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ENERGY EFFICIENCY AUDIT REPORT
FOVAROSI SUTOIPARI VALLALAT BAKERY
BUDAPEST, HUNGARY

APRIL 1992

PREPARED BY: RCG/HAGLER, BAILLY, INC.
Arlington, VA

and

EGI CONTRACTING/ENGINEERING
Budapest, Hungary

U.S. EMERGENCY ENERGY PROGRAM FOR EASTERN AND CENTRAL EUROPE

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
BUREAU FOR EUROPE
WASHINGTON, D.C. 20253

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The contents of this report include recommendations based on data provided by the client plant, measurements made on site, calculations, and engineering judgment. The conclusions reached were based on a limited engagement of only about one week's duration in the plant, and not an exhaustive engineering analysis. RCG/Hagler, Bailly, Inc. certifies that this report conforms to the level of best commercial practice for industrial energy audits of similar level of effort, as conducted in the United States. This report has been prepared under the guidance of a registered Professional Engineer, licensed to practice in the United States.

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ACKNOWLEDGEMENTS

The assistance of the bakery personnel in the conduct of this brief audit study is much appreciated. In particular, we wish to acknowledge the major participation of Mr. Peczek, the Energy Manager, and Mr Gabor, Bakery Manager, in providing information and guiding us around the bakery. The help of Mr Gidofalvi should also be mentioned: his enthusiastic work in checking combustion conditions on ovens and boilers was most welcome. Finally, we wish to thank Mr Gyula Kasa, Technical Director, for his interest.

EXECUTIVE SUMMARY

ACTIVITIES

The bakery trust operates 47 plants, although 80 percent of production is concentrated in just four large bakeries. One of these, at Szazados Street, was visited for a short energy audit. This bakery produces bread, rolls and pasta: in 1990, total production was 24,300 tonnes. The bakery employs 430 persons.

ENERGY USE

The total energy used in 1990 was as follows:

	Basic units	Energy GJ	Energy %	Costs Thou.Ft	Costs %
Electricity	2,017,600 kWh	7263	6.2	9886	19.5
Natural gas	3,231,000 Nm^3	109854	93.8	40808	80.5
		117117	100.0	50694	100.0

The costs shown are based on 1991 price levels (figures used were 12.63 Ft/m^3 and 4.9 Ft/kWh).

The total steam production in 1990 was about 38250 tonnes, of which 7710 tonnes were sold and 30540 tonnes used in the bakery itself. About 60 percent of the steam is used for production related activities and 40 percent for "social" purposes such as space heating and hot water.

The overall energy consumption is calculated as 4.8 GJ/tonne. Energy costs represent about 8.5 percent of the total product selling price.

PLANT EVALUATION

Data on production and energy are collected daily and reported monthly. However, in the absence of sufficient metering, many of the figures are estimated or based on fixed allocations. Much of the data is therefore not useful for energy management but is an accounting exercise.

With respect to the data, these could be presented in a better format than currently, preferably with data side by side in columns. this would allow easier comparison of performance and make discrepancies in the figures more obvious. The data should also show key ratios such as fuel consumption per tonne of bread produced.

The bakery has three boilers with a capacity of about 3 tonnes/hour (and one of 1.7 t/h on standby). Boiler feed water comes partly from returned condensate and the remainder is city water. A check of combustion conditions showed Boiler II to be well adjusted but Boiler III operating with too much excess air (75 %). Losses from boilers by radiation and convection from the outside surfaces are low.

There are 8 ovens available, all of the same general design with a single burner on the top, a circulating fan for hot gases, and the dough carried through the oven on a travelling wire mesh. Tests of combustion conditions showed vey high excess air levels, from 90 percent at the lowest to a more typical 300 percent. Attempts at adjusting the air rates had limited success: safety shutdowns on the ovens appear to be set for excessively conservative margins.

The temperatures of stack gases from the ovens are quite high (around 260-280 deg C) and present an opportunity for heat recovery. The economics of preheating combustion air are being checked: initial estimates of payback suggested about 3 years, which is not highly attractive.

Hot water for social uses, for space heating and for the pasta lines is produced at a heat centre. There appears to be insufficient control of radiators and the space heating system deserves detailed analysis.

A brief check of the plant electrical loads was made. There may be an opportunity for small savings to be made by delaying some equipment start ups to the off peak period.

RECOMMENDATIONS

The main recommendations concerning energy management and data are to improve the format and content of routine reports, to monitor energy related performance more closely and to install additional meters. Similar energy monitoring systems should be set up in all the bakeries and comparisons of energy efficiency made across the plants. Some instruments should be purchased to assist the plant in checking selected parameters (TDS meter, steam trap tester, electricity load survey meter).

With respect to the boilers, combustion should be checked regularly (say once per week) and appropriate adjustments made. Boiler water quality should be maintained at under 3500 ppm TDS by adjusting the blowdown. Some improvements in insulation of warm water lines can be made around the water feed pumps.

Combustion conditions on the ovens need attention. The best burners available in stock should be installed on all ovens and the old burners left in store for spares. Air rates should be adjusted to the lowest excess air levels, and safety interlocks examined and reset if possible to permit more efficient operation.

The costs and benefits of heat recovery options from oven stack gases should be examined carefully: costs are being determined for burners able to utilise hot air and for suitable heat exchangers.

A detailed survey of the space heating system should be made next heating season and efforts made to simplify the system control, preferably by using inside temperature as a control parameter.

POTENTIAL SAVINGS

Initial estimates of the savings potentials for various measures are given in the Exhibit. The total savings achievable through these relatively simple measures amount to about 6 percent of the current energy bill.

RECOMMENDED EQUIPMENT PURCHASES

Recommended equipment purchases are:

		US dollars
(1) Purchase of instruments		
	-- electrical system survey instrument	6000
	-- sonic steam trap tester	1300
	-- TDS meter	300
	Total	7600

All the above instruments could be utilised at the other 46 bakeries and thus the potential benefits are substantial.

(2) Purchase of low excess air burner for demonstration, say $ 5000

(3) Purchase of heat recovery system for preheating combustion air, say $ 8200.

EXHIBIT

ESTIMATES OF POTENTIAL SAVINGS

Item	Cost	Savings	Payback months
(1) Energy management and data -- reports, monitoring, extra meters, inter-bakery comparisons	--	--	--
(2) Sonic trap tester	$ 1300	Detection of 10 faulty traps per year, leakage 5 kg/hr, 6000 hr/yr 300,000 Ft/y = $ 4100	3.8
(3) TDS meter	$ 300	--	--
(4) Electricity survey instrument	$ 6000	Say 5 % of elec. use shifted to off peak 290,000 Ft/y = $ 4000	18.0
(5) Combustion control on ovens and boilers	(use the existing instrument)	Say 5 % of gas use 2,000,000 Ft/y = $ 27400	--
(6) Insulate warm water lines	--	--	< 12
(7) Replace oven burner with low excess air design	200,000 Ft or $ 3000	Say 10 % of avg 20 Nm^3/h (5000 h/yr) 122,000 Ft/yr = $ 1680	19.0
(8) Add heat recovery for air preheat	600,000 Ft or $ 8200	Further 15 % of gas use 180,000 Ft/yr = $ 2500	39.0
Totals	**$ 18,800**	**$ 39,680**	**5.7**

1 INTRODUCTION TO THE PLANT

1.1 Plant Activities

The bakery trust operates 47 plants but some are quite small and can be classed as "traditional" bakeries. About 80 percent of production is now concentrated in 4 large plants: one of these, at Szazados Street, was visited briefly from April 18 to 22, 1991 for a short energy audit. The bakery employs 430 persons.

The bakery produces bread, rolls and pasta in a wide variety of shapes. Flour is brought to the bakery and stored in several silos and transferred pneumatically to the mixing sections. The main production facilities consist of 8 large gas fired ovens for baking bread and rolls. In addition, there are two lines for pasta (both of which were shut down during our visit), four boilers for making medium pressure steam, and a heat centre for producing hot water.

The energy sources for the bakery are natural gas and electricity. The gas is used in the ovens and boilers: steam is used in the ovens, to make hot water (for use in the bakery and for space heating), for a small section of the space heating system, and for selling to a nearby bakery. Electricity is of course used throughout the bakery, especially for mixing and kneading dough.

In 1990, the bakery produced an average of almost 2000 tonnes of bread and other products each month. The total production for the year was 24,334 tonnes.

1.2 Energy Consumptions

The total energy used in 1990 was as follows:

	Basic units	Energy GJ	%	Costs Thou.Ft	%
Electricity	2,017,600 kWh	7263	6.2	9886	19.5
Natural gas	3,231,000 Nm^3	109854	93.8	40808	80.5
		117117	100.0	50694	100.0

The costs shown are based on 1991 price levels (figures used were 12.63 Ft/m^3 and 4.9 Ft/kWh).

The total steam production in 1990 was about 38250 tonnes, of which 7710 tonnes were sold and 30540 tonnes used in the bakery itself. About 60 percent of the steam is used for production related activities and 40 percent for "social" purposes such as space heating and hot water.

Production in 1990 was reported as follows:

Pasta	1356	tonnes
Strudel pastry	381	
Bread, rolls	22597	
	24334	

Overall, the energy consumption is calculated to be 4.8 GJ/tonne: the consumption for bread is reported by the plant to be about 3 GJ/t. Energy costs represent about 8.5 percent of the total product selling price.

2 FINDINGS AND RECOMMENDATIONS

2.1 Energy Management

Energy has become a greater proportion of production costs in the last few months and there is concern about how energy use may be reduced. Data on production and energy are collected daily and reported monthly. However, in the absence of adequate metering, many of the figures are estimated or based on fixed allocations (based on historical experience). This means that much of the data relating to thermal energy is of little or no use for energy management, but is simply used as an accounting exercise. Data provided for 1990 are presented in Appendix A.

Metering in the bakery is as follows:

Natural gas
- total to the bakery only (amounts to ovens and boilers not metered separately)

Steam
- steam sold
- steam to baking section 101
- steam to sections 100/102, space heating, etc.
- total steam produced from boilerhouse

Electricity
- meters generally available

The lack of gas and steam meters was discussed and the plant said that there were no suitable meters manufactured in Hungary. However, it was pointed out that simple and inexpensive orifice plate meters were quite suitable for monitoring gas and steam flows within the bakery and these should be installed, initially on the gas lines to meter separately the gas used by the baking operations (2 meters, to section 101 and to section 102) and that used by the boilers. Steam meters should also be installed to allow proper monitoring of steam used by all major production centres and the heat centre (hot water and space heating uses). Three steam meters should be installed at the boilerhouse to allow individual boiler productions to be measured.

It is recommended that gas meters be installed eventually on each oven to allow a regular check of efficiency to be made. Indeed, this should be done throughout the bakery trust plants, so that comparisons of energy productivity (GJ per tonne of product) for each oven can become a routine activity. As there appears to be spare baking capacity in the plants, management should ensure that only the most efficient ovens are used to meet the demand and that inefficient ovens be used only in cases of emergency. Ovens that are seen to be significantly less efficient than the majority should be investigated and their performance improved if feasible.

With respect to the data which were made available for 1990 (Appendix A), these could be presented in a better format than currently. It is recommended that the format for daily and monthly reporting be improved to show the key consumption and production data side by side. Comparison of performance becomes much easier and discrepancies in figures are more obvious. In addition to basic consumption data, regular reports should show the values for important ratios, such as fuel consumption per tonne of bread produced. More comprehensive monitoring and calculation of more ratios is made easy if the entire system is put on a computer using a simple spreadsheet (e.g. Lotus 123).

As the metering in the plant is not adequate and some consumptions are based on historical ratios or allocations, some of the ratios presented in Appendix A can be considered estimates only. However, even bearing this in mind, there are some rather wide fluctuations in the figures. For example, electricity use in Sections 100 to 103 fluctuate between wide limits:

	kWh per tonne		Ratio of max.
	Minimum	Maximum	to min.
Section 100	149.7	288.2	1.93
101	29.7	47.3	1.59
102	41.0	115.7	2.82
103	469.6	607.6	1.29

As natural gas use is allocated, not metered, and the steam consumptions are affected by energy used for space heating, we have not attempted any detailed analysis of the thermal energy. A brief review of electricity use was made however. A graph was drawn of total electricity consumption against total production. In ideal circumstances, this type of graph would typically be a straight line, such as that shown in Exhibit 2.1. The energy consumption can be divided into two parts, the energy which is clearly related to production and that which is essentially constant and has no obvious relationship to the level of production. These are shown in the exhibit. The "fixed" energy is a function of items such as losses due to idle machinery being left switched on, and "real" energy uses such as lighting.

The data for the bakery for 1990 were plotted (Exhibit 2.2) and an attempt made to draw a straight line. Most of the points are clustered together and therefore the line cannot be considered reliable. There is an indication that the fixed portion of electricity consumption is rather high for the bakery, perhaps 50 percent of the total electricity use. Some of this is undoubtedly electricity used to run the main ovens, which is more or less fixed irrespective of the production. This cannot be changed except by ensuring the machines are not switched on unless absolutely necessary (that is,the warm up and cool down times are minimal) although this is likely to have only a small effect. In addition, however, the data do suggest wide variations in total electricity use (e.g. the significant difference of about 50 percent between points 2 and 11 for essentially the same level of production).

Exhibit 2.1

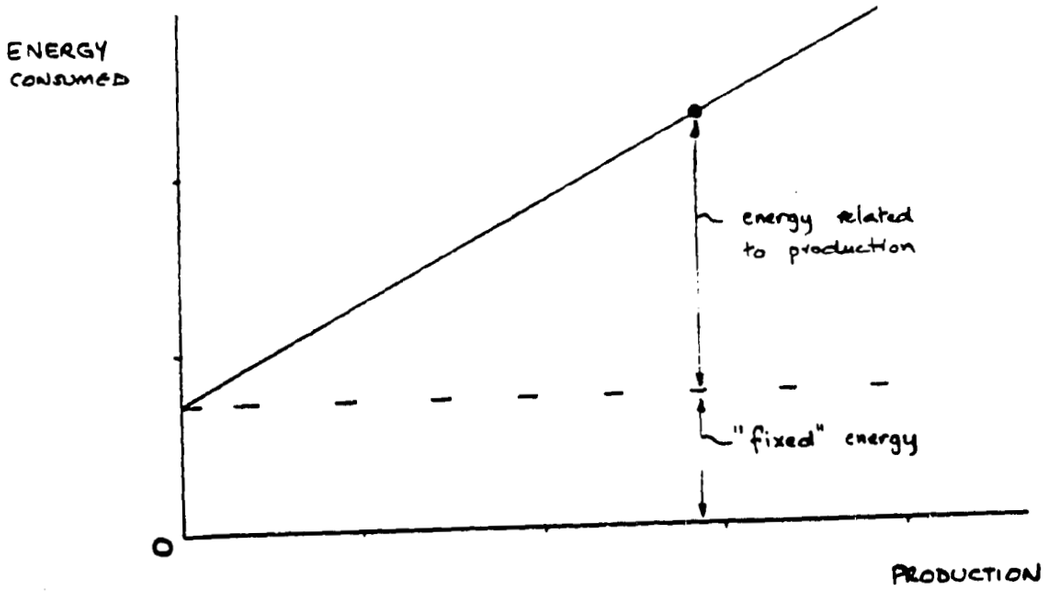
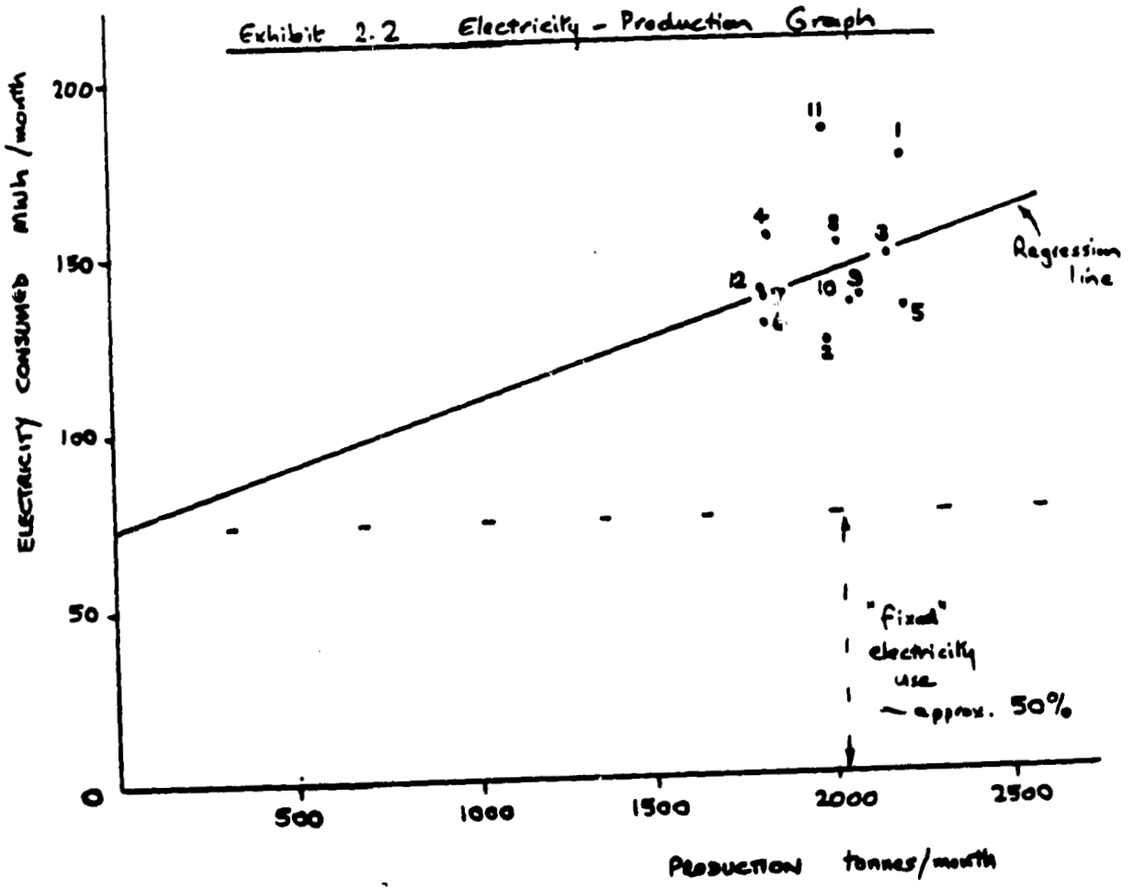


Exhibit 2.2 Electricity - Production Graph



This brief analysis cannot be used to draw exact conclusions. Rather, it suggests that closer monitoring of energy use and production would be desirable and that efforts should be made in future to find the reasons for any wide variations of the type we have observed in the historical data.

2.2 Boilerhouse

There are a number of uses for steam in the bakery. Some steam is used for producing hot water for social uses and some is used for heating dough, for assisting the leavening, and for injecting as 0.4 bar steam into the entry of the main ovens to provide the correct humidity during the initial stages of the baking process.

The bakery has three Lavatherm Model SLT-3 boilers installed in the central boilerhouse. These were made in Hungary around 1971 and are three-pass gas fired units. They produce 4 bar saturated steam at a rate of about 3 tonnes/hour (although nominal capacity is 3.4 t/h). The control system for the boilers is tied to the burner firing rate: the burners can be switched off, run on low fire, or on high fire. The gas rates on low and high fire are 175 and 350 Nm^3/h respectively. There is also one small boiler (capacity 1.7 t/h) which is used normally only as a standby.

Steam from the boilerhouse is either sold to a nearby bakery or sent to the main heat centre for reduction to 0.4 bar steam or for heating of water. Steam sales were about 3 t/h during much of our visit while the plant itself was consuming about 2 t/h.

Boiler feed water comes partly from returned condensate and partly from city water. We were unable to check the water quality ourselves as the equipment was being used at the Budafok paper plant. The TDS level of the boiler water, for example, is not determined every day and thus it appears the blowdown is not controlled on the basis of regular water testing for dissolved solids. Water quality is however monitored by the boiler operators who check firstly the pH and secondly the hardness. It is therefore recommended that the plant be supplied with a TDS meter and institute a regular programme of water quality testing for blowdown control.

It is worth pointing out that many of the feed water lines in the system between the condensate tank, the deaerator and the boilers are not insulated. A thorough check of all lines that are supposed to contain warm or hot water should be made and insulation improved where necessary.

A new water treatment system has recently been installed: this is a magnetic device that is supposed to alter the nature of the compounds in the water and prevent scaling on interior surfaces of the boiler. It is too early to say if this system will work well but initial indications are hopeful.

Tests of the combustion conditions on the boilers were made using a stack gas analyser brought to the plant by the audit team. Subsequently, it was decided to use the bakery's own combustion gas analyser which is a similar microprocessor design with printer.

	Oxygen % vol	Excess air %	CO ppm	
Boiler II	3	16	< 2	(at full load)
Boiler III	9	75	1	(at high and low fire)

It therefore appears that boiler II is well adjusted and is operating at fully acceptable excess air levels. Boiler III requires urgent attention and should be adjusted to match Boiler II performance as it is identical.

A quick check of temperatures on the outer surfaces of the boilers showed that these were generally below 45 deg C. Heat loss through radiation and convection is therefore low, certainly under 1 percent of energy input.

Stack temperatures were found to be in the range 160 to 190 deg C which is also good. The overall combustion efficiency of these boilers is thus around 79 to 83 percent.

2.3 Ovens

At present there are 8 ovens available at the bakery, the oldest being about 15 years old: there is one new oven under construction. The existing ovens are all of the same general design. Each has a single burner mounted on the top of the oven with a fan to circulate the combustion gases around the oven space. The gases are kept separate from the bread side of the oven as no contact is allowed under Hungarian regulations. As the dough enters the oven, humidity is controlled by the injection of low pressure steam. The uncooked bread or rolls move through the oven on a travelling wire mesh. The bread side temperatures have been checked by the plant to ensure that there is a minimum variation in temperature across the mesh. The highest bread side temperature was found to be about 280 deg C.

Four of the ovens are large, and two of these were built under license from a Swiss designer. These ovens are generally used for bread. The other four are smaller and are used mainly for rolls. Not all the ovens are operated regularly as the total capacity is significantly greater than current demand.

Most of the burners were made by Hungarian manufacturers but even these pose problems in obtaining spare parts. The large burners operate at two firing levels, with gas rates of 18 and 30 Nm^3/h for low and high fire respectively.

The interior construction of the burners includes a disc perforated with many holes through which the air is dispersed. We noticed that a number of burners had drawn in significant quantities of flour and there is a danger that flour could block some of the holes, adversely affecting the fuel/air mixing. Erosion of the burner interior parts could also occur. The air to the burners should therefore be kept clean.

Various tests were conducted on the ovens. On one of the small ovens used for baking rolls, three steam traps were checked and one was found defective. It would be useful for the plant to have a sonic steam trap testing instrument to conduct routine checks of all traps.

The insulation on the ovens appears to be in good condition. Most ovens are believed to have the insulation replaced every 5 years or so. A check of surface temperatures showed that these were rarely over 30 deg C and thus the heat loss is quite minimal.

The burners are checked and adjusted four times a year. We therefore made spot checks of combustion conditions and found excessive amounts of oxygen in the combustion gases. For reasonably efficient combustion with natural gas fuel, we would expect to find 5 percent oxygen or less, and essentially no carbon monoxide, in the gases. We found the following values:

		Oxygen % vol	CO ppm
Small oven/rolls	-- low fire	16.9	4
	-- low fire	14.3	17
	average	15.6	11
	-- high fire	12.6	7
	-- high fire	10.1	44
	average	11.4	26
Large oven/bread	-- low fire	15.9	25
	-- low fire	16.8	21
	-- low fire	17.8	29
	-- low fire	17.8	31
	-- low fire	17.8	27
	average	17.2	27
	-- high fire	13.7	23
	-- high fire	11.8	25
	-- high fire	15.5	30
	average	13.7	26

Oxygen levels of 16 or 17 percent indicate excess air rates of 300 or 400 percent, well in excess of acceptable levels. Even 11 percent oxygen signifies excess air over 100 percent instead of the 30 percent or less that should be achieved. As the ovens were in full production, we were unable to make any significant adjustments to the air rates. Stack gas temperatures were in the range 240 to 260 deg C.

We therefore returned to the plant to check conditions on another of the large ovens on which we could attempt to obtain better air to fuel ratios. The results were as follows;

	Oxygen % vol	CO ppm
Start of tests, as found	16.8	3
	14.8	9
	14.5	5
	13.4	7
	14.1	7
	13.6	6
End of tests	13.4	7

It proved impossible to reduce the air rate as the burner safety interlock tripped as soon as air pressure at the burner entry dropped slightly. It was impossible to bypass the safety mechanism. At 13.4

percent oxygen, the excess air is still much too high at 175 percent. From our observations on the ovens, we suspect that all ovens are incorrectly set or are unable to run at a reasonably low excess air level, and thus combustion in the ovens is quite inefficient.

This inefficiency is of course compounded by the typical operating cycle. On most days, the ovens are started up about 1600 hrs and warm up for 1 hour. They are then operated until say 0600 or 0700 hrs the next morning. Because the bread has to be delivered fresh to the shops by 0700 hrs every day, the plant says it cannot run fewer ovens at high throughput for say 24 hours: some of the production would be made too early and customers might reject it. The plant believes there could be a fuel penalty of as much as 25 percent for running only 15 hours or so each day.

During the time the oven is off, it obviously cools down and this represents a waste of energy. During our visit, we noticed many side doors and top vents left open on non-working ovens. This means even more cooling will take place and a longer warm up period will be needed. Although the benefits may be rather small, on principle the doors should be closed whenever possible.

The bakery could save fuel by replacing the existing burners with a design that permits operation at low excess air rates. Savings by reducing the present excess air from say 300 percent to even 50 percent should be at least 12 - 15 percent of current fuel use.

The high stack temperatures on most ovens present an opportunity for heat recovery. The possibilities include recycling part of the stack gases into the combustion air, installing a heat exchanger to preheat combustion air, generating 0.4 bar steam for use in the baking process itself, or using recovered heat for domestic water heating. It is suggested that air preheating with a new heat exchanger be investigated: price quotes for the necessary equipment are being obtained. A comparison of the costs and benefits will be made to determine the payback period for the investment.

2.4 Main Heat Centre

This department takes the 4 bar saturated steam and produces hot water for social purposes and also hot water at 80 deg C for the pasta lines. Steam is let down to 0.4 bar for use in the baking ovens. The heat centre is also responsible for operating the plant space heating system. This is controlled by time clocks which can be set to switch heating on or off, and there is an exterior sensor which can adjust the circulating water temperature in accordance with the outside temperature. There is no control of the system by thermostat or sensor inside the heated spaces.

There appears to be insufficient control of radiators and several were found operating even with relatively mild outside conditions and in areas of the plant which were unoccupied. Control of the existing system does appear rather complicated and a careful review is recommended with a view to simplifying the control and perhaps to introducing direct measurement of the temperature of heated spaces as a control parameter.

The amount of energy used for space heating is not known with any precision and no attempt is made to relate space heating with degree days.

2.5 Electrical System

The Esterline electrical load survey instrument was set up at the bakery over a weekend to monitor loads. Examples of the chart record are shown in Appendix C.

The main electrical loads are the mixers for dough and the kneading machines, as can be seen in the charts. The load builds up as the flour and water mixture stiffens. Other loads such as the motor drives for the ovens are generally a steady contribution to the overall load.

The cost of electricity for the peak and day times is the same at about 5.7 Ft/kWh. The peak period is from 1600 to 2200 hours. The cost of off peak or night consumption is half, 2.8 Ft/kWh. Examination of the chart record suggests that there may be small opportunity for savings to be made by delaying the start of large mixing or kneading machines until after 2200 hrs if possible. The charts for both Friday and Sunday evening show that some machines were operated in the period 2100 to 2140 hrs and these might have been operated after 2200 hrs to cut energy costs.

Further detailed study of electrical loads and the times of operation of major energy consumers is needed to make a reasonable estimate of the potential cost savings, although these are likely to be quite small.

3 SUMMARY OF ENERGY SAVING OPPORTUNITIES

3.1 Recommendations

The recommendations are as follows:

Energy Management and Data

(1) Improve the format and content of regular reports (e.g. to include more performance ratios) and begin plotting energy - production graphs for both electricity and thermal energy. Draw these graphs for the bakery as a whole and for individual departments if information is available.

(2) Monitor energy related performance and identify the reasons for any major fluctuations in the data.

(3) For improved efficiency of data reporting and analysis, install the data system on a computer.

(4) Install additional gas and steam meters (e.g. gas to the ovens, gas to the boilerhouse, gas to each oven, gas to each boiler, steam from each boiler, steam to space heating/hot water, etc.)

(5) Set up similar comprehensive reporting systems in all bakeries and compare equipment efficiencies. Calculate the cost variations due to different energy performances and evaluate the cost effectiveness of equipment modernisation or replacement. Operate only the most efficient equipment when there is spare capacity available, if practical. It is understood that there are about 100 ovens in the 47 plants operated by the bakery trust.

(6) To assist in energy management, purchase some portable instruments such as a sonic steam trap tester, a meter for the determination of Total Dissolved Solids in water, and an electrical system survey meter.

Boilers

(1) Check boiler water regularly for TDS and maintain under 3500 ppm by adjusting the blowdown.

(2) Check the combustion gases from the boilers regularly (at least once per week) and adjust the air to fuel ratio regularly to maintain the lowest possible excess air rates at all times.

(3) Where consistently low air rates are not possible, repair or replace the burners or other relevant parts.

(4) Survey the boiler feed water lines around the condensate tank, deaerator and feed pumps. Insulate lines carrying warm water.

(5) Check all steam traps in the bakery: repair and replace as required.

(6) Check the effect of the new magnetic water treatment system through water quality analyses and by direct inspection of internal surfaces.

Ovens

(1) Install the best available burners on all ovens, taking new items from stock and leaving the old burners in store for spare parts.

(2) Check combustion conditions regularly and adjust burners to operate on minimum excess air rates. Review the safety interlocks and modify as required to remove excessive margins (e.g. a minimum excess air rate of nearly 200 percent is totally unnecessary).

(3) When ovens are shut down, ensure side doors and top vents are kept closed to avoid unnecessary cooling down (and thus saving fuel during the subsequent warm up period).

(4) Review the policy and procedures for initial cooling of ovens at the end of the baking period. Ovens should be left as hot as practicable, subject to prevention of mechanical stress due to temperature differences across components.

(5) Determine the cost of new low excess air burners and the savings

(6) Evaluate the costs and benefits of various heat recovery options for the ovens, such as partial recycle of hot gases (especially during the warm up period), installation of a heat exchanger for preheating combustion air, and recovery of heat for low pressure steam generation. The cost of burners able to utilise hot air and the cost of a suitable heat exchanger are being determined.

(7) As a contribution to determining the cost effectiveness of new burners, monitor the current gas consumption on the large bread ovens: gas use, quantity and type of product, and the combustion gas oxygen and CO contents should be recorded daily for 1-2 months.

(8) For the next scheduled replacement of insulation on an oven, consider the replacement of standard insulation by low mass ceramic fiber insulation. This should save energy by reducing the heat stored in the massive walls of the oven during the cyclic process. Energy lost through the walls during normal operation is already minimal.

(9) Future plans for equipment upgrading or replacement should include the use of higher efficiency oven designs with heat recovery.

Electricity

(1) Use the load survey instrument to check loads especially during peak periods. Shift loads where possible to off peak.

(2) Identify contributors to the "fixed" electricity consumption evident in electricity/production graphs (e.g. lighting, unnecessary machine idling).

Other

(1) Study the options for controlling the space heating system and simplify the procedures. If practical, control the heating using inside temperatures.

(2) Ensure that radiators are off when areas are unoccupied.

(3) A survey of inside temperatures would be useful during the next heating season to identify those areas that are overheated and those that require more heat. The survey will also assist in the design of a simplified space heating system, which may require installation of sensors and control valves in various locations.

3.2 Estimate of Savings Potential

Initial estimates of the potential savings are given in Exhibit 3.1. The total savings listed are equivalent to about 6 percent of the current energy bill and the average payback is around 6 months.

3.3 Possible Assistance and Demonstration Projects

Assistance with equipment purchase could be given to the plant on the following items:

		US dollars
(1) Purchase of instruments		
	-- electrical system survey instrument	6000
	-- sonic steam trap tester	1300
	-- TDS meter	300
	Total	7600

All the above instruments could be utilised at the other 46 bakeries and thus the potential benefits are substantial.

(2) Purchase of low excess air burner for demonstration, say $ 5000

(3) Purchase of heat recovery system for preheating combustion air, say $ 8200.

Cost estimates for the hardware for items (2) and (3) are being verified to recheck the initial payback estimates. The replication potential for a low excess air burner with heat recovery is certainly high but the payback period of over 3 years is not attractive.

EXHIBIT 3.1

ESTIMATES OF POTENTIAL SAVINGS

Item	Cost	Savings	Payback months
(1) Energy management and data -- reports, monitoring, extra meters, inter-bakery comparisons	--	--	--
(2) Sonic trap tester	$ 1300	Detection of 10 faulty traps per year, leakage 5 kg/hr, 6000 hr/yr 300,000 Ft/y = $ 4100	3.8
(3) TDS meter	$ 300	--	--
(4) Electricity survey instrument	$ 6000	Say 5 % of elec. use shifted to off peak 290,000 Ft/y = $ 4000	18.0
(5) Combustion control on ovens and boilers	(use the existing instrument)	Say 5 % of gas use 2,000,000 Ft/y = $ 27400	--
(6) Insulate warm water lines	--	--	< 12
(7) Replace oven burner with low excess air design	200,000 Ft or $ 3000	Say 10 % of avg 20 Nm^3/h (5000 h/yr) 122,000 Ft/yr = $ 1680	19.0
(8) Add heat recovery for air preheat	600,000 Ft or $ 8200	Further 15 % of gas use 180,000 Ft/yr = $ 2500	39.0
Totals	**$ 18,800**	**$ 39,680**	**5.7**

APPENDIX A

AKERY ENERGY AND PRODUCTION REPORTS -- TYPICAL FORMAT -- DATA FOR 1990

ITEM	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
RODUCTION -- tonnes													
100 pasta	161.6	91.5	124.1	110.5	150.7	0.0	109.8	174.5	92.3	95.8	153.8	91.4	1356.0
101 rolls/cake	1251.9	1007.7	1081.7	984.9	1200.2	1123.4	1054.4	1137.5	1231.4	1156.8	1152.3	1041.9	13424.1
102 bread	831.4	866.8	937.6	862.2	832.0	682.6	628.0	703.6	729.5	762.2	656.7	680.6	9173.2
103 strudel pastry	32.1	28.8	35.9	28.0	35.0	37.7	37.6	20.1	31.3	33.2	33.6	28.0	381.3
total	2277.0	1994.8	2179.3	1985.6	2217.9	1843.7	1829.8	2035.7	2084.5	2048.0	1996.4	1841.9	24334.6
101/102 bread, rolls	2083.3	1874.5	2019.3	1847.1	2032.2	1806.0	1682.4	1841.1	1960.9	1919.0	1809.0	1722.5	22597.3
ATURAL GAS -- Nm3													
100 alloc.	30163	20500	22000	20000	25824	3000	13000	24719	20000	20000	20000	20000	239206
101 alloc.	135000	90560	92054	77749	98057	83634	107862	92107	106446	95600	102599	98640	1180308
102 alloc.	203228	145407	149428	130550	155090	100000	100000	86144	88210	118779	122405	112254	1511495
total alloc.	368391	256467	263482	228299	278971	186634	220862	202970	214656	234379	245004	230894	2931009
ATURAL GAS RATIOS													
otal gas/total prodtn cubic metres per tonne	162	129	121	115	126	101	121	100	103	114	123	125	120
ction 100 gas/prod.	187	224	177	181	171	---	118	142	217	209	130	219	176
ction 101 gas/prod.	108	90	85	79	82	74	102	81	86	83	89	95	88
ction 102 gas/prod.	244	168	159	151	186	146	159	122	121	156	186	165	165
TEAM -- tonnes													
101 metered	501.1	390.4	383.7	313.7	316.4	224.2	271.8	219.4	373.8	390.7	535.4	535.4	4456.0
100/2 metered	3479.6	2611.1	2908.6	2191.0	2141.0	1274.3	1547.8	1647.2	1828.6	1762.0	2430.0	2265.3	26086.5
sales metered	1638.0	1235.3	955.3	532.4	70.4	76.9	40.8	62.5	126.2	726.1	1123.3	1123.3	7710.5
net to bakery	3980.7	3001.5	3292.3	2504.7	2457.4	1498.5	1819.6	1866.6	2202.4	2152.7	2965.4	2800.7	30542.5
total steam	5618.7	4236.8	4247.6	3037.1	2527.8	1575.4	1860.4	1929.1	2328.6	2878.8	4088.7	3924.0	38253.0
TEAM RATIOS													
otal bakery steam/prod tonnes per tonne	1.91	1.60	1.63	1.36	1.21	0.83	1.08	1.01	1.12	1.12	1.64	1.63	1.35
ction 101 steam/prod	0.40	0.39	0.35	0.32	0.26	0.20	0.26	0.19	0.30	0.34	0.46	0.51	0.33
ction 100/102 steam/prod	3.50	2.72	2.74	2.25	2.18	1.87	2.10	1.88	2.23	2.05	3.00	2.93	2.48

App. A

ITEM	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
ELECTRICITY -- MWh													
100 metered	39.1	13.7	18.6	27.6	22.6	14.2	16.5	35.3	26.6	25.9	31.5	23.0	284.6
101 metered	37.2	31.0	43.3	46.6	46.6	38.0	42.3	45.5	39.0	35.2	46.1	41.7	492.5
102 metered	63.8	54.0	56.1	62.2	34.1	45.6	49.0	48.7	45.0	46.9	76.0	48.3	629.7
103 metered	15.1	17.5	16.9	14.5	16.7	20.4	17.7	9.5	14.7	15.9	15.8	17.0	189.7
Koz. metered	9.5	5.8	12.1	11.6	11.4	9.9	10.5	11.3	10.9	9.3	11.2	6.7	120.2
subtotal	164.7	122.0	147.0	152.5	131.4	120.1	136.0	150.3	136.2	133.2	180.6	136.7	1716.7
Sales	32.4	29.1	24.9	29.1	20.1	20.7	17.1	19.2	23.4	24.3	30.9	29.7	300.9
total	197.1	151.1	171.9	181.6	151.5	148.8	153.1	169.5	159.6	157.5	211.5	166.4	2017.6
ELECTRICITY RATIOS													
Total bakery elec/ prodtn kWh per tonne	72.3	61.2	67.5	76.8	59.2	69.5	74.3	73.8	65.3	65.0	90.5	74.2	70.5
Section 100 elec/prod	242.0	149.7	149.9	159.3	150.0	----	150.3	202.3	288.2	270.4	204.8	251.6	209.9
Section 101 elec/prod	29.7	30.8	40.0	47.3	38.8	33.8	40.1	40.0	31.7	30.4	40.0	40.0	36.7
Section 102 elec/prod	76.7	62.3	59.8	72.1	41.0	66.8	78.0	69.2	61.7	61.5	115.7	71.0	68.6
Section 103 elec/prod	470.4	607.6	470.8	517.9	477.1	541.1	470.7	472.6	469.6	478.9	470.2	607.1	497.5
OVERALL ENERGY USE													
Natural gas GJ/tonne	5.50	4.37	4.11	3.91	4.28	3.44	4.10	3.39	3.50	3.89	4.17	4.26	4.10
Electricity GJ/tonne	0.26	0.22	0.24	0.28	0.21	0.25	0.27	0.27	0.24	0.23	0.33	0.27	0.25
Total	5.76	4.59	4.35	4.19	4.49	3.69	4.37	3.66	3.74	4.13	4.50	4.53	4.35

BOILER II

SERIAL # 11001934

SERIAL # 11001934

SERIAL # 11001934

ENERAC MODEL 2000
COMBUSTION TEST RECORD

FOR: RCG/HBI

TIME: 14:57:58
DATE: 04/19/91

FUEL NATURAL GAS:21870 BTU/LB

COMBUSTION EFFICIENCY:	83.0	%
AMBIENT TEMPERATURE:	30	°C
STACK TEMPERATURE:	162	°C
OXYGEN:	03.7	%
CARBON MONOXIDE:	0	PPM
CARBON DIOXIDE:	09.8	%
COMBUSTIBLE GASES:	0.00	%
STACK DRAFT (INCHES H20):	+ 00.0	
EXCESS AIR:	19	%
CARBON MONOXIDE ALARM:	50	PPM

MODE:PPM OXY_REF=TRUE%

BOILER II

BOILER II

```
****************
*   ECOM - SL  *
****************
```

GAZELEMZES

ora:perc:	15:06	
datum :	19.04.91	
tuzeloan. :		
nyom foldgaz		
T-gaz:	181	GRD
T-szoba:	30	°C
O2 :	2.5	%
CO :	2	PPM
SO2 :	0	PPM
NOx :	67	PPM
CO2 :	10.3	%
hatafok:	93.3	%

COMBUSTION TEST RESULTS

APPENDIX B

BOILER III

HIGH

****
ECOM - SL *
****

Z E L E M Z E S
---
perc: 15:13
m : 19.04.91

loan. :
foldgaz
z: 190 GRD
oba: 31 °C
: 8.2 %
: 1 PPM
0 PPM
32 PPM
7.1 %
ok: 89.7 %

BOILER III

LOW

****
* ECOM - SL *
****

G A Z E L E M Z E S
---
ora:perc: 15:27
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 189 GRD
T-szoba: 32 °C
O2 : 10.0 %
CO : 1 PPM
SO2 : 0 PPM
NOx : 25 PPM
CO2 : 6.1 %
hatafok: 88.2 %

OVEN/ROLLS

LOW LOAD

****
* ECOM - SL * (1)
****

G A Z E L E M Z E S
---
ora:perc: 15:47
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 34 GRD
T-szoba: 30 °C
O2 : 16.9 %
CO : 4 PPM
SO2 : 2 PPM
NOx : 14 PPM
CO2 : 2.2 %
hatafok: 99.2 %

OVEN/ROLLS

FULL LOAD

****
* ECOM - SL * (1)
****

G A Z E L E M Z E S
---
ora:perc: 15:52
datum : 19.04.91

tuzeloan. :
nyom foldgaz 278 °C
T-gaz: ~~39~~ GRD
T-szoba: 30 °C
O2 : 12.6 %
CO : 7 PPM
SO2 : 2 PPM
NOx : 25 PPM
CO2 : 4.6 %
hatafok: 99.1 %

LOW

LOW LOAD

****
ECOM - SL *
****

E L E M Z E S
---
erc: 16:01
: 19.04.91

oan. :
foldgaz
: 63 GRD
ba: 31 °C
14.3 %
17 PPM
4 PPM
25 PPM
3.4 %
ok: 95.7 %

ROLLS HIGH

HIGH LOAD

****
* ECOM - SL *
****

G A Z E L E M Z E S
---
ora:perc: 16:03
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 68 GRD
T-szoba: 31 °C
O2 : 10.1 %
CO : 44 PPM
SO2 : 2 PPM
NOx : 44 PPM
CO2 : 6.9 %
hatafok: 97.2 %

Ybr Computertechnik
Tel. 02371/41011

(A)

BREAD OVEN/LOW

****
* ECOM - SL *
****

G A Z E L E M Z E S
---
ora:perc: 16:46
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 285 GRD
T-szoba: 26 °C
O2 : 15.9 %
CO : 25 PPM
SO2 : 6 PPM
NOx : 7 PPM
CO2 : 2.9 %
hatafok: 83.1 %

BREAD OVEN/LOW

****
* ECOM - SL *
****

G A Z E L E M Z E S
---
ora:perc: 16:53
datum : 19.04.91
BREAD
tuzeloan. : START
nyom foldgaz
T-gaz: 283 GRD
T-szoba: 27 °C
O2 : 16.8 %
CO : 21 PPM
SO2 : 5 PPM
NOx : 5 PPM
CO2 : 2.3 %
hatafok: 99.9 %

APPENDIX W

^D – HIGH

****
COM - SL *
****
LEMZES

c: 16:56
: 19.04.91

n. :
ldgaz
288 GRD
29 °C
13.7 %
23 PPM
6 PPM
6 PPM
4.9 %
95.7 %

LOW

BREAD low load

****
* ECOM - SL *
****

GAZELEMZES

ora:perc: 17:01
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 299 GRD
T-szoba: 29 °C
O2 : 17.8 %
CO : 31 PPM
SO2 : 4 PPM
NOx : 3 PPM
CO2 : 1.7 %
hatafok: 80.6 %

HIGH

Bread/high load

****
* ECOM - SL *
****

GAZELEMZES

ora:perc: 17:19
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 21 GRD
T-szoba: 27 °C
O2 : 11.8 %
CO : 25 PPM
SO2 : 6 PPM
NOx : 23 PPM
CO2 : 5.1 %
hatafok: 99.9 %

LOW

****
* ECOM - SL *
****

GAZELEMZES

ora:perc: 18:28
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 220 GRD
T-szoba: 30 °C
O2 : 17.8 %
CO : 27 PPM
SO2 : 0 PPM
NOx : 5 PPM
CO2 : 1.7 %
hatafok: 99.8 %

LOW

(Rye) Bread. low

****
* ECOM - SL *
****

GAZELEMZES

ora:perc: 18:32
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 217 GRD
T-szoba: 30 °C
O2 : 17.8 %
CO : 29 PPM
SO2 : 0 PPM
NOx : 6 PPM
CO2 : 1.7 %
hatafok: 75.0 %

HIGH

HIGH

****
* ECOM - SL *
****

GAZELEMZES

ora:perc: 18:35
datum : 19.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 225 GRD
T-szoba: 31 °C
O2 : 15.5 %
CO : 39 PPM
SO2 : 0 PPM
NOx : 15 PPM
CO2 : 3.0 %
hatafok: 95.0 %

APPENDIX B

22

OVEN — LOW | AS FOUND

Z E L E M Z E S

perc: 09:18
m : 22.04.91

loan. :
foldgaz
z: 26 GRD
oba: 20 °C
: 16.8 %
: 3 PPM
: 2 PPM
: 11 PPM
: 2.3 %
fok: 98.0 %

****
ECOM - SL *
****

Z E L E M Z E S

perc: 10:17
m : 22.04.91

loan. :
foldgaz
z: 38 GRD
oba: 21 °C
: 14.1 %
: 7 PPM
: 2 PPM
: 24 PPM
: 3.8 %
fok: 98.0 %

kemenyhuzat.....hPa

koromszam.....

Computertechnik
. 02371/41011

****
* ECOM - SL *
****

G A Z E L E M Z E S

ora:perc: 09:23
datum : 22.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 34 GRD
T-szoba: 20 °C
O2 : 14.9 %
CO : 9 PPM
SO2 : 2 PPM
NOx : 20 PPM
CO2 : 3.4 %
hatafok: 98.2 %

****
* ECOM - SL *
****

G A Z E L E M Z E S

ora:perc: 10:19
datum : 22.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 40 GRD
T-szoba: 21 °C
O2 : 13.6 %
CO : 5 PPM
SO2 : 2 PPM
NOx : 28 PPM
CO2 : 4.1 %
hatafok: 97.9 %

kemenyhuzat.....hPa

koromszam.....

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Tel. 02371/41011

****
* ECOM - SL *
****

G A Z E L E M Z E S

ora:perc: 09:59
datum : 22.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 34 GRD
T-szoba: 21 °C
O2 : 14.5 %
CO : 5 PPM
SO2 : 0 PPM
NOx : 22 PPM
CO2 : 3.6 %
hatafok: 98.4 %

****
* ECOM - SL *
****

G A Z E L E M Z E S

ora:perc: 10:20
datum : 22.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 42 GRD
T-szoba: 21 °C
O2 : 13.4 %
CO : 7 PPM
SO2 : 2 PPM
NOx : 29 PPM
CO2 : 4.2 %
hatafok: 97.7 %

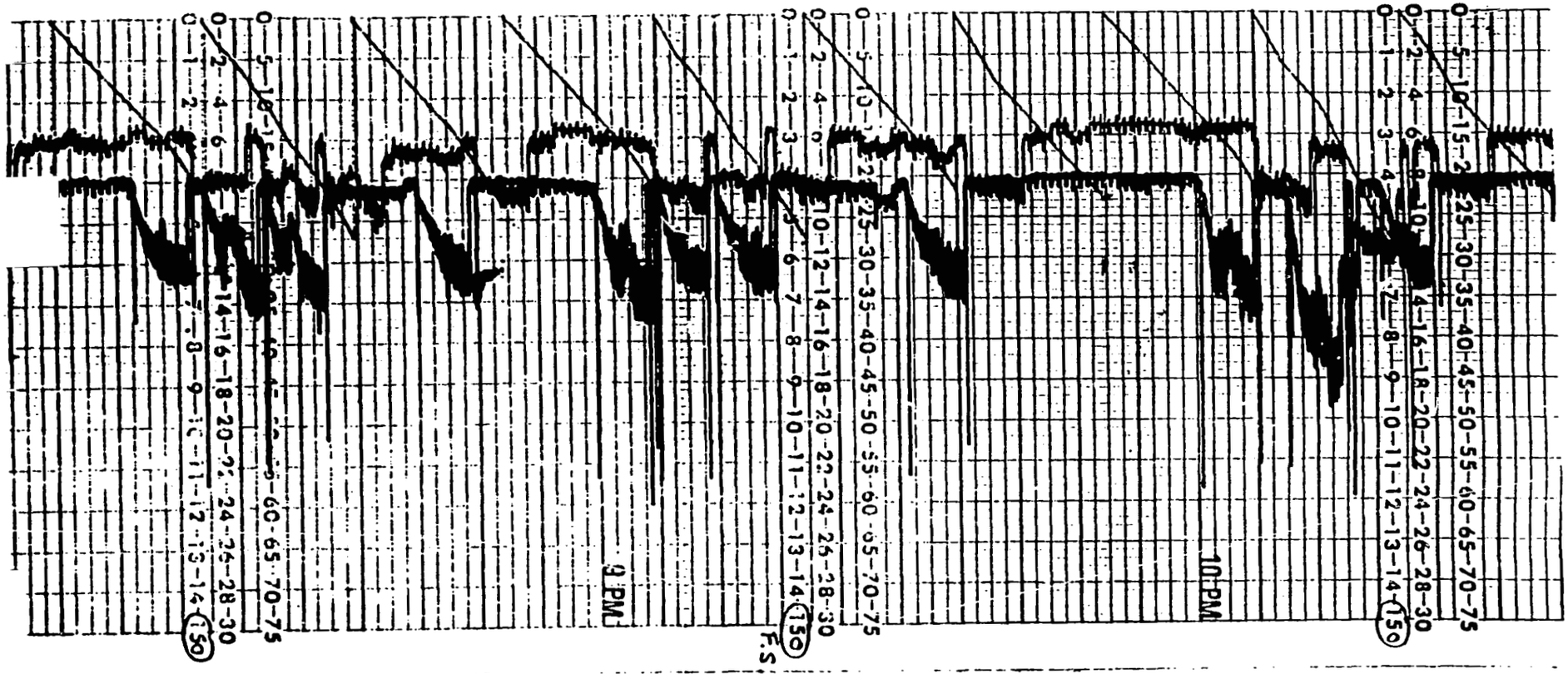
****
* ECOM - SL *
****

G A Z E L E M Z E S

ora:perc: 10:22
datum : 22.04.91

tuzeloan. :
nyom foldgaz
T-gaz: 45 GRD
T-szoba: 21 °C
O2 : 13.4 %
CO : 7 PPM
SO2 : 2 PPM
NOx : 29 PPM
CO2 : 4.2 %
hatafok: 97.6 %

APPENDIX W

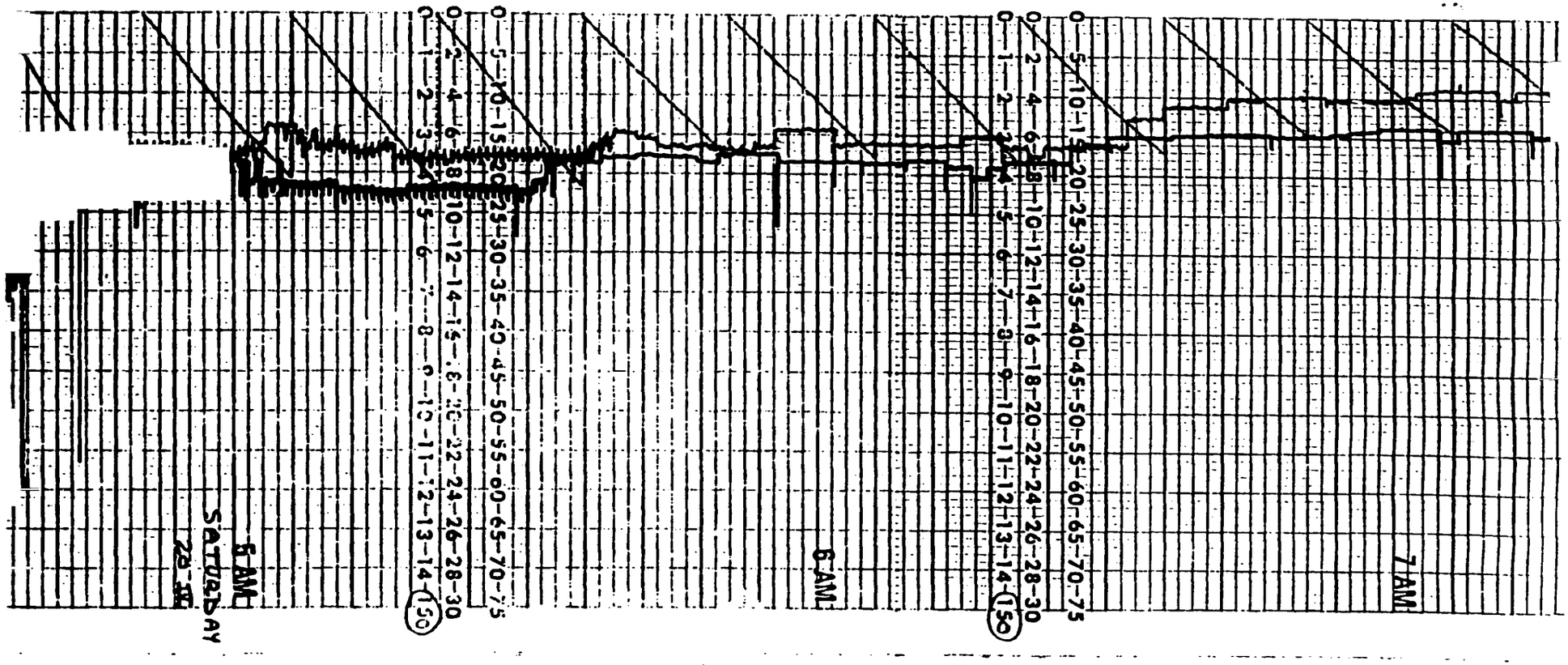


FRIDAY 8pm — — — — — — — — — — — → 10 pm → (NIGHT)

(PEAK)

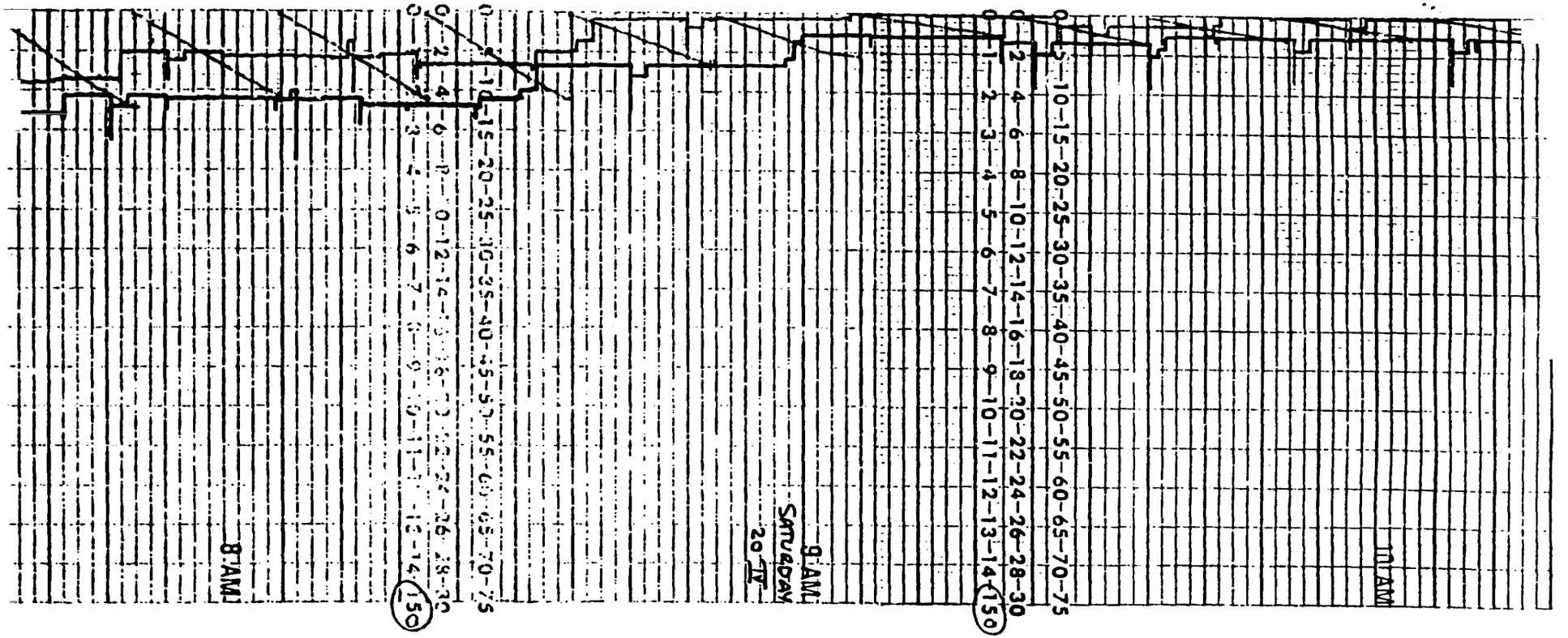
APPENDIX C

APPENDIX C



E ANGUS INDIANAPOLIS, IND., U.S.A. MADE IN CANADA CHART No. 59325-1100

(LAST MIX OF DOUGH) - - - - SATURDAY MORNING - - - -



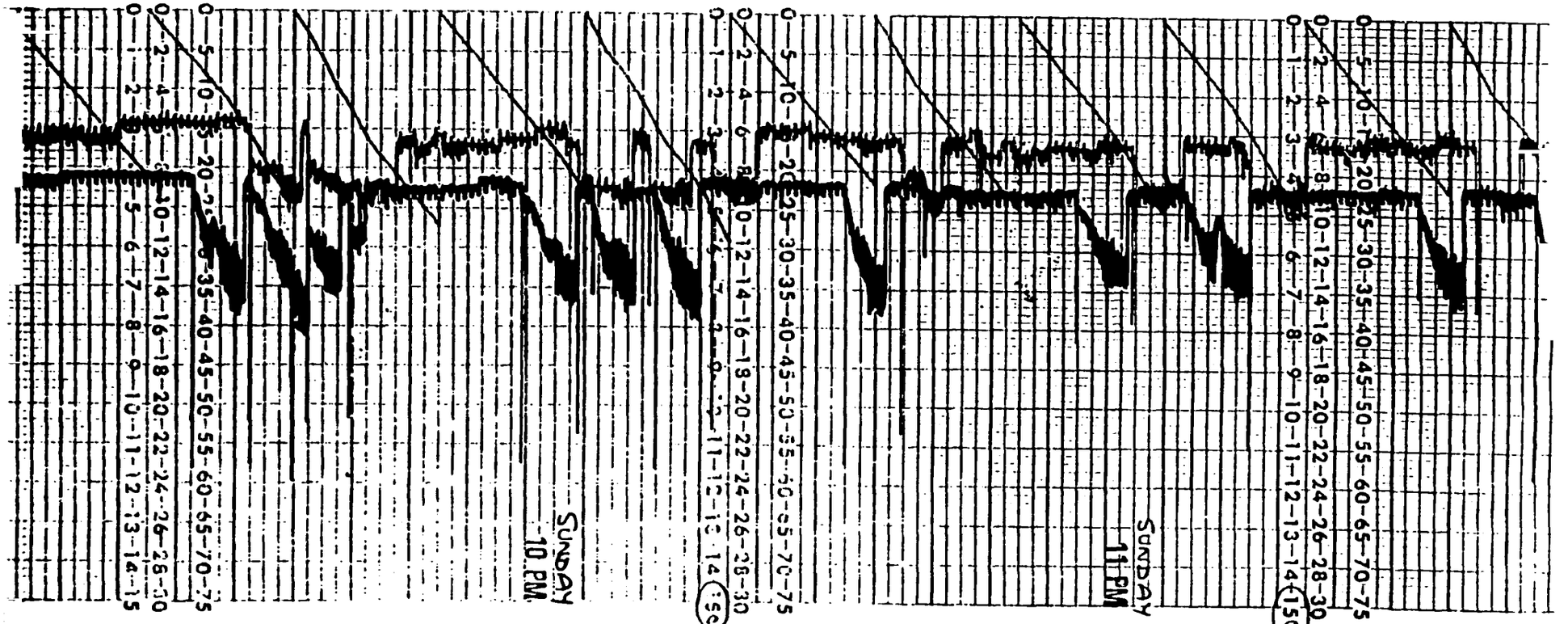
ANGUS INDIANAPOLIS, IND., U.S.A. MADE IN CANADA CHART No. 59323-10

— → — SATURDAY MORNING — — →

(OVENS SHUT DOWN)

APPENDIX C

26



ESTERLINE ANGUS INDIANAPOLIS, IND., U.S.A. MADE IN CANADA CHART No. 59323-T100

(PEAK) - - - - → ‖ - - - → (OFF-PEAK/NIGHT)

SUNDAY EVENING RESTART

APPENDIX C

PROJECT FORMS

APPENDIX 1. DETAILED RECOMMENDATIONS FOR ENERGY EFFICIENCY IMPROVEMENT

Following is a detailed recommendation by RCG/Hagler, Bailly for energy efficiency improvement. This project fits under the general energy management category as described below.

A. General and Energy Management

These projects are opportunities which are recommended for immediate action, and require little or no expenditure. These projects affect management systems and techniques, rather than process equipment. These projects are the primary focus of the USAID Emergency Energy Program for Hungary.

Following is list of the recommended projects for Fovarosi Sutoipari Vallalat Bakery:

Action A.1: Institute energy efficiency teams to reduce energy losses

This project is presented in a stand-alone project form which provides all basic information to qualify the project. The data are provided at the "inventory" level (first order of magnitude approximation), and include the following:

- Description and rationale
- Calculation of savings (energy and others)
- Implementation cost
- Financial analysis limited to the pretax pay-back period
- Planning
- Technical risk and reference
- Back-up data and calculations.

ACTION A.1 - Institute Energy Efficiency Teams to Reduce Energy Losses

1. PROCESS AREA

Portable instruments: to be used throughout the plant for combustion, steam and electrical systems.

2. STATEMENT OF RECOMMENDATION

Set up at least 3 energy efficiency teams to test and optimize equipment operation on a regular basis. Teams should be organized for the boilers, the steam system, and the electrical systems. Following are recommendations for the activities on each of these teams:

2.1 Steam Trap Testing Program

Inventory all steam traps. Begin a regular testing program using the ultrasonic test instrument, ensuring that every trap is tested on a regular basis at least twice per year. Tag or otherwise identify each malfunctioning trap and schedule its repair or replacement as soon as possible.

2.2 Optimize Boiler Blowdown and Combustion Efficiencies

Use TDS or conductivity meter to monitor the boiler water dissolved solids content 3 times per day. Manually adjust the blowdown or change the bottom blowdown rate in order to maintain the solids concentration inside the boiler less than 3500 ppm (mg/l).

Use existing exhaust gas analysis instrumentation to monitor and adjust to optimum levels the levels of excess air on the boilers and the burners for the ovens, to maintain combustion efficiencies as high as possible.

2.3 Reduce Peak Electrical Demand

Use an electric power analyzer to determine the variations in electrical demand for the bakery as a whole, and for the larger individual pieces of equipment. Analyze the results of these measurements to determine the peak demand period during the day, and to identify the equipment which most importantly contribute to this electrical demand. Develop a program for manual rescheduling of equipment operation, or shutoff of certain equipment during the peak demand period in order to reduce the peak demand.

3. DESCRIPTION/RATIONALE

Use of portable instruments will allow the testing of steam traps, boiler water, and electrical equipment to ensure that equipment is operating in optimum condition. While the operation is generally good, the use of instruments provides a basis for an optimization

of operation, offering energy savings of several percent. In addition, regular testing of plant equipment improves the staff knowledge and understanding of the equipment, and can serve as a basis for a better preventive maintenance program.

4. BENEFITS

4.1 Energy Savings

Energy savings are obtainable primarily by using the ultrasonic tester to identify leaking steam traps, and by using the electric power analyzer to identify possible electrical demand reductions.

Leaking steam traps identified/repaired:

10/yr x 5 kg/h (loss) x 6000 h/y x 1 Ft/kg = 300,000 Ft/y = $4100

Possible electrical demand reduction:

5% of electricity use shifted to off peak = 290,000 Ft/y = $4000

Total possible savings: $8100

5. IMPLEMENTATION COSTS

Equipment	Number	US$ Cost
Ultrasonic tester	1	1,500
TDS meter	1	300
Electric power analyzer	1	6,000
TOTAL		7,800

6. PAYBACK

The payback period for the purchase of all three instruments is approximately one year.

7. SCHEDULE

Task 1 -- completion date: May 20, 1991

HBI prepares and addresses to Fovarosi Bakery the specifications for the instruments.

Task 2 -- completion date: May 25, 1991

HBI gets quotations from US manufacturers.

Task 3 -- completion date: June 10, 1991

Fovarosi reviews specifications and makes recommendations for selection of supplier.

Task 4 -- completion date: June 15, 1991

USAID gives clearance for equipment procurement based on HBI financial and economic study and evaluation of quotations.

Task 5 -- completion date: June 16, 1991

HBI sends purchase orders for equipment.

Task 6 -- completion date: August 10, 1991

Shipment of equipment arrives in Hungary.

Fovarosi completes an operating procedure for the use of portable instruments, including who is responsible, where they will be stored, frequency of use for different applications, etc.

Task 7 -- completion date: August 31, 1991

Fovarosi presents results of initial tests using the instruments. A list of steam traps tested and their operating condition, recommended action, and implementation plan should be included. Initial measurements of electrical equipment and their contribution to electrical demand should also be available.

Task 8 -- completion date: September 10, 1991

HBI reviews Fovarosi test procedures and results, and assists in making additional energy-saving recommendations based on the test results.

8. TECHNICAL RISK AND REFERENCE

Proper operation of the instruments presents no risk to the company. As part of the operating procedures mentioned in Task 6, instructions for instrument operation should be translated or adapted into Hungarian.

9. SPECIFICATION OF EQUIPMENT

9.1 Ultrasonic Tester

Type: Ultrasonic detector
Physical characteristics: Pistol-type detector/stethoscope, with minimum 4" probe, extendable to 15"
Output: Analog meter on pistol and audible sound converter for use with earphones; 10/1 sensitivity calibration dial
Power: 9 V battery, optionally rechargeable
Accessories: lightweight plug-in headset, carrying case; tone-generator and rubber focusing extension optional

9.2 TDS Meter

Type: Conductivity meter
Physical: Integral measuring cup
Output: Analog meter, 0-5000 ppm in a minimum of 3 ranges
Power: 9V battery

9.3 Electric Power Analyzer

Type: Three-channel kW, kVAr, power factor recorder
Physical: Benchmount model, NEMA II drip-proof case
3-pen chart recorder
100% zero adjust
voltage and current leads (6 ft minimum)
Input: maximum 600 V, 1000 A AC
Output: power factor: 0.5 lag to 0.75 lead
kW, kVAr: 0-1200, minimum 6 ranges
kWh, kVArh counter, resettable to zero
max kW, kVAr demand: selectable 15, 30, 60 min periods
chart drive minimum 10 speeds in cm/hr and cm/min
Power: input 220V 50Hz
Accessories: 3 x 1000A:1A current transformers
Spares: fuses
3 x pens/cartridges and chart paper