemical composition				
	of flue gaza after				Stach tempe-
4	regenerator %CO2		7,6		rature=750oC
	%O2		6,9		
	Row material humedi-				
	fyied %				
	-humidity Kg/h	4	2		
5	-quantity dry Kg/h	7000	3300	Supply station	Weing machine
	-water quantity Kg/h				
	-temperature oC	25	22		
	-cullets %	35	30		
	Production				
	-glass Kg/h	6650	2150		
	-losses Avg%	10	15		
6	-melting tank temp oC	1400	1400		
	-glass temp. on exit	1105	1105		
	from furnace oC				
7	Orificies and non en-	4mx0,25	1x0,25	Mout of Melttank	
	closures	2x0,1x0,15	0,45x0,15	Sighting	

253

Heat loss on furnace surfaces

Nr	Surface destination	C-1			C-2		
		m2	Ta oC	T_S oC	m2	Ta oC	T_S oC
1	Lateral wall,melting zone	61,4	48	430	30,48	32	370
2	Lateral wall,superior melting zone	50,2	62	390	32,78	50	280
3	Back melting zone	91,5	18	145	52,5	26	210
4	Crown melting zone	118	80	325	71,64	77	305
5	Lateral wall melting zone	7,9	25	220	6,6	29	245
6	Back working zone	13,5	16	150	11,2	19	200
7	Crown working zone	16,8	61	275	13,22	44	270
8	Lateral feeder zone	4x1,7	55	290	3x1,6	55	295
9	Back feeder zone	4x6,2	20	151	3x5,62	18	194
10	Crown feeder zone	4x62	60	342	3x5,60	49	328
11	Passing tunel melting-working zone	1,2 lat 0,8 up,1,8 down	210	318	0,8 lat 0,7 up,1,44 down	186	296
12	Lateral walls regenerator	2x432	32	210	328,5	27	154
13	Crown regenerator	2x96	39	270	67,6	32	230

256

6 5. QUANTIFY THE PROCESS

1.Why quantify the process?

-Rule of 2M'S-"If you can't measure it,you can't manage it."
-Measure he "AS IS" process
-Measure the "TO BE" process

2.Ways to Quantify the Process

-A simplified energy process model
-Calculating specific energy consumption (SEC)
-Calculating theo. process energy efficiency (TPPE)
-A simplified energy process model for glass fabrication:
Existing=theoretical+unavoidable+avoidable
Input(1) required(2) waste(3) waste(4)
(1) Existing is actual usage of current process,KJ/kg(GJ/To)
(2) Theoretical is thermodinamic minimum with zero losses
(3) Unavoidable losses which require >= 2 year payback
(4) Avoidable are losses which require < 2 year payback
(2) and (3) : Oportunities for process energy reduction
(4) Opportunity for conventional energy conservation

SEC-Specific energy consumption calculation (actual)

$$Gj/To = \frac{(GJ/h\ Gaz)+(Kwh/h x 3,6*0.001)}{To/h\ glass\ melted}$$

A Jardstick of energy performance
Actual date

	Mo	Gaz/Mo Nm3x10^3	Gaz/Mo GJ	Kwh/Mo	To/Mo	Sec (AC) Gj/To	SEC(Theo) GJ/To
Furnace C-1	Nov.93	1108	39423	305136	4400	9,21	1,32
Furnace C-2	Nov.93	630	22415	186480	2150	10,74	1,98

$$SEC(Actual\ C-1) = \frac{39423+3,6*305,136}{4400} = 9,21\ GJ/To\ (2200Kcal/Kg)$$

$$C-2 = \frac{22*415+3,6*186,48}{2150} = 10,74\ GJ/To\ (2565Kcal/Kg)$$

SEC(Theoretical)

$$SEC(Theo) = \frac{Theo.gaz(GJ)+Theo\ Elec(3,6\ Mwh)}{Production\text{-}out}$$

Theo.heat Qn=Qto1+Qt02+Qev+Qtot+Qpd

Glass forming heat
Qt01=(qr+tq+to+qdi)*Gmp

qr=Reaction heat
qto=Dissolving heat
qdi Gmp=Dry quantity of row material,
In fonction of component of the row material
qr=101 Kcal/Kg
qto=59,14 Kcal/Kg
qdi=11,82 Kcal/Kg
Gmp=7000 Kg/h (C-1),3300 Kg/h (C-2)
C-1 Qto1=(101+59,14+11,82)*7000=1203720Kcal/h
C-2 Qto1=171,96*3300=567468 Kcal/h

Heat required for cullets melting

Qto2=qto*Gc
qto=59,14Kcal/Kg
C-1 Gc=0,35*6650=2328 Kg/h
C-2 Gc=0,30x2150=645 Kg/h
C-1 Qto2=59,14*2328=137678 Kcal/h
C-2 Qto2=59,14x645=38145 Kcal/h

Heat required for water vaporization from R.M.mixture

Qev=Ga*Ca
Ga=Kg/h water content from R.M.mixture C-1=25Kg/h C-2=22Kg/h
Ga=597 Kcal/Kg heat req. for vaporization of water
C-1 Qev=25*597=14925 Kcal/h
C-2 Qev=22*597=13134 Kcal/h

Heat existing in melted mass at exit of the furnace

Qto=Gto*Cto*tst
Gto=Melted quantity C-1=6650 kg/h,C-2=2150 kg/h
Gto=0,352 Kcal/Kg specific heat of the melted glass
tst=1105oC melted glass temp-at exit of the furnace
C-1 Qto=6650x0,352x1105=2586584 Kcal/h
C-2 Qto=2150x0,352x1105=836264 Kcal/h
Sensible heat of the degasing products in chemical reactions on exit of the furnace

Qpd=VpdxCpdxTtO
Vpd=GmpxV(CO2+SO2)

$$V(CO_2)=0,15\frac{22,41}{64}=0,0764 \text{ Nm3/kg*mixture}$$

$$V(SO_2)=0,005\frac{22,42}{64}=0,00175 \text{ Nm3/Kg*mixture}$$

C-1 Vpd=7000x(0,0764+0,00175)=547 Nm3/oC*h
C-2 Vpd=3300x0,07815=258 Nm3/oC*h
Cpd=0,494 Kcal/Nm3*oC
C-1 Qpd=547*0,494*1400oC=378305 Kcal/h
C-2 Qpd=258*0,494*1400oC=178432 Kcal/h
C-1 Qu=12032720+137678+14925+378305=1734628 Kcal/h
C-2 Qu=567468+38145+13134+178432=797179 Kcal/h

Theo. el energy 0,7. Eel.actual C-1 423,8 Kwh/h

256

C-2 259 Kwhr

C-1

SEC(Theo)=

$$\frac{1734*628Kcal/h*10^{-6}*4.188GJ/Kcal+3.6Gj/Mwh*10^{-3}*23,8Kwh/h}{6650*10^{-3}\ Kg/h}$$

$$\frac{7,25+1,525}{6,650}\ \frac{8,775}{6,650}=1,32\ GJ/To\ (315\ Kcal/Kg)$$

C-2

SEC(Theo)=

$$\frac{797179Kcal/h*10^{-6}*4.18GJ/Kcal+3,6GJ/Mwh*10^{-3}*259Kwh/h}{2150*10^{-3}\ Kg/h}$$

$$\frac{3,33+0,932}{2,15}\ \frac{4,262}{2,15}=1,98GJ/To\ (454\ Kcal/Kg)$$

Actual energy input C-1 9,21 GJ/To
C-2 10,74GJ/To

Theo. process energy efficiency=

C-1 $TPEE=\frac{SEC(Theo)\ 1,32}{SEC(Act)\ 9,21}*100=14,33\%$

C-2 $TPEE=\frac{1,98}{10,74}=18,43\%$

Combustion efficiency

$$C.E.=\frac{Qu-Qev}{Qinput}=$$

C-1 $CE=\frac{(1734628-14925)\ Kcal/h*10^{-6}*4,18GJ/Kcal}{54,754\ GJ/h}=$

$$=\frac{1,719703*4,18}{54,754}\ \frac{7,188*100}{54,754}=13,12\%$$

C-2 $CE=\frac{(797179-13134)*4,18}{31,13}\ \frac{3,277}{31,13}*100=10,52\%$

Primary fuel use (gaz) as conclusion is that specific consumptions and combustion efficiency must be improved.

Based on a structured group Brain-Storming for new ideas was concluded as follow for furnace C-1 and C-2:

BEST AVAILABLE COPY

259

STIROM Brainstorming Session #1

IDEAS TO SAVE ENERGY IN THE FURNACES

1. Add Blanket Insulation to Wall of Melter

2. Recover Waste Heat from Exhaust

   a.To Preheat Combustion Air
   b.To Preheat Cullet with SORG Technologies

3. Replace V-Belts on 55kW Motors with COG Belts (Dedusting)

4. Install 8-Point Controller for Temp. Measure/Control of glass furnace.

5. Use Blanket-Type Insulation to Crown of Furnace (280-350oC - 100 m^2)

6. Maximize Furnace Combustion Efficiency with Optimum Control of Excess Air (and Auto Trim)

7. Insulate Ends of C-2 U Flame Generator (120-230oC) 10*20'

8. Punch IR Pyrometers (-20 to 500oC and 400-1700oC)

9. Install New High Efficiency Burners on All Furnaces

10. Repair Furnace Envelope Uilize IR Pyrometer to Identify Hot Spots before Refractory Failure

11. Install VFD on Combustible Air Fan

12. Control Humidity (Moisture) in Raw material Feed (Charge) to 5% Specifications

13. Optimize Reversing Cycle of Regenerators (Time,etc.)

14. Maintain Constant % Cullet in Feed (Charge) from Prep. Station

15. Find Better Quality Refractory Material

16. Visit Tungstrum to See (First Hand) New Techologies in Refractory,Temperature Measurements,etc.

17. Computer Model to Simulate Glass Furnace Process

18. Adjust Feed Point independently to improve temperature and composition control

258

6.6 Non-Energy Issues:Constraints and Problems

-Lack of Testing Equipament
-Lack of Funding for imported items and refractory
-Production program don't allow adequate time for testing,but it will be in Line Factory has 105% Production Program

6.7 Weakness Analysis

It is necessary to have more testing and up to date information about glass process (ex. articles with thin walls fabrication and combustion equipament and new desing of the furnaces.

7.0 Development of recomandations for energy efficiency

Recommendations for energy efficiency improvements
RCG/Hagler,Bailly,Inc. and ARCON'S recomandations for energy management and efficiency improvement have been grouped in three categories:

A.General and energy management

These projects are opportunities which are recommended for immediat action,and require little or no expenditure.These projects affect management system and techniques,rather than process equipament.
These projects are primary focus of the USAID program for Romania.

Low-cost,short-term,efficiency improvements

These projects are low-cost improvements to process plant and equipament which are recommended for implementation in the short-term.Because of the low-cost and quick payback/less than one year) ,these projects could be implemented from the company's anual maitenance budget.
Some of these projects may be of interst to the USAID Program for Romania.
Some of these projects require significant funding,but are necessary to return the plant equipament to design conditions and may be more,payback being in one year or less.

Capital improvements

These projects are longer term projects,requiring significant capital investment.Such projects would require careful study,beyond the scope of this preliminary energy audit.These projects are also beiyond the scope of this preliminary energy audit.These projects are also beyond the scope of funding under the USAID-Emergency energy program for Romania.

259

A.General and ENERGY MANAGEMENT

STIROM Action A1 Put energy efficiency teams to reduce energy losses.

Existing conditions during the audit,the RCG/Hagler,Bailly and ARCON team observed some motors are underloaded.

Recommended action

RCG/Hagler,Bailly and ARCON recommends that STIROM form "Energy Efficiency Team" for electric motor.Personal for this team should become a continuous part of plant operations and maitenance.

The Electric Motors Efficiency Team would be responsable to survey electric motor load and efficiency,check and clean motors with excessive reactance and develop a plan for introduction of high efficiency motors.The team will have the following specific tasks:

-Based on nameplate and available meters make a complete inventory of all motors over 55 kW which identifies the motor number,rating (kW),location,age,voltage,rot/min,runing amperes,e-xpected annual energy consumption,description of use.

-Obtain curves of efficiency VS percentage load and power factors from STIROM major suppliers of motor families,of motors now installed in the Plant.

-Develop specifications for new procurement of new motors for the plant,for new applications.Optain manafucturers data on price,efficiency and power factor for alternative lines.In same cases high efficiency motors which reduce energy consumption by 3-10% for the same applications especially under 50 kW,since large motors are relatively efficient,but cost of this motors is about 50% higher.for over 4000h/yr running this type of motors can recover the cost in maximum one year or less.

-After carring out the analysis and developing the new high efficiency specifications for new motors consider the possible replacement of existing motors with high efficiency motors on a phased basis.One way to implement this policy would be to buy a quantity of high efficiency motors,instead of rewinding them.Often,rewound motors have lower efficiency than new motors,as the magnets can suffer reduced flux if they are overheated in the process.

Efficiency less can also result because rewinding is usually done to lower quality standarts than new manufacturing,so increased friction can result from slight misaligment.Finally,if wire of smaller diameter of higher resistivity is used in the rewingd job,resistivity lesses will increase.It is the RCG/Hagler,Bailly and ARCON team's experience that rewound motor has an efficiency 1-5% less than a new motor rewinding costs 50% or more of the cost of a new motor;

-With portable volt-ampermeter volt-ammerer,cosmeter,carry out an electric motor load survey.The load (kW,kVAR,CosO) voltage an each phase,and efficiency of all motors over about 10kW should be checked using a systematic procedure;

-Carry out power demand survey(kW,kVAR,meteres kW demand and kW/shift) for load centers and factory.Based on this data,develop a power demand balance for the plant,undervarious operating conditions;

-Based on result of power demand survey,with process personnel work to investigate ways to reschedule operations to

reduce peak demand and to shift consumption from peak to off-peak (mechanical work shop)

-If motors with excessive reactance are identified,they should be taken out of service for rewinding or replacement;

-Institute a monthly policy of motor maitenance check that bearings are getting proper lubrication.Electrical connections should be checked and tightened if necessary.The housing and ventilation air intake on all motors should be cleaned to improve cooling and efficiency.Dust and dirt from internal parts of the motors shall be blow out with compressed air (air should be dry and less than 4 bar pressure to avoid damaging insulation).

The motor and it's drive system should be checked for proper alignement,proper belt tension,and proper lubrication.Insulation should be testes with megohmmeter and a logbook should be kipt of these readings so that comparisons can be made from month-to-month.Check for excessive vibration.

-As underloaded motors are identified by the survey they should be changed for motors appropriately sized for the job.The inventory (developed above) should serve as the basis for moving motors from one location to another within the plant to match sizes to loads.If properly sized motors are available from spares or stocks,replacements of a given kW rating should prioritized on the basis of the possible efficiency improvement (degree of underloading and operating hours per year).

-If phase-to phase voltage unbalance is found (over 2%),then adjustement should be made to correct the problem.For every 2% variation in phase-to phase voltage,a motor losses about 1% inefficiency.For the 0.4 kV system,the phase voltages should be equal within ±5 Volts,otherwise efficiency is reduced.Voltage unbalanced can de caused by loose or corroded connections at bus bars,starters terminals,fuses.or the motor it self.If the problem is caused by single-phase loads which are attached one of the phases,these loads should be more equally distributed among the phases,or else the transformer should be retapped.

-STIROM can utilize COG Belts on drivers with V-Belts due to double life,1,5% savings.

261

List of V-Belts motor drivers

Dimension (mm)	Kw/Motor	No Motor	No Belt Drive	Total Belts	USD Unit	Cost USD	Total Kwh/h
610x10x6	0,75	30	1	30	7	210	22,5
1300x13x8	3	4	2	8	7	56	12
2000x17x11	4	5	3	15	10	150	20
1400x13x8	5,5	2	3	6	7	42	11
1900x17x11	5,5	4	3	12	70	84	22
4500x22x13	18,5	1	5	5	30	150	18,5
1800x17x11	7,5	5	3	15	7	105	37,5
1900x17x11	7,5	2	3	6	10	60	15
1900x17x11	7,5	1	6	6	10	60	7,5
3000x17x11	55	4	5	20	30	600	220
				123		1517	386 k=0,7
Savings:49652 Kwh/jr							

-STIROM shall replace all 6 KV cables on main feeders.They are out of life duration (25 years and can cause major break downs.

-For Power factor (cos fi) ARCON recommends to provide new capcitors battery and MCC-s with cos fi automatic compensation.

-To put in commisioning the Sincronous Motor 300 KW,6 KV as compensation Motor.Now is idling due to defective 6 BAR Air Compressor.

-To provide load disconnectors on Machines from Mechanical Workshop.

-To provide 6 KV capacitors on each 6 KV Air Compressors (1000-1500 KW Each) connected just an 6 KV Motor Terminals to compensate cos fi up to 0,95 maximum.

-STIROM shall look to provide two speed motors on Cooling Tower Fans (changing of number of poles/phase available in Romania).

<u>Expected results</u>

ARCON and RCG/Hagler,Bailly team estimates that the potential savings of an improved maitenance program based on these procedures is cca 3% of plant's electric energy consumption excluding for Compressed Air (See action A2)

(1-0,715)x47925000 Kwh/Jrx0,03=407363 Kwh/Jr
407363 Kwh/Jr*0,05 USD/Kwh=20,368 USD

Total energy savings:407363Mwh*3,6*10^-3*Ty/Mwh=1,466 TJ/Jr

262

The maitenance programe will increase motor life,there by reducing replacement and rewinding costs over the long run.The maitenance and monitoring program will also reduce the frequency of shutdowns in production operations because of motor failures,therby having a productivity benefit.

Equipament required:

(123) COG belts 123 Pc out of which from USAID-20 Belts (See action A1.1 List 1 pos 4).
(1) Digital strobe tachometers -STIROM (existing)
(1) Digital multimeter/megohmeter with current clamp and power factor meter-STIROM
(4) Infrared thermal imager (USAID-List 1 pos2 (Action A3.1)
(1) Ultrasonic motor bearing tester (USAID List1,pos 5,Action A2.1)
Total STIROM Cost:1517 USD
Total USAID Cost:600 USD

ARCON estimates that STIROM should budget aproximately 30000 USD/Jr for additional incindental equipament and repairs (aditional maitenance) such as new motors,bearing,insulation B for motors,grease,new 6 KV cables and new circuit breakers.

financial analysis

Based on cost of 1517 USD and a net savings of 20.368 USD,the project payback period is aprox. 0,07 Jr (1 Mont).

A.General and Energy Management

STIROM-Action A2

Reduce compressed air losses

Existing conditions

The Plant has a large compressed air house composed from:

(1) Compressor CENTAC (ING.RAND) 3,5 Bar,Pd=1500 Kw
W=1000 kWh/h 15000 Nm^3/h

(1) Compressor ALCATEL 2/3 Bar,Pd=1000 kW,W=900 kWh/h,12000 Nm^3/h

(1) Compressor ALCATEL 1/3 Bar.Pd=1100 kW,W=650 kWh/h,8000 Nm^3/h

(1) Compressor 4V45 6 Bar,Pd= 300 kW,W=220 Kwh/h, 2700 Nm^3/h

Total production:37700 Nm^3/h,W=2770 kWh/h+Utility consumption 294 kWh/h (10,6%) total W=3964 kWh/h

Total 8700h/jx 37700 Nm^3=10^6*328 Nm^3/Jr
8700h/jx 3964 kWh/h=34487 MWh/Jr (71,9%)

$$\text{Specific consumption}=\frac{W}{Q}=\frac{34487000}{328000000}=0,105\ \text{kWh/Nm}^3$$

263

Cost of 1000Nm^3/h=0,105 kWh/Nm^3*0,05 USD/10^3 kWh=5,25 USD/1000Nm^3 (87 lei/Nm^3)

I.S. Machines NORMAL CONSUMPTIONS C.AIR Table A2

Furnace	IS NORM	IS ACTUAL	ISMachine		Total Nm^3/h	
C1	1020	1944	1/1	dp	6044	New
		1300	1/2	sp		
		1300	1/3	sp		New
	1104	1500	1/4	dp		
C2		1944	2/1	dp	5832	
		1944	2/2	dp		
		1944	2/3	dp		
C3		1944	3/1	dp	6488	
		1300	3/2	sp		
		1300	3/3	sp		
		1944	3/4	dp		
C4	942	1944	4/1	dp	7232	
	942	1944	4/2	dp		
	942	1944	4/3	dp		
	942	1400	4/4	dp		New
C5		1360	5/1		2720	
		1360	5/2			
C6	1250	1200	6/1		4100	
	1200	1400	6/2			
	1250	1500	6/3			Actual

dp-20896 Nm^3/h
sp-12020 Nm^3/h

Total 32916 Nm^3/h

5. Carry out a survey of the Plant every month to identify compressed air leaks using a Ultra Probe 2000,220 V with accesories and/or Ultrasonic Leak Detector for C.A (eg. ULD-100). All data record them in a logbook.Measure the flow of Leaks using a velometer etc and prepare a report with the monthly cost of each Leak clearly indicated.Develop a plan for Leak repair,based on priority.

6. Reduce as much is permissible,Compressors pressure.

7. Reduce air Compressed pressure dropp on headers

8. Disconnect all idle pipes and consumers

9. Provide air traps and dryers first of all an instrumentation air

10. Replace al old S.I. Machines and make on procedure for repairing of pistons (cylinders) with clear tollerances and quantity of Leaks allowed,compared with new machines

11. Reduce as much is possible A.C. consumption and usage in process

12. Provide compressed Air Control System to maximize efficiency of Ingelsoll Rand Units and to minimize venting.Minimize Blow-Off on centrifugals

13. Replace Resita compressor with a new compressor with automatic start-stop and most energy efficiency option.

14. Evaluate central versur Descentralized System

15. Optimize Units sizing to facility needs

16. Ade quately size Compressed Air Surge Tank

<u>Expected results-effect of recommandation</u>

ARCON and RCG/Hagler,Bailly team estimated that the potential savings of an improved maitenance program based on the procedures is 35% of energy consumption for fabrication of Compressed Air or 2,53% out of total energy consumption (3,48% out of C.Air. production-11.428571 Nm^3/Jr)

<u>Savings</u>

El.energy 0,023x47925 Mwh/Jr=1212 Mwh/Jr
1212x0,05*10^3=60.600 USD/Jr

Total Energy Savings:
1212 mWh/Jr*3,6 GJ/MWh*10^-3=4,36 TJ

<u>Equipament required</u>

List 1,pos 5 (1) Ultrasonic LEAK DETECTOR FOR COMPRESSED AIR
USAID EQUIVALENT TO MODEL ULD-100
COST:500 USD,SAV:1000 USD,PB:6 Mo

265

List 1,pos 6 (1) USAID	Anubar FOR COMPRESSED AIR FLOW 3,5 BAR fi 600 mm,MAX 30.000 Nm^3/h Flow Cost:1900 USD,SAV:2000 USD,PB:2,95 Jr
List 2,pos 5 (1) USAID	ULTRA PROBE 2000.220 V.with accesories Cost:4000 USD,SAV:4000 USD,PB:12
List 2,pos 6A(1)	ANUBAR FLOW METER FOR COMPRESSED AIR 2,5 BAR, 500 mm fi.MAX FLOW 25.000 Nm^3/h Cost:1800 USD SAV:1800 USD,PB=12 Mo
List 2,pos 6B(1)	ANNUBAR FLOW METER FOR COMPRESSED AIR 6 BAR, 200 mm fi,MAX.FLOW.3600 Nm^3/h COST:1800 USD.SAV:1800 USD.PB:12 Mo

Pos. 6A and 6B:INCLUDING INDICATORS IN Nm^3/h FOR EACH

List 2,Pos.8.	COMPRESSED AIR CONTROL SYSTEM TO MAXIMIZE EFFICIENCY OF INGELSON RAND UNITS AND TO MINIMIZE VENTING Cost:50.000 USD,SAV 50.000 USD PB:12 Mo Total cost:60000 USD,SAVINGS:60600 USD

<u>FINANCIAL ANALYSYS</u>

Based on COST of 60.000,and a net savings of 60.600 USD,the project payback period is aprox. 12 Mo

For LISTA USAID See Action A2.1 and List 2,USAID action A2.2

A.General and Energy Management

STIROM-Action A3

Reduce heat losses on gaz fired furnaces and heat treatment owens

Existing Conditions:

Substantial heat is radiated in a wide range of heating and gaz,fired equipament throughout STIROM facility.This equipament ranges from refractory lined glass furnaces as regenerator,melting tank,bath working tank,feeder,I.S. Machines and heat treatment owens.

While maitenance on insulation on refractories is routinely performed generally during shutdowns for capital repairing,STIROM does not currently have a good practice of monitoring all this equipaments for heat leaks and hot spots due to wear or deterioration of the insulation refractory.

Recommended action:

The ARCON and RCG/Hagler,Bailly team recommends that STIROM adopt a new procedure for monitoring the condition of insulation on refractories,based on temperature readings from an infrared noncontact thermal imager -45oC to 550oC and one I.R.PYROMETER 400 to 3000oC.This devices can locate hot spots and damaged refractory of the furnace anvelop so that repairs can be performed during scheduled maitenance shutdowns or by incidental repairing having a SUIT FOR HOT WORK.

I.R.devices should be used in conjunction with a logbook drawn up for this purpose.The log should contain a complete inventory of thermal equipament to require the operators of the termal imager to enter readings for each equipament.A repair order should be prepared for each place identified.

Based on reading taken on furnace C-2 and C-1 we come to the conclusion that providing a Insulation Blanket for Crown of Glass Furnace C-1 and C-2 etc. we can save a lot of energy due to decreasing temperature on exterior side from 300-350oC to refractory < 100oC (Avg.60oC) dT=290oC S=1400m^2/C-1 and 720 m^2/C-2=2120 m^2)

ARCON finded insulation ceramic wool plates which are under testing.The caracteristics are:ceramic fibre rezistant to 900oC type I32A-900P,conductivity at 400oC,Uo=0,063 W/m.k,250 kg/m^3,Procema.STIROM will provide 30-60 mm and will pursuit refractory temperature.

Calculation of energy savings at 30 mm thickness

$$Q=Uo*A*dt=\frac{1}{R}*A*dt \qquad R=\frac{d}{Uo}=\frac{0,03\ m}{0,063\ W/mk}=0,5\frac{m^2*k}{W}$$

A=2120 m^2
dt=290oC
d=0,03 m,Uo=0,063 W/m.k

$$Q=\frac{2120\ m^2*290oC}{0,5\ k*m^2/W}=1229600\ W=1,2296\ MWh/h$$

267

Total heat required by system is 5,5 Gcal/h out of which 4 Gcal/h from heat recovered system and 1,5 Gcal/h from RADET city grid.

Recuperators of the flue gaz heat to stack are:

R1=1,3 Gcal/h
R2=0,5 Gcal/h
R3=1,3 Gcal/h
R4=0,4 Gcal/h
R5=0,5 Gcal/h

Total=4 Gcal/h

In fig 4.4.4 is shown one-line diagram for hot-water and heat recovery system at STIROM.

Hot-watefor building heating (6 Mo) is prepared from 5 recuperators and domestic H-W by two heat exchangers with a separate circuit.

Plant has big capacity for heat-recovery from flue gaz to the stacks but there is not available consumer.Recuperators are heavy corodet.

Recommended action

-Recuperators design is necessary to be improved with materials more corosion rezistant.
-Taking in consideration capacity of heat recovery system it is necessary to reduce importing from RADET outside system up to 50% (0,75 Gcal/h)
-During winter it is necessary to pursuit room temperature not to exceed 20-22%
-Provide heat flow-meter on RADET pipe and on heat recovery main pipe
-Check all building heat installation and implement a temperature controll system

Heat saving:0,75 Gcal/h * 4,186 GJ/Gcal = 3,14 GJ/h
3,14 GJ/h * 5000 h/Jr=15700 Gj/J

Cost:3,97 USD/GJ * 15700 Gcal/Jr=62329 USD/Jr

Investment cost for 3 pcs. of heat ultrasonic flow-meters and P.I. is 13.000 USD

Financial analysys

Based on a cost of 13.000 USD and a saving of 62329 USD,the payback period is 2,5 Mo

268

B.Low-cost,short term efficiency improvements

STIROM action B2

Improve combustion efficiency at gaz fired furnaces existing conditions

STIROM has 10 gaz fired furnaces.As per prezent job,furnace C-1 and C-2 is our scop of Wark.

The characteristics of furnace C-1 and C-2 are shown in table 5.4 (Data collection) and some consideration about system performance are computed on cop.6.5.

The furnace C-1 is the biggest furnace from STIROM.

The furnace C-1 and C-2 are 27 years old design and years 1980 were up to date technic but at the moment needs modernization.

Row material is prepared by an automatic station.Glass melting process is fully automatized but without PC in line computer.combustion air is ensured by F.D.Fan.Combustion ration,air/gaz is automatized,including all temperature controll flow,etc. by analog Controllers.Combustion air is prehited in a regenerator U flame regenerator (120-230oC) on C-1 with a reversing cycle time routinely set at 20 minut regardeless of furnace size,regeneration performance.furnace charge.furnace age,etc.Burners are very old at C-1 (16 burners) and 6 burners new one at C-2 under trial.

Refractory on C-2 is rebuilded in 1994 and at C-1 is 4 years old and is planed to be rebuild on 1995.

Humidity control in Row material feed charge which suppose to be 5% as per specification is poor cullets are not preheated before metilizing in feed charge.

Exterior refractory temperature on Regenerator and Melting tank is to high-avg 300oC.

The temperatures outside of the furnace anvelop.inside the furnace,on outgoing to I.S Machines are measured by surface termocouple thermometer glass gobs temperature is measured poor.

I.S.Machines for finished products (botles,glasses etc.) on C-1.two are new and two 27 years old.on C-2 three I.S. Machines old type.The old I.S.Machines are high compressed air consumers and low productivity.The new I.S.Machines on C-1 are VFD (Variable Frequency Drive) low C.air consumer and higher productivity.The old I.S.Machines ar mechanical speed drive type.

Combustion O2,CO2 and CO content was checked by Orsat and now by a new gaz analyzer up to date technic.Combustion efficiency on C-1 is CE=13,12% and on C-2 CE=10,52%.The process energy efficiency on C-1 is TPEE=14,33% and on C-2 TPEE=18,43% (See 6.5).

Specific energy consumption actual

C-1 SEC=9,2 GJ/To
C-2 SEC=10,74 GJ/To

Recommended actions

1.Recover wasted heat from exhaust

a)Preheat combustion air

Furnace C-2

Burners:3x200 Nm^3/h (working)
Gaz consumption:680 m^3 (Melting)
Working pressure of Air to Burners:200 mm W.C
Primery burning air flow:700 Nm^3/h
Burners cooling air flow:350 Nm^3/h
Air temperature :200-300oC
Total air flow :3x350=1050 Nm^3/h (minimum)
at 200 mm W.C
Fan Flow :1500 Nm^3/h
Temperature of FAN :350oC (max)
Fan pressure :110+200+40=350 mm W.C

Recovered heat (savings)=Q=m*Cp*dt

m=1050 Nm^3/h
Cp=1,2776 KJ/m^3*oC
dt=300-40=260oC
Q=1050* 8700 h/Jr * 1,2776 * 10^-6 * 260 = 3034 GJ/Jr;
3034 GJ/Jr * 2,51 USD/Gj=7616 USD/Jr

Furnace C-1

Burners 8 x 200 Nm^3/h (working)
Gaz consumption:1350 Nm^3/h
Primary burning air flow:1600 Nm^3/h
Burners cooling air Flow:800 Nm^3/h
Air temperature:200-300oC
Total air flow:8x800=6400 Nm^3/h
Fan Flow:1700 Nm^3/h
Fan Temp:350oC
Fan pressure:350 mm W.C.
Recovered heat
Q=6400 Nm^3/h * 8700 h/Jr * 1,2776 KJ/m^3oC * 10^-6*260oC=
=18496 GJ/Jr

Savings:2,51 USD/GJ * 18496 GJ/Jr;54041 USD/Jr

Total savings C-1 + C-2 : 21530 GJ/Jr;54.041 USD/Jr

Cost:6000 USD for installing of a new FAN and ducting

b).Preheat cullets with waste gaze

C-1 35% * 6,65 To/h = 2,32 To/h * 8700 h/Jr = 20249 To/Jr
C-1 30% * 2,15 To/h = 0,645 To/h * 8750 h/Jr = 5611 To/Jr

TOTAL 25860 To/Jr

Q = m * Cp * dt
m = 25 * 860 To/Jr
Cp=1,21 KJ/Kg*oC
Gaz Ti=400oC
Te=200oC
Cullets:
ti=20oC
te=300oC
dt = 280oC
Q=10^3*25860 To/Jr*1,21 KJ/kgoC*10^-6*280oC=8761 GJ/Jr
Savings:2,51 USD/GJ * 7961 GJ/Jr=22492 USD/Jr
Cost:20.000 USD (SORG Cullet Preheater or similar)

270

2.Install New high efficiency burners on all furnaces

Taking STIROM'S testings and burner's supplier quaranty by installing new high efficiency burners production of furnaces can be increased at least 15%.

For Furnace C-1 and C-2 efficiency can be:

Production C-1 = 6,65 To/h*8700 h/j = 57855 To/Jr
C-2 = 2,15 To/h*8700 h/j = 18705 To/Jr

TOTAL 2923200 Nm^3/Jr

2923299 Nm^3/Jr * 35.58 GJ/1000 Nm^3 = 104007 GJ/Jr
2,51 USD/GJ * 104.007 = 261058 USD/Jr
INV.COST : 67.000 USD,USAID LIST 2,Pos.1.
PROVIDING OF NEW BURNERS IS CONNECTED WITH REDISIGNING OF FURNACE MELTING TANK (BATH).

3.OPTIMIZE COMBUSTION EFFICIENCY

Testings with gaz analyser were done at furnace C-1 and C-2.
The results are : 6,9% O2 and 7,6 CO2,750oC STAK flue gaz temperature (1382oF).
Savings from fig B2.Natural gaz savings available by reducing oxygen to optimum 2% O2 are 11,5%

C-1 1440 Nm^3/h * 8760 h/Jr * 0,115 = 1450656 Nm^3/Jr
C-2 800 Nm^3/h * 8760 h/Jr * 0,115 = 805920 Nm^3/Jr

TOTAL 2.256.576 Nm^3/h

Savings:2256576 Nm^3/h * 35,58 GJ/1000 Nm^3 = 80289 GJ/Jr
2,51 USD/GJ * 80289 GJ/Jr = 201,525 USD/Jr

ARCON AND RCG/HAGLER TEAMS RECCOMENDS:

-To optimize combustion on all furnaces of the STIROM PLANT

-To provide 8-Point Digital controllers for Flow/Temp and with optimum controll of excess air including PC computer specialized with soft for maximizing of furnace combustion and process efficiency.

-Add blanket insulation to Wall of Melter and to crown of furnace.

-Insulate Ends of C-2 U Flame regenerator 3*6 m

-Use daily I.R. Pyrometer for controlling of anvelop temperature and globs and process temperatures

-Controll Humidity (Moisture) in row material feed (charge) to 5% specification.

-Find better quality refractory material

-To implement computer model to simulate the glass furnace process

-Adjust feed point independently to improve temperature and composition control

271

Action B2 SUM-UP

	Savings		Financial cost USD under USAID INCI-DENCE	Remarks
	Energy Gj/Jr	Cost USD		
1.Recover waste heat from exhaust				
1a,ab.Preheat combustion air preheat cullets with waste gaz	21530 8761	54041 22492	6000* 20000*	*New FAN+ducting *Sorg cullet preheat
2.Install new high efficiency burners in all furnaces	104.007	261058	67000*	C-1+C-2 *16 New burners USAID List 2, pos1
3.Optimize combustion efficiency	80289	201525	14.000*	*Digital controllers+PC in line USAID,List2,Pos2
4.Optimize reversing cycle of regenerator	6934	17.400	2000*	Multicalibrator USAID,List1,Pos1
5.Install V.F.D on F.D.Fan C-1, C-2	720 (200MWh)	10.000	10.000	VFD on FDFAN C-1 and C-2 USAID, List 2,Pos 4
TOTAL	222241	566516	119.000	PB=2,5 Mo

ARCON and RCG/Hagler,Bailly estimates an additional maintenance budget for refractory work at C-1 64 To*5500 USD/To=352.000 USD and 18.000 USD for retrofit of installations.

Equipament required for action B2

USAID LIST No1

Pos.1 (1) Universal digital measurement kit with generator for unified signal in mA,mV,OHM with high ACC.For checking process loop signals on glass furnace similar to Supercall II multifunctional calibrator as per Davis Instruments MD 21215
Calibrator as per Davis Instruments MD 21215
Catalog No-RS 140101 Model CL 4500
Cost:2000 USD Savings:2000 USD (See action B2.1)

USAID-List No2

Pos.1.(16)High efficiency burners for glass furnace C-1 equivalent to korting,gaz 1500 Nm^3/h,LHV=8500 Kcal/Nm^3 to obtain 1580oC in furnace with complete

272

combustion to obtain at least 180 To/day production.
Cost:67.000 USD,Savings:100.000 USD

Pos.2.(1) Digital controller for min. 8 channels to provide continuous pid with 4-20 mA input/output capable to communicate with RS 232oC computer including computer 486 microprocessor,33 Mhz with 4MB RAM and 170MB hard drive to include 2 floppy drives (3,5 and 5,25") an SVGA monitor.
COST:14.000 USD,SAVINGS:14.000 USD

Pos.4 (2) Variable frequency drives:a)22 kW F.D.FAN on C-1 50Hz,1500 RPM,1/5 ratio
COST:4000 USD,SAVINGS:4000 USD

TOTAL COST:92.000 USD,SAVINGS:126.000 USD

Financial analysys:

Based on a costof 93.000 USD and a net savings of 126.000 USD,the payback is 0,75Jr (9 Mo).

8.0 Implementation plan

8.1 Responsability for Results

8.11 STIROM is responsable to implement all actions to put in work all USAID equipament imediatelly after receiving and to organise the Energy Management as proposed further

213

THE ENERGY MANAGEMENT APPROACH

Top management commitment

The decision of company management to control energy costs is a vital first step.This must be clearly started and understood by all within the company.Senior management should participate in energy committee meetings or in other energy related activities.The company managing director has Energy Manager reporting directly to him,particularly at the beginning of the energy management programme.

It is often useful for the company to publish a formal statement of it's energy policy.This can be used to define company activities in energy matters for it's employees and it can inform the general public about the company commitment to energy efficiency.

Finally,an important part of top management commitment is to appoint STIROM for implementing the energy management programme.This is commonly at two levels,the Energy Manager and the Energy Comittee,and these are discussed further below.Evidence of top management commitment will be seen in the level of support given to the Manager and the Committee,especially the resources authorised.

The Energy Committee

Because energy concerns different departaments within STIROM,an effective energy management programme must involve a number of people.In many companies,a committee is formaed to include representatives of important departaments.While unnecessary bureaucracy must be avoided,there are advantages to having an active **Energy Committee:**

* it can encourage communications and the sharing of ideas amongst various departaments (and even other plants) throughout the company

* it can serve to obtain agreements on energy conservation projects which affect more then one departament

* it can provide a stronger voice to top management than a single manager normally could

The Energy Comittee will have specialists for electrical,glass furnaces,natural gaz,row-material,compressed air,heating,water and mechanical.

When should the Commitee met? This will depend on the importance of energy costs in the overall cost structure of the company and what projects are in progress at any time.Normally a monthly meeting is usual,so that monthly production and energy consumptions may be reviewed regularly by the Committee.This review would include a comparasion of actual performance against previously set targets and budget figures,as well as against previous months.Other items for the agenda should be a review of the status of energy conservation investments,in progress or planned.

as consultants or equipament vendors to assist problem solving

* proper perspective of the role played by energy in the company,in relation to other elements such as raw materials,capital and labour
* ability to use initiative to develop solutions to problems,and to relate his plant problems to those encountered by others elsewhere or in different industries and to adapt solutions to his different industries and to adapt solutions to his own circumstances

Above all,the Energy Manager needs an open mind to view problems from different perspectives and the skill to convince others that savings are both possible and worthwhile if the right measures are taken

Performance Evaluation

Evaluation of plant performance is best done by regularly comparing the actual levels of energy consumption with the expexted consumtion,as defined by standards that draw on past performance.Differences between actual energy use and the standarts will reveal either improvements in energy use and the standards will reveal either improvements in energy efficiency or a deterioration in performance.This eveluation of performance should be done regularly,say monthly.

In this way,the information produced by monitoring forms a basis for continuous performance evaluation and control.First,it will indicate if and where failures have occured and trigger the necessary remedial action.Second,it will provide quantified evidence of exactly how succesful any energy conservation measures have been.

Of course,to allow valid compararions to be made,data should be "normalize" to take account of changes in product quality or other characteristic,of climate changes,of raw material changes,etc.When the E-P (Energy Production) graphs are being drawn,it is important to mark each point with the date:in this way,it is often possible to see seasonal patterns in this data.If the appropiate climate data are available,it should be possible to "remove" the effects of space heating or cooling and continue with the data analysis on the process data alone.

Above all,it is important that performance evaluations be carried out promptly at the end of each month.A review of plant performance is a useful task for the plant Energy Comittee,as the Committee provides an exchellent chanel of communication for the findingsof the review and can ensure that all concerned take need action.The Energy Manager should develop clear and concise reporting formats for the Committee,suitable for wide distribution within the plant (both succeses and failures can proide motivation for the workforce).If the analysis is left for too long,it becomes much more difficult to account for any discrepancies that are observed,and of course it is always desirable that corrective measures be taken as soon as possible.

Monitoring and Targetting

"M & T" is a management approach that enables firms to

manage energy as a controllable resource in the same way as they manage other resources such as raw materials and manpower.M and T helps companies eliminate waste and reduce their current use of energy by providing timely and relevant information.It also provides the incentive for further improvement by giving concrete evidence of succesful energy conservation activities,from which the economic benefits of energy management become evident.

Central to the success of M and T is the establishment of "energy accountable centres" for which targets can set.A centre might consist of an individual machine,a process department or even the entire Plant.Recording and reporting procedures for the centres should be set up the appropriate levels in the company to allow regular control by line supervisors and control at less frequent intervals by senior management.

At STIROM each centre is corresponding to a nominated individual responsible for operational achievements in that area.Tying resource consumption to those responsible for operational achievement is a key factor in the M and T system since it focusses atention to those responsible for operational acchievements in that area.Tying resource consumption to those responsible for operational achievement is a key factor in the M and T system since it foccuses attention on those with authority to effect improvements in performance.It is also essential that those held accountable for energy performance should be able to asses that performance should be able to asses that performance and have the pertinent information on which to base judgements,decisions and actions to bring about improvements.

The targets set by a plant can relate to the whole firm or to a specific energy cost centre,or even to a particular machine.Targets may be set using a detailed engineering analysis of operations,or can be developed using historical data such as that described earlier in this section.Graphs of E-P and SEC-P will reveal the occasions when energy efficiency are particularly high,and thus it would be resonable to set historical performance (or somenting close to that) as a challenging but attainable target.

To maitain the momentum of M and T programmes may be difficult.It is important for a firm to carry out a periodic evaluation of the operation of the system,to determine if targets are being achieved or not,to mesure the relative success of the techiques used to reach the targets,and to identify opportunities for further progress.

To maintain interest,it is ussualy worthwhile to offer energy-related training to plant personnel necessary to operate the plant efficiently.

8.12 ARCON is responsable for Energy Audit Report,Actions proposed for Energy Savings,List 1 of equipament ensured by USAQID free of cost and List 2 of Equipament proposed to be approved by RCH/H-B and USAID if additional USAID fundint will be available to pursuit implementation of audit plan.

Note:all taxes (custom,TVA,accize,transportation) and installing and commisioning cost-<u>is responsability of STIROM.</u>

8.13 RCH/Hagler,Bailly will approve Energy Audit Report,List 1

STIROM, BUCHAREST

APPENDICES:

1. 30 Guidelines for designing and operating compressed air systems.
2. Figure- Natural gas savings available by reducing Oxygen to optimum(assumed 2%)
3. Effect of Flue Gas composition and temperature on BOILER efficiency
4. Blanket specification fo Reducing of heat losses on furnaces C-1 and C-2(WALTER SMITHS FAX)
5. Ceramic fibre plates for blanketing of walls of furnace C-1 and C-2, supplyier PROCEMA Bucharest.
6. Specification for redesigning of glass melting furnace C-1 at STIROM Plant.
7. LIST NO 1 of Equipment for STIROM .
8. LIST NO 2 of Equipment for STIROM.
9. LIST NO1 approved by STIROM Management.
10. Readings from electrical system.

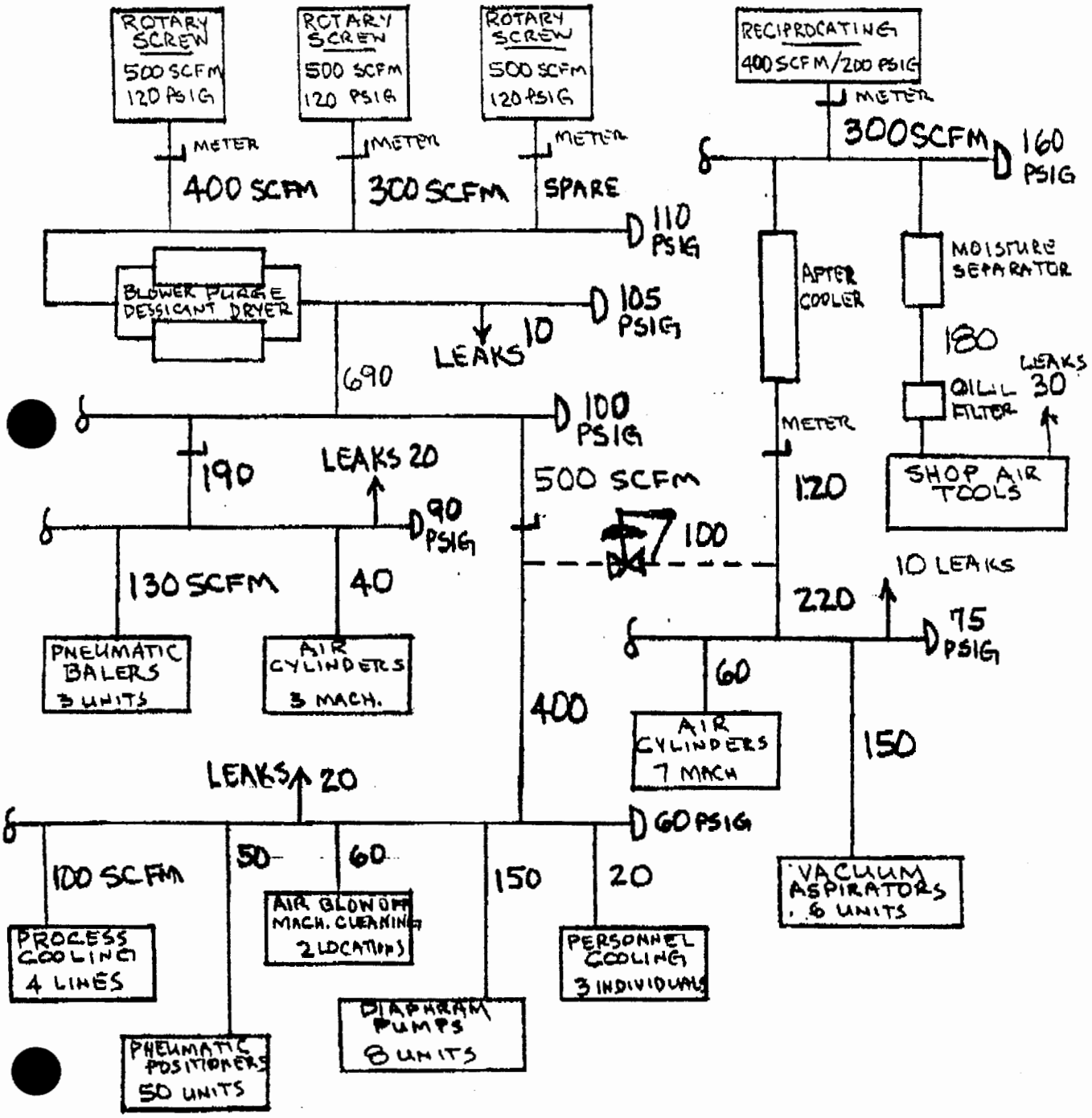
SINGLE LINE COMPRESSED AIR BALANCE

- SHOWS COMPLETE SYSTEM
  - GENERATION ... INDIVIDUAL UNITS
  - DISTRIBUTION ... PRESSURE LEVEL
  - USERS ... INDIVIDUAL LOADS
- INDICATES FLOW RATES
  - SCFM (14.696 PSIA, 60°F)
  - ACTUAL FLOWS NOT DESIGN
  - ANNUAL OR MONTHLY AVERAGE
- ACCOUNTS FOR 100% GENERATED
  - TOTAL GENERATED
  - LOSSES AT COMPRESSOR (BLOW-OFF)
  - LEAKS IN DISTRIBUTION
  - CONSUMPTION AT LOADS
  - LOSSES, LEAKS AT LOADS
- INDICATES TYPE OF USER
  - CONTINUOUS (100% USE FACTOR)
  - INTERMITTENT (<100% USE FACTOR)
  - BATCH, REPETITIVE (<100 USE FACTOR)
- USE SINGLE LINE C.A. BALANCE TO:
  - IDENTIFY INEFFICIENCIES
  - QUESTION OPERATING PRACTICES
  - CHALLENGE PROCESS USE/USERS

WPS/8-91

ONE-LINE COMPRESSED AIR BALANCE

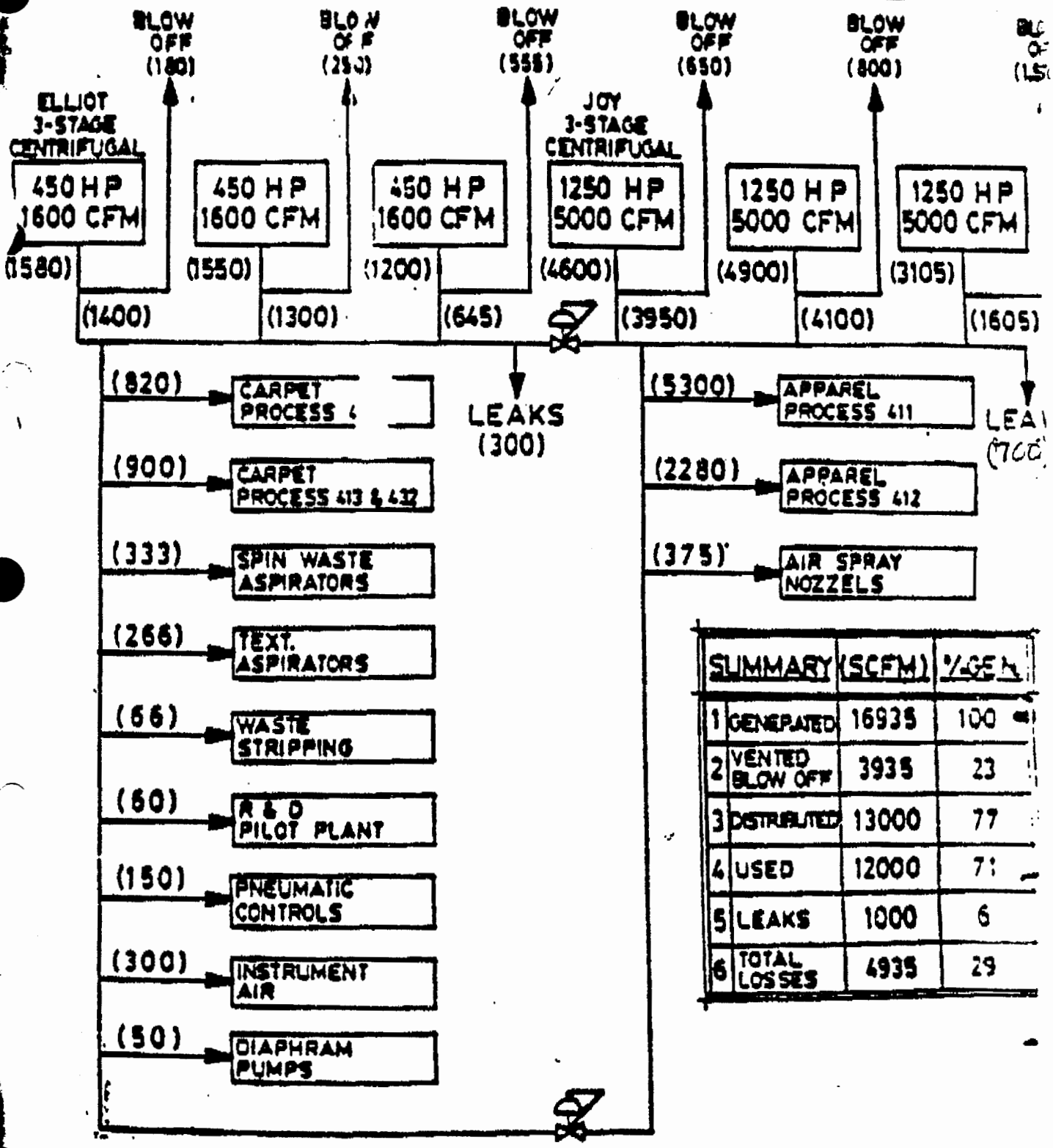
- WHERE DOES IT COME FROM?
- HOW DOES IT GET THERE?
- WHO USES IT AND HOW?



WPSmith /9-91

SINGLE LINE UTILITY DIAGRAM

ONE-LINE COMPRESSED AIR SYSTEM (S.C.F.M.)



SUMMARY		(SCFM)	%GEN
1	GENERATED	16935	100
2	VENTED BLOW OFF	3935	23
3	DISTRIBUTED	13000	77
4	USED	12000	71
5	LEAKS	1000	6
6	TOTAL LOSSES	4935	29

280

GUIDELINES FOR DESIGNING & OPERATING COMPRESSED AIR SYSTEMS

III. OPERATING CONDITIONS/PRACTICES

18. TIE MULTIPLE PRESSURE SYSTEMS TOGETHER

19. BALANCE OUTPUT OF MULTIPLE UNITS

20. MONITOR AND ALARM FOR PERFORMANCE AND RELIABILITY

21. OPERATE AT LOWEST ACCEPTABLE DISCHARGE PRESSURE

22. FLOAT OUTPUT PRESSURE TO SATISFY HIGHEST PRESSURE USER

23. RUN AS FEW UNITS AS POSSIBLE

24. MINIMIZE VENTING (BLOW-OFF) ON CENTRIFUGALS

GUIDELINES FOR DESIGNING & OPERATING COMPRESSED AIR SYSTEMS

III. OPERATING CONDITIONS/PRACTICES -- CONT.

25. OPERATE WITH CLEAN INLET FILTERS
26. PROVIDE LOWER TEMPERATURE INTERCOOLER WATER
27. USE SPECIALIZED SOFTWARE AND CONTROL SYSTEMS
28. CONSIDER USE OF SYNTHETIC LUBRICATION OIL
29. MAINTAIN CONDENSATE TRAP SYSTEMS
30. MAINTAIN OIL SEPARATOR SYSTEMS

TEN MOST PRODUCTIVE ENERGY AUDIT QUESTIONS

COMPRESSED AIR (C.A.) SYSTEMS

1. IS THERE A FORMAL C.A. CONSERVATION PROGRAM WITH WELL-DEFINED OBJECTIVES, GOALS, AND PLANS?

2. WHAT IS THE ANNUAL OPERATING COSTS OF THE C.A. SYSTEM (VARIABLE AND FIXED, AVERAGE AND INCREMENTAL)?

3. WHAT IS THE TOTAL ECONOMIC IMPACT (T.E.I.) OF THE C.A. SYSTEM PERFORMANCE ON THE SITE'S PERFORMANCE?

4. HAS A DETAILED, SITE-WIDE COMPRESSED AIR AUDIT BEEN DONE WITHIN THE LAST THREE YEARS?

5. HOW MUCH COMPRESSED IS PRODUCED? WHERE DOES IT ALL GO? HOW DOES IT GET THERE? IS THERE AN UP-TO-DATE "ONE-LINE COMPRESSED AIR BALANCE" SHOWING SCFM (OR M^3/HR) FROM ALL COMPRESSORS, THROUGH THE DISTRIBUTION SYSTEM TO ALL MAJOR END USERS?

6. WHAT IS THE SPECIFIC EFFICIENCY (M^3/KWH OR BHP/100 CFM) OF EACH MAJOR AIR COMPRESSOR?

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TEN MOST PRODUCTIVE ENERGY AUDIT QUESTIONS

COMPRESSED AIR (C.A.) SYSTEMS (CONT.)

7. WHAT CONTROL STRATEGY IS CURRENTLY USED FOR INDIVIDUAL COMPRESSORS AND THE SYSTEM AS A WHOLE?

8. IS THERE A FORMAL, SITE-WIDE LEAK REDUCTION PROGRAM (L.R.P.) AND IS THERE A COMPREHENSIVE C.A. PREVENTATIVE MAINTENANCE PROGRAM (P.M.P.)?

9. DO THE AUXILIARY C.A. SYSTEMS (COOLING WATER SUPPLY, INTERCOOLERS, OIL COOLERS, AFTER COOLERS, DRYERS, CONDENSATE TRAPS, ETC.) FUNCTION AS THEY SHOULD?

10. HAVE THE OPERATIONS AND PROCESSES WHICH CURRENTLY CONSUME C.A. BEEN QUESTIONED AND CHALLENGED AS TO HOW CONSUMPTION CAN BE REDUCED AT THE POINT-OF-USE?

REFERENCES:

- ❶ *COMPRESSED AIR ENERGY CONSERVATION OPPORTUNITIES, W. SMITH, 4-92.*
- ❷ *GUIDELINES FOR DESIGNING & OPERATING C.A. SYSTEMS, W. SMITH, 9-91.*
- ❸ *THE INDUSTRIAL/COMMERCIAL ENERGY AUDIT, W. SMITH, 3-92.*
- ❹ *COMPRESSED AIR CONSERVATION (TECHNOLOGY: JAHRESTREFFEN '92), W. SMITH, 6-92.*
- ❺ *COMPRESSED AIR AUDIT: HILADOS FLEXILON, W. SCALES, W. SMITH, 5-92.*

WPS/Sept92

A SEVEN-STEP APPROACH TO ENERGY AUDITS

EXAMPLE: COMPRESSED AIR PRODUCTION AND USE

TOPIC OUTLINE

Step One	Business Economics of Compressed Air
Step Two	Facility Personnel Input and Guidance
Step Three	Analysis of Supply, Distribution and End-Users
Step Four	Survey of System Performance
Step Five	Analysis of Process Use of Compressed Air
Step Six	Developing "Preliminary" Recommendations
Step Seven	Deliverables: Wrap-Up Meeting, Report and Follow-Up

Summary, Conclusions: The Value of a Comprehensive Approach

WPS/1-93

285

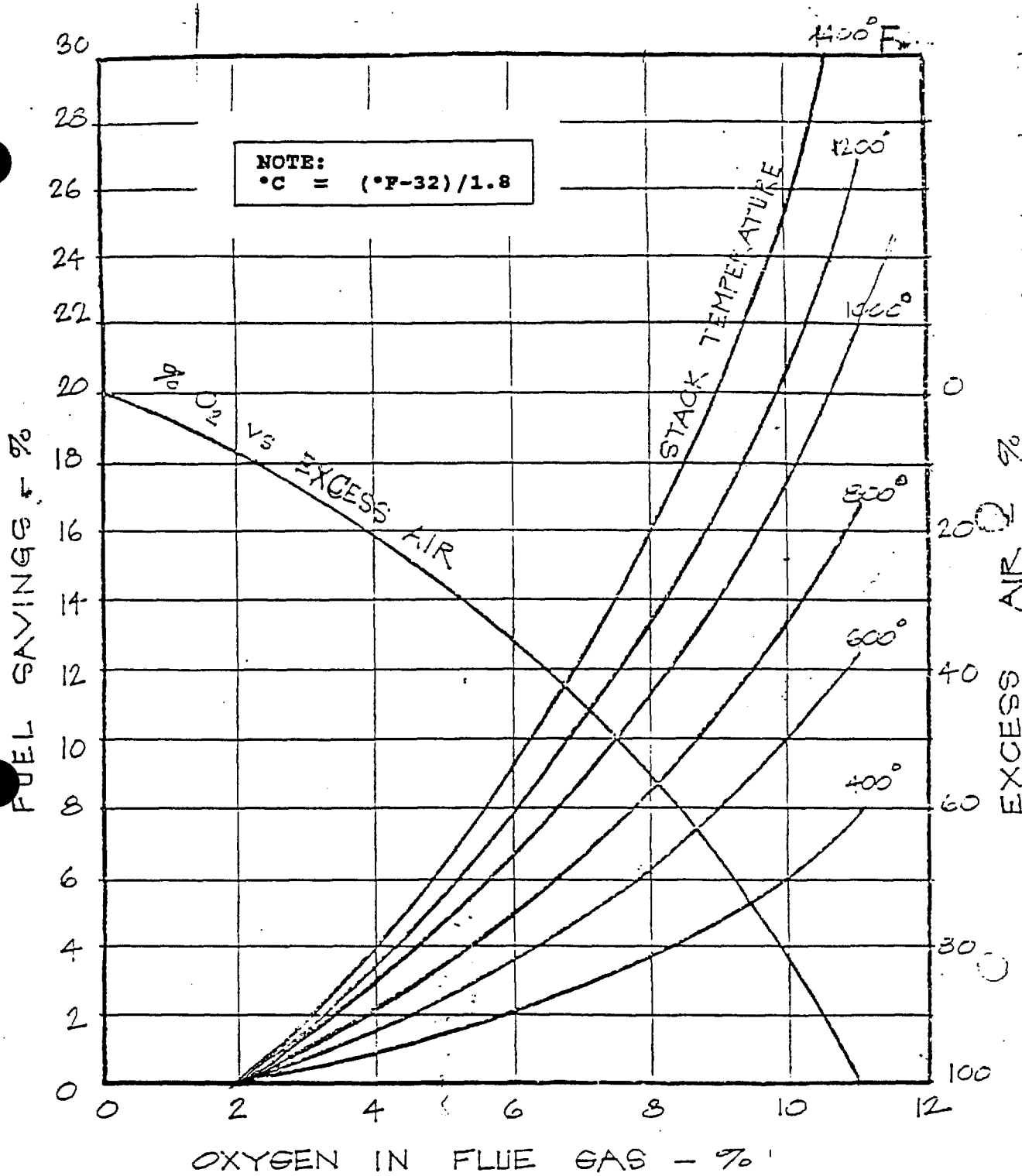


FIGURE — NATURAL GAS SAVINGS AVAILABLE BY REDUCING OXYGEN TO OPTIMUM

(assumed 2%)

286

FAX (504) 343-0475

Date: 28 MAR '94

To: Billy Peck

From: Walt Smith

Please provide a "budget" spec and cost (fax answer today to fax no 011-40-1-312-9023 attention Mr. Manica, Chief of Furnaces):

Description of application: A blanket to cover the crown of glass furnace (see sketch)

2. Two(2) specifications on temp. limits

Case 1: 400 ± 50°C

Case 2: 600 ± 50°C

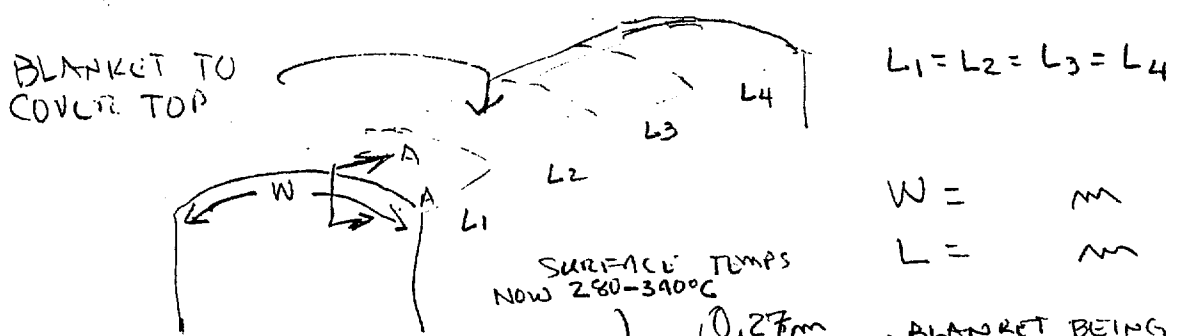
3. Size is 100 m² total in 4 sections (see sketch)

Thickness options: A = 2 cm

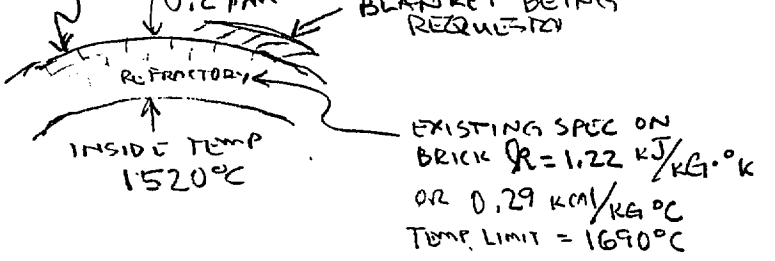
B = 3 cm

4. Provide: thermal conductivity (k/m-°K)

price for 100 m² total



Sketch



Thank You,

Walt Smith

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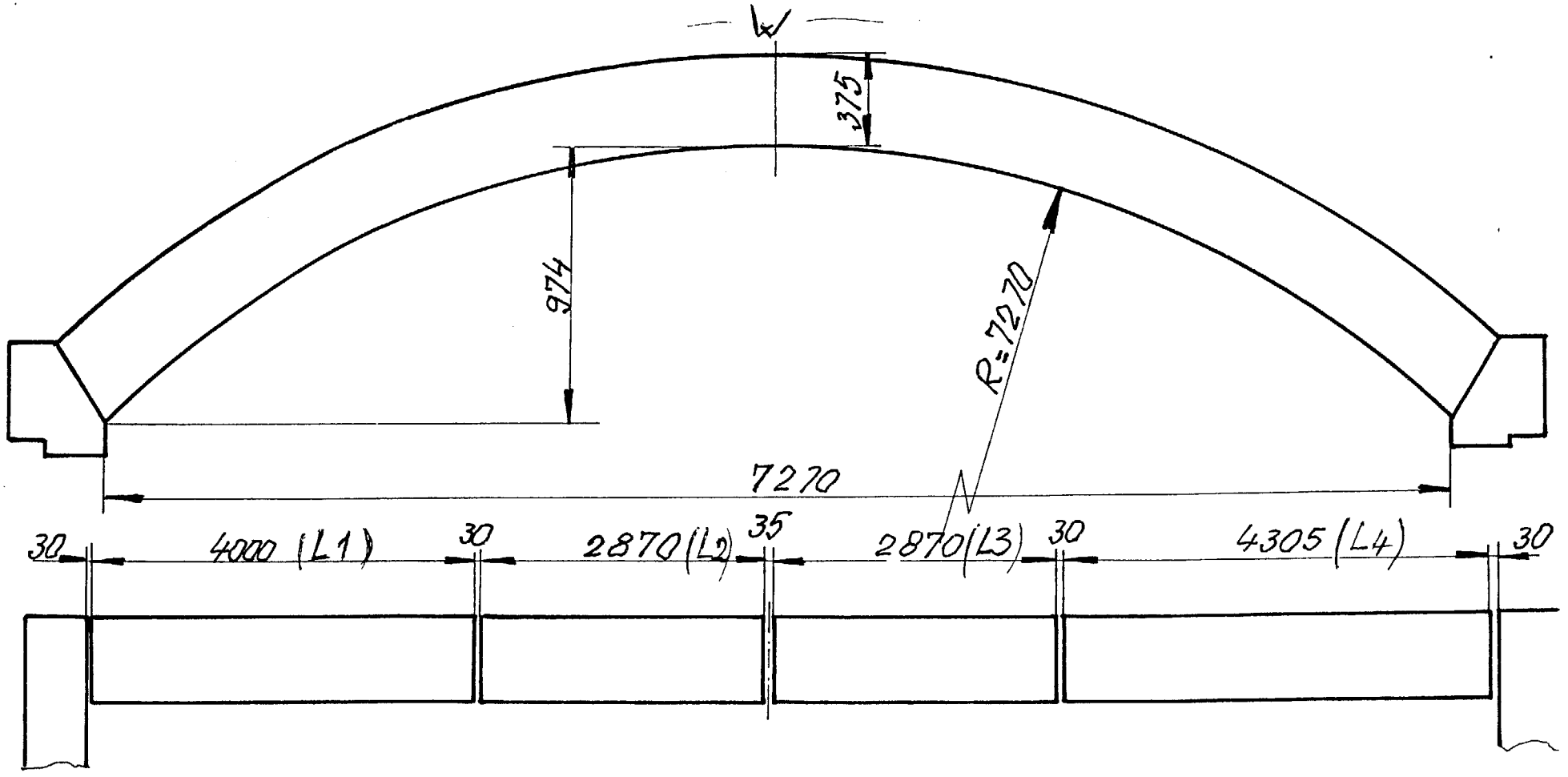
BOLTĂ BAZIN TOPIRE - CUPTOR TOPIRE Nr. 1.



PROCEMA BUCURESTI CATRE ARCON-SRL

ANEXA 1

Tipuri de fibre ceramice și produse din fibre ceramice realizate în cadrul Laboratorului de cercetare fibre ceramice

Nr. crt.	Produsul	Principalele caracteristici tehnice: Caracteristica	U.M.	Valoare
0	1	2	3	4
1.	Fibre ceramice rezistente la 1000°C (I33A-1000)	Diametrul, max.	μm	8
		Lungime medie	mm	135
		Densitate aparentă, max.	kg/m³	200
		Coeficient de conductivitate termică	W/m.K	0,04
		Temperatura de deformare, min.	°C	1000
2.	Fibre ceramice rezistente la 1250°C (I45A-1250)	Diametrul max.	μm	3
		Lungime medie	mm	150
		Densitate aparentă, max.	kg/m³	200
		Coeficient de conductivitate termică	W/m.K	0,04
		Temperatura de deformare, min	°C	1250
3.	Fibre ceramice rezistente la temperaturi pînă la 1350°C-fibre ceramice silico-aluminoase (I50A-1350°C)	Diametrul mediu	μm	3
		Lungime medie	mm	40
		Densitate aparentă, max.	kg/m³	180
		Coeficient de conductivitate termică	W/m.K	
		la 600°C		0,052
		800°C		0,110
		1000°C		0,160
				0,210
		Temperatura de deformare, min.	°C	1350
4.	Fibre ceramice rezistente la temperaturi de pînă la 1350°C-fibre ceramice silico-aluminoase cu adaosuri de oxid de crom (I42A-1350°C-Cr)	Diametrul mediu	μm	3,5
		Lungime medie	mm	40
		Densitate aparentă, max.	kg/m³	200
		Coeficient de conductivitate termică	W/m.K	0,038
		la 600°C		0,119
		800°C		0,160
		1000°C		0,210
		Temperatura de deformare, min.	°C	1350

0	1	2	3	4
5.	Fibre ceramice rezistente la temperaturi de 1450°C (în cercetare)	Diametrul mediu	µm	3,5
		Lungime medie	mm	40
		Densitate aparentă, max.	kg/m³	200
		Coeficient de conductivitate termică	W/m.K	0,040
		Temperatura de deformare	°C	1450
6.	Plăci rigide din fibre ceramice rezistente la 900°C (I32A-900 P)	Densitate aparentă, max.	kg/m³	250
		Contracția liniară după 24 h la 900°C, max.	%	3
		Temperatura de deformare, min.	°C	900
		Coeficient de conductivitate termică	W/m.K	
		la 20°C		0,053
		400°C		0,063
		600°C		0,097
		800°C		0,120
		1100°C		0,130
7.	Plăci rigide din fibre ceramice rezistente la 1250°C (I35A-1250 P)	Densitate aparentă, max.	kg/m³	350
		Contracția liniară după 24 h la 1250°C, max.	%	3
		Coeficient de conductivitate termică	W/m.K	
		la 20°C		0,053
		400°C		0,063
		600°C		0,097
		800°C		0,120
		1100°C		0,180
		Temperatura de deformare, min.	°C	1250
8.	Plăci rigide din fibre ceramice rezistente la 1350°C (I47A-1350 P)	Densitate aparentă, max.	kg/m³	350
		Contracția liniară după 24 h la 1350°C, max.	%	3
		Coeficient de conductivitate termică	W/m.K	0,044
		la 400°C		0,067
		600°C		0,098
		800°C		0,120
		1000°C		0,150
		Temperatura de deformare, min.	°C	1350
9.	Plăci rigide din fibre ceramice rezistente la 1350°C (I53A-1350Cr-P)	Densitate aparentă, max.	kg/m³	350
		Contracția liniară după 24 ore la 1350°C, max.	%	3
		Coeficient de conductivitate termică	W/m.K	0,040
		la 400°C		0,070
		600°C		0,107
		800°C		0,149
		1000°C		[illegible]

240

0	1	2	3	4
		Temperatura de deformare, min	°C	1350
10.	Plăci rigide din fibre ceramice rezistente la 1450°C (în cercetare)	Densitate aparentă	kg/m³	350
		Contracţia liniară după 24 h la 1450°C, max.	%	3
		Coeficient de conductivitate termică	W/m.K	0,048
		la 600°C		0,099
		1000°C		0,169
		Temperatura de deformare, min	°C	1450
11.	Elemente fasonate din fibre ceramice rezistente la 1250°C (I35A-1250°C-F)	Densitate aparentă	kg/m³	350
		Contracţia liniară după 24 h la 1250°C, max.	%	3
		Coeficient de conductivitate termică	W/m.K	0,053
		la 400°C		0,080
		600°C		0,117
		800°C		0,162
		1000°C		0,225
		Temperatura de deformare, min	°C	1250
12.	Saltele din fibre ceramice rezistente la 1000°C (I32A-1000 S)	Densitate aparentă, max.	kg/m³	150
		Coeficient de conductivitate termică	W/m.K	
		la 20°C		0,045
		400°C		0,073
		600°C		0,114
		800°C		0,16
		1000°C		0,25
		Căldura specifică medie	KJ/kg.k	1,42
		Contracţia după 24 ore la 1000°C, max.	%	5
		Temperatura de deformare, min	°C	1000
13.	Saltele din fibre ceramice rezistente la 1250°C (I40A-1250 S)	Densitate aparentă, max.	kg/m³	160
		Căldura specifică medie	KJ/kg.k	1,21
		Coeficient de conductivitate termică	W/m.K	
		la 20°C		0,045
		400°C		0,073
		600°C		0,114
		800°C		0,16
		1000°C		0,25
		Contracţia liniară după 24 ore la 1250°C	%	3
		Temperatura de deformare, min	°C	1250

DEPARTAMENTUL INDUSTRIEI LEMNULUI
STIROM-S.A. BUCURESTI
Strada:Theodor Pallady Nr:43-45 Sector 3.
Telex: 10 089 Telefon:630.20.45.
RC-10/26 12 1990 FAX:312.90.23

REPROIECTAREA CUPTORULUI DE TOPIT STICLA NR.1 - STIROM
- RK 1995/96 -

Prezentarea situației actuale

- Cuptor care elaborează sticlă silico-calco-sodică culoare verde destinată produselor de ambalaj.
- Cuptor cu flacără transversală, sistem regenerativ, cu 4 perechi arzătoare.
- Extracție max.150 tone/zi, 4 linii de fabricație echipate cu mașini IS cu 6 secțiuni (2 mașini IS6 - simplă picătură; 2 mașini IS6 - dublă picătură).
- Incălzirea cuptorului se realizează prin arderea gazelor naturale (putere calorifică 8500 Kcal/Nmc); fără încălzire electrică suplimentară
- consum caloric 1500-1700 Kcal/Kg sticlă
- suprafață bazin topire - 90 mp
- suprafață bazin lucru - 16,8 mp
- Adâncime bazin topire - 1100 mm
- Adâncime bazin lucru - 500 mm
- Baraj - lățime - 500 mm
  - înălțime - 675 mm (de la vatră)
- Canal de trecere normal - lungime 1500 mm
  - secțiune 600 x 350 mm
- Cuptorul are instalație de bouillonere (10 buc.)

Noua geometrie a cuptorului (bazin topire, bazin lucru) care să permită o extracție de aprox.200-220 tone/zi și scăderea consumului specific caloric la aprox.1000 Kcal/Kg sticlă.

Deasemeni îmbunătățirea sistemului de ardere - noua geometrie de focare, tipuri de arzătoare.

DIRECTOR TEHNIC,
ing. Lucra[illegible] Popescovici

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292

STIROM - SA BUCHAREST ROMANIA
STREET: THEODOR PALLADY NO 43-45 SECTOR 3
TELEX : 10089, PHON: 630.20.45, FAX: 4-01-312.90.23

REDESIGNIN OF GLASS MELTING FURNACE C-1 AT STIROM BUCHAREST .

Present situation .

- Furnace for delivery of silica-calcium-sodic glass green colour destinated for paking products(botles, glasses,etc)
- Furnace has transversal flame, regenerator system,with 4 pairs of burners(8 in working position and 8 not working)
- Production (extraction) max.150 To/day, 4 lines of fabrication equiped with IS Machines with 6 sections(2 IS Machines IS6 with single gobs and 2 Machines IS6 with double gobs)
- Furnace is working with gas fired, LHV 8500kCal/Nm3 (without supplimentary heating with electricity)
- Heat consumption 1500-1700 kCal/kg glass
- Surface of melting bath(tank).... 90 m2
- Surface of working bath 16,8 m2
- Deepnes of melting bath 1100 m2
- Deepnes of working bath 500 m2
- Dam -Width ....500 mm
  -hight ....675 mm(starting from fireplace)
- Passing chanel normal - lenght...1500 mm
  - section..600x350 mm
- Furnace has bouillonering (10 pcs.)

New designe of the furnace shall have a geometry(melting bath, working bath, etc.)to produce Avg.200-220 To/day and higher efficiency for energy consumptions Avg. 1000 kCal/kg glass.
The offer shall contain an advanced burning system along with a new geometry of firebox, type of burners.
Konsultant can offer only a technical project detailled drawings can be elaborated by a local privet Company -ARCON - Bucharest Romania, Ph/FAX 4-01-6736081.

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LIST NO. 2 FOR STIROM

Item No.		Cost	Savings	Payback
1.	High Efficiency Burners for Glass Furnace C-1 (16 units) -- equivalent to Körting; GAZ = Total Flow 1500 m^3/h, 8300 $Kcal/m^3$ (LHV) 16 burners to obtain 1580°C in Furnace with Complete Combustion. Out of 16 burners, 8 must be working and 8 not operating (cooling conditions) at total production of 180 tons/day. Similar to Körting Hannover.	67,000	100,000	8 mos.
2.	Digital Controllers for 8 Channels to Provide Continuous PID with 4-20 MA input/output capable of communicating with RS232C computer.			
	5 Loops for Gas Flow) 1 Loop for Gas to Air Ratio) 2 Loops for Draft Pressure)			
	Computer 486 Microprocessor, 33 MHZ with 4 MB RAM and 170 MB Hard Drive. To include 2 floppy drives (3.5" and 5.25") and super VGA monitor.	6,000	6,000	12 mos.
3.	Insulation Blanket for Crown of Glass Furnace C-1 to Include	30,000	30,000	12 mos.
4.	Variable Frequency Drives			
	A. 22 KW F.D. Fan on C-1 380 V, 50 HZ, 1500 RPM	6,000	6,000	12 mos.
	B. 15 KW F.D. Fan on C-2 380 V, 50 HZ, 1500 RPM	4,000	4,000	12 mos.
5.	Ultra Probe 2000, 220 V with Accessories	4,000	4,000	12 mos.

Societatea Comercială ARCON SRL, Autorizaţia J40/6382/1991,
Str. Intr. Odobeşti nr.1, Bl.Z2, Et.1, Sc.5, Ap.59, Telefon
6736081, Bucureşti, Sector 3, CP.74578, România. FAX 4-01-67

TO: ESTI - WALTER SMITH
FAX: (704)665-9323
FROM: ARCON-MIHAIL ZDRAVCU
FAX: 4-01-6736081
REF: INDUSTRIAL ENERGY AUDIT AT STIROM BUCHAREST
LIST 1 OF ENERGY EFFICIENCY EQUIPMENT FOR PLANT
USAID CONTRACT NO- EUR-003-C-00-2053-00
ITEM NO

1. SUPERCAL II MULTIFUNCTIONAL CALIBRATOR FOR PROCESS EQUIPMENT - TEMPERATURE °C, mV, mA, OHMs, AS PER DAVIS INSTRUMENS MFG.CO.INC 4701 Mt. HOPE DRIVE BALTIMORE, MD21215-CATALOG NO RS1401b1, MODEL CL4500.
   QTY: 1, COST: 2000 USD.
2. I.R. NONCONTACT THERMOMETER IR-550, -45°C TO 550°C, DAVIS CATALOG NO-DK1164198 OR SIMILAR(DICKSON IR550).
   QTY: 1, COST: 500 USD.
3. I.R. PORTABLE STANDARD SIGHT NON CONTACT TEMPERATURE MEASUREMENT TYPE DHS-29X FOR °C, WHAL INSTRUMENTS USA, RANGE 482-1760°C, ACC. ± 0,3%FSI, RESOLUTION 1°C, SIGHTING SYSTEM ENCLOSED PLUS ACCESSORIES, SUPPLY 220V, 50Hz. → DHS-53 + L-50 for DHS-53 (WAHL)
   QTY: 1, COST: 4500USD.
4. ULTRASONIC LEAK DETECTOR (COMPRESSED AIR) ULD-100.
   QTY: 1, COST: 500 USD.
5. COG BELTS DRIVE 5BELTSx4DRIVE, 3000x17x11 mm.
   QTY: 20, COST: 600 USD.
6. ANNUBAR FOR COMPRESSED AIR FLOW, 3,5 BAR, 600 mmØ, MAX. 30.000Nm³/h
   QTY: 1, COST: 1900 USD.

TOTAL: 10.000 USD.

ARCON
Eng. MIHAIL ZDRAVCU

APPROVED STIROM
GEN. MANAGER
Eng. MIHAI POPESCU

295

PARAMETRI TRAFO

DATA: 20.05.1994

SCH. I
SCH. II
SCH. III

ORA	TR 1	TR 2	TR 3	TR 4	TR 5	TR 6	TR 7	TR 8	TR 9	TR 10	TR 11
7	10		11,7	40	27		27	16	25	36	22
8	11		11,8	39	28		29	17	27	35	23
9	12		11,8	40	29		29	16	29	34	24
10	11		11,8	39	28		28	16	30	33	24
11	10		11,8	40	27		30	17	31	34	20
12	10		12	40	28		31	18	32	34	22
13	14		12	39	27		32	18	30	32	17
14	15		11,8	39	28		32	17	31	33	15
15	15		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	12		11,8	42	29		34	20	30	34	16
18	12		11,8	42	29		33	20	28	33	15
19	11		11,8	43	30		31	20	26	33	14
20	12		[illegible]	[illegible]	[illegible]		[illegible]	20	33	33	[illegible]
21	[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	20	31	[illegible]	14
22	[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	20	30	[illegible]	15
23	14		11,4	38	26		33	20	32	31	15
24	14		11,4	39	26		32	20	31	32	14
1	12		11,2	37	24		32	20	31	33	13
2	12		11,3	40	26		30	20	31	30	15
3	13		11,5	42	26		31	20	30	30	14
4	13		11,7	41	26		32	20	30	33	14
5	15		11,8	42	25		31	20	32	28	14
6	10		11,3	43	27		31	20	31	18	14
7											

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- ROMANIA

FINAL ENERGY AUDIT REPORT

for work at

Terapia, S.A.

by

Vasile Grasin, CEM

Georgeta Padureanu, CEM

ECO-ERG Tehnologie Service, S.R.L.

for

Hagler Bailly Consulting, Inc.

297

ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	S.C. TERAPIA S.A.
Address	FABRICII STR.,NR. 124
	3400 CLUJ NAPOCA
Telephone	40-(0)64-147088
Fax	40-(0)64-194357
Contact Person	MOGANU NICOLAE
Title	DIPL.ENG.
Telephone	40-(0)64-147088/400

2. Energy auditor information

Dates - audit started: february 1994 audit completed: _____

Energy audit company	S.C."ECO-ENG" Tehnologie Service S.R.L.
Energy audit team leader	dipl. eng. Vasile Grosin ,C.E.M. nucl.phys. Georgeta Pădureanu,C.E.M.
Address	26,Anton Pann Str., 3400 Cluj Napoca
	Romania
Telephone	40-(0)64-194208
Fax	

298

3. Energy audit information

Energy audit focus - describe the major tasks, or areas of the plant, which were investigated during the energy audit:

The energy audit is focuse on the production,distribution and utilization of the thermal energy in the whole plant (each section of this plant beeing like a small plant)

Energy efficiency - in the energy auditor's opinion, what were the most significant findings of the energy audit:

The most significant findings of the energy audit were:

- low energy efficiency of the steam boilers ,in the boiler's house
- there does not exist steam,hot water and gas meters (either in the boilers'house,either at the consumers -production plants)
- malfunction and wrong choose of the most steam traps ,in the boilers' house and at the consumers
- the condensate recovering system it is not used.It is required technical improvement.
- great energy losses through the bad insulation of the steam and hot water distribution pipe lines.

New experience - in the energy auditor's opinion, what were the most significant lessons learned during the energy audit:

- how to estimate the economical efficiency of the technical sollutions proposed,and how to choose the best sollutions regarding to the simple pay back period.

299

4. Energy savings

List the energy efficiency measures ALREADY IMPLEMENTED, during the course of the audit (if any):

Description of measure	Fuel saved	Savings/units	Payback
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years

300

4. Historical production and energy consumption

4.1 Summarize the recent production and energy consumption at the plant in physical units (also list the type of units per year,i.e. tons/year,kWh/year etc.)

Year	1990	1991	1992	1993	Units
Production					
1989 comparative price	585.2	524.6	485.0	596.1	mill. lei
Current price	661.3	1,851.8	6,445.6	1,778.2	mill. lei
Energy:					
heavy fuel oil:					
diesel fuel oil:					
natural gas:	19,388	16,440	14,734	13,479	Nem 10^3
coal:					
electricity:	19,255	16,677	13,287	11,338	MWh
steam:	132,820	112,164	100,262	90,743	GCal
	556,117	469,630	419,797	379,941	GJ
other(describe):					

The steam is produced from a part of natural gas

Energy/Production index:					
thermal	33.13	31.33	30.37	22.61	Nem10^3/89 mill.lei
electrical	32.9	31.79	27.39	19.02	Nem10^3/89 mill.lei

7. Detailed forms - required

Complete and attach the following forms:

Fuel, steam, or heat energy consumption - 12 month audit period
(complete for each major fuel type for areas studied)

Steam generation - 12 month audit period (if plant has boiler)

Energy balance - fuel, steam or heat

Electric energy consumption - 12 month audit period

Electric energy generation - 12 month audit period (if plant has generator)

Energy balance - electrical

Action plan - summary of energy efficiency project opportunities

Recommended action - energy efficiency opportunity
(complete one for each recommended action)
(attach additional details if required to justify project)

8. Narrative

Provide any other information which would be useful to USAID and RCG/Hagler Bailly:

_____

_____

_____

_____

_____

302

8. Narrative

8.1. The contract between S.C. "ECO-ERG"Tehnologie Service S.R.L. and S.C.Ter S.A.it is made for 13 thermal energy audits ,Which includes:

1. Boilers' House
2. Pipe lines distribution systems
3. Calcium Pantheteat II plant
4. Calcium Pantheteat I plant
5. Medium synthesys and opium plant (S.M.F.O.)
6. Rectification plant
7. Medium synthesysIplant
8. Medium synthesys II plant
9. Hormones plant
10. Glucose plant
11. Calcium glue plant
12. Calcium glue and athomizer plant
13. Pack plant

In this report are presented the results of the first three energy audits which include the process of thermal energy production in the Boilers' Hou the pipe lines distribution system and the thermal consumptions in the Ca Pantheteat II Plant.

8.2. For this three audits we presented the most important sollutions proposed implemmented to improve the energy efficiency

8.2.1Boilers' House

Action 1. -Metering the heat content of generated steam in CT2

Action 2. -To reduce energy losses by changing the used traps(steam tra

Action 3. -To adjust the burning efficiency with a performant combustion analyzer

Action 4. -Metering the gas consumptions in all boilers house,and the he content of generated steam in CT1.

8.2.2.Pipe lines distribution system

Action 5. -To changw the used insullations of steam and hot water distri pipe line systemfrom boilershouse to the whole plant

8.2.3. Calcium Pantheteat II plant

Action 6. - To reduce the energy losses by repacing the used steam trap

Action 7 - To reduce energy losses trough bad insulationsof reactors and steam -condensate pipe line distributions

Action 8. - Metering the steam heat consumptions in Calcium Pantheteat plant.

8.3. For the electrical consumptions the presented datas are just the statistic due to the fact that we have no contract for electrical energy balance.

FUEL [illegible] AM OR HEAT ENERGY CONSUMPTION
E[illegible]RGY CONSUMPTION – 12 MONTH AUDIT PERIOD
Prepared [illegible] USAID and RCG/Hagler Bailly

Energy type: natural gas used to hot water generation

Plant name: S.C. Terapia S.A. Cluj Napoca

Address: 124, Fabricii Str., 3400 Cluj Napoca

Auditor's name: S.C. " ECO_ERG" Tehnologie Service S.R.L.

Report date:

Electricity contract terms: Supply Gas

Electricity supply company's name	ROMGAZ
Contract maximum demand (kW):	
Minimum charge (cost):	
Other:	

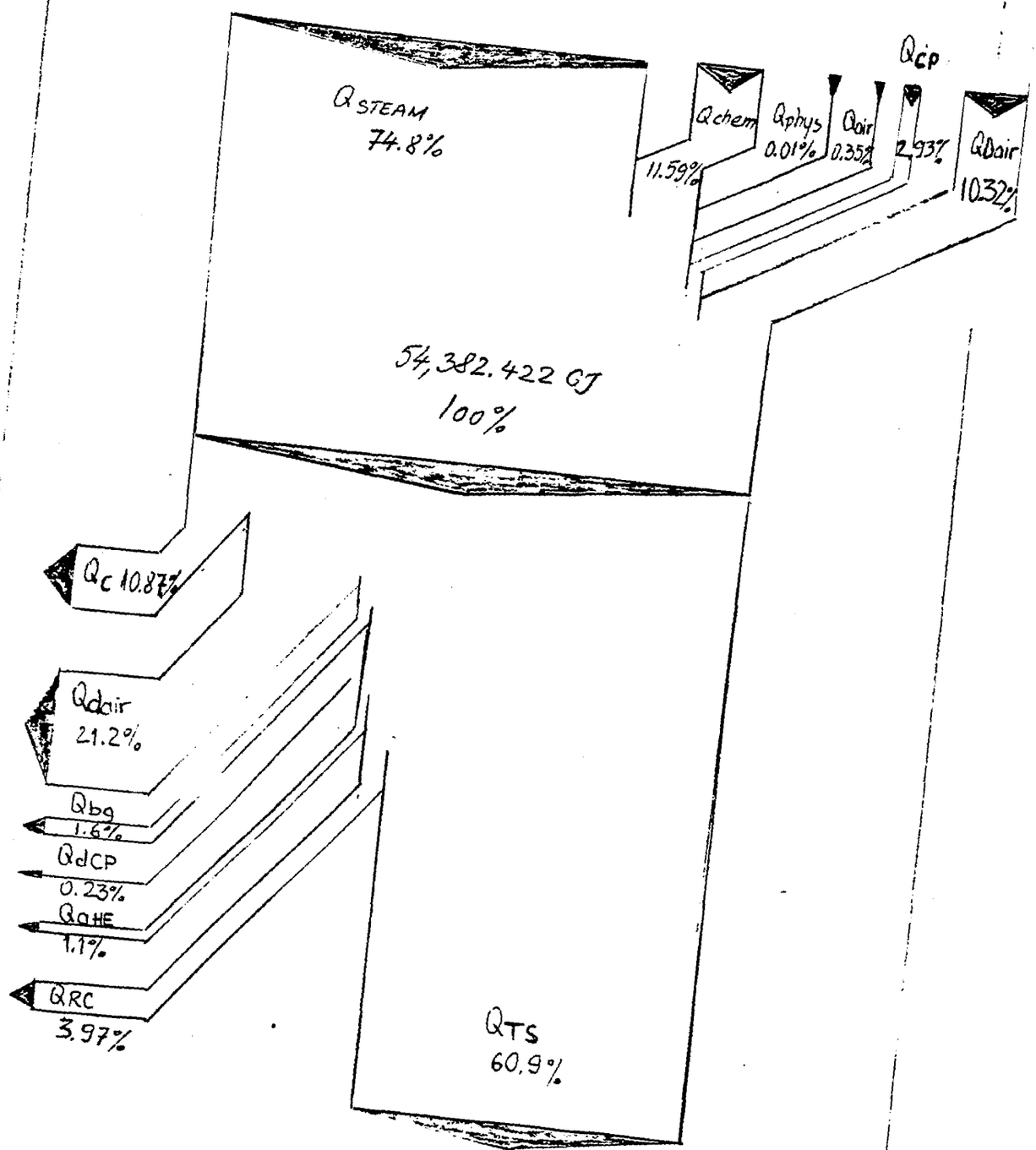
CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD:

Meter Reading Mo/day/yr	nat.gas phys. cons. 10^3 Nm	nat.gas heat cont. GJ	Max Demand kW	Max Demand kVA	Power Factor cos φ	Load Factor	natural gas Total Cost million lei	generated heat Product. Index kWh per GJ/month	monthly heating degree-days HDD	generated heat index Heating index GJ/HDD
Jan/ 93	156,860	5,619.48					15.725.215	5,347.9	639	8.369
Feb/ /93	161,920	5,800.753					16.232480	5,520.33	633	8.721
Mar/ /93	134,320	4,811.988					13.465580	4,579.37	525	8.723
Apr/ /93	81,880	2,933.335					8.208470	2,791.53	294	9.495
May/ /	–	–					–	–	5	–
Jun/ /	–	–					–	–	9	–
Jul/ /	–	–					–	–	5	–
Aug/ /	–	–					–	–	-27	–
Sep/ /	–	–					–	–	164	–
Oct/ /93	69,000	2,471.912					6.91725	2,352.4	398	5.91
Nov/ /93	82,800	2,966.294					8.3007	2,822.9	440	6.415
Dec/ /93	142,600	5,108.618					14.29565	4,861.65	605	8.036
TOTAL 93	829,380	29,712.38					83.145345	28,276	3,690	7.663

Note: Heating degree-days based on reference temperature of 18° C

Page 9

SANKEY DIAGRAM OF ENERGY BALANCE FOR
CALCIUM PANTHOTENAT II SECTION (PLANT)
LEGEND ON THE NEXT PAGE (APENDIX)



385

APENDIX

TO

SANKEY DIAGRAM OF ENERGY BALANCE DUE FOR CALCIUM PANTHOTENAT II SECTION – SC. TERAPIA SA.

LEGENS:

Q_{STEAM} – TECHNOLOGICAL STEAM HEAT CONTENT (FROM CT)

Q_{chem} – CHEMICAL HEAT CONTENT OF NAT. GAS USED FOR ATOMIZING THE CALCIUM PANTHOTENAT (TO DRY THE SOLLUTION)

Q_{phys} – PHYSICAL HEAT CONTENT OF NAT GAS

Q_{air} – COMBUSTION'S AIR HEAT CONTENT

Q_{CP} – CALCIUM PANTHOTENAT SOLUTION'S HEAT CONTENT

Q_{Doir} – DRYING AIR'S HEAT CONTENT

Q_c – WASTED CONDENSATE HEAT CONTENT

Q_{doir} – WASTED DRYING'S AIR HEAT CONTENT (FROM ATOMIZING INSTALLATION)

Q_{bg} – HEAT CONTENT OF BURNED GASES

Q_{dCP} – HEAT CONTENT OF DRIED CALCIUM PANTHOTENAT

Q_{aHE} – AIR WASTES FROM THE AIR / AIR HEAT EXCHANGERS

Q_{RC} – WASTES DUE TO REACTORS' WALL, STEAM DISTRIBUTION PIPING LINE, CONDENSATE PIPING LINE, ATOMIZING INSTALLATION WALLS TROUGH RADIATION AND CONVECTION

Q_{TS} – TECHOLOGICAL USED STEAM'S HEAT CONTENT

STEAM GENERATION - 12 MONTH AUDIT PERIOD and hot water generation
Prepared for USA[redacted]CG/Hagler Baily

Plant name: S.[redacted] Terapia S.A. ,Cluj Napoca
Address: 124,Fabricii Str.,3400 Cluj Napoca ,Romania
Auditor's name: S.C. "ECO_ERG"Tehnologie Service S.R.L.

Report date:

Boiler characteristics:

	CR 9		CR 16				CAP 7/ 2
Name/number	nr.2	nr.3	nr.1	nr.2	nr. 4	nr.5	nr.2
Manufacturer	Vulcan		Vulcan				
Type (firetube/watertube)	watertube		water tube				watertube
Type (saturated/superheated)	superheated		superheated				
Capacity (tons/hour)	10 to/h		10		to/h		10 Gcal/h
Year installed:	1968-1969		1973-1974-		1976		1974-1976
Year last major overhaul:			no for nr. 3				
Operational? (yes/no)	yes		yes for nr.		1,2,4,5		yes
Steam pressure: (nominal)	10 bar		10 bar				
Steam temperature: (nominal)	280°C		280°C				h.w.t. 140
Stack temperature, after economizer °C	242	158	129	124	119	142	
Stack gas analysis: percent O2	6.6	11.9	8.8	14.4	6.6	8.6	
Combustion efficiency:	87.7	87.6	92.7	91.1	93.7	91.8	
Blowdown analysis: dissolved solids PPM	890	896	560	510	478	525	

STEAM GENERATION DATA FOR 12-MONTH AUDIT PERIOD: boilers average

	STEAM GENERATION BY PLANT				IMPORTS	STEAM SALES AND DISTRIBUTION TO CONSUMERS:							NOTES
Meter Reading Mo/day/yr	Fuel Consumption GJ	Steam Generation tons	Steam Generation GJ	Monthly Efficiency %	Steam Purchased GJ	sales GJ	internal GJ	GJ	GJ	GJ	GJ	Losses & Unaccounted GJ	Unusual Operating conditions
Jan/ 1993	44,446.4	14,280.6	41,043.5	86.6	-	3,387	37,656.5						
Feb/ 93	44,027.8	14,145.5	40,657.4	-"-	-	3,282	37,375.4						
Mar/ 93	44,721.5	14,368.7	41,297.2	-"-	-	2,914	38,383.1						
Apr/ 93	36,699.3	11,790.7	33,890.3	-"-	-	1,645	32,245.3						
May/ 93	24,251.6	7,794.9	22,466.2	-"-	-	904	21,562.2						
Jun/ 93	27,515.9	8,840.5	25,409.0	-"-	-	846	24,563.0						
Jul/ 93	27,141.6	8,720.1	25,063.8	-"-	-	728	24,335.8						
Aug/ 93	24,099.4	7,742.5	22,254.2	-"-	-	410	21,844.2						
Sep/ 93	29,026.1	9,325.6	26,803.8	-"-	-	569	26,234.9						
Oct/ 93	26,454.7	8,499.6	24,430.1	-"-	-	699	23,731.1						
Nov/ 93	43,764.1	14,060.9	40,412.7	-"-	-	2,223	38,189.7						
Dec/ 93	35,191.1	11,306.5	32,496.5	-"-	-	1,905	30,591.5						
TOTAL 93	407,350	130,876	376,225			19,512	356,713						

Energy balance -fuel,steam or heat
Prepared for USA[illegible]RCG/Hagler Bailly

Plant name: S.[illegible]erapia S.A. Cluj Napoca
Address: 124, Fabricii Str., 3400 Cluj Napoca
Auditor's name: S.C."ECO-ERG" Tehnologie Service S.R.L.

Report date:

Item No.	Equipment or Process Description	Maximum Load units:	Average Load units:	Load at Peak Demand units.	Energy Consumption units: /year	Total Energy Cost /year
1	The energy balance is prepared for the whole					
	boilers house.The primary energy is the heat					
	content of natural gas.The generated steam is					
	prepared for proper uses and for sales.The					
	steam is generated by CR9 and CR 16 type steam					
	boilers. there are,in function 2 CR 9 steam					
	boilers and 4 CR 16 type steam boilers.					
2	The hot water for heating is prepared with one					
	CAF 7 type hot water boiler. Just 1 is in fune					
	ction					
3	The energy balance maded for Calcium Pantheteat					
	II plant regards two kind of used thermal energy					
	: - natural gas used to prepare the drying air					
	to dry the calcium pantheteat sollution					
	(a complex of B vitamins for animals),with					
	a small gas burner located in section.					
	- the techelogycal steam prepared by the					
	steam boilers, which is used for techenogycal purposes					
	(to preheat,to heat and to maintaine at					
	the reaction temperature the chemical reactors)					
TOTAL PEAK DEMAND						
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)						

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ELECTRIC ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
Prepar USAID and RCG/Hagler Bailly

Not in scop work

Plant name: S.C.Terapia S.A. Cluj Napoca
Address: 124,Fabricii Str., 3400 Cluj Napoca
Auditor's name: S.C."ECO-ARG" Tehnologie Service S.R.L.

Report date:

Electricity contract terms:

Electricity supply company's name	RENEL
Contract maximum demand (kW):	
Minimum charge (cost):	
Other:	

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD:

81.4 lei/kWh

Meter Reading Mo/day/yr	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Power Factor cos 0	Load Factor	Total Cost million lei	Product. Index kWh per:	Notes on plant conditions and changes
Jan/ 93	546,000	144,000	2,600	–	0.967		44.444		Not in scope of work
Feb/ 93	828,000	158,400	–"–	–	0.982		67.3992		the price of electric energy: 63.6 lei/kwh /dec.93
Mar/ 93	986,000	122,400	–"–	–	0.992		80.2604		81.4 lei/kwh/june 94
Apr/ 93	1,080,000	93,000	–"–	–	0.997		87.912		
May/ 93	828,000	151,200	–"–	–	0.984		67.3992		
Jun/ 93	864,000	223,200	–"–	–	0.968		70.3296		
Jul/ 93	1,173,600	280,800	–"–	–	0.972		95.531		
Aug/ 93	1,051,200	280,800	–"–	–	0.966		85.56768		
Sep/ 93	1,159,200	230,400	–"–	–	0.981		94.3589		
Oct/ 93	792,000	237,600	–"–	–	0.958		64.4688		
Nov/ 93	1,188,000	259,200	–"–	–	0.977		96.7032		
Dec/ 93	842,400	108,000	–"–	–	0.991		68.5714		
TOTAL 93	11,338,400	2,289,600	–"–	–			922.94576		

Peak demand during audit period (kW):

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ELECTRIC ENERGY GENERATION - 12 MONTH AUDIT PERIOD
Prepared for US[illegible]d RCG/Hagler Bailly

Plant name:
Address:

Auditor's name:

Report date:

Generator characteristics:

Name/number				
Manufacturer				
Capacity (kW):				
Year installed:				
Year last major overhaul:				
Drive type (steam, gas, diesel)				
If steam – Condensing/extraction/backpressure				
Operational? (yes/no)				

GENERATION DATA FOR 12-MONTH AUDIT PERIOD:

	SELF-GENERATION BY PLANT				SOLD TO OTHERS:				PURCHASED FROM OTHERS				NOTES
Meter Reading Mo/day/yr	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Energy Active kWh	Energy Reactive kVARh	Max Demand kW	Max Demand kVA	Unusual Operating conditions
Jan/__/__													
Feb/__/__													
Mar/__/__													
Apr/__/__													
May/__/__													
Jun/__/__													
Jul/__/__													
Aug/__/__													
Sep/__/__													
Oct/__/__													
Nov/__/__													
Dec/__/__													
TOTAL													

not in scope of work

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Prepared for USAID and RCG/Hagler Bailly

Plant na
Address:

Auditor's name:

Report date:

Item No.	Equipment or Process Description	Connected Load kW	Maximum Load kW	Average Load kW	Load at Peak Billing Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost /year
TOTAL PEAK DEMAND (equals maximum billing demand)							
TOTAL ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)							

not in scope of work

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ACTION PLAN – SUMMARY OF ENERGY EFFICIENCY PROJECT OPPORTUNITIES
Prepared for USAID and RCG/Hagler Bailly

Plant name:
Address: S.C.TERAPTA S.A. 3400 cluj napoca . 124, Fabricii Str. Romania

Auditor's name: S.C."ECO ERG" Tehnologie Service S.R.L.

Report date:

BEST AVAILABLE COPY

BASELINE – EXISTING CONDITIONS

	Only for steam generation in Boilers House (CT1 & CT2)	Gsa consumption 10^3 NCm/y Thermal Consumption GJ/year	Thermal Consumption GJ/year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost $ /year	%
BASE CASE	Gas consumption for steam generation	11,370.613					662,735	100

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS:

Action No.	Action Description	Gas 10^3 Ncm/y Thermal Consumption GJ/year	Gas Cost $/y Thermal Consumption GJ/year	Net reduction Gas red. 10^3 Ncm /y Thermal Consumption GJ/year	$/y Electric Peak Demand kW	% Electric Energy Consumption kWh/year	Total Energy Cost /year	Action Project Cost $	Action Payback Period (years)
1	toinstall 2 gas meters & 2 steam energy meters in CT	10,441.338	608,572	929.275	54,163	8.2		24,000	.0.45
2	To replace the used steam traps in Ct (CT1 & CT2)	9,838.757	573,451	602.541	35,121	5.3		4,850	0.15
3	To adjust the boilers burning efficiency wit a comb. analyz	9 627.171	561,119	211 586	12 332	1.9		4 500	0.3
	Subtotal 1 (for all boilers House)			1 743.442	101.616	15.3		33,350	0.33
4	to replace the used insullation on steam and Hot water DISTRIBUTION system (piping system in all the plant)	9 255.478	539.455	371.693	21.664	3.3		26,294	1.21
	Subtotal 2 (for all piping distribution system)			371.693	21.664	3.3		26,294	1.21
5	To replace the used steam traps in PantHo II Section	9,076.769	529,039	178.709	10,416	1.6		3,192	0.4
6	To change the used insullations in PantHo II Section	9,026.882	526,131	49.887	2.908	0.4		2,439	0.8
7	Metering the steam consumption in PantHo II Section	8,798.31	512,809	228.572	13,322	2.0		5,500	0.42
	Subtotal 3 (for PantHo II Section)			457.168	26,646	4.0		11,131	0.42
8 and 9	To replace the used steam traps in PantHo I Section ~~and~~ To install steam meters on 4 & 8 bar piping distribution ~~systems~~ in PantHo I Section	8,544.437	498,012	253.873	14,797	2.2		13,228	0.89
	Subtotal 4 (for PantHO I Section)			253.873	14,797	2.2		13,228	0.89
10	To replace the used steam traps on 4 bar steam distribution piping system in Gluconolactat de Calciu Section	8,533.354	497,366	11.083	646	0.1		1,303	2.01
11	To replace the used steam traps on 8 bar steam distribution piping system in Gluconolactat de Calciu Section	8,229.433	479,652	303.921	17,714	2.67		580	0.03
	Subtotal 5 (for Gluconolactat de Calciu Section)			315.004	18,360	2.77		1,883	0.1
	TOTAL SAVINGS (1+2+3+4+5)	8,229.433	479,652	3,141.18	183,083	27.57		85,886	0.5
SAVINGS AS PERCENTAGE OF BASE CASE				3,141.18	183,083	27.57			

Note. Assumes that the actions are taken in order of best payback period first, in order to take into account the interaction between the various measures

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 1

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Plant name: S.C. TERAPIA S.A.
Address: 124, Fabricii Str., 3400 Cluj Napoca, Romania
Auditor's name: S.C."Ace-Erg" Tehnologie Service S.R.L.
Report date:

ACTION NO. AND BRIEF DESCRIPTION: Metering the gas consumptions and the generated steam in GT1 & GT2

AREA OF THE PLANT AFFECTED: Boilers House

FINDINGS CONCERNING EXISTING CONDITIONS: THERE IS NO METERING SYSTEM

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. to install a gas meter on the principal gas pipe line distirbution system in GT1
2. to install a gas meter on the principal gas pipe line distributionsystem in GT2
3. to install a steam energy meter on the principal steam pipe line in GT1
4. to install a steam energy meter on the principal steam pipe line in GT2

It is known that metering, in apperrance, produce no economy, but has a major importance in monitorizing the energetic consumptions.

To estimate the economies we do appreciate that it is possible to impouve boilers house efficiency by reducing the specifique consumptions from 30.22 Mem/GJ to 27.75 Mem/GJ.

The estimated economy is: 375,224.914 GJ/y(30.22 Mem/GJ – 27.75 Mem/GJ)x 100.25 lei/M :1,720 lei/$ = 54,163 $

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: 10^3 Mem	Total cost $ /year	
Baseline – existing conditions			11,370.613	662,735	
After recommended action			10.441.338	608,572	
Net reduction			929.275	54,163	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineering design		
Equipment procurement	24,000	(2x5,500 $ + 2x 6,500 $) gas & steam meters for GT1 & GT2
Equipment installation	291	
Equipment commisssioning	–	
TOTAL INSTALLED COST	24,291	(b)
Estimated increase in annual (non–energy) operations and maintenance cost	232	(c)

PAYBACK PERIOD:

$$\frac{b: 24,291}{a: 54,163 - c: 232} = .45 \text{ years} = 6 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

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ACTION NO 2

Plant name: S.C.Terapia S.A. Cluj Napoca
Address: 124,Fabricii Str., Cluj Napoca
Auditor's name: S.C."ECO-ARG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: to improve energy efficiency of whole boilers'house,reducing the energ losses due to condensate wastes treuhg bad steam traps

AREA OF THE PLANT AFFECTED: Boilers'house (CT 1 & CT 2)

FINDINGS CONCERNING EXISTING CONDITIONS:

Due to the malfunction of existing steam traps,the yearly energy wastes are :
1. 20,145.333 GJ/y at the end of steam piping line
2. 4.842.662 GJ/y at the regulating pressure systems
3. at heat exchengers
4. The waste condensate quantity is: 57,041,000 kg/year,due to:

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: – heat exchangers:2,400kg/h x 4,767 h/y
-the end of steam pipe line: 2 x 3,000kg/h x 4,300 h/y
- regulating pressure systems: 2x 1,500 kg/h x 2,600 h/y
-To replace all used steam traps in boilers'house
-To connect the condensate return line to the condensate tank
Condensate return rate : 57,041,000 kg/y at aprox. 85°C
Fuel saving: 57,041,000 kg/y x 355.93 kJ/kg x 29.68 Nem/GJ x 100.25 lei/Nem =60,407,074 lei/y
Feed water saving : 57,041 to/y x 243.5 lei/to = 13,889,483 lei/y
Total savings (fuel & water): 60.407 lei/y + 13.889 lei/y = 74.296 million lei/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	fuel 10³Nem	water to/y	million lei/year
Baseline – existing conditions			11,167,763	103,876.	1,438.25
After recommended action			10,565,199	73,825	1,363.95
Net reduction			602,564	57,041	74.296 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost (million lei)	Notes
Engineering design	1.0	
Equipment procurement	8.342	(4,850 $ x 1,720 lei/$)
Equipment installation	1.7	
Equipment commisssioning	–	
TOTAL INSTALLED COST	11.042 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	0.3 (c)	

PAYBACK PERIOD:

$$\frac{b: 11.042}{a: 74.296 - c: 0.3} = 0.15 \text{ years} = 2 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 3

Plant name: S.C. Terapia S.A. Cluj Napoca
Address: 124, Fabricii Str., Cluj Napoca

Auditor's name: S.C. "ECO-ERG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: Adjusting of burning efficiency

AREA OF THE PLANT AFFECTED: Boilers' House

FINDINGS CONCERNING EXISTING CONDITIONS: The existing combustion analyzer is not a performant one, and there for, is not indicated for a good adjustment. The reals burning efficiency, measured in auditing period, had values between 88 – 93 %, for each measured boiler.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
To achieve a Bacharach combustion analyzer. (model 300)
To instruct the operators to work with this type of analyzer and to make daily adjustments of burning efficiency, for each boiler in use.
Total yearly gas consumption for boilers' house was 12,199,993 Nem.
Considering the possibility of an adjustment of burning efficiency, for each boiler from 91 % to 93 %, the expected yearly fuel economy will be:

$$12{,}199{,}993 \text{ Nem/y} \times \frac{.93 - .91}{.93} \times 100.25 \text{ lei/Nem} = 26{,}302{,}135 \text{ lei /y}$$

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: 10^3 Nem	Total cost million lei/year	$
Baseline – existing conditions			12,199.993	1,223.049	
After recommended action			11,937.628	1,196.747	
Net reduction			262.365	26.302(a)	15,292

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineering design	–	
Equipment procurement	4,500	Bacharach combustion analyzer model 300
Equipment installation	–	with NO_x & SO_x
Equipment commisssioning	–	
TOTAL INSTALLED COST	4,500 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	100 (c)	

PAYBACK PERIOD:

$$\frac{b: 4{,}500}{a: 15{,}292 - c: 100} = 0.3 \text{ years} = 4 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and RCG/Hagler Bailly

ACTION NO 4

name: S.C. Terapia S.A.
Address: 124, Fabricii Str., 3400 Cluj Napoca, Romania
Auditor's name: S.C. "ECO_ERG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To change the used insulations of steam and hot water distribution pipe lines system from the boilers' house to the whole plant

AREA OF THE PLANT AFFECTED: S.C. Terapia area

FINDINGS CONCERNING EXISTING CONDITIONS:

The total energy yearly distributed by boilers' house is: 313,456 GJ/y. There are losses on distribution pipe line system due to the used insulations of the pipes:

Losses on pipe lines:	Total (GJ/y)	Normal (GJ/y)	Used insulation (GJ/y)
8 bar (461 m)	1,461.3	293.1	1,168.2
4 bar (1,289 m)	11,141.6	4,509.4	6,632.2
hot water (2,113 m)	2,353.1	833.2	1,519.9

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To replace the used insulation for :

8 bar pipe line	: 461 m	– 4,317,354 lei
4 bar –"–	: 1,289 m	– 20,406,828 lei
hot water –"–	: 2,113 m	– 20,500,886 lei
	Total cost	45,225,068 lei

Estimated save energy : 1,168.2 GJ/y + 6,632.2 GJ/y + 1,519.9 GJ/y = 9,320.3 GJ/y
Specific natural gas consumption : 39.88 Nem/GJ
Actual fuel consumtion : 313,456 GJ/y x 39.88 Nem/GJ = 12,500.625x 10^3 Nem/y
Estimated fuel consumption : (313,456 GJ/y – 9,320.3 GJ/y) x 39.88 Nem/y= 12,128.932 x10^3 Nem/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: 10^3 Nem	Total cost million lei/year
Baseline – existing conditions			12,500.625	1,253.187
After recommended action			12,128.932	1,215.925
Net reduction			371.693	37.262 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	million lei Cost	Notes
Engineering design	–	
Equipment procurement	–	
Equipment installation	45,225	
Equipment commisssioning	–	
TOTAL INSTALLED COST	45.225 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	– (c)	

PAYBACK PERIOD:

$$\frac{b: 45.225}{a: 37.262 - c: \bullet} = 1.2 \text{ years} = 15 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 5

name: S.C. Terapia S.A.
ess: 124, Fabricii Str., 3400 Cluj Napoca, Romania

Auditor's name: S.C. "NCO_RRG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To reduce energy losses by changing the used steam traps

AREA OF THE PLANT AFFECTED: Calcium Pantheteonat II plant

FINDINGS CONCERNING EXISTING CONDITIONS:

The energy quantity yearly wasted due to malfunction of steam traps is: 5,913.6 GJ/y
No condensate is returned or recuperated by existing system.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To replace all used steam traps, with performant Armstrong type steam traps
To connect the condensate return line from the condensate tank to boilers' house
Condensate return rate is : 14,721.258 to/y (heat content 5,913.6 GJ/y)
Fuel saving : 5,913.6 GJ/y x 30.22 Nem /GJ x 100.25 lei/ Nem = 17.915.576 mill. lei/y
Treated water saving : 14,721.258 to/y x 243.5 lei/to = 3.584.626 mill. lei/y
Total saving (fuel & water) : 17.915 mill. lei/y + 3.584 mill. lei/y = 21.5 mill. lei/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	gas Nem/y	water to/y	million lei /year
Baseline – existing conditions			11,370,613	130,876.09	1,171.772
After recommended action			11,191,904	116,154.83	1,150.272
Net reduction			178,709	14,721.258	21.5(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost (million lei)	Notes
Engineering design	–	
Equipment procurement	5.49	
Equipment installation	2.0	(including return line to the boilers' house
Equipment commisssioning	–	
TOTAL INSTALLED COST	7.49 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	0.4 (c)	

PAYBACK PERIOD:

$$\frac{b: 7.49}{a: 21.5 - c: 0.4} = 0.36 \text{ years} = 4.3 \text{ month}$$

MMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 6

name: S.C. Terapia S.A.
ress: 1 24, Febrieii Str., 3400 Cluj Napoca, Romania

Auditor's name: S.C. "ECO_ERG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION:
To reduce energy losses due to bad insullations in the Calcium Pantotenat II plant

AREA OF THE PLANT AFFECTED:
Calcium Pantotenat II plant

FINDINGS CONCERNING EXISTING CONDITIONS:
The yearly energy losses due to bad insulation in this plant is: 1,650 GJ/y ,which from:
- 314.9 GJ/y represents losses in reactors surfaces
- 917 .8 GJ/y represents losses in steam pipe line
- 418.1 GJ/y represents losses in condensate pipe lines

Total losses : 1,650.8 GJ/y

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
To replace all used insulations on reactors surfaces, steam pipe lines and condensate pipe lines
Estimate fuel saving : 1,650.8 GJ/y x 30 .22 Ncm/y x 100.225 lei/Ncm = 5 million lei

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: Nm³/y	Total cost million lei/year
Baseline – existing conditions			11,370,613	1,139.9
After recommended action			11,320,726	1,134.9
Net reduction			49,887	5.0 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost (million lei)	Notes
Engineering design	–	
Equipment procurement	4.195	
Equipment installation	2.0	
Equipment commisssioning	0.2	
TOTAL INSTALLED COST	6.395 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	0.3 (c)	

PAYBACK PERIOD:

$$\frac{b: 6.395}{a: 5.0 - c: 0.3} = 1.4 \text{ years} = 17 \text{ month}$$

MMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 7

Plant name: S.C. Terapia S.A.
Address: 124,Fabricii Str., 3400 Cluj Napoca,

Auditor's name: S.C."ACO_ERG" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: Metering the steam heat consumption in Calcium Pantotenat II plant

AREA OF THE PLANT AFFECTED:
Calcium Pantotenat II plant – the principal pipe line distribution of steam

FINDINGS CONCERNING EXISTING CONDITIONS:

In Calcium Pantotenat II plant does not exist energy meter equipment

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To install a steam energy meter on the principal pipe line steam distribution system. Due to the fact that a steam energy meter does not produce energy saving, but it is important to monitorize the real consumptions ,the payback period of the investment is related to the energy improvements by implementing the recommandat ions.

Estimated fuel saving (5,913.6 GJ/y + 1,650 GJ/y) x 30.22 Nem/GJ x 100.25 lei/Nem =

=22.914 million lei/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: gasNem/y	Total cost million lei/year
Baseline – existing conditions			11,370,613	1,139.9
After recommended action			11,142,041	1,116.98
Net reduction			228,572	22.92 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost (million lei)	Notes
Engineering design	–	
Equipment procurement	9.46	
Equipment installation	0.2	
Equipment commisssioning	–	
TOTAL INSTALLED COST	9.66 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	0.1 (c)	

PAYBACK PERIOD:

$$\frac{b: 9.66}{a: 22.92 - c: 0.1} = 0.42 \text{ years} = 5 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 8

Plant name: S.C. Terapia S.A Cluj Napoca
Address: 124, Fabricii Str., 3400 Cluj Napoca, Romania

Auditor's name: S.C. "Eco-Arg2 Tehnologie Sreviere S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: To replace the bad steam traps in Calcium Panthotenat I Section with performant steam traps

AREA OF THE PLANT AFFECTED: Calcium I Panthotenat Plant

FINDINGS CONCERNING EXISTING CONDITIONS:

all the steam traps are wrong. They are not in function.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

This Section(Plant) consume 6,079.01 Gcal/y. This is technological heat, delivered by the boilers house, trough the 8 bar and the 4 bar steam piping distribution systems. The delivered heat price is: 21,460 lei/Gcal
The yearly delivered heat price is: 6,079.01 Gcal/y x 21,460 lei/GCal = 130.456 mill lei : 1,720 lei/$ = 75,846 $/y

The normal heat waste due to condensate (using good steam traps) is:

5,079.01 GCal/y x 12% = 729.5 GCal/y

The actuall heat waste due to condensate wastes (with existing steam traps) is: 1,915.5 GCal

The expected economy is: (1,915.5 GCal/y – 729.5 GCal/y) x 21,460 lei?GCal : 1,720 lei/$ = 14,797 $/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: GCal/y	Total cost $ /year	
Baseline – existing conditions			1,915.5	23,899	
After recommended action			729.5	9,102	
Net reduction			1,186	14,797	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineering design	–	
Equipment procurement	2,728	(8 ARMSTRONG steam traps)
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	2,728 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	– (c)	

PAYBACK PERIOD:

$$\frac{b: 2,728}{a: 14,797 - c: -} = .18 \text{ years} = 3 \text{ month}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 9

name: S.C. Terapia S.A.
ress: 124, Fabricii Str., 3400 Cluj Napoca, Romania
Auditor's name: S.C. "Eco-Erg2 Tehnologie Service S.R.L"

Report date:

ACTION NO. AND BRIEF DESCRIPTION: to insatll a steam meter on the 4 bar steam disribution piping system & a steam meter on the 8 bar steam distribution piping system

AREA OF THE PLANT AFFECTED: Calcium I Funthotenat Section (Plant)

FINDINGS CONCERNING EXISTING CONDITIONS:

It does not exist metering systems

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

The expected efficiency & economy comes fwom Action 8, considering the same economy: 14,797 $/y, but it is necessary to sumerize, by metering, the energy consumption.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: GCal/y	Total cost $ /year	
Baseline – existing conditions					
After recommended action					
Net reduction			1,186	14,797	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineering design		
Equipment procurement	10,500	(4,950$ on 4 bar piping +5,550$ on
Equipment installation	400	8 bar piping system)
Equipment commisssioning	–	
TOTAL INSTALLED COST	10,900	(b)
Estimated increase in annual (non–energy) operations and maintenance cost	300	(c)

PAYBACK PERIOD:

$$\frac{b: 10,900}{a: 14,797 - c: 300} = .75 \text{ years} = 9 \text{ month}$$

MMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 10

name: S.C. Terapia S.A.
ress: 124, Fabricii Str., 3400 Cluj Napoca, Romania

Auditor's name: S.C. "Ace-Erg" Tehnologie Service S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION:
to replace the used steam traps on 4 bar steam piping system, in ~~Calcium Gluconolactat~~ section(plant)

AREA OF THE PLANT AFFECTED:
~~Calcium~~ Calcium Gluconolactat Plant

FINDINGS CONCERNING EXISTING CONDITIONS:
All the condensate is wasted due to wron g steam traps(not in use)

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
The actuall heat consumtion, on 4 bar steam piping system is: 812.86 GCal/y. The delivered heat price is: 21,460 lei/GCal. The actuall heat wastes due to condensate wastes is: 149.3 GCal/y. The normal heat condensate wastes are: 812.86 GCAl/y x 12% = 97.56 GCal/y
Expected economy: 149.3 GCal/y – 97.5 GCal/y = 51.8 GCal/y
Money economy: 51.8 GCal/y x 21,460 lei/GCal : 1,720 lei/$ = 646 $/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: GCal/y	Total cost $ /year
Baseline – existing conditions heat waste due to condensate			149.3	1,863
After recommended action			97.5	1,217
Net reduction			51.8	646 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineenng design	–	
Equipment procurement	1,303	(Armstrong steam traps)
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	1,303 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	– (c)	

PAYBACK PERIOD:

$$\frac{b: 1,303}{a: 646 - c: -} = 2.01 \text{ years}$$

MMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO 11

name: S.C. Terapia S.A.
ess: 124, Fabricii Str., 3400 Cluj Napoca, Romania

Auditor's name: S.C. "Eco-Erg" Tehnologie Srevice S.R.L.

Report date:

ACTION NO. AND BRIEF DESCRIPTION: to replace the used steam trap on 8 bar steam piping system in

AREA OF THE PLANT AFFECTED: ~~Calcium Gluconolactat Section (plant)~~ ATOMIZING INSTALLATION

FINDINGS CONCERNING EXISTING CONDITIONS:

The actuall steam trap it is not in use

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

The normal heat waste due to condensate is 25% from the enering steam heat content in installation, and 12 – 15 % is the effective energy economy due to condensate recovering system.

Actuall wastes: 1,779.75 GCal/yx 21,460 lei/GCal : 1,720 lei/$ = 22,205 $/y

Normal Wastes: 2,977.92 GCal/y x12% = 360 GCal/y x 21,460 lei/GCal :1,720 lei/$= 4,491$/

Expected economy;1,419.75 GCal/y x 21,460 lei/GCal : 1,720 lei/$ = 17,714 $/y

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: GCal/y	Total cost $ /year
Baseline –existing conditions			1,779.75	22,205
After recommended action			360	4,491
Net reduction			1,419.75	17,714 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	$ Cost	Notes
Engineering design	–	
Equipment procurement	580	Armstrong steam trap model 814
Equipment installation	–	
Equipment commisssioning	–	
TOTAL INSTALLED COST	580 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	– (c)	

PAYBACK PERIOD:

$$\frac{b: 580}{a: 17,714 - c: -} = .03 \text{ years} = 11 \text{ days}$$

MMENDED IMPLEMENTATION SCHEDULE:

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- ROMANIA

FINAL ENERGY AUDIT REPORT

for work at

Vega, S.A.

by

Simona Parvu

Automatizari Orion, S.L.

for

Hagler Bailly Consulting, Inc.

324

ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise: S. C. VEGA S. A.

Address: PLOIESTI
ROMANIA

Telephone: 4044143921

Fax: 4044114469

Contact Person: ADRIAN VENGHERSCHI

Title: ENGINEER

Telephone:

2. Energy auditor information

Dates - audit started: 02.1994 audit completed: 05.1995

Energy audit company: S.C. AUTOMATIZARI ORION S.R.L.

Energy audit team leader: SIMONA PARVU

Address: 2000 PLOIESTI - ROMANIA
STR.MALU ROSU 99A BLOC 120C AP.25

Telephone: 4044155799

Fax: 4044114469

Se trans suite fax

325

3. Energy audit information

Energy audit focus - describe the major tasks, or areas of the plant, which were investigated during the energy audit:

- production of steam
- condensate recovery .

Energy efficiency - in the energy auditor's opinion, what were the most significant findings of the energy audit:

1. Total lack of air/fuel control.
2. After 1 week from start, the stack temperature encreases.

- over 21o deg.C., because of soot deposit in air overheaters and of salt layers from foccus, from wich we can deduce a poor quality of oil and an incomplete combustion.

New experience - in the energy auditor's opinion, what were the most significant lessons learned during the energy audit:

If you want to get savings, you must automate the process.

326

4. Energy savings

List the energy efficiency measures ALREADY IMPLEMENTED, during the course of the audit (if any): NONE. We'll be ready in about a month.

Description of measure	Fuel saved	Savings/units	Payback
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years
_____	_____	_____/year	_____years

321

7. Detailed forms - required

Complete and attach the following forms:

Fuel, steam, or heat energy consumption - 12 month audit period
(complete for each major fuel type for areas studied)

Steam generation - 12 month audit period (if plant has boiler)

Energy balance - fuel, steam or heat

Electric energy consumption - 12 month audit period

Electric energy generation - 12 month audit period (if plant has generator)

Energy balance - electrical

Action plan - summary of energy efficiency project opportunities

Recommended action - energy efficiency opportunity
(complete one for each recommended action)
(attach additional details if required to justify project)

8. Narrative

Provide any other information which would be useful to USAID and RCG/Hagler Bailly:

_____

_____

_____

_____

_____

328

FUEL, STE[redacted]R HEAT ENERGY CONSUMPTION -- 12 MONTH AUDIT PERIOD
ENERGY T[redacted] NATURAL GAS
Prepared for USAID and RCG/Hagler Bailly

Plant name: VEGA SA
Address:

Auditor's name:

Report date:

Supply contract terms:

Fuel or heat supply company's name ROMGAZ

Contract maximum demand:

~~Minimum charge (cost)~~: Rate: 55 lei/Nm^3 - [redacted]

Other:

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR. (NAME OF ENERGY FORM):

Meter Reading Mo/day/yr	Physical Consumption units = 1000Nm3	Thermal Consumption GJ	Total Cost th.lei	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index GJ per: t	Notes on plant conditions and changes
Jan/ 93	1108	37339.6	60940			1.34	
Feb/ /93	1561	52605.7	85855			2.1	
Mar/ /93	1502	50617.4	82610			2.02	
Apr/ /93	1590	65715.0	107250			2.63	
May/ /93	1820	61334.0	100100			2.45	
Jun/ /93	1850	62345.0	101750			2.35	
Jul/ /93	1760	59312.0	96800			2.28	
Aug/ /93	1748	58907.0	96140			2.3	
Sep/ /93	1665	56110.0	95810			2.18	
Oct/ /93	1724	58098.0	94820			2.31	
Nov/ /93	1614	54391.8	88770			2.17	
Dec/ /93	1641	55301.7	90255			2.04	
TOTAL	19943	672077.2	1096865				

Note: Heating degree-days based on reference temperature of ____ C

STEAM GENERA[redacted]2 MONTH AUDIT PERIOD
Prepared for USA[redacted]CG/Hagler Bailly

Plant name VEGA SA PLOIESTI
Address:

Auditor's name:

Report date:

Boiler characteristics

Name/number	CR 1	CR 2	CR 3	IPROM	STEIN MULLER
Manufacturer	VULCAN BUC. WT	VULCAN BUC. WT	VULCAN BUC. WT	VULCAN BUC. WT	GERMANY WT
Type (firetube/watertube)					
Type (saturated/superheated)	Superheated	Superheated	Superheated	Superheated	Superheated
Capacity (tons/hour)	3o t/h	3o t/h	3o t/h	2o t/h	4o t/h
Year installed	1981	1981	1981	1956	1943
Year last major overhaul	1992	199o	1991,1994	199o	1991
Operational? (yes/no)	Y	Y	N	Y	Y
Steam pressure	15 bar	15 bar	15 bar	2o bar	15 bar
Steam temperature	25o deg.C.	25o C deg.	25o C deg.	35o C deg.	35o C deg.
Stack temperature, after economizer	19o C	19o C	19o C	24o C	26o C deg.
Stack gas analysis, percent O2	min 3%	min 3%	min 3%	min 3%	min 3%
Combustion efficiency	75%	75%	75%	7o%	65%
Blowdown analysis: dissolved solids PPM	25oo	25oo	25oo	25oo	25oo

STEAM GENERATION DATA FOR 12-MONTH AUDIT PERIOD: 1993

Meter Reading Mo/day/yr	STEAM GENERATION BY PLANT: Fuel Consumption GJ	Steam Generation tons	Steam Generation GJ	Monthly Efficiency %	IMPORTS: Steam Purchased GJ	STEAM SALES AND DISTRIBUTION TO CONSUMERS: GJ	GJ	GJ	GJ	GJ	GJ	Losses & Unaccounted GJ	NOTES: Unusual Operating Conditions
Jan/ /	16o142	46174	135428	84.5									
Feb/ /	143449	4548o	133993	92.1									
Mar/ /	147125	45415	1332o2	9o.5									
Apr/ /	164982	46486	136343	82.6									
May/ /	129790	37854	1o9778	84.5									
Jun/ /	114126	3340o	96860	84.8									
Jul/ /	134297	39653	114994	85.6									
Aug/ /	132211	39249	113735	86.o									
Sep/ /	122173	36222	1o5o44	85.9									
Oct/ /	14417o	365oo	1o585o	73.4									
Nov/ /	151772	3636o	1o5444	69.4									
Dec/ /	167284	35127	1o1868	6o.8									
TOTAL		477893	1385889										

ENERGY BALANCE ELECTRICAL
Prepared for USAID and RCG/Hagler Bailly

Plant name:
Address: VEGA SA PLOIESTI

Auditor's name

Report date:

Item No.	Equipment or Process Description	Connected Load kW	Maximum Load kW	Average Load kW	Load at Peak Billing Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost /year
1.	DA2 (Atmospheric Distillation 2)	50	40	25		93025	2540
2.	DV Fuel (Vacuum distillation Fuel)	50	30	20		82026	2240
3.	DV Bulk (" " Bulk)	50	9	4		5782	156
4.	Bitum	40	21	12		65042	1775
5.	Comercial oils.	25	17	5		4051	111
6.	Hexane.	900	750	630		5154895	140728
7.	Rectification.	60	50	20		159586	4356
8.	Catalyzators.	2000	900	500		2673168	72977
9.	Manipulated production.(?)	600	2500	100		328187	8960
10.	Compressors.	1500	1000	700		3159562	86256

TOTAL PEAK DEMAND (equals maximum billing demand)

TOTAL ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)

ENERGY BALANCE – FUEL STEAM OR HEAT
ENERGY TYPE: STEAM
Prepared for USA RCG/Hagler Bailly

Plant name
Address: VEGA SA PLOIESTI

Auditor's name

Report date:

Steam balance is not in the scope of the energy audit . Readily available data are not significant. The numbers used in these Energy Audit Report are obtained by interwiews and some are estimated.

Item No.	Equipment or Process Description	Maximum Load units: t/month	Average Load units: t/mo.	Load at Peak Demand units: t/mo.	Energy Consumption units: t /year	Total Energy Cost /year th.lei
1.	DA2 (Atmospheric distillation 2)	5000	1886	2557	22635	81033
2.	DV FUEL (Vacuum distillation Fuel)	10000	2078	4890	24947	96046
3.	DV BULK	6000	705	3013	8457	32560
4.	ASPHALT	7000	2518	3488	30225	116366
5.	Comercial oils.	3000	403	1091	4848	18638
6.	Hexane.	20000	11733	15300	140794	542057
7.	Rectification.	5000	2158	2899	25897	99703
8.	Catalysers.	7000	2395	5450	28745	110668
9.	Prod.manip.	1500	1131	1223	13571	52248
TOTAL PEAK DEMAND						
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)						

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO. 1

RCG/Hagler,Bailly
TO: MR. LAURENT POMMIER

Plant name: VEGA SA
Address: 146 Valeni str., 2000 Ploieşti, ROMANIA

Auditor's name: SIMONA PARVU
Report date: 15.05.1995

ACTION NO. AND BRIEF DESCRIPTION: FUEL OIL SAVINGS

AREA OF THE PLANT AFFECTED: CR1 AND CR2 BOILERS (30 t/h, 15 bar)

FINDINGS CONCERNING EXISTING CONDITIONS:

-Gas stack analysis is performed on manual once a day (average O2%=10%)
-The average of temperature of gas stack is 230 grd.Celsius.
-The air is preheated with steam (1,3 t/h at 14,7 bar).
-Fuel oil consumption: 10350 t/year per boiler,at 154500 lei/t (jan.'95) price

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

-To be installed a fuel-air ratio control system plus O_2 control {-O2 analyzer, -controllers, -actuators}
Efficiency improvement potential:
-2,5% for each 52 gr.C.(100F) decrease in stack gas temp.
-0,25% for each 1% decrease in excess % O2.
So: Max.efficiency improvement potential:
- stack temp.: 230 grd.C.-> 120 grd.C. -> 110/52 x 2,5= 5,28%
- decrease exc.%O_2: 10% O2 -> 2% O_2 -> 10/2 x 0,25 = 1,25%
- Decrease flow of steam for preheated air: min.30%x1,3t/h=0,39t/h => 1,2%
Total efficiency improvement potential: 5,28%+1,25%+1,2%= 7,73%.
Because of problem of insufficient fuel oil atomization,we estimate an efficiency improvement about 5%.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

PER ONE BOILER	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: t/y	Total cost mil.lei /year
Baseline –existing conditions			10350	1599.075
After recommended action			9832.5	1519.12
Net reduction			517.5	79.935 (a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	3	
Equipment procurement	50	40 mil.lei-imported equipement
Equipment installation	20	
Equipment commisssioning	2	
TOTAL INSTALLED COST	75 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	6 (c)	

PAYBACK PERIOD

$$\frac{b: 75}{a: 79.935 - c: 6} = 1.01 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

333

Plant name: vEGA SA
Address: 146 Valeni str., 2000 Ploieşti, ROMANIA

Auditor's name: SIMONA PARVU

Report date: MAI, 1995

ACTION NO. AND BRIEF DESCRIPTION: BLOWDOWN

AREA OF THE PLANT AFFECTED: CR1 & CR2

FINDINGS CONCERNING EXISTING CONDITIONS:

- Boiler blowdown is performed on manually, when is necessary(required).
- 31% blowdown losses.
- Not recovering the heat of water of purge.
  About 109000 t/y water consumption per boiler.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

- To be installed an automatic boiler blowdown system and heat recovering.
- To be installed an automatic drum level.

Savings potential:

- 10% blowdown -- 1-3% heat loss (from "EFFICIENT BOILERS..")
- 20% blowdown saved by changeing from manual control to automatic adjust. (from "ENERGY MANAGEMENT HANDBOOK")

Maximal savings:

- Reducing from 31 to 11% blowdown losses =>
  => 20% of makeup water - 0,2x 109000t/y x 850 lei/t = 18.53 mil.lei/y.

2 x 2% = 4% efficiency improvement.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

FOR 1 BOILER	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: fuel t/y	Fuels, heat and steam: water t/y	Total cost mil.lei /year	
Baseline – existing conditions			10350	109000	1691	
After recommended action			9832.5	87200		
Net reduction			517.5	21800	98.5	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost	Notes
Engineering design	10	
Equipment procurement	70	(There is only 1/3 from heat exchanger's price)
Equipment installation	40	
Equipment commisssioning	4	
TOTAL INSTALLED COST	124	(b)
Estimated increase in annual (non–energy) operations and maintenance cost	6	(c)

PAYBACK PERIOD:

$$\frac{b: 12.4}{a: 98.5 - c: 6} = 1.34 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

RECOMMENDED ACTION – ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAD and RCG/Hagler Bailly

ACTION NO M

Plant name: VEGA SA
Address: PLOIESTI, ROMANIA
Auditor's name: SIMONA PARVU
Report date: 05.1995

ACTION NO. AND BRIEF DESCRIPTION: TOTAL OIL (FUEL OIL) SAVINGS

AREA OF THE PLANT AFFECTED: CR BOILERS

FINDINGS CONCERNING EXISTING CONDITIONS:
- Gas stack analysis is performed on manual once a day.
- Boiler blowdown is performed on manual, when is necessary.
- Existing instrumentation cannot provide all necessary measurements to compute the real boilers efficiency and thermal energy losses due to insulations system defficiency. - Average plant eff.: 80%.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
- To be installed a fuel-air ratio control system plus O2 trim control.
- To be installed an automatic boiler blowdown system with heat recovering.
- To be inst. an automatic drum level control.
- To be inst. an automatic control system for steam pressure.

Expected savings:
- 5% - improvement from combustion control.
- 4% - from recovering the heat of 20% blowdown.
  18.53 mil.lei/year - 20% economy of makeup water.
- 1% - complete automation of boiler.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

FOR 1 BOILER	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: fuel t/y	Fuels, heat and steam: water t/y	Total cost mil.lei /year	
Baseline – existing conditions			1035o	109ooo	1691	
After recommended action			9315	872oo	1513.5	
Net reduction			1o35	218oo	178.5	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost		Notes
Engineering design	15		
Equipment procurement	14o		
Equipment installation	75		
Equipment commisssioning	7		
TOTAL INSTALLED COST	232	(b)	
Estimated increase in annual (non–energy) operations and maintenance cost	14	(c)	

PAYBACK PERIOD:

$$\frac{b: 232}{a: 178.5 - c: 14} = 1.41 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

335

Plant name:
Address: VEGA SA PLOIESTI

Auditor s name:

port date:

ACTION NO. AND BRIEF DESCRIPTION: RETURN STEAM CONDENSATE TO BOILER

AREA OF THE PLANT AFFECTED: CATALYSERS

FINDINGS CONCERNING EXISTING CONDITIONS

- No condensate return is recovered.
- Existing installation is broken and uncompleted.

Fuel oil price: 154500 lei/t (1995)

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

- To buy and install new pomps.
- To connect the existing condensate return line to the condensate tank.
- To insulate the existing condensate return line.
- To insulate the condensate tank.

Steam pressure: 5.5 bar.
Saturated steam enthalpy at 5.5 bar (80psig): 2,755 kJ/kg.
Make-up water temperature: 11 C.deg.
Differential enthalpy for steam generation with no condensate return:
2,755 - 4.19 x 11 = 2,709 kJ/kg.
Differential enthalpy for steam generation with condensate return (40% at 65C
2,755 - 4.19 (11 x 0.6 + 65 x 0.4) = 2618.4

Efficiency gain: (2,755 - 2,618)/ 2,755 = 4.9% .

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: t/y	Total cost mil.lei /year	
Baseline – existing conditions			10350	1599	
After recommended action			9944,2	1	
Net reduction			405.8	62.7	(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement		
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	(b)	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD

b: years

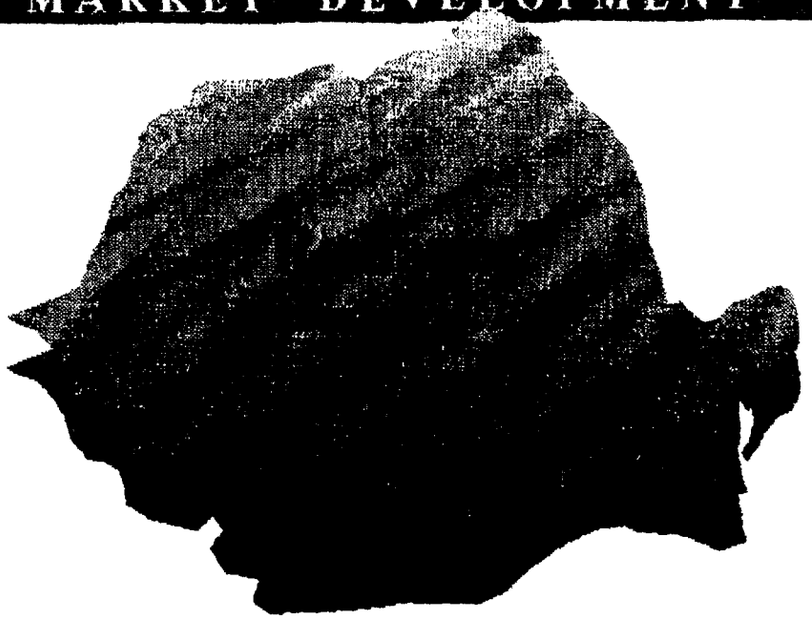
a: – c =

RECOMMENDED IMPLEMENTATION SCHEDULE:

336

ENERGY EFFICIENCY

MARKET DEVELOPMENT



Sponsored by:

United States Agency for International Development

Presented by:

Association of Energy Engineers

ENERGY EFFICIENCY MARKET DEVELOPMENT IN ROMANIA
Sponsored by the US Agency for International Development and the Association of Energy Engineers

PROGRAM REVIEW MEETING - ROMANIA
November 18, 1996

Location: Bucharest Hotel

Attendees: Certified Energy Managers; Plants participating in USAID industrial energy efficiency projects; Representatives of the Ministry of Industry; USAID and its contractors.

Objective: To discuss and review energy efficiency activities, results, and future directions of: (1) support to the development of local energy service companies; (2) establishment of Romanian Chapters of the Association of Energy Engineers; and, (3) energy efficiency project demonstrations.

0830-0900	Registration	
0900-0915	Introduction and Welcoming remarks	Mihail Zdravcu and Georgetta Padureanu, AEE Romania
0915-0930	AID Romania - Country Program Description	Roberto Figueredo, USAID, Romania
Review of Project Results		
1.	**Demonstration Projects at Industrial Plants**	**Moderator:** Hagler Bailly
0930-1045	Roundtable with managers from plants participating in demonstration projects **Topics:** Concrete results achieved by the plants with the help of the USAID Program Results and lessons learned Benefits of hiring ESCOs	
1045-1100	**Coffee Break**	
1100-1200	**Summarize Results of the Roundtable Discussion**	**Moderator:** Hagler Bailly
12:00-1300	**Luncheon with Keynote Speaker** AEE Organization and Future Trends	Al Thumann, AEE
2.	**Support to Energy Service Companies (ESCOs)**	**Moderator:** Hagler Bailly
1300-1315	Introduction (Results of the ESCO Survey, Highlight of some Results and Trends)	Laurent Pommier
1315-1345	What it Takes to Succeed as General Manager of an ESCO	Peter Garforth
1345-1400	USAID ESCO Training Program	Dr. Aureliu. Leca - Invited
1400-1415	Open Discussion	
3.	**Establishment of AEE Chapters**	**Moderator:** Al Thumann, AEE
1415-1445	AEE Chapters Status Report	Mihail Zdravcu, AEE Bucharest Georgetta Padureanu, AEE Cluj
1445-1500	Open Discussion	
1500-1515	**Coffee Break**	
4.	**Financing Energy Efficiency - Future Directions**	**Moderator:** Hagler Bailly
1515-1530	Global and regional trends in energy efficiency financing	Laurent Pommier
1530-1545	EBRD Financing Mechanisms	Dr. Virgil Musatescu, EBRD
1545-1615	Group Discussion	*Invited: Dr. Ionut Purica, EBRD* *Emilian Radu, Romanian Commercial Bank* *Rasvan Radu, Romanian Commercial Bank*

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5.	**Discussion of Energy Efficiency Issues and Future Cooperation**	**Moderator:** Robert Archer, USAID WDC
1615-1630	Strategies for overcoming obstacles to Energy efficiency projects	Elektrotek (Scott Vicary)
1630-1700	Group Discussion	
2000	Dinner	Sponsored by Hagler Bailly

ENERGY EFFICIENCY MARKET DEVELOPMENT IN ROMANIA
Sponsored by the US Agency for International Development
AND THE ASSOCIATION OF ENERGY ENGINEERS

OPEN CONFERENCE - ROMANIA
November 19, 1996

Location: Bucharest Hotel

Attendees: Representatives from industrial and institutional enterprises nominated by the AEE members; Plants and vendors who participated in USAID Industrial Energy Efficiency Project and Emergency Energy Project; AEE members; Certified Energy Managers; Representatives from Government Ministries and agencies, utilities, and other assistance programs; USAID and its contractors.

Objective: To promote a market-oriented approach to energy efficiency.

0800-0830	Registration	
0830-0840	Welcoming Remarks	Mr. Rotaru, ARCE
0840-0850	Role of USAID in Romania	Roberto Figueredo, USAID
0850-0900	AEE in Romania	Mihail Zdravcu and Georgetta Padureanu

Results of Demonstration Projects — **Moderator:** Hagler Bailly

ESCO presentation with Plant Energy Manager

	CEM	Plant
0900-0930	Mihail Zdravcu	Stirom, Matizol
0930-1000	Vasile Grasin and Georgetta Padureanu	Terpia, Borsa
1000-1015	Haralambie Pavel	Muha
1015-1030	**Coffee Break**	
1030-1045	Simona Parvu	Vega
1045-1115	Florin Mihailescu	Danubiana, Mobins
1115-1200	Open Discussion	
1200-1330	**Luncheon with Keynote Speaker** Developments in the Global Energy Efficiency Market Concurrent Press Conference	Al Thumann, AEE

AEE Chapters — **Moderator:** Al Thumann, AEE

1330-1345	Presentation of AEE	Al Thumann, AEE
1345-1400	AEE Chapters in Romania	Mihail Zdravcu, AEE Bucharest Georgetta Padureanu, AEE Cluj
1400-1415	Open Discussion	

Financing Energy Efficiency Projects in Romania — **Moderator:** Hagler Bailly

1415-1430	Global and regional trends in energy efficiency financing	Laurent Pommier
1445-1515	European financing mechanisms	Dr. Virgil Musatescu, EBRD *Invited: Dr. Ionut Purica, EBRD* *Emilian Radu, Romanian Commercial Bank* *Rasvan Radu, Romanian Commercial Bank*

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Objective: To promote a market-oriented approach to energy efficiency.

1515-1530	**Coffee Break**	
1530 -1620	**Concluding Remarks**	Robert Archer, USAID WDC Roberto Figueredo, USAID Mihail Zdravcu, AEE Bucharest Georgetta Padureanu, AEE Cluj
1620 - 1830	**Conference and Exhibition Networking Meeting**	

DEZVOLTAREA PIETEI LIBERE PENTRU EFICIENTA ENERGETICA IN ROMANIA
Sponsori : Agentia pentru dezvoltare internationala din Statele Unite(USAID) si Asociatia Inginerilor Energetici cu sediul central in Atlanta SUA(AEE)

PROGRAMUL SEDINTEI DE ANALIZA
18 Noiembrie 1996

Locul : Hotel Bucuresti

Participanti : * Managerii Energetici autorizati de AEE (CEM) ;
* Societatile Comerciale din Romania, participante in proiectele de Eficientizare Energetica Industriala de USAID ;
* Oficialitati din tara ;
* USAID.

Obiectivul : Discutarea si analizarea rezultatelor Programului USAID din Romania pentru Eficienta Energetica Industriala inclusiv :
1. Suportul pentru dezvoltarea societatilor locale de servicii in domeniul energiei (ESCO) ;
2. Infiintarea AEE a filialelor din Romania (Bucuresti) si Cluj - Napoca ;
3. Proiectele demonstrative pentru Eficienta Energetica.

0830-0900	Inregistrarea	
0900-0915	Introducere si cuvant de bun venit	Mihail Zdravcu si Georgeta Padureanu, AEE Romania
0915-0930	USAID Romania - trecere in revista a programului	D-nul Roberto Figuerento, Reprezentantul USAIDdin Romania

Trecerea in revista a rezultatelor proiectelor

1. Proiectele demonstrative din Societatile industriale

0930-1045 Masa rotunda cu Managerii din Societatile participante la proiectele demonstrative
Teme : * Rezultate concrete obtinute de societati cu ajutorul Programului USAID ;
* Ce a functionat bine ;
* Cum ar fi fost sa se faca mai bine ;
* Avantajele conlucrarii cu ESCO.

1045-1100 **Coffee Break** (Pauza pentru servirea unei cafele etc.)

1100-1200	Sumarizarea rezultatelor discutiilor de la masa rotunda	**Moderator :**Hagler Bailly
1200-1300	Masa urmata de cuvantarea cu tema :Organizatia AEE si tendinta in viitor	Al Thumann, PE, CEM, Director executiv AEE

2. Suportul dat ESCO(Societatile din Romania care se ocupa cu servicii in domeniul energiei) **Moderator :**Hagler Bailly

1300-1315	Introducere (trecere in revista a rezultatelor obtinute de societatile ESCO, scoaterea in evidenta a unor rezultate mai importante si tendintele)	**Moderator :**Hagler Bailly
1315-1345	Ce trebuie sa cunoasca si calitatile unui General Manager a unei societati ESCO	Peter Garfoth
1345-1415	Programul USAID de Training a ESCO	Se va anunta
1400-1415	Discutii libere	

3.	**Infiintarea AEE-filialele din Romania**	**Moderator:**Al. Thumann. AEE
1415-1445	Raportul AEE Chapter Romania Raportul AEE Chapter Cluj-Napoca	Mihail Zdravcu. CEM Georgeta Padureanu. CEM
1445-1500	Discutii libere	
1500-1515	**Coffee Break**	
4.	**Finantarea Eficientei Energetice-Directii in viitor**	**Moderator:** Hagler Bailly
1515-1545	Tendinte globale si regionale in finantarea eficientei energetice	Laurent Pommier Dir.Gen. Cornel Rotaru. ARCE Consultant BERD: V. Musatescu
1545-1615	Discutii libere in grup	
5.	**Discutarea problemelor legate de Eficienta Energetica si a cooperarii in viitor**	**Moderator:**Robert Archer.USAID WDC
1615-1630	Programul plan de asistenta tehnica a USAID in Romania	Electrotek SUA
1630-1700	Discutii libere in grup	
2000	**Dinner - Sponsorizat de Hagler Bailly**	

DEZVOLTAREA PIETEI LIBERE PENTRU EFICIENTA ENERGETICA IN ROMANIA
Sponsori: Agentia pentru Dezvoltare Internationala din Statele Unite(USAID) si Asociatia Inginerilor Energetici cu sediul central in Atlanta SUA(AEE)

CONFERINTA DESCHISA
19 Noiembrie 1996

Locul : Hotel Bucuresti

Participanti :
* Reprezentanti din societati industriale si de stat nominalizate de membrii AEE din Romania ;
* Societati comerciale si furnizoare de echipamente care au participat la proiectele demonstrative din programul USAID de Eficienta Energetica si Proiectele Energetice de Urgenta ;
* Membrii AEE;
* Certified Energy Managers-CEM din Romania ;
* Reprezentanti din Ministere si Agentii ;
* Utilitati si alte programe de asistenta ;
* USAID si contractorii sai.

Obiectivul : Promovarea unei piete libere, legata de Eficienta Energetica.

0800-0830	Inregistrarea la secretariat	
0830-0840	Cuvant introductiv	Dicu Constantin, Secretar de Stat
0840-0850	Rolul USAID in Romania	D-nul Roberto Figueredo, Reprezentantul USAIDdin Romania
0850-0900	AEE Romania	Mihail Zdravcu si Georgeta Padureanu

Rezultatul Proiectelor Demonstrative — **Moderator:**Hagler Bailly

Prezentarea ESCO, cu Managerii Energetici din societatile participante

	CEM	**Plant**
0900-0930	Mihail Zdravcu	Stirom, Matizol
0930-1000	Vasile Grasin si Georgeta Padureanu	Terapia, Borsa
1000-1015	Haralambie Pavel	Muha
1015-1030	**Coffee Break** (Pauza pentru servirea unei cafele etc.)	
1030-1045	Simona Parvu	Vega
1045-1115	Florin Mihailescu	Danubiana, Mobins
1115-1200	Discutii libere	
1200-1330	Masa urmata de Conferinta "Dezvoltari in Piata Libera Globala a Eficientei Energetice" (in paralel Conferinta dePresa)	Al. Thumann, AEE

AEE Chapters (filialele din Romania) — **Moderator:**Al. Thumann

1330-1345	Prezentarea AEE	Al. Thumann, AEE
1345-1400	Filialele AEE din Romania	Mihail Zdravcu, AEE Bucuresti Georgeta Padureanu, AEE Cluj
1400-1415	Discutii libere	

Finantarea in Romania a Proiectelor de Eficienta Energetica		**Moderator:**Hagler Bailly
1415-1430	Tendinte globala si regionale in finantarea Eficientei Energetice	Laurent Pommier
1445-1515	Mecanismul de finantare European	Steven Fawkes, Consultant Min.Industrei Ionut Purica, Consultant BERD
1515-1530	**Coffee Break**	
1530-1620	Concluzii	Robert Archer, USAID WDC Roberto Figueredo, USAID Mihail Zdravcu, AEE Bucharest Georgeta Padureanu, AEE Cluj
1620-1830	Vizitarea expozitiei cu echipamente expuse de firmele din tara si SUA	

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Developments in the Global Energy Efficient Marketplace

Part 1: The Association of Energy Engineers

Albert Thumann, P.E., CEM, Executive Director of the Association of Energy Engineers

The Beginning

In 1977 the role of the energy engineer and the energy manager was not defined. When the Association of Energy Engineers (AEE) embarked on its mission to promote the information exchange in the emerging energy marketplace it also needed to define the role of the energy engineer manager. The energy engineer emerged as the systems integrator who utilized all technologies from lighting to heating and air conditioning to makeing buildings and plants more efficient. The energy manager needed a fundamental understanding of the efficient technologies involved but also needed expertise in financing energy projects and purchasing fuels. The Association of Energy Engineers is comprised of engineers and managers from all disciplines including professionals with electrical, mechanical and process backgrounds. In addition, AEE nembers come from various segments of the marketplace as indicated in Figure 1.

FIELD OF EMPLOYEMENT	
	27.7
Consultant	4.4
Equipment Supplier	.3
Architect	9.7
State, Local or Federal Government	8.3
Contractor	2.2
Educator & R&D	26.8
Energy User (Building, Plant & Facilities)	3.1
Other	15.6
Utility & Energy Supplier	2.0
Developer & IPP	
PERCENT	

Figure 1: Field of Employment

The true strength of AEE is that it brings together consultants, end users and utilities in an important forum to share information. The mission of AEE is to promote the scientific and educational aspects of those involved in the energy industry. AEE growth has truly been outstanding as indicated in Figure 2.

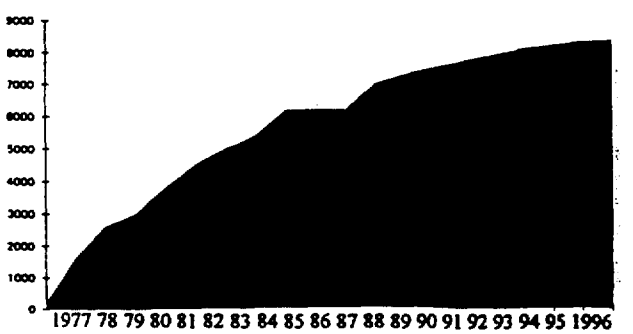


Figure 2: AEE Membership Growth

Today AEE membership includes 8,338 members in 71 countries. The Association of Energy Engineers is a non-profit professional society continues to provide the leadership role in the energy industry.

Chapters

The Association of Energy Engineers chapter network includes 56 chapters comparing 39 in the United States and 17 international cities. Members have the opportunity to meet with professionals in their area, participate in meetings and address issues of importance in their areas. In addition, chapters have the opportunity to network with professionals in other chapters. Each year at the World Energy Engineering Congress, the Chapter Leadership meeting is held. Workshops to help chapters reach their potential are presented at this time.

The AEE international chapters continue to grow. International Chapters include:

Brazil
British Columbia, Canada
ılgaria
ıracas, Venezuela
Hong Kong
Hungary
Japan
Malaysia
Mexico (Guadalajara)
Mexico (Monterrey)
N. Alberta, Canada
Netherlands
Philippines
Romania (Bucharest)
Romania (Cluj Napoca)
Trinidad
Ukraine

Certification

Certification is an essential ingredient in developing qualified energy engineers and managers. The Association of Energy Engineers has developed the Certified Energy Managers Program. The below highlights the Association of Energy Engineers certification program.

AEE Certification Programs

"E is recognized as a leader in promoting high ,ality industry standards and develops certification programs to meet industry needs.

Why Become Certified?

Certification is part of total quality management. When an individual becomes certified in a designated field it recognizes the professional achievement in the eyes of colleagues, governmental agencies, perspective employees and clients. Certification establishes a standard of professional competence which is recognized throughout the industry and inspires the development through encouragement of long-term career goals. Certification also promotes quality through continuing education to assure a high level of competence in constantly changing fields and enhances the status of professionals in the industry.

What Certification Programs Does the Association of Energy Engineers Offer?

Industry demands specialization and certification needs to meet these requirements. The Association of Energy Engineers offers certification programs in lighting and specialized areas. The most important certification program is the Certified Energy Managers Program (CEM) and is described below.

Certified Energy Managers Program (CEM)

Started in 1981 the CEM program now includes 2,300 professionals and represents virtually a who's who in energy management. The CEM program has been used as follows.

- The US Agency for International Development has used the CEM program in the Ukraine, Romania, Hungary and Bulgaria to develop qualified energy service professionals.
- Companies such as Johnson Controls and Honeywell have used the CEM program as a job requirement in performance contracting.
- The state of Kentucky has recognized the CEM program as a requirement to do performance contracting.
- The US Government recognizes the CEM as meeting the training requirements of facility federal managers.
- Utilities such as Florida Power & Light, Detroit Edison, El Paso Electric, Commonwealth Edison, Niagara Mohawk and United Illuminating are using the CEM as part of their total quality management efforts.
- To bid on various government projects the candidate had to be a CEM.

In addition, the Association of Energy Engineers offers the following certification programs.

Certified Lighting Efficiency Professional (CLEP)

The CLEP program was developed out of the need to identify specialists in lighting efficiency. The CLEP program includes 435 professionals who have been certified and are recognized as meeting the certification requirements of the EPA Green Lights Lighting Management Company Ally Program. The program includes a two-day refresher course and a four hour examination.

Certified Indoor Air Quality Professional (CIAQP)

The CIAQP is a program designed to meet the growing needs of businesses to identify qualified indoor air quality practitioners who solve the problems created by "sick building syndrome" as well as facility managers who are responsible for operating healthy buildings while maintaining comfort and reducing energy costs. The program includes a two-day refresher course and a four hour exam.

Internet Access

The Association of Energy Engineers has established a home-page on the internet. The address is *aeecenter.org*. The home page is illustrated in Figure 3. Information on seminars, conferences and shows, as well as a current list of chapters.

The Association of Energy Engineers is a society of over 8,000 professionals involved in all areas of the energy field. With a 19-year track record of excellence in service to its membership of energy and environmental engineering professionals, AEE is dedicated to remaining in the forefront of a rapidly changing network of industries. To serve its members, AEE seeks to provide practical direction and reasonable solutions in areas of energy management strategies, contingency planning and viable alternatives for dealing with fuel price increases in a positive way.

Figure 3. Association of Energy Engineers Home-Page

The World Energy Engineering Congress

The 20th World Energy Engineering Congress (WEEC) will be held at the Georgia World Congress Center in Atlanta, Georgia, USA, November 19-21,1997. This is the most important event AEE presents each year. In 1997 WEEC will be expanded to include special events coinciding with AEE's 20th anniversary. The WEEC features eleven conference tracks, 44 sessions, 180 speakers, networking banquet and luncheons and the big 500-booth exposition.

Collocated events include the Energy Service & Power Marketing Center, Plant & Facilities Expo, Strategic Gas Forum, and the Environmental Technology Expo. In addition, the annual Executive Committee and Chapter Leadership meetings are held.

Continuing Education Programs

In 1997 AEE has added a complete line-up of new seminars. These seminars are presented around the United States and can be conducted as an in-house course in any location around the world. AEE has presented these programs in the Ukraine, Eastern Europe, Australia and cities around the world. Seminars for 1997 include:

- Measurement & Verification
- Performance Contracting
- Financing Energy Projects
- Applying HVAC Pump Systems
- Optimizing the Performance of Motors & Drives
- Upgrading HVAC and Central Plants

Awards Program

The Association of Energy Engineers gives special recognition both to individuals and companies who have demonstrated notable contributions to the profession and exceptional service to the Association. This recognition is awarded on both a chapter basis and as part of AEE's international awards. Award plaques are available from AEE for chapter presentation. The international awards are presented at the AEE Awards banquet as part of the World Energy Engineering Congress. In 1996, AEE created the International Energy Project of the Year to recognize an energy management project developed and installed outside the United States. The project is recognized for its first-of-a-kind approach in the country where it is or will be installed.

Publications

AEE members receive, as part of their membership, complimentary subscriptions to the following:

- **Energy Engineering** published since 1904. This authoritative journal's editor is Dr. Wayne Turner, a noted author and expert in the field. Each issue is 80 pages published in a 6x9 format and issued six times a year.
- **Strategic Planning for Energy & the Environment** is published quarterly and edited by William Payne. Each journal is 80 pages and published in a 6x9 format and covers the

Development in the Global Energy Efficient Marketplace

Part 2: Where is the industry heading

Albert Thumann, P.E., CEM, Executive Director of the Association of Energy Engineers

Where is the Industry Heading

The United States spends; $500 billion for energy, $210 billion for buildings, $180 billion for transportation and $110 billion on industry annually. On an international scene, economic growth in developing countries is causing increases in energy use. There is world wide concern that increase energy use causes environmental degradation and global warming. The Association of Energy Engineers annually surveys its members to find out market trends and evaluate the effectiveness of various energy products. The results below are based on 949 responses and was issued this year.

Product Evaluation & Installation

The reason energy management technologies makes ·ood sense is because of high use satisfaction. Energy Ianagement Systems, Lighting Efficiency Products and Motors and Drives are effective strategies as indicated in Figure 4.

	Very Good	Good	Poor	Very Poor
Energy Management Systems	38.6%	53.9%	7.0%	.5%
Thermal Storage	11.2%	58.0%	27.8%	3.0%
Lighting Efficiency Products	56.2%	39.3%	4.4%	.1%
Waste Heat Recovery	17.1%	57.2%	24.9%	.8%
Cogeneration	17.6%	51.2%	28.1%	3.2%
Waste-to-Energy Plants	10.0%	39.3%	43.3%	7.4%
Efficiency Motors	29.9%	59.7%	9.8%	.7%
Adjustable Speed Drives	36.6%	54.0%	8.8%	.6%
Interruptible Power Supplies	12.2%	53.7%	31.7%	2.3%
Gas Cooling Equipment	10.4%	49.6%	36.3%	3.7%

Figure 4: Product Evaluation

Market trends and what technologies are being adopted are illustrated in Figure 5. Again, it can be seen that products with highest user satisfaction are planned for installation during the next twelve months.

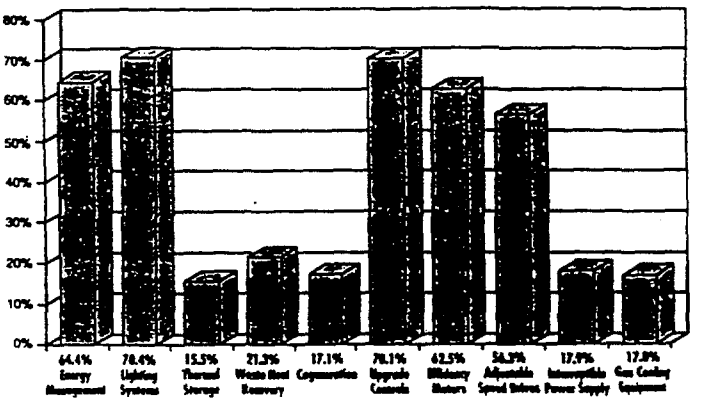


Figure 5: Products Planned for Installation in Next 12 Months

Selling Energy Management Services

In selling energy management services there are several client issues:

- User Satisfaction with Products
- Savings Achieved
- Energy Awareness.

The AEE survey indicates that the results of installing energy· management systems have truly been outstanding; 39% have saved their companies $2 million or more and 8.2% have achieved and energy cost reduction of 35% or more. These results are truly outstanding as illustrated in Figure 6 & 7.

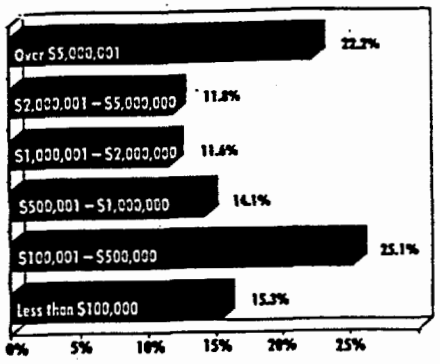


Figure 6: Accumulated Energy Costs Saved

% Savings	% Respondents
0-10%	25.4
11-15%	25.7
16-20%	20.1
21-25%	10.2
26-30%	7.3
31-35%	3.1
36-40%	3.6
41-45%	2.4
46-50%	1.2
Over 50%	1.0

Figure 7: Estimated Accumulated Savings Since Program Started

Impact of Utility Restructuring

The utility marketplace is radically changing from a year ago. Utilities are merging and acquiring new companies and providing services to their customers. The reason is clear that utility customers would switch if prices were lower as indicated in Figure 8.

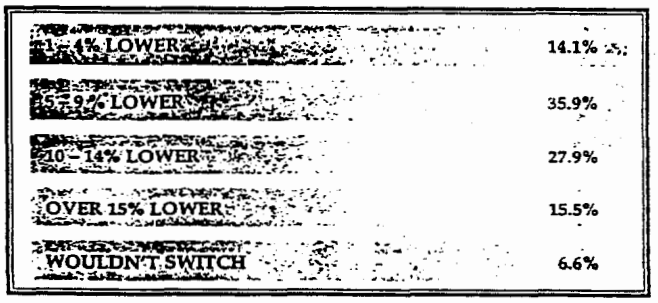


Figure 8: Would You Buy Power from Another Supplier if Utility Rates Were Lower

Cogeneration & Independent Power

The survey indicated that 52.1% felt that international was the best market for cogeneration and independent power. Figure 9 shows international locations where good cogeneration and independent markets exist.

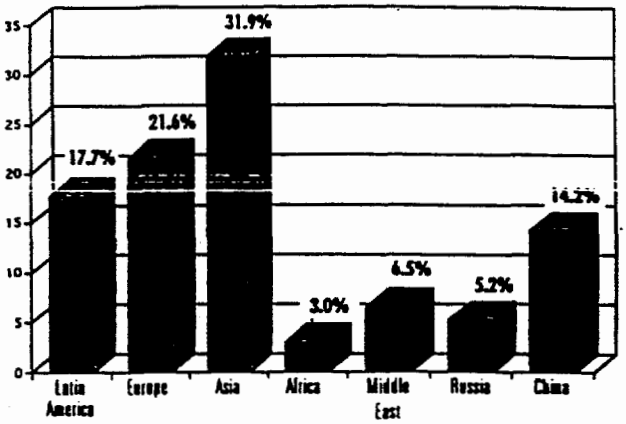


Figure 9: International markets for Cogeneration & Independent Power

Measurement & Verification

In 1995, North America installed $5 billion in efficiency equipment for their buildings in order to save money and conserve energy and water. If all cost effective efficiency investments were made in public and commercial buildings, the United States alone would save $20 billion per year on energy bills, create 100,000 jobs and significantly reduce pollution. When firms invest in energy efficiency they want to know how much they saved and how long their savings will last. Unfortunately until now efficiency financing has been limited because investors and financial institutions have lacked reliable means to measure and ensure energy savings from efficiency investments. To overcome this barrier, the Department of Energy has led the development of the North American Energy Measurement and Verification Protocol. This document provides a common way to carry out and measure savings and will greatly increase the quality and reliability of energy efficiency investment.

This protocol can be obtained electronically on the World Wide Web by accessing the US Department of Energy's "Energy Efficiency and Renewable Energy Network (EREN) homepage at *www.eren.doe.gov*.
A free copy is availabe from Scott McGaraghan:

US Department of Energy Contractor
Room 8 F089
1000 Independence Ave. SW
Washington, DC 20585
Scott McGaraghan@hq.doe.gov
Fax: (202) 586-1737

The Bridge to the Energy Future

The energy industry is alive, well and growing. High use satisfaction with energy management technologies and new measurement and verification protocols make investments in this industry a wise choice. The Association of Energy Engineers and its chapters in Eastern Europe are playing a key role in the dissemination of energy efficiency and in speeding up the adoption of technologies that improve a company's profitability. The Association of Energy Engineers's members and certified energy managers are instrumental in building the energy infrastructure in Eastern Europe and providing a bridge to our energy future.

As outlined before ARCE is now moving towards investment through a set of projects aimed at helping enterprises identifying, evaluating and implementing investments in energy efficiency projects. There are major problems on both the supply and demand sides of project financing and these problems are being addressed through the various projects including:

- Integrated Energy Services; this 2 year project is providing assistance to about 10 companies in order to improve their energy management, install monitoring systems, identify and evaluate projects and seek funding for investment.

- Financing energy efficiency projects for large industrial consumers; this project is working with a long list of 30 large consumers to identify and evaluate energy efficiency projects with a capital cost greater than $5 million. The companies will be assisted with project preparation and negotiations with lenders, particularly the EBRD.

- Energy Conservation Financing Scheme (ECFS); this involved EBRD making a $10 M credit line available to a local Romanian bank specifically for investing in energy efficiency projects. The PHARE programme is also spending 2.5 MECU on this project to provide a grant element in order to lower the effective interest rate as well as providing Technical Assistance in evaluating projects.

ECFS - PROJECT DESCRIPTION.

The current energy efficiency financing situation in Romania can be characterised as a "market failure". Technically viable and financially attractive projects exist in creditworthy industrial enterprises with a need for capital. However, local capital markets are not responding to this need due to a host of factors, including shortage of resources for long term lending and unfamiliarity with energy efficiency project evaluation. This project aims to partially solve the "market failure" by providing mid and long term (hard currency) capital investment for energy conservation projects.

For over 100 companies the BCEOM consortium (including Forenerg and Coopers & Lybrand as subcontractors) assessed:

- the technical viability and financial performance of the proposed energy conservation projects;
- the creditworthiness of the proposed host firm; and ,
- the economical and environmental impact of their project.

What it takes to succeed as the General Manager of an ESCO

Energy Efficiency Market Development in Romania
Bucharest, November 1996

Peter Gerforth
Energy Efficiency Consulting

Topics

- Understand the role of the ESCO
- Pick you customers with care
- Pick your projects with care
- Understand the cash flows
- Manage the phases of a project
- Pick your people with care
- Don't be afraid to team
- Be commited continuous improvement
- Don't be afraid of profit

35

Understand the role of the ESCO

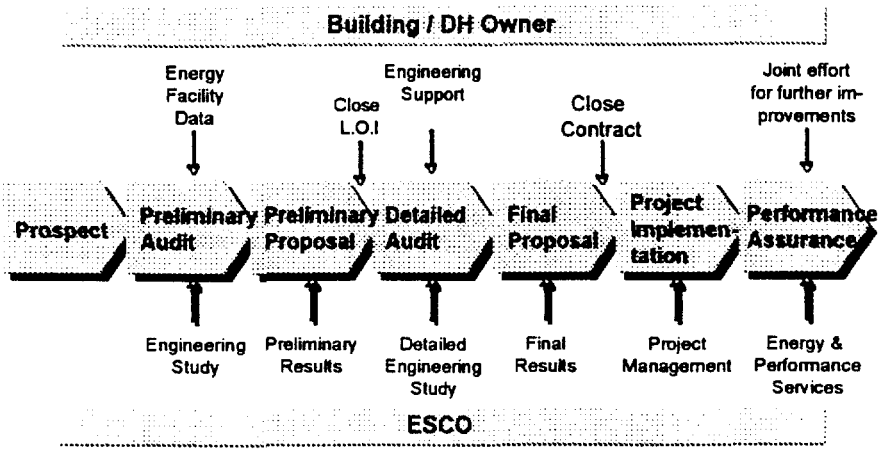
- **An ESCO is not an equipment supplier, a bank, an engineering contractor, ...**
- **An ESCO is all of these together...**
- **An ESCO is an energy solutions provider**
  - Provides investment upgrade infrastructure
  - Manages desgn and installation
  - Guarantees performance in financial terms
  - Ensures continuing perfromance
- **An ESCO is partner with customer for many years**
- **An ESCO selects projects with profit in mind!**

The energy efficiency project team

A long-term marriage

356

EPC Process



Pick you customers with care

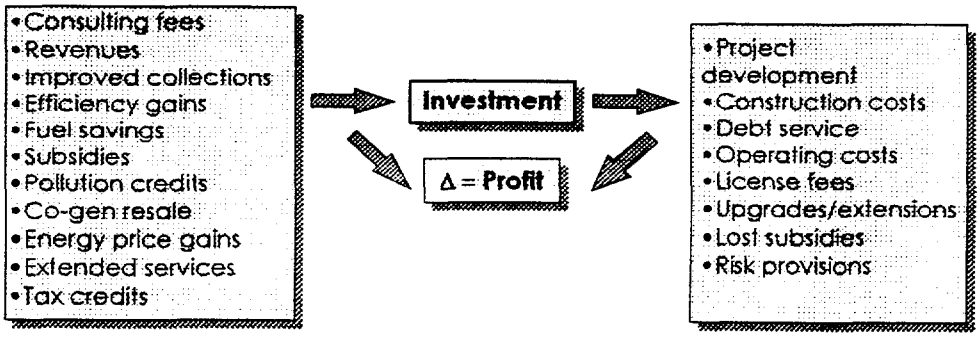
- Does your customer....
  - Control the energy cash flow?
  - Have an energy strategy?
  - Demonstrate good business ethics?
  - Show a desire to be competitive ?
  - Have good economic prospects?
  - Possess a creditworthy image?
  - Accounts are open for investor and ESCO?
  - Be prepared to work with private partners?
  - Be open to work with foreign partners?

Pick your projects with care

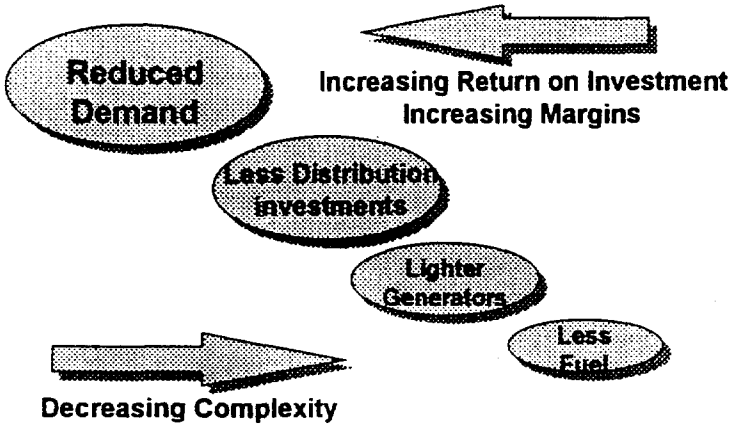
- **Generally EPC projects work best when:**
  - Customer must reduce energy costs
  - Customer can resell energy savings
- **Be realistic about the size you can handle**
- **Understand the time it takes to prepare a project**
- **Understand the costs it takes to prepare a project**
- **Budget the preparation costs carefully**
- **Project should have a clear financial benefit for all customer, ESCO and Investor**
- **ESCO businesses generally fail when built on subsidies**

Understand the cash flows

- **ESCO invests in efficiency upgrade**
- **Repays investment through reduced operating costs**
- **Savings in excess of financing costs generate profits**

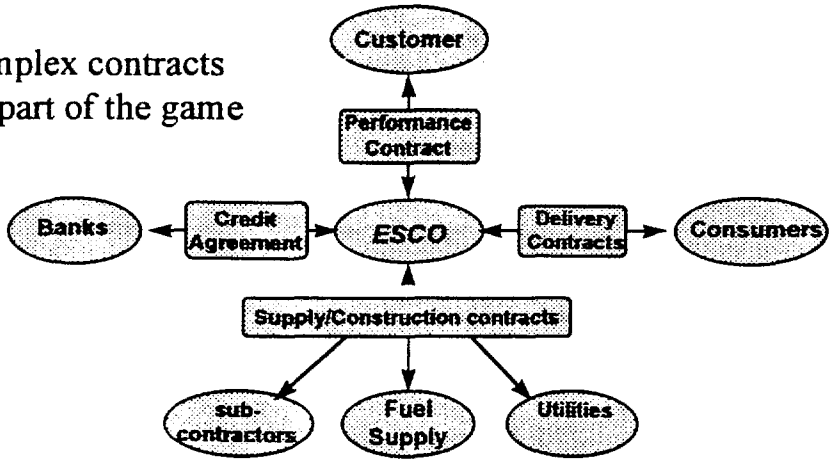


Manage the Phases of a Project

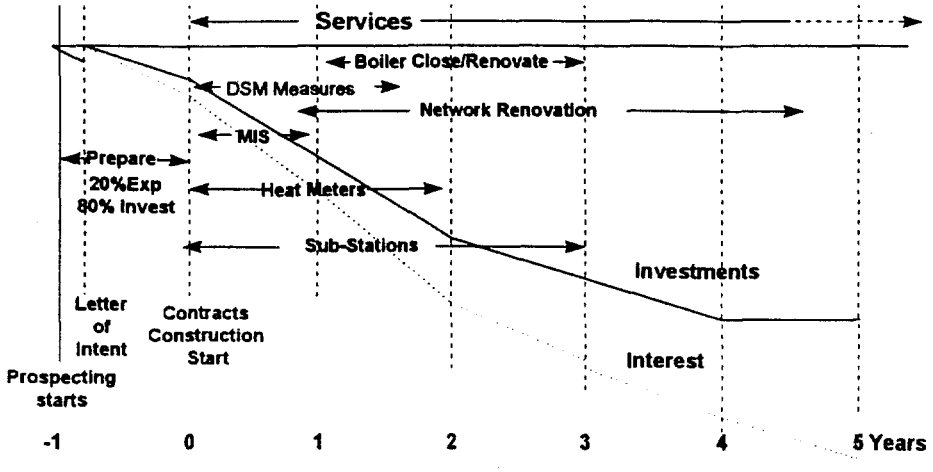


Construction of the deal

Complex contracts are part of the game



Phases - district heat example



General management and selling skills

- **Sales target is general manager and financial manager**
- **The key influences to a positive decisions are (in rough order of importance)**
  - General manager
  - Financial Manager
  - Politicians
  - Investing Banks and Investing Partners
  - Technical services manager
- **ESCO needs strong local general management and sales expertise able to operate with all influences**

Pick your people with care

- **Management roles critical to found a successful ESCO**
  - High level selling and marketing skills
  - Energy Engineering to evaluate and commit to performance improvements
  - High level project management
  - Legal support of EPC contracts structures
  - Financial
- **Core functions for success in prospecting, development and construction phase of Energy Performance projects**

Don't be afraid to team

- **Energy Performance Contract has multiple dimensions**
- **Team solutions often the best**
- **Strong partners can be key to success:**
  - Financial/ Legal
  - Engineering contracting
  - Service expertise
  - Sales and Marketing

BUT....

Stay in control of the customer relationship

Commitment to continuous improvement

- **Less than half value of EPC in the initial phase**
- **Remaining value from ongoing improvements in energy effciiency and cost reduction**
- **Structure relationship where your ESCO is part of customer energy management team**
  - Reduces selling expense
  - Capture extended value of EPC
  - Potential to extend from energy to new services

Don't be afraid of profit

- **A successessful ESCO will:**
  - Reduce pollution
  - Create quality employment
  - Add to competitiveness of national economy
  - Improve social standards

BUT...

It will only be successful if it is profitable

362

ASSOCIAȚION OF ENERGY ENGINEERS

A.E.E. CLUJ NAPOCA CHAPTER ,ROMANIA

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1. S.C. CASEROM S.R.L.

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Tel / Fax + + 40(0) 64 410 775
dipl.eng. MAGDA AMBRUS

PROFESSIONAL COMPETENCE

The specialists of the LTD are graduates of technical and humanustic Universities of Cluj and they all attended postuniversity courses.

For the reports and engineering we colaborate with research institutes and Universities from all over the country.

We also participate at scientific conferences in the country and abroad exchanging informations and scientific reports.

We are capable of getting into interdisciplinary exchanges and the activity of applicate research and engineering for civil engineering and installtion.

ENVIRONMENTAL PROTECTION

- Research and engineering
- Consulting management
- Studies of ecological impact
- Environmental audit
- The controled storage and treatement of solid wastes
- Studies of the dispersion of the polluting agents in the air
- Studies of the diffusion of the noise
- Technology of water treatement

ENERGY

-Studies of sollution and optimizing
- Heat transfer
- Heat variable
- Energetical studies
- Energical resources
- External network

2. CLIMATIC S.A.
Vasile Lupu Nr. 18
Tel++ 40 (0) 64 147 595
Fax++40 (0) 64 413 504
Manager:
Dorel Ciumafaia

Our companyi is organized to import and distribute a large range of heat and air conditioner equipments and also fitting, pipes, severage instalation, plumbing and gas distribution.
We are autorized in these domains.

3. S.C. ECO -ERG TECHNOLOGIE SERVICE S.R.L.
26,ANTON PANN STR.
3400 CLUJ NAPOCA,ROMANIA
Tel / Fax 40 (0) 64 432 304
Ing. Vasile Grasin, CEM
Ing. Georgeta Padureanu, CEM

S.C. ECO- ERG is engaged in providing turn-key energy solutions to industrial clients.

It conducts energy audits, feasibility studies , project design and management ,some one based on performance contracts.

Beeing an E.S.CO. ,our specialists are envolved in infrared imaging and analysis for building rehabilitation.

It also installs and maintains energy efficient equipment and make energy savings verifications for own projects and for equipment vendors.

S.C. ECO- ERG employes two partners, for full time employees,and occasional consultants or temporary employes.

It also relies on a network of complementary companies for project implementation and mutual business development in in various field.

4. FROsys L.T.D.
13 Septembrie Str. Nr. 1
P.O. Box 636
RO 3400 Cluj- Napoca
e- mail hedesiu @utcluj
Manager:
dpl. Ing. Horia Hedesiu
dpl. Ing. Radu Ciorba

FROsys is a joint - venture , founded in 1994 between Romanian and French partners. Our goal is to promote modern and efficient technologies in Romania.
FROsys is focused on industrial domain, especially in the field of electric equipment and automation systems. We have very good relationships with OEMs in the nord-west country side . Our company is authorised partner for Siemens in the field of electric drives , automation, switching devices and installations. In the field of Virtual Instrumentation, FROsys is authorised system for National Instruments, USA . In 1995 , our company acquired ASIS, the former NI system integrator in Cluj.
Our customers belong to industries constructions, R&D and academic environments. FROsys is main supplies for high performance electric equipment required in bulding industries. We are also involved in the implementation of automation system and process monitoring for food processing industries, power distribution, water distribution network. Our company performs regulate product presentation, traning courses, at customer facility or at our site. Our products and techniques are used curently in student classes, with positive impact.

has a young team of engineers and specialists, well experienced and motivated, trained in Germany and United States. We performe both design and execution for projects, offering turnkey solutions.
FROsys means triple P solutions Professional, Performance, Price.

5. S.C. INFOTRACT SRL
Cosminului street Nr 65
Cluj- Napoca
Tel 40- 064- 137919
Ing. Ioan Dascal

INFOTRACT has extensive experience in the installation, maintenance and residential boilers, heating equipment, and air conditioners. It currently builds, installs, customizes, maintains, and repairs energy efficient equipment from all major international equipment vendors.

6. S.C KUBIK PROD COM SRL
Ferdinand street Nr 97 ap. 29
Sector 2, Bucharest
Tel/ Fax 40 - 01 - 250 8916
Ing. Mihai Suta

KUBIK concentrates its activities in the rehabilitation of energy systems of industrial enterprises and in the manu facture and sales of thermal energy technologies. It is also involved in the development and implementation of recycling and industrial waste systems, and providing local representation for foreign companies.

7. ROM- ENERGY ARMSTRONG L.T.D.
B-dul N. Balcescu Nr. 26 Et. IV
Tel. 40 -01 614 19 45
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Ing. Dan Ionita
Ing. Florin Voicu

ROM- ENERGY ARMSTRONG is the exclusive Romanian representative of ARMSTRONG INTERNATIONAL INC. of the U.S. and is involved in the sale and service of the entire line of Armstrong products. It's expertise include the import and export of energy efficiency and other equipment.

8. TERMATIC PROD. SRL.
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Manager:
Dpl. Eng. Sergiu

Desi Seulean ,Ph.D.
Our company profyle permit us to have activyties in design and research for thermatical and air conditioner equipments.
We also are installing these eqouipments for domestic and institutional customers.
We are authorised in these domains.

REDUCTION OF ENERGY CONSUMPTIONS

IN MOBINS S.A. BUCHAREST

FURNITURE FACTORY-DRYING SECTIONS

Eng.Florin Mihailescu,CEM

THE PROJECT IN BRIEF

1. Initial situation

The drying process management is carried out manually, according to the pshirometric measurement and temperatures, implementing a manoeuvre of the valves from the circuits of steam injection alimentation and on the air closing damper from the ventilation circuit of the drying chambers.

This management way, along the disfunctionalities associated with the absence of immediate correction possibilities, in function to the answer of the system, has also the disadvantage of the wood humidity measurement in one point only and in time intervals, that allow a more rapid installation of superficial drying that negatively influences the quality of the product (rejects, waste, etc)

The drying chambers ventilation system works manually, the consumption reduction through the redimensionalization and automatisation of the process being possible.

The condense recovery system does not function adequately, the steam traps, being defective, present leaks and steam losses.

The transmission system is outdated, the convection belts were not tightened appropriately, working with slipping, that imply supplementary electric power consumption.

2.Reccomended action

For reduction of the consequences connected with the manual control of the wood humidity in a single point and at large time intervals, it is suggested to mount DELMHORST SYSTEM (USA), control and humidity measuring system for all those 10 drying chambers, which are in the drying section. By the use of Delmhorst system $4,700 US equipment cost, the annual savings are about $49,600 US. Total estimated installed cost is $28,125 US and the estimated simple payback time is 0.72 years.

BACKGROUND OF THE PROJECT

The USAID industrial Energy Efficiency Project in Romania has assisted private Certified Energy Managers (CEM) in developing an energy service company practice and thus bring needed energy consulting services to Romanian industry enterprises. The program has consisted of training and energy auditing activities, conferences and exhibitions, and procurement of

367

equipment for energy efficiency demonstration projects.

This energy audit made by CAMIGO Ltd BUCHAREST, represents the beginning of the implementation of fuel and energy saving measures, being a part of the U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) technical assistance program entitled "ROMANIA ENERGY EFFICIENCY MARKET DEVELOPMENT " USAID gave support to this activity.

In March 1994 a US expert had helped Romanian expert from Camigo Ltd. in providing MOBINS-S.A. BUCHAREST - furniture company with an energy audit.

In the course of this action the interviews had been held in the Company with the General Manager, Technical Director, and Mechanic-Energetic Chief Engineer, aiming at carrying out quick reviews on organisational, financing and tariff structures, technical operation of the company.

After the studies of power consumers, steam and hot water, ventilation and pneumatic transportation systems, distribution and utilisation of electric energy for force and illumination, there were identified the following energy problems that could be improved:

- modernisation of the drying section, where there are installed 10 drying chambers 12.5 cub. meters BA type .
- The control of the thermal agent supply.
- The installation of an automatic inside temperature control for the finishing section, creates a safe possibility of important energy savings.
- The inexistence of a control system of inside spaces heating implies energy losses and overheat costs
- The heat exchangers system analysis implied the necessity of their redimensionalization in function of actual conditions.
- The pneumatic transport system is a great power consumer, for example, the first 5 primary transport fans from the production department cost over $40,000 US /year/electricity.

The electric energy distribution and utilisation:

- The lighting system the analysis of consumptions reductions possibilities through mount of some local and central control systems, which would allow the interruption of energy supply when it is not necessary (for example in first shift)
- Also the current illumination system with fluorescent lamp it's possible to change with a system at pressurised sodium lamps.
- Replacement of engines that work is in a regime of unload (less than 50%) with engines of interior power
- The compressed air production and distribution system worn out, working at low efficiency.
- The modernisation of the thermal station may cause great savings, utilising with maximum efficiency the caloric power of th wood fuel, through the following actions:

-Design and mount of an automated transport, dosage and alimentation installation for the boiler with fuel

-Design and mount of automated burning installation, utilising injected air for the fuel complete burning.

-The assessement of the burnt gas exhaust system, taking it's account the possibility for mount of an efficient exhaust installation.

In the following pages, there will be presented the opportunity of continuous management of the timber drying department, taking into account the obtained energy savings, since MOBINS SA BUCHAREST demanded a report of energy audit of the drying process.

368

IMPLEMENTATION OF THE USAID PROJECT

Major dates of program implementation

Audit	1994-1995
Delivery of equipment	1995
Installation and commissioning	1995-1996
Monitoring	1996

Summary of delivery of equipment, installation and commissioning

DELMHORST WOOD MOISTURE SYSTEM - fully implemented in 1996

The equipment was installed in August 1996 and the staff is satisfied with them.

The monitoring of energy savings started in September 1996, in compliance with the monitoring plan and evaluation. Data collection was made with the installed meters and by basing of the measures done on the drying cycles of oak and poplar wood.

The Delmhorst wood moisture system reduce the consequences connected with the control of humidity in a single point / drying room, because it measure in 6 point/room, according to the pshirometric difference, resulting a more exact drying process parameters estimation.

- The drying cycle heat savings and thus annually as it follow:

TABLE 1

Specifications			SAVINGS	
	Gcal/ cycle	$ US	Gcal/year	$ US
Hemstitched poplar	3.47		127.8	
Unhemstitched poplar	2.58		95.04	
Hemistitched beech	1.04		42.9	
Unhemstitched beech	0.77		31.6	
Hemstitched oak	0.34		0.79	
Unhemstitched oak	0.24		7.12	
TOTAL	8.44	148	176.25	3,084

- The introduction of continuous humidity control in drying chambers has as a result the obtaining of the timber savings made through drying defects reductions:

TABLE 2

SPECIFICATION	SAVINGS		
	%	cubic meter	$US/yr
Poplar	7	202	12,120
Beech	10	42	3,780
Oak	12	112	16,800
TOTAL			32,700

- The electric power absorbed by one drying chamber is 7.5 KW (6 fans x 1,5 KW)

The savings of electric energy which are obtained from continuous control system introduction are:

TABLE 3

Electric savings	1 chamber	10 chambers	$/year
	36 MW/yr	68 MW/yr	3,400

- After the installation of the DELMHORST SYSTEM the annual energy savings are:

TABLE 4

RESULTS	1 chamber Gcal/year	$	10 chambers Gcal/year	$
Thermal energy	215	3,765	685	11,988

- The total annual energy savings, realised by installation of the DELMHORST WOOD MOISTURE SYSTEM are follows:

369

TABLE 5

Results	Gcal /yr	Mwh/ yr	cubic meters/ yr	$US/yr
Thermal energy	685			11,988
Electric energy		68		3,400
Timber			356	32,700
TOTAL SAVINGS				48,088
PAYBACK PERIOD	0.28 years			
Total installed cost				5,100

Other observations

- By changing the monitoring initial method of the humidity by probe-control placed inside the drying chamber, and with noticing from the outside done using the DELMHORST system there were obtained the following advantages:

-The elimination of the heat losses which existed when the doors get opened at the entrance of the drying chamber for the observation of the probe-control

-The reduction of defective possibilities (slits, fissures) in the wood unit by the elaboration of a drying medium, without temperature variations.

The installation of Delmhorst system realises by the elimination of the probe-control of a greater loading degree of the drying chambers than the initial method, resulting in economical and efficient functioning.

TABLE 6

Timber thickness [mm]	Filling degree %
25	+6.2
32	+3.5
40	+3.8
50	+4.5

- The MOBINS current timber demand is estimated according to the data supplied by the beneficiary at 4250 mc /year as it follows:

TABLE 7

Specifi-cations	Quantity cubic meter/yr	Initial humidity %	Final hum. %
poplar	2,880	80	6
beech	420	35	8
oak	950	35	8

Analising the drying capacities according to different species after the installation of Delmhorst system, has resulted that for poplar timber drying there are necessary 6 chambers, for beech timber -1 chamber and for oak timber - 3 drying chambers

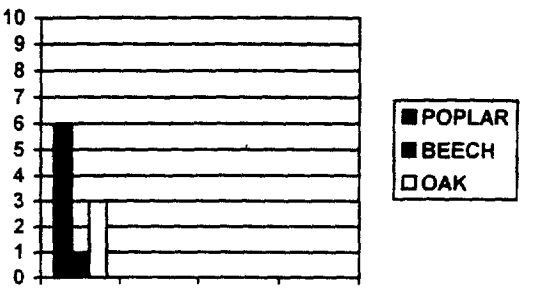

fig. 1

- The measured drying time reduced at oak by 9% and at poplar by 7% (timber beech haven't been dried in this period)

TABLE 8

Timber species	Drying time reduction %
Oak	9
Beech	7

370

- The continuous control has eliminated intermediary measurement which lasted 40-50 minutes period in that the whole timber quantity pulling out of the drying chamber and in this time the energy losses were very big
- The drying timber quality is better than the old technologic process, respectively the final humidity differences are less than 1% comparatively with 2-3% in the old process
- During the realisation of the energy audit it was studied the complete automatically control variant of the drying process (steam control, humidification, fans, dampers, etc.) which was given up because:

-The drying chambers are technically and constructively worn out, working with inferior efficiency requiring in a subsequent period an important investment for their replacement with other performant equipment, a situation when the automatic equipment would be efficient.
-The payback is more longer 2.37 years.
-The supplementary savings are not bigger, about 3,000 dollars per year.
-The continuous humidity control Delmhorst installed can control the quality of the final product, indirectly adjusting thus the parameters of the drying process.

CONCLUSIONS AND RECOMMENDATIONS

- The realisation in the USAID program of this energy audit regarding the implementations of the continuous humidity control Delmhorst is a efficient application for obtaining the energy savings
- The equipment installation is easy, doesn't require high qualified personal, MOBINS installed with it's own forces, which did that the payback period to be 0.28 years despite the 0.72 years estimated in energy audit.

Certainly, as I mentioned in the "Background of the project" at MOBINS there are more possibilities of energy saving which have been investigated together with the Hagler Bailly Consulting's specialist but there are not promoted because:
-In this period MOBINS have confronted with the problems inherent to privatisation, and because it doesn't existed a clear vision of the future principal development directions.
-Mobins invested a lot for the modernization of the outrun technology (e.g. imported a modern finishing section, machines for the wood processing, a new massive panel section, etc.).

We hope that in the next period together with the MOBINS staff to realise another efficiency energy actions which have been mentioned in this rapport.
As in Romania exists in wood industry more than 1100 of diverse types and capacities drying chambers which can get modernised by the installation of a Delmhorst system, should be needed that this action of energy saving to be promoted by financing support for the implementations and to be the object of one of the next programs of USAID in Romania.

371

REDUCTION OF ENERGY CONSUMPTIONS IN DANUBIANA SA BUCHAREST TYRE COMPANY

Eng. Florin Mihailescu, CEM

THE PROJECT IN BRIEF

Danubiana-tyre company is one of the biggest energy consumer in Bucharest and for this reason the plant is very interested in the production process modernisation productivity growth, and in diminution of energy consumptions in the thermal unit, heat and hot water distribution, consumers of the production section.

Following the study of the energy consumers and also of the distribution and use of the electric energy for the force part on one side, a series of problems have been identified and the correcting solutions have been elaborated in the present study:

1.Improvement of the illuminating system

The replacement of the existing mercury vapour lamps having a nominal power of 400W with high pressure sodium lamps, which have a lower consumption, of only 250W. This realises a 93MWh annual saving, the yearly savings are 40,300US, and the simple payback is 0.2 year.

2.Energy consumption decrease for compressors, compressor section

We suggest reorganising the compressor section by installing measuring apparatus, controlling the energy consumption with a sensor for the upper limit and adjusting the air consumption to the needed level. Verifying the relation Pu/Pnom for the compressor's motors, it became obvious that an optimal selection of these motors can lead to decrease in the energy consumption.

The continuous correlation between the functioning of the compressor and the other technological parameters is also suggested.

All these suggested procedures will lead to a decrease in energy consumption to 150MWh/year.

Yearly savings are $6,450 US and the payback period is 0.37 years.

3.Reduction of fuel consumption through automatically guided burning

The Danubiana thermal power station is currently equipped with three steam boilers CR12 type, 50 to/hr, 40 bar.

Currently the control of burning is carried out periodically through it's testing with a

378

portable flue gas analyzer BACHARCH - 300 USA, purchased by the plant in 1995.

Important energy savings can be realized through the utilization of the automatically guided process of the boiler type BAILEY-ICSS.

The estimated savings of specific fuel average consumption are 3.5% ant the equipment cost is $39,900 US. Yearly savings are 101,150 US and the payback period is 0.62 years.

4.Equiping the vulcanization presses with performant steam traps

An important measure for reduction of steam consumption is the equipping of the presses with the efficiently steam traps, ARMSTRONG USA that would reduce the leaks of the uncondensed steam to the equipment of condense recover. It is well known that the thermodynamic steam traps which equipped the presses even in the caseRPf the correct functioning can admit leaks of steam between 3-10%.

The energy savings are estimated to 10-15% given to actual consumption.

Yearly savings are $21,510 US and the total installation cost is $26,525 US.

The payback period is 1.4 years.

5.Recovering under pressure of warm drainage from the hot water for tire vulcanization

It is obvious that the losses reduction through recovering of the heat of these drainage conducts to reduction of consumptions of thermal energy at the CUT (utilities) that are necessary for preparation of vulcanization hot water.

Thus it is recommended the recuperation under pressure of the warm drainage proceeded from the presses at the end of the vulcanization.

The yearly savings are $ 150,000 US and the total installed cost is $387,000 US

The payback period is 3.15 years.

6.Reduction of the steam consumption at the fuel oil reservoirs .

Since there isn't any automatic control of fuel oil deposit temperature, the steam consumption for fuel heating is higher than the strictly necessary one depending on the temperature of exterior.

Also the thermodynamic steam trap which is equipped the reservoir, has a defective functioning
(steam evacuation)

It is suggested that reservoir to be supplied with:

-1 automatic valve for steam flow control
-1 corresponding steam trap

The yearly savings are $2,312 US and the total installation cost is $2,050 US.

The payback period is 0.97 years.

Danubiana also experiences some problems with its energy supply:

-low natural gas pressure in the winter
-decreased steam demand (internally and from outside customers) which results in lower electricity production on the back pressure turbo-generators, and proportionally higher electricity costs.
-varying composition of purchased fuel oil
-Danubiana is aware of the high energy consumption and is attempting to improve this situation.
-The purchase of three new centrifugal compressors, to replace the three very old existing units, also the purchase of three new steam boilers , represented a major investment effort.

IMPLEMENTATION OF THE USAID PROJECT

Major dates of program implementation

Audit	1995
Delivery of equipment	1995-96
Installation and commissioning	1996
Monitoring	1996

373

BACKGROUND OF THE PROJECT

This energy audit made by CAMIGO Ltd BUCHAREST, represents the beginning of the implementation of fuel and energy saving measures, being a part of the U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) technical assistance program entitled "ROMANIA ENERGY EFFICIENCY MARKET DEVELOPMENT " in. USAID gave support to that activity.

In May 1995 a US expert had helped Romanian expert from Camigo Ltd. in providing DANUBIANA-SA.BUCHAREST-tyre company with an energy audit.

In the course at this action the interviews had been held is the company with Technical Director, Chief Energy Engineer, Chief of Energy section and Danubiana' s energetic experts aiming at carring out quick reviews on organizational, financing and tariff structures, the plant's energy consumptions, operations and maintenance practice.

We inspected the boilers and turbo-generators, the hot water plant, the new compressed air plant and the production halls.

The specific energy consumptions at Danubiana is very high. The information provided by the plant translates into a global energy intensity of 80 GJ/to, which two-to three times as high as the intensity found in some developing countries.

This high energy intensity can be attributed to:

-low production, compared to capacity

-old facilities and equipment(boilers, compressors..)

-poor maintenance practice(insulation, bypassed traps, leaks..)

-no clear system of accountability and responsibility for energy consumption.

SUMMARY OF DELIVERY OF EQUIPMENT ,INSTALLATION AND COMMISIONING

ITE	QTY	ITEM DESCRIPTION	PRICE $	SUPPLIER	OBSERVATION
1	1	Heavy fuel oil flowmeter	13174,2	Brooks Instrument	Delivered, but not yet installed
2	1	Natural gas flowmeter	4,291	Brooks Instrument	,,
3	1	Superheated stem flowmeter	4,090	,,	Partially delivered
4	1	Ultraprobe 2000 detector	3,718	UE System	Installed
5	1	Flue gases analysis system	7,860	Bailey Controls	Not delivered
6	1	Superheated steam flowmeter for CUT2	4,550	Brooks Instrument	Delivered , but not installed
7	1	Hot water energy meter for CUT 2	4,550	,,	,,
8	24	Steam traps	19,506	Armstrong	Not delivered
9	2	Refillable steel cylinder	2,980	Ametek	Not delivered
		TOTAL	**45,213**		

31

SUMMARY OF ENERGY EFFICIENCY PROJECT OPORTUNITIES

Action No.	Action Description	Thermal cons. Gcal/year	Fuel/To Nat. Gas/Nmc	Electric Energy Consumption MWh/year	Total Savings $/year	Payback Period (years)
1	Improvement of the illuminating system			938	40,300	0.20
2	Energy consumption decrease for compressors			150	6,450	0.37
3	Reduction of fuel consumption through automatically guided burning		549/625		101,150	0.62
4	Reduction of the steam consumption of the fuel oil reservoirs	112	15.9/ -		2,312	0.97
5	Equipping the vulcanisation presses with steam traps	1119	158/-		21,510	1.40
6	Recovery under pressure of the warm drainage	8	1.09/-	7	150,000	3.15
TOTAL SAVINGS		**1239**	**724/625**	**1095**	**321,722**	

ULTRA PROBE 2000-ultrasonic detection system

The condense recovery rate is less than 50% (probably between 30-50%). Annually steam production of 710.000 t/h with a 30% recovery rate, represents $320.000 per year in treated water costs.

An ULTRAPROBE 2000 type ultrasonic leak detector was delivered to the plant for the verification of the steam traps pipes heat exchangers and to be repaired or changed.

Danubiana purchase 24 steam traps ARMSTRONG which are installed on technology channel nr.3 in the vulcanisation section (There exist 14 technologic channels).

By the measurements made in June 1996 have been obtained reductions of the steam consume of about 3.2% respectively 20 steam to/month (fig 1).

Steam traps installation at all technological channel goes to energy savings estimated in the energy audit (10-15%) that confirms the opportunity of these energy efficiency action.

36

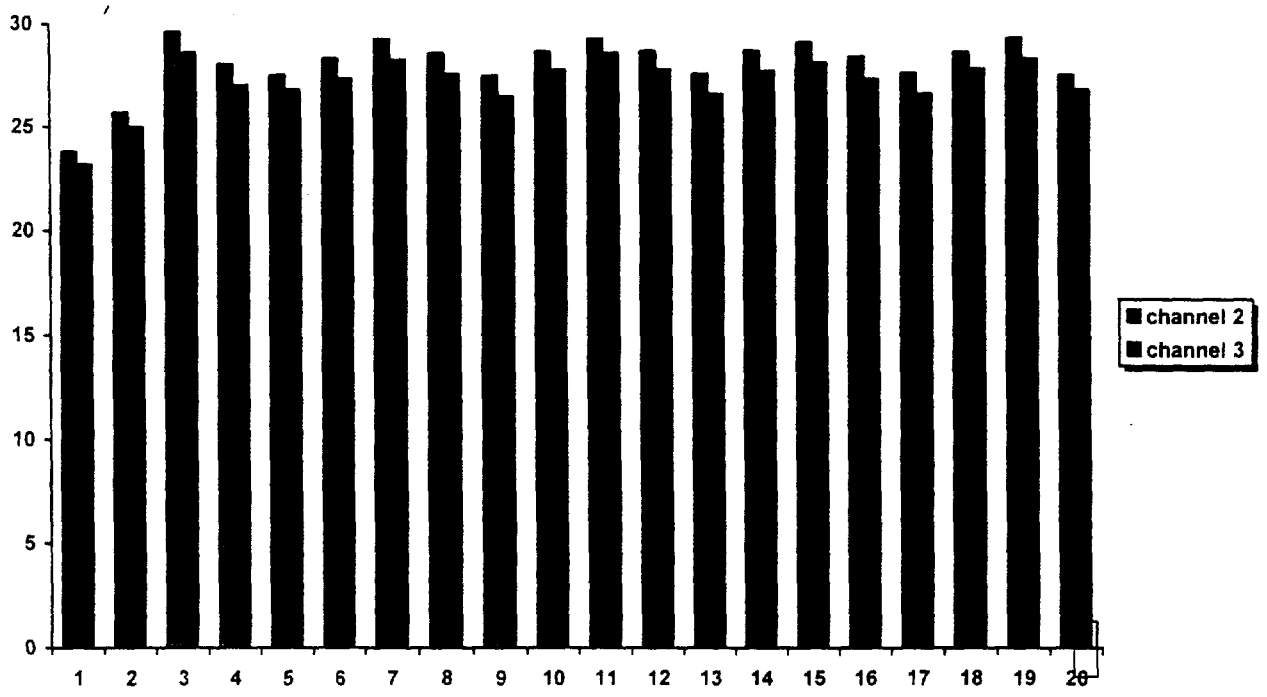

Fig. 1

REDUCTION OF FUEL CONSUMPTION THROUGH AUTOMATICALLY GUIDED BURNING

We tested only one boiler (old type) with a portable combustion analyzer. If we assume that the boilers run at 125% excess air, 88% combustion efficiency and that for the average loading they can be brought down to, conservatively 20% excess air for gas and heavy oil, then the new combustion efficiency would be around 93-94%, or a 5-6% fuel reduction, which corresponds to about $275,000 US/year.

The installation of the Bailey automatically burning control system composed of a fixed flue gas analyser and control system for the functioning parameters of the boilers couldn't be done because:

376

- The action implementations required big installation costs and quite a large realisation time being necessary the design of the hole control system and purchasing of a performant burner from import, as the actual burners installed on the boilers are technically worn out and can't be integrated in the automatic system.
- The steam boiler required capital reparations to function at nominal parameters.
- Danubiana contracted later in 1996 with Cleaver Brooks the purchasing of three performant steam boilers of 30 to/hour to replace the old boilers by 50 tone/hour (CR 03).
- The installation of the Bailey control system can be realised thus on one of the newer boilers (CR 12) which can be adapted efficiently, following that in function of the economical obtained results to be extended at the other two boilers in the power station, too.

In these conditions we can partially anticipate the results of these action from the USAID project, by the presentation of the obtaining energy savings by the utilisation through gas portable analyser by which Danubiana works since 1995.

By the constant utilisation of this apparatus at Danubiana which realises the burning control by the chemical analyse of flue burning gas (O2, N, CO) and optimises the boiler efficiency obtained the following energy savings:

- The fuel savings are 1.5% which represent 56,000 cubic meter natural gas/month, at about $3,100 US/month
- By the evidence of the energetic consumers from Danubiana energetic department and by the measurements done in July and September in 1996 for the steam boilers have been identified the smallest specific consumers by the last 6 years, raported to the tyre production (table 1):

Specific Consumption	Sept 1995	Sept 1996	%
Mwh/to	100	98.4	-1.6
tcc/to	100	89.5	-10.5
Tyre production	100	91.2	-8.8

- By the simple implementations of energy savings measures at Danubiana, the actual demand of the thermal energy is satisfied by the functioning only a two steam boilers facing the similar period from the last year when there where functioning three steam boilers obtaining thus important energy savings. These measures are:
- The tuning of the burning installation of the boilers with flue gas analyser BACHARACH
- The replacement of the steam traps only on one technologic channel
- The replacement of some used technological steam transport pipes which have been located using ULTRAPROBE 2000
- The converting of some steam consumers on warm water produced by the existing boilers

This action have been realised by Danubiana in this year and cost near $500,000 US in the modernisation and energetic consumers program promoted by the energetic department to the plant.

RECOMANDATIONS

The presented actions in this report doesn't represent but a part of the real energy savings possibilities which exists at Danubiana and which are under the attention of the Energetic Department and will be realised -we are sure- soon. We suggest a big attention to the next actions:

- Maximise benefits from the newly acquired BACHARACH for the boilers maintenance

377

- Install fixed flue gas analyser. Even if the portable combustion analyser is used regularly, the achievable savings will not be as big as the savings through fixed through gas analyser.
- Install the new three boilers in the power house.
- Repairing or replacing the dampers should be a high priority for the plant, as properly operating dampers could allow to achieve big fuel and gas savings (at least 3-5%) in combination with combustion analyser (the portable one plus any fixed one).
- Minimize the boiler's fan powers by trying to use the most efficient combinations of dampers and rheostats.
- Re-evaluate the consumptions of all electric motors.
- Repairing steam and hot pipes insulation.
- Maximise benefits from ULTRAPROBE 2000 detection system for steam traps, pipes, bearing, etc
- Implement a steam trap maintenance team so the operators can trust their traps
- Check the current use of mixers during on-peak hours and during off-peak time
- Evaluate the actual (not nominal) load of the mixers when in use

378

ENERGY EFFICIENCY IMPROVEMENT AT S.C TERAPIA S.A Cluj

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I. OBJECTIVE DESCRIPTION

S.C TERAPIA S.A Cluj - Napoca is a pharmaceutical plant which includes 11 plants: Calcium, Panthotenat I, Calcium Panthotenat II, Medium synthesis and opium, Rectification, Medium synthesis I , Medium synthesis II, Hormms, Glucose, Calcium glue, Calcium glue and atomiser and Pack plant.

The thermal energy for this plants are produced in Boiler's House in two units: CT, equipped with four steam boilers CR3,10 t/h, 16 bar.

CT 2, equipped with four steam boilers CR 16, 10 t/h, 16 bar two warm water boilers CAF 7 - 10 Gcal/h.

The transport and distribution of thermal energy from the Boilers House to the plants, in made through a pipe line distribution system in total length of 20,069.km.

Before the start of USAID/CEM, Energy Efficiency Project, based on the plant statistics and on the energy audit results, the base line for 1993 thermal energy consumptions were 11,370. 613 10^6 Ncm/y gas consumptions, meaning US $ 662,735/year gas cost.

II. THE PROJECT IN BRIEF.

The scop of contract between "TERAPIA" and "ECO-ERG" was to identify and to implement energy efficiency solutions in:

- thermal energy production process in the Boiler's House
- transportation and distribution of thermal energy from the Boiler's House to the plants, through the pipe distributions systems

- the utilization of thermal energy in technological process from each plant.

During USAID/CEM ENERGY EFFICIENCY PROJECT IN ROMANIA, AT S.C TERAPIA S.C Cluj - Napoca were identified and already implemented the following actions:

In Boiler's House

1. Steam Traps replacement and using de Condensate Recovering System.

All existing steam traps, which were found defective or by passed were replaced with new inverted bucket steam traps.

The implemented cost were US $ 3,086.

The money savings being US $ 53,019/year the payback period is 0.06 year.

379

The gas net reduction is 909,649 10^3 Ncm/year

2. The Boiler's Burning Efficiency Improvement by using the Combustion Analyzer.

To adjust the burning efficiency by using a BACHARANCH COMBUSTION ANALYSER, MODEL 300, it is expected to gain 1.9 % economies from the initial gas usage, which means US $ 12,332/year money saving.

The implemented cost being US $ 4,752. The payback period is 0.4 year. The gas net reduction is 211,586 10^3 Ncm/year.

3. To install two gas meters and two steam meters in CT 1 and CT 2 boilers house, it is expected, based on organization and maintenance operations, 8.2 % gas consumptions economised, from the initial gas consumptions, which means US $ 54,177.

Total project cost being US $ 23,942, the payback period is 0.4 year. The gas reduction is 929,275 10^3 Ncm/year.

4. To install automated continuous blowdown system on each steam boiler, improuve the energy efficiency in the Boiler's House; by reducing the maintenance costs.

The total project cost being US $ 64,00, and money savings US $ 31,032, the payback period is 0.44 year. The gas reduction is 190,032 10^3 Ncm/year

5. To install at one boiler (CR 16/3) a performant gas burner for low pressure.

The gas net reduction being 76,074 10^3 Ncm/year the money saving is US $ 4,435/year and the project cost is US $ 12,000.

The payback period is 2.7 year.

PIPE LINE DISTRIBUTION SYSTEM.

6. To replace the used installation on steam and hot water DISTRIBUTION SYSTEM means a net reduction of gas 371,693 10^3 Ncm/year, which means money saved US $ 19,332/year.

The total project cost being US $ 26,294 the payback period is 1.36 year.

7. To eliminate 210 m pipe line for reduce the total length of distribution system. This is one no cost method, which after implementation, created a net reduction of gas 51,110 10^3 Ncm/year, meaning US $ 2,979/year money saving.

UTILIZATION OF THERMAL ENERGY CALCIUM PANTHOTENAT II PLANT.

8. To replace the steam traps in the plant means a net reduction of gas with 178,709 10^3 Ncm/year, and US $ 104,16 money saved.

The cost at the project is US $ 19,770 and the payback period 0.9 year.

9. By changing the steam thermal insullation of the reactors with US $ 869 investment, rezult 30,007 10^3 Ncm/year net reduction of gas which means US $ 1,749/ year money saved.

The payback period is 0.5 year.

10. By changing the used installation at the steam and condensate pipe lines with US $ 1,742 investment, result 47,148 10^3 Ncm/year net reduction of gas which means US $ 2,748/year money saved.

The payback period is 0.64 year.

11. By metering the steam consumption and thermal energy in the plant the net gas reduction is 228,572 10^3 Ncm/year, which means US $ 13,332/year money saved.

The cost of investment is US $ 5,405 and the payback period is 0.4 year.

CALCIUM PANTHOTENAT I, CALCIUM ATHOMISER, CALCIUM GLUE MEDIUM SYNTHESIS, MEDIUM SYNTHESIS II, MEDIUM SYNTHESIS AND OPIUM GLUCOSE AND HORMMONES PLANTS

12. To replace the steam traps in the plants.

By added the total net reduction of gas from these plants, which means US $ 454,474 10^3 Ncm/year, lie direct effect of steam traps replacement, at the total US $ 18,635 the money saved are US $ 26, 489/year.

The payback period is 0.7 years.

13. To change the used thermal installation at the reactors means to save 3,123 10^3 Ncm/year and US $ 182/year. The cost investment being US $ 412 the payback period is 2.26 years.

14. To change the used thermal installation on the steam and condensate lines means to save 143,090 10^3 Ncm/year and US $ 8,340/year

The cost investment being US $ 8,5 72, the payback period is 1.02 year.

15. Metering the steam consumptions and thermal energy in the plants, means to invest US $ 44,400 in this action. The net gas reductions being 732,470 10^3 Ncm/year which means US $ 42,692, the payback period is 1.03 years.

III. BACKGROUND OF THE PROJECT

The USAID Industrial Energy Efficiency Project in Romania has assisted private Certified Energy Managers (C.E.M.s) in developing an energy service company practice and thus bring needed energy consulting service to Romanian industrial plants and institutional energy users.

The program consisted in training, auditing activities, conferences exhibitions and equipment for the energy efficiency demonstrative projects.

Regarding the USAID Industrial Energy Efficiency Project in Romania, the estimated actions results and the partial obtained results after the implementation at the proposed solutions, we are able to make known the total money saving by the whole factory is US $ 264, 553/year meaning 4, 538,584 10^3 Ncm/year gas net reduction (form 11,370,612 10^3 Ncm/year) the total energy saving is 39.91 %

These money saving and natural gas consumption reduction are the directly effects of the energy efficiency improvements in steam generation, thermal energy distribution and thermal energy utilization.

In steam generation process the factory money saving is US $ 136,294/years meaning

a net gas consumption reduction 2,238,152 10^3 Ncm/year.

This represents 20.87 % from the total money saving.

The money savings by decreasing the thermal energy losses in distribution pipe line system is US $ 22,311, reprezenting 382,803 10^3 Ncm/year gas net reduction it is 3.36 % money economic results from energy saving.

In thermal energy utilization the net gas saving is 1,817,593 10^3 Ncm/year and money savings US $ 105,948/year reprezenting 15.98 % in energy savings.

A high finnalcial effort was made by the factory to invest in CALCIUM GLUE AND ATHOMISER PLANT, where the old athomizer with steam/air heat exchanger was change with a performant one with gas/air heat exchanger, and a lot of other technological facility.

The total investment in aquisition end installing this equipement was US $ 3,007,000 and the installation just started to work.

IV. IMPLEMENTATION OF THE USAID PROJECT

Major datas of program implementation.

Audits	1993 - 1994
Delivery of equipment	1995 - 1996
Installation and commissioning	1996
Monitoring	1996

Summary of delivery of equipment, installation and commissioning.

• Portable combustion gas analyser:
- fully implemented

• Steam traps replacement
- fully implemented

• Gas flow meters
- already implemented

• Superheated steam flow meters

- already implemented

In table no. 1 is presented sinthesis of energy efficiency solutions implemented at S.C TERAPIA S.A

In fig. 1 is presented the diagram of energy efficiensy solutions implemented at S.C TERAPIA S.A.

V. FURTHER RECOMMENDATIONS FOR ENERGY EFFICIENCY IMPROVEMENT

In our opinion, after the implementation of the above mentioned actions is necessary to extend the improvement of energy efficiency project by:

• monitoring the gas usage, the thermal energy production and usage through data logger and data acquisition systems.

• installing automate continuous blowdown system on each boiler

• installing performant gas burner for low gas pressure on the CR 16 boiler's

• meating the thermal energy usage on each plant

• changing the reactors installations

TABLE 1 SYNTHESIS OF ENERGY EFFICIENCY SOLUTIONS IMPLEMENTED AT S.C TERAPIA S.A

Action no	Action description	Gas consumption 10^3 Ncm/y	Gas net reduction 10^3 Ncm/y	Total gas cost $/y	Money saved $/y	Action cost $	Payback year
0	Initial conditions	11,370,612		662,735			
1	BOILER'S HOUSE Steam traps replacement in Boiler's House	10,460,963	909,649	609,717	53,019	3,086	0.06
2	USING COMBUSTION Analyser to improuve burning efficiency	10,249,395	211,586	597,385	12,332	4,752	0.39
3	To install two gas meters and two steam meters in Boiler's House	10,037,809	929,275	585,053	54,177	23,942	0.44
4	To install automated continuous blowdown system each steam boiler	9,108,534	190,032	530,876	31,032	6,400	0.2
5	To install at one boiler (CR16/3) a performant gas burner for low pressure PIPE LINE DISTRIBUTION SYSTEM	9,032,460	760,74	526,441	4,435	12,000	2.7
6	To replace the used installation on steam and hot water meter distribution pipe line system	8,700,767	331,693	507,109	19,332	26,294	1.36
7	To eliminate 210 m pipe line for reduce the total length of distribution system	8,649,657	51,110	504,130	2,979	no cost	-
8	UTILIZATION OF THERMAL ENERGY CALCIUM PANTHOTENAT II PLANT Tot replace the steam traps	8,470,348	178,709	493,714	10,416	1,977	0.19
9	To change the used thermal installation at the reactors	8,440,941	30,007	431,695	1,749	869	0.5
10	To change the used thermal installation at the steam and condensate pipes lines	8,393,793	47,148	489,217	2,748	1,742	0.64
11	Metering the steam consumption and thermal energy in Calcium Pantothenat II plant	8,165,221	228,572	475,885	13,332	5,405	0.4

Action no	Action description	Gas consumption 10^3 Ncm/y	Gas net reduction 10^3 Ncm/y	Total gas cost $/y	Money saved $/y	Action cost $	Payback year
12	CALCIUM PANTHOTENATI, CALCIUM ATOMISER, CALCIUM GLUE MEDIUM SYNTHESIS, MEDIUM SYNTHESIS II, MEDIUM SYNTHESIS AND OPIUM GLUCOSE AND HORMMONES PLANTS To replace the steam traps in the plants	7,701,074	454,474	449,396	26,489	18,635	0.7
13	To change the used thermal installation of the reactors.	7,707,624	3,123	449,214	182	412	2.26
14	The change the used thermal installation at the steam and the condensate pipe lines	7,564,534	143,090	440,874	8,340	8,572	1.02
15	Metering the steam consumptions and thermal energy in the plants	6,832,064	732,470	398,182	42,692	44,400	1.03

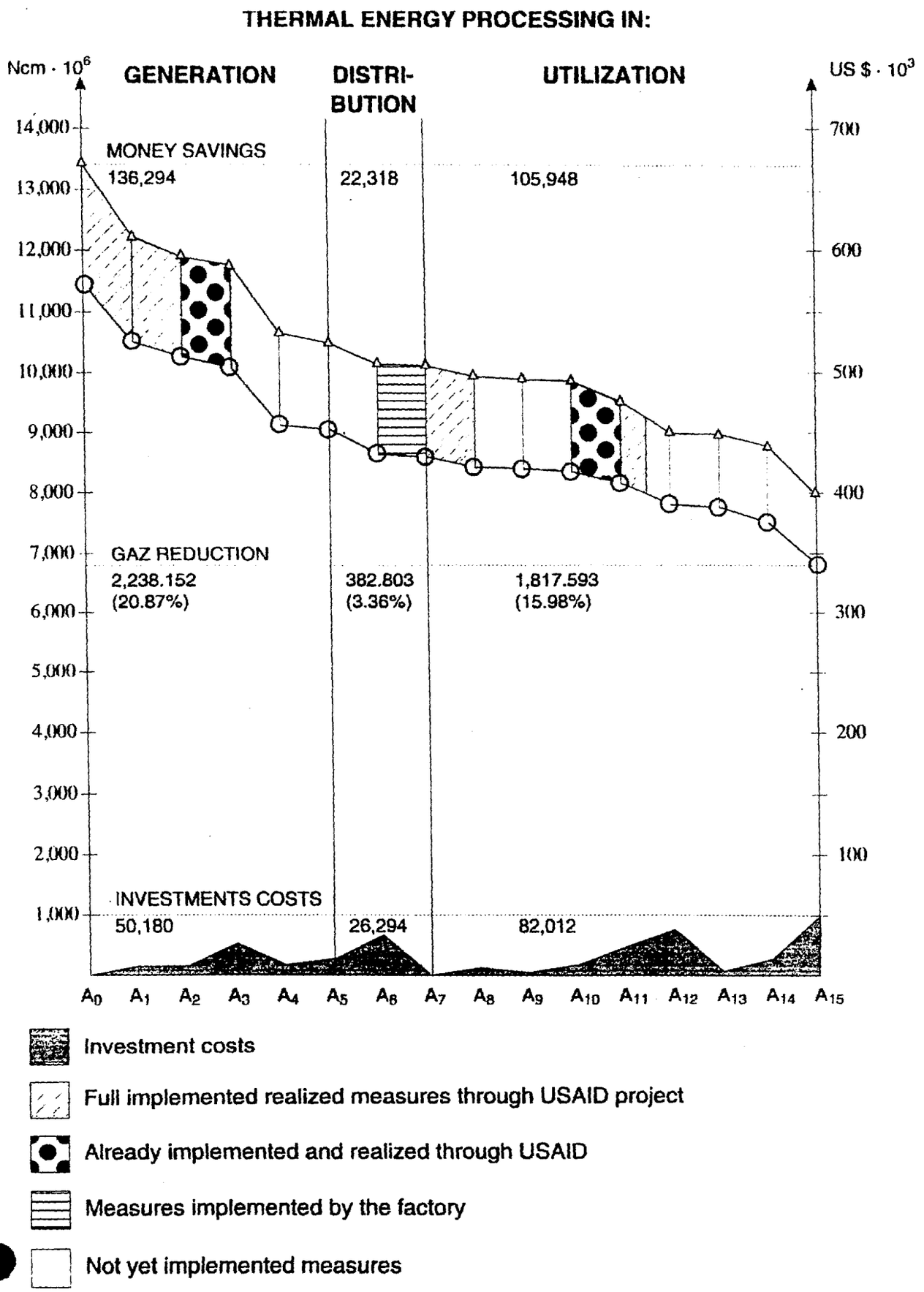

Fig. 1 THE DIAGRAM OF ENERGY EFFICIENCY SOLUTIONS IMPLEMENTED AT S.C. TERAPIA S.A.

8/385

REDUCTION OF PRIMERY ENERGY USE AND INCRESING OF ENERGY EFFICIENCY AT MATIZOL PLOIESTI WATER PROOFING, HEAT AND INSULATING MATERIALS MANUFACTURE

Mihail Zdravcu, CEM

THE PROJECT IN BRIEF

1. **Portable Infra Red Pyrometers**
   New procedury has been adopted for monitoring the conditions of insulations and refractories based on temperature readings by Infra Red portable thermometers (one for 0 - 500^{0}C and one for 0-1600^{0}C). With a total project cost of $ 2.600 US saving of $ 3.000 US / year has been obtained. The payback time is 0,93 years.
2. **Steam traps**
   Three new steam traps 1 T / H inverted bucket were provided and installed at Card Board machine. Anual $ 5.350 US savings have been obtained by $ 5.000US investment, payback time being 1,15 years.
3. **Combustion optimisation**
   A portable flue gas analyser have been provided with $ 4.900 US investment $ 13.348US savings has been obtained , payback being 0,38 years.
4. **Ultrasonic leak detector**
   Several leaks of steam, compressed air and gas are rapidly detecting reducing annual losses. Yearly savings of $ 800 US have yet been obtained by $ 495 US investment, payback is 0,6 years.
5. **COG Belts**
   Utilising ribed belts and making proper alinement $ 288 US (0,5 %) / year with $ 360 US i nvestment, payback being 1,25 years.
6. **Glass furnace automation**
   Providing a full automation of a 6 To/day glass furnace (combustion optimisation glass level control in Melting Bath, pressure control in burning box) , four new burners and a Process Monitoring System with investment of $ 75. 469 US savings of $ 56.158 US / year, are expected , payback being 1 ,4 years. Controlled by a special Honey Well UDC 6000 specialised controller for ratio Air / Fuel control. Electric energy saving can be up to 50 % 94.600 kwH / year.

BACKGROUND OF THE PROJECT

In 1994 a US expert had helped Romanian CEM in providing Matozol Ploiesti with an energy audit. Interviews had been held in the Matizol Company with Management aiming at to carry out quick reviews on organisational, financing and tariff structure,technical operation of the company and on energy conservation projects. Electrical system glass and mineral wool furnaces (8 furnaces), compressed and steam and condesation system were deeply investigated. An agreement was reached on equipment to be supplied by USAID for improvement of operation, automation of a glass furnace and energy monitoring system. Based on results of energy audit performed and delivered equipment Matizol factory began to operate a long term development program Matizol is a full privatised factory therefore is very interested in implementing any measure which can reduce energy consuption and increasing of the process productivity controlled by a special Honey Well UDC 6000 specialised relay for ratio Air / Fuel control. Electric energy saving can be up to 50 % 94.600 kwH / year.

IMPLEMENTATION OF THE USAID PROJECTS

Major dates of program implementation

Audit	1994
Delivery of equipment phase I	1994
Delivery of equipment phase II	1995-1996
Installation and commissioning	1996
partly	1997
Monitoring	1995-1996

Summary of delivery of equipment, installation and commissioning :

* Portable digital I. R. PYROMETER Mikron M90H fully in operation;
* Portable combustion analyser Siegert formula Bacharach Model 300 - fully in operation ;
* Ultrasonic leak detector - in use;
* Non contact I.R. Temperature indicator - in use
* Set of COG belts - installed;
* Cost iron inverted bucket steam traps Armstrong type - installed and in operation;
* Glass level sensor - delivered and will be installed during this shut down of the furnace in December ;
* Pressure transmiters and digital Honeywell controllers - delivered ;
* Natural gas flow meters for furnance C3 with Anubar sensor - delivered and installed ;
* Monitoring system. Data aquisition (Host Computer, UPS System, multiplexer board, current and voltage modules software etc.) of National Instruments - delivered and installed.
* Computer system of Hewlett Packard -delivered by O-Net including printer - delivered and installed.
* High efficient natural gas hot burners (TEC) - delivered.
* Damper actuators (Barbery Colman) - delivered

All above equipment was specified by ARCON SYNERGY PROJECT Ltd. (Former ARCON Ltd.), under direct supervision of USAID / Hagler Bailly consultants. ASP as an ESCO has elaborated detail drawing for automation of C3 glass furnace,etc.Reduction of radiation heat losses by Monitoring with a portable Infra Red Pyrometer 0 - 1600^{0}C and a I.R. portable thermometer (0-500^{0}C) as refractory briks temperature measurement, glass from Melting Bath Working Bath and Feeders of the glass furnaces etc . has achieved energy savings about 0,6 % on over all factory about 73.000 SCM / year, natural gas. Quality of production has been increased and losses were reduced. Actually, I.R. Pyrometers become most valuable operation tool for this factory.

STEAM TRAPS AND CONDESATE RECOVERY

Many existing steam traps were defective and by-passed during energy audit. The condensate was recovered and returned only 30 %. New steam traps 1 T/H inverted bucket were provided and installed at Card Board machine, the bigest steam consumer of the Plant. Steam leakage come down with about 2 T /day.Condesate was recovered and returned to the cogeneration plant 21.600 T/year in addition. Do to leak of funding there are many defective steam traps and could not be relaced until now. Fuel savings are 2 % about 228.000 liters and 21.600 Tonnes of Make-up Treated Water.

COMBUSTION OPTIMISATION AT MINERAL WOOL AND GLASS MELTING FURNACES

The oxygen content in flue gas on all furnaces measured by protable analyser was 10% to 1 1%. A combustion flue gas monitoring procedure was implemented and under direct of General Managers Supervision measures were enforced by operation.Savings achieved in natural gas are about 2,5 %, 325.000 SCM / year, which are measured at main gas flow meter of the Plant.

REDUCTION OF LEAKS

An ultrasonic leak detector was provided to check up - among others - steam traps, steam and compressed air leaks, even valves on reciprocating compressors. Plants cost reduction in the last two years by use of the equipment is at least 32.000 KWh ($1.600 US).

COG BELTS

Electricity saving was about 5.760 KWh($288US)

GLASS FURNACE AUTOMATION

Furnace C3 was provided to be automised with digital controllers and a process monitoring system on a PC (5 loops : Melting and Working Baths feeder, pressure in burning box, glass level). In addition gas flowmeter, temperature measurements KWh meter and compresed air were connected to the Monitoring System.

Four new burners and new Damper actuators were provided.Results :energy consuption reduction by 10 % , reduction of the production losses (cullets) and increasing in furnace capacity by 20%

In energy saving the expectation are :
Natural gas of 140.184 SCM/year ($ 5.758 US)
and production increase with 360 Tonnes of glass
($ 150.400 US). Total savings are $ 56.158 US
Matizol want to extend the project to all furnaces.

Summary results of actual savings and some financial indices are indicated in the following table :

EQUIPMENT TAKEN IN USE IN THE COURSE OF THE PROJECT	INVESTMENT COST IN $ US	SAVINGS IN $ US/YEAR	SIMPLE PAYBACK TIME IN YEARS	USAID CONTRIBUTION $ US	ANNUAL ENERGY SAVINGS (TOE)
Radiation heat losses monitoring with I.R.Pyrometer	2.600	3.000	0,93		62
Steam traps and condensate	5.000	5.350	6,15		182
Combustion optimisation	4.900	13.348	0,38		276
Reduction of leaks	495	800	1		15,4
COG Belts	360	288			5,56
Glass furnace C3 automation	75.469	56.158	1,4		119
Total	**88.824**	**157.888**	-	**71.810**	**660**

FURTHER RECOMANDATIONS FOR ENERGY EFFICIENCY IMPROVEMENT

Improvement of energy management and operation on all furnaces such as combustion analysis, reduction of steam and compressed air leaks, checking the temperature on owens and furnaces ; Steam traps replacement and steam condensate recovery ; Improvemnent of steam and condensate pipes insulation;Insulation of all steam valves and flanges ; Provision of the gas flowmeters and electric wattmeters on all consumers; Introduction of a efficient process control system at all furnaces ; Reduction of the glass losses (glass sticks cullets) on all furnaces, by increasing of production quality and proper control ; Replacement of incandescent lamps with compact fluorescent lamps ; Windows sealing.

RECOMANDATIONS FOR LONGER - TERMS ACTIONS AS FOLLOW ON WORK

* Replace the existing reciprocating compressors with two new dry compressors
* Redisign in new base energy efficient all furnaces (refractory, automation, combustion,ASD's on ID fans etc.)
* Provide new efficient burners on liquid fuel
* Introduce I.R. Pyrometers in place of T.C.
* Expand existing energy monitoring system to all proper DSM (Demand Side Management)
* Provide new production lines for advanced heat efficient insulation materials.

Since Matizol is a full privatized factory and with high requerement of new and efficient insulation materials for construction, it is expected that for the company will pay more attention to efficient use of primery energy than before.

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1. The Project in brief

1.1. Portable apparatus for measuring the lumber humidity of the 1RC-1E/PKG type

The cost of the apparatus is 446.74 $. It permits the measurement of lumber humidity in storage room, at its taking over from suppliers and before the beginning of the manufacturing process. Given the current activity volume of MUHA company the pay back time is 0.5 years.

1.2. Equipment for the automation of lumber drying process

- energy metering bloc for the dryer
- equipment for the supervising humidity during the drying process
- process computer
- implementation mechanisms

The full value of the equipment is 11,527 $. The annual savings are 7,685 $ so the pay back time is 1.5 years.

1.3. Electronic meter for power, type A1R10A

By using this meter we obtain an annual saving of about 775 $, compared to the "classic" situation of using the electromagnetic meter.

1.4. Equipment for automatic control of the power factor, type ACCUVAR Jr. 105 Kvar

It permits a steady functioning at a power factor (cos Φ) bigger than 0.92 which brings, compared to the situation before installation, annual savings of 2,882$ by getting rid of the fines from suppliers, as the result of exceeding the neutral factor. This means a pay back time of 2.15 years.

2. The background of the project

The USAID program for technical assistance in Romania was implemented at MUHA company through SC INVEST PROIECT SRL Suceava, an energy consulting firm.

SC MUHA SRL Suceava is a civilian and industrial building company that has a production base where furniture, wooden accessories, metallic manufactures, concrete prefabs etc. are made.

2.1. For the appropriate quality selection of the raw material for furniture and wooden accessories the humidity checking in the storage room is necessary as well as at the taking over from the suppliers and before the beginning of the manufacturing process.

The portable apparatus for measuring wood humidity permits the reduction of the analysing time for the wooden samples, the disappearance of uneconomical manipulations and the reduction to disappearance of the drying faults following the wooden products manufacturing.

2.2. The use of naturally dried lumber does not permit the obtaining of quality products. This imposed the building up of a lumber drier. The automatic management of the drying process based on some pre-established diagrams imposed itself as strictly necessary, otherwise being impossible to obtain a satisfactory lumber quality and, at the same time, competitive costs. For that, a

preliminary study has been made and, following the recommendation of SC INVEST PROIECT, the USAID offer was accepted.

From the equipment provided by USAID the following were fully implemented:

- Energy metering equipment for the drier:
  - hot water flow meter
  - 3 way electro-valve for the hot water going to the drier
  - 2 way electro-valve for the water coming from the drier
  - thermal resistors for measuring the temperature of the water going to and coming from the drier
  - Masstrol energy flow totalizer
- The system for controlling and measuring the temperature and humidity inside the drying room

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The actual system of working is not fully automatic, it uses the data given by the implemented equipment.

As the dual input ramp/soak temperature controller has not yet been installed it is impossible to work in a fully automatic system based on the initial program.

2.3. The tariff electric meter type A1R does a precise consumption measurement, memorises the power and energy values on certain time periods permitting a minute analysis of the daily and monthly consumption curve. Its economic efficiency is indirect, offering precise data about the consumption curve that permits the making of the best decisions for its flattening and for obtaining a minimum medium price based on the supplier's tariff.

The apparatus is installed, it is functioning to the given parameters, the payment for the electric power being made on it.

2.4. All the equipment functioning within the production base are driven by asynchronous engines, this determining a natural power factor far beyond its admissible value that swings between 0.45÷0.65, according to the using of low or high power consumers.

To correct the power factor the firm owned a capacitors battery that worked in a manual system. This led to a functioning under the minimum limit (0.92) of the power factor and to the reaching a medium power factor of about 0.7.

The equipment for the power factor automatic control, ACCUVAR Jr., provided by USAID, led to the elimination of the above inconveniences, bringing along a saving of about 300$ per month by getting rid of the fines owed to the suppliers.

The apparatus is installed and functions together with the previously existing battery.

3. Implementation of the USAID Project

Audit	: 1994
Equipment delivery	: 1995÷1996
Equipment installation	: 1996
Monitoring	: 1996÷1997

4. Recommendations and suggestions

4.1. Concerning "next step" activities

It is recommended to finalise the installation and implementation for the management of the drying process to a fully automatic regime. Also, the extension of the A1R meter to A1RL is recommended for long distance data transfer and for direct visualisation of the consumption curve.

The correlation of the power correction equipment of the power factor to the consumption regime issued after the extinction of activity within the production base is also recommended.

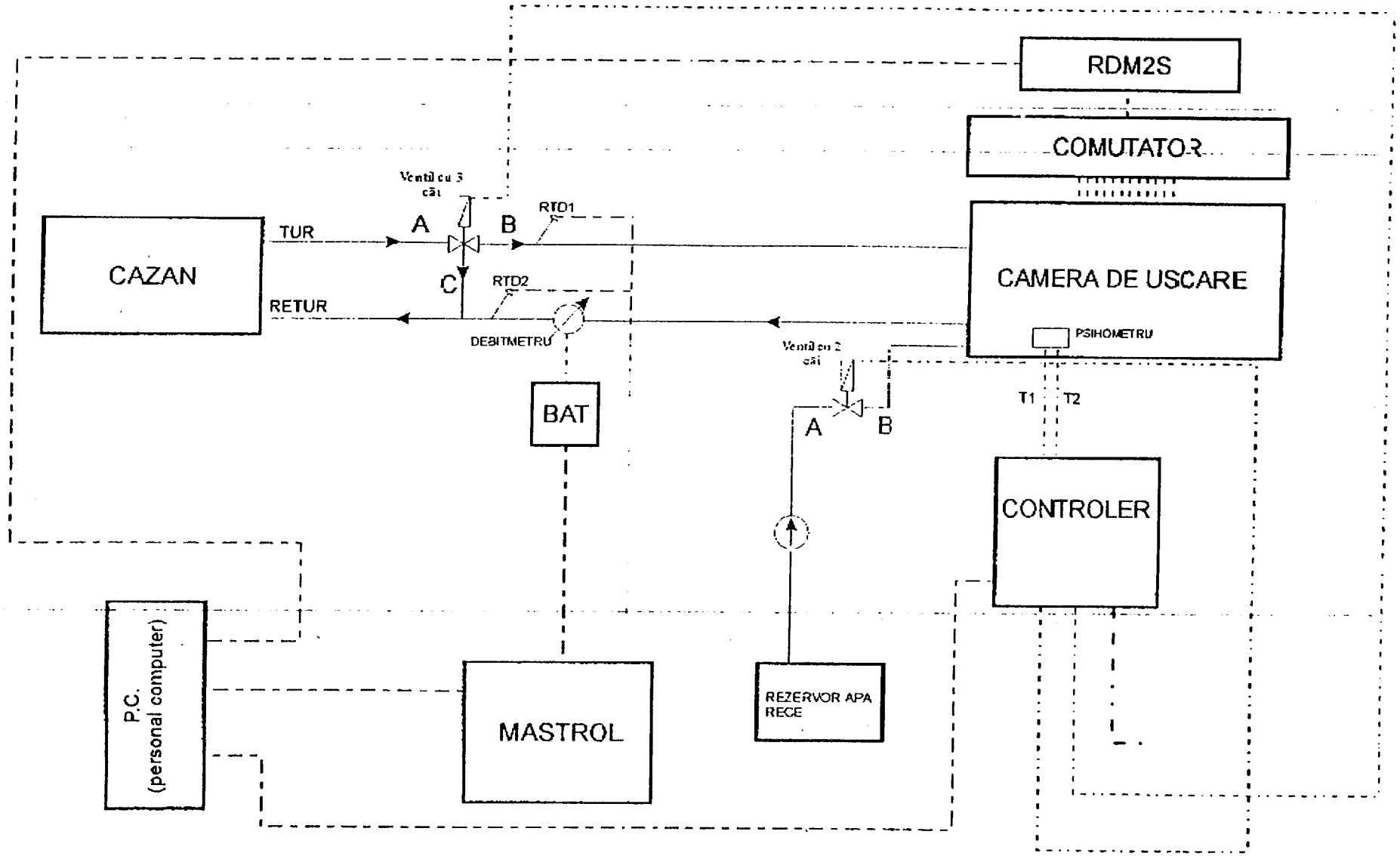
4.2. Concerning long term activities

A global energy survey is recommended for tracing high power consumers and ways to optimise them.

It is recommended the elaboration of a preliminary energy study for the planned developments to counterbalance the networks.

Haralambie Pavel
C.F.M.

SCHEMA INSTALAȚIEI DE CONTROL AUTOMATĂ A USCĂTORULUI DE LA SC MUHA SRL SUCEAVA



COMBUSTION OPTIMIZATION AND ENERGY EFFICIENCY IMPROVEMENT OF A STEAM BOILER AT VEGA REFINERY PLOIESTI

eng. Simona Pârvu - CEM
eng. Mihai Filip
dr.eng. Andy Dumbravă

The USAID Industrial Energy Efficiency Program in Romania has assisted private Certified Energy Managers (CEM) in developing an energy service company practice and bringing energy consulting services to Romanian industrial enterprises. The entire program consisted of training courses in energy efficiency and managing field, supporting energy auditing activities, procurement of equipment for energy efficiency demonstration projects and, now, this final conference, focused on energy efficiency market developement in Romania.

Our company, AUTOMATIZARI ORION, was involved in this program from the begining, and participated only to the phase one of the USAID program.

The job performed by AUTOMATIZARI ORION under qualified monitoring and consulting of Hagler,Bailly and the USAID financial support, materialized in american equipment, was executed at VEGA Refinery in Ploiesti.

The job consists in COMBUSTION OPTIMISATION AND ENERGY EFFICIENCY IMPROVEMENT at one steam boiler of 30 tons/hour and 250 Celsius degrees of produced steam.

The Energetic Sector is an important one at VEGA refinery, because it is furnishing the medium and low pressure of technological steam for the units on this industrial platform. The right functioning of the thermal unit lead to a good functioning of the entire plant, of course.

The boilers house has in composition five boilers , three of them being installed after 1978 , while the other two being older.

For the energy efficiency study and the implementation of the recomandations, we have chosen one of the three boilers, named below - CR1.

CR1 is a steam boiler with natural circulation, having 2 burners, functioning on heavy fuel oil, watertube type, wich is producing superheated steam at 15 bars and 250 °C.

In 1993, before started USAID action, the situation of CR1 was as following:

1. The boiler couldn't be used continously because of its very low endowment with parameters measurement loops; there existed inaccurate measurements of water flow and superheated steam.
2. The gas stack analysis was performed manually, once a day, by the Orsat method.
3. The boiler blowdown was performed also manually, when necessary.
4. The boiler ran into a low work cycle, due to the incomplete combustion caused by the low values of air excess (1 - 1,2).
5. The estimated efficiency of the boiler was under 80%.

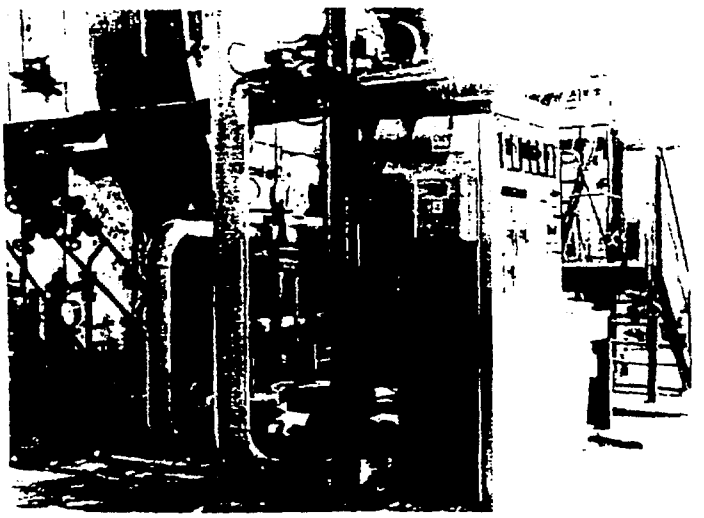
The energy audit, finished in november 1993, described the steam boiler like an installation able to improve its efficiency.

From the numerous recomandations made by the study, we put into action many of it:
1. The boiler was equiped with all required measurements loops necessary to count the losses and also the efficiency of the boiler:

The existing measurements are follows:

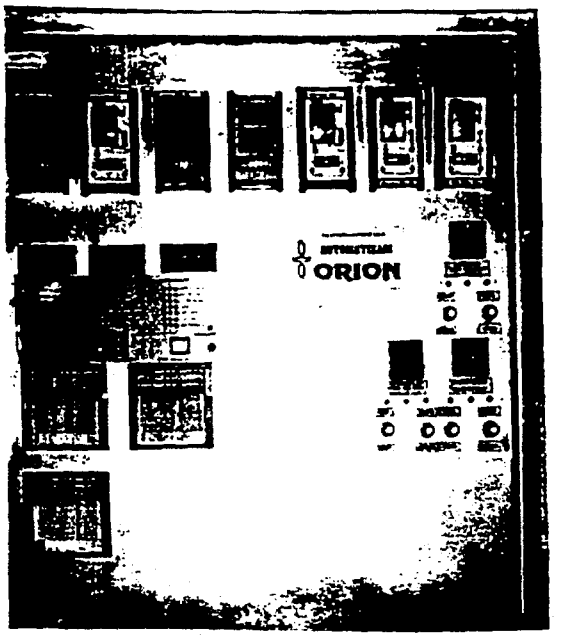
- feeding water flow
- produced steam flow
- fuel oil flow (tour and retour)
- temperatures of : feeding water,

fuel oil, produced steam, gas stack



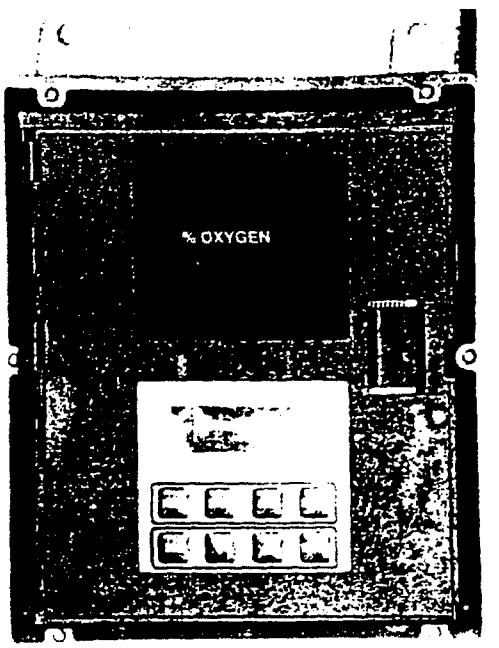
2. A drum level control system was installed and it is working very well, with good performances for the boiler.
3. An air - fuel ratio control system based on the oxygen measurement in the stack gas was also made by our energy and automation specialists.

The apparatus and equipments for the modernization and automation of the boiler are from Romanian industry.
The entire installation was performed by AUTOMATIZARI ORION wich is a supplier of such industrial services.



However, the most important improvement brought to the installation at CR1 boiler was the put into operation of the OXYGEN ANALYZER, provided by USAID. This equipment is a ROSEMOUNT product, World Class 3000, with an Intelligent Field Transmitter.

The ROSEMOUNT equipment was received by VEGA in April 1995 and it was installed by our specialists quite soon, meens one week later.
The oxygen analyzer displays the percent of O2, makes a calculation of the combustion efficiency, also displayed, and shows the stack gas temperature.



The results of this very large, ample action are concrete. Thus, we can observe these following obvious improvements :

1. The increasing of the work cycle with 60%. Before it ran only 20-30 days and now the longest period was even 60 days.

2. The decreasing of the heavy fuel consumption with 4%. This performance was obtained by:

- the decreasing of the mean temperature of stack gas at about 150°C.
- the decreasing of the working regim with low oxygen excess.

3. The efficiency of the combustion increased to 85%.

As a result of all these improvements, the CR1 boiler is now the most used boiler, due to the improved efficiency and automation.

Our calculations and conclusions based on gathered data, lead to 4% fuel oil savings, 15% demi water savings. The resulted payback period is 0.74 years.

Unfortunately, the Phase II was not approved for our project, the Romanian refineries being included into another program of USAID.

As a conclusion, the USAID program was really usefull and beneficial for both ESCO-s and beneficiary plants.

On my behalf and VEGA's behalf too, we have to thank to Hagler,Bailly for the consulting supplied during the energy efficiency program, for the good advices and for the numerous memorandum sent to help us. Once again I was impressed when I looked through all materials for preparing this report, by the multitude of the sheets with Hagler,Bailly heading. Great thanks again to Mr. Laurent Pommier, who became almost our friend, to Mr. M. Ellis, also to Mr. David Keith and to all other members from Hagler,Bailly that we have met in Washington and who helped us.

Thanks also very much to USAID and its representants for their great help during these three years, for the financial support , for their generous offer, for their invitations to participate at two interesting conferences, in Budapest and Atlanta, to show us another side of this wonderfull world!

INCREASING EFFICIENCY AND REDUCTION OF PRIMERY ENERGY USE IN STIROM GLASS FACTORY BUCHAREST ROMANIA

Mihail Zdravcu, CEM

THE PROJECT IN BRIEF

1. **Infra Red Pyrometers**
   By use of portables Infra Red Thermometer of 0 to 550^{0}C and I.R.Pyrometer 0 to 1600^{0}C $ 17.892US cost,savings has been achived in a year by $ 3000 US investment.The pay back time is 0.13 years.
2. **Combustion control and optimisation on C-3 glass furnace.**
   Providing an online oxigen analyzer in existing air / fuel ratio control loop $ 16.500 US cost saving can be obtained in a year by $16.000US investment simple payback time being 1 year.
3. **Adjustable speed drives for 22kw induced combustion Air Fan on C-3 glass furnace.**
   Replacing Damper type control by a frecquency adjustable speed drive of 22kw, 380V, 50Hz motor $ 4.730 US yearly savings have been achived by $ 17.300 US investment. The simple payback time is 3,6 years.
4. **Adjustable speed drive for 75 kw motor drive cooling air blower at Molding Machine**
   With $ 97.655 US total project cost $ 78.228 US savings can be obtained, payback being 1,3 years.
5. **Supercalibrator portable for instrumentation.**
   By use of a supercalibrator for thermocouples and unified signal 4-20 mA generation with $ 2.300 US investment $ 47.700 US savings has been achieved, payback being 0,05 years.
6. **COG Belts**
   Changing of Trapez Type of belts with ribed (tooth) belts with $ 500 US investment savings of $ 302 US/year have been obtained simple payback being 1,65 years.
7. **I.R PYROMETER on melting both of C-7 glass furnace.**
   Fixed type of non contact Infra Red Pyrometer has been replaced (Pt18% Rh) thermocouple. With $ 3.000 US investment $ 8.708US has been obtained the payback being 0,34 years.
8. **Energy Monitoring System.**
   By installing of a Energy Monitoring System for all utilities like electricity, compressed air, natural gas,heating hot water and flue gas heat recovery system etc. with an investment of $ 97.655 US will be achieved $ 78.228 US savings / year, the simple payback being 1,3 years.

BACKGROUND OF THE PROJECT

The USAID Industrial Energy Efficiency Project in Romania has helped private Certified Energy Manager (CEM' s) in developing an energy service company (ESCO) enssuring needed local energy consulting services to Romanian Industrial Enterprises.The program has consisted of a deep training and energy auditing activities, conferences and exhibitions and procurement of needed equipment for energy efficiency demonstrations projects. One of the Romanian Industrial Enterprises for consulting services in energy management was ARCON SYNERGY PROJECT Ltd. (former ARCON Ltd.). In 1994 an US expert had helped A.S.P experts in performing an energy audit for one of the biggest glass factory in Romania, STIROM SA. Based on energy audit mentioned above, ASP as a ESCO drew up a development program,assisted by USAID / Hagler Bailly Consultance with

396

delivery of US made equipment for demonstrations project.

IMPLEMENTATION OF THE USAID PROJECTS

Major dates of program implementation

Audit	1994
Delivery of equipment phase I	1995
Delivery of equipment phase II	1996
Installation and commissioning	1995-1996
Monitoring	1995-1996

Summary of delivery of equipment, installation and commissioning :

* I.R.PYROMETER portable for 0-1600^{0}C and I.R.Thermometer 0 - 550^{0}C -fully implemented
* Supercalibrator portable for instrumentation - fully implemented
* COG belts - implemented
* I.R. PYROMETER fixed type (C7) - fully implemented
* Flue - gas analyzer (O_2,, CO on line control) on furnance C_3 - installed and will be soon commissioned
* 22kw adjustable speed drive-installed and will be commissioned soon
* 75kw adjustable speed drive-cable work ready will be commissioned up to end of 1996 do to production reasons

Energy Main Monitoring System :

- Computer, Hostcomputer, Multiplexor and all cable work installed
- Flowmeters on gas consumption - installed
- Flowmeters on compressors will be installed up to end of 1996 do to production reasons
- Electric meassuring points installed
- Commissioning of the Monitoring System soft - 60 % ready

PORTABLE INFRARED PYROMETERS

Plant has 10 glass furnaces, several anealing owens etc. and substantial heat was radiated-Do to lock a proper testing equipment glass gobs temperature measurement was poor and production losses were relative high - many briks are often broken - down do to high temperature operation. Using of I.R. PYROMETERS results were spectacular espeacially in glass gobs temperature measurements and refractory briks temperature monitoring. The gobs temperature diference were 20-50°C , giving 0,5% fuel gas saving (252.000 SCM / year 214 toe). I.R. PYROMETER become a vital tool for operation and Plat want to instal I.R.PYROMETERS on all furnaces at least to the feeders.

COMBUSTION CONTROL AND OPTIMISATION ON GLASS FURNACE

The C3 furnace has 150o t /day melted glass, gas consumption being 1400 SCM/H on Melting Bath and 90 SCM / H on Working Bath. For combustion control and optimisation it was provided an oxygen analyser,which was inserted in ratio Air/Fuel loop.Excess air will be reduced by 2 % and if project will be succesfully Plant want to generalyze on another large furnaces.Gas saving an C3 furnace calculated is about 232.200 SCM/year.

Provision of an adjustable speed drive for 22 kw motor drive of the I.D. Combustion Fan at C3 Furnace.

Actually combustion air is controlled thrue a Damper. The system was changed providing an ASD of 22 kw, 380 V, 50 Hz motor which is controlled by a special Honey Well UDC 6000 specialised controller for ratio Air / Fuel control. Electric energy saving can be up to 50 % 94.600 kwH /year.

REDUCTION OF THE COMPRESSED AIR CONSUMPTION

Compressed air consumption is very high 71,9 % out of Plants electrical energy consumption about 34.487 MwH/year is for production of compressed air.Factory did not have a monitoring systhem and energy audit recomended to be designed and implemented with USAID help.

An ultrasonic leak detector was provided for detection of compressed air leaks.

The monitoring systhem has :

- Anubar air sensors on all five compressors
- flowmeters for all compressors and consumers with HoneyWell DPT, PT etc.
- V, A, Cos ø, KWH, KVARH etc., metering

The monitoring system will reduce air consumption with min. 6 % (4,3 % out of total energy consumption of the Plant, respective 2006 MWH / year).

SUPERCALIBRATOR PORTABLE FOR INSTRUMENTATION

STIROM has installed over 50 Thermocouples Pt Pt 18 % Rh - calibration with a Rochester super II with AC adapter / charger 220V make shorter TC calibration. TC can be stimuled on the spot in working condition having an Unified signal 4 - 20 mA own generation. Do to all above mentioned losses (cullets) were reduced 0,5 % only in one furnace that increasing the production with 225 To/year

COG BELTS

Ribett belts are recomanded because we can reduce frictions having about 0,5 % energy consumption par example: at 4 Motor Drives of 50 KWH/H on Deduster(belts / each) savings being 8000 KWH / year investment being low.

I.R. PYROMETER ON MELTING BATH

Measuring of the temperature on Melting Bath of furnance C7 with a fixed non contact JJ 1000 Intronic Instruments I.R. PYROMETER is very satisfaction:

* higher class of precision
* lifecycle at least 4 years
* increase in production at least 0,5 %

The I.R. Technique will be generalised on all other furnaces .

Summary results of saving and some financial indices are indicated in the following table :

EQUIPMENT TAKEN IN USE IN TEH COURSE OF THE PROJECT	INVESTMENT COST IN $ US**	SAVINGS IN $ US	SIMPLE PAYBACK TIME IN YEAR	SAVING (TOE)
Portable I.R.Pyrometer	3.000	17.892	0,17	214
Oxygen anoly ser on line	16.000	16.000	1,00	197
Adjustable speed Drive 22 Kw	17.300	4.730	3,6	27,4*
Adjustable speed Drive 75 Kw	33.000	12.209	2,8	93,5*
Energy Monitoring Systhem	97.655	78.228	1,3	599*
Supercalibrator portable for instrumentation	2.300	47.700	0,05	53,75
COG Belts	500	302	1,65	2,32
I.R. Pyrometer fixed	3.000	8.708	0,34	8,00
Total	**167.755**	**186.269**	-	**1194,97**

* Indicates Implementation not completed, savings only estimated

**Cost of USAID equipment $ 130.000 US ; cost of materials installation and commissionig STIROM's constribution $ 37.755 US + taxes and A.V.T.

ACTIONS TAKEN BY STIROM BY OWN INVESTMENT FUNDING

* Provision of new high efficient burners on furnace C3
* Implementation of a SPM puls vibration system for all factory motor bearings and integration in Energy Monitoring System (about 3000 motors)
* Automation of furnaces with digital controllers

SUGESTIONS FOR LONGER - TERMS STUDIES AS FOLLOW ON WORK

* Analyse installation of a higher efficient heat exchanger on flue gas heat recovery.
* Replace reciprocating Resita compressors.
* Provide on all 75KW motors adjustable speed motor drives (10 motors).
* Modernise I.S. Molding Machines reducing as much possible air compresse use - providing adjustable frequency drives.

FURTHER RECOMANDATIONS FOR ENERGY EFFICIENCY IMPROVEMENT

* Stabilised optium combustion level on all furnaces cheking O_2 content on flue gas with a portable analyser until fixed analyser will be installed.
* Continuation in installing all sensors for measuring point as natural gas, compressed air KWH and completion of the existing Energy Monitoring System
* Replace Alcatel low efficient compressor do to out of life cycle.
* Redisign glass furnaces based on high energy efficiencly and longer life cycle of the refractories.
* Sustain existing waste-heat utilisation.

SUMMARY AND EVALUATION

The glas factorie being a high primery energy consumer, do to energy price with increasing makes it necessary among others, to introduce and generalyse new messures and equipments to modernise systematicly installations.

It is necessary that a new energy audit and evaluation to be performed. For any future consideration one of the major inputs for decision making is reliable informations on the economic viability of such investments. Therefore it is an essential part of the energy monitoring actions not only to establish the achieved saving s but also to compare the financial benefits savings should be broken down to individual measures whenever it is possible to evaluate the effect on economic performance of these measures directly.

Financial viability to different influencing factors is also an essential part of the project. The factors will include energy price changing, inflation devaluation of the national currency etc.

Projects of this kind result in benefits both in global and local level. Energy is actually saved by such measures, which has a positive effect on the company's energy and financial balance, reduces enviroumental pollution etc. STIROM being a full privatised factory it is expected that the company will pay a lot more attention to efficient use of energy than before.

One thing is sure that after this job Energy Management will be on higher level and all factory management is determined to follow any measure to improve energy efficiency.

ENERGY SAVINGS METHODS

AT BORSA CITY REHABILITATION

HOSPITALS' BOILERS HOUSE

Nucl. Phys. Georgeta Padureanu ,C.E.M.
Dipl. Eng. Vasile Grasin , C.E.M.

I. OBJECTIVE DESCRIPTION

Borsa Rehabilitation Hospital is located in the northern part of the country ,in Maramures district.

The Rehabilitation Hospital is strucured as it follows :

- The Hospital bouilding
- The Policlinic bouilding ,including the new Emergency section
- The Rehabilitation section ,including a swiming pool,a covered sport area
- The administratives bouildings

The Hospital is him own thermal energy supplier .The thermal energy is supplied by the Boilers House .

The steam is considered to be a technologycal energy and it was and it is prepared by two steam boilers .

The hot water is supplied by two 3 Gcal / h hot water boilers .

The supplied hot water is used for heating and for domestic hot water ,by a rigurous program due to the budgetarian reasons.

Before the start of USAID / C.E.M., Energy Efficiency Project ,based on Hospitals stathistics and on the energy audits results , the baseline for 1993 energy consumptions were : - 780.475 liters . year heavy fuel oil meaning US $ 99.333 year fuel cost

- 934 MWH /year meaning electric energy cost US $ 58.587 year .

Due to the budget and financial reasons the real heating demand and the real needed domestic hot water consumptions were not covered with the above mentioned consumptions .For example the real heating demand is 12.642 Gcal / year and the real total delivered thermal energy was 2.539 3 Gcal / year .

II. THE PROJECT IN BRIEF

The scope of contract between the Hospital and " ECO -ERG " was to identify and to implement energy efficiency solutions in

480

thermal energy production , distribution to end users and to reduce the electric energy consumptions.

The actions presented below are estimations for initiall conditions.

During USAID / C.E.M. ENERGY EFFICIENCY PROJECT IN ROMANIA AT BORSA CITY REHABILITATION HOSPITAL were identified and already implemented the following actions :

1. **Steam Traps Replacement And Condensate Recovering System Reinstallation**

Nearly all existing steam traps , which were found defective or bypassed , were replaced with new inverted bucket steam traps

The condensate recovery system , which was found disconnected , was reinstalled implemented equipment cost was US$ 800 .

The total project cost beeing US $ 1,374 and the money savings (in world prices) beeing US $ 14,724 the payback period is 0.1 year

2. **The Boilers Burning Efficiency Improvement By Adjusting The Fuel Combustion**

Until the action implementation the fuel combustion and the boilers burning were adjust only by the operators and depended on operators experiences .

By adjusting periodicaly the steam and hot water boilers with a portable Bacharach combustion analyzer , tip Fyrite II , the achievement in fuel usage was 3 % .

The project cost was US $ 1,147 and the money savings (in world prices) are US $ 7,335 .

The payback period is 0.2 year .

3. **To Improve Boilers House Metering Leading To Improve Operation Practices**

There were found human errors in operation actyvities.

By metering the steam,the hot water production, the fuel usage and by monitoring the energy consumptions it is possible to improve , through operations activyties , the boilers house efficiency.

It is estimated that by monitoring the boilers house energy production installing steam, hot and water meters the boilers house thermal efficiency will increase only to operations activiyties strongly related to maintenance activyties.The estimated equipment cost is US $ 24,734 the estimated money savings in world US $ 37,287

The payback period will be 0.7 year .

4. **Installation Of New Steam To Water Heat Exchangers For Domestic Hot Water Preparation**

For the hospital domestic hot water demand ,the domestic hot water was prepared by the hot water boiler ,with a huge fuel usage ,through two water to water old and out of fashioned heat exchangers .

By installing the new instantaneus steam to water heat exchangers Armstrong Int. production,model 535 , it was saved US $ 30,600 at money world prices .

The total project cost was US $ 22,530 .

The payback period is 0.7 year.

401

5. **To Replace The Electric Energy Meter With A Performant One**

The electric energy meter was installed in the high voltage distribution room, a closed place.which belonged to the the electric energy supplier.

Due to this the hospitals operators had not the possibilities to read the electric consumptions only periodicaly and with the electric energy supplier assistance.

To monitorize the electric energy demand it was installed an electric energy meter tip ABB Model A1R 5A, in line with a data logger and a P.C.

Until now by monitoring the electric consumptions has been created the needed conditions to eliminate the load peak by a better organization of a few hospitals sections activyties.

The project cost was US $ 800.

The estimated world prices money savings are US $ 3.750 and the payback period is 0.21 year

III. BACKGROUND OF THE PROJECT

The USAID Industrial Energy Efficiency Project in Romania has assisted private Certified Energy Managers (C.E.M.s) in developing an energy service company practice and thus bring needed energy consulting services to Romanian industrial plants and institutional energy users.

The program consisted in training, auditing activities,conferences exhibitions and equipment for the energy efficiency demonstrative projects

The single institutional energy user entered into the USAID's demonstrative energy efficiency project in Romania was the Borsa City Rehabilitation Hospital.

The thermal energy audit was focused on the thermal energy production, distibution and utilization at the end users

The thermal and electric energy audits were the baseline for the energy diagnosis and for the energy efficiency improvement actions.

In addition, at Hospital's special request it was made the Hospitals' building infrared imaging and analysis

The most significant findings of the audits were:

- In the Boilers House there was any metering systems
- The fuel combustion and the burning adjustment based on operators experiences
- Low burning efficiency due to the fuel quality, even when provided by the same supplier.
- Low steam boilers efficiency due to condensate wastes, defective and by passed steam traps.
- Great energy wastes through buildings envelope due to uninsulated walls and windows
- Money losses due to an inefficient electric energy metering system
- An inefficient lighting system
- There is any alternative solution in heating ,in emergency cases

409

IV. IMPLEMENTATION OF THE USAID PROJECT

Major dates of program implementation

Audits	1993-94
Delivery of equipment	1995-96
Installation and commissioning	1995-96
Monitoring	96

Summary of delivery of equipment installation and commissioning

* Portable combustion gas analyzer :
  - fully implemented
* Steam traps replacement :
  - fully implemented
* Steam to domestic water heat exchangers :
  - fully implemented
* Time of use electric meter :
  - fully implemented
* Steam,hot water and domestic water meters :
  - already installed
* Fuel meter for hot water boilers:
  - already installed
* Fuel meter for steam boilers :
  - not yet commissioned
* Data aquisition and monitoring system :
  - already installed and partial in work

In Figure Nr. 1 it is shown the shematic Boilers' House thermal equipment ,metering and data aquisition systems positioning .

Considering the full actions implementation regarding the boilers house energy efficiency we are able to show some results in energy and money savings :

- By adjusting the boilers burning efficiency with a combustion gas analyzer the net fuel reduction is 24,454 l / year ,meaning US $ 3,111 / year . The realised economies were after one year of analyzer utilization.
- By steam traps replacement and by condensate recovering system reinstallation the fuel saving is 149,650 l /year and the coresponding money saving is US $ 19,038 / year .The saving are obtained after one year of the action implementation .
- By steam to domestic hot water heat exchangers installation (instantaneus steam / water heat exchangers) , which are in use for three month , the fuel savings are 25,500 l / 3 month, meaning in money savings US $ 3,244

The syntheses of implemented measures are presented in Table Nr. 1 and 2.The diagrams are presented in Fig. Nr. 2

- The electric energy consumptions monitoring has been recently started , but after the first daily energy consumption monitoring,it is necessary to decide ,with the Hospitals,staff which are the best opportunities to organize the activity in the hospital , on the purpose to reduce the peak load of energy consumptions and to reduce the billings for these .

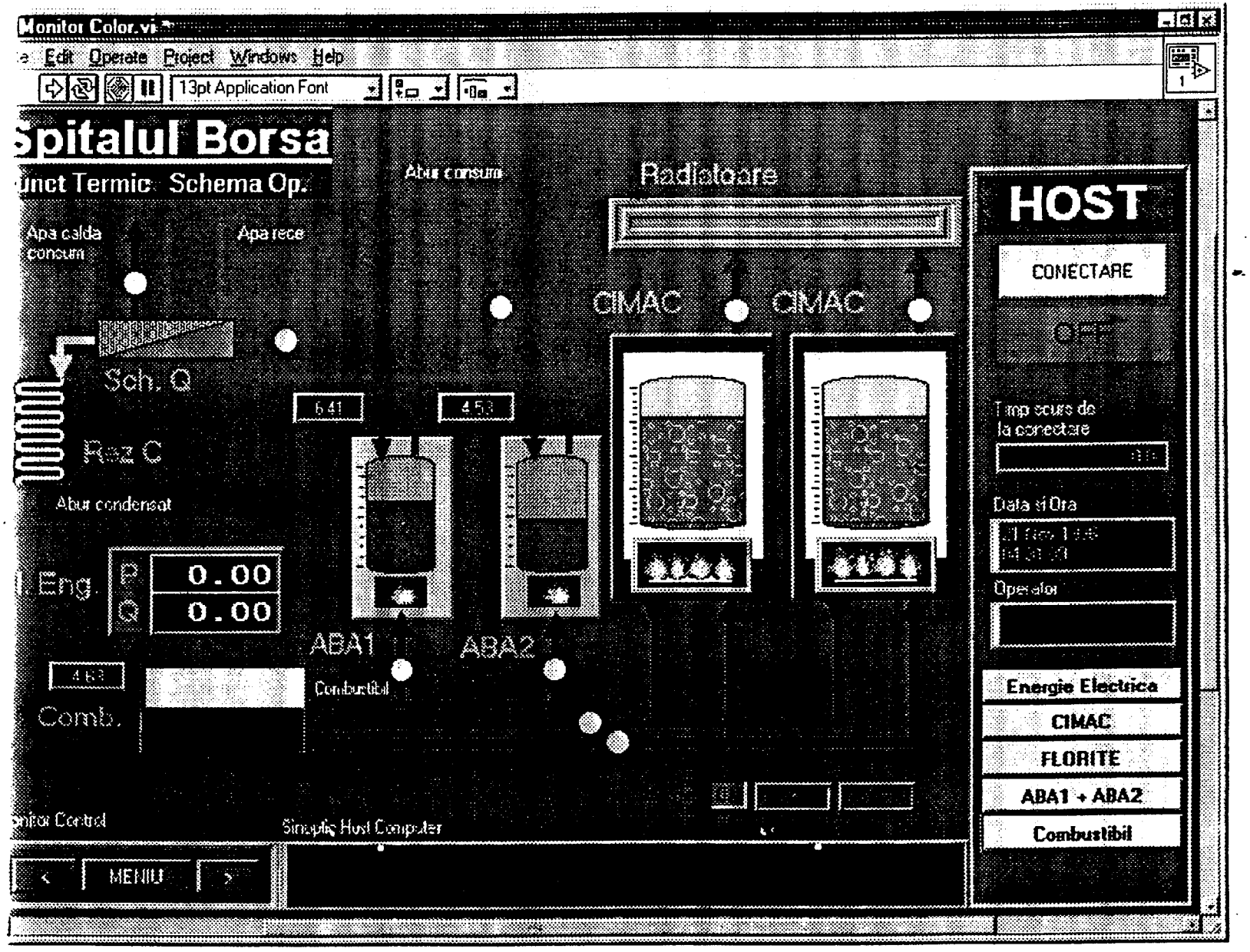


Fig. 1

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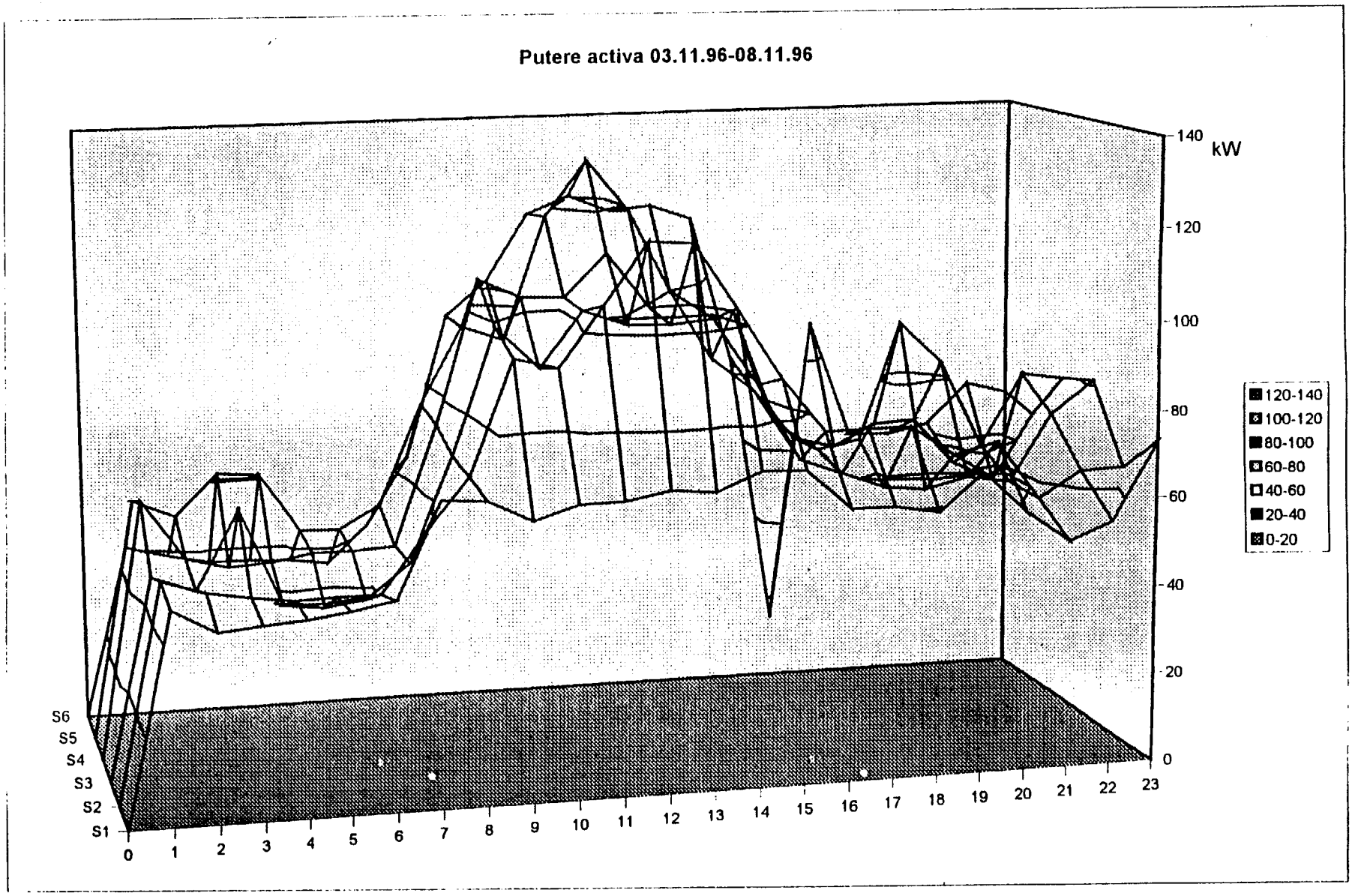

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Fig. 1A. Results of monitoring: Daily active power variations during a week

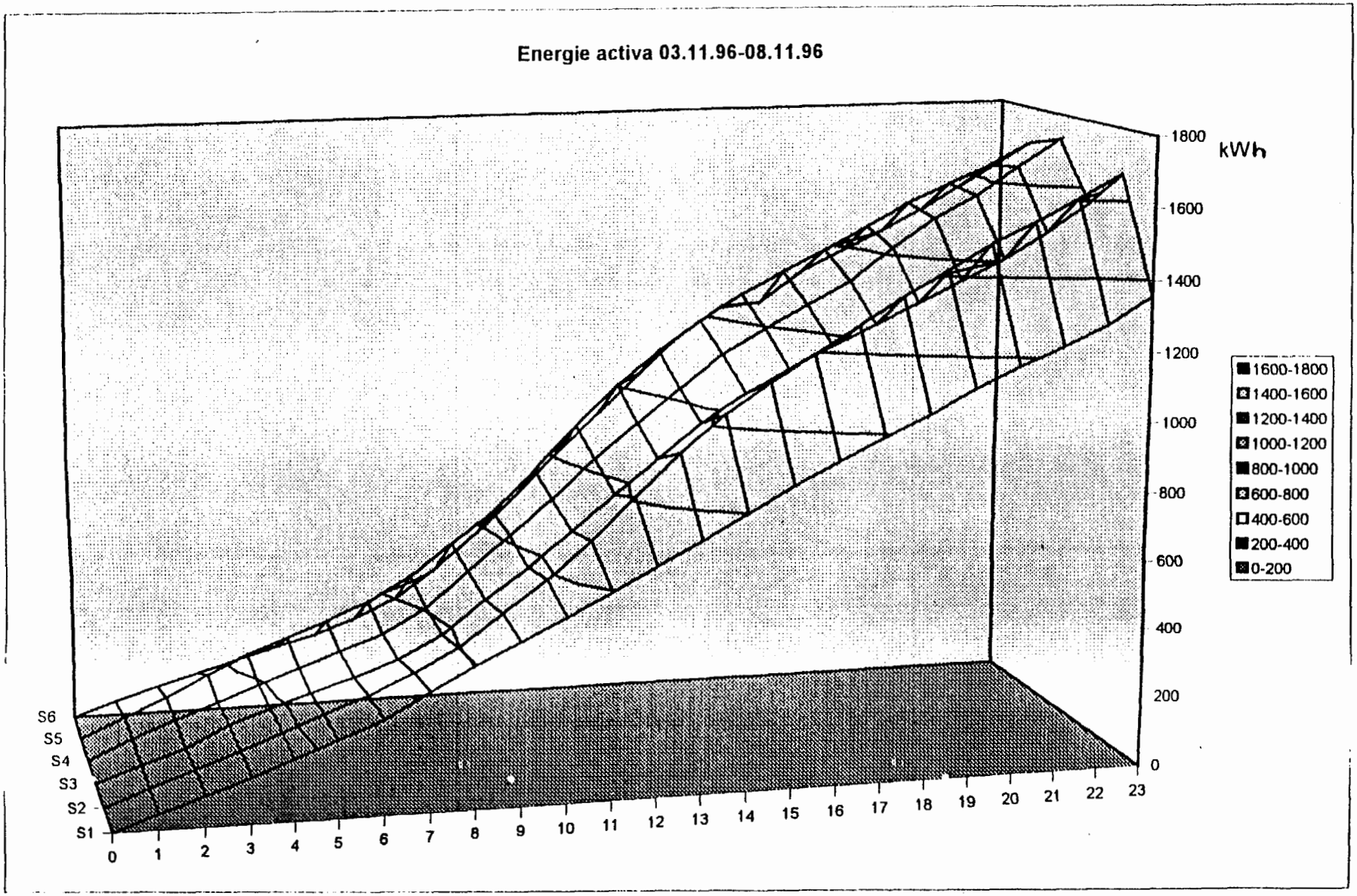

Fig. 1B. Results of monitoring: Daily electric active energy consumption during a week

Table 1

Action	Equipments	Equipments Costs US $	Project implementation Costs US $	Toatal Project Costs US $
Steam traps replacement and condensate recovering system	Steam traps	706.56	667.44	1,374
Boilers burning adjustments	Portable gas analyzer	1,066.99	80.01	1,147
Boilers House Metering	Steam flow & energy meter	4,046.75		
	Hot water flow & energy meter	4,371.00		
	Domestic hot water flow & energy meter	2,336.25		
	Fuel flow meters	3,078.00		
	Fuel filters	375.00		
	Datas aquisition system	8,853.00		
	Monitoring system	3,278.97		
	TOTAL	26,338.97	6,114.33	32,453.3
Heat exch.	Flo Rite Temp.	21,566 .00	8,618.00	30,184.00
New electric energy meter	ABB electric energy meter	624.00	-	624.00
TOTAL		**50,302.52**	**15,479.78**	**65,782.30**

The equipments ,the projects implementations and the actions total costs

407

Table 2

Action no	Action description	Fuel consumption	Fuel net reduction	Total fuel cost	Money saving	Action cost	Payback period	Simple payback period
		l/y	l/ y	$/y	$/y	$	year	year
A_0	Initial condition	780,745	-	99,333	-	-	-	-
A_1	The boilers burning adjustments	756,291	24,454	96,222	3,111	1,147	0.4	0.3
A_2	Steam treps replacement and condens system reinstallation	606,641	149,650	77,184	19,038	1,374	0.07	0.04
A_3	Instantaneous steam/water heat exchanger installation	504,641	102,000	46,208	12,976	30,184	2,3	1,7

Syntheses of implemented actions in the Boiler's House

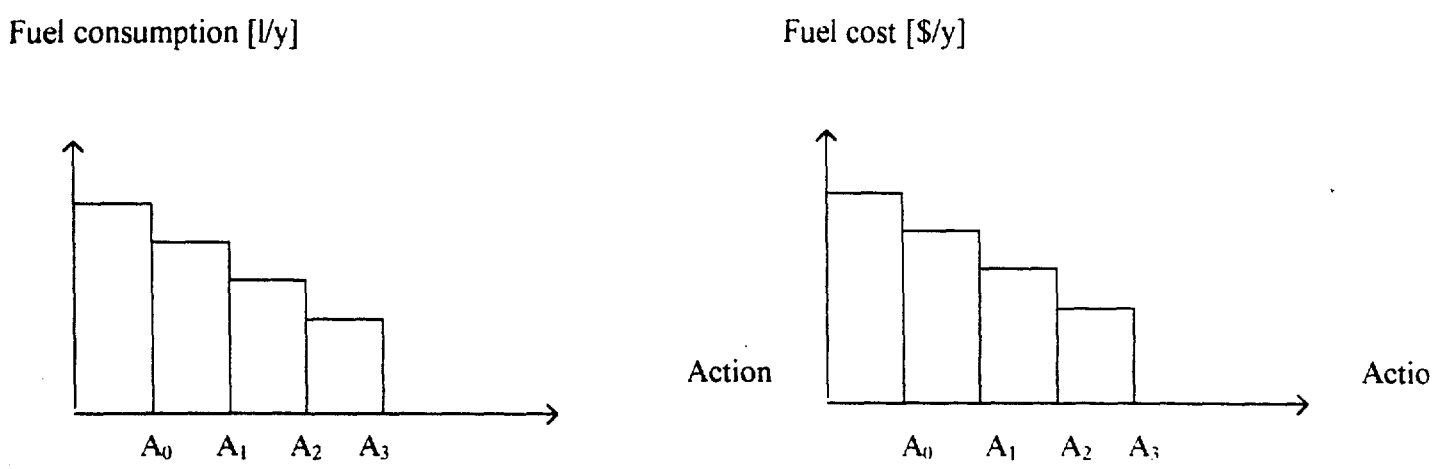

Fig. 2 The diagrams of fuel and money saved after the implemented actions.

408

V. FURTHER RECOMMENDATIONS FOR ENERGY EFFICIENCY IMPROVEMENT

In our oppinion ,after the implemented measures for hospitals energetical rehabilitation , based on the maded audits and after monitoring actions, we are considering that there are necessary to extend energy efficiency improvement actions .

The low cost recommended actions are :

- to extend the electric metering and to monitor the electric energy consumptions at all the hospital 's sections
- to change the actual hospital ' s lighting systems
- to replace the hospital " s water pumps which have huge electric consumptions with performant ones
- to install fuel filters on dayly fuel tank
- to install on the feed water pipe lines magnetic decalcifier.
- to install on the radiators thermostatic valves

The high cost recommended actions are :

- to replace the steam boilers burners with automatic performant burners
- to install a new 2 tons / h steam boiler, like reserve at the actual steam usage for the steam to water heat exchangers
- to install an alternative heating system, for emergency cases (heat pumps)
- to rehabilitate the buildings envelope by insullating the buildings walls and by windows replacement with new and performant ones

To realize the above mentioned actions it is necessary to find financing resources based on performants contracts .

After the recommandations mentioned above , the first step maded by the hospital was the last floor windows replacement ,with performent ones.
The last floor is the pediatrical section.
It was improved the inside thermal comfort and it was reduced the energy loosses trhough the windows . The energy savings represents 6% . In terms of money savings it means US $ 5,947 /year .
This action was maded by hospital own financial effort .

VI . U.S . ENERGY EFFICIENCY EQUIPMENTS MANUFACTURER AND VENDORS

- **For energy data aquisition system**
  Manufacturer : National Instrument
  Vendor : FROsys L.T.D.
- **Fuel oil filters for fuel flowmeters**
  Manufacturer : Filter Products CO.
  Vendor : Dynamation
- **Steam flow meter with spares**
  Manufacturer : Meter Equipment Manufacturing
  Vendor : Dynamation
- **Hot water volume and energy flow meter**
  Manufacturer : - Flow research/Peek Measurement
  - Camco
  - Kessler Ellis Products
  - JW Sweet Co
- **4 tarriff electric meter with two relay outputs**
  Manufacturer : ABB POWER T&D CO
  Vendor : ABB Robomatrics
- **Steam Traps and Heat Exchangers**
  Manufacturer: Armstrong International
  Vendor : Rom-Energy Armstrong L.T.D.
- **The portable combustion analyzer** manufacturer and vendor is Bacharach .

409

Establishment of AEE Chapter Romania

Chapter Romania was founded in February 1994 as a legal person and Non Gouvernamental Organisation and is incorporated in Energy Commission of Romanian Academy.
AEE Chapter Romania has 18 members out of which 10 members are CEM (Certified Energy Managers) and are working as ESCO's in Romania.
In short time another 25 engineers are potential to become members.
We would like to have many energy engineers to become AEE members because you have key access to both the vital information you need and professionals whose expertise can help you achieve your goals. AEE provides a framework within which a member can network and promote your business interests and, through its programs, unables you to aquire the "tools" needed to maitain your competitive edge into the next millennium.

Publications

AEE members automatically receive complimentary subscriptions to four proffessional publications

a) Energy Engineering
b) Strategic Planning for Energy and the Environment
c) Energy User News
d) AEE Energy Insight

Industry surveys

AEE each year polls its members on vital issues affecting profession. The salary survey, Memebers oppinion survey Energy Services and DSM (Demand Side Management Survey, along with Cogeneration. This surveys reflect the trends in Energy Efficiency.

AEE Chapter Romanian members has performed under USAID program seven Energy Audits and one member have received the International Project Word in 1995 and three members chapter's aword.

Certification of CEM

AEE under USAID program a support has organised a 8 Months Training Course, for Energy Efficiency and atendees have succided succesfully, the Certification as CEM reconised in US and Europe etc. As CEM you can become an international consultant.

Conferences and Expos

AEE shows are held 2-3 times during a year. AEE's fall convention in Atlanta the WEEC (World Energy Engineering Congress) with 180 technical presentations and 450 firms exhibits only in 1996.

Testing and Auditing equipment

AEE Chapter Romania and Chapter Cluj Napoca were supported by USAID with key testing tools in such a way that modest our members can performe all testings required by an energy efficiency audit in industry etc.

Equipment utilisation is coordinated by Chapter's President.

We know that many things we could do better but what we have achieved is tremendus. AEE Chapter Romania is sharing a lot out of existing market from Romania in Energy Efficiencies Projects. Our AEE ESCO's are recognised and are confidential parteners to many foreign consultants.