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ENERGY EFFICIENCY AUDIT REPORT

CERNY DUL FABRIC PLANT
Horice, Czechoslovakia

JANUARY 1992

PREPARED BY: RESOURCE MANAGEMENT ASSOCIATES OF MADISON, INC.
Madison, WI

and

ENERGOPROJEKT
Prague, Czechoslovakia

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

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
BUREAU FOR EUROPE
WASHINGTON, D.C. 20523

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OFFICE OF DEVELOPMENT RESOURCES
ENERGY & INFRASTRUCTURE DIVISION
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i. Executive Summary

Czechoslovakia faces unprecedented energy problems including uncertain oil supplies, pollution from coal, and questions about the future of nuclear energy. The Czechoslovakian industrial sector has experienced large increases in energy prices, the latest in January, 1991, bringing energy costs in-line with world energy prices. At the same time, the country is embarked upon a fundamental economic structural reform. The U.S. Agency for International Development established the Industrial Energy Efficiency Improvement Program to help mitigate the impacts of increased energy costs on the industrial sector by providing technical support through energy audits and economic support through purchase and installation of energy conservation equipment in selected representative industrial plants. Resource Management Associates of Madison, Inc. (RMA) is the technical assistance contractor for this portion of the program in Czechoslovakia. RMA was provided valuable assistance by two in-country subcontractors: 1) Stedisko pro Efektivni Vyuzivni Energie (SEVEn), in plant selection and in-country logistics; and 2) Energoprojekt in the audit and equipment installation work.

Energy Audit

As part of the USAID program, an energy audit was conducted at the Cerny Dul fabric finishing plant, which is one of 16 plants operated by Mileta. The energy audit showed many short-term low-cost/ no-cost energy conservation opportunities (ECOs). The major opportunities are: 1) improving maintenance, 2) repairing existing equipment; and 3) improving control equipment. It is estimated that these improvements could save 10% to 15% of the present combined steam and electric energy consumption (45,536 GJ per year). The adoption of the recommended measures will reduce energy consumption by about 6,800 GJ, or 15% in the first year. The recommended measures are widely applicable and should be highly replicable within Czechoslovakia. Additional first year savings of 19,700 GJ, or 3.7% of 530,000 GJ could be realized, if these measures are adopted, at other Mileta plants.

Based on the audit results, specifications were prepared for installation of a new burner on an existing boiler. The new burner will have automatic control of combustion air, and will burn heavy oil fractions which were formerly a waste product. The new burner will reduce fuel oil use by 5%, or 2,100 GJ/year, and use 2,400 GJ/year waste oil. In subsequent years, 800 GJ/year of waste oil will be burned. The second recommended measure is to provide the plant engineering staff with test equipment enabling them to test boilers and identify energy conservation opportunities at the other 16 plants. This measure should save 5% to 10% of total energy consumption of 530,000 GJ/year.

Implementation Phase

A follow-up visit was made to the plant on August 7 and 8, 1991. The auditors verfied that the equipment purchased for the plant under the program had been delivered. Training was provided to plant staff on the use of the portable equipment. The fixed equipment was not completely installed at the time of the implementation visit, but has since been completed.

ii. Description of Energy Efficiency Program

Czechoslovakia's industrial sector is well developed and contains many large and heavy industries. However, there are many medium size industries within the country that consume a large percentage of the industrial energy used. Many of these industries are made up of multiple companies and plants within the country, making them ideal targets for industrial energy audit work because of high potential replication. Many of these medium size plants are quite viable, but have not yet implemented energy conservation activities.

Increases in energy prices to equivalent world prices have put additional pressures on industrial firms to conserve energy. Changes within the economic system (increasing energy prices, privatization, etc.) will necessitate increased energy efficiency and reduced energy intensity of production. The Industrial Energy Efficiency Program will train Czech managers and engineers in energy efficiency measures and practices, as well as in energy management. This training will demonstrate the benefits of energy conservation and illustrate the advantages of making all employees aware of energy waste.

The Industrial Energy Efficiency Program is based on four distinct tasks:

1. Industrial plant screening
2. Industrial plant energy audit
3. Policy analysis
4. Implementation.

Fifteen industrial plants were screened and eight were selected to be audited. Criteria used in this selection included:

- opportunity for energy savings (with a focus on oil savings)
- potential replicability of energy saving options in similar plants or systems
- future viability of the plant in the changing economy
- size of the plant
- other activities such as joint ventures or other bi-lateral aid projects.

The energy audit activity, described in detail in this report, determined the overall energy efficiency of the plant, which was used to identify no/low-cost equipment opportunities with short-term payback. An assessment was made of the technical and management capabilities and capital investment decision making processes regarding energy conservation applications. Preparation of equipment specifications and other documents required for procurement of U.S. equipment or materials completed the audit.

In the implementation phase, equipment specified in the energy audit was procured, cleared through customs, and delivered to the plant. Also, requirements for installation of the material were identified. Where possible, this was done by plant personnel, or alternatively, by CSFR contractors. Following installation, the effectiveness of the energy conservation application was evaluated.

1.0 Plant Description

Following are the key data for the Cerny Dul Plant.

Name: Cerny Dul Fabric Finishing Plant, (Mileta Plant X)

Address: Cerny Dul Plant, Mileta
508 01 Horice (East Bohemia)
Czechoslovakia

Contacts: Mr. Jaroslav Medricky, (Mileta Director)
Ms. Ing. Renata Hanusova, Assistant Power Engineer
Mr. Z. Havlak, Director, Cerny Dul Plant

Phone: (438) 92 106
FAX: (435) 3740
(+42-435) 3111 (international)

Product: Finishing of cotton cloth (bleaching, mercerizing, drying)
18,602,090 meters per year (1990).

Plant size: 138 employees, approximately 33,000 square meters of floor space.

Date of Plant Commissioning: 1939

Electric Energy: Demand: 318 kW
Consumption: 930,720 kW
Self generation capacity: none
Refrigeration load: none

Steam Requirements:
Method of supply: Oil Fired Boilers
Average demand: 4-5 metric tons/hr
Temperature 180-190 °C
Pressure: 0.8-1.0 MPa
Annual fuel oil use: 84,000 GJ

2.0 Process Description

Cerny Dul receives rolls of woven cloth from other plants in the Mileta system and performs the following operations on the cloth:

- bleaching with sodium hydroxide solution: This process requires the recycling and concentration of the lye solution by evaporation.
- mercerizing (conditioning the cloth)
- drying and ironing
- printing patterns by silk screen methods
- dying (including dye setting)
- preparing finished cloth for shipping in bulk form

The energy used in processing is primarily in the form of steam for heating water or other solutions to 30-60 °C, and for drying cloth after operations such as bleaching, mercerizing and dying are completed. Smaller amounts of electrical energy are used for motor drives; electricity is never used for heating. A small amount of compressed air is used for material handling systems.

Major processes are well automated, however material handling requires extensive manual effort. Equipment has been updated periodically; a new bleaching line was commissioned during the audit. Cerny Dul has installed heat recovery units to recover waste heat from hot solution streams. Recovered heat is used for other processes requiring lower temperatures or for preheating water/solution streams.

Approximately 60% of plant production is sold for export. The remainder is sold to other Mileta plants for production of finished cloth products.

3.0 Audit Description

Two audit team members surveyed the plant from March 18 to 22, 1991. The audit team toured the plant on the first day, and conducted tests using instrumentation on the second and third days.

On the second day, combustion tests on the No. 3 boiler showed efficiencies in the 76-78% range. These results were questioned at first by plant personnel, since previous test results indicated efficiencies above 85%. On the third day, tests on the No. 1 boiler initially indicated efficiencies near 85%, but after cycling the boiler from full load to minimum and back again, efficiencies were in the 80% range. On Friday, the No. 3 boiler was retested; initial measurements showed an increase to over 83%, but again, cycling the boiler decreased efficiencies. This indicates that by manual "tweaking", the operating staff can achieve satisfactory efficiencies, but they rapidly decrease with boiler cycling.

Other tests used the infrared thermometer to check steam trap performance. The tests identified several failed steam traps responsible for a continuing production quality problem. After trap replacement, the problem was eliminated, to the delight of the production and maintenance staff.

In-depth discussions were held with plant and company staff regarding energy related operations, procedures and future plans. In addition, the lighting condition at the Mileta Borovnice weaving plant was assessed on March 20, 1991. The final day was devoted to discussing the audit findings with company staff, outlining specifications for implementation of the recommendations.

4.0 Energy Profile

The Cerny Dul fabric finishing plant uses "heavy oil" (similar to U.S. No. 6 fuel oil) to generate steam for process and space heating needs. Three 6 metric tons per hour boilers generate steam at approximately 0.8 MPa. Normally, only one boiler is required, but in very cold weather two boilers must be operated. One existing boiler is out of service due to combustion chamber damage. One of the remaining two is in fair to good condition; the other has had numerous tube leaks and is considered irreparable. Cerny Dul plans to replace the two damaged boilers with one gas-fired boiler in the near future.

Plant steam demand averages approximately 4 to 5 metric tons/hour. Annual use is about 31,500 GJ (based on an average 75% boiler efficiency resulting in an estimated fuel oil use of 42,000 GJ). No daily steam demand profile was available with current metering devices. Demand is highest at 6 a.m when process equipment is started up. Demand is fairly constant throughout the first shift and decreases to about 60% of the morning load when the second shift begins.

Electricity use is fairly modest; nominal peak demand is 318 kW for the next quarter and will probably be nearly constant in the remaining months. There is a tendency to be conservative and nominate 10% to 15% excess demand due to severe cost penalties if the projection is exceeded. Annual consumption is about 748,000 kWh. Actual demand and consumption for 1990 is presented in the table below.

Table 1. Annual Energy Use

Month	Electric (kWh)	Electric (GJ Equiv)	Fuel Oil (GJ)	Costs (Kcs) Electric	Fuel Oil
Jan	82,740	297.9	5,301	88,534	795,135
Feb	72,380	260.6	4,739	85,115	710,913
Mar	85,540	207.9	4,459	89,458	668,802
Apr	70,140	252.5	4,040	84,376	606,060
May	76,300	274.7	3,983	86,409	597,468
Jun	80,000	288.0	3,969	87,630	595,320
Jul	37,100	133.6	1,624	73,473	243,575
Aug	83,270	299.8	3,248	88,709	487,150
Sep	75,600	272.2	3,248	86,178	487,150
Oct	89,180	321.0	4,459	90,659	668,802
Nov	90,580	326.1	4,896	91,121	734,448
Dec	80,360	289.3	5,562	87,749	834,360
Total	923,190	3,323.484	49,528	1,039,413	7,429,183

Annual energy usage and costs are presented graphically in *Figure 1* and *Figure 2*, respectively. In *Figure 1*, electric consumption (kWh) has been converted to GJ to be consistent with fuel oil consumption. These graphs show that: 1) electricity is a relatively small portion of the plant's energy use; and 2) there is a significant weather factor (space heating) involved in the amount of heavy oil use. Estimated distribution of electricity and steam use by process is shown in *Figure 3*. *Figure 4* presents the cost distribution by process. Energy conservation opportunities can be graphically determined by focusing on areas of high energy consumption and costs. For instance, the bleaching and drying lines are the highest energy users. The plant is in the process of replacing the bleach line which was in service during 1990, so the audit team did not investigate the process in detail. The drying operation appears to offer an excellent opportunity for recuperation of heat for space heating (see additional discussion in Section 5.0).

Figure 1. Annual Energy Use

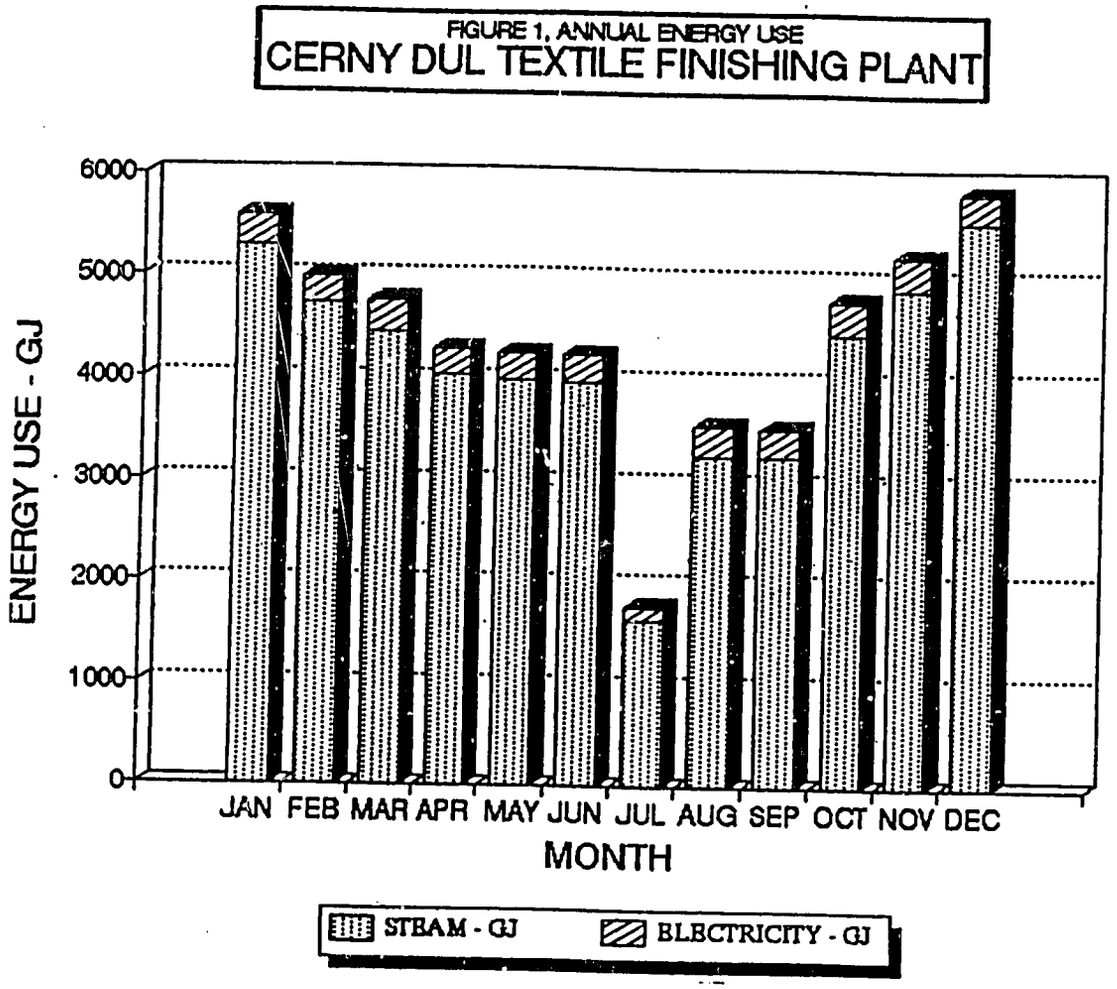


Figure 2. Annual Energy Cost

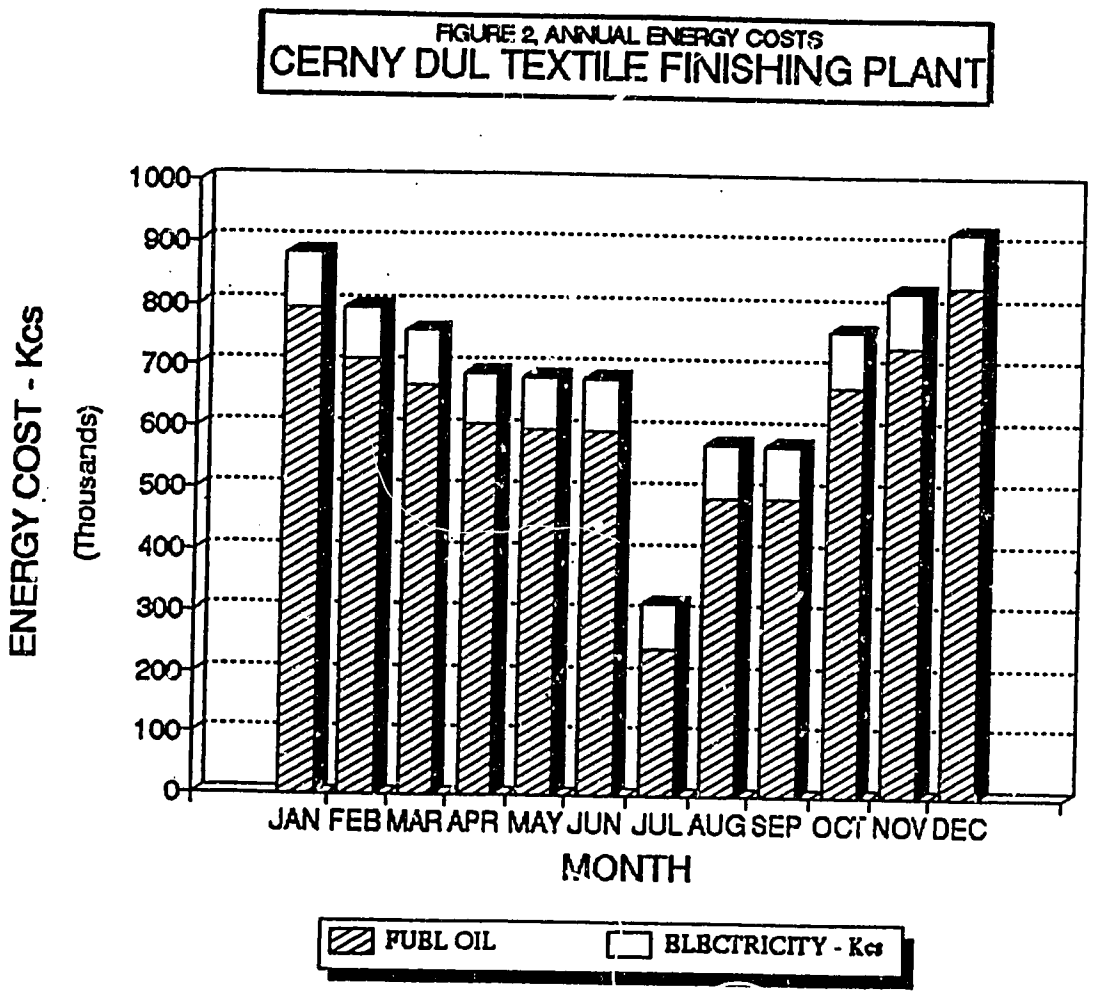


Figure 3. Estimated Electrical and Steam Use Distribution by Process

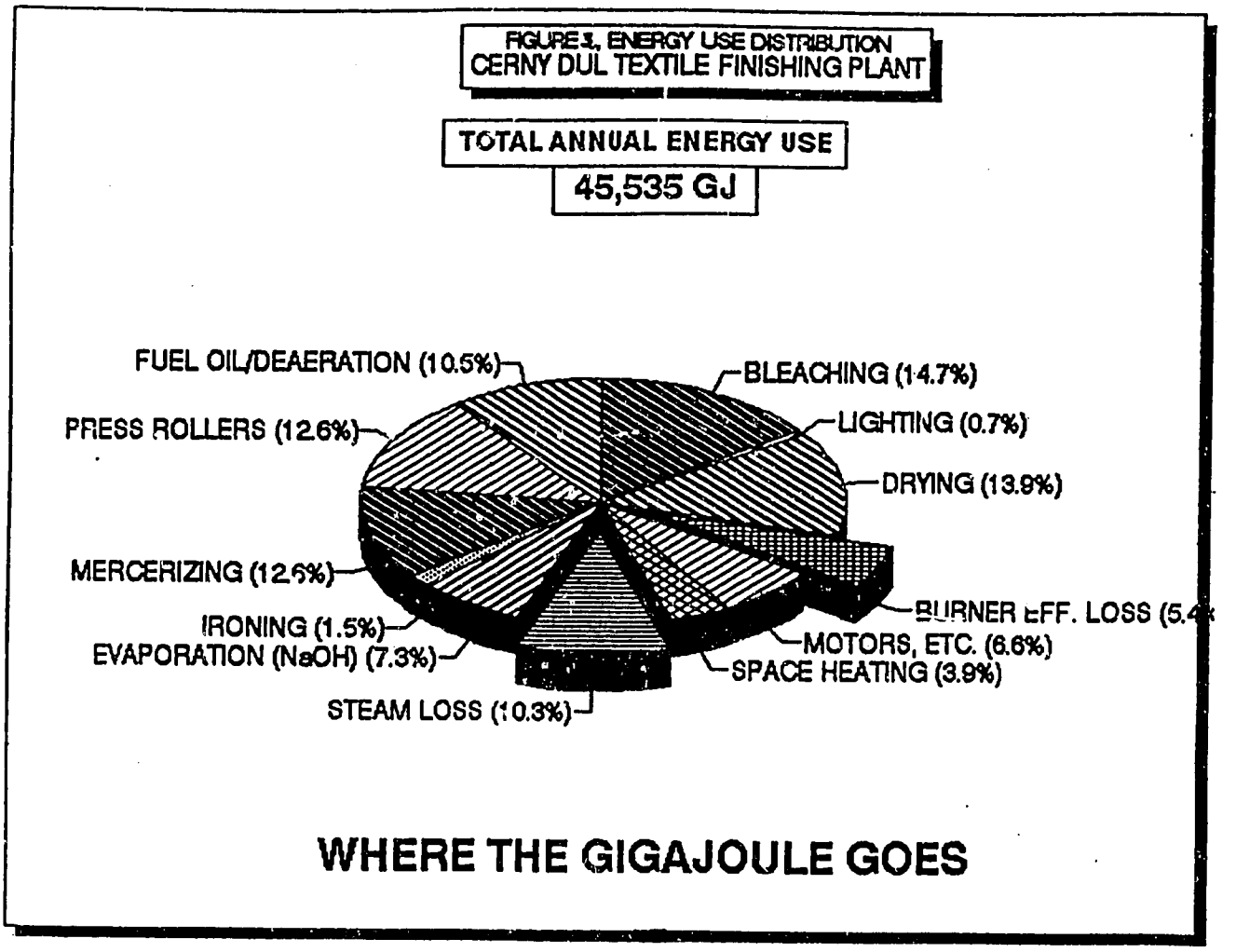
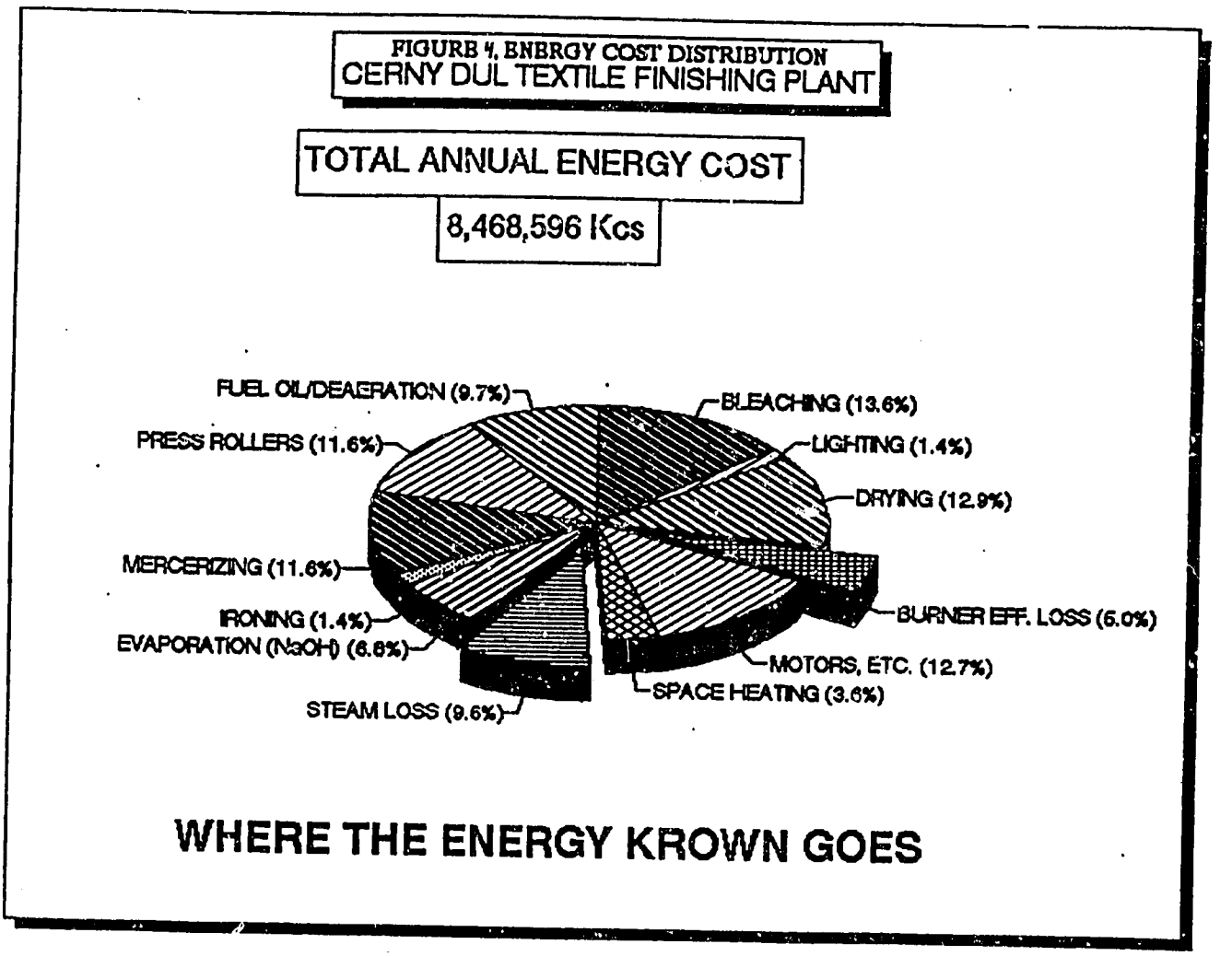


Figure 4. Energy Cost Distribution by Process



5.0 Summary of Results

The audit revealed that at least 10-15% of the present 49,500 GJ of fuel oil energy used in the plant could be saved by low-cost/no-cost measures. Among the energy conservation opportunities identified, the burner replacement will save 5% (2,100 GJ) of the fuel oil consumed annually. The burner replacement will also allow the use of waste fuel totalling 2,400 GJ in the first year and 800 GJ in each succeeding year. The second measure of portable energy monitoring equipment is applicable in all 17 Mileta plants (including Cerny Dul) and can potentially save an additional 5% of the fuel oil consumption.

5.1 Recommended Energy Conservation Opportunities for Demonstration

Two energy conservation opportunities are recommended at the Cerny Dul plant. Measures installed at this plant will have direct application to the other 16 plants of the Mileta group, as well as many similar plants in Czechoslovakia.

1. Install High Efficiency, Low Emissions (NO_X) Burner System on the No. 3 Boiler

Current Condition: Three 6 metric tons/hr, 20 year old steam boilers are presently installed and are operating at .7 to 1 MPa. The fuel is a heavy oil with a heat content slightly higher than U.S. No. 6 fuel oil. Firing level control is manual with air fuel adjustments made by "eyeball". CO_2 tests are performed periodically by a central office power engineer, and annually by the Central Energy Inspectorate.

Boilers 1 and 2 are in disrepair, and are scheduled for replacement by a natural gas fired boiler with automatic controls. A governmental policy stating that heavy oil fired boilers will not be allowed after 1993 prompted this action. However, Mileta plans to retain the No. 3 fired boiler for operation for at least 3-5 years for two reasons: 1) governmental policies are not clear at this time; and 2) the future uninterrupted availability of gas supplies cannot be guaranteed.

Combustion efficiency tests conducted by the audit team on the No. 3 oil fired boiler showed varying efficiencies in the 77-80% range. The boiler operator's inability to effectively control the boiler manually caused the variation. Installation of a new high efficiency burner system with automatic controls will ensure a minimum efficiency of 83%.

The current oil burners cannot handle the heavier oil fractions of the standard fuel, resulting in the disposal of at least 10 metric tons of oil per year that cannot be burned. Thirty metric tons had been accumulated at the time of the audit.

Recommended ECO: Purchase a high efficiency oil burner system complete with oxygen trim controls to automatically maintain high combustion efficiency. The new burner system will increase overall combustion efficiency from about 78% to a minimum of 83%, and allow the burning of the heavier oil fractions (an estimated 1-2% of the total annual fuel consumed or 4.2-8.4 GJ). Specifications for the new burner system are given in Appendix A.

Estimated Energy Savings: The savings are calculated on an annual basis, considering both the improved combustion efficiency and the burning of the heavier oil fractions.

Fuel savings from burner efficiency improvement are as follows:

Five percent of annual fuel oil use	2,400 GJ
Accumulated heavy fraction	2,500 GJ
Total first year savings	4,900 GJ
First year cost savings	750,000 Kcs ($25,000)
Estimated cost of equipment:	$14,500

The Mileta Company will pay all costs for labor and materials for installation of the new burner system including any boiler modifications that may be necessary. These costs will be the plant contribution to the program.

Estimated Payback: 7 months

2. Energy Conservation Test Equipment

Current Condition: Neither the staff power engineers nor the plant operating personnel have test equipment for identifying or monitoring potential energy conservation measures, such as boiler combustion efficiency, faulty stream traps, inadequate pipe insulation and air ventilation rates. The audit team demonstrated the potential uses and benefits of key test instruments and plant personnel eagerly endorsed the need for such equipment. Key test instruments should be purchased for the Mileta staff power engineers for use throughout the 17 operating plants.

Recommended ECO: Purchase the following key test instruments for use by company staff power engineers:

- 1 portable combustion analyzer
- 1 infrared thermometer (hand held)
- 1 portable anemometer

Specifications for the above instruments are given in Appendix B.

Estimated Energy Savings: The savings are based on Mileta annual energy consumption of 530,000 GJ. It is estimated that conservative company wide savings of 5% is possible for no/low-cost measures.

Five percent of 530,000 GJ	26,500 GJ
Estimated cost savings:	675,000 Kcs*
	($25,000)
Estimated cost of equipment:	$8,000
Estimated Payback:	0.3 years

* Based on weighted average energy costs

3. Electrical Control Systems for Waste Water Treatment Plant

Current Conditions: The waste water treatment plant is required to aerate the water. The purpose of aeration is to raise the waters dissolved oxygen content to 3-5 ppm before it is discharged into the river. Aeration is accomplished by mechanically mixing surface water in holding tanks at high speed to introduce air into the water. The mixing action is provided by a series of motor/turbine sets. Previously, three motor/turbine sets with a total connected demand of 40 kW (but loaded to only 30 kW) were operated continuously, since the facility had no on-stream measuring device for determining dissolved oxygen. Recent tests conducted by Mileta, based on manual oxygen analyses, showed that the average energy requirements could be reduced about 30% if the dissolved oxygen contents of the discharge water were continuously monitored to prevent over aeration.

Recommended ECO: Provide a frequency controlled power supply and oxygen sensor control for the modulation of power supplied to the motor/turbine sets based on dissolved oxygen content of the discharge water. With this type of power supply, the signal from the oxygen sensor modulates the frequency generated by the power supply, and hence, modulates the power to the motors. In addition to saving electrical energy, the control system will assure that the water discharge continuously meets the environmental requirements for dissolved oxygen.

Specifications for the frequency controlled power supply and oxygen control sensor are given in Appendix B.

Estimated Energy Savings:

Current annual energy consumption: 262,800 kWh or 417,000 Kcs ($13,900)

Estimated annual savings, based on 30% of current usage: 78,800 kWh or 125,100 Kcs ($4170)

Estimated cost of equipment: 143 000 Kcs ($4,770)

Estimated payback: 1.1 years

5.2 Summary of Recommended No-Cost/Low-Cost ECOs

1. Space Heating

Current Conditions: Textile production areas are heated by the combination of steam-heated fin tube radiation, steam unit heaters, and heat loss from process equipment. It is difficult to assess the relative contributions of the various sources due to variable production rates and high uncontrolled ventilation rates. Process line updating and efforts to reduce steam losses will increase use of conventional space heating sources, most of which are either uncontrolled or manually controlled. Cerny Dul is preparing plans to renovate the space heating system within the production area. Currently, there are no plans for automatic control of the new space heating system.

Recommended ECOs:

Short-term:

1. Install thermostatic controls on heaters in smaller work rooms.
2. Monitor/assign responsibility for controlling heaters in main process plant.
3. Reduce air infiltration through windows and doors in smaller work areas.

Long-term:

1. Reduce uncontrolled infiltration in high heat load process areas, and provide sources of controlled ventilation or dilution air to prevent use of space heating to offset local drafts, etc.
2. Utilize heat recovery from dryer line for space heating. This was previously attempted, but it was abandoned due to the plugging of heat recovery devices by lint from the dryers. Use of rotary self cleaning filters was suggested. Use of high efficiency high temperature heat pumps should be explored to recover high latent (moisture) content in the dryer exhaust.

2. Steam Distribution

Current Conditions: The steam distribution system is under-maintained in terms of steam leaks, faulty or missing insulation, and minimal repair/replacement of steam traps. Plant personnel lack test equipment and maintenance supplies to properly maintain the system. Steam traps are a particular problem. East German traps were formerly used, but are no longer available or are prohibitive in cost. Also, Czechoslovakian traps have proven unsatisfactory since none other than the orifice type of traps are available.

Recommended ECOs:

Short-term:

1. Repair steam leaks.
2. Repair and/or replace leaking or malfunctioning steam traps.
3. Repair faulty and/or missing insulation and keep insulation dry.
4. Install insulation on all lines to "economic thickness".

Long-term:

1. Increase condensate return.
2. Identify and/or increase the use of heat recovery from process waste streams.
3. Verify steam trap sizing to meet changing load conditions. Extremely wide load ranges may require multiple traps.

3. Lighting

Current Conditions: Lighting management appears to be good. There is extensive use of daylighting, unnecessary lights are turned off and lighting levels are not excessive. Lighting is predominantly fluorescent with low efficiency lamps and ballasts. Few reflectors are in use. When present, many luminary lenses are dirty and badly deteriorated.

Recommended ECOs:

Short-term:

1. Replace lamps at end of useful life. Many tubes show blackened ends indicating light output is reduced significantly, some tubes are barely glowing but draw nearly as much current as properly performing tubes.
2. Disconnect fixtures with burnt out tubes that are no longer necessary, otherwise relamp or repair.
3. Clean tubes and luminaries.
4. Replace dirty/yellowed luminary lenses.
5. Clean skylights and windows.

Long-term:

1. Install high efficiency lamps, ballasts and luminaries. Use reflectors in existing or replacement luminaries.
2. In high bay or where appropriate, relight with high pressure sodium (HPS) lights. In areas where color rendition is important use high color rendition index (CRI), HPS or other similar high intensity discharge (HID) lamps. Better color rendition can also be provided by task lighting with high CRI fluorescent lamps (CRI>85) and luminaries.
3. Relight with area and task lighting as determined by detailed lighting analysis.

4. Boiler System

Current Condition: Three 6 metric tons/hr, 20 year old steam boilers operating at .7 to 1 MPa are presently installed. The fuel is a heavy oil with a heat content slightly higher than U.S. No. 6 fuel oil. Firing level control is manual with air fuel adjustments made by "eyeball". CO_2 tests are performed periodically by a central office power engineer, and yearly by the Central Energy Inspectorate.

Boilers 1 and 2 are in disrepair, and are scheduled for replacement by a natural gas fired boiler with automatic controls. Combustion efficiency tests conducted by the audit team on the No. 3 oil fired boiler showed varying efficiencies in the 77-80% range. The boiler operator's inability to effectively control the boiler manually caused the variations. Installation of a new high efficiency burner system with automatic controls will ensure a minimum efficiency of 83%.

Recommended ECOs:

Short-term:

1. Installation of a new burner and control system has been recommended as in Section 5.1.

Long-term:

1. The Republic of Czechoslovakia power distribution policies are presently being established. If they are favorable, cogeneration should be evaluated using a combined gas turbine and extraction steam turbine cycle. With favorable purchase rates this system will: 1) result in large cost savings or possibly a positive net cash flow; 2) reduce overall Republic of Czechoslovakia emissions, particularly CO_2; and 3) increase fuel consumption only fractionally. The audit team estimates that a 3-4 MW combined cycle power plant could be justified. Cerny Dul would have to sell most of the generated power. Presently a maximum of .33 MW is used internally, so at least 2.7 MW would be available for sale.

2. If cogeneration is not feasible, install gas boiler as presently planned.

5. General/Administration:

Current Condition: The plant has no established Energy Conservation program or personnel assigned to implement energy conservation measures.

Recommended ECOs:

Short-term:

1. Assign Energy Conservation management responsibility to senior staff.
2. Provide Energy Conservation training for key personnel.
3. Institute a plant wide energy conservation awareness program.
4. Institute energy accounting function at plant level.
5. Assign personnel to maintain energy equipment.

Long-term:

1. Establish a continuing Energy Management program.
2. Install energy metering equipment.
3. Include energy management measures in the budgeting cycle.

6.0 Plant Energy Management/Organization

Energy management follows a dual path matrix organizational approach. Corporate energy staff are responsible for all aspects of power generation, including overseeing operation of steam boilers, meeting current operating power needs, and planning for future needs, fuel supplies and equipment. The plant management is responsible for the use of supplied power, maintenance of energy using systems, process modification, and budgeting of current and future energy requirements.

Both corporate and plant management are well aware of the need for energy conservation and minimization of energy costs. The corporate staff are knowledgeable of technologies available in the domestic market, but were eager to learn about western combustion and control systems. In contrast, plant management does not have access to energy related technologies, and consequently, had a "make-do" attitude toward maintenance. Due to production demands, limited resources, limited test equipment and lack of training in energy conservation methods, energy related maintenance is minimal.

The corporate energy function is formalized in the sense that the power engineering staff had well defined missions. However, uncertainties in availability and pricing of coal, heavy oil and natural gas, force management to focus on developing maximum flexibility in the use of fuels to assure continuing operations. Also, due to pending privatization plans, future capital expenditures are approached cautiously by corporate management.

The plant level attitude towards energy and energy conservation is less developed. Energy considerations are less important, understandably so, than product quality and production levels. Consequently, energy equipment isn't routinely maintained unless production is directly affected. It is expected that energy conservation will receive increased attention since energy costs have risen to about 14% of production costs and will probably increase further (on a relative basis). Plant personnel were eager to learn of the audit team's recommendations. If minimal technical and financial (e.g. spare parts) support is available, the audit team believes they would effectively implement many no/low-cost measures. Greater coordination with the corporate energy staff would accelerate the efforts of the plant personnel.

7.0 Implementation Evaluation

Dates visited: August 7-8, 1991

Contacts: Mr. Z. Havlak and Ms. Ing. Renata Hanusova

Objectives of visit:

1. Assess the status of delivery of equipment.
2. Evaluate the status of the demonstration projects.
3. Assess the status of other energy conservation projects undertaken by Mileta.

7.1 Status of Equipment

All equipment items were received at the plant prior to the visit except for the motor drive and oxygen sensor for the waste water treatment plant. The delivery of the remaining items is expected by mid-November.

The high efficiency oil burner is in the boiler house and will be installed in the No. 3 boiler within two weeks of the implementation phase visit. Prior to its installation, Mileta will modify the fuel oil supply system and other fittings to match the requirements of the new burner. Photograph 1 in Appendix C shows this new burner.

The test instruments were checked for completeness and operation. The infrared thermometer and the anemometer were found to be complete and in good working order. However, the combustion analyzer was inoperable due to damage during shipment. The audit team investigated the problem with the instrument and was successful in repairing it. Consequently, all test instruments were left in good working order.

The operation of the test equipment was reviewed with the plant personnel.

7.2 Status of the Demonstration Projects

The objectives of the demonstration projects were to:

1. To increase boiler combustion efficiency by installation of a high efficiency oil burner.
2. To reduce energy losses in combustion and process equipment.
3. To reduce the electrical energy consumption for treatment of waste water.

The high efficiency oil burner was to be installed within two weeks of the visit. Prior to installation of the new burner, baseline combustion efficiency data was obtained for the existing burner over a period of several days (using the provided combustion analyzer).

Upon installation of the new burner, similar combustion tests will be performed, and the differences in combustion efficiencies compared. Mileta agreed to provide RMA the test data upon request.

The infrared thermometer will be used by plant personnel at Cerny Dul to identify faulty steam traps and pipe insulation. The combustion analyzer and anemometer will be used by the Mileta corporate energy staff to monitor combustion efficiencies and ventilation rates at all of the 17 plants operated by Mileta.

By field testing, Mileta staff had determined that electrical power required for driving aeration turbines in the waste water treatment facility could be reduced by about 30% if the aeration action were matched to the required level of dissolved oxygen. New aeration motor/turbine sets have been ordered by Mileta and are expected to be installed in early 1992. Prior to the installation of the new motor/turbine sets, the motor frequency control system and oxygen sensor provided for the demonstration project will be installed to control the existing equipment. Upon arrival of the new motor/turbine sets, the motor frequency control system will be utilized for powering the new units. A photograph of the oxygen sensor is included in Appendix C.

As with the other demonstration projects, Mileta agreed to furnish test data on the performance and energy savings realized to RMA upon request.

7.3 Status of Energy Conservation Measures

During the visit, the audit team observed that many of the steam leaks throughout the plant had been significantly reduced, apparently by greater emphasis on maintenance. However, due to the lack of steam metering instrumentation and varying production schedules, the effect of reduced steam leakage on total steam consumption could not be determined.

The plant has identified a number of energy conservation measures, but due to financial constraints, only a few of the measures have been funded. Measures to be implemented during the 1991 include replacement of single glazed windows with double glazed windows and an improved heating system in the fabric packaging area.

During discussions regarding availability and costs of replacement steam traps, it was noted by plant personnel that East German traps are considered to be of low quality, and the higher quality western traps were too expensive. For example, it was stated that a given type of steam trap would cost $33.00 and $765.00 from East Germany and West Germany respectively. Plant personnel were not aware that similar high quality steam traps from U.S. suppliers could be obtained for about $275.00, such as those supplied to the Matador plant for demonstration. The audit team provided information on sources of high quality steam traps available from U.S. suppliers.

APPENDIX A
Heavy Oil Burner System Specifications

Contacts:

Mr. Milan Cizek
Mrs. Ing. Renata Hanusova
Husona Street
CS - 50801 Horice, Czechoslovakia
Phone +42-435 3311
FAX +42-435 3740

Shipping Address:
as above

Equipment to be supplied:

One complete burner system with oxygen trim control to fit existing 6 metric ton/hr (13,200 lb/hr) steam boiler. Mileta will furnish drawings showing existing boiler configuration, burner mounting flange, combustion chamber configuration, combustion air connection, etc. Mileta will also furnish oil specifications including viscosity and heat content.

1. Firing Rate - Maximum of 16 GJ/hour (6 metric tons/hr at 1 MPa, 85% efficiency, must be matched to existing boiler)
2. Fuel - "Heavy oil" specifications to be furnished by Mileta
3. Mechanical or acoustic atomizing burner capable of burning "heavy oil" and oil bottoms. A "tulip" flame pattern is preferred, but should be evaluated for suitability for combustion chamber configuration and for use of bottom fractions.
4. Burner performance:
   a. Minimum efficiency - 85% maintained.
   b. NO_x emissions - less than 50 ppm without flue gas recirculation.
   c. Throttling range - 15% to 100% of rated firing rate under automatic control.
5. Bidder to quote optional prices for:
   a. Visit by technical representative to plant at Cerny Dul, Czechoslovakia to specify burner.
   b. Supervision of burner system installation.

Suggested suppliers:

1. Coen Burner.
2. Gordon-Piatt.
3. Kewanee.
4. See attached telex for Czechoslovakian supplier.

MIL
23. III. 1991

Ing. Hanušová
28.3.91 - 8.30h

MILETA

BAVLNÁŘSKÉ ZÁVODY - NÁRODNÍ PODNIK - HOŘICE
PODNIKOVÉ ŘEDITELSTVÍ — 508 14 HOŘICE V PODKRKONOŠÍ

Hotel Lux
To:
Mr. R.W.Anderson and
Mr. J.A.Nation

Prosím o předání

VÁŠ DOPIS ZNAČKY / ZE DNE	NAŠE ZNAČKA	VYŘIZUJE / LINKA	HOŘICE
		Ing. Hanušová	27.3.1991

VĚC Oil burners

A possibility of replacing the original burners of the BK 6 boilers has been consulted with original manufacturer, the ČKD Dukla Prague. The manufacturer offers an innovated jet burner, model SMH 560. There is no sign that other oil burner systems than the jet burners will be produced in Czechoslovakia in the near future. The price quoted for one burner including a control system is 125,000.-Kčs. The manufacturer guarantees the minimal efficiency of a boiler of 86%. With respect to this year oil price the pay back time is less than one year for both boilers. (It is expected that boiler No.1 will be in operation for at least two years, and the boiler No.3 for more than five years.)

Description of the burner in use:
Heavy oil jet burner. Oil parameters (approx. equivalent to No.5 oil): viskosity at 100°C...57cSt(=7.5°E), ignition temperature (Marcusson) ≥140°C, congealation temperature 40°C, sulphur content ≤ 3%. Proper atomization is achieved on condition that the oil is preheated to 140÷150°C. Combustion air is forced by a blower through an annular cavity round the jet. The oil pressure in the feeding pipe is 2.1 MPa. The oil flow is controlled by means of a throttle valve in the excess fuel outlet. The value the steam pressure is maintained by control of fuel and combustion air flows through a solenoid valve. The oil/air ratio is set by a mechanical coupler, i.e. a cam action on a flap valve in the combustion air inlet. A corrective signal derived from flue gas analysis is provided neither for the old, nor for the innovated burner. The innovated burner features a better coupler in the oil pressure/air flow rate control system. For this system, the minimum efficiency of 86% is guaranteed for boiler loads ranging from 40 to 100%.

Boiler parameters:
Combustion chamber: length 2,700mm, diameter 1,500 mm, wall thickness 20 mm, total heating surface (including the fire tubes) 160 m², operating water volume 8.2 m³, maximum operating pressure 1 MPa.
Burner flange: bolt circle diameter 455 mm, 4 bolts M 16 (holes 17).
Burner diameter 408 mm (the hole permits somewhat bigger burner diameters, though).

Apart from the fact that the new boiler is not supplied with a control system with a correction signal from the stack gases, its another serious disadvantage is that it cannot be fed with oil turbidities containing particles.- The delivery terms for supply of the new burner model (in-

TELEFON 3111-13, 3311-12 | BANKOVNÍ SPOJENÍ SBČS Jičín 508-541 | IČO 012 858 JČO 322 7006 | DÁLNOPIS 194540 | TELEGRAMY MILETA Hořice

cluding the control system) are acceptable.

Should [illegible] a case arise that a Czechoslovak burner will have to be puchased instead of the proposed U.S. made system, the remaining funds should be used, according to your judgement, either for the lighting programme, and/or for more instrumentation (an ultrasoud flow rate meter capable of measuring feed, condensate and process water, as well as other liquids, with appropriate corrections, would be much appreciated and could be used at most corporate plants).

Quality of the fuel, which is used in whole Milota

	W_p	% A_e	S_{ave}	grain size mm	fuel efficiency MJ/kg
1. Black coal	14	13.5	1	18 - 30	23.07
	14.5	12	1	18 - 30	22.64
	5	14	1.5	18 - 30	26.88
	15	21	1	6 - 30	20,13
2. Brown coal	29	15	1	10 - 20	16.95
	30.5	17	1.5	10 - 20	16.1
	30	13	1.2	10 - 20	16.6
	31.3	16	1.5	10 -20	16.1
	31.2	15.5	1.5	10 - 20	16.2
	29	15	1.1	0 - 10	16,75
	30	15.5	1.6	0 - 10	16.2
	29	32	1.5	0 - 10	12.75
	29.5	19	1.8	0 - 8	15.75
	26.5	44	2.4	0 - 40	16
	29.5	32.1	1.6	0 - 30	12.31
	26	45.5	1.5	0 - 40	10.25
	32	19	0.6	0 - 22	14.4
	32	29	0.6	0 - 40	11.93

3. Heavy oil max 1 max 3% of sulfur 40.6
viskosity at 100°C... 57 cSt (=7.5°E)

4. Light oil max 0.5 max 2% of sulfur 42.3
viskosity at 50°C... 2.5 - 12.5 cSt (=1.17 - 2.07°E)

5. Natural gas 0.1 mg/m^3

(95- 98 % CH_4 , 2% inert gas)

CO_2 max
1. 18.9 - 19,45
2. 18.4 - 19.4
3. 15.8
5. 11.9 - 12

Yours sincerely,
Ing. Renata Hanušová
Assistant Power Engineer

APPENDIX B
Power Supply and Oxygen Measuring Set Specification

Point of contact:

Mr. Milan Cizek
Mrs. Ing. Renata Hanusova
Husona Street
CS - 50801 Horice, Czechoslovakia
Phone +42-435 3311
FAX +42-435 3740

Equipment Specifications:

Frequency modulated power supply - Type VLT 240, Code Danfoss 175F0063, or equivalent.

Oxygen measuring set - Type EMCO, Code Danfoss 085G1005, or equivalent.

All warranties from the manufacturers should be extendable to Mileta.

APPENDIX C
Photographs

1. The new heavy oil atomizing burner, manufactured in-country by C.D. Dukla and installed by Cerny Dul.

2. An oxygen sensor in an aeration tank at a wastewater treatment plant. The sensor will allow manual control of oxygen levels.

APPENDIX D
List of Abbreviations

AC	= alternating current
amps	= amperes
atm	= atmosphere = 14.696 pounds per square inch
bar	= 100,000 pascals = 14.504 pounds per square inch
BTU	= British thermal unit
cfm	= cubic feet per minute
cm	= centimeter = 0.3937 inches
cm^2	= square centimeter = 0.155 square inches
CO	= carbon monoxide
CO_2	= carbon dioxide
DC	= direct current
°C	= degree Celsius T[°C] = 5/9*(T[°F] - 32)
°F	= degree Fahrenheit
°R	= degrees Rankine T[°R] = T[°F] + 460
eff	= efficiency
ex air	= excess air
Gcal	= gigacalorie = 1 billion calories = 3.968 million BTU
GJ	= gigajoules = 1 billion joules
gph	= U.S. gallons per hour
gpm	= U.S. gallons per minute
GWh	= gigawatt hours = 1 billion watt hours
H_2	= hydrogen
H_2O	= water
H_2SO_4	= sulfuric acid
hectare	= 10,000 square meters = 2.471 acres
hectoliter	= 100 liters = 26.42 U.S. gallons
Hg	= mercury
hr	= hour
Hz	= hertz = cycles per second
J	= joules
kcal	= kilocalories = 1 thousand calories = 3.968 BTU
Kcs	= 29.77/$1 US
kg	= kilogram = 2.2046 pounds
Kgcc	= 7,000 Kcal = 27,776 BTU
kJ	= kilojoules = 1 thousand joules = 0.947813 BTU
km	= kilometer = 0.621 miles
kN	= kilonewton = 1 thousand newtons
kPa	= kilo pascals = 1 thousand pascals = 0.14504 pounds per square inch
kV	= kilovolts = 1 thousand volts
kVA	= kilovolt-amperes
kVAr	= kilovars = 1 thousand volt-amperes (reactive)
kW	= kilowatt = 1 thousand watts
kWh	= kilowatt hour = 1 thousand watt hours
lbs	= pounds
liter	= 0.2642 U.S. gallons = 0.03531 cubic feet
m	= meter = 39.37 inches
m^2	= square meter = 10.76 square feet

m^3	= cubic meter = 35.31 cubic feet
mA	= milliampere = 0.001 amperes
MCal	= megacalorie = 1 million calories
metric ton	= 1 thousand kilograms = 1.1023 U.S. tons
mg	= milligrams
min	= minute
MJ	= megajoules
mm	= millimeter = 0.03937 inches
MPa	= 1 million pascals = 145.04 pounds per square inch
MVA	= megavolt-amperes
MW	= megawatt = 1 million watts
MWh	= megawatt hours = 1 million watt hours
NG	= natural gas
nm	= nanometer
Nm^3	= cubic meters at standard conditions of temperature and pressure (20°C and 1 atmosphere)
NO_X	= nitrogen oxide
O_2	= oxygen
P	= pressure
PC	= personal computer
ppm	= parts per million
psi	= pounds per square inch
psig	= pounds per square inch (gauge)
R	= thermal resistance
s	= second
SO_2	= sulfur dioxide
sq ft	= square feet
Tcal	= teracalorie = 1 trillion calories = 3.968 billion BTU
T	= temperature
V	= volts
VArs	= volt-amps (reactive)
VSD	= variable speed drive
yr	= year