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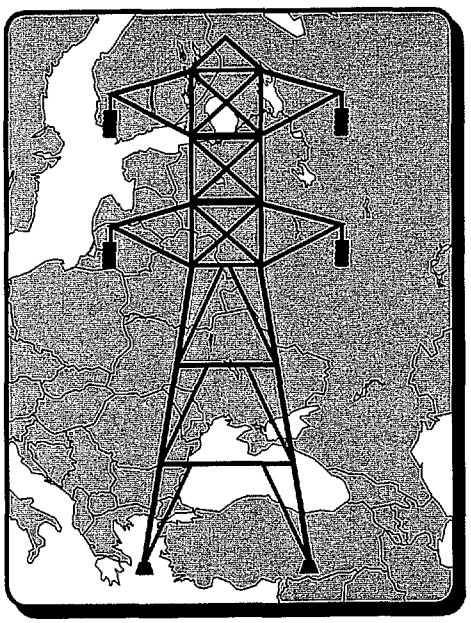
Central and Eastern Europe Regional Energy Efficiency Project
EUR-0030-C-00-2053-00



Energy Pricing, Energy Efficiency, and Energy Sector Restructuring Component

Final Report
December 1996

Volume X

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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CENTRAL AND EASTERN EUROPE
REGIONAL ENERGY EFFICIENCY PROJECT
EUR-0030-C-00-2053-00

Energy Pricing, Energy Efficiency, and
Energy Sector Restructuring Component

Bulgaria
Energy Efficiency Market Development

Task Completion Memorandum

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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September 1996

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CENTRAL AND EASTERN EUROPE
REGIONAL ENERGY EFFICIENCY PROJECT

Task Completion Memorandum

Bulgaria - Energy Efficiency Market Development

Summary Task Description

The primary of objective of this task is to foster the development of the energy efficiency market in Bulgaria. This objective will be achieved with two major parallel efforts: (1) the development and enhancement of energy efficiency consulting capabilities in Bulgaria; and (2) the development of a market for these services among industrial and other facilities in Bulgaria.

Consultant capabilities will be developed by providing training in energy audits, energy technology, management, quality control, and running consulting companies. In addition, support will be offered by organizing professional groups among the energy auditors (such as the Association of Energy Engineers) and providing technical assistance in both marketing and carrying out the energy audits. Development of the market for energy services will be supported by providing promotional and marketing support to the consultants trained under the program, and by offering incentives in the form of U.S. energy efficiency equipment and quality control of locally performed energy audit work to potential client plants.

The end result of this task will be industrial energy audits paid for by local companies and performed by local consultants, with demonstrated implementation of energy efficiency measures. A final conference will disseminate these results to other consultants and other facilities.

Specific Goals and Objectives

The general goal and objective of the EEMD project will be to serve as a catalyst to begin the development of a market for an industrial energy efficiency industry in Bulgaria, and to assist firms in the private sector to develop their capability to serve this market.

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The specific objectives of the EEMD project are:

1. Foster the development and capability of Bulgarian private firms to provide energy efficiency services, equipment, and financing to industrial clients;

2. Improve energy efficiency in the industrial sector, through provision of energy audits and energy-saving equipment;

3. Expand Bulgarian-U.S. technical and commercial ties through linkages between energy efficiency associations, energy service companies, and equipment suppliers.

Expected Outputs

There will be five major outputs of the EEMD project:

1. Training in energy efficiency for private sector engineers

2. Focused energy management programs in 5 industrial enterprises

3. Comprehensive energy management programs in up to 5 industrial enterprises

4. Conference and exhibition on industrial energy management

5. Assistance preliminary to financing for industrial energy efficiency investment projects

Deliverables

- trip reports to AID
- monthly progress reports to AID
- energy audit training curriculum to AID
- energy audit training course materials to trainees - books, lecture notes
- advisory reports to energy auditors
- energy audit reports performed by local consultants
- energy audit equipment package (AEE Chapter)
- energy efficiency equipment for each plant
- conference agenda
- conference proceedings
- final report (task completion memorandum)

Results and Next Steps

The results of the Bulgaria Industrial Energy Efficiency program were positive and all program objectives and deliverables were met. The following summarizes the key results:

Training and Promotional Program

The training and promotional program was conducted over a twelve month period and consisted of three phases:

Phase I Selection - A selection criteria was developed for potential private sector energy service companies and an invitational campaign conducted through the local media, government energy agencies, utilities, Polytechnic University, and other Bulgarian technical organizations. Over fifty companies were evaluated and a final selection of 16 companies was made. The primary criteria for selection centered on:

- Potential for market development and provision of essential services
- Company and staff experience
- Resources and capabilities

The sixteen companies selected are described in Table 1:

Phase II Training - A training program was developed and designed to suit the needs of Bulgarian energy service companies. The program had four main elements:

- Business/Management Training: University of Delaware/Small Business Development Center of Sophia:
  - Principles of Running a Small Business
  - Accounting/Finance
  - Marketing/Client Relations
  - Negotiating Techniques
  - Staffing/Human Resource Development
  - Management by Objectives
  - Legal Issues/Contracting

- Technical Training - Hagler Bailly Consulting:
  - Thermal Energy Efficiency
  - Project Management
  - Performance Contracting

Table 1 - Participant List

1. **Nikola Borislavov Stankov, Independent Consultant** - Mr. Stankov has an MSc in Mechanical Engineering. He has worked for the Thermal Power Engineering Department at Sofia Technical University for 17 years and is currently working as an independent consultant. His projects include boiler optimization, heat energy audits in industrial plants, and waste heat utilization.

2. **Georgi Rampov Ivanov, Rampov & Son Company** - Mr. Ivanov has an MSc in Engineering and 23 years of professional experience. His previous positions include professor of Power energetics at the Technical University. His consulting experience includes projects related to heat and electric energy pricing.

3. **Nikolai Michailov Pavlov, Gazoterm Ltd.** - Mr. Pavlov has a BSc in Engineering. His consulting experience includes industrial management. He has 12 years of professional experience at the Fuels and Combustion Technology Department at Sofia Technical University.

4. **Nikola Kaloyanov, Energy Save** - Mr. Kaloyanov has a PhD in Engineering. He lectured at Sofia Technical University for 10 years on heat exchange systems. His consulting experience includes energy conservation in buildings, analyses of combined systems and heat exchange systems.

5. **Jordan Petkov Katzarov, Risk Engineering Ltd.** - Mr. Katzarov has an MSc in Thermoenergetics and a PhD in Applied Mathematics. He has 15 years of experience at the Bulgarian Energy Research and Design Institute and 3 years of experience at the Bulgarian Academy of Science. He is currently a partner at Risk Engineering, a firm specializing in upgrading power and industrial cogeneration power plants and steam-gas combined cycle power distillation plants.

6. **Janos Zhelev, Rendd G. Ltd. Varna.** - Mr. Zhelev has a PhD in Engineering with 13 years of professional experience. He worked for the Institute of Chemical Engineers in the area of combustion and utilization of oil wastes. He has participated in projects that developed energy saving methods in the chemical and ceramics industries.

7. **Deian Iordanov, Argus 91** - Mr. Iordanov was a faculty member of Sofia Technical University's Energy-Mechanical Department from 1979-1984. In 1984 he formed Argus 91, a consulting firm with experience in project design and maintenance and building of industrial thermal energy systems.

8. **Lubomir Spassov, Vigoz Ltd.** - Mr. Spassov's firm, Vigoz, works in the are of electrical motors and control equipment, temperature-controlled processes, and the design and operations of automatic control systems. He taught classes for 13 years in electrical and automation equipment at the Higher Air Force School.

9. **Stefan H. Hristov, EEI, Ltd.** - Mr. Hristov has an MSc in Thermal and Nuclear Power Engineering. He has 7 years of work experience as a steam turbine and boiler operator, consulting in gas emissions and steam boiler investigations and as an engineer in South Africa focusing on combustion kinetics, gas emissions and boiler investigations.

10. **Boris Petkov, Ivel Ltd.** - Mr. Petkov has an MSc in Engineering. He has free lance experience in HVAC and control systems. He started Ivel Ltd. in 1990 and has worked on the reconstruction of central heating systems, heat waste utilization and energy efficiency audits of industrial steam systems.

11. **Dimitar Baev, Dimitar Baev Consulting** - Mr. Baev has a PhD in Engineering. Mr. Baev has 25 years of professional experience. He was the Chief of the Production Management Department in Sofia's Central Institute of Complex Automation, and two years as director of the Development and Technological Center. He currently manages his own consulting firm which specializes in process and operations control systems, energy efficiency audits and analyses and marketing in the industrial sector.

12. **Jordan Lazarov, Lazener Co.** - Mr. Lazarov is the president of Lazaner Company, a consulting firm experienced in industrial energy systems. He has completed energy savings projects in the food and chemical manufacturing facilities. He has 15 years of experience including positions at the Institute of Industrial Heat Power Engineering and Institute of Chemical Engineering at the Bulgarian Academy of Sciences. Mr. Lazarov has a PhD in Engineering.

13. **Mrs. Strugarova, Ecotechproduct**

14. **Christian Spassov, Ecotechproduct** - Christian Spassov is the president of Ecotechproduct, a privately-held company specializing in no/lost cost energy investment and middle term investment. Mr. Spassov has 20 years of professional experience, including 4 years as an assistant professor in mass heat transfer and 12 years as the Department Chief of the Thermal Solar Energy at the New Energy Sources Institute.

15. **Jolian Marinov Ivanov, Jolly** - Mr. Ivanov has a PhD in Cybernetics and Robotics. He worked for several years at the Robot & Control Systems Research Center on the problems of control and optimization of technological process. He has also identified investments opportunities and privatization projects for the Ministry of Industry and Trade. Mr. Ivanov started Jolly, which focuses on management and applications of innovation processes and technologies in industry.

16. **Dimitar Shivkov, Sofia Technical University** - Mr. Shivkov has a PhD in Engineering and has been a professor at Sofia Technical University for 16 years. He has completed consulting assignments for systems engineering, process control and operations for plants in the chemical, biotechnological and plastics industries.

- Motorola University:
  - Quality System Initiation
  - Organizational Mapping & Analysis
  - Total Productive Maintenance

- Association of Energy Engineers:
  - CEM Review Course

Phase III Certification - The participating energy service companies were administered the AEE Certified Energy Manager examination, all passed and were awarded the certification.

Energy Efficiency Program Equipment

The USAID program was designed to assist the participating energy service companies in obtaining initial private sector contracts, and thus provided an energy audit 'kit' of energy measurement and monitoring equipment. This equipment was turned over to the Association of Energy Engineers and made available in an equal access basis. The initial energy audit kit consisted of:

-	Combustion Analyzers	-	Ultrasonic Leak Detectors
-	Thermocouples	-	Dissolved Solids Meter
-	Multimeter	-	Pyrometer
-	Infrared Thermometer	-	Velocity Meter

The energy audit equipment was purchased, tested, and delivered to Bulgaria.

Demonstration Energy Service Company Projects

Hagler Bailly provided on-site consultants to assist the participating companies in developing actual contracts for energy audits and energy efficiency projects at selected industrial enterprises. This technical assistance consisted of:

- Marketing calls to prospective clients with the energy service company
- Walk-thru energy audits
- Initial advisory audit reports
- Contract review and detailed energy audit review
- Procurement of USAID co-funded energy efficiency equipment
- Shipment and follow-up support for equipment installation
- Development of a monitoring program
- Review of project performance indicators

A total of eight industrial energy efficiency projects were developed in conjunction with five

Bulgarian energy service companies. Each company negotiated a contract with the selected plant for energy audit support, specification and procurement of equipment, commissioning, and start-up. Hagler Bailly assisted the CEM's in the specification of this equipment, procured the equipment in the United States, and shipped it to Bulgaria. The CEMs assisted the plant with clearance through customs, installation, and commissioning. Each plant assumed the liability for installation cost, and customs duties and fees.

Table 2 is a listing of projects and energy efficiency equipment that was procured.

AEE Chapters, Invitational Travel, and Regional Conference

Hagler Bailly solicited the support of the Association of Energy Engineers (AEE) in Atlanta to participate in the USAID program by establishing local chapters in Hungary, Bulgaria, and Bulgaria. The purpose of these Chapters was to establish a lasting linkage with a US energy organization actively engaged in promoting energy efficiency. AEE now has five fully chartered chapters in Eastern Europe:

Hungary:	Budapest
Bulgaria:	Sophia
	Plovdiv
Bulgaria:	Bucharest
	Cluj

These Chapters hold regular meetings, engage in energy efficiency promotional activities, meet with Government policy makers on energy efficiency legislation, disseminate information among members, promote the services of members, and loan the energy audit equipment to members and non-members for energy audits. The Chapters have approximately 85 members total and are actively recruiting new members. Future plans for call for technical training courses, CEM certification programs, and expanded ties with US manufacturers and service firms.

Hagler Bailly also coordinated the attendance of selected CEMs from each country at the annual AEE World Energy Conference in Atlanta for 1992, 1993, 1994, and 1995. Approximately 25 CEMs attended the event over four years.

In 1995, a regional AEE conference was held in Budapest, Hungary. The conference brought together Chapter members from all three countries and presented many interesting topics on energy efficiency. An exhibition was also held in conjunction with the conference which gave US manufacturers and representatives an opportunity to promote their products.

The next step for industrial energy efficiency in Bulgaria would be to build upon the private sector approach set out in this program and further support the development of a market for

energy services in Bulgaria. USAID can support this by:

- Continued support of AEE chapter activities and CEMs
- Expansion of energy manager training and certification programs
- Demonstration energy efficiency measures at selected sites
- Promotion of DSM/IRP programs in the country
- Promotion of power sector restructuring and tariff reform
- Process engineering efficiency studies at selected industries

Table 2 - Bulgarian Energy Efficiency Projects

Table 2 - Bulgarian Energy Efficiency Projects

Plant Name/Location	CEM	Project Description	Equipment
Crystal Pernik Glass Factory	Yordan Katzarov	Glass Furnace Process Control	Digital Recorder and Thermocouple Calibration Kit
KMH Paper Plant	Georgi Rampov Ivanov	Boiler Systems Improvement	Steam Flow Meter and Level Control System
Lev Leather Tannery	Nikola Kaloyanov	Steam Systems Improvement	Regulating Valves
Runo Raw Wood Finishing Plant	Nikola Kaloyanov	Steam Systems Improvement	Regulating Valves Plate Heat Exchanger
MDK Copper Smelting Plant	Dimitar Baev	Preheater Efficiency Improvement	SCR Power Controllers
ZMM Machine Tool Factory	Dimitar Baev	Steam Systems Improvement	Regulating Valves
Petar Karaminchev	Raina Zlatareva	Steam Systems Improvement Boiler System Improvement	Regulating Valves Combustion Analyzer
Silikat Keram Construction Materials factory	Boris Petkov	Humidity Control Improvement Boiler Systems Monitoring	Humidity Meter Steam & Fuel Oil Meter
Varna Shipyard	Dein Yordanov	Steam Systems Improvement	Steam Pressure Regulator & Traps
Zlatna Panega Cement Plant	Dimitar Shivkov	Kiln Combustion Improvement Facility Energy management	Combustion Analyzer Computer/Software

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT-BULGARIA

ENERGY EFFICIENCY MARKET DEVELOPMENT

VOLUME I

ENERGY AUDIT ADVISORY REPORTS

Prepared by:

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FINAL ENERGY AUDIT REPORTS - BULGARIA

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TAB 4	MDK - Pirdop	Mark Oven, Hagler Bailly Consulting, Inc.
TAB 5	Petar Karaminchev Ltd.	Mark Oven, Hagler Bailly Consulting, Inc.
TAB 6	RUNO - Gabrovo Ltd.	Mark Oven, Hagler Bailly Consulting, Inc.
TAB 7	Silicateram AD	Mark Oven, Hagler Bailly Consulting, Inc.
TAB 8	Varna Shipyard	Mark Oven, Hagler Bailly Consulting, Inc.
TAB 9	Zlatna Panega	Mark Oven, Hagler Bailly Consulting, Inc.
TAB 10	ZMM Inc., Sofia	Mark Oven, Hagler Bailly Consulting, Inc.

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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.

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

Crystal, Pernik

by local energy consultants

Yordan Katzarov, Risk Engineering

Kamen Radivojev, Risk Engineering

prepared by

RCG/Hagler Bailly

July 1994

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Industrial Energy Audit Guidance Report for Crystal, Pernik

1. Introduction

This report is based on approximately three days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants, joint analysis of the data collected and measured by the consultants, and gathering of reference information on the plant process in the U.S. literature. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Crystal is the oldest glass plant in Bulgaria, operating since 1933. Over the years, its variety of glass products have been consolidated into a single flat glass production facility, using the Belgian Fourco process. The annual production of 4.5 million m^2 of flat glass is used primarily for building windows; in addition some 150,000 m^2 of tempered automobile glass is also produced. The current production level represents approximately half of the plant capacity. About 20% of the production is currently exported.

Energy consumption in the plant is valued at nearly US$ 1.8 million (US$ 1.3 million in natural gas) representing 65% of the production costs of the plant. In the course of 1994 alone, natural gas prices are expected to increase by 80%.

The Fourco process, which draws the glass vertically out of the melt, is now obsolete with respect to efficiency and capacity. There are very few Fourco plants still operating in the world, having gradually been replaced by the more efficient and higher-volume float glass production process. In the U.S. there are still one or two plants operating the Fourco process, but will close or be converted soon.

The Crystal plant also has plans to convert its production to float glass in the coming years, and while they have begun looking at investments, they are far from having the necessary funding to make the

change. In the meantime, they plan to continue operating the existing plant, trying to make small improvements in efficiency in order to reduce their production costs.

3. Recommended Approach

The approach should be the following: a detailed energy audit on the flat glass production process, focusing on the following areas:

(1) Energy accounting and energy management

(a) Review the monthly glass production and natural gas consumption logs. Plot this data to determine the evolution of plant operation and the efficiency of the same. Take 2-3 months of daily data and plot production versus consumption, and specific production versus consumption. The variation in the data will provide a basis to draw general conclusions on the operation of the process, and may lead to additional energy efficiency recommendations.

(b) Recommend setting up an ongoing monitoring program for daily updating of the production and energy consumption relationships.

(c) There appears to be a good communication among the three key persons in the glass production process: the plant director, the head maintenance engineer, and the production chief. Review the relationship and data flow among these managers and between them and their operating staff.

(d) Furnace controls are in very poor shape, and the operators tend to run the process by eye and by experience rather than relying on the control system. Review in detail the existing control system and its components to determine which need to be repaired, upgraded or replaced, and how the whole system should be operated to allow operators to optimize production and minimize gas consumption.

(3) Possible energy efficiency-related measurements

(a) Use infrared thermometer to measure furnace temperatures, comparing to furnace control readouts. Use thermocouples to measure furnace wall temperatures and ambient temperature in the furnace room.

(b) Perform exhaust gas analysis of the furnace exhaust gases. Unfortunately, it may be difficult to measure these gases before they procede to the regenerator, where they will most likely become cooled and diluted.

(c) Perform a rudimentary balance of the glass furnace, estimating the exhaust gas losses, wall losses, reaction energy, and the heat left in the exiting glass. Compare these figures to data from the literature provided by Hagler Bailly as part of this audit work.

(d) Monitor electrical consumption of the central air compressor. Identify the main users of compressed air, and estimate the requirements of air for the furnace controls.

(4) Possible recommendations for energy efficiency improvement

(a) Optimize temperature distribution in the furnace. Improve furnace thermocouple readout and measuring ability in order to obtain a better and more reliable temperature reading.

(b) Reduce unnecessary excess air to the gas burners. Adjust the vanes on the aspirated air to the burners to reduce the excess oxygen measured in the flue gases.

(c) Improve monitoring of glass drawing process in order to improve product quality.

(d) Develop new techniques of furnace operation based on actual measured values of gas consumption, combustion air pressure, process temperature in different zones.

(e) Install a dedicated oil-free instrument air compressor for the furnace controls, reducing the need for the large, inefficient central air compressor to operate.

4. Possible Equipment Purchases under the USAID Project

Possible first phase equipment:

- portable exhaust gas analyzer
- process recorder to continously monitor thermocouples for furnace temperatures in different zones
- new upgraded thermocouples for furnace installation, in order to improve the confidence and reliability of the furnace temperature measurements
- portable thermocouple readout and calibrator
- permanently installed oxygen sensor in the furnace exhaust in order to monitor excess air

Possible second phase equipment (depending partly on purchase decisions for the first phase):

- process recorder to continously monitor thermocouples for furnace temperatures in different zones
- new upgraded thermocouples for furnace installation, in order to improve the confidence and reliability of the furnace temperature measurements
- permanently installed oxygen sensor in the furnace exhaust in order to monitor excess air
- automatic on-line glass thickness sensor and control system for speed adjustment
- small new oil-free instrument air compressor dedicated to the operation of the furnace control system
- upgraded furnace control system using direct digital technology

The selection for the Phase 2 equipment must take into consideration the paybacks of the measures, since the existing furnace has a maximum life of approximately 3 years.

5. Additional Information Provided

Under separate cover, Hagler Bailly has provided copies of several articles on glass processes and on energy consumption and efficiency in such processes.

In addition, in response to inquiries from the plant, Hagler Bailly evaluated potential on-line glass thickness sensors for application to the vertical draw process.

hand-held micrometer ($100 - 200) the basic system, currently used by the plant

air follower system ($1,600 - 2,000) least expensive single-point on-line system, but not a typical glass application

ultrasonic system ($35,000 - 100,000) ranges from a single-point measurement to a scanning system; limited to 80 C

laser system ($30,000 - 125,000) ranges from a single-point measurement to a scanning system; typical but costly glass application.

While there is no more Furco process (or vertical-draw process) plants operate in the U.S., a

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discussion by some operators of the last plant to operate here brought forth an offer of telephone advice regarding any aspect of the plant operation. The persons to contact are:

George Valesky or Joe Dacaro
General Glass
Wisconsin
(608) 847-2497

Mr. Valesky said they loved working with the Fourco process and would be willing to answer questions any time. Regarding the glass thickness measurement, Valesky claims that relying on the speed of the machine is the most accurate way of controlling glass thickness. He did not see any value in spending large sums of money on thickness measurement; many plants in the U.S. simply use hand-held micrometers.

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

KMH Belovo

by local energy consultants

Georgi Rampov, Rampov & Son

Nikola Stankov, STIF

prepared by

Dean Oliver Engineering Consultants

under contract to RCG/Hagler Bailly

May 1994

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Industrial Energy Audit Guidance Report for Petar Karaminchev, Russe

1. Introduction

This report is based on approximately three days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants, joint analysis of the data collected and measured by the consultants, and gathering of reference information on the plant process in the U.S. literature. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Petar Karaminchev is a medium-sized industrial facility strangely located over 4 stories in a large industrial building on a main street in Russe.

Energy consumption in the plant is valued at nearly US$ 1.8 million (US$ 1.3 million in natural gas) representing 65% of the production costs of the plant. In the course of 1994 alone, natural gas prices are expected to increase by 80%.

The Fourco process, which draws the glass vertically out of the melt, is now obsolete with respect to efficiency and capacity. There are very few Fourco plants still operating in the world, having gradually been replaced by the more efficient and higher-volume float glass production process. In the U.S. there are still one or two plants operating the Fourco process, but will close or be converted soon.

The Crystal plant also has plans to convert its production to float glass in the coming years, and while they have begun looking at investments, they are far from having the necessary funding to make the change. In the meantime, they plan to continue operating the existing plant, trying to make small improvements in efficiency in order to reduce their production costs.

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3. Recommended Approach

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(d) Furnace controls are in very poor shape, and the operators tend to run the process by eye and by experience rather than relying on the control system. Review in detail the existing control system and its components to determine which need to be repaired, upgraded or replaced, and how the whole system should be operated to allow operators to optimize production and minimize gas consumption.

(3) Possible energy efficiency-related measurements

(a) Use infrared thermometer to measure furnace temperatures, comparing to furnace control readouts. Use thermocouples to measure furnace wall temperatures and ambient temperature in the furnace room.

(b) Perform exhaust gas analysis of the furnace exhaust gases. Unfortunately, it may be difficult to measure these gases before they procede to the regenerator, where they will most likely become cooled and diluted.

(c) Perform a rudimentary balance of the glass furnace, estimating the exhaust gas

losses, wall losses, reaction energy, and the heat left in the exiting glass. Compare these figures to data from the literature provided by Hagler Bailly as part of this audit work.

(d) Monitor electrical consumption of the central air compressor. Identify the main users of compressed air, and estimate the requirements of air for the furnace controls.

(4) Possible recommendations for energy efficiency improvement

(a) Optimize temperature distribution in the furnace. Improve furnace thermocouple readout and measuring ability in order to obtain a better and more reliable temperature reading.

(b) Reduce unnecessary excess air to the gas burners. Adjust the vanes on the aspirated air to the burners to reduce the excess oxygen measured in the flue gases.

(c) Improve monitoring of glass drawing process in order to improve product quality.

(d) Develop new techniques of furnace operation based on actual measured values of gas consumption, combustion air pressure, process temperature in different zones.

(e) Install a dedicated oil-free instrument air compressor for the furnace controls, reducing the need for the large, inefficient central air compressor to operate.

4. Possible Equipment Purchases under the USAID Project

Possible first phase equipment:

- portable exhaust gas analyzer
- process recorder to continously monitor thermocouples for furnace temperatures in different zones
- new upgraded thermocouples for furnace installation, in order to improve the confidence and reliability of the furnace temperature measurements
- portable thermocouple readout and calibrator

- permanently installed oxygen sensor in the furnace exhaust in order to monitor excess air

Possible second phase equipment (depending partly on purchase decisions for the first phase):

- process recorder to continously monitor thermocouples for furnace temperatures in different zones
- new upgraded thermocouples for furnace installation, in order to improve the confidence and reliability of the furnace temperature measurements
- permanently installed oxygen sensor in the furnace exhaust in order to monitor excess air
- automatic on-line glass thickness sensor and control system for speed adjustment
- small new oil-free instrument air compressor dedicated to the operation of the furnace control system
- upgraded furnace control system using direct digital technology

The selection for the Phase 2 equipment must take into consideration the paybacks of the measures, since the existing furnace has a maximum life of approximately 3 years.

5. Additional Information Provided

Under separate cover, Hagler Bailly has provided copies of several articles on glass processes and on energy consumption and efficiency in such processes.

In addition, in response to inquiries from the plant, Hagler Bailly evaluated potential on-line glass thickness sensors for application to the vertical draw process.

<u>hand-held micrometer</u> ($100 - 200) the basic system, currently used by the plant

<u>air follower system</u> ($1,600 - 2,000) least expensive single-point on-line system, but not a typical glass application

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

Lev, Gabrovo

by local energy consultants

Nikola Kaloyanov, Alpha-Pro

Stoyan Nevenkin, Alpha-Pro

prepared by

RCG/Hagler Bailly

April 1994

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Industrial Energy Audit Guidance Report for Lev, Gabrovo

1. Introduction

This report is based on approximately three days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants, joint analysis of the data collected and measured by the consultants, and gathering of reference information on the plant process in the U.S. literature. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Lev is a typical medium-sized leather tanning and finishing facility located in central Bulgaria. The 32-year old facility is located on two separate sites within one-half mile of each other in the industrial zone of central Gabrovo. Lev produces both primary tanned leather ("chrome blue" skins) and finished leather products. Lev employs nearly 400 persons, working with a variety of small equipment to clean, pickle, tan and dye the leather, fashion it into final products, and paint, emboss or otherwise finish it.

As with may other Bulgarian plants, the process equipment is in reasonable condition, but the steam and water piping and controls are in extremely poor state, resulting in significant energy and water waste. Lev buys steam and electricity from local utilities. Energy costs nearly US$ 500,000 per year, and represents approximately 11% of total production costs.

The technical director is extremely capable and has begun a modernization program of sorts, replacing steam traps and improving control systems.

3. Recommended Approach

The approach should be the following: a detailed energy audit of the thermal side of the plant, as provided in the contract between Alpha-Pro and Lev.

(1) Energy accounting and energy management

(a) Review the monthly production for the past two years in the main departments of the plant, and make a preliminary summary of the electricity and steam consumption logs for the whole plant. Plot this data to determine the evolution of plant operation and the efficiency of the same. The variation in the data may provide a basis to draw general conclusions on the operation of the process, and may lead to additional energy efficiency recommendations. The key here will be to divide (or rather, agglomerate) the different production units into departments for purposes of more organized record-keeping and energy management.

(b) Recommend a formalized ongoing monitoring program for weekly or monthly updating of the production and energy consumption relationships. List possible steam meters which should be installed for submetering the important departments.

(c) Review the relationships and data flow between the technical director and the different production department heads, and between them and their operating staff.

(3) Possible energy efficiency-related measurements

The plant is extremely dispersed, with varied and specialized located in many different rooms on different stories of the building. For this reason, it is important to begin with a detailed inventory of the major equipment, its operating hours, the level (pressure) and quantity of steam (or hot water) consumption. The establishment of this inventory will require a detailed combing of the whole plant, during which the following activities should also be undertaken:

--- Follow the steam distribution piping. Identify any leaks, missing insulation, or valves which should be closed but are not.

--- Follow the condensate return system piping. Check for leaks, measure surface temperatures. Use steam trap tester to check steam traps on all steam-using machines.

--- Check space-heating units and their steam traps.

--- Review the operation of the process hot water system, including the recently installed hot water converters. Analyze the operation of the control system for hot water production, and compare to process needs.

--- Use thermocouples to measure dryer air temperatures. Review control system used to maintain constant and uniform temperatures in the dryers. Recommend new

temperature control valves where necessary. Identify equipment where new or repaired humidity control is necessary.

(4) Possible energy efficiency recommendations

(a) Replace additional steam traps to ensure proper operation of the condensate return system.

(b) Replace automatic control valves operating the steam-hot water converters.

(c) Consider heat recovery from condensate to preheat hot process water.

(d) List leaks or missing insulation in the steam and condensate system, or in steam or hot water-using equipment.

(e) Install automatically modulating temperature control valves for steam to ensure proper control of the dryers.

(f) Install air humidity measurement and control systems in the larger consumers among the many leather dryers.

4. Possible Equipment Purchases under the USAID Project

Possible first phase equipment:

- temperature control valves for steam flow to dryers
- control valves for hot water system automatic regulations
- portable humidity measuring system, both for air and for leather

Possible second phase equipment (depending partly on purchase decisions for the first phase):

- condensate heat recovery system to preheat hot process water
- control valves for additional dryers
- humidity control system to optimize leather drying on certain dryers

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

MDK, Pirdop

by local energy consultants

Janos Zhelev, Rendd, Inc.

Nikola Zikatanov, Alustyle, Inc.

prepared by

RCG/Hagler Bailly

October 1993

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Industrial Energy Audit Guidance Report for MDK, Pirdop

1. Introduction

This report is based on approximately three days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants, joint analysis of the data collected and measured by the consultants, and gathering of reference information on the plant process in the U.S. literature. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

MDK is actually two large plants, one copper smelter and one sulfuric acid plant, necessarily integrated and dependent as is usually the case with such plants, since the large quantities of sulfur dioxide gas byproduct of the smelter can be used to produce sulfuric acid. In fact, the sulfuric acid plant is a basic prerequisite for both the environmental and economic operation of the copper smelting process. At MDK, part of the problem is that the world glut of sulfuric acid has reduced the need for production, yet the plant needs to continue to operate if the smelter production is to continue.

Given the size and complexity of the MDK plant, a detailed energy audit would require several person-months of work, and different process experts for different areas of the plant. Since the plant is willing to provide only a small initial sum of money for the audit contract, approximately equivalent to several person-weeks of work, it is important to limit the scope of the audit for it to be useful.

This report is divided into four additional sections which follow: the first addresses the areas to be covered during the preliminary audit; and the second presents comments, suggestions and possible conclusions based on the analysis of the energy consumption and production data obtained and analyzed as part of the preliminary audit. The third section offers some suggestions regarding equipment to be purchased under the USAID project, and the last section documents additional information provided to the consultants. At the end, several additional graphs are attached based on some of the data provided in the audit.

3. Recommended Approach

The approach should be the following: a preliminary energy audit, focusing on the following areas:

(1) Plant energy management

(a) evaluate and discuss the existing relationships among the general manager, chief engineer, heads of production for the two plants, overall head of energy (chief energetic), and the heads of energy for each of the two plants

(b) investigate the numbers of existing meters for energy installed and operating, and find out how the data are recorded and stored; include electricity meters, fuel oil meters and steam meters; since there appears to be no central collection and control of the data from these meters, conduct interviews and collect data as necessary, including from the accounting, measuring, production, and energy departments

(c) recommend improvements in the data collection systems, including computers and software for data recording and analysis, repair of non-functioning fuel and steam meters, calibration of meters, and installation of new meters in important process areas

(d) recommend the setting up of a management system for energy, including assignment of responsible personnel, support for energy and production data collection and analysis, and review of specific energy consumption for major products on a daily or shift basis by top management

(2) Analysis of historical energy consumption and production

(a) collect and analyze data on energy consumption and production, concentrating on the copper smelting plant; include primarily data on electricity and fuel oil (mazut) consumption

(b) present data in graphical form, mainly energy vs. production, and specific energy consumption vs. production

(c) derive conclusions from the trends which appear in these data, and use this information to bolster the argument for the development of an energy management system in the company

(3) Investigation of the main factors affecting breaks in the production process

(a) analyze the history of production outages and their effects on increased energy consumption by the process

(b) since breaks, delays or other problems in the production process appear to be one of the primary causes of large energy consumption in the plant, analyze records of these breaks, their times and attempt to identify ways in which the breaks could be avoided and minimized; include discussions of the following possibilities:

- identify improved communication among the different production units which might result in better planning of the production loads, and or allow turning off or reducing the load on upstream equipment when a downstream process has gone down

- identify possible control equipment which might improve the flow of process variables and increase the flexibility of process operation; this may include variable speed motors, improved heater controls, pressure sensors, etc.

(4) Possible energy efficiency-related measurements

(a) if it might be interesting and useful to the plant, and time permitting, offer the measurement of quantities related to the energy efficiency of the processes, such as:

- exhaust gas analysis of the boilers, rotating dryers

- check on the operation of steam traps in the process steam or heating steam systems

- temperature, air flow and exhaust gas analysis in order to perform an energy balance on the rotating dryers

- electric power and power factor measurements on any low voltage motors of interest to the plant

- evaluation of the energy losses due to the operating problems and unplanned process interruptions, including heating time for process re-start, idling motors and equipment, and product losses.

4. Comments on the Historical Energy Consumption / Production Curves

General Observations and Preliminary Conclusions

- MET (metallurgical area) data rather than MDK (company-wide) data should be used for initial analysis of both mazut and electricity consumption.

- The conclusions are only as good as the data. More detail on the way the data are obtained,

and what is counted as production (for example, anode and electrolysis copper), should be obtained.

- Both mazut and electrical data point out the high penalties of operating at low capacity. Very high specific energy consumptions are observed in months of low load.

- The operation during the months of June and July 1993 (months 30 and 31 of the period analyzed) should be investigated. June registers significantly higher gross consumption and specific consumption of both mazut and electricity; it is the worst month. Similarly, the month of July is the best month: it offers the highest production and lowest specific energy consumption. This abrupt and wide difference suggests a possible accounting mixup during the two months; alternatively it may mean that production and consumption data are not accounted for in the same way (months 28-29, 26-27, 24-25 and 22-23 also show large variations).

Electricity

- Electricity consumption for electrolysis needs to be metered separately.

- Electricity consumption shows wide variation from month to month, even accounting for differences in production. For similar production levels, for example, electricity can be as much as 75-100% higher from one month to the next. In the same way, there are many months that have significantly higher electricity consumption than months with much higher production levels. If one month's production can be achieved at a lower level, in theory such operation should be repeatable other months; thus the data imply significant potential for energy savings.

- Specific electricity consumption (GJ/t) shows the same wide variation. While the trend is correct (decreasing specific consumption with increasing production), variations of up to 100% in specific consumption are observed for different months with similar production levels.

- This wide variation can be due to a variety of factors, among them for example:

  -- unreliable data on electricity consumption or production levels, due to poor or inconsistent measurement, or due to lack of measurement

  -- possible inconsistent accounting periods between consumption and production

  -- method of production accounting (possibly counting rejected product recycled through the system)

  -- electricity uses not related to copper production that are included in the measurement

of the metal area

-- differences between winter and summer operation (although these should be relatively small)

-- lack of turndown capability on electricity consuming equipment

-- careless use of electricity in the process, lack of automatic and manual control of electricity consumption.

- the possibility that there are large uses of electricity unrelated to the production levels is shown on the MET EL/Cu graph: when the regression line is extrapolated to zero production, the corresponding energy consumption is more than 50% of the energy used at various production levels. Thus it can be concluded that more than half the electricity consumed is not related to production; this offers good potential for electricity savings.

- As mentioned above, the data imply a significant energy saving potential. More detailed data, observation of process operation, measurements and analysis are required in order to identify the exact manner of achieving the savings.

Fuel Oil

- Above a production of approximately 3500 t/mo, the total mazut consumption and the specific mazut consumption show high (20-30%) but not unreasonable variation, and the expected trend of increasing consumption with production and decreasing specific consumption with production. Below 3500 t/mo, however, the data do not exhibit any explainable consistency; the variations are wide and erratic.

- 1992 data appear to be more consistent and reasonable than 1993 data. Variations in data collection, equipment operation and general operating procedures between the two years should be reviewed.

- As in the electrical case, regression lines drawn on the MET MAZUT or the MET MAZUT/Cu curves imply that essentially 50% of the mazut consumption is independent of the production, that is, even at no production, 50% of the total mazut consumption will continue. While some mazut is necessary at no production to keep the equipment in operation condition, this number is too high, and ways to reduce it using either automatic or manual controls must be investigated.

- The various reasons cited for the variability in the electrical data apply also to mazut, and should be investigated in more detail. Electricity can be measured more precisely than mazut, so more variation in mazut than electricity could be expected; nevertheless, in both cases the variations are too high and must be accounted for.

Rotary Dryers

- The audit has not yet analyzed the rotary dryers, which represent a large consumption of fuel oil in the smelting process. Attached are three graphs which characterize this drying process, and show that while there is some consistency of consumption with production as expected, the proportion of energy that the dryers consume does not correlate at all well with the total energy used for smelting. The graphs indicate that there is significant possibility for reduction in consumption of dryer energy, both resulting from a better control and communication with the main process, and in absolute terms.

4. Possible Equipment Purchases under the USAID Project

The most likely equipment to be purchased for MDK under this project should be components of an energy management system, including PC computer and software, costing a total of approximately $3,000. In addition, the beginning of an automated interface to the computer can also be considered, in order to accept direct real-time data from digital outputs of electric meters and fuel and steam flow meters. However, in the case of MDK, most of these meters would have to be replaced in order to provide digital output; this cost is far greater than the cost of human labor required to regularly monitor all of these meters (e.g., once a shift). Neither MDK nor USAID would be willing at this point to invest a large sum of money in replacing meters.

Nevertheless, there are several places where fuel and steam meters are not installed and should be considered. The project may support such meters for steam flow at the heating boiler and at the smelting boiler.

Finally, depending on the results of the audit interviews, it may be interesting to provide some control equipment for the process that will provide smoother and more stable operation. Examples of such equipment could be pressure sensors in the smelter exhaust gases which go to the sulfuric acid plant, improved temperature controls for the feed to the sulfuric acid reactors, or control equipment that would assist in improving the stability of the steam generation process in the smelter exhaust boiler.

5. Additional Information Provided

Under separate cover, Hagler Bailly has provided 6 articles on energy efficiency in copper smelting processes in the U.S. and other countries. These articles were selected based on a literature search through the major sources of technical literature available in English.

Comprehensive Energy Audit for Copper Smelting Area: MDK, Pirdop

Preliminary Time Estimate

Tasks	Days of Consultant
Analysis of general operations, production, energy consumption and scheduling	5
Rotary dryer system evaluation	3
Smelting furnace and auxiliaries evaluation	6
Electric system measurement and development of electric demand profile and energy balance	5
Lighting inventory and analysis	1
Motor inventory and analysis	3
Calculations and cost estimates	13
Report preparation	12
Total days (comprehensive audit and report)	48
Equipment specification and installation supervision	10
Total Days	**58**

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

Petar Karaminchev, Russe

by local energy consultants

Raina Zlatareva, Ecotech Product

Christian Spassov, Ecotech Product

prepared by

RCG/Hagler Bailly

April 1994

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Industrial Energy Audit Guidance Report for Petar Karaminchev, Russe

1. Introduction

This report is based on approximately three days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants and joint analysis of the data collected and measured by the consultants. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Petar Karaminchev is a medium-sized industrial facility strangely spread over 4 stories in a large industrial building on a main street in Russe. The main production is PVC products, including floor coverings, foam rubber, and waterproofing materials. The main process equipment is French, Belgian and German. Plant production in 1993 was about the same as in 1991 and 1992, but down to one third of what it had been in the peak year of 1990. As a result, the specific energy consumption was approximately 2.7 times that of 1990 for thermal energy and 2.3 time that of 1990 for electrical energy.

Current annual energy consumption in the plant is valued at approximately US$ 866,000 (61% for electricity, 25% for natural gas, and 14% for diesel fuel). Natural gas consumption is about 3.2 million m^3/year, and electricity use is 14.5 million kWh/year, with a maximum demand of approximately 4000.

3. Recommended Approach

The approach should be the following: a detailed energy audit on the thermal energy consumption (natural gas and diesel). It would be interesting in this plant to evaluate the potential for electricity savings, given the high costs and large electricity consumption, and especially in light of the reduction of only 25% of the consumption while the production has been reduced by 67% since 1990.

However, the plant's interest in signing the contract with the local consultant is on the thermal energy side, and thus the audit will concentrate on thermal energy efficiency and savings. Among others, the audit team should concentrate on the following areas:

(1) Energy accounting and energy management

(a) Review the monthly plant production, steam generation and natural gas consumption logs at the boilerhouse. Plot this data to determine the evolution of plant operation and the efficiency of the same. If possible, take 2-3 months of daily data and plot production versus consumption, and specific production versus consumption. The variation in the data will provide a basis to draw general conclusions on the operation of the process, and may lead to additional energy efficiency recommendations.

(b) Recommend setting up an ongoing monitoring program for daily updating of the production and energy consumption relationships.

(c) The boilers appear to be in reasonable shape, with actual modulating burner controls (the first observed by this auditor anywhere in Bulgaria). Review the logs for consumption and steam production.

(d) Review the logs for diesel oil consumption by the hot thermal fluid generators located in various areas of the process. Try to relate these consumption numbers to production.

(2) Possible energy efficiency-related measurements

(a) Perform exhaust gas analysis of the boilers at different firing rates, adjusting the air to optimum levels (minimum CO, below 200 ppm). Use infrared thermometer to measure boiler surface temperatures. Check blowdown procedures and quantities, and review water treatment system.

(b) Perform exhaust gas analyses on the various thermal fluid heaters burning diesel oil. Estimate the quantity of hot gases to see if it might be possible to recover the heat and use it for preheating water or other materials close to the heater locations.

(c) Review the steam system, identifying and evaluating the faulty steam traps, missing or deteriorated insulation, and leaky valves and pipes. Help the plant lay out an updated drawing showing the steam system.

(d) Check condensate system for flash steam, live steam, uninsulated piping. Estimate the amount of condensate actually returned to the boilers.

(e) Evaluate the operating status of the different linoleum production machines. Review production and operation logs, and estimate fuel or steam consumption of the different machines.

(3) Possible recommendations for energy efficiency improvement

(a) Improve combustion efficiency in the steam boilers; improve overall operating efficiency in the boilers, including reduction of heat losses, minimizing blowdown or use of blowdown heat recovery, and exhaust stack economizer.

(b) Cycle the different boilers depending on the plant loads to minimize their energy consumption.

(c) Reduce unnecessary excess air to the diesel burners in the thermal oil heaters. Adjust the vanes on the aspirated air to the burners to reduce the excess oxygen measured in the flue gases.

(d) Recover heat from the high temperature (300 C) exhaust gases of the thermal oil heaters, using it for water preheating or for air heating in the wintertime.

(d) Replace faulty steam traps.

(e) Increase the amount of condensate returned to the boilers by eliminating leaks in the piping, and installing local collectors and pumps to return the condensate.

(f) Improve insulation on steam lines.

(g) Install thermostatic control on winter space heating systems, which currently operate with manual control, often providing unnecessary heating and wasting energy.

(h) Recover heat from the solvents currently exhausted to cleaning filters by burning them with natural gas.

(i) Find a better way to schedule plant operations in order to make the best use of the space heating energy. Most of the processes are operating at less than 50% load; there might be a way to reschedule and consolidate some of the process activity.

4. Possible Equipment Purchases under the USAID Project

Possible first phase equipment:

- portable exhaust gas analyzer
- submeters for natural gas process consumption measurement
- self-actuating steam control valves for room temperature control
- high quality steam traps

Possible second phase equipment:

- upgraded condensate return system components, based on steam- powered condensate pumps
- new gas burners for the thermal oil heaters and for the linoleum process lines
- solvent heat recovery modules for the linoleum lines, including solvent combustion system with supplementary gas firing and recovery of exhaust heat
- additional self-actuating steam control valves for room temperature control

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

Runo, Gabrovo

by local energy consultants

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Stoyan Nevenkin, Alpha-Pro

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April 1994

Industrial Energy Audit Guidance Report for Runo, Gabrovo

1. Introduction

This report is based on approximately three days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants, joint analysis of the data collected and measured by the consultants, and gathering of reference information on the plant process in the U.S. literature. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Runo is a small wool scouring and combing plant, serving the sheep-growing area in central Bulgaria and employing approximately 200 persons. The 30-year old facility has fairly new process equipment (scouring machines, dryers) but old infrastructure (steam lines, steam traps, condensate return system) At US$ 270,000 per year, energy represents approximately 18% of the production costs, and is used primarily for steam water heating of the washing and scouring sections, and for the dryers. Electrical energy is consumed mainly for compressed air, lighting, and the operation of the combing machines. Both electricity and steam are purchased from local utilities.

Raw wool is washed (scoured) using large amounts of hot (55°C) water, then dried in a steam-heated dryer. This accounts for almost all the non-space heating usage of steam. In some cases, the product is passed through the wash cycle a second time.

In the combing section, approximately a dozen machines are located in a single room lit by fluorescent lighting. A relatively large reciprocating air compressor (215 kW) provides compressed air needed for process and controls uses.

3. Recommended Approach

The approach should be the following: a detailed energy audit of the whole plant as provided in the contract between Alpha-Pro and Runo.

(1) Energy accounting and energy management

(a) Review the monthly production for the past two years in both the scouring and the combing departments, and make a preliminary with electricity and steam consumption logs for the whole plant. Plot this data to determine the evolution of plant operation and the efficiency of the same. The variation in the data may provide a basis to draw general conclusions on the operation of the process, and may lead to additional energy efficiency recommendations.

(b) Recommend a formalized ongoing monitoring program for weekly or monthly updating of the production and energy consumption relationships.

(c) Review the relationship and data flow between the director, the energy manager and between them and their operating staff.

(3) Possible energy efficiency-related measurements and recommendations for improvements:

(a) Use thermocouples to measure steam pipe surface temperatures, as well as dryer surface temperatures to check effectiveness of insulation. Measure hot water bath temperatures to ensure proper control and minimization of heat losses. Recommend additional insulation on steam piping, condensate tank, and dryer as necessary and economically viable.

(b) Test steam traps for operation. Use thermocouples to check for non operating traps; use ultrasonic steam trap tester to check for faulty or leaking traps. Recommend repairs or new steam traps where necessary.

(c) Check condensate return system. Measure temperature. Review at what temperature the heating plant contract requires return, and consider heat recovery from condensate to preheat wash water.

(d) Review steam and condensate system for leaks. Recommend specific actions to correct specific leaks identified.

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(e) Use thermocouples to measure dryer air temperatures. Review control system used to maintain constant and uniform temperatures in the dryers. Recommend new temperature control valves where necessary.

(f) Check steam valves for leakage to the outside, or across the valve if closed. Recommend valve repair or the installation of new valves.

(g) Measure light levels in the combing department. Calculate lighting power per unit area, and compare to standards. Consider the replacement of lighting with high efficiency fluorescent lamps, and high efficiency ballasts.

(h) Estimate maximum electrical demand of the plant. Identify main electrical users; measure motor loads to determine their relative importance in the plant. Determine to the extent possible the time of day of the demand peak, and consider possible ways to reduce this peak by reprogramming operation, or controlling certain loads during this period.

(i) Evaluate the operation of the large central air compressor. Calculate efficiency of compressed air usage, and list the main air users. Check air compressor system for leaks. Consider the installation of one (or two) smaller local air compressors which would reduce consumption. Include calculations of water savings, oil savings and maintenance cost savings associated with the compressor replacement.

(j) Check plant power factor. Identify sources of low power factor and determine the feasibility of installing a power factor correction system, either on the main problem loads, or centrally with automatic compensation.

(k) Evaluate the cost and potential savings and energy accounting benefits from the installation of submeters for electricity and steam consumption in the two major departments of the plant.

4. Possible Equipment Purchases under the USAID Project

Possible first phase equipment:

- temperature control valves for steam flow to dryers
- portable thermocouple for local temperature measurement and calibration of hot water wash and dryer temperatures

- new steam traps and valves
- condensate heat recovery system to preheat hot wash water (if available locally in Bulgaria)
- new steam heat meter

Possible second phase equipment (depending partly on purchase decisions for the first phase):

- high efficiency fluorescent lighting system, including new lamps and ballasts
- new smaller air compressor sized for actual and future plant loads
- high efficiency motors for combing machines
- condensate heat recovery system to preheat hot wash water

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

Silicatkeram, Plovdiv

by local energy consultants

Boris Petkov, Ivel, Inc.

Janos Zhelev, Rendd, Inc.

prepared by

RCG/Hagler Bailly

November 1993

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Industrial Energy Audit Guidance Report for Silicatkeram, Plovdiv

1. Introduction

This report is based on approximately three days of work at Silicatkeram by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants, joint analysis of the data collected and measured by the consultants, and gathering of reference information on the plant process in the U.S. literature. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations, as well as measurements in the boiler room.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Silicatkeram is a producer of both red clay and silica bricks, on two separate and independent production lines producing about 15 million and 17 million bricks annually, respectively. Fuel oil consumption is approximately 3,000 tonnes per year, and electricity demand is aproximately 500 kW.

The plant technical manager has implemented a number of projects for energy efficiency, including attempts at boiler exhaust gas heat recovery, but these projects have deteriorated over time due to lack of maintenance, and low level of technology. Nevertheless, the consciousness of the importance of energy efficiency projects is high, in spite of the relative lack of funds for their implementation.

What has never been done in this plant, and what the audit will attempt to do, is to evaluate, compare and prioritize all the possible energy conservation measures with paybacks of less than 3 years. As a result, the plantwill be able to develop a plan for their implementation based on their complexity, financial return, and production priorities.

The following pages provide an outline of the task of the consultants in planning and carrying out the energy audit in this plant.

Silikatkeram - Plovdiv

Comments and Suggestions on the Energy Audit

Data Analysis

-- Make plots of monthly consumption for 12-18 months, for all sources of energy: electricity, steam, hot water, drinking water, technological water

-- Make plots of daily consumption and production for a typical month for both kinds of bricks

-- Make scatter diagrams (with regression lines) of consumption versus production, or specific consumption versus production (on a daily basis if possible). Do this for both red brick and silica brick production (if energy consumption should be estimated by balances on a daily basis)

Electrical Systems

-- Make pie charts (or just a table) with an electrical balance for the facility: 1) by building or submeter; and 2) overall by usage (different productions, lighting, preparation, boiler room, administrative offices, etc)

-- Identify the major electricity consumers, and try to identify ways to reduce their consumption.

-- Check for possible equipment that can be shut down during the peak rate period.

-- Perform lighting inventory in all areas: number of lamps, types of lamps, hours of operation. Include outdoor lights.

-- Make a check in the evening to see how many lights are on in the different areas.

Steam Use

-- Finish balance on the boiler room, based on our measurements. Take additional measurements or confirm as necessary.

-- Check boiler blowdown, using the TDS meter in the new kit. Estimate the percentage. Remember, the plant thinks it's 15%, but it's probably a lot less.

-- Check the efficiency of the additional boiler that is used for winter heating, if it is already operating.

-- Make a monthly balance for all the steam in the plant: apportion the steam usage among the different users, including heating, drying, autoclaves, etc. Try to estimate the amount of steam that goes to plant heating (you should be able to do that fairly soon, since they will probably be operating it now). Perhaps do a typical summer month and a typical winter month.

-- Check on the number of people taking showers and use a standard amount of hot water used by each person; see if this agrees with the amount of steam usage each day apportioned to the hot water; check also the restaurant steam usage.

-- Inspect the whole steam system including all piping: note leaks (including approximate intensity), missing insulation (including the length and surface temperature), test steam traps with ultrasonic tester.

-- Check autoclave operation, and approximate a consumption balance on this equipment. Observe the operators during the filling and the discharge operations. Calculate steam usage, and based on this, perform a very preliminary design of the equipment needed for recovery.

-- Perform a water analysis of the autoclave condensate. (We can reimburse it.)

Brick Production

-- Observe the overall operations of the brick production, from mixing to forming to drying and baking (or autoclaving). What kinds of process steps cause increases in energy consumption; what kind of decisions could be made to improve the process?

-- Based on measurements already taken and additional ones to be performed with Janos, do a general energy balance of the brick kiln. Use this as a basis to approximate the savings with different recommendations.

-- Check operation of the dryers. Find out what is going on, and what the approximate steam usage is. Monitor also the electric consumption of all those little fans: do they really consume alot? Have the in-house laboratory make some spot checks on the moisture content of the bricks, before and after the dryer, in different dryer locations.

-- Does the dryer consume more in the winter than the summer? Should it?

-- Find out daytime and nightime brick production rates. Try to estimate nightime fuel consumption compared to daytime. There is no evidence that the operators really reduce the fuel flow at night. Is there any information on brick quality at night versus during the

day? Try to get info on number of rejected bricks. There should be more information than simply the difference between production and sales.

Possible Energy Conservation Measures (ECM) to Evaluate

Each of these should be analyzed with complete cost and savings estimates (as shown in the sample reports)

- Institute improved energy accounting and management system
- Disconnect ballasts to burned out lamps
- Replace mercury lamps with sodium lamps (for outside lighting)
- Replace mercury lamps with sodium lamps (in some production areas)
- Use electric radiant heating in some manufacturing areas
- Improve insulation and reduce leaks in steam and hot water systems
- Repair or replace faulty or leaking steam traps
- Increase amount of condensate returned
- Improve sealing of windows, doors and walls on heated buildings
- Identify equipment that is operating unnecessarily -- turn it off
- Change operation of any equipment possible to non-peak hours
- Recover condensate from autoclaves (for boilers; or for the process)
- Improve boiler efficiency (estimate the cost of a new burner)
- Install boiler economizer

Equipment Purchase Possibilities

-- hand-held electric power factor analyzer

-- recording electric power analyzer

-- ultrasonic leak detector for steam traps, steam leaks, air leaks

-- electronic combustion efficiency analyzer (Bacharach, not ENERAC)

-- optical infrared temperature measuring equipment

-- thermocouples for brick kiln temperature monitoring

-- locally made fuel flow meters?

-- some U.S. control and monitoring system for the autoclave condensate recovery; perhaps partial support for the autoclave condensate recovery? (if it's at all economically feasible...)

Comprehensive Energy Audit: Silicatkeram, Plovdiv

Preliminary Time Estimate

Tasks	Days of Consultant
Analysis of general organization, operations, scheduling and energy consumption	4
Boiler system measurement and evaluation	3
Steam/condensate system measurements and evaluation	6
Brick kiln operation and heat recovery	2
Electric system measurement and development of electric demand profile and energy balance	3
Lighting inventory and analysis	1
Motor inventory and analysis	2
Calculations and cost estimates	8
Report preparation	8
Total days (comprehensive audit)	37
Equipment specification and installation assistance (not including system design)	8
Total Days	**45**

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REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

Varna Shipyard, Varna

by local energy consultants

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RCG/Hagler Bailly

October 1994

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Industrial Energy Audit Guidance Report for Varna Shipyard

1. Introduction

This report is based on two days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants and joint analysis of the data collected and measured by the consultants. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Varna Shipyard is the largest shipyard in Bulgaria, and at 87 years old, one of the oldest still operating. It focuses on container ships and oil tankers, but has built a wide variety of ship types. It is scattered over a several kilometer square area, with independent buildings and workshops ranging from metal working to carpentry. Over the last 3-4 years, production has fallen to about 60% of its 1990 peak. The shipyard still employs over 3000 workers, operating basically during one shift.

Electricity consumption occurs throughout the plant and is distributed through a central transformer station. Main electricity uses are the oxygen generating station and the air compressors. The major energy cost, however, is fuel oil: current consumption is about 2000 tonnes annually. Some of the large electricity-consuming equipment is relatively new, and since the thermal energy consumption is higher, the plant has asked that the audit concentrate on the use of thermal energy.

All fuel oil is used for steam generation at a central boiler station where 4 similar 8t/h saturated steam boilers are located. Two are in reparation, the other two operating year-round, although the main process loads (wood-drying kiln and a plating process) have a relatively small demand. The major consumption is for space heating of the different buildings and workshops. A large amount of the steam is likely lost in the long distribution system, which shows deteriorated insulation and occasional leaks. There appears to be no steam metering operational (although a boiler room metering station is installed).

This report is divided into four additional sections which follow: the first addresses the areas to be covered during the preliminary audit; and the second presents comments, suggestions and possible conclusions based on the analysis of the energy consumption and production data obtained and analyzed as part of the preliminary audit. The third section offers some suggestions regarding equipment to be purchased under the USAID project, and the last section documents additional information provided to the consultants. At the end, several additional graphs are attached based on some of the data provided in the audit.

3. Recommended Approach

The approach should be the following: a preliminary energy audit of the thermal energy, focusing on the following areas:

(1) Plant energy management

(a) evaluate and discuss the existing relationships among the general manager, overall head of energy (chief energetic), and the production heads of the different departments and facilities throughout the plant

(b) recommend improvements in the data collection systems, including computers and software for data recording and analysis, repair of non-functioning fuel and steam meters, calibration of meters, and installation of new meters in important areas

(c) recommend the setting up of a management system for energy, including assignment of responsible personnel, support for energy and production data collection and analysis, and review of specific energy consumption for major products on a daily or shift basis by top management

(2) Analysis of historical energy consumption and production

(a) collect and analyze data on energy consumption and attempt to relate it to production, analyzing the numbers and types of ships produced

(3) Possible energy efficiency-related measurements

The plant facilities are dispersed over a large area. with varied and specialized located in many different rooms on different stories of the building. For this reason, it is important to begin with a detailed inventory of the major equipment, its operating hours, the level (pressure) and quantity of steam consumption. The establishment of this inventory will require a detailed combing of the whole plant, during which the following activities should also be undertaken:

--- Follow the steam distribution piping. Identify any leaks, missing insulation, or valves which should be closed but are not.

--- Follow the condensate return system piping. Check for leaks, measure surface temperatures. Use steam trap tester to check steam traps on all steam-using machines.

--- Check space-heating units and their steam traps. Check adequacy of steam trap type and size for the particular steam use.

--- Review the operation of the processes using steam. Observe the operation and note the operation of the controls, which in most cases, are likely manual.

--- Perform exhaust gas analysis of the boilers at different firing rates, adjusting the air to optimum levels minimum excess air without significant smoking. Use infrared thermometer to measure boiler surface temperatures. Check blowdown procedures and quantities, and review water treatment system.

(4) Possible energy efficiency recommendations

(a) Replace failed or leaking steam traps to ensure proper operation of the condensate return system.

(b) Return additional condensate where it is now wasted, except from the most distant steam users.

(c) Improve boiler efficiency by more closely controlling excess air, based on exhaust gas analysis.

(d) List leaks or missing insulation in the steam and condensate system, or in steam or hot water-using equipment.

4. Possible Equipment Purchases under the USAID Project

Possible first phase equipment:

- steam traps
- electronic exhaust gas analyzer

Possible second phase equipment (depending partly on purchase decisions for the first phase):

- heat pump to use geothermal heat for building and process heating for outlying buildings, to avoid large losses in the distribution piping

- waste heat recovery boiler on the forge, using the recovered heat for steam generation for the wood drying kiln

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

Zlatna Panega Cement Plant

by local energy consultants

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Anguel Dangov, Tech Cem

prepared by

RCG/Hagler Bailly

April 1994

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Industrial Energy Audit Guidance Report for Zlatna Panega Cement Plant

1. Introduction

This report is based on approximately three days of work at the plant by Mark Oven of RCG/Hagler Bailly, followed by discussions with the consultants, joint analysis of the data collected and measured by the consultants, and gathering of reference information on the plant process in the U.S. literature. The in-plant work consisted primarily of interviews with plant management and technical staff and observations of the plant operations.

The objective of this report is to provide technical guidance in the completion of the audit and the preparation of the final report to the local energy consultants who are conducting the audit of the plant based on a contract directly with the plant. Eventually, the consultants will also provide an English summary of the data and report recommendations, allowing Hagler Bailly to offer a review of the final report to the plant.

2. Background

Zlatna Panega is one of the larger of the nine or so Bulgarian cement plants. It has five kilns, two with 25 t/h clinker capacity, and three with up to 60 t/h capacity, and employs nearly 800 workers. Overall production is about 300,000 tonnes each of cement and clinker, down almost half from the production levels of 1990. Two of the larger kilns are normally operating, the smaller kilns are older and even less efficient. Zlatna Panega is struggling to operate as a profitable company now that the state planning and price protection has stopped, but its production costs are very close to world market prices. It exports about 20% of its production to the Middle East.

The general manager and energy manager are aware of many of the problems stemming from the inefficiency of the operation of the plant. Their objective is to maintain the plant operation until a suitable buyer can be found. As a result, they continue making small improvements out of retained earnings, but have not been able to make the big investments. A number of energy efficiency investments have been made in the past, but some, such as a centralized computer monitoring and control system were never fully and successfully implemented. The large computer room designed 5 or 6 years ago can now easily be replaced with one or more personal computers.

The main energy users are clearly the cement kilns, originally designed for fuel oil and now burning natural gas. Gas is also used in a boiler room to operate a 20 t/h boiler primarily for space

heating. While this consumption is high, it is a small fraction of the kiln fuel consumption, and the audit should concentrate on the process rather than on the auxiliary equipment. On the electrical side, consumption is also high: there is large electrical equipment (air compressors, grinders, fans). The electrical distribution system is supplied by approximately two dozen transformers, each submetered; however the process equipment is not segregated or distributed by transformer, making it essentially impossible to monitor electricity consumption by productive processes.

Gas metering of the kilns has been installed recently, but is not used in detail to help control the kiln operation. Only monthly consumption of the kilns is recorded, instead of hourly or daily consumption.

Significant energy and environmental improvements can be made in the kiln firing process. For example, currently the combustion fuel and air mixture cannot be properly controlled, resulting in high excess air. This results in higher temperatures and increased heat losses due to both temperature and air flow. Finally, the flow through the cyclones and filters is higher than design, resulting in increased dust emissions out the stack.

3. Recommended Approach

The audit approach should concentrate in two areas: 1) energy accounting and management; and 2) large energy consumers, including kilns and large electrical equipment.

(1) Energy accounting and energy management

(a) Review the monthly production of clinker and cement for the past two years, and make a preliminary summary of the electricity and gas consumption logs for the whole plant. Plot this data to determine the evolution of plant operation and the efficiency of the same. The variation in the data may provide a basis to draw general conclusions on the operation of the process, and may lead to additional energy efficiency recommendations. To the extent possible, plot this data for each kiln; use daily production and consumption figures over a 2-3 month period if possible.

(b) Recommend a formalized ongoing monitoring program for daily or weekly updating of the production and energy consumption relationships. List possible additional meters which should be installed for submetering the important departments. Develop simple spreadsheets for data entry and analysis, as well as long-term data storage.

(c) Review the relationships and data flow between the technical director, the energy

manager and the different production department heads, and between them and their operating staff. Recommend staff functions to record and analyze data required for regular and continuous production efficiency monitoring.

(2) Energy efficiency-related measurements

The primary focus of measurements should be on the kilns, complementing the existing instrumentation with temperature and exhaust gas analysis equipment from the audit kits.

--- Carry out a complete mass and energy balance of each of the two working kiln lines (nos. 4 and 5). The plant has specific equipment for this, including pitot tubes, manometers and dust probes. Use the audit kit thermocouples and exhaust gas analyzer to complement this equipment. Work with plant staff to organize a measurement campaign and monitor all fuel and process flow parameters during the measurements.

--- Compare results to original kiln design conditions, as well as to information on typical operating kilns and processes of similar types.

--- Use results of the measurements to recommend improved air flow measurement and control in the kilns, as well as exhaust gas oxygen measurement. Improved control can result from: operational changes due to improved training or greater conscience of the operators; physical reconstruction of parts of the kiln, grate cooler and air system; and better instrumentation and control systems.

List all the major separate electrical energy consumers by department. Map out the departmental distribution compared to the existing transformer distribution, and recommend consolidation, rewiring and submetering to increase the ability to follow departmental consumption of electrical energy.

Analyze the loading of the different fans. Where fan load varies in conjunction with process throughput or other variables, analyze the possible application of variable speed drives.

4. Possible Equipment Purchases under the USAID Project

Possible first phase equipment:

- desktop computer equipped with basic spreadsheet, word processing and data base software, as well as a color printer for clear presentation of results; a simple data organization and analysis program should be developed with standard spreadsheet software

- portable electronic combustion gas analyzer

Possible second phase equipment:

- automated gas sampling and analysis station for one of the kilns to monitor O2 and NOx in the kiln exhaust

- kiln simulator software to allow training of kiln operators on the optimization of kiln operation

- variable frequency motor drive systems for the large fans (750 kW and 320 kW) on the cement kilns and the electrostatic

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

INDUSTRIAL ENERGY AUDIT GUIDANCE REPORT

for work at

ZMM, Sofia

by local energy consultants

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RCG/Hagler Bailly

November 1993

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ZMM - Sofia

Comments and Suggestions on the Energy Audit

Data Analysis

-- Make plots of monthly consumption for 12-18 months, for all sources of energy: electricity, steam, hot water, drinking water, technological water

-- Make plots of daily consumption of steam and hot water for 1-2 months last winter; try to correlate with outside temperature to see how much effect it has, or is the energy consumption relatively constant

-- Make plots of hourly consumption (kWh) for several days for all major TPs; we can put several on one graph

Electrical Systems

-- For major power factor problem TPs identified during the first days of the audit, plot hourly kWh and kVAr values for several working days, and for one or two typical weekend (non-working) days. Use this information as a basis for the sizing of the capacitor systems necessary.

-- Make pie charts (or just a table) with an electrical balance for the facility: 1) by TP; and 2) by usage (different productions, lighting, machine testing, compressed air, administrative offices, etc)

-- Complete the measurements of the consumption of the underloaded transformers

Lighting

-- Perform lighting inventory in all areas: number of lamps, types of lamps, hours of operation. Include outdoor lights.

-- Make a check in the evening to see how many lights are on in the different areas. (Also use the kWh data for each building to try to identify those with higher consumption at night.) Check the status and operation of the outdoor lights at the same time.

Compressed Air

The compressor does not seem to be unloading much during the day. Its average load should be checked during various hours and correlated with plant activities. It is possible that leaks account for a major portion of the air consumption.

-- Follow all compressed air lines; check leaks of air throughout the plant, noting down the location and approximate intensity of the leak; make a table of all leaks identified. In some areas, this can be done at the end of the day when the operators are no longer there: the quietness will facilitate identification of leaks.

-- Check how late the compressor operates, and how often; it may be too much to keep the large compressor operating after a certain time of the evening, and the smaller compressor should be used.

-- Note hourly kWh consumption for the compressor for at least 3 days during the week. Plot this on a graph. Try to relate the level of plant activities during this time.

Steam Use

-- Note hourly steam consumption readings for at least two days; these should include the two central meters as well as the two submeters.

-- Make a monthly balance: apportion the steam usage among the different users, including heating, galvanized baths, and hot water for bathrooms.

-- Check on the number of people taking showers and use a standard amount of hot water used by each person; see if this agrees with the amount of steam usage each day apportioned to the hot water.

-- Inspect the whole steam system including all piping: note leaks (including approximate intensity), missing insulation (including the length and surface temperature), test steam traps with ultrasonic tester.

-- Check galvanized operation and the steam submeters for the galvanized area to ensure that there is no steam consumption after the second shift, and compare the consumption between the second and first shift, and with the production during each of the shifts.

Miscellaneous

-- Check operation of air curtains (is this a large electricity consumer?)

-- Ensure cooling tower pumps are turned off when large compressor is not operating; check if these pumps are necessary for the cooling of the smaller compressor: if not, then there are even more savings when the smaller compressors are used (might it be worthwhile to use two small compressors instead of one large one? (in this case, the credit for the hot

water generated by the heat recovery system should also be analyzed))

Possible Energy Conservation Measures (ECM) to Evaluate

Each of these should be analyzed with complete cost and savings estimates (as shown in the sample reports)

- Institute improved energy accounting and management system
- Improve power factor
- Disconnect unloaded transformers, or combine two lightly loaded transformers
- Reduce lighting operation
- Disconnect ballasts to burned out lamps
- Replace mercury lamps with sodium lamps (for outside lighting)
- Replace mercury lamps with sodium lamps (in some production areas)
- Reduce compressed air leaks (and compressor operating time) (perhaps operate smaller compressor instead of the larger one during non-peak consumption periods)
- Use electric radiant heating in some manufacturing areas
- Improve insulation and reduce leaks in steam and hot water systems
- Install pressure reduction valves in steam/hot water boilers and steam distribution system
- Repair or replace faulty or leaking steam traps
- Increase amount of condensate returned
- Improve sealing of windows on buildings
- Identify equipment that is operating unnecessarily -- turn it off
- Change operation of any equipment possible to non-peak hours (for example, machine testing) (perhaps consider operating a larger second shift than a first shift)

Equipment Purchase Possibilities

-- hand-held electric power factor analyzer

-- recording electric power analyzer

-- ultrasonic leak detector for steam traps, steam leaks, air leaks

-- some permanently installed electric or flowmeters? (perhaps the USAID project can help fund part of the Bulgarian-made energy monitoring system?)

Focused Energy Audit for Electricity Consumption: ZMM, Sofia

Preliminary Time Estimate

Tasks	Days of Consultant
Electric system measurement and development of electric demand profile and energy balance	8
Power factor system evaluation and testing of existing capacitor systems	5
Lighting inventory and analysis	2
Motor inventory and analysis	7
Calculations and cost estimates	8
Report preparation	8
Total days (focused audit)	38
Equipment specification and installation assistance	10
Total days	**48**

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MEMORANDUM OF UNDERSTANDING

This agreement covers the energy efficiency-related equipment to be purchased for ZMM, Sofia under the auspices of the Industrial Energy Efficiency Project in Bulgaria of the U.S. Agency for International Development (USAID).

The following equipment, identified as a result of an energy audit performed at ZMM will be purchased, up to a limit of US$ 10,000:

1 steam pressure reduction valve 180 mm / 6 bar

2 steam pressure reduction valves 50 mm / 2 bar

7 steam temperature control valves 32 mm / 100 C

4 steam temperature control valves 25 mm / 100 C

As contractor to USAID, RCG/Hagler Bailly will purchase and ship the equipment to Bulgaria. U.S. Government procurement regulations will be followed. Equipment must be of U.S. or Bulgarian manufacture and origin. The cost of the equipment will be approximately US$ 10,000, exclusive of taxes and shipping costs. Shipping costs to Bulgaria will be covered by the USAID project.

Taxes and duties are not covered by the USAID project. The equipment will be shipped to the Bulgarian Ministry of Industry, which will assist with customs clearance. It will be the responsibility of ZMM to contact the Ministry to take possession of the equipment.

ZMM agrees to install, utilize and maintain this equipment, covering any corresponding costs.

For RCG/Hagler Bailly	For ZMM
Signed	Signed
Mark Owen	Vladimir Hranov
Name	Name
Principal	dipl. engineer
Title	Title
July 1, 1994	July 22 1994
Date	Date

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT-BULGARIA

ENERGY EFFICIENCY MARKET DEVELOPMENT

VOLUME II

FINAL ENERGY AUDIT REPORTS

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FINAL ENERGY AUDIT REPORTS - BULGARIA

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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.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

Crystal, Pernik

by

Yordan Katzarov, Risk Engineering

Kamen Radivojev, Risk Engineering

for

Hagler Bailly Consulting, Inc.

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РИ/Д-28
1994

OPTIMIZATION OF TEMPERATURE MODES OF OPERATION AND BURNING PROCESS IN GLASS FURNANCE OF CRYSTAL - PERNIK

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OPTIMIZATION OF TEMPERATURE MODES OF OPERATION

AND BURNING PROCESS IN GLASS FURNACE OF CRYSTAL - PERNIK

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Optimization of temperature modes of operation and burning process in glass furnace of Crystal - Pernik

Introduction

The present contract signed by "Crystal" Pernik and Risk Engineering Ltd is included in the program of USAid (represented in Bulgaria by RCG/Hagler Bailly, Inc) for energy efficiency.

The goal of the present study is energy an analysis for glass furnace "Furco" to be made to amend the mode by modernization of the system for temperature control and optimization of combustion in the furnace. The final goal is to realize real economy of the basic technological fuel - natural gas by not big and inexpensive measures. Such formulated goal is exclusively topical for Crystal as the price of natural gas in 1994 increased about two times creating serious problems to the factory where the energy component for the final product - glass represents 2/3 from the total manufacturing costs.

1.Short description of factory "Crystal", it basic equipment and technology

The "Crystal " - Pernik is the oldest glass enterprise in Bulgaria. The annual capacity of the factory is 4.5 millions m^2 sheet glass (on the base of 2 mm thickness) and 150 thousands tempered car glass (type "securit"). Now as a result of the total recession in Bulgaria's economy of the factory is working below it's normal capacity.

The main production of the factory is sheet glass - 80 % of total output. The factory operates with one glass furnace type "Furco" equipped with 4 machines for withdrawal of glass band. The first design of the factory, provided equipment for burning gas, generated from low rank coal extracted in the region of Pernik. The furnace was later modernized consequently for work with fuel oil and liquefied propane butane. The last modernization imposed natural gas as basic fuel.

The glass furnace "Furco" is a pan type furnace with low disposed recirculating system for continuous activity. The pan furnace is conditionally subdivided to melting and cooling parts. The melting zone has a total mirror surface of 94 m^2 and the cooling zone with the furco's channel of withdrawal machines together - 143 m^2 . The molting zone is deep 1.2 m and the cooling zone - 1.2 m. The furnace is equipped with 4 pairs of burners disposed one against other on the lateral walls with output width of 1.8 m. Every pair of burners depending on its disposition in the melting zone is equipped with different heat power gas nozzles.

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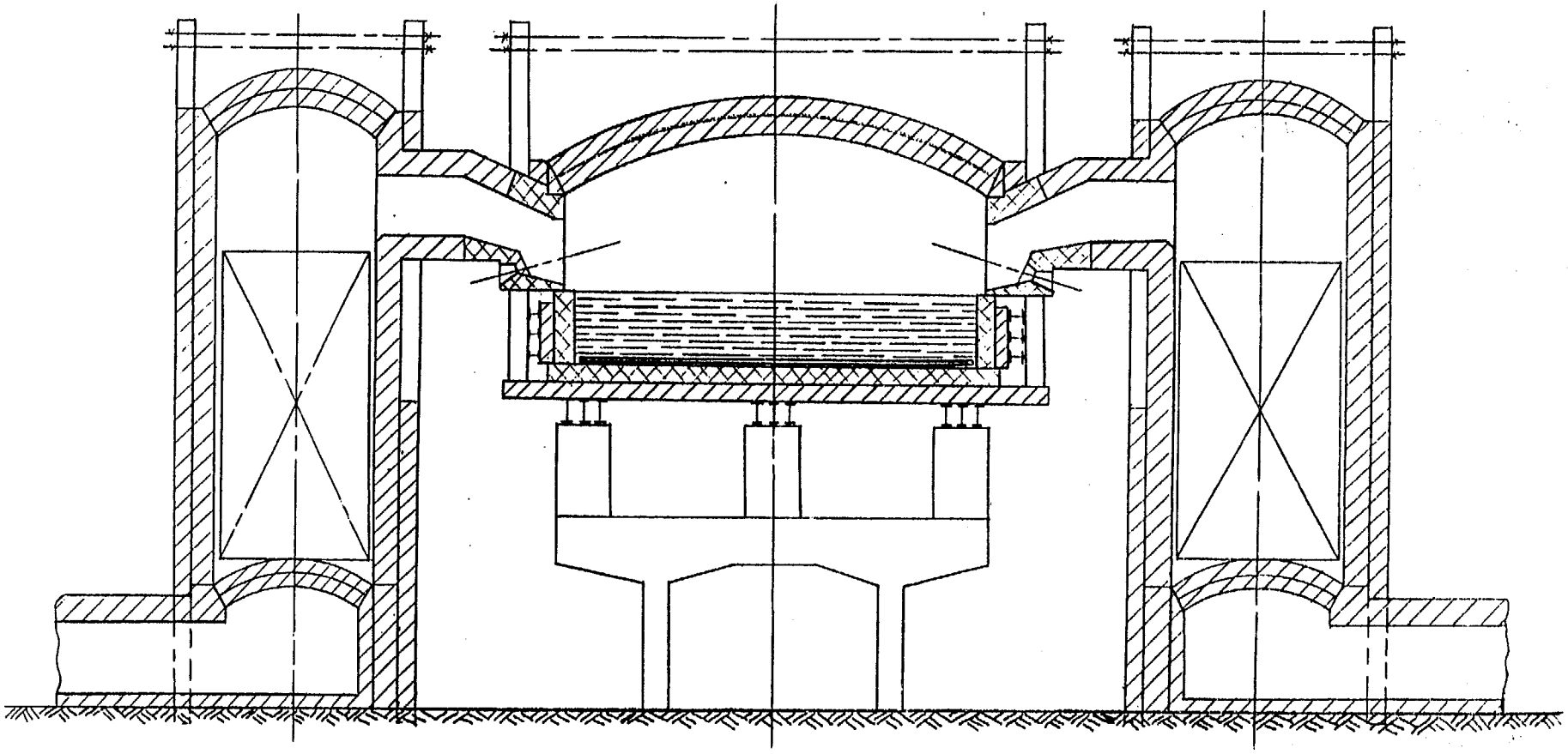

Fig. 1. Cross section of glass furnace "Furco"

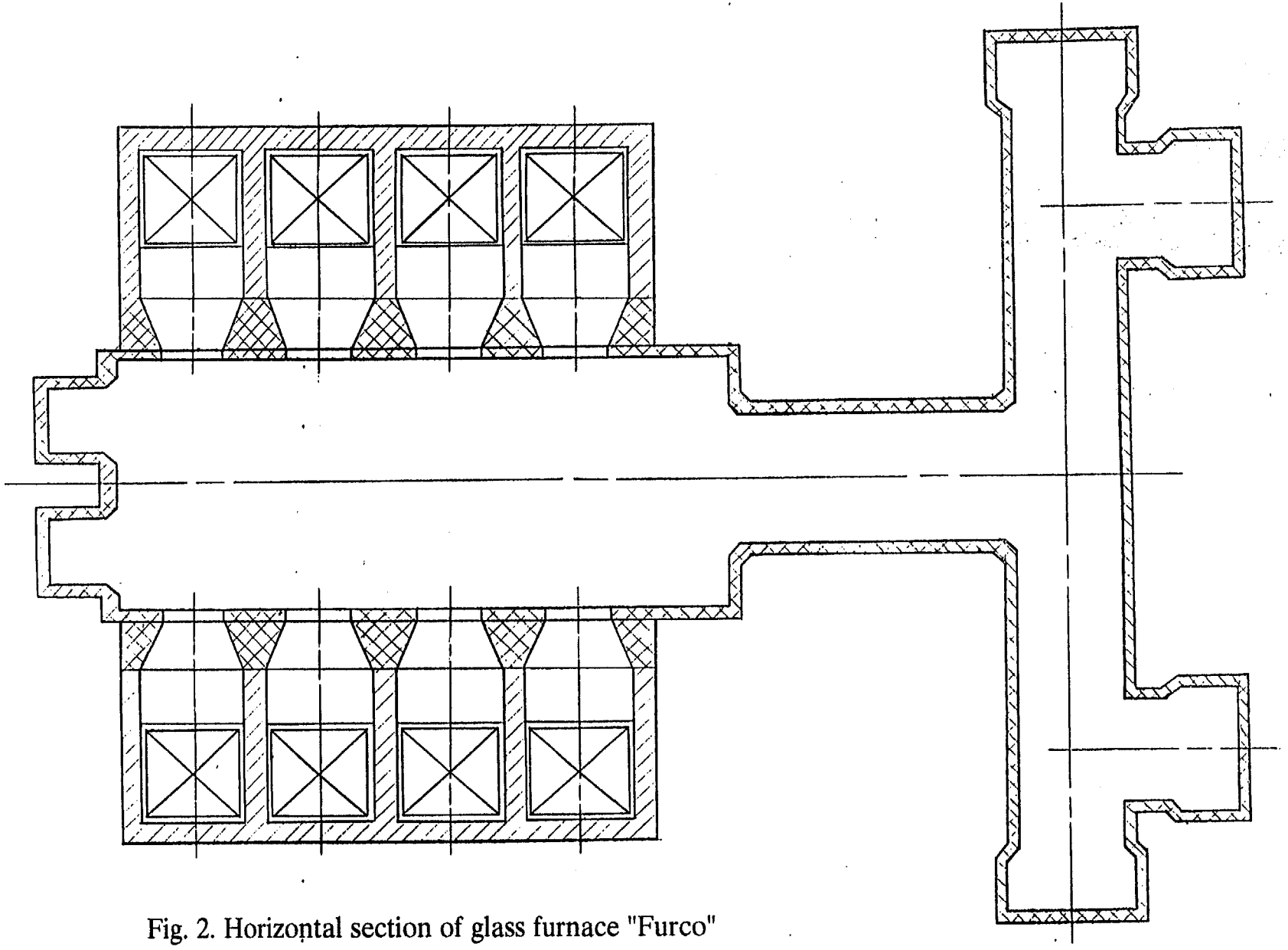

Fig. 2. Horizontal section of glass furnace "Furco"

The flame space of the melting zone is separated from the cooling zone by 3 screens. The set up of these screens is enforced by the temperature conditions and is accounted for decrease and elevation of the temperatures in the cooling part of the furnace. For isolation of the gas space of furco's channels and ensurance of the necessary temperature for shaping of the glass band in the furco's channels are constructed screens immersed 100 mm in the glass mass. For neutralization of the convective streams in the melting zone between the screens are disposed 2 floating bridges 600 mm high.

The melting piscin is constructed from refractory blocks "Korthartzag" and of the working channels from blocks "Bacor". The vault of the furnace is constructed from silica bricks and the vaults of the burners are constructed by chrome magnesite bricks.

The burners are provided with regenerative chambers and every pair of them with the related chambers found out self operating section. For I, II and II sections the filling is type "Amercan cradle" and for IV section type "Lihte". The filling of the chambers is from chrome magnesite bricks. The active zone dimensions are: height - 5 m., width - 2.75 m. length - 3 m. So constructed filling ensures sufficient high temperature for the air for combustion.

At the end of the pan furnace are disposed 4 "Furco" machines for withdrawal of the glass band Two machines are disposed in one cross, other two on the second cross. In the glass mass under the withdrawing machine is immersed „ a boat" (nozzle) from high quality chammote mass, which serves for primary shaping of the glass band. There are special requirements relating to the dimensions of the nozzle and the roughness of the surfaces as these are the factors influencing the quality of the glass. Immediately after the nozzle, laterally of the glass band are mounted the coolers, which represents metallic sheet plane hollow bodies where circulates cooling water. Their purpose is to cool down the glass band immediately after coming out of the nozzle. On the depth of immersion of the nozzle in the glass mass depends it flow. The defined depth of immersion is realized by the activity of lever mechanism. Above the boat in cast iron vertical shaft consisting of separated sections is mounted the mechanism for withdrawal of the glass band. It consists of 15 pairs equal diameter asbestos rolls. The rolls are turned on by el. motor coupled with gear. One of every roll in the pairs is steady and the second is movable so it can be brings near or recedes from the unmovable so the thickness of the band to be controlled. Between the rollers there are sloped metallic sheets protecting the band from the dropping crushed glass particulate.

The main condition for receiving the quality of the sheet glass is the steady chemical composition of the glass mass and the temperature mode of the furnace.

The used glass mass in "Crystal" for the production of qualitaty glass has following composition:

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SiO_2=73.3±0.5%
Al_2O_3=1.6±0.3%
CaO=6.8±0.2%
MgO=4.0±0.2%
NaO=14.07±0.5%
SO_3=0.3÷0.5%

The pan furnace is supplied with a glass mixture and glass crushed particulate in relation 75 -80% to 20 - 25% supported in quoted limits. The quality of the mixture should to be very high about homogeneity. The deviations of the components from the limits should not exceed ±(0.5 -1)% and the humidity should be in the limits of 4.8 to 5%. The used crushed particulate should not contain an alien elements as stones, metals etc. and should have the same composition as the glass mass in the furnace.

Premature prepared mixture is passed to the furnace from special bins by 2 rotor mixture filler wide 1.2 m. The right filling and distribution of the mixture and the crushed glass particulate is an important condition for optimal control of the melting process. The level of the glass mass is continuously supported and is controlled by electronic levelmeter (EL). The deviations in the level at operating EL are changed in the limits of ±0.2 mm. It's previewed possibility for manual control of the furnace supply meanwhile keeping constant level of the glass mass.

The melting of the glass mass is the most important term in the whole technological process of production of sheet glass. This is a complex of a complicate physical chemical-physical and chemical events and reactions. It can be divided into 5 successive phases:

1. Silicateforming - This is a process of transformation at high temperature of carbonates, oxides and other compounds in silicates. After finishing of this process it can't be found the materials in their primary type. Chemically this phase can be characterized as reactions in solid state.

2. Glassforming - It's characterized by forming complex compounds interacting between themselves and dissolving in each other. The melted material is not yet glass as technical product.

3. Degasation - This is a phase at which the temperature is increasing to maximum besides the viscosity of the melted glass mass is decreased. The phase is characterized by intensive separation of gaseous products from the whole surface as bursting bubbles. At these conditions degasation is accomplished to equilibrium situation.

4. Homogenization - The melted glass mass is kept some times in the same or lower temperature and as result of the diffusion acquires homogeneity of the chemical and physical properties.

5. Cooling - This is a phase at which the temperature of the glass mass is decreased to the rate at which it achieves the viscosity convenient for shaping.

A defined temperature of the glass mass, time and place are required for the right development of each of the phases. The keeping of constant temperature mode for every phase has exclusive importance. The control of the temperature mode is performed by thermocouples placed alongside the vault of the furnace. The following temperature mode is established in the practice:

1. Temperatures in the melting zone:
   - between I and II burner 1410-1420°C
   - between II and III burner 1460-1480°C
   - between III and IV burner 1430-1440°C
   - between melting and cooling zone 1305°C

   The temperature mode in the melting zone is kept with precision ±10°C
2. Temperatures in the cooling zone:
   - temperature in the right cross 1180°C
   - temperature in the left cross 1185°C
   - temperature before machine 1 1100°C
   - temperature before machine 2 1095°C
   - temperature before machine 3 1100°C
   - temperature before machine 4 1100°C

The temperature of the furnace is controlled periodically by the operational staff besides the thermocouples by optical thermometer.

An important condition for preserving the constant temperature mode in the furnace is the exact observance of the time for conversion of the flame direction performed automatically every 20 minutes by switching over of gas and air tracts by vexel device "Kuning". The exact observance of the time for conversion ensures constant temperature mode in the regenerative chambers and in the furnace. Same purpose is aimed by the support of constant pressure above 100 mm from the mirror's surface of the glass mass in the area of the central cross at 0.01 to 0.02 mm H_2O with maximum deviation of ±0.005 mm H_2O.

The support of maximum overpressure of the furnace is realized by the natural draft of the stack which is kept constant 42±5 mm H_2O measured behind the control slide valve. The temperature of the exhaust furnace gases of the is kept constant and before the vexel device has value of 400°C±20°C.

2. Fuel price analysis in 1994

The price of used fuel defines the basic costs for the production of sheet glass. This is the reason why an analysis of the change in the prices of two kinds of fuel has been made: gas and heavy fuel oil containing 3.5% sulfur. The change in price is shown in Fig.3. The prices are presented in local currency but for some characteristic periods they are presented for comparison additionally in USD. On the basis of statistical data the following conclusion can be made:

1. In the first half of 1994 the prices of natural gas and heavy fuel oil increased by constant value every 15 days. By the end of June this increase doubled the primary values and now the prices are close to the average international prices (natural gas 100\$/10^3 m^3, heavy fuel oil 133\$/t).

2. The above fuel prices tripled in the first half of the year in leva but this is not representtive because of the changes in the lev/dollar exchange rate

3. In the second half of the year the prices in leva changed unevenly in line with the exchange rate and alternated around the average international prices

4. The fixed ratio between the prices of natural gas and heavy fuel oil is kept and the price of gas was 75% of the heavy fuel oil price. Only at the end of the year the heavy fuel oil price were raised.

5. The increase of the prices for 1994 is:
- natural gas from 1771 leva/10^3 m^3 to 6511 leva/10^3 m^3 (from 54\$/10^3 m^3 to 100\$/10^3 m^3)
- heavy fuel oil from 2530 leva/t to 9301 leva/t (from 77\$/t to 143\$/t)

6. The international trend for average increase of the natural gas price is not valid for Bulgaria because of the price forming influence of various other factors.

7. The natural gas and heavy fuel oil prices do not correspond to the general economic development of Bulgaria.

Taking into account the relatively high gas price for the Bulgarian conditions, the problem for the effective use of natural gas is a prominent one.

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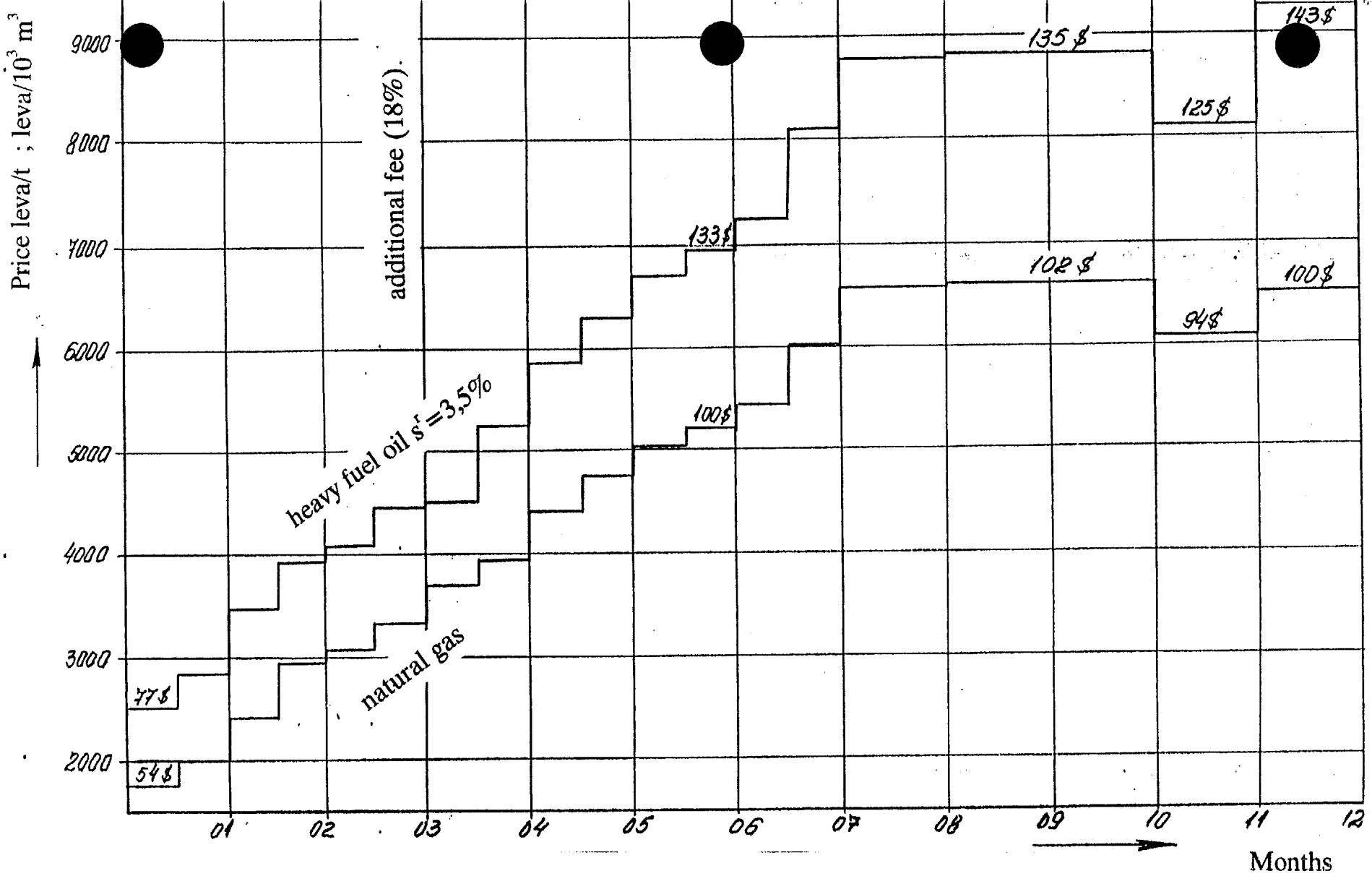

Fig. 3. The change of prices of heavy fuel oil (S^r=3,5%) and natural gas in 1994

3. Analysis of glass furnace "Furco" operation

Long term statistical data were gathered for estimation of the glass furnace operation. Subjects of attention were the temperature mode, subpressure in the furnace and the glass thickness, factors influencing the quality of production and the rational use of natural gas.

In the investigations of the furnace temperature mode of the were used the existing thermocouples and where the construction permits the temperature was measured intermittently by optical pyrometer. The scheme of measure point positions is shown in Fig.4. The results are represented in tables 1÷17. In every table figures the results from measurements for one workday by 1 hour interval. For the comparison goal the productivity of the furnace and the consumption of natural gas are given. The results of observations indicates that the furnace load is constant and the temperature mode of the different zones is kept steady. The temperatures in the measurement points practically are near to optimum values.

The question for assuring of reliable control over the temperature mode of the furnace is very topical. A temperature control system aged 20 years and is amortized is implemented In the glass furnace. One part of the thermocouples are burned, the recorder is also amortized and the measurements are not reliable. That's why the authors propose immediate replacement of the temperature measurement system in the furnace. By realization of the system one economy of 2% natural gas can be achieved. Additionally the quality of the molten glass material would be ensured. (degasation, homogeneity, necessary viscosity).

In conclusion we can say that the main conditions for quality assurance of the production - keeping the optimal temperature control is fulfilled by the continuos efforts of the operational staff and if a new temperature measurement system is implemented this would amend to a large degree the operation of the glass furnace.

Along with the keeping of the temperature mode of the furnace the staff controls the overpressure in the gas volume of the furnace. This is necessary to prevent in leakage of cool air in the furnace and cooling of the glass mass, events leading to overconsumption of natural gas. In the existing situation the assurance of necessary overpressure is connected with considerable difficulties caused by the unreliable operation of the appliance. The slide valve mounted before the chimney and controlling the natural draught by signal from the gas volume of the furnace is amortized and needs replacement. At definite modes it can not insure the narrow limits for regulation of necessary overpressure. The effect of implementation of one system for insurance of minimal overpressure is analogous to the system for temperature control.

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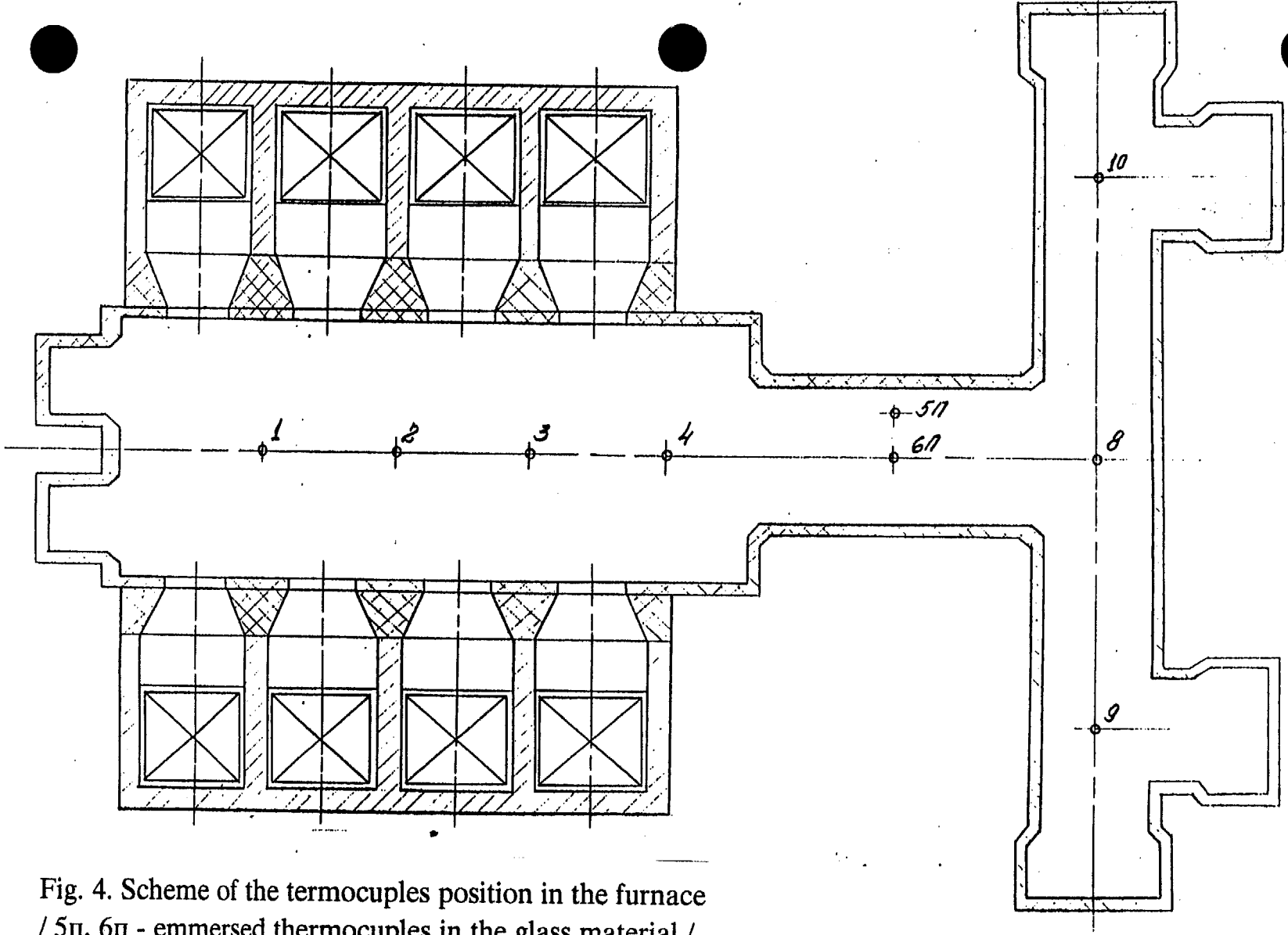

Fig. 4. Scheme of the termocuples position in the furnace
/ 5п, 6п - emmersed thermocuples in the glass material /

Measured temperature values in control points glass furnace - (Kristal - Pernik) Table 1

Date 10. 05. 1994 ~~10.05.94 г.~~

hour \ Contr. point №	1	2	3	4	5	6	7	8	9	10		Pyrometry			
18	1348	1414	1366	1336	1234	1232	-	1098	978	997		centre cross	principal cross	left cross	right cross
19	1340	1411	1358	1324	1336	1230	-	1096	978	998		Ц.к.	Гл.к.	Л.к.	Д.к.
20	1340	1412	1355	1325	1231	1230	-	1095	978	995					
21	1349	1415	1365	1338	1231	1231	-	1095	977	994		1350	1194	1080	1072
22	1357	1400	1370	1341	1232	1230	-	1094	977	933		1363	1194	1077	1069
23	1355	1400	1369	1342	1232	1230	-	1094	973	993		1371	1094	1077	1068
24	1350	1420	1368	1340	1231	1230	-	1094	972	993					
1	1356	1410	1363	1345	1238	1232	-	1094	971	991					
2	1350	1450	1369	1342	1238	1232	-	1094	970	991					
3	1350	1420	1370	1342	1233	1232	-	1094	950	991					
4	1352	1420	1375	1342	1235	1232	-	1094	970	991					
5															

Gas flow : 30 700 m^3/24 hours

Produced glass: 7 450 m^2/24 hours /6 = 2 mm/

90

Table 2

Measured temperature values in control points of glass furnace - (Kristal - Pernik)

13.05.94 г.

hour \ Contr. point	1	2	3	4	5	6	7	8	9	10					
10	1351	1412	1363	1334	1232	1232	-	1098	978	997					
11	1340	1412	1358	1324	1339	1230	-	1096	978	998					
12	1340	1412	1350	1325	1231	1230	-	1095	978	995		centre cross	principal cross	left cross	right cross
12	1349	1415	1362	1338	1231	1231	-	1095	977	994		1350	1194	1080	1072
13	1357	1400	1370	1341	1231	1231	-	1094	977	933		1363	1194	1077	1069
14	1356	1400	1369	1342	1232	1230	-	1094	973	993		1371	1094	1077	1068
15	1350	1420	1368	1340	1231	1230	-	1094	972	993					
16	1356	1410	1363	1344	1238	1232	-	1094	971	991					
17	1350	1450	1369	1342	1238	1232	-	1094	970	991					
18	1350	1430	1370	1342	1233	1232	-	1094	950	991					
19	1352	1420	1375	1341	1235	1232	-	1094	970	991					
20															

Gas flow : 30 780 m^3/24 hours

Produced glass: 7 520 m^2/24 hours

/б = 2 мм/

Table 4

19.05.94 r.

Measured temperature values in control points of glass furnace - (Kristal - Pernik)

hour \ Contr. point	1	2	3	4	5	6	7	8	9	10					
8	1352	1414	1366	1336	1234	1232	-	1098	978	997					
9	1345	1412	1358	1324	1339	1230	-	1096	978	998					
10	1345	1412	1355	1325	1231	1230	-	1095	978	995		centre cross	principal cross	left cross	right cross
11	1347	1415	1365	1338	1231	1231	-	1095	977	994		1350	1194	1080	1072
12	1355	1400	1370	1340	1230	1230	-	1094	977	933		1363	1194	1077	1069
13	1355	1400	1369	1342	1232	1230	-	1094	973	993		1371	1094	1077	1068
14	1350	1420	1365	1340	1231	1230	-	1094	972	993					
15	1356	1400	1363	1345	1236	1232	-	1094	971	991					
16	1350	1450	1369	1342	1238	1232	-	1094	970	991					
17	1350	1420	1370	1342	1233	1232	-	1094	930	991					
18	1352	1420	1375	1341	1235	1232	-	1094	970	991					
19	1353	1420	1375	1342	1234	1232	-	1094	970	991					

Gas flow : 30 710 m^3/24 hours Produced glass: 7 460 m^2/24 hours /б = 2 мм/

Measured temperature values in control points of glass furnace - (Kristal - Pernik) Table 5

22.05.94 r.

hour \ Contr. point	1	2	3	4	5	6	7	8	9	10					
21	1352	1414	1366	1336	1234	1232	–	1098	978	997					
22	1340	1412	1358	1324	1343	1230	–	1096	978	998					
23	1340	1412	1350	1329	1231	1230	–	1095	978	995		centre cross	principal cross	left cross	right cross
24	1349	1415	1365	1338	1231	1231	–	1095	977	993		1350	1194	1080	1072
1	1357	1400	1370	1340	1230	1230	–	1094	977	933		1363	1194	1077	1069
2	1355	1400	1309	1342	1232	1230	–	1094	975	993		1371	1094	1077	1068
3	1350	1420	1368	1340	1231	1230	–	1094	972	993					
4	1356	1400	1364	1350	1238	1232	–	1094	971	991					
5	1350	1450	1370	1342	1238	1232	–	1094	970	991					
6	1350	1420	1370	1342	1233	1232	–	1094	930	991					
7	1352	1420	1375	1341	1235	1232	–	1094	970	991					

Measured temperature values in control points of glass furnace - (Kristal - Pernik) Table 6

25.05.94 г.

Contr. point / hour	1	2	3	4	5	6	7	8	9	10					
20	1352	1414	1364	1336	1234	1232	-	1098	978	997					
21	1340	1413	1356	1324	1343	1230	-	1096	978	998					
22	1340	1412	1350	1329	1231	1230	-	1095	978	995		centre cross	principal cross	left cross	right cross
23	1347	1414	1365	1335	1231	1231	-	1095	977	993		1350	1194	1080	1072
24	1355	1400	1370	1340	1230	1230	-	1094	977	933		1363	1194	1077	1069
1	1353	1400	1309	1342	1230	1230	-	1094	975	993		1371	1094	1077	1068
2	1349	1419	1365	1340	1231	1230	-	1094	972	993					
3	1353	1400	1364	1350	1238	1232	-	1094	971	991					
4	1349	1450	1370	1339	1238	1232	-	1094	970	991					
5	1349	1420	1370	1342	1233	1232	-	1094	930	991					
6	1351	1420	1375	1341	1235	1232	-	1094	970	991					
7	1350	1420	1374	1340	1235	1232		1094	970	991					

Gas flow : 30 730 m^3/24 hours

Produced glass: 7 540 m^2/24 hours /б = 2 мм/

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Table 7

Measured temperature values in control points of glass furnace - (Kristal - Pernik)

29.05.94 r.

hour \ Contr. point	1	2	3	4	5	6	7	8	9	10					
21	1366	1421	1380	1348	1242	1245	-	1102	980	1000					
22	1368	1422	1381	1348	1242	1245	-	1102	980	1000					
23	1368	1424	1380	1346	1242	1225	-	1103	980	1000		centre cross	principal cross	left cross	right cross
24	1368	1424	1381	1346	1242	1245	-	1103	980	1000		1363	1200	1082	1080
1	1365	1426	1381	1346	1242	1245	-	1103	980	1000		1362	1201	1083	1080
2	1366	1424	1382	1346	1242	1246	-	1103	980	1000		1364	1200	1085	1080
3	1368	1424	1982	1348	1244	1246	-	1104	980	1000					
4	1366	1422	1383	1346	1244	1246	-	1104	980	1000					
5	1366	1422	1382	1346	1246	1246	-	1104	980	1000					
6	1368	1424	1384	1347	1244	1247	-	1105	980	1000					
7	1309	1424	1385	1348	1244	1247	-	1105	980	1000					

Measured temperature values in control points of glass furnace - (Kristal - Perník)

Table 8

03.06.94

hour \ Contr., point	1	2	3	4	5	6	7	8	9	10					
												centre cross	principal cross	left cross	right cross
7	1366	1428	1380	1345	1244	1244	-	1106	994	1000		1366	1204	1081	1084
8	1364	1428	1380	1344	1245	1244	-	1106	994	1000		1363	1203	1083	1085
9	1364	1430	1381	1344	1245	1244	-	1106	995	1000		1360	1205	1083	1085
10	1362	1433	1380	1342	1245	1242	-	1106	996	1000					
11	1362	1430	1378	1342	1246	1246	-	1107	996	1000					
12	1362	1430	1378	1343	1246	1246	-	1106	999	1000					
13	1360	1426	1374	1343	1242	1242	-	1106	999	1000					
14	1361	1422	1376	1341	1241	1241	-	1105	999	1000					
15	1361	1422	1378	13411	1241	1241	-	1105	998	1000		1363	1206	1084	1085
16	1340	1380	1350	1325	1224	1222	-	1101	998	1000		1358	1198	1087	1083
17	1355	1410	1368	1335	1237	1237	-	1101	998	1000		1350	1204	1082	1074
18	1360	1413	1374	1340	1236	1238	-	1101	997	1000					

Measured temperature values in control points of glass furnace - (Kristal - Pernik) Table 9

06.06.94 г.

hour \ Contr. point	1	2	3	4	5	6	7	8	9	10					
17	1352	1412	1362	1336	1234	1232	-	1098	978	997					
18	1340	1412	1358	1323	1339	1230	-	1096	978	998					
19	1340	1412	1350	1325	1233	1230	-	1095	978	995		centre cross	principal cross	left cross	right cross
20	1347	1415	1363	1332	1231	1231	-	1095	977	994		1350	1194	1080	1072
21	1357	1400	1365	1335	1230	1230	-	1094	977	933		1363	1194	1077	1069
22	1353	1400	1369	1341	1232	1230	-	1094	973	993		1371	1094	1077	1068
23	1350	1420	1368	1340	1233	1230	-	1094	972	993					
24	1354	1430	1363	1345	1238	1232	-	1094	971	991					
1	1350	1450	1368	1341	1238	1231	-	1094	970	991					
2	1350	1420	1370	1342	1232	1232	-	1094	940	991					
3	1352	1420	1375	1341	1235	1232	-	1094	970	991					
4															

Gas flow : 30 750 m^3/24 hours Produced glass: 7 500 m^2/24 hours /б = 2 мм/

Table 10

09.06.94

Measured temperature values in control points of glass furnace - (Kristal - Pernik)

hour \ Contr., point	1	2	3	4	5	6	7	8	9	10					
7	1358	1420	1379	1343	1240	1245	-	1105	990	998					
8	1359	1422	1379	1343	1241	1245	-	1105	990	998					
9	1360	1421	1380	1345	1241	1244	-	1105	990	998					
10	1361	1421	1380	1345	1241	1246	-	1105	990	998		1362	1202	1081	1081
11	1361	1420	1374	1343	1242	1247	-	1105	990	1000		1362	1209	1085	1085
12	1358	1420	1378	1342	1242	1247	-	1105	991	1000		1362	1202	1083	1085
13	1350	1418	1378	1342	1242	1247	-	1105	992	1000					
14	1350	1418	1378	1342	1242	1247	-	1105	992	1000					
15	1350	1415	1387	1342	1242	1247	-	1105	992	999					
16	1350	1414	1378	1342	1242	1246	-	1104	992	999		1362	1202	1083	1085
17	1352	1414	1388	1343	1241	1243	-	1104	999	999		1360	1202	1081	1084
18	1452	1417	1375	1343	1240	1242	-	1103	994	999		1358	1200	1079	108[illegible]

Measured temperature values in control points of glass furnace - (Kristal - Pernik)

Table 11

Manufactured glass m^2 and gas consumption m^3/24 hours

Contr. point / hour	1	2	3	4	5	6	8	9	10	centre cross	principal cross	left cross	right cross	2 - M	3 M
7	1370	1415	1378	1338	1230	1228	1100	990	992	1352	1196	1081	1083		
8	1370	1415	1378	1330	1230	1228	1095	991	993						
9	1370	1418	1375	1332	1230	1228	1096	990	993					8709	32 [illegible]
10	1368	1416	1375	1335	1231	1226	1095	990	993						
11	1367	1416	1373	1335	1231	1226	1098	994	990						
12	1370	1418	1370	1332	1231	1220	1098	994	990						
13	1369	1412	1373	1332	1230	1220	1094	993	990	1351	1196	1080	1082		
14	1365	1413	1373	1332	1230	1224	1095	993	991						
15	1368	1415	1375	1335	1230	1224	1096	995	991						
16	1370	1418	1370	1335	1231	1225	1100	996	992						
17	1370	1410	1370	1338	1232	1224	1100	998	991						
18	1368	1413	1370	1338	1231	1220	1100	996	991	1350	1195	1082	1083		

Measured temperature values in control points of glass furnace - (Kristal - Pernik) Table 12

Manufactured glass m^2 and gas consumption m^3/24 hours

hour \ Contr point	1	2	3	4	5	6	8	9	10	centre cross	principal cross	left cross	right cross	2 M	3 M
7	1371	1418	1370	1338	1231	1228	1100	990	992	1350	1194	1078	1070		
8	1370	1418	1370	1338	1231	1228	1100	992	992						
9	1370	1415	1378	1338	1230	1228	1100	991	992					[illegible] 330	[illegible] 340
10	1365	1416	1378	1336	1231	1226	1095	991	990						
11	1366	1416	1375	1336	1231	1226	1098	992	990						
12	1370	1417	1370	1335	1231	1220	1098	992	990						
13	1368	1415	1373	1335	1230	1220	1098	990	990	1352	1196	1080	1080		
14	1364	1413	1373	1332	1230	1220	1096	990	992						
15	1368	1415	1378	1335	1231	1220	1096	992	992						
16	1372	1417	1372	1335	1231	1224	1100	992	992						
17	1371	1415	1370	1338	1232	1224	1100	998	991						
18	1369	1415	1370	1338	1231	1220	1100	996	991	1351	1195	1082	1083		

Measured temperature values in control points of glass furnace - (Kristal - Pernik) Table 15

Manufactured glass m^2 and gas consumption m^3/24 hours

27.07.9

Contr. point / hour	1	2	3	4	5	6	8	9	10	centre cross	principal cross	left cross	right cross	2 M [illegible]	3 M [illegible]
7	1370	1418	1370	1338	1230	1229	1098	990	990	1350	1195	1080	1080		
8	1370	1418	1370	1338	1231	1228	1096	992	991						
9	1371	1416	1378	1338	1230	1228	1100	991	992					8 66[illegible]	3[illegible]
10	1368	1417	1378	1337	1231	1226	1095	992	990						
11	1368	1418	1378	1333	1231	1227	1098	993	990						
12	1370	1418	1370	1334	1231	1223	1098	992	991						
13	1368	1420	1377	1332	1230	1223	1098	991	993	1351	1196	1080	1080		
14	1366	1416	1377	1332	1230	1223	1096	990	993						
15	1369	1418	1378	1334	1232	1224	1097	990	991						
16	1370	1419	1378	1335	1232	1224	1098	992	992						
17	1371	1416	1378	1338	1233	1222	1100	997	991						
18	1370	1417	1377	1338	1230	1220	1100	996	991	1350	1194	1081	1082		

Measured temperature values in control points of glass furnace - (Kristal - [illegible]ernil[illegible] Table 14

Manufactured glass m^2 and gas consumption m^3/24 hours

28.07.94

Contr. point / hour	1	2	3	4	5	6	8	9	10	centre cross	principal cross	left cross	right cross	2 M CTHKMO	3 M ГАЗ
7	1370	1418	1370	1338	1232	1228	1097	991	991	1349	1195	1082	1084		
8	1368	1416	1368	1338	1232	1228	1096	992	991						
9	1368	1416	1371	1338	1231	1228	1098	991	992					8 221	32 [illegible]
10	1365	1416	1375	1336	1230	1225	1095	992	990						
11	1365	1418	1376	1334	1230	1226	1096	993	992						
12	1369	1418	1370	1336	1231	1223	1096	992	992						
13	1368	1421	1377	1334	1230	1223	1098	991	990	1350	1195	1080	1082		
14	1366	1418	1377	1333	1230	1223	1096	990	990						
15	1369	1418	1378	1334	1231	1225	1098	990	992						
16	1370	1416	1378	1335	1232	1224	1098	991	990						
17	1375	1417	1379	1335	1232	1223	1100	992	991						
18	1370	1417	1377	1336	1230	1220	1100	996	991	1351	1195	1080	1081		

Measured temperature values in control points of glass furnace - (Kristal - Tchnik) Table 15

Manufactured glass [illegible] and gas consumption m^3/24 hours

Contr. point / hour	1	2	3	4	5	6	8	9	10	centre cross	principal cross	left cross	right cross	[illegible]	[illegible]
7	1370	1419	1378	1337	1231	1228	1096	990	990	1350	1194	1080	1083		
8	1369	1417	1370	1339	1234	1227	1097	992	991						
9	1372	1416	1372	1338	1231	1228	1099	991	993					7 633	32 [illegible]
10	1365	1418	1374	1337	1230	1225	1095	992	990						
11	1364	1419	1376	1334	1230	1228	1096	994	992						
12	1370	1416	1370	1335	1231	1223	1096	992	992						
13	1369	1420	1377	1334	1232	1222	1099	991	992	1351	1196	1082	1081		
14	1368	1416	1376	1335	1230	1223	1096	990	990						
15	1369	1416	1378	1334	1231	1224	1097	991	993						
16	1370	1416	1379	1336	1233	1223	1098	992	990						
17	1375	1417	1379	1336	1232	1223	1100	993	991						
18	1371	1416	1376	1337	1230	1221	1097	995	992	1349	1194	1079	1082		

Table 16

Measured temperature values in control points of glass furnace - (Kristal - Per...k)

Manufactured glass m^2 and gas consumption m^3/24 hours

Contr. point / hour	1	2	3	4	5	6	8	9	10	centre cross	principal cross	left cross	right cross	[illegible]	[illegible]
7	1372	1420	1379	1338	1232	1229	1099	990	991	1350	1194	1081	1082		
8	1370	1418	1369	1339	1233	1228	1097	992	991						
9	1371	1416	1370	1338	1231	1228	1099	993	993					9 932	33 712
10	1369	1418	1375	1338	1230	1225	1097	992	991						
11	1366	1419	1376	1334	1230	1225	1096	994	992						
12	1369	1418	1370	1336	1231	1222	1097	993	992						
13	1369	1419	1377	1334	1232	1222	1099	991	992	1352	1195	1081	1083		
14	1368	1416	1376	1336	1232	1221	1096	990	992						
15	1367	1416	1377	1334	1231	1224	1097	992	993						
16	1370	1418	1379	1337	1232	1223	1099	992	992						
17	1376	1418	1380	1336	1232	1224	1099	993	991						
18	1371	1417	1377	1338	1231	1222	1097	996	992	1349	1196	1078	1081		

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Table 17

Measured temperature values in control points of glass furnace - (Kristal - Pernik)

Manufactured glass m^2 and gas consumption m^3/24 hours

31.07.94

Contr. point our	1	2	3	4	5	6	8	9	10	centre cross	principal cross	left cross	right cross	m^2 стъкло	m^3 газ
[illegible]	1371	1419	1378	1337	1231	1228	1098	990	990	1351	1192	1082	1083		
[illegible]	1370	1416	1370	1339	1232	1228	1097	993	991						
[illegible]	1371	1416	1370	1337	1231	1227	1098	995	992					8 834	31 715
10	1370	1418	1374	1338	1230	1225	1097	992	991						
11	1366	1418	1375	1334	1230	1225	1098	996	994						
[illegible]	1370	1418	1370	1336	1231	1223	1096	995	992						
[illegible]	1369	1418	1376	1334	1230	1222	1096	993	994	1363	1194	1077	1069		
14	1369	1416	1370	1336	1232	1223	1096	993	992						
15	1369	1416	1370	1335	1230	1224	1097	994	996						
16	1370	1416	1378	1337	1232	1223	1095	992	992						
17	1378	1417	1375	1338	1230	1224	1095	995	994						
18	1370	1418	1376	1337	1230	1223	1096	997	992	1371	1194	1077	1065		

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The third question connected with the quality of the sheet glass and the economy of fuel is glass thickness control. Now this control is fulfilled manually over the ready production. This prolongs the time for reaction and setting up of the rollers of the drawing machine. The operational staff prefers to operate with surplus tolerances for the glass band thickness (in the frame of the standard) which ensures more reliable operation of the machines but is accompanied with overconsumption of glass mass. A system for automatic control of the glass band thickness will eliminate the above mationed problems and will ensure continuously high quality of the production. Such system will permit a production of 2 mm glass to be organized and to prepare the conditions for auto glass „Triplex" production, as well as other specific glass production. Implementation in operation of the system grants a minimum 5-7% economy of natural gas.

Considering the operation of the glass furnace „Furco" it's clear that by relatively small investments for implementation of a new system for temperature measurement, system for control of over pressure in the furnace and a system for control of glass band thickness economy of 8-10% natural gas can be realized.

4. Heat engineering measurements and heat balance of glass furnace "Furco"

After some observations and delivering of statistical data for the operation of the furnace some heat engineering measurements needed for heat balance were made. The air distribution trough the different section, gas analysis and the fluid temperatures were the subjects of main attention.

The total quantity of air supplied to the furnace as well as separate section quantities are measured. In the same points where the air flow is measured air temperature is measured also. The measurements are made by the specialized devices furnished by USAid for energy efficiency purposes. The scheme of the measurement points of air flow and air temperature are represented in Fig.5. The multiple repetitions of measurements in the indicated points shows high rate of homogeneity of the stream i.e. the section for measurements are rightly chosen and the results are reliable.

In parallel with the air measurements an outlet gas analysis was made. The scheme for disposition of the gas analysis points is represented in Fig.6. The gas analysis is realized in every section in two points for everyone of the section sides, in input and outlet of the regenerator. The measurements are made by portable gas analyzer „BACHARACH". Separately one gas analysis for total quantity before the vexel appliance is made. In this way the operation of every section and all furnace can be checked.

All measurements are made in continuos mode of furnace operation. For the period of experiments the forth section of the furnace was not included in

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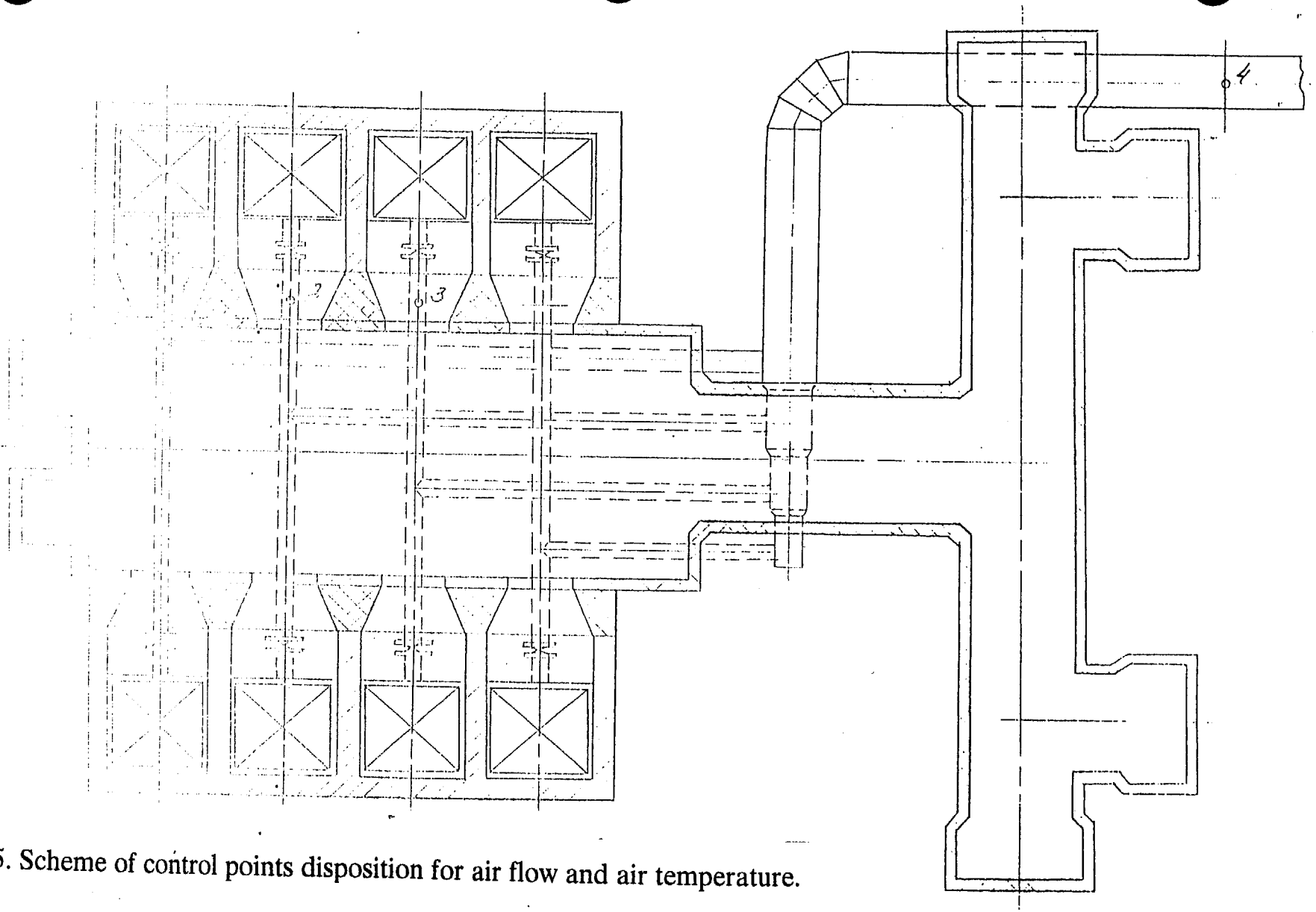

Fig.5. Scheme of control points disposition for air flow and air temperature.

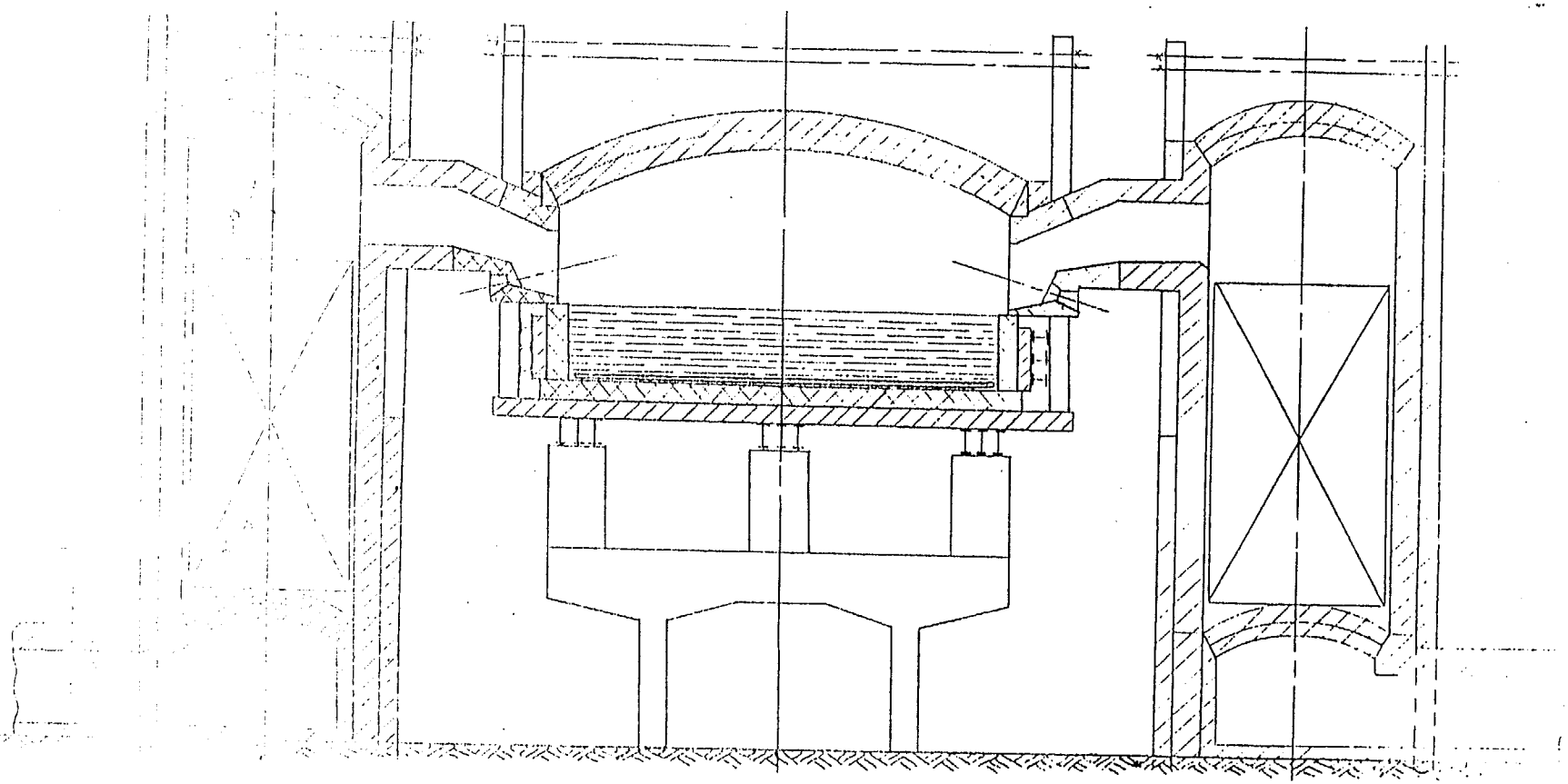

Fig. 6. Scheme of disposition of control points for gas analysis.

operation. The practice established that in this way are ensured better conditions for elevate drawing of glass band.

The results of air measurements for two characteristic experiments are represented in the following table:

date	measurement points	air pipe diameter [mm]	average stream velocity [m/s]	Temperature [°C]	air flow [m^3/h]
11.29.94	total air air I section air II section air III section	900 480 480 480	9.78 2.62 24.60 6.48	22 22 22 22	24197 1845 17321 4563
11.30.94	total air air I section air II section air III section	900 480 480 480	10.16 2.33 25.44 4.64	22 22 22 22	25138 1640 17912 3267

From the presented results is clear that the air flow on the separate burners is unevenly distributed independently from their heat power. For the same period of measurement by the mounted on the furnace gas meters was measured the gas flow to the separate sections which is:

date	11.29.94	11.30.94
I section	280 m^3/h	320 m^3/h
II section	400 m^3/h	400 m^3/h
III section	590 m^3/h	590 m^3/h
Total	1270 m^3/h	1310 m^3/h

One rough comparison between the real measured air quantities and theoretic needed quantities shows, that to the first section was supplied hardly half of the needed quantity of air, while to the second section is passed four times more than the theoretic quantity and for the third section - 1.5-2 times less. This predetermines one badly organized burning process in the volume of the furnace, which was affirmed by gas analysis of the outlet gases. It's obvious that in the flame furnace space a redistribution exists between the quantities of natural gas and the air entered through the separate sections. On the other hand as all in the furnace is passed 1.8 times more quantity of air than the theoretic needed for the burning which predetermines the overconsumption of natural gas.

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The construction of air pipes to the separate sections don't permit control of the air flow to them. That's why the ratio air-fuel would be regulated in some limits by decreasing or increasing the natural gas quantity. Most expedient way in the occasion is one correction of the ratio air/fuel by decreasing the total air quantity for burning. Constructive changes in the system for receiving and distribution of the air are not possible now, because one such action needs shut down of the furnace. After consultation with the operational staff one correction in the air mode is necessary. The accomplished gas analysis on the separate sections affirms the high difference in the burning process along the furnace. The excess combustion air coefficient on the different sections was changing and the alone explanation of that fact is an intensive redistribution of the air and the fuel in the furnace. The measured α values on the sections are:

I section $\alpha=1.45$
II section $\alpha=1.02$
II section $\alpha=1.29$

Those values don't correspond to direct calculated values given in the following table:

Section	α as ratio of measured natural gas and air	α measure by gas analyzer
I section	0.66	1.45
II section	4.33	1.02
III section	0.77	1.29
IV section	not in operation	not in operation

It's obvious that the furnace process are accompanied by internal for the furnace redistribution of fuel, air and furnace gases.

The measurements of smoke gases before the vexel appliance give expressions for the burning process and defined the efficiency of operation. The measured values are:

$\alpha_{outlet\ gases}=2.25$ and $t_{outlet\ gases}=570°C$

From here can be defined the losses with outlet gases defining the efficiency of the furnace (The proposals for more detailed investigations for the burning process and reconstruction of burners and air distribution will be made after signing of additional contract).

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6. Implementation of system for measurement and control of the temperatures in the furnace

It is obvious from the analysis of the furnace operation that the primary and most important task for the improvement of its operation is ensuring temperature control in the different zones and keeping it in stringent limits. This will grant on one hand fuel savings and on the other hand will increase the quality of the sheet glass.

After market investigations the consultants propose the use digital recorder model MCR-412/A007-00 manufactured by „Barber Coleman" - USA.

The proposed recorder is unified recorder with 32 inputs. The presentation of the data can be made in text format as well as in graphics. The device is universal because it can show not only temperatures but other different parameters as well. The constructed on the base of microprocessor MCR6 corresponds of the highest requirements for operation of industry conditions. It is easy for use and reliable in operation.

REL proposes the digital recorder to be used not only for temperature control but for other control systems as control of the pressure of gases inside the furnace, control of the excess of air etc. Its possibilities permit it.

The company „Risk Engineering" which is the consultant of Kristen participated in procurement of MCR6 funded by USAid. The company was advised and supported in all activities connected with the energy saving measures in Crystal by RCG/Hagler, Bailly Inc. REL uses the opportunitiy to thank the co-operation in realization of the first phase of the project and for the delivery of MCR6

Protocol

On the base of the signed Contract #28/94 between Risk Engineering Ltd (Sofia) and Crystal Pernik a commission by:

1- Kamen Radivoev REL
2. Iordan Iliev Crystal Pernik
3. Mitko Stoianov Chief of department „Sheet Glass"

Accepted after 72 hours operation delivered and mounted in department „Sheet Glass" recorder „Barber Coleman" delivered by „Risk Engineering" on the program Energy Efficiency - USAID.

The device is in complete functional availability. The commission has not remarks. It recommends one careful observation of device operation in the grantee period.

Commission:

07.12.95

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5. Expected economical results

1. Implementation of temperature recorder MCR-6
   economy 2%
   quality of the glass

2. System for cooling water temperature control for glass band coolers
   economy 2%

3. System for measurement and control of the glass band thickness by laser beam.
   economy 5÷7%
   thickness of glass $\leq$2mm

4. Restoration of normal operation of the pneumatic actuators and the all system of pneumoautomation by mounting of new oilless compressors
   economy 2%
   quality of the glass

For calculation of expected economical results we proceed from the assumption that:

- average annual consumption of natural gas of the furnace „Furco" is 8.5 $x10^9$ m^3/y
- natural gas price at the end of 1994 is 100\$/ $x10^3$ m^3

The complex effect from the realization of the different technical solutions in general consists of two parts:

- clear economical part represented by fuel economy which can be substantiated and calculated
- sheet glass quality improvement or discovering of possibilities for production of new kinds of glass (for example: with thickness less than 2 mm), which is difficult to express by economical effect.

We are focusing our attention to the first part

1. The engineering estimation for the first technical solution (improvement of the temperature control in the furnace give as economy of natural gas 2%). Therefore the annual economy at one average furnace load will be:

$C_1 = 8500 m^3/y \cdot 0.02 \cdot 100\ \$/10^3\ m^3 = 17000\ \$/y$

2. The realization of the system for cooling water temperature control for glass band coolers by improvement of the temperature mode and decrease of the waste will give economy accordingly the expert estimation of minimum 2%.

The average annual savings will be

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

Prepared for USAID and RCG/Hagler Bailly

Plant name: KRYSTAL PERNIK LTD

Address: 2300 PERNIK, BULGARIA

Auditor's name: YORDAN KATZAROV, "BRISK ENGINEERING" LTD

Report Date: 24.07.1995

ACTION NO. AND BRIEF DESCRIPTION: I. Installation of a new multipoint digital recorder

AREA OF THE PLANT AFFECTED: Glass furnace type Furco

FINDINGS CONCERNING EXITING CONDITIONS: The measurment of the temperatures in the furnace is very important for the consumption of the natural gas and for the quality of the glass. The existing way of measurement give wrong indication and doesn't permit automation of the technologic process.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY

It's recommended the old way of incorrect measurement to be changed and for this purpose to be implemented new multipoint digital recorder which has enough possibilities for input signals of the existing thermocouples.

This will allow stabilization of the burning process and saving of energy(natural gas)

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost $/year
	Peak kW	Energy MWh/year	Gas 10^3 m³/year			
Baseline - exiting conditions			8500			
After recommended action			8330			
Net reduction			I70			I7000 (a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost $	Notes
Engineering design	3000	
Equipment procurement	8000	
Equipment installation	500	
Equipment commissioning		
TOTAL INSTALLED COST	II500	(b)

Estimated increase in annual (non-energy) operations and maintenance coast: I000 (c)

PAYBACK PERIOD: $\frac{(b)\ \text{II500}}{(a)\ \text{I7000} - (c)\ \text{I000}} = 0{,}72$ years

RECOMMENDED IMPLEMENTATION SCHEDULE:

I. Observation of implement operation during warrantly period

2. Determination of real energy (natural gas) saving

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

Prepared for USAID and RCG/Hagler Bailly

Plant name: KRYSTAL PERNIK LTD

Address: 2300 PERNIK, BULGARIA

Auditor's name: [illegible]

Report Date: [illegible]

ACTION NO. AND BRIEF DESCRIPTION: [illegible]

AREA OF THE PLANT AFFECTED: [illegible]

FINDINGS CONCERNING EXITING CONDITIONS: [illegible]

RECOMMENDED ACTION TO IMPROVE EFFICIENCY

Replace existing compressors with a new ~~oilless~~ screw air compressor one, which is economical and reliable in operation. At the moment there are 3 compressors at the plant, although only one is necessary.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost $/year
	Peak kW	Energy MWh/year	oil $/year	water $/year	mainten. $/year	
Baseline - exiting conditions	185					
After recommended action	115					
Net reduction	70	560	4290	9290	2000	28300 (a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost $	Notes
Engineering design	7500	
Equipment procurement	48000	
Equipment installation	1300	
Equipment commissioning		
TOTAL INSTALLED COST	56800	(b)

Estimated increase in annual (non-energy) operations and maintenance coast: 4800 (c)

PAYBACK PERIOD: $\frac{(b)\ 56800}{(a)\ 28300 - (c)\ 4800} = 2{,}42$ years

RECOMMENDED IMPLEMENTATION SCHEDULE:

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

Prepared for USAID and RCG/Hagler Bailly

Plant name: KRYSTAL PERNIK LTD

Address: 2300 PERNIK, BULGARIA

Auditor's name: YORDAN KATZAROV, "RISK ENGINEERING" LTD

Report Date: 11.07.1995

ACTION NO. AND BRIEF DESCRIPTION: [illegible]

AREA OF THE PLANT AFFECTED: Four machines [illegible]

FINDINGS CONCERNING EXITING CONDITIONS: The [illegible] cooling of glass bond is of great importance for the quality of the glass. For this purpose there must be very strict control on the temperature of input and output water. At the moment this is being done manually and periodically depending on the qualification of the master workman.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY

Install systems for automatic control of the cooling water temperature on each four of the pulling machines.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost $/year
	Peak kW	Energy MWh/year	Gas $10^3 m^3$/year			
Baseline - exiting conditions						
After recommended action						
Net reduction			170			17000 (a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost $	Notes
Engineering design	1200	
Equipment procurement	3200	
Equipment installation	800	
Equipment commissioning		
TOTAL INSTALLED COST	5200	(b)

Estimated increase in annual (non-energy) operations and maintenance coast: 400 (c)

PAYBACK PERIOD: $\frac{(b)\ 5200}{(a)\ 17000 - (c)\ 400} = 0,32$ years

RECOMMENDED IMPLEMENTATION SCHEDULE: 1. Install the systems on the four machines by the end of 1995, as the results from the operation of the already installed experimental system are very good.

2. Estimate real savings of natural gas

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

Prepared for USAID and RCG/Hagler Bailly

Plant name: KRYSTAL PERNIK LTD

Address: 2300 PERNIK, BULGARIA

Auditor's name: YORDAN KATZAROV, "RISK ENGINEERING" LTD

Report Date: 14.07.1995

ACTION NO. AND BRIEF DESCRIPTION: [illegible] of the thickness of the [illegible]

AREA OF THE PLANT AFFECTED: Four machines for glass pulling

FINDINGS CONCERNING EXITING CONDITIONS: The Bulgarian standard allows large-scale diversions in glass thickness. This leads to over-consumption of glass material (natural gas). Uninterrupted and precise measuring of the quality and realise direct saving of natural gas. At the moment measurements on the finished product are taken manually.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY It is necessary to install on each of the four machines systems for uninterrupted measuring of moving glass band. Systems based on laser sensors are most suitable & precise.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost $/year
	Peak kW	Energy MWh/year	Gas $10^3 m^3$/year			
Baseline - exiting conditions						
After recommended action						
Net reduction			765			76500 (a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	2700	
Equipment procurement	39200	
Equipment installation	1200	
Equipment commissioning		
TOTAL INSTALLED COST	43100	(b)

Estimated increase in annual (non-energy) operations and maintenance coast: 4900 (c)

PAYBACK PERIOD: $\frac{(b)\ 43100}{(a)\ 76500 - (c)\ 4900} = 0,60$ years

RECOMMENDED IMPLEMENTATION SCHEDULE: Apply for help from international banks (funds) for preferential financing of the project, as the plant has no resourses .

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C_2=17000 $/y

3. The realization of system for measurement and control of the glass band thickness by laser beam will permit one thickness for example of 2 mm. Now the Bulgarian standard permits nominal thickness of 2 mm, the real value to be in the limits of 2±0.15 mm, which is used by the operational staff in the plus tolerances for ensuring more reliable operation of the drawing machines.

In this occasion overconsumption of glass mass will be

$\Delta=0.15/2\cdot100=7.5\%$

respectively same procents of natural gas.

By the system which ensures nominal thickness or even possibilities for operation with minus tolerances can be realized as minimum 7.5% savings of natural gas.

$C_3=8500\cdot10^3\ m^3/y\cdot0.075\cdot100\$/10^3\ m^3=63750\$/y$

4. The restoration of the pneumoautomation device operation by mounting of special oilless compressors will permits the faults of the devices and the troubles in the modes of the furnace connected with the operation of those devices to be avoided. The savings by that measure are estimated as minimum 2%.

The average annual economy will be:

C_4=17000 $/y

NOTE: The more detailed proposal for modernization of the supply of air to control system is made in „Proposal for participation in the second phase of the program of USAid - Energy Efficiency in Bulgaria". This proposal was made by „Risk Engineering Ltd" for the needs of Crystal Pernik.

The total annual economy from the considered technical solutions for the glass furnace „Furco" will be:

$C=C_1+C_2+C_3+C_4=17000+17000+63750+17000=114750$ $/y

The expected total expenses for realization of the proposed measures are:

$E=E_1+E_2+E_3+E_4=8000+2500+14500+45000=70000\$$

The payback period of the investments is:

$PB=E/C\cdot12=7.3$ months

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УТВЪРДИЛ,
УПРАВИТЕЛ:
/инж.Кр.Божков/

П Р О Т О К О Л

Въз основа на сключен договор № 28/94 г. между "Кристал-Перник" ЕООД - гр.Перник и "Риск-инженеринг" - гр.София, комисия в състав:

1. Камен Радивоев - РИСК
2. Йордан Илиев - "Кристал-Перник" ЕООД(
3. инж.Митко Стоянов - н-к цех "Плоско стъкло" в "Кристал" ЕООД,

след 72-часова проба прие доставеният и монтиран в цех "Плоско стъкло" измерителен прибор "Барбер-Колеман", доставен от "Риск-инженеринг" по линия на Американската програма за помощ в областта на ефективното използване на енергийните ресурси.

Комисията няма забележкипо годността и функциите на прибора. Същата препоръча да продължи наблюдението до края на гаранционния срок.

КОМИСИЯ: 1. .....

2. .....

3. .....

12.07.1995 г.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

KMH Belovo - AD

by

Nikola Stankov, CEM

Rampov & Son Co.

for

Hagler Bailly Consulting, Inc.

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ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	KMH BELOVO- AD
Address	Belovo - KMH BELOVO / Bulgaria
Telephone	(+359-903481) 2105 / oper.387
Fax	(+359-903481)
Contact Person	Eng. Borislav Zlatanov
Title	Chief of Energy and Power Departement
Telephone	(+359-903481) 2105 /oper.387

2. Energy auditor information

Dates - audit started: 01.02.1994 audit completed: 31.05.1994

Energy audit company	RAMPOV & SON Co.
Energy audit team leader	Eng. Nikola Stankov - Ph.D., CEM
Address	1612 Sofia , Smoljanska Str. 3 , Bl.56/V/49ap.
	Bulgaria
Telephone	(+359-2) 545895
Fax	(+359-2) 545895

E-mail: atanas.ivanov@infolink.infotel.bg

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3. Energy audit information

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

Boiler Departement ;

Makeup Water Supply ;

Steam and Condensate Systems;

HVAC System ;

Paper Machines and Technologies ;

Compressed Air System.

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

1. Bad maintenance of Steam and Condensate Systems.
2. Low Condensate Recovery Rate.
3. Absence of Steam , Heat and Makeup Water Flow Measurements.
4. Low Rate of Control and Operational communication.
5. Low Energy Efficiency due to some differences in operation Schemes from Designed.
6. Significant Losses in the Compressed Air System.

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

1. We have got acquainted with a new industrial technology - the paper production.
2. The usage of modern measuring equipment (purchased by USAID) is helped us signifficant.
3. New sophisticated approach to the energy audit.

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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

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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:					
Tissue	35107	15534	22652	23118	tons/year
Energy:					
heavy fuel oil:	20040	14440	17900	18000	tons/year
diesel fuel oil:					
natural gas:					
coal:					
electricity:	65013	41155	49326	46950	MWh/year
steam:					
other (describe):					
Energy/Production index:					
thermal	5.423	8.831	7.507	7.397	Gcal/ton
electrical	1.852	2.649	2.178	2.031	MWh/ton

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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:	160.10^6	115.10^6	143.10^6	144.10^6	leva/year
diesel fuel oil:					
natural gas:					
coal:					
electricity:	55.10^6	35.10^6	42.10^6	40.10^6	leva/year
steam:					

other (describe):

Remark: In the calculation are used the recent energy prizes. (July, 1994)

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:

Reconstruction of one high pressure boiler and its burners for operation with new fuel - natural gas. The burners (4 pcs.) are with high efficiency, and automatic control of air-fuel ratio.The aproximate cost of the project is about USD 200 000. Own and goverment funding.

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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:

There were some difficulties with the fuel supply and with the sales during the observed period , especially in 1990 and 1991 . The low energy efficiency , identified in the audit is due to the low energy prizes during the previous years and the absence of a real host of the plant.

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FUEL, STEAM OR HEAT ENERGY CONSUMPTION – 12 MONTH AUDIT PERIOD
'ERGY TYPE: Heavy fuel oil
'pared for USAID and RCG/Hagler Bailly

Plant name: KMH BELOVO AD
Address: Belovo , Bulgaria
Auditor's name: N. Stankov , G. Rampov
Report date: July, 1994
Supply contract terms:

Fuel or heat supply company's name	
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 = tons	Thermal Consumption GJ	Total Cost BGL * 10^6	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index GJ per: ton	Notes on plant conditions and changes
Jan/31/93	2100	55 363	16.8	682	41	17	Thermal consumption includes:
Feb/28/93	1900	51 564	15.2	504	38.1	16.8	-Paper Technology ; +
Mar/31/93	1800	46 059	14.4	403	39.2	17.1	-HVAC .
Apr/30/93	1650	45 414	13.2	176	38.1	17.1	
May/31/93	1200	31 633	9.6	–	–	15	
Jun/30/93	1100	26 759	8.8	–	–	16.6	
Jul/31/93	1250	35 444	10.	–	–	15.8	
Aug/31/93	1100	32 750	8.8	–	–	15.6	
Sep/30/93	1100	33 276	8.8	–	–	17.1	
Oct/31/93	1200	31 171	9.6	32.	34.1	15.8	
Nov/30/93	1700	45 477	13.6	360	36.3	15.5	
Dec/31/93	1900	51564	15.2	651	34.4	16.5	
TOTAL	18 000	486 474	144	2808	–	–	

Note: Heating degree-days based on reference temperature of 19 C

STEAM GENERATION – 12 MONTH AUDIT PERIOD
epared for USAID and RCG/Hagler Bailly

Plant name: KMH BELOVO
Address: Belovo- Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

Boiler characteristics

Name/number	PK-35/N1	KM12 / N1	KM12 / N2	PK-35 / N2	PKM12 / N3
Manufacturer	Boiler Plant-Sof	Boiler Plant-Sofia	Boiler Plant-Sof	Boiler Plant-Sof	Boiler Plant-Sofia
Type (firetube/watertube)	watertube	firetube	firetube	watertube	firetube
Type (saturated/superheated)	superheated	saturated	saturated	superheated	saturated
Capacity (tons/hour)	35 t/h	12 t/h	12 t/h	35 t/h	12 t/h
Year installed	1968	1973	1977	1970	1984
Year last major overhaul	1991	1992	1988	1994	1994
Operational? (yes/no)	yes	yes	yes	no	no
Steam pressure	22 bar	8,5 bar	9 bar	–	–
Steam temperature	250 °C	173 °C	176 °C	–	–
Stack temperature, after economizer	154 °C	194 °C	197 °C	–	–
Stack gas analysis percent O2	12,3 %	11,4 %	11,1 %	–	–
Combustion efficiency:	87,6 %	86,1 %	86,3 %	–	–
Blowdown analysis, dissolved solids PPM	–	–	–	–	–

STEAM GENERATION DATA FOR 12-MONTH AUDIT PERIOD:

STEAM GENERATION BY PLANT — no IMPORTS — STEAM SALES AND DISTRIBUTION TO CONSUMERS:

Meter Reading Mo/day/yr	Fuel Consumption GJ	Steam Generation tons	Steam Generation GJ	Monthly Efficiency %	[redacted] HVAC GJ	Old machine GJ	Russian machines B34+B34 GJ	VOITH 1 GJ	BELOIT GJ	VOITH 2 GJ	Deinking GJ	Losses & Unaccounted GJ
Jan/31/93	83511	29491	72922	66,3	27956	1141	3448	1979	3951	14843	2043	28148
Feb/28/93	75557	26682	65976	68,2	19194	1880	3486	3726	4940	15307	3032	23993
Mar/31/93	71580	25278	62504	64,3	15832	1843	2923	1825	7107	14270	2260	25521
Apr/30/93	65615	23171	57295	69,2	6719	1887	2288	5711	7815	18373	2627	20201
May/31/93	47720	16852	41669	66,3	873	1948	3121	2165	7895	13273	2358	16087
Jun/30/93	43744	15448	38197	61,2	874	1593	2745	567	6968	11755	2257	16985
Jul/31/93	49709	17554	43406	71,3	874	2060	–	4140	9854	15923	2593	14265
Aug/31/93	43744	15448	38197	74,8	873	1571	–	5442	7704	14690	2470	10994
Sep/30/93	43744	15448	38197	76,1	873	1675	–	2765	7932	16194	2581	10468
Oct/31/93	47720	16852	41669	65,3	1090	1912	–	909	7992	16452	2816	16549
Nov/30/93	67604	23874	59032	67,2	13063	1970	257	3694	7726	16550	2219	22127
Dec/31/93	75557	26682	65976	68,2	22395	1451	728	4063	6447	14229	2250	23993
TOTAL	715805	252780	625040	–	110616	20931	18996	36986	86331	181859	29506	229331

NOTES
Unusual Operating conditions

1. Losses include:
- auxiliary power supply to boiler and fuel Dpt.;
- leakages;
- heat losses from nonreturned condensate.

2. Monthly efficiency: Thermal/Fuel consumption, %

ENERGY TYPE: FUEL
ared for USAID and RCG/Hagler Bailly

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

Item No.	Equipment or Process Description	Maximum Load units:	Average Load units:	Load at Peak Demand units:	Energy Consumption units: GJ /year	Total Energy Cost BGL /year $\times 10^6$
1.	Paper Machine BELOIT				86 331	20.5
2.	Paper Machine VOITH - 1				36 986	8.8
3	Paper Machine B-37 A1 - russian				18 996	4.5
4.	Paper Machine B-34 - russian				—	—
5.	Paper Machine VOITH - 2				181 859	43.1
6.	Old Machine - Department N1				20 931	5.
7.	Deinking - Department				29 506	7.
8	HVAC - summer				4 367	1.
	- winter				106 244	25.2
TOTAL PEAK DEMAND						
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)					485 220	115.1

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

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

Electricity contract terms:

Electricity supply company's name
Contract maximum demand (kW):
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: ton	Notes on plant conditions and changes
Jan/31/93	2022900						1723511	1811.8	
Feb/28/93	4364909						3718902	1643.1	
Mar/31/93	4298090						3661973	1722.1	
Apr/30/93	4876260						4154574	1872.4	
May/31/93	4248750						3619935	1862.5	
Jun/30/93	3196130						2723103	1524.9	
Jul/31/93	4022040						3426778	1790.1	
Aug/31/93	4041030						3442957	2111.5	
Sep/30/93	3825980						3259735	1558.4	
Oct/31/93	3725060						3173751	2099.9	
Nov/30/93	4121040						3511126	2088.1	
Dec/31/93	4208000						3585216	2171.9	
TOTAL	46950189						40001558	2030.9	

Peak demand during audit period (kW):

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

Plant name. KMH BELOVO – AD
Address. Belovo – Bulgaria
Auditor's name. N.Stankov, G. Rampov
Report date. July , 1994

BASELINE – EXISTING CONDITIONS

		Thermal Consumption GJ/year	Thermal Consumption ton/year (water)	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption MWh/year	Total Energy Cost BGL /year $\cdot 10^6$
BASE CASE	Plant total consumption		12.5×10^6	486474		46975	184

1 $ = 55 BGL

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS:

Action No.	Action Description	Thermal Consumption GJ/year	Water Consumption t /year	Thermal Consumption GJ/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost BGL /year	Action Project Cost	Action Payback Period (years)
1.	Steamflow meter for firetubeboilers							$4300	≈2
2.	Makeupwater flowmeter							$1400	≈2
3.	Boiler blowdown wasteheat recovery system			12400			2200000	$6000	0.15
4.	Level control-condensate stor. tank		4000				80000	$600	0.41
5.	Compressed air saving		480000	1390		3600000	17600000	$2700	0,08
6.	Gas/heavy oil burners for firetube boilers						2000000	$50000	1,4
7.	Makeup water preheating			42200			10000000	$125000	0,69
8.	Condensate recovery		18850	1277			680000	$7500	0.61
9.	Improvement of pressure reducing valves							$52000	~3
10.	BELOIT – technical water heater		3660	9300			1993000	$10	~0
11.	BELOIT & VOITH 2 cylinder flashsteam loss		7000	18000			3600000	–	0
12.	Paper machines steam control valves loss		5400	17200			4000000	$22000	0,3
13.	VOITH 1-heat recovery system overhaul		5900	22700			5500000	$60000	0.6
14.	Paper machines waste heatexchengers			15112			3600000	$41000	0.63
TOTAL SAVINGS			$0,525 \cdot 10^6$	139579		3600000	51260000		
SAVINGS AS PERCENTAGE OF BASE CASE			4,2%	28,7%		7,67%	27,86%		

Note: Assumes that the actions are taken in order of best payback period first, n 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

Plant name: KMH BELOVO - AD
Address: Belovo- Bulgaria

Auditor's name: N.Stankov, G.Rampov

Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*1 Steamflowmeter for firetubeboilrs

AREA OF THE PLANT AFFECTED: The whole Plant

FINDINGS CONCERNING EXISTING CONDITIONS:

There is only one steam flowmeter installed in the Paper Mill - at PK 35 (35 t/h boiler). It is not possible to make a heat balance or to evaluate an energy efficiency action.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Installing a steamflowmeter at the firetubeboilers, it will be possible to meassure continuously the total steamflow generated from the powerdepartment and on that way to start to evaluate any energy efficiency actions.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Can not be predicted.

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam		Total cost /year
Before –existing conditions					
After recommended action					
Net reduction					(a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:		Cost	Notes
Engineering design	USD	500	
Equipment procurement	USD	3300	
Equipment installation	USD	500	
Equipment commisssioning		–	
TOTAL INSTALLED COST	USD	4300	(b)
Estimated increase in annual (non–energy) operations and maintenance cost			(c)

PAYBACK PERIOD: b: / (a – c) = approx. 2 years

RECOMMENDED IMPLEMENTATION SCHEDULE:

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

ACTION NO. 2

Plant name: KMH BELOVO – AD
Address: Belovo – Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*2 Makeup water flowmeter

AREA OF THE PLANT AFFECTED: Power Department

FINDINGS CONCERNING EXISTING CONDITIONS:

Until now the makeup water flow has been measured by the capacity and operation time of the makeup water pumps , filling the makeup water tank. This kind of measurment is very unaccurate and the mass and heat balances are also unaccurate.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To install a makeup water flowmeter. That will give the opportunity, combined with the proposed steamflowmeter, to make a mass and heat balance of the Plant and to estimate the condensate recovery rate – which increasing is one of the major energy efficiency actions.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Can not be predicted

	Electricity		Fuels, heat and steam:			Total cost
	Peak kW	Energy MWh/year				/year
Baseline – existing conditions						
After recommended action						
Net reduction						(a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:		Cost	Notes
Engineering design	USD	100	
Equipment procurement	USD	1200	
Equipment installation	USD	100	
Equipment commisssioning		–	
TOTAL INSTALLED COST	USD	1400	(b)
Estimated increase in annual (non–energy) operations and maintenance cost			(c)

PAYBACK PERIOD

$$\frac{b}{a - c} = \text{approx. } 2 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

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

ACTION NO. 3

Plant name: KMH BELOVO – AD
Address: Belovo – Bulgaria

Auditor's name: N.Stankov , G.Rampov

Report date: July , 1994

ACTION NO. AND BRIEF DESCRIPTION: No*3 Boiler blowdown wasteheat recovery system

OF THE PLANT AFFECTED: Power Department

FINDINGS CONCERNING EXISTING CONDITIONS:

According to the designed scheme, the boiler blowdown waterheat has to be recovered by a steamflashtank and a condensate cooler. The necessary control equipment is not functioning, the flash tank is in a good condition, but not operating, due the control devices.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To install a level control system for the blowdown flash tank.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Reduction of the heat losses	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost
			GJ/y	BGL/year
f e –existing conditions			12400	2.2×10^6
After recommended action			–	–
Net reduction			12400	2.2×10^6 (a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE		Cost	Notes
Engineering design	USD	1000	
Equipment procurement	USD	3000	
Equipment installation	USD	2000	
Equipment commisssioning		–	
TOTAL INSTALLED COST	USD	6000 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost		(c)	

PAYBACK PERIOD

$$\frac{b\ \text{USD } 6000}{\text{BGL } 2.2\times10^6\ c\ -} = 0.15 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE

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

ACTION NO. 4

Plant name: KTH BELOVO – AD
Address: Belovo – Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*4 Level control system for condensate storage tank

OF THE PLANT AFFECTED: Power Department

FINDINGS CONCERNING EXISTING CONDITIONS: There is a condensate storage tank feeding the boilers. It is fed by the continuously recovering condensate from different steam consumers and the boiler makeup water. On the last line there is only a handcontrol valve. Often happens the tank overflows.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To install a level control system acting on the makeup water inlet to the storage tank. All recovered condensate can be used and some of the makeup water can be saved.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Makeup water saving	Electricity Peak kW	Electricity Energy MWh/year	Water t/y	Fuels, heat and steam	Total cost BGL /year
E e – existing conditions			4000		80000
After recommended action			–		–
Net reduction			4000		80000 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:		Cost	Notes
Engineering design	USD	200	
Equipment procurement	USD	200	
Equipment installation	USD	200	
Equipment commisssioning		–	
TOTAL INSTALLED COST	USD	600 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost		(c)	

PAYBACK PERIOD:

$$\frac{b\ \text{USD}\ 600}{\text{BGL}\ a\ 80000 - c\ -} = 0.42\ \text{years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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

ACTION NO. 5

Plant name: KTH BELOVO - AD
Address: Belovo - Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*5 Compressed air saving

OF THE PLANT AFFECTED: The whole plant

FINDINGS CONCERNING EXISTING CONDITIONS: The installed pneumatic control equipment requires for its proper operation compressed air quantity delivered by 3-4 units, instead of 6 now, operating continuously.The big air losses are due to bad maintenance and moisture purging. The dryers are not functioning.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To install an air drying system based not on absorbing principle (like silicagel) but on mechanical one- based on centrifugal dryers and periodicaly drained receivers - automatic controled - in the comressor room and air drain traps on the supply lines.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Reduction of the air compressor power	Electricity Peak kW	Electricity Energy MWh/year	Water t/y	Fuels, heat and steam GJ/y	Total cost BGL/year
ne –existing conditions		3600	480000	13900	17.6×10^6
After recommended action		–	–	–	–
Net reduction		3600	480000	13900	17.6×10^6 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE		Cost	Notes
Engineering design	USD	2000	
Equipment procurement	USD	20000	
Equipment installation	USD	5000	
Equipment commisssioning		–	
TOTAL INSTALLED COST	USD	27000 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost		(c)	

PAYBACK PERIOD.

USD b 27000 / BGL a 17.6×10^6 c – = 0.084 years (1month)

RECOMMENDED IMPLEMENTATION SCHEDULE.

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

ACTION NO. 6

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria

Auditor's name: N.Stankov, G.Rampov

Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*6 Gas/heavy oil burner for firetubeboilers

AREA OF THE PLANT AFFECTED: Power Department

FINDINGS CONCERNING EXISTING CONDITIONS:

Existing heavy oil firetubeboiler burners are unefficient. There is no automatic control of fuel/air ratio, and abilities for gas operation.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: To put in operation at least one new gas/heavy oil burner with the following characteristics:

1) Improved efficiency due to automatic optimal fuel/air ratio operation;
2) Low auxiliary power consumtion (at least in the summer) when the Paper Mill will be gas supplied. Boiler PK 35/No2 (under reconstruction) is already equiped with such burners.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Improvement of boiler efficiency and heat&makeup water saving	Electricity		Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	t/y	GJ/y	BGL /year
Line – existing conditions			3500	1980	30×10^6
After recommended action			3340	–	28×10^6
Net reduction			160	1980	2×10^6 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:		Cost	Notes
Engineering design	USD	500	
Equipment procurement	USD	50000	
Equipment installation	USD	1000	
Equipment commisssioning		–	
TOTAL INSTALLED COST	USD	51500 (b)	

Estimated increase in annual (non–energy) operations and maintenance cost (c)

PAYBACK PERIOD:

$$\frac{\text{USD } b: 51500}{\text{BGL } a: 2\times10^6 - c: -} = 1.42 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

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

ACTION NO. 7

Plant name: KMH BELOVO – AD
Address: Belovo – Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*7 Makeup water preheating

OF THE PLANT AFFECTED: Paper Production and Power Department

FINDINGS CONCERNING EXISTING CONDITIONS:

The makeup water with input temperature about 12°C has to be preheated in boiler department with steam to abot 82°C. At the same time in the paper production and in the compressor room is a lot of wastheat available.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To manage a new way of the makeup water to the compressor room and the pressure reduction station for wasteheat preheating

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Heat & fuel saving	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: GJ/y	Total cost BGL /year
Before – existing conditions			42200	10×10^6
After recommended action			–	–
Net reduction			42200	10×10^6 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	USD10000	
Equipment procurement	USD75000	
Equipment installation	USD40000	
Equipment commisssioning	–	
TOTAL INSTALLED COST	USD 125000 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD:

$$\frac{\text{USD } b: 125000}{\text{BGL } a: 10\times10^6 - c: -} = 0.7 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

First implementation in compressure room

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

ACTION NO. 8

Plant name: KMH BELOVO – AD
Address: Belovo – Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*8 Condensate recpvery

OF THE PLANT AFFECTED: The whole plant

FINDINGS CONCERNING EXISTING CONDITIONS:

The condensate from the heavy oil heating and downloading systems is not returned . The same situation is in No1 (old machines) department and in the deinking department.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To install a condensate recovery pipesystem from this departments.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Heat & makeup water saving

	Electricity		Water/Fuels, heat and steam:		Total cost
	Peak kW	Energy MWh/year	t/y	GJ/y	BGL /year
ne – existing conditions			18850	1277	680000
After recommended action			–	–	–
Net reduction			18850	1277	680000 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:		Cost	Notes
Engineering design	USD	500	
Equipment procurement	USD	4000	
Equipment installation	USD	3000	
Equipment commisssioning		–	
TOTAL INSTALLED COST	USD	7500 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost		(c)	

PAYBACK PERIOD

$$\frac{\text{USD } b: 7500}{\text{BGL } a: 680000 - c: -} = 0.61 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

The highest efficiency is in the deinking department and the implementa on must start there.

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

ACTION NO. 9

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*9 Improvement of pressure reducing valves

OF THE PLANT AFFECTED: The whole plant

FINDINGS CONCERNING EXISTING CONDITIONS: There are 3 reducing valves used to obtain the operation steam pressures from the fresh steam 39 bar-RV 39/13, RV39/6 and RV6/1.5. The first two are not functioning properly, especialy in the temperature control function. RV6/1.5 is damaged.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To improve the efficiency and the quality of the production it is necessary to change the reducing valves with new.

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Can not be precalculated

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:			Total cost /year
Before –existing conditions						
After recommended action						
Net reduction						(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost	Notes
Engineering design	USD 1000	
Equipment procurement	USD 50000	
Equipment installation	USD 1000	
Equipment commisssioning	–	
TOTAL INSTALLED COST	USD 52000 (b)	

Estimated increase in annual (non–energy) operations and maintenance cost (c)

PAYBACK PERIOD

$$\frac{b}{a - c} = \text{approx. 3 years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE

RV 6/1.5 ; RV39/13 ; RV 39/6

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

ACTION NO. 10

Plant name: KMH BELOVO – AD
Address: Belovo – Bulgaria

Auditor's name: N.Stankov, G.Rampov

Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*10 Papermachine Beloit-technical water heater

OF THE PLANT AFFECTED: Paper machine Beloit

FINDINGS CONCERNING EXISTING CONDITIONS:

For the heating of technical water for washing is used direct condensing of flash steam from the cylinder condensate flash tank.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

For this purpose could be used flash steam from the atmospheric condensate tank , which is normaly vented to atmosphere. In future should be used not a direct condensing of the heating steam into the water , but a heat exchanger;

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Flash steam saving	Electricity Peak kW	Electricity Energy MWh/year	Water/Fuels, heat and steam: t/y	GJ/y	Total cost BGL /year	
The –existing conditions			3660	9300	2×10^6	
After recommended action			–	–	–	
Net reduction			3660	9300	2×10^6	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost	Notes
Engineering design	–	
Equipment procurement	–	
Equipment installation	USD 10	
Equipment commisssioning	–	
TOTAL INSTALLED COST	USD 10 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD

$$\frac{\text{USD } b.\ 10}{\text{BGL } a.\ 2\times10^6 - c.\ -} = \text{zero years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE

Not yet implemented.

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

ACTION NO 11

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria

Auditor's name: N.Stankov, G.Rampov

Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*11 Beloit and Voith2-cylinder flash steam losses

OF THE PLANT AFFECTED: Paper machines Beloid and Voith 2

FINDINGS CONCERNING EXISTING CONDITIONS:

Usualy the operators open the atmospheric ventvalve for flash steam from the c the cylinder condensate flash tank. So this flash steam instead to the thermocompressor flows to atmosphere.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Reducing the flash steam flow to the atmosphere to the technological minimum (approx. 10% from the now value).

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Flash steam saving	Electricity Peak kW	Electricity Energy MWh/year	Water t/y	Fuels, heat and steam: GJ/y	Total cost BGL /year
F e –existing conditions			7500	18700	4×10^6
After recommended action			500	1700	0.4×10^6
Net reduction			7000	17000	3.6×10^6 (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

$$\frac{b: -}{BGL\ a\ 3.6\times10^6 - c.\ -} = 0 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE

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

ACTION NO. 12

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria
Auditor's name: G.Rampov, N.Stankov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*12 Reduction of control,shutoff&drain valves leakages

OF THE PLANT AFFECTED: All paper machines

FINDINGS CONCERNING EXISTING CONDITIONS

Many of the steam control valves , the steam shut Off valves and the steam line drainvalves in the paper production are leaking. The same situation is at many steam line joints and flanges.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Change of same valves , glands packings and gaskets and better mainte - nance of the steam lines in the paper production .

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Reduction of steam leakages	Electricity Peak kW	Electricity Energy MWh/year	Water/Fuels, heat and steam: t/y	Water/Fuels, heat and steam: GJ/y	Total cost BGL /year
E e –existing conditions			5400	17200	$4x10^6$
After recommended action			–	–	–
Net reduction			5400	17200	$4x10^6$ (a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost	Notes
Engineering design	–	
Equipment procurement	USD 20000	
Equipment installation	USD 2000	
Equipment commisssioning	–	
TOTAL INSTALLED COST	USD 22000 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	(c)	

PAYBACK PERIOD

$$\frac{\text{USD } b\ 22000}{\text{BGL } a\ 4x10^6 - c\ -} = 0.3 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE

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

ACTION NO. 13

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria

Auditor's name: N.Stankov, G.Rampov

Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*13 VOITH1 heat recovery system general overhaul

OF THE PLANT AFFECTED: Paper machine VOITH 1

FINDINGS CONCERNING EXISTING CONDITIONS:

All flash tanks are not functioning , there are no steam traps installed, the control equipment is damaged.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Reconstruction of the heat recovery system to the designed operation Scheme .

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Reduction of the heat losses	Electricity Peak kW	Electricity Energy MWh/year	Water t/y	Fuels, heat and steam: GJ/y	Total cost BGL/year	
e –existing conditions			5900	22700	5.5×10^6	
After recommended action			–	–	–	
Net reduction			5900	22700	5.5×10^6	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE	Cost	Notes
Engineering design	USD 5000	
Equipment procurement	USD40000	
Equipment installation	USD15000	
Equipment commisssioning	–	
TOTAL INSTALLED COST	USD 60000	(b)
Estimated increase in annual (non–energy) operations and maintenance cost		(c)

PAYBACK PERIOD

$$\frac{\text{USD}_{\,b}\ 60000}{\text{BGL}_{\,a}\ 5.5\times10^6 \quad c\ -} = 0.6 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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

ACTION NO. 14

Plant name: KMH BELOVO - AD
Address: Belovo - Bulgaria
Auditor's name: N.Stankov, G.Rampov
Report date: July, 1994

ACTION NO. AND BRIEF DESCRIPTION: No*14 Rebuild of wasteheatexchangers in the paper productio

OF THE PLANT AFFECTED: All paper machines

FINDINGS CONCERNING EXISTING CONDITIONS:

Many of the heatexchangers using flash steam for heating technical water for washing or other tecnological purposes are not functioning or are cut off .

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To rebuild the system of heatexchangers and to recover the flashsteam - heat , not to purge it through the ventpipe .

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

Heat saving	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: GJ/y	Total cost BGL /year
ne –existing conditions			15112	3.6×10^6
After recommended action			–	–
Net reduction			15112	3.6×10^6 (a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE	Cost	Notes
Engineering design	USD 1000	
Equipment procurement	USD 30000	
Equipment installation	USD 10000	
Equipment commisssioning	–	
TOTAL INSTALLED COST	USD 41000 (b)	

Estimated increase in annual (non–energy) operations and maintenance cost (c)

PAYBACK PERIOD

$$\frac{\text{USD}\ b\ 41000}{\text{BGL}\ a\ 3.6\times10^6\ c\ -} = 0.63\ \text{years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE.

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

Lev, Gabrovo

by

Nikola Kaloyanov

Stoyan Nevenkin

Alpha-Pro

for

Hagler Bailly Consulting, Inc.

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ENERGY AUDIT REPORT

"LEVE" JOINT STOCK COMPANY

LEATHER PROCESSING PLANT

GABROVO , BULGARIA

Prepared for:

RCG/ Hagler, Bailly, Inc.

370 L'Enfant Promenade, S.W., Suite 700

Washington, D.C. 20024

Prepared by:

ALPHA - PRO Energy Consultants

Sofia

October 1994

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FOREWORD

This report presents the results of the detailed energy audit of the leather processing plant which belongs to the LEVE JSCo in Gabrovo, Bulgaria. The audit was performed by a team of consultants from ALPHA -PRO Energy Consulting Group, Sofia over the period from April 1 to May 30 1994.

The audit was performed as a part of a program funded by the United States Agency for International Development (USAID) to promote improved energy efficiency in the industrial sector of Bulgaria. The operation of this program was co-ordinated by the professional staff of the RCG/Hagler, Bailly, Inc.

The audit of LEVE JSCo is important to the audit program because the plant is one of the several Bulgarian leather processing plants. The energy conservation measures identified at LEVE can be applied advantageously to the other ones and thus to multiply the benefits for the country.

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ACKNOWLEDGEMENTS

The energy audit of the LEVE JSCo in Gabrovo was performed under a program sponsored jointly by:

- The United States Agency for International Development (USAID),

- The LEVE JSCo - G Ltd.

Technical assistance was provided by a team of consultants from RCG/Hagler, Bailly, Inc. ALPHA-PRO wishes to tank all the people at USAID, RCG/Hagler, Bailly, Inc. (especially to Mr. Mark Oven and Mr. Laurent Pommier) and Mr. Baev - Technical Director of LEVE JSCo that contributed to the success of this audit program. Everyone with whom we came in contact was supportive and co-operative working toward the common goal of improved energy efficiency in the Bulgarian industrial sector.

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EXECUTIVE SUMMARY

1. INTRODUCTION

This executive summary presents the findings, conclusions and recommendations resulting from the energy audit of the leather processing plant "LEVE" in Gabrovo, Bulgaria.

To identify the areas where energy savings can be made, ALPHA - PRO conducted both preliminary audit of the plant and detailed energy audits of the biggest energy consuming areas. Interviews with key plant personnel provided an understanding of LEVE's operations and help to identify major energy consuming equipment and systems. This led to testing of the key processes and evaluation of their operating efficiency.

2. PLANT BACKGROUND AND ENERGY CONSUMPTION

LEVE - Joint Stock Company is a state leather processing company.The company's plant consists of several departments, the largest one of which is Department 5 . As it was shown by the preliminary audit this department is the biggest energy consuming department of the plant. That is why the detailed energy audit was performed only for it.

The Department 5 operates two shifts five days per week, now operating between 55 and 65 % of the full capacity.

The annual production of the plant is approximately 56453352 dm2 of leather while the total energy consumption is about 1 344 000 kWh electricity and between 12 000 and 25 000 Gkal of steam. After the preliminary audit results discussion and following the local priorities for the plant, the detailed audit was directed especially to the steam consumption.

With energy prices due to continue rising in the coming years, LEVE can expect energy to become the most significant component of its production costs. The annual energy and utility consumption for the last three years is presented in the energy audit forms.

The plant is supplied with electricity by the National Energy Company and with steam by the Thermal Power Station of Gabrovo.

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3. SUMMARY OF SAVINGS

For the purpose of this summary, all the energy cost savings are calculated on the basis of local energy prices and labour costs.

The total annual energy savings identified as a result of this audit are about 4016 Gkal of steam and 50 000 m3 of water. The savings represent more than 33.9% savings in steam consumption.

The cost savings are 2 747940 lvs on local 1993 energy prices.

The investment required to implement the energy conservation program detailed in this report is 2 755 220 lvs. Nearly 50% of the savings are achievable by implementing housekeeping type projects with no outside financial assistance. The simple paybacks of all the projects recommended for implementation are less than 3 years.

Exhibit 1 presents a listing of all the recommended project showing the calculated energy and costs savings, costs of implementation and payback. The projects are arranged in two groups - A and B .

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Exhibit 1. LEVE Summary of Energy Conservation Recommendations

Project No	Project Title	Annual Energy Saving		Cost Savings, Investment Cost and Simple Payback, lvs		
		Gkal	kWh	Savings	Costs	Payback
A.1	Institute Steam Trap Management Program	720		288000	58400	0.21
A.2	Reconstruction of the condensate system	248		374488	165000	0.44
A.3	Insulate Hot Water Tanks	665		469404	179600	0.38
A.4	Repair steam Leaks	216		86832	22000	0.25
B.1	Improve the temperature control in the drying process	780		550579	1690000	3.06
B.2	Improve the water flow rate control	236		166380	151500	0.91
B.3	Impement water heating system utilizing condensate heat	580		409405	376720	0.92
B.4	Control of the production moisture	571		403052	112000	0.27
	Total	4016		2747940	2755220	1.007

ENERGY AUDIT REPORT FORMS

1. Plant information

Name of Enterprise:	LEVE Joint Stock Company
Address:	7 Totio Benev Str, Gabrovo, Bulgaria
Telephone:	+359 (66) 2 20 81
Fax:	+359 (66) 2 70 83
Contact Person:	Dipl. Eng. P. Baev
Title:	Technical Director
Telephone:	359 (66) 2 73 48

2. Energy auditor information

Dates - audit started: April 1994 ; audit completed: May 1994

Energy audit company: ALPHA - PRO Energy Consultants

Energy audit team leader: Prof. Dr. Stoyan Nevenkin

Address:	95 V. Levski Blvd. 1000 Sofia, Bulgaria
Telephone:	+359 (2) 58 09 86
Fax:	+359 (2) 52 67 40

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3. Energy audit information

The purpose of this audit was to identify, and evaluate the energy consumption concerning steam and water consumption in leather processing , as well as the heating system of the plant, and to recommend appropriate energy conservation opportunities.

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

The low overall energy efficiency of the plant is due to the complexity of the following major factors: decreasing the production during the last 5 years, wearing out of energy transfer, control and measurement equipment.

There are several energy technological systems with significant potential for increasing the energy efficiency:

1. the steam distribution and condensate return systems;
2. the leather dryers;
3. the department heating system system.
4. the industrial water heating system

New experience

1. Applying in practice the knowledge obtained during the energy management course, provided by UNSAID and RCA/Haggler, Bailey, Inc.

2. Experience in contracting between a plant as a client and TPS as a heat/steam supplier.

3. Experience in leather processing energy transfer technologies

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4. Historical production and energy consumption

Year:	1991	1992	1993	UNITS
Production:			(Jan -Apr.)	
Soft leather	74298259	51004780	14607376	dm2
Bull leather	56056	733345	284380	kg
Pig leather	17564	-	-	numb
Chrome leather	288675	162713	78480	kg
Customer's leather	252350	244638	262249	kg
Customer's leather	2295225	8728497	3792489	dm2
'Buck skin' leather	-	230018	109869	dm2
Energy:				
electricity:	1 726740	1344400	680000	kWh
steam:	35994	11824	4366	Gkal
other :				
water	450790	292810	57440	m3
Energy/Production index:				
thermal	7.61	2.59	3.57	kWh/kg
electrical	0.314	0.253	0.478	

5. Historical energy costs

electricity:	653231	912583	680000	lvs
steam:	825672	4730162	2217121	lvs
other:				
water	354068	274930	107100	lvs

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

Plant name: LEVE JSCo.
Address: 7 Totio Benev Str., Gabrovo, BULGARIA
Auditor's name: Prof.Dr. S.Nevenkin
Report date: May, 1994

Supply contract terms:

Fuel or heat supply company's name TPS GABROVO
Contract maximum demand: 20000 Gkal
Minimum charge (cost):
Other:

CONSUMPTION OR BILLDING DATA FOR 12 - MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM): STEAM for Department 5

Meter Reading Mo/day/yr	Physical Consumption tons	Thermal Consumption Gkal	Total Costs lvs	Montly Heating Degree-Day Hdd	Heating Index Gkal/HDD	Product Index Gkal/ton	Notes on plant conditions and changes
Jan/22/92	3052	1987	681541	595	3.3394958	5.05	
Feb/22/92	2225	1462	501466	484	3.02066116	3.08	
Mar/22/92	2167	1424	488432	386	3.68911917	2.83	
Apr/22/92	1521	1007	345401	156	6.45512821	2.26	
May/22/92	1249	833	347039	57	14.6140351	2.09	
Jun/22/92	1445	933	431979	-	-	1.7	
Jul/22/92	51	33	15279	-	-	1.72	
Aug/22/92	687	437	202331	-	-	1.75	
Sep/22/92	747	518	239834	26	19.9230769	1.12	
Oct/22/92	870	887	410578	145	6.11724138	1.785	
Nov/22/92	961	954	441904	330	2.89090909	2.67	Note: Heating degree-days based on
Dec/22/92	1961	1349	624377	521	2.58925144	4.08	reference temperature of
TOTAL	16927	11824	4730162	2700	4.379	2.23	12 oC - ambient, 19 oC - room.

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

Plant name: LEVE JSCo.
Address: 7 Totio Benev Str., Gabrovo, BULGARIA
Auditor's name: Prof.Dr. S.Nevenkin
Report date: May, 1994

Supply contract terms:

Fuel or heat supply company's name TPS GABROVO
Contract maximum demand: 20000 Gkal
Minimum charge (cost):
Other:

CONSUMPTION OR BILLDING DATA FOR 12 - MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM): STEAM for Department 5

Meter Reading Mo/day/yr	Physical Consumpti tons	Thermal Consumption Gkal	Total Costs lvs	Montly Heating Degree-Day Hdd	Heating Index Gkal/HDD	Product Index Gkal/ton	Notes on plant conditions and changes
Jan/22/93	958	976	491173	595	1.64033613	2.67	
Feb/22/93	1609	1108	563962	484	2.2892562	3.53	
Mar/22/93	2147	1440	733187	386	3.73056995	3.62	
Apr/22/93	1226	842	428797	156	5.3974359	2.44	
							Note: Heating degree-days based on reference temperature of
TOTAL	5940	4366	2217121	1621	2.69	3.57	12 oC - ambient, 19 oC - room.

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ENERGY BALANCE - FUEL, STEAM OR HEAT
ENERGY TYPE: STEAM
Prepared for USAID and RCG/Hagler, Bailly

Plant name: LEVE JSCo.
Address: 7 Totio Bevev Str., Gabrovo, BULGARIA
Auditor's name: Prof. Dr. S.Nevenkin
Report date: June, 1994

Item No	Equipment or Process Description	Maximum Load t/h	Average Load t/h	Load of Peak Demand t/h	Energy Consumption Gkal/year	Total Energy Cost lvs/year
1	Drier "Finclip"	0.8	0.48			2061532.7
2	Drier "Bic"	0.5	0.3			2189173.2
3	Drier "Gusini"	1.59	0.95			1276997.8
4	Drier "Cela"	0.75	0.45			182441.3
5	Drier "Ugo"	1.1	0.6			
6	Vacuum Drier "IMPIANTI"	0.96	0.6			
7	Vacuum Drier	0.46	0.276			
	for all driers	6.16	3.7	6.5	8620	3448400
8	Heating system	1.76	1.55	1.76	1814	725565
9	Water heating system	1.2	0.97	1.2	1390	556197
TOTAL PEAK DEMAND				9.46		
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)					11824	4730162

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

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: **A.1** Institute Steam Trap Management Program
AREA OF THE PLANT AFFECTED: Steam Distribution and Utility System
FINDINGS CONCERNING EXISTING CONDITIONS: Faulty steam traps and their consequent energy losses as well as their negative impacts on production are a significant problem at LEVE. The team tested over 26 traps. 75% were found to be failed open.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase of new steam traps (16 of 1/2"; 6 of 3/4"; 2 of 1") of the type already used throughout the plant. Replacement of traps identified as failed open. 2. Purchase 8 closing valves (1/2") and installation on bypasses and other areas as the traps are repaired or replaced. 3. Train maintenance staff in testing and replacement of traps.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				720		288000(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design		
Equipment procurement	46400	
Equipment installation	12000	
Equipment commissioning		
TOTAL INSTALLED COST	58400	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 58400}{a: 288000 - c: 0} = 0.21 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: Begin replacement of traps and installation of the valves in August 1994.

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

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: **A.2** Reconstruction of the condensate system
AREA OF THE PLANT AFFECTED: Condensate System
FINDINGS CONCERNING EXISTING CONDITIONS: 12 air heaters use steam and the condensate is not returned to the main tanks because of the unproper designed system. The monthly condensate losses are about 130 tons, and the penalty is 0.48 lvs per kg.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Install two additional tanks (each of volume of 150 l) in order to accommodate the condensate pumps. 2. Install 4 condensate pumps. 3. Connect the tanks and the heaters by the existing pipes and new ones where necessary. 4. Install level control system for pumps operation.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr	t/yr	Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction			4146	248		374448(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	15000	
Equipment procurement	125000	
Equipment installation	25000	
Equipment commissioning		
TOTAL INSTALLED COST	165000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 165000}{a: 374488 - c: 0} = 0.44 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1.Design of the system - September 1994 , 2. Purchase of equipment - October 1994, 3.Implement - December 1994

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NoA.3
Prepared for USAID and RCG/Hagler, Bailly

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: **A.3** Insulate Hot Water Tanks
AREA OF THE PLANT AFFECTED:
FINDINGS CONCERNING EXISTING CONDITIONS: There are three main industrial hot water tanks. One of them, placed inside the building is uninsulated. The other two, placed outside have poor quality insulation
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Insulate the inside hot water tank with glass wool insulation. 2. Insulate the outside hot water tanks with glass wool and metal sheathing. .

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				665		469404(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design		
Equipment procurement	131800	
Equipment installation	47800	
Equipment commissioning		
TOTAL INSTALLED COST	179600	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 179600}{a: 469404 - c: 0} = 0.38 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1.Begin insulation - August 1994

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

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: **A.4** Repair Steam Leaks

AREA OF THE PLANT AFFECTED: Steam distribution system

FINDINGS CONCERNING EXISTING CONDITIONS:

A total of 24 leaks were identified during the energy audit. They are aggravated by the quality of valves and packing material available locally.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. Start a steam leak identification program, preferably hanging a tag near each steam leak until it is repaired. A master list of steam leaks should be organized and maintained.
2. Use the leaks identified during this audit as a base of such a program.
3. Types of repair which are needed include the following:

- replacement of valve steam packing,
- tightening of leaking flanges, replacement of flange gaskets,
- repairing/replacing gasket seals

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		t/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				216		86832(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design		
Equipment procurement	17200	
Equipment installation	3800	
Equipment commissioning		
TOTAL INSTALLED COST	22000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 22000}{a: 86832 - c: 0} = 0.25 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

1.Begin in - August 1994

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

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: B.1 Improve the temperature control in the drying process
AREA OF THE PLANT AFFECTED: Dryers
FINDINGS CONCERNING EXISTING CONDITIONS: Heating of the dryers is done by steam. Most of the steam control valves do not operate and the temperature control of the process is maintained by hand.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase of 10 electric driven valves , temperature PID regulators, temperature sensors and remote control. 2. Replace the existing control system

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				780		550579(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design		
Equipment procurement	1650000	
Equipment installation	40000	
Equipment commissioning		
TOTAL INSTALLED COST	1690000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 1690000}{a: 550579 - c: 0} = 3.06 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1. Purchase 6 temperature control valves - may 1995 2. Purchase 4 temperature control valves , temperature PID regulators, sensors and remote control - Nov. 1995 3. Installation - January 1996

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

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: **B.2** Improve the water flow rate control
AREA OF THE PLANT AFFECTED: Hot water system
FINDINGS CONCERNING EXISTING CONDITIONS: The existing control subsystem in the water heating system has to guarantee the necessary water quantity to the tanks. The tanks are often overfilled and the monthly water losses are estimated as 17% of the total water consumption.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase and replace of two existing electric driven (0-220V) valves for water

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Water, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr	m3/y	Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction			49700	236		166380(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design		
Equipment procurement	148000	
Equipment installation	3500	
Equipment commissioning		
TOTAL INSTALLED COST	151500	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 151500}{a: 166380 - c: 0} = 0.91 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1. Purchase 2 motor valves - may 1995 2. Installation - June 1995

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

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: **B.3** Implement water heating system utilizing condensate heat

AREA OF THE PLANT AFFECTED: Water heating system

FINDINGS CONCERNING EXISTING CONDITIONS:

The condensate is returned to TPS via 40 m3 in volume tank with temperature 98 Co. Due to the existing local conditions the plant will be charged if the returned condensate temperature drops below 30 oC. The condensate heat can be used for preheating the industrial water.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. Design and installation of recuperative heat exchange system utilising condensate heat for pre-heating water required for the leather processing. The recuperative system consists of a plate heat exchanger, two hot water pumps, closing valves.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Water, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				580		409405(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	30000	
Equipment procurement	323720	
Equipment installation	23000	
Equipment commissioning		
TOTAL INSTALLED COST	376720	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 376720}{a: 409405 - c: 0} = 0.92 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

1. Purchase of heat exchange substation - Nov. 1995
2. Installation - Dec. 1995

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

Plant name: LEVE Joint Stock Company
Address: 7 Totio Benev Str., 5305 Gabrovo, BULGARIA

Auditor's name: Prof.Dr.S. Nevenkin

Report's date: May 1994

ACTION NO. AND BRIEF DESCRIPTION: **B.4** Control of the production moisture
AREA OF THE PLANT AFFECTED: Drying process
FINDINGS CONCERNING EXISTING CONDITIONS: The end moisture of the dried leather is not controlled properly due to the lack of measurement equipment. As a result the leather is returned for second time drying.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase of 6 portable contact moisture meters. 2. Implement a program for moisture control 3. Train maintenance operators in moisture control

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Water, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				571		403052(a)

COST - BENEFIT ANALYSIS:

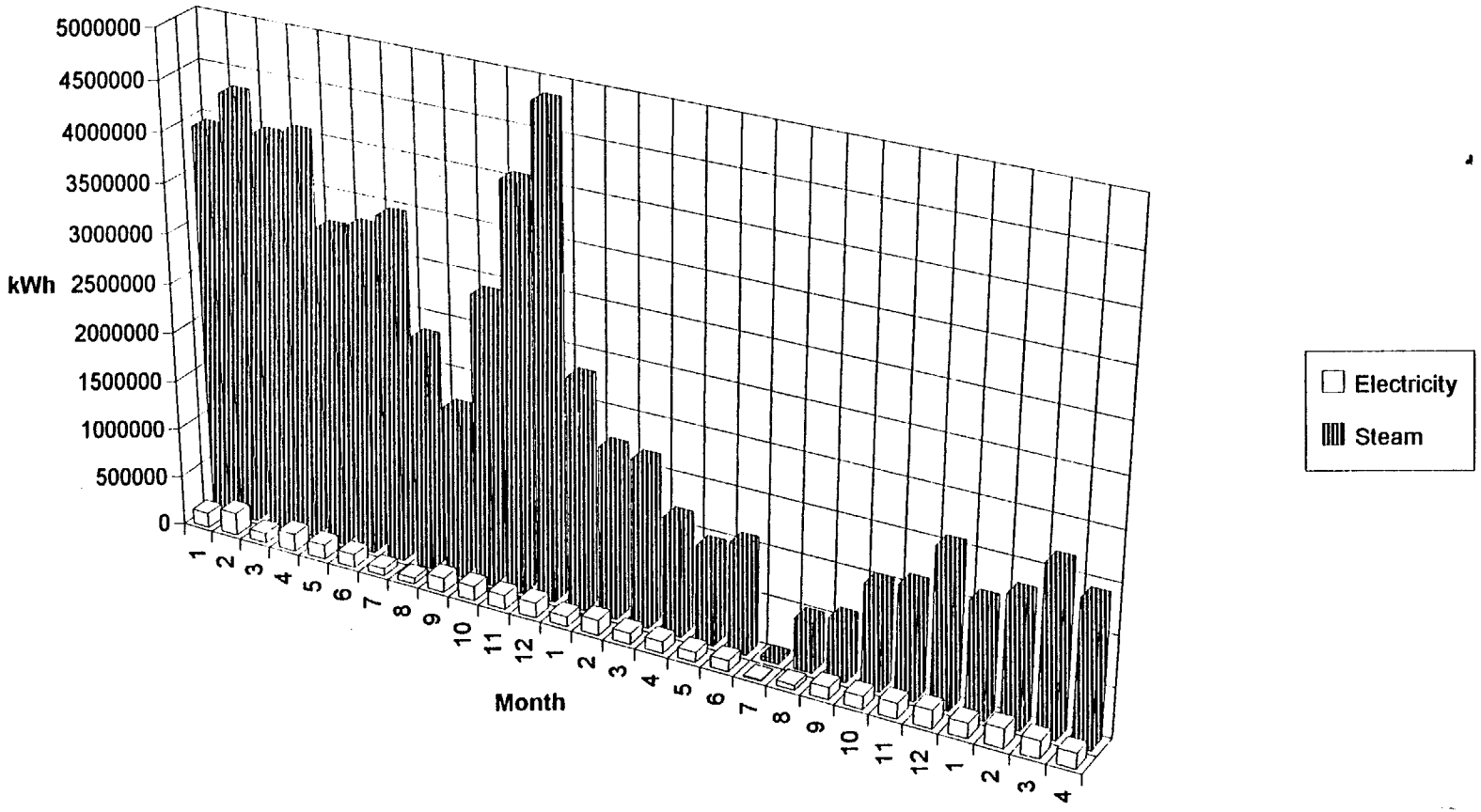
PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design		
Equipment procurement	112000	
Equipment installation		
Equipment commissioning		
TOTAL INSTALLED COST	112000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 112000}{a: 403052 - c: 0} = 0.27 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:
1. Purchase of heat exchange substation - Nov. 1995 2. Installation - Dec. 1995

APPENDICES

Steam & Electricity Consumption from Jan.91 to Apr.93



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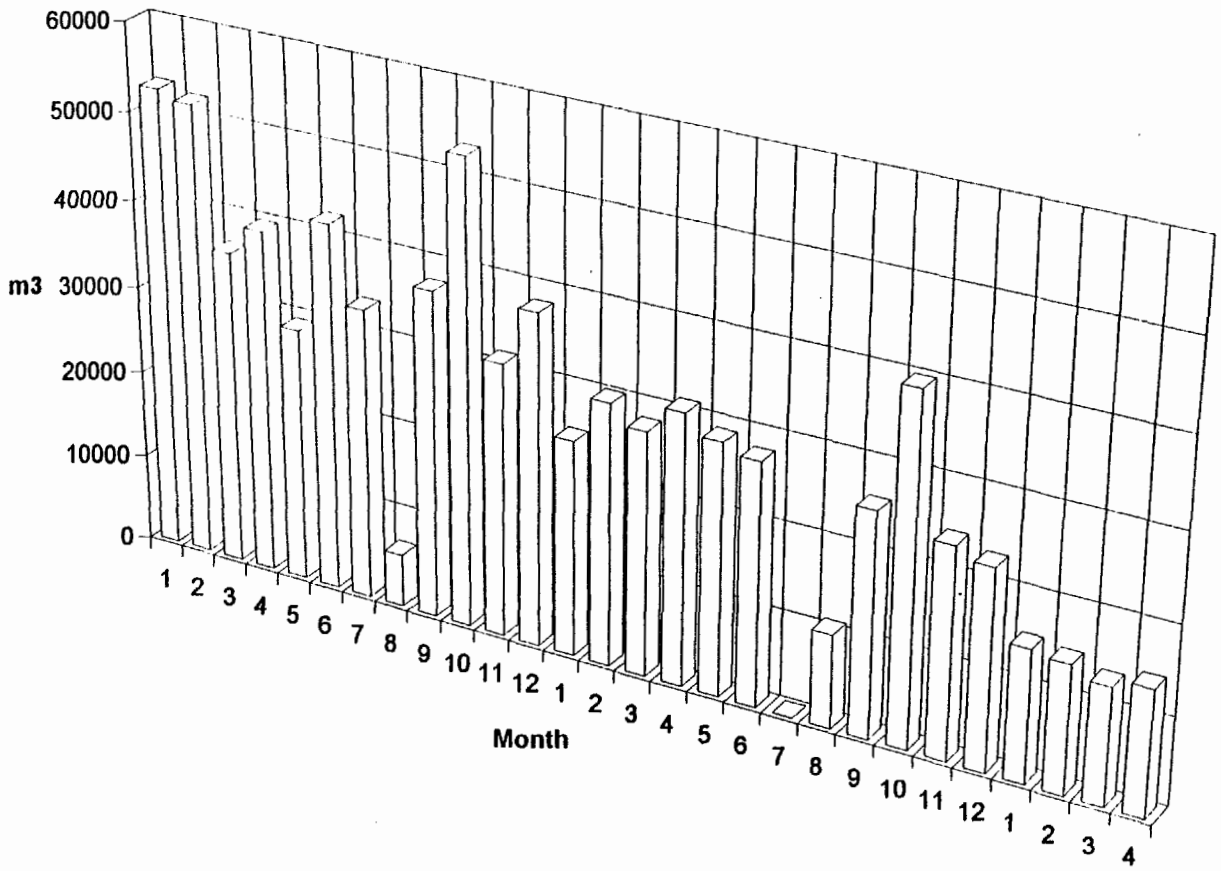
Water Consumption from Jan.91 to Apr.93



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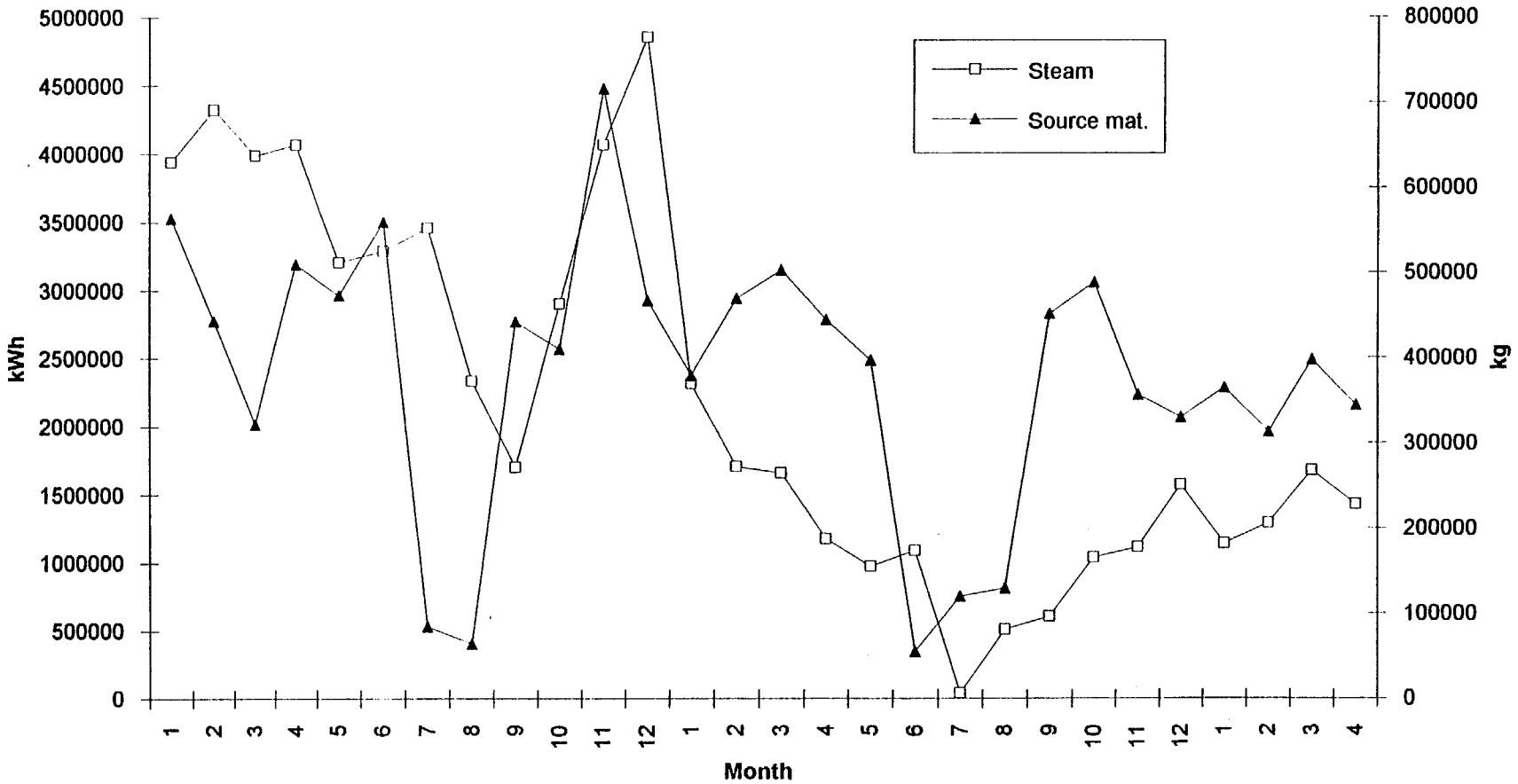
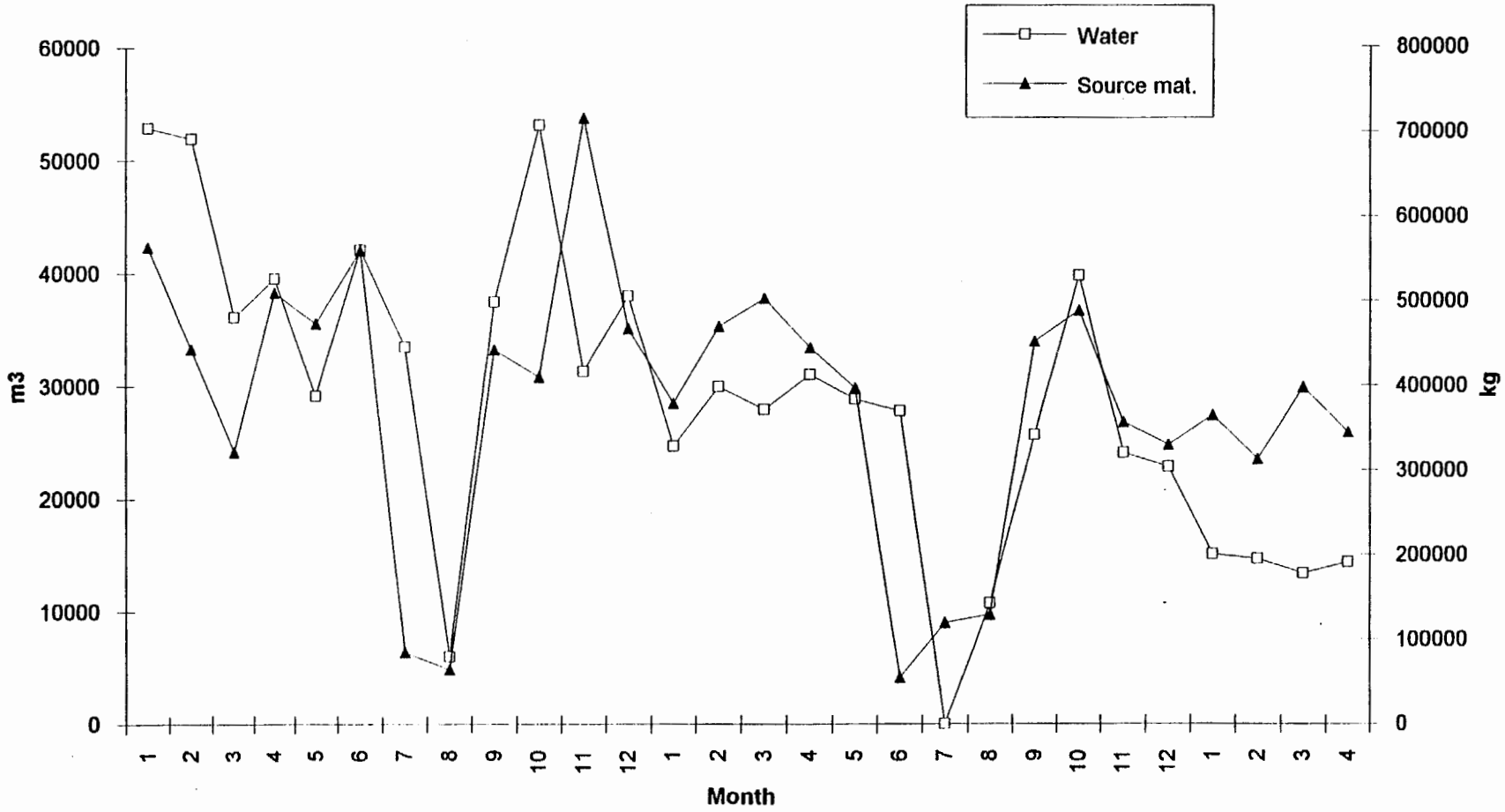
Steam & Source material (Jan.91 - Apr.93)



Water Consumption & Source material (Jan.91 - Apr.93)



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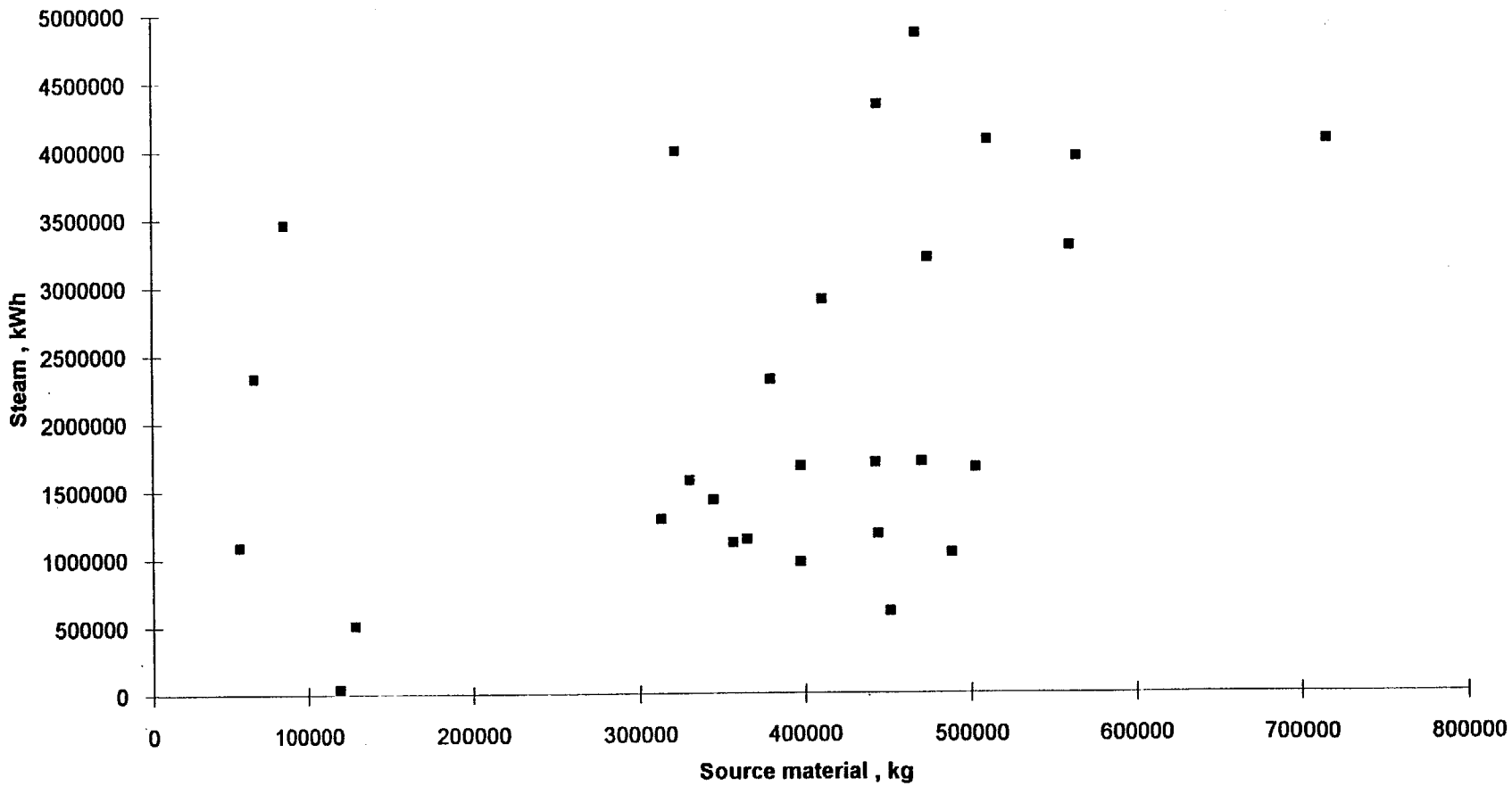
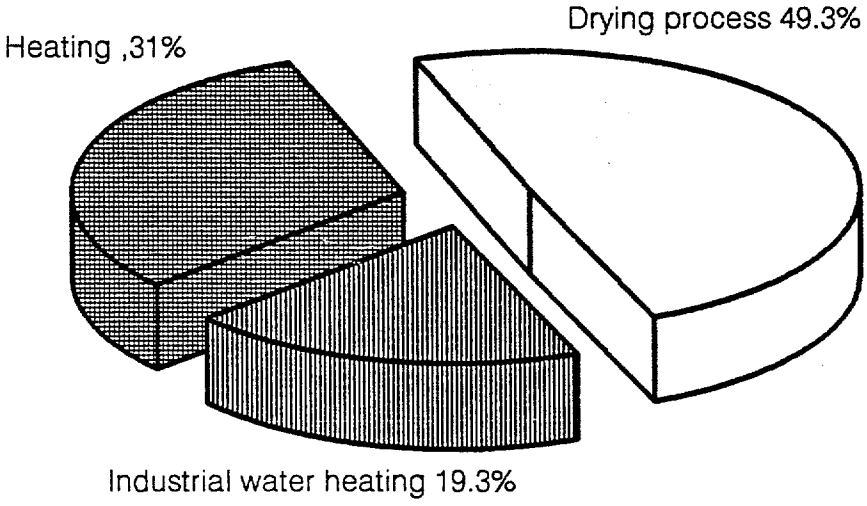
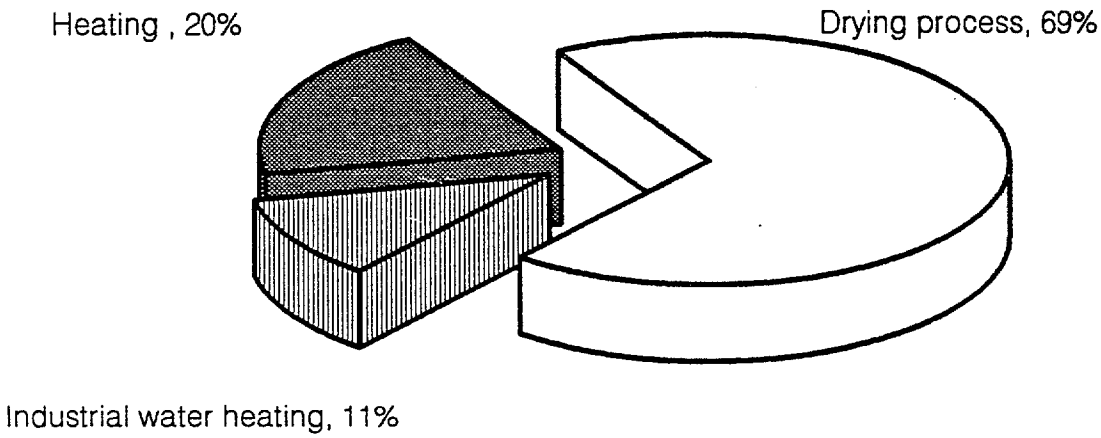
Steam consumption vs. Source material (Jan.91-Apr.93)



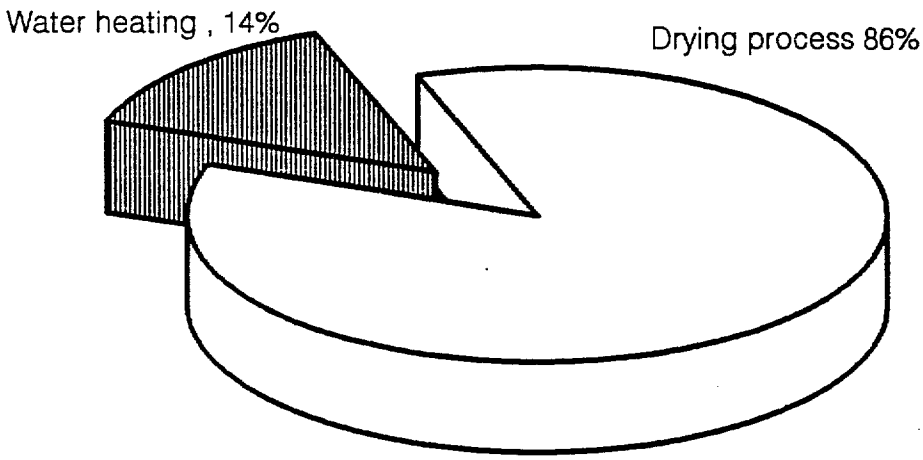
Distribution of the steam consumption (Jan.93-Apr.93)



Distribution of the steam consumption in winter



Distribution of the steam consumption in summer



UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

MRK AD - Pirdop

by

Janos Zhelev, CEM

ExErg Co. Ltd.

for

Hagler Bailly Consulting, Inc.

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ENERGY AUDIT REPORT

Prepared fo

USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	MDK AD - Pirdop
Address	Pirdop
Telephone	(0728) 57 17
Fax	(359 2) 87 22 69
Contact Person	Marin ALEKSANDROV
Title	Chief Energetic
Telephone	(0728) 51 06

2. Energy auditor information

Dates - audit started	15th September 1993
- audit completed	15th January 1994
Energy audit company	ET Janos Zhelev, now ExErg Co.Ltd.
Energy audit team leader	dr.Janos ZHELEV, C.E.M.
Address	Vladislavovo 9/6/54
	Varna 9023
	for post 9023 P.O.Box 62
Telephone	(359 52) 25 96 12 & 42 55 91
Fax	(359 52) 46 35 62 & 22 33 49

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

1. Electricity and heavy fuel oil consumption in the whole plant and in the smelting area. The management directs our effort towards smelting area.
The analysis of the performance of this area and the availability of the data shows, that the main problem is the energy management.

2. Energy management

3. Main electric consumers - in the Oxygen and compressed air plant & in the Sulfuric acid plant.

4. Boilerhouse & steam distribution.

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

1. The high price of operation at law load. The specific energy consumption when operating at loads under 3,500 t/month anode copper is two - three times bigger than at loads over 4,000 tonnes per month.

2. The absence of a real energy management procedure. Very high variability (up to 78%) of energy consumption is indicated for a given level of production.

3. Problems with data accuracy. The data about fuel oil and steam consumption in major areas is more estimation than result of mesurements.

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

1. Great differences between the planed technical capabilities of the equipment and the real operation.

2. The absence of any controll of the energy consumption, especially of steam, oxygen and compressed air.

There is no any enrgy efficiency measure implemented during the course of the audit.

4. Historical production and energy consumption

4. Historical production and energy consumption

Summary of the recent production and energy consumption at MDK in physical units:

Year:	1991	1992	1993	Units
Production:				
anode copper	25,892	50,605	46,436	tons
electrolite copper	12,784	17,978	28,500	tons
sulphuric acid	200,000	279,281	318,500	tons
Energy:				
heavy fuel oil	812,566	1,318,600	1,202,526	GJ
electricity	691,782	939,358	625,208	GJ
steam		74,000	60,000	GJ
diesel fuel oil		45		GJ
natural gas		92		GJ
coal		30		GJ
Energy/Production index:				
thermal	31	26	26	
electrical	27	18	13	

5. Historical energy costs

Year:	1991	1992	1993	Units
heavy fuel oil	35,70	62,03	83,00	BGleva/GJ
electricity	106,39	165,55	215,28	BGleva/GJ

6. Previous actions

During the planed shutdown for general repairs in 1993 the company closed one old transformer station and transfer consumers to the newer transformers. The cost of this project is about 1.5 Mlv and will cause savings of 1 Mlv/year electricity. The project was initiated from the chief energetic and the engineering department and was funded by the company. The company now is working on implementing variable speed dryvers. The project is on experimental stage. Other project under discussion, which will save energy is an atempt to increase the reliability of utilisation coilers after the flash smelter.

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7. Detailed forms

Attached are the following forms and diagrams:

Hevy fuel consumption in the plant and in the smelting area.

Electricity consumption in the plant and in the smelting area.

Steam production in boilers and utilisation boiler of the flash smelter.

Recomended actions - energy efficiency opportunity.

ENERGY BALANCE - HEAVY FUEL OIL

1992

#	Equipment description	Maximum load kg/month	Average load kg/month	Energy consumption GJ/year	Total energy cost Mlv./year 92
1.	Fast Smelting Furnace	462,720	272,000	127,300	7.9
2.	Anode Furnace 1	338,220	217,000	101,500	6.3
3.	Anode Furnace 2	333,870	270,000	126.400	7.8
4.	Rotary Dryer 1	274,640	200,000	93,600	5.8
5.	Rotary Dryer 2	322,730	162,000	75,800	4.7
6.	Boilers - no metering estimated data for 1992	1,350,000	950,000	444,600	28
Total				962,200	

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.

Prepared for USAD and RCG/Hagler Bailly

Plant name:	M D K
Address:	Pirdop BULGARIA
Auditor's name:	Janos ZHELEV
Report date:	1994.08.3

ACTION NO. AND BRIEF DESCRIPTION:	Installing new electric heaters and controllers
AREA OF THE PLANT AFFECTED:	Sulphuric Acide Plant

FINDINGS CONCERNING EXISTING CONDITIONS:

The synthesys of sulphuric acide needs more than 450 C. The process is autothermic, but it needs external heating on low load, especialy on start-up. The heating is realised by 1.6 MW electrical heaters. There is no possibility to replace the electrical with other type of heater due to risk of the contamination of the cataliser. The made in Bulgaria el.heaters have short life time. Normaly between two yearly made major repairs about 50% of all heating elements are out of order, which means longer heating time. It meens slower heating of the reactor, which cannot meet the SOx gases from the flash smelter.Extra 8 hours the flash smelter is heated with 5 oil burners with capacity 300 kg/h each during each start up (10 times a year).

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Change the home made electrical heaters with USA made heaters and controllers. It will reduce the time of heatingof the flash smelter with about 80 hours/annum. Extra benefits are expected from the increased reliability and effective control provided by the controller.

The time between stopages for repare of the heaters is expected to increase from 4200 hr. to 5700 hr. It will cut the maintanance cost by 432,000 leva/annum (USD8,150). The shorter time for start up will reduce the electrical energy consumption in all areas of the plantThe start up needs usualy 24 hours. Due to decreased power of el. heaters this time is increased by about 8 hr. ten times a year.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: t mazut/year	Fuels, heat and steam: GJ/year	Total cost USD/year
Baseline -existing conditions			460	18720	76800
After recommended action			360	14040	57600
Net reduction			120	4680	19200 (a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost		Notes
Engineering design	6604		
Equipment procurement	11310		
Equipment installation		12794	Higher cost for repairing the BG heaters
Equipment commisssioning			
TOTAL INSTALLED COST	17914	(b)	
Estimated increase in annual (non-energy) operations and maintenance		(c)	-8151

PAYBACK PERIOD: b: / a: - c: = 0.65496 years

RECOMMENDED IMPLEMENTATION SCHEDULE: The project is already ready.

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The new heaters have to be installed during the next stopage for general repairs (remont).

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.
Prepared for USAD and RCG/Hagler Bailly

Plant name:	M D K
Address:	Pirdop BULGARIA
Auditor's name:	Janos ZHELEV
Report date:	1994.06.0

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ACTION NO. AND BRIEF DESCRIPTION:	Installing new electric heaters and controllers
AREA OF THE PLANT AFFECTED:	Sulphuric Acide Plant

FINDINGS CONCERNING EXISTING CONDITIONS:

The synthesys of sulphuric acide needs more than 450 C. on low load, especialy on start-up. The heating is realised by 1.2 MW electrical heaters. There is no possibility to replace the electrical with other type of heater due to risk of the contamination of the cataliser. The made in Bulgaria el.heaters have short life time. Normaly between two yearly made major repairs about 50% of all heating elements are out of order, which means longer heating time. It means slower heating of the reactor, which cannot meet the SOx gases from the flash smelter.Extra 8 hours the flash smelter is heated with 5 oil burners with capacity 300 kg/h each during each start up (10 times a year).

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Change the home made electrical heaters with USA made heaters and controllers. It will reduce the time of heatingof the flash smelter with about 80 hours/annum. Extra benefits are expected from the increased reliability and effective control provided by the controller.

The time between stopages for repare of the heaters is expected to increase from 4200 hr. to 5700 hr.

It will cut the maintanance cost by 432,000 leva/annum (USD8,150). The shorter time for start up will reduce the electrical energy consumption in all areas of the plantThe start up needs usualy 24 hours. Due to decreased power of el. heaters this time is increased by about 6 hr. ten times a year.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:	Electricity		Fuels, heat and steam:		Total cost	
	Peak kW	Energy Mwh/year	t mazut/year	GJ/year	USD/year	
Baseline -existing conditions			460	18720	76800	
After recommended action			360	14040	57600	
Net reduction			120	4680	19200	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost		Notes
Engineering design	6604		
Equipment procurement	11310		
Equipment installation		12784	Higher cost for repairing the 6G heaters
Equipment commisssioning			
TOTAL INSTALLED COST	17914	(b)	

Estimated increase in annual (non-energy) operations and maintenance (c) -8151

PAYBACK PERIOD: b: / a: - c: = 0.65496 years

RECOMMENDED IMPLEMENTATION SCHEDULE: The project is already ready.

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

Petar Karaminchev Ltd.

by

Cristian Spassov

Ecotech Products

for

Hagler Bailly Consulting, Inc.

184

ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise	"PETAR KARAMINCHEV" LTD
Address	73 Lipnik Boulevard
	7 000 RUSSE
	B U L G A R I A
Telephone	359 82 442 090
Fax	359 82 448 609
Contact Person	dipl.eng.Georgi Bairakov
Title	President
Telephone	359 82 442 090

2. Energy auditor information

Dates - audit started: 27.01.1994 audit completed: 30.04.1994

Energy audit company	ECOTECH PRODUCTS
Energy audit team leader	dipl.eng.Cristian Spassov
Address	29 Jaroslav Veshin str.
	1 408 SOFIA B U L G A R I A
Telephone	359 2 541 267
Fax	359 2 541 267

185

3. Energy audit information

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

- Boiler station
- Measurement of natural gas consumption
- Regulation of steam supply to air heating systems
- Burning of exhausted gases from producing processes
- Steam and condensate systems

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

- Regulation of burning processes in the boilers

  expected result-reduing of natural gas consumption - 3%
- Precise measurement of natural gas consumption

  expected result-reducing of the bill for natural gas consumption- 6%
- Equip air heating systems with regulators for steam supply

  expected result-reducing of steam consumption of air heating systems - 15%

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

- Systems for burning ofexhausted gases from producing processes
- Wrong energy management

27
410 288 - 0560

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3. Energy audit information

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

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

- System for burning of exhausted gases from producing processes

  expected result - reducing of natural gas consumption - 7%

- Re-equip of the steam and condensate systems(reducing valves,steam traps)

  expected result - redusing of natural gas - 25%

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

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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

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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:					
PVC products	34 003	11 905	11 475	11 024	tons
(floor covers,					
foam rubber,					
waterproofs)					
Energy: (all energy consumption per year - for production and heating)					
heavy fuel oil:	2 200	1 880	409	-	tons
diesel fuel oil:	1 233	679	360	360	tons
natural gas:	-	1 117	2 781	3 258	1 000 nm3
coal:					
electricity:	19 329	12 000	14 200	14 500	$\cdot 10^3$ kWh
steam:					
other (describe):					

Energy/Production index:

thermal	0.96	2.79	2.58	2.69	Gcal fuel/ton product
electrical	568	1 008	1 237	1 315	kWh/ton production

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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:	33 660	189 880	45 400	-	$
diesel fuel oil:	51 786	229 502	102 600	123 840	$
natural gas:	-	78 190	215 527	215 028	$
coal:					
electricity:	386 580	251 309	548 498	527 273	$
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:

-PROJECT - Re-equip of steam and condensate systems(reducing valves,steam traps,pumping steam traps- production of ARMSTRONG - USA)

-SOURCE OF THE IDEA - E C O T E C H P R O D U C T S

-COST - 150 000 $

-SOURCE OF FUNDING - Own investments
-REALISATION - I stage - 20 000 $

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

Plant name: "Petar Karaminchev"
Address: 73 Lipnik Boulevard,7 000 RUSSE, B U L G A R I A

Auditor's name: dipl.eng.Cristian Spassov

Report date: 01.05.1994

Supply contract terms:

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

TABLE 1

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM): NATURAL GAS (8 000 kcal/nm^3), DIESEL FUEL OIL(10 000 kcal/kg)

Meter Reading Mo/day/yr	natural gas, diesel fuel oil Physical Consumption units = 1000nm3,ton	Thermal Consumption GJ	total Total Cost $	Monthly Heating Degree-Days HDD	GJ heating Heating Index GJ/HDD	GJ production Product. Index GJ per: ton	Notes on plant conditions and changes
Jan/__/93	576,30	20 551	48 336	486	34,87	3,94	
Feb/__/93	580,30	20 685	48 600	425	40,20	3,94	
Mar/__/93	371,30	13 684	34 806	316	31,59	4,02	
Apr/__/93	123,30	5 376	18 438	154	10,44	4,09	
May/__/93	62,30	3 333	14 412	44	0	3,65	
Jun/__/93	65,30	3 433	14 610	0	0	3,76	
Jul/__/93	68,30	3 534	14 808	0	0	3,87	
Aug/__/93	90,30	4 270	16 260	0	0	4,58	
Sep/__/93	125,30	5 442	18 570	18	65,11	4,58	
Oct/__/93	150,30	6 280	20 220	154	16,31	4,10	
Nov/__/93	590,30	21 019	49 260	284	60,15	4,27	
Dec/__/93	458,30	16 597	40 614	414	31,80	3,77	
TOTAL							

Note: Heating degree-days based on reference temperature of 20 C

STEAM GENERATION - 12 MONTH AUDIT PERIOD
Prepared for USAID 'CG/Hagler Bailly

Plant name: "1 ar Uaraminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A
Auditor's name: DIPL.ENG.CRISTIAN SPASSOV
Report date: 01.05.1994

TABLE 2

Boiler characteristics:

Name/number	I - PKM 12	II - PKM 12	III - PKM 6,5	IV - PKM 12	V - PKM 12
Manufacturer		"GEORGI KIRKOV" LTD - Sofia, BULGARIA			
Type (firetube/watertube)		f i r e t u b e			
Type (saturated/superheated)		s a t u r a t e d			
Capacity (tons/hour)	12	12	6	12	12
Year installed:	1988	1988	1988	1963	1963
Year last major overhaul				1987	
Operational? (yes/no)	yes	yes	yes	margin	no
Steam pressure:	10	10	10	10	
Steam temperature:	180	180	180	180	
Stack temperature, after economizer					
Stack gas analysis: percent O2					
Combustion efficiency:		86 %			
Blowdown analysis dissolved solids PPM					

STEAM GENERATION DATA FOR 12-MONTH AUDIT PERIOD

Meter Reading Mo/day/yr	STEAM GENERATION BY PLANT: Fuel Consumption GJ	Steam Generation GJ	Steam Generation tons	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/ 9/3	19 924	16 593	8 255	86									
Feb/ 9/3	19 427	16 707	8 313	86									
Mar/ 9/3	12 427	10 687	5 317	86									
Apr/ 9/3	4 120	3 543	1 762	86									
May/ 9/3	2 076	1 785	888	86									
Jun/ 9/3	2 177	1 872	931	86									
Jul/ 9/3	2 287	1 959	975	86									
Aug/ 9/3	3 015	2 593	1 290	86									
Sep/ 9/3	4 187	3 601	1 791	86									
Oct/ 9/3	5 024	4 321	2 150	86									
Nov/ 9/3	20 098	17 284	8 599	86									
Dec/ 9/3	15 341	13 193	6 563	86									
TOTAL	109 464	94 138	46 833										

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ENERGY BALANCE – FUEL, STEAM OR HEAT
ENERGY TYPE: heat
Prepared for USAID RCG/Hagler Bailly

Plant name: "P. ar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A
Auditor's name: DIPL.ENG.CRISTIAN SPASSOV
Report date: 01.05.1994

TABLE 3

Item No.	Equipment or Process Description	Maximum Load units: Gcal/h	Average Load units: Gcal/h	Load at Peak Demand units:	Energy Consumption units: 1000 nm3 /year	Total Energy Cost $ /year prices1994
1	Conventional heating systems for productional volumes	8,750	6,125		1 336	133 600
2	Air heating systems for productional volumes (ventilation chamber)	8,500	5,950		1 303	130 300
3	Heating systems for administration	0,750	0,750		163	16 300
4	Technological consumption(natural gas)	3,000	2,000		456	45 600
5	Technological consumption(diesel fuel oil)	1,032	0,681		360	90 000
TOTAL PEAK DEMAND		22,032		22,032		
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)						415 800

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ELECTRIC ENF ' CONSUMPTION - 12 MONTH AUDIT PERIOD
Prepared for U. and RCG/Hagler Bailly

Plant name: "Petar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE · B U L G A R I A

Auditor's name: DIPL.ENG.CRISTIAN SPASSOV

Report date: 01.05.1994

Electricity contract terms:

Electricity supply company's name	N E C
Contract maximum demand (kW):	
Minimum charge (cost):	
Other:	

CONSUMPTION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD:

TABLE 4

prices 1994

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: ton	Notes on plant conditions and changes
Jan/__/93	1 186 000	672 000	3 500	15 500	0,88		42 000	1 290	
Feb/__/93	1 299 000	480 000	3 500	15 500	0.94		46 150	1 413	
Mar/__/93	1 284 000	575 000	3 000	15 500	0,93		45 600	1 397	
Apr/__/93	1 206 000	540 000	3 000	15 500	0,91		42 840	1 312	
May/__/93	1 109 000	500 000	3 000	15 500	0,91		39 400	1 207	
Jun/__/93	1 230 000	576 000	3 500	15 500	0,91		44 000	1 348	
Jul/__/93	1 128 000	492 000	3 000	15 500	0,92		40 070	1 227	
Aug/__/93	993 000	440 000	2 800	15 500	0,91		35 280	1 080	
Sep/__/93	1 237 000	500 000	3 700	15 500	0,93		44 000	1 346	
Oct/__/93	1 094 000	456 000	3 300	15 500	0,92		38 900	1 190	
Nov/__/93	1 557 000	620 000	4 000	15 500	0,93		55 310	1 694	
Dec/__/93	1 179 000	480 000	3 600	15 500	0,93		41 880	1 283	
TOTAL									

Peak demand during audit period (kW): 4 000

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ENERGY BALANCE ELECTRICAL
Prepared for US. JRCG/Hagler Bailly

Plant name: "Petar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A
Auditor's name: DIPL.ENG.CRISTIAN SPASSOV
Report date: 01.05.1994

TABLE 5

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	Calander macnines - 3	3 800	3 600	2 800	2 800	650 000	23 090
2	Waterproof machines - 5	2 000	1 800	1 600	1 600	4 600000	163 410
3	Coating machines - 4	500	400	350	350	2 500000	88 810
4	Other producing loads	10 000	7 000	5 500	5 500	1 500000	53 286
TOTAL PEAK DEMAND (equals maximum billing demand)					10 250		
TOTAL ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)						15 100 000	328 600

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

ACTION NO. 1

Plant name: "Petar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A
Auditor's name: DIPL.ENG.CRISTIAN SPASSOV
Report date: 01.05.1994

ACTION NO. AND BRIEF DESCRIPTION: MEASUREMENT OF NATURAL GAS CONSUMPTION

OF THE PLANT AFFECTED: ENERGY EFFICIENCY - GAS SUPLLY SYSTEM

FINDINGS CONCERNING EXISTING CONDITIONS:

$ 7390

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Measurement of natural gas consumption in the firm in order to pay real consumption (now it is realize on the counter-there are three counters-with highest natural gas consumption)

expected result - reducing of the bill for natural gas consumption - 6%

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: 1 000nm3	Total cost /year
B – existing conditions			3 258	$ 325 800
After recommended action			3 062	$ 306 200
Net reduction				19 600 (a)

COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost $	Notes
Engineering design	300	
Equipment procurement	6 840	14% taxes
Equipment installation	250	
Equipment commisssioning		
TOTAL INSTALLED COST	7 390 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	100 (c)	

PAYBACK PERIOD:

$$\frac{b: 7\ 390}{a: 19\ 600 - 100_{c:}} = 0{,}379 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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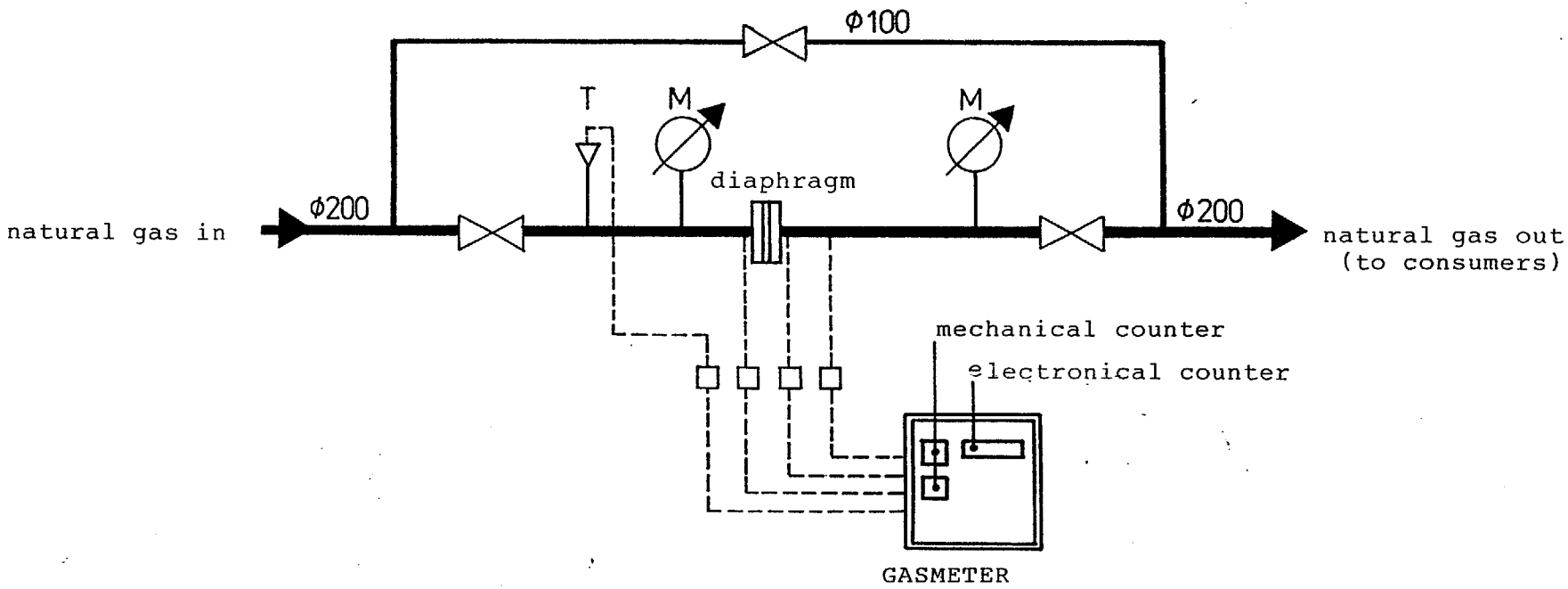
ϕ100
T
M
M
diaphragm
natural gas in
ϕ200
ϕ200
natural gas out
(to consumers)
mechanical counter
electronical counter
GASMETER

FIG. 1

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

ACTION NO. 2

Plant name: "Petar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A
Auditor's name: DIPL.ENG.CRISTIAN SPASSOV
Report date: 01.05.1994

ACTION NO. AND BRIEF DESCRIPTION: GAS ANALYSER

OF THE PLANT AFFECTED: ENERGY EFFICIENCY - BOILER STATION

FINDINGS CONCERNING EXISTING CONDITIONS:

$ 6 000

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Regulation of burning processes - 7 boilers

4 - working with natural gas

3 - working with diesel fuel oil

expected result - reducing of fuel consumption - 3%

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost	
	Peak kW	Energy MWh/year	1000nm3	tons	$ /year	
Line – existing conditions			3 258	360	414 000	
After recommended action			3 160	349	401 500	
Net reduction			98	11	12 500	(a)

COST–BENEFIT ANALYSIS.

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	300	
Equipment procurement	5 700	14% taxes
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	6 000	(b)
Estimated increase in annual (non–energy) operations and maintenance cost	200	(c)

PAYBACK PERIOD:

$$\frac{b\ 6\ 000}{a\ 12\ 500 - c\ 200} = 0{,}488 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

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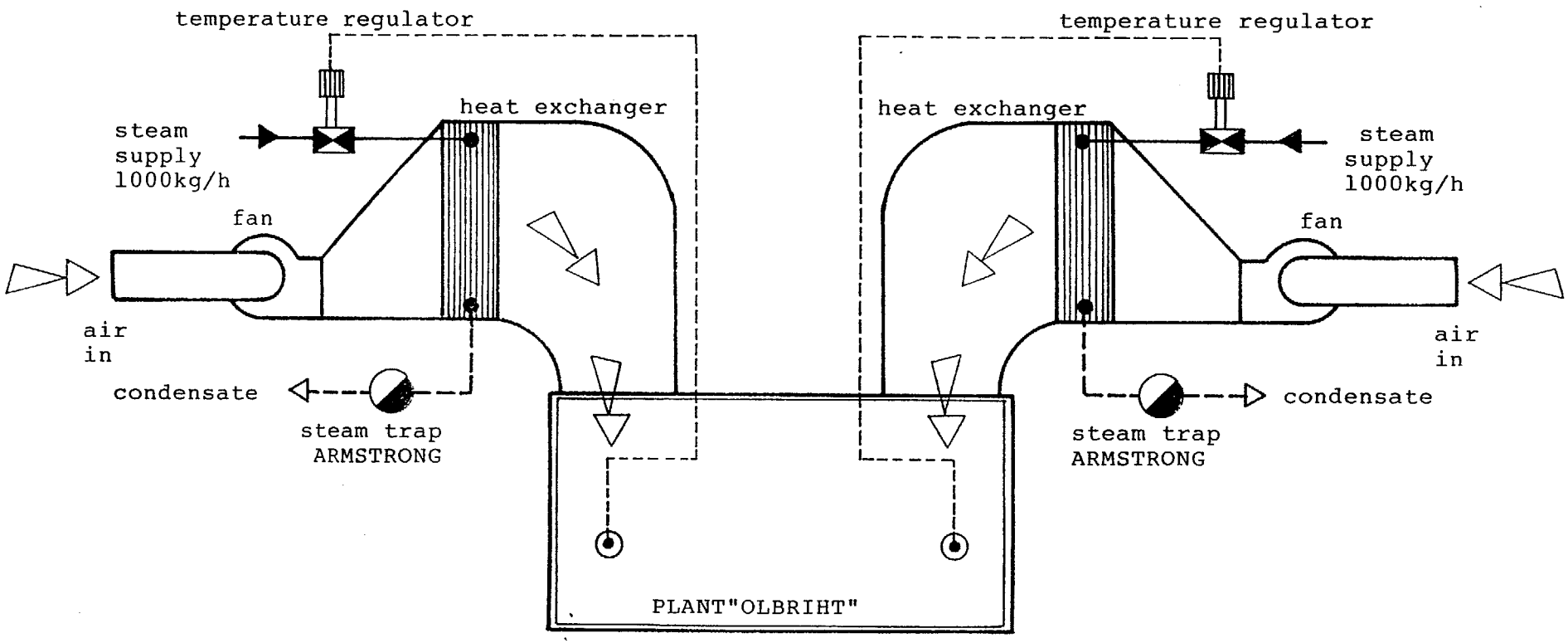

temperature regulator
heat exchanger
steam
supply
1000kg/h
fan
air
in
condensate
steam trap
ARMSTRONG
temperature regulator
heat exchanger
steam
supply
1000kg/h
fan
air
in
condensate
steam trap
ARMSTRONG
PLANT"OLBRIHT"

FIG. 2

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

ACTION NO. 3

Plant name: "Petar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A
Auditor's name: DIPL.ENG.CRISTIAN SPASSOV
Report date: 01.05.1994

ACTION NO. AND BRIEF DESCRIPTION:
OF THE PLANT AFFECTED: REGULATOR FOR STEAM CONSUMPTION OF AIR HEATING
ENERGY EFFICIENCY - steam consumption for heating

FINDINGS CONCERNING EXISTING CONDITIONS:

$ 2 400

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

The way of working of system:
Ventilation chamber - in summer(sanitary requirements)
Air heating - in winter
In the time between summer and winter in the producing volumes the temperature rise more than producing requirements, because of non-working regulators.
The choice is air heating system for plant "OLBRIHT"
two ventilation chambers with steam consumption
2 x 1 000 kg/h max
expected result - reducing of steam consumption - 15%

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: 1 000nm3	Total cost $ /year	
e –existing conditions			104	10 000	
After recommended action			88,4	8 840	
Net reduction			15,6	1 560	(a)

COST–BENEFIT ANALYSIS

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	$ 100	
Equipment procurement	$ 2 400	14% taxes
Equipment installation	$ 100	
Equipment commisssioning		
TOTAL INSTALLED COST	$ 2 600 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	50 (c)	

PAYBACK PERIOD:

$$\frac{b: 2\ 600}{a: 1\ 560 - c: 50} = 1{,}72 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

200

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

ACTION NO.

Plant name: "Petar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A

Auditor's name: DIPL.ENG.CRISTIAN SPASSOV
Report date: 15.06.1994

ACTION NO. AND BRIEF DESCRIPTION: BURNING-OUT OF EXHAUSTED GASES OF PRODUCTION

OF THE PLANT AFFECTED: ENERGY EFFICIENCY - UNIT "HOFMAN and SHVABE"

FINDINGS CONCERNING EXISTING CONDITIONS:

$

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

The exhausted gases from the unit "HOFMAN and SHVABE" have the parameters as follow:

- capacity - 7 330 nm^3/h,
- temperature - 110°C,
- content of burning component /dioctilftalat/- 15,5mg/m^3/117g/h/

expected result - reducing of haphta consumption - 4,7%

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

		Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam: naphta, kg/h		Total cost $/year
ine –existing conditions	4 000 h/year			130		157 560
After recommended action	4 000 h/year			124		150 288
Net reduction						7 272 (a)

ST–BENEFIT ANALYSIS:

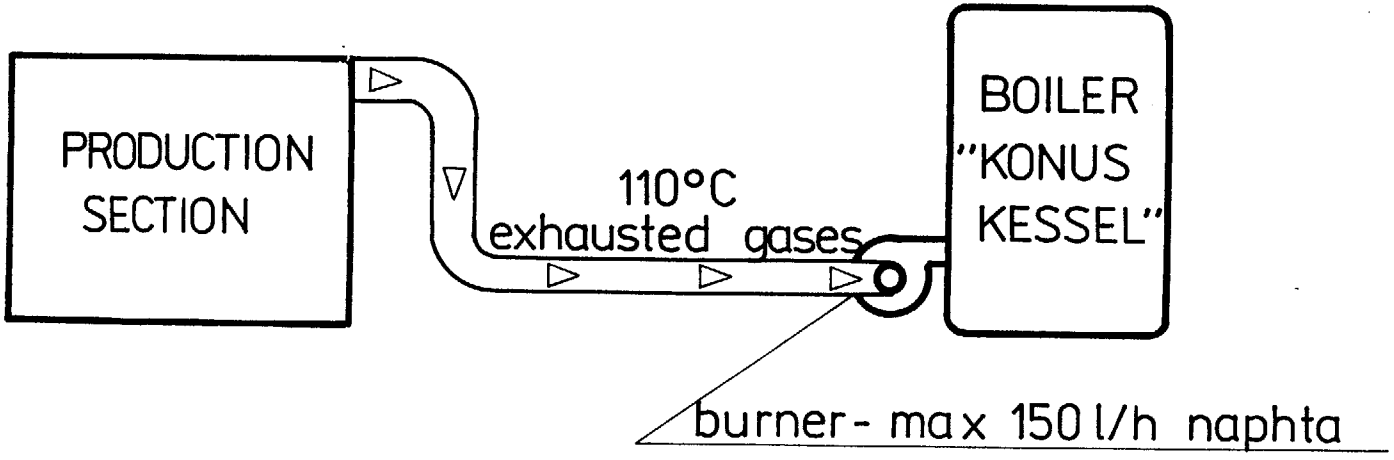
PROJECT COST ESTIMATE:	Cost $	Notes
Engineering design	300	
Equipment procurement		14% taxes
Equipment installation	400	
Equipment commisssioning		
TOTAL INSTALLED COST	100 (b)	

Estimated increase in annual (non–energy) operations and maintenance cost (c)

PAYBACK PERIOD:

$$\frac{b:}{a:7272 - c:100} = \text{years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:



UNIT "HOFMAN AND SHVABE"
FOR FLOOR COVER

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

ACTION NO. 3

Plant name: "Petar Karaminchev" LTD
Address: 73 Lipnik Boulevard 7 000 RUSSE B U L G A R I A
Auditor's name: DIPL.ENG.CRISTIAN SPASSOV

Report date: 15.06.1994 UNIT "MOR"(for production of floor covers)

ACTION NO. AND BRIEF DESCRIPTION: REEQUIPMENT OF BURNERS FROM NAPHTA(diesel oil) TO NATURAL GAS

OF THE PLANT AFFECTED: ENERGY EFFICIENCY AND QUALITY OF THE PRODUCTS

FINDINGS CONCERNING EXISTING CONDITIONS:

The unit "MOR" is equiped with 15 burners,working with naphta (max 15 l/h).The difference between the prices of naphta and natural gas is:

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

- naphta – 30,30 $/Gcal
- natural gas – 12,50 $/Gcal

expected result – reducing of the bill for fuel consumption with 58%

APPROXIMATE PRICE – 7 400 $ per burner

EXPECTED RESULTS – EFFECT OF RECOMMENDATION:

	Electricity Peak kW	Electricity Energy MWh/year	Fuels, heat and steam:	Total cost $/year
Before –existing conditions naphta consumption				90 900
After recommended action natural gas consumption				38 180
Net reduction				52 720 (a) (per 15 burners)
				3 520 (per burne

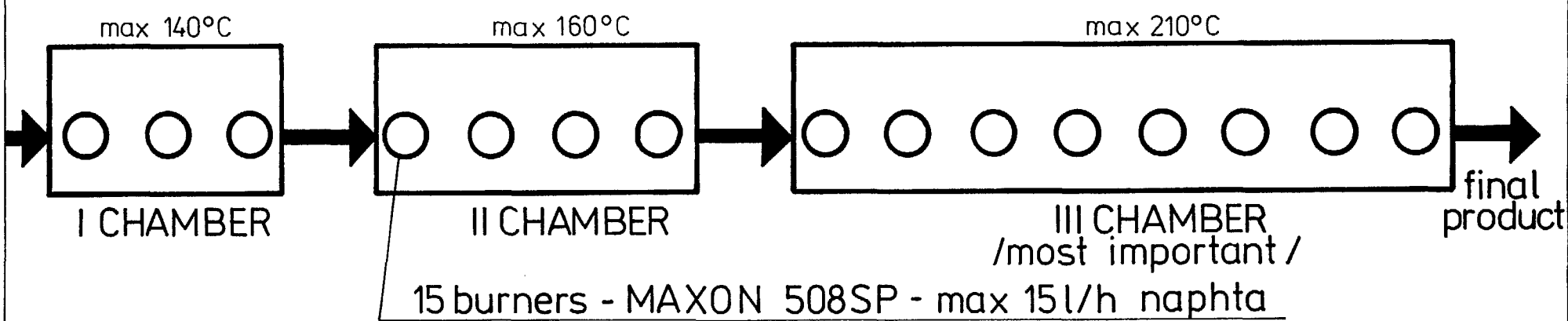
COST–BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost $	Notes
Engineenng design	300	
Equipment procurement	6 900	14% taxes
Equipment installation	200	
Equipment commisssioning		
TOTAL INSTALLED COST	7 400 (b)	
Estimated increase in annual (non–energy) operations and maintenance cost	100 (c)	

PAYBACK PERIOD:

$$\frac{b: 7\ 400}{a: 3\ 520 - c: 100} = 2,16 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:



UNIT "MOR"
FOR FLOOR COVER

PROJECT FOR ENERGY EFFICIENCY IN EASTERN EUROPE

INDUSTRIAL ENERGY EFFICIENCY COMPONENT

RCG /Hagler Bailly, Inc.

ENERGY AUDIT OF "PETAR KARAMINTCHEV" Ltd.

RUSSE - BULGARIA

Consultant: Raina Zlatareva, M.Sc., Mech. E.

March, 1995
Sofia, Bulgaria

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PROJECT FOR ENERGY EFFICIENCY IN EASTERN EUROPE

INDUSTRIAL ENERGY EFFICIENCY COMPONENT

RCG /Hagler Bailly, Inc.

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RUSSE - BULGARIA

Consultant: Raina Zlatareva

March, 1995
Sofia, Bulgaria

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    5.1. Source of heating
    5.2. Steam consumers
    5.3. Direct consumers of fuels
    5.4. Consumers of electricity
6. Recommendations for raising energy efficiency in the company - list of the recommendations

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1. PRINCIPAL OBJECTIVE

Energy house audit procedure:

* source of heating,
* heat consumption,
* electricity consumption,

with the principal objective the energy efficiency to be raised and the following results to be achieved:

* maximum production of heat at optimal fuel and electricity costs;
* minimum costs for heat consumption per same final product (for technological and domestic needs);
* minimum costs for fuel and electricity per same final product (for technological needs);
* minimum costs for electricity per same final product (for technological and domestic needs).

2. STRUCTURE OF THE ENERGY HOUSE

2.1. SOURCE OF HEATING

Private boiler station including 4 /four/ steam boilers of the following types:

* 3 /three / boilers ПКМ 12 - 3 x 12 t/h steam,
* 1 /one/ boiler ПКМ 6.5 1x 6 t/h steam

maximum production of steam - 42 t/h

Parameters of the boilers:

* coefficient of efficiency - 89%,
* temperature of saturated steam - 180° C,
* working pressure - 10 bars,
* fuel used - natural gas (8000 kcal/nm^3).

2.2. STEAM CONSUMERS

Conventional heating systems for the production departments

- maximum - 17.5 t/h (8750Gcal/h)
- average - 12.25 t/h (6125 Gcal/h),

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Air heating systems for the production departments
- maximum - 17 t/h (8500 Gcal/h)
- average - 11.9 t/h (5950 Gcal/h),

Heating systems for the administration department
- maximum - 1.5 t/h (750 Gcal/h)
- average - 1 t/h (500 Gcal/h),

Technological consumers of steam
- maximum - 6 t/h (3000 Gcal/h)
- average - 4 t/h (2000 Gcal/h).

CONSUMPTION OF STEAM

- maximum - 42 t/h (21000Gcal/h)
(at -16° C outside temperature and full loading of the production capacities, losses due to transportation included)
- average - 29.15 t/h (14580 Gcal/h)

2.3. DIRECT CONSUMERS OF FUELS

Technological consumers of natural gas:

HOFMAN - SHVABE - 1 pc.
* consumption of natural gas - 150 nm^3/h
* coefficient of efficiency - 75 %
* discharged exhausted air - parameters
  - debit - 7330 nm^3/h
  - temperature - 110° C
  - combustion component - 114g/h (15.5 mg/nm^3)

Technological consumers of diesel oil:

MOR - 1 pc.
* consumption of diesel oil - 15 pcs.of burners x 15 l/h each
* coefficient of efficiency - 76%

OLBRIHT - 1 pc.
* consumption of diesel oil - 150 l/h
* coefficient of efficiency - 76%

2.4. CONSUMERS OF ELECTRICITY

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* calender line 1 - 1500 kw
* calender line 2 - 1200 kw
* unit for flooring pavement - 1000 kw
* unit for synthetic leathers - 1500 kw
* domestic needs - 700 kw
(lighting of rooms and industrial shops)

CONSUMPTION OF ELECTRICITY

- maximum - 5900 kw
(at full loading of the production capacities)
- average - 4000 kw

3. ANNUAL COSTS FOR FUELS AND ELECTRICITY

Type \ Year		1990	1991	1992	1993	1994
Mazut	t/year	2 200	1 880	409	-	434
	$/year	33 660	189 880	45 400	-	40 620
Diesel oil	t/year	1 233	679	360	360	295
	$/year	51 786	229 502	102 600	123 840	75 100
Natural gas	1000 nm^3/year	-	1 117	2 781	3 258	2 580
	$/year	-	78 190	215 527	215 028	201 300
Electri-city	-10^3 KWh/year	19 329	12 000	14 200	14 500	14 208
	$/year	386 580	251 309	548 498	527 273	284 000

4. ANNUAL WATER COSTS

Water consumption in \ Year	1990	1991	1992	1993	1994
t / year	957 000	793 000	665 000	620 000	393 000
$ / year	22 000	30 100	61 400	71 800	46 920

5. ENERGY AUDIT's RESULTS

5.1. SOURCE OF HEATING

The consumption of natural gas is measured with a device, having three displays - two for the mechanical counters and a third for the electronic one. The payment of the consumed natural gas is done according to the highest indication (see Figure 1.). The difference between the highest and the lowest indications varies

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in the range of 10 to 15%. Supposing that real consumption is within this range, we can assume that the costs for the natural gas consumption exceed the real ones by approximately (~) 5%.

Permanent checking and agjusting of the combustion processes in the boilers is needed, because measurements indicate average coefficient of efficiency of ~ 0.85. According to the data, presented by the producer company, the maximum coefficient of efficiency is 0.89, therefore losses are about 4%.

5.2. STEAM CONSUMERS

- about 80% of the steam traps in the company are out of operation - 25% losses,
- 60% of the reducing valves are out of operation - 5% losses,
- 10% of the thermoregulators in the air heating systems are out of operation - 0.5% losses,
- during 20% of the annual working time period the condensate tanks are out of operation due to depreciated automation units and pumps (average capacity 4 kw - 10 pcs.). For this reason condensate is discharged on emergency. The price per ton of condensate , including the price of the water, its softening and heating, runs up to 3.42 USD/ton, while heat losses (from discharge, lack of heat insulation etc.) are 5%.
- lack of heat insulation on about 15% of the pipelines - 0.3% total losses.

5.3. DIRECT CONSUMERS OF FUELS

- HOFMAN - SHVABE discharges 7330 nm^3/h of air at 110° C and content of the combustion component 114 g/h.. Conservation of about 5% could be achieved if part of this air is used to heat the burner of the unit.

- MOR is equiped with 15 burners, working on diesel oil. The prices of the diesel oil and its equivalent in natural gas are respectively 30.30 USD/Gcal and 12.50 USD/Gcal. Having such a considerable difference in prices (probably influenced rather by the state of affairs) a reduction of fuel costs by ~ 58% is possible. There are other additional advantages: there is no more need in maintenance and each year replacement of a filter, with the price of ~ 4500 USD, the quality of the emissions, discharged in the environment is improved, the low-quality final product is reduced by ~ 1%.

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5.4. CONSUMERS OF ELECTRICITY

The consumption of electricity for lighting can be reduced by replacing the conventional lighting units with such of lower energy consumption, observing the sanitary standards for room lighting.

6. RECOMMENDATIONS FOR RAISING ENERGY EFFICIENCY IN THE COMPANY

All calculations have been done on the basis of an average consumption and duration of operation of the equipments 4000 hours per year.

The following recommendation have been fulfilled:

* ii. 2 and 5 - USAID, RCG/ Hagler, Bailly
* ii. 3 and 4 - investments of the company itself, delivery from ARMSTRONG Int., Inc.- USA.

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LIST OF RECOMMENDATIONS

N°	Recommendation (Description)	Necessary equipment	Preliminary investments needed [USD]				Maintenan -ce of the new equipment	Annual savings [USD/year]			Payment period	Other additional
			Delivery	Installation	Enginee-ring	Total	USD/year	From ener-gy conser-vation	From maintenance	Total	[years]	effects
1	2	3	4	5		7	8	9	10	11	12	13
1	Measurement of natural gas consumption	Figure 1. Natural gas consumption meter 6000 nm^3/h	6 840	250	300	7 390	100	16 900	-	16 900	0.379	-
2	Adjustment of boilers combustion processes	Gasanalyser	5 700	-	300	6 000	200	12 500	-	12 500	0.487	Environmental protection
3	Steam Traps replacement - 270 pcs.	Steam traps - 270 pcs	48 000	5 000	1 000	54 000	1 000	122 000	4 000	126 000	0.432	-
4	Reduction valves replacement - 11 pcs.	Reduction valves - 11 pcs.	30 000	2 000	500	32 500	500	25 000	3 000	28 000	1.18	-
5	Replacement of thermoregulators - 2 pcs.	Figure 2. Thermoregulators - 2 pcs.	2 400	100	100	2 600	50	1 560	500	2 060	1.293	Observation of sanitary requirements
6	Replacement of condensate tanks - 10 pcs.	Condensate stations - 10 pcs.	67 000	4 000	2 000	73 000	1 000	23 280	Water prep 43 350 El.consum. 1 600 Mainten. 5 000	75 230	0.983	Reduced water consumption
7	Setting of heat insulation	Heat insulation ~ 300 m	3 000	1 000	-	4 000	200	14 700	-	14 700	0.276	-
8	Replacement of the burner of HOFMAN-SHVABE	Figure 3.Burner with 1 500 000 kcal/h,diesel, 1pc.	~13 000	2 000	1 000	16 000	500	7 000	-	7 000	2.46	Environmental protection

LIST OF RECOMMENDATIONS

N°	Recommendation (Description)	Necessary equipment	Preliminary investments needed [USD]				Maintenan -ce of the new equipment USD/year	Annual savings [USD/year]			Payment period [years]	Other additional effects
			Delivery	Installation	Enginee-ring	Total		From ener-gy conser-vation	From maintenance	Total		
1	2	3	4	5		7	8	9	10	11	12	13
9	Replacement of the burners of MOR	Figure 4.Burner with 150000 kcal/h,gas. 15 pcs.	75 000	7 000	1 000	83 000	15 000	110 500	Quality 252 000 Mainten. 75 000	110 500 437 500	0.869 0.196	Environmental protection
10	Replacement of lighting units	Lighting units with lowered consumption - 350 KW	14 000	7 000	1 000	22 000	4 000	35 000	-	35 000	0.710	-

NOTE: ii.2 and 4 are proposals for financing first stage projects (1994)
ii. 6 and 9 are proposals for financing second stage projects (1995)

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

RUNO - Gabrovo Ltd.

by

Nikola Kalayanov

Stoyan Nevenkin

Ljubomir Spassov

ALPHA-PRO Energy Consultants

for

Hagler Bailly Consulting, Inc.

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ENERGY AUDIT REPORT

"RUNO - G" Ltd.

WOOL SCOURING PLANT

GABROVO , BULGARIA

Prepared for:

RCG/ Hagler, Bailly, Inc

370 L'Enfant Promenade, S.W., Suite 700

Washington, D.C. 20024

Prepared by:

ALPHA - PRO Energy Consultants

Sofia

October 1994

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Production & Electricity consumption in scouring department from Jan.1991 to Dec. 1993

Production & Water consumption in scouring department from Jan.1991 to Dec. 1993

Water consumption (Jan.92 - Dec.92) in the main departments

Steam consumption vs. Production in scouring department from Jan. 1991 to Dec.1993

Electricity consumption vs. Production in scouring department from Jan.1991 to Dec.1993

Water consumption vs. Production in scouring department from Jan. 1991 to Dec.1993

Specific Steam consumption vs. Production in scouring department from Jan. 1991 to Dec.1993

Specific Electricity consumption vs. Production in scouring department from Jan. 1991 to Dec.1993

Monthly heat consumption (1992) - bills and heat meter readings

Wool returned for second scouring (period Jan.92 - Apr.93)

Heat for wool drying (Jan.92 - Dec.92)

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FOREWORD

This report presents the results of the detailed energy audit of the wool scouring plant "RUNO - G" in Gabrovo, Bulgaria. The audit was performed by a team of consultants from ALPHA - PRO Energy Consulting Group, Sofia over the period from May 5 to June 30 1994.

This audit was performed as a part of a program funded by the United States Agency for International Development (USAID) to promote improved energy efficiency in the industrial sector of Bulgaria. The operation of this program was co-ordinated by the professional staff of the RCG/Hagler, Bailly, Inc.

The audit of RUNO-G Ltd. is important to the audit program because the plant is one of the several Bulgarian wool processing plants. The energy conservation measures identified at RUNO can be applied advantageously to the other ones and thus to multiply the benefits for the country.

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ACKNOWLEDGEMENTS

The energy audit of the RUNO - G Ltd. in Gabrovo was performed under a program sponsored jointly by:

- The United States Agency for International Development (USAID),
- The RUNO - G Ltd.

Technical assistance was provided by a team of consultants from RCG/Hagler, Bailly, Inc. ALPHA-PRO wishes to tank all the people at USAID, RCG/Hagler, Bailly, Inc. (especially to Mr. Mark Oven and Mr. Laurent Pommier) and RUNO - G Ltd. that contributed to the success of this audit program. Everyone with whom we came in contact was supportive and co-operative working toward the common goal of improved energy efficiency in the Bulgarian industrial sector.

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EXECUTIVE SUMMARY

1. INTRODUCTION

This executive summary presents the findings, conclusions and recommendations resulting from the energy audit of the wool scouring plant "RUNO - G" in Gabrovo, Bulgaria.

To identify the areas where energy savings can be made, ALPHA - PRO conducted both preliminary and detailed energy audits of the plant. Interviews with key plant personnel provided an understanding of RUNO - G's operations and help to identify major energy consuming equipment and systems. This led to testing of the key processes and evaluation of their operating efficiency.

2. PLANT BACKGROUND AND ENERGY CONSUMPTION

The wool primary processing plant of RUNO - G Ltd. is a facility for row wool scouring as well as producing Merino tops. The plant operates two shifts five days per week, now operating near 60% of the full capacity.

The annual production of the plant is approximately 1 600 000 kg of wool products while the total energy consumption is about 700 000 kWh electricity and 12 000 Gkal of steam.

With energy prices due to continue rising in the coming years, RUNO can expect energy to become the most significant component of its production costs. The annual energy and utility consumption for the last three years is presented in the energy audit forms.

The plant is supplied with electricity by the National Energy Company and with steam by the Thermal Power Station of Gabrovo.

3. SUMMARY OF SAVINGS

For the purpose of this summary, all the energy cost savings are calculated on the basis of local energy prices and labour costs.

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The total annual energy savings identified as a rezult of this audit are 3574 Gkal of steam and 163760 kWh of electricity. The savings represent 35.3% savings in steam consumption and 25,2% savings in electricity.

The cost savings are 3 780 300 lvs on local energy prices.

The investment required to implement the energy conservation program detailed in this report is 2 837 700 lvs. Nearly 67% of the savings are achievable by implementing housekeeping type projects with no outside financial assistance. The simple paybacks of all the projects recommended for implementation are less than 3 years.

Exhibit 1 presents a listing of all the recommended project showing the calculated energy and costs savings, costs of implementation and payback. The projects are arranged in three groups - A,B and C.

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Exhibit 1. RUNO Summary of Energy Conservation Recommendations

Project No	Project Title	Annual Energy Saving		Cost Savings, Investment Cost and Simple Payback, lvs		
		Gkal	kWh	Savings	Costs	Payback
A.1	Institute Steam Trap Management Program	1386		900900	51000	0.1
A.2	Improve Insulation of Pipes and Fittings	408		289680	142500	0.49
A.3	Control the Wool Scouring	156		234000	316000	1.37
A.4	Repair compressed Air Leaks		63360	126720	18200	0.15
B.1	Implement new Steam Measuring System	820		582200	352000	0.6
C.1	Implement of Condensate Heat utilizing System	372		558000	333000	0.6
C.2	Replace existing Air Compressors		100400	440800	1625000	3.6
C.3	Reorganizing the Wool Scouring Process	432		648000	0	0
	Total	3574	163760	3780300	2837700	0.987

ENERGY AUDIT REPORT FORMS

1. Plant information

Name of Enterprise:	RUNO-G Ltd.
Address:	41 Industrialna Str, 5305 Gabrovo, Bulgaria
Telephone:	+359 (66) 2 65 70
Fax:	+359 (66) 2 70 42
Contact Person:	Eng. Tsonka Boevska
Title:	President
Telephone:	359 (66) 2 53 45

2. Energy auditor information

Dates - audit started: May 1994 ; audit completed: June 1994

Energy audit company: ALPHA - PRO Energy Consultants

Energy audit team leader: Dr. Nikola Kaloyanov

Address:	h.c. Mladost 1, bl.71, en.A, app.40 Sofia, Bulgaria
Telephone:	+359 (2) 74 26 09
Fax:	+359 (2) 52 67 40

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3. Energy audit information

The purpose of this audit was to identify, and evaluate the energy consumption concerning heat, electricity and water consumption in the scouring and carding departments, as well as the heating system of the plant, and to recommend appropriate energy conservation opportunities.

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

The low overall energy efficiency of the plant is due to the complexity of the following major factors: decreasing the production during the last 5 years, wearing out of energy transfer, control and measurement equipment, lack of a consistent energy management program.

There are several energy technological systems with significant potential for increasing the energy efficiency:

1. the steam distribution and consumption system;
2. the compressed air system;
3. the steam measuring system.

New experience

1. Applying in practice the knowledge obtained during the energy management course, provided by UNSAID and RCA/Haggler, Bailey, Inc.

2. Experience in contracting between a plant as a client and TPS as a heat/steam supplier.

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4. Historical production and energy consumption

Year:	1991	1992	1993	UNITS
Production:				
scoured wool:	1302927	1945347	1302472	kg
worsted band:	371984	516834	324260	kg
Energy:				
electricity:	805465	799800	649500	kWh
steam:	10881	13604	10130	Gkal
other :				
water	92200	107620	72600	m3

5. Historical energy costs

Year:	**1991**	**1992**	**1993**	**UNITS**
electricity:	328196	577321	600011	lvs
steam:	548590	5673743	5710115	lvs
other:				
water	73491	124817	232434	lvs

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

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA
Auditor's name: Dr. N.Kaloyanov
Report date: June, 1994

Supply contract terms:

Fuel or heat supply company's name TPS GABROVO
Contract maximum demand: 15 000 Gkal
Minimum charge (cost):
Other:

CONSUMPTION OR BILLDING DATA FOR 12 - MONTH AUDIT PERIOD
FOR: (NAME OF ENERGY FORM): STEAM for scouring department

Meter Reading Mo/day/yr	Physical Consumpti tons	Thermal Consumption Gkal	Total Costs lvs	Montly Heating Degree-Day Hdd	Heating Index Gkal/HDD	Projrct. Index Gkal/ton	Notes on plant conditions and changes
Jan/22/93	1535	1052	569634	595	1.768	8.356	
Feb/22/93	2198	1498.8	811719	484	3.097	12.45	
Mar/22/93	2196	1470.5	797267	386	3.809	10.47	
Apr/22/93	756	529.6	286348	156	3.395	8.027	
May/22/93	726	565.3	343696	57	9.917	4.978	
Jun/22/93	627	486.15	311451	-	-	3.953	
Jul/22/93	767	594,49	380862	-	-	4.513	
Aug/22/93	198.6	158.74	101552	-	-	13.955	
Sep/22/93	425	335.42	216083	26	12.9	2.749	
Oct/22/93	495.2	394.7	254164	145	2.722	3.242	
Nov/22/93	2533.8	1520.3	98551	330	4.606	13.243	Note: Heating degree-days based on
Dec/22/93	1564.2	1016.7	655788	521	1.951	9.109	reference temperature of
TOTAL	14021.8	9622.7	5710115	2700	3.564	7.388	12 oC - ambient, 19 oC - room.

ENERGY BALANCE - FUEL, STEAM OR HEAT
ENERGY TYPE: STEAM
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA
Auditor's name: Dr. N.Kaloyanov
Report date: June, 1994

Item No	Equipment or Process Description	Maximum Load t/h	Average Load t/h	Load of Peak Demand t/h	Energy Consumption Gkal/year	Total Energy Cost lvs/year
1	Wool scouring process (water heating)	4.5	1.13	4.5	3474.1	2061532.7
2	Wool drying process	2.2	1.2	0	3689.2	2189173.2
3	Plant heating system	2.8	0.7	0.7	2152	1276997.8
4	Hot water utility	0.7	0.1	0.1	307.4	182441.3
TOTAL PEAK DEMAND				5.3		
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)					9622.7	5710115

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

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **A.1** Institute Steam Trap Management Program
AREA OF THE PLANT AFFECTED: Steam Distribution and Utility System
FINDINGS CONCERNING EXISTING CONDITIONS: Faulty steam traps and their consequent energy losses as well as their negative impacts on production are a significant problem at RUNO. The team tested over 45 traps. 40% were found to be failed open.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase a number of new steam traps (a minimum of 20) of the type already used throughout the plant. Replacement of traps identified as failed open. 2. Purchase 13 closing valves and installation on bypasses and other areas as the traps are repaired or replaced. 3. Train maintenance staff in testing and replacement of traps.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				1386		900900 (a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	8000	
Equipment procurement	33000	
Equipment installation	10000	
Equipment commissioning		
TOTAL INSTALLED COST	51000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	5000	(c)

$$\text{PAYBACK PERIOD: } \frac{b: 51000}{a: 900900 - c: 5000} = 0.1 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: Begin replacement of traps and installation of the valves during the tests performed by the team as the equipment is available.

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY **ACTION No A.2**
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **A.2** Improve Insulation of Pipes and Fittings
AREA OF THE PLANT AFFECTED: Steam and hot water distribution system
FINDINGS CONCERNING EXISTING CONDITIONS: The majority of the steam and condensate lines were found equipped with adequate insulation. The findings indicate an urgent need for insulation both inside lines about 110 m in length and outside located lines 120 m in length.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. The inside lines should be insulated with glass wool insulation. 2. The outside lines should be insulated with glass wool insulation and metal sheathing. 3. The main hot water utility tank is to be insulated with glass wool insulation.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				3408		289680 (a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	-	
Equipment procurement	99750	
Equipment installation	42750	
Equipment commissioning		
TOTAL INSTALLED COST	142500	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	-	(c)

$$\text{PAYBACK PERIOD: } \frac{b: 142500}{a: 289680 - c: 0} = 0.49 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: Begin insulation of pipes in august 1994.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY **ACTION No A.3**
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **A.3** Control of the wool drying process
AREA OF THE PLANT AFFECTED:
FINDINGS CONCERNING EXISTING CONDITIONS: During the drying process the wool is overheated in the range of 50 oC above the required temperature level. This is a result of the temperature regulating valves.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase and installation of 4 new temperature self-operated regulators Dy= 50 mm.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	MWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				156		234000 (a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	-	
Equipment procurement	312000	
Equipment installation	4000	
Equipment commissioning		
TOTAL INSTALLED COST	316000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	4000	(c)

$$\text{PAYBACK PERIOD: } \frac{b: 316000}{a: 234000 - c:4000} = 1.37 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: Purchase of TRV - March 1995 (1 Gkal = 1500 lvs) Instalation - May 1995

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY **ACTION No A.4**
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **A.4** Repair compressed air leaks
AREA OF THE PLANT AFFECTED: Compressed air system
FINDINGS CONCERNING EXISTING CONDITIONS: Air leaks were found in fittings, joints and pin holes in air distribution lines. Based on observations made by the team in the plant about 25% of the compressed air may be lost to leaks.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Replacement of 40 m pipes Dy 1/2" and repair leaks at times when the compressed air system is not operating.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	KWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction		63360				126720(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	-	
Equipment procurement	15800	
Equipment installation	2400	
Equipment commissioning		
TOTAL INSTALLED COST	18200	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	2400	(c)

$$\text{PAYBACK PERIOD: } \frac{\text{b: 18200}}{\text{a: 114048 - c:2400}} = 0.15 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1. Identify air leaks - May 1995 2. Purchase spares, fittings - May 1995 3. Repair air leaks - June 1995

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION No B.1
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **B.1** Implement new steam measuring system

AREA OF THE PLANT AFFECTED:

FINDINGS CONCERNING EXISTING CONDITIONS:

The main heat meter in use is an orifice based steam flow meter. It is necessary to change the orifice twice a year. Nevertheless, as a result of the daily variation of the load an error of 30% occurs for more than 12 hours per day in the winter. The heat is calculated by the TPS using the flow rate reading and the steam parameters (enthalpy) in TPS.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. Replace the existing steam flowmeter by a steam heat meter IWK - EWZ350.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	KWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				820		582200(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	-	
Equipment procurement	312000	
Equipment installation	40000	
Equipment commissioning		
TOTAL INSTALLED COST	352000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	-	(c)

$$\text{PAYBACK PERIOD: } \frac{b: 352000}{a: 582200 \;-\; c: 0} = 0.6 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

1. Purchase - September 1994
2. Installation - October 1994

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY **ACTION No C.1**
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **C.1** Implement of condensate heat utilizing system

AREA OF THE PLANT AFFECTED: Stem distribution system

FINDINGS CONCERNING EXISTING CONDITIONS:

The condensate is returned to TPS via 30 m3 in volume tanks with temperature 98 Co. Due to the existing local conditions the plant will be charged if the returned condensate temperature drops below 30 oC.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. Design and installation of recuperative heat exchange system utilising condensate heat for pre-heating water required for the scouring process. The recuperative system consist of a plate heat exchanger, two hot water pumps, closing valves.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	KWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				372		558000(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	35000	
Equipment procurement	280000	
Equipment installation	18000	
Equipment commissioning		
TOTAL INSTALLED COST	333000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	15000	(c)

$$\text{PAYBACK PERIOD: } \frac{b: 333000}{a: 558000 - c: 15000} = 0.6 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

1. Design of the system - October 1994
2. Purchase of equipment - May 1995
3. Installation - August 1995

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY **ACTION No C.2**
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **C.2** Replace existing air compressors system
AREA OF THE PLANT AFFECTED: Air compressor room.
FINDINGS CONCERNING EXISTING CONDITIONS: Two water cooled compressors of nominally 175 kW and 75 kW are installed in order to provide the main technology processes with compressed air. Compressed air accounts for nearly 30% of all electricity use in the plant. The existing compressors are not reliable, very expensive for maintenance and too large for the plant.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase of one air cooled compressor (10 l/min , 8 bar) 2. Replace of the 175kW existing compressor.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy	Oil		Water	Total cost
	kW	KWh/yr	lvs/y	Gkal/yr	lvs/y	lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction	50+10	100400	170000		70000	440800(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design		
Equipment procurement	1625000	
Equipment installation		
Equipment commissioning		
TOTAL INSTALLED COST	1625000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:		(c)

$$\text{PAYBACK PERIOD: } \frac{b: 1625000}{a: 440800 - c: 0} = 3.6 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1. Design of the system - 2. Purchase of equipment - 3. Installation -

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY **ACTION No C.2**
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **C.2** Replace existing air compressors system
AREA OF THE PLANT AFFECTED: Air compressor room.
FINDINGS CONCERNING EXISTING CONDITIONS: Two water cooled compressors of nominally 175 kW and 75 kW are installed in order to provide the main technology processes with compressed air. Compressed air accounts for nearly 30% of all electricity use in the plant. The existing compressors are not reliable, very expensive for maintenance and too large for the plant.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY: 1. Purchase of one air cooled compressor (10 l/min , 8 bar) 2. Replace of the 175kW existing compressor.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy	O.C		water	Total cost
	kW	KWh/yr	lv/y	Gkal/yr	lvs/y	lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction	50+10	132400	116500		60000	264800(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	~~5000~~	
Equipment procurement	1625000	
Equipment installation	~~12000~~	
Equipment commissioning		
TOTAL INSTALLED COST	1642000	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	15000	(c)

$$\text{PAYBACK PERIOD: } \frac{\text{b: } 1642000 \quad (65000)}{\text{a: } 264800 - \text{c: } 15000} = 6.62 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1. Design of the system - 2. Purchase of equipment - 3. Installation -

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY **ACTION No C.3**
Prepared for USAID and RCG/Hagler, Bailly

Plant name: RUNO - G Ltd.
Address: 41 Industrialna Str., 5305 Gabrovo, BULGARIA

Auditor's name: Dr.N. Kaloyanov

Report's date: June.1994

ACTION NO. AND BRIEF DESCRIPTION: **C.3** Reorganizing the wool scouring process.

AREA OF THE PLANT AFFECTED:

FINDINGS CONCERNING EXISTING CONDITIONS:

In average 25% of the wool scoured has to be scoured twice due to the dirty row material. The wool is dryied twice which can be avoid.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. Reorganize the scouring process: After the first scouring the wool is not necessary to be dryied by steam. It can pass the dryied by steam. It can pass the dryers squeezed and can to be transported for second time scouring, or stored for the next day scouring.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam			
	Peak	Energy				Total cost
	kW	KWh/yr		Gkal/yr		lvs/year
Baseline - existing conditions						
After recommended action						
Net reduction				432		648000(a)

COST - BENEFIT ANALYSIS:

PROJECT COST ESTIMATE	Cost, lvs	Notes
Engineering design	-	
Equipment procurement	-	
Equipment installation	-	
Equipment commissioning		
TOTAL INSTALLED COST	-	(b)
Estimated increase in annual (non-energy) operations and maintenance cost:	20000	(c)

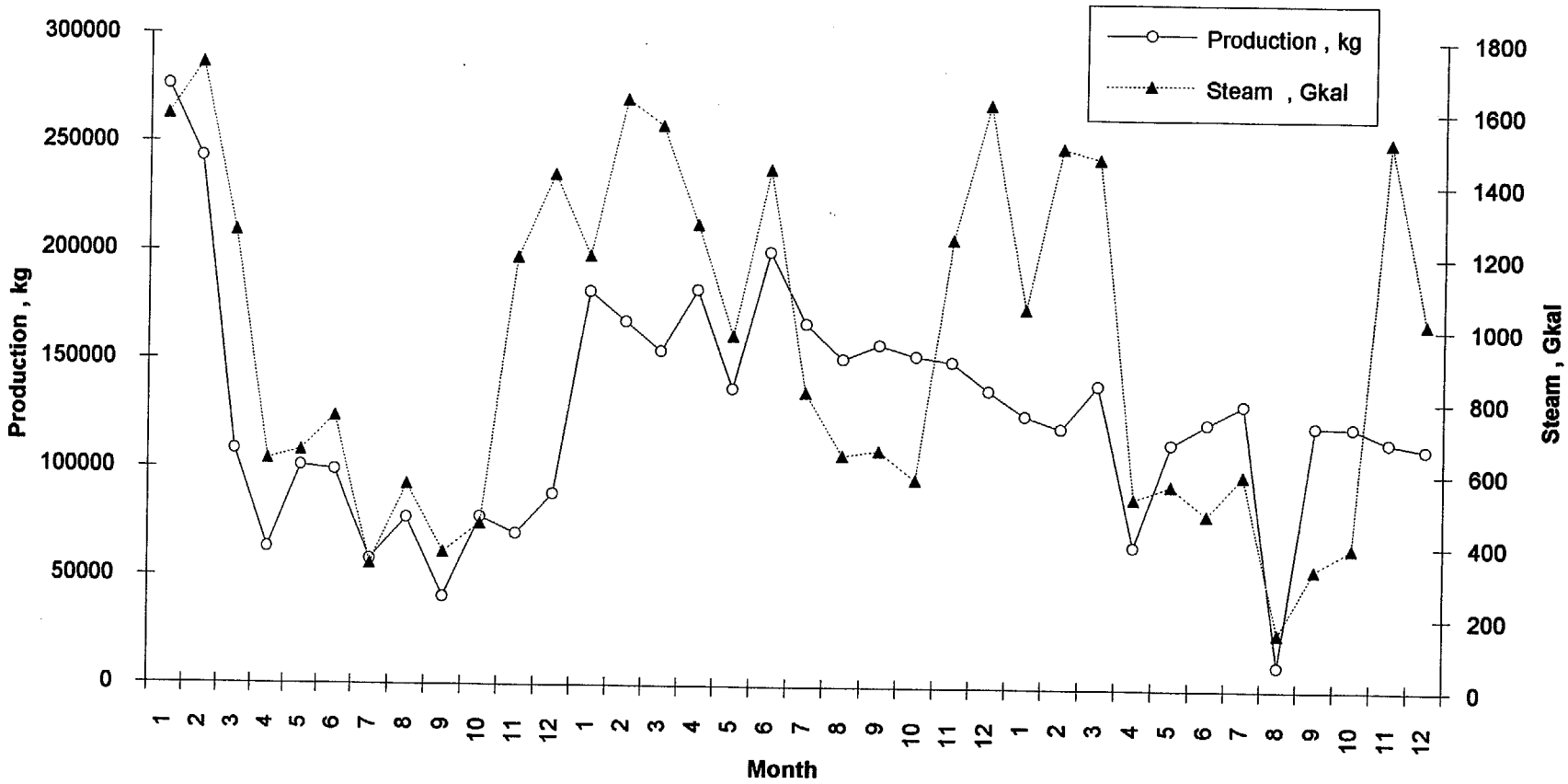
$$\text{PAYBACK PERIOD: } \frac{b: 0}{a: 648000 - c: 20000} = 0 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

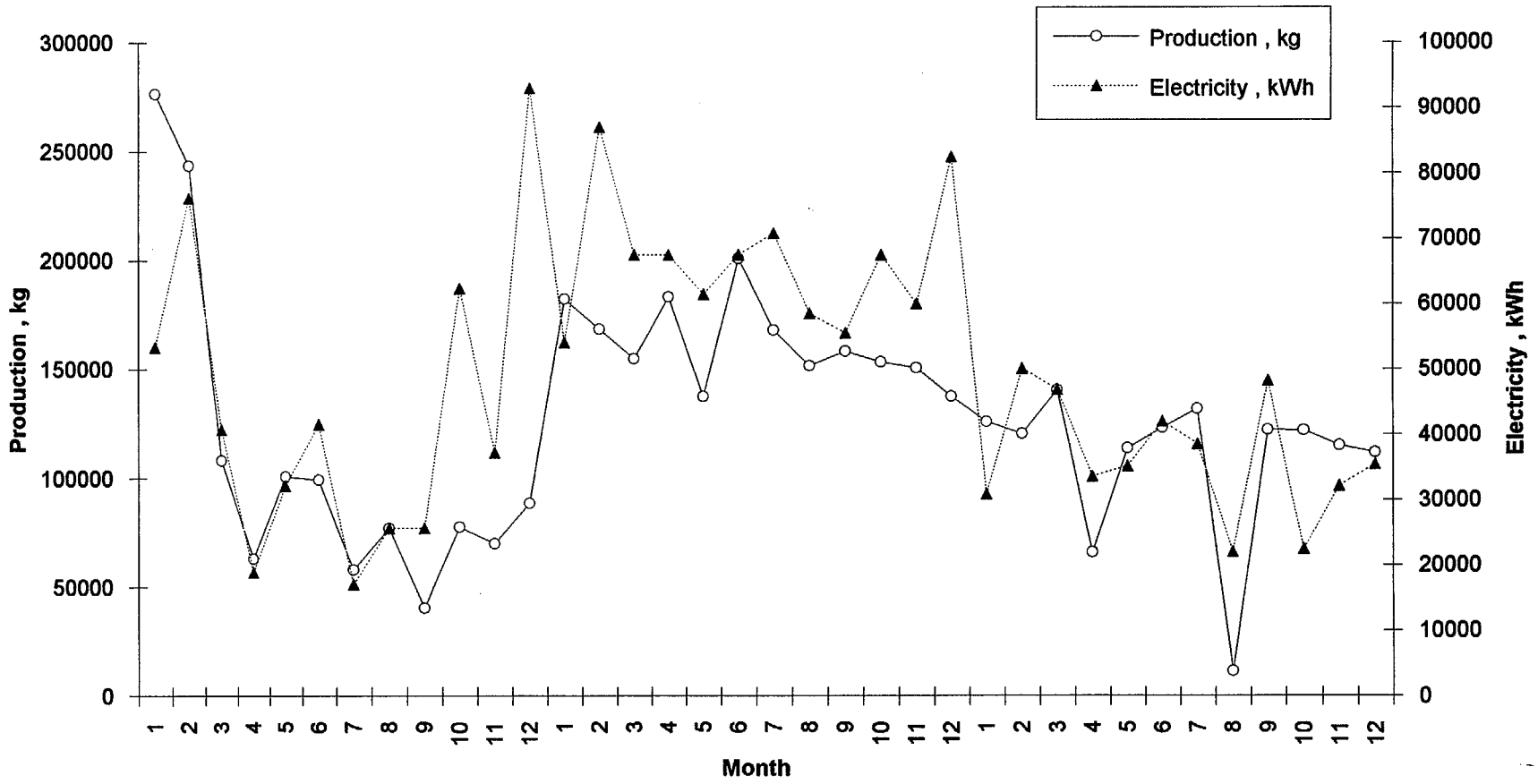
1. Design of the system of organisation -
2. Train of the team -

APPENDICES

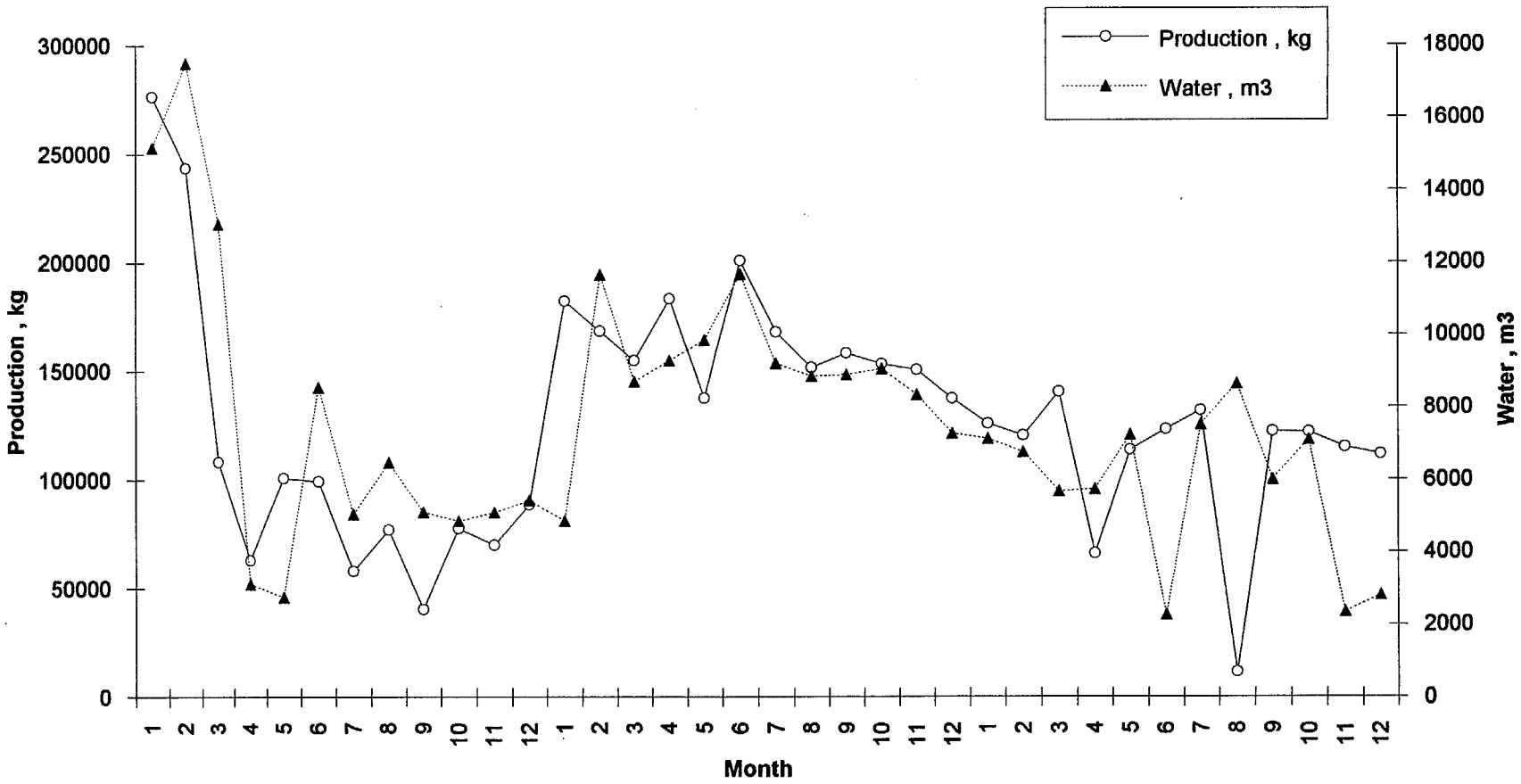
Production & Steam consumption in scouring department from Jan.1991 to Dec.1993

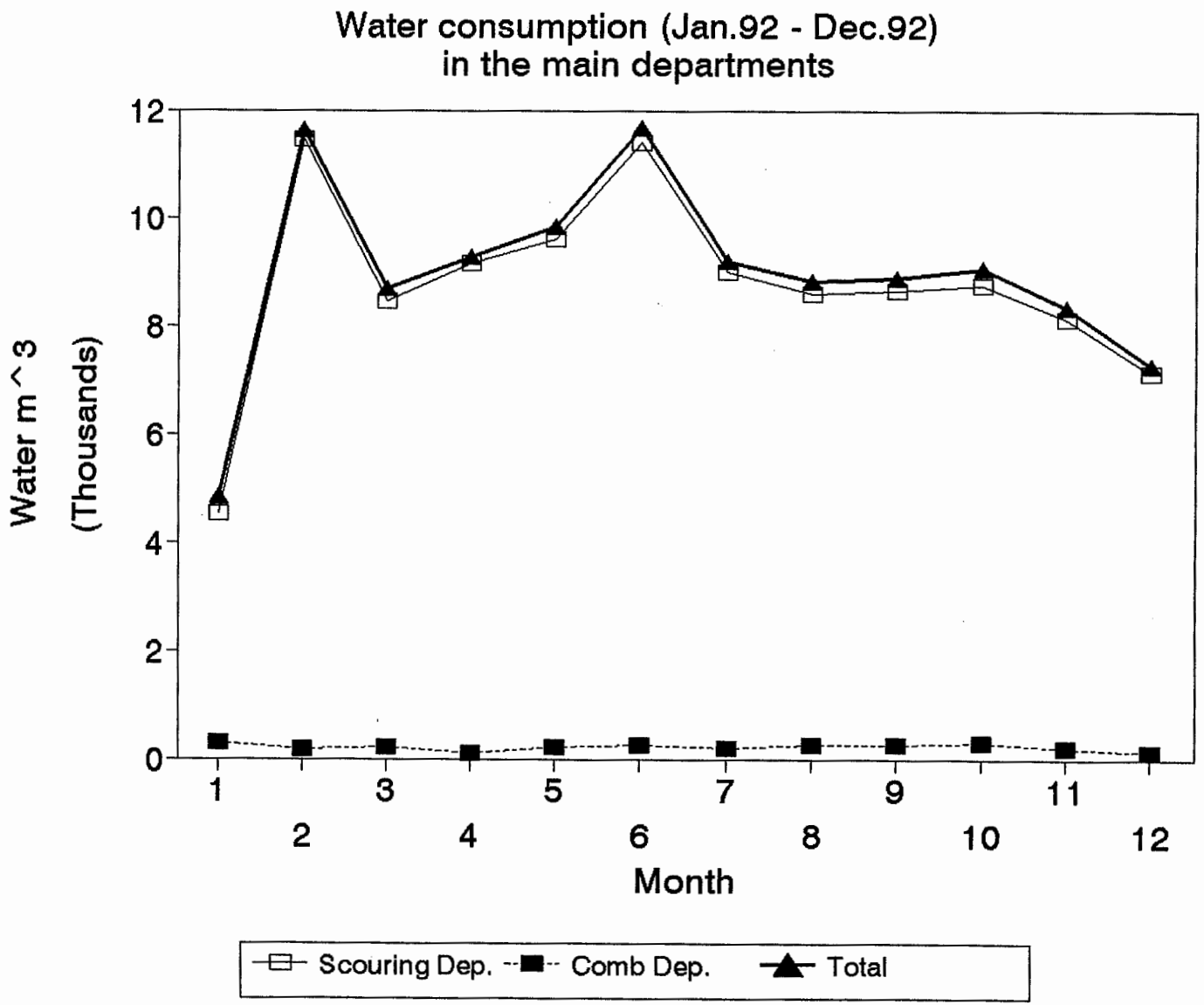


Production & Electricity consumption in scouring department from Jan.1991 to Dec.1993

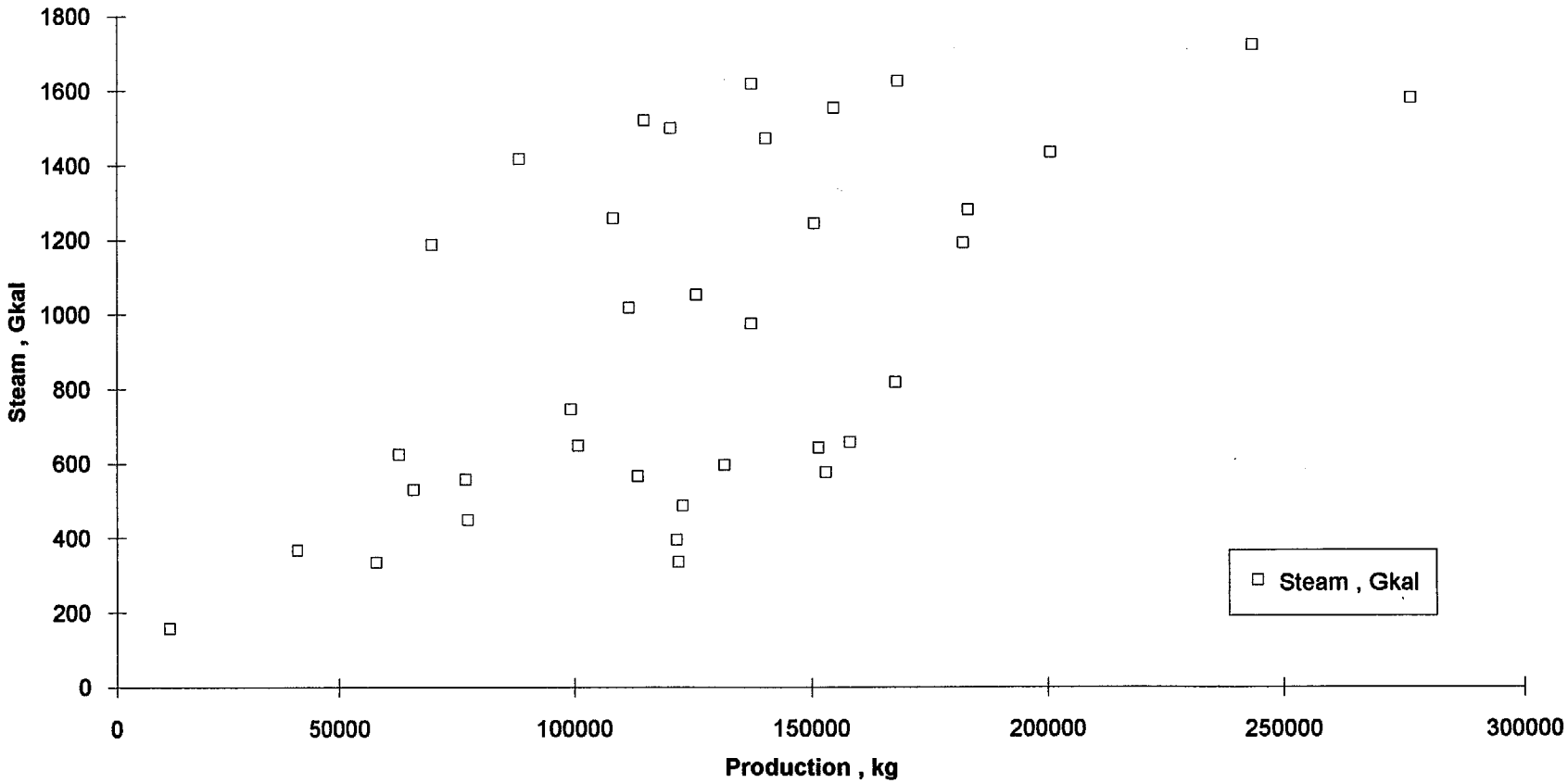


Production & Water consumption in scouring department from Jan.1991 to Dec.1993




Water consumption (Jan.92 - Dec.92)
in the main departments
Water m ^ 3
(Thousands)
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
Month
Scouring Dep.
Comb Dep.
Total

Steam consumption vs. Production in scouring department from Jan.1991 to Dec.1993



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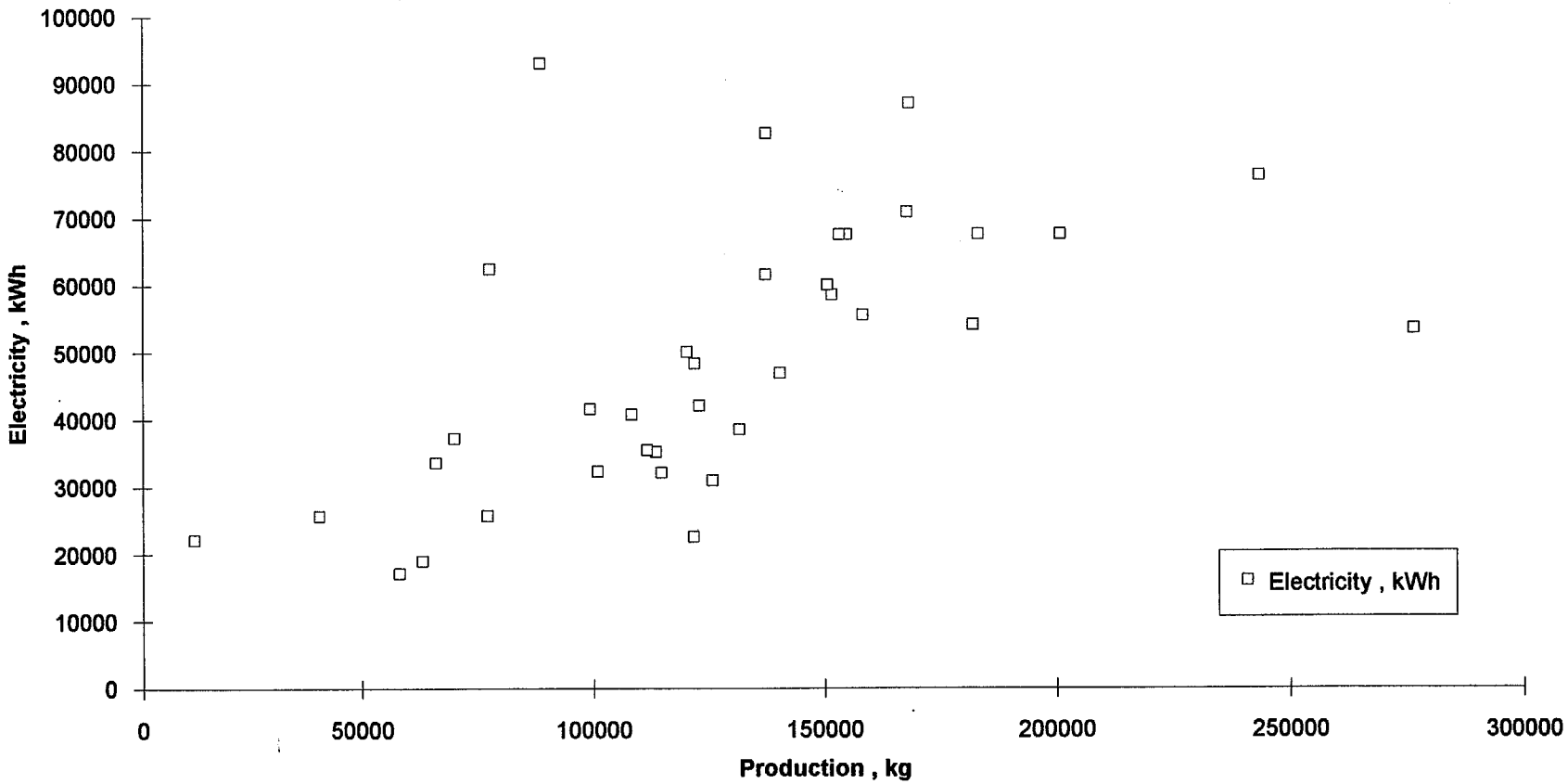
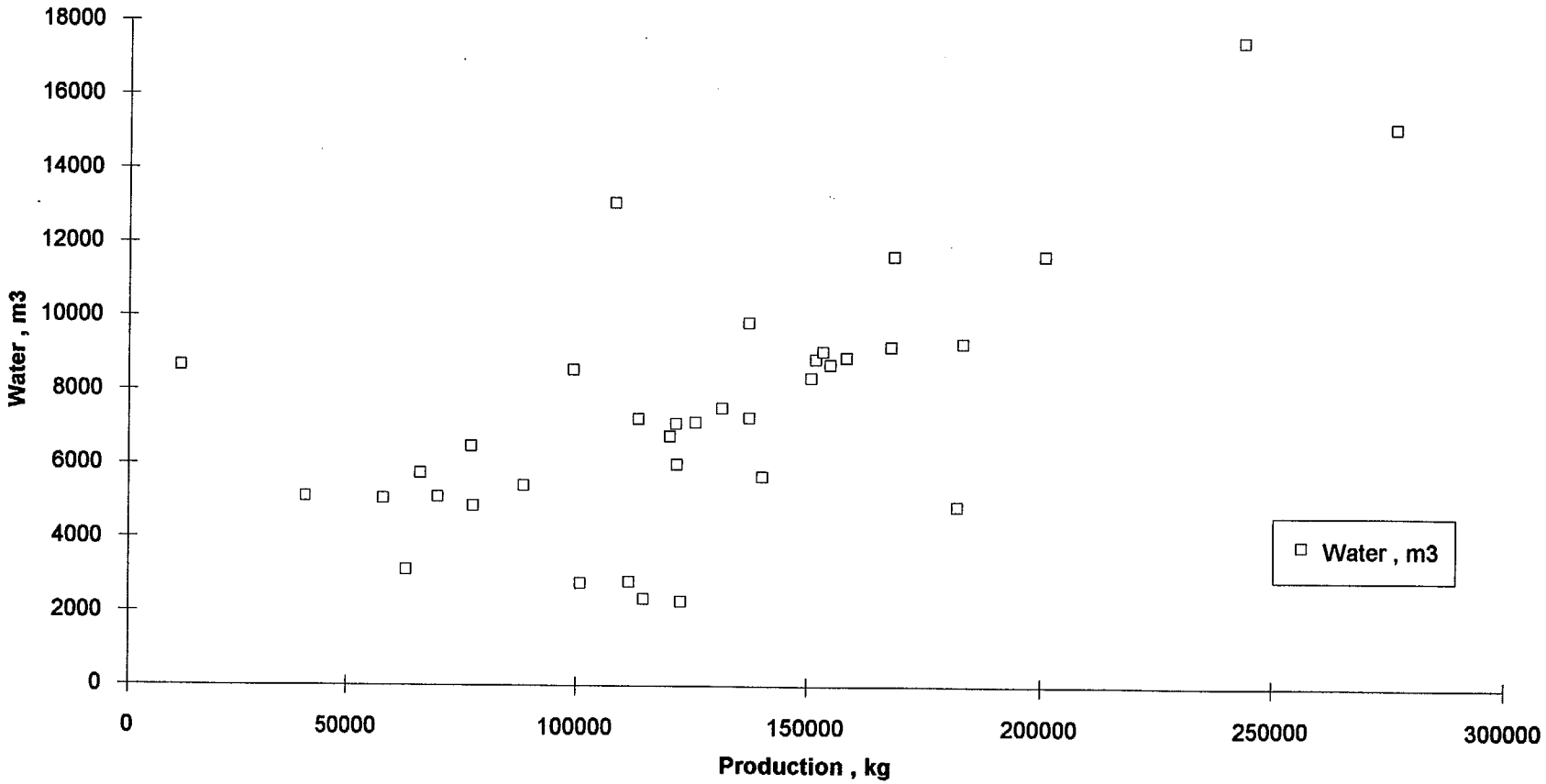
Electricity consumption vs. Production in scouring department from Jan.1991 to Dec.1993



Water consumption vs. Production in scouring department from Jan.1991 to Dec.1993



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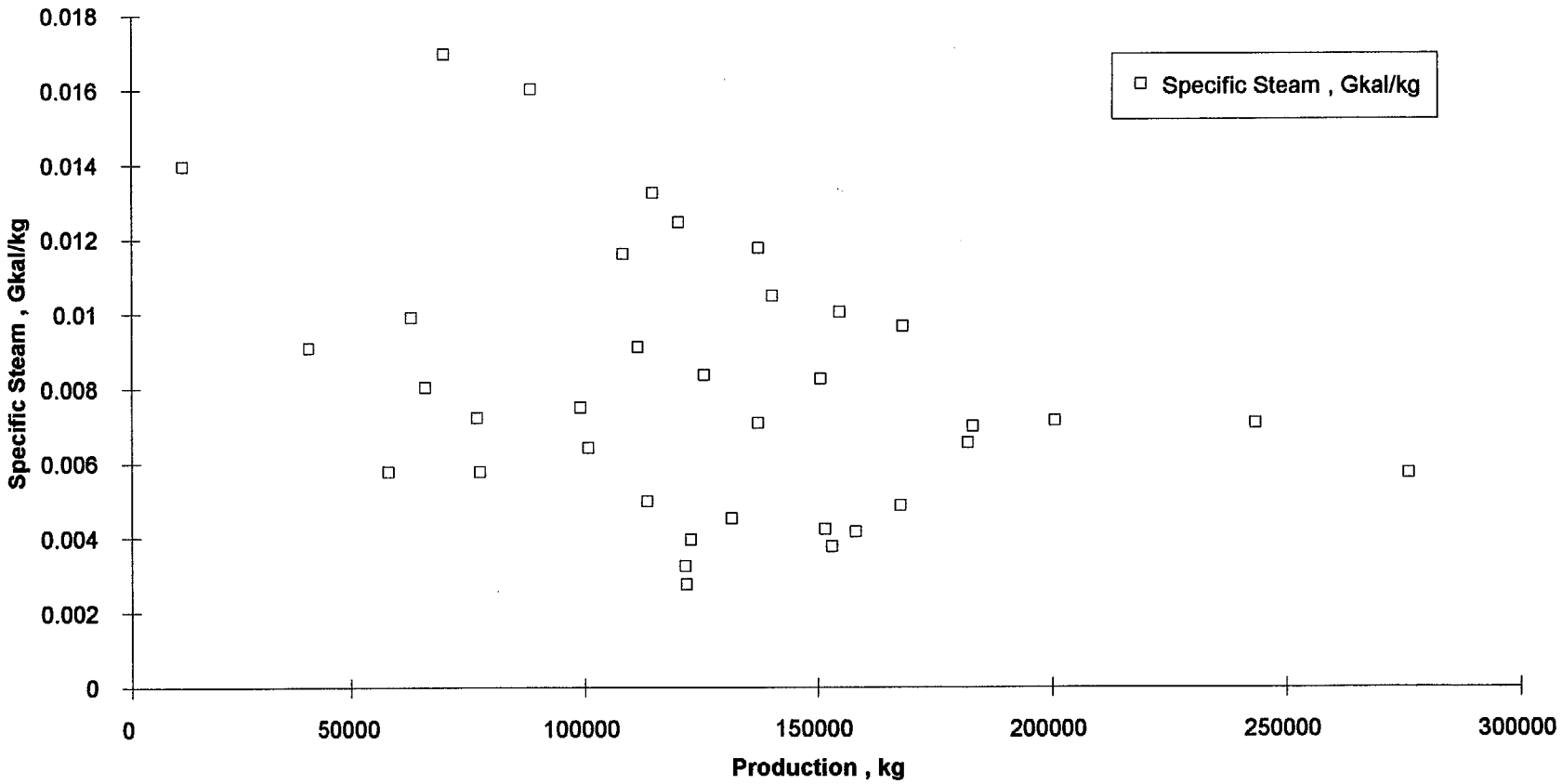
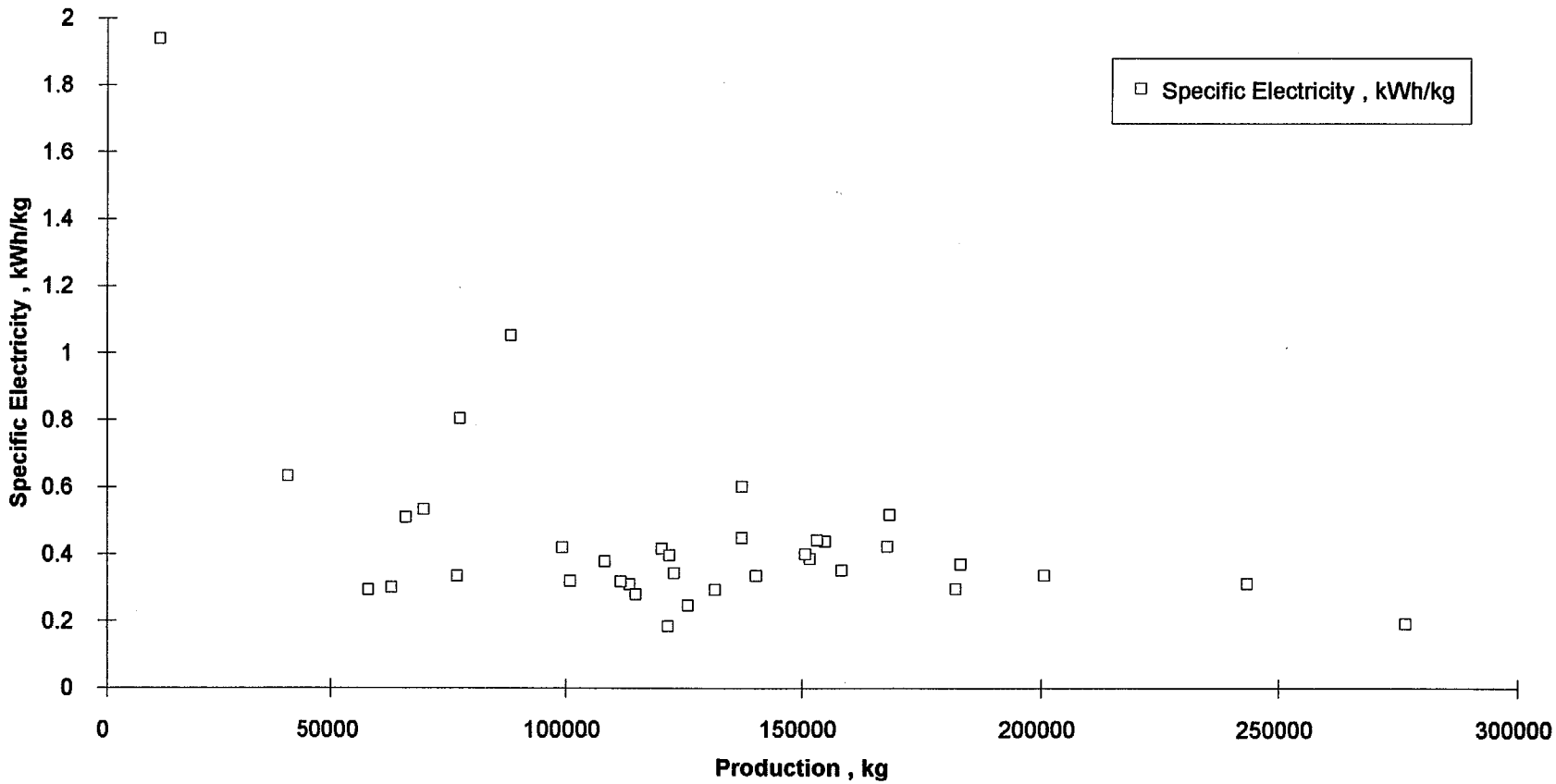
Specific Steam consumption vs. Production in scouring department from Jan.1991 to Dec.1993



Specific Electricity consumption vs. Production in scouring department
from Jan.1991 to Dec.1993



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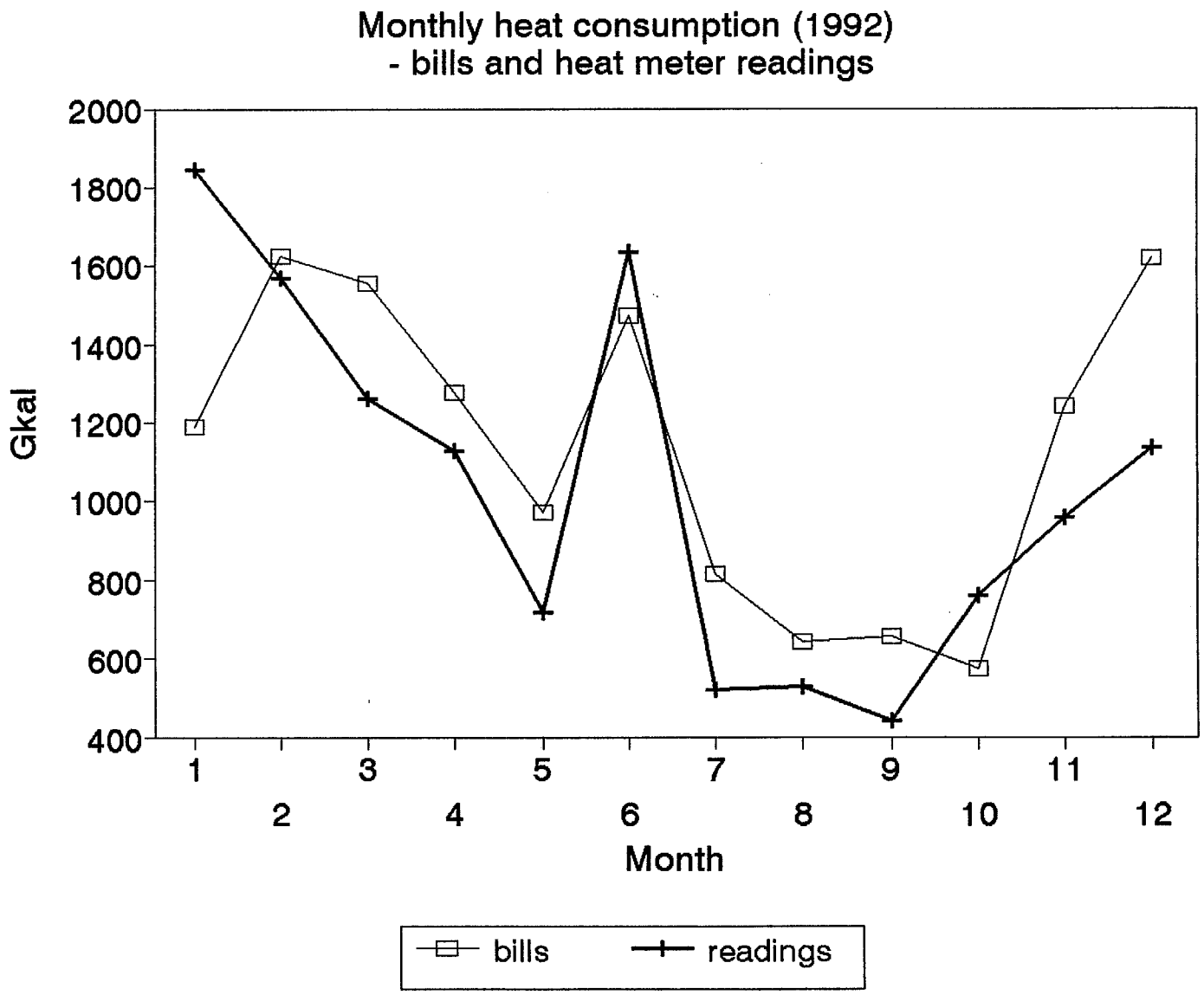
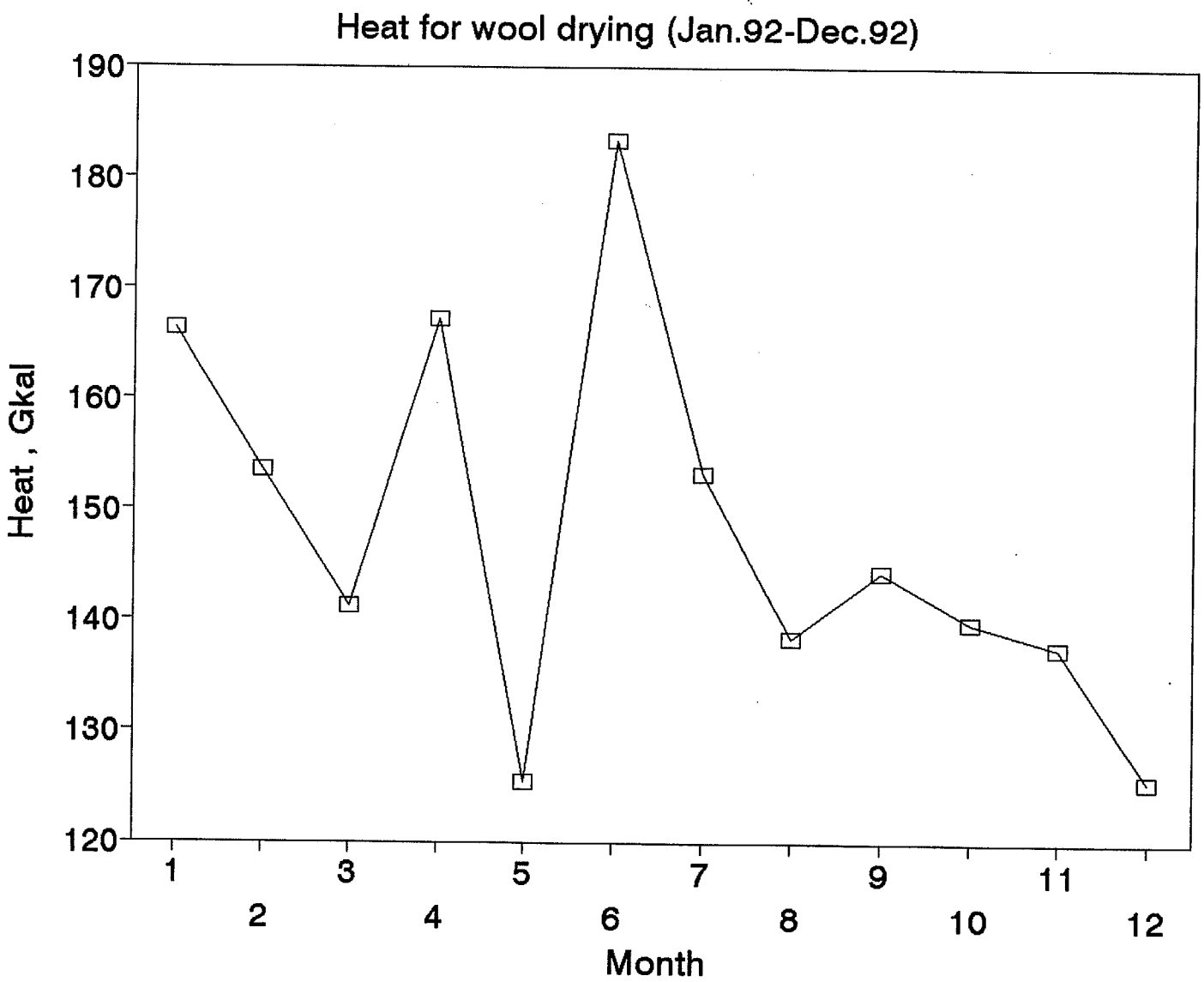

Monthly heat consumption (1992)
- bills and heat meter readings
Gkal
2000
1800
1600
1400
1200
1000
800
600
400
1
2
3
4
5
6
7
8
9
10
11
12
Month
bills
readings

24


Heat for wool drying (Jan.92-Dec.92)
Heat , Gkal
190
180
170
160
150
140
130
120
1
2
3
4
5
6
7
8
9
10
11
12
Month

28

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

Silicatceram AD

by

Boris Petkov

IVEL Ltd.

for

Hagler Bailly Consulting, Inc.

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ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailly

1. Plant information

Name of Enterprise:	Silicatceram AD
Address:	30, Kuklensko Shosse St. Plovdiv Bulgaria
Telephone:	+359 32 778991
Fax:	+359 32 772420
Contact Person:	Angel Koichev
Title:	Production and Technical Manager
Telephone:	+359 32 772369

2. Energy audit information

Dates - audit started: October 1993 audit completed: January 1994

Energy audit company:	IVEL Ltd.
Energy audit team leader:	Boris Petkov, CEM
Address:	56, Svoboda St. Plovdiv 4002 Bulgaria
Telephone:	+359 32 455055 +359 32 447563
Fax:	+359 32 455055

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3. Energy audit information

This energy audit focused on:

1. Process Description
2. Red brick Fabrication
3. Silica brick fabrication
4. Production Capacity and Output
5. Operating Schedule
6. Plant Utilities
7. Overall Energy Consumption and Costs
8. Energy and Production Relationships
9. Electricity Supply and Distribution
10. Electric Utility Bills
11. Plant Electricity Consumption
12. Electric Power end use Distribution
13. Electricity Use for Lighting
14. Petroleum-Based Fuels use: Mazout
15. Boilers
16. Steam and Steam Use

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Energy efficiency - the most significant findings of the audit:

1. Recover and Install Energy Monitoring Instrumentation
2. Reduce Boiler Blowdown
3. Return Steam Condensate to the Boilers
4. Optimal Selection, Repair of Faulty or Leaking Steam Traps
5. Improve Insulation and leaking of Pipes and Fittings in Steam and Hot Water Systems
6. Improve Efficiency of Mazout Burners
7. Improve Efficiency of Mazout Burners of the Brick Kiln
8. Quality Improvement measures contributing to Reduction of Energy Consumption and rejects

New experience - the most significant lessons learned during the energy audit:

1. Negotiate a good contract only with the top manager
2. Keep the top manage well informed in the course of the audit
3. Try to get as much information as possible from various sources
4. Try to focus on problems which have attracted the managers attention before but they were not able to solve them
5. Try to fulfill all your promises if any
6. Try to focus on energy efficiency measures which could be accepted by the top managers or at least could be easily explained and have the managers convinced in their feasibility.

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4. Previous actions

Other projects which resulted in improved energy efficiency:

In the previous years Silicatceram AD completed several important energy-related and energy conservation projects. These included the installation of:

- **insulation of the outdoor mazout tank**
- **new steam traps and filters from the silica bricks autoclaves**
- **boiler blowdown water recovery system**
- **flash steam recovery from silica brick autoclaves**

All of these systems have not been maintained and have deteriorated over time.

All of these projects were funded by the company.

State company "Silicatceram" Plovdiv

Energy consumption and production quantity for 1992

	Production of large size ceramic bricks (250x250x140)					Lime-silicate bricks size 1NF and 3.7 NF		
Month	**Mazut for HW & heating**	**Mazut for steam**	**Mazut for curing**	**Total**	**Production**	**Fuel oil 2**	**Mazut for steam**	**Production**
	ton	**ton**	**ton**	**ton**	**thousand pcs**	**ton**	**ton**	**thousand pcs**
January	15.6	111	128	254.6	1483	1	0	0
February	33	0	0	151.9	0	1	118.9	1863
March	6.6	63	64.686	226.786	943	4.4	92.5	1489
April	22	81	106	311.5	1233	0	102.5	1605
May	15	16	129	260	1389	0	100	1463
June	10	22	163	298	1628	0	103	1354
July	12	24	150	233.4	1414	0	47.4	748
August	7	13	145	263.5	1430	0	98.5	1930
September	7	8	140	267.5	1535	0	112.5	1947
October	9	42	120	281	1299	0	110	1897
November	15	56	128	317	1279	0	118	1648
December	23	112	121	353	1331	0	97	1259
TOTAL:	175.2	548	1394.69	3218.186	14964	6.4	1100.3	17203

		State company "Silicatceram" Plovdiv				
		Electric power consumption and production quantity for 1992				
	Production; (ten thousand unit)	Electricity Consumption - peak; (MWh)	Electricity Consumption - day; (MWh)	Electricity Consumption - night; (MWh)	Electricity Consumption - total; (MWh)	Mazuth Consumption; (ton)
January	148.3	37.146	48.674	56.4	142.22	254.6
February	186.3	18.788	62.772	20.8	102.36	151.9
March	243.2	23.2	84.4	33.6	141.2	226.786
April	283.8	26.4	88.4	36	150.8	311.5
May	285.2	40	121.2	45.6	206.8	260
June	298.2	62.4	106.8	43.6	212.8	298
July	216.2	54	85.6	39.6	179.2	233.4
August	336	55.161	91.509	38.4	185.07	263.5
September	348.2	58.8	88.8	36	183.6	267.5
October	319.6				0	281
November	292.7	57.588	110.382	39.6	207.57	317
December	259	58.8	104.4	36.4	199.6	353
TOTAL:	3216.7	492.283	992.937	426	1911.22	3218.186

Source: Silicatceram AD bills

FUEL, STEAM OR HEAT ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD

ENERGY TYPE MAZOUT

Prepared for USAID and RCG/Hagler Bailly

Plant name: Silicatceram AD

Address: 30, Kuklensko Shosse St.; Plovdiv; Bulgaria

Auditor's name: Boris Petkov

Report date: 34425

Supply contract terms:

Fuel or heat supply company's name	various suppliers
Contract maximum demand:	not defined
Minimum charge (cost):	not defined
Other: mazout LHV = 9460 kcal/kg; density = 985 kg/m3	

CONSUMPTION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD

FOR: (NAME OF ENERGY FORM): MAZOUT (fuel oil # 6) LHV = 9460 kcal/kg; density = 985 kg/m3

Meter Reading Mo/day/yr	Physical Consumption units = m.t	Thermal Consumption GJ	Total Cost BGL	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product. Index m.ton per: thd	Notes on plant conditions and changes
Jan/ /	254.6		534660			0.171	The boiler house normally
Feb/ /	151.9		334180			0.082	operates only one boiler with
Mar/ /	226.8		498960			0.093	a steam capacity of 4.5 t/h at
Apr/ /	311.5		763175			0.111	13 to 15 bar sometimes as low as
May/ /	260		624000			0.091	8 bars.
Jun/ /	298		730100			0.099	
Jul/ /	233.4		571830			0.108	
Aug/ /	263.5		645575			0.078	
Sep/ /	267.5		628625			0.077	
Oct/ /	281		688450			0.088	
Nov/ /	317		792500			0.108	
Dec/ /	353		882500			0.136	
TOTAL	3218		7694555			0.101	

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

STEAM GENE ON - 12 MONTH AUDIT PERIOD
Prepared for USAID and RCG/Hagler Bailly

Plant name: Silicatceram AD
Address: 30, Kuklensko Shosse St.; Plovdiv; Bulgaria

Auditor's name: Boris Petkov
Report date: January 1994

Boiler characteristics:

Name/number	boiler #1	boiler #2	boiler #3	boiler #4
Manufacturer	Polish	Polish	Bulgarian	Bulgarian
Type (firetube/watertube)	firetube	firetube	firetube	firetube
Type (saturated/superheated)	saturated	saturated	saturated	saturated
Capacity (tons/hour)	4.5	4.5	4	4
Year installed:	1982	1982	1982	1982
Year last major overhaul:	1992	1990	1988	1988
Operational? (yes/no)	yes	yes	no	no
Steam pressure:	13 - 15 bar	13 - 15 bar		
Steam temperature:				
Stack temperature, after economizer:	272	274		
Stack gas analysis: percent O2	8.4	8.6		
Combustion efficiency:	82	80		
Blowdown analysis: dissolved solids PPM	2200	2200		

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 m.ton	Steam Generation tons	Steam Generation GJ	Monthly Efficiency %	Steam Purchased GJ	GJ	GJ	GJ	GJ	GJ	GJ	Losses & Unaccounted GJ	Unusual Operating conditions
Jan/___/___	126.6	1438.176											
Feb/___/___	151.9	1725.584											
Mar/___/___	162	1840.32											
Apr/___/___	205.5	2334.48											
May/___/___	131	1488.16											
Jun/___/___	135	1533.6											
Jul/___/___	83.4	947.424											
Aug/___/___	118.5	1346.16											
Sep/___/___	127.5	1448.4											
Oct/___/___	161	1828.96											
Nov/___/___	189	2147.04											
Dec/___/___	232	2635.52											
TOTAL	1823.4	20713.824											

Plant Steam Balance Summary for a representative winter day

Consumer	Steam	Portion
End Use	kg/h	%
Steam trap losses	110	3
Steam leaks	120	3
Boiler blowdown	142.6	3.6
Hot water	149	3.8
Mazout tanks and lines preheat	219.4	5.6
Underground pipes losses	340	8.6
Red brick Drying	984	25
Silica brick autoclaving	1875	47.6
TOTAL:	3940	100

LIGHTING SURVEY

ITEM	NUMBER OF FIXTURES	TYPE OF FIXTURE	BULBS PER FICTURE	BULBS WORKING	WATTS PER BALLAST	WATT PER BULB	DAILY OPERATING HOURS	DAILY ELECTRICAL CONSUMPTION; WH
Red Brick Production								
	207	MERCURY	1	149		250	24	894000
	20	FLOUR	3	34	7.30	40	24	38597
TOTAL								932597
Silica Brick Production								
	8	MERCURY	1	6		500	24	72000
	173	FLOUR	3	221	12.00	80	10	203320
TOTAL								275320
Outside Lighting								
	28	MERCURY	1	22		500	12	132000
TOTALS:		MERCURY		177			60	1098000
		FLOUR		255			34	241917

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PLANT ELECTRICAL ENERGY BALANCE SUMMARY

ITEM	ELECTRIC POWER; kW	OPERATING HOUR	DAILY ENERGY CONSUMPTION (KWH)	Production ; units	PERCENT OF TOTAL ENERGY
Red Brick Production				70380	
Clay Handling and treating	417.5	3	1253		11.14
Brick forming	231.25	7.5	1734		15.43
Brick drying	67.5	24	1620		14.41
Brick curing	62.5	24	1500		13.35
Lighting	38.9	24	934		8.31
TOTAL			7040	70380	62.64
Silica Brick Production				88000	
Sand and lime handling	525	2	1050		9.34
Sand and lime maturing	100	3	300		2.67
Brick forming	225	7.5	1688		15.01
Lighting	27.6	10	276		2.46
Brick autoclaving			10		0.09
TOTAL			3324	88000	29.57
Boiler house	30	24	720		6.41
Maintanance	17.3	7.5	130		1.16
Outside Lighting	11	12	132		1.17
TOTAL			11240	158380	100.00

State company "Silicatceram" Plovdiv

Water consumption in boiler house and production for 1992

	Water Use boiler house; cm	Water Use Red brick; cm	Production red brick; 1000 units	Water Use Silica brick; cm	Production red brick; 1000 units
January	3390	296.6	1483	0	0
February	2701	0	0	372.6	1863
March	3072	188.6	943	297.8	1489
April	2867	246.6	1233	321	1605
May	2800	277.8	1389	292.6	1463
June	2420	325.6	1628	270.8	1354
July	1010	282.8	1414	149.6	748
August	2200	286	1430	386	1930
September	2368	307	1535	389.4	1947
October	2713	259.8	1299	379.4	1897
November	3280	255.8	1279	329.6	1648
December	3538	266.2	1331	251.8	1259
TOTAL:	32359	2992.8	14964	3440.6	17203

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

Plant name: SILICATCERAM AD
Address: 30, Kuklensko Shosse Str.; Plovdiv 4002; Bulgaria

Auditor's name: Boris Petkov

Report date:

Mazout price: 2500 BGL/ton
Electricity price: 1.004 BGL/kWh

BASELINE - EXISTING CONDITIONS

		Thermal Consumption ton mazout/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost /year
BASE CASE		3218.186		1911220	9964329.88

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS:

Action No.	Action Description	Thermal Consumption ton ton mazout/year	Electric Peak Demand kW	Electric Energy Consumption kWh/year	Total Energy Cost /year	Action Project Cost	Action Payback Period (years)
1	Recover and install Energy Monitoring Instrumentation	3025.09484		1796546.8	9366470.09	528000	1
2	Reduce Boiler Blowdown	72.23			180575	15000	.0.2
3	Return Steam Condensate to the Boilers					120000	1
4	Optimal Selection, Repair of Faulty or Leaking Steam Traps					33000	0.3
5	Improve Insulation and leaking of Pipes and Fittings in Steam systems					156600	1
6	Improve Efficiency of Mazout Burners	1710			4275000	500000	1
7	Improve Efficiency of Mazout Burners of the Brick Kiln	1374.8			3437000	450000	1
8	Quality improvement measures contributing to Reduction of Energy Use	2992.9		1778000	9267362	541000	1
TOTAL SAVINGS		739		247673			
SAVINGS AS PERCENTAGE OF BASE CASE		23		13			

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.
Prepared for USAD and RCG/Hagler Bailly

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994
ACTION NO. AND BRIEF DESCRIPTION:	**PROJECT N 1: RECOVER AND INSTALL ENERGY MONITORING INSTRUMENTATION**
AREA OF THE PLANT AFFECTED:	PLANT ENERGY MANAGEMENT

FINDINGS CONCERNING EXISTING CONDITIONS:

Energy management improvement actions are an important category of potential savings in a fast changing economic environment. However, in order to obtain these savings and to make optimum decisions, a more reliable base of information is needed at Silicatceram. Currently, only the data of number of produced and sold bricks is collected by hand every day. There is no information on brick rejects on daily basis. The rejects are calculated by the end of the month: rejects = bricks produced - bricks sold. There is no logs or other records on steam, electricity and water consumption. Monthly mazout consumption is estimated by measuring the level in the mazout tank once a month. Electric use is measured once a month by the utility company.
The audit team observed that there is no energy demand management system at Silicatceram as employed in Western market-oriented companies. The management cannot accurately allocate the energy costs and cannot provide energy management. The regression analysis presented in the previous chapter indicates that there is no strong correlation between product throughput and energy consumption.In absence of real pressure to control the quantity of energy used there are situations where poor state of conditions of the energy using equipment or control device still permits process operation but at a higher energy cost.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

In order to improve energy management in the plant it is necessary to install or rehabilitate meters on:

- autoclaves steam header line (1 steam meter)
- air-steam heat exchanger line after the distribution center in red brick production area (1 steam meter)
- boiler fuel line (1 fuel meters)
- kiln burners fuel line (1 fuel meters)
- feed water line (1 water meter)
- **Install local electric meters and repair the existing meters**
- **Create energy management procedures**

Each process unit of red brick process and silica brick process should be subjected to a budget procedure specifying standards for energy use according to determining criteria. Such criteria might be: (production throughput; events such as start-up and shut-down procedure; quality of raw material or finished product; ambient temperature or seasonal variation; availability of critical process equipment)
Each energy use will be a simple function of the determinant criteria: usually constant (e.g. X tons per day of steam in winter, Y tons per day of steam in summer) proportional (e.g. Energy = A x Production) or linear (e.g. Energy = A x Production + B).
The establishment of such cost function is one of the primary targets of an energy demand analysis:
The difference between actual and target consumption will be translated into Leva according to marginal costs of utilities calculated by the Energy Department. The summation of all these differences will give an indication of the status of energy savings or over consumption. This can be easily displayed as a trend or graph.

ENERGY SAVINGS

Based on previous experience the audit team estimates that an improved energy management system together with specific management actions to control operational efficiency can achieve energy savings in the amount of 6 to 10%. The expected value of the potential energy savings is:

plant-wide base mazout demand: 3218.186 tonnes	plant-wide base electric demand: 1 911 220 kWh
(1992 purchased mazout)	(1992 purchased electricity)
energy savings estimated = 6 %	energy savings estimated = 6 %
annual benefit estimate = BGL 482 728 per year	annual benefit estimate = BGL 115 117 per year

Additional savings such as reduced use of raw materials, reduced generation of scrap bricks, improved operating rate on capacity of equipment are likely to result from the improved management control system. Potential benefits of these additional savings are not taken into account in the assessment of the profitability of this action.

IMPLEMENTATION COST

List of equipment	number	unit cost (BGL)
steam integrator	2	90000
fuel meters	2	45000
water integrator	2	8000
computer system, software and training	1	250000

Total cost is estimated at 528000

PAY BACK

Estimated at 12 months

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

ACTION NO.2

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994
ACTION NO. AND BRIEF DESCRIPTION:	**PROJECT N 2: REDUCE BOILER BLOWDOWN**
AREA OF THE PLANT AFFECTED:	BOILER HOUSE

FINDINGS CONCERNING EXISTING CONDITIONS:

Current boiler blowdown in Silicatceram boilers is high. While this may help to keep boiler surface clean it results in a waste of energy and fuel. American boiler manufacturers recommend a limit of 3500 ppm for blowdown in the type of boilers operating at Silicatceram at the pressure ranges of operation at Silicatceram. Currently boiler water TDS concentrations of only 2200 ppm as measured during the audit. By reducing the blowdown rate the TDS concentration in Silicatceram's boilers could be maintained at 3300 ppm.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Institute a daily analysis of boiler water total dissolved solids in one of the boiler house laboratory. Other chemical parameters should also be checked on a regular basis. Based on these analyses adjust the boiler blowdown rate to maintain boiler TDS at 3300 ppm. This can be achieved by reducing the frequency and timing of the blows.

ENERGY SAVINGS

The audit team estimates that the project will result in annual savings of ca 100000 BLV.
Reducing boiler blowdown will lead to reducing thermal losses and water losses.

Savings are calculated below:

Current fuel losses for blowdown: 13.83 kg/h
Recommended fuel losses for blowdown: 9.12 kg/h

Fuel savings: 4.71 kg/h

7920 hr/yr. * .4.71 kg/h = 37303.2 kg/yr.

Current water blowdown: 0.47 m3/h
Recommend water blowdown: 0.314 m3/h

Water savings: 0.156 m3/h

7920 hr/yr. * 0.156 m3/h = 1235.5 m3

IMPLEMENTATION COST

List of equipment	number	unit cost (BGL)
TDS meter	1	15 000

Total cost is estimated at 15,000.00 BGL.

PAY BACK

The pay-back on this project is one and a half month.

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

ACTION NO.3

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994
ACTION NO. AND BRIEF DESCRIPTION:	PROJECT NO 3 RETURN STEAM CONDENSATE TO THE BOILER
AREA OF THE PLANT AFFECTED:	RED BRICK PROCESS AREA

FINDINGS CONCERNING EXISTING CONDITIONS:

Condensate return piping already exists but is not maintained well. Some of the condensate from the air steam heat exchangers is drained to the sewage. Returning condensate will result in savings in boiler make-up water and blowdown losses, as well as an overall improvement in boiler efficiency.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Return steam condensate from the air-steam heat exchangers of the dryers and the hot water steam heater by rehabilitating the existing condensate return system. Find out where the condensate is contaminated.

ENERGY SAVINGS

From Exhibit 4.1 the plant steam balance shows that condensate from red brick production area will be ca 910 kg/h. The condensate return temperature measured by the audit team is 93 C. It is expected that this same temperature will reach the feed water tank if proper insulation is applied.

Savings are calculated as follows (assuming condensate at 90 C will replace make up water at 70 C):

910 kg/h * 300 kJ/kg = 273000 kJ/h

273000 kJ/h / 39637.4 kJ/kg = 6.88 kg/h fuel

Annual savings:

4000 h * 6.88 = 27520 kg

There are additional annual savings in water:

4000 * 910 = 3640 m3

IMPLEMENTATION COST

List of equipment	cost (BGL)
piping and steel plate	65000
installation	55000

Total cost is estimated at: 120000 BGL

PAY BACK

Pay back is estimated to about a year.

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

ACTION NO.4

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994
ACTION NO. AND BRIEF DESCRIPTION:	PROJECT NO 4 OPTIMAL SELECTION, REPAIR OF FAULTY OR LEAKING STEAM TRAPS
AREA OF THE PLANT AFFECTED:	RED BRICK PROCESS AREA, DISTRIBUTION STATIONS IN RED BRICK AND SILICA BRICK PROCESS AREAS

FINDINGS CONCERNING EXISTING CONDITIONS:

Eleven steam traps to the air-steam heat exchanger are faulty and leaking. All the leaking steam from the steam traps goes to the dryers and deteriorates the efficiency of the drying process too.
The steam traps to the hot water heat exchangers are also not functioning.
Steam traps to the autoclaves are fairly well maintained.
Faulty steam traps cause steam loss and decreased efficiency.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Replace or repair the existing faulty or leaking steam traps found from the audit team during the audit.

ENERGY SAVINGS

Steam trap losses were estimated on the basis of their intensities and steam pressure in the lines.
Calculation of savings is based on the plant steam balance.

Annual savings are calculated as follows:

Steam trap losses are estimated at 110 kg/h.

4000 hr/yr. * 110 kg/hr = 440000 kg/yr.

440000 kg/yr. / 2575 = 1133000000 kJ/yr.

1133000000 kJ/yr. / 39637.4 kJ/kg / 0.74 = 38.8 t mazout fuel

Improves drastically the efficiency of the dryers since all the leaking steam from the dryers steam traps holes goes with the air.

IMPLEMENTATION COST

List of equipment	number	cost (BGL)
repairs of steam traps	11	33000
Total cost is estimated at:		33000

PAY BACK

Pay back is estimated to three months.

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

ACTION NO.5

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994

ACTION NO. AND BRIEF DESCRIPTION: **PROJECT NO 5:IMPROVE INSULATION AND LEAKING OF PIPES AND FITTINGS OF STEAM AND HOT WATER SYSTEMS**

AREA OF THE PLANT AFFECTED: RED BRICK PROCESS AREA, DISTRIBUTION STATIONS IN RED BRICK AND SILICA BRICK PROCESS AREAS

FINDINGS CONCERNING EXISTING CONDITIONS:

All the pipe lines are with old insulation not well maintained which causes energy losses measured and empirically estimated by the audit team. The audit team expects very deteriorated insulation on the underground pipes. Steam leaks were found in boiler house, steam distribution centers. The leaks are from the fittings and welding beads. The losses are estimated on the basis of measured temperatures and pressures and estimated hole sizes.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Replace or repair the existing faulty or leaking steam pipes in the boiler house, service tunnel and production areas where leaks were found by the audit team.
Improve insulation.

ENERGY SAVINGS

Calculation of savings is based on the plant steam balance.

Savings are calculated as follows:

4000 hr/yr. * 120 kg/hr = 480000 kg/yr.

480000 kg/yr. * 2575 = 1236000000 kJ/yr.

1236000000 kJ/yr. / 39637.4 kJ/kg / 0.74 = 42.1 t mazout fuel

Improves drastically the efficiency of the dryers since all the leaking steam from the dryers steam pipes goes with the air.

IMPLEMENTATION COST

List of equipment	number	cost (BGL)
repairs of leaking fittings	18 pcs	21600
repairs of insulation	450 sq.m.	135000

Total cost is estimated at: 156600

PAY BACK

Pay back is estimated to approximately an year.

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

ACTION NO 6

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994
ACTION NO. AND BRIEF DESCRIPTION:	**PROJECT NO 6: IMPROVE EFFICIENCY OF MAZOUT BURNERS FOR THE TWO BOILERS "ECONOMIC" TYPE**
AREA OF THE PLANT AFFECTED:	BOILER HOUSE

FINDINGS CONCERNING EXISTING CONDITIONS:

Some of the mazout consumed by Silicatceram goes to fuel boilers for steam generation in the boiler house. Of four boilers installed in the plant one is operating with a capacity of 4.5 t/h of saturated steam at 13 -15 bar. The boilers are not in good condition and the burners are operated manually. Air-to-fuel ratios are adjusted visually by the experience of the operators; no stack measurements are performed. Boiler efficiencies are generally low due to 2 main reasons: 1/high stack temperatures; high air-to-fuel ratios. The measured boiler combustion efficiencies ranged from 80 to 82% for the Polish boilers. The audit team found that the boiler operators rarely change the boiler firing rate.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Replace the existing low efficient Polish mazout burners with new modern automated efficient burners.

ENERGY SAVINGS

Calculation of savings is based on the measured boiler efficiency and designed efficiency of the fully automated efficient burners 86 - 88 %:

Savings are calculated as follows:

5000 hr/yr. * 360 kg/hr = 1800000 kg/yr.

1800000 kg/yr. * 0.05 = 90 t mazout fuel

Reduces emissions.

IMPLEMENTATION COST

List of equipment	number	cost (BGL)
Mazout burners	2 pcs	500000

Total cost is estimated at: 500000

PAY BACK

Pay back is estimated to approximately an year.

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

ACTION NO 7

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994
ACTION NO. AND BRIEF DESCRIPTION:	**PROJECT NO 7: IMPROVE EFFICIENCY OF MAZOUT BURNERS OF THE RED BRICK KILN**
AREA OF THE PLANT AFFECTED:	RED BRICK PRODUCTION AREA

FINDINGS CONCERNING EXISTING CONDITIONS:

Some of the mazout consumed by Silicatceram goes to the burner groups of the red brick kiln. The burner groups are manually controlled on the base of the operators' experience. The audit team measured all the parameters of the kiln in order to prepare a balance. Analyzing the data the audit team found that the thermal efficiency of the kiln is high but it was observed that there is unburned mazout left due to bad maintenance of the existing burners.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Retrofit the existing mazout burners and improve their controls. Improve the atomization of the fuel.

ENERGY SAVINGS

Calculation of savings is based on the estimated quantity of unburned mazout of 6 to 12 %:

Savings are calculated as follows:

7500 hr/yr. * 195 kg/hr = 1462500 kg/yr.

1462500 kg/yr. * 0.06 = 87.7 t mazout fuel

IMPLEMENTATION COST

List of equipment	number	cost (BGL)
Retrofit burner groups and controls		450000

Total cost is esti 450000

PAY BACK

Pay back is estimated to approximately an year.

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

ACTION NO 8

Plant name:	Silicatceram AD
Address:	30, Kuklensko Shosse Str; Plovdiv; Bulgaria
Auditor's name:	Boris Petkov
Report date:	January 1994
ACTION NO. AND BRIEF DESCRIPTION:	**PROJECT NO 8: QUALITY IMPROVEMENT MEASURES LEADING TO REDUCTION OF ENERGY CONSUMPTION AND THE NUMBER OF REJECTS**
AREA OF THE PLANT AFFECTED:	BRICK FACTORY

FINDINGS CONCERNING EXISTING CONDITIONS:

Bricks not meeting the proper quality standard cannot be sold for the full price, and under many conditions, cannot be sold at all. This rejected product implies a significant waste of energy, since 50 to 60 % of the production cost is energy.
A daily accounting system of total production, first quality production, second quality production, and unacceptable or rejected production must be established as part of the management system. Such a system should also identify and correct the causes of poor quality, including:

- Maintenance of the proper gaps between rollers at the final stages of the clay mixture preparation process. The large gaps result in particles of too large size which disrupt the uniformity of the brick drying and cause cracks.
- Careful control of the kiln, including monitoring of high temperature distribution and residence time in the kiln. Locally hotter areas and too long residence times contribute to the common problem of deformed bricks.
- Careful control of the red brick dryers, including monitoring of temperature, humidity and residence time in the dryer. Bad drying process contribute to the common problem of cracked bricks.

Quality control must be instituted in the plant in order to save energy, at the same time it will improve the product.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Establish full accounting of production meeting the proper quality standards
Retrofit control system of the kiln, including monitoring of high temperature distribution and residence time in the kiln.
Retrofit careful control of the red brick dryers, including monitoring of temperature, humidity and residence time in the dryer.

ENERGY SAVINGS

Calculation of savings is based on the observed quantity of brick rejects and bricks not complying the Bulgarian standards for red and silica bricks which is approximately 11 % that could be reduced to approximately 4 %:

Savings are calculated as follows:

Annual mazout consumption:

3218.1 t/yr. * 0.07 = 225.2 t/yr. mazout fuel

Annual electricity consumption:

1911 MWh/yr. * 0.07 = 133 MWh/yr. electric power

IMPLEMENTATION COST

List of equipment	number	cost (BGL)
Temperature sensors	14	45000
Humidity sensors	9	46000
Microprocessor based controller	3	140000
Actuators	10	180000
Supervisor and software	1	130000
Total cost is estimated at:		541000

PAY BACK

Pay back is estimated to approximately an year.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

Varna Shipyard

by

Janos Zhelev, CEM

Exerg Co. Ltd. of Varna

for

Hagler Bailly Consulting, Inc.

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ENERGY AUDIT REPORT
Prepared for
USAID and RCG/Hagler Bailey

1. Plant information

Name of Enterprise: Varna Shipyard

Address: Varna 9000. Bulgaria

Telephone: 359 52 222 731

Fax: 359 52 237 222

Contact Person: Aleko ANGELOV

Title: Chief Engineer

Telephone: 359 52 222 731

2. Energy auditor information:

Dates - audit started: 1994 July 17th
audit completed: 1995 April 17th

Energy audit company: Exerg Co.Ltd. of Varna

Energy audit team leader: Dr. János ZHELEV, CEM

Address 9/6/54 Vladislavovo, Varna 9023 POBox 62, Bulgaria

Telephone 359 52 472 672

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3. Energy audit information

Energy audit focus : Parts of the steam system.

Because the system is too large (there are consumers more than 1,5 km from the boilerhouse) and there are problems with supplying steam to the remote consumers the audit focus was only the part of the steam system, namely:

The boilerhouse
The steam mains
The technological consumers
All users near the boilerhouse (were is the highest pressure and so the biggest loses).

The company mainly produces ships for export. The main problem of the company is the cash-flow problem, caused by high interest rates of Bulgarian banks, long production cycle and customer payments after completion of the ship. The steam system works intermittently, because there is simply no money for mazout.

There are 4 boilers with 12 t/hr capacity each mainly for heating requirements. The main consumers in the summer are the two carpentry workshops with maximum demand 1-2 t/hr which are located 1 km far from the boiler plant. So our focus was also to investigate the possibility (and pay back) for supplying the steam to this consumers from independent steam generator near by the workshops.

Energy efficiency . There are three most significant findings

The tune up of boilers - There are old boilers in bad condition. The main consumer is the heating. It is better to heat the big workshops with infra red gas heaters than by steam. In near future there have to be gas pipe to the company, so there is no reason to spend on capital investments in old mazout boiler plant. However it was useful to adjust the excess air.

Steam trap survey - the steam distribution system is in relatively good condition except of the steam traps. It is hard to find working steam trap and there are many places needing trapping without traps. We find that it is the main reason the steam can't reach the remote users with pressure higher than 1 bar.

Waste heat steam generator - there is a significant waste heat source (1000 C stack gas in the forge shop - 4500 GJ/yr). This location is not far from the carpentry workshops, so it is possible to use the waste heat to produce steam for the main technological users!

New experience:

Boiler tuneup procedures approved by local authorities.

Energy awareness and energy management are the biggest problems in most of Bulgarian plants. However it is very difficult to handle this issues. If one will address this problems visibly he will loose the support of the management and personnel. Definitely it is more easy to address technical problems.

4. Energy savings

Description of measure	Fuel saved	Savings	Payback
Boiler tuneup	134 t mazout/yr	5 226 GJ/Jr	3 days

5. Historical energy consumption

Year	1990	1991	1992	1993
heavy fuel oil (tones)	3,112	2,748	2.688	2,076
electricity (MWh)	40.990	41,061	40.999	42,076

The production cycle for a ship is more than a year. In production there are mainly 5 types of ships. We find it is difficult to define energy/production index for the whole plant. May be it is possible to define such an index for the different workshops, however there is no any measurement of steam production and usage.

6. Previous actions

The domestic hot water is made from geothermal source. This hot water will be utilized in the gas station also.

7. Detailed forms

Attached are the following forms

Heavy fuel oil consumption (from bills).
Steam generation.
Recommended actions (ECO forms).

HEAVY FUEL OIL (MAZOUT) CONSUMPTION - 12 MONTH AUDIT PERIOD
ENERGY TYPE: mazout
Prepared for USAID and RCG/Hagler Bailly

Plant name: VARNA SHIPYARD
Address: 9000 VARNA
BULGARIA
Auditor's name: DR.JANOS ZHELEV. CEM

Report date: APR. 1995

Supply contract terms:
Fuel supply company's Diferent companies
Cost: 150 $/t

BILLING DATA FOR 12-MONTH AUDIT PERIOD
FOR: MAZOUT

Meter Reading	Physical Consumptio	Thermal Consumptio	Total Cost	Monthly Heating Degree-Day	Heating Index
Mo/yr	units = t	GJ	$	HDD	GJ/HDD
Jan/93	209	8 151	31 350	595	13,7
Feb/93	39	1 521	5 850	484	3,1
Mar/93	507	19 773	76 050	386	51,2
Apr/93	172	6 708	25 800	156	43,0
May/93	116	4 524	17 400	57	79,4
Jun/93	50	1 950	7 500	0	-
Jul/93	246	9 594	36 900	0	-
Aug/93	106	4 134	15 900	0	-
Sep/93	48	1 872	7 200	26	72,0
Oct/93	27	1 053	4 050	145	7,3
Nov/93	236	9 204	35 400	330	27,9
Dec/93	158	6 162	23 700	521	11,8
TOTAL	1914	74 646	287 100	2 700	27,6

Note: There is no fuel measuring equipment.
The data is the billing data from invoices!
Heating degree-days based on reference temperature of 19

STEAM GENERATION
Prepared for USAID and RCG/Hagler Bailly

Plant name: VARNA SHIPYARD

Address: 9000 VARNA
BULGARIA

Auditor's name: DR. JANOS ZHELEV, CEM

Report date: Jan. 1995

Boiler characteristics:

Name/number	1	2	3	4
Manufacturer	G.Kirkov	G.Kirkov	G.Kirkov	G.Kirkov
Type (firetube/watertube)	firetube	firetube	firetube	firetube
Type (saturated/superheated)	saturated	saturated	saturated	saturated
Capacity (tons/hour)	12	12	12	12
Year installed:	1967	1967	1967	1967
Year last major overhaul:	1994	1991	1992	1993
Operational? (yes/no)	yes	yes	yes	yes
Steam pressure, bar :	10	10	10	10
Steam temperature, C :	180	180	180	180
Stack temp.,after economizer,C:	188 C	192 C	186 C	195 C
Stack gas analysis: percent O2	3,2	3,2	5,7	3,6
Combustion efficiency:	0,9	0,9	0,89	0,89

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO. 1
Prepared for USAID and RCG/Hagler Bailly

Plant name: VARNA SHIPYARD
Address: 9000 VARNA
BULGARIA
Auditor's name: DR. JANOS ZHELEV
C E M
Report date: APR.1995

ACTION NO. AND BRIEF DESCRIPTION: 1. BOILER TUNEUP

AREA OF THE PLANT AFFECTED: BOILER HOUSE

FINDINGS CONCERNING EXISTING CONDITIONS:
Boilers operate with high exess air (60-70%) and low efficiency - 0,83-0,85%

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
Regular (at least 3 times a year) exess air adjustment.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Fuel: t/yr	Energy GJ/yr	Total cost $ /year
Baseline -existing conditions	1 914	74 646	287 100
After recommended action	1 780	69 420	267 000
Net reduction	134	5 226	20 100

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE: Cost
TOTAL INSTALLED COST 450

Estimated increase in annual (non-energy) operations and maintenance cost 3x$450 = 1350

$$\text{PAYBACK PERIOD: } \frac{450}{20100 - 1350} = 6 \text{ days}$$

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ON NO.

Prepared for USAID and MOD.Major Baily

Plant name:	VARNA SHIPYARD
Address:	9000 VARNA
	BULGARIA
Auditor's name:	DR. JANOS ZHELEV
	S E M
Report date:	APR.1995
ACTION NO. AND BRIEF DESCRIPTION:	2. INSTALLMENT STEAM TRAPS.
AREA OF THE PLANT AFFECTED:	BOILER HOUSE

FINDINGS CONCERNING EXISTING CONDITIONS:

There are no steam traps installed in the area. We recommend installment traps.
This action will save about 20% of steam consumption.
Steam consumers in boiler house are: mazout heaters and radiators with 1760 t annual steam consumption.
We recommend installment traps of the following types and sizes: inverted bucket steam traps with body of stainless steel, 3/4"-5 pcs., thermostatic traps: 3/4"-6 pcs. and 1 1/2"-1 pcs.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Steam trap management

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Fuel, heat and steam: t mazout/year	GJ/year	Total cost $ /year	
Baseline -existing conditions	135	5 265	20 250	
After recommended action	108	4 212	16 200	
Net reduction	27	1 053	3 969	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost		Notes
Engineering design	100		
Equipment procurement	1500		
Equipment installation	16		Steam traps will be installed
Equipment commisssioning	0		by plant's personal.
TOTAL INSTALLED COST	1616	(b)	

Estimated increase in annual 'non-energy' operations and maintenance (c)

$$\text{PAYBACK PERIOD: } \frac{b:}{a: - c:} = 0.41 \text{ years}$$

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.
Prepared for USAID and RDS/Nagler Bailly

Plant name:	VARNA SHIPYARD
Address:	9000 VARNA
	BULGARIA
Auditor's name:	DR. DANOS ZHELEV
	C E M
Report date:	APR.1995

ACTION NO. AND BRIEF DESCRIPTION:

AREA OF THE PLANT AFFECTED: DYE-WORKS AND CO2 STATION

FINDINGS CONCERNING EXISTING CONDITIONS:

All steam traps are of float type and they are in poor condition.
There are many missing traps.
Consumers are: radiators and carbon dioxide evaporators. Total annual consumption is 400 t.
We recommend replacing (installment) existing traps with steam traps of following types and sizes:
inverted bucket steam traps, carbon steel body-1 pcs.; thermostatic type 1/2"-7 pcs.
This action will save about 15 % of steam consumption.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Steam trap management

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Fuels, heat and steam:		Total cost	
	t mazout/year	GJ/year	$/year	
Baseline -existing conditions	38	1 482	5 700	
After recommended action	32	1 260	4 845	
Net reduction	6	222	855	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost		Notes
Engineering design	100		
Equipment procurement	586		
Equipment installation	11		Steam traps will be replaced (installed) by plant's personal.
Equipment commissioning	0		
TOTAL INSTALLED COST	697	(b)	

Estimated increase in annual (non-energy) operations and maintenance (c)

$$\text{PAYBACK PERIOD:} \frac{b:}{a: - c:} = 0.82 \text{ years}$$

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.
Prepared for USAID and PUB/Naçler Baily

Plant name:	VARNA SHIPYARD
Address:	9000 VARNA
	BULGARIA
Auditor's name:	DR. DANOB ZHELEV
	C E M
Report date:	APR.1995

AREA OF THE PLANT AFFECTED: PROPAN-BUTAN STATION

FINDINGS CONCERNING EXISTING CONDITIONS:
There are no steam traps installed.
Consumers in the area are: gas heater, gas evaporators, steam superheaters, radiator and drainers for steam lines.
Total annual steam consumption is 176t t.
We recommend installing traps of following types and sizes:
inverted bucket steam traps - stainless steel body. 1/2"-4 pcs., iron steel body 1/2"-4 pcs..
thermostatic type 1/2"-1 pc. This action will save about 15 % of steam consumption.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Steam trap management

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Fuels, heat and steam:		Total cost	
	t mazout/year	GJ/year	$/year	
Baseline -existing conditions	170	6 630	25 500	
After recommended action	145	5 636	21 675	
Net reduction	26	995	3 825	(a)
		0		

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost, $		Notes
Engineering design	100		
Equipment procurement	1250		
Equipment installation	16		Steam traps will be installed
Equipment commissioning	0		by plant's personal.
TOTAL INSTALLED COST	1366	(b)	

Estimated increase in annual non-energy operations and maintenance (c)

$$\text{PAYBACK PERIOD: } \frac{b:}{a: - c:} = 0.36 \text{ years}$$

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.
Prepared for USAID and ACS/Maclar Baltic

Plant name: VARNA SHIPYARD

Address: 9000 VARNA
BULGARIA

Auditor's name: DR. JANOS ZMELEV
C E M

Report date: APR.1995

ACTION NO. AND BRIEF DESCRIPTION:

AREA OF THE PLANT AFFECTED: OXYGEN STATION

FINDINGS CONCERNING EXISTING CONDITIONS:
All steam traps are of float type and they are in poor condition.
There are many missing traps.
Steam consumers are radiators. Total annual steam consumption is 1470 t.
We recommend replacing (installment) existing traps with steam traps of following types and sizes:
inverted bucket type: stainless steel body, 3/4"-1 pc.,iron steel body, 3/4"-4 pcs.;
thermost. type: 1/2"-4pcs., 3/4"-2pcs.
This action will save about 15 % of steam consumption.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Steam trap management

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Fuels, heat and steam:		Total cost	
	t macout/year	GJ/year	$ /year	
Baseline -existing conditions	141	21 150	20 727	
After recommended action	120	17 973	17 640	
Net reduction	21	3 173	3 067	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost		Notes
Engineering design	100		
Equipment procurement	1362		
Equipment installation	20		Steam traps will be installed
Equipment commissioning	0		by plant's personal.
TOTAL INSTALLED COST	1502	(b)	

Estimated increase in annual (non-energy) operations and maintenance (c)

PAYBACK PERIOD:

$$\frac{b)}{a) - c)} = 0,49 \text{ years}$$

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.

Prepared for USAID and ROS/Maglar Bailly

Plant name:	VARNA SHIPYARD
Address:	9000 VARNA
	BULGARIA
Auditor's name:	DR. JANOS IHELEV
	C E M
Report date:	APR.1995

AREA OF THE PLANT AFFECTED: CARPENTRY WORKSHOP #1

FINDINGS CONCERNING EXISTING CONDITIONS:

All steam consumers are of float type and are in poor condition. There are many missing traps.
Steam consumers in the area are heaters. Total annual steam consumation is 2526 t.
We recommend replasing (installing) existing traps
and reckon this action will save about 15 % of steam consumation.
We recommend installing following types and sizes traps:
inverted bucket type: with carbon steel body, 3/4" for dryers - 6 pcs., with stainless steel body, 1/2" for drainage steam lines-1 pc;
thermostatic type, for radiators: 1/2"-1 pc., 3/4"-1 pc.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Steam trap installing (replacement)

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Fuels, heat and steam:		Total cost	
	t mazout/year	GJ/year	USD/year	
Baseline -existing conditions	243	7 477	36 450	
After recommended action	207	6 055	30 982	
Net reduction	36	1 422	5 468	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost		Notes
Engineering design	100		
Equipment procurement	1382		
Equipment installation	10		Steam traps will be installed (replaced) by plant's personal.
Equipment commissioning	0		
TOTAL INSTALLED COST	1492	(b)	

Estimate increase in annual (non-energy) operations and maintanance cost: (c)

$$\text{PAYBACK PERIOD: } \frac{b:}{a: - c:} = 6.27 \text{ years}$$

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY ACTION NO.

Prepared for USAID and ROB-Sofia Bulgaria

Plant name:	VARNA SHIPYARD
Address:	9000 VARNA BULGARIA
Auditor's name:	DR. DANOS ZHELEV C E M
Report date:	APR.1995

ACTION NO. AND BRIEF DESCRIPTION:

AREA OF THE PLANT AFFECTED: Carpentry Workshop #2

FINDINGS CONCERNING EXISTING CONDITIONS:
All steams traps are of float type and are in poor condition. There are many missing traps.
We recommend replacement (installment) existing traps with inverted bucket and thermostatic steam traps and reckon this action will save about 15 % of steam consumation.
The consumers in the area are heaters and presses with annual steam consumoton of 1860 t.
We recommend instalment traps of the following types and sizes:
inverted bucket type, carbon steel body, 3/4"-24 pcs.; thermostatic type,3/4"-2 pcs.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY: Installing (replacement) steam traps

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Fuels, heat and steam:		Total cost	
	t mazout/year	GJ/year	USD/year	
Baseline -existing conditions	186	7 254	27 900	
After recommended action	159	6 166	23 715	
Net reduction	28	1 088	4 185	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost		Notes
Engineering design	100		
Equipment procurement	3000		
Equipment installation	23		Steam traps will be instaled (replaced) by plant's personal
Equipment commissioning	0		
TOTAL INSTALLED COST	3123	(b)	

Estimated increase in annual (non-energy) operations and maintanance cost: (c)

0:

PAYBACK PERIOD: --------- = 0,75 years

a: - c:

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

Zlatna Panega

by

Dimiter Shivkov

Angel Dangov

Amecon, Techcem

for

Hagler Bailly Consulting, Inc.

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ENERGY AUDIT REPORT

Prepared for
USAID and RCG/Hagler Bailly

1. Plant Information

Name of Enterprise ZLATNA PANEGA Cement Plant

Address 5760 Zlatna Panega, Bulgaria

Telephone: (+ 359) 697 5084

Fax: (+ 359) 697 5084

Contact Person: Mr. Ivan Tsakov

Title: General Director

Telephone: (+ 359) 697 5084

2. Audit Information

Dates - audit started: August 1994 audit completed: October 1994

Energy audit company: AMECON, TECHCEM

Energy audit team leaders: Mr. Dimiter Shivkov, Mr. Angel Dangov

Address: P.O. Box 35
1582 Sofia, Bulgaria

Telephone: (+359 2) 708 509; 725 328; 779 329

Fax: (+359 2) 708 509; 775 200

3. Energy Audit Information

Energy audit focus

The report contains the findings, the conclusions and the recommendations obtained as a result from the energy audit at the "Zlatna Panega" cement plant. The audit of the main energy consumers at the plant was carried out in the period August 1994-October 1994.

The main goal was to define the major areas, where possible energy savings measures could be implemented. In connection with this a walk-through and then a comprehensive energy audit was concluded. The chief engineers and executives responsible for the decision making in the area of energy consumption and production capacities utilisation were interviewed. The heat and mass balance equations for the main equipment used were obtained and analysed. As a result the values for the optimal technological parameters were obtained.

Based on the collected and analysed data for the energy consumption of the main energy consumers at the plant a package of energy savings measures including operational management and investment decisions was proposed.

Energy efficiency

The findings connected with the current energy utilisation and the recommendations for improving it are given in Appendix 1 as part of the report prepared for the plant management.

New experience

The energy audit was a useful experience because of the following:

1. It was the first energy audit carried out for this cement plant. This helped the managers of the plant to recognise the problems connected with energy utilisation and the effect of small investment projects. Plant personnel was also involved in the audit and got a new experience in this field.
2. The measuring equipment provided by USAID for audit purposes helped to carry out the analysis of the processes and to gather useful data about the current situation of energy utilisation. It also helped local consultants and plant personnel to get familiar with modern measuring equipment.
3. Mass and heat balance calculations were made during the audit in order to estimate the energy consumption by different processes and give recommendations for further energy savings measures including maintenance, investment and repair works.

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4. Energy Savings

The following energy efficiency measures have been already implemented during the course of the audit (for kiln 4):

1. Repair of the preheater for kiln 4.
2. Repair of the inlet and outlet seals of kiln 4.
3. Repair of the grate cooler - repair of existing fans and installation of two additional fans. This repair works are still in progress.

As a result the working regime of kiln 4 has improved. The O2 content before the outlet gases fan has decreased up to 5.5 - 6% instead of more than 10% at the beginning of the audit.

The achieved savings are still subject to estimation which is difficult because of lacking the appropriate measuring equipment.

5. Historical Production and Energy Consumption

1. Recent production and energy consumption at the plant in physical units:

The production data of cement and clinker for the five years period (1990-1994) are summarised in Table 1.

Table 1

Production	1990	1991	1992	1993	1994
	tons	tons	tons	tons	tons
clinker	581 876	348 254	305 563	307 258	388 627
cement	695 120	412 555	382 243	363 994	303 161

The energy consumption data for natural gas, electricity and steam for the five years period (1990-1994) are summarised in Table 2.

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Table 2

Energy	1990	1991	1992	1993	1994
natural gas (1000 x cub.m.)	102 983	60 521	52 658	48 064	56 753
natural gas (Gcal)	823 864	484 168	405 264	384 512	454 024
electricity (MWh)	126 484	83 463	69 981	67 864	70 649
electricity (Gcal)	108 776	71 778	60 184	58 363	60 758
steam (tons) *	88 460	76 700	49 190	44 900	30 440
Total energy (Gcal)	932 640	555 946	465 448	442 875	514 782
gas/electricity (%) from total energy	88.3/11.7	87.1/12.9	87.1/12.9	86.8/13.2	88.2/11.8

Note: Steam is produced by natural gas and its energy is included in that of natural gas.

Energy/Production Index:

The energy/production index for cement only is given in table 3. It should be noted however that a big part of the clinker produced in the last year was directly exported and not used for cement production itself. Therefore an average value for cement based on this clinker quantity was used to obtain the energy/production index for 1994.

Table 3

Energy/Production Index for cement Gcal/ton	1990	1991	1992	1993	1994
thermal	1.185	1.174	1.060	1.056	1.169
electrical	0.156	0.174	0.157	0.160	0.156

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6. Historical Energy Costs

The energy costs calculated in the national currency Bulgarian levs (BGL) are given in Table 4. It should be noted however that because of the high inflation rate in the last four years the energy prices their self do not give a real picture on the energy costs. In addition energy prices is still subsidised by government. Therefore a percent ratio of fuel or electricity from cement price is given in order to get a view on the real situation now.

Table 4

Energy costs	1990	1991	1992	1993	1994
natural gas x 1000 BGL	11 523	77 570	109 032	87 684	271 000
fuel price in % from cement price	19.4	50.0	50.7	37.0	52.3
electricity x 1000 BGL	5 776	26 557	38 978	48 297	69 220
electricity price in % from cement price	9.7	17.1	18.1	20.4	13.2
fuel/electricity ratio in energy costs	66.3/33.7	74.5/25.5	73.7/26.3	64.5/35.5	79.8/20.2

Note: All prices are given in Bulgarian levs (BGL).
The exchange rate now is $ 1 = 66 BGL. This exchange rate is accepted for all the calculations concerning investment projects as well.

7. Previous actions

The main measures implemented at the plant up to now are as follows:

1. Follow up of the different electricity loads during the various tariff zones: during the day, at night and during the high tariff zone (9 to 12 a.m. and 2 to 5 p.m.). During the high tariff zone the cement and when possible the raw meal mills are switched off.

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2. Applying of capacitors in order to improve the power factor. With the capacitors installed now it is possible to control the power factor within the prescribed ranges.

3. Registering of the gas consumption by the different kilns in order to get a real information necessary for the plant managers. For that reason flow meters are installed at every kiln and it is possible to sum up the quantities of gas for a given time period, e.g. one month. Unfortunately this data are not used for every day energy management purposes but are summarised by the end of the month only.

8. Detailed Forms

Detailed forms including data for the use of the different energy sources by processes are given in the following tables. It should be noted that not all energy consumption data for the various consumers could be obtained because of lack of installed measuring devices for each separate consumer. The consumed energy data at the plant are usually available in summarised monthly forms based on group consumption data or on estimates according to predetermined specific rates.

The tables below give an overview on the different energy consumers and their participation in energy utilisation at the plant. Natural gas is used mainly by kilns and a very small part for the boilers. Therefore in the table for natural gas the total gas quantity used is given.

All the data in the tables relate to year 1994 consumption.

ENERGY TYPE: NATURAL GAS
Prepared for USAID and RCG/Hagler Bailly

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega
Bulgaria

Auditor's name: D. Shivkov, A. Dangov
Report date: March 1995 (data are based on year 1994 consumption)

Supply contract terms:

Fuel or heat supply company's name: BULGARGAS
Contract maximum demand: up to 60 Mio. cubic m
Minimum charge (cost): 2.5 BGL/cubic m
Other: Price has increased up to 6.6 BGL/cubic m by the end of year 1994

CONSUMPTION DATA FOR 12-MONTH PERIOD
FOR: NATURAL GAS

Meter Reading mo/da/yr	Physical Consumption units=1000 x cubic m	Thermal Consumption GJ	Total Cost x 1000 BGL	Monthly Heating Degree-Days HDD	Heating Index GJ/HDD	Product index GJ per: ton clinker
Jan /31/94	460	15 407		682	22.6	2)
Feb /28/94	3 742	125 338		504	246.7	5.20
Mar /31/94	5 367	179 768		403	446.1	4.81
Apr /30/94	4 144	138 803		176	788.7	4.80
May /31/94	4 168	139 607		-		4.89
Jun /30/94	4 106	137 530		-		4.67
Jul /31/94	5 486	183 754		-		4.83
Aug /31/94	6 039	202 276		-		4.86
Sep /30/94	6 560	219 727		-		4.45
Oct /31/94	4 953	165 901		32	5184.4	4.87
Nov /30/94	7 369	246 825		360	685.6	4.86
Dec /31/94	4 359	146 005		651	224.3	5.54
TOTAL	56 753	1 900 941	274 000	2808	676.97	4.89

Notes: 1. Heating degree-days based on reference temperature of 19 C
2. There was no clinker production in January 1994.

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ELECTRIC ENERGY CONSUMPTION BY PROCESS::
Prepared for USAID and RCG/Hagler Bailly

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega cement plant
Bulgaria

Auditor's name: D. Shivkov, A. Dangov

Report date: March 1995 (data are based on year 1994 consumption)

Item No.	Equipment or Process Description	Maximum Load units: kW	Average Load units: kW *)	Load at Peak Demand units: **)	Energy Consumption units: kWh/year	Total Energy Cost 1000 x BGL/ year
1	Quarry	2 700			1 387 000	
2	Raw meal mills	12 100			25 935 000	
3	Kilns	2 200			13 677 000	
4	Cement mills	14 000			11 116 000	
5	Packaging dpt.	2 100			862 000	
6	Water pumps	3 200			2 423 000	
7	Compressor station	4 580			11 926 000	
8	Dedusting dpt.	2 030			344 000	
9	Others	7 090			2 979 000	

TOTAL PEAK DEMAND		[illegible]	
TOTAL ENERGY CONSUMPTION AND COST (equals total billed consumption)		70 649 000	69 220

Notes: 1. The average load of the equipment used is about 40% of maximum load due to the bad situation for cement industry in Bulgaria now.

2. There is no additional tariff for operating at peak demand and therefore load at peak demand is not measured.

ELECTRIC ENERGY BALANCE
Prepared for RCG/Hagler Bailly

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega
Bulgaria

Auditor's name: D. Shivkov, A. Dangov

Report date: March 1995 (data are based on year 1994 consumption)

Electricity contract terms:

Electricity supply company's name: Electrosnabdjavane-Lovetch
Contract maximum demand (kWh): 84 000
Minimum charge (cost): 1.2 BGL/kWh
Other: Prices are changing during the year

In the following table the data for the electricity consumption are summarised for the whole plant for one year period (1994).

Meter Reading Mo/da/yr	Energy Active kWh	Energy Reactive kVARh	Max. Demand kW *)	Power Factor	Load Factor **)	Total Cost levs	Product Index kWh per ton cement
Jan /31/94	1 278 072	560 904		0.91		853 565	115.9
Feb /28/94	4 012 368	1 725 432		0.92		3 110 438	437.1
Mar /31/94	5 257 704	2 602 080		0.90		5 059 979	169.2
Apr /30/94	6 116 904	2 696 736		0.90		6 831 244	196.7
May /31/94	5 322 216	1 990 104		0.94		5 769 889	203.9
Jun /30/94	6 157 500	2 225 016		0.94		6 754 940	229.7
Jul /31/94	6 903 936	3 681 072		0.88		6 532 011	207.6
Aug /31/94	7 330 104	4 120 080		0.87		7 040 360	214.8
Sep /30/94	7 858 752	4 734 960		0.86		7 493 418	251.9
Oct /31/94	6 902 664	3 777 456		0.88		7 553 965	264.4
Nov /30/94	8 051 040	4 429 728		0.88		8 862 951	294.3
Dec /31/94	5 337 480	2 935 872		0.88		5 828 054	264.9
TOTAL:	70 528 740	35 479 440		0.90		69 220 814	232.6

Notes: 1. The maximum demand specified according to the contract with the electricity company is 28 MW for year 1994. The installed capacity of all the equipment is 55 MW.

2. The load factor for the plant is about 40 % of the total capacity.

3. In February 1994 the main production was that of clinker. This is the reason for the high energy/production index for cement.

Peak demand during audit period (MW): 15 MW

ACTION PLAN:
Prepared for USAID and RCG/Hagler Bailly

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega
Bulgaria

Auditor's name: D. Shivkov, A. Dangov

Report date: March 1995

BASELINE-EXISTING CONDITIONS

	Thermal Consumption GJ/year	Electric Energy Consumption kWh/year	Total Energy Cost 1000 x BGL/year
BASE CASE: 1993	1 609 875	67 864 000	135 981

SUMMARY OF RECOMMENDED ENERGY EFFICIENCY ACTIONS

Action No.	Action Description	Thermal Consumption GJ/year *)	Electric Energy Consumption kWh/year *)	Total Energy Cost 1000 x BGL/year	Action Project Cost 1000 x BGL **)	Action Payback Period (years)
1	Information system for daily energy consumption analysis	3 215		175	212.2	1.20
2	Portable gas analyser	1 608		360	396	1.1
3	Automated gas analysing station	10 551		2 362	2 640	1.12
4	Kiln training simulator	1 608		360	528	1.47
5	Installation of sectionalising circuit breakers		60 000	86	70	0.81

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6	Installation of additional electric meters		67 800	142.4	600	4.2
7	Reconstruction of the kiln 5 seals	29 810		6 048	6 500	1.03
8	Reconstruction of the preheater	56 270		12 096	14 800	1.23
9	Reconstruction of the great cooler	56 270		3 968	14 860	1.49

TOTAL SAVINGS	159 332	127 800	25 597
SAVINGS AS PERCENTAGE OF BASE CASE	9.9	0.19	18.8 ***)

Notes: 1. The thermal and the electric energy consumption are considered as energy savings resulted from the respective action.

2. The action project costs are based on the price of the equipment only. For projects 1 to 4 it is expected to be provided by USAID. The other project costs (e.g. for local consultants and the installation costs) are not included here because they are subject to contracts for each case.

3. The savings in BGL as percentage of base case do not give a real picture because of the high inflation rate in the last years. The base line is calculated based on 1993 prices and the investment and energy costs relate to 1994 prices.

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

ACTION No.1: Information system for daily energy consumption analysis

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega, Bulgaria

Auditor's name: Dimiter Shivkov, Angel Dangov

Report date: March 1995

ACTION No. 1 AND BRIEF DESCRIPTION The implementation of an information system for daily energy consumption analysis has to solve energy management problems. The goal is to organise a daily collection of energy consumption data from all the departments to analyse them and to prepare reports for the responsible managers. This should help in making decisions on better energy management.
AREA OF THE PLANT AFFECTED All the departments of the plant will be affected by introducing such an information system because data on consumed electric or thermal energy will be gathered or estimated for each of them. The main effect is expected to be for the kilns (for thermal energy) since they are the biggest consumer of natural gas.
FINDINGS CONCERNING EXISTING CONDITIONS At the moment the information on energy consumption by different processes is analysed by the end of the month so it is not possible to influence the energy utilisation during that period.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY An implementation of a personal computer with appropriate software including spreadsheets like EXCEL and a text editor like WORD for WINDOWS will help in preparing the daily energy consumption reports for the plant managers. This will provide a tool for making decisions on equipment utilisation with respect to energy efficiency and will reduce energy costs.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION
The expected savings are estimated roughly at 0.2% of consumed total quantity of gas for 1993. This estimate is based on the gas consumption by kilns only because of its greater impact on energy costs. This will save about 3 215 GJ/year.

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

ACTION No. 2: Purchase of a portable gas analyser BACHARACH 24-8122 model 300 NSXEB with an extended probe allowing to measure nitrogen and sulphur oxides.

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega, Bulgaria

Auditor's name: Dimiter Shivkov, Angel Dangov

Report date: March 1995

ACTION No. 2 AND BRIEF DESCRIPTION
The purchase of a portable gas analyser model BACHARACH will help in doing periodical analysis of the fume gases at different points of the installation. This will result in improved burning processes and will enable to define deviations from the optimal working conditions.
AREA OF THE PLANT AFFECTED
The portable gas analyser will be used to measure the composition of the fume gases at different points. As a result deviations due to non optimal burning processes or seal and equipment problems will be defined and causes could be recognised easily.
FINDINGS CONCERNING EXISTING CONDITIONS
At the moment the operational personnel and the energetics do not posses such a tool for express gas analysis. Therefore the kilns and the other equipment like filters, fans and preheater are not operating optimally.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY
It is recommended to purchase a portable gas analyser for carrying out periodical analysis of the fume gases. This will improve operation of fans, filters and preheater due to more accurate information on the processes. As a result the natural gas consumption will reduce.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION
Expected result from action 2 is the decrease of natural gas consumption at the estimate of 0.1% of consumed total quantity for year 1993. This will save about 1608 GJ/year.

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

ACTION No. 3: Installation of automated gas analysing station for kiln 5

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega, Bulgaria

Auditor's name: Dimiter Shivkov, Angel Dangov

Report date: March 1995

ACTION No. 3 AND BRIEF DESCRIPTION The installation of a gas analysing station for kiln 5 will bring about a considerable reduction of energy consumption because it will allow to monitor continuously the gas composition and the interference in the burning process. Subsequently, by installing additional probes to kilns 3 and 4, the latter will also be involved in the system of continuous centralised analysis of the gas composition. This is expected to yield a significant energy saving effect.
AREA OF THE PLANT AFFECTED The kiln 5 operation will be mainly affected. This is one of the two biggest kilns at the plant and the installation of gas analysing station will allow the continuous measuring and control of the gas composition. Through additional probes it will be also possible to include kilns 3 and 4 in a centralised analysing system.
FINDINGS CONCERNING EXISTING CONDITIONS At the moment there is no continuous gas analysing system for the kilns installed. A system for continuous gas analysis is installed after the electric filters only to prevent blowing up. The data from this system are not used for controlling the burning processes. Therefore the kilns and the other equipment are not operating optimally.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY It is recommended to purchase and install a gas analysing station for kiln 5 to ensure continuous measuring and control of the gas composition at the kiln input. This will considerably reduce the energy losses in comparison to previous situation. The project and installation works will be financed by the plant itself.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION
Expected result from action 3 is the decrease of natural gas consumption for kiln 5 at the estimate of 1.5% of consumed quantity of this kiln in 1993. This will save about 10 551 GJ/year.

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

ACTION No.4: Kiln training simulator

Plant name: Zlatna Panega cement plant
Address: 5760 Zlatna Panega, Bulgaria

Auditor's name: Dimiter Shivkov, Angel Dangov

Report date: March 1995

ACTION No. 4 AND BRIEF DESCRIPTION A kiln simulator for training the operational personnel by computer simulation is proposed. Such systems are built up on the basis of a specialised computer software. The purpose is to provide a tool for improving the qualification of the personnel, which will lead to reducing the energy losses as a result of better control of the burning processes. The purchase of such a device will certainly have a multiplier effect because it can be used to offer paid up training of personnel from other cement plants also.
AREA OF THE PLANT AFFECTED The kilns operation will be mainly affected through improved qualification of the personnel. This will also reduce energy losses when starting up and stopping the processes.
FINDINGS CONCERNING EXISTING CONDITIONS At the moment the kilns operators are not using specialised prescriptions on how to monitor and control the burning processes. They are controlling the processes based on own experience. No training measures for the kiln personnel are used at the plant. As a result the operation of kilns is not optimal.
RECOMMENDED ACTION TO IMPROVE EFFICIENCY It is recommended to implement a kiln simulator for training purposes. This will considerably improve the qualification of the working personnel and will have a multiplier effect for other cement plants as well.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION
Expected result from action 4 is the decrease of natural gas consumption at the estimate of 0.1% of consumed total quantity for year 1993. This will save about 1608 GJ/year.

The actions 1 to 4 are recommended to be financed through USAID for purchasing the necessary equipment. The plant itself is ready to finance the project and installation works for all these actions.

9. Narrative

The detailed description of the audit conditions and findings is given in Appendix 1 which contains a summary of the Bulgarian version of the audit report.

APPENDIX 1

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SUMMARY

1. Introduction

This report contains the measurements data, the conclusions and the recommendations obtained as a result from the energy audit of the "Zlatna Panega" cement plant. The audit of the main energy consumers in the plant was carried out in the period August 1994-October 1994.

The main goal was to define the major areas, where possible energy savings measures could be implemented. In connection with this a walk-through and then a comprehensive energy audit was concluded. The chief engineers and executives responsible for the decision making in the area of energy consumption and production capacities utilisation were interviewed.

Based on the collected and analysed data for the energy consumption of the main consumers a package of energy savings measures including operational management and investment decisions was proposed.

2. Current state of the energy consumption

In connection with the development of suitable energy savings measures a preliminary analysis of the current energy consumption was carried out. The conclusions based on this analysis are as follows.

Natural gas consumption:

1. The main natural gas consumers are the cement kilns and the steam generation station. The consumed gas quantities are measured with flow meters, accurate enough to allow the balance calculations for the different consumers. The metering of the consumed quantities is done monthly, which does not allow the operational control and energy/production index calculations per shift or even per day.
2. There is no computerised system for gathering and analysing the consumed quantities of gas or electricity. The metering is done by flow meters and the data are then collected and analysed manually. This does not allow the continuous metering of the natural gas consumption.

Electrical energy consumption:

1. Within the current electricity supply scheme for the different consumers there is no possibility of accurate metering of the consumed electrical energy for most of them. For the cement mills only it is possible to measure the consumed energy but even in that case there are additional small loads connected to the supply transformers. Nevertheless it is possible to obtain a picture of the electrical energy that is used for the cement mills.

2. There are no electric meters (or many of the already installed are out of order). As a result even in the current case of different loads connected to one and the same transformer it is not possible to get information on their group consumption.

3. As a result of the insufficient production capacities utilisation many of the transformers are working unloaded which causes additional energy losses.

4. Within the current structure of the chief energetic's department there is no person responsible for continuous tracking the energy consumption at the different departments and main utilities.

5. The report and the balance sheet for the consumed electric energy and natural gas are prepared at the end of the calendar month, whereas they are available for the plant managers in the middle of the next month. This does not allow the control of the main energy consumers of the plant: kilns and cement mills in order to minimise the energy losses during operation hours.

Main technological processes

For the main technological processes and utilities it can be concluded that they are not operating at their optimal values:

1, The false air in the preheater (PH) is almost the same quantity as the technological gas coming from the kiln which has the following negative effects:

- very high speeds of the gas flows;
- increase in dust quantity that is taken away;
- decrease of the heat exchange time between mill and gas heat flow which limits its preparation time before baking;
- overload of the dust cleaning utilities with dust and gases;
- increase in the temperature of the output gases leading to several times increase of the heat losses as well as the pressure loss (decrease), that affects the electrical energy consumption.

2. The false air in the raw mill meals leads to overloads of the electric filters (EF) with gases and dust making ineffective the work in the mills and the separation utilities at the same time. This affects the energy efficiency of the grinding process and the quality of the raw mill.

3. The temperature of the secondary air is low and this decreases the heat benefit cost ratio, decreases the heat from the grate cooler and removes and redistributes the kiln zones leading to processes removal to inappropriate and ineffective utilities thus decreasing the line productivity.

4. The joint work of kiln, grate cooler, filter, raw meal mills and dedusting installations is not optimised leading therefore to unbalanced load of the ventilators. This has as a result the creation of over pressure in some areas, breaking out of dust in the work rooms and leading to excess electrical energy consumption.

Information on process parameters

1. There is no information on important processes and parameters available:
- the gas composition at the kiln input;
- the secondary air temperature;
- the material's temperature in the sinter-zone,
- the clinker temperature at the output of the kiln and the output of the grate cooler,

2. There is a big difference in the values metered by the measuring devices in the command room in comparison to their real values:
- in respect to the gas composition after the preheater,
- in respect to outlet gases temperature,
- in respect to gas fuel flow.

Taking into account that most of the kiln operators are controlling the kilns based on these values it should be stressed that new measuring and control devices are urgently needed.

Heat losses and their causes

1. Losses that are caused by the increased flow and temperature of the outlet gases. The main reason for this is the great quantity of false air in the PH.

2. Losses with the dust in the outlet gases due to the big quantity of dust take away from the PH. The main reason is the bad work of the cyclones when the outlet gases flow is high. They have greater impact in the current situation of low clinker production.

3. Losses due to convection and radiation, especially from the kilns and the PH due to bad isolation parameters of low quality isolation material that is used.

4. The recuperation in cooling processes is ineffective. The heat that is recuperated is small, the heat benefit cost ratio of the grate cooler is low because of the thin clinker layer in the grate cooler. The more important conclusion is that the stabilisation of the clinker phase content is following its modification.

5. A major deviation from the calculated parameters is caused by the fact that a big part of the grate cooler air is being formed in the so called additional chimney. This not only spoils the quality of the environment but also sets out of balance the two major ventilators - for the outlet gases and the filter. They have the task to divide the cooling air coming into the grate cooler into secondary and aspiration air. The specialists recommend to stabilise the flow of the secondary air because through it about 20 % of the quantity necessary for the kiln is being transported. At the same this causes about 50 % of the fluctuations. The kiln is more sensitive with respect to fluctuations of heating flows than to fluctuations of the other process parameters even compared with the chemical substrates of the raw mill.

3. Previous energy saving measures

The main measures implemented at the plant up to now are as follows:

1. The follow up of the different electricity loads during the various tariff zones: during the day, at night and during the high tariff zone (9 to 12 a.m. and 2 to 5 p.m.). During the high tariff zone the cement and when possible the raw meal mills are switched off.

2. Applying of capacitors in order to improve the power factor. With the capacitors installed it is possible to control the power factor within the prescribed ranges.

3. Registering of the gas consumption by the different kilns in order to get real information for management purposes. For that reason flow meters are installed at every kiln and is possible to sum up the quantities of gas for a given time period, e.g. one month. Unfortunately this data are not used for every day energy management purposes but are summarised by the end of the month only.

4. Recommended energy saving measures

In table A.1 the recommended energy saving proposals are summarised. The annual savings for the different projects are calculated in physical units and in BGL (Bulgarian levs). For the saving potential estimation calculations are made based on the 1993 consumed quantities of electricity and gas.

Table A.1

No.	Project title	Annual savings			Investment and pay back period		
		gas 1000x m3	MWh	steam tons	savings 1000 x BGL	invest-ment 1000 x BGL	pay back period years
1	Information system for energy consumption analysis	96			175	211.2	1.20
2	Portable gas analyser for controlling the gases content	48			360	396	1.1
3	Automated gas analysing station for kiln 5	315			2 362	2 640	1.12
4	Kiln training simulator	48			360	528	1.47
5	Implementation of sectionalising circuit breakers		60		86	70	0.81
6	Installation of additional electric meters		67.8		142.4	600	4.2
7	Reconstruction of the kiln 5 inlet and outlet seals	890			6048	6500	1.034
8	Reconstruction of the preheater	1680			12096	14800	1.23
9	Reconstruction of the grate cooler	1680			3968	14860	1.49
Total for all projects:		4 757	127.8		25 597	40 606	1.58

Note: The payback period is calculated for the equipment only. Not included is the contribution of the plant that is subject to negotiation for each separate contract. This will also include project and installation works by Bulgarian experts.

Main measures

Based on the energy audit analysis the following main measures for reducing the energy consumption are proposed:

1. In connection with energy management measures the implementation of an information system for daily data analysis of energy consumption is necessary. The goal is to computerise the process of carrying out analysis and to do this on a daily and not on a monthly basis. A person within the department of the chief energetic should be authorised to do this daily analysis and to prepare reports for the plant managers.

2. Division of the electrical loads according to supply transformers and electrical sections in order to enable the exact metering of the consumed energy. Decrease of losses caused by unloaded transformers through circuit breakers between the different supply sections.

3. Installation of an automated gas analysing station for kiln 5 in order to control the burning processes in the kiln and to reduce the consumed gas quantity.

4. Completion of the project for energy consumption monitoring (real time information system for gathering data on the consumed quantities of natural gas).

5. Implementation of a system for controlling the secondary air that is taken away in the cyclones.

6. Reconstruction and modernisation of the 5-th technological line. The different projects connected with such reconstruction are given in table A1.

Projects connected with the operational management and maintenance

1. Repair of inlet and outlet seals in order to decrease the excess air.
2. Optimisation of the kiln loads in order to reduce the specific energy for the various kilns.

Capital investment projects

As described in Table A.1. See also the Recommendations below.

RECOMMENDATIONS

1. Main Directions for Reducing Energy Consumption

The energy consumption has been analysed and the following basic measures for its reduction are proposed:

1. With respect to the energy management - the implementation of an information system for current (everyday) analysis of the consumed electric energy and gas aiming in the future at on line monitoring of the consumption and its comparison with the production output.

2. Division of the electric charges among the main transformers and sections in view of creating possibilities for accurate reading of the consumed electric energy. Reducing the losses resulting from no load running of the transformers by disconnection of individual sections by means of additional sectionalising circuit breakers.

3. Installation of an automated gas analyser at the entrance of kiln 5 aiming at continuous monitoring of the burning process and reducing the consumption of natural gas.

4. Finishing the project on energy monitoring (an information system for current monitoring and recording of the quantities of gas consumed by each kiln). Subsequently other gas consumers can be connected to the system for central monitoring and calculating the main energy and production indices.

5. Building up a system for controlling the secondary air in view of decreasing the quantity of heat transferred to the cyclones.

6. Reconstruction and updating of production line 5. The rated data on the project and the investment costs can be found in item 3.4.

2. Energy Management

It is recommended that a person be appointed to collect and process the data about the daily energy consumption regarding both natural gas and electric energy. These data will serve to prepare reports for the chief power engineer and the plant managers thereby making it possible to take the necessary management decisions. A PC with a printer and the corresponding basic software are planned to be purchased in order to realise these functions (data analysis and presentation) thus automating the data processing activity.

The funds for purchasing the computer and the basic software are envisaged to be given by USAID within the framework of the energy saving programme for Bulgaria. The development of the specialised part of the software for processing, analysing and presenting the results (on the basis of spreadsheets) will be contracted with the plant and accomplished by the Bulgarian consultants. They will offer free training to the person appointed to work with the daily monitoring system.

3. Projects Concerned with Operational Management and Maintenance

The following measures are proposed to be taken bearing in mind that they do not entail large additional investments and can be accomplished by the plant personnel:

1. Sealing the smoke flues with the aim of decreasing the amount of excess air;

2. Developing a program for the optimisation of the furnace loading in view of its specific energy consumption so that the production schedule should be accomplished with a minimum energy consumption. In the course of accomplishing this task further consultancy assistance can be offered if required.

Taking into account the different weight of the factors causing heat losses and fuel over consumption, it is suggested that the program of measures put forward for reducing fuel consumption be implemented in two stages:

Stage 1: Measures which do not require big investments and involve repair, maintenance and adjustment of the regimes of the units and by which fuel consumption can be decreased by 13-15%.

1.1. Repairing the preheater, welding all visible cracks, sealing hatches and flanges;

1.2. Repairing and adjusting the swing valves along the mill ducts;

1.3. Sealing the entrance of the kiln or replacing the seal;

1.4. Repairing the seal of the kiln exit;

1.5. Blocking up and sealing the auxiliary chimney of the grate cooler, repairing and adjusting of the layered filter;

1.6. Repairing the burner, replacement and adjustment of the frontal parts;

1.7. Repairing, checking and adjusting the control equipment;

1.8. Adjusting the joint operation of the grate cooler, the kiln and the raw mill;

- reducing the excess (false) air in the kiln installation by approximately 40%;
- recycling the mill gases until the temperature at the mill exit (after the mill fan) is normalised and reaches about 110°C;
- loading (raising the clinker layer on the grate area) above 30 cm;
- loading the kiln with raw mill, increasing the degree of filling the kiln by over 12-13%, raising the rotation speed over 1 rpm;
- phasing (conjugating) the operation of the exhaust fan and the layered filter fan with the purpose of guaranteeing a maximum of 10% excess air in the kiln, which will correspond to approx. 2.5% vol. of O_2 content;
- gradual increase in the radial gas up to 30% of the total amount;

1.9. Training of service and maintenance personnel and strict control on the execution of technological instructions and observance of recommendations.

The state of the burning process should correspond to heat consumption of about 950-1000 kcal/kg clinker that will cause a decrease in the fly ash content by about 30%, the output of the kiln reaching up to 24-25 tons/h.

4. Projects Concerned with Capital Investments

1. Building up an information system for on line reading and analysis of the energy consumed by individual users.

The first stage of such a system could be the implementation of a daily reading of the consumed quantities of gas (flow meters have been installed for the purpose) and electric energy for some main consumers as well as the computer processing and analysis of data. In this way it will be possible to introduce a continuous monitoring of the energy consumed and its comparison with the production output..

Expenses for such an investment:

- computer 486 DX
- 8 MB RAM memory
- 210 MB disk
- SVGA display
- mouse and keyboard (Cyrillic/Latin)
- software (MS Windows, MS Word, MS Excell)

are estimated to approx. $3200 (incl. software).

At an exchange rate of $1=66 BGL this amounts to 211 200 BGL.

Taking into account the expected energy saving of about 0.2% (the lowest possible effect from such systems) from 48 064 x 10^3 cubic m (only for gas at prices towards the end of 1993) as a result of the improved energy management, the following figures are obtained:

Investment: 211 200 BGL ($3 200 x 66 BGL)

Expected savings: 175 200 BGL per annum (0.2% of 87 600 000 BGL)

Payback period: 211 200/175 200 = 1.20 years

or about 1 year estimated for prices towards the end of 1993. At present this period will be considerably shorter because of the higher prices of natural gas as a fuel and due to the higher gas consumption as compared with the unfavourable 1993.

2. The purchase of a portable gas analyser BACHARACH 24-8122 model 300 NSXEB with an extended probe allowing to measure nitrogen and sulphur oxides is proposed in view of reducing the natural gas consumption by currently analysing the gas composition.

At a price of about $6000 for such analyser

the investment cost will be 396 000 BGL ($6000 x 66)

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Expected savings from the improvement of burning processes:
0.1% of the total amount of natural gas consumed - 48 064 thousand m^3 (towards 1993) is assumed as expected savings. i.e. predicted savings of 48 thousand m^3 resulting from the improvement of the burning processes. At prices of 7.5 BGL/m^3

the savings amount to 360 000 BGL per annum.

Payback period: 396 000/360 000 = 1.1 years

In this case the data about the quantities of gas consumption are estimated towards 1993. It can be also expected that according to 1994 consumption rate this period would be less than a year.

The funds for projects 1 and 2, provided the latter are justified, can be given by USAID within the framework of the first stage of the energy saving programme.

3. Automated reading of the gas composition of kiln 5 by a gas analysing station. The installation of such a device as one of the measures to be taken during the second stage of the energy saving project will bring about a considerable reduction of energy consumption because it will allow to monitor continuously the gas composition. Subsequently, by installing additional probes to furnaces 3 and 4, the latter will also be involved in the system of continuous centralised analysis of the gas composition. This is expected to yield a significant energy-saving effect.

At a price of approximately. $40 000 for such an automated gas analysing station (probable supplier Applied Automation/Hartmann Braun),

the investment costs will be 2 640 000 (66 x $40 000).

1.5% of the total amount of natural gas consumed is assumed as expected savings. In this case it can be determined on the basis of the annual output of 150,000 tons of clinker per year multiplied by the gas consumption of appr. 140 cubic m/t.

Therefore,

0.15 x (150 000 t clinker/y x 140 cubic m/t = 315 000 cubic m/y

At a price of 7.5 BGL/cubic m

the annual saving will be 2 362 000 BGL/year (315,000 cub m x 7.5 BGL)

Payback period: 2 640 000/2 362 000 = 1.12 years

4. A kiln training simulator for the operational personnel. In this case a system for training the personnel by computer simulation of the operation of a cement kiln is envisaged. Such systems are built up on the basis of a specialised computer software. The purpose is to provide a tool for improving the qualification of the personnel, which will lead to reducing the energy losses as a result of better control of the burning processes. The purchase of such a device will certainly have a multiplier effect because it can be used to offer paid-up training to kiln personnel from other cement plants. A possible supplier of such simulators is the American company FULLER.

At an estimated price of appr. $8000 for such a simulator (provided the necessary PC is available), the investment costs will be:

Investment costs: 528 000 BGL ($8 000 x 66)

Possible savings can be expected from the improved control of the processes of starting, stopping and burning. For simplifying things, only the potential savings from improved burning processes are considered.

0.1% of the total amount of natural gas used - 48 064 thousand m^3 (towards 1993) is assumed as expected savings, i.e. suggested savings of 48 thousand m^3 as a result of improved burning processes. At prices of 7.5 BGL/m^3 this amounts to:

Annual savings of 360 000 BGL (48 000 m^3 x 7.5 BGL)

Payback period: 528 000/360 000 = 1.47 years

The funds for projects 3 and 4, provided the latter are justified, can be given by USAID within the framework of the second stage of the energy saving programme.

5. In order to reduce the energy consumption during periods of light loading, it is necessary to install sectionalising circuit breakers for switching the loads to different load sections. In this way it is possible save from losses during the no-load running of the transformers.

Installation of sectionalising circuit breakers:

Losses from no-load running of transformers:

For an 1250 kVA transformer:
- no-load running losses 2780 W (performance characteristic)
- losses for 1 year: 24 019 kWh (8 640 h x 2780 W)
- losses at 50% load: 12 000 kWh (which can be assumed as normal having in mind the incomplete loading of the production capacities)
- costs for losses in BGL: 17 294 BGL (at a price of 1.44 BGL/kWh)
- total losses for one section with 5 transformers: 86 470 BGL (5 x 17 295 BGL).

In this case the expected savings are: 86 470 from one breaker.

Investment costs for one breaker: appr. 70 000 BGL.

Payback period: 70 000/86 000 = 0.81 years.

6. Installation of additional electric meters:

The installation of additional electric meters is imposed by the requirement for more accurate reading of the energy consumption by the individual consumers. Of the 65 individual consumers connected to the separate sections (motors and transformers) at present, only 35 are connected to electric meters, some of which are out of order. That is, it is necessary to purchase and install additional electric meters to the remaining consumers. Since the costs for such an investment would rise beyond half a million BGL (30 electric meters x appr. 20 000 on the average), it is suggested that the purchase and installation go step-by-step along with the

development and implementation of a system for reading the electric energy by the separate consumers.

Estimated investment costs: 600 000 BGL. (30 x 20 000)

Expected savings from improved on line control of power supply:

0.1% of the total consumption is assumed as savings, i.e. 67 800 kWh. At a price of 2.1 BGL/kWh

the expected savings are 142 380 BGL/year.

Payback period: 600 000/97 600 = 4.2 years,

i.e. at the present prices of electric energy the use of additional electric meters without a system for automatic monitoring and control of loading is inefficient in view of the long payback period. However, given the progressively rising prices of electric energy, it could be expected that this period be considerably shortened.

7. Another group of measures are related to reconstruction.. These can be realised mainly by the plant personnel and design organisations and can be attributed to the II stage of reconstruction and modernisation.

II stage: Measures concerning investments for reconstruction and modernisation of separate units and whole installations:

II. 1. Reconstruction and sealing of the kiln entrance;

II. 2. Reconstruction of the mill feeding at the separate steps of the heater;

II. 3. Reconstruction of I-degree cyclones;

II. 4. Reconstruction of the grate cooler;

II. 5. Modernisation of the management information system.
II. 6. Training of the managing staff.

Some approximate design data about the necessary funds and the payback period for the reconstruction works are given in Table A.2.

Table A2

No.	Project	Expected annual savings 1000 x m3	Net annual cash flow 1000 x BGL	Investment costs 1000 x BGL	Payback period
1	Reconstruction of inlet and outlet seals for kiln 5	890	6 048	6 500	1.03
2	Reconstruction the of preheater	1 680	12 096	14 800	1.23
3	Reconstruction of the grate cooler	1 680	3 968	14 800	1.49

The investment for all this reconstruction works are expected to be made by the plant itself with the financial support of appropriate institution.

The proposal made regarding the investments are given in a summarised form in Table A.1 of the Report Resume.

CONCLUSION

The following basic conclusions can be drawn on the basis of the analysis of the energy consumption:

1. There are considerable reserves for energy savings (both electric energy and natural gas). The realisation of these savings is possible to be accomplished both by organisation measures and by additional investments.

2. The realisation of the energy saving measures by organisation activities is possible within the framework of the existing structure of personnel. In this case it is necessary to appoint a person who will perform daily tasks for collecting and processing of data on energy consumption with the purpose of taking duly measures by the management for controlling the energy consumption. For the purpose, an information system is proposed implemented on the basis of a PC and software, the fund for which will be provided by USAID within the framework of the energy saving programme in Bulgaria. The training of the person appointed will be done by the working team free of charge.

3. The realisation of considerable savings is possible by additional investments for reconstruction of the basic technological equipment. A preliminary assessment of some of these investment decisions is made in the Report Summary. In this case it is also necessary to bear in mind that the greater part of the funds are well justified and can be given along the lines of the energy saving programme.

4. The preliminary effect of the expected savings from all energy saving solutions put forward in the report can be estimated to approximately 25 597 BGL per annum, which, at the total of 40 606 thousand BGL investments leads to a pay-out period within an year and a half. The latter shows clearly the effect which could be achieved as a result of implementing the proposed solutions.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

REGIONAL EASTERN EUROPE ENERGY EFFICIENCY PROJECT -- BULGARIA

FINAL ENERGY AUDIT REPORT

for work at

ZMM Inc. - Sofia

by

DBC - Dimitar Baev

for

Hagler Bailly Consulting, Inc.

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ZMM ENERGY AUDIT

Final report

Prepared for:

ZMM Inc. - Sofia

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
Project for Energy Efficiency in Eastern Europe

Prepared by:

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ZMM ENERGY AUDIT

EXECUTIVE SUMMARY

INTRODUCTION

The audit was carried out on the base of contract No 12 from 07.12.1993 between ZMM Inc. - Sofia and ET "Dimitar Baev - DBC". It is implemented as a part of the Project of the US Agency of International Development (USAID) for energy efficiency in Bulgaria and includes the participation of an expert-consultant of the RCG/Hagler, Bailly Inc. and the gratuitous supply of suitable energy-conservation equipment to the plant.

The purpose of the audit is:

* To summarize, systemise and provide to the plant management information about the energy consumption and the energy costs;

* To propose to the plant management measures for improvement of the management of the energy costs;

* To propose to the plant management measures for saving of energy and of the costs, related to it.

The audit comprises the whole activities of the plant, the use of the electrical and thermal energy and the all kinds of energy carriers - electricity, steam, hot and drinking water.

The following forms of data collection were used in the audit:

* Analysis of the data from the existing accounting forms and documentation;

* Check lists and questionnaires addressed to the managers and specialists from ZMM Inc. - Sofia at different levels of management and with different responsibilities with respect to the energy consumption;

* Observations and measurements of various parameters of the energy consumption in the systems of distribution, transfer and consumption of the energy.

Part of the experimental measurements were carried out with the precision measurement equipment, provided by USAID.

During the audit on the part of USAID and RCG/ Hagler, Bailly, Inc. actively participated the American expert - consultant Mr. Mark Oven, for which we express our sincere gratitude to him.

S.1. Plant description

ZMM Inc. - Sofia is an enterprise with traditions in the production of machine-tools. During it's 98 years of existence it supplied to the market various machine-building production - from the general

purpose lathes to modern NC-controlled machines, machining centres and automatic production lines.

The production activity is organised in the following productions and divisions, standing apart:

- foundry;
- pre-processing of raw materials and preparation of blanks;
- production "Rotation - symmetric components";
- production of "bodies";
- tooling shop;
- assembly;
- production "3-D shape-generating tools".

There are complex technological connections between the production divisions. The production cycle varies from one to several months. The production is order-oriented and could be characterise rather as unique. This makes difficult the comparison of the productivity in natural units for various periods of time.

The production equipment is a combination of comparatively obsolete production capacities and contemporary machining centres and flexible manufacturing systems. The average age of the equipment is 14 years.

The organizational structure of the plant is of typically functional type. The enterprise is managed by a Board of directors and Executive director with deputy- directors managing the corresponding functional departments.

- economic department;
- commercial department;
- production department;
- technical department.

The preparation of the operational plans and the operational accounting are carried out and coordinated by the "Production department". The plans are monthly and order-oriented.

The accounting and the balance sheets are prepared for the enterprise as a whole. In every one of the productions, standing apart there are planning-accounting offices where the output and the labour-costs are accounted.

During the audit the top management of the plant and the heads of the productions specified as a problem of highest priority the procurement of financial sources and credits.

In ZMM Inc. Sofia there is programme for efficient use of the energy, developed by the plant specialists and experts. In the frames of this programme in a process of implementation is the system for information, control and management of the energy costs, developed by "Electrosystemengineering".

The departments "Investment & Maintenance" and "Service" are responsible for the supply, transformation and distribution of the

energy and for the reliable work of the energy systems.

As a whole in the plant an efficient energy consumption control and management system is created. Available are experienced qualified specialists in this field. The top management has understanding of the increasing importance of the issues of the efficient energy usage and readiness for undertaking of practical measures for energy costs decrease.

The analysis of the energy consumption management system allows to draw the following conclusions, which lead to possible measures for refinement of this system and for energy savings:

* In the plant there is no implemented form of internal cost accounting, accurate enough, according to which the separate productions, standing apart, to be charged with the energy costs and they to influence the final results and the salaries.

* The information obtained by now does not reflect the energy consumption, actually involved, for all productions, because of technical limitations of the existing system for measuring of the consumption of electric energy and particularly of thermal energy.

* The system for management and control of the energy consumption, being implemented now, has considerable potential for efficient management of the energy consumption - it can provide continuous and complete information for the current consumption, as well as summarised information for particular time periods. But it based on the existing outline for measuring of the electric energy consumption by transformers and the information is not oriented to all real consumers.

* In the operative reports (weekly, monthly) for the plant as a whole and for the productions and divisions, standing apart, no calculations are carried out of the energy consumption, related to an unit of produced output, as well as comparison of this consumption to specific average values or norms.

* There are no norms or standards for energy consumption related to unit of production.

The total costs for energy carriers in 1993 are 21 948 295 BGL, including:

- for electric energy - 9 489 341 BGL
- for Thermal energy - 10 591 411 BGL
- for water - 1 867 543 BGL.

The energy costs in 1993 represent 10.4% of the annual commodity output. For 1992 this part is 7.19%. The prices of the energy increase in higher rate than the prices of the sold production. This fact demonstrates the increasing importance of the issues of efficient energy usage, taking into account that most probably the tendency will stay.

S.2. Description and analysis of energy systems

S.2.1. Thermal Energy Systems

The heat consumption in ZMM Inc. - Sofia is effected basically through two energy carriers: steam and hot water. It is predetermined by the needs for heating of the production and administrative premises as well as of the hot water for domestic needs. The technological processes are insignificant direct consumer of steam.

Heat source and supplier is Sofia Thermal Power Station (TPS Sofia). The supply of hot water is effected by the Industrial water main of TPS Sofia. The heat-carrier arrives in the main subscriber station, where the heat consumption is measured with heat meter with diaphragm sensors.

For the heat-carrying steam two inputs are provided - central input from Iliensko shousse blvd. and secondary - from steam mains of the TPS Sofia, coming from the plant for automotive tyres. The heat consumption is measured at each input through heat meters of diaphragm - type sensors.

The heating is organized mainly as direct water heating and hot air heating.

The preparation of the hot water for domestic purposes is in conformity with the schedules for heat supply from the heat source - in winter period by steam and hot water and in the summer period only by steam.

In ZMM Inc. - Sofia are implemented heat meters for steam and hot water in the main subscriber stations and in the input of the enterprise. The observations indicate that the heat meters functioning is not stable. The data for the heat energy consumption are recorded and processed manually.

The basic installed capacities (consumers) could be structured in two main groups according to the type of the primary heat-carrier:

HEAT-CARRIER HOT WATER:

- Hot-air devices
- Heat-exchanging devices water-water
- Boilers water-water
- Air conditioning
- Heating
- Ventilation

HEAT-CARRIER STEAM

- Boilers steam-water
- Hot-air devices
- Process baths
- Drying units
- Heating

These are the rated capacities, which exceed considerably the actual heat consumption.

The maximum heat demand (determined at calculated temperature conditions) is 27.5 MW for energy carrier hot water and 4.5 MW for energy carrier steam.(4.6 MW in winter conditions and 4.14 MW in summer conditions)

Two basic reasons determine the expected difference between the rated and the actual heat consumption:

One is the factor "climate" and on the other is the measures for diminishing of heat consumption, undertaken and effected by the Energy department. These two factors cause mutually related effects. The second factor admits considerable dosage of intuitiveness because of lack of automated control and as a consequence - potential for savings at the expense of underheating the rooms.

The dynamics of the energy consumption implies that predominant part of the hot water over the steam correlates with the change of the generalised characteristics of the climate - the monthly degree-days. Clearly expressed season component is outlined, to which there are added reactions, caused by the undertaken managing actions. In the months February, March and April an increased consumption with about 1.5 Mkal/month and in November - "underheating" with 1 Mkal/month.

The connection investigated between the daily consumption and the outdoor temperature of the air (for 46 days of the heating season 1993-94) indicates that the temperature variations are not the factor determining the daily consumption.

The expected cyclic reduction of the consumption during the Saturdays and Sundays did not confirm itself. Here the evident potential for savings should be searched and used.

The cause for the high average hour consumption of the mains water is the low temperature of the supplied heat carrier, which determines the low actual rate of it's cooling in the heating devices.

In the real conditions the low temperature level in the mains and it's lack of correspondence with the changes of the outdoor air temperature, the specific features of the heating installations of the "direct circuit" type, as well as the lack of automatic control of the quality of the heating are the factors determining almost "zero" controllability of the system as a whole.

The efforts to find out regularity in hourly aspect were unsuccessful.

The aspiration to decrease the consumption of heat is connected to the only alternative - regulation of the capacity of the heat carrier, which in spite of the rich experience of the energy

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department is accompanied inevitably with subjectivity.

The basic consumer of heat with steam as a heat carrier is the process of warming up the water for communal needs. The share of this consumer varies between 40 and 60% (winter and summer regimen) of the total quantity of consumed steam. The steam for technological needs is about 30%. The rest is consumed by the heating and ventilation installations.

The variation of the monthly consumption shows weak correlation with the change of the climatic factors. This could be explained with the distribution of the consumption, described above.

The course of the variation of the daily consumption reflects an unestablished process with clearly expressed fluctuations, caused by operator's interventions.

Again in Saturdays and Sundays over-expenditure of steam is noted, caused by the subjectiveness at the regulation of the capacity.

The analysis for a period of the summer season - without heating (20 Sept. - 14 Oct. 1993) indicates that the variation of the daily consumption fluctuates about 5 MW.

The disclosure of the peculiarities of the hour consumption has made it necessary to complement the available data base with new experimental data. From the experiment it is clear, that the pressure of the steam incoming to the system is much higher (9 Atm) than the pressure (6 Atm) sufficient for the processes, being used. The high pressure is a natural factor for the often caused punctures of the steam transmitting mains and equipment.

There is absolutely no expressed hourly regularity. Fluctuations in the hourly consumption are caused by the consumers, connected to the branch 2 from which no condensate returns back.

In order to establish the condition of the steam transmitting and condensing lines for branch 1 comparison is made between the supplied steam and the returned condensate. Disbalance is between 25 and 30%, which signals leakages in the system.

Condensate is returned back with very high temperature and represents steam-water mixture - an indication of non-functioning steam traps.

S.2.2. Electrical Distribution System

The plant has it's own distribution substation for middle voltage 20 kV with two sectioned bus systems. The basic production workshops are supplied with electric energy by two separate cable lines and transformers 20 kV/0.4 kV with the exception of the workshop for rough machining and the workshop for pre-processing of the raw materials and preparation of the blanks. The administrative building and the communal complex are supplied by separate cable lines.

The electric energy supply system of the plant includes 16 transformers 20 kV/0.4 kV of 1000 kVA each, two transformers 20 kV/0.4 kV of 560 kVA each and one transformer 20 kV/0.4 kV of 400 kVA. At the outputs of each transformer with exception of the transformer for the administrative building, measuring is carried out of the active electric power by electric meters. The commercial measurement of the electric energy is carried for the plant as a whole.

In the transformer sub-stations of the workshops (at the side of 0.4 kV) of the basic production workshops (20, 04, 09, 03, 06, 18, 08, 10) condenser batteries are installed, but not connected and beside they are in poor technical condition.

In order to analyse the loading of the workshop transformer sub-stations for each transformer, recording of the load chart on hour basis is carried out for three working days (Monday, Wednesday and Thursday) and one holiday (Sunday) of the week.

In the production workshops the basic consumers of electric energy are the lighting systems and the production units.

In all production workshops common lighting system is used, designed with mercury vapour lamps of 400 W. Fluorescent lamps are also used in the various rooms for the administrative staff, the corridors and the service rooms. For the last 18 months almost no technical servicing or repair of the lighting system is carried out.

The basic part of the production units are various kinds of machine tools, installed in the production workshops. In part of the workshops measuring processes are carried out.

Large consumers of electric power are the electric thermal and galvanic installations, the compressor shop, the ovens for artificial aging in the preparatory shop and various types of bridge cranes in the workshops.

Generally from the analysis of the electric supply system and the consumption of electric power in ZMM Inc. - Sofia , the following conclusions could be drawn:

* The electric supply system is designed for transmission and distribution of considerably larger demand. At present with the decreased demand for diminishing of the electric power losses in the electric supply system it is worth while to carry out optimization.

* The power factor of the electric supply system is very low, and because no artificial compensation is carried out, large fines for bad power factor are to be paid (2 200 000 BGL annually. The basic part of the electrical equipment works not sufficiently loaded and especially the electric motors. This leads to lower efficiency and power factor.

* The lighting system is generally inefficient.

* The thermal equipment (ovens and baths) function with considerable losses of heat, respectively of electric power.

* The idling of the electric motors is not limited.

* No tariff strategy is used in the electric energy consumption.

* There is considerable over-consumption of electricity because of the leakages of compressed air.

S.2.3. Water Systems

The water consumption for communal and technological purposes is evaluated only in monthly aspect. The basic source of water are the mains.

The share of the water obtained by own drilling is insignificant. The peak load is due to technological needs, but because of lack of working pumps, entirely mains water is used.

Taking into account the water crisis in the region of Sofia and the related drastic price increase of the water, the issue of using own water sources is of high priority.

S.3. Recommended measures for energy efficiency improvement

A. Energy Management Improvement

A.1. Energy Information and Management System Improvement.
A.2. Integrated Production and Energy Information System Development.

B. Thermal Energy Efficiency Measures

B.1. Pressure Control in the Steam Distribution System.
B.2. Hot Water Temperature Control in the Heat Exchangers.
B.3. Improved Inspection of Steam Traps and Steam, Water and Air Leaks.
B.4. Implementation of Regime-Technological Card for Steam Rate Control.
B.5. Implementation of a Heat Exchange System for Condensate Heat Utilization.

C. Electrical Energy Efficiency Measures

C.1. Disconnection of the Unloaded Transformers.
C.2. Lighting Systems Improvement.
C.3. Power Factor Improvement.
C.4. Replacement of Incandescent Lamps in the Dining Area and Trade Complex by Fluorescent Lamps.
C.5. Installation, insulation and sealing of the electric

furnaces.
C.6. Shifting the test operations to the non-peak-hour zone.
C.7. Rationalizing the control system of the elevators.
C.8. Improvement of the regime of work of electrolyte furnaces.
C.9. Replacement of the Electromagnetic Tables with magnetic ones.

The implementation of all measures could save 4,077 Gcal/year and 936.5 MWh/year. The expected total savings are 7,059.6 ths. BGL/year. That is 32.2% of total energy costs. The total costs for the implementation of the measures are 4,715 ths.BGL. The average payback period is 0.67 year.

These estimations are based on the presumption of the independent actions of the measures and do not take into account the fact, that some of them are oriented to the same object or problem.
In this sense the energy savings and the project costs of the measures B.2. and B.5. depend on the sequence of their implementation.

D. Socially-oriented Measures

D.1. Improvement of the Heating in the Production Facilities and Administration Building.

S.4. Action Plan

S.4.1. Specification of the Required Equipment (see Table 4.1.)

S.4.2. Low-Cost and Short-Payback Measures

* cost of the project - less than 200 000 BGL.
* payback period - less than 6 months.

B.1. Pressure Control in the Steam Distribution System.
B.3. Improved Inspection of Steam Traps and Steam, water and Air Leaks.
B.4. Implementation of Regime-Technological Card for Steam Rate Control.
B.5. Implementation of a Heat Exchange System for Condensate Heat Utilization.
C.1. Disconnection of the Unloaded Transformers.
C.5. Installation, insulation and sealing of the electric furnaces.
C.6. Shifting the test operations to the non-peak-hour zone.
C.8. Improvement of the regime of work of electrolyte furnaces.

S.4.3. Medium Sized Cost Measures

* cost of the project - less than 1,000,000 BGL.
* payback period - less than 1.5 year.

A.1. Energy Information and Management System Improvement.
B.2. Hot water temperature control.
C.3. Power Factor Improvement.

Table 4.1

No	Required equipment	Number of units	Related ECO	Total cost $
	First stage			
1.	Pressure control valves:		B.1.	
	- Py 180 mm/6 bar	1		2,130
	- Py 50 mm/2 bar	2		1,566
2.	Thermo control valve		B.2.	
	- TCV Dy 32 mm	7		5,250
	- TCV Dy	4		2,500
3.	Plate heat exchanger	1	B.5.	2,375
4.	Ultrasonic		B.3.	3,000
	Second stage			
1.	Hand-held electric power factor analyzer	1	C.3.	600
2.	Equipment for power factor improvement - capacity batteries and controller	-	C.3.	10,000
3.	Lighting system for two Shops	-	C.2.	5,000
4.	Software for integrated production		A.1, A.2	10,000
5.	Steam traps		B.3.	
6.	Vacuum interrupting device 2 x 20 kV	1	C.1	

S.4.4. Capital Intensive or Long Payback Measures

* cost of the project - more than 1 000 000 BGL.
* payback period - more than 1,5 year.

A.2. Integrated Production and Energy Information System.
C.2. Lighting Systems Improvement.
C.4. Replacement of Incandescent Lamps in the Dining Area and Trade Complex by Fluorescent Lamps.
C.7. Rationalizing the control system of the elevators.
C.8. Improvement of the regime of work of electrolyte furnaces.
C.9. Replacement of the Electromagnetic Tables with magnetic ones.
D.1. Improvement of the Heating in the Production Facilities and Administration Building.

S.4.5. Recommended Schedule of Implementation

A. First Priority Measures

* To start immediately and to be implemented by the end of 1994 - B.1., B.4., B.5., C.1., C.5., C.6., C.8.,

* To start immediately and to be implemented in portions by 30. 06. 1995. - A.1., B.2., B.3., C.3.

The measures B.2. and B.5. are interrelated and the sequence of their implementation will influence the scope and the costs of the measures.

B. Second Priority Measures

* To start in 1995 and to be implemented in portions by the end of 1995. - A.2., C.2., C.4., C.7., C.9.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO A.1.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994

ACTION NO. AND BRIEF DESCRIPTION: Energy information and management system improvement.

AREA OF THE PLANT AFFECTED: Plant management

FINDINGS CONCERNING EXISTING CONDITIONS:

* Production managers have not update and precis information about energy consumption
* Performance indexes, energy/production indexes are not prepared
* Energy cost accounting of the production areas is not adequate to the requirements of energy saving

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. Correction of the electrical energy metering system;
2. Internal cost accounting system improvement;
3. Energy measurment and contril system improvement;
4. Plant energy efficiency councel;
5. Energy saving personal motivation system development.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year		h.water Gcal/yr	steam Gcal/yr	ths. BGL /year	
Baseline -existing conditions		8,904		16,574	7,352	21,948	
After recommended action		8,548		15,911	7,058	21,070	
Net reduction - 4% reduction of all energy costs		356		663	294	878	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	150	ths. BGL
Equipment procurement		
Equipment installation	100	ths.BGL
Equipment commisssioning		
TOTAL INSTALLED COST - ths. BGL	250	(b)
Estimated increase in annual (non-energy) operations and maintenance cost	50	(c)

PAYBACK PERIOD:

$$\frac{b:\ 250}{a:\ 878 - c:\ 50} = 0{,}30 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

To implement by the end of 1994 tasks 1, 3, and 4, and by 30.06.1995. - tasks 2 and 5.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO A2

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994

ACTION NO. AND BRIEF DESCRIPTION: Integrated production and energy information system

AREA OF THE PLANT AFFECTED: Plant management

FINDINGS CONCERNING EXISTING CONDITIONS:

There is not enougth relation between production management and energy management systems.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To develop and implement

Computer integrated information system

- daily, week and month production reports
- paralell processing of production and energy consumption data
- data base support
- statistics and analysis

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year		h. water Gcal/yr.	steam Gcal/yr	ths.BGL /year	
Baseline -existing conditions		8,904		16,574	7,352		
After recommended action		8,860		16,491	7,315		
Net reduction 0.5% of all production costs		44		83	37	1,000	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	600	ths. BGL
Equipment procurement	800	
Equipment installation	100	
Equipment commisssioning		
TOTAL INSTALLED COST	1,500	(b)

Estimated increase in annual (non-energy) operations and maintenance cost	120	(c)

PAYBACK PERIOD:

$$\frac{b: 1500}{a: 1,000 - c: 120} = 1.7 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

1.03.1995 - 30.03.1996

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO. B1

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994

ACTION NO. AND BRIEF DESCRIPTION: Pressure control in the steam distribution system

AREA OF THE PLANT AFFECTED: The main substation and steam pipelines

FINDINGS CONCERNING EXISTING CONDITIONS:

* The main steam flow incomes in the subscriber central station with too high pressure;
* Unsufficiant hidraulic conditions of steam transfer in the steam pipes.

  This causes the unsufficiant steam pressure in the end consumers.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

* To install 1 pressure control valve (Dy 180mm/6bar) before the heat meter
* To install 2 pressure control valves before the central hot water heat exchangers (Dy 50mm/2bar).

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost	
	Peak kW	Energy MWh/year			Gcal /year	ths.BGL /year	
Baseline -existing conditions					7,352	5,231	
After recommended action					6,728	4,787	
Net reduction					624	444	(a)

≈Б10,78/Gcal

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement	202	
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	202	(b)
Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 202}{a: 444 - c:} = 0.45 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

01.09.1994 - 30.09.1994

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO. B3

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994

ACTION NO. AND BRIEF DESCRIPTION: Institute Steam Traps and steam, water and air leaks

AREA OF THE PLANT AFFECTED: Steam traps and pipelines systems

FINDINGS CONCERNING EXISTING CONDITIONS:

The condition of the installed steam traps requires improved control. In Branch 1 of the distribution network approximatly 24% of the steam doesn't condensate because of the bad condition of the steam traps and air leaks

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Procurement of Ultrasonic tester to help the Energy Department in steam traps and air leaks testing.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year			steam Gcal/yr	ths.BGL /year	
Baseline -existing conditions					3,100	2,201	
After recommended action					2,356	1,756	
Net reduction					744	445	(a)

~$9.06/Gcal

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement		
Equipment installation (ths.BGL)	176	
Equipment commisssioning		
TOTAL INSTALLED COST (ths.BGL)	176	(b)

Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 176}{a: 445 - c: 0} = 0.4 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

30.09.1994

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO B.4.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
B.4. Introduction of regime-technological card for steam rate control

AREA OF THE PLANT AFFECTED:
Steam substation

FINDINGS CONCERNING EXISTING CONDITIONS:

The steam rate control carried out by the staff is not adequate to the course of the production. During the night shifts the consumption is unjustifiably large.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Develop regime-technological card, which has to indicate the number of turns of the main steam valve depending on the expected night temperature of the air

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:		Total cost	
	Peak kW	Energy MWh/year		steam Gcal/yr	ths.BGL /year	
Baseline -existing conditions				7352	5231	
After recommended action				6272	4470	
Net reduction				1080	761	(a)

≈$10.67/Gcal

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	40	ths. BGL
Equipment procurement		
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST ths BGL	40	(b)

Estimated increase in annual (non-energy) operations and maintenance cost	10	(c)

PAYBACK PERIOD:

$$\frac{b: 40}{a: 761 - c: 10} = 0.05 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

01.09. - 30.12.1994.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO B.5.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
B.5. Implementation of a heat exchange system for condensate heat utilisation

AREA OF THE PLANT AFFECTED:
The main subscriber station (MSS)

FINDINGS CONCERNING EXISTING CONDITIONS:

The collected condensate has high temperature (95-98 oC). The reservoir is opened and secondary vaporisation and cooling results.

With this temperature the condensate is thrown out.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

The heating of the water for communal purposes in voluminous vessels is used (the three boilers in the MSS).

It is possible to create cascade scheme - in one of the boilers the initial warming of the cold water is carried out using the heat from the condensate and in the next two boilers additional heating with steam is carried out to temperature 55 oC.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year			Gcal	ths.BGL /year	
Baseline -existing conditions					7,352	5,231	
After recommended action					6,704	4,774	
Net reduction					648	457	(a)

≈ B10.6B/Gcal

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	15	ths. BGL
Equipment procurement	147	
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST	162	(b)

Estimated increase in annual (non-energy) operations and maintenance cost	0	(c)

PAYBACK PERIOD:

$$\frac{b: 162}{a: 457 - c: 0} = 0.35 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

01.09 -30.10.1994.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO B.6.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
B.6. Improvement of the heating of the working premises

AREA OF THE PLANT AFFECTED:
Production shops and administrative rooms

FINDINGS CONCERNING EXISTING CONDITIONS:

Despite the considerable expenses for heating, the temperature in the shops and the rooms is below the required norms

The reason is the low temperature of the incoming heat carrier and in the accepted direct scheme of heat exchange.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

A. Passing in stages to direct scheme of heat exchange. Building of subscriber stations in the administrative building, in the canteen and in the communal combine as a first stage.

B. Increase of the temperature of the heat carrier through centralised warming-up of the whole capacity or selective warming-up of the heat carrier immediately befor the consumer.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				/year	
Baseline -existing conditions							
After recommended action							
Net reduction Social effect							(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement ths.BGL	380	for 1st stage of A
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST		(b)

Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b:}{a: - c:} = \boxed{}\ \text{years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 1995.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO C.1.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
C.1. Disconnection of the unloaded transformers.

AREA OF THE PLANT AFFECTED:
The system of transformers

FINDINGS CONCERNING EXISTING CONDITIONS:

In the electric supply system of the plant there are 17 transformers installed with capacity of 1000 kVA each, two two transformers of 560 kVA each and one of 400 kVA.

They operate under loads, that are considerably lower than the rated loads.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

The research and the calculations of the maximal long lasting loads shows, that it is possible without essential essential reconstructions to switch-off four of the transformers and their load to be undertaken by other transformers. As a result 15 MWh of losses are saved for each transformer annually or 37,5 ths. BGL.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

37 591 BGL for one transformer x 3 = 112,773

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				ths.BGL /year	
Baseline -existing conditions	-	-					
After recommended action	-	-					
Net reduction	-	60				150	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement		
Equipment installation (ths.BGL)	50	
Equipment commisssioning		
TOTAL INSTALLED COST		(b)

Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 50}{a: 150 - c: -} = 0.3 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

Three of the transformers were swiched-off in the course of the project. It is necessary to prepare the switching-off of the transformer No 3 and it's load to be undertaken by transformer No 15.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

| ACTION NO C.2.1.-2 |

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994

ACTION NO. AND BRIEF DESCRIPTION:
Lighting system improvement.

AREA OF THE PLANT AFFECTED:
Production areas.

FINDINGS CONCERNING EXISTING CONDITIONS:

In each production area section (module) 210 x 400 W mercury lamps are installed.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

* To replacethe mercury lamps by 200 x 250 W high pressure sodium lamps. The reduction of the demand in one section is 34,65 kW.
* Lighting system automation control implementation.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				ths BGL /year	
Baseline -existing conditions	92,4	314				356	
After recommended action	57,75	196				222	
Net reduction	34,65	118				134	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement	105	
Equipment installation	50	
Equipment commisssioning		
TOTAL INSTALLED COST	155	(b)

Estimated increase in annual (non-energy) operations and maintenance cost	0	(c)

PAYBACK PERIOD:

$$\frac{b: 155}{a: 134 - 0} = 1,15 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

30.09.1994. - 30.06.1995. To start with shopfloors 03 and 06.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO C.4.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994

ACTION NO. AND BRIEF DESCRIPTION:
Replacement of the incandescent lamps by fluorescent lamps.

AREA OF THE PLANT AFFECTED:
Dining area and trade complex.

FINDINGS CONCERNING EXISTING CONDITIONS:

In the dining area 210 x 40 W incandescent lamps are installed.

In the trade complex 200 x 40 W incandescent lamps are installed.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

1. To replace the existing incandescent lamps in the dining area by 30 fluorescent lamps (3 x 40) W.
2. To replace the existing incandescent lamps in the trade complex by 200 x 7 W compact fluorescent lamps.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				ths. BGL /year	
Baseline -existing conditions	16,4	60,7				72,6	
After recommended action	5,2	19,0				22,7	
Net reduction	11,2	41,7				49,9	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	5	ths.BGL
Equipment procurement	68	
Equipment installation	20	
Equipment commisssioning		
TOTAL INSTALLED COST	93	(b)

Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 93}{a: 49,9 - c: 0} = 1,86 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 01.06. - 30.09.1995.

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO C.5.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
C.5. Installation, insulation and sealing of the electric furnaces

AREA OF THE PLANT AFFECTED:
Forge shop

FINDINGS CONCERNING EXISTING CONDITIONS:

The furnaces are obsolete and are not sealed. They have considerable losses of heat, about 10 %.

They do not operate at night only.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To replace the furnaces with the already supplied new ones with better energy efficiency.

To ensure the operation of the furnaces at night tariff.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

About 10 % savings of electric energy	Electricity		Fuels, heat and steam:			Total cost	
	Peak	Energy				ths. BGL	
	kW	MWh/year				BGL/year	
Baseline -existing conditions	480	780				9,360	
After recommended action	432	702				8,424	
Net reduction	48	78				936	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement	-	
Equipment installation	30	ths.BGL
Equipment commisssioning		
TOTAL INSTALLED COST		(b)
Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 30}{a: 93.6 - c: -} = 0.32 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

30.07-30.09.1994.

The new furnaces are bought

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO C.6.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
C.6. Shifting the tests operations in the non-peak-hour zone.

AREA OF THE PLANT AFFECTED:
Shop 03

FINDINGS CONCERNING EXISTING CONDITIONS:

At the moment part of the tests of the new machines are carried out during the peak hour zone.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To shift the test operations, using to the maximum the cheap night zone.

The maximum load to be shifted to the following zones:

12:00 - 18:00 in winter
12:00 - 20:00 in summer

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

About 30 % savings	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				BGL/year	
Baseline -existing conditions		50				60	
After recommended action		35				42	
Net reduction According to expert's evaluation		15				12	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	5	ths. BGL
Equipment procurement		
Equipment installation		
Equipment commisssioning		
TOTAL INSTALLED COST		(b)

Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 5}{a: 18 - c:} = 0.28 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

30.07 -30.09.1994.

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RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

| ACTION NO C.7. |

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
C.7. Rationalizing the control system of the elevators

AREA OF THE PLANT AFFECTED:
Administrative building

FINDINGS CONCERNING EXISTING CONDITIONS:

The control system of the elevators permits to call all the elevators from the ground floor even if only one person wishes to use the elevators.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

The control system should be re-designed in order to diminish the idle work of the elevators (it is possible for certain hours to switch off some of the elevators).

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

516 kWh x 1.136 BGL = 586 BGL

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				BGL/year	
Baseline -existing conditions	8	4.128				4,953	
After recommended action	7	3.612				4,334	
Net reduction	1	0.516				0,619	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement	0,5	ths. BGL
Equipment installation	0,5	
Equipment commisssioning		
TOTAL INSTALLED COST	1,0	(b)

Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 1,0}{a: 0,619 - c: 0} = 1,61 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

30.03 -30.06.1995.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO C.8.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
C.8. Improvement of the regime of work of electrolyte furnaces

AREA OF THE PLANT AFFECTED:
Thermal shop

FINDINGS CONCERNING EXISTING CONDITIONS:

In non-working hours part of the heat of the furnaces is transmitted to the working room

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

Insulate the opening of the baths in non-working hours by means of insulated lids.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

About 10 % diminishing of the costs in non-working hours	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				ths. BGL /year	
Baseline -existing conditions	200	1,100				1,320	
After recommended action	180	990				1,188	
Net reduction	20	110				132	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement		
Equipment installation	20	ths. BGL
Equipment commisssioning		
TOTAL INSTALLED COST	20	(b)
Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b: 20}{a: 132 - c: 0} = 0.15 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

01.08 -30.09.1994.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY

ACTION NO C.9.

Prepared for USAD and RCG/Hagler Bailly

Plant name: ZMM Inc. - Sofia
Address: 8, Iliensko shosse Str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.94

ACTION NO. AND BRIEF DESCRIPTION:
C.9. Replacement of the electro-magnetic tables with magnetic ones.

AREA OF THE PLANT AFFECTED:
The whole plant

FINDINGS CONCERNING EXISTING CONDITIONS:

The electro-magnetic tables consume continuously electric energy during the operation

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

It is proposed to replace the electro-magnetic tables with magnetic tables with permanent magnets controlled by electric-impulses. The calculations show that annual savings of 2,700 kWh for one table are possible.

It is proposed to replace 10 tables.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

2700 kWh annually per a table x 10 = 27 000 kWh	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy MWh/year				ths. BGL /year	
Baseline -existing conditions		28				33,6	
After recommended action		1				1,2	
Net reduction		27				32,4	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design		
Equipment procurement		
Equipment installation	80	ths. BGL
Equipment commisssioning		
TOTAL INSTALLED COST	80	(b)

Estimated increase in annual (non-energy) operations and maintenance cost		(c)

PAYBACK PERIOD:

$$\frac{b:\ 80}{a:\ 32{,}4 - c:\ 0} = 2{,}45 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE:

01.03 -30.06.1995.

BALANCE - ELECTRICAL
d for USAID and RCG/Hagler Bailly

ame: ZMM Inc. - Sofia
: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

's name: DBC - Dimitar Baev

date: 30.06.1994

	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 BGL/year
1	TP No 5 - compressor station	420	43.2	31.2	36	201,360	242,813
2	II - output - compressors (disconnected)	410	52.2	37.7	43.5	246,240	293,400
3	I - output - compressors	820	194.4	140.4	162	919,980	1,092,657
4	TP No 7 - foundry	864	77.4	55.9	64.5	370,764	435,040
5	TP No 11 - foundry	910	124.2	89.7	103.5	592,488	698,087
6	TP No 2 - comunal complex	326	41.4	29.9	34.5	168,064	232,695
7	TP No 10 - metal-working, thermo - and galvanic shops	960	210.6	152.1	175.5	969,816	1,183,712
8	TP No 9 - metal-working shop	724	82.8	59.8	69	396,036	465,391
9	TP No 13 - pre-processing and tooling shops	933	70.2	50.7	58.5	332,988	394,570
10	TP No 22 - 3-D-shape generating tools	830	271.8	196.3	226.5	1,296,912	1,527,697
11	TP No 19 - FMS	540	20.7	149.5	172.5	983,196	1,163,478
12	TP No 17 - combined maschines shop	275	59.4	42.9	49.5	283,296	303,516
13	TP No 16 - combined machines shop		14.4	10.4	12	71,064	80,938
14	TP No 8 - forgery	920	97.2	70.2	81	456,780	546,328
15	TP No 4 - shop 03 and shop 06	453	106.2	76.7	88.5	504,948	596,915
16	TP No 3 - shop 06	724	129.6	93.6	108	612,888	728,438
17	TP No 1 - administration building	294	18	13	15	112,000	101,172
	PEAK DEMAND (equals maximum billing demand)					8,518,820	10,086,847
	ELECTRIC ENERGY CONSUMPTION AND COST (equals total billed consumption)		1,613.7	1,300.0	1,500.0		

C ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD
d for USAID and RCG/Hagler Bailly

ame: ZMM Inc. - Sofia
: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

's name: DBC - Dimitar Baev

date: 30.06.1994

city contract terms:

Electricity supply company's name	NEC
Contract maximum demand (kW)	15,000
Minimum charge (cost):	
Other:	

TION AND BILLING DATA FOR 12-MONTH AUDIT PERIOD:

r ng /yr	Demand Active kW	Demand Reactive kVAR	Max Demand kW	Consump MWh/ month	Power Factor cos 0	Load Factor	Total Cost ths. BGL	Penalty for cos0 ths. BGL	Notes on plant conditions and changes
/93	1,360	1,250	1,500	980.0			1,154	252.3	
/93	1,350	1,320	1,740	1,108.6			1,275	363.6	
/93	1,400	1,290	1,440	1,021.6			879	2.8	
/93	985	980	1,450	708.8			959	314.2	
/93	720	710	930	515.5			584	149.4	
/93	860	850	1,440	617.5			735	211.5	
/93	870	860	1,040	623.0			772	234.0	
/93	760	750	1,000	565.4			607	145.0	
/93	870	850	1,120	621.2			718	167.0	
/93	760	750	870	544.4			698	176.8	
/93	1,100	940	1,360	780.4			931	167.4	
/93	1,200	1,000	1,220	837.0			804	0.2	
	12,235	11,550	15,110	8,923.4			10,116	2,184.2	

Peak demand during audit period (kW):

TEAM OR HEAT ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD
TYPE: DRINKING WATER
d for USAID and RCG/Hagler Bailly

ame: ZMM Inc. - Sofia
: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

's name: DBC - Dimitar Baev

date: 30.06.94

contract terms:

Fuel or heat supply company's name:	Water supply and drainage JSC-Sofia
Contract maximum demand:	20,000 m3/month
Minimum charge (cost):	
Other:	2,000 m3/month from own water source

TION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
AME OF ENERGY FORM):

r ng /yr	Physical Consumption units = m3	Thermal Consumption Gcal	Total Cost ths.BGL	Monthly Heating Degree-Days HDD	Heating Index Gcal/HDD	Product.Index Gcal per:	Notes on plant conditions and changes
/93	15,450		55.4				
/93	17,800		118.1				
/93	19,200		126.4				
/93	19,100		126.0				
/93	28,140		183.2				
/93	34,000		224.0				
/93	22,090		113.6				
/93	22,400		123.5				
/93	37,100		248.6				
/93	25,000		167.5				
/93	22,700		151.3				
/93	21,100		141.0				
	284,080		1778.6				

Note: Heating degree-days based on reference temperature of 19 C

TEAM OR HEAT ENERGY CONSUMPTION - 12 MONTH AUDIT PERIOD
TYPE: STEAM
d for USAID and RCG/Hagler Bailly

ame: ZMM Inc. - Sofia
: 8 Ilienskо shousse str. 1220 Sofia, Bulgaria

's name: DBC - Dimitar Baev

date: 30.06.94

contract terms:

Fuel or heat supply company's name: Heating Supply Co. - Sofia
Contract maximum demand: 23,500 Gcal/year
Minimum charge (cost):
Other:

TION OR BILLING DATA FOR 12-MONTH AUDIT PERIOD
AME OF ENERGY FORM):

r ng /yr	Physical Consumption units =	Thermal Consumption Gcal	Total Cost th.BGL	Monthly Heating Degree-Days HDD	Heating Index Gcal/HDD	Product.Index Gcal per:	Notes on plant conditions and changes
/93		694.0	353.3	520	1.33		
/93		906.1	461.2	500	1.81		
/93		1,007.7	512.9	470	2.14		
/93		947.4	482.2	240	4.05		
/93		75.8	46.2	30	-		
/93		509.6	310.9	-	-		
/93		393.9	240.3	-	-		
/93		315.8	192.6	-	-		
/93		294.9	199.9	18	16.38		
/93		189.2	115.4	165	1.14		
/93		955.4	582.8	506	1.89		
/93		1,062.0	647.8	508	2.09		
		7,351.8	4,145.5				

Note: Heating degree-days based on reference temperature of 19 C

BALANCE - FUEL, STEAM OR HEAT
TYPE: HOT WATER
d for USAID and RCG/Hagler Bailly

ame: ZMM Inc. - Sofia
: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

's name: DBC - Dimitar Baev

date: 30.06.1994

	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 ths.BGL/year
1	Water-air heaters	8.05	1.58		7,015.0	2,279.8
2	Water-water heaters	0.88	0.17		751.5	244.2
3	Hot water supply	0.25	0.05		208.0	67.6
4	Air conditioning	0.05	0.01		41.7	13.4
5	Water heating	6.32	1.24		5,512.0	1,791.4
6	Ventilation	8.39	1.65		7,350.0	2,388.7
	PEAK DEMAND	23.94				
	ENERGY CONSUMPTION AND COST (equals total billed consumption)				20,878.2	6,785.1

ALANCE - FUEL, STEAM OR HEAT
YPE: STEAM
l for USAID and RCG/Hagler Bailly

me: ZMM Inc. - Sofia
8 Iliensko shousse str. 1220 Sofia, Bulgaria

's name: DBC - Dimitar Baev

ate: 30.06.1994

	Equipment or Process Description	Maximum Load units: Gcal/h	Average Load units: Gcal/h	Load at Peak Demand units: Gcal/h	Energy Consumption units: Gcal/year	Total Energy Cost ths.BGL/year
1	Steam - water heaters	4.65	1.55	4.65	3,970	2,235.1
2	Steam - air heaters	0.91	0.30	0.91	735	413.8
3	Process baths	0.95	0.32	0.95	1,726	971.7
4	Drier	0.19	0.06	0.19	480	270.2
5	Water heating system	2.23	0.74	2.23	441	248.3
EAK DEMAND				8.93		
NERGY CONSUMPTION AND COST (equals total billed consumption)					7,352	4,139.1

Fig.3.1. Principle Diagram for utilisation of the condensate heat

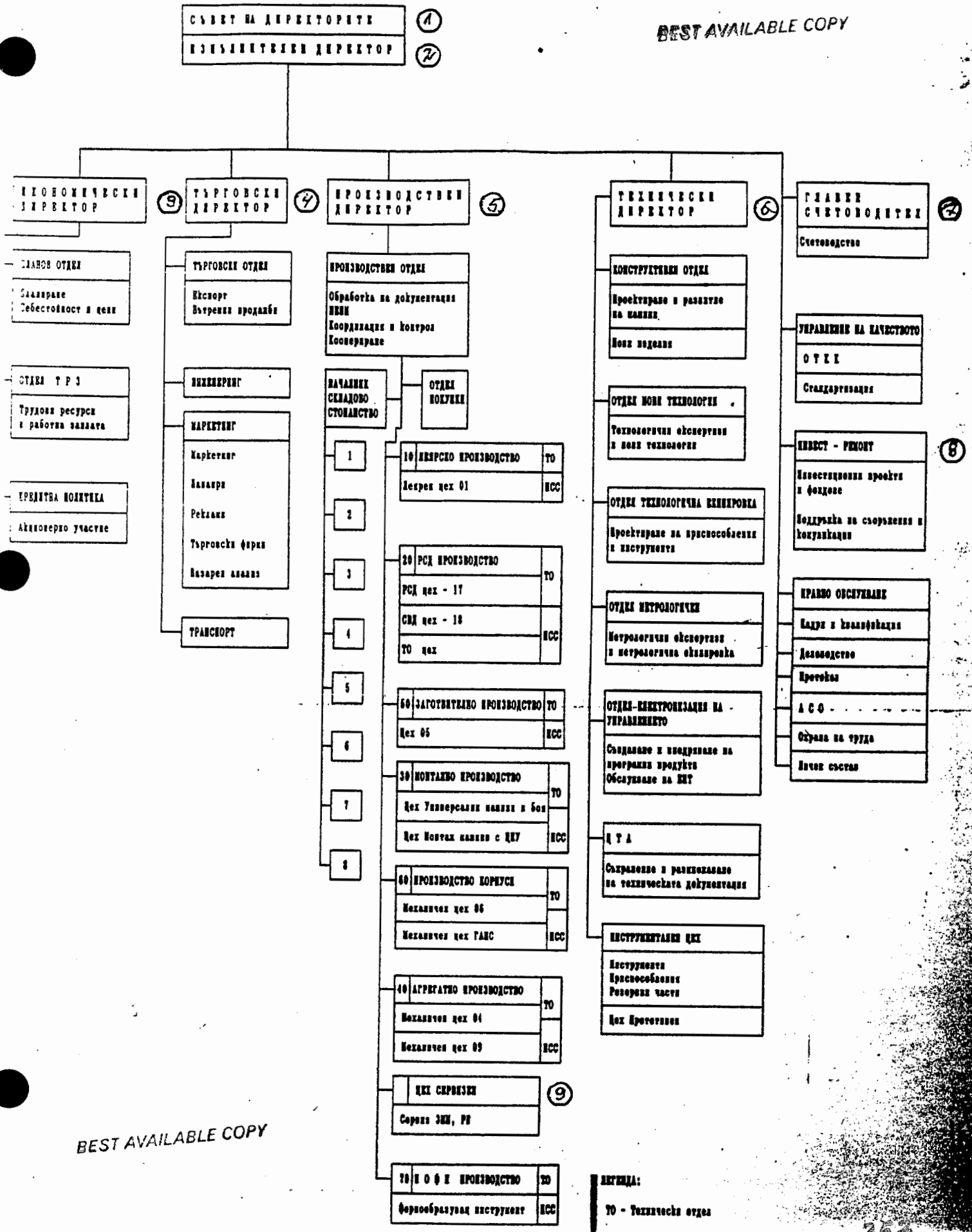
1. Cold water 6-10 oC
2. Condensate reservoir V = 9.6 m^3
3. Boiler 1 V = 5 m^3
4. Boiler 2 V = 5 m^3
5. Collector
6. Hot water 55-60 oC

Table 2.12. Composite ranking of the consumers of electric energy

1. Transformer station No.
2. Consumers
3. Consumed energy Kwh
4. Average monthly
5. Weighting criteria
6. Percentage of the summary
7. Priority

Fig.1.1 Structure of ZMM Inc. - Sofia

BEST AVAILABLE COPY



BEST AVAILABLE COPY

Фиг.1.2. СХЕМА НА МАТЕРИАЛНИТЕ ПОТОЦИ В ЗММ-АД

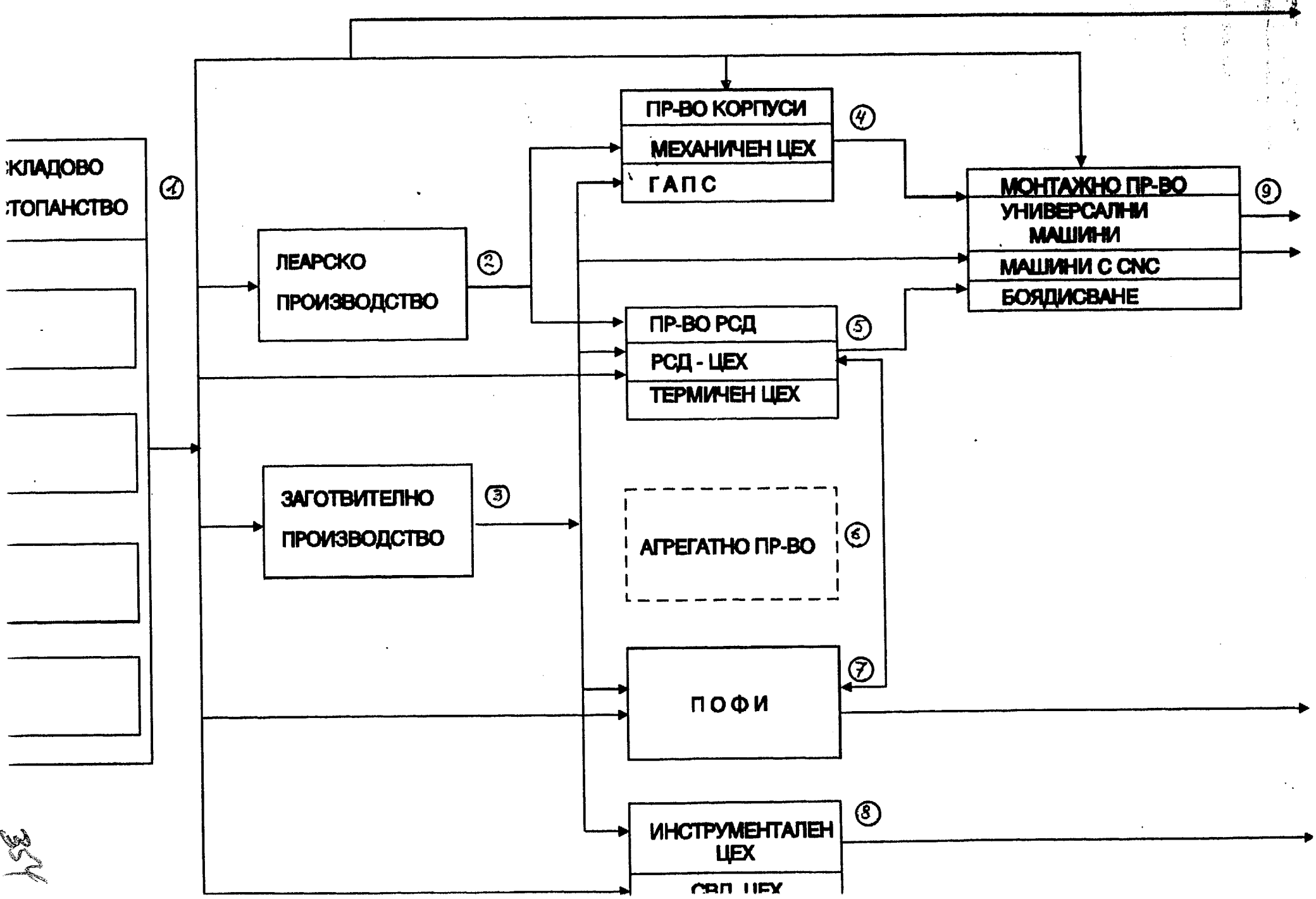


Fig.1.3. Structure of the production - 1993

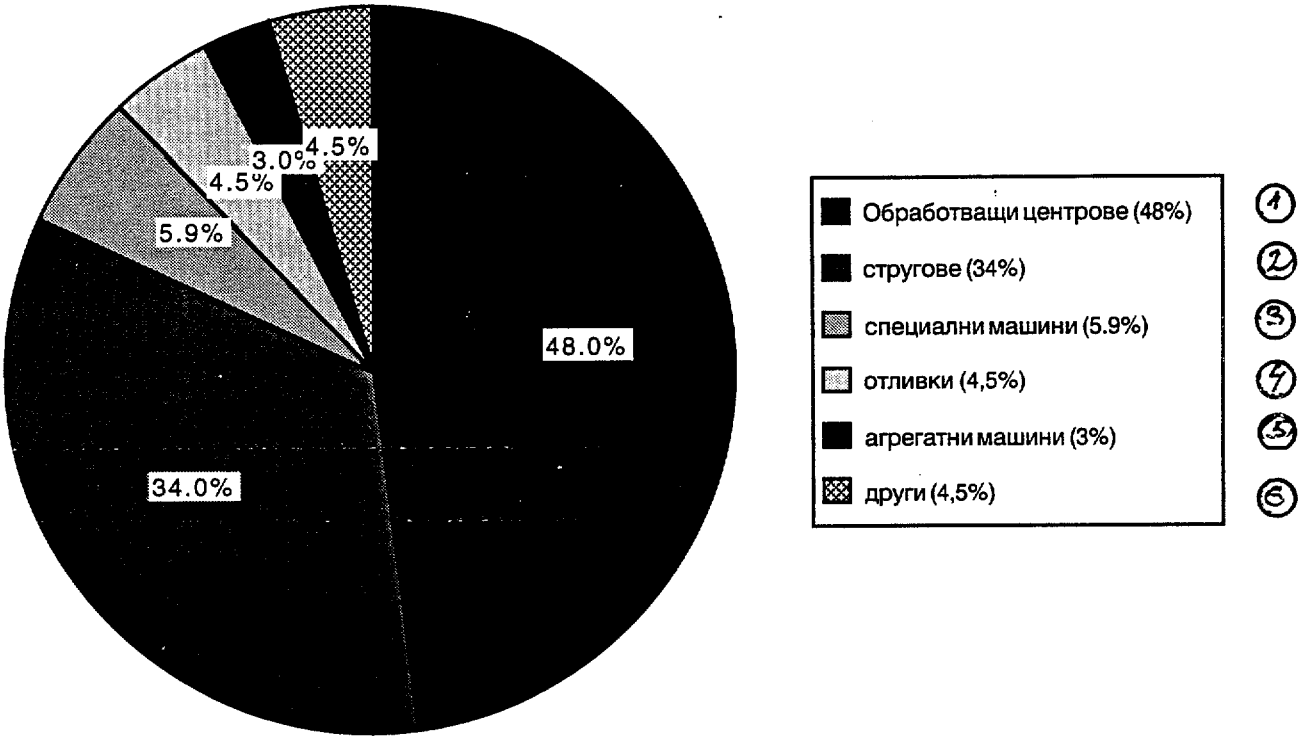
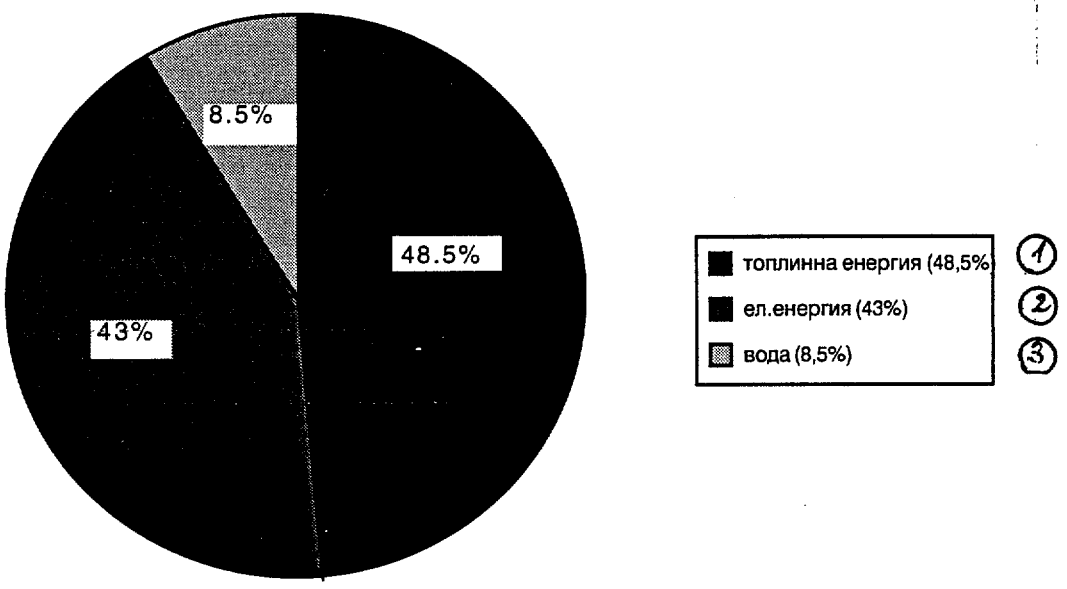
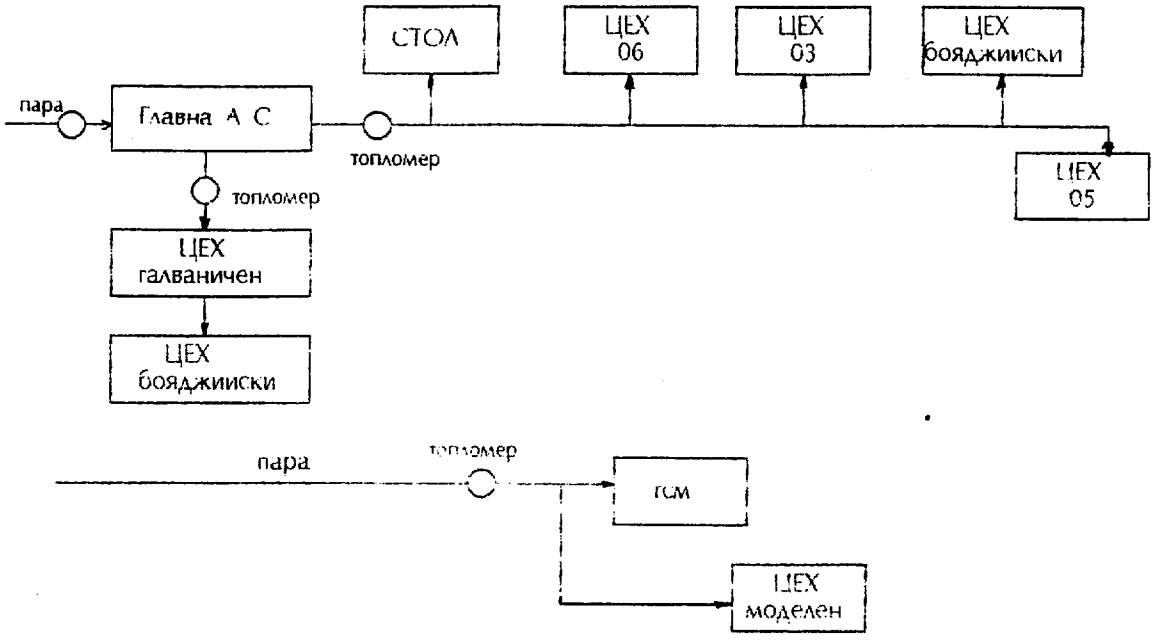


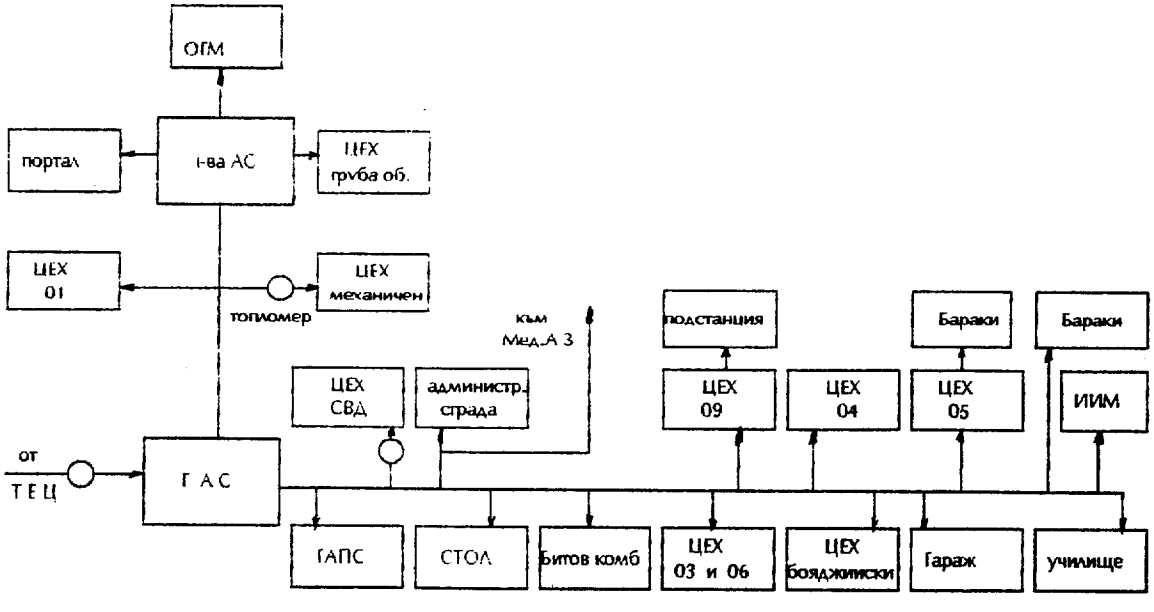
Fig.1.5 Structure of the energy costs



Фиг.2.2 Блок схема на захранването с пара



Фиг.2.1 Блок схема на захранването с гореща вода

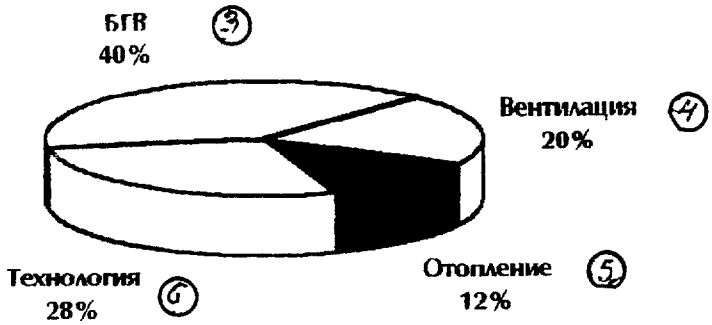


Фиг.2.3

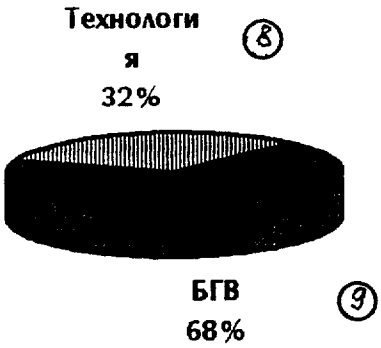
БАЛАНС НА ИНСТАЛИРАНАТА МОЩНОСТ

ПАРА (1)

ЗИМЕН РЕЖИМ (2)



ЛЕТЕН РЕЖИМ (7)



Фиг.2.4

БАЛАНС НА ИНСТАЛИРАНАТА МОЩНОСТ

ВОДА ①

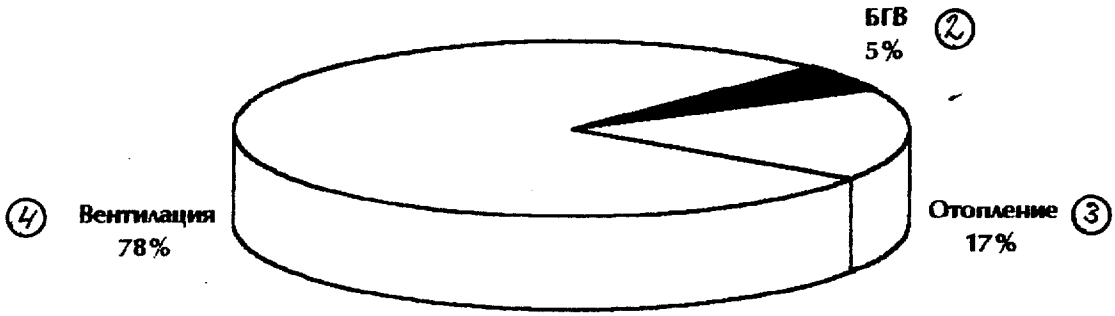
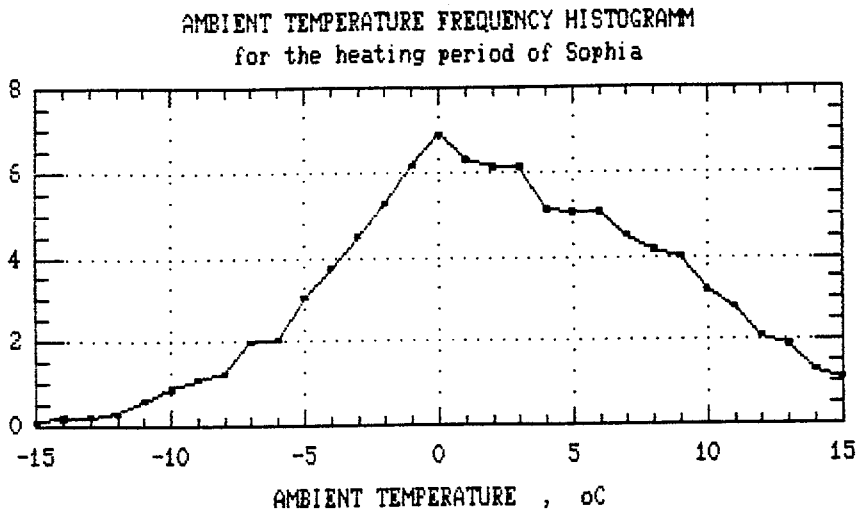


Fig.2.5


AMBIENT TEMPERATURE FREQUENCY HISTOGRAMM
for the heating period of Sophia
8
6
4
2
0
-15
-10
-5
0
5
10
15
AMBIENT TEMPERATURE , oC

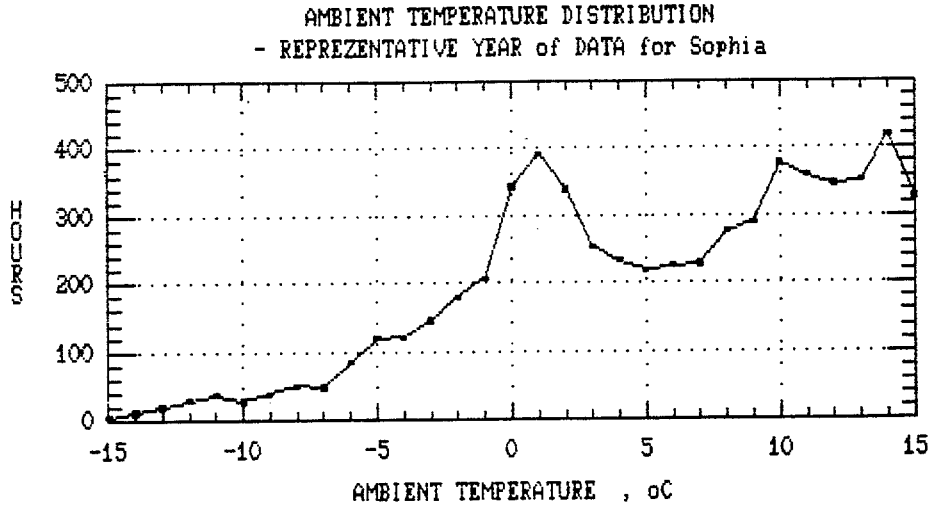

AMBIENT TEMPERATURE DISTRIBUTION
- REPREZENTATIVE YEAR of DATA for Sophia
500
400
300
200
100
0
HOURS
-15
-10
-5
0
5
10
15
AMBIENT TEMPERATURE , oC

Fig.2.6 Heat vs. Time '93

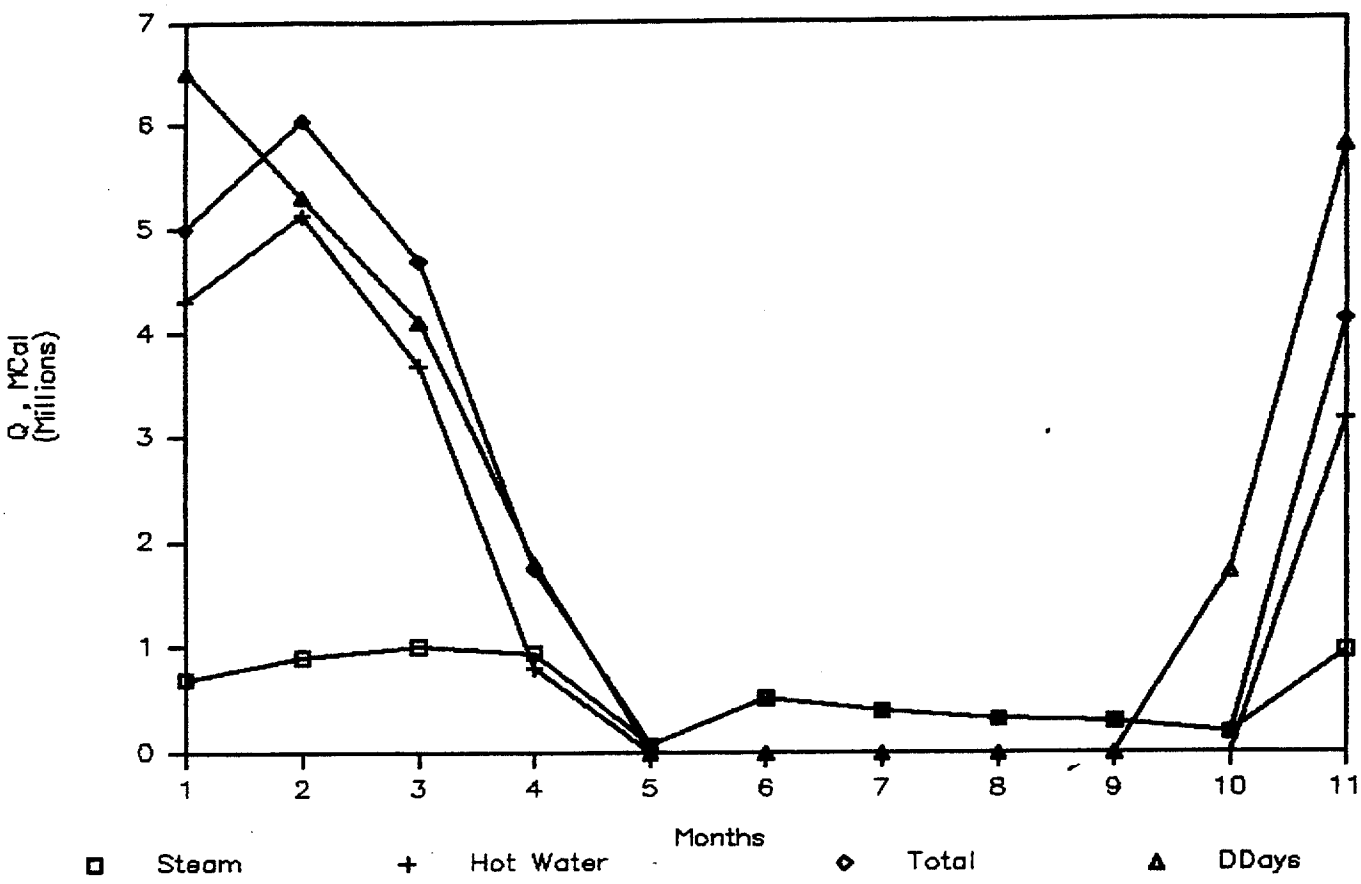


Fig.2.7 HotWater — DDays cor.

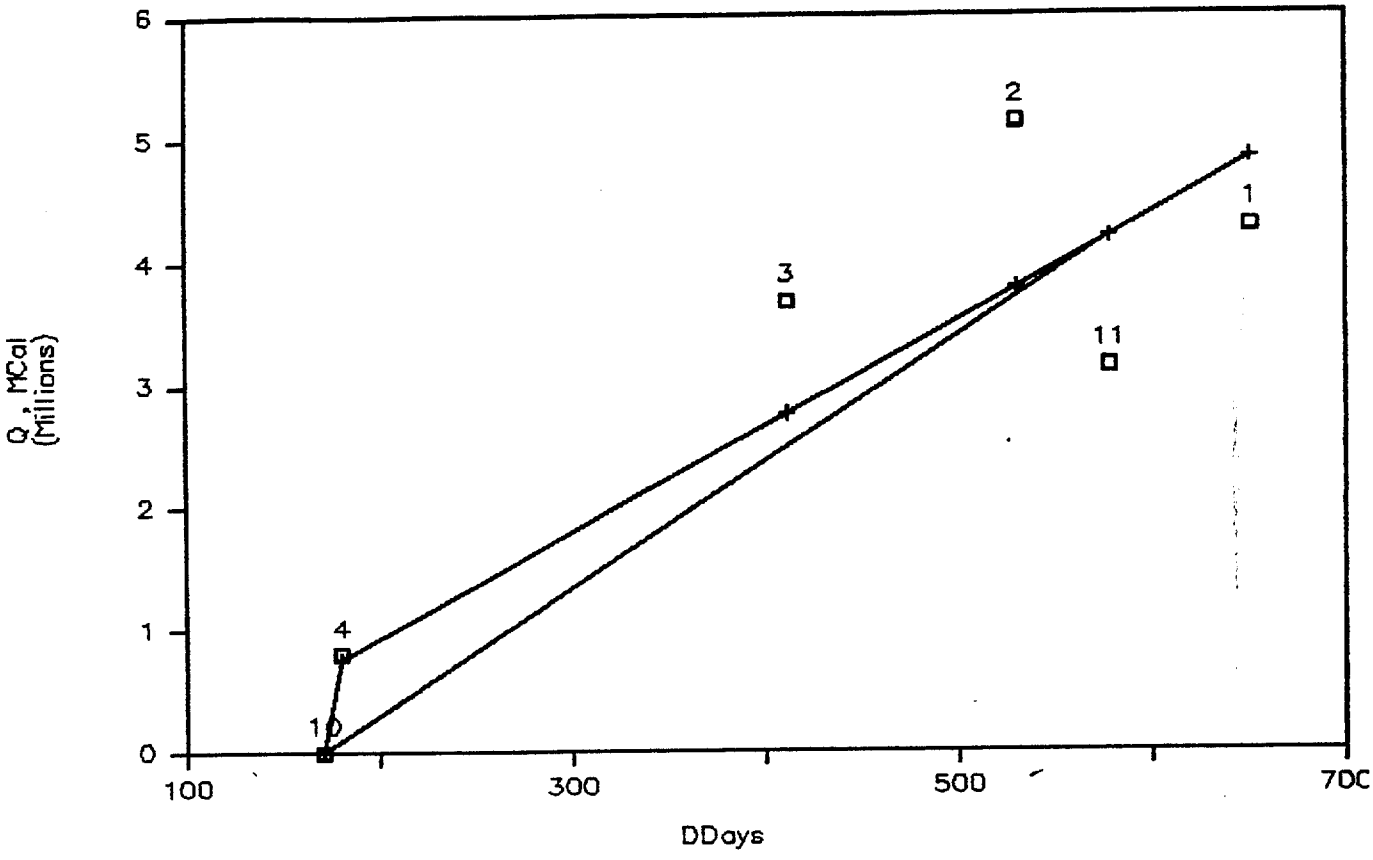


Fig.2.8 TPS HOT WATER CONSUMPTION

vs. AMBIENT TEMPERATURE

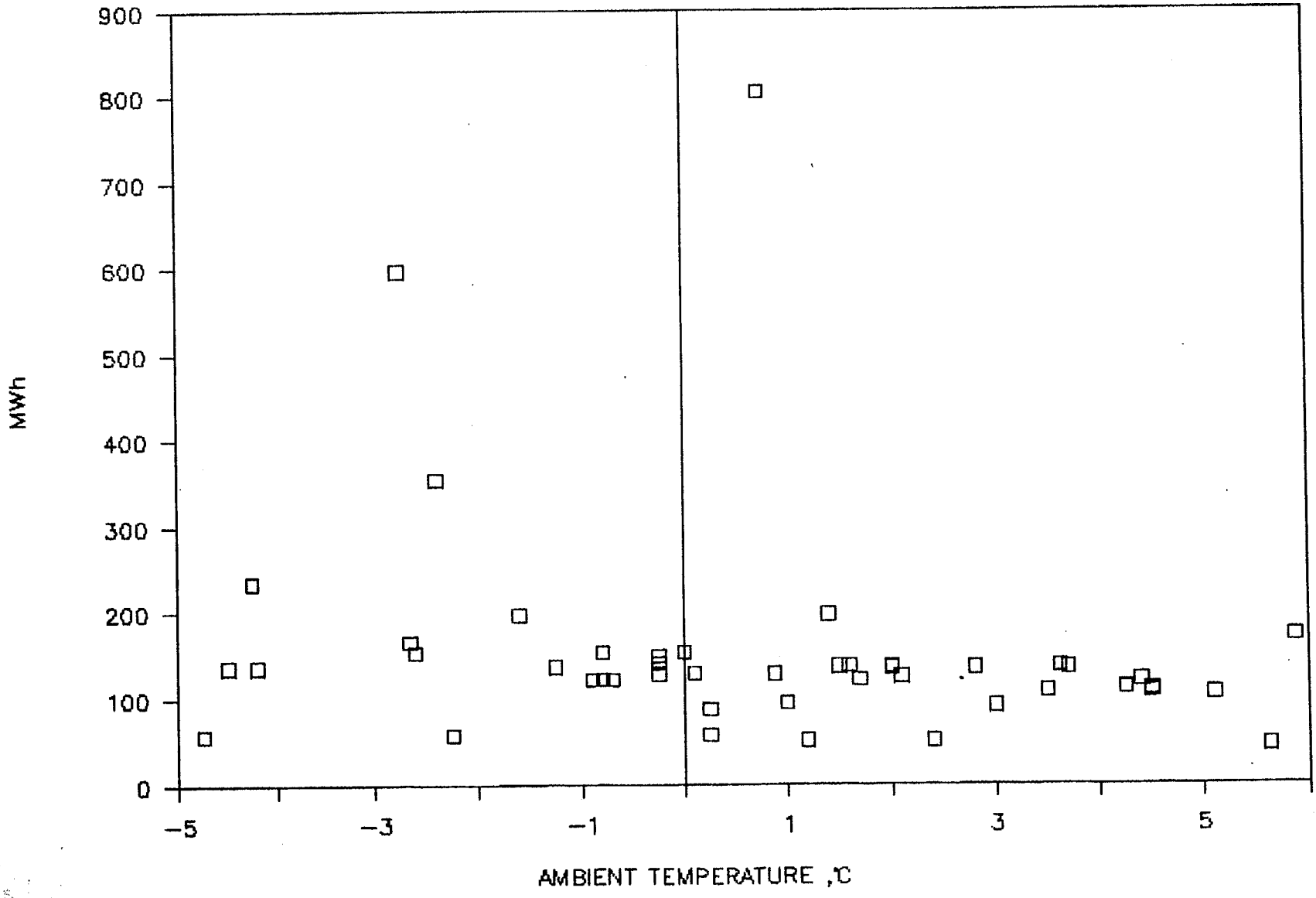
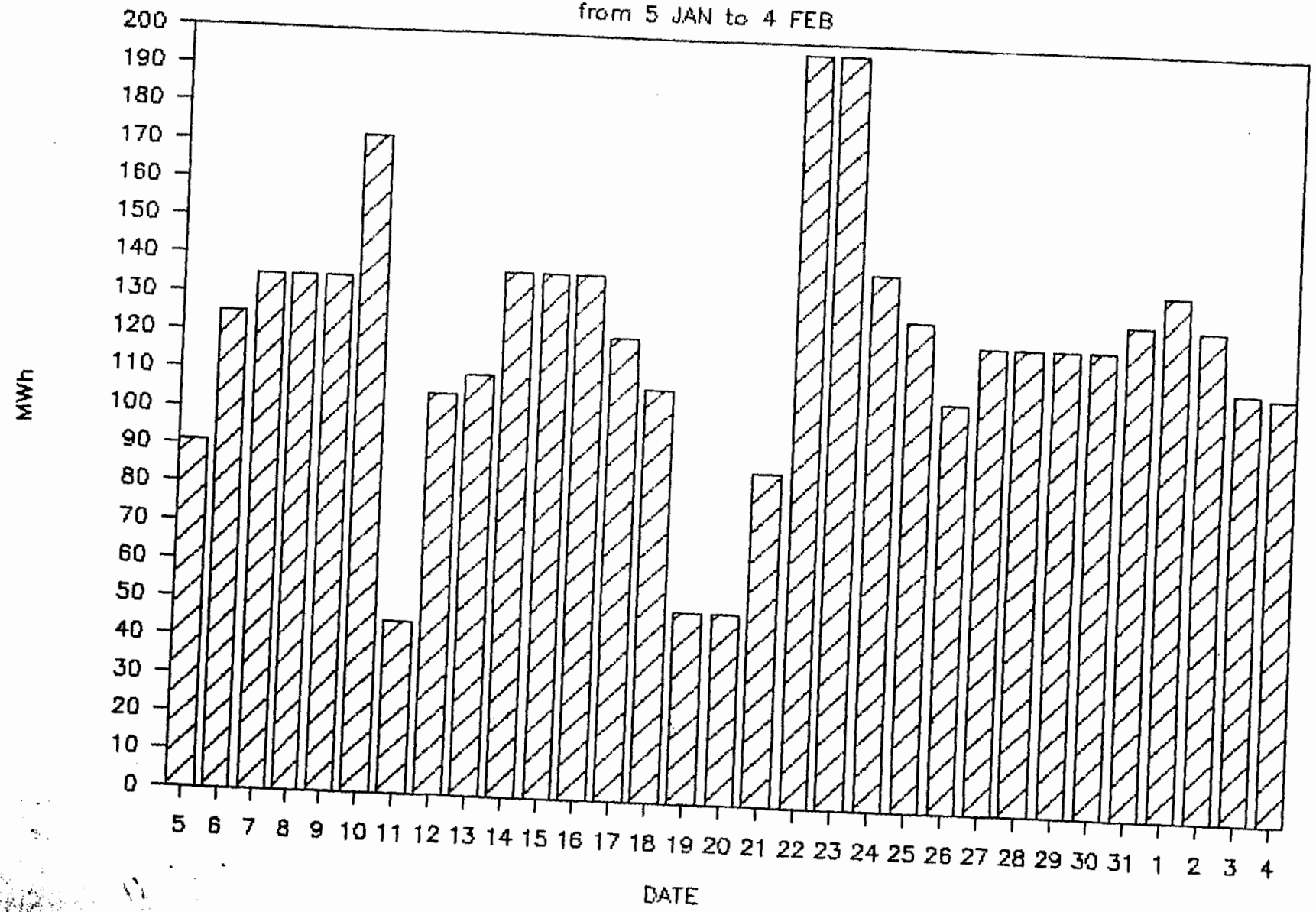


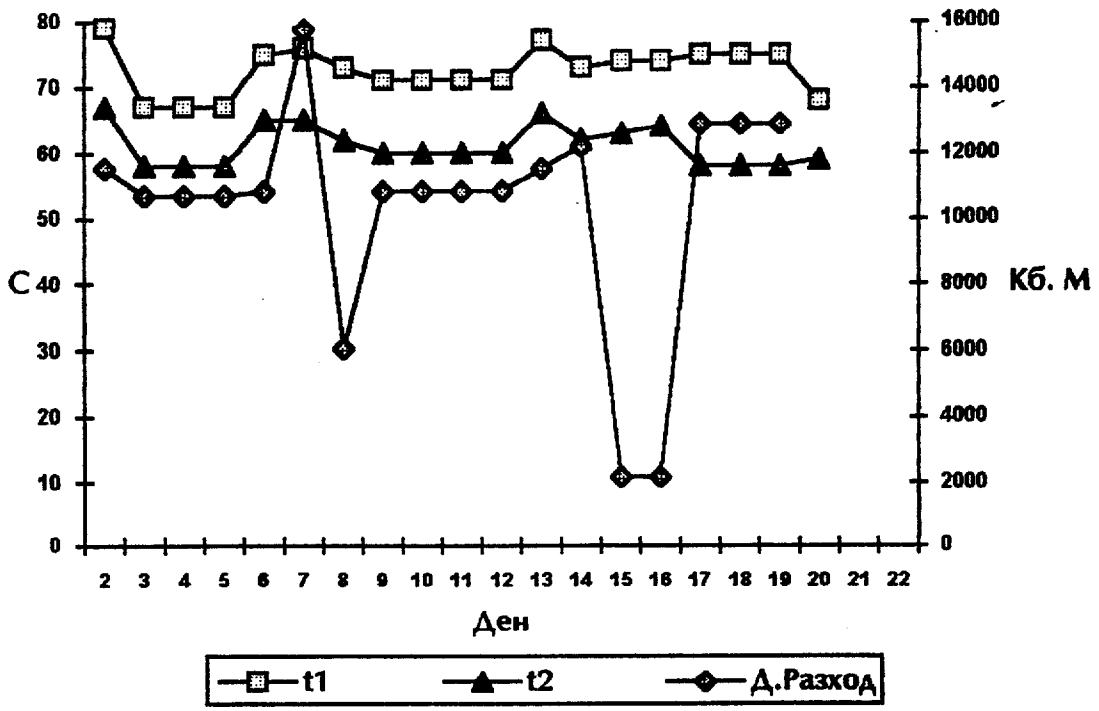
Fig.2.9 TPS HOT WATER DISTRIBUTION

from 5 JAN to 4 FEB



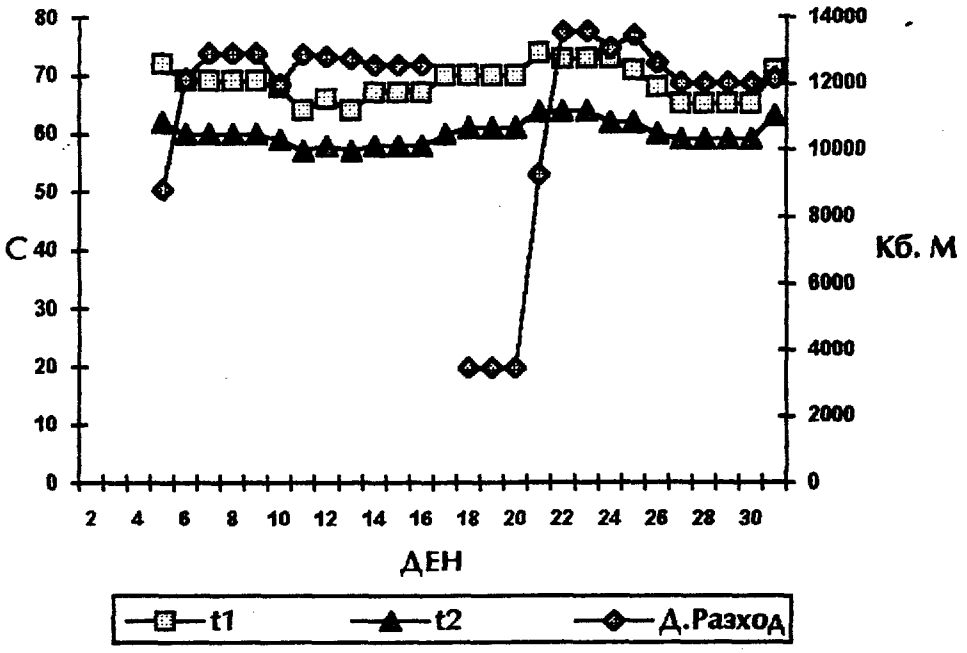
Фиг.2.10

ДНЕВЕН РАЗХОД НА ГОРЕЩА ВОДА (КУБ.М.) , ВХОДНА И ИЗХОДНА ТЕМПЕРАТУРА (°С) ПО МЕСЕЦИ ЗА МЕСЕЦ **ДЕКЕМВРИ**



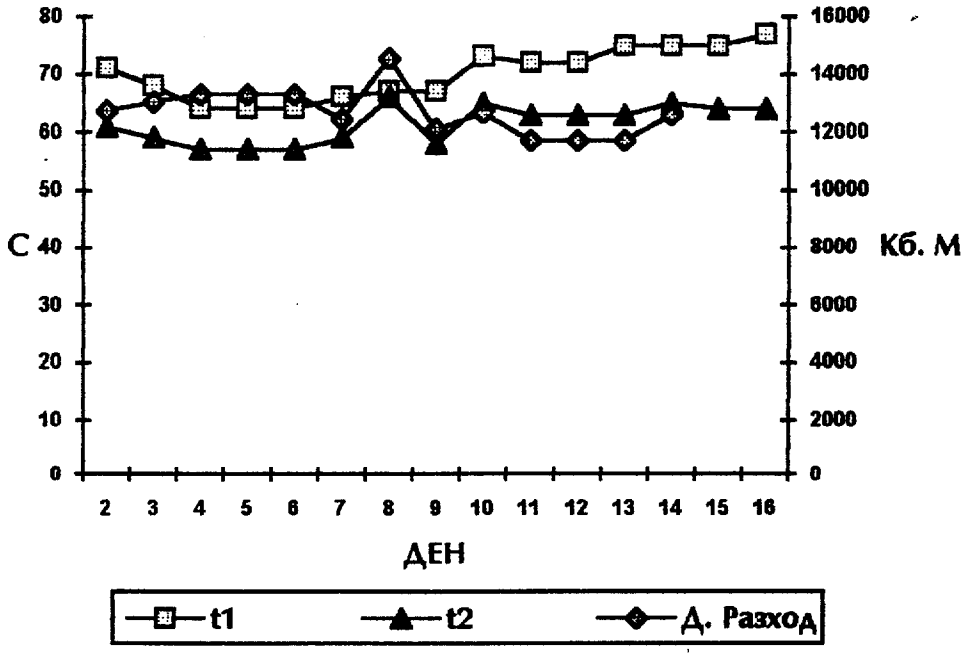
Фиг.2.11

ДНЕВЕН РАЗХОД НА ГОРЕЩА ВОДА (КУБ.М.) , ВХОДНА И ИЗХОДНА ТЕМПЕРАТУРА (°C) ПО МЕСЕЦИ ЗА МЕСЕЦ **ЯНУАРИ**



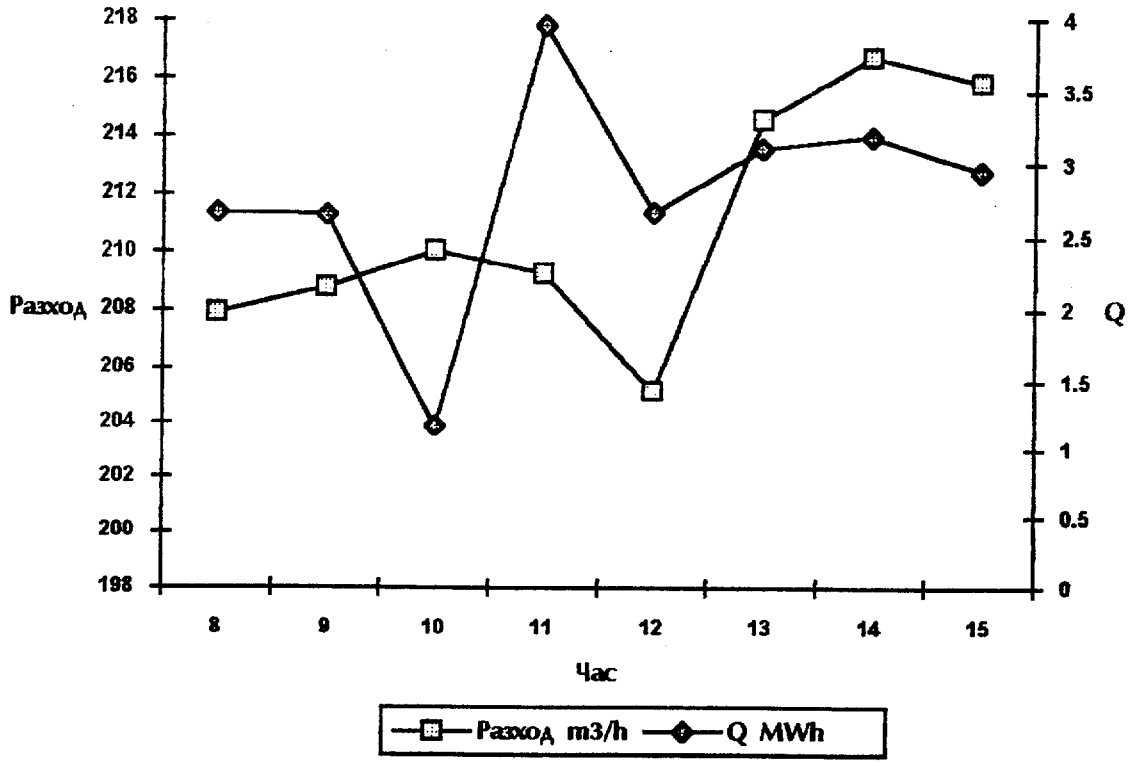
Фиг.2.12

ДНЕВЕН РАЗХОД НА ГОРЕЩА ВОДА (КУБ.М.) , ВХОДНА И ИЗХОДНА ТЕМПЕРАТУРА (°С) ПО МЕСЕЦИ ЗА МЕСЕЦ **ФЕВРУАРИ**



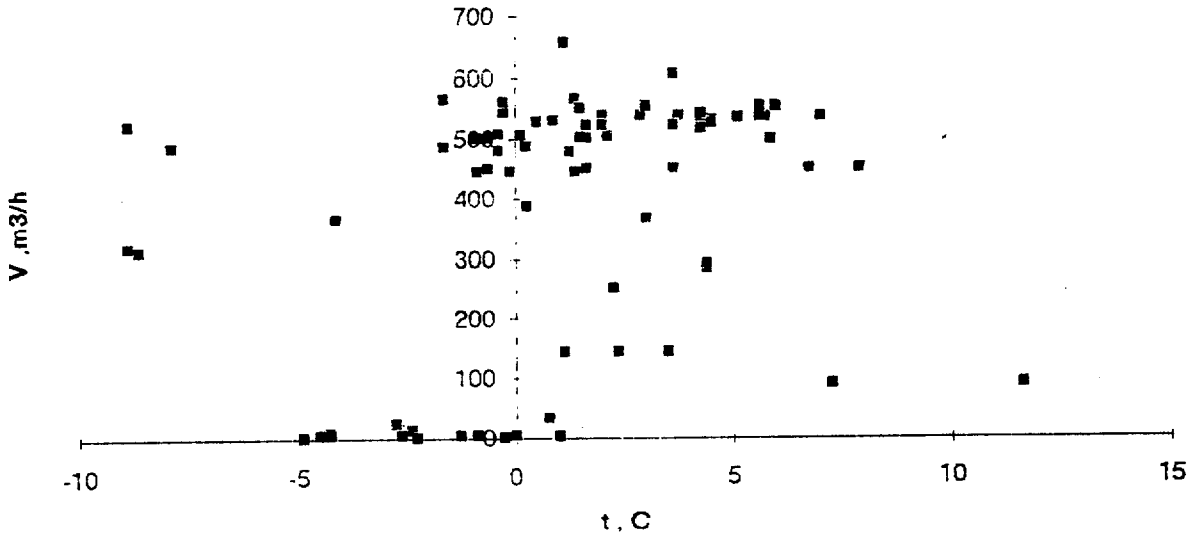
Фиг. 2.13

ЧАСОВ РАЗХОД НА ГОРЕЩА ВОДА И КОНСУМИРАНА ТОПЛИНА НА 15.03.1994г.



Фиг.2.14

Разпределение на дебита на горещата вода в зависимост от външната температура



Фиг.2.15

РАЗПРЕДЕЛЕНИЕ ПО ДНИ НА КОНСУМИРАНАТА ТОПЛИНА С ПАРА
МЕСЕЦ **ЯНУАРИ - ФЕВРУАРИ**

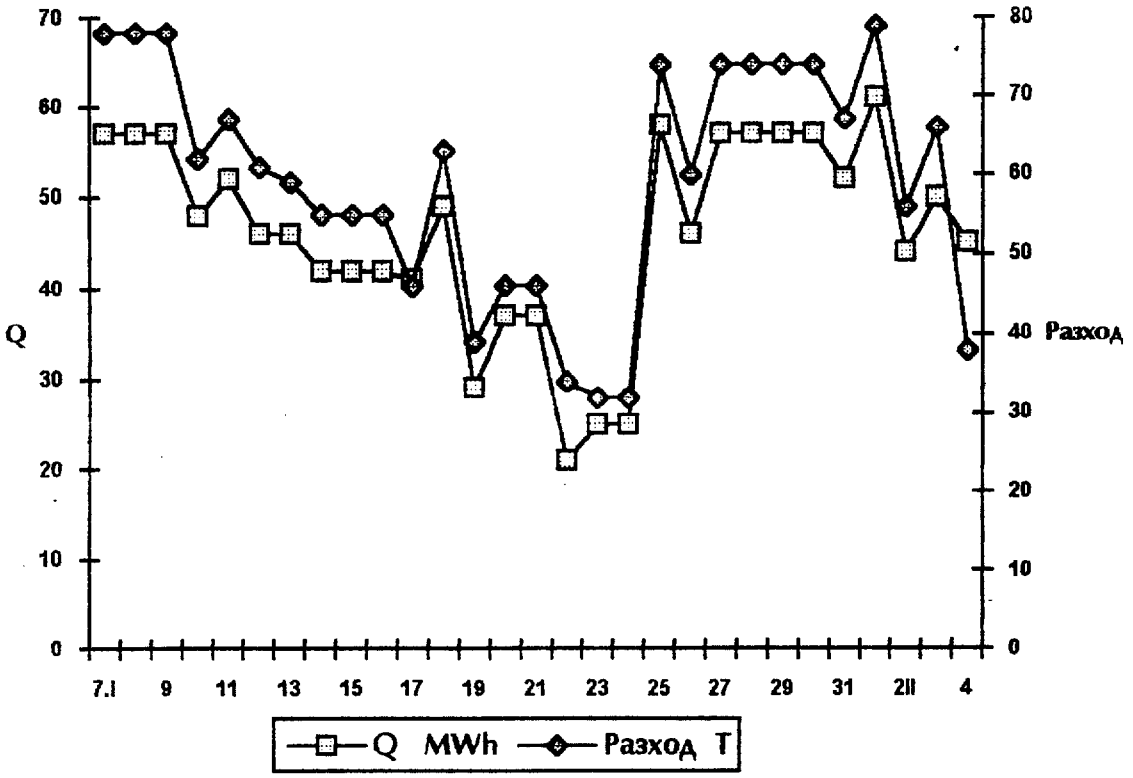
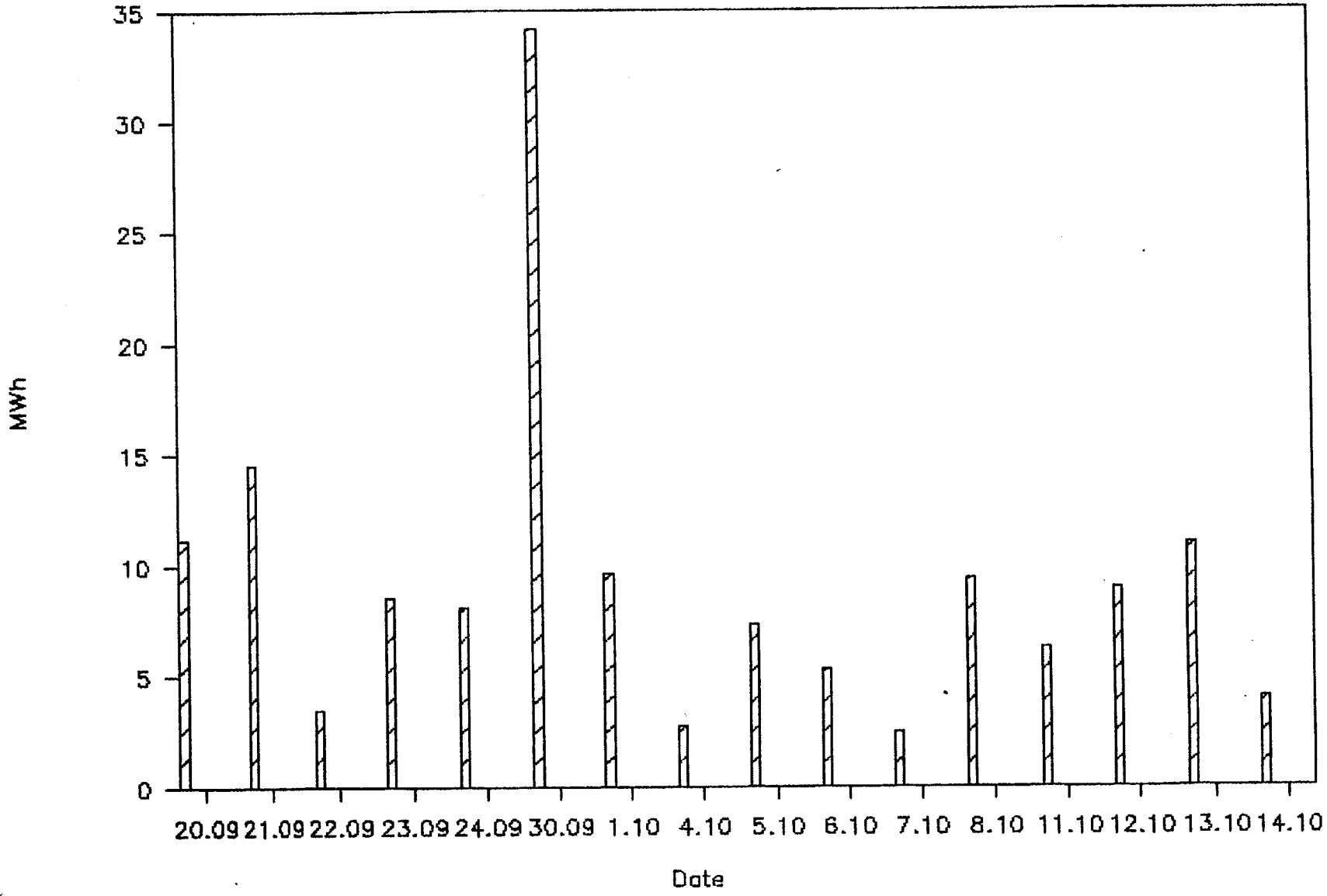
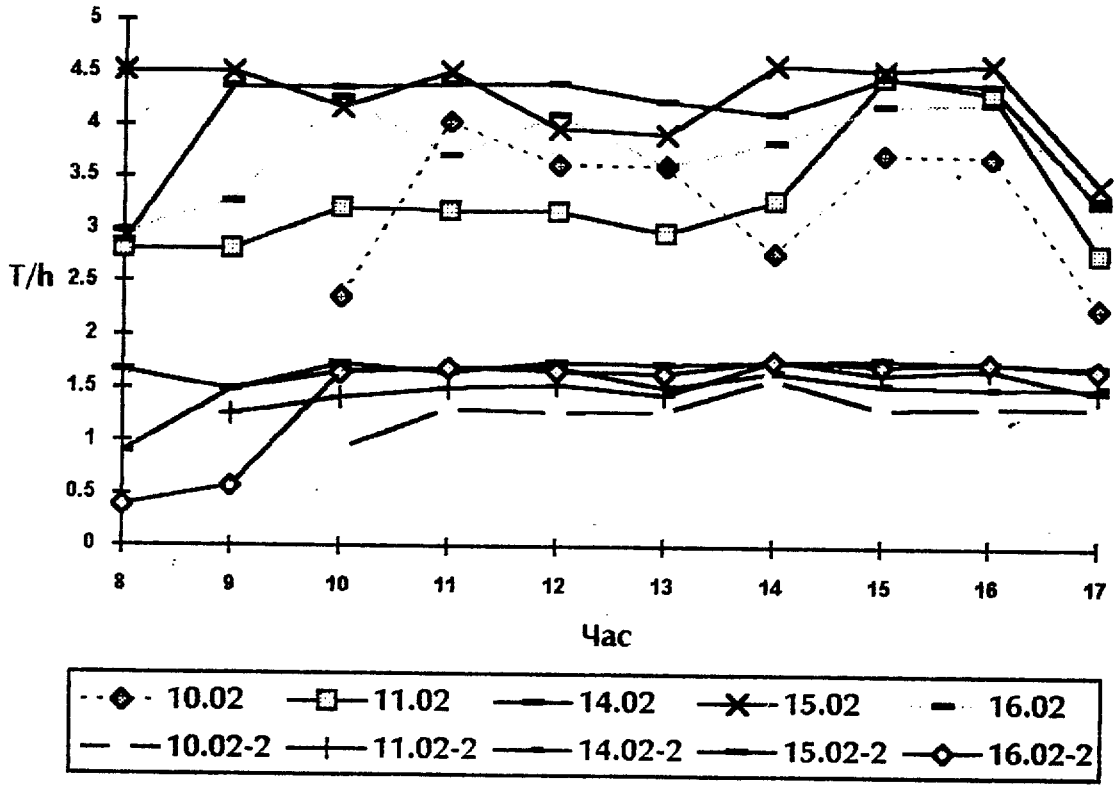


Fig.2.16 Consumption of steam



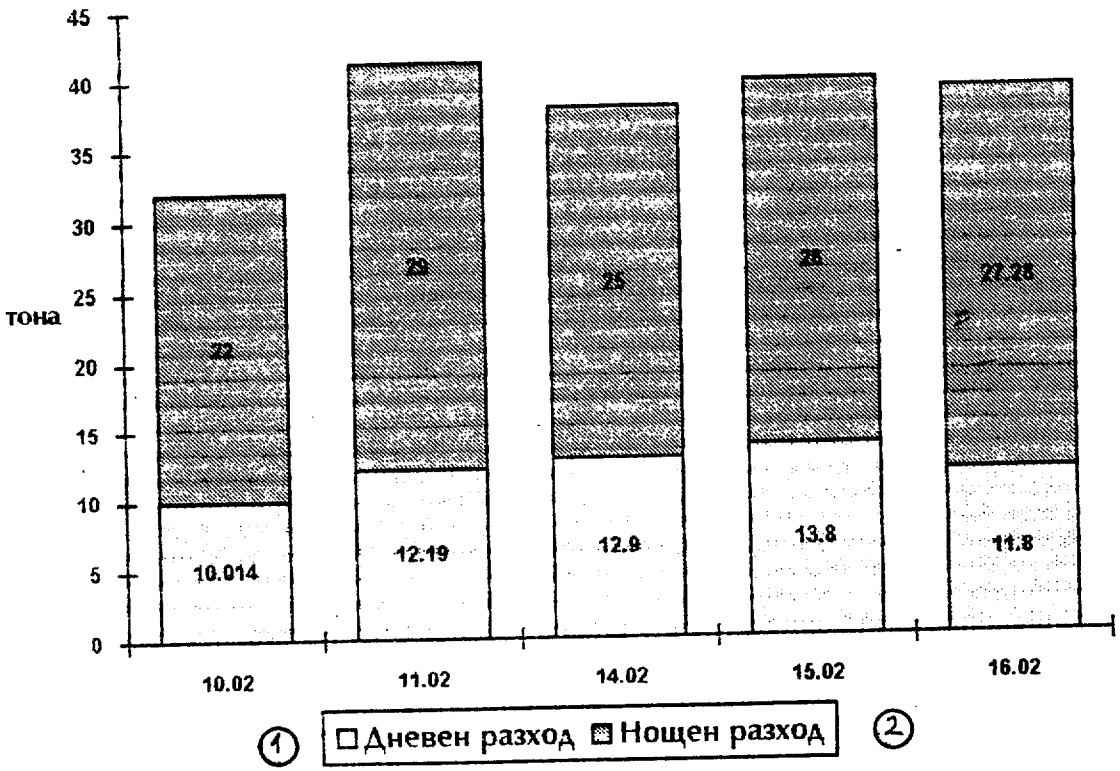
Фиг.2.17

РАЗХОД НА ПАРА ЗА НАБЛЮДАВАНИТЕ ДНИ, ОТЧЕТЕН ПО ЧАСОВЕ



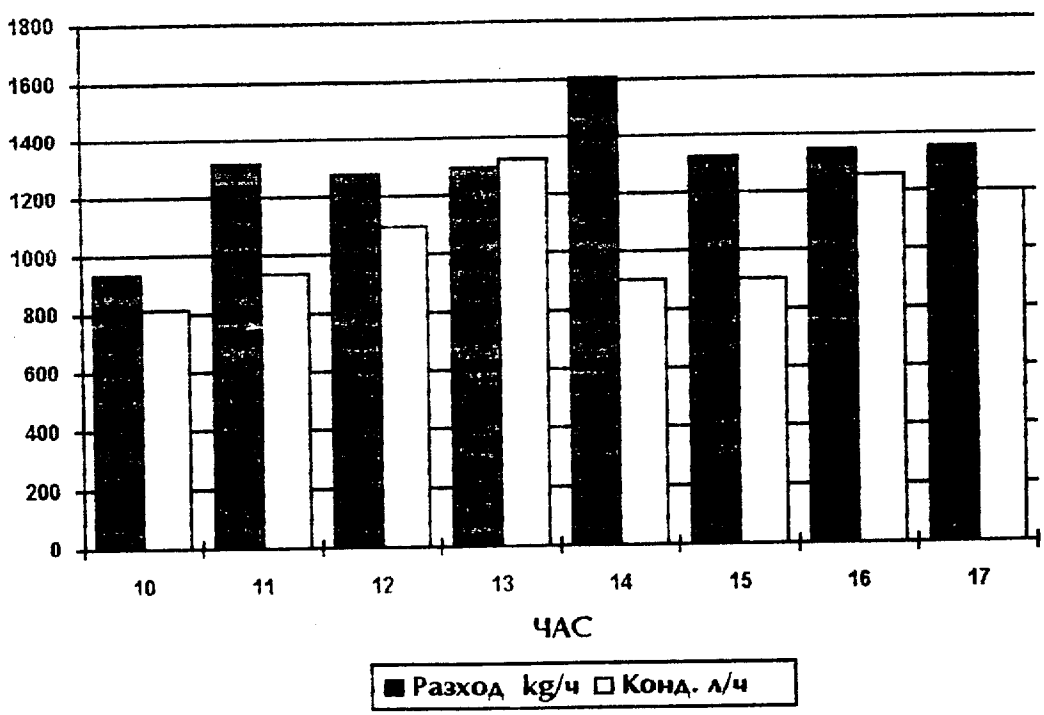
Фиг.2.18

РАЗХОД НА ПАРА ПРЕЗ ДЕНЯ И НОЩТА ЗА НАБЛЮДАВАНИТЕ ДНИ



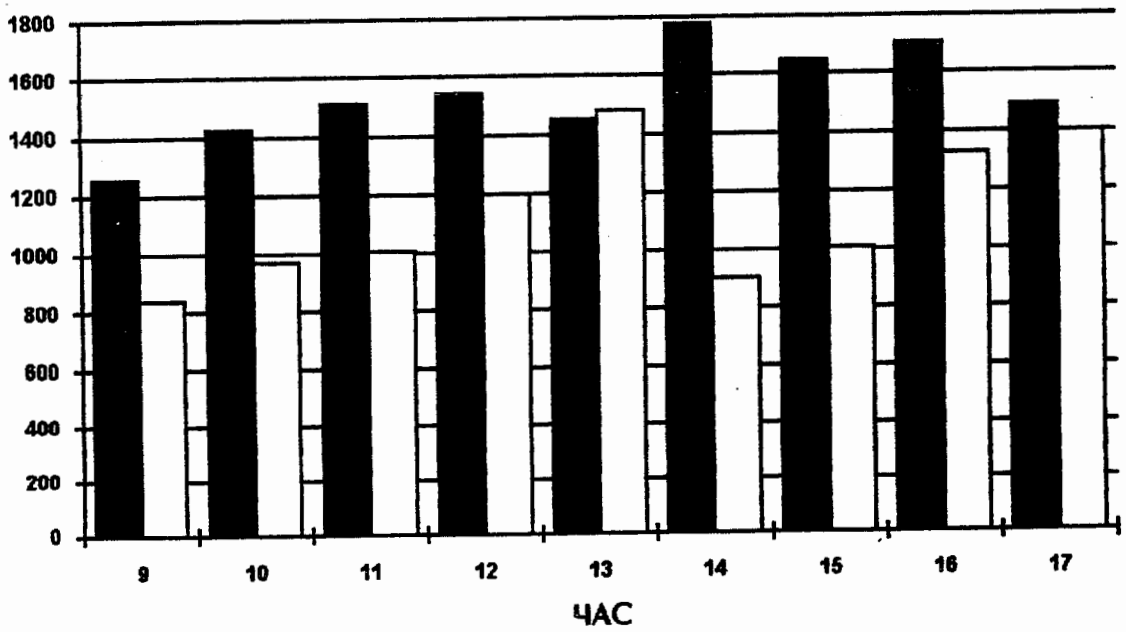
Фиг.2.19

РАЗХОД НА ПОСТЪПВАЩА ПАРА (kg/ч) И
ВРЪЩАЩИЯ КОНДЕНЗАТ (л/ч) ЗА **ПЪРВИЯ** ДЕН



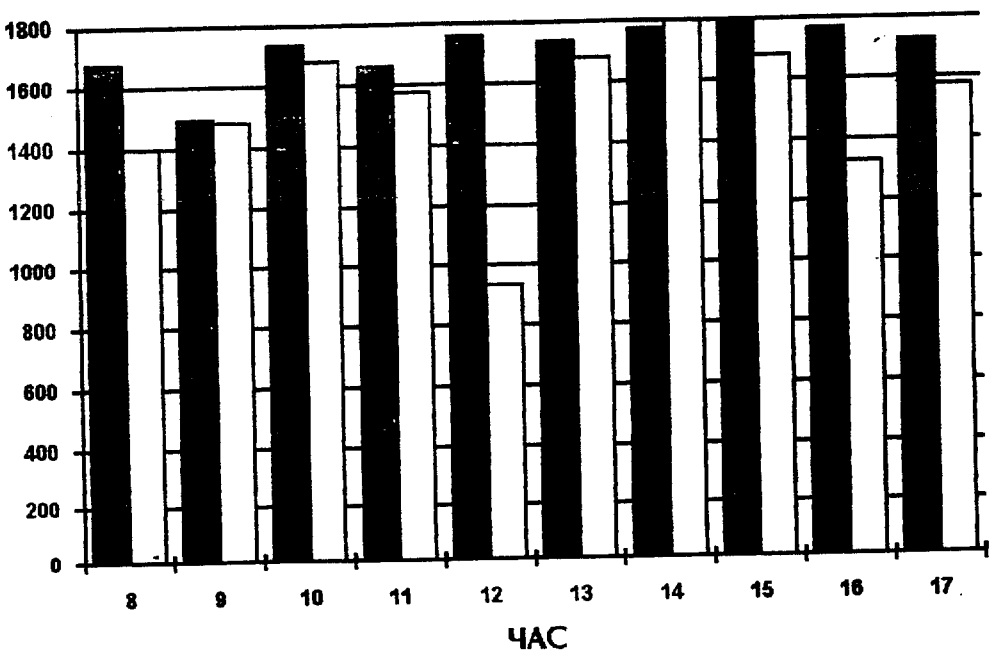
Фиг.2.20

РАЗХОД НА ПОСТЪПВАЩА ПАРА (kg/ч) И ВРЪЩАЩИЯ КОНДЕНЗАТ (Л/Ч) ЗА **ВТОРИЯ** ДЕН



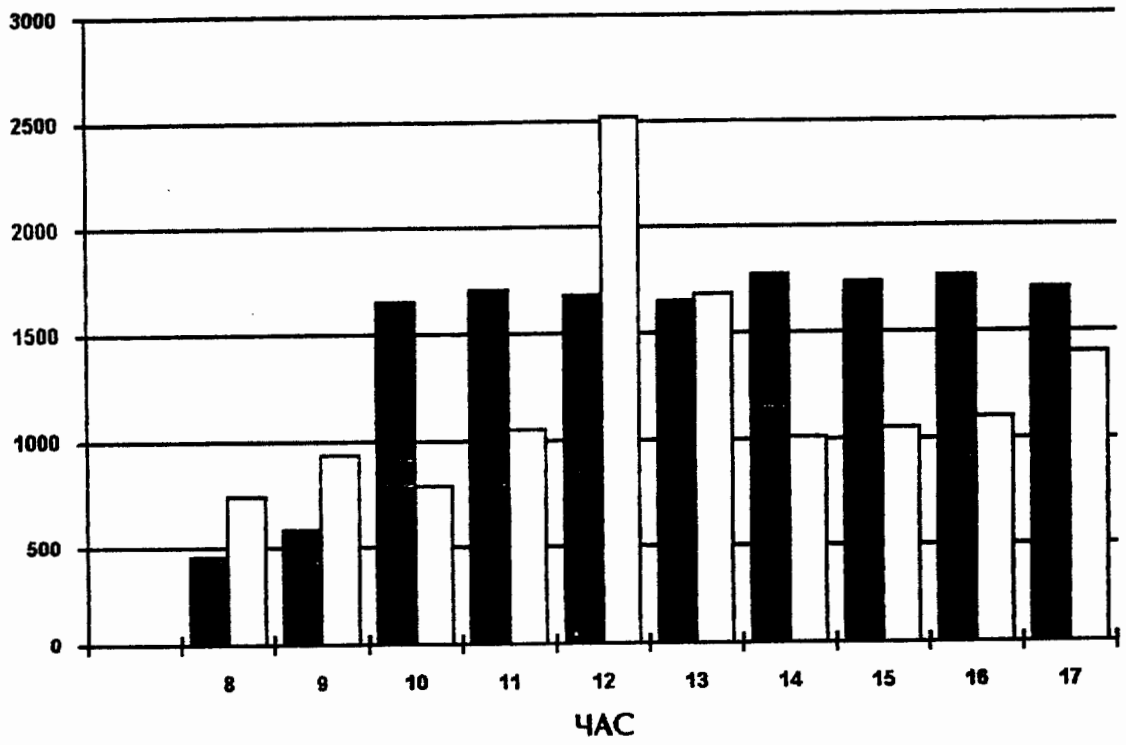
Фиг.2.21

РАЗХОД НА ПОСТЪПВАЩА ПАРА (kg/ч) И ВРЪЩАЩИЯ КОНДЕНЗАТ (Л/Ч) ЗА **ЧЕТВЪРТИЯ** ДЕН



Фиг.2.22

РАЗХОД НА ПОСТЪПВАЩА ПАРА (kg/ч) И ВРЪЩАЩИЯ КОНДЕНЗАТ (Л/Ч) ЗА **ПЕТИЯ** ДЕН



Фиг.2.23

РАЗХОД НА ПАРА И КОНДЕНЗАТ ЗА НАБЛЮДАВАНИТЕ ДНИ

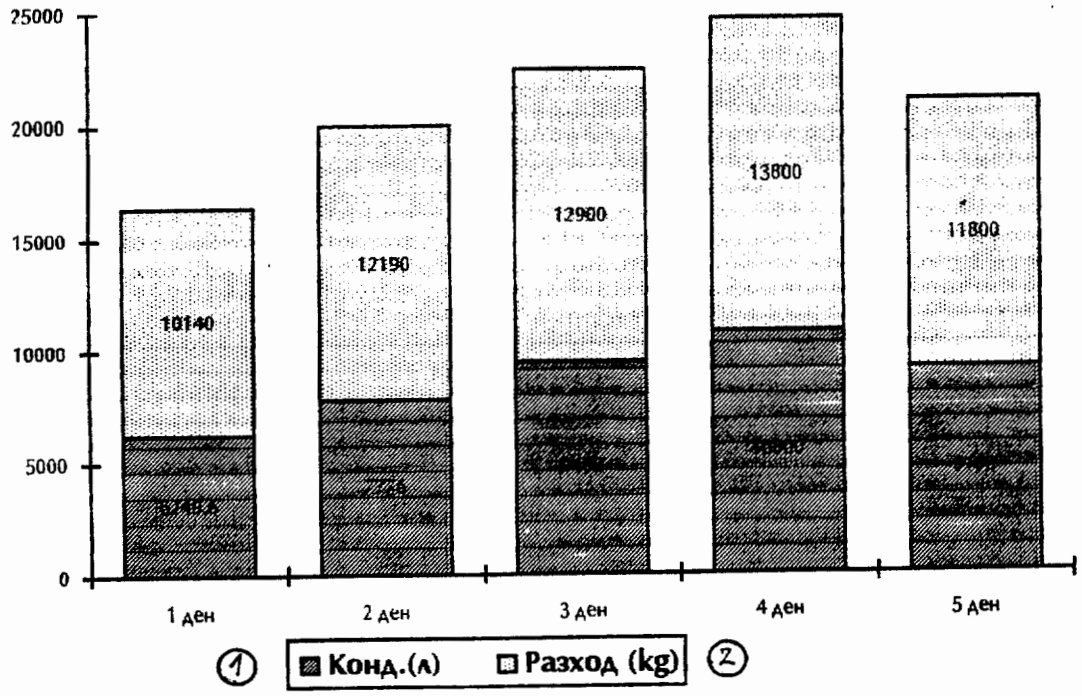


Fig.2.24 Hourly consum. of steam , MWh

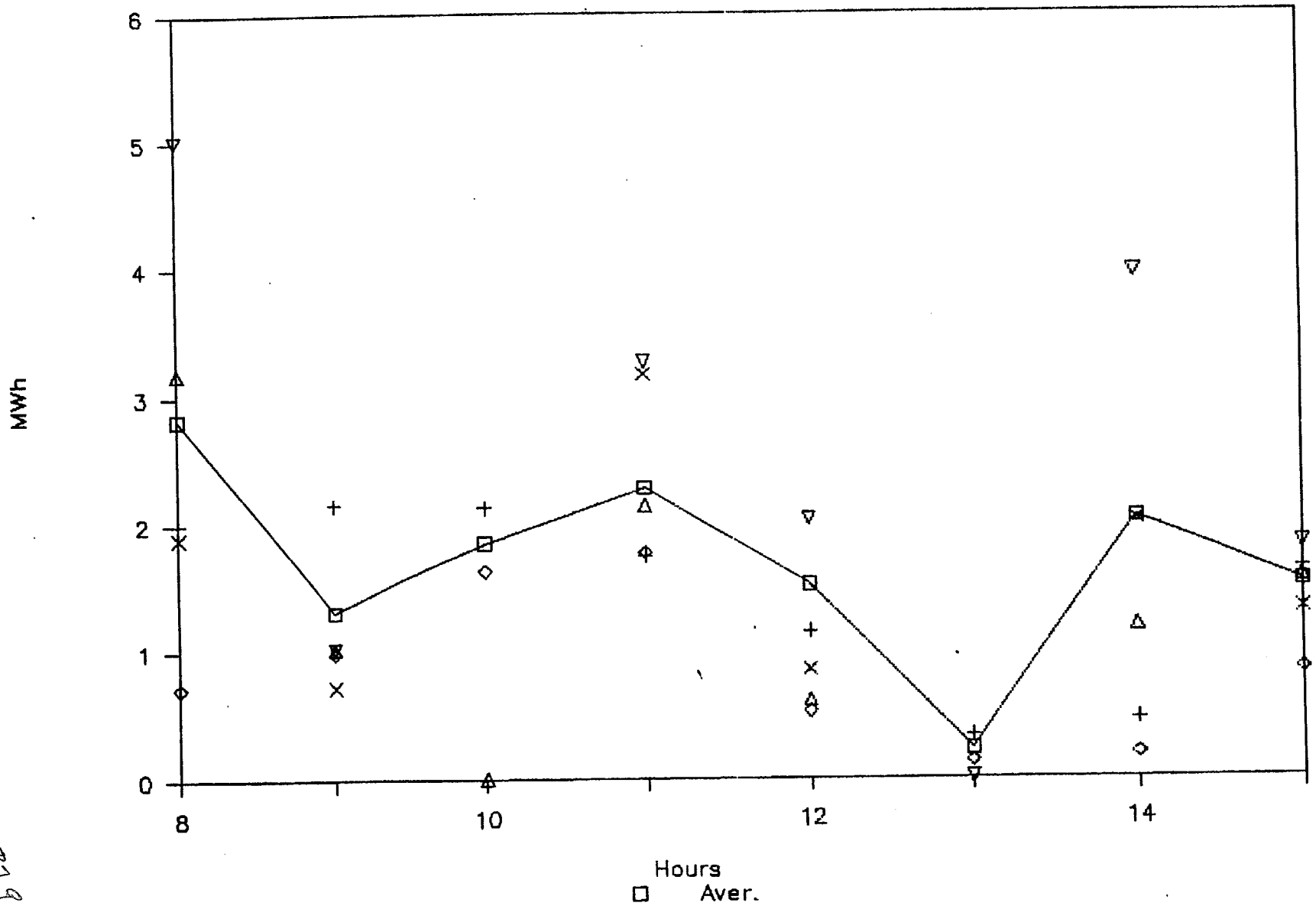
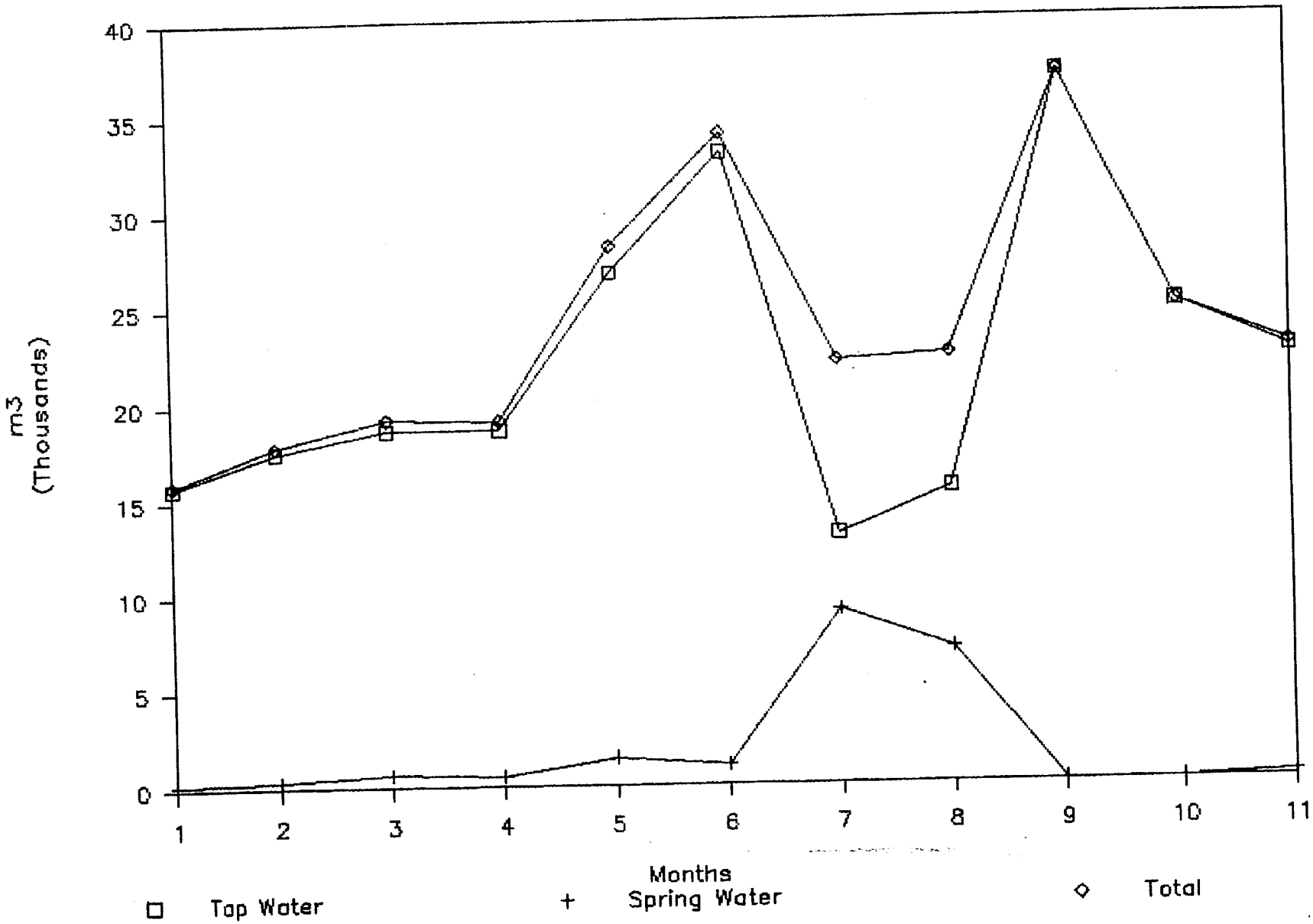


Fig.2.25 Water Consumption , m3



Фиг.3.1

ПРИНЦИПНА СХЕМА
за оползотворяване топлината на кондензата

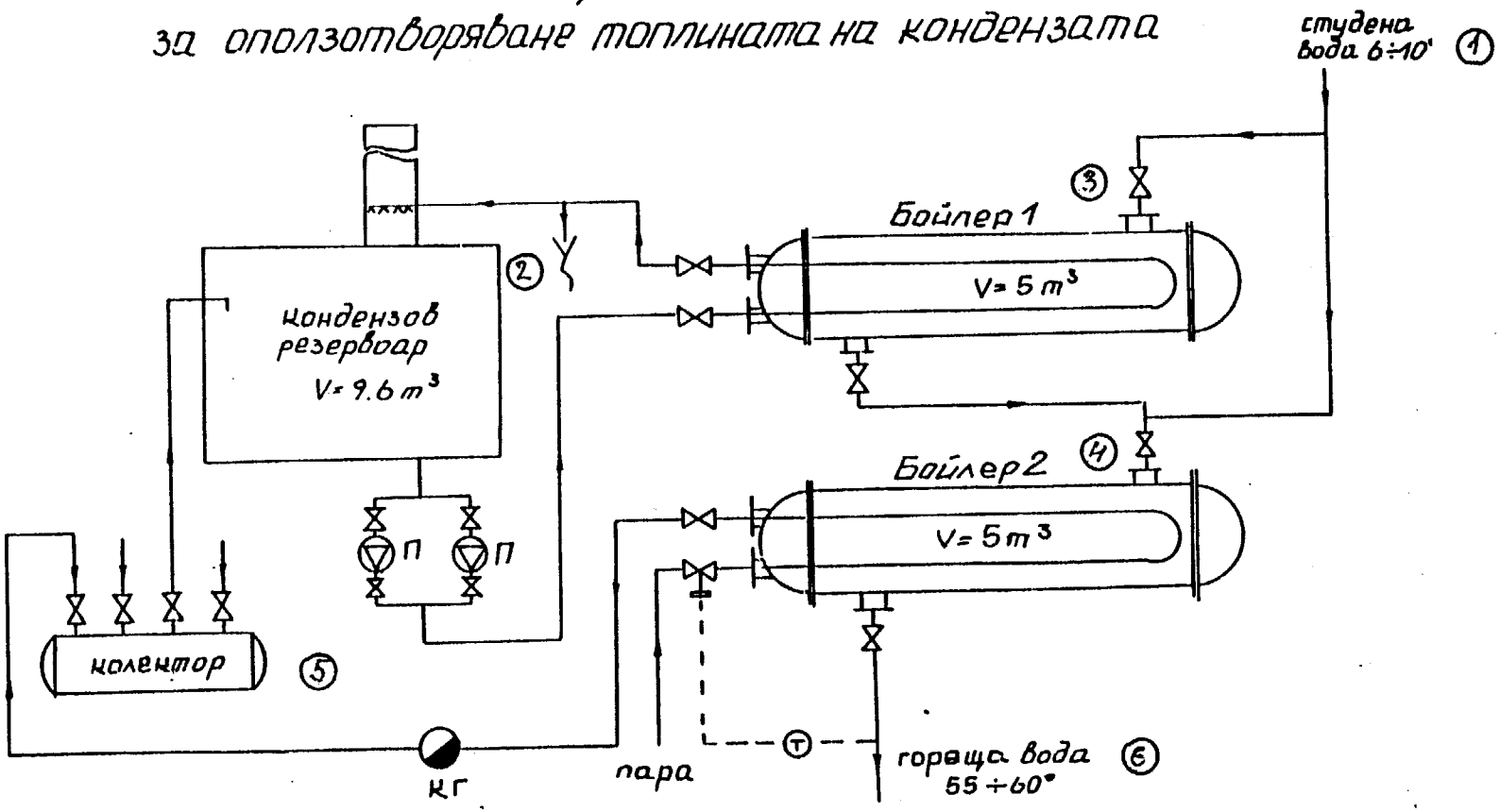


Табл.2.12

КОМПЛЕКСНО ПОДРЕЖДАНЕ НА КОНСУМАТОРИТЕ НА ЕЛ.ЕНЕРГИЯ

1 Трафопост N	2 Консуматори	3 Консумирана енергия Kwh	4 Средно месечен cos φ	5 Критерий за тежест K = kwh (0,90-cos φ)K	6 Процент от сумарното	7 Приоритет
1	Компресори	99936	0,75	14990	19	3
3	Механичен цех 06	57504	0,50	28752	36	1
4	Монтаж и бояджийна	40728	0,55	18327	23	2
7	Част от леярната	42384	0,72	7628	10	4
11	Леярна	37008	0,89	370	0,01	8
10	Цех 17(термични пещи)	81912	0,87	2457	3	6
19	ГАПС	59640	0,80	5964	7,5	5
22	ПОФИ	58320	0,89	583	0,7	7
Общо	-	477432	-	79072	-	-

ENERGY EFFICIENCY

MARKET DEVELOPMENT

Sponsored by:

United States Agency for International Development

Presented by:

Association of Energy Engineers

ENERGY EFFICIENCY MARKET DEVELOPMENT IN BULGARIA

Sponsored by the US Agency for International Development,
Ministry of Industry, and the Association of Energy Engineers

PROGRAM REVIEW MEETING - BULGARIA

November 21, 1996

Location: National Palace of Culture

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 Bulgarian Chapters of the Association of Energy Engineers; and, (3) energy efficiency project demonstrations.

0830-0900	Registration	
0900-0915	Introduction and Welcoming remarks	Georgi Rampov Ivanov and Boris Petkov, AEE Bulgaria
0915-0930	AID Bulgaria - Country Program Description	Lada Stoyanova, USAID Bulgaria
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
12:00-1315	**Luncheon with Keynote Speaker** AEE Organization and Future Trends	Al Thumann, AEE
2.	**Support to Energy Service Companies (ESCOs)**	**Moderator:** Hagler Bailly
1315-1330	Introduction (Results of the ESCO Survey, Highlight of some Results and Trends)	Michael Ellis
1330-1400	What it Takes to Succeed as General Manager of an ESCO	Peter Garfoth
1415-1430	Open Discussion	
3.	**Establishment of AEE Chapters**	**Moderator:** Al Thumann, AEE
1430-1500	AEE Chapters Status Report	Georgi Rampov Ivanov, AEE Sofia Boris Petkov, AEE Plovdiv
1500-1515	Open Discussion	
1515-1530	**Coffee Break**	
4.	**Financing Energy Efficiency - Future Directions** **Future Cooperation**	**Moderator:** Hagler Bailly
1530-1600	Global and regional trends in energy efficiency financing	Michael Ellis
1600-1615	Group Discussion	
5.	**Discussion of Future Cooperation**	**Moderator:** Robert Archer, USAID WDC
1615-1630	Current USAID technical assistance program	Electrotek /EnEffect
1630-1700	Group Discussion	
2000	Dinner	Sponsored by Hagler Bailly

ENERGY EFFICIENCY MARKET DEVELOPMENT IN BULGARIA
Sponsored by the US Agency for International Development,
Ministry of Industry, and the Association of Energy Engineers

Open Conference
November 22, 1996

Location: National Palace of Culture

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.

0900-0925	Registration	
0925-0935	Welcoming Remarks	Mr. Stanislav Dimitrov, Deputy Minister
0935-0945	Role of USAID in Bulgaria	John Tennant/Lada Stoyanova, USAID
0945-0955	AEE in Bulgaria	Georgi Rampov Ivanov and Boris Petkov

Results of Demonstration Projects — **Moderator:** Hagler Bailly

ESCO presentation with Plant Energy Manager

	CEM	Plant
0955-1015	Nikola Kaloyanov	Lev, RUNO
1015-1030	Boris Petkov	Silikat Keram
1030-1045	~~Georgi Rampov Ivanov~~ NIKOLA STANKOV	KMH
1045-1100	~~Dimiter Shivkov~~ ANGEL DANGOV	Zlatna Panega

1100-1115 **Coffee Break**

1115-1130	Yordan Katzarov	Crystal Pernik
1130-1145	Dein Yordanov	Varna Shipyard
1145-1200	Dimitar Baev	ZMM
1200-1230	Open Discussion	

1230-1330 **Luncheon with Keynote Speaker** — Al Thumann, AEE
Developments in the Global Energy Efficiency Market
Concurrent Press Conference

AEE Chapters — **Moderator:** Al Thumann, AEE

1330-1345	Presentation of AEE	Al Thumann, AEE
1345-1355	AEE Chapters in Bulgaria	Georgi Rampov Ivanov, AEE Sofia Boris Petkov, AEE Plovdiv
1355-1405	Open Discussion	

Financing Energy Efficiency Projects in Bulgaria — **Moderator:** Hagler Bailly

1405-1420	Global and regional trends in energy efficiency financing	Michael Ellis
1420-1435	European financing mechanisms	*To be announced*
1435-1450	**Coffee Break**	

1450-1510	**Concluding Remarks**	Robert Archer, USAID WDC John Tennant/Lada Stoyanova, USAID Georgi Rampov, AEE Sofia Boris Petkov, AEE Plovdiv

1510-1830 **Conference and Exhibition Networking Meeting**

Конференция и изложба:
Развитие на пазара за енергийна ефективност в България

Организирана от Американската агенция за международно развитие, Министерството на промишлеността на Република Бъргария и Асоциацията на енергийните инженери

Конференция
22 Ноември 1996

Място:	Зала 8, Национален Дворец на Културата	
Участници:	Сертифицирани енергийни мениджъри, представители на предприятията, участвали в програмите на USAID, представители на Министерства и други правителствени организации, USAID и нейните подизпълнители	
Цел:	Да се представи пазарно ориентиран подход към енергийната ефективност.	
0900 - 0925	Регистрация	
0925 - 0935	Откриване	Г-н Станислав Димитров Зам.Министър на МП
0935 - 0945	Роля на USAID в България	Бил Фоердърър / Лада Стоянова, USAID
0945 - 0955	АЕИ в България	Георги Рампов и Борис Петков
Резултати от деонстрационните проекти		***Водещ: Michael Ellis Hagler Bailly***
	Сертифициран енергиен мениджър	Предприятие
0955 - 1015	Никола Калоянов	Лъв, Руно - Габрово
1015 - 1030	Борис Петков	Силикат Керам - Пловдив
1030 - 1045	Георги Рампов	КМХ - Белово
1045 - 1100	Ангел Дангов	Златна Панега
1100 - 1115	*Кафе пауза*	
1115 - 1130	Йордан Кацаров	Кристал - Перник
1130 - 1145	Деян Йорданов	Корабостроителен завод Варна
1145 - 1200	Димитър Баев	ЗММ ЕАД - София
1200 - 1230	Открита дискусия	
1230 - 1330	***Обяд със съпровождаща реч***	***Ал Туман, АЕИ***
	Развитие на световния пазар на енергийна ефективност Същевременно Прес конференция	
АЕИ клоновете		***Водещ: Ал Туман, АЕИ***
1330 - 1345	Представяне на АЕИ	Изпълнител: Ал Туман, АЕИ
1345 - 1355	АЕИ клоновете в България	Георги Рампов - АЕИ София Борис Петков - АЕИ Пловдив
1355 - 1405	Открита дискусия	
Финансиране на проекти за енергийна ефективност в България		***Водещ: Hagler Bailly***
1405 - 1420	Гробални и местни пътища за финансиране	Майкъл Елис
1420 - 1445	Открита тема	Владимир Старирадев
1445 - 1500	*Кафе пауза*	
1500 - 1520	***Закриване***	Робърт Арчър, USAID Бил Фордърър / Лада Стоянова, USAID Георги Рампов - АЕИ София Борис Петков - АЕИ Пловдив
1520 - 1830	***Осъществяване на контакти с изложителите***	

Конференция и изложба:
Развитие на пазара за енергийна ефективност в България

Организирана от Американската агенция за международно развитие, Министерството на промишлеността на Република Бъргария и Асоциацията на енергийните инженери

Кръгла маса
21 Ноември 1996

Място:	Зала 8, Национален Дворец на Културата	
Участници:	Сертифицирани енергийни мениджъри, представители на предприятията, участвали в програмата на USAID, представители на Министерството на промишлеността, USAID и нейните подизпълнители	
Цел:	Да се обсъдят и покажат дейностите свързани с енергийга ефективност, резултатите и бъдещите насоки на: 1) подпомагане на фирмите извършващи услуги свързани с енергийна ефективност; 2) основаване на български клонове на Асоциацита на енергийните инженери; и 3) демонстрационните проекти за енергийна ефективност	
0830 - 0900	Регистрация	
0900 - 0915	Откриване	Георги Рампов и Борис Петков АЕИ България
0915 - 0930	AID Bulgaria - Описание на програмата	Бил Фоердърр/Лада Стоянова USAID Bulgaria
Преглед на резултатите от проектите		
1.	***Демонстрационни проекти в промишлени предприятия***	***Водещ: Hagler Bailly***
0930 - 1045	Кръгла маса с представители на предпритията участвали в проекта Теми: Конкретни резултати, постигнати от предприятията с помощта на програмата на USAID, изводи от програмата и ползата от наемане на фирми предлагащи услуги за енергийна ефективност	
1045 - 1100	*Кафе пауза*	
1100 - 1200	Обобщаване на резултатите от кръглата маса	
1200 - 1315	***Обяд със съпровождаща реч*** Организацията АЕИ и бъдещите и насоки	Ал Туман, АЕИ
2.	***Подпомагане на фирми предлагащи*** **услуги за енергийна ефективност ESCO**	***Водещ: Hagler Bailly***
1315 - 1330	Въведение	Майкъл Елис
1330 - 1400	Каквое необходимо за успех като управител на ESCO	Питър Гарфорт
1415 - 1430	Открита дискусия	
3.	***Основаване клонове на АЕИ в България***	***Водещ: Ал Туман, АЕИ***
1430 - 1500	Доклад за състоянието на клоновете	Георги Рампов - АЕИ София Борис Петков - АЕИ Пловдив
1500 - 1515	Открита дискусия	
1515 - 1530	*Кафе пауза*	
4.	***Финансиране на енергийна ефективност Бъдещи насоки и сътрудничество***	***Водещ: Ал Туман, АЕИ***
1530 - 1600	Глобални и местни пътища за финансиране	Майкъл Елис
1600 - 1615	Групова дискусия	
5.	***Бъдещо сътрудничество***	***Водещ: Робърт Арчър, USAID***
1615 - 1630	Настояща програма на USAID	Electrotek / ЕнЕфект
1630 - 1700	Групова дискусия	

A . Batinkov Balkankar Rekord PLC
A. Asenov, Ministry of Environment
A. Dangov, Techtzem Ltd.
A. Emanuilov VIHVP
A. Jeliazkov Neochim Dimitrovgrad
A. Koitchev Silikat Keram PLC
A. Kotzev Flavia PLC,Plovdiv
A. Petleshkov, TU Sofia
A. Thumann, AEE
A. Velkov, FPAEE
B. Boitchev TU, Sofia
B. Cholev, Izida PLC Elin Pelin
B. Stroup, AEE
B. Tasev, Alex H&Z Ltd.
B. Tzaneva Magnet Electric
B. Yahova, Gotze Deltchev Regional Hospital
Chr. Gatchov Atlas Alfa Ltd.
Chr. Nedev, Balkankar PLC
Chr. Spassov AEE - Bulgarian Chapter
D. Atanasov, Neftochim Bourgas
D. Bachvarov, BTK
D. Bachvarova NCID
D. Baev, AEE - Bulgarian Chapter
D. Djankov, Electrosystems Engineering
D. Gadev, BSK
D. Garlanov, Flam Ltd.
D. Grozdanova, Parliament Commission of Energy
D. Kanev, National Electricity Company
D. Marinov, CNIKA Ltd.
D. Obretenov, Bulauto Lada
D. Oreshkov Ministry of Industry
D. Partziklidis, TU Sofia
D. Petrov, Dunarit Ltd. Rousse
D. Pulov Comeco Ltd.
D. Romanov Zhelezopaten Raion Plovdiv
D. Serkedzhiev National Electricity Company
D. Shevikov, Electroconsultenginering
D. Stoev, Neochim Dimitrovgrad
D. Tomov, NTSE
D. Yordanov, AEE - Bulgarian Chapter
E. Bozhanov SAI
E. Dimitrova TU, Sofia
E. Gentchev Ivel Ltd., Plovdiv
E. Goranov Energy Gpranov
E. Katzarova, Kremikovtzy
E. Natcheva Elios
E. Poliakova, BDJ
G. Andreev Krepezhny Izdelia PLC
G. Chavdarov, WEC
G. Gantchev, Agrotechnika PLC Karlovo
G. Handzhijsky,BTK
G. Kalaikov, INSOF
G. Kartelov, test Engineering
G. Kimenov VIHVP
G. Momtchev MEEP
G. Mumdzhian, AEE - Bulgarian Chapter
G. Rampov, AEE - Bulgarian Chapter
G. Terziel, Izopecht Ltd.

G. Vangelov HEI
G. Vassilev Plovdiv Comunity
G. Vultchev VIHVP
H. Fukayama, EEC
I. Banov, AEE - Bulgarian Chapter
I. Berov, Denima
I. Birnbaum, USAID
I. Boyadzhieva Ministry of Industry
I. Dragotinov VIHVP
I. Filev, Denima
I. Georgieva Flavia PLC, Plovdiv
I. Kalaikov, TU Sofia
I. Kolev, Poultry Dobritch
I. Kosev, Unitech
I. Kostadinov, Denima
I. Lambriev, NITI LTD.
I. Paldamov G.R.E.E.N. Energy Consulting
I. Petkov Ivel Ltd.
I. Shishkov, EnEffect
I. Stoev, NITI Ltd.
I. Tchalakov EAZ, Plovdiv
I. Tritchkov, Kremikovtzy
I. Vagljarsky, TMU
I. Yontchev, Far
I. Yoshiharu EEC
I. Yurukov, Ministry of Energy
J. Krysicki, Conco Systems
J. Marinov Commitee of Standartization
J. Tennant, USAID
K. Esaki EEC
K. Georgakas, TU Sofia
K. Ivanov, Denima
K. Karaivanov Balkankar Rekord PLC
K. Kuruzidis, TU Sofia
K. Lebedov Ecosapiens Foundation
K. Naplatarov, TU Sofia
K. Petkov, Ministry of Industry
K. Yurukov, Pirin - Hart Razlog
K.Shushulov, TU Sofia
L. Dunelovsky, VMZ Ltd. Sopot
L. Kaloferov, National Electricity Company
L. Ljubenov Voulkan, Dimitrovgrad
L. Mashkin,BNCPE
L. Paralanov, National Electricity Company
L. Petkantchin, TU Sofia
L. Spassov, AEE - Bulgarian Chapter
L. Stoyanova, USAID
L. Terziev Botilirashta Compania Ltd.
M. Dimitrov, Toploficatzia Pravetz Ltd.
M. Ellis, Hagler Bailly Consulting Inc
M. Georgieva, Razlog Regional hospital
M. Grigorova SAI
M. Ilieva, CITS
M. Ivanova, Energoproekt
M. Mintchev VIHVP
M. Petkova, ZMM Sofia
M. Piskov Alen Mak PLC
M. Prandzheva, Tzelhart PLC

M. Russalov Science Engineering Ltd.
M. Stantcheva Sofia Comunity
M. Stoyanov, Bulgarian Consulting Centre
M. Tzvetkova Vida Style PLC
M.Novev Podem Engineering
N. Christova NTMU
N. Kaloyanov, AEE - Bulgarian Chapter
N. Karambetzos, TU Sofia
N. Kuzmanov BDJ
N. Mumdzhiev, VMI Pleven
N. Nenova, TM JSC Rousse
N. Petrov G.R.E.E.N. Energy Consulting
N. Pisarov, SD Reflex
N. Savov Kremikovtzy
N. Stankov, AEE - Bulgarian Chapter
N. Statkov FNTS
O. Gekin, Sunytex PLC
O. Kishkilov Unicom Microsystems Ltd.
O. Tastchijan, Galatex PLC Varna
P Yantchik, Knizhna Fabrika Iskar PLC
P. Belokapov, Process Control
P. Christov IKKS BAN
P. Dentchev, Parliament Commission of Energy
P. Efremov, Bulgargas Botevgrad
P. Garforth, IFC
P. Karakasilis, TU Sofia
P. Koleva, Zlatna Panega
P. Mahmudiev, Technologitchna Avtomatica Ltd.
P. Mitkov, Svetlina Sliven
P. Petkov, Vagonen Raion Plovdiv
P. Petkov, Vidachim JSC Vidin
P. Petrova, Insist DZU Sofia branch
P. Todorov, Energoproekt
P. Veleva, NTSE - BNEN
Ph. Shkembov, Denima
R. Daraktchiev, IIH - BAN
R. Otoguro EEC
R. Rangelov, ZMM Sofia
R. Russo, Electrotek
R. Shevkenova - Mohamed, BTC
R. Spellman, GDS Associates
R. Stefkin, Denima
R. Zlatareva, AEE - Bulgarian Chapter
S Sendov, TU Sofia
S. Andreev, VMZ Ltd. Sopot
S. Christov, AEE - Bulgarian Chapter
S. Dimitrov, Ministry of Industry
S. Dimov, Kremkovtzy
S. Gishin, TU Sofia
S. Kantchovsky, National Electricity Company
S. Karachorsky, Pharmatzia PLC Dupnitza
S. Nikolov, HMS
S. Notovska, ZMM Sofia
S. Savov, Ministry of Industry
S. Simov, MEEP
S. Torosjan, BTK
S. Tzvetkova, Magnet Electric
S. Yovkova, Insist DZU Sofia branch

S.Ditchev AEE - Plovdiv
T. Bozveliev, BKI
T. Clark, CMP International Consultants
T. Dzhelatov ET TID
T. Georgiev AEE - Plovdiv
T. Georgiev, CNIKA Ltd.
T. Iliev, ZMM Sofia
T. Ivanov, Ministry of Environment
T. Michailov Podem - Gabrovo
T. Penzov, ET Trapen
T. Stoilov, Druzhba PLC Plovdiv
T. Zhechev, Bourgas Arport
T. Zhelev, IIH - BAN
Tz. Lakov, Exact - 3
Tz. Tzvetkov, Road Machinery PLC
V. Akivanov CNIKA Ltd.
V. Bozhichkov Vitebo
V. Chipev, Energoproekt
V. Hranov, ZMM Sofia
V. Ivanov, Antibiotic PLC Razgrad
V. Ivanov, Ministry of Energy
V. Kaneva, Energoproekt
V. Karlson, FNTS
V. Kishkilov Unicom Microsystems Ltd.
V. Nikolov, Alfa Laval Int. Eng.
V. Petkov Ivel Ltd.
V. Roseva
V. Stoyanov, TU Sofia
V. Tzolov Universalimpex
V. Tzvetkova, Magnet Electric
V. Valkov, VMZ Ltd. Sopot
V. Velev, SKGT Ltd.
V. Velichkov BDJ
V. Vlahov, ADEME
V. Vlutchkova, VMI Sofia
Y. Benov, Vida Style Vidin
Y. Katzarov, AEE - Bulgarian Chapter
Y. Nikolov, Flam Ltd.
Y. Stoyanov Land Combustion
Z. Natcheva, ABC Technika

ПОВИШАВАНЕ НА ЕНЕРГИЙНАТА ЕФЕКТИВНОСТ ВЪВ ФИРМА „ЛЪВ"- ГАБРОВО

Н. Калоянов , Ст. Невенкин - Технически Университет София
П. Баев - Фирма „Лъв", Габрово
Ив. Илиев - Технически Университет -Габрово

ВЪВЕДЕНИЕ

Този доклад представя основните резултати от извършен енергиен анализ и внедрени технически решения за повишаване на енергийната ефективност във Фирма „Лъв"-Габрово.

През 1993 год. фирмата беше включена чрез конкурс в Програмата на Американската Агенция за Международно Развитие (USAID) за повишаване на енергийната ефективност в индустриалния сектор на България.

Целта на програмата беше да се ***идентифицират, оценят и предложат мерки за повишаване на енергийната ефективност във фирмата, а така също да се финансира техническото реализиране на някои от тях***.

Фирма "Лъв" - Габрово е един от основните държавни технологични центрове за обработка на кожи в България. Производството е съсредоточено в 7 цеха, като един от тях - наименован като "номер 5" формира над 50% от енергийния баланс на фирмата. Този цех бе избран за обект на изследването.

Разработването на проекта премина през две основни части. Първата от тях включи извършване на анализ на енергопотреблението в цех 5 и разработване на обосновани технически решения за повишаване на енергийната ефективност. След приемане на резултатите и от експерти на USAID се премина към изпълнението на Втората част - доставка на енергоспестяващи съоръжения от USAID, въвеждането им в експлоатация и мониторинг за оценка на реалния ефект.

При реализирането на проекта активно участие взе американската консултантската фирма Hagler Bailly Consulting Inc. и нейните експерти г-н Mark Owen, г-н Mike Ellis, г-н Laurent Pommier и г-н Bill Watson, на които авторите изказват сърдечна благодарност.

РЕЗУЛТАТИ ОТ ЕНЕРГИЙНИЯ АНАЛИЗ

Енергийният анализ в основния цех на фирмата е осъществен чрез използване на CUSUM техниките , които са част от системен подход за оценка на състоянието на сложни системи. За разлика от традиционния инженерен подход при анализ на такива системи, при който крайната оценка за състоянието на обекта се получава след детайлно изучаване на конкретните инсталации , използваният инструментариум позволява първо да се открият съществените компоненти на енергийните загуби, да се отсеят значимите и

тези с реална възможност за намаляване, след което да се търсят конкретни решения за практическото им реализиране.

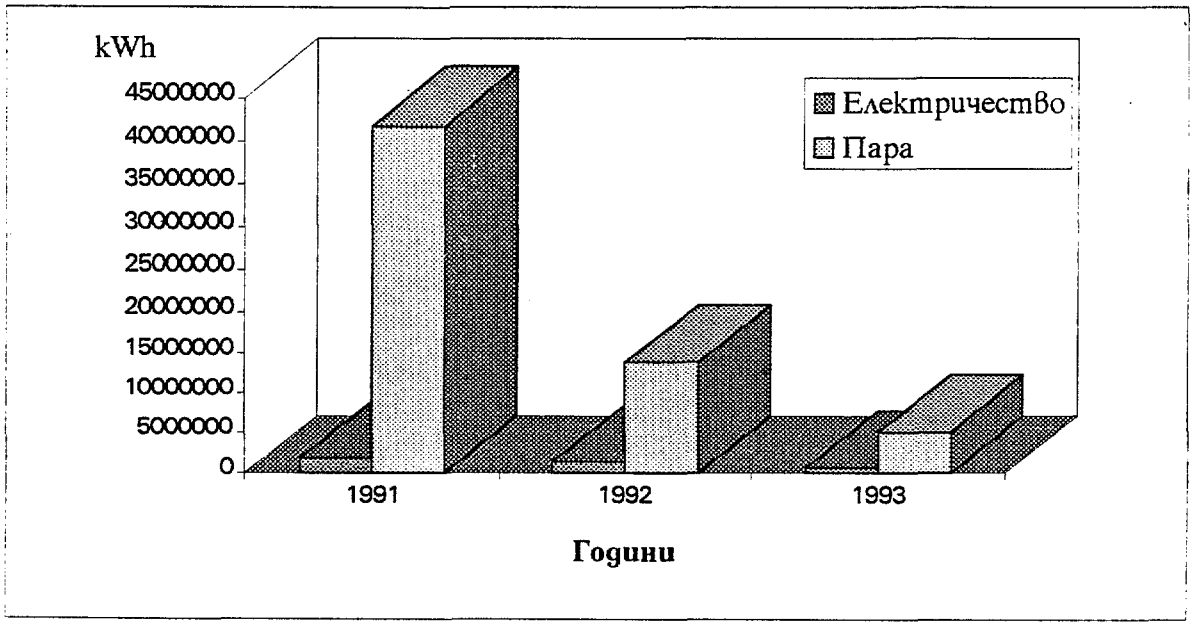
Извършеният анализ на консумацията на енергия обхвана два периода - от януари 1991 до април 1993 год. и от май 1993 до септември 1996 год.

Това разделение е предизвикано от факта, че получаването на достоверни резултати по този метод изисква анализиране на период по дълъг от една година, а от м.май 1993 год. стартира Програмата за повишаване на енергийната ефективност и от началото на 1994 год. започнаха целенасочени действия за намаляване на загубите.

Необходимата информация за осъществяване на анализа е събрана както по данни от официалните отчетни документи на фирмата, така и чрез реални измервания с прецизна преносима измервателна апаратура, предоставена от USAID.

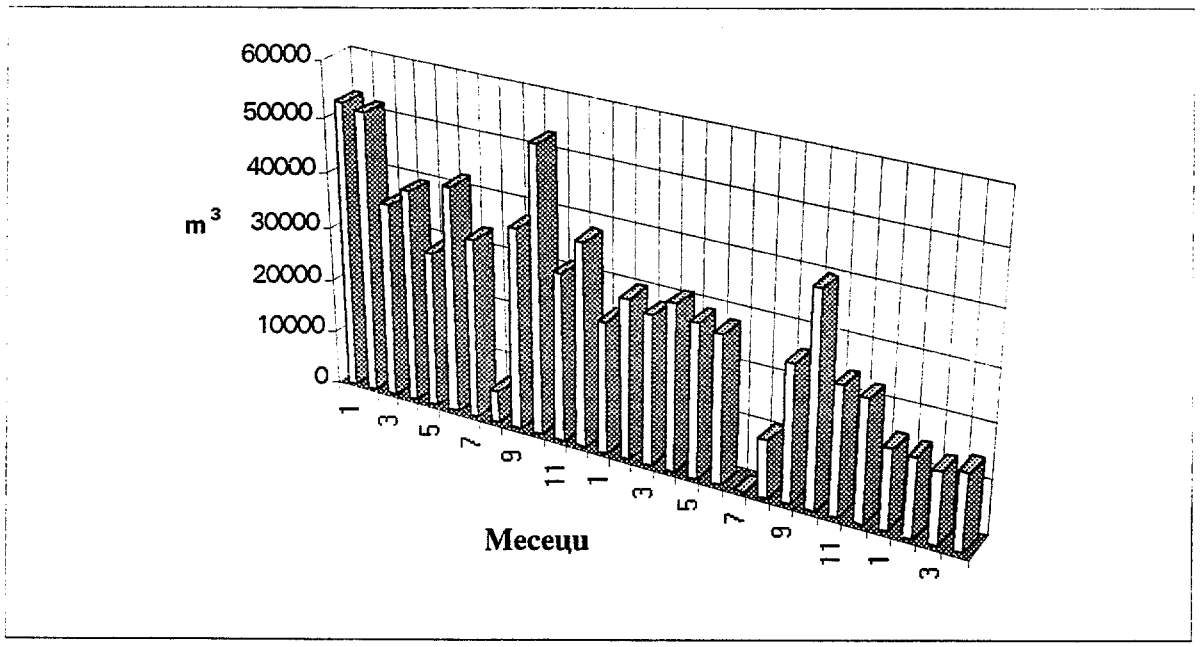
А. ПОТРЕБЛЕНИЕ НА ЕНЕРГИЯ ПРЕЗ ПЕРИОДА януари 1991 - април 1993 год.

Основните енергоносители, използвани за нуждите на цех 5 са водна пара, доставяна от ТЕЦ-Габрово, електричество и вода. Разходът на пара се причинява както от основните технологични процеси, при които се използва топла вода и пара за изсушаване на обработваните кожи, така и от отоплителните инсталации в цеха. От фиг.1а може да се проследи хода на изменение, големината и съотношението между отделните потоци преди началото на проекта. Както се вижда същественият дял в енергийния баланс се пада на консумацията на пара, която надвишава чувствително тази на електроенергията. По тази причина и основните усилия бяха насочени към търсене на решения за намаляване разхода на пара.



Фиг.1а. Разход на пара и електроенергия през периода Януари'91- Април'93

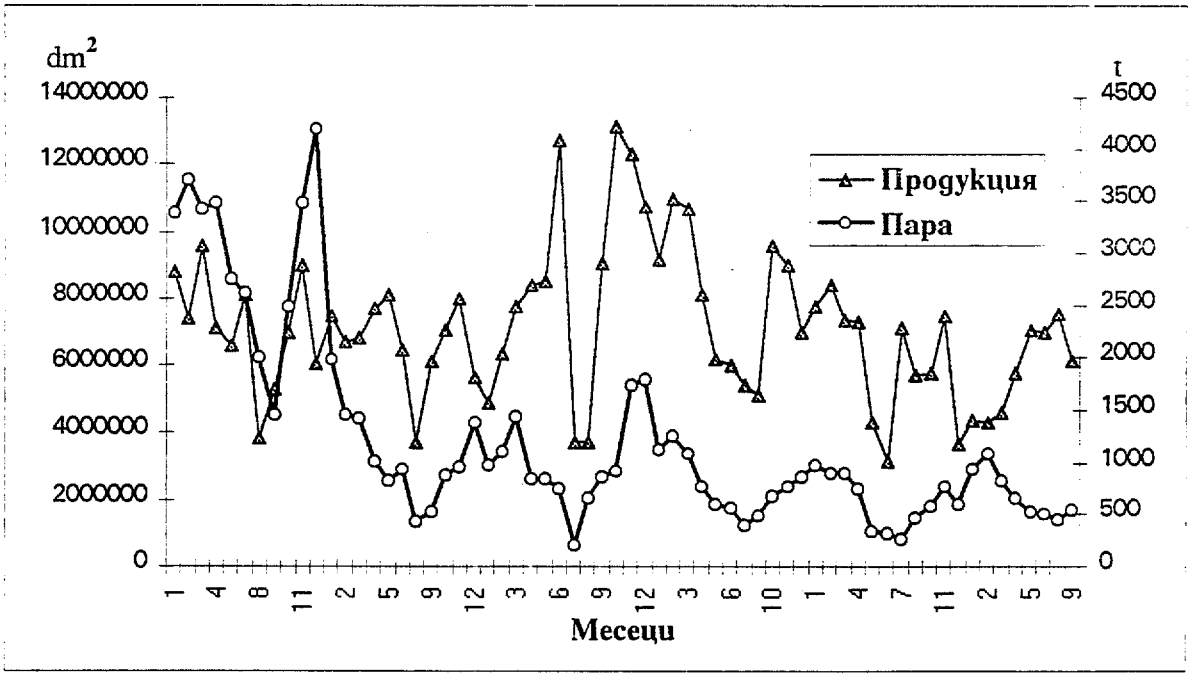
Проблемите на водоснабдяването и намаляването на консумацията на вода, разхода на която може да се проследи от фиг.1б, имат своя собствена значимост. Осигуряването на собствен водоизточник е стара и примамлива идея, разработвана от специалистите на фирмата, но в тази програма не е обект на разглеждане .



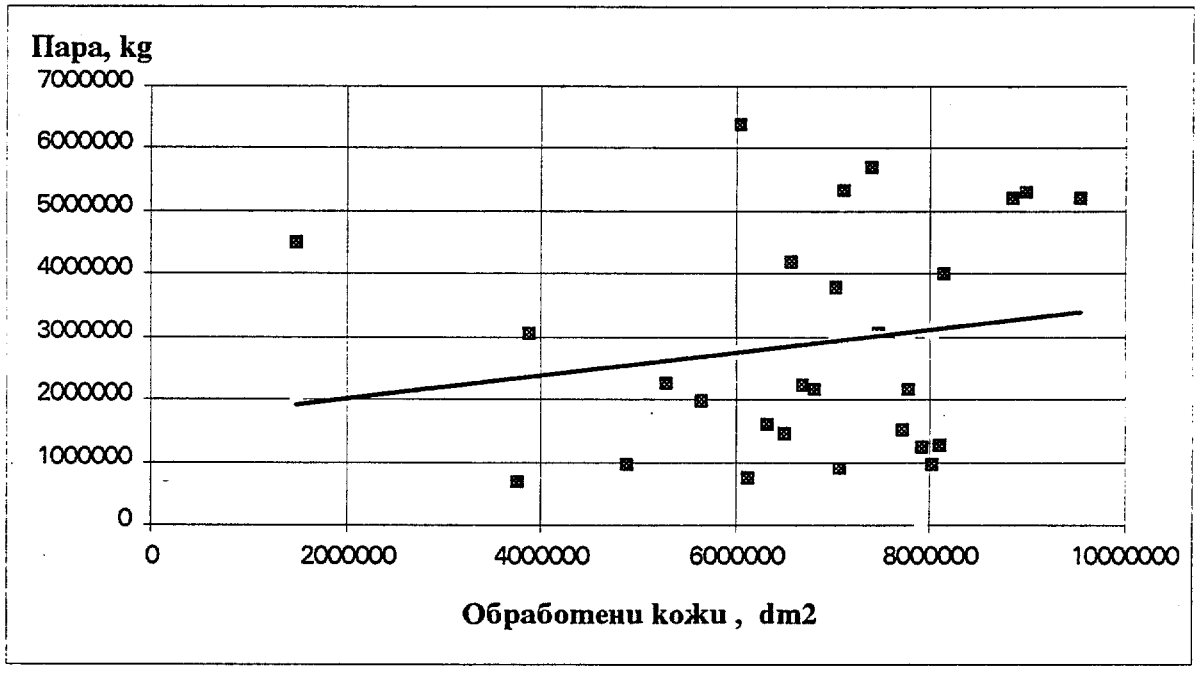
Фиг.1б. Месечен разход на вода периода Януари'91- Април'93

Анализът на изменението на произведената продукция (обработените кожи) и разхода на пара за този период, както са показани на фиг.2, установява силно изразен нелинеен характер. Взаимната корелацията е очевидна, но с различна степен на значимост през зимните и летните месеци. Разминаването във върховете на кривите при някои месеци се обяснява с времето на отчитане на продукцията и консумираната енергия.

Разкриването на връзката между тези два параметъра осигури съществена информация, която насочи към възможните фактори, определящи установения характер на консумацията. Анализирани бяха енергопреобразуващите процеси при загряване на вода за осигуряване на технологиите на варене, дъбене и намасляване на кожите, както и процесите на апретура и сушене. Качествена и количествена оценка за управлението на консумацията на пара е потърсена чрез използване на корелационния и регресионния анализ. Както може да се види от фиг.3 голямото разхвърляне на точките свидетелства за реални потенциални възможности за икономии. Получаващият се постоянен разход на пара (не зависещ от производството) е около 1300 тона при размах на разсейването 5200 тона. Постоянната компонента на разхода се причинява от сумарния ефект от отоплението и загубите на топлина (включително пропуски на пара), които нямат връзка с големината на производството.



Фиг.2. Продукция и разход на пара през периода Януари'91- Септември'96



Фиг.3. Корелация между продукцията и разхода на пара
през периода Януари'91- Април'93

Тези резултати се потвърдиха и от потърсената оценка на изменението на специфичния разход на пара за обработка на единица продукция, показано на фиг.4.

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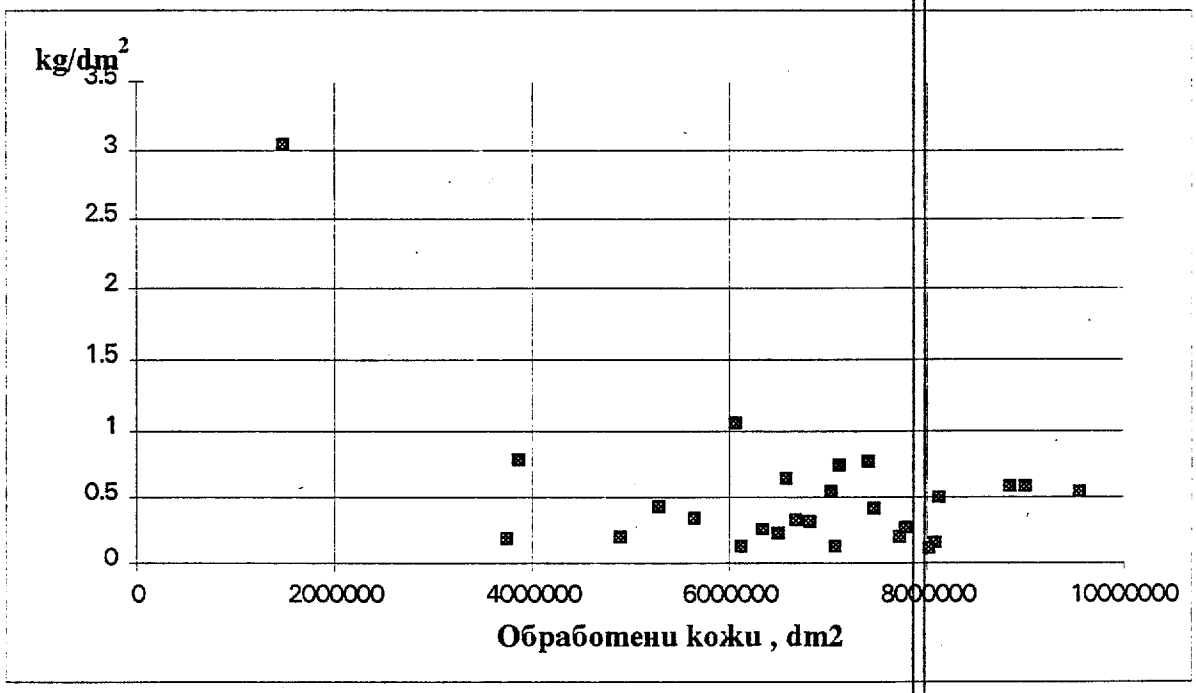

Фиг.4. Специфичен разход на пара и произведена продукция
през периода Януари'91- Април '93

Въз основа на извършения анализ на енергопотреблението, включително и по видове консуматори, се разработиха, оцениха и предложиха за въвеждане технически решения, които може да се обобщят в следните две нива:

А.Елементно-агрегатно ниво

- **А.1** ***Въвеждане на програма за проверка и подмяна на кондензните гърнета.***

  Тази мярка предвижда обучение на техническия персонал за периодична проверка работоспособността и състоянието на кондензните гърнета и спирателната арматура, както и установяване на съществуващото им състояние. С предоставената от USAID апаратура се извърши тестване на използваните кондензни гърнета и се установи , че около 75% тях не функционират и са байпасирани.

- **А.2** ***Реконструкция на кондензната мрежа и инсталиране на междинни кондензни резервоари.***

  Поради лошо хидравлично оразмеряване на тръбната мрежа кондензата от мнозинството топловъздушни апарати, използвани за отопление на помещенията в цеха се изхвърля директно в канализацията.

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- **А.3** ***Топлинно изолиране на акумулиращите топлообменници за топла вода.***

В системата за подгряване на вода за технологични цели се използват три обемни топлообменници с общ обем 45 m3. Единият от тях, инсталиран в неотопляемо помещение от сградата и без топлинна изолация реализира топлинни загуби 9% от полезната топлина за подгряване на водата в него.Топлинните загуби от останалите два, изложени на атмосферно въздействие извън сградата и с нарушена топлинна изолация са оценени чрез измерване през периода декември 1993-януари 1994год. като 21.5% от топлинната произвоителност на системата.

- **А.4** ***Отстраняване пропуските на пара в пароразпределителните устройства.***

В.Енергопреобразуващи процеси и управление:

- **В.1** ***Подобряване на контрола на сушилния процес.***

Установи се, че същесвуващите автоматични регулиращи вентили по парните линии към сушилните инсталации не функционират надеждно, при което често се използват байпасните връзки. От това следва и излишно подаване на пара към калориферите, когато сушилните не работят.Сушилните агрегати работят на рециркулация, като изхвърлят отработения въздух в работните помещения, с което се удължава времето за сушене и се увеличава разхода на енергия. Съществува възможност за изхвърляне на отработения въздух навън, при това с оползотворяване на топлината му.

- **В.2** ***Подобряване контрола на водното ниво и температурата в акумулаторите за топла вода***

- **В.3** ***Въвеждане на система за индиректно загряване на водата за технологични цели.***

Системата за подгряване на вода е изпълнена по директна схема с обемни топлообменници , споменати по-горе. Въпреки нереалните досега ниски цени и глоби за невърнат кондензат, неоспоримо по-високата топлинна ефективност на директния пред индиректния принцип за загряване на вода не е достатъчен аргумент, който да обуслови непременното му приложение. След извършване на ***функционален анализ на системата*** и нестационарния по технологични изисквания режим на консумация на топла вода, се установи, че е подходящо въвеждане на комбинирано скоростно и акумулационно подгряване по индиректна схема. Технологията на обработка на кожи осигурява достатъчно количество кондензат, чиято топлина при подходящо използване в конкретния случай позволява структуриране на индиректна схема с по-висока обща ефективност от тази на същесвуващата система.

- **В.4** ***Контрол на влагата на готовата продукция след сушилния процес.***

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Необходимостта от тази мярка се определи от факта, че поради субективност при определяне на крайната влага на изсушената продукция се налага 3-5 кратно рециклиране на процеса. Това може да е избегне ако влагата на изходящия от сушилнята продукт се измерва. Подходящи за случая са контактни влагомери.

- **В.5** ***Подмяна на буталния въздушен компресор с винтов.***

Предложените мерки бяха оценени по следните показатели:

- ***срок на откупуване***
- ***взаимно изключване***
- ***перспективност съобразно местните условия.***

След оценка на предложените мерки и от американските експерти , USAID прие за финансиране и достави основното необходимото оборудване за мерки В.1;В.2, В.3 и В.5 :

4 броя ТРВ за пара (3") , тип ET124 ;

2 броя ТРВ за вода (3") , тип ET124 ;

Един пластинчат топлообменник "Алфа-Лавал" , модел M3-VG, - вода- вода , мощност 500 kW;

Три пластинчати топлообменници "Алфа-Лавал" , модел M10-MG, - пара-вода, всеки с мощност 1000 kW;

Винтов компресор за въздух Ингерсол-Ранд TM300

Изсушител на въздух Ингерсол-Ранд TM300 (хладилен).

Останалите предложени решения се осъществиха със собствени средства на фирма "Лъв".

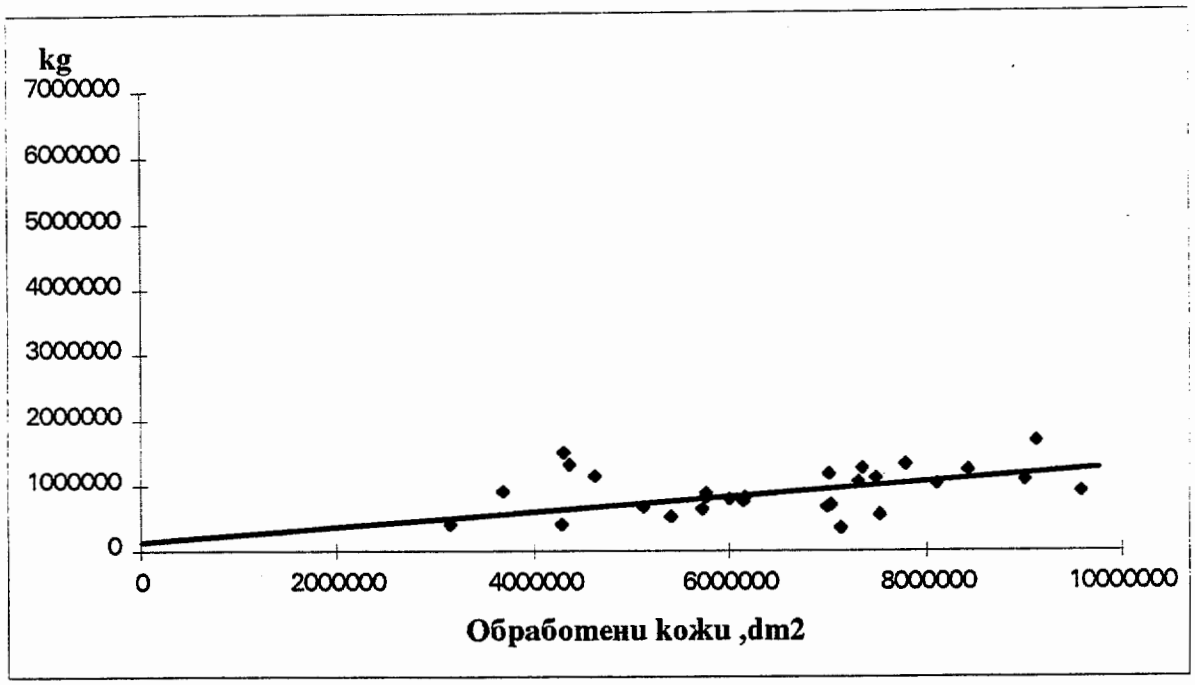
Б. АНАЛИЗ НА КОНСУМАЦИЯТА НА ПАРА ПРЕЗ ПЕРИОДА м.април 1994 - м. септември 1996

В началото на 1994 год. започна въвеждането на някои от предвидените технически решения като :

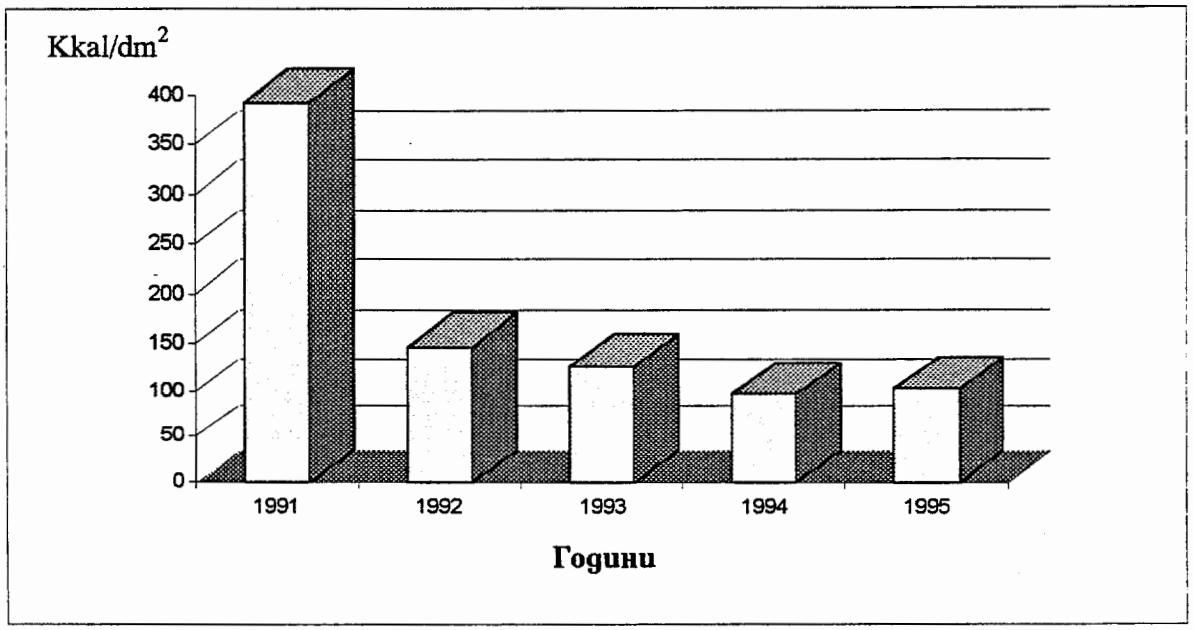
- топлинна изолация на бойлерите за гореща вода ;
- отстраняване на пропуските на пара;
- проверка и подмяна на кондензни гърнета и монтиране на липсващи такива;
- реконструкция на кондензната мрежа;
- подмяна на недействащата спирателна арматура;
- подобряване на регулирането на процеса сушене,

които до края на 1995 год. формираха първата фаза на проекта.

В резултат на подобряване на енергийния мениджмънт се осъществи и промяна в характера на енергопотреблението. Установи се нова основна линия на процеса (фиг.5а) със силно стеснен диапазон на разхвърляне на точките и още по-ярко изразена зависимост на консумацията от произведената продукция.



Фиг.5а. Корелация между продукцията и разхода на пара през периода Април'94- Септември'96



Фиг.5б. Изменение на средния годишен специфичен разход на пара

Извършеното сравнение на получените резултати до края на 1995 год. показва следното (фиг.5б) :

средният специфичен разход на топлина за обработка на кожи от 127 Kkal/dm^2 за 1993 год. се редуцира на 102 Kkal/dm^2, което съставлява 19.7% годишна икономия на енергия.

През втората фаза на проекта се внедриха предложения В.3 и В.5.

Показаната на фиг.6 обща блокова схема и фиг.7 (изгледи) на индиректната система за подгряване на вода включи три пластинчати пароводни топлообменници, топлообменник за използване топлината на кондензата и допълнителен кондензен резервоар. От съществуващата система са използвани акумулиращите обемни апарати и топлообменната система за оползотворяване топлината от вторичното изпарение на кондензата. Системата е автоматизирана, като за това са преустроени и използвани три от предоставените от USAID терморегулиращи вентили. Тя е въведена в експлоатация на 2.09.1996 год.

Анализът на работата на системата е извършен както чрез моделиране и симулиране, така и на основата на измервания в реални условия. Част от резултатите от извършените измервания са показани в табл.1, а на фиг. 8а,б,в и г са показани резултати от симулационното изследване на изменението на температурата в акумулаторите при различни начални условия и режимни параметри. Резултатите от измерванията са използвани основно за калибриране на симулационния модел , както и за проверка на топлинната ефективност на топлообменниците при екстремни режими на експлоатация. Получената информация ще бъде използвана още за предстоящата настройка на системата.

Оценка за ефективността на системата може да се получи от сравнение на регистрираните според счетоводните документи на фирмата данни за м. септември 95 и 96 год. Произведената продукция, нейната структура, количеството изразходвана топлина и невърнатия кондензат за двата месеца са показани в табл.2.Поради неблагоприятните метеорологични условия през м. септември 96 год. отоплението в цеха се включваше, което не позволява приемането на специфичния разход на топлина за отправна точка. Тогава долната граница на ефективността може да се оцени по разликата в невърнатия кондензат, която без отчитане на разликата в количеството произведена продукция се равнява на (396.5 - 325.34)x0.71 = **51 Gkal/месец.**

Трябва да се има предвид, че през зимните месеци количеството на разполагаемия от отоплителните системи кондензат ще бъде значително по-голямо, което ще повиши ефективността на системата.

Въздушният компресор с изсушителя бяха монтирани в специално за целта помещение (фиг. 9) и са пуснати в експлоатация на 16.05.1996 год. От този момент до 9.10.1996 год. новият компресор е работил общо 399 часа, от които

137 часа в натоварен режим. Извършените измервания на режимните параметри на компресора показаха ток при натоварен режим 84 А и при ненатоварен режим 48 А.

За един работен ден с продължителност 8 часа съгласно регистрираните данни е изчислена консумация от 114 kWh за режима на натоварване и 126.7 kWh за режима на разтоварване. Или в месечен план средно при 21.7 работни дни и едносменна работа се консумира 5222 kWh енергия, докато при стария компресор със 75 kW двигател - 13020 kWh, т.е реализира се месечна икономия от 7748 kWh електроенергия.

Осигурена е също възможност за използване през зимата на топлината на охлаждащия компресора възух за затопляне на автомобилния гараж.

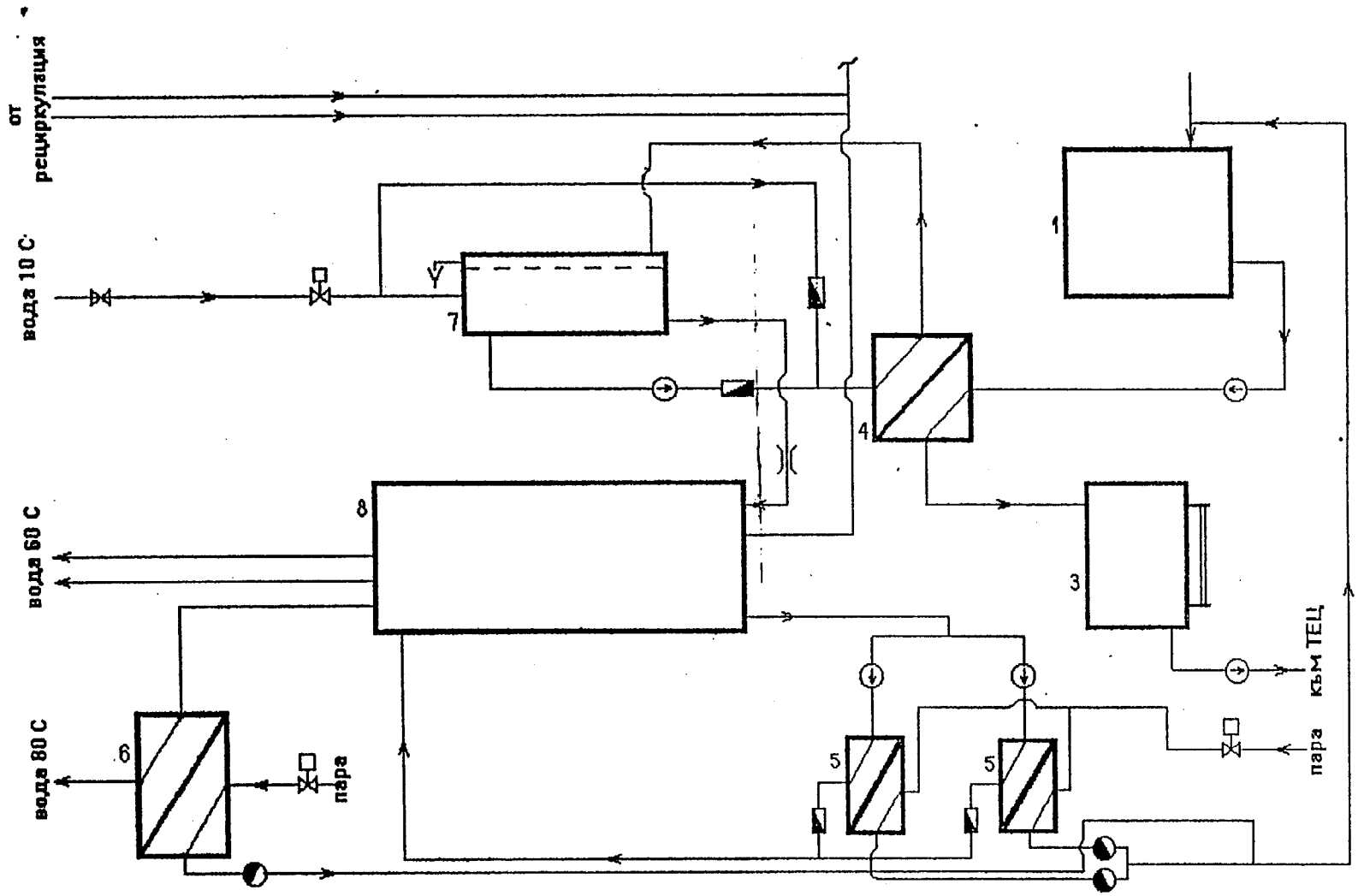
ЗАКЛЮЧЕНИЕ

За основен при оценка на приетите за внедряване технически решения е използван показателят "срок на откупуване" по доларовата равностойност на капиталовложенията за оборудване, проектиране, монтаж и експлоатация .

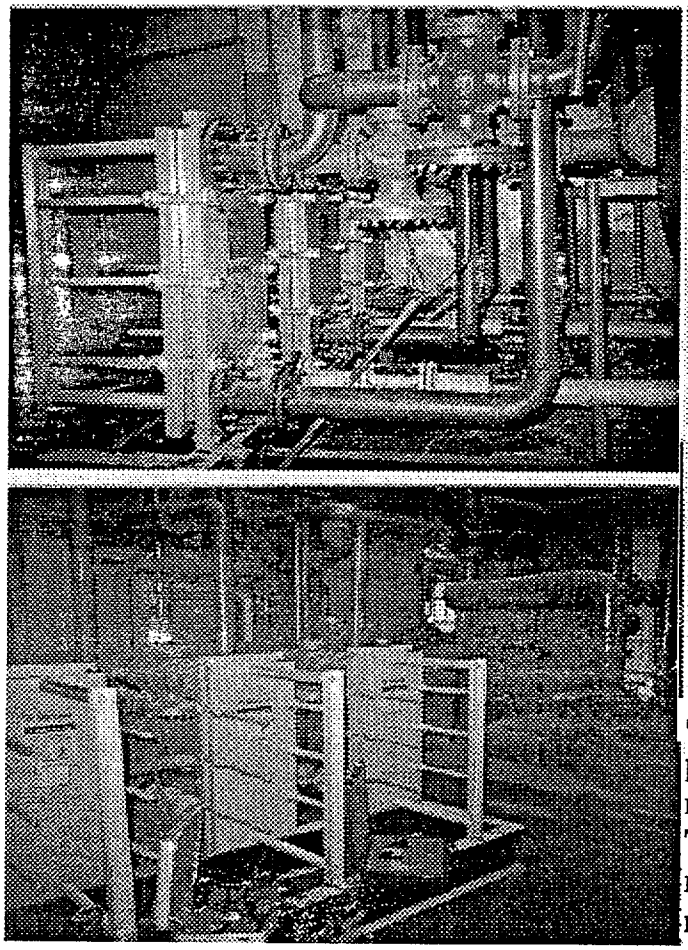
В таблица 3 са представени данните за прогнозираната икономия (получена на на етапа генериране на решението), реално установената след въвеждане на техническото решение, както и срокът на откупуване.

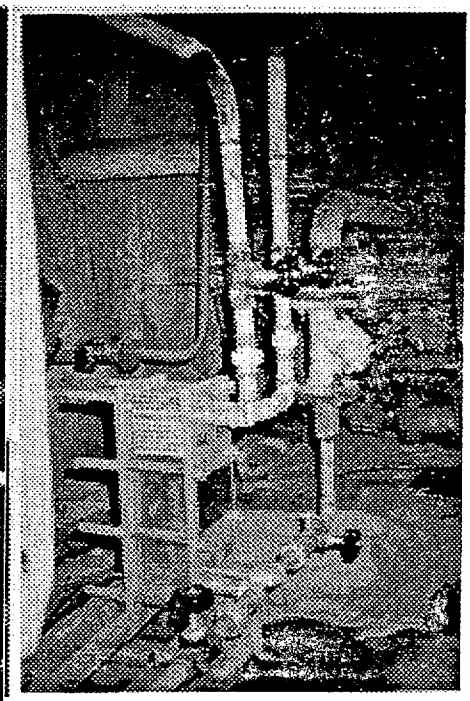
За компресора не са включени икономиите от масло и подръжка в сравнение със стария бутален компресор. Това ще стане след едногодишна експлоатация на компресора.

Резултатите показват, че въведените мерки имат общ среден срок на откупуване по-малък от две години, което е несъмнено доказателство за високата им ефективност.

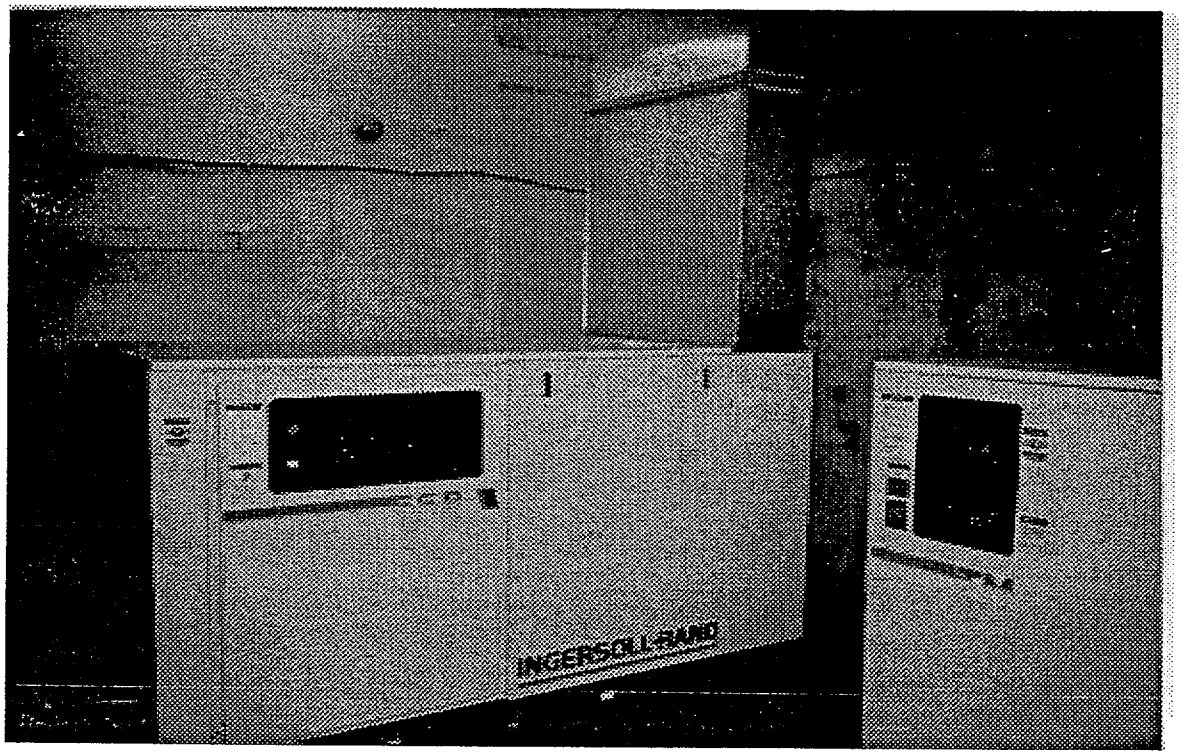


Фиг. 6. Обща блокова схема на индиректната система за загряване на вода за технологични нужди





Фиг.7.Изгледи от реконструираната система за загряване на вода (в ляво-пароводните ТОА, в дясно - водоводният топлообменник за използване топлината на кондензата).



Фиг.9 . Изглед от инсталирания винтов компресор и изсушителя.

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Таблица 1

Час	Темпер. на въздуха	Показания на топломера	Разход на пара	Налягане на парата	Темпера-тура на парата	Показания на конден-зомера	Върнат кондензат към ТЕЦ	Темпер. в кръговете на ТОА-1	Темпер. в кръговете на ТОА-2	Темпер. в кръговете на ТОА-3	Бойлер-1		Бойлер-2		Конд. р-ри		Темпер. в кръговете на ТОА-К1	Темпер. в кръговете на ТОА-К2	Темпер.на водата към бойл.
	Твн			*P*	*T*			*пара/вода*	*пара/вода*	*пара/вода*	*Тв*	*Тв*	*Тв*	*Тв*	*Осн.*	*Доп.*	*конд/вода*	*конд/вода*	*Тсм*
-	*°C*	*Gkal*	*Gkal/h*	*MPa*	*°C*	*m³*	*m3*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*
6:45	7.4	7212	-	0.185	130	15694	-	-	120/98 40/54	-	40	12	35	12	55	35	-	-	-
7:00	7.4	7213	4	0.205	128	15694	0	-	120/98 35/48	-	35	12	35	12	99	35	-	-	-
8:00	9.8	7217	4	0.19	160	15694	0	152/100 32/63	-	152/73 32/54	32	8		9	98	61	93/75 32/82	75/52 32/37	40
9:00	10.5	7220	3	0.201	170	15698	4	-	-	-	27	6		8	97	79	92/70 27/65	70/60 27/36	48
10:00	10.9	7222	2	0.38	160.8	15701	3	-	-	-	42	10		11	98	80	-	-	-
11:00	11.0	7224	2	0.44	181.8	15701	0	-	161/100 41/62	-	41	12		11	99	80	96/76 41/75	76/65 41/50	60
12:00	11.5	7225	1	0.49	156.4	15706	5	-	143/101 26/51	-	26	13		12	93	57	91/67 26/63	67/60 26/36	48
13:00	11.2	7228	3	0.29	180.3	15710	4	-	145/104 35/64	-	35	16		15	99	82	92/74 35/68	74/66 35/46	55
14:00	11.0	7231	3	0.352	185.5	15713	3	-	-	-	49	13		11	99	82	-	-	-
15:00	9.5	7234	3	0.39	179.7	15713	0	-	-	-	40	13		11	98	80	-	-	-
				0.3123	163.25														

Общ разход на топлина за деня : 22 Gkal
Общ разход на пара за деня : 33.015771 t
Върнат кондензат за деня : 19 t

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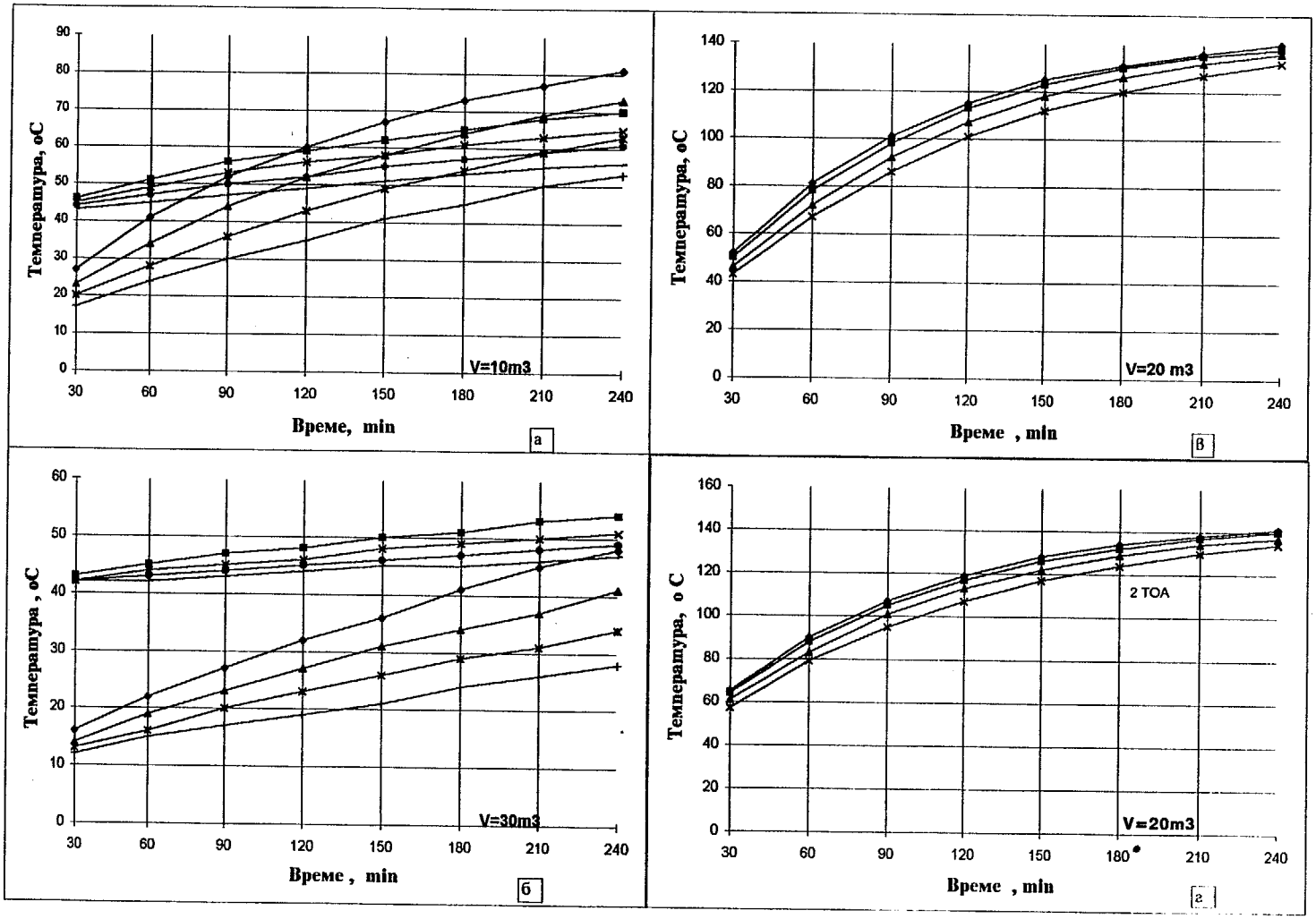

Фиг.8. Влияние на дебита на подгряваната вода, началните условия и обема при :
(а-б) използване на водоводния топлообменник с номинална топлинна мощност 500 kW
(в-г) използване на пароводните топлообменници всеки с номинална мощност 1000 kW

Таблица 2

м. 09	Продукция					Разход на топлина	Разход на пара	Спец. топлина	Невърнат кондензат
	ГОТОВА		WET BLUE		Всичко				
	dm2	%	dm2	%	dm2	Gkal	t	Gkal/t	t
1995	2726783	47.7	2992888	52.3	5719671	464.08	650	0.71	396.5
1996	2744542	44.7	3391180	55.3	6135722	539.74	756.6	0.71	325.34

Таблица 3

Решение	Наименование	Год.икономии, Gkal		Печалба	Разходи	Възвращ.
№		проектни	реални	USD	USD	год.
A.1	Въвеждане на програма за проверка и подмяна на кондензни гърнета	720	480	9850	910	0.09
A.2	Реконструкция на кондензната мрежа	260	248	5087	4196	0.82
A.3	Топлинно изолиране на акумулаторите за топла вода	665	470	9640	5790	0.60
A.4	Отстраняване пропуските на пара	216	180	3692	450	0.12
B.1	Подобряване контрола на температурата при сушилния процес	780	650	10500	6301	0.60
B.3	Реконструкция на системата за подгряване на вода от директна в индиректна схема	484	561	8960	13718	1.53
B.5	Подмяна на буталния въздушен компресор с винтов	30000 kWh	85778 kWh	7800	24535	3.15
			ВСИЧКО	55529	55900	1.01

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ENERGY EFFICIENCY IMPROVEMENT IN LEVE -JSCo - GABROVO

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Iv. Iliev - Technical University of Gabrovo

SUMMARY

This report presents the results of an Industrial Energy Efficiency Project for the Leather Processing plant "LEVE" in Gabrovo, Bulgaria. The Project is part of the USAID ENERGY EFFICIENCY MARKETING DEVELOPMENT PROGRAM.

Started in 1993, the purpose of this Project was to identify, evaluate and recommend energy conservation opportunities as well as to provide financial support for implementation of energy efficient equipment and thus to promote improved energy efficiency in the industrial sector of Bulgaria. The operation of this program was co-ordinated and technical assisted by the professional staff of the Hagler Bailly Consulting Inc. In addition of the team USAID and Hagler Bailly Consulting Inc. provided a set of portable instruments to conduct on site measurements.

To identify the areas (in the biggest energy consuming department of the plant selected as a representative one) where energy savings can be made, the team conducted both preliminary and detailed energy audits.

The department operates two shifts five days per week, the last 5 years between 55 and 65% of its full capacity. Before the start of the program the annual production was approximately 56453352 dm^2 of leather processed while the energy consumption was about 1 344 000 kWh of electricity and between 12000 and 25000 Gkal of steam.

The plant is supplied with electricity by the National Energy Company and with steam by the Thermal Power Station of Gabrovo.

The low overall energy efficiency of the plant found was due to the complexity of the following major factors: decreasing the production during the last 5 years, wearing out of energy transfer, control and measurement equipment, lack of a consistent energy management program. There were found several energy technological systems with significant potential for increasing the energy efficiency as the steam distribution and condensate return systems; the industrial water heating system; the leather dryers; the department heating system.

The team proposed several energy conservation measures as: Institution of steam trap management program, Reconstruction of the condensate system, Insulation of hot water tanks, Temperature control improvement of the drying process, Implementation of water heating system utilising condensate heat, Replacement of the reciprocated water-cooled air compressor, etc.

After evaluation of the measures proposed some of them were selected for implementation. Significant part of the equipment required was provided by USAID : Four 3" Temperature Regulating Valves for Steam with Spare Pilots and Pilot Repair Kit, Two 3" Temperature Regulating Valves for Water with Spare Pilot , Pilot Repair Kit and Diaphragms, One Alfa Laval Water-Water Plate Heat Exchanger Model M3-VG9, Three Alfa Laval Steam-Water Plate Heat Exchangers Model M10-MG , One Ingersoll-Rand EP60 Air-Cooled Rotary Screw Air Compressor and One Ingersoll-Rand TM300 Refrigerated Air Dryer.

The monitoring and evaluation procedure performed in 1996 showed that after ECM's implementation annual energy savings of 19.5% of steam and 16% of electricity were obtained which led to an overall average payback period of the measures implemented less than 2 years.

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РЕЗУЛТАТИ ОТ ПРОГРАМАТА ЗА ПОВИШАВАНЕ НА ЕНЕРГИЙНАТА ЕФЕКТИВНОСТ ВЪВ ФИРМА „РУНО-Г"- ГАБРОВО

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Ц. Боевска - Фирма „РУНО", Габрово
Ив. Илиев - Технически Университет -Габрово

ВЪВЕДЕНИЕ

Фирма "РУНО-Г" - Габрово е държавна фирма за първична обработка на вълна и производство на камгарни ленти.

През 1993 год. фирмата беше включена чрез конкурс в Програмата на Американската Агенция за Международно Развитие (USAID) за повишаване на енергийната ефективност в индустриалния сектор на България.

Целта на програмата беше да се ***идентифицират, оценят и предложат мерки за повишаване на енергийната ефективност във фирмата, а така също да се финансира техническото реализиране на някои от тях.*** "РУНО-Г" е една от няколкото фирми в България за пране на вълна и производство на камгарни влакна, поради което разкриването на потенциални енергоспестяващи мерки се очаква да има мултипликативен ефект.

Разработването на проекта премина през две основни части. Първата част включи извършване на анализ на енергопотреблението във фирмата и генериране на обосновани технически решения за повишаване на енергийната ефективност. След приемане на резултатите и от експерти на USAID се премина към изпълнението на Втората част, която включи доставка на енергоспестяващи съоръжения от USAID, въвеждането им в експлоатация и мониторинг за оценка на реалния ефект.

При реализирането на проекта активно участие взе американската консултантската фирма Hagler Bailly Consulting Inc. и нейните експерти г-н Mark Owen, г-н Mike Ellis, г-н Laurent Pommier и г-н Bill Watson, на които авторите изказват сърдечна благодарност.

РЕЗУЛТАТИ ОТ ЕНЕРГИЙНИЯ АНАЛИЗ

Енергийният анализ е осъществен чрез използване на CUSUM техниките , които са част от системен подход за оценка на състоянието на сложни системи. За разлика от традиционния инженерен подход при анализ на такива системи, при който крайната оценка за състоянието на обекта се получава след предварително детайлно изучаване на конкретните инсталации , използваният инструментариум позволява първо да се открият съществените компоненти на енергийните разходи, да се отсеят значимите и тези с реална възможност за намаляване, след което да се търсят конкретни решения за практическото им реализиране.

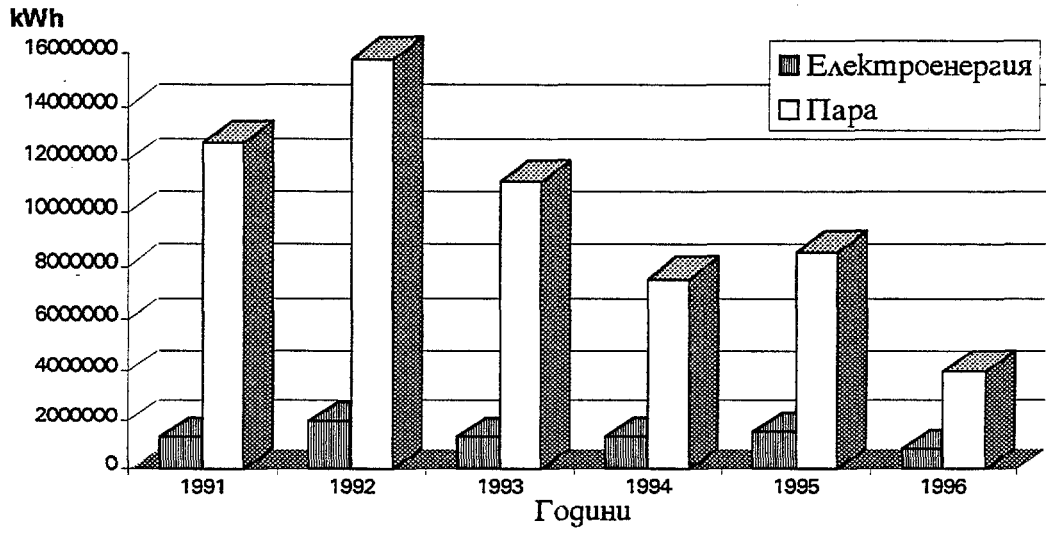
Необходимата информация за осъществяване на анализа е събрана както по данни от официалните отчетни документи на фирмата, така и чрез реални измервания с прецизна преносима измервателна апаратура, предоставена от USAID.

Извършеният анализ на консумацията на енергия обхвана два периода - от януари 1991 до април 1993 год. и от май 1993 до септември 1996 год. Това разделение е предизвикано от факта, че получаването на достоверни резултати по този метод изисква анализиране на период по дълъг от една година, а от м.май 1993 год. стартира Програмата за повишаване на енергийната ефективност.

А. ПОТРЕБЛЕНИЕ НА ЕНЕРГИЯ ПРЕЗ ПЕРИОДА януари 1991 - април 1993 год.

Основните енергоносители, използвани за нуждите на фирмата са водна пара, доставяна от ТЕЦ-Габрово, електричество и вода.

Разходът на пара се причинява както от основния технологичен процес-пране, при които се използва топла вода и пара за изсушаване на праната вълна, така и от отоплителните инсталации и бойлерите за гореща вода за битови нужди. От фиг.1а може да се проследи регистрирания ход на изменение, големината и съотношението между отделните потоци преди началото на проекта. Както се вижда същественият дял в енергийния баланс се пада на консумацията на пара, която надвишава 16 - 24 пъти тази на електроенергията. По тази причина и основните усилия бяха насочени към търсене на решения за намаляване разхода на пара.



Фиг.1а Основни енергоносители (1991 - 1996 год.)

Проблемите на водоснабдяването и намаляването на консумацията на вода,

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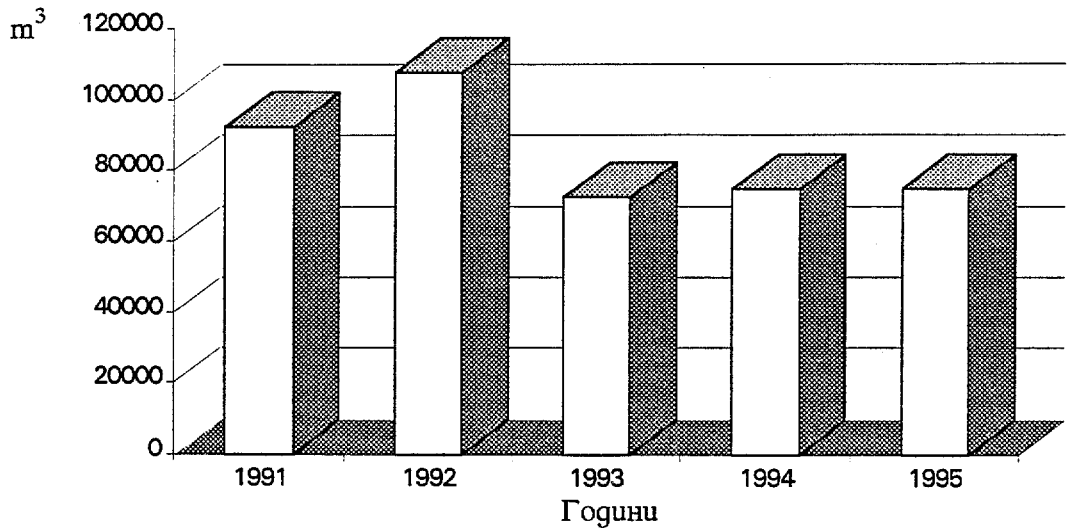
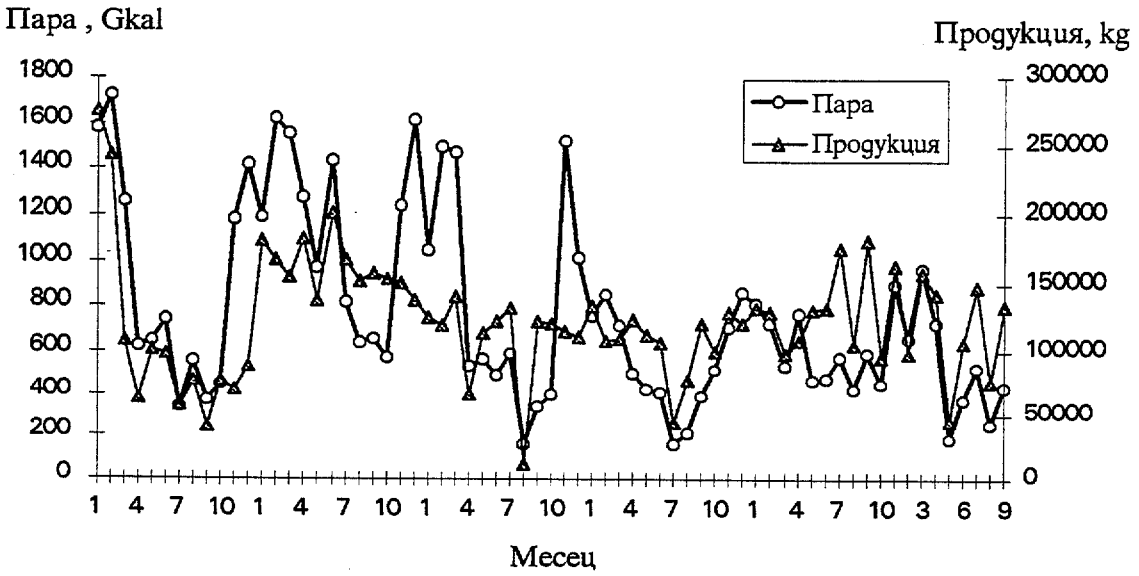
разхода на която може да се проследи от фиг.1б, имат своя собствена значимост и не са обект на разглеждане тук.



Фиг.1б. Разход на вода (1991 - 1996 год.)

Ако се проследи изменението на произведената продукция (прана вълна) и разхода на пара за този период, както е показано на фиг.2, се установяват ясно изразени пикове в зимните месеци. Разминаването във върховете на кривите при някои месеци се обяснява с времето на отчитане на продукцията и консумираната енергия.



Фиг.2. Произведена продукция и консумирана пара (Януари'91-Септември'96)

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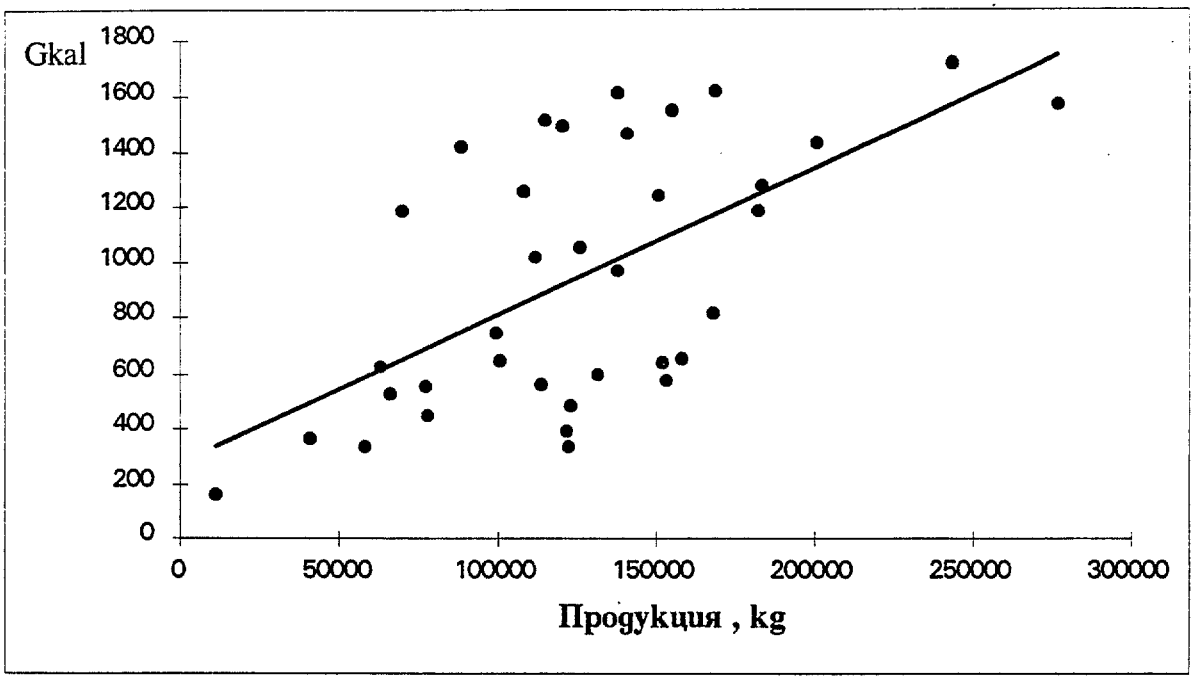
Разкриването на връзката между тези два параметъра с помощта на корелационния и регресионния анализ осигури съществена информация както за факторите обуславящи консумацията, така и за резервите по отношение на намаляването и. Както може да се види от фиг.3 голямото разхвърляне на точките свидетелства за реални потенциални възможности за икономии.

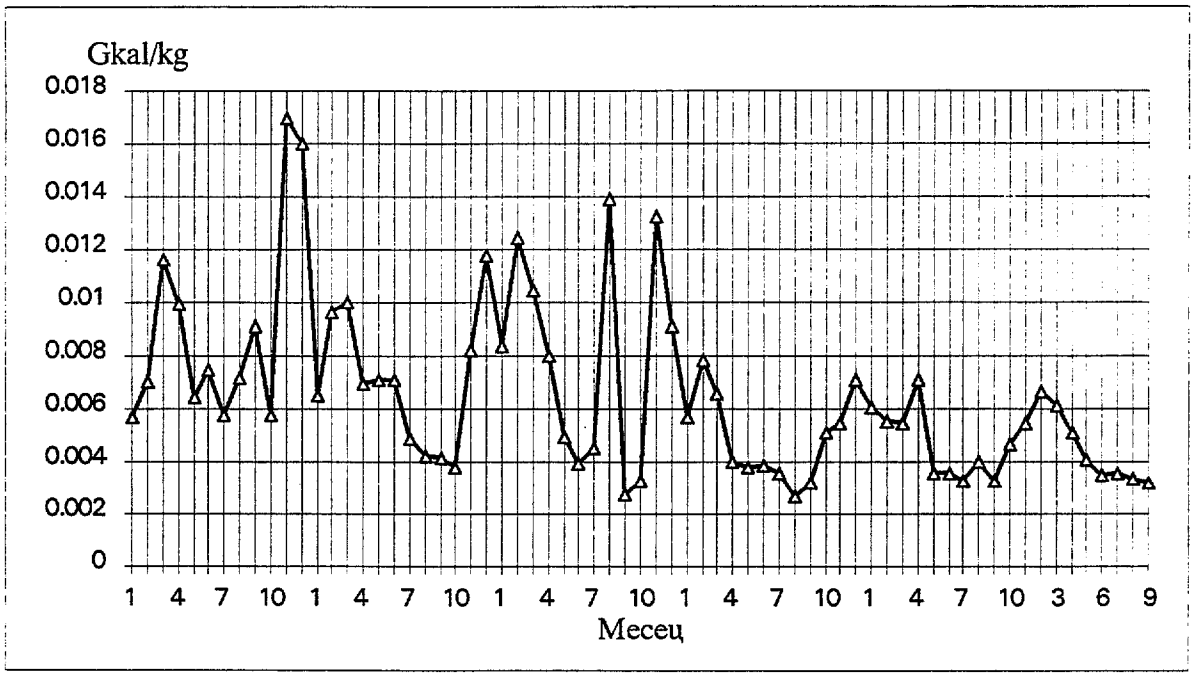


Фиг.3. Корелация между разхода на топлина и произведената продукция за периода Януари 1991 - Декември 1993 год.

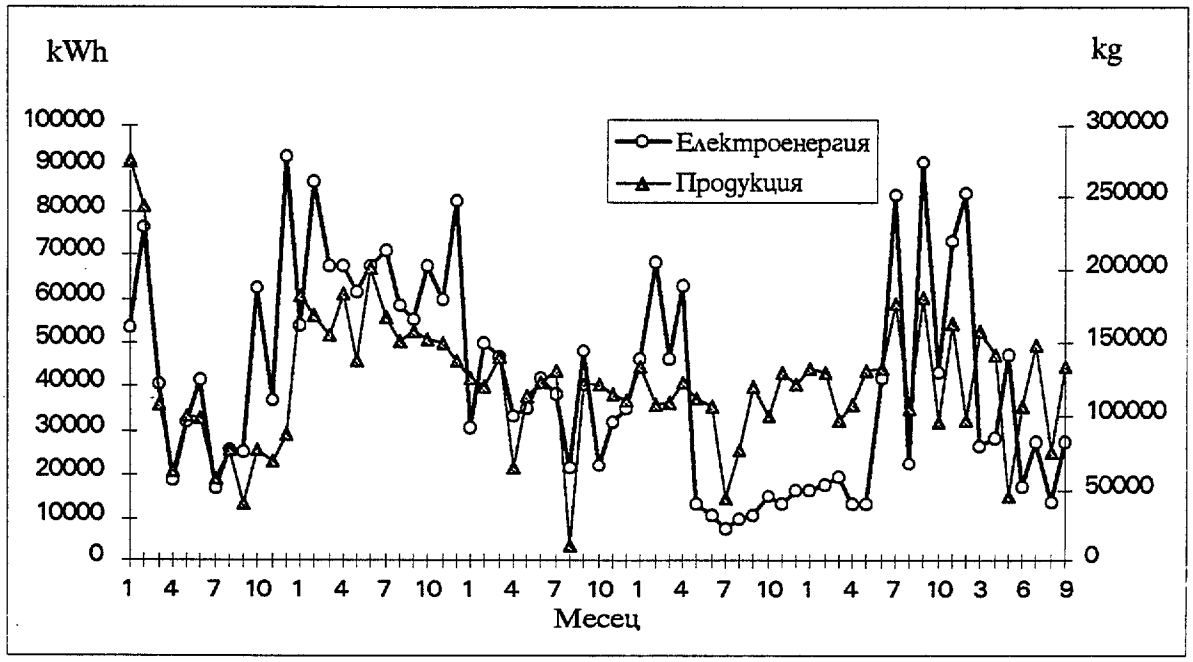
Получаващият се постоянен разход на пара (не зависещ от производството) е около 250-280 Gkal. Той се дължи на сумарния ефект от отоплението, загряването на вода за битови нужди и загубите на топлина (включително пропуски на пара), които нямат връзка с големината на производството.

Тези резултати се потвърдиха и от потърсената оценка на изменението на специфичния разход на пара за обработка на единица продукция , показан на фиг.4.

Анализът на консумацията на електроенергия показа аналогични тенденции. На фиг.5 и 6 са показани изображенията на месечния разход на електроенергия и корелацията и с произведената продукция. Както можеше да се очаква, управлението на този енергоносител с изменението на големината на произведената продукция се оказа по-удачното. Въпреки постоянния разход от около 2000 kWh, "облакът точки" е по-компактен в сравнение с този при парата.



Фиг.4. Изменение на специфичния разход на топлина
през периода Януари 1991 - Септември 1996 год.



Фиг.5. Произведена продукция и консумирана електроенергия
през периода Януари 1991 - Септември 1996 год.

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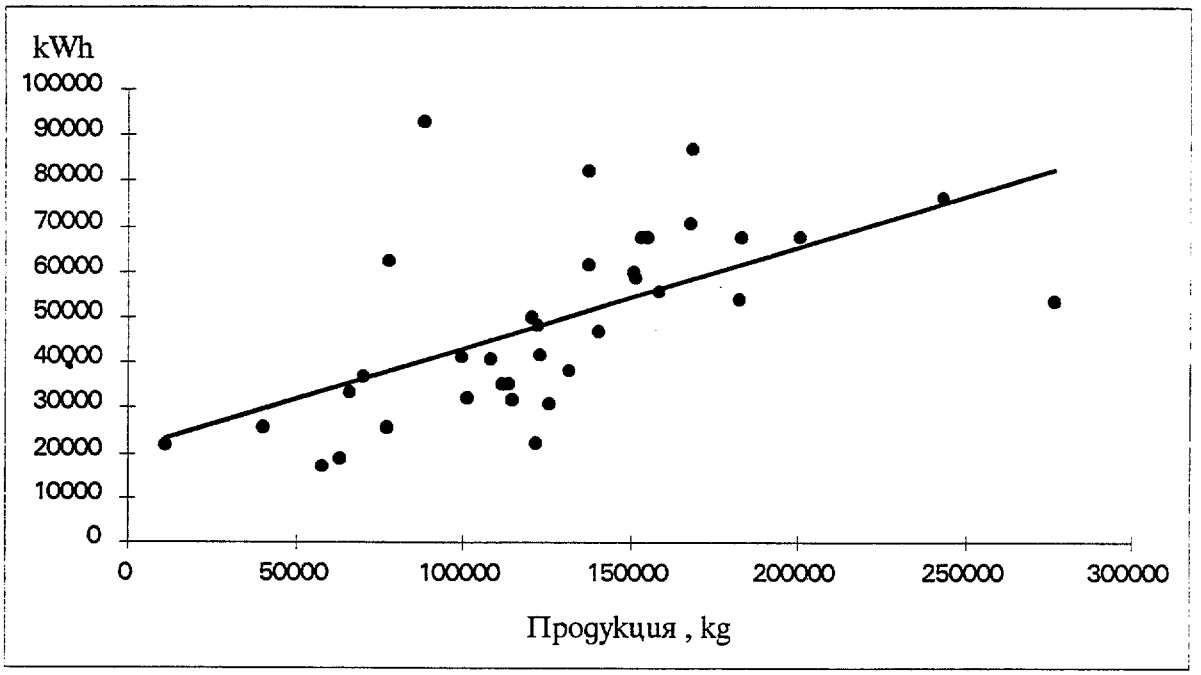


Фиг.6. Корелация между разхода на електроенергия и произведената продукция за периода Януари 1991 - Декември 1993 год.

Въз основа на извършения анализ на енергопотреблението, включително и по видове консуматори, се разработиха, оцениха и предложиха за въвеждане технически решения, които може да се обобщят както следва:

- **А.1- Въвеждане на програма за проверка и подмяна на кондензните гърнета**. Установи се, че 22 кондензни гърнета и 13 парни вентили с ръчно управление не функционират и част от тях са байпасирани. В резултат на това към някои топловъздушните апарати за отопление се подава пара непрекъснато. Програмата предвижда и обучение на техническия персонал за периодична проверка, подръжка и подмяна на арматурата.

- **А.2 - *Топлинно изолиране на тръбната мрежа и бойлерите за топла вода.*** Основните паропроводни и кондензни линии, както и бойлера за гореща вода в основния корпус са неизолирани. Част от тръбната мрежа е положена на открито, която поради прекъснатия режим на подаване на пара от ТЕЦ-Габрово често пъти замръзва. Потенциалните резерви тук са оценени на 450 Gkal/год.

- **А.3 - *Подобряване температурния контрол на сушилния процес.***

  Измерванията показаха, че в края на сушилния процес вълната се прегрява с до 50 °С температурна разлика над необходимото ниво. Това е резултат

от неправилно функциониращата и амортизирана пневматична система за температурен контрол. Процесът позволява подмяната на системата, която и без това не може да бъде възстановена в първоначалния и вид, с по-проста чрез монтиране на парни терморегулиращи вентили с пряко действие.

- **А.4 - *Отстраняване пропуските на въздух.***

Въздухоразпределителната мрежа за необходимия въздух с налягане 0.4-0.8 Мра е недостатъчно уплътнена, поради което, както се установи при анализа, около 25% от произвеждания в компресорната станция сгъстен въздух се губи.

- **В.1 - *Подобряване на измерването на доставената пара.***

Съществуващият топломер за пара беше блендов тип. Използваше се предимно като разходомер за пара, като топлината се определяше чрез пресмятане по параметрите на парата в ТЕЦ. Въпреки подменянето на блендата за зимен и летен режим, силното колебание в консумацията на пара причиняваше грешка по-голяма от 30% в повече от 12 часа на ден. Ето защо се наложи да бъде инсталиран топломер IWK -EWZ350.

- **С.1- *Въвеждане на топлообменна система за оползотворяване топлината на кондензата.***

Съществуващото подгряване на вода до температура 40-50 °С в технологичните линии за пране на вълна се основава на директен принцип. Кондензатът от сушилните агрегати, както и от отоплителните системи (които са парни) се събира в кондензни резервоари с общ обем от 30 m^3 и с температура 98 °С. Поради съществуващите местни условия и даденост, кондензатът се прехвърля в съседно кондензно стопанство и се охлажда чувствително. Тази топлина може да се използва посредством рекуперативен високоефективен топлообменник за осигуряване на предварително подгряване на студената вода.

- **С.2 - *Подмяна на съществуващите бутални компресори за сгъстен въздух с винтов.***

Компресорите за сгъстен въздух консумират около 30% от общата електроенергия във фирмата. Инсталирани са два бутални компресора с водно охлаждане и електрическа мощност 145 и 75 kW. Разходите за подръжката на тези компресори не съответства на потребността от сгъстен въздух. Долната граница на възможните икономии от електроенергия са оценени на 50200 kWh.

- **С.3 - *Реорганизация на процеса пране.***

Необходимостта от тази мярка се определи от факта, че около 25% от вълната се връща за повторно изпиране поради висока начална замърсеност. При съществуващото положение вълната се изсушава два

пъти. Анализирани са възможностите за избягване на сушенето след първото пране и се предложи схема за реорганизация на процеса.

Предложените мерки бяха оценени по следните показатели:

- *срок на откупуване*
- *взаимно изключване*
- *мултипликативност.*

След оценка на предложените мерки и от американските експерти , USAID прие за финансиране и достави основното необходимото оборудване за мерки А.3, С.1 и С.2 :

4 броя ТРВ за пара (3") , тип Е ;

Един пластинчат топлообменник "APV" , модел SR2-MS-12 - вода-вода , мощност 700 kW;

Винтов компресор за въздух Ингерсол-Ранд EP75

Изсушител на въздух Ингерсол-Ранд TM600 (хладилен).

Останалите предложени решения се осъществиха със собствени средства на фирма "РУНО".

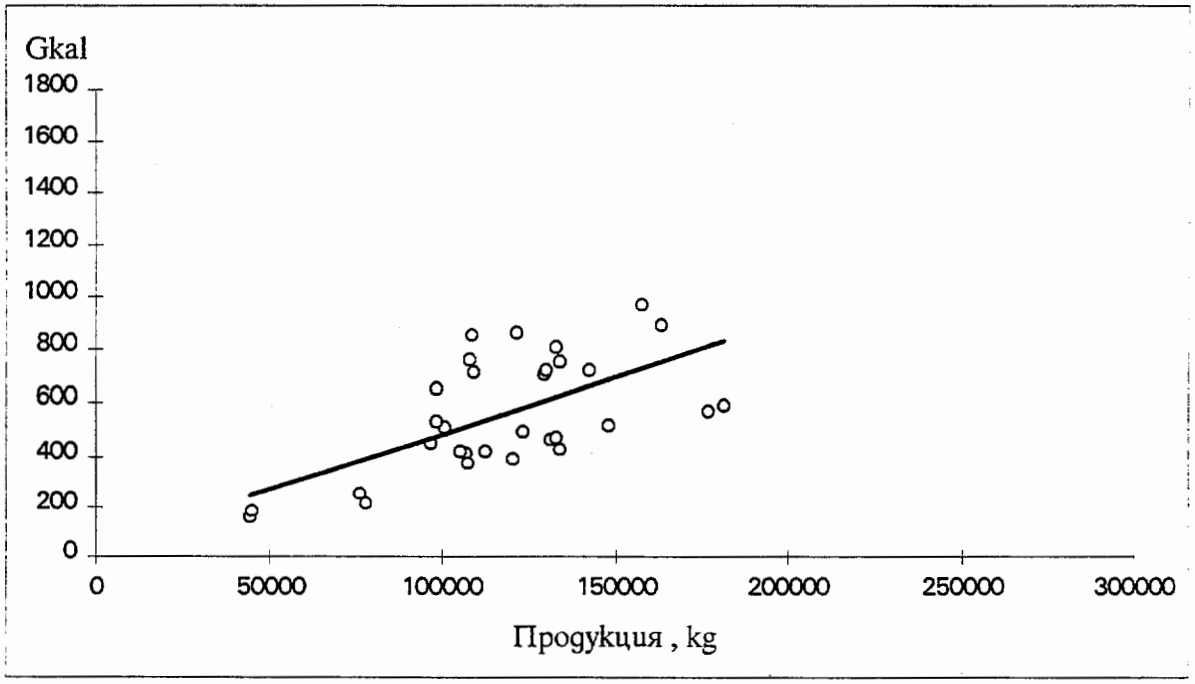
Б. АНАЛИЗ НА КОНСУМАЦИЯТА НА ПАРА ПРЕЗ ПЕРИОДА м.април 1993 - м. септември 1996

От м.април 1993 год. еновременно с извършването на анализа започна и въвеждането на някои от срочните мерки като :

- проверка и подмяна на кондензни гърнета и монтиране на липсващи такива;
- инсталиране на прецизен топломер за пара;
- топлинна изолация на тръбната мрежа и бойлерите за гореща вода ;
- подмяна на недействащата спирателна арматура;
- прецизиране на договорните отношения с доставчика на топлина,

които до края на 1995 год. формираха първата фаза на проекта.

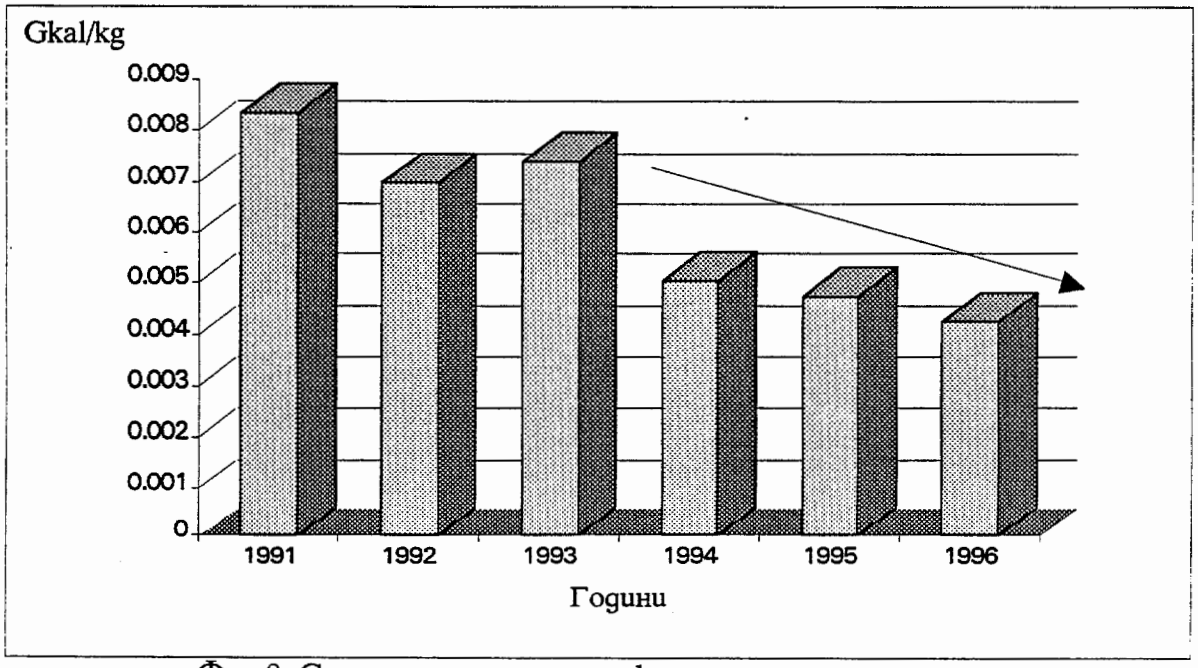
В резултат на подобряване на енергийния мениджмънт се осъществи и промяна в характера на енергопотреблението. Установи се нова основна линия на процеса (фиг.7) със силно стеснен диапазон на разхвърляне на точките. Постоянните разходи на топлина се редуцираха до 50-60 Gkal.



Фиг.7. Корелация между разхода на топлина и произведената продукция за периода Януари 1994 - Септември 1996 год.

Извършеното сравнение на получените резултати до края на 1995 год. показва следното (фиг.8) :

средният специфичен разход на топлина за пране на вълна от 0.006993 Gkal/kg за 1992 год. се редуцира на 0.004738 Gkal/kg за 1995 год., което съставлява 32.25% годишна икономия на енергия.



Фиг.8. Среден годишен специфичен разход на топлина

През втората фаза на проекта се внедриха предложения А.3 и С.2.

На фиг.9 са показани изгледи от монтираните терморегулиращи вентили на сушилните агрегати, а на фиг.10 - изгледи от инсталирания въздушен компресор и охладителя към него. Системата за оползотворяване топлината на кондензата все още не е изпълнена.

Въздушният компресор с изсушителя от момента на пускане в действие до 25.10.1996 год. е работил общо 703 часа, от които 513 часа в натоварен режим. Извършените измервания на режимните параметри на компресора показаха ток при натоварен режим 110 А и при ненатоварен режим 90 А.

За един работен ден при двусменна работа съгласно регистрираните данни е изчислена консумация от 638 kWh. Или в месечен план средно при 21.7 работни дни и двусменна работа се консумира 13844.95 kWh енергия, докато при стария компресор със 75 kW двигател - 26040 kWh, т.е реализира се месечна икономия от 12195 kWh електроенергия.

Ефектът може да се прецени и от директното сравняване на специфичния разход на електроенергия за м.септември 1995 (0.5 kWh/kg) и този за м. септември 1996 год. (0.25 kWh/kg).

Таблица 1

Реш.	Наименование	Год.икономии, Gkal		Печалба	Разходи	Възвр.
No		проектни	реални	USD	USD	год
A.1	Въвеждане на програма за проверка и подмяна на кондензни гърнета	870	520	10660	927	0.09
A.2	Полагане на топлинна изолация на тръбната мрежа и бойлерите	450	408	8370	2830	0.34
A.3	Подобряване контрола и управлението на сушилния процес	200	156	3200	4970	1.55
B.1	Инсталиране на прецизен топломер за пара	820	1300	26600	9812	0.37
C.3	Подмяна на буталния въздушен компресор с винтов и изсушител	50200 kWh	134145 kWh	13048.7	36101	2.77
			ВСИЧКО	61878.7	54640	0.88

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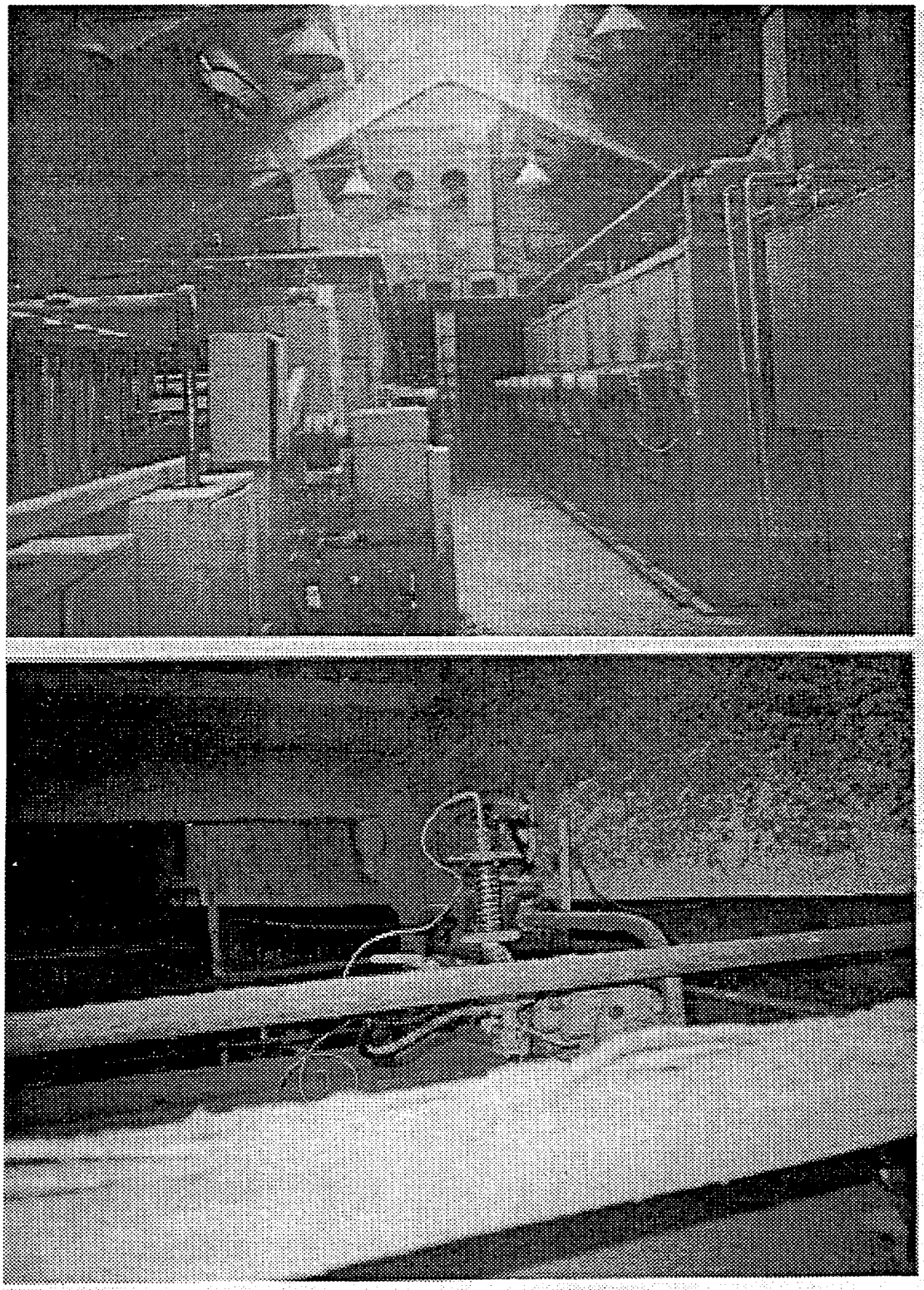

Фиг.9. Изгледи от сушилните агрегати и монтираните терморегулиращи вентили с пряко действие

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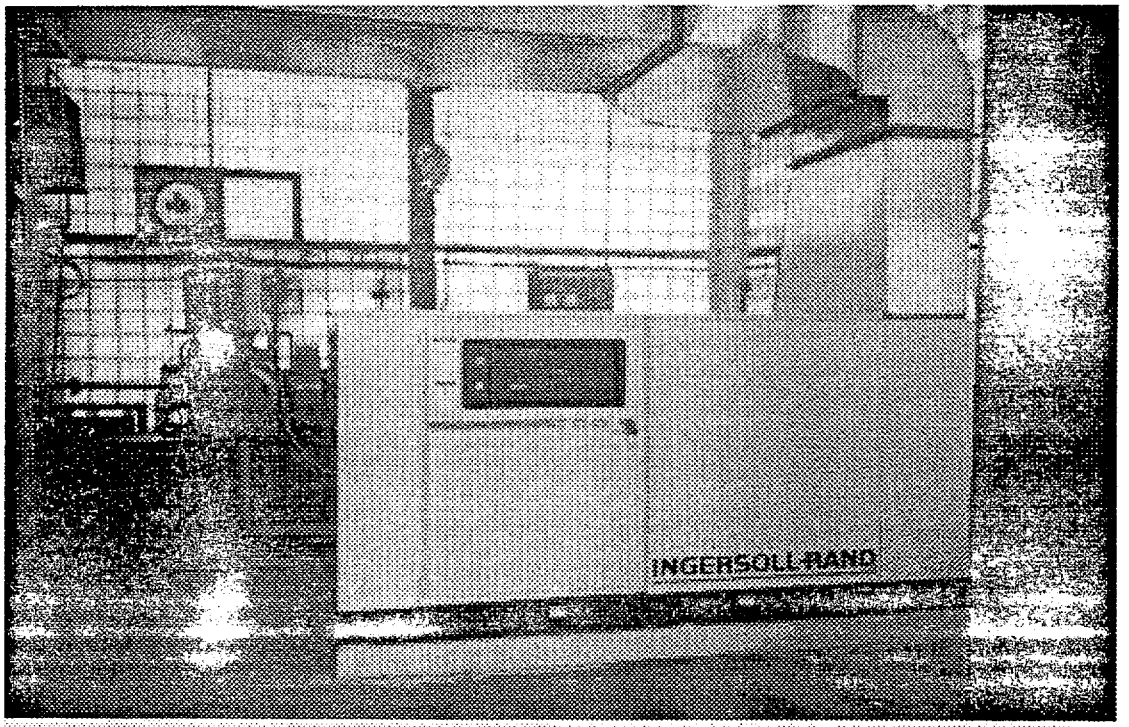

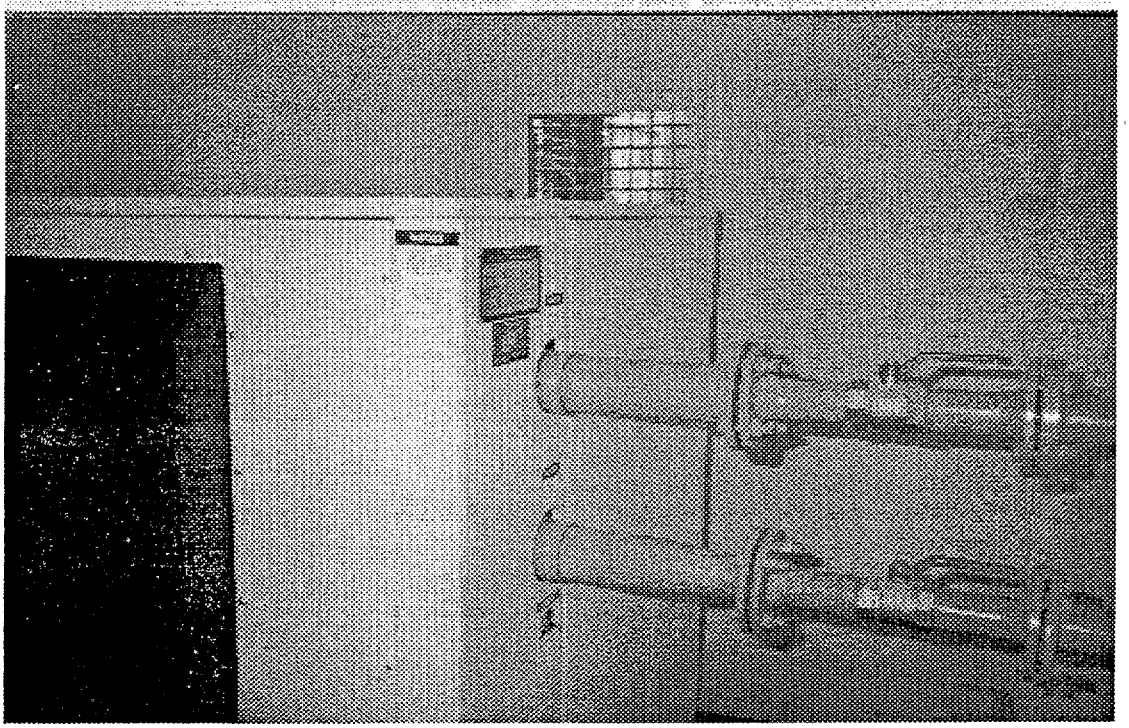

Фиг.10. Изгледи от инсталирания винтов компресор и изсушителя

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ЗАКЛЮЧЕНИЕ

За основен при оценка на приетите за внедряване технически решения е използван показателят "срок на откупуване" по доларовата равностойност на капиталовложенията за оборудване, проектиране, монтаж и експлоатация .

В таблица 1 са представени данните за прогнозираната икономия (получена на на етапа генериране на решението), реално установената след въвеждане на техническото решение, както и срокът на откупуване.

За компресора не са включени икономиите от масло и подръжка в сравнение със стария бутален компресор. Това ще стане след едногодишна експлоатация на компресора.

Резултатите показват, че въведените мерки имат общ среден срок на откупуване по-малък от една година.

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RESULTS OF THE ENERGY EFFICIENCY IMPROVEMENT PROGRAM FOR RUNO -G Ltd. - GABROVO

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Ts. Boevska - RUNO-G Ltd. , Gabrovo
Iv. Iliev - Technical University of Gabrovo

SUMMARY

This report presents the main results of the Industrial Energy Efficiency Project for the Primary Wool Processing Plant "RUNO-G" in Gabrovo, Bulgaria from the USAID ENERGY EFFICIENCY MARKETING DEVELOPMENT PROGRAM.

The purpose of this Project, started in 1993, was to identify, evaluate and recommend energy conservation opportunities as well as to provide financial support for implementation of energy efficient equipment and thus to promote improved energy efficiency in the industrial sector of Bulgaria. The operation of this program was co-ordinated and technical assisted by the professional staff of the Hagler Bailly Consulting Inc. In addition of the team USAID and Hagler Bailly Consulting Inc. provided a set of portable instruments to conduct on site measurements.

To identify the areas where energy savings can be made, the team conducted both preliminary and detailed energy audits.

The plant operates two shifts five days per week, the last 5 years near 60% of its full capacity. Before the start of the program the annual production was approximately 1 600 000 kg wool products while the energy consumption was about 700 000 kWh of electricity and between 12000 of steam.

The plant is supplied with electricity by the National Energy Company and with steam by the Thermal Power Station of Gabrovo.

The low overall energy efficiency of the plant found was due to the complexity of the following major factors: decreasing the production during the last 5 years, wearing out of energy transfer, control and measurement equipment, lack of a consistent energy management program. There were found several energy technological systems with significant potential for increasing the energy efficiency as the steam distribution and consumption system; the steam measuring system; the compressed air system.

The team proposed several energy conservation measures as: Institution of steam trap management program, Improvement insulation of steam pipes and water heating tanks, Temperature control improvement of the wool drying process, Implementation of new steam measuring system, Implementation of condensate heat utilising system, Replacement of the reciprocated water-cooled air compressors, Reorganising the wool scouring process in order to avoid drying when preliminary scouring is necessary, etc.

After evaluation of the measures proposed some of them were selected for implementation. Part of the equipment required was provided by USAID : Four 2" Temperature Regulating Valves for Steam with Spare Pilots and Pilot Repair Kit, One APV Water-Water Plate Heat Exchanger Model SR2-MS-12, One Ingersoll-Rand EP75 Air-Cooled Rotary Screw Air Compressor and One Ingersoll-Rand TM600 Refrigerated Air Dryer.

The monitoring and evaluation procedure performed in 1996 showed that after ECM's implementation annual energy savings of 32.2% of steam and 20% of electricity were obtained which led to an overall average payback period of the measures implemented less than 1 year.

РЕЗУЛТАТИ ОТ ПРОЕКТА ЗА ЕНЕРГИЙНА ЕФЕКТИВНОСТ

СИЛИКАТКЕРАМ АД

Пловдив, България

Изготвил: инж. Борис Петков, ИВЕЛ ООД, Пловдив

Със съдействието на: инж. Ангел Койчев, Силикаткерам АД

София, ноември 1996

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I. УВОД

В този доклад се представят технически и организационни решения, спомагащи за подобряване енергийната ефективност на предприятието за производство на тухли "Силикаткерам" АД, Пловдив, България. За практическата реализацията на тези решения Американската агенция за международно развитиета предостави безвъзмезно част от необходимото оборудване. Предложените решения са част от идентифицираните възможности за подобряване на енергийната ефективност в „Силикаткерам" АД, описани в Енергетичния анализ, изготвен от екип български и американски консултанти, работещи по Проекта за енергийна ефективност в България, спонсориран от Американската агенция за международно развитие, в периода от 30 октомври 1993 до 30 януари 1994 година.

II. ОБЕКТ НА ПРОУЧВАНЕТО

Предприятието „Силикаткерам" АД е типичен представител на средно голямо предприятие за производство на строителни материали, със собствено генериране на пара, външно електрозахранване и технологични системи подобни на тези, които съществуват в повечето предприятия от бранша в България.

Силикаткерам АД е единственият производител на керамични и силикатни тухли в Пловдивския район. Предприятието е пр

оектирано да произвежда около 30,000,000 керамични условни тухли и 40,000,000 силикатни тухли за година; в годините на прехода предприятието работи приблизително респективно с 60% и 25% капацитет. Обемът на продукцията е сезонно зависим и е по-голям през летните месеци и по-малък през зимните.

Годишните енергийни разходи за 1993 са показани в таблица 1.

Таблица 1 Енергийни разходи на Силикаткерам АД (година 1993)

Енергопотребление	Керамични тухли	Силикатни тухли	Общо
Електричество	1,108,508 kWh	802,712.4 kWh	1,911,220 kWh
Тежко котелно гориво	2,018 tonnes	1,200 tonnes	3,218 tonnes
Вода			42,358 m^3

III. ОПИСАНИЕ И ОЦЕНКА НА МЕРКИТЕ ЗА ИКОНОМИЯ, ЗА ЧИЯТО РЕАЛИЗАЦИЯ БЕШЕ ПРЕДОСТАВЕНО БЕЗВЪЗМЕЗНО ОБОРУДВАНЕ ОТ USAID

3.1. ВЪЗСТАНОВЯВАНЕ И МОНТАЖ НА ИЗМЕРВАТЕЛНИ УРЕДИ ЗА ЕНЕРГИЕН МОНИТОРИНГ

3.1.1. ТЕХНОЛОГИЧНА ОБЛАСТ

Енергиен мениджмънт на предприятието

3.1.2. ОПИСАНИЕ

Действията в посока на подобряване на енергийния мениджмънт са важна категория от потенциалните икономии в една бързо променяща се икономическа среда. Но за да се постигнат тези икономии и да се взимат оптимални решения, е необходимо в Силикаткерам АД да има надежна информационна основа. Консултантският екип забеляза, че не съществува система за енергиен мениджмънт на енергийните нужди. Ръководството на Силикаткерам АД не би могло точно да определи във всеки един момент къде и какви енергийни разходи има и затова не би могло да прилага енергиен мениджмънт.

3.1.3. ПОЛЗИ

На базата на предишен опит консултантският екип оценява, че подобрената система за енергиен мениджмънт заедно с специфичните управленски действия по отношение контрола на технологичната ефективност може да доведе до икономии от порядъка на 6 до 10%.

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Допълнителни ползи, като например намален разход на суровини, намалено производство на некачествени тухли, подобрен режим на работа на оборудването са вероятни да се постигнат с подобряване на системата за контрол, извършван от ръководството на предприятието.

3.1.4. НЕОБХОДИМО ОБОРУДВАНЕ ЗА ПРИЛАГАНЕ НА ПРЕПОРЪКАТА

Списък на съоръженията	количество
разходомер за пара	2
разходомер за ТКГ	2
водомер	2
компютърна система, софтуеър и обучение	1
уред за измерване и регистриране на електрически величини	1

3.1.5. СРОК НА ОТКУПУВАНЕ

Оценен на около 12 месеца

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3.2. ПОДОБРЯВАНЕ ЕФЕКТИВНОСТТА НА МАЗУТНИТЕ ГОРЕЛКИ ЗА ДВАТА КОТЕЛА ТИП "ЕКОНОМИК"

3.2.1. ТЕХНОЛОГИЧНА ЗОНА

Котелна централа

3.2.2. ТЕЗА НА ПРЕПОРЪКАТА

Да се сменят двете съществуващи ниско ефективни полски горелки, с нови съвременни автоматизирани високоефективни горелки.

3.2.3. ОПИСАНИЕ

Отношението гориво въздух се настройва визуално от огняра по цвета на пламъка; не се измерва температурата на изходящите газове. Общото КПД на котлите е ниско. Консултанският екип забеляза, че огнярите рядко променят режима на работа на котела при промяна на товара.

3.2.4. ПОЛЗИ

Икономиите са изчислени: 90 t ТКГ; Намаляват се вредните емисии.

3.2.5. НЕОБХОДИМО ОБОРУДВАНЕ ЗА ПРИЛАГАНЕ НА ПРЕПОРЪКАТА

Списък на съоръженията	количество
Горелка за ТКГ	2 бр

3.2.6. СРОК НА ОТКУПУВАНЕ

Оценен на около година.

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3.3. МЕРКИ ЗА ПОДОБРЯВАНЕ НА КАЧЕСТВОТО, ВОДЕЩИ ДО НАМАЛЯВАНЕ НА ЕНЕРГОРАЗХОДИТЕ

3.3.1. ТЕХНОЛОГИЧНА ЗОНА

СИЛИКАТКЕРАМ АД, площадка Пловдив

3.3.2. ТЕЗА НА ПРЕПОРЪКАТА

Да се води подробен отчет на произведената продукция отговаряща на стандартите за качество. Да се ремонтира системата за управление на пещта, като се включи следене на температурното поле в пещта. Да се разработи работоспособна система за управление на сушилните камери, включваща следене на температура, влажност и време на престояване в сушилните камери. Да се контролира качеството на суровините и съдържанието на влага в тях..

3.3.3. ОПИСАНИЕ

Тухлите не отговарящи на съответните български стандарти за качество не могат да бъдат продавани за пълната им цена и при много други условия изобщо не могат да се продават. Нестандартната продукция води и до значителни енергийни загуби, тъй като 50 до 60 % от производствените разходи се падат на енергията. Трябва да се внедри система за контрол на качеството и ежедневен отчет на вида и обема произведена продукция: първо качество, второ качество, бракувана продукция, която да е част от цялостната система за управление. Такава система също така трябва да идентифицира и отстранява причините, довели до лошо качество.

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3.3.4. ПОЛЗИ

Икономиите се изчисляват на: 225.2 t/год. ТКГ

3.3.5. НЕОБХОДИМО ОБОРУДВАНЕ ЗА ПРИЛАГАНЕ НА ПРЕПОРЪКАТА

Списък на съоръженията	количество
Температурни сензори	14
Сензори за влажност на въздух	9
Микропроцесорен контролер	3
Изпълнителни механизми	10
Компютърен блок и софтуеър	1
Преносим уред за измерване на температура и влажност на въздух	1
Влогомер за насипни материали	1

3.3.6. СРОК НА ОТКУПУВАНЕ

Оценен на около година.

IV. ОБОРУДВАНЕ ПРЕДОСТАВЕНО ОТ АМЕРИКАНСКАТА АГЕНЦИЯ ЗА МЕЖДУНАРОДНО РАЗВИТИЕ:

1. Мазутомери
2. Паромер
3. Сензори за влажност на въздух
4. Преносим уред за измерване на температура и влажност на въздух
5. Уред за измерване, регистриране и управление на електрически величини (A, V, W, cosϕ , Hz, хармоници) и допълнителни устройства
6. Компютър с принтер
7. Високоефективна мазутна горелка
8. Влагомер за насипни материали

Общата стойност на предоставеното оборудване възлиза на над четиридесет хиляди щатски долара.

Използването на мазутомера, паромера и съществуващите водомери осигурява възможност да се определя КПД на работещите котли по правия баланс, с което се постига контрол върху спазването на прецизен процес на горене и минимизиране на продувките.

Сензорите за влажност и преносимия уред за измерване на влажност бяха интегрирани в компютърна система за управление на процеса сушене. Въвеждането на системата доведе до рязко намаляване времето на сушене, което от своя страна позволи снижаване с 30 % на топло- и електро-енергийните разходи.

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Използването на втория мазутомера дава възможност за следене и минимизиране разходите на мазут за пещта при различен темп на вкарване на вагоните и променлива температура на околната среда. Икономията на мазут при фиксирано натоварване на пещта (вагон на час) и различни околни температури е около 20 %.

С уред за измерване на електрически величини се извършва регистриране товаровите графици на различни групи консуматори и следене и управление на cosφ в реално време. Набраната информация спомага за вземане на управленски решения за разместване на работното време на отделни групи консуматори с цел оптимизиране на капацитетите на кондензаторните батерии и постигане на изискуемия cosφ за дневна и нощна тарифа и за изключване на групи консуматори във върховите часове. Регистрира се прецизността на работа на cosφ регулаторите. В резултат се намаляват санкциите плащани на НЕК за непрецизно управление на товарите в предприятието.

С новата мазутна горелка се достига максималното паропроизводство на котела - 4.5 тона на час пара. Намаляването на излишъка на въздух довежда до подобряване общото КПД на котела. Поддържането на оптимално съотношение гориво-въздух при различни режими на работа на котела води до поддържане на максимално възможен КПД, което е особено важно при променливи товари.

С влагомера за насипни материали се постига контрол на влагата на варопясъчната смес за производство на варосиликатни тухли. Ефектът от внедряване на уреда е по отношение подобряване якостта на изделията в процеса формоване, без да се увеличават топлоенергетичните разходи за процеса автоклавиране. Снижаване на средномесечния брой бракувани изделия с около 3 %.

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V. ЗАКЛЮЧЕНИЕ

В резултат от прилагане на част от мерките за повишаване енергийната ефективност, набелязани в Енергетичния анализ са снижени натуралните разходи на мазут за 1000 броя условни тухли (керамични и варосиликатни) от 100 на 85 килограма ТКГ или около 15 %, което прави около 324 тона мазут икономии за 1995 година. Този резултат е получен на база анализ на финансово-счетоводни документи за 1994 спрямо 1995 година.

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РЕЗУЛТАТИ ОТ ПРОЕКТА ЗА ЕНЕРГИЙНА ЕФЕКТИВНОСТ В КМХ "БЕЛОВО" АД - гр. Белово

Автори: инж. Г. Рампов - СЕМ
д-р инж. Н. Станков - СЕМ
инж. П. Блажев

Реализираният проект в КМХ "Белово" - АД е в рамките на програмата за повишаване на енергийната ефективност на промишлените предприятия в България, осъществена от Американската агенция за международно развитие. Изпълнението на проекта е активно подпомогнато от консултантската фирма " Hagler-Bailly" - САЩ и от инженерно-техническия персонал на КМХ "Белово". Осъществен е на два етапа, като в етап I е направен енергиен преглед на предприятието и се осъществени енергоспестяващи мерки на обща стойност 15661 щ. дол., а в етап II - като продължение на етап I са осъществени енергоспестяващи мероприятия на обща стойност 52500 щ. дол. Сумите са изцяло финансирани от Американската агенция за международно развитие.

КМХ "Белово" - АД е предприятие за производство на малограмажна хартия, характеризиращо се със значително енергопотребление на единица продукция. Характеристиките на енергопотребление и на общата продукция по години за периода от 1990 до 1995 г. е представено в Таблица 1. При горивопотреблението следва да се има предвид, че до 1994 г. включително предприятието е ползвало гориво мазут, а от 1995 г. е преминало на гориво природен газ.

Таблица 1

	1990	1991	1992	1993	1994	1995
Производство т хартия/год	35107	15534	22652	23118	23118	23110
Мазут т/год	20040	14440	17900	18000	16329	1900
Природен газ *10 нм^3/год	-	-	-	-	-	20066
Ел.енергия МВч/год	65013	41155	49326	46950	51110	51474
Спец. ел.производство МВч/т	1,85	2,65	2,29	2,03	2,21	2,23
Спец.топлопроизвод-ство Гкал/т	5,42	8,83	7,51	7,40	6,15	7,84

Извършеният енергиен преглед на топлинното и спомагателно стопанство откри значителни възможности за икономия на енергия. По-долу са изброени препоръчаните основни мерки за икономия на енергия в резултат на извършения технико-икономически анализ.

Котелен цех:

* Изграждане на нова система за оползотворяване на отпадната топлина от постоянните продувки на котли ПК35, тъй като старата отдавна не функционира;
* Липсва система за поддържане на ниво в общите кондензни резервоари;
* Замяна на старите неефективни горелки с ръчно управление на съществуващите 3 броя котли КМ12;
* Реконструкция или подмяна на съществуващите РОУ 39/6 и РОУ 39/13, които не са в състояние да поддържат оптималните параметри на технологичната пара в резултат, на което се явява значително количество брак при производството на хартия;

Компресорен цех:

* Констатирани са значителни преразходи на масло, охлаждаща вода и ел. енергия при работа на съществуващите 6 броя бутални компресори с паропроизводителност 6x20 $м^3$/мин. Препоръчана мярка - подмяна на старите компресори с нови;
* Ефективно отделяне на водо-маслената емулсия пред потребителите на сгъстен въздух, което да доведе до значителна икономия на сгъстен въздух, в това число монтиране на въздушни кондензни гърнета, автоматична система за дренаж на ресиверите и др.;
* Ремонтна дейност по тръбопроводната система и арматура с цел отстраняване на пропуските.

Технология на хартиеното производство:

* Машина Белойт - подгряване на техническа вода вместо с директна пара от разширителя на цилиндъра, с вторична пара от атмосферен кондензен резервоар;
* Машина Белойт и и Фойт N2 - намаляване до технологичния минимум на изхвърляната пара от сушилния цилиндър (разширителя на кондензат от него);
* Премахване на неконтролируемото изтичане на пара от специализираната арматура и тръбопроводи;
* Основна реконструкция на регенеративната система на Фойт N1, която е прогнила и е байпасирана;
* Възстановяване на рекуперативните топлообменници за използване на отпадната топлина от всички технологични машини.

Парово и кондензно стопанство:

* Изграждане на площадкови надземни кондензопроводи;

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* Използване на отпадна топлина от компресорна и главна абонатна станция за предварително каскадно подгряване на подпитъчна вода от ХВО;
* Реконструкция на кондензното стопанство на I цех с цел връщане на кондензата към котелен цех;
* Подгряване на водата за битови и технологични нужди чрез отпадна топлина от технологиите.

Изграждане на информационна система за анализ на текущите енергийни потоци:

* Измерване на количеството пара от парокотелната;
* Разходомер за добавъчна вода от ХВО;
* Изграждане на оповестителна информационна система.

От проведените изпитания, анализиране на печалбите от въвеждане на горепосочените мероприятия спрямо годишните разходи на електро и топлоенергия, са оценени в проценти възможностите за обща икономия на енергия както следва:

- за топлинна консумация - 28,7%;
- за ел.консумация - 7,7%
- обща икономия на енергия - 27,8%.

От така предложените мерки, след взаимно съгласуване с ръководството на комбината и консултантската фирма "Hagler-Bailly", бяха одобрени и финансирани на два етапа от Американската агенция за международно развитие, следните мерки за икономия на енергия:

ЕТАП I

Мерки, касаещи отчетността на енергийните разходи:

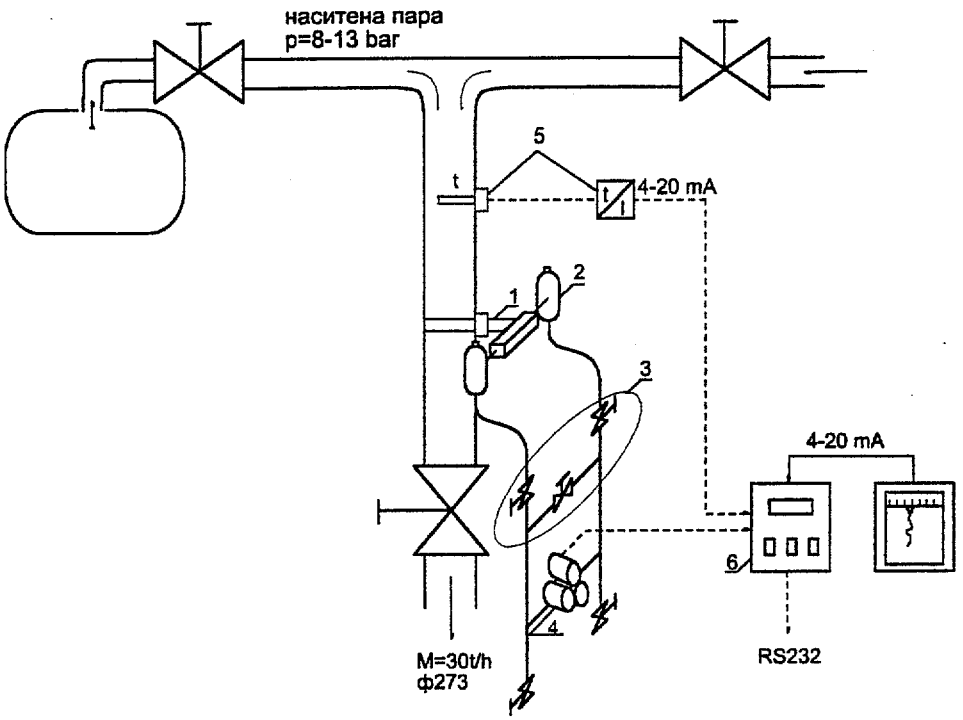
* Паромер за парокотелката (3 броя котли КМ12);

Схемата на връзване на паромера е показана фиг.1.

До въвеждането му в експлоатация, разхода на пара се измерваше само в котелен цех, където са разположени 2 бр. котли ПК35, с производителност 2х35 т/ч. Парата, получавана от парокотелката, в която са монтирани 3 бр. котли КМ12 не се измерваше. Целта на мярката се свежда до:

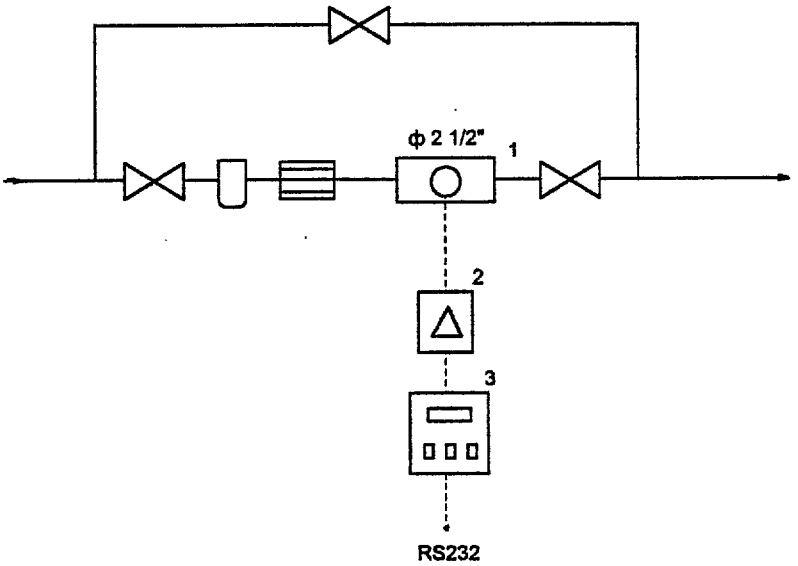
- мерене на парата, произведена в пламъчно-тръбните котли;
- възможност за изготвяне на топлсинния баланс на предприятието;
- оценка на печалбата от всяка мярка в парокотелното, касаеща енергийната ефективност;
- тази мярка допълва предвиденото от ръководството на комбината изграждане на мониторингова система за следене на енергийните разходи.

Въведен в експлоатация на 1 март 1996 г.



фиг.1

* Разходомер за добавъчната вода от ХВО;



фиг.2

Схемата на присъединяването на разходомера е показана на фиг. 2.

Точното оценяване на количествата добавъчна вода от ХВО, а оттам и на загубите на кондензат в пароконденсното стопанство е невъзможно без наличието на такъв разходомер. Това се отнася и за общия топлинен баланс на предприятието. За целта се наложи лека реконструкция на тръбната система за захранване с добавъчна вода на котелен цех.

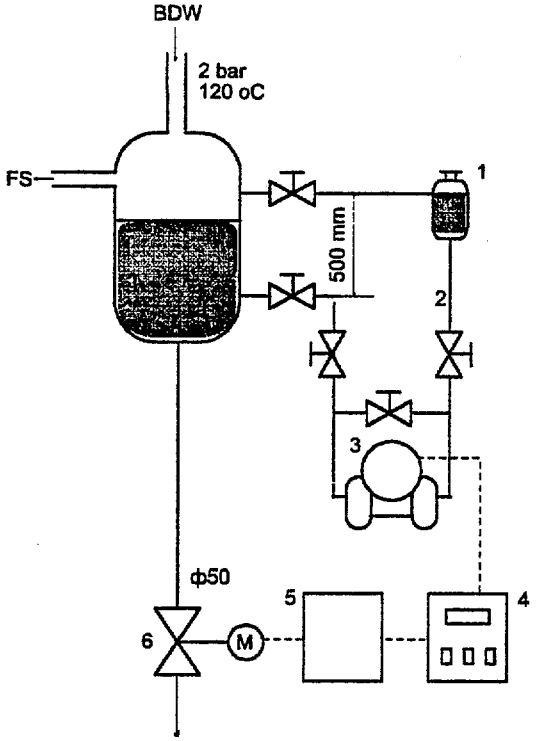
Заедно с меренето на парните потоци тази мярка дава възможност за извършване по всяко време на цялостен топлинен баланс на пароконденсната система в предприятието.

Въведен в експлоатация на 1 април 1996 г.

<u>Технологични мерки:</u>

* Ниворегулиране на експандера на постоянната продувка на котел ПК35 - кот. N1;

Схемата на свързване на ниворегулатора към експандера на продувката е посочен на фиг. 3.



фиг.3

В оригиналната схема за възстановяване на загубите от постоянни продувки е предвиден експандер за оползотворяване на вторично изпарената пара и охладител на продухваната вода постъпила директно в канала. При настоящите условия процентът на продухваната вода е около 4%. Предвижда се монтирането на ниворегулатор на експандера и нов охладител. Очаква се печалба от около 1,5% от общата топлинна производителност на котела.

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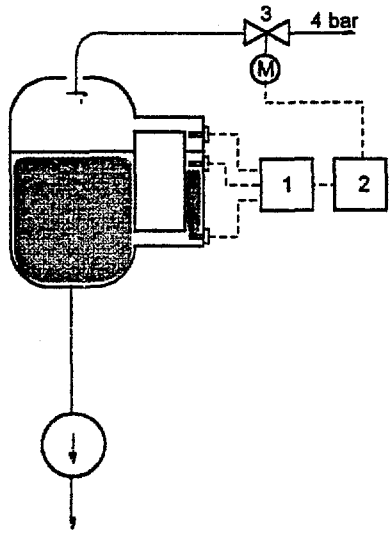
В момента е конструиран и ще се въведе в експлоатация нов деаератор, заедно с принадлежащото оборудване за утилизация на продухваната вода, където ще се монтира закупения вече ниворегулатор.

Очакван пусков срок 31 януари 1997 г.

* Ниворегулиране на общите кондензни резервоари към котелен цех;



фиг.4

Схемата на подвързване е показана на фиг. 4.

Кондензните резервоари захранват котлите и съхраняват връщания кондензат и добавъчната вода от ХВО. Няма ниворегулиране и резервоарите преливат.

Инсталирането на ниворегулатора задейства регулиращия вентил на постъпващата добавъчна вода от ХВО. Целият върнат кондензат може да бъде използван и част от водата от ХВО да се спести. Системата индиректно подпомага цех ХВО, както и надеждната работа на деаератора. Създават се условия за точност при отчитане на масовите топлинни потоци.

Инсталиран на 1 април 1996 г.

* Въздушни кондензни гърнета

Схемата на подвързване на кондензните гърнета е показана на фиг. 5.

Монтирани са 5 броя въздушни кондензни гърнета към ресиверите в компресорното стопанство. Целта е да се демонстрира ефективния начин на дрениране на водо-маслената суспензия и допълнително да се внедрят въздушни гърнета по целия въздушен тракт с оглед да се намалят до минимум пропуските на въздуха при дренажа.

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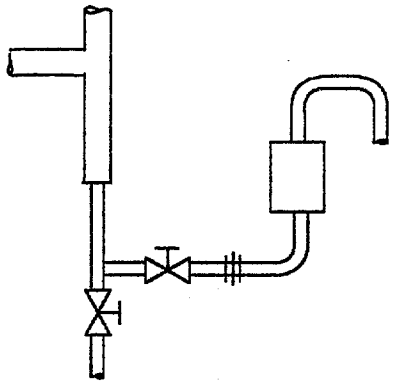
ЕТАП II

- Подобряване на енергийната ефективност на системата за сгъстен въздух;



фиг.5

По време на енергийния одит в компресорното съществуваха 6 стари бутални компресора, работещи със следните експлоатационни характеристики:

- производителност на 1 компресор - 20 м^3/мин; p=7 бар;
- мощност на двигателя - 145 кВт;
- годишна консумация на ел. енергия в компресорното - 6090 Мвтч./г;
- месечна консумация на смазочно масло за компресор - 320 л/мес;
- консумация на охлаждаща вода (компресорното работи по отворен цикъл) за компресор - 10 т/ч.

Тези данни показват, че съществуващите бутални компресори работят изключително неефективно и водят до значителен преразход на ел. енергия, охлаждаща вода и масло. При това в сгъстения въздух попада значително количество водо-маслена суспензия.

Монтирането на нов, съвременен винтов компресор Ingersoll - Rand - 20 м^3/мин. ще доведе до значителна икономия на ел. енергия, премахване необходимостта от охлаждаща вода и чувствително намаляване на разхода на масло. Като страничен ефект се получава значително количество топъл въздух, удобен за вторично използване. Към винтовия компресор е монтиран хладилен изсушител, способстващ за подобряване качеството на въздуха.

Въведено в експлоатация 30.10.1996

- Оптимизиране на постоянните продувки на котли ПК35.

Постоянните продукти на котли ПК35 се определят по предписание на Химическа лаборатория въз основа на периодични анализи на котловата вода.

Не съществува система за автоматично измерване на солесъдържанието и управление количеството на постоянните продувки. Разхода на постоянните продувки е неоправдано висок, като поддържаното ниво за общо солесъдържание на котловата вода е между 150 и 350 mg.екв/л. а препоръчваното от завода производител - 1500 mg.екв/л. Последното може да

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се постигне с неколкократно намаляване разхода на котлова вода за постоянни продувки, с което ще се намали и загубата на топлина, както и разхода на химически очистена добавъчна вода.

За тази цел е доставена Автоматична система за контрол на солесъдържанието и управление на постоянните продувки по сигнал от солесъдържание, от фирмата Fischer-Rosemount, с която ще се поддържа постоянно предписаното от производителя ниво на солесъдържание.

Поради продължаващата реконструкция на деаератора, системата все още не е въведена в експлоатация.

Предвижда се това да стане до 31.1.1997г.

Оценка на резултатите от мерките за енергийна ефективност в КМХ „Белово" АД

ЕТАП I

- Паромер за пламъчно тръбните котли, състоящ се от:
  - сонда за разход пара тип „Verabar"
  - диференциален манометър от „Rosemount"
  - температурен сензор ПГ100 преобразувател Комеко
  - изчислителен блок - Masstrol.
  - обща цена $3081

Икономически анализ:

Цена на оборудването	Транспорт у нас	Проектиране	Други материали	Монтаж	Наладка	Допълн. Разходи за поддръжка	Общи разходи
$3081	$20	$350	$200	$300	$200	$450	$4600

Мярката има стойност за изграждане на мониторингова система на топлинното стопанство, с оглед да се оценява ефективната му работа. В тази връзка пряко отчитане на икономия на енергия и срок за възвръщане на инвестициите е невъзможно.

- Разходомер за добавъчна вода от ХВО, включващ:
  - турбинен разходомер 2 ½" от Hoffer
  - предусилвател/формирователи - Kessler-Ellis
  - изчислителен блок Minitrol от Kessler-Ellis

Икономически анализ:

Цена на оборудването	Транспорт у нас	Проектиране	Други материали	Монтаж	Наладка	Допълн. Разходи за поддръжка	Общи разходи
$1325	$20	$300	$550	$600	$200	$300	$3295

Съоръжението служи за отчитане разход на ХОВ и за съставяне на енергийния баланс на паро-кондензното стопанство, като получените икономии са в неявен вид и не могат да бъдат оценени.

- Ниво-регулираща система за експандера на постоянните продувки на котел ПК35, състояща се от:
  - диференциален манометър от Rosemount
  - програмен регулатор от Комеко
  - електрически изпълнителен механизъм от Johnson Controls.

Икономически анализ:

Цена на оборудването	Транспорт у нас	Проектиране	Други материали	Монтаж	Наладка	Допълн. Разходи за поддръжка	Общи разходи
$1700	$20	$1000	$2000			$200	$5100

Икономии	% Спестено	Натурално спестено	Парични икономии при български цени
Гориво	1.5	387.10^3 m^3 прир.газ/г.	$36280
ХОВ	1	2800 т/г.	$700
Обща икономия			$36980
Срок на изплащане, години			0,14

- Ниво-регулираща система на общите кондензни резервоари към котелен цех, състояща се от:
  - ниворегулатор от Warrick Controls
  - осезатели за ниво от Warrick Controls

Икономически резултати:

Цена на оборудването	Транспорт у нас	Проектиране	Други материали	Монтаж	Наладка	Допълн. Разходи за поддръжка	Общи разходи
$274	$20	$950				$350	$1594

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Икономии	% Спестено	Натурално спестено	Парични икономии при български цени
ХОВ	1.4	4000 т/г.	$1000
Обща икономия			$1000
Срок на изплащане, години			1.5

- Въздушни кондензни гърнета - 5 броя от Armstrong

Икономически резултати:

Цена на оборудването	Транспорт у нас	Проектиране	Други материали	Монтаж	Наладка	Допълн. Разходи за поддръжка	Общи разходи
$600	$20	$200				-	≈ $820

ЕТАП II

- Подобряване на енергийната ефективност на компресорното чрез монтиране на нови винтови компресори
  - винтов компресор Hafi - 15м^3/мин. - закупен от предприятието
  - винтов компресор Ingersoll Rand - 20м^3/мин
  - хладилен изсушител Ingersoll Rand

Икономически резултати:

Цена на оборудването	Транспорт у нас	Проектиране	Други материали	Монтаж	Наладка	Допълн. Разходи за поддръжка	Общи разходи
$76790	$500	$ 6500				-	$ 83 790

Икономии	% Спестено	Натурално спестено	Парични икономии при български цени
Ел. енергия	18.3	761 481 кВтч/г	$34 114
Масло	44.1		$13 560
ХОВ	50	140 000 т/г.	$6 720
Обща икономия			$54 394
Срок на изплащане, години			1.5

- Система за автоматизиране на постоянните продувки, съсояща се от:
  - двупозиционна система за автоматична продувка от Rosemount.
  - електрически изпълнителен механизъм Fisher-Baumann.

Икономически анализ:

Цена на оборудването	Транспорт у нас	Проектиране	Други материали	Монтаж	Наладка	Допълн. Разходи за поддръжка	Общи разходи
$5 755	$20	$ 2480				-	$ 8 255

Икономии	% Спестено	Натурално спестено	Парични икономии при български цени
Топлина	87	5 813 ГДж/г	$18 150
ХОВ	85.8	5470 т/г.	$1 700
Обща икономия			$19 850
Срок на изплащане, години			0.4

В резултат на изпълнението на програмата в КМХ Белово АД, бяха набелязани мерки за икономия на близо 51 млн. лева (цени Юли 1994), беше инсталирано оборудване за около $62 000, което се очаква да доведе до годишна икономия от около $110 000.

В заключение бихме желали да изразим нашата лична и тази на ръководството на комбината, благодарност към Американската Агенция за Международно Развитие за цялостното реализиране на този проект.

От друга страна изразяваме нашата благодарност към ръководството на КМХ за отличните условия, които ни предоставиха за работа, и за активното участие в разработката и изпълнението на проекта.

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Results from the energy efficiency project in KMH Belovo

G. Rampov, M.Sc., CEM
N. Stankov, PhD, CEM
P. Blazhev, M.Sc.

Summary

The project for energy efficiency improvement in the KMH Belovo - Papermill started in February 1994 with Phase 1 - audit and equipment engineering. Equipment was donated for about $7 600. It is designed to save energy for about $38 000 yearly. Within the Phase 2 - equipment for $ 52 550 was purchased and delivered to the plant by the USAID. This energy efficiency equipment saves about $74 250 yearly.

In the report the different energy efficiency tasks in KMH are described, and technical details of the systems are discussed. The results of the implementation of the measures are given and evaluated.

The management of the plant expresses its gratitude for the friendly support of USAID and Hagler Bailly Co.

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Ефективно използване на горивоенергийните ресурси в „Златна Панега" ЕАД

Др.инж. Ангел Дангов - Техцем ООД София
Инж. Пенка Колева - Златна Панега ЕАД

В структурата на общите производствени разходи (себестойността на цимента) дела на разходите за гориво и електроенергия вече надминават 70 - 75 % (при средно за Западна Европа 30%). Тези промени, съчетани със срива на производството поставят проблемите за икономично използване на енергоресурсите на предно място в задачите на мениджмънта.

Като се вземат предвид рзнообразието на енергийните ресурси, специфичните условия на ценообразуването в условията на преход от централизирано към свободно пазарно стопанство, технологическата подготовка на производството, свързана по принцип с високи разходи на горива и електроенергия и с ненормално високи преразходи не толкова поради остарелите технологии, колкото поради липсата на адекватен мениджмънт, за условията на Златна Панега ЕАД т.н. Енергиен мениджмънт беше изведен на челно място в приоритетите на мениджмънта.

Както ще се види по-долу, в структурата на горивоенергийния баланс на Дружеството горивото заема около 90% от общите енергийни приходи, а в стойностно изражение около 65%. За това при разработването на концепцията за Енергийния мениджмънт основно внимание беше обърнато на средства и системи за количествен и качествен контрол на енергопотреблението. Със съдействието на USAID бяха разработени и реализирани изцяло или частично:

1. Лабораторна апаратура за контрол на горивните процеси (изцяло).

2. Компютъризирана станция за обработка данните за енергопотреблението, като база за развитие на Система за енергиен мениджмънт (в режим off-line).

3. Газанализаторна станция за контрол на горенето на една въртяща се циментова пещ, като база за развитие на Експертна система за управление на изпичането на портланд циментов клинкер (на фаза изграждане).

Анализа на енергопотреблението обхваща ретроспективно сравнително по-дълъг период от време за да се разкрият обективните тенденции в развитието на процесите и да се изведат макроикономичеси изводи, на базата на които да се дефинират и съответните макроикономически препоръки и идеи.

В Таблица 1 са показани основните производствени и енергийни показатели на ЦЗ Златна Панега ЕАД за последните 6 години.

В общия горивоенергиен баланс на завода участват още:
- транспортни горива - бензини и дизелово гориво;
- инженерни газове - пропан-бутан, ацетилен;
- взривни вещества.

Последните енергоносители формипат само около 0.8% от общите приходи на гориво и енергия.

В Таблица 2 е показан баланса на основните енергоносители - природен газ и електроенергия, които формират около 99.2% от общите приходи на горива и енергия.

Първият привиден парадокс, който трябва внимателно да се изследва е защо при промяната на продуктовата структура клинкер-цимент към по-голямо потребление на гориво дела на електроенергия не само не намалява, но даже се увеличава.

В Таблица 3 са показани и основните икономически резултати от производствената дейност за същия период.

Разпределението между горивото и електроенергията в разходната част на баланса общо за горивоенергийните ресурси е показан в Таблица 4:

За периода цената на цимента е нараснала 1809%, цената на единица гориво - 5782%, а на електроенергията - 3762%, което показва чуствително изоставане в развитието на цената на цимента в съответствие с цените на горивата и електроенергията.

В същото време цените на двата основни енергоносители отнесени за един и същ енергиен еквивалент, стойностното им участие в структурата на разходите за гориво и електроенергия се видоизменя от 66.6:33.4 през 1990 година на 75.8:24.2 през 1995 година.

За 1996 година динамиката в изменението на показателите предизвика сериозни промени и в горивоенергийната ефективност на производствената дейност. В Таблица 1.96 са показани тези резултати помесечно:

За периода цената на цимента е нарастнала 266%, цената на единица гориво - 383%, а на електроенергията - 315%, което показва чуствително изоставане в развитието на цената на цимента в съответствие с цените на горивата и електроенергията.

В същото време цените на двата основни енергоносители, отнесени за един и същ енергиен еквивалент,например 1 Гкал., са се развивали по месеци, както е показано в Таблица 5.96.

Изводи:

1. Държавното регулиране на цените на енергийните ресурси при монополното положение на производител и вносител в условията на преход към свободно пазарно стопанство не стимулира производителите към ефективното им използване.

2. Липсва методическа база за държавна система за повишаване на енергийната ефективност на производството.

3. В отраслов мащаб също липсва система за оценка на ефективността на енергопотреблението (за разлика от например отрасъл химическа промишленост).

4. Предвид огромните резерви за икономия на горива и енергия Системите за енергиен мениджмънт се явяват много ефективни - намаление на разхода на електроенергия само с 0.1% изплаща капиталовложенията за Системата за компютърна обработка на данните за енергопотребление само за 1 година.

5. Поради остарелите технологии мероприятията за намаляване на разхода на горива са значително по-ефективни.

Effective use of the fuel and energy resources in Zlatna Panega

Abstract

Dr. Angel Dangov - Techtsem Ltd. Sofia
Eng Penka Koleva - Zlatna Panega

The tools and systems for control of the quality and volume of the energy consumption have leading role in the concept for the Energy Management in Zlatna Panega. The following improvements in the plant were designed and implemented (to a different extend) with the cooperation of the USAID :

1. Laboratory equipment for control of burning processes (fully implemented).

2. Computer station for the energy consumption data analysis as a base for the development of Energy Management System (in off-line phase).

3. Gasanalysing station for burning processes control of a turnable cement oven (in stage of development).

Having in mind the big reseves for economy of energy the systems for Energy Management are very effective - decrease of the expences for electric energy by 0.1% repays the expences for the Computer System for Energy Consumption Data Analysis for one year.

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Таблица 1

	90	91	92	93	94	95
Клинкер-т.	581876	348254	305563	307258	388627	548599
	100%	59,9%	52,5%	52,8%	66,8%	94,3%
Клинкер-експорт-т.					142395	301623
Цимент-т.	695120	418160	394014	358561	303161*	303726*
	100%	60,1%	56,7%	51,6%	43,6%	43,7%
РН-т.кл/т.ц.	0,837	0,833	0,776?	0,857	0,812	0,813
Гориво-х.м3	102983	60512	50658	48064	56753	74375
	100%	58,8%	49,2%	46,7%	55,1%	72,2%
РН-м3/т.кл.	177,0	173,8	165,8	156,4	146,0	135,6
РН-ккал/кг.кл.	1416	1390	1326	1251	1168	1085
	100%	98,2%	93,6%	88,4%	82,5%	76,6%
Е.Е.-х.Квтч	126484	83463	69981	67864	70644	87917
	100%	66,0%	55,3%	53,7%	55,9%	69,5%
РН-Квтч/т.Ц.	182,0	199,6	177,6	189,3	199,5**	189,4**
	100%	109,7%	97,6%	104,0%	109,6%	104,0%

Hu за природния газ е приет 8000 ккал/м3(20°С,1,01325 бара)

*)Във връзка с износа на клинкер се видоизмени значително и структурата на енергопотреблението:

-горивото се разчита по произведения клинкер;

-за електроенергията се въвеждат т.н. приведени и осреднени РН.

**)Разходната норма за електроенергията е изчислена на базата на експертно разпределение на потреблението за производството на клинкер и допълнително само за смилането и експедицията на цимента.

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Таблица 2

	90	91	92	93	94	95
Гориво-Гкал	823864	484168	405264	384512	454024	595000
Е.Е.-/Гкал/	108776	71778	60184	58363	60754	75609
Общо* -Гкал	932640	555946	465448	442875	514778	670609
Общо*-МВтч	1084465	646449	541218	514971	598579	779777
	100%	59,6%	49,9%	47,5%	55,2%	71,9%
РН-Гкал/т.Ц.	1,34	1,35	1,22	1,22	1,33*	1,04*
РН-Квтч/т.Ц	1560	1567	1416	1416	1542*	1204*
	100%	100,7%	91,0%	91,0%	99,3%	77,2%
Гориво	88,3%	87,1%	87,1%	86,8%	88,2%	88,7%
ЕЕ	11,7%	12,9%	12,9%	13,2%	11,8%	11,3%

1 КВтч=860 ккал.
1 Гкал=1162,791 КВтч.
1 МВтч=1000 КВтч.

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Таблица 3

	90	91	92	93	94	95
ПРИХОДИ х.лв.	59419	155030	215190	257932	524000	936731
/от пр.д-ст/	100%	261%	362%	434%	882%	1576%
ср.цена лв/т	85,50	370,75	546,15	708,60	1097,50	1547,11
	100%	433,6%	638,8%	828,8%	1284%	1809%
в т.ч.х.лв.						
за гориво	11523	77570	109032	87684	274000	473000
	100%	673%	946%	761%	2378%	4105%
лв/1000 м3	111,89	1281,89	2152,32	1824,32	4827,94	6359,66
	100%	1163%	1955%	1663%	4391%	5782%
дял в ОПР	19,4%	50,0%	50,7%	34,0%	52,3%	50,5%
за ЕЕ	5776	26557	38978	48814	71691	128310
вкл.ДДС					82562	151406
	100%	460%	699%	845%	1429%	2621%
лв/1000 КВтч	45,66	318,18	556,98	719,29	1168,70	1722,15
	100%	697%	1220%	1575%	2560%	3762%
дял в ОПР	9,7%	17,1%	18,8%	18,9%	15,8%	16,2%
или общо	17299	104127	149426	136498	356652	624406
	100%	602%	694%	789%	2062%	3609%
дял от ОПР	29,1%	67,1%	69,6%	52,9%	68,1%	66,7%

Таблица 4

	90	91	92	93	94	95
дял Г	66,6%	74,5%	73,0%	64,2%	76,8%	75,8%
------от РГЕ------	-----	-----	-----	-----	-----	-----
дял ЕЕ	33,4%	25,5%	27,0%	35,8%	23,2%	24,2%

Таблица 5

	90	91	92	93	94	95
лв/Гкал(г)	13,75	160,00	259,75	225,75	631,63	773,57
лв/Гкал(е)	53,09	369,98	647,65	836,38	1358,95	2002,50
Ке-г	3,86	2,31	2,49	3,70	2,15	2,59

Ке-г е коефициент,отчитащ ценността на ел.енергията спрямо цената на горивото

Таблица 1.96

	I	II	III	IV	V	VI
Клинкер-т.	35898	36364	40221	50268	59726	60077
Кл.стоков-т.	29200	30147	25110	22860	22852	22584
Цимент-т.	10510	8520	17135	36200	43000	47200
РН-т.кл/т.ц.	0,637?	0,730?	0,882?	0,757?	0,858?	0,794
Гориво-х.м3	5033	5381	5549	6687	7393?	8461
РН-м3/т.кл.	140,2	148,0	138,0	133,0	123,8	140,8
РН-ккал/кг.кл.	1122	1184	1104	1064	990	1126
	100%	105,6%	98,4%	94,9%	88,3%	100,4%
Е.Е.-х.Квтч	5552,9	5979,7	7417,6	8336,2	8284,6	
РН-Квтч/т.цж.						
	100%					
Гориво-Гкал	40264	43048	44384	53496	59160	67688
Е.Е.-Гкал	4775,5	5142,5	6379,1	7169,1	7124,8	9943,1
Общо -Гкал	45039,5	48190,5	59763,1	60665,1	66284,8	77131,1
Общо-МВтч	52371,5	56035,5	59026,9	70540,8	77075,4	89687,3
	100%	107,0%	112,7%	134,7%	147,2%	171,3%
РН-Гкал/т.Ц.	1,	1,	1,	1,	1,	1,
РН-МВтч/т.Ц						
	100%					
Гориво	89,4	89,3	87,4	88,2	89,3	87,8
------	----%	----%	----%	----%	----%	----%
ЕЕ	10,6	10,7	12,6	11,8	10,7	12,2
ОПР - х.лв. общо за 3-мес.			195090	113387	148758	188654
ср.цена лв/т	2462	2667	2667	2667	2968	3363
	100,0%	108,3%	108,3%	108,3%	120,6%	136,6%
в т.ч.х.лв.						
за гориво	23365	26449	28389	36064	47944	67889
лв/1000 м3	5478	5800	6038	6364	6485	9468
	100%	105,88%	110,23%	116,17%	118,38%	172,83%
дял в ОПР	средно за 3-мес.		40,08%	31,80%	32,23%	35,98%
за ЕЕ	11493	12451	15050	14509	18882	24659
лв/1000Квтч	2070	2082	2029	1740	2279	
	100,00%	100,60%	98,04%	84,09%	110,12%	108,50%
дял в ОПР	средно за 3-мес.		19,99%	12,80%	12,69%	13,07%
или общо	34858	38900	43439	50573	66886	92548
дял от ОПР	средно за 3-мес.		60,07%	44,60%	44,92%	49,06%
дял Г	67,03	67,99	65,96	71,31	71,68	73,36
-----от РГЕ------	%	----%	----%	----%	----%	----%
дял ЕЕ	32,97	32,01	34,04	28,69	28,32	26,64

Таблица 1.96.2

	VII	VIII	IX	X	XI	XII
Клинкер-т.	52057	49516	46022			
Кл.стоков-т.	19852	17980	14664			
Цимент-т.	36250	41300	38960			
РН-т.кл/т.ц.	0,888	0,764	0,805			
Гориво-х.м3	7479	7089	6571			
РН-м3/т.кл.	143,6	143,2	142,8			
РН-ккал/кг.кл.	1149	1146	1142			
	102,4%	102,1%	101,8%			
Е.Е.-х.Квтч	9135,6	9301,4	8203,2			
РН-КВтч/т.цж.						
Гориво-Гкал	59832	56712	52568			
Е.Е.-Гкал	7856,6	7999,2	7054,8			
Общо -Гкал	67688,6	64711,2	59622,8			
Общо-МВтч	78707,7	75245,6	69328,8			
	150,3%	143,7%	132,4%			
РН-Гкал/т.Ц.	1,	1,	1,			
РН-МВтч/т.Ц						
Гориво	88,4	87,6	88,2			
------	----%	----%	----%			
ЕЕ	11,6	12,4	11,8			
ОПР - х.лв.	212779	252585	252448			
ср.цена лв/т	5115	5880	6540			
	207,8%	238,8%	265,6%			
в т.ч.х.лв.						
за гориво	92351	120711	137724			
лв/1000 м3	12348	17028	20025			
	225,4%	310,8%	365,2%			
дял в ОПР	43,4%	47,8%	54,6%			
за ЕЕ	43052	51484	51681			
лв/1000 КВтч	4712	5535	6300			
	235,4%	276,5%	314,7%			
дял в ОПР	20,2%	20,4%	20,5%			
или общо	135403	172195	189405			
дял от ОПР	63,6%	68,2%	75,0%			
дял Г	68,2	70,1	72,7			
------от РГЕ	----%	----%	----%			
дял ЕЕ	31,8	29,9	27,3			

Таблица 5.96

	I	II	III	IV	V	VI
лв/Гкал-г	684,75	725,00	754,75	795,50	956,50	1183,50
лв/Гкал-е	2406,98	2420,93	2359,30	2023,26	2650,00	
Ке-г	3,51	3,34	3,12	2,54	3,27	

Съответно за второто полугодие:

	VII	VIII	IX	X	XI	XII
лв/Гкал-г	1543,50	2128,50	2619,88			
лв/Гкал-е	5479,07	6436,05	7325,58			
Ке-г	3,55	3,02	2,80			

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РЕЗУЛТАТИ ОТ ПРОЕКТА ЗА ЕНЕРГИЙНА ЕФЕКТИВНОСТ В СТЪКЛАРСКА ФАБРИКА „КРИСТАЛ“ ЕАД - ПЕРНИК

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В резултат на проведения анализ на енергийната ефективност в стъкларска фабрика „Кристал“ Перник в рамките на програмата за повишаване на енергийната ефективност на USAID бяха определени някои значителни фактори, влияещи върху консумацията на енергия при производството на плоско стъкло. На базата на тези изследвания бяха отбелязани мероприятия, включени в двуетапна програма, чието изпълнение би довело до енергоспестявания. Мероприятията бяха подредени така, че при сравнително малки капиталовложения да се постигне значителен икономически ефект. В резултат на първия етап на програмата бе изследван горивния процес на стъкларската пещ и бе внедрен многоточков регистратор за контрол на температурата в пещта. По време на втория етап бяха внедрени винтови компресори, които подобряват надеждността на работата на основното оборудване и повишават ефективността в използването на енергията.

Извършената работа по проекта и постигнатите резултати са представени в настоящия доклад.

Фирма "Кристал - Перник" ЕАД е най-старото стъкларско предприятие в България. Годишният му капацитет е 4.5 млн.м^2 плоско стъкло (на база δ = 2 mm) и 150 хил.м^2 закалено автомобилно стъкло тип "Секюрит". В настоящият момент, вследствие на общата регресия в икономическия живот на България, заводът работи с намален капацитет.

Основното производство на завода е плоско стъкло, което представлява около 80% от общата продукция. За тази цел се използва стъкларска пещ тип „Фурко“, оборудвана с 4 машини за изтегляне на стъклена лента. Стъкларската пещ „Фурко“ е от типа ванна пещ с ниско разположена регенеративна система с непрекъснато действие. На фиг. 1 и 2 са представени напречен и хоризонтален разрези на пещта, които показват устройството и принципа на работата й.

Ванната пещ се разделя условно на топилна и охладителна част. Топилната зона е с обща огледална повърхност 94 м^2, а охладителната зона заедно с фурковите канали на изтеглячните машини - 143 м^2. Пещта е оборудвана с 4 чифта горелки, разположени срещуположно на двете

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странични стени с широчина на устието 1.8 м. Всеки чифт горелки, в зависимост от месторазположението им в топилната зона е оборудван с различни по топлинна мощност газови дюзи.

Горелките са снабдени с регенеративни камери, като всеки чифт заедно със съответните камери образува самостоятелно работеща секция. Размерът на активната зона на регенеративната камера е: височина 5.00 м; широчина - 2.75 м; дължина 3.00 м. Камерите са запълнени с огнеупорни тухли, които осигуряват достатъчно висока температура на въздуха за горене.

В края на ванната пещ са разположени 4 броя „Фурко"-машини за изтегляне на стъклена лента.

За правилното протичане на процеса на топене на стъклената маса се изисква определена температура по време и място. Ето защо поддържането на постоянен температурен режим за всяка фаза от процеса на топене има изключително важно значение. Контролът на температурния режим се извършва чрез термодвойки, поставени в свода на пещта по цялата й дължина (фиг. 2).

Резултатите от наблюденията показаха, че пещта работи с постоянно натоварване, като се спазва температурния режим по зоните. Температурите в отделните измервани точки практически не се променят по време и остават постоянни, близки до оптималните.

Стъкларската пещ беше оборудвана със система за температурен контрол, която е работила вече 20 години и беше напълно амортизирана. Част от термодвойките са изгорели, самият измервателен прибор беше амортизиран и не даваше надеждни показания. Ето защо се наложи заменянето на съществуващите елементи от системата за измерване на температурата в пещта с цялостна система за температурен контрол. В този смисъл бе направено предложение (първи етап от проекта) от което се очакваше икономия на природен газ и подобряване на качеството на стопената стъкломаса (пълно дегазиране, хомогенност, необходим вискозитет).

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За тази цел, след обстойно маркетингово проучване, бе предложено да се използва цифров регистратор модел МСК6 - 412//А007-00 производство на фирмата Barber Colman, САЩ.

Доставеният прибор за температурен контрол представлява унифициран пишещ прибор, регистриращ до 32 входни сигнала (фиг. 3). Представянето на данните е както в графичен режим, в избрани от потребителя формати, така и в текстови отчети за параметрите на технологичния процес. Приборът има широк кръг приложения в различни промишлени технологии. Изграденият на микропроцесорна основа МСК6 отговаря на най-високите изисквания за експлоатация в промишлени условия, лесен е за ползване и надежден в работа.

След първоначалното усвояване на прибора в промишлена експлоатация енергийният консултант предложи цифровия регистратор да се използва не само за температурен контрол, но и за цялостно регулиране на технологичния процес на производството на плоско стъкло, като се включат например регулирането на налягането на газовете в пещта, регулирането на излишъка на въздух в пещта и др. Възможностите му позволяват това. Приборът бе монтиран на пулта на управление на стъкларската пещ в края на Юни 1995 г. и досега работи безотказно.

На фиг. 4 се представени резултатите от измерването на температурите в стъкларската пещ с помощта на монтирания прибор МСК6.

Заедно с прибора беше доставена и специална термодвойка SAT-24-70 със защитна керамична обвивка за контрол на температурата на стъклената маса. Термодвойкта е потопена в нея и контролира индиректно най-важния технологичен параметър - вискозитета на стъклената маса.

За калибриране на стандартните термодвойки използувани в пещта беще доставен калибратор тип SL 23A производство на фирмата Tegam, който специалистите от лаборатория КИП и А използват постоянно.

С това първия етап на изпълнението на проекта приключи успешно.

По време на втория етап от програмата за подобряване на енергийната ефективност в „Кристал" ЕАД основно внимание бе обърнато на централизираното подаване на въздух във фабриката. От първоначално

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монтираните 5 компресора, 2 бяха снети от експлоатация поради физическо износване. Компресорите изпълняват следните функции:

- снабдяване с въздух на всички пневматични инсталации във фабриката;
- осигуряване на въздух за управляващата система за горенето в пещта;
- осигуряване на въздух за охлаждане на вала на стъклоизтеглящите машини при прекъсване на стъклената лента;
- осигуряване на въздух за охлаждане на персонала от ремонта в аварийни ситуации.

Техническите данни на тези 3 компресора (фиг. 5) са както следва:

- тип ВП 250 80/30 производство на завод „Борец"
- номинална ел.мощност 210 kW.
- производителност 30 $м^3$/мин;
- налягане 0,8 Мра.

Направеният анализ показа, че поради ликвидиране на съществуващото производство на буркани действащите компресори се явяват преоразмерени. В настоящия момент схемата на работа на съществуващите 3 броя бутални компресори е следната: 1 компресор в работа, 1 в резерв и 1 в ремонт. След внимателен анализ на реалните условия на работа и на реалната консумация на сгъстен въздух в завода беше предложено трите компресора да се заменят с един нов винтов компресор с гарантирана надеждна работа. Подходящ тип е XF150 производство на фирмата „Ingersoll Rand" с производителност 20 $м^3$/мин, налягане 0,8 MPa и номинална мощност 115 KW. (фиг. 6). Компресорът вече е доставен с финансиране от програмата за енергийна ефективност на USAID. Компресорът е монтиран, преминал е успешно пусковите изпитания и вече са направени първите изпитания за доказване на неговата ефективност. Веднага се открои значителната икономичност на новия компресор.

На фиг. 7 са показани сравнителните резултати от измерването на консумацията на електроенергия за два от старите бутални компресори (ВП250 30/80) и новомонтирания винтов компресор FX150. Към предимствата

на новия компресор може да се посочи неговата безшумна работа и повишена надеждност. Освен това той осигурява автоматично преминаване в енергоикономичен режим при липса или намалена консумация на сгъстен въздух.

Като второ мероприятие от втория етап на проекта енергийният консултант предложи разделно захранване с въздух на КИП и А на стъкларската пещ. Съществуващата система за контрол и управление е хибридна с електрически и превматични прибори. Поради това, че до сега въздух за управляващите прибори се подаваше от общия захранващ тръбопровод, не се спазваха строгите изисквания за подсушаване и филтриране на въздуха. Това водеше до смущения и откази в някои от регулаторите, което бе причина за увеличаване разхода на гориво в стъкларската пещ. Предложи се монтирането на два винтови компресори, единия за работа в основен режим, а другия в режим на горещ резерв. Специфицирани бяха компресори тип EP7.5 с производителност 0.8 $м^3$/мин, мощност 5.5 KW и налягане 0.8 MPa. Компресорите бяха окомплектовани с един изсушител-охладител на въздуха тип DXR35. Цялото оборудване бе финансирано в рамките на програмата за енергийна ефективност на USAID. Компресорите и изсушител-охладителят са монтирани в специално помещение в близост до щита за управление на стъкларската пещ при съблюдаване на всички изисквания за засмукване на чист въздух и поддържане на нормална температура (фиг. 8). Въвеждането на тези компресори в нормална експлоатация не създаде никакви проблеми.

С това приключи успешно вторият етап от изпълнението на проекта.

В резултат от работата на монтирания цифров регистратор MCR6 и подобрения вследствие на това температурен контрол се стабилизира температурния режим на стъкларската пещ, което непосредствено се отрази върху икономията на гориво.

По експертни оценки, след 1.5 години успешна експлоатация, икономията на природен газ е 2%. Тази оценка се потвърждава и от намалената обща консумация на природен газ при запазено ниво на производство.

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Тогава общата икономия на природен газ е 20570 $/ г. Изчисленията са направени при текуща цена на газа към 1 октомври 1996 г. - 121 $/$10^3$ м^{3}N и консумация на природен газ 8500.10^3 м^3 N /г. Предварителната оценка от 1995 г преди доставяне на прибора [1] предвиждаше икономия 17000 $/г. Разликата се дължи на непрекъснатото увеличаване на цената на природния газ.

Пълните разходи от реализирането на първи етап от проекта са 10800 $, при което реалният срок на откупуване на цифровия регистратор е 6.5 месеца.

Направените предварителни оценки за икономиите, които могат да се реализират с монтирането на винтовия компресор, също се оказаха занижени [2]. Това се дължи на първо място на повишаването на цената на електроенергията от 0.032 $/kWh на 0.046 $/kWh и повишането на цената на консумативните материали. Тук са взети предвид различните тарифи на електроенергията за 24 часа, а именно 6 часа върхова, 10 часа дневна и 8 часа нощна и непрекъснатата работа на компресора 8000 часа годишно.

В следващата таблица са показани актуализираните годишни разходи за компресор ВП250 30/80 и тези за винтов компресор FX150.

Фактор	Цени към 01.10.1996 г	Компресор ВП 250 30/80 $/г.	Компресор FX150. $/г.
Електроенергия	0.046 $/kWh	58880	42320
Масло:			
картерно	0.824 $/l	1710	
компресорно	0.570 $/l	593	
специално	52.9 $/galon		1323
Техническа вода	0.092 $/m^3	2134	
Общо годишни разходи:		63317	43643

Така се формира годишна икономия от 19674 $ от замяната на съществуващите бутални компресори с нов винтов компресор FX150.

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Пълните разходи по реализирането на тази част от проекта (заедно със заплащането на енергийния консултант и пълния инженеринг) са равни на 35840 $/год. При това положение срокът за откупуване на винтовия компресор се равнява на 2.0 години.

Отделянето на системата за КИП и А от заводската промишлена магистрала за сгъстен въздух и самостоятелното и захранване от нови винтови компресори ЕР-7.5 довежда до цялостно подобряване работата на стъкларската пещ и до повишаване надеждността на автоматиката и контрола. По експертни оценки подобряването на работата на пещта, свързано с автоматиката и контрола, е довело до икономия на енергия, респективно на природен газ в размер на 2%. В годишен план икономията се изразява в 20570 $. В същото време пълните разходи по реализирането на тази част от втория етап на проекта се оценяват на 12260 $. Срокът за откупуване на комплексната инсталация за самостоятелно захранване със сгъстен въздух на системата за КИП и А е 7.2 месеца.

В следващата таблица са показани основните икономически резултати от изпълнението на проекта за енергийна ефективност в стъкларския завод „Кристал - Перник" по етапи и като цяло.

Изпълнение на проекта	Цена на оборудването, $	Труд на консултанта (пълен инженеринг), $	Годишни разходи за експлоатация, $	Реализирана годишна икономия, $	Срок на откупуване
I етап	8090	2710	621	20570	6.5 мес.
II етап	34240	1600	1609	19674	2.0 год.
	11940	320	342	20570	7.2 мес.
Всичко за проекта	54270	4630	2572	60814	1 г и 1 мес.

Резултатите убедително показват високата ефективност на проекта за икономия на енергия в стъкларския завод „Кристал - Перник".

В хода на реализацията на разглеждания проект бяха установени добри делови връзки между фирмата - енергиен консултант „Риск Инженеринг" ООД и стъкларския завод „Кристал - Перник". Съвместната работа по подобряване на енергийната ефективност при производството на плоско

стъкло продължава чрез нов проект, финансиран директно от завода. Той е свързан с подобряване процеса на изгаряне на природния газ в стъкларската пещ чрез цялостната реконструкция на съществуващите газови горелки и въздуховоди към тях. Проектът ще се реализира през 1997 год. при изпълнението на плановия капитален ремонт на стъкларската пещ.

Литература

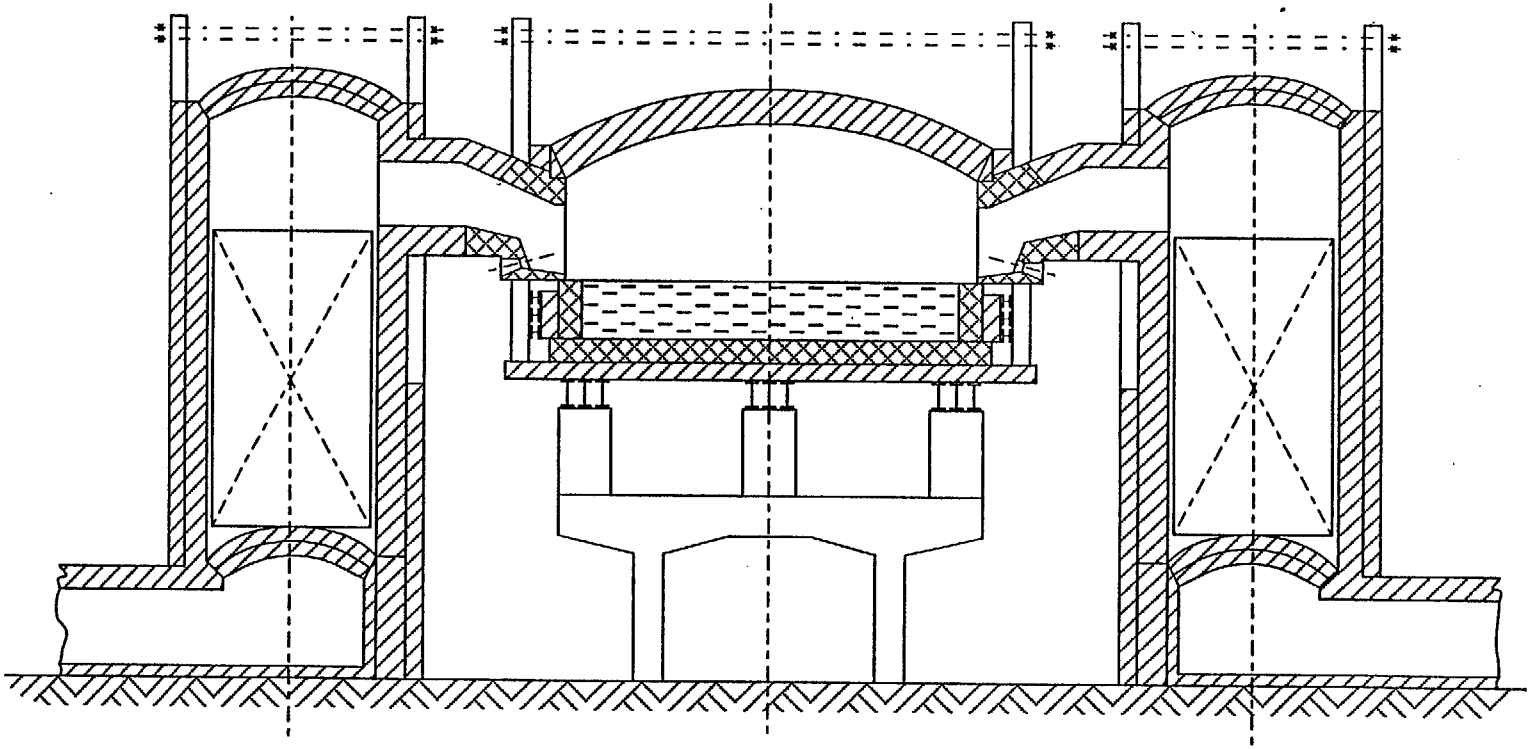
1. Оптимизиране на температурните и горивни процеси на стъкларска пещ в „Кристал-Перник" ЕООД чрез внедряване на апаратура, доставена от агенция на САЩ за международно развитие". Отчетен доклад на „Риск Инженеринг" ООД, София, Юли 1995 г.
2. Описание на предложението за втората фаза на програмата за спестяване на енергия в стъкларска фабрика „Кристал-Перник". Доклад на „Риск Инженеринг" ООД, София, Юни 1995 г.

SUMMARY

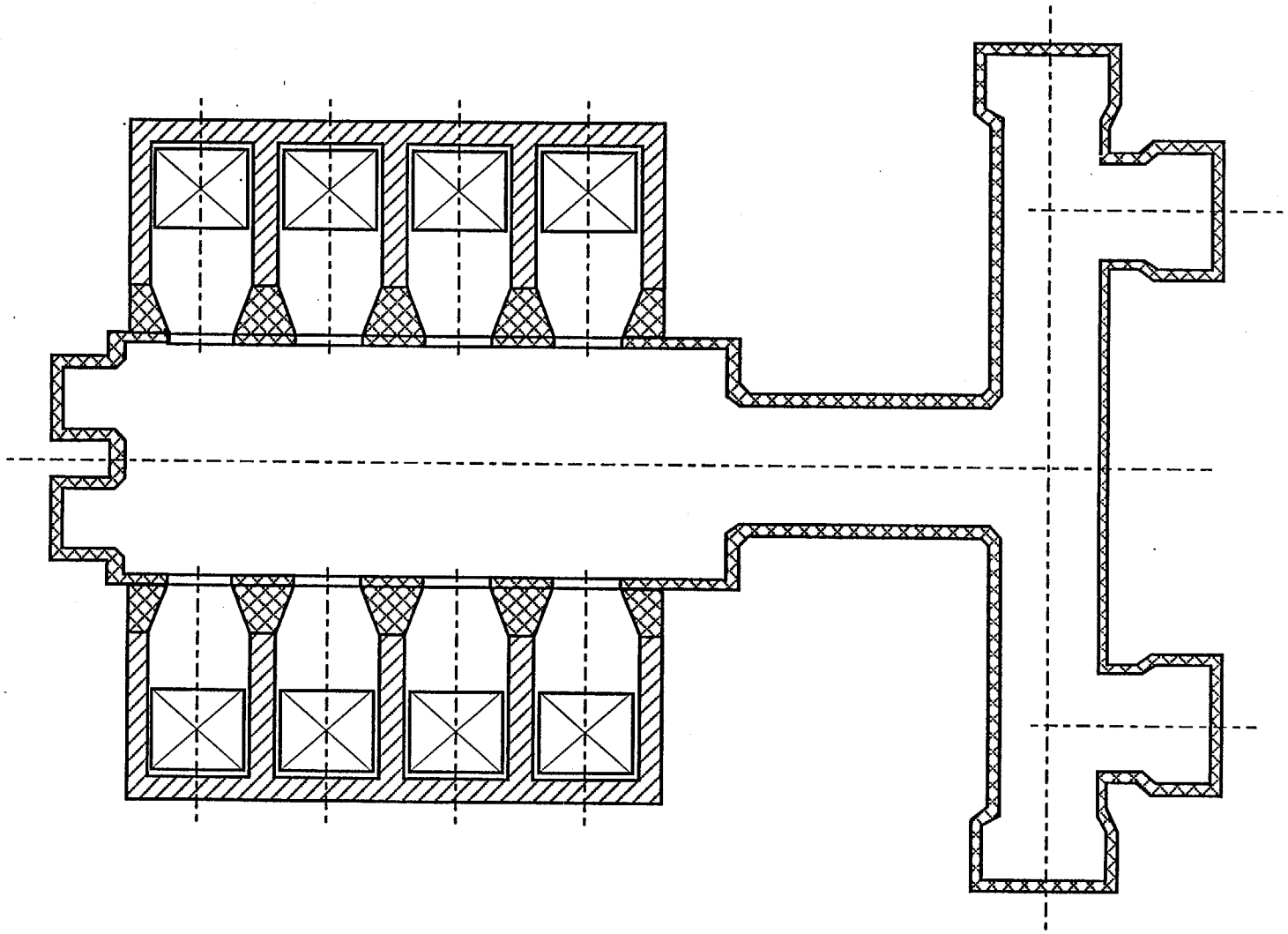
In glass factory Crystal - Pernik was fulfilled energy savings audit in the frame of the program for energy efficiency improvement in the industry sector of Bulgaria. As result were defined the most significant impact factors over the consumption of energy at glass production of the factory. On the base of these investigations were planned measures included in two phase energy saving program. The measures were ranged so that with small capital investments to reach significant economic benefit. In the first phase of the Program was studied the combustion process in the glass furnace and was implemented multipoint recorder for temperature control inside the furnace. In the second phase of the Program were implemented screw driven air compressors which will increase the reliability of basic equipment operation and will improve the energy efficiency.

In this report are descripted the activities connected with the implementation of the measures for energy savings enclosed in the program of energy efficiency promoted and funded by USAID (represented in Bulgaria by RCG/Hagler Bailly Inc). The authors received also continuous methodological help by Association of Energy Engineers (USA)

Приложения

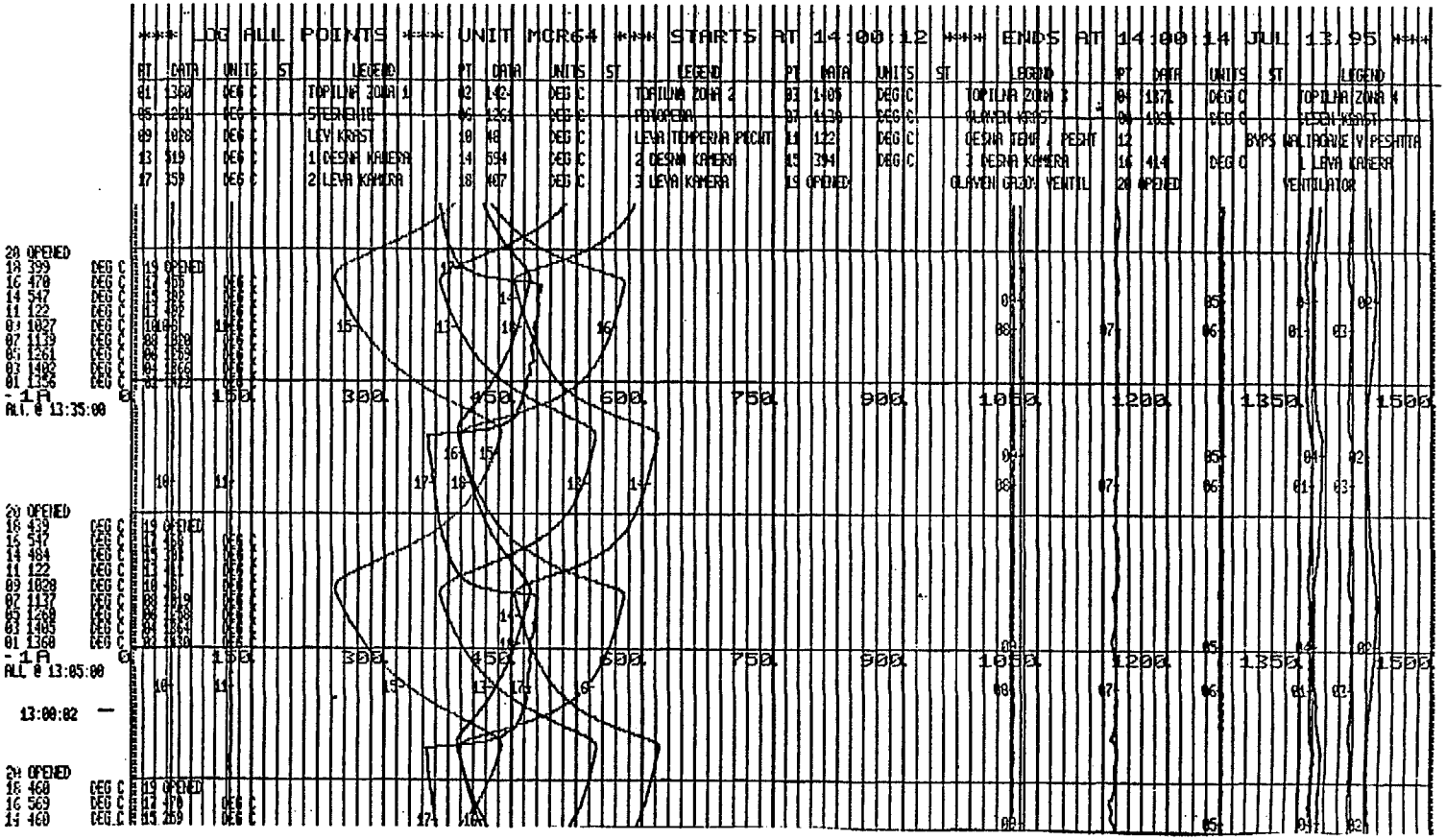


Фиг. 1. Напречен разрез на стъкларска пещ тип „Фурко“

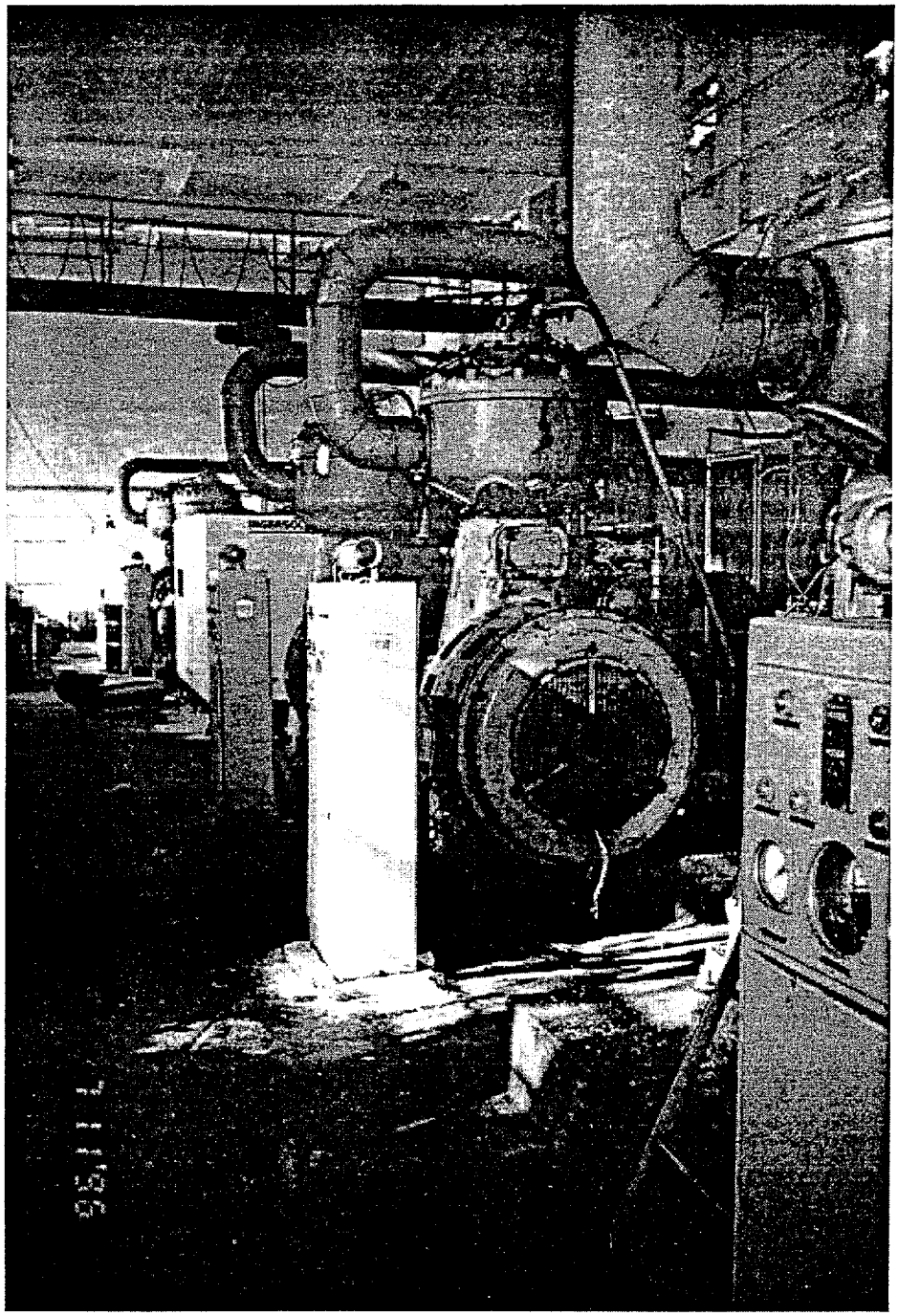


Фиг. 2. Хоризонтален разрез на стъкларска пещ тип „Фурко“

Фиг. 3. Цифров регистратор модел МСК6-412/А007-00, монтиран на панела за управление на стъкларската пещ.



Фиг. 4. Резултати от измерване на температурния режим на стъкларската пещ.



Фиг. 5. Общ вид на съществуващия компресор тип “Борец”

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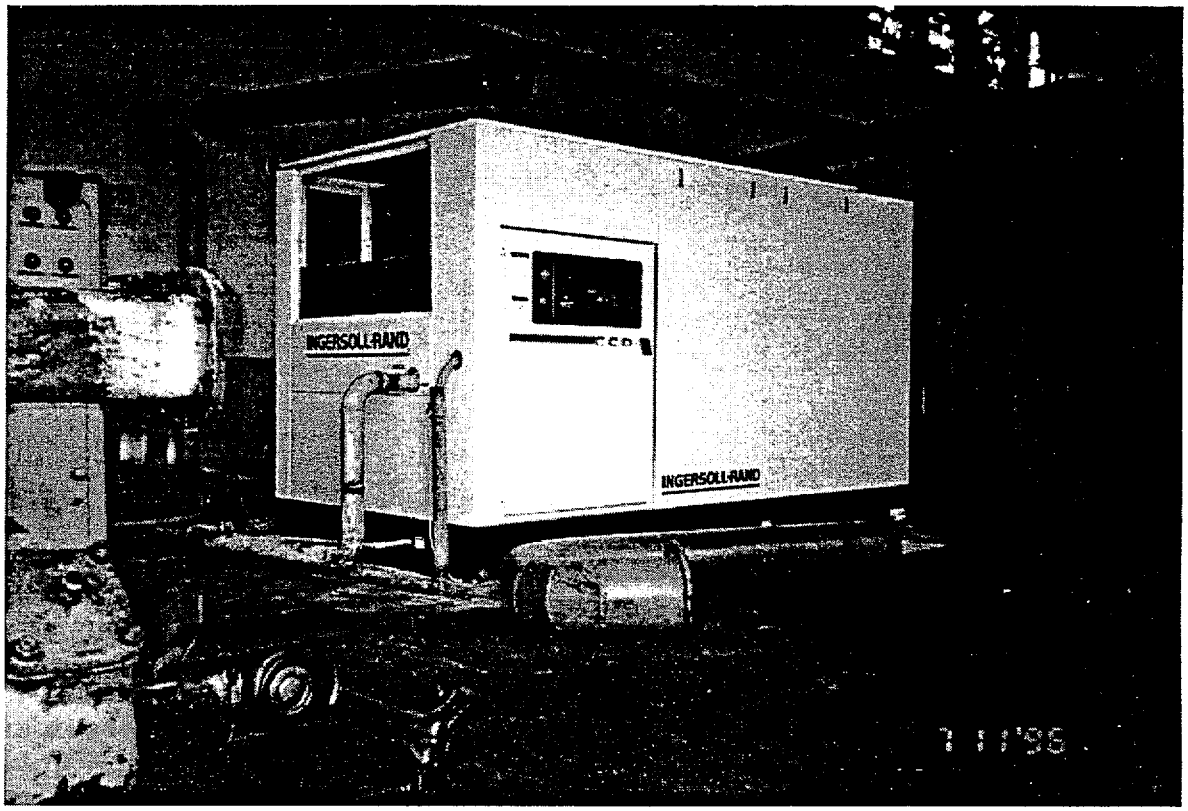

Фиг. 6. Общ вид на инсталирания компресор INGERSOL RAND тип FX150.

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Компресор тип ВП 250 30/80 #1

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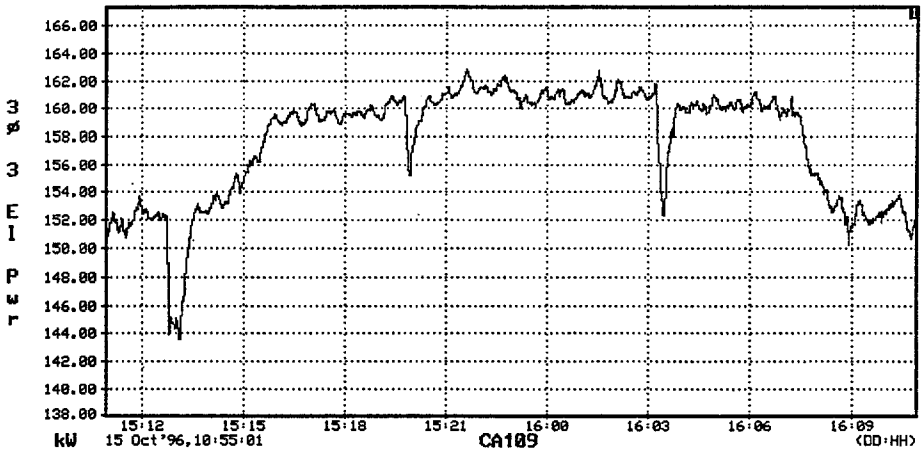
Graph 1 Trace 1 CA109.DTA Adaptive Line 22 Oct 1996



Компресор тип ВП 250 30/80 #2

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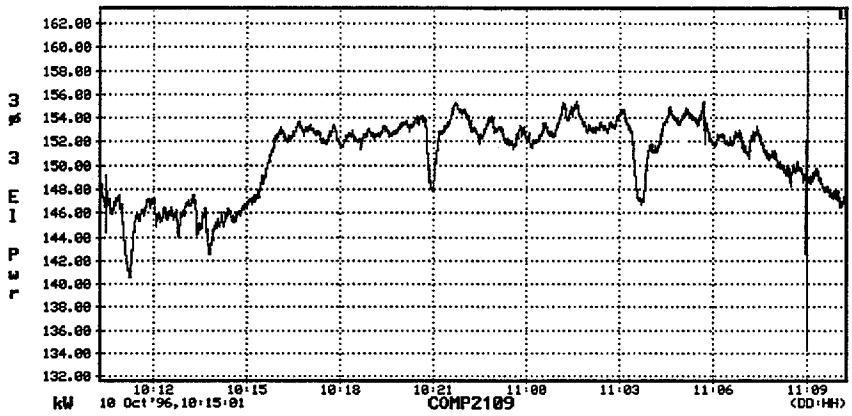

Компресор "INGERSOLL RAND" тип FX - 150

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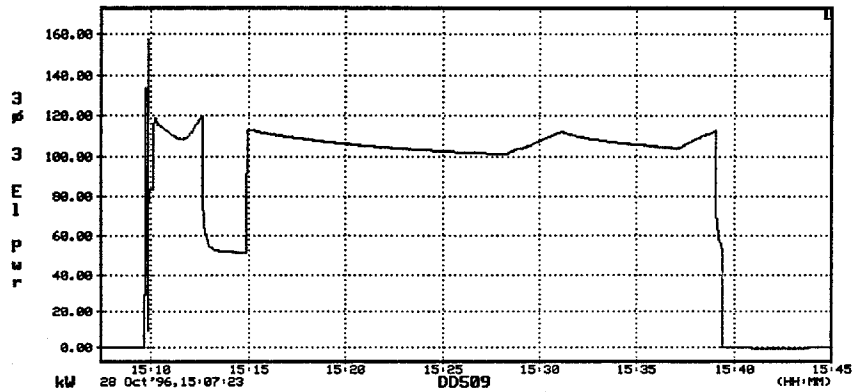
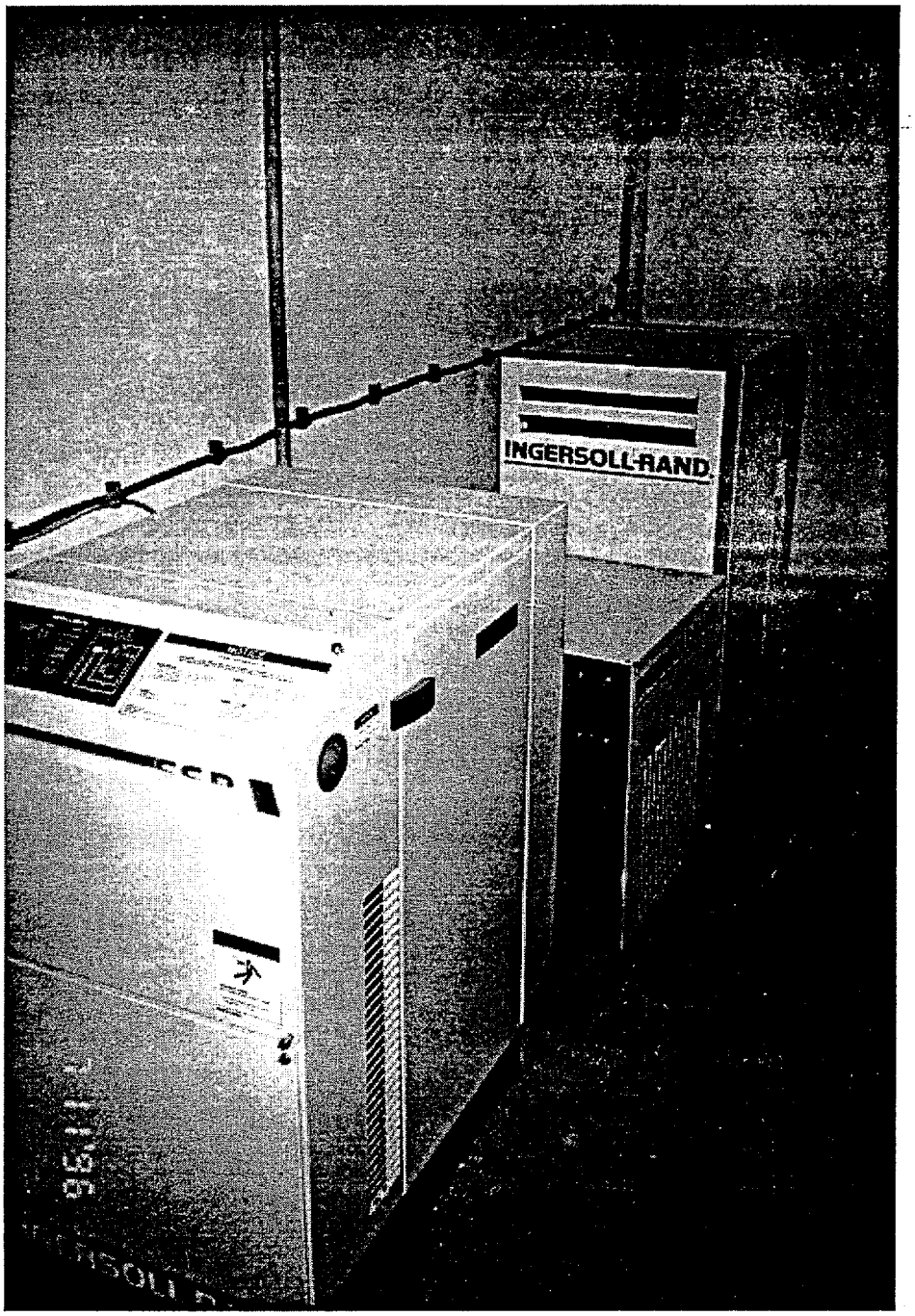
Graph 1 Trace 1 DD509.DTA Adaptive Line 30 Oct 1996



Фиг. 7. Сравнителни резултати за консумираната електроенергия от различните компресори в завод "Кристал".



Фиг. 8. Общ вид на инсталираните компресори тип EP-7.5 и осушител-охладителя тип DXR35.

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Доклад
относно състоянието на договор EUR-0030-C-00-2053-00 сключен между "Варненска корабостроителница" АД и USAID

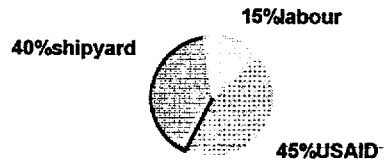
инж. Д. Йорданов

През 1994 год. бе сключен договор между "Варненска корабостроителница" АД иUSAID за помощ при решаване на задачи касаещи енергийната ефективност наинсталациите в завода. Първият етап на договора бе сключен между "Ексерг" ООД гр. Варна със СЕМ Янош Желев и ръководството на завода. Към края на м. ноември 1996 г., са реализирани два етапа от договора, като всеки етап е оформен в отделен поддоговор. Довеждането до край на всеки от подетапите е предпоставка за преминаване към следващи стъпки и това бе детайлно обяснено на ръководството на завода, подкрепено от него и прието като начин на работа. Естествено бе всеки следващ етап да решава по-мащабни проблеми и да изисква използуването на по-скъпа техника и участие на по-голям брой квалифицирани специалисти.

Първият етап обхващаше доставка и монтаж на кондензни гърнета с цел възстановяване кондензната инсталация на завода и свързване на отделните участъци в единна система. До момента на стартиране на етапа, поради частична илипълна дефектация на наличните кондензни гърнета, конденз в парова станция не се връщаше. Имаше участъци от завода за които нямаше изградена цялостна кондензна линия и част от отработената пара се изпущаше директно в атмосферата. Паровата централа на завода е съоръжена с 4 броя мазутни котли тип КМ 12, работещи постоянно при наличие на върхов товар в завода (без резерв). Поради големите разходи на мазут и вода, ръководството на завода бе взело решение за периодична работа на котлите през отоплителния период, променяйки частично и режима на работа на производствените звена, съобразно работата на парова централа. В ход бяха някои мерки за подобряване на моментното състояние на топлинното стопанство, като изграждане на кондензна линия за част от завода (наречена магистрала юг), която обхваща около 50% от консуматорите на топлинна енергия на основната заводска площадка. Друга основна задача пред енергиен отделбе ремонта и обновяването на редуциращия възел в парова централа, за да се сведе налягането на подаваната пара до 4 атм. - както е според проектното решение на обекта. Един от съществените проблеми обаче, при решаване на втората задача, бе в невъзможността да се подържа налягане в парната инсталация по заводската площадка, поради липсата на кондензни гърнета и регулираща арматура по паропроводите. В резултат - още след консуматорите най-близо до парова централа част от парата отива в атмосферата и често пъти до крайните консуматори не достига изобщо топлинна енергия. Подобни примери има достатъчно из завода и при всички решението бе пряко или косвено свързано с лошото състояние на кондензното стопанство и в частност с липси или неработещи кондензни гърнета. Съвместно със заводското ръководство и

специалисти от енергиен отдел бяха огледани всички инсталации и подбрани тези от тях, които са най-натоварени или най-проблематични, с оглед предоставеното финансиране в рамките на 10 000$. Доставени бяха 66 кондензни гърнета и редуцир вентил за парова централа. Всички съоръжения бяха монтирани по най-дългата магистрала на завода, в резултат на което бе отчетена реална икономия на гориво 4% и икономия на омекотена вода 20%. Следва да се отбележи и положителното отношение на заводската администрация към доставената апаратура, като бяха направени допълнителни капитални вложения по парното стопанство на обекта. Изхождайки от натрупания опит за експлоатация на системата, бе преценено, че е необходим монтаж на допълнителни филтри и калоуловители, за да се запази работоспособността на кондензните гърнета. Бяха закупени и монтирани по линиите филтри и друга арматура на обща стойност около 9000 $. За разходи по инсталацията, пуска и настройката на арматурата бяха вложени допълнителни средства 3 300 $, като цялата дейност бе поета от служители на завода. По този начин се оформи крайна сума инвестирана в I етап - 22 300$, разпределена както следва:

- *Оборудване доставено от USAID - 10 000 $*
- *Оборудване закупено от Варненска корабостроителница - 9 000 $*
- *Монтаж, пуск и настройка на апаратурата - 3 300 $*



Разпределение на разходите за I етап от договора

Опитът от последвалата експлоатация доказа, че направените инвестиции са целесъобразни и допринасят за правилната работа на съоръженията и надеждността на системата като цяло. В резултат от работата на инсталацията за периода V- XI 96 г. средната икономия на гориво е средно 4% или 88 тона мазут. Реализираната икономия от омекотена вода е средно 20% или 5 260 м^3. Отнесено към годината, дори да се приеме същия процент икономия това са 176 тона мазут и 10 520 м^3 обработена вода. Трудно е да се прецени процента икономия средно за годината, тъй като през отоплителния сезон част от парата се използва за

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отопление и това от една страна води до по-големи загуби поради повечето места откъдето се изпуща пара, но от друга страна количеството топлоносител пренасяно през паропровода е по-голямо и следва да се очаква по-голяма икономия в абсолютни стойности. При средна цена на мазута 160$/тон за отчетния период, икономисаната сума от горива е 14 080$. По преценка на заводското ръководство икономията от омекотена вода възлиза на 2 820$ или цялостната икономия е 16 900$. Вижда се, че отнесено към оборудването предоставено от USAID, срокът на откупуване е 0,3 години - т.е. то е вече откупено. За по-голяма коректност оценката за икономическа ефективност ще бъде върху цялата сума вложена в проекта, независимо кой е осигурил финансирането.

Това са 22 300$ вложени от двете страни и при очаквана годишна икономия от 33 800$ срокът за откупуване е 0,66 - т.е. осем месеца от момента на пуск в експлоатация. Следва веднага да се отбележат обаче и нефинансовите печалби от въвеждане на кондензопровода отново в действие. Вече бе споменато, че част от консуматорите отдалечени от парова централа не бяха в състояние да достигнат технологичните си параметри поради ниското налягане на парата достигаща до тях, а имаше и такива, които не получаваха изобщо пара поради многобройните пропуски след близките консуматори. След въвеждане на кондензопровода в действие, няма консуматор по линията останал незахранен с пара, при това количеството пара загубено от пропуски по линията намаля видимо, тъй като работното налягане бе свалено до разчетните 4 атмосфери, от използуваните до тогава 8. Разбира се резултатът не изненада никого, но при трудностите от финансово естество, типични за голяма част от предприятията в България, реализацията на програма за повишаване енергийната ефективност на завода не е от главните приоритети на управленския екип. Важно е също да се отчита и все още ниската цена на топлинната енергия по време на началото на проекта - края на 1994 и началото на 1995 година. При настоящия темп на растеж цените на енергоносителите, сроковете за откупуване на сродни проекти би следвало да се съкратят. Друг фактор влияещ върху срока на откупуване, макар и не толкова силно, е сезонното нарастване цената на горивата, което съкращава срока за откупуване през отоплителния сезон.

Изброявайки положителните следствия от I етап на договора следва да се отбележат и допълнителните мерки за възстановяване кондензното стопанство на завода, предприети отчасти и за да се съхрани доставеното и инсталирано оборудване. Разбира се трудно е да се направи количествена оценка доколко доставката е повлияла върху ускоряване на работата по кондензното стопанство, но сигурно е че тя беше изключително навременна и благодарение активните действия на заводското ръководство резултатите от I етап са твърде обнадеждаващи и естествено се стигна до II етап на договора.

Вторият етап от договора бе сключен между ЕТ "Аргус '91" - Варна със СЕМ Деян Йорданов. При избора на подходящ обект и оборудване за II етап активно бяха използувани наблюденията и разчетите направени по време на първоначалния оглед и I етап от договора. В крайна сметка бе реализирана идея предложена от специалистите на енергиен отдел в завода.

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По време на огледа на кондензната линия и разговори с работници в различните цехове се установи, че в края на най-дългия паропровод (2,5 км.) пара достига изключително рядко с необходимото налягане и за да се достигнат технологичните параметри понякога е необходимо да работи един котел КМ 12 само за нуждите на две дървесни преси с консумация 254 кг/ч пара общо (160 + 94) кг/ч, като понякога пара се подава и към 3 сушилни за дърво с консумация 210 кг/ч всяка, както и съвсем рядко към обезмаслителни вани с разход по 105 кг/ч пара всяка. Необходимото налягане на парата за всеки от консуматорите е 2 атмосфери. Особено проблематично е захранването на тези консуматори извън отоплителния сезон, тъй като тогава е необходимо разпалването на котел КМ 12 и експлоатацията му в продължение на 3 часа дневно 80 дни от годината извън сезона. Направена е схема за рационално използуване на съоръженията, като обезмаслителните вани са съоръжени с ел. нагреватели за да се подържа необходимата температура в тях при нужда, а сушилните за дървен материал работят само през отоплителния сезон, когато се подава пара и за отопление на работните помещения намиращи се в близост с изброените консуматори. Проблематично остава обаче захранването на пресите, които не могат да престояват извън отоплителния сезон и да работят само от XI до IV. За тях се налага подаване на пара периодично в гореописания обем. По възможност при тези целеви пароподавания се захранват и сушилните за дървен материал, но е трудно да се подържа оптимален за сушенето режим на топлозахранване.

От друга страна в непосредствена близост до пресите се намира ковашки участък в който има шест огнища работещи с нафтови горелки. По данни от началник участъка среднодневната натовареност на участъка е 50% или едновременно работят 3 от огнищата. Мощността на различните работни места е различна, но всеки ден задължително работи една от големите пещи с дневна консумация 300 кг. нафта. Задължително работи също и една от по-малките пещи с дневен разход 200 кг. нафта. Другите пещи се включват според нуждите и не могат да се считат за сигурни топлинни източници. Твърде примамлива бе идеята да се използува отпадната топлина от ковашките огнища за производство на пара за дървесните преси и по възможност за сушилните и/или обезмасляващите вани. След направените пресмятания се оформиха два варианта - за използуване отпадната топлина само от голяма пещ или от комбинацията малка и голяма пещи. Преценено бе, че изграждането на инсталация обхващаща всички пещи би усложнила технически реализацията на проекта, тъй като сградата на ковашкия участък е 90 годишна и следва да се изгради сериозна металоконструкция, за да се укрепят необходимите въздуховоди. Поради променящия се режим на работа на отделните огнища, автоматиката необходима за правилното включване и изключване би изисквала подръжка от квалифициран специалист, чието работно време не би било уплътнено само от тази инсталация, а е невъзможно да се съвмести с работещите наблизо уредби. Идеята бе одобрена от специалистите на Hagler Bailly Inc. и USAID и в резултат бе доставено комплектно оборудване на Hurst Boiler, състоящо се от:

- *Утилизационен котел с номинално топлопроизводство 225 кг/ч*
- *Вентилатор за димни газове с регулираща клапа*

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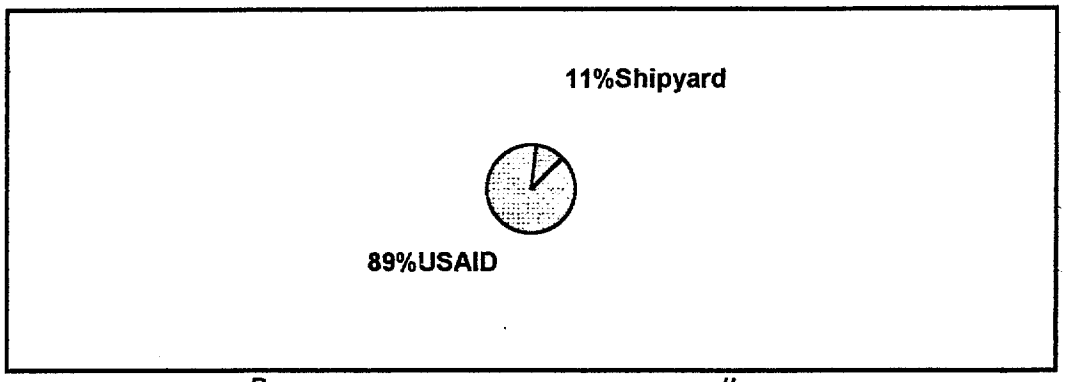
- Водна помпа

Всичко монтирано на обща рамка. Стойността само на оборудването за II етап е 16966 $, без разходите за транспорт и държавни такси. Към тази стойност следва да се добави и стойността на металната конструкция изградена на мястото за монтаж, както и разходите за допълнителни тръбопроводи и изолации за подвързване на котела към консуматорите. Не се изискваше изграждане на нов комин и това бе определено облекчаващо проекта обстоятелство. Изграждането на необходимата за монтажа инфраструктура струваше около 2 000 $. За ниската цена благоприятствуваше подходящото място на монтажа, като тръбните връзки бяха с минимални дължини. За монтажа на свързващите тръбопроводи бе избран след търг правоспособен изпълнител поради изискванията на ДТН - секция Котлонадзор.



Разпределение на разходите по II етап

Инсталацията все още не е узаконена от органите на ДТН и няма преки наблюдения върху работата и, но спестяването само на експлоатацията на КМ 12 извън отоплителния сезон би довело до икономия на 52 640 $. Цифрата се получава от разходите за мазут по 658 $ дневно и 80 дни работа извън сезона. Без да се отчита икономията на омекотена вода означава, че инсталацията би се откупила за 29 спестени дни.

Основни трудности при реализацията на етапите:

Трудностите биха могли да се разделят на две основни групи: следствия от вътрешнозаводски проблеми и следствие от проблеми извън завода. Към първата група спадат основно проблеми свързани с честите реорганизации, структурните промени и все още неустановена собственост. Резултатът е, че често се сменят хората отговарящи за определени направления - в случая енергийното стопанство. Тези промени не са фатални за проектите, но водят до неприятни забавяния, дължащи се най-вече на необходимостта новия служител да се запознае с приетите решения и да продължи работата по вече приетата схема. Явлението не е непознато за повечето стопански единици държавна собственост, но това не го прави по-приемливо. В случая с "Варненска корабостроителница" АД благоприятно бе, че човекът, който движеше персонално договора в началото, продължава да работи в

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завода, но на по-висока длъжност и при нужда винаги помага за решаване на конкретни проблеми. Благоприятно е и запазването на средния ръководен персонал - ръководителя и инженерите в енергиен отдел. Това улесни много работата по II етап на договора, когато след доставка на утилизационния котел се появиха различни виждания за монтажа му на други места в завода, но след намесата на Гл. Инженер и с подкрепата на началника на Енергиен Отдел, надделя първоначалната идея за използуване на съоръжението.
Друга голяма група проблеми са тези, създадени от външни институции и в случая с "Варненска корабостроителница" основните бяха свързани с митническите власти и ДТН.

Имаше период от 2 месеца след доставката на котела в София, през който се водеше преписка за освобождаване на съоръжението от митница София. Основният проблем се оказа липсата на част от придружаващите документи, според служители на митницата, а след това се оказа че те не са необходими, по реда одобрен за внос на помощи. Забавянето с два месеца обаче, повлия твърде зле на крайния срок за въвеждане в експлоатация, тъй като съвпадна с периода на отпуските и отне време повече от допустимото.

Друг съществен проблем бе липсата на паспорт на котела по смисъла на изискванията на органите от ДТН. Документацията доставена от производителя съдържа основните характеристики на котела, но липсват изчисленията на предпазната арматура и данните от дефектоскопските изследвания, задължителни по БДС за съдове работещи под налягане. Тези липси станаха повод органът на ДТН да откаже регистрацията на котела и въвеждането му в експлоатация. Предложено бе да се използува като водогреен, за да не е под надзора на ДТН. След разговори с компетентните органи бе решено да се направи нов паспорт на съоръжението съгласно БДС. Паспортът ще се изготви съвместно с инспектор от ДТН и въз основа на направените замервания и дефектоскопия ще се издаде необходимата документация.

Считам, че пропуските и забавянията в реализацията на етапите се дължаха основно на липсата на опит при осъществяване на подобни международни програми за участниците от Българска страна. Няма създаден стереотип за реакция и в контролните органи, което се отразява най-вече на сроковете за въвеждане в експлоатация, а оттам и в реализираната икономия. Това не е трудно за разбиране, като се отчете липсата на традиция при реализация на програми с чужда помощ, но в хода на работа се утвърдиха взаимоотношения както с контролните, така и с други държавни органи, които биха били полезни за бъдещи проекти на всеки от участниците.

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A review has been made over the 2 stages of contract EUR-00-2053-00 between "Varna Shipyard" and USAID. Since 1994 66 steam traps and a pressure reducing valve were delivered as equipment for the I stage of the contract. The total sum of delivery was 10 000 $. Another 12 300 $ were invested by the Shipyard in order to prevent damages of the delivered equipment. Since April 1996 an economy of 14080 $ from fuel savings and 2 820 $ from treated water savings were made. For the second stage a waste heat boiler was delivered. According to preliminary calculations it had to supply steam to the most distant consumers, which are consuming fuel for 658 $ daily, 80 days out of the heating season. The equipment price is 16 966 $ and another 2 000 $ are invested from the Shipyard to the moment. Due to the differences between Bulgarian and American Standards concerning the boiler documentation, it has not been put into operation, but a procedure has been established on how to proceed in order The Pressure Vessel Inspector to put the boiler in operation. It is expected the payback period to be not more than 29 days out of the heating season.

РЕЗУЛТАТИ ОТ ПРОЕКТА ЗА ЕНЕРГИЙНАТА ЕФЕКТИВНОСТ В ЗММ-ЕАД, СОФИЯ

Димитър Баев, Владимир Хранов, Цанчо Цанев, Никола Калоянов

1. Увод

Проектът е изпълнен въз основа на договор между ЗММ-ЕАД и ЕТ"Димитър Баев - DBC". Той е част от Проекта за енергийна ефективност на Министерството на промишлеността на Република България и Американската агенция за международно развитие (USAID). и бе реализиран с активното участие на консултанта от фирмата Hagler, Bailly Consulting, Inc. г-н Марк Оувън и с използването на безвъзмездно предоставеното от USAID енергоспестяващо оборудване. Проектът е разработен в съответствие с методологическите изисквания и стандартите, възприети от Асоциацията на енергийните инженери и фирмата Hagler, Bailly Consulting, Inc.

Изпълнението на проекта премина през следните етапи:

- енергиен преглед (одит);
- доставка на енергоспестяващо оборудване - I етап;
- технически проект;
- доставка на енергоспестяващо оборудване - II етап;
- работен проект;
- инсталация и внедряване.

Той стартира през 1994 г. и се очаква да приключи с цялостна реализация и оценка на резултатите през първата половина на 1997 г.

2. Обект и обхват на прегледа

ЗММ е предприятие с традиции в производството на металообработващи машини. През своето почти 100-годишно съществуване той е предлагал на пазара разнообразна машиностроителна продукция - от универсални стругове до съвременни машини с CNC-управление, обработващи центрове и автоматични линии.

Производствената дейност е организирана в обособени производства и звена. Технологичните връзки между тях са сложни. Производственият цикъл варира от един до няколко месеца. Производството е поръчково-ориентирано и има по-скоро единичен характер.

ЗММ се намира в труден период на развитието си в новите условия на преход към пазарна икономика. Има съществен спад на производството, сериозни икономически и финансови затруднения.

ЗММ задоволява потребностите си от енергия чрез доставка на:

- електроенергия от НЕК;
- топлоенергия от "Топлофикация " София;
- питейна вода от централния водопровод и собствен водоизточник.

Разходите на завода по видове енергия и по години са показани на Табл. 1 и Фиг.1 (в проценти по отношение на 1993 год.)

Табл. 1

Година	Консумация на гореща вода Gcal/год.	Консумация на пара Gcal/год.	Консумация на ел. енергия kWh/год.	Общи разходи за енергия хил. BGL/год.
1993	16,574	7,352	8,904	21,948
1994	8,837	6,070	7,233	26,276
1995	11,010	4,895	8,297	47,613
1996	1,369 (до 30.04.)	4,295 (до 30.04.)	6,373 (до 30.09.)	53,018 (до 30.09.)

Частта на разходите за енерия от годишната стокова продукция са показани на Табл. 2 и Фиг.2. Вижда се , че тази част расте много бързо и се превръща в основна конпонента от общите разходи.

Табл.2

Година	1992	1993	1994	1995
разходи за енергия/ стокова продукция	7.19%	10.4%	11.89%	22.71%

Проучването обхваща цялостната дейност на завода - от заготовитвлните производства до монтажните цехове, използването на всички видове енергоносители - електричество, пара, гореща и питейна вода.

Този комплексен подход наложи съставянето на колектив, включващ няколко от членовете на Асоциацията на енергийните инженери, както и активното участие на ръководители и специалисти от завода и особено от дирекция „Инвестиции и ремонт"

Целта на прегледа бе:

- Да се обобщи, систематизира и предостави на ръководството на завода информация за използването на енергията и за енергийните разходи;
- Да се предложат на ръководството на завода мерки за подобряване на управлението на енергийните разходи;
- Да се предложат на ръководството на завода мерки за икономия на енергия и на разходите, свързани с нея.

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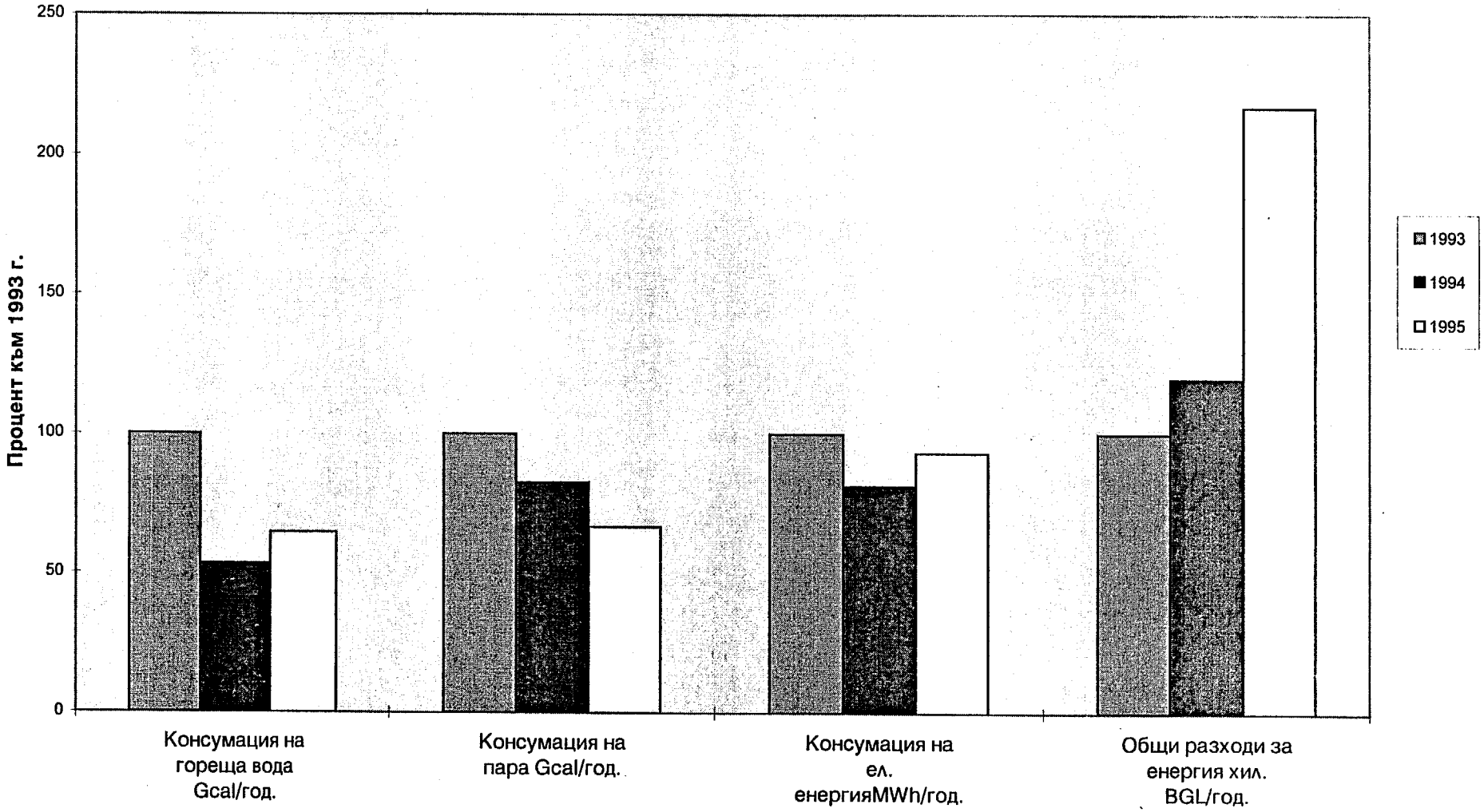
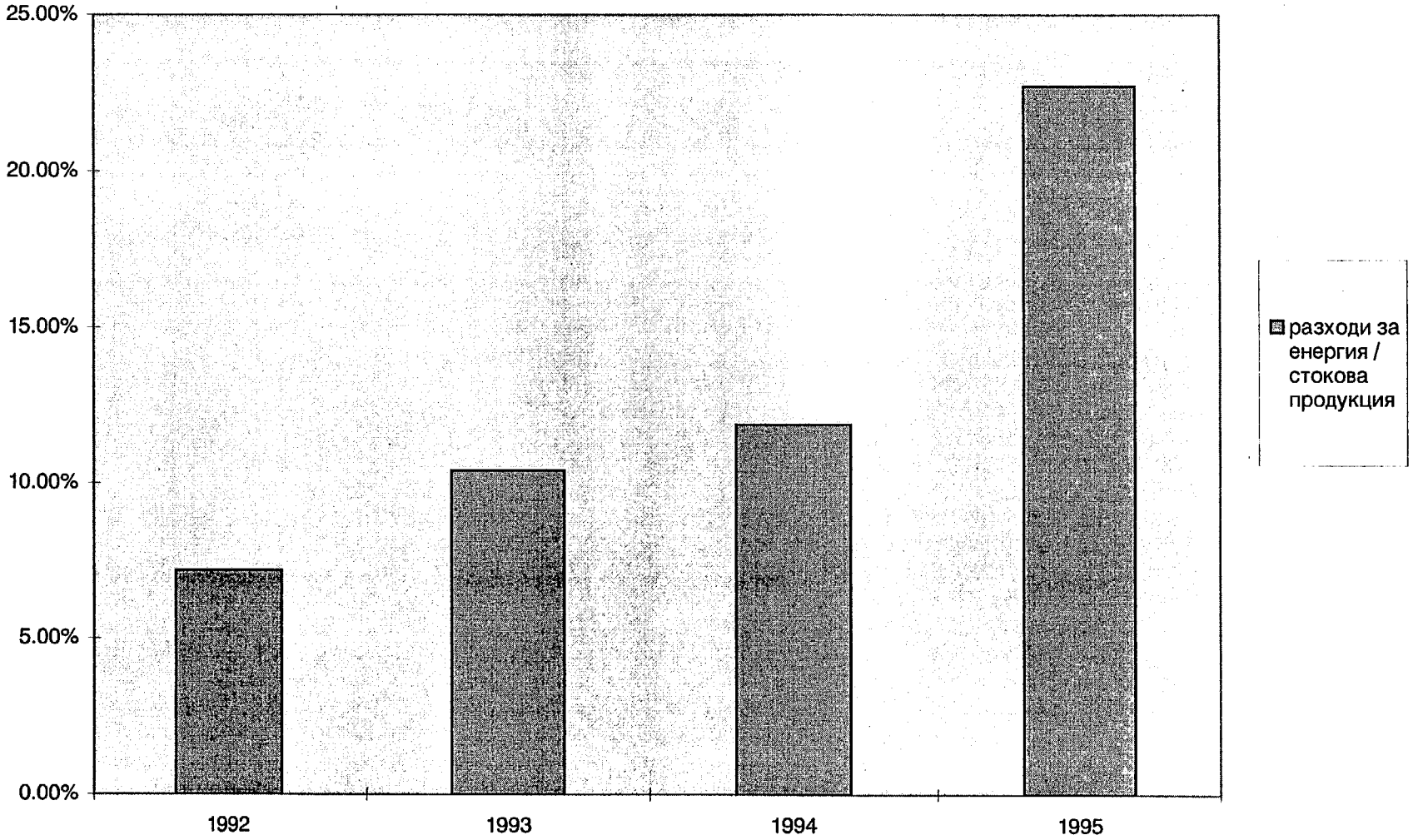
Фиг.1


250
200
150
100
50
0
Процент към 1993 г.
1993
1994
1995
Консумация на гореща вода Gcal/год.
Консумация на пара Gcal/год.
Консумация на ел. енергияMWh/год.
Общи разходи за енергия хил. BGL/год.

Фиг.2


25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
1992
1993
1994
1995
разходи за енергия / стокова продукция

В хода на прегледа са използвани следните форми за събиране на информация:

- Анализ на ретроспективните данни за консумацията на енергия от съществуващите отчетни форми и документеция;
- Въпросници и анкетни карти, адресирани към ръководители и специалисти на ЗММ от различни нива на управлението и с различни отговорности по отношение на енергопотреблението;
- Опис на състоянието на агрегати, прибори и технологии, оказващи влияние върху консумацията на енергия;
- Наблюдения и измервания на различни параметри на енергопотреблението в системите за разпределение, пренос и консумация на енергията.

Анализът е извършен върху база данни, структурирана чрез активни експерименти и измервания, която представлява допълнение и прецизиране на съществуващата в ЗММ информационна банка от данни за енергопотреблението.

Експерименталните измервания са извършени чрез предоставената от USAID преносима измервателна техника - комбинирани електрически прибори, ултразвуков дефектомер, цифрови термометри, пирометър и др.

По-специфичните измервания и наблюдения включваха:

- едноседмични часови показания на топломерите в главната абонатна станция и измерване количеството на връщания кондензат;
- ендоседмичен почасов товаров график на всички трансформаторни подстанции;
- запис на характеристиките на енергопотреблението на най-значимите консуматори.

3. Анализ на резултатите и изводи от енергийния преглед

В резултат на обработването на данните от прегледа бяха получени:

- индекси на съотнощението „енергия/продукция";
- баланси на инсталираните мощности по видове енегоносители;
- баланси на потреблението на енегия по видове енегоносители, консуматори и по години.

Извършеният анализ позволи да бъдат направени следните по-важни изводи, свързани с възможности за икономия на енергия:

- В завода не е въведена форма на достатъчно точна вътрешностопанска сметка, съгласно която на отделните обособени производства и самостоятелни звена да се начисляват разходите за енегия и те, както и останалите разходи, да влияят върху крайните резултати и заплащането. Към ръководството на завода и по звена не постъпва актуална и точна информация за действителната консумация, което не дава възможност за предприемането на оперативни и адекватни мерки за икономия на енергия.

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- Анализът на действителната консумация на топлина, извършен за периода от 14 месеца (01.01.1993 г. - 01.03.1994 г.). показа, че преобладаващият дял на горещата вода спрямо парата се корелира с изменението на обобщената характеристика на климата - месечните денградуси. Очертава се ясно изразена сезонна компонента, към която има и наслагващи се реакции, породени от предприети управленчески въздействия. Относителната независимост на топлинния товар за отопление от размера на произведената продукция прави още по-съществен въпроса за рационалното потребление на топлината на горещата вода.

- Причина за установения висок среден часов разход на мрежовата вода е ниската температура на топлоносителя. Без съществени отклонения температурата на постъпващата в главната абонатна станция вода от ТЕЦ се поддържа около 70 ^{o}C. Това температурно ниво съответства на температура на външния въздух 8 ^{o}C . Ниската начална температура на топлоносителя определя и ниската действителна степен на неговото охлаждане в отоплителните тела (около 6 до 10 ^{o}C), което понижава още повече на ефективността на системите.

- В действителната обстановка ниското температурно ниво в магистралата и несъответствието му на измененията на температурата на външния въздух, спецификата на отоплителните инсталации по "директна схема", както и липсата на автоматичен контрол на качеството на отоплението, са фактори, обуславящи почти "нулева" управляемост на системата като цяло.

- Налягането на постъпващата в системата пара е много по-високо (9-12 атс.) от достатъчното (6 атс.) за извършващите се процеси. Високото налягане е фактор и за често предизвикване на пробиви в паропреносната мрежа и съоръженията.

- Съпоставката между подадената пара и връщания кондензат показва дебаланс 25-30 %, което е признак за неплътности в системата. Кондензатът се връща с много висока температура и представлява паро-водна смес - признак за неработещи кондензни гърнета.

- Електроснабдителната система е проектирана за пренос и разпределение на значително по-големи мощности. Изследването показва, че е възможно с подходящо включване и изключване на силовите трансформатори да се повиши cosϕ и да се намалят загубите от работата им на празен ход.

- cosϕ на електроснабдителната система е много нисък, не се извършва изкуствено компенсиране и това води до плащане значителни суми за глоби на лош cos ϕ).

- В основната си част осветителната система е неефективна поради използването на освтителини тела и източници с висока консумация.

- Не се използва тарифна стратегия за разход на електрическа енергия.

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4. Мерки за икономия на енергия

В рзултат на извършения анализ бяха предложени мерки за икономия на енергията, разделени на три групи - мерки за усъвършенстване на управлението на енергопотреблението, за икономия на топлинна енергия и за икономия на електроенергия. Обобщени характеристики на тези мерки - възможната икономия в натурални единици и на средства, както и на сроковете за изкупуване на разходите са показани на Табл. 3. Цялостното им въвеждане крие потенциални възможности за съкращаване на разходите за енергия с около 30%. Разбира се, комулативният ефект на някои от взаимно-свързаните мерки, особено на тези за икономия на пара, следва да бъде редуцуран. Както се вижда, в състава на предложените мерки има такива, изискващи ниски разходи (B1, B3, B4, B5, C1, C5, C6 и C8), средни разходи (A1, B2 и C3) и значителни инвестиции (A2, C2, C4, C7, C8, и C9). На ръководсрвото на завода беше предложен план-график за етапно внедряване на най-целесъобразните мерки, отчитайки размера на възможните икономии, ресурсите, които заводът може да насочи за реализацията им, както и помощта, която беше предложена от USAID.

На първия етап основното внимание бе насочено към мерки, не изискващи големи инвестиции. Заводът се ангажира с въвеждането на режимно-технологични карти, изключването на ненатоварените трансформатори, подобряване управлението на асансьорите. USAID подкрепи въвеждането на мерките за управление на налягането в системата за разпределение на парата и за автоматично управление на подгряваната вода, като достави безвъзмедно следните технически средства на фирмата Spence от САЩ на обща стойност около $10,000:

- Редуцир-вентили за пара 4" и 2";
- Терморегулуращи вентили за пара - 10 бр.

През втория етап вниманието бе насочено към задчи с по-големи възможности за икономии на енергия и изискващи значителни инвестиции, в съответствие с условията на USAID за участие във втората фаза на програмата. Тези задачи бяха разгледани като части на една интегрирана система за управление на енергопотреблението в завода в разработения технически проект:

- Преминаване към собствено топлозахранване;
- Компенсиране на реактивните товари чрез кондензаторни батерии;
- Преустройство на осветителните уредби в цеховете 03 и 06;
- Развитие на системата за контрол и управление на енергийните разходи (СИКУЕН).

В таблични форми са показани основните характеристики на всяка от тези мерки.

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ТАБЛИЦА 3. ОБОБЩЕНИ ХАРАКТЕРИСТИКИ НА МЕРКИТЕ ЗА ЕНЕРГИЙНА ЕФЕКТИВНОСТ - ЗММ-ЕАД СОФИЯ

СЪЩЕСТВУВАЩИ УСЛОВИЯ

	Гор.вода консумация Gcal/год.	Пара консумация Gcal/год.	Ел.върхова мощност kW	Електроенергия консумация kW/год	Общо разходи за енергия хил.лв./год
РАЗХОД	16,574	7,352	14,810	8,904	21,948

ОБОБЩЕНИЕ НА ПРЕПОРЪЧИТЕЛНИТЕ МЕРКИ ЗА ЕНЕРГИЙНАТА ЕФЕКТИВНОСТ

Мярка No	Описание на мерките	Гор.вода икономии Gcal/год.	Пара икономии Gcal/год.	В.мощност икономии kW	Електроенергия икономии kW/год	Общо иконом. на енергия хил.лв./год	Разходи за мярката хил.лв	Период на изкупуван. (год.)
А.1.	Усъвършенстване на системата за инф. и управление на енергията	663	924		356.5	878.0	300	0.34
А.2.	Интегрирана инф.система за производство и енергия	83	37		37.0	1000.0	1,720	1.72
В.1.	Управление на налягането в системата за разпредление на парата		624			444.0	202	0.45
В.2.	Управление на температурата на гореща вода в топлообменниците		504			359.0	426	1.19
В.3.	Контрол на течове в конд. гърнета, на вода и въздух		744			445.0	176	0.40
В.4.	Въвеждане на режимно-технол. карта за контрол на разхода на пара		1,080			761.0	50	0.07
В.5.	Внедряване на сист.от топлообм.за изп.на топлината на кондензата		648			457.0	162	0.35
С.1.	Изключване на ненатоварените трансформатори				60.0	150.0	50	0.33
С.2.	Усъвършенстване на осветителните системи			62.4	212.0	240.0	400	1.67
С.3.	Подобряване на cos ϕ					2,000.0	1,000	0.50
С.4.	Подмяна на ЛНЖ с луменисцентни лампи			11.2	41.0	50.0	93	1.86
С.5.	Инсталиране и изолиране на новите електролитни пещи			48	78.0	93.0	30	0.32
С.6.	Изместване на изпитателните операции в извънпиковите зони				15.0	18.0	5	0.28
С.7.	Рационализиране на управлението на асансьорите			1	0.5	0.6	1	1.67
С.8.	Подобряване на режима на работа на електролитните пещи			20	110.0	132.0	20	0.15
С.9.	Заместване на електромагнитните маси с магнитни				27.0	32.0	80	2.50
							4,715	0.67
ОБЩО ИКОНОМИИ		746	4,561	142.6	937.0	7,059.6		
ИКОНОМИИТЕ КАТО % ОТ ТЕКУЩИЯ РАЗХОД		4.5	62.0	0.96	10.5	32.2		

Мярка 1: Преминаване към собствено топлозахранване

Начални условия:

Общо разходите за пара и гореща вода за 1995 г. са 38,028 хил. лв. Анализът на съществуващата топлообменна система на основния топлоносител - горещата вода показва следните главни недостатъци:

- В точките на присъединяване към основната топлопреносна мрежа (на ТЕЦ София) падът на налягането е недостатъчен;
- Вътрешната отоплителна система е изпълнена преобладавщо по директна схема;
- Температурата на постъпващия топлоносител е ниска при развита вътрешна топлопреносна мрежа на голяма площ.

Описание на мярката:

Създавне на собствен топлоизточник. Съществуващият топлинен товар за пара и гореща вода се осигурява от 1бр. парен котел ПКМ 2 и два броя водогрейни котли ВКГМ4 - българско производство. Парният котел ще обслужва и спомагателните съоръжения за подгряване на горивото в основните и дневните резервоари. Инсталацията на съоръженията се извърши със средства на завода в периода октомври-ноември 1996 год.

Финансов анализ:

Материални разходи	Разходи за проектиране и инсталация	Общи разходи	Годишно разходи за поддържане
$ 160,000	$ 13,000	$ 173,000	$ 48,000

Ефект Икономия на енергия	% Икономии	Икономия в нат. единици	Икономия на средства в $US
Гориво (MBTU)			
Ел. енергия (MWh)			
Общо икономии			84,000
Срок на изкупуване (год.)			2.05

План-график за внедряване: 1995-1996 год.

Продължителност на действие на мярката: 15 год..

Мярка 2. Компенсиране на реактивните товари чрез кондензаторни батерии

Начални условия:

В завода не се извършва компенсиране на реактивните товари. За периода септември 1995-септември 1996 г глобите за лош cosϕ са 2,995,066 лв.

Освен това, намаленият cosϕ води до следните нежелателни последици:

- увеличване загубите на мощност и енергия;
- увеличение загубите на напрежение.

Значителна реактивна мощност консумират трансформаторите. Реактивната мощност на празен ход на трансформаторите е около 7% от номиналната им мощност. При празен ход на трансформатора cosϕ е около 0,1-0,2. Подобни са характеристиките на ненатоварените трансформатори.

Описание на мярката:

При подчертано неравномерния график на реактивните товари се възприе да се монтират кондензаторни батерии със система за автоматично поддържане на cosϕ.

Кондензаторните устройства трябва да се оборудват с кондензаторни батерии с обща реактивна мощност 360 kVar за 100% натоварване на трансформаторите. Тъй като в момента натоварването е около 60%, като начало се реши да се включат 240 kVar. Инсталирането на системата бе извършено на части в периода септември-ноември 1996 год. От началото на м. октомври cosϕ е 0.90 и заводът не плаща глоби.

Финансов анализ:

Материални разходи	Разходи за проектиране и инсталация	Общи разходи	Годишно разходи за поддържане
$ 8,750	$ 3,500	$ 12,250	$ 2,000

Ефект Икономия на енергия	% Икономии	Икономия в нат. единици	Икономия на средства в $US
Гориво (MBTU)			
Ел. енергия (MWh)			
Общо икономии			12,000
Срок на изкупуване (год.)			0.98

План-график за внедряване: 09.-11. 1996 год.

Продължителност на действие на мярката: 5 год.

Мярка 3. Преустройство на осветителните уредби в цеховете 03 и 06

Начални условия:
Съществуващите осветителни уредби са изпълнени с живачни лампи 210 бр. x 400 W, 20,000 lm, цокъл E - 40, които са неефективни.

Описание на мярката:

Замяна на съществуващите 210 бр. тела във всеки от цеховете живачни лампи по 400 W с 64 бр. нови тела с натриеви лампи с високо налягане по 400 W. При това положение инсталираната мощност в един корпус се намалява с 58.4 kW, като се запазват проектните характеристики за осветеност на помещенията.
Създаване на система за ръчно и автоматично управление на осветлението по секции. Броят на обособените секции за всеки цех е 4. Предвижда се възможност за промяна на броя на включените лампи в зависимост от осветеността на помещенията.
Мярката бе включена във втората фаза на проекта на USAID, като на завода беше предоставено безвъзмездно следното оборудване:

N	Бройки	Модел #	Описание на устройството	Цена $US
1	128	BL-400 SE-LB1	Осветителни тела на фирмата Hubbell	17,024
2	156	LU 400, E -40	Натриеви лампи с високо налягане	1,872
3	2	LCX 810	Контролери за управление на осветлението - 8 универсални входа на фирмата Andover Control	2,960
4	8	MK7-BCCS-1/5	Сенсори за осветеност	960

Инсталирането на системата се извършва в периода октомври-ноември 1996 год.

Финансов анализ:

Материални разходи	Разходи за проектиране и инсталация	Общи разходи	Годишно разходи за поддържане
$ 22,816	$ 3,846	$ 26,662	$ 2,000

Ефект Икономия на енергия	% Икономии	Икономия в нат. единици	Икономия на средства в $US
Гориво (MBTU)			
Ел. енергия (MWh)		300	9,415
Общо икономии			9,415
Срок на изкупуване (год.)			2.83

План-график за внедряване: 09.-12. 1996 год.

Продължителност на действие на мярката: 10 год..

Мярка 4. Развитие на системата за управление и контрол на енергийните раходи (СИКУЕН).

Начални условия:

В завода е внедрен първи етап от системата за управление и контрол на енергийните разходи. Тя се базира на интегрираната система за измерване, контрол и регистрация „InPac 500", произведена от българската фирма „ИНЛОГ" и внедрена от ЕЛЕКТРОСИСТЕМИНЖЕНЕРИНГ. Първият етап на системата включва:

- Операторска станция - 1бр. - за наблюдение на електропотреблението, разхода на топлоенергия, обработка на събраната информация и разпечатване на товарови графици и енергийни баланси.
- Концентратор на данни - 1 бр. - за събиране и съхраняване на информация от 54 електромера за активна и реактивна енергия.
- Топломери за измерване на количеството топлина и разход при топлоносител пара - 4 бр.
- Топломери за измерване на количеството топлина и разход при топлоносител прегрята вода - 3 бр.

Описание на мярката:

Да се разшири СИКУЕН по обхват и с функции на управление, като се добавят:

- в разпределителната система за пара - 2 управляващи модула към 2 от съществуващите топломери и 2 електронно-управляеми вентила;
- в разпределителната система за топла вода - 3 нови топломера и 2 електронно-управляеми вентила;
- развитие на функциите по мониторинг и контрол на системата.

Мярката бе включена във втората фаза на проекта на USAID, като на завода беше предоставено безвъзмездно следното оборудване:

N	Бройки	Модел #	Описание на устройството	Цена $US
1	2	859108-1B20-1A1-ITFJ5E	Управляеми вентили за пара на Honeywell - 3" и 2"	5,156
2	2	859108-1B20-2BJ и 2AJ	Управляеми вентили за гореща вода на Honeywell - 6" и 5"	8,437
3	4	InPac и 200-C InPac 200	Топломери с управляващи модули на ИНЛОГ	3,720
4	1	InLog 100	Топломер на ИНЛОГ	2,520
5	1	5/50 VE2 Model 640	Компютърна система на Hewlett Packard	4,658

ЗММ пое ангажимента да участва със закупуването на останалите необходими технически средства като диафрагми за топломерите, датчици за температура, налягане, диференциални манометри, проводници и др. на обща стойност 7,850 $US.

Финансов анализ:

Материални разходи	Разходи за проектиране и инсталация	Общи разходи	Годишно разходи за поддържане
$ 32,816	$ 9,500	$ 41,891	$ 3,500

Ефект Икономия на енергия	% Икономии	Икономия в нат. единици	Икономия на средства в $US
Топл. енергия (Gcal)	пара - 7 топла вода - 5	460 454	13,650 11,334
Ел. енергия (MWh)			
Общо икономии		914	24,984
Срок на изкупуване (год.)			1,67

План-график за внедряване: 09.1996 - 03.1997 год.

Продължителност на действие на мярката: 10 год..

5. Заключение

Проектът за енергийна ефективност, спонсориран от USAID, оказа съществено влияние върху задълбочаването и развитието на програмата за икономии на енергия в завода. В хода на изпълнението му бяха разкрити възможности за ефективни мерки, някои от които бяха успешно реализирани. Безвъзмездно дареното оборудване от USAID дава възможност за изпълнението на проекти, изискващи по-висока концентрация на инвестиции за въвеждането на съвременни, високоефективни решения. Необходимо е, въпреки трудностите, които изпитва завода, да продължат усилията за цялостна реализация на мерките и на икономиите, произтичащи от тях.

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Results from the ZMM Energy Efficiency Project
(Abstract)

Dimitar Baev, Vladimir Hranov, Tsancho Tsanev, Nikola Kaloyanov

The project was carried out on the base of contract between ZMM Inc. - Sofia and ET "Dimitar Baev - DBC". It is implemented as a part of the Project of the US Agency of International Development (USAID) for energy efficiency in Bulgaria . and passed though the following stages - energy audit, first phase equipment delivery, technical project, second phase equipment delivery, installation and implementation.

ZMM Inc. - Sofia is an enterprise with traditions in the production of machine-tools. During it's 100 years of existence it supplied to the market various machine-building production - from the general purpose lathes to modern NC-controlled machines, machining centers and automatic production lines.

The audit comprises the whole activities of the plant, the use of the electrical and thermal energy and the all kinds of energy carriers - electricity, steam, hot and drinking water.

During the audit have been identified 2 Energy Management Improvement Measures, 5 Thermal Energy Efficiency Measures and 9 Electrical energy Efficiency Measures. The implementation of all measures could save 4,077 Gcal/year and 936.5 MWh/year. The expected total savings are 7,059.6 ths. BGL/year. That is 32.2% of total energy costs. The total costs for the implementation of the measures are 4,715 ths.BGL. The average payback period is 0.67 year.

USAID has supported the implementation of the measures for improved pressure control in the steam distribution system and for hot water temperature control and donated to the plant 2 steam pressure reducing valves and 10 steam temperature regulating valves.

The following energy efficiency measures have been developed during the second phase of the Project:

- Transition to a local thermal supply station;
- Power factor improvement;
- Lighting systems in shop-floors 03 and 06 improvement;
- Development of Integrated Energy Monitoring and Control System.

All investments and engineering works for the first two measures were covered by the plant. For the last two measures USAID donated to the plant the following energy saving equipment:

- High pressure sodium vapor lamps;
- Industrial low bay lighting fixtures;
- Lighting Control Systems;
- Thermal Control Valves;
- Thermal Metering and Control System;
- Computer System.

Lighting equipment is installed in the plant and is in process of implementation. the thermal control and management equipment is expected to be installed by the end of 1996. All measurements confirmed the preliminary estimations of the energy savings.

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

Beginning

)77 the role of the energy engineer and the energy ıger was not defined. When the Association of gy Engineers (AEE) embarked on its mission to ıote the information exchange in the emerging ;y marketplace it also needed to define the role of :nergy engineer manager. The energy engineer ged as the systems integrator who utilized all ıologies from lighting to heating and air itioning to makeing buildings and plants more :ent. The energy manager needed a fundamental rstanding of the efficient technologies involved but needed expertise in financing energy projects and ıasing fuels. The Association of Energy Engineers ɔmprised of engineers and managers from all ɔlines including professionals with electrical, ıanical and process backgrounds. In addition, AEE bers come from various segments of the etplace as indicated in Figure 1.

:LD OF EMPLOYEMENT	
	27.7
nsultant	4.4
ıipment Supplier	.3
:hitect	9.7
te, Local or Federal Government	8.3
ntractor	2.2
ıcator & R&D	26.8
ergy User (Building, Plant & Facilities)	3.1
ıer	15.6
lity & Energy Supplier	2.0
veloper & IPP	
RCENT	

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.

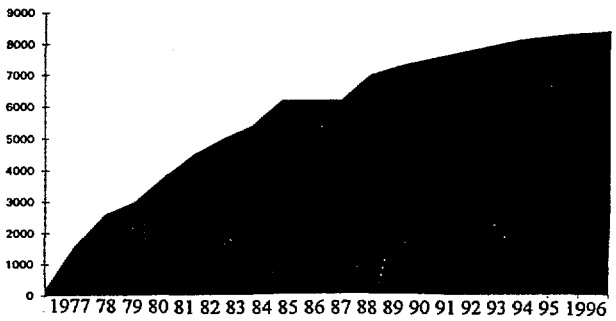


Figure 2: AEE Membership Growth

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
Bulgaria
Caracas, 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

AEE is recognized as a leader in promoting high quality 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)

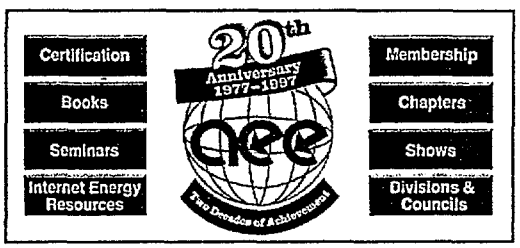
The CLEP program was developed out of the need to identify specialists in lighting efficiency. The CLEP program includes 435 professionals who have been certified and are recognized as meeting the certification requirements of the EPA Green Lights Lighting Management Company Ally Program. The program 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 good sense is because of high use satisfaction. Energy Management 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.

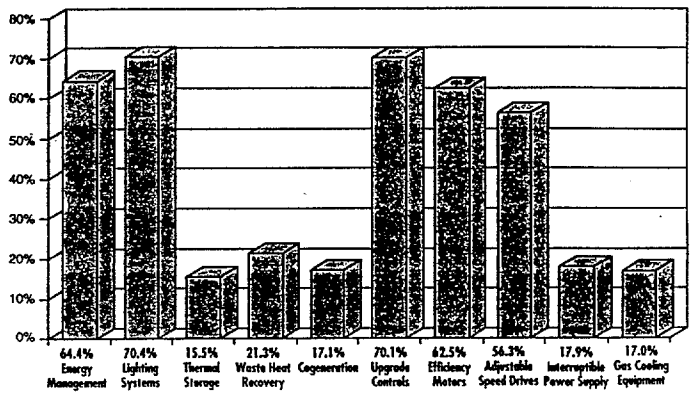


Figure 5: Products Planned for Installation in Next 12 Months

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.

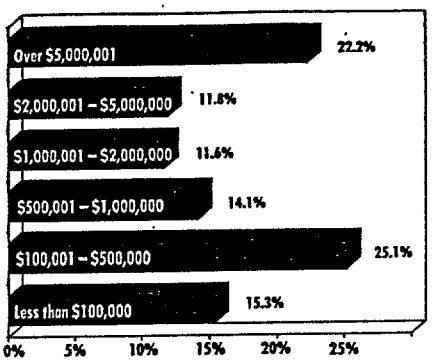


Figure 6: Accumulated Energy Costs Saved

% 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.

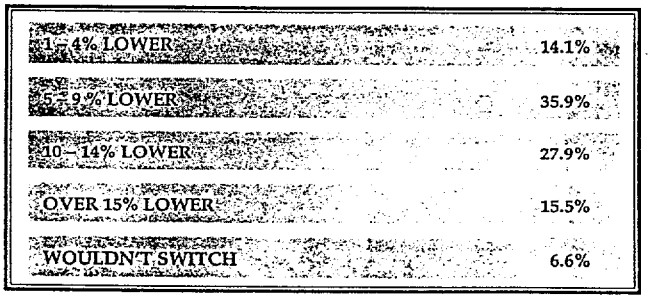


Figure 8: Would You Buy Power from Another Supplier if Utility Rates Were Lower

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.

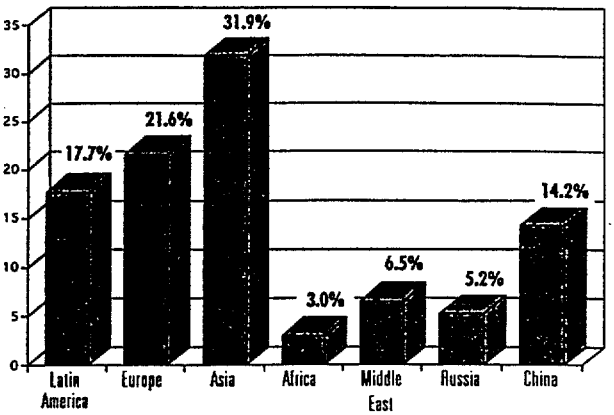


Figure 9: International markets for Cogeneration & Independent Power

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.

USAID ENERGY EFFICIENCY MARKET DEVELOPMENT PROGRAM FOR EASTERN EUROPE

1996 SURVEY of ENERGY MANAGERS

by:

Michael Ellis
Hagler Bailly Consulting

INTRODUCTION

This Energy Efficiency Market Development Program builds upon the results of the 1991 USAID Emergency Energy Project, in which energy management programs were carried out in various industrial, commercial, and public enterprises.

In the 1991 project, the primary objective was to achieve short-term, low-cost energy savings, focusing on oil and gas, and U.S. contractors had primary responsibility for the work, assisted by a local subcontractors. In the Energy Efficiency Market Development (EEMD) project, the effort was extended to include greater attention to management and organizational issues, and primary responsibility for the work will shift to multiple East European private sector enterprises.

The EEMD project in Hungary, Romania, and Bulgaria is designed to serve as a catalyst to assist private energy service firms to develop a market for energy efficiency services, and to develop their capability to serve this market.

The major activities under this program have been:

1.Training in energy efficiency for private sector engineers on market-oriented business subjects (such as management, accounting, economics and finance), energy audit techniques, hands-on use of energy efficiency monitoring equipment, performance contracting, project management, industrial management, quality, maintenance and optimization, marketing and management for energy efficiency service companies, and a certification examination (Certified Energy Manager by Association of Energy Engineers, AEE).

2. Establishment of a local chapter of AEE, supply of US energy audit equipment, and assistance to develop AEE as a sustainable market-oriented professional association.

3. Energy management programs in representative facilities, predominantly industrial enterprises. Each program will include advice in energy management from local experts, an energy audit report, and a grant to be applied as cost-sharing toward the purchase of US equipment. Each client

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enterprise has signed a contract to participate in the program, and will pay a market-based fee to the local consultants for the services.

4. Conference and exhibition on industrial energy management. Project results will be reported to plant directors, chief engineers, production managers, and energy managers in a conference, with related publicity.

OBJECTIVES

The general objective of the EEMD project will be to serve as a catalyst to accelerate the development of a market for an energy efficiency industry, and to assist firms in the private sector to develop their capability to serve this market.

The specific objectives of the EEMD project are:

1. Foster the development and capability of private firms to provide energy efficiency services, equipment, and financing to industrial clients;

2. Assess the climate for investments in energy efficiency projects, and provide advice, studies, and seminars to promote increased private investment in energy efficiency;

3. Improve energy efficiency in specific pilot sites (especially industrial enterprises), through provision of energy audits and energy-saving equipment;

4. Expand East European-U.S. technical and commercial ties through linkages between energy efficiency associations, engineering and energy service companies, and equipment suppliers.

THE SURVEY

A survey of private energy service companies who participated in the program from the inception, through to the completion of energy efficiency projects, was conducted in 1996. The purpose of this survey was to assess the business operations of these firms and evaluate the impact that the USAID EEMD program has had on developing a market for energy efficiency services.

The survey covered the period 1992 through 1996 and addressed the following indicators:

1. Company Profile
2. Business Activities
3. USAID Training Program
4. On-Site Technical Assistance
5. Association of Energy Engineers
6. Recommendations for Future Programs

The results of the survey have been compiled and the key conclusions and findings presented in this brief report.

FINDINGS

Company Profile:

All of the firms experienced a significant increase in the number of clients and number of contracts for the period 1992 through 1996: for Hungary there was a three-fold increase, for Bulgaria a five-fold increase, and for Romania a two-fold increase. In Romania, The ratio of contracts to clients also increased from approximately 1:1 to 1.25:1.

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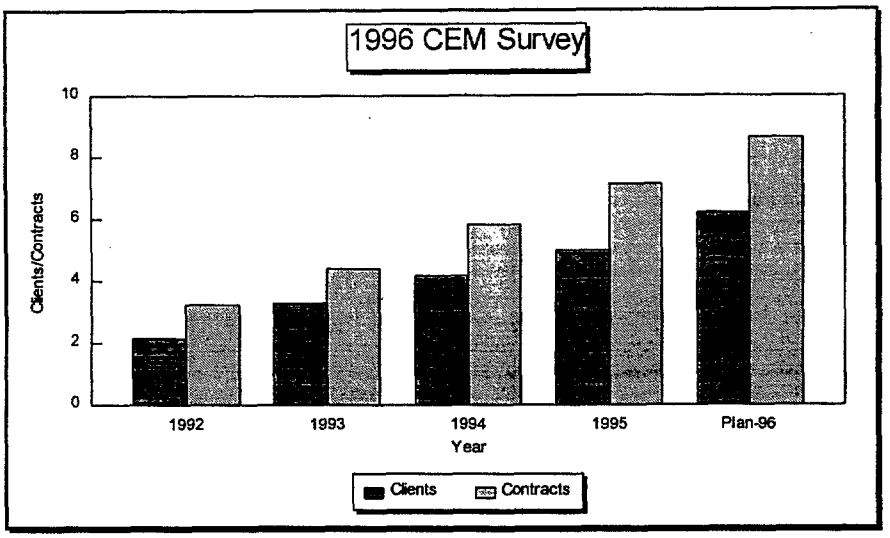
Turnover increased at a healthy rate, averaging 300% for Hungary, 1,400% for Bulgaria, and 2,500% for Romania.



Full-time staff remained relatively constant for all firms for all three countries, but part-time employment (associates, consultants, etc.) Increased sharply with increasing contract work.

A summary of the results of the company profile survey are included herein as attachments.

Business Activities:

The survey respondents were asked a series of six questions:

1. How helpful was the USAID program to improving your capabilities to carry out the normal business activities of your firm?

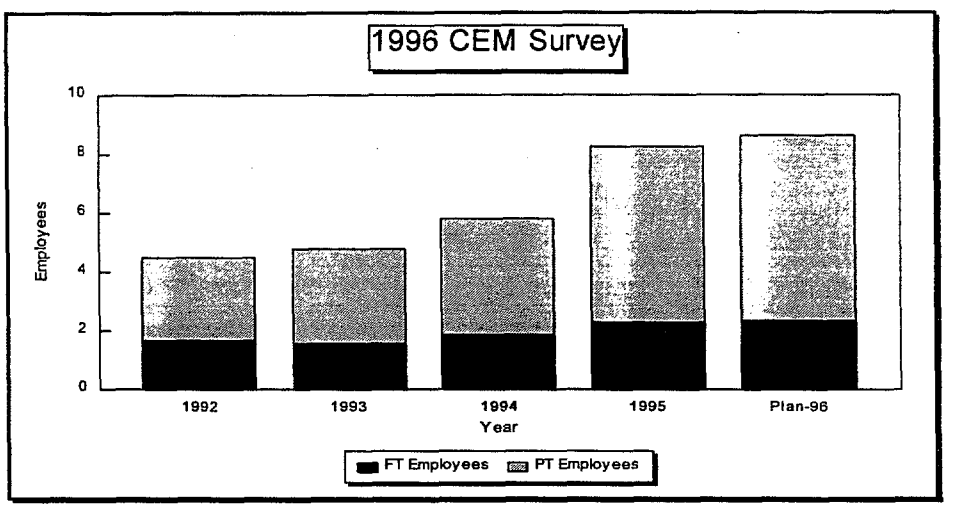
The majority of respondents answered *very helpful*, and cited management and marketing techniques as the primary enhancement.

2. As a result of the USAID program, have you ventured into any new areas of business activity, or expanded the range of services you provide to your clients?

The major response was yes, but many respondents made note of the difficult domestic economic conditions and the impediments to expanding their business.

3. Has you level of business activity increased as a result of benefits your firm may have gained from the USAID program?

This question generated a mixed response from *just a bit* to *yes a lot*, and again reflected



the general economic conditions of the country.

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4. Was your participation in this USAID program helpful in enhancing the professional standing of your firm?

This question generated the most number of positive responses with the AEE energy manager certification noted as the greatest benefit.

5. Was the USAID program helpful in making you aware of the commercial market potential of energy efficiency and related activities?

Again, this question yielded a mixed response from *somewhat helpful* to *extremely helpful*, with the difficult commercial market opportunities cited as the major hurdle.

6. Was the USAID program helpful in enhancing your capabilities to offer services to your clients in the field of energy efficiency?

This question also yielded a large number of positive responses with most CEMs indicating a higher level of confidence in offering energy efficiency services.

Training Program

The survey respondents all completed the CEM training program and were asked a series of six questions regarding the training program:

1. Was the training program relevant to your business activity?

Yes, all respondents cited the various program elements as having a direct bearing on their business activities.

2. What particular aspect of the training program was most beneficial and what was the least beneficial?

Most participants did not make a distinction, however, the more immediate and applicable topics (e.g. performance contracting) were cited as the most beneficial.

3. Did you obtain CEM certification and if so, was the certification program helpful in enhancing your capabilities, professional standing, or marketing capability?

Yes, all the participants passed the certification exam and felt that the certification enhanced their professional standing.

4. Has your business realized a higher level of expertise and professional capability as a result of the training program?

Yes, particularly in the business and organizational management areas.

5. Has the general level of professional competence among individual staff members been enhanced by the training program?

Yes, particularly in the business and organizational management areas.

6. What other training activities would you like to see offered to make your business successful?

Some of the training areas mentioned are:

- marketing
- proposal writing
- organizing an ESCO
- DSM
- business plans

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- organizational efficiency
- financing energy efficiency projects
- AEE outreach training programs

ON-SITE TECHNICAL ASSISTANCE

Four questions were asked of the respondents relating to the on-site technical assistance of USAID advisors on the industrial audit and energy efficiency improvement projects:

1. Did working with the advisor help you develop skills and methodologies that were helpful in enhancing your ability to provide similar energy audit services for your clients?

The majority of participants answered *very helpful* to this question, citing the experience of the on-site advisors.

2. Did working with the advisor help you develop skills and methodologies that were helpful in enhancing your ability to provide similar energy audit services for your clients?

Yes, particularly in the presentation of results and organization of energy audits.

3. Was the equipment provided to your client plant helpful to the development of your own business?

Again, the equipment was rated *very helpful* in the majority of responses

4. Overall, did the USAID program give a significant boost to marketing your services?

Most respondents rated the USAID program as *very helpful*, although they also illustrated the problems of marketing energy efficiency services in their respective countries.

ASSOCIATION OF ENERGY ENGINEERS

The survey respondents were queried on the benefits of the AEE chapters established in each country:

1. Have you been active in the local chapter of the Association of Energy Engineers?

Yes, most respondents are very active.

2. Do you feel that the development of the AEE chapter is worthwhile?

Everyone agreed that the AEE chapter is worthwhile, primarily for professional development and contacts. Many respondents cited the need for additional AEE programs.

3. USAID provided energy auditing equipment to the AEE Chapter. Did the USAID-supplied equipment help you in your business?

The consistent response was, *very helpful.* Most respondents cited the availability of advanced diagnostic equipment is significant benefit of the AEE chapter.

4. For those who attended the AEE meetings in Atlanta, was your participation in these events worthwhile?

Yes, particularly the opportunity to meet US experts and equipment manufacturers and make contacts.

RECOMMENDATIONS FOR FUTURE PROGRAMS

There were a wide variety of recommended programs for consideration:

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- Funding of energy efficiency projects is a major problem in Eastern Europe and additional technical assistance in this are would be helpful.

- Continued support of local AEE chapters and expansion of the AEE programs and services

- Promotion of joint ventures with US companies

- Training in project financing and energy audit technologies

- Establishment of an energy efficiency fund

- Expanded CEM certification programs

- Joint Eastern European AEE activities

- Training in demand-side-management

- Training in environmental impact of energy efficiency

- How to organize an energy service company

- Training and support for performance contracts

- Broad based promotional and information dissemination programs

- Additional diagnostic equipment

SUMMARY

The overall response to the survey was very positive, particularly in the more practical areas of: training, on-site technical assistance, and energy audit equipment.

The CEMs also recognized the advantage of AEE chapter membership and potential beneficial services offered by the Chapters.

The recommended future actions all concern positive and proactive programs which would serve to support the development of private sector orientated energy service companies.

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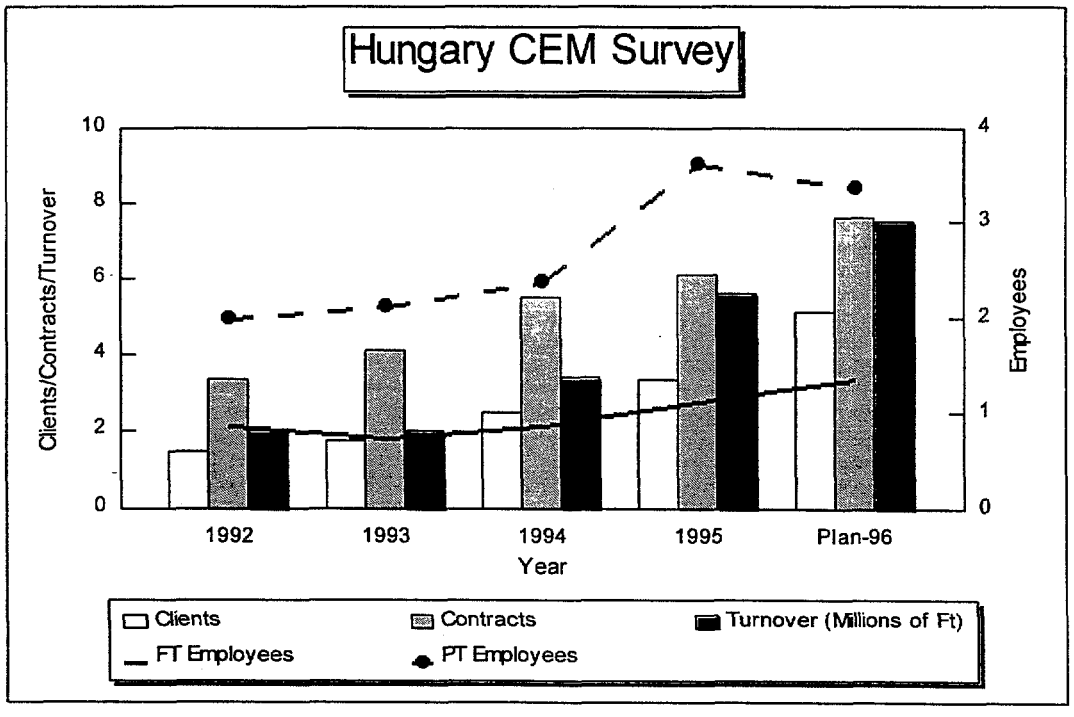
USAID EEMD Program - Hungary
Survey of Hungarian Certified Energy Managers
Company Profile
Averages

Category	1992	1993	1994	1995	Plan-96
CLIENTS	12	14	20	27	41
Average	1.50	1.75	2.50	3.38	5.13
%	0%	17%	43%	35%	52%
CONTRACT	27	33	44	49	61
Average	3.38	4.13	5.50	6.13	7.63
%	0%	22%	33%	11%	24%
TURNOVER	16.00	16.00	27.50	44.90	60.00
Average	2.00	2.00	3.44	5.61	7.50
%	0%	0%	72%	63%	34%
FT EMPLOY	7	6	7	9	11
Average	0.88	0.75	0.88	1.13	1.38
%	0%	-14%	17%	29%	22%
PT EMPLOY	16	17	19	29	27
Average	2.00	2.13	2.38	3.63	3.38
%	0%	6%	12%	53%	-7%



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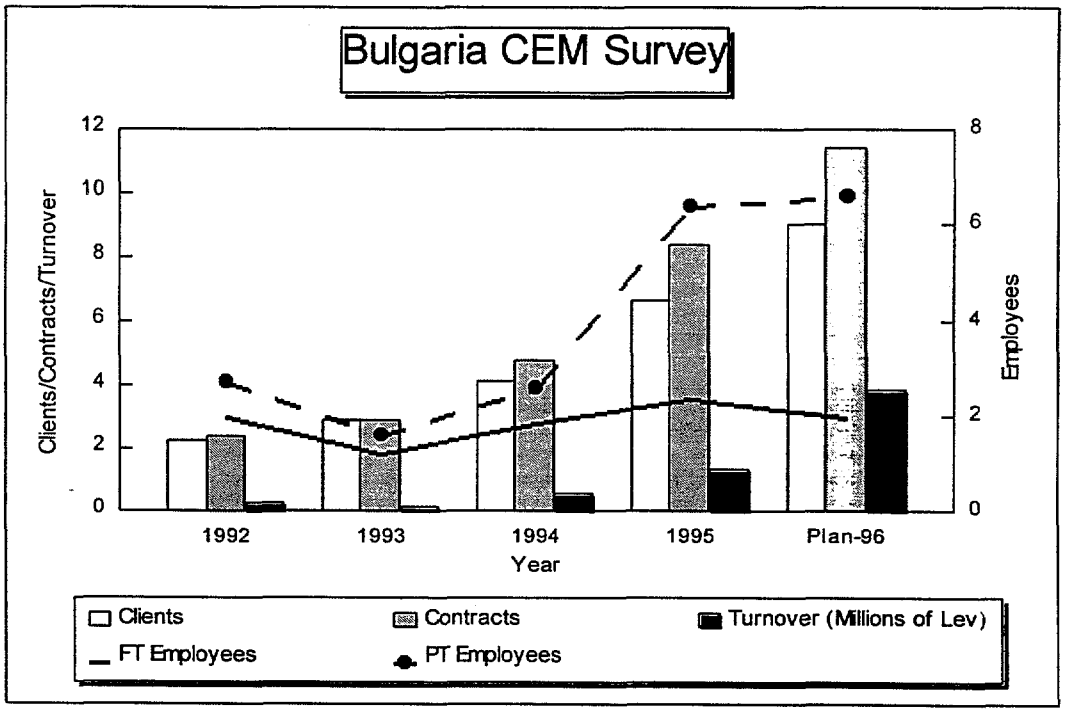
USAID EEMD Program - Bulgaria
Survey of Bulgarian Certified Energy Managers
Company Profile
Averages

Category	1992	1993	1994	1995	Plan-96
CLIENTS	18	23	33	53	72
Average	2.25	2.88	4.13	6.63	9.00
%	0%	28%	43%	61%	36%
CONTRACT	19	23	38	67	91
Average	2.38	2.88	4.75	8.38	11.38
%	0%	21%	65%	76%	36%
TURNOVER	1.93	0.96	4.63	10.53	30.84
Average	0.24	0.12	0.58	1.32	3.86
%	0%	-50%	380%	127%	193%
FT EMPLOY	16	10	15	19	16
Average	2.00	1.25	1.88	2.38	2.00
%	0%	-38%	50%	27%	-16%
PT EMPLOY	22	13	21	51	53
Average	2.75	1.63	2.63	6.38	6.63
%	0%	-41%	62%	143%	4%



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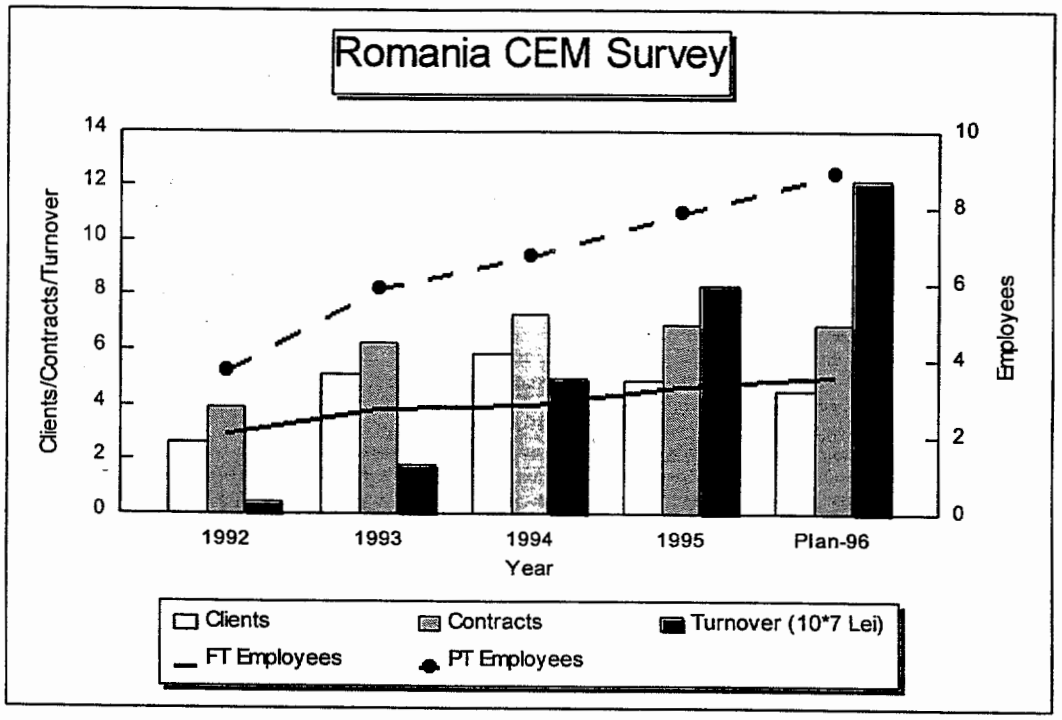
USAID EEMD Program - Romania
Survey of Romanian Certified Energy Managers
Company Profile
Averages

Category	1992	1993	1994	1995	Plan-96
CLIENTS	21	41	47	39	36
Average	2.63	5.13	5.88	4.88	4.50
%	0%	95%	15%	-17%	-8%
CONTRACT	31	50	58	55	55
Average	3.88	6.25	7.25	6.88	6.88
%	0%	61%	16%	-5%	0%
TURNOVER	3.64	14.46	39.53	66.40	97.50
Average	0.45	1.81	4.94	8.30	12.19
%	0%	297%	173%	68%	47%
FT EMPLOY	17	22	23	27	29
Average	2.13	2.75	2.88	3.38	3.63
%	0%	29%	5%	17%	7%
PT EMPLOY	30	47	54	63	71
Average	3.75	5.88	6.75	7.88	8.88
%	0%	57%	15%	17%	13%



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АСОЦИАЦИЯ НА ЕНЕРГИЙНИТЕ ИНЖЕНЕРИ БЪЛГАРИЯ

Асоциацията на Енергийните Инженери (АЕИ) - България е неправителствена организация-сдружение с идеална цел на професионалисти, независими инженери и специалисти, работещи в области, свързани с енергийната ефективност и енергийния мениджмънт. Тя е клон на Американската Асоциация на Енергийните Инженери (AEE - Атланта, САЩ).

ЦЕЛИ И ЗАДАЧИ

Съдейства за създаването и развитието на свободен конкурентен пазар на консултантски и инженерингови услуги в областта на енергийната ефективност и подпомага и насърчава професионалното развитие и растеж на членовете си и техните частни фирми.

ОБУЧЕНИЕ И СЕРТИФИКАЦИЯ

Учредителите на АЕИ взеха участие в семинари, организирани от USAID и AEE, по широка гама от проблеми на енергийната ефективност, провеждани от изтъкнати американски специалисти. Семинарите включваха: проучвания за изпълнимост на проекти; енергийна ефективност при производството и потреблението; финансиране на проекти; енергийни оценки; анализ на енергийните разходи; предлагане на енергийни услуги; политика за енергийна ефективност; енергиен мениджмънт на осветлението, електрозадвижванията и др.; горивна ефективност; управление на промишлени процеси и др. Членовете - учредители се включиха в програмата за Сертифицирани Енергийни Мениджъри (CEM), която демонстрира техните знания върху темите, включени в семинарите. CEM е широко признат като професионална титла за водеща фигура в енергийно ефективния одитинг и внедряване в САЩ. Писменият CEM изпит се провежда на английски език.

ЕНЕРГИЕН ОДИТИНГ, УПРАВЛЕНИЕ И ИЗПЪЛНЕНИЕ НА ПРОЕКТИ

Много от членовете на АЕИ имат съществен опит в провеждането на енергиен одитинг, в разработването на препоръки за подобрения и изпълнение на проекти при внедряването на ново оборудване в производствени условия. В рамките на Програмата за енергийна ефективност в България на USAID и Министерството на промишлеността от членове на клона бяха разработени енергийни проучвания в 10 промишлени предприятия.

КОНТАКТИ С ДРУГИ ПРОФЕСИОНАЛИСТИ

Много от членовете на АЕИ са участвували в Световния Конгрес по Енергийно Инженерство, провеждан всяка година в Атланта, Джорджия, САЩ. На него те могат да чуят над 160 доклада и да видят витрини на над 300 изложители. Членовете на АЕИ се срещат с производители на енергийно оборудване от целия свят и с водещи фигури в индустрията. Членовете на АЕИ могат да публикуват статии в бюлетини и технически издания, спонсорирани от АЕИ в Атланта, САЩ.

ИЗДАНИЯ

Членовете на АЕИ получават информация за последните технологии и методи в инженеринга, стратегическото планиране и мениджмънта за енергийна ефективност чрез четири издания, получавани съответно ежемесечно, двумесечно и тримесечно. На разположение на членовете е библиотека от учебници и ръководства по енергийно инженерство, одитинг, мениджмънт, финанси и информация за производители.

УСЛУГИ

Членовете на АЕИ разполагат с модерно оборудване за провеждане на експресни измервания и енергийни експертизи.

Членовете на АЕИ разполагат със специализирана информация за комбинираното производство, нетрадиционните източници на енергия, опазването на околната среда, ефективност на потреблението и др.; както и с възможност за привличане на водещи американски експерти.

Членовете на АЕИ могат да дават компетентни мнения с участието си в съвети и комитети и да споделят своя опит и знания със заинтересовани организации.

Към АЕИ са изградени:

Съвет по енергийна политика , който предлага решения на енергийните нужди на България чрез развитие на критерии и изисквания към доставчиците на енергия и крайните потребители.

Съвет по сертификация , който се стреми да издигне националния авторитет в областта на енергийните експертизи, методите за управление и изпълнение чрез провежданите от него семинари.

ЧЛЕНОВЕ НА АСОЦИАЦИЯТА НА ЕНЕРГИЙНИТЕ ИНЖЕНЕРИ (АЕИ) - БЪЛГАРИЯ

Георги Рампов е главен асистенг в Техническия Университет в София, катедра Топло и Ядрена енергетика и е специалист в областта на паро-кондензните регенеративни топлинни измервания и икономика на енергетиката. Той е също и президент на ЕФ „РАМПОВ&СИН", която се специализира в КИП и топлинни измервания, софтуер и хардуер, автоматизация, консултиране по енергоспестяване, влажност на пара и инженерингови услуги. Тел./ Факс: (+3592) 545 895

Деян Йорданов е президент на „АРГУС 91", проектантска фирма, специализираща в областта на енергийно ефективните отоплителни и вентилационни системи за търговски и жилищни сгради във Варна, България. Той е завършил Техническия Университет във Варна със специализация в областта на използването на геотермична и слънчева енергия и е специализирал една година в Университета Рийдинг, Великобритания. Тел./ Факс: (+3592 052) 884 613

Димитър Баев е управител на „ЕНЕРГИЙНО ЕФЕКТИВНИ СИСТЕМИ" ООД, фирма със специализация в областта на енергийните проучвания и инсталации на оборудване за енергийна ефективност и енергиен мениджмънт. Като президент на „DBC", създадена през 1992 г., той е изпълнил редица проекти, свързани с проучвания на сектори от българската икономика. Той е д-р и ст.н.с. II в областта на автоматизацията и информационните технологии. Тел./ Факс: (+3592) 499 351

Димитър Живков е управител на „АМЕКОН Консултации", която осигурява консултиране по системен и индустриален инженеринг, производствен мениджмънт и автоматизация на процеси за промишлеността. Той е д-р в областта на автоматиката и е доцент в Техническия Университет в София. Получл е магистърска степен от Университета Еразмус в Ротердам по Икономика и Мениджмънт и е лицензиран бизнес оценител. Тел/ Факс: (+3592) 708 509

Йордан Кацаров е заместник управител на „РИСК ИНЖЕНЕРИНГ" ООД, осигуряваща консултантски услуги в областта на конвенционалната енергетика, ядрената енергетика и индустрията. В индустрията се извършват експертизи, проекти и инженеринг на енергийната ефективност и екологията. Завършил е Техническия Университет в София със специализация в областта на енергийните и горивни процеси и има публикации в тези области в България и чужбина. Тел.: (+3592) 951 5086, (+3592) 521 217, Факс: (+3592) 954 9100.

Кристиян Спасов е президент на „ЕКОТЕХПРОДУКТ", официален представител на Ф. „Armstrong" - производител на оборудване за паро-кондензни стопанства и технологичен въздух и Ф. „CLEAVER BROOKS" - водещ производител на промишлени котли. Ф. „Екотехпродукт" е специализирана в инженерингови дейности, водещи до значителна икономия на енергия, свързани с реконструкция на: паро-кондензни стопанства, системи за сгъстен въздух, хладилни инсталации, комплексно оборудване на котелни инсталации. Тел./ Факс: (+3592) 541 267; 542 743; 542 379.

Любомир Спасов е управител на „ЕНЕРГОКОНТРОЛ" ООД, специализираща в сферата на енергийния мениджмънт и енергийното договаряне за Плевен и околните райони. „ЕнергоКонтрол" е внедрила ефективни отоплителни системи в жилищни блокове, апартаменти и военни училища и е създала енергийни икономии, които да реинвестира в бъдещи проекти. Той е инженер - топлотехник. Тел.: (+359 064) 419 262.

Никола Зикатанов е директор в „ЕНЕРГИЙНО ЕФЕКТИВНИ СИСТЕМИ" ООД, фирма със специализация в областта на енергийните проучвания и инсталации на оборудване за енергийна ефективност и информационно обслужване. Той ръководи и други дейности, свързани с енергийната ефективност. Има магистърска степен по безнес администрация от Университета

Питсбърг в САЩ и Международния Център по Мениджмънт Будапеща, Унгария. Тел./ Факс (+3592) 445 878.

Никола Калоянов е инженер, доктор, доцент в Техническия Университет в София, ръководител на катедра „Топлинна и хладилна техника". Работи в областта на енергийната ефективност на топлообменни съоръжения, системи и сгради, моделиране и симулиране на топло и масообменните процеси, функционалния анализ на комбинирани топлотехнически системи. Тел./ Факс: (+3592) 287 5971. E-mail: NGKGVMEI.ACAD.BG

Никола Станков е програмен мениджър на „ТЕТИВА" ООД по горивни и паро-кондензни системи и приложения. „ТЕТИВА" специализира в енергийно ефективни проучвания и внедряване на нови технологии, автоматизационни системи и компютърни програми за топлинна икономичност. Той е главен асистент по ТЕЦ в Техническия Университет в София и е к.т.н.. Тел.: (+3592) 439 735

Стефан Христов представлява „ЕНЕРГО ЕКО ИКОНОМИЯ" ООД, компания, която осигурява проучвания на енергийната ефективност на парни котли и финансови услуги за подпомагане изпълнението на техните препоръки. Той има десетгодишен опит в сферата на топлинната енергийна ефективност. Тел.: (+3592) 727 131 Факс: (+3592) 727 650

Йолиан Иванов е ел. инженер. Президент е на фирма „ЙОЛИ" , която осигурява консултантска дейност в областта на енергийната ефективност и трансфера на know-how в обекти от българската индустрия, мениджмънт, инвестиционни и приватизационни проекти. Защитил е дисертация в областта на роботиката и е ръководител на проекти в БАН. Завършил е международна програма за икономическо развитие в Университета на Централен Ланкашир, Великобритания. Той е директор на Международна Инвестиционна Група „ЕВРОКАПИТАЛ" АД. Тел.: (+3592) 808 500 Факс: (+3592) 314 180.

Янош Желев е управител на „ЕКСЕРГ" ООД и технически директор на „ЦЕНТЕХ" (Център за Енергийни Технологии - Будапеща). Той е кандидат на техническите науки. След повече от десет години развойна и изследователска дейност в химическото машиностроене от 1992 г. той активно участва в енергийни анализи на предприятия в Унгария и България. Специалист е в областта на топло- и масопреносните процеси и апарати, производството и паро-кондензните системи. Тел.: (052) 472 672, (+3660) 303 048 Факс: (052) 463 562.

Гореспоменатите членове са регистрирани Сертифицирани Енергийни Мениджъри, признати от Американската Асоциация на Енергийните Инженери в Атланта, Джорджия, САЩ, за техните постижения в енергийната ефективност , одитинг и мениджмънт. Те са учредители на АЕИ в България и са квалифицирани членове.

Методи Константинов е президент на фондация „ЕКОСАПИЕНС", насочена към екологичната и енергийната ефективност. Той е ст.н.с. в Техническия Университет в София в областта на енергетиката, околната среда и енергийната ефективност. Координатор на проект GREEN Energy. Член е на Американската Асоциация на Енергийните Инженери в Атланта, Джорджия, САЩ. Тел.: (+3592) 884 351 вътр. 353 Факс: (+3592) 807 609 E-mail: 101346.3376@compuserve.com

Цанчо Цанев е президент на „ПЪРВА ЧАСТНА АГЕНЦИЯ ЗА ЕНЕРГИЙНА ЕФЕКТИВНОСТ" ООД извършваща консултантска, издателска, проектантска, производствена и внедрителска дейност в областта на енергийната ефективност, експлоатацията и екологията на електрическите уредби в промишления и комунално-битовия сектор и на „МАГНЕТЕЛЕКТРИК" - фирма, специализирана в областта на проектирането и производството на енергоефективни магнитно технологични приспособления. Той е д-р и доцент в Техническия Университет в София. Изнася лекции по Рационално използуване на електрическата енергия, Електрообзавеждане и Експлоатация на електрически уредби. Има 10 патента за изобретения в областта на магнитно технологичните приспособления и е член на Американската Асоциация на Енергийните Инженери в Атланта, Джорджия, САЩ. Тел.: (+3592) 702 151 , 520 439 , 835 546.

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НОВОПРИЕТИ ЧЛЕНОВЕ

ИНДИВИДУАЛНИ ЧЛЕНОВЕ

1. Христо Василев
2. Александър Велков
3. Ивайло Банов
4. Илия Итков
5. Райна Златарева
6. Николай Павлов
7. Иван Калайков
8. Вяра Пожидаева
9. Стоян Гишин

КОЛЕКТИВНИ ЧЛЕНОВЕ

1. Българска Фондация „ЕНЕФЕКТ"
2. „ТРАПЕН" - ООД
3. „ЛИНТЕК"
4. МикроЛинкс"
5. Технологичен център ЦНИКА
6. „КОМИКОМ"
7. „КИРОВ" - ООД
8. „ХАНИУЕЛ" - България
9. „СКОРТЕЛ - ПРП" - ООД

ЗА ПОВЕЧЕ ИНФОРМАЦИЯ ОТНОСНО АСОЦИАЦИЯТА НА ЕНЕРГИЙНИТЕ ИНЖЕНЕРИ (АЕИ) - БЪЛГАРИЯ СЕ ОБРЪЩАЙТЕ КЪМ КООРДИНАТОРИТЕ, УПРАВИТЕЛНИТЕ СЪВЕТИ И ОТДЕЛНИТЕ ЧЛЕНОВЕ.

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The Association of Energy Engineers

The Association of Energy Engineers (AEE) is a nonprofit, non-governmental organization comprised of professionals, independent engineers and specialists working in fields connected with energy efficiency and energy management. It is a Chapter of the American Association of Energy Engineers (AEE - Atlanta, GA, USA). There is also an AEE Chapter in Plovdiv.

Goals and Objectives

It assists in the creation and the development of a free competitive market for consulting and engineering services in the field of energy efficiency. It supports and encourages the professional development and growth of its members and their private companies.

Training & Certification

The founding AEE members participated in seminars sponsored by USAID & AEE on a wide range of energy efficiency problems and conducted by leading American specialists. The seminars included: Feasibility Studies; Project Financing; Demand-Side Management; Auditing Energy Accounting; Marketing; Lighting Management; Motor Management; Combustion Efficiency; Industrial Process Control, and others. The founding members entered a Certified Energy manager program (CEM) which demonstrated their working knowledge of the seminar topics. The CEM is widely recognized as the leader in Energy Efficiency Auditing and Implementation in the United States. The written CEM examination is conducted in English.

Energy Auditing, Project Management, and Implementation

Many of AEE members have substantial experience conducting energy audits, preparing recommendations for improvements and implementing their recommendations with the installation of new equipment and operating procedures. In the framework of the Program for Energy Efficiency in Bulgaria of USAID and the Ministry of Industry, the members of the chapter conducted energy audits in ten industrial enterprises.

Access to other professionals

AEE members have attend the World Energy Engineering Congress, held every year in Atlanta, GA, USA, which delivers over 160 presentations and showcases over 300 exhibits and where AEE members converse with worldwide energy equipment manufacturers and leaders in the industry. AEE members can publish articles in newsletters and technical publications sponsored by AEE - Atlanta.

Publications

The AEE members receive information on the latest technology and methods in engineering, strategic planning, and management for energy efficiency through four publications received monthly, bi-monthly, and quarterly. A library of energy engineering, auditing, management, and finance textbooks and manuals and manufacturer information is available for each members' use.

Services

AEE members have, as a resource, the latest equipment to conduct on-site energy audits to provide immediate measurements.
AEE members have as a resource specialized information on Cogeneration & Competitive Power, Environmental issues, Demand-Side Management and others. They have the opportunity to interact with leading American experts.
AEE members can give competent opinions through their participation in various councils and committees and share their expertise with other interested organizations.
AEE contains the following councils:
The Policy Council which creates awareness and proposes solutions to Bulgaria's energy needs through the development of criteria and prerequisites for energy suppliers and end-users.
The Certification Council which seeks to elevate the local expertise in the area of energy audits, management, and implementation methods through self-administered seminars and certification programs.

AEE Members
Bulgarian Chapter

Christian I. Spassov is the President of "ECOTECH PRODUCTS", an official representative of "Armstrong"- a manufacturer of steam and condensate equipment systems - and "Cleaver Brooks" - a leading manufacturer of industrial boilers. "ECOTECH PRODUCTS" specializes in engineering activities resulting in substantial energy savings from the reconstruction of steam and condensate systems, compressed air, refrigerators and complete boiler installations. Tel/fax:(+3592) 541-267.

Deyan Yordanov is the President of "Argus 91", a design and consulting company specializing in HVAC and electricity projects. Deyan holds an MS from Varna Technical University in geothermal and solar energy implementation and studied one year at Reading University, UK, specializing in over the heat pipe technology. He has over 10 years' experience in HVAC project design and energy efficiency. Tel/fax: (+35952) 884-613

Dimitar Baev is the Executive Manager of "Energy Efficient Systems, Ltd.", a company specializing in energy audits and installation of equipment, business development and information services. As the President of "Design and Business Consulting" he conducted marketing research projects for the transforming Bulgarian business environment. Dimitar holds a PhD in the field of Information Technology. Tel/fax: (+3592) 447-495

Dimiter Shivkov is the Manager of "AMECON Consulting" which provides industrial engineering, operations management and process automation consulting for various industries. Dimiter has a PhD in Control Engineering and is an Associate Professor at the Sofia Technical University. He received a Master's degree in Economics and Management from Erasmus University in Rotterdam is a licensed business valuer. Tel/fax: (+3592) 708-509.

Georgi Rampov is a Senior Assistant Professor at the Sofia Technical University in the Thermal and Nuclear Power Department. He is a specialist in the field of steam and condensate heat recovery systems, thermal measurements and energy economics. He is the President of "Rampov & Son Company" which specializes in instruments, steam quality measurements, software & hardware and automation designs & engineering. He holds an MS in Thermal Engineering. Tel/fax:(+3592)545-895

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AEE Members
Bulgarian Chapter

Nikola Zikatanov is the Director of "Energy Efficient Systems Ltd.", a company specializing in energy audits and the installation of energy efficiency equipment, business development and information services. He manages a manufacturing facility and various businesses in the Sofia area, including energy efficient and decorative window film dressing. He holds an MBA from Pittsburgh University, USA and IMC in Budapest, Hungary. Tel/fax: (+3592)445-878

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Yordan Katzarov is the Senior Project Manager of "Risk Engineering Ltd.", a company specializing in nuclear reliability, energy conservation, safety, quality assurance, management studies and software development services. He has an extensive background in conventional power production. He holds an MS in the fields of power and combustion processes and is the author of Bulgarian and foreign translated articles in those areas. Tel: (+3592) 521-217 Fax: (+3592) 522-546

The above members are registered Certified Energy Managers (CEMs) recognized by the Association of Energy Engineers in Atlanta, Georgia, USA for their achievement in energy efficiency, auditing and management. They Founded the AEE Chapter in Bulgaria.

Methody Konstantinov is the president of "Ecosapiens", a Foundation for ecology and energy efficiency. He holds a PhD and teaches at the Sofia Technical University in the field of energetics, environment and energy efficiency. Tel: (+3592) 884-351 ext 353; Fax: (+3592) 521-390

Tsancho Tsanev is the President of "Magnet Electric" a company specializing in electrical and lighting equipment. He is also an Associate Professor at the Sofia Technical University, lecturing in electricity, lighting, and motors. Tsancho holds a United States Patent for his revolutionary magnet design. Tel: (+3592) 520-439

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Plovdiv Chapter

Boris Petkov holds an MS in Control Engineering from the University of Food Technology. He is a Control Engineer with five years' experience in the design and implementation of control systems. He is the President of "IVEL Ltd., Engineering Consulting Company." He is also one of the founders of the Bulgarian Chapter - Sofia and is a Certified Energy Manager (CEM). Tel/fax: (+35932) 455-505

Georgi Vangelov is an Electrical Engineer who has been working in the design, maintenance and servicing of high and low voltage electrical systems for more than 30 years. He has several inventions awarded for his contribution in innovative activities. He is a private consultant in the design of energy efficient electrical systems. He is an Advisor on illumination standards for the Bulgarian Ministry of Health.

Prof. Dr. Ivan Dragotinov is a Control Engineer and is Head of the Automatic Control Department at the Higher Institute of Food Industry in Plovdiv. His professional achievements include the application of control theory for solving control problems in the food industry. He has presented and published over 40 papers has worked in the Department of Industrial Control at the Sofia Technical University

Petko Kostadinoff holds an MS in Architecture from the University of Civil Engineering and Architecture in Sofia. He is the President of the Plovdiv Chapter of the Bulgarian Architectural Society. He is the owner of the "Architectural Consulting Company."

Plovdiv Chapter

Maxim Dunchev holds an MS in Control Engineering from the University of Food Technology. He is a Control Engineer with 14 years' experience in the design of control systems and equipment. He is the Vice President and one of the founders and owners of "COMECO" - the largest private Bulgarian manufacturer of thermostats and temperature, pH, level and humidity electronic controllers and sensors.

Marietta Vracheva holds an MS in Control Engineering from the University of Food Technology. She is a Control Engineer with five years' experience in the design and implementation of control systems. She works as a freelance consultant in the area of control and monitoring systems.

Minko Rusalev is the Managing Director of "Naukaenginering, Ltd." which is a subsidiary of the Bulgarian Union of the Scientists and provides management and engineering consulting services, mostly to subcontracting members of the union and outside consultants. He holds a Master's degree in Business Administration (MBA).

Prof. Dr. Stefan Dichev has a PhD in the fields of Refrigeration and Air-Conditioning. He has been elected as "Academician" of the Academy of Science of Ukraine and the International Academy of Science, Technology and Engineering. He has presented and published over 180 papers and has registered over 20 inventions and patents. He has worked as a designer, researcher and an instructor for over 30 years in the fields of refrigeration, air-conditioning, and heat pump systems.

Toma Georgiev is a Law Expert on Commercial Law in Bulgaria. He graduated from the Sofia University and completed his training in Business Administration. He is an expert in Performance Contracting and other energy related contract methods.

Velik Petkov is a Mechanical Engineer who has been working in the design, maintenance and servicing of HVAC systems for more than 30 years. He has several inventions awarded for his contribution in innovative activities. He is the leader of the design group, "SINTZ", a subsidiary of the Bulgarian Union of the Scientists in Plovdiv. He is an Advisor on HVAC Standards for the Bulgarian Ministry of Health.

For more information concerning the Association of Energy Engineers (AEE), feel free to contact the Chapter Coordinators, the Executive Boards and the individual members.

Bulgarian Chapter

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АСОЦИАЦИЯ НА ЕНЕРГИЙНИТЕ ИНЖЕНЕРИ БЪЛГАРИЯ

Асоциацията на Енергийните Инженери (АЕИ) - България е неправителствена организация-сдружение с идеална цел на професионалисти, независими инженери и специалисти, работещи в области, свързани с енергийната ефективност и енергийния мениджмънт. Тя е клон на Американската Асоциация на Енергийните Инженери (AEE - Атланта, САЩ).

ЦЕЛИ И ЗАДАЧИ

Съдейства за създаването и развитието на свободен конкурентен пазар на консултантски и инженерингови услуги в областта на енергийната ефективност и подпомага и насърчава професионалното развитие и растеж на членовете си и техните частни фирми.

ОБУЧЕНИЕ И СЕРТИФИКАЦИЯ

Учредителите на АЕИ взеха участие в семинари, организирани от USAID и AEE, по широка гама от проблеми на енергийната ефективност, провеждани от изтъкнати американски специалисти. Семинарите включваха: проучвания за изпълнимост на проекти; енергийна ефективност при производството и потреблението; финансиране на проекти; енергийни оценки; анализ на енергийните разходи; предлагане на енергийни услуги; политика за енергийна ефективност; енергиен мениджмънт на осветлението, електрозадвижванията и др.; горивна ефективност; управление на промишлени процеси и др. Членовете - учредители се включиха в програмата за Сертифицирани Енергийни Мениджъри (CEM), която демонстрира техните знания върху темите, включени в семинарите. CEM е широко признат като професионална титла за водеща фигура в енергийно ефективния одитинг и внедряване в САЩ. Писменият CEM изпит се провежда на английски език.

ЕНЕРГИЕН ОДИТИНГ, УПРАВЛЕНИЕ И ИЗПЪЛНЕНИЕ НА ПРОЕКТИ

Много от членовете на АЕИ имат съществен опит в провеждането на енергиен одитинг, в разработването на препоръки за подобрения и изпълнение на проекти при внедряването на ново оборудване в производствени условия. В рамките на Програмата за енергийна ефективност в България на USAID и Министерството на промишлеността от членове на клона бяха разработени енергийни проучвания в 10 промишлени предприятия.

КОНТАКТИ С ДРУГИ ПРОФЕСИОНАЛИСТИ

Много от членовете на АЕИ са участвували в Световния Конгрес по Енергийно Инженерство, провеждан всяка година в Атланта, Джорджия, САЩ. На него те могат да чуят над 160 доклада и да видят витрини на над 300 изложители. Членовете на АЕИ се срещат с производители на енергийно оборудване от целия свят и с водещи фигури в индустрията. Членовете на АЕИ могат да публикуват статии в бюлетини и технически издания, спонсорирани от АЕИ в Атланта, САЩ.

ИЗДАНИЯ

Членовете на АЕИ получават информация за последните технологии и методи в инженеринга, стратегическото планиране и мениджмънта за енергийна ефективност чрез четири издания, получавани съответно ежемесечно, двумесечно и тримесечно. На разположение на членовете е библиотека от учебници и ръководства по енергийно инженерство, одитинг, мениджмънт, финанси и информация за производители.

УСЛУГИ

Членовете на АЕИ разполагат с модерно оборудване за провеждане на експресни измервания и енергийни експертизи.

Членовете на АЕИ разполагат със специализирана информация за комбинираното производство, нетрадиционните източници на енергия, опазването на околната среда, ефективност на потреблението и др.; както и с възможност за привличане на водещи американски експерти.

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Членовете на АЕИ могат да дават компетентни мнения с участието си в съвети и комитети и да споделят своя опит и знания със заинтересовани организации.

Към АЕИ са изградени:

Съвет по енергийна политика , който предлага решения на енергийните нужди на България чрез развитие на критерии и изисквания към доставчиците на енергия и крайните потребители.

Съвет по сертификация , който се стреми да издигне националния авторитет в областта на енергийните експертизи, методите за управление и изпълнение чрез провежданите от него семинари.

ЧЛЕНОВЕ НА АСОЦИАЦИЯТА НА ЕНЕРГИЙНИТЕ ИНЖЕНЕРИ (АЕИ) - БЪЛГАРИЯ

Георги Рампов е главен асистенг в Техническия Университет в София, катедра Топло и Ядрена енергетика и е специалист в областта на паро-кондензните регенеративни топлинни измервания и икономика на енергетиката. Той е също и президент на ЕФ „РАМПОВ&СИН", която се специализира в КИП и топлинни измервания, софтуер и хардуер, автоматизация, консултиране по енергоспестяване, влажност на пара и инженерингови услуги. Тел./ Факс: (+3592) 545 895

Деян Йорданов е президент на „АРГУС 91", проектантска фирма, специализираща в областта на енергийно ефективните отоплителни и вентилационни системи за търговски и жилищни сгради във Варна, България. Той е завършил Техническия Университет във Варна със специализация в областта на използването на геотермична и слънчева енергия и е специализирал една година в Университета Рийдинг, Великобритания. Тел./ Факс: (+3592 052) 884 613

Димитър Баев е управител на „ЕНЕРГИЙНО ЕФЕКТИВНИ СИСТЕМИ" ООД, фирма със специализация в областта на енергийните проучвания и инсталации на оборудване за енергийна ефективност и енергиен мениджмънт. Като президент на „DBC", създадена през 1992 г., той е изпълнил редица проекти, свързани с проучвания на сектори от българската икономика. Той е д-р и ст.н.с. II в областта на автоматизацията и информационните технологии. Тел./ Факс: (+3592) 499 351

Димитър Живков е управител на „АМЕКОН Консултации", която осигурява консултиране по системен и индустриален инженеринг, производствен мениджмънт и автоматизация на процеси за промишлеността. Той е д-р в областта на автоматиката и е доцент в Техническия Университет в София. Получл е магистърска степен от Университета Еразмус в Ротердам по Икономика и Мениджмънт и е лицензиран бизнес оценител. Тел/ Факс: (+3592) 708 509

Йордан Кацаров е заместник управител на „РИСК ИНЖЕНЕРИНГ" ООД, осигуряваща консултантски услуги в областта на конвенционалната енергетика, ядрената енергетика и индустрията. В индустрията се извършват експертизи, проекти и инженеринг на енергийната ефективност и екологията. Завършил е Техническия Университет в София със специализация в областта на енергийните и горивни процеси и има публикации в тези области в България и чужбина. Тел.: (+3592) 951 5086, (+3592) 521 217, Факс: (+3592) 954 9100.

Кристиян Спасов е президент на „ЕКОТЕХПРОДУКТ", официален представител на Ф. „Armstrong" - производител на оборудване за паро-кондензни стопанства и технологичен въздух и Ф. „CLEAVER BROOKS" - водещ производител на промишлени котли. Ф. „Екотехпродукт" е специализирана в инженерингови дейности, водещи до значителна икономия на енергия, свързани с реконструкция на: паро-кондензни стопанства, системи за сгъстен въздух, хладилни инсталации, комплексно оборудване на котелни инсталации. Тел./ Факс: (+3592) 541 267; 542 743; 542 379.

Любомир Спасов е управител на „ЕНЕРГОКОНТРОЛ" ООД, специализираща в сферата на енергийния мениджмънт и енергийното договаряне за Плевен и околните райони. „ЕнергоКонтрол" е внедрила ефективни отоплителни системи в жилищни блокове, апартаменти и военни училища и е създала енергийни икономии, които да реинвестира в бъдещи проекти. Той е инженер - топлотехник. Тел.: (+359 064) 419 262.

Никола Зикатанов е директор в „ЕНЕРГИЙНО ЕФЕКТИВНИ СИСТЕМИ" ООД, фирма със специализация в областта на енергийните проучвания и инсталации на оборудване за енергийна ефективност и информационно обслужване. Той ръководи и други дейности, свързани с енергийната ефективност. Има магистърска степен по безнес администрация от Университета

Питсбърг в САЩ и Международния Център по Мениджмънт Будапеща, Унгария. Тел./ Факс (+3592) 445 878.

Никола Калоянов е инженер, доктор, доцент в Техническия Университет в София, ръководител на катедра „Топлинна и хладилна техника". Работи в областта на енергийната ефективност на топлообменни съоръжения, системи и сгради, моделиране и симулиране на топло и масообменните процеси, функционалния анализ на комбинирани топлотехнически системи. Тел./ Факс: (+3592) 287 5971. E-mail: NGKGVMEI.ACAD.BG

Никола Станков е програмен мениджър на „ТЕТИВА" ООД по горивни и паро-кондензни системи и приложения. „ТЕТИВА" специализира в енергийно ефективни проучвания и внедряване на нови технологии, автоматизационни системи и компютърни програми за топлинна икономичност. Той е главен асистент по ТЕЦ в Техническия Университет в София и е к.т.н.. Тел.: (+3592) 439 735

Стефан Христов представлява „ЕНЕРГО ЕКО ИКОНОМИЯ" ООД, компания, която осигурява проучвания на енергийната ефективност на парни котли и финансови услуги за подпомагане изпълнението на техните препоръки. Той има десетгодишен опит в сферата на топлинната енергийна ефективност. Тел.: (+3592) 727 131 Факс: (+3592) 727 650

Йолиан Иванов е ел. инженер. Президент е на фирма „ЙОЛИ" , която осигурява консултантска дейност в областта на енергийната ефективност и трансфера на know-how в обекти от българската индустрия, мениджмънт, инвестиционни и приватизационни проекти. Защитил е дисертация в областта на роботиката и е ръководител на проекти в БАН. Завършил е международна програма за икономическо развитие в Университета на Централен Ланкашир, Великобритания. Той е директор на Международна Инвестиционна Група „ЕВРОКАПИТАЛ" АД. Тел.: (+3592) 808 500 Факс: (+3592) 314 180.

Янош Желев е управител на „ЕКСЕРГ" ООД и технически директор на „ЦЕНТЕХ" (Център за Енергийни Технологии - Будапеща). Той е кандидат на техническите науки. След повече от десет години развойна и изследователска дейност в химическото машиностроене от 1992 г. той активно участва в енергийни анализи на предприятия в Унгария и България. Специалист е в областта на топло- и масопреносните процеси и апарати, производството и паро-кондензните системи. Тел.: (052) 472 672, (+3660) 303 048 Факс: (052) 463 562.

Гореспоменатите членове са регистрирани Сертифицирани Енергийни Мениджъри, признати от Американската Асоциация на Енергийните Инженери в Атланта, Джорджия, САЩ, за техните постижения в енергийната ефективност , одитинг и мениджмънт. Те са учредители на АЕИ в България и са квалифицирани членове.

Методи Константинов е президент на фондация „ЕКОСАПИЕНС", насочена към екологичната и енергийната ефективност. Той е ст.н.с. в Техническия Университет в София в областта на енергетиката, околната среда и енергийната ефективност. Координатор на проект GREEN Energy. Член е на Американската Асоциация на Енергийните Инженери в Атланта, Джорджия, САЩ. Тел.: (+3592) 884 351 вътр. 353 Факс: (+3592) 807 609 E-mail: 101346.3376@compuserve.com

Цанчо Цанев е президент на „ПЪРВА ЧАСТНА АГЕНЦИЯ ЗА ЕНЕРГИЙНА ЕФЕКТИВНОСТ" ООД извършваща консултантска, издателска, проектантска, производствена и внедрителска дейност в областта на енергийната ефективност, експлоатацията и екологията на електрическите уредби в промишления и комунално-битовия сектор и на „МАГНЕТЕЛЕКТРИК" - фирма, специализирана в областта на проектирането и производството на енергоефективни магнитно технологични приспособления. Той е д-р и доцент в Техническия Университет в София. Изнася лекции по Рационално използуване на електрическата енергия, Електрообзавеждане и Експлоатация на електрически уредби. Има 10 патента за изобретения в областта на магнитно технологичните приспособления и е член на Американската Асоциация на Енергийните Инженери в Атланта, Джорджия, САЩ. Тел.: (+3592) 702 151 , 520 439 , 835 546.

Гарабед Мумджиян е професор в техническия университет в София и е бивш ръководител на катедра „Топло и Ядрена Енергетика". Той е автор на над 100 научни публикации. Най-новите му изследвания са насочени към технологиите за преобразуване на енергия и системи за контрол на процеси. Член е на българския национален съвет на Световната Енергийна Конференция и участва в програмата ФАР на ЕО в българския енергиен сектор. Той е почетен член на АЕИ. Тел.: (+3592) 750 175

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The FISHER - ROSEMOUNT ™ family of companies offers the most comprehensive line of industrial measurement, comprehensive, control, and valve products in the world. Owned and operated by EMERSON ELECTRIC Co., a Fortune 100 company, each of these organizations is the world leader in its respective products area. FISHER-ROSEMOUNT™ locations are based in over 200 locations in 75 countries.

The FISHER-ROSEMOUNT™ companies bring the combined experience of countless years of leadership in supplying and servicing products for industrial markets. We offer more real-time process management solution than over process instrumentation or control company, and they are solutions with the proven quality and value that more company trust.

The FISHER-ROSEMOUNT™ family of companies:

- *ROSEMOUNT MEASUREMENT DIVISION* supplies products to industrial process instrumentation markets that cover a full range of pressure, temperature, flow, and level measurement.
- *FISHER-ROSEMOUNT SYSTEM, Inc.* The process management systems available from Fisher-Rosemount System, Inc. are unmatched at integrating process and business information, from intelligent field devices to the plant wide information network.
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- *ROSEMOUNT ANALYTICAL Inc.* provides unsurpassed global analytical capabilities for gas, liquid, combustion, and selected laboratory applications.
- *BROOKS INSTRUMENT* is a world leader in flow measurement and control instrumentation with the broadest product line of any flowmeter manufacturer.
- *MICRO MOTION, Inc.* is the industry leader in Coriolis technology. Micro Motion meters provides direct mass flow and density measurement that is virtually unaffected by changing fluid properties.
- *DIETERICH STANDART* with its Pro Bar™ Series and Annubar® technology is another Fisher-Rosemount™ company, that provides flow measurement systems.

In Bulgaria FISHER-ROSEMOUNT™ is represented by

Process Control
Tzarichina Str. 1
1505 Sofia / BG
tel./fax. : 359 2 70 35 49, 75 51 61
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FISHER - ROSEMOUNT™ е фамилия от компании, предлагащи широка гама от прибори за промишлено приложение, в области свързани с измерване, анализ и управление. Компанията е собственост на EMERSON ELECTRIC Co. и включва над 100 фирми, всяка от които е световен лидер в съответната си област.

Многобройните внедрени и работещи в производството продукти на компанията и отреждат едно от челните места сред производителите на измервателно оборудване, аналитични прибори, управляващи клапани и разпределени системи за управление и контрол.

FISHER - ROSEMOUNT™ е представена в над 75 страни по целият свят.

Основните поделения на компанията са:

- *ROSEMOUNT MEASUREMENT DIVISION* - предлага широка гама от прибори с промишлено приложение за измерване на налягане, температура, разход и ниво. Продукцията обхваща пълната линия от сензори и SMART преобразуватели, позволяващи лесната интеграция и комуникация, чрез HART® протокол на всяко устройство с цифрови системи за управление.
- *FISHER - ROSEMOUNT SYSTEM Inc.* - предлага системи обединяващи управлението на всички нива - от датчици и преобразуватели до информационни системи с бизнес приложение.
- *FISHER CONTROLS* - предлаганата от фирмата продукция включва широка гама от плъзгащи се и ротационни вентили, регулатори с пряко действие, изпълнителни механизми и др.
- *ROSEMOUNT ANALITICAL Inc.* - предлага прибори за всички основни видове аналитични измервания на газове и течности, за горивни процеси и някои лабораторни приложения. Фирмата е лидер в измерването на pH и проводимост и е разработила няколко технологии за газов анализ.
- *BROOKS INSTRUMENT Inc.* - фирмата е световен лидер в производството на оборудване за измерване на разход и управляващи устройства.
- *MICRO MOTION Inc.* - предлаганата от фирмата продукция обхваща широка гама от устройства за измерване на разход базирани на кориолисовия метод. Тези разходомери извършват директно измерване на масов разход и плътност.
- *DIETERICH STANDART.* С новата Pro Bar™ Series и Annubar® технология, Dieterich Standart е друга фирма от семейството на Fisher-Rosemount™, която осигурява оборудване за измерване на разход на газове и течности.

Изключителен представител на FISHER - ROSEMOUNT™ за България е фирма "Процес Контрол" със седалище :

София 1505
ул. Царичина N.1
тел./факс. : 359 2 70 35 49, 75 51 61
тел.: 359 2 75 51 62

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"МИКРОЛИНКС" ООД

Дружеството с ограничена отговорност "МИКРОЛИНКС" е създадено през 1995 г. в София. Основната му дейност включва проектиране и производство на технически средства (хардуер и софтуер) за автоматизирани системи за управление на технологични процеси. Във фирмата е разработена разпределената система за управление от четвърто поколение MOUVON на базата на технологията LONWORKS. Тя има редица предимства пред досега съществуващите централизирани системи за управление по отношение на цени, сигурност, универсалност, удобство за ползване и възможности за оптимизация на управляваните процеси. В нея е заложен нов метод, защитен със собствен патент, за безконтактно измерване на позицията на изпълнителните механизми. Неотделна част от системата са оргиналните софтуерни продукти : системата за администриране на индустриални мрежи QUANTAMAGNUM и разпределен по мрежата GRAFCET.

Разпределената система за управление на базата на модулите MOUVON получи международно признание на изложбите INTERCHEMIE'95 в Париж (декември 1995 г.) и ISA-Show в Чикаго (октомври 1996 г.). Тя е в процес на внедряване в предприятия от енергетиката, металургията, химическата и хранително-вкусовата промишленост на Франция и България.

Търговските права за разпространението на гамата модули от системата MOUVON са закупени от американската фирма KEYSTONE - един от най-големите производители в света на промишлени клапани и изпълнителни механизми.

MICROLINKS LTD.

The MICROLINKS Ltd. was established in 1995 in Sofia. The basic field of activities includes the design and the manufacturing of automated control systems and dedicated software for industrial technological processes. The company has developed a fourth-generation distributed control system - MOUVON, which is based on the LONWORKS technology and has a number of advantages over the currently existing centralised control systems in terms of price, reliability, versatility, easy-to-use features and options for the optimisation of the controlled process. The system employs an entirely new method which is patent-protected for a contact-free measurement of the position of actuators. Several unique software packages are included as an indelible part of the MOUVON system: the QUANTAMAGNUM system for industrial networks management, and the net-distributed GRAFCET.

The MOUVON modules based distributed control system was awarded an international recognition at the INTERCHEMIE '95 exhibition in Paris in December 1995, and at the ISA-Show in Chicago in October 1996. The system is currently being commissioned in a number of power engineering, metallurgy, chemical and foodstuff enterprises in France and Bulgaria.

The commercial rights on the distribution of the series of MOUVON modules were purchased by Keystone of the USA - one of the largest world manufacturers of industrial valves and actuators.

G.R.E.E.N. Energy
PROJECT PROFILE

Dr. Metodi Konstantinoff
G.R.E.E.N. Energy Project
tel. / fax 807 609 and tel. 804 097
E - mail : 101346.3376@CompuServe.Com
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Dr. Metodi Konstantinoff
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BULGARIA

The G.R.E.E.N. Energy is a Dutch - Bulgarian Project supported from the Dutch Government to execute „On site energy / environment advice for the communities in Bulgaria". The Dutch Agency for Energy and the Environment - NOVEM is the supervisor of the project. The Project is under the leadership of a Steering Committee where are presented different governmental, non governmental institutions and Universities. Professor Lazar Petkanchin is elected for Chairman of The STECO and Dr. Metodi Konstantinoff is the Project Co-ordinator.

The number of employee is 5 as a permanent staff and nearly 20 on data contract base. The main fields of activities could be sitted as follow :

- energy management
- generation, distribution and end consumption of heating and electroenergy
- energy efficiency in both production and demand sides
- energy efficiency audits in buildings, small and medium sized boiler hoses and in public lighting systems
- burner system adjustment and boilers efficiency tests
- utilisation of renewable energy sources
- utilisation of by - products from coal production

As most of the members are University lecturers, the main efforts are oriented in the following main directions :

- reduction the energy consumption in all sectors
- introduction of more environmental friendly means not only in the field of energy, but also in the other areas
- introducing an integral approach in dealing with above topics (not only technically, but also educational and socio - economic ones)

The G.R.E.E.N. Energy Project has experience in the field of :

- consulting and auditing
- feasibility studies
- environmental impact assessments

G.R.E.E.N. Energy
КРАТКО ОПИСАНИЕ НА ПРОЕКТА

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БЪЛГАРИЯ

G.R.E.E.N. Energy е Холандско - Български проект, финансиран от Холандското правителство за изпълнение на „Консултиране на Български общини по проблемите на енергийната ефективност и опазване на околната среда". Холандската агенция за енергия и околна среда - NOVEM осъществява контрол и наблюдение по изпълнение на дейностите. Проекта се ръководи от Управителен Съвет в чийто състав са включени представители на различни държавни ведомства, неправителствени организации и висши учебни заведения. За Председател на Управляващия Комитет е избран професор Лазар Петканчин, а д-р Методи Константинов е координатор на Проекта за България.

Постоянно заетите с дейностите по проекта специалисти са 5, а около 20 други експерти са ангажирани в изпълнението на конкретни дейности. Основните дейности, изпълнявани по проекта са следните :

- енергиен мениджмънт
- производство, пренос и консумация на топлинна и електроенергия
- двустранна енергийна ефективност - от страна на енергопроизводство и енергоконсумация
- енергийни ревизии на сгради, малки и средни по мощност котелни инсталации и обществено осветление
- настройка на горивни уредби и оценка ефективността на котли
- използване на възобновяеми енергийни източници
- оплозотворяване на отпадъчни продукти от въгледобивната промишленост

Повечето от членовете са преподаватели в Университета, като главно усилията са съсредоточени в следните насоки :

- намаляване на консумацията на енергия във всички сектори
- внедряване на високоекологични технологии не само в областта на енергетиката, а също и в други области
- внедряване на интегрален подход в описаните по - горе дейности (не само технически, а също така и образователни и социално - икономически)

Проекта G.R.E.E.N. Energy има голям практически опит в :

- консултации и обследвания
- приложни изследвания
- оценка на въздействието върху околната среда

ALEX H&Z Ltd.

THE BEST WINDOW FILM

ALEX H&Z Ltd. is a private company which was founded in 1990.

Activity: ALEX H&Z Ltd. is a distributor of ITD Metallized Products. Our company is specialized in SUN-GARD window films distribution and installation. SUN GARD window film is a high technology product which is created to:

- reduce cooling and heating costs
- reduce glare
- reduce fading
- reject harmful UV rays
- provide safety

Please contact us at:

ALEX H&Z Ltd.
100-A, Vasil Levski Blvd.
1527 Sofia, Bulgaria
Phone.: + (359 2) 943 3158
Fax: + (359 2) 946 1703
For the attention of Mr. Borislav Tasev - Managing Director

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АЛЕКС ХиЗ ООД

НАЙ - ДОБРОТО ФОЛИО ЗА СТЪКЛО

АЛЕКС ХиЗ ООД е частна фирма създадена през 1990 година.

Предмет на дейност: Фирмата е дистрибутор на американската компания ITD Metallized Products. Специализирана е в доставка и монтаж на фолио за стъкло SUN-GARD. Фолиото е високотехнологичен продукт, който:

- намалява разходите за отопление и охлаждане
- намалява слънчевия блясък
- намалява избеляването на материалите
- спира вредните ултравиолетови лъчи
- повишава здравината на стъклата

За контакти:

1527 София
Бул. Васил Левски 100 - А
Тел.: (359 2) 943 3158
Факс: (359 2) 946 1703
На вниманието на: Г-н Борислав Тасев

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5 26

Energy Efficient Systems Ltd.
10, Vasil Aprilov Str.,app.10
1504 SOFIA, BULGARIA
PHONE/FAX: (359-2) 439-351

МЕРКИ ЗА ПОДОБРЯВАНЕ НА ЕНЕРГИЙНАТА ЕФЕКТИВНОСТ

Въпросите на ефективното използване на енергията с всеки изминат ден стават все по-важни и актуални за всички. Енергията е най-бързо нарастващата част от разходите. Изчакването и частичните решения водят до шок при всяко поредно повишение на цените. Всичко това налага нов подход и системни грижи в търсенето на решения за по-икономичното й използване.

ЕЕС - ООД предлага да стане Ваш партньор и помощник в намирането на решения и мерки, водещи до по-висока ефективност.

Гамата на предлаганите от нас услуги в тази област включва като начало провеждането на ***проучване на енергийната ефективност (енергиен одит).***

Цел на проучването - да се представи на ръководството на фирмата по-богата и систематизирана информация за използването на енергията и извършваните разходи, както и да се предложат целесъобразни мерки за икономия на енергия.

Обхват на проучването:

- отделни агрегати, технологични процеси и по-големи консуматори;
- административни сгради, битови комплекси;
- цялостния производствен комплекс.

Обекти на проучване и анализ:

- системата за информация и управление на енергопотреблението;
- системата за доставяне, трансформиране и разпределение на различните енергоносители;
- балансите на разходите на различните енергоносители по видове консуматори;
- системата за подържане и ремонт на енергосъоръженията и оборудването;
- контролно-измервателната, регулираща и управляваща апаратура;
- потреблението на върхова енергия;
- конкретни значими подсистеми от консуматори - осветление, фактора на мощността, двигатели и задвижвания, бойлери, котли, помпи, ОВК, компресорни станции, пещи, вани, хладилни инсталации и др.
- връзката между енергопотреблението и произвежданата продукция;
- временните характеристики на енергопотреблението;
- зависимост от условията на външната среда;
- екологични проблеми и др.

Източници на информация:

- дневници, записи и документация, свързани с енергопотреблението и производството;
- въпросници и интервюта с ръководители и персонала;
- наблюдения на режимите на работа в различни периоди от време;

В резултат на ръководството се предоставят:

- резултатите от анализите и налагащи се изводи;
- предложения за мерки за икономия на енергия и средства, заедно с техническите разчети и оценки на очакваните разходи и ефекти. Като правило в резултат на проучването се предлагат реални възможности за икономия на около 20-25% от използваната енергия. Особено внимание се отделя на нискостойностните решения и на мерките със срок на изкупуване по-малък от 1 година.
- предложение на план (програма) и график за въвеждане на мерките, осигуряване на финансирането им и на необходимите инвестиции.

Срокове за провеждане на проучването - 1-3 месеца.

Цена на проучването - по договаряне в зависимост от обхвата на проучването и взаимното разпределение на задачите. Като правило тези разходи се възвръщат в рамките на едно-две тримесечия при бързо въвеждане на нискостойностните мерки за икономия.

ЕЕС - ООД има готовност за изпълнение на проекти и да внедри утвърдените мерки съвместно със специалистите на фирмата, както и с привличане при необходимост на подходящи подизпълнители от страната и чужбина.

ЕЕС- ООД доставя, инсталира и въвежда в действие необходимите апарати и технически съоръжения, като осигурява необходимото обучение, сервиз и поддържане. Дружеството представя в България редица водещи производители на енергоспестяващо оборудване.

ЕЕС - ООД разполага със специалисти и експерти с висока квалификация и опит в областта на енергопотреблението и на свързаните с това дейности. Те използват съвременни методи за енергийни проучвания и анализи. Основната част от тях са удостоени със сертификати за енергийни мениджъри от Амерканската асоциация на енергийните инженери (AEE).

ЕЕС - ООД е готов да стане Ваш партньор във всяко Ваше начинание - от консултацията по специфичен проблем и решаването на конкретни локални задчи по икономия на енергия, до участие в разработването и етапното внедряване на стратегически ориентираните цялостни проекти, изискващи сложни инвестиционни решения.

ЗА КОНТАКТИ:

1504 София,
ул. „В. Априлов“, 10, ет. 4, ап. 10,
тел./ факс (+02) 43-93-51,
E-mail адрес: eesyst@main.infotel.bg

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LINTEC

Linear Technology and НАЙ-BEST™
Uninterruptible Power Systems

A private company

Address:
P.O.Box 9, 1233 Sofia, Bulgaria
Office: Tzarigradsko Shose 7th km,
BIC IZOT (CIIT) office 268
1113 Sofia, Bulgaria
Phone: (+359 2) 974 39 65, 740 168
Fax: (+359 2) 974 39 65
GSM: (+359 88) 57 07 57
Executives:
Dr.Borislav Mantchev, President. Born 1952.
Contact: ***Dr.Borislav Mantchev***
Established: 1991
Business:

- Uninterruptible Power Supplies in range **300 VA** to **3000 kVA** with line-interactive or double-conversion absolutely **no break** in output power on-line design, **98% efficiency**
- Generating sets 0,75 kVA to 1600 kVA AC (220 or 3x380 V, 50 Hz) and DC (24, 48, 60, 120 or 168 V) with Diesel, Gasoline or Natural Gas engines
- Development and manufacturing of DSP boards and data acquisition systems
- High-precision and high-performance analog-to-digital and digital-to-analog converters - 20 bits/100 Mhz
- Switching Power Supplies and Pre-Converters with Power-Factor Correction
- Large RAID disk and magnetic tape/cartridge arrays
- Data coding and compression, data security

Products:

- Complete engineering in Uninterruptible Power Supply and Generating Systems
- Data Acquisition and Analysis Systems
- IEE 488 (GPIB) and VXIbus control
- Analog modeling
- Digital and analog filters design programs Switching Power supplies and converters

Company relations:

- General distributor and Service center of **BEST Power,a Unit of GENERAL SIGNAL, USA** Uninterruptible Power Systems - 300 VA to 3 000 kVA
- Distributor of F.G.WILSON (Engineering) Ltd., UK, and SDMO, France, Diesel Generator set manufacturers

LINTEC

(ЛИНТЕК)

Линейни технологии и НАЙ-BEST™
Непрекъсваеми захранващи системи

Адрес за кореспонденция:
София 1233, п.к.9
Офис:
София 1113, бул."Цариградско шосе", 7-ми км
БИЦ ИЗОТ (ЦИИТТ), офис 268
Телефон: (02) 974 39 65, 740 168
Факс: (02) 974 39 65
GSM (мобилен): 088 57 07 57
Ръководител:
Д-р инж. Борислав Манчев. Роден 1952 г.
Фирмата е основана 1991 г.
Дейност:

- Проектиране, доставка, комплексно изпълнение, монтаж и обслужване на Непрекъсваеми захранващи системи от 300 VA до 3000 kVA с линейно-интерактивни "on-line" абсолютно непрекъсваеми едностепенни и двойнопреобразуващи UPS, с **работен kng 98%**, производство на **Best Power, САЩ**
- Електрически генератори от 0,75 kVA до 1600 kVA, променливотокови еднофазни и трифазни 220 V и 3x380 V, 50 Hz, постояннотокови (24, 48, 60, 120 и 168 V) с дизелови, бензинови или газови двигатели
- Разработка, производство и доставка на системи за обработка на аналогова информация и управление на измерванията и процесите, GPIB (IEE 488) и VXIbus системи
- Прецизни и скоростни аналогоцифрови и цифроаналогови преобразуватели - точност до 20 дв.разряда, честота до 100 MHz
- Импулсни захранващи блокове, коректори на фактор мощност, защити и филтри
- RAID дискови и лентови/картридж системи
- Кодиране и компресиране на данни, защита на информацията
- Софтуер за събиране и обработка на информация, аналогово моделиране, компресиране, проектиране на цифрови и аналогови филтри, проектиране на импулсни захранващи модули

Партньорство:

- Главен дистрибутор и Сервизен център на **Best Power**, поделение на **GENERAL SIGNAL**, САЩ Абсолютно непрекъсваеми еднофазни и трифазни захранващи системи (UPS)
- Дистрибутор на F.G.Wilson (Engineering) Ltd, Великобритания и SDMO, Франция - Най-големите производители на дизелови генератори в Европа

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TRAPEN

Фирма "ТРАПЕН" - София извършва научно-изследователска и производствена дейност по разработване и внедряване на системи за автоматизация на непрекъснати технологични процеси. Тя е специализирана по управление на:

- процесите на дозиране и смесване на суровини
- процеса сухо и мокро смилане на материали и руди в топкови мелници;
- измерване и регулиране на ниво в аванкамери, флотационни клетки и други хидротехнически съоръжения;
- измерване параметри на вибрацията на съораженията и използуването им като косвени показатели при управлението на технологичните процеси.

За решаване на Вашите проблеми фирмата предлага следните технически средства:

1. Диференциални магнитоелектрически датчици за измерване на натоварването на топкови мелници.
2. Датчици за измерване на сили.
3. Безконтактни датчици за контрол на положението на подвижни обекти.
4. Измервател на линейно преместване DISPLACEMARIN.
5. Вибрационен индикатор VIBROTRACER.
6. Многоканална микропроцесорна система за виброиндикация VIBROTRACER 8.
7. Ротационен вискозимер.
8. Тегловен разходомер за падащ материален поток.
9. Турбинен разходомер - дозатор на течности.
10. Електромагнитен вибропитател за регулируемо дозиране на насипни материали.
11. Постояннотокови и променливотокови регулируеми електрозадвижвания.
12. Поплавков плътномер DENSYMETER.

Адрес за кореспонденция:

Bulgaria
1618 Sofia
46, Liubliana blvd..

Tel.: +359 2 - 57 51 35
+359 2 - 25 52 82
Fax: +359 2 - 56 48 50

Управител: ст.н.с. ктн. инж. Трайчо Пензов

TRAPEN

Scientific research, experimental and manufacturing activities for continuous technological processes automation development and implementation.

The TRAPEN Ltd. offers you the following technical equipment:

1. Differential magnetic - electrical sensors and microprocessor module for filling level of boll mills;
2. Power sensors;
3. Contactless location sensors for mobile objects;
4. Linear displacing sensor DISPLACEMARIN;
5. Vibroindicator VIBROTRACER;
6. Multichannel microprocessor system for vibrocontrol VIBROTRACER 8;
7. Viscosimeter;
8. Weight measuring device for falling material flux;
9. Pneumatic centrifugal vibrators;
10. Electromagnetic vibrofeeder for continuous control of loose material dosage;
11. AC and DC controlled electrical drivers;
12. Floating densitymeter.

The TRAPEN Ltd. has experience in building of process automation systems: dosage and mixing of raw materials; wet and dry milling of materials and ores; measuring and controlling of filling level in frontcameras, flotation cells and other hidrotechnical equipment. A considerable part of the systems are licensed as inventions and have all rights reserved.

Please, contact us for all kinds of information at the following address:

Bulgaria
1618 Sofia
46, Liubliana blvd..

Tel.: +359 2 - 57 51 35
+359 2 - 25 52 82
Fax: +359 2 - 56 48 50

Manager: Assoc. Prof. Dr. Traycho Penzov

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QUICK REFERENCE

for "REFLEX ENGINEERING" firm.

"Reflex engineerig" have long and sinificant experience in developing systems for control of technical processes in several spheres :

- Energetics, Metallurgy, Chemical Industry, Greenhouses and Food and Beverage Industry, Pulp and Paper Industry.

The firm has realised projects at the above mentioned branches of economy using mostly nonustandard solutions which have led to considerable economies of energy and materials as well as to reduction of the harmful emissions into Nature.

The realized systems ensure dynamic reading of the loading of power equipments (powerelectric stations; steam generators with industrial and central-heating function; metallurgical furnaces, etc.) which allows a lower energy consumption to be maintained in static conditions. The realization of optimal conditions is performed by using modified algorythmus for control.

The economy of energy which has already been achieved in the built systems ranges from 8 to 20 % depending on the working conditions of the power equipment.

The employees in "Reflex engineering" are experts with high qualification in the fields of technological parametres, control of machines and installations objects, computer hard and software and others.

"Reflex engineering" works not only with its own technical solutions and equipment, it has built up systems including technology from major companies such as Siemens, Honeywell,AEG, Sauter, Seibold, Valmet, Fisher and Porter and others.

Address for Correspondence
1618, Sofia "Ljubliana" str., N 46 , "Reflex engineering" firm. Tel/fax 56-31-81, Eng. Emil Ivanov Sapundjiev.

Р

И Н Ф О Р М А Ц И Я

за фирма "РЕФЛЕКС ИНЖЕНЕРИНГ"

Фирма "Рефлекс инженеринг" има значителен и многогодишен опит в разработване и внедряване на системи за управление и контрол на технологични процеси в енергетиката, металургията, химическата промишленост, оранжерийното производство и хранително-вкусовата промишленост, целулозно-хартиената промишленост.

В реализираните проекти в посочените отрасли на промишлеността са използувани преди всичко нестандартни решения, водещи до значителни икономии на енергийни и материални ресурси, или намаляване на вредните емисии в околната среда.

Реализираните системи осигуряват динамично отчитане на натоварването на енергийните съоръжения (ТЕЦ, промишлени и топлофикационни котли, абонатни станции на административни сгради, хотели и др., металургични пещи и т.н.), което позволява в статичен режим да се поддържа значително по-нисък разход на енергия като реализирането на оптимален режим се осъществява чрез използване на модифицирани алгоритми за управление.

Икономията на енергоносители, която се постига в изградените системи е от 8 до 20 % в зависимост от режима на работа на енергийните съоръжения.

Основните специалисти на фирма "Рефлекс инженеринг" са с висока квалификация в областта на измерване на технологични величини, управление и контрол на машини и агрегати, дискретни и непрекъснати обекти, компютърна техника и програмиране.

Освен със свои технически решения и средства, фирма "Рефлекс инженеринг" е реализирала системи с различна техника на водещи фирми като Сименс, Хъниуел, Заутер, АЕГ, Зайболд, Валмет, Фишер и Портер, и др.

Адрес за кореспонденция :
София,1618, ул. Любляна", N 46 - Фирма "Рефлекс инженеринг",
тел/факс 56-31-81, ст.н.с. инж. Емил Иванов Сапунджиев

АСОЦИАЦИЯТА НА ЕНЕРГИЙНИТЕ ИНЖЕНЕРИ - БЪЛГАРИЯ - В РАЗВИТИЕ

Георги Рампов Иванов, председател на АЕИ
ЕФ „Рампов и син", София

Проектът на Американската Агенция за Международно Развитие (USAID) и Асоциацията на Енергийните Инженери (AEE) - Атланта, Джорджия, за създаване и развитие на пазарни условия за енергийната ефективност в страните от Източна Европа, проведен в нашата страна с решаващото съдействие на Министерството на промишлеността, имаше главната цел да послужи като катализатор в следните основни процеси:

- развитие и укрепване на български частни фирми предлагащи специфични услуги, оборудване и финансиране в областта на енергийната ефективност в промишлените предприятия;

- подобряване енергийната ефективност на промишлените предприятия чрез извършване на енергийни одити и доставка на енергоспестяващо оборудване;

- разширяване на българо - американските научно-технически и търговски връзки, посредством установяване на тесни връзки и сътрудничество между сдружения за енергийна ефективност, фирми за енергийни услуги и инженеринг и доставчици на оборудване.

Така, в резултат на тези намерения на USAID, за участие в проекта, чрез явен конкурс, проведен от изпълняващата проекта в нашата страна фирма RCG/Hagler Bailly, Inc., бяха набрани 13 представители или титуляри на частни фирми, работещи в областта на енергоспестяването. Семинарната подготовка се състоеше от обучение в области, свързани с:

- развитие на бизнес в условията на свободно пазарно стопанство - мениджмънт, икономика, счетоводство и финанси;

- принципи и техники за провеждане на енергийни одити и запознаване с модерно енергоспестяващо оборудване;

- специфични въпроси, отнасящи се до промишления мениджмънт, модерната поддръжка на промишлените предприятия и оптимизацията на енергопотреблението в тях;

- маркетинг и мениджмънт за фирми, предлагащи услуги в областта на енергийната ефективност.

След като се положи с успех писменият изпит за званието Сертифициран Енергиен Мениджър (CEM) - едно много уважавано в САЩ и Северна Америка професионално звание, издавано от Асоциацията на

Енергийните Инженери (АЕЕ) - Атланта, Джорджия, през есента на 1993 година бе учреден в София нейният български клон и за негов председател бе избран доц. д-р Никола Калоянов, от ТУ София. Следващият и настоящ председател - гл. ас. Георги Рампов, от ТУ, продължи започнатото дело и в края на 1995 г. бе извършена и официалната регистрация на Асоциацията на Енергийните Инженери - България (АЕИ), като сдружение с идеална цел по Закона за лицата и семейството.

АЕИ - България е сдружение на професионалисти, независими инженери и специалисти, работещи в области, свързани с енергийната ефективност и енергийния мениджмънт.

Нейни главни цели са:

- да спомага за създаването и развитието на свободен конкурентен пазар за консултантски и инженерингови услуги в областта на енергийната ефективност,
- да подпомага и насърчава професионалното развитие и израстване както на своите членове, така и на всички заинтересовани специалисти,
- да съдейства за ефективното им участие в професионални активности, свързани с енергийната ефективност и енергийния мениджмънт,
- да спомага за създаване и поддържане на високо професионално ниво в тези области,
- да участва в работата на държавни органи и други професионални организации и центрове по енергийна ефективност, при подготовка и създаване на нормативни документи,
- да извършва информационно-пропагандна дейност, сред широките обществени кръгове, по тематиката на енергийната ефективност.

В Асоциацията на Енергийните Инженери могат да членуват всички специалисти, споделящи идеите, залегнали в Устава й и имащи препоръка от двама квалифицирани члена на Асоциацията. Новите членове, освен членския внос, заплащат и встъпителна такса. Който желае, може да членува чрез АЕИ и в АЕЕ - Атланта, САЩ. В организацията могат да членуват и колективни членове - фирми, организации и други юридически лица. Студентите от горните курсове на ВУЗ членуват като учащи, при значително намален членски внос. При 13 учредители първоначално, сега броят на членовете е 20, а днес ще връчим грамоти и на най-новите.

АЕЕ - Атланта, Джорджия подари на нашата Асоциация голям брой специализирана литература от световно-известни автори и периодично допълва библиотеката ни с нови издания и периодика. Тези книги са от голяма полза за професионалното израстване на нашите членове, за което благодарим от все сърце на нашата братска асоциация.

Изпълнявайки първоначалните си намерения USAID ни дари някои основни измерителни прибори, полезни при извършване на енергийни одити или оценка резултатите от приложението на енергоспестяващи мерки. Това са термометри, разходомери, газоанализатори, цифров регистратор и анализатор на консумираната ел. енергия, измерител на осветеност, ултразвуков набор - детектор на пропуски, акустичен анализатор на кондензни

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гърнета и др. Тези уреди могат да се ползват както от членовете на АЕИ, така също и от външни специалисти, при съответно заплащане.

Успешно бе завършена работата по десетте пилотни проекта в промишлените предприятия, включени в общия проект. През първа и втора фаза на тези проекти Сертифицираните Енергийни-Мениджъри, членове на АЕИ, подпомогнати от специалистите от американската консултантска фирма RCG/Hagler Bailly Inc., направиха енергийни одити, набелязаха мерки за подобряване енергийната ефективност на предприятията, избраха подходящо оборудване и след безплатната му доставка от USAID, го монтираха и въведоха в експлоатация. Накрая бяха извършени измервания за доказване ефекта от приложените мерки.

Сега, когато отчитаме резултатите от този проект, ние вече работим по друг пилотен проект на USAID - за подобряване енергийната ефективност на Окръжната болница в Габрово, този път като технически съизпълнители на американската консултантска фирма Elektrotek и фондация ЕнЕфект. Тук ние изпълнихме енергийният одит, избрахме оборудването и след доставката му, сега, се извършва инженеринга по монтажа. По-нататък ни предстои 5 месечно измерване резулатите от приложените мерки и доказване тяхната ефективност.

В близкото бъдеще възнамеряваме да разработим пилотен проект за икономия на енергия в топлофикационна система, чрез автоматизация на абонатните станции и прилагане на активни мерки за икономия на енергия при потребителите, като приложим схемата за финансиране на проекта без първоначални капиталовложения и изплащането му от спестените разходи за енергия. За тази цел търсим партньори в лицето на някоя общинска фирма за топлофикация.

Изпълнявайки основните цели, залегнали в Устава, специалистите на АЕИ са разработили и предлагат на заинтересованите организации, фирми, промишлени предприятия и общини, курсове за обучение и преквалификация по:

- Икономия на енергия в парокотелни и отоплителни централи;
- Икономия на енергия в парокондензни стопанства на предприятия;
- Методи за подобряване топлоенергийната ефективност, за енергетици и мениджъри на промишлени предприятия;
- Икономия на ел. енергия в обществени сгради и промишлени предприятия;
- Икономия на топлина при централно топлоснабдяване на обществени, промишлени и битови сгради.

В заключение, мисля,че АЕИ не би имала тези успехи и даже не би съществувала, ако не бе този проект на USAID, за което изразявам най - горещи благодарности на всички, помогнали за осъществяването му!

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THE BULGARIAN CHAPTER OF THE ASSOCIATION OF ENERGY ENGIMEERS - MOVING AHEAD

Georgi Rampov, president of the Sofia chapter

Rampov & Son, Co.

The creation of the Bulgarian chapter of AEE was a result from the Eastern Europe Regional Energy Efficiency Program of USAID. The Sofia Chapter has the main aims:

- To foster the development and capability of Bulgarian energy servicing companies;
- To create a competitive energy service market;
- To help its members in their professional and business development;
- To inform the public for the energy efficiency problems.

13 were the initial founder members. Now there are more than 20. The AEE - Atlanta helps our chapter with any kind of literature and information support. The USAID has donated energy auditing measuring equipment which is very important for the growing up of the chapter.

The CEM's have successfully concluded the initial project, supported by Hagler Bailly Inc.

Now the chapter participates in a new energy saving project in Bulgaria - the pilot project in the district hospital in Gabrovo, together with Electrotek.

The chapter has prepared a courses program for industrial plants and municipal companies.

The Sofia chapter of the AEE is grateful to USAID, AEE - Atlanta and Hagler Bailly Inc. for their entire help and its creation at all.

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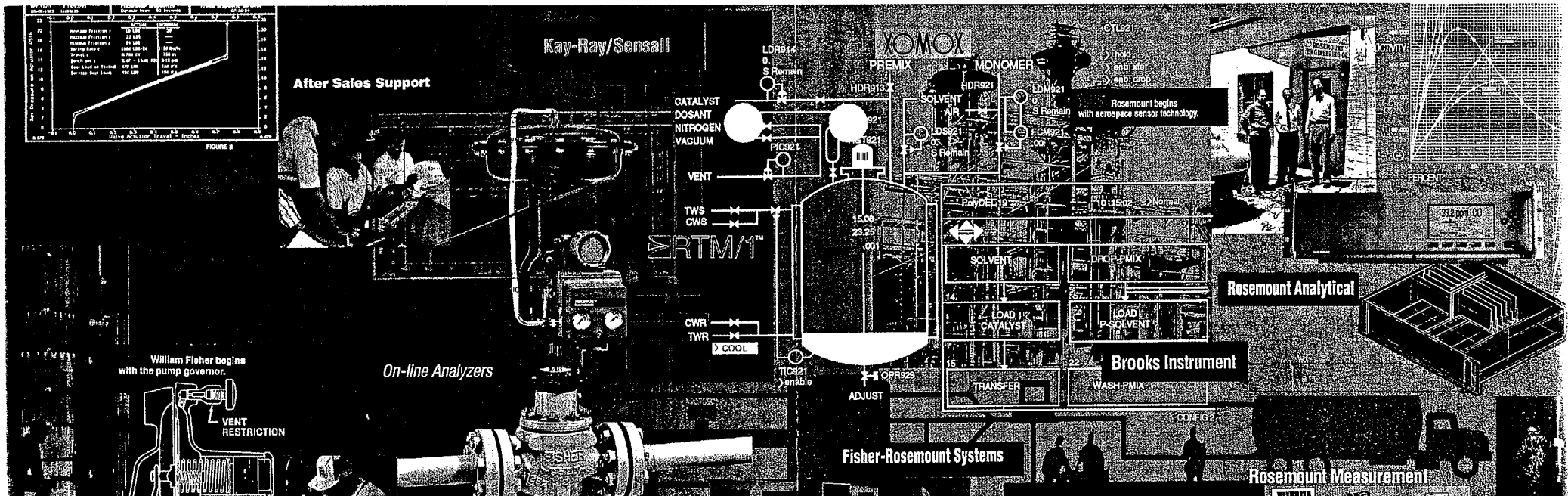
FISHER-ROSEMOUNT



Our Product Program

- Digital Process Control System RS3
- Electronic Pressure Transmitters
- Temperature Transmitters and Sensors
- Flow Meters
- Mass Flow Meters
- Analytical Instruments for pH, conductivity, residual chlorine and dissolved oxygen
- O_2/CO Analyzers
- Analyzers for gases and liquids
- Process Gas Chromatographs
- Non-contacting Measurement Systems for level, density and weigh scale
- Tank Management Systems
- Indicators, Monitors, Calibrators, Power Supply Units and Signal Conditioners

We are pleased to invite you and your instrumentation and process control specialists, to visit us again this year at the

CONFERENCE

Energy Efficiency Market Development in Bulgaria

in Sofia, NDK, sala 8
22 November 1996

We look forward to your visit and to be able to offer more detailed information on our products.

FISHER-ROSEMOUNT

represented by: Process Control, 1 Tzarichina Str., BG-1505 Sofia
Tel. (2) 70 35 49
Fax (2) 75 91 43

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_E M S Y S T_
Bulgaria, 1113 Sofia, boul. "Tzarigradsko Shose" 7 km, BIZ-IZOT
Tel/Fax 00359/2/740269

"EMSYST" is a private firm, which consists of 5 persons - two engineers in Electronics, one - in Computer Engineering, one engineer in Mechanics and one technician. All members of "**EMSYST**" are former scientific workers in the Institute of Computing Techniques. They have developed complicated test systems for qualification of magnetic disks and diskettes.

"**EMSYST**" was established as a private firm in 1991. We hired premises in the building of the Institute of Computing Techniques. We have at disposal a great amount of laboratory equipment, which is necessary for development and repair of electronic devices - power supplies, oscilloscopes, sweep generators, harmonic analyser, computers, EPROM programmer, etc.

The main job of the firm is the development, manufacture and installation of non-standard electronic measuring devices. Some of our own devices, which work in many factories are:

- Microprocessor based thermoregulator for industrial needs;
- Room thermostat;
- Microprocessor power factor regulator.

Our power factor regulator has winned a golden medal on the Plovdiv's International Fair. This regulator works successfully in ***120*** factories in Bulgaria.

In 1995 in consortium with another firm "EMSYST" has winned a competition of a Project financed by the PHARE Programme called "Actions Connected with Heat Efficient Use and Accounting". According to this Project we had to equip a laboratory for verification of heat-meters. The laboratory is already equipped and will start working from the beginning of 1997. Part of the equipment was made by ourselves.

"**EMSYST**" has also worked together with the Natinal Metrological Center. We have three times winned competitions concerning improvement and automation of national reference standards. The following tasks were carried out:

- Improvment of the accuracy and automation (connection with a computer) of a working place for test of tachometers;
- Automation of a force standard;
- Development of a tester for taximeters.

"**EMSYST**" is also a distributor of the production of ***Badger Meter Europa GmbH***, Germany. We offer and sell their flowmeters and levelmeters to the plants, we install and service these devices.

From the brief presentation of the firm above, could be concluded, that the specialists of "**EMSYST**" could cope with the development, installment, engineering and service of all kinds of electronic devices.

Three of our engineers have graduated language schools - english, german and french school respectively, so they could cope with all kind of technical documentation from western countries.

We insist on quality for all our products. We insist also on fair dealing with our business-partners.

DIRECTOR:.....

/Dipl.Eng. Petja Petrova/

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CHEMINST - АВСТРИЯ

ПРЕЗЕНТАЦИЯ

Австрийската фирма CHEMINST със седалище Виена е на българския пазар от 60-те години. Фирмата предлага две продукт линии - аналитична и химическа апаратура за лаборатории и индустриално произсводство, както медицинска апаратура. CHEMINST има клонове и представителства в Берлин, Варшава, Прага, Загреб, Букурещ, Будапеща, Москва, Търнава и София.
За България фирма CHEMINST е със статут на търговско предстаставителство, регистрирано с решение 135/11.06.92 на БТПП.
CHEMINST е официален дистрибутор на следните фирми за аналитично-химическата апаратура: AMETEK, DIONEX, GILSON, CECIL, DUPONT SORVALL, HAMILTON, LAB LINE, LABCONCO,ORION и MITSUBISHI.
В областта на енергийната ефективност AMETEK има световна известност и произвежданата от нея продукция се отличава със суперкачество и висока надежност на технологиите.

CHEMINST - AUSTRIA

PRESENTATION

CHEMINST Ges.m.b.h. - Vienna presents on Bulgarian market from the origin of sixty years. The company offers two product lines - analytical and chemical instruments for laboratories and industry as well as medical equipment. CHEMINST has branches Berlin, Warszawa, Prague, Zagreb, Bucharest, Budapest, Moscow, Trnava and Sofia.
In Bulgaria CHEMINST has Trading Office registered in legal form No 135 / 11 June 1992 of BCIP. CHEMINST is authorized dealer of the following companies for chemical and analytical equipment: AMETEK, DIONEX, GILSON, CECIL, DUPONT SORVALL, HAMILTON, LAB LINE, LABCONCO, ORION and MITSUBISHI.
In the area of power efficiency AMETEK is world leader. Their process and analytical instruments are high quality and reliability.

BULGARIA, SOFIA - 1606, 31 STR. VIKTOR GRIGOROVICH, FL.4, AP.25, TELEPHONE: 510 839, FAX / TELEPHONE: 951 67 11

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ABOUT HONEYWELL

Honeywell is 50,000 people in 95 countries pursuing a **vision** to grow profitably by delighting our customers and achieving undisputed worldwide leadership in control.

Our **mission** is to create value for shareholders through our leadership in advanced control solutions that help customers worldwide achieve their goals.

The company has three businesses, all linked by common technologies:

- **Home and Building Control**
- **Industrial Control**
- **Space and Aviation Control**

Honeywell was founded in 1885, incorporated in 1927, and listed on the New York Stock Exchange in 1929. The company's stock is also listed on exchanges in London, Paris, Amsterdam, Antwerp, Brussels, Geneva, Zurich and Basel. Based on sales, Honeywell ranks No. 195 on the Fortune 500 list of the largest U.S. industrial and service companies.

Honeywell has a single focus: controls. It was the basis of the company's founding in 1885 with the invention of the automatic thermostat control for home heating. Today we are a global leader in control technology that benefits millions of people and organizations.

Here are a few examples of how Honeywell control solutions benefit customers:

Enhancing Comfort

- For homeowners, our new Perfect Climate Comfort Center™ controls temperature and indoor air quality. It is the first thermostat product to earn Energy Star™ designation from the U.S. Environmental Protection Agency.
- The Brussels International Airport, which serves more than 21 million travellers a year, depends on a Honeywell integrated system that provides state-of-the-art centralized control of many building management systems.
- At the Hong Kong University of Science and Technology, Honeywell provides temperature and humidity control, and fire and security monitoring for the 18-building campus.
- Honeywell is the preferred supplier of home control systems for the Walt Disney Company's new town of Celebration near Orlando, Florida.

Protecting the Environment & Saving Energy

- Honeywell district heating controls for cities, such as Beijing, Moscow and Krakow, are reducing up to 30 percent of the energy required and reducing air pollution.
- Our energy efficient systems to upgrade buildings, such as schools and hospitals, pay for themselves through energy savings, which we guarantee.
- A Honeywell sensor in Maytag's revolutionary „smart" dishwasher automatically reduces energy and water consumption.
- Plantwide automation for Hoogovens Steel Works in the Netherlands has reduced carbon monoxide emissions by 70 percent while improving productivity.
- Our gimbal assembly on the NASA Earth Observing System Satellite ensures accurate data gathering for scientists monitoring the Earth's atmosphere.

Products

Perfect Climate Comfort Center™ Control System; SYSNet™ Facilities Integration System; thermostats; integrated control solutions, including the TotalHome® home automation system and the EXCEL 5000® building management system; controls for heating, ventilation and air conditioning equipment; heat recovery and energy recovery ventilators; integrated furnace and boiler controls; demand-side management systems; electronic and portable room air cleaners; security and fire alarm systems; ServiceNet remote HVAC monitoring; energy-efficient lighting equipment; utility services; and building maintenance services.

TotalPlant™ open solutions, including industrial automation and control system; advanced control applications and professional services, such as consulting, networking, engineering and installation; production management software; field instrumentation; recorders, controllers and support services; solid-state sensors; for position, pressure, air flow, temperature and current; vision based sensors; precision electromechanical switches; manual controls; fiber-optic components; and solenoid valves.

Affiliate in Bulgaria: Honeywell EOOD, 14, Iskarsko Chaussee, POB 79, 1592 Sofia
phone: ++359 2 794027, 791512, fax: ++359 2 794090, 9713213

ФИРМА ХАНИУЕЛ

Фирма Ханиуел - това са 50,000 човека в 95 страни, които се стремят чрез удовлетворяване потребностите на нашите клиенти да достигнат несъмнено световно лидерство в средствата за управление.

Нашата мисия е да създадем стойност за акционерите чрез нашето лидерство в съвременните решения за управление, като помогнем на клиентите си по цял свят да постигнат своите цели.

Фирмата има три направления, свързани с общи технологии:

- **Автоматизация на сгради**
- **Автоматизация на промишлени процеси**
- **Автоматизация в авиацията и космоса**

Ханиуел е основан в 1885, регистриран през 1927 и вписан в Ню Йоркската стокова борса в 1929. Фирмените акции също са вписани на борсите в Лондон, Париж, Амстердам, Анвърпен, Брюксел, Женева, Цюрих и Базел. Въз основа на продажбите си, Ханиуел е на 195 място в класацията на най-големите предприятия за промишленост и услуги в САЩ Fortune 500.

Ханиуел има една основна задача: средствата за управление. Такава е била тя и при създаването на фирмата през 1885 чрез изобретяването на автоматичното термостатно управление за домашно отопление. Днес ние сме лидери в технологиите за управление, от които се ползват милиони хора и организации.

Ето някои примери за това как решенията за управление на Ханиуел помагат на клиентите ни:

Повишаване на комфорта

- За притежателите на жилища, нашият нов Perfect Climate Comfort Center™ регулира температурата и качеството на въздуха в помещенията. Това е първият термостатен продукт, заслужил името Energy Star™ от Агенцията за опазване на околната среда на САЩ.
- Международното летище в Брюксел, което обслужва повече от 21 милиона пътници на година, разчита на една интегрирана система на Ханиуел, която осигурява централизирано управление на много системи за сградна автоматизация.
- В Хонгконгския университет за наука и технология Ханиуел осигурява регулирането на температурата и влагата, както и противопожарни и охранителни системи на 18-сградни корпуса.
- Ханиуел е предпочитан доставчик на системи за сградна автоматизация на новото увеселително гредче на компания Уолт Дисни, което се намира близо до Орландо, Флорида.

Защита на околната среда и спестяване на енергия

- Средствата за управление на Ханиуел за централно отопление на градовете, например Пекин, Москва и Краков намаляват до 30 процента необходимата енергия и замърсяването на въздуха.
- Ние гарантираме изплащането на нашите енергоефективни системи за модернизация на сгради, например училища и болници чрез спестяване на енергия.
- Един единствен датчик на Ханиуел в революционно „интелигентната" машина за миене на съдове на фирма Maytag автоматично намалява разхода на енергия и вода.
- Цялостната автоматизация на Завода за стомана Hoogovens в Холандия намали отделянето на карбонов монооксид със 70 процента, като при това производителността се увеличи.
- Наше карданно съединение на Сателитната обсервативна станция Земя на НАСА, осигурява точни данни за научни наблюдения на земната атмосфера.

Продукти

Система за управление Perfect Climate Comfort Center™; гъвкава интегригана система SYSNet™; термостати; интегрирани решения за управление, включващи автоматичната система за жилищни сгради TotalHome® и системата за управление на сгради EXCEL 5000®; средства за управление на отопление, вентилация и климатизация; вентилатори за възстановяване на топлина и енергия; интегрирани средства за управление на пещи и котли; електронни и преносими стайни въздухоочистители; противопожарни алармени системи и системи за безопасност; дистанционно следене на отопение и вентилация ServiceNet; комуникационни услуги и услуги, свързани с поддръжката на сгради.

Отворените цялостни решения TotalPlant™ включват промишлена автоматизация и управляваща система; приложения със съвременно управление и професионални услуги, такива като консултации, свързване в мрежа, инженеринг и инсталация; софтуер за управление на продукцията; полево оборудване; регистриращи прибори; контролери и услуги по поддръжката им; датчици за позиция, налягане, въздушен поток, температура и ток; прецизни електромеханични превключватели; средства за ръчно управление; оптични компоненти и магнет вентили.

Филиал в България: Ханиуел ЕООД, 14, Искърско шосе, п.к. 79, 1592 София
тел.: ++359 2 794027, 791512, факс: ++359 2 794090, 9713213

"СКОРТЕЛ - ПРП" ООД
Фирмена характеристика

РЕГИСТРАЦИЯ

Регистрация: регистрирана в гр. София, Ф. Д. 21591/16.09.93, □ 11547, том 159, рег. 1, стр. 120. Адрес на регистрация: ул. "Вихрен"□ 39А, вх. 3, гр. София, п. код:1618, България

Статистически □ (ЕКПОУ): 831067581.

Данъчен номер по ДДС: 3220009180

Сметка в Българска пощенска банка, гр. София: 940 100 327 1918

Управител : Валентин Бозаров

Офис: кв."Изгрев", ул. 165, □ 3, офис 207
гр. София, п. код:1797
тел.:(+359)(2)971 3118, (2)973 3324
тел/факс: (+359)(2)973 3324
E-mail: scortel@main.infotel.bg

ОРГАНИЗАЦИОННА СТРУКТУРА

Отдел "Инженеринг и развитие" - осъществява консултантска, развойна и инженерингова дейност в областта на комуникационните и информационните системи. Включва менажерски екип от висококвалифицирани специалисти: 1 д.т.н., 3 к.т.н.

Отдел "Персонално радиоповикване" - в момента ангажира основната част от състава на фирмата; развива всички функции по експлоатацията и развитието на пейджинг мрежата СКОРТЕЛ-ПЕЙДЖИНГ. "Скортел - ПРП" ООД притежава лиценз за обществен пейджинг оператор за гр. София. Включва екип от 19 души.

Направление "Сателитни комуникации" - осигурява се от професионален екип на "Скортел" ЕООД.

Отдел "Маркетинг и продажби" .

ИСТОРИЯ

Октомври 1993 - основаване на фирмата от "Валтрейд" ООД, "Скортел" ООД и ЕТ "Елком". Цел: реализиране на телекомуникационни проекти, главно за мобилни телекомуникации, включително и пейджинг (персонално радиоповикване).

Ноември 1993 - получава лиценз от Комитета по пощи и далекосъобщения за локален пейджинг оператор (за гр. София).

Юни 1994 - организира семинар за наземните приложения на Инмарсат в София, партньор на Инмарсат.

Август 1994 - започва редовната експлоатация на мрежата за персонално радиоповикване СКОРТЕЛ-ПЕЙДЖИНГ.

Септември 1994 - официален член на програмата Inmarsat Partnership.

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Декември 1994 - подписан дистрибуторски договор с Motorola GmbH (Висбаден, Германия).

Март 1995 - подписан дистрибуторски договор с Морсвязьспутник (Москва) за представителство в България на наземни станции на Инмарсат 015 (Laurentides - Канада и Perth - Австралия), разширен през **август 1996 г.** и за Станция 012 (Burum - Холандия).

Юни 1995- подписан дистрибуторски договор с Thrane&Thrane A/S (Дания) за мобилно и стационарно комуникационно оборудване по стандартите на Инмарсат.

Ноември 1995 - член на Българската асоциация за информационна индустрия.

Април 1996 - лицензирано право за ползване на търговските марки на Инмарсат: „Inmarsat Partnership Member", „Via Inmarsat".

ПРОФЕСИОНАЛЕН ОПИТ

"Скортел - ПРП" ООД е частна фирма, основана върху опита на "Валтрейд" ЕООД и "Скортел" ЕООД, както и на специалисти, работили по-рано в сферата на информационните и комуникационните технологии в БАН, Института по специална електроника и др.

Реализирани проекти след 1993 г.:

1. Проектиране и изграждане на мрежа за персонално радиоповикване „Скортел-пейджинг" (1993).
2. Експлоатация и развитие на мрежата „Скортел-пейджинг" (от 1994).
3. Проектиране и изграждане на малки информационни системи за частни фирми на базата на локални мрежи, съвместими с NetWare и LANLink (1993) .
4. Проектиране и изграждане на ведомствена мрежа за персонално радиоповикване за северното крайбрежие на Параходство БМФ - Варна (1995).
5. Инсталиране и пускане в експлоатация на системи и средства за мобилна спътникова връзка: СОМАТ (1995), БМФ (1995), Океански риболов (1996) и др.
6. Изследователски, нженерингови и технологични проекти в областта на телекомуникациите, в това число наземни и морски радиокомуникации, наземните мобилни приложения на Inmarsat: Холдинг „Велес" (1993), Simex Ltd. (1993), RISS International Ltd. (1994), Черноморска технологична групировка (1994), Холдинг „Евроенержи" (1994), СОМАТ АД (1995, 1996), Параходство БМФ (1995, 1996), МОНТ (Фонд СТТП - 1995, 1996).
7. Маркетингови и технически проучвания и консултации.

НАСТОЯЩА ДЕЙНОСТ НА ФИРМАТА

1. Пейджинг услуги - като обществен оператор за гр. София.
2. Проекти за ведомствени комуникационни мрежи и системи.

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3. Търговска дейност - внос, износ и дистрибуторство.
4. Консултации и представителство на чуждестранни фирми в сферата на телекомуникациите и информационните технологии.

ФИРМЕНА ФИЛОСОФИЯ

1. Пазари за телекомуникационни и информационни услуги има винаги.
2. Силата ни е в системния подход, в квалификацията и опита на нашия екип.
3. Потребителите и конкурентите са наши партньори.
4. Предпочитание към преките лични контакти.
5. Винаги е добре, когато работим заедно!
6. Работим за информационен комфорт във вашето ежедневие.

СТРАТЕГИЯ

Предлагане на висококачествени услуги чрез прилагане на съвременни комуникационни технологии и за решаване на непосредствените нужди на българските потребителите. Постигане на конкурентни цени чрез пряк контакт с производителите.

ДЕЛОВИ ПАРТНЬОРИ

1. Motorola Global Paging Operations - Висбаден, Германия
2. Единая пейджинговая система России - Москва
3. Inmarsat - Лондон
4. Thrane&Thrane A/S - Копенхаген, Дания
5. Морствязьспутник - Москва, Русия
6. THEOS Software Corporation - САЩ
7. INGRAM Micro - САЩ
8. NERA Satcom Division - Норвегия
9. Zetron - Великобритания
10. Navigs b.v. - Франция
11. Secmat N.T. - Франция
12. Комитет по пощи и далекосъобщения
13. Българска телекомуникационна компания - Център за телематични услуги

SCORTEL GROUP

COMPANY PROFILE

MANAGEMENT TEAM

1. **Mr. Valentin Bozarov** (52) M.Sc., Associate Professor in Comm.Eng., has an experience as a system engineer, researcher, head of department, 25 years was with the Institutes of the Bulgarian Academy of Sciences, last four years heads a private communication company. Fields of interests - telecommunications technologies and services.

2. **Mr. Valery Tzanov** (43), Ph.D., has an experience as a system engineer, researcher, project manager, last 10 years was with the Central Laboratory of Control Systems (Bulgarian Academy of Sciences). Fields of interests - telecommunications, data transmission and data processing.

3. **Mr. Ivan Korobko** (51), Ph.D., Dr.Sci., Associate Professor in Radio Electronics, has an experience as a researcher, designer, project manager, head of design department in the Institute of Radio and Electronic Technologies (Sofia). Field of Interests - high frequency electronics, radar and antenna systems, telecommunications systems.

PROFESSIONAL EXPERIENCE

SCORTEL is a group of private companies with accumulated business and engineering experience in the following fields:

1. Personal Radio Calling (Paging)

SCORTEL is a public paging operator for Sofia city and a distributor of the paging products and systems of **MOTOROLA;**

2. Mobile Satellite Communications

SCORTEL has a Partnership status in the **International Maritime Satellite Organization (INMARSAT)** and is an exclusive distributor of **MORSVIAZSPUTNIK** (Moscow) in Bulgaria and the region, as well as a distributor of other **INMARSAT** equipment manufacturers;

3. Large Scale Radio Systems

SCORTEL has an accumulated science and engineering experience in the design, implementation and maintenance of equipment and corporate information systems;

4. SCORTEL is in contact with government officials and institutions, well informed about the national regulations in telecommunications, and has gained experience in the application of the Bulgarian laws in the business environment.

SCORTEL * kv. Izgrev, ul.165, no 3, office 207 tel: (+359)-2-971 31 18
1797 Sofia, Bulgaria fax./tel: (+359)-2-973 33 24

CURRENT ACTIVITIES

1. Paging operator and service provider for Sofia city (started in 1993).

2. Paging project for the Navigation Maritime Bulgarie (NMB) in Varna (1995).

3. Consulting and demo system for paging technologies for the National Police.

4. Coastal VHF radio system Area A1. Feasibility study for NMB (1995), project design (1996).

5. Consulting on Trunking system for Bulgargaz (1996).

6. Project design and implementation of „Fleet management based on mobile satellite telecommunications technology Inmarsat-C for SO MAT - The biggest transport company in Bulgaria and Europe (1996 - 1997).

7. Dispatching Center and satellite communications for international transport (1996-1997). Contract with Ministry for education, Science and Technology (1996).

8. Projects for satellite communications for financial and transport companies.

9. System desing and feasibility study for Global Paging System of Russia (1996).

HISTORY

November 1992 - Scortel Ltd. founded in Sofia.
November 1993 -Received a license from the Bulgarian PTT for Public Paging Operator.
August 1994 - Regular exploitation of the „SCORTEL PAGING" network.
September 1994 -Member of Inmarsat Partnership.
October 1995 - Member of Bulgarian Association of Information Industry (BAII)

STAFF

The total number of employees in „SCORTEL" is 24, among which:
- Management - 3;
- Development and engineering - 4
- Marketing and sales - 2;
- Technical and service staff - 13;
- Financing - 2.

Qualification of the employees:
- Doctor of Science - 1;
- Ph. D. - 2;
- Engineers - 4.

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COMPANY'S PHILOSOPHY

1. There always are new markets for telecommunication and information services.
2. The system approach and qualification of our staff is our power.
3. Users and competitors are our partners.
4. Direct personal contacts are preferable.
5. It's always better for people to work together.
6. We are working for the information comfort in your life.

SCORTEL IS A PARTNER OF:

1. Motorola Global Paging Operations - Wiesbaden, Germany;
2. Bulgarian Post and Telecommunications Committee;
3. Bulgarian Telecommunications Company PLC.;
4. INMARSAT - London;
5. „MORSVIAZSPUTNIK" - Moscow;
6. Global Paging Russia - Moscow;
7. Thrane & Thrane A/S - Denmark;
8. Navigation Maritime Bulgarie PLC. - Varna;
9. LINCOM FS LTD. - Sofia;
10. Bulgargaz, PLC - Sofia.

КОМИКОН

Предмет на дейност

КОМИКОН е частна фирма създадена през 1991 г.

Основният предмет на дейност на фирмата е разработка, производство и внедряване на технически средства и програмно осигуряване за автоматизация на дискретни и непрекъснати процеси в строителството и промишлеността - химия, металургия, машиностроене, фуражна и хранителна промишленост и др. Фирмата предлага на своите клиенти следните продукти:

ТЕХНИЧЕСКИ СРЕДСТВА ЗА АСУТП

Програмируем контролер - JUNIOR 048	- 48 входо-изхода
Програмируем контролер - JUNIOR 160	- 60 входо-изхода
Програмируем контролер - COMICON 002/003	-126 / 202 входо-изхода
Показващ контролер - JUNIOR V4	- 24 / 48 входо-изхода

Панели за въвеждане и индикация на данни - JUNIOR V2
Температурни преобразуватели и галванични разделители-
Прибори за ръчно управление - JUNIOR DMC, JUNIOR MC
Релейни усилватели и декодери
Мрежови и комуникационни устройства
Захранващи устройства
Табла за управление на асансьори, асансьорни бутониери и индикатори

ИНДУСТРИАЛЕН СОФТУЕР ЗА ПЕРСОНАЛЕН КОМПЮТЪР И ФИРМЕНИ СИСТЕМИ

Операционни среди и езици за програмиране използвани от фирмата - WINDOWS95, DOS, C, C++, Clipper, ACCESS, PARADOX, EXCEL, VISUAL BASIC

Програматори и операторски станции за система от програмируеми контролери

Система за контрол за енергопотребление в промишлен комбинат ел. енергия, горива, промишлен въздух, пара, топла и студена вода

Информационна система за пожароизвестяване

Система за комплексно управлвние на зърнопреработвателно предприятие състоящо се от фуражен завод, мелница, складови бази

Информационна система за диспечеризация на газ и енергопотребление в населено място

Система за дистанционен контрол на оборудване в промишлено предприятие чрез модеми по комутируема телефона линия

ДРУГИ ДЕЙНОСТИ

Внедряване в експлоатация и сервиз на системи за управление

Обучение, консултации и прекалификация на експлоатационен и поддържащ персонал

Ремонт за 48 часа на технически средства доставени от фирмата. Абонаметно поддържане

Разработка и производство на електронни изделия и програмно осигуряване по задание на клиента

Адрес:	1784 София, бул. Цариградско шосе 7-ми км.(ИПАКТ)
Телефон:	77 11 58
Факс:	777 104
Телекс:	22711

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COMICON

Company profile

Comicon is a private company founded in1991.
The application area of our HARDWARE and SOFTWARE is:

- chemical and food industry;
- energy production;
- power consumption control, emergency and fire warning control for industrial enterprises and hotels;

Last six years the activity of the company covers:

* Design, development, production and implementation of:
  - small and medium size programmable controllers, data acquisition systems, remote control and operator panels
  - transmitters, isolating interface units
  - power supplies and accessories

* We offer the next types programmable controllers:
  - JUNIOR048-16DI, 16DO, 6FI, 8AI, 4AO, RS232
  - JUNIOR160 -24DI, 24DO, 8AI, 4AO, RS485
  - COMICON 002 -136DI/O, 6FI, 60AI/O, RS485, RS232
  - JUNIOR V4-24DI/O, 8AI, 4AO, RS485

* Software based on Microsoft Windows 95, DOS 6.22, C, C++, Excell, Clipper, Access,Paradox:
  - development of communication between controllers, computers, operator stations and other control equipment,
  - local area networks and industrial communication by modems via telephone lines;
  - PC based software for industrial processes management and control including packages for low-cost IBM-PC based operator stations, packages for software development stations with ladder logic under IEC1131-3 and editors, compilers, interpreters, simulators, LAN analysis and simulations;
  - least /cost formulation programs for food proccessing industry;

Address:	7-th km. Tzarigradsko chausse (IPAKT) 1784 Sofia, Bulgaria
Tel:	(+359 02) 77 11 58
Fax:	(+359.02) 777 104
Telex:	22711

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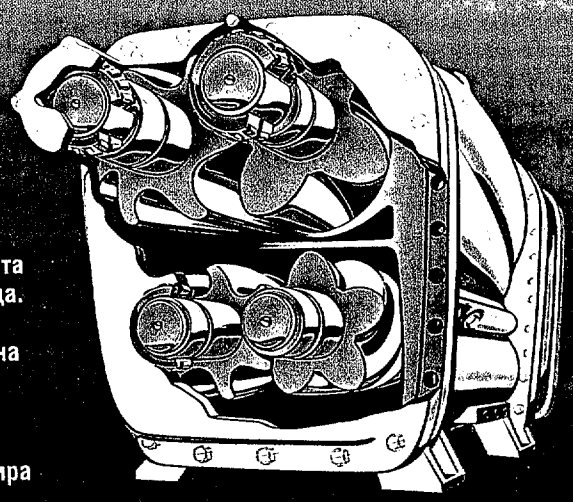
КИРОВ
ПРОФЕСИОНАЛНА ТЕХНИКА

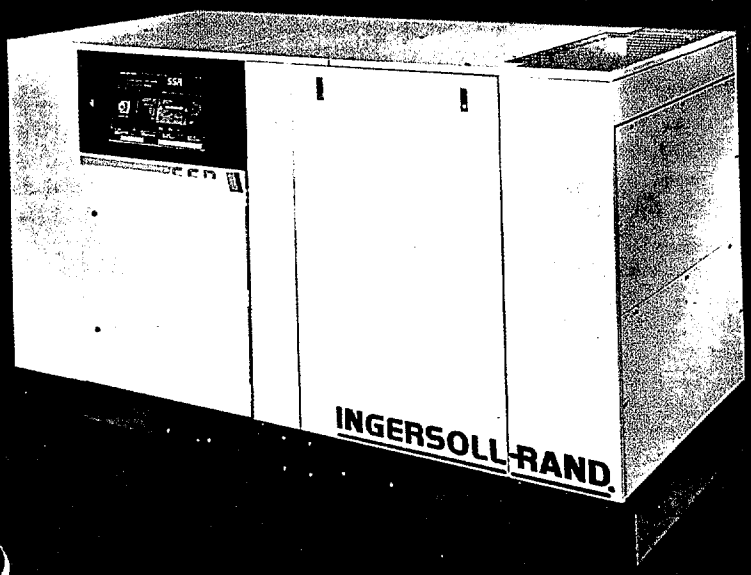
INGERSOLL-RAND

ЕДНОСТЕПЕННИ И ДВУСТЕПЕННИ ВИНТОВИ ВЪЗДУШНИ КОМПРЕСОРИ SSR-M

ЕЛЕГАНТНОСТ И ОПРОСТЕНОСТ, КОМБИНИРАНИ С ПОРАЗЯВАЩ РЕЗУЛТАТ

Ротационният винтов компресор SSR на INGERSOLL-RAND е едновременно елегантен и опростен.
Двата взаимно зацепени ротора (движещите се части на тази машина) се въртят плавно, компресирайки въздуха с ротационно движение без пулсации. Резултатът от тази опростеност на концепцията и елегантност на изпълнението е високо надежден, безавариен компресор, проектиран така, че поддръжката му да бъде сведена до минимум.
Това е компресор, който снабдява с чист, висококачествен сгъстен въздух Вашата разпределителна система, като на изхода на машината той е с температура само с 10°C по- висока от тази на околната среда.
Стандартната работна температура на околната среда за винтовите компресори INGERSOLL-RAND е от +2°C до +46°C, но по желание на клиента се произвеждат компресори, работещи от –10°C до +46°C с възможности за работа на открито.
Всъщност, само една силна международна корпорация като INGERSOLL-RAND има човешките и финансови ресурси да реализира концепцията, проекта, разработването и големия производствен капацитет на висококачествен компресор като SSR, което води и до най-ниски продажни цени в сравнение с конкурентните производители на компресори.





СЪРЦЕТО НА РОТАЦИОННИЯ ВИНТОВ КОМПРЕСОР SSR Е НЕГОВАТА ВИНТОВА ДВОЙКА

Всяка винтова двойка на SSR е шедьовър на елегантност и опростеност. Тя е също много здрава, с голяма трайност при употреба и може да се разчита, че ще осигури дълги години безаварийна работа при тежък режим на работа (24 часа в денонощието).
За повече от две десетилетия на непрестанни подобрения на продукта, INGERSOLL-RAND разработи най-опростената и надеждна опорна система, прилагана някога при ротационна винтова двойка, която се състои от:

- двойка конусни лагери, които напълно поглъщат осовото натоварване;
- уникална „смазочна преграда“ („coolant dam“), която задържа смазващия материал за лагерите в периоди на престой, като по този начин осигурява смазване по всяко време;
- цилиндрични ролкови лагери за радиалните товари.

ЗАПАЗЕНА МАРКА ЗА КАЧЕСТВО

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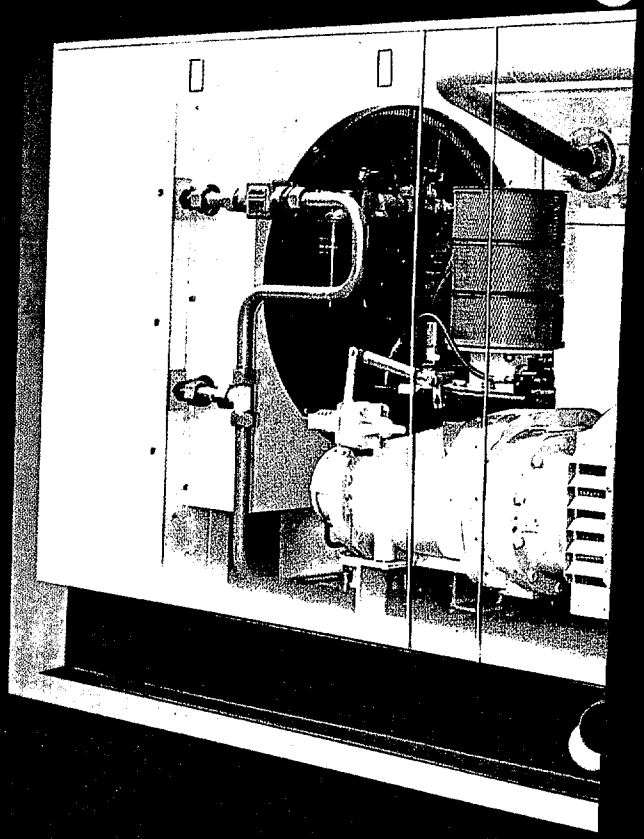
ЕДНОСТЕПЕННИ ВИНТОВИ ВЪЗДУШНИ КОМПРЕСОРИ

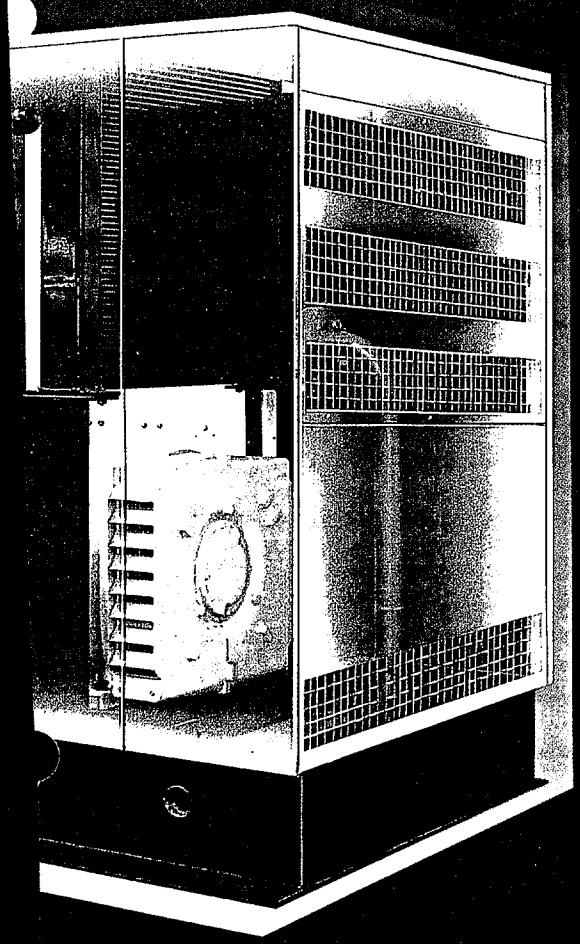
Модел	Налягане bar	Мощност на двигателя, Kw	Мощност на двигателя за охлаждане, Kw	Капацитет m^3/min	Размери Д mm	Ш mm	В mm	Тегло kg	Ниво на шума, dB
SSRML4 SSRMH4 SSRMU4	7,5 10 13	4		0.52 0.40 0.31	500	700	855	164	66
SSRML5.5 SSRMH5.5 SSRMU5.5	7.5 10 13	5.5		0.79 0.65 0.46	500	700	855	179	67
SSRML7.5 SSRMH7.5 SSRMU7.5	7.5 10 13	7.5		1.07 0.91 0.71	500	700	855	185	68
SSRML11 SSRMM11 SSRMH11 SSRMU11	7.5 8.5 10 13	11		1.75 1.59 1.40 0.91	1210	700	1100	420	70
SSRML15 SSRMM15 SSRMH15 SSRMU15	7.5 8.5 10 13	15		2.50 2.27 2.10 1.47	1210	700	1100	456	71
SSRML18.5 SSRMM18.5 SSRMH18.5 SSRMU18.5	7.5 8.5 10 13	18.5		2.90 2.78 2.50 1.84	1210	700	1100	456	72
SSRML22 SSRMM22 SSRMH22 SSRMU22	7.5 8.5 10 13	22		3.50 3.26 3.00 2.27	1460	700	1100	508	72
SSRML30 SSRMM30 SSRMH30 SSRMU30	7.5 8.5 10 13	30		4.30 4.11 3.80 3.11	1460	700	1100	610	73

КОМПРЕСОРЪТ SSR Е МОДЕЛИРАН В СЪВРЕМЕНЕН ДИЗАЙН

Основен критерий при проектирането в INGERSOLL-RAND са техническите решения, отговарящи на съвременните очаквания. Чрез този ръководен принцип в работата ни ние вграждаме тези технически решения във всеки компресор SSR, който е управляван от интелигентна система, наречена INTELISYS. Това наименование е символ на качество, безотказност и дълъг живот. Тази система е с подходящ дизайн и е изградена на основата на микропроцесор. Контролерът на системата показва на монитора работните параметри на компресора и следи за спазване на границите на безопасност при работа. Диагнозата, че е настъпила грешка в системата е конкретна и ясна и се индикира върху панела. INTELISYS предпазва от повреди в захранването, промяна на напрежението, от високи температури и осигурява



Модел	Налягане bar	Мощност на двигателя, Kw	Мощност на двигателя за охлаждане, Kw	Капацитет m^3/min	Размери Д mm	Ш mm	В mm	Тегло kg	Ниво на шума, dB
SSRML37B	7.5	37	2.5	5.74	1300	900	1780	800	75
SSRMM37B	8.5			5.49					
SSRMH37B	10			5.14					
SSRMU37B	13			4.52					
SSRML45	7.5	45	2.5	7.40	2590	1067	1042	1008	75
SSRMM45	8.5			6.80					
SSRMH45	10			6.50					
SSRML50	7.5	50	2.5	8.00	2590	1067	1042	944	75
SSRMM50	8.5			7.20					
SSRMH50	10			6.70					
SSRML55	7.5	55	2.5	9.90	2610	1320	1365	1475	75
SSRMM55	8.5			9.20					
SSRMH55	10			8.50					
SSRML75	7.5	75	2.5	13.31	2610	1320	1365	1585	76
SSRMM75	8.5			12.68					
SSRMH75	10			11.61					
SSRML90	7.5	90	5.0	16.70	2770	1320	1700	2430	76
SSRMM90	8.5			14.30					
SSRMH90	10			12.00					
SSRML110	7.5	110	5.0	20.00	2770	1320	1700	2580	76
SSRMM110	8.5			18.30					
SSRMH110	10			16.00					
SSRML132	7.5	132	5.0	23.00	2770	1321	1700	2590	77
SSRMM132	8.5			22.00					
SSRMH132	10			20.00					
SSRML150	7.5	150	5.0	27.00	2770	1321	1700	2600	77
SSRMM150	8.5			25.00					
SSRMH150	10			23.00					
SSRML200	7.5	200	5.5	34.00	3020	1740	2000	3490	82
SSRMM200	8.5			31.00					
SSRMH200	10			28.00					
SSRML250	7.5	250	5.5	41.10	3020	1740	2000	3556	82
SSRMM250	8.5			37.70					
SSRMH250	10			34.80					



В УНИСОН С ИЗИСКВАНИЯТА НА СЪВРЕМЕННИЯ ПОТРЕБИТЕЛ

условия за правилно използване на машините. Тези машини осигуряват от 0,31 $м^3$/мин до 66,0 $м^3$/мин сгъстен въздух при работно налягане от 7,5 бара до 14,0 бара и номинална мощност на двигателя от 4 kW до 350 kW.

Всеки винтов компресор INGERSOLL-RAND е зареден фабрично с масло тип Ultra coolant, което е на синтетична основа и е конструирано по специална формула. Това масло се използва изключително само при винтовите компресори, като освен смазващите качества, има и качеството да охлажда системата като не създава вътрешни напрежения, поради изключително ниската си пенливост. Маслото Ultra coolant се подменя на всеки 8000 работни часа, което допълнително намалява разходите по поддръжката на компресора.

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КИРОВ
ПРОФЕСИОНАЛНА ТЕХНИКА

INGERSOLL-RAND

ДВУСТЕПЕННИ ВИНТОВИ ВЪЗДУШНИ КОМПРЕСОРИ

Модел	Налягане bar	Мощност на двигателя, Kw	Капацитет m^3/min	Размери Д mm	Ш mm	В mm	Тегло kg	Ниво на шума, dB
SSRML200-2S	7.5	200	41.2	4138	1740	2022	6000	80
SSRMM200-2S	8.5	200	37.2	4138	1740	2022	6000	80
SSRMH200-2S	10	200	35.0	4138	1740	2022	6000	80
SSRMU200-2S	13	200	31.7	4138	1740	2022	6000	80
SSRMXU200-2S	14	200	29.6	4138	1740	2022	6000	80
SSRML250-2S	7.5	250	48.7	4138	1740	2022	6050	80
SSRMM250-2S	8.5	250	47.1	4138	1740	2022	6050	80
SSRMH250-2S	10	250	42.8	4138	1740	2022	6050	80
SSRMU250-2S	13	250	38.8	4138	1740	2022	6050	80
SSRMXU250-2S	14	250	36.4	4138	1740	2022	6050	80
SSRML300-2S	7.5	300	57.8	4138	1740	2022	6100	81
SSRMM300-2S	8.5	300	55.7	4138	1740	2022	6100	81
SSRMH300-2S	10	300	50.3	4138	1740	2022	6100	81
SSRMU300-2S	13	300	45.7	4138	1740	2022	6100	81
SSRMXU300-2S	14	300	44.3	4138	1740	2022	6100	81
SSRML350-2S	7.5	350	65.9	4138	1740	2022	6150	81
SSRMM350-2S	8.5	350	61.5	4138	1740	2022	6150	81
SSRMH350-2S	10	350	57.3	4138	1740	2022	6150	81
SSRMU350-2S	13	350	52.1	4138	1740	2022	6150	81
SSRMXU350-2S	14	350	50.3	4138	1740	2022	6150	81

INGERSOLL-RAND и неговите дистрибутори по цял свят са готови да предложат разнообразни творчески решения за Вашите нужди от сгъстен въздух. Заводите, офисите и дистрибуторите на INGERSOLL-RAND са разположени на територията на над 130 държави и разполагат с опитни и добре подготвени кадри. Вие можете да разчитате на професионална помощ, на своевременна поддръжка, ремонт, сервиз и резервни части – независимо от това къде се намирате.

„SINGLE SOURCE RESPONSIBILITY" – това е много повече от лозунг, това е истинският ангажимент към Вас! Оценката за една отлична компания често се прави въз основа на това, как тя застава зад своите продукти при тяхната употреба.

Както INGERSOLL-RAND така и нашите дистрибутори споделят тази философия и искрено вярват, че не е достатъчно да произвеждаш качествени продукти, необходимо е тези продукти да бъдат защитени с качествен сервиз след продажбата. Първо, всеки компресор SSR е тестван при максимално налягане и пълен дебит на въздух. След това за всеки компресор SSR се поема уникален ангажимент за сервиз, наречен „SINGLE SOURCE RESPONSIBILITY", т.е. INGERSOLL-RAND и нашите дистрибутори поемат 100% отговорност за Вашето удовлетворение от притежаването на тези машини. Този ангажимент е толкова силен, че всъщност той е дал името на продукта: SSR е съкращение от „SINGLE SOURCE RESPONSIBILITY".

Производството на INGERSOLL-RAND е гъвкаво и предлага както стандартните изпълнения, така и изпълнения със специфичен дизайн, съгласно изискванията на клиента. Ако машините, които са Ви необходими не са включени в този каталог, то влезте във връзка с фирма КИРОВ, официален представител на INGERSOLL-RAND за България, за да уточните исканите от Вас технически параметри и конфигурации.

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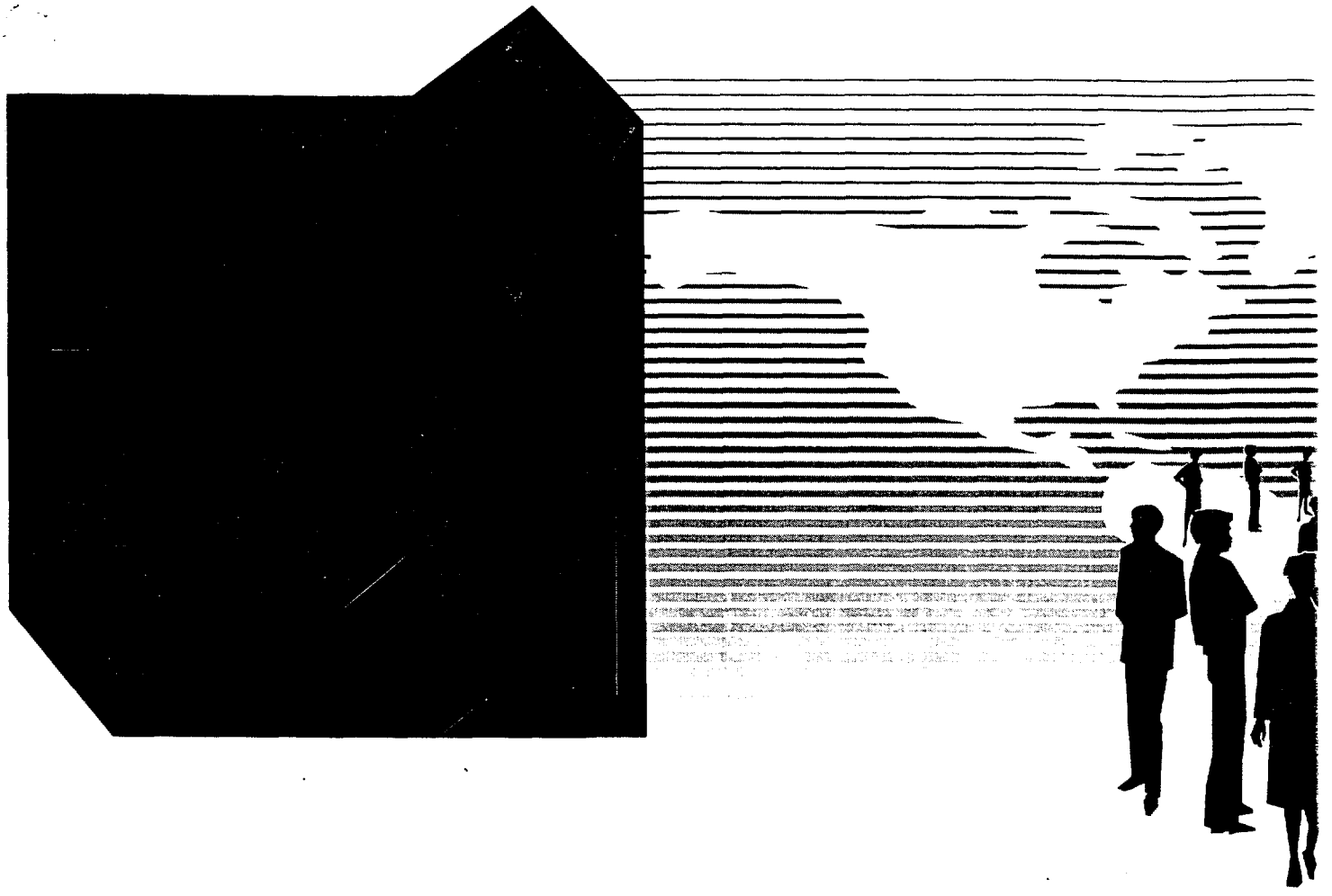

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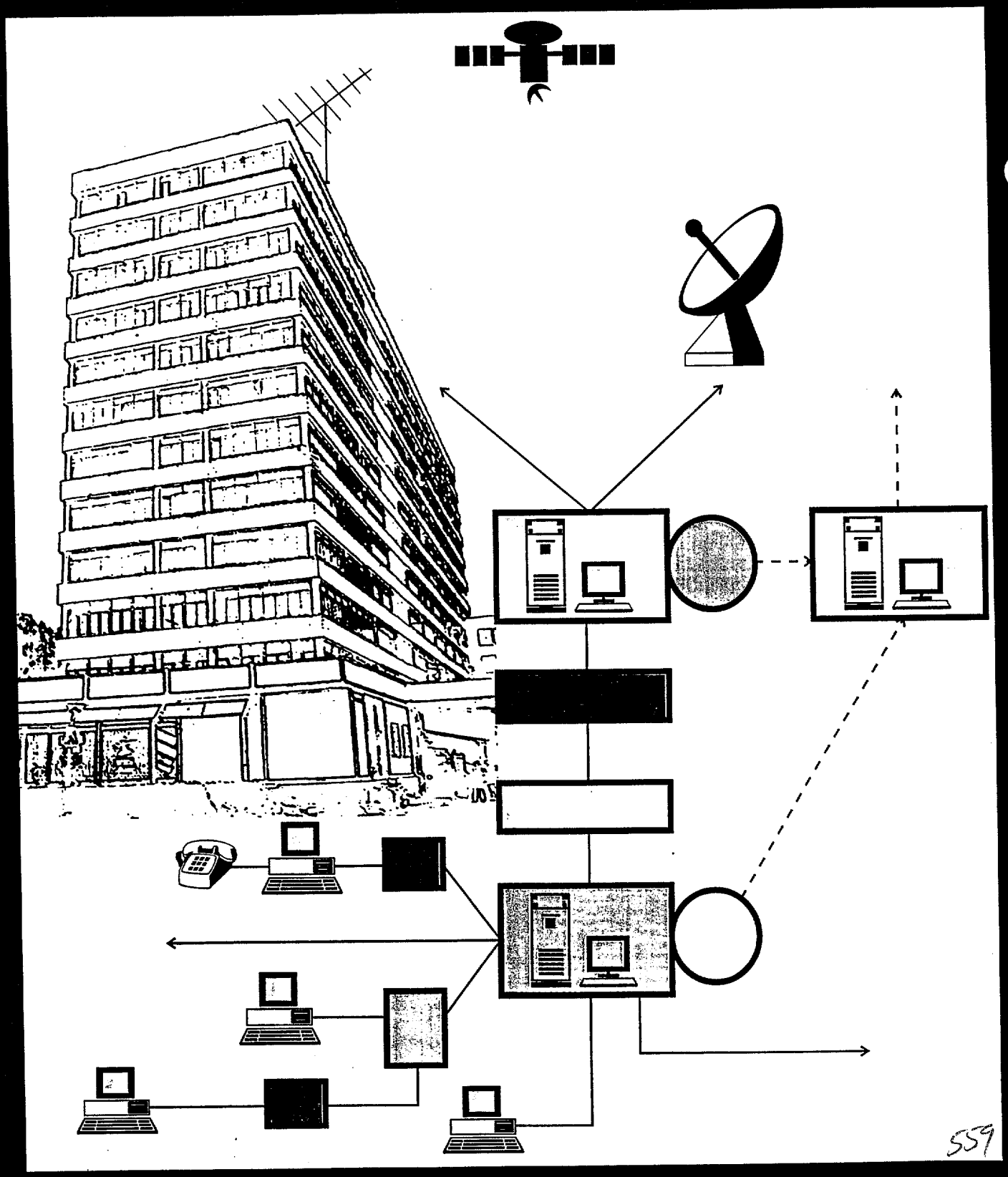

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