APPENDIX
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ORGANIZATION for
ENERGY
PLANNING

جهاز تخطيط الطاقة

AUDIT
FINAL REPORT

VOLUME 1 OF 2
VOLUME 2 OF 2

BY
JOINT ENGINEERING GROUP

* ORGANIZATION FOR ENERGY PLANNING (OEP)
* NATIONAL METAL INDUSTRIES COMPANY (NAMETIN)
* FOSTER WHEELER EN

April

O.E.P. تلكس دولى ٢٣٤٠٤ ٩٢٦٣٤٢ أو ٩٢٧٧٨١
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AUDIT REPORT

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1.0 Introduction

The Organization for Energy Planning, in conjunction with the plant staff of the National Metal Industries Company, and with the technical assistance of Foster Wheeler Energy Corporation, has executed an energy audit of the National Metal Industries Company plant in Abou Zaabal Egypt. The audit activity completes the final phase of a three step program (screening, preaudit and audit) undertaken to determine and evaluate the energy conservation opportunities which could be developed at the National Metal Industries Company.

This report documents the steps taken to identify the energy conservation opportunities and describes salient technical details, investment cost, and economic evaluation.

Section 2.0 of this report provides a summary of the results of the audit, Section 3.0 includes an indepth discussion of all features of the work, and the appendices present various significant items of backup data.

2.0 Summary and Conclusions

2.1 Summary

The National Metal Industries Company Plant at Abu Zaabal, Egypt produces nominally 150,000 tons/year of finished rebar (R.C. bar), beginning with scrap, pig iron and billets (produced elsewhere).

The plant overall, is energy intensive, consuming 39,400 metric tons/year of mazout, and 22,329,000 kwh/year of electricity, for a total energy bill of 11.7 million LE, based upon worldwide prices, as explained in Appendix "A".

The Organization for Energy Planning (OEP) in conjunction with the National Metal Industries Company (NAMETIN) and Foster Wheeler Energy Corporation (FWEC) have conducted an audit of the NAMETIN plant to develop, formulate, and rank energy conservation opportunities (ECO's). These energy conservation opportunities are presented in two catagories, entitled:

- No cost/low cost ECO's, and
- Investment ECO's

The overall program to evaluate the energy conservation opportunities in the NAMETIN plant was performed in three steps, namely:

- Screening
- Preaudit, and
- Audit

The initial phase, screening, resulted in the selection of the NAMETIN plant as a reasonable candidate for an energy audit.

Upon completion of the screening activity, the preaudit phase was undertaken, the energy consumption of the plant was evaluated, and a list of ECO's was prepared.

This report documents the results of the audit activity, which include:

- A discussion of the approach
- A detailed description of each ECO
- Supporting documentation as required

The preaudit report predicted a goal which envisioned the savings of 10 percent of plant energy in the first year, following partial implementation of no cost/low cost ECO's. Audit results reveal a potential saving of 1,076,200 LE/year with the implementation of only the most attractive no cost/low cost ECO's, thus making this goal quite realistic.

Additionally, a total of 9 (nine) investment ECO's will provide simple payout in one (1) year or less, thus pointing up the practical achievement of the 30 percent savings set for a five (5) year period.

The total list of ECO's, in summary form with predicted annual savings, estimated investment and payout in years is presented in Table 1.1 which follows. Those items which have an investment cost of LE 40,000 or less are listed in Table 1.1 as no cost/low cost.

TABLE 1.1 (Priority 1)

PLANT: NATIONAL METAL INDUSTRIES COMPANY

ECO Payout Summary

Payout of Less Than One Year

NO COST/LOW COST

ECO #	TITLE	Worldwide Cost, LE Annual Energy Savings	Investment Cost, LE	Payout, years
A-15	Form a Committee to Plan and Implement ECO's	Extensive	0	Immediate
A-16	Publicity to Make Employees Aware of Importance of Energy Conservation	Extensive	0	Immediate
A-21	Describe a Formal Maintenance Program	Extensive	0	Immediate
A-5	De-energize Excess Electrical Transformer Capacity	37,000	0	Immediate
A-23	Investigate Measurement of Mazout unloading from Barges	87,500	3,500	0.04
A-2	Exhaust Ducting Cleanout for Reheating Furnaces #1 and 2	20,700	1,100	0.05
A-1a	Repair all Leaks	45,000	3,300	0.07
A-13b	Improve Combustion in Open Hearth Furnaces	433,200	31,000	0.07
A-13a	Improve Boiler Combustion Efficiency	180,000	16,200	0.09
B-13	Improve Performance or Replace Steel Cranes in Steelmaking Shop	41,000	7,000	0.17
A-14	Install Temperature Indicators on Mazout Lines	23,900	6,900	0.29
B-12	Obtain Extra Oxygen Bottles	63,100	24,000	0.38
B-15	Install Automatic Door Controls (both doors) in Sequence with Pushers in Reheating Furnaces	25,000	12,000	0.48
A-26	Investigate Instrumentation to Quantify Air Leaks into Automatic Mill Furnace Exhaust Gases	3,600	1,800	0.50

TABLE 1.1 (Priority 1) (Cont'd)

Payout of Less Than One Year

ECO #	TITLE	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, years
A-10 and A-11	Install New Instruments in Mazout and Combustion Air Lines, Repair or Modify Inoperative Instruments	56,100	29,900	0.53
B-1	Automatic Air Switching for the Open Hearth Furnaces	15,400	10,100	0.66
A-9	Improve Combustion in Reheating Furnace #2	44,700	36,700	0.82
	Subtotal	1,076,200	183,600	0.17

TABLE 1.1 (Priority 1) (Continued)

Payout of Less Than One year

INVESTMENT

ECO #	TITLE	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, Years
B-11	Insulate Water-Cooled Runners in all Reheat Furnaces	1,725,200	173,900	0.10
B-3	Install Recuperator in #1 Reheating Furnace in Semi-automatic Rolling Mill	197,000	44,200	0.22
A-8	Improve Combustion in Reheating Furnace #1	158,000	45,800	0.29
A-6	Repair and/or Replace Outside Bricks on Furnaces to Prevent Excessive Heat Loss	207,700	134,500	0.65
B-25	Investigate Other Materials or Techniques for Recuperator in Automatic Mill	63,500	42,000	0.66
A-13c	Improve Combustion Efficiency in Automatic Mill Reheating Furnace	101,600	77,500	0.76
B-10c	Investigate the Replacement of Refractory in Automatic Mill Reheating Furnace	257,800	203,400	0.79
B-10a	Investigate the Replacement of Refractory in Reheating Furnace #1	105,000	92,100	0.88
B-18	Review Transportation of Billets from Cold Shear to Automatic Rolling Mill Reheating Furnace	75,000	71,600	0.95
	Subtotal	2,890,800	885,000	0.31
	Total	3,967,000	1,068,600	0.27

TABLE 1.1 (Priority 2)

Plant: National Metal Industries Company

ECO Payout Summary

Payout of One to Three Years

No Cost/Low Cost

ECO #	TITLE	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, Years
A-1b	Add Insulation on Hot Bare Pipes	10,200	13,600	1.33
A-20	Install Windshields for all Reheating Furnaces	20,000	36,200	1.81
B-2	Install Instrumentation in Oxygen Plant	4,900	11,900	2.43
B-14e	Automatic Air/Fuel Ratio Control in Automatic Mill Reheat Furnace	15,900	39,000	2.45
	Subtotal	51,000	100,700	1.97

TABLE 1.1 (Priority 2) (Continued)

Payout of One to Three Years

Investment

ECO #	Title	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, Years
B-10b	Investigate the Replacement of Refractory in Reheating Furnace #2	39,500	50,200	1.27
B-7	Demand Controller for Reducing Electric Power Demand	57,000	73,800	1.29
A-17	Blower Repair for Automatic Mill Furnace	33,000	48,400	1.47
B-4	Investigate Installing Heat Recuperator for Semiautomatic Rolling Mill #2 Reheating Furnace	53,000	79,000	1.49
B-5	Install Steam Generators in Open Hearth Furnace Exhaust Flue Gas System	520,000	898,800	1.73
A-3	Establish Procedures for Cooling Water Shutdown	30,100	60,800	2.02
B-8	Consider Adding Seals Around Doors of Reheating	20,000	40,900	2.05
B-6	Capacitor Installation to Improve Power Factor	404,300	847,100	2.10
	Subtotal	1,156,900	2,099,000	1.81
	TOTAL	1,207,900	2,199,700	1.82

TABLE 1.1 (Priority 3)

Plant: National Metal Industries Company
ECO Payout Summary
Payout of Three to Five Years

NO COST/LOW COST

ECO #	TITLE	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, Years
B-24	Pump Suction	1,544	5,600	3.63
	Subtotal	1,544	5,600	3.63
INVESTMENT				
A-1c	Add Insulation to Bare Tanks	52,300	203,895	3.89
	Subtotal	52,300	203,895	3.89
	TOTAL	57,844	209,495	3.89

TABLE 1.1 (Priority 4)

Plant: National Metal Industries Company
ECO Payout Summary
Payout of Five to Ten Years

NO COST/LOW COST

ECO #	TITLE	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, Years
A-4	Mazout Filter Cleanout/ Maintenance	2,600	17,200	6.62
	Subtotal	2,600	17,200	6.62
INVESTMENT				
B-14 (a,b, c,d)	Automatic Air/Fuel Ratio Controls	25,500	156,000	6.12
	Subtotal	25,500	156,000	6.12
	TOTAL	28,100	173,200	6.16

TABLE 1.1 (Nc Priority)

Plant: National Metal Industries Company
ECO Payout Summary
ECO'S Not To Be Implemented

NO COST/LOW COST

ECO#	TITLE	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, Years
A-18	Flume Heating Lance	Not applicable	Not applicable	Not applicable
A-19	Efficiency Improvement in Open Hearth Furnaces	309,400	Not applicable	None
A-22	Investigate Replacing Existing Old Compressors with Existing Spare Machine	0	Not applicable	Not applicable
A-25	Review Improvement to Level Measurements at Mazout Tanks in Automatic Rolling Mill	0	Not applicable	Not applicable

TABLE 1.1 (No Priority) (Cont'd)

ECO's Not to be Implemented

INVESTMENT

ECO #	TITLE	Worldwide Cost, Annual Energy Savings, LE	Investment Cost, LE	Payout, Years
B-9	Charging Hot Ingots from the Steelmaking Shop to Reheating Furnaces	Not applicable	Not applicable	Not applicable
B-16	Investigate Use of Electric Heat or Oil/Oil Exchanger to Replace Steam in Mazout Heating	0	0	Not applicable
B-17	Investigate Scrap and Pig Iron Preheat	0	Not applicable	Not applicable
B-19	Investigate Heat Recovery from Cast Iron Supports in Reheat Furnace #2	0	Not applicable	Not applicable
B-20	Investigate a Mechanical Charge System for Reheating Furnace #2	0	30,500	Not applicable
B-21	Investigate Variable Speed Motors	0	0	Not applicable
B-22	Investigate New Flywheel to Decrease Motor Overload on Semiautomatic Mill #1	0	Not applicable	Not applicable
B-23	Investigate Handling of Small Billets from the Old Rolling Mill #1 Directly to #2 Reheating Furnace	55,000	655,000	11.9

2.2 Conclusions

The audit activity, and the results obtained, permits the following conclusions:

a) Significant savings can be experienced by implementation of no cost/low cost ECO's, based on current worldwide pricing.

b) A large number of investment ECO's can readily achieve a rapid payout, based on worldwide pricing.

c) Plant performance and production improvements should be expected, due to operating efficiency improvements obtained during implementation of the ECO's.

d) Some ECO's were found to be unattainable from a technical or economic standpoint and are not to be implemented.

3.0 DISCUSSION

3.1 Objectives of the Audit

The dual objectives of the energy audit are:

- o identify and measure where energy is used, and
- o identify, evaluate and list in order of priority each no cost/low cost and each capital investment energy conservation opportunity (ECO).

3.1.1 To Identify Where Energy Is Used

The achievement of this objective requires the evaluation, in some detail, of all features of energy consumption in the plant.

Subactivities to the objective include;

- o the creation of a "base case", as a reference for savings corresponding to current operation.
- o the careful scrutiny of records, and their supplementation by field measurements, as necessary to establish the utility consumption.
- o particular attention to the energy consumption of large users, with the reasonable assumption that major utility consumption devices offer much greater opportunities for savings.
- o a review of all sources of lost energy, such as leaks in steam, air, or water systems, and missing or insufficient insulation.
- o a review of all losses which can be recovered, and an appraisal of those which can not be recovered.

3.1.2 Identify Energy Conservation Opportunities

This objective is based upon the proper and effective completion of the identification of all locations in which energy is currently used. After this definition is complete, the task of completing the identity and the economic justification, or lack thereof, of each ECO can be completed.

Again, the achievement of the objective includes several sub tasks, which include:

- o evaluation of ECO's which relate to no cost/ low cost implementation.
- o evaluation of ECO's which require an investment for implementation.
- o development of all significant data to prioritize the ECO's, highlight attractive investments, and provide a basis for rejection of unsatisfactory ECO's.

3.2 Method of Approach

During the preaudit a detailed schedule for carrying out the audit was developed. The time frame for the audit was set at seven weeks, including reports and presentation.

OEP, plant personnel as required, and FWEC specialists were all deployed in a coordinated effort to accomplish this task.

The first day started with a planning meeting between OEP and FWEC personnel. A detailed measurement plan was set up, followed by a visit to the plant to acquaint the plant personnel with the plan, discuss the need for penetrations, agree upon the exact location of penetrations, and incorporate any comments which plant personnel might have.

During the first two weeks, after the necessary preparations were made by plant personnel, instrument measurements, visual observations and all necessary information required for the audit report was gathered. In addition to the team present previously for the preaudit, the audit staff was augmented by FWEC specialist personnel, which included an additional process engineer, and combustion, electrical, and steel mill experts. These personnel worked with other audit team members previously utilized in the preaudit and assisted in instrument measurements, as well as in the gathering and analysis of other relevant data.

After the first week of the audit was completed, a cost estimating specialist joined the team, and started the estimating work required for each of the ECO's.

Almost all of the necessary plant data was collected in the first two weeks, with the next two weeks used for verification of plant data where required.

During this period sketches were started for the various systems, as well as listings of equipment and other technical data, as necessary for complete definition of each of the ECO's.

At the end of the second week, estimated sizing of equipment was well under way.

The major part of the work after the first two weeks of the audit was carried out in OEP's offices in Cairo, with plant coordination as necessary to produce a complete, coherent, and usable report.

Equipment sizing, system design, energy savings, and estimated investment for the various ECO's were continued through the fourth week. Economic evaluation and priority listing of ECO's extended into the fifth week.

During the latter part of the fourth week report preparation began and continued through the fifth week.

Weeks six and seven were reserved for presentations to OEP and then to the plant, culminating with the finished report at the end of the seventh week.

3.3 Goals and Special Considerations

In order to have an effective energy conservation program it is necessary to establish a goal, as a target for which everyone in the plant strives. This goal should be realistic and also somewhat conservative, rather than overly optimistic, in order to insure that it can be achieved. A goal which we would recommend is a reduction in yearly energy consumption of 10 percent at the end of the first year, following partial implementation of low cost/no cost items and 30 percent at the end of a five year program of implementation of investment related items.

The results achieved each year are plotted and compared against the base case (energy consumption before any implementation was started) in order to demonstrate the actual reduction in consumption versus the predicted goal. Any deviation in energy consumption must be accounted for in terms of increased production, new products, new units, etc.

Different sections of the plant are shut down for various considerations, and then periodic maintenance is undertaken. Scheduling of subsequent work must be coordinated in such a way that energy conservation recommendations can be implemented, preferably when these planned maintenance downtime intervals occur.

3.4 Analysis of Energy Consumption

The preaudit established, the need for a formal audit, and the advantages which could be obtained from that audit.

The preaudit provided a review of the energy consumption of the plant, including an examination of the various types of energy consumed, and their cost impact on production. This energy consumption analysis, as further described below, provides the baseline for the audit, and the implementation of its recommendations.

The basic analysis of these variables is accomplished through the use of a specialized computer program developed by FWEC, and employed by OEP personnel in their preaudit and audit work.

This program requires, as input, the quantities and unit cost of all energy supplied to the plant. This includes fuel oils, electricity, natural gas, and other fuels, as applicable. These data, which includes production quantities, are entered on a monthly basis, for one recent calendar year. Through systematic calculations the program produces a variety of results. These include monthly cost of the energy sources themselves in units of currency or energy consumption, as well as the relationship of energy cost and consumption to production units.

In specific terms, the following inputs related to the plant are provided to the program:

- Mazout consumed, by month (metric tons)
- Sular consumed, by month (metric tons)
- electricity consumed, by month (KWH)
- cost of Mazout, by unit (LE/metric ton)
- cost of Sular, by unit (LE/metric ton)
- cost of electricity, by unit (LE/KWH)
- production units, by month (thousands of tons)

The program then calculates a series of tables which permit an effective review of quantity, cost and percentages of each, and all, energy source(s).

Specific calculations produced, for each energy source, for each month are:

o total cost of this energy source,	LE/month
o total cost of this energy source,	LE/yr
o energy unit cost of this energy source,	LE/MMBtu
o energy unit average cost of this energy source	LE/MMBtu
o production unit cost of this energy source	LE/unit
o energy cost per production unit of this energy source	MMBtu/unit/month
o production cost of this energy source	MMBtu/month
o percentage cost of this energy source	% of total Btu/mon

Additionally, the program calculates the following totals, again based on the primary input data.

- o totals of all of the above, annually
- o energy and grand totals per month
- o averages of all of the above

Please note that each of the above tables is produced with both domestic energy prices and with worldwide prices to permit a true evaluation of cost and cost savings. (pricing basis as per Basic Engineering Data, see Appendix "A" of this report.) The worldwide price is of particular value in this analysis, as it reflects the value of the energy, if used as an export product.

The existence of this calculation technique permits direct plots to be made on the computer, to exhibit a graphic display of the table's data, and to aid with analysis.

The choice of curves to be presented is generally made after a careful review of the tables, to detect trends which would be meaningful as curves when plotted.

Such trends may include those which indicate costs not directly dependent upon production, such as heating or air conditioning, costs which vary with season, such as fuel (in other parts of the world), discontinuities in production or energy consumption, and the like.

Generally, the plots of greatest interest will be production units, unit cost, and energy consumption per production unit, plotted against calendar time.

Tables A, B, C and D reflect the energy consumption for the plant, in both the domestic and the worldwide price structure, as discussed above. Note that, in the worldwide pricing case, the total energy cost is 11.7 million LE/year.

In all, six graphs have been plotted by the computer for the National Metal Industries Co. The following conclusions are drawn from the four energy consumption tables and the five graphs.

3.4.1 Conclusions from Tables.

A) Domestic Cost.

1. (Table A, col. 5 & 9, Table B. col. 27 and 31). In terms of Btu/month, mazout typically represents about 95 percent of the total energy consumption, while electricity represents about 5 percent, yet if we compare the yearly cost of electricity and mazout they are roughly equal. This indicates a very large incentive to save electricity, because of its high cost per Btu.

2. (Table B, col. 22). The months of July 1983 and June 1984 each have much lower production figures than the rest of the year.

3. (Table B, col. 42 bottom). The months of July 1983 and June 1984 are 33 percent different in energy consumption per unit of production, even though the production figures for each month are identical. Since the electrical consumption is virtually the same for each of these two months, the difference is associated totally with the consumption of mazout which perhaps was delivered or paid for in a different month. This 33 percent difference should be investigated for verification at a later dat

4. (Table B, col. 39). The use of sular represents a negligible percentage of the total monthly energy consumption.

5. (Table B,. col 42 bottom). Monthly figures of total Btu/per unit of production vary from a low of 7,919 MMBtu/thousand tons in October to a high of 12,680 MMBtu/thousand tons in February. This represents a spread of nearly 60 percent. The low figure is 32% below the monthly average of 10,414 MMBtu/thousand tons and the high figure 22% above this average.

B) <u>Worldwide Cost</u>

1. (Table D col. 31 and table C col. 5 & 9) The mazout portion is still close to 95 percent of the total energy consumption, however the monthly costs are now no longer approximately equal, the mazout cost being about four times higher than the electrical cost.

2. All other conclusions remain the same as for the domestic case

Plot #1

Plot #1 reflects production rate plotted against time. The rate varies around an average of 13,000 tons per month (13 production units), with swings from a low of 9.27 in both July 1983 and June 1984 to a high of 15.75 in April 1984.

Plot #2

Plot #2 displays the total domestic energy cost of a production unit, and the two major cost elements which add up to that total (mazout and electricity). Note that, even though mazout represents roughly 95% of the thermal energy, in Btu's, the cost of these energy sources is roughly equal. i.e., the cost of electrical energy is severely out of proportion to its energy content.

Note that the unit production rate curve contour is generally in phase with production unit cost, and, similarly, all other cost curves. Production rate leads the cost curve by 1 month, however, this is apparently due to administrative procedures in recording and documenting cost/production rate.

Plot #3

Plot #3 presents total domestic energy costs vs time This plot follows the same trends as unit cost vs time, although the peaks and valleys in the curve are less severe, i.e. the curve approaches its average.

Plots #4 and #5

Plots #4 and #5 provide worldwide cost data in a format identical to that of Plots #2 and #3 and thus shown the same trends relative to production rate.

Plot #6

Plot #6 illustrates the fact that the energy input to the plant results mainly (roughly 95%) from mazout

FILE: STLCOABI

CLIENT NATIONAL METAL INDUSTRIES COMPANY

PLANT ABU ZABAL TABLE A

DATA, YEARS 83/84

ENERGY CONSUMPTION SUMMARY : DOMESTIC PRICING

DATE JAN.10,1985
REV MAR.30,1985

MONTH	HEATING DEGREE DAYS	COOLING DEGREE DAYS	ELECTRICITY QUANTITY KWH	ELECTRICITY COST L.E. TOTAL L.E.	ELECTRICITY COST L.E. LE/KWH	ELECTRICITY COST L.E. LE/MMBTU	OIL # 6 (SEE NOTE) QUANTITY TONS,METRIC	OIL # 6 COST L.E. TOTAL LE	OIL # 6 COST L.E. LE/TON	OIL # 6 COST L.E. LE/MMBTU	NATURAL GAS QUANTITY MCM	NATURAL GAS COST L.E. TOTAL LE	NATURAL GAS COST L.E. LE/MCM	NATURAL GAS COST L.E. LE/MMBTU	OTHER SULAR QUANTITY TONS,METRIC	OTHER SULAR COST L.E. TOTAL LE	OTHER SULAR COST L.E. LE/TON	OTHER SULAR COST L.E. LE/MMBTU	TOTAL ENERGY COST
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
JUL	0.00	0.00	1546247	15462.47	0.0100	2.931	2125.66	15942.45	7.500	0.194	0.00	0.00	.00	.0000	10.30	370.80	36.00	0.850	31776
AUG	0.00	0.00	2034103	20341.03	0.0100	2.931	3090.27	23177.03	7.500	0.194	0.00	0.00	.00	.0000	21.70	781.20	36.00	0.850	44299
SEP	0.00	0.00	2621468	26214.69	0.0100	2.931	3578.75	26840.63	7.500	0.194	0.00	0.00	.00	.0000	19.80	712.80	36.00	0.850	53768
OCT	0.00	0.00	1587954	15879.54	0.0100	2.931	2987.67	22407.53	7.500	0.194	0.00	0.00	.00	.0000	16.00	576.00	36.00	0.850	38863
NOV	0.00	0.00	1955537	19555.37	0.0100	2.931	3434.39	25757.93	7.500	0.194	0.00	0.00	.00	.0000	19.20	691.20	36.00	0.850	46004
DEC	0.00	0.00	1822004	18220.04	0.0100	2.931	3846.68	28851.60	7.500	0.194	0.00	0.00	.00	.0000	21.00	756.00	36.00	0.850	47828
JAN	0.00	0.00	1967336	19673.36	0.0100	2.931	3081.66	23112.45	7.500	0.194	0.00	0.00	.00	.0000	21.90	788.40	36.00	0.850	43574
FEB	0.00	0.00	1782218	17822.18	0.0100	2.931	4195.51	31466.33	7.500	0.194	0.00	0.00	.00	.0000	31.00	1116.00	36.00	0.850	50405
MAR	0.00	0.00	1995140	19951.40	0.0100	2.931	3820.72	28655.40	7.500	0.194	0.00	0.00	.00	.0000	16.90	608.40	36.00	0.850	49215
APR	0.00	0.00	1779383	17793.83	0.0100	2.931	3312.41	24843.08	7.500	0.194	0.00	0.00	.00	.0000	23.30	838.80	36.00	0.850	43476
MAY	0.00	0.00	1765938	17659.38	0.0100	2.931	3005.01	22537.58	7.500	0.194	0.00	0.00	.00	.0000	18.50	666.00	36.00	0.850	40863
JUN	0.00	0.00	1472074	14720.74	0.0100	2.931	2867.95	21659.63	7.500	0.194	0.00	0.00	.00	.0000	14.30	514.80	36.00	0.850	34895
ANNUAL TOTALS	0.00	0.00	22329400	223294.00	**********	**********	39366.88	295251.60	**********	0.194	0.00	0.00	**********	**********	233.90	8420.40	**********	**********	526966
ANNUAL AVERAGES	**********	**********	**********	**********	0.0100	2.931	**********	**********	7.500	0.19	**********	**********	0.00	0.0000	**********	**********	36.00	0.850	**********

ELECTRICITY 3412 BTU/KWH

OIL: # 2 42.719 MILLION BTU
OIL: # 6 38.646 PER M. TON

GAS 36775 # METRIC MER

OTHER 4234000 BTU/TON

CLIENT NATIONAL METAL INDUSTRIES COMPANY

PLANT ABDU TARZAL TABLE B PAGE 1 OF 2 ENERGY CONSUMPTION PER PRODUCTION UNIT DOMESTIC PRICING DATE JAN.10,1985

DATA,YEARS 1983/84 REV MAR.20,1985

MONTH	PRODUCTION UNITS PRODUCED X 1000	BTU TOT (MM BTU)	ELECTRICITY COST/UNIT (L.E.)	ELECTRICITY BTU/MONTH (MM BTU)	ELECTRICITY BTU/UNIT (MM BTU)	ELECTRICITY % OF BTU/MO	OIL,D & COST/UNIT (L.E.)	OIL,D & BTU/MONTH (MM BTU)	OIL,D & BTU/UNIT (MM BTU)	OIL,D & % OF BTU/MO	NATURAL GAS COST/UNIT (L.E.)	NATURAL GAS BTU/MONTH (MM BTU)	NATURAL GAS BTU/UNIT (MM BTU)	NATURAL GAS % OF BTU/MO	OTHER SOLAR COST/UNIT (L.E.)	OTHER SOLAR BTU/MONTH (MM BTU)	OTHER SOLAR BTU/UNIT (MM BTU)	OTHER SOLAR % OF BTU/MO	TOTAL COST PER UNIT (L.E.)
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
JUL	9.27	87860	1669.012	5276	569.126	6.00	1719.790	82149	8861.732	93.50	0.00	0.00	0.00	0.00	0.00	436	47.044	0.50	3427.802
AUG	15.13	127286	1344.417	6740	459.715	5.45	1531.859	119427	7893.362	93.83	0.00	0.00	0.00	0.00	1.63	919	60.726	0.72	2927.998
SEP	12.93	148687	2027.431	8944	691.759	6.01	2075.841	138394	10696.394	93.39	0.00	0.00	0.00	0.00	5.13	838	64.824	0.57	4158.400
OCT	15.25	121537	1636.478	5418	352.971	4.46	1457.774	115461	7521.921	94.99	0.00	0.00	0.00	0.00	7.52	677	44.133	0.56	2531.796
NOV	11.22	140211	1742.903	6672	594.679	4.76	2295.715	132725	11829.761	94.46	0.00	0.00	0.00	0.00	1.60	813	72.453	0.58	4100.223
DEC	13.46	155772	1353.645	6217	461.863	3.99	2143.507	148667	11045.061	95.44	0.00	0.00	0.00	0.00	6.17	889	66.058	0.57	3553.316
JAN	14.54	126734	1353.051	6713	461.661	5.30	1589.577	117094	8190.773	93.97	0.00	0.00	0.00	0.00	4.22	927	63.772	0.73	2996.551
FEB	13.37	169533	1332.998	6081	454.919	3.59	2353.502	162140	12127.126	95.64	0.00	0.00	0.00	0.00	3.47	1313	98.171	0.77	3767.970
MAR	14.70	155179	1339.020	6807	456.874	4.39	1923.181	147636	9909.758	95.13	0.00	0.00	0.00	0.00	0.83	716	48.023	0.46	3303.034
APR	15.75	135069	1129.767	6071	385.476	4.47	1577.238	128011	8127.703	94.77	0.00	0.00	0.00	0.00	3.26	987	62.636	0.73	2760.382
MAY	11.60	122940	1522.369	6025	519.429	4.79	1942.894	116112	10011.346	94.46	0.00	0.00	0.00	0.00	7.41	783	67.525	0.64	3522.668
JUN	9.27	117236	1587.998	5023	541.825	4.28	2336.529	111608	12039.667	95.20	0.00	0.00	0.00	0.00	5.53	605	65.314	0.52	3989.061
ANNUAL TOTALS	156.79	1607464	**********	76188	**********	**********	**********	1521372	**********	**********	**********	0.00	**********	**********	**********	9903	**********	**********	41032.39
ANNUAL AVERAGE		133955.31	1455.41	6349	471.77	4.74	1912.66	126781	9854.97	94.64	0.00	0.00	0.00	0.00	55.99	825.28	63.19	0.62	3419.37

TABLE 8 PAGE 2 OF 2

MONTH	TOTAL BTU PER UNIT (MM BTU) 41 42
JUL	9477.90
AUG	8412.80
SEP	11452.99
OCT	7919.02
NOV	12496.49
DEC	11522.98
JAN	8716.21
FEB	12690.12
MAR	10414.67
APR	8575.82
MAY	10598.30
JUN	12663.81

ANNUAL

TOTAL 124964.11 MM BTU PER UNIT

ANNUAL

AVERAGE 10413.68 MM BTU PER UNIT

ABBREVIATIONS

MM BTU	MILLIONS OF BRITISH THERMAL UNITS
KWH	KILOWATT HOURS
L.E.	EGYPTIAN POUNDS
MCM	THOUSANDS OF CUBIC METERS

CLIENT NATIONAL RETAIL INDUSTRIES COMPANY

PLANT APPH ZAAPAL TABLE C

DATA,YEARS 83/84

ENERGY CONSUMPTION SUMMARY WHOLESALE PRICING

DATE JAN.1C,1985
REV MAR.30,1985

MONTH	HEATING DEGREE DAYS	COOLING DEGREE DAYS	ELECTRICITY QUANTITY KWH	ELECTRICITY COST L.E. TOTAL L.E.	ELECTRICITY COST L.E. LE/KWH	ELECTRICITY COST L.E. LE/MMBTU	OIL # 6 & ISCE NOTE1 QUANTITY TONS,METRIC	OIL # 6 & ISCE NOTE1 COST L.E. TOTAL LE	OIL # 6 & ISCE NOTE1 COST L.E. LE/TON	OIL # 6 & ISCE NOTE1 COST L.E. LE/MMBTU	NATURAL GAS QUANTITY MCM	NATURAL GAS COST L.E. TOTAL LE	NATURAL GAS COST L.E. LE.MCM	NATURAL GAS COST L.E. LE.MMBTU	OTHER QUANTITY TONS,METRIC	OTHER COST L.E. TOTAL LE	SOLAR COST L.E. LE/TON	SOLAR COST L.E. LE/MMBTU	TOTAL ENERGY COST
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	2
JUL	0.00	0.00	1546247	142254.72	0.0920	26.964	2125.66	513581.59	241.800	6.257	0.00	0.00	.00	.0000	10.30	3347.50	325.00	7.676	659367
AUG	0.00	0.00	2034103	187137.48	0.0920	26.964	3090.27	747227.29	241.800	6.257	0.00	0.00	.00	.0000	21.70	7052.50	325.00	7.676	941417
SEP	0.00	0.00	2621462	241175.06	0.0920	26.964	3578.75	865341.75	241.800	6.257	0.00	0.00	.00	.0000	19.80	6435.00	325.00	7.676	1112952
OCT	0.00	0.00	1587954	146091.77	0.0920	26.964	2987.67	722418.61	241.800	6.257	0.00	0.00	.00	.0000	16.00	5200.00	325.00	7.676	873710
NOV	0.00	0.00	1955537	179909.40	0.0920	26.964	3434.39	830435.50	241.800	6.257	0.00	0.00	.00	.0000	19.20	6240.00	325.00	7.676	1016585
DEC	0.00	0.00	1822004	167624.37	0.0920	26.964	3846.88	930175.58	241.800	6.257	0.00	0.00	.00	.0000	21.00	6825.00	325.00	7.676	1104625
JAN	0.00	0.00	1967336	180994.91	0.0920	26.964	3081.66	745145.29	241.800	6.257	0.00	0.00	.00	.0000	21.90	7117.50	325.00	7.676	932258
FEB	0.00	0.00	1782218	163964.06	0.0920	26.964	4195.51	1014474.32	241.800	6.257	0.00	0.00	.00	.0000	21.00	6825.00	325.00	7.676	1158512
MAR	0.00	0.00	1995149	183552.88	0.0920	26.964	3876.72	937850.10	241.800	6.257	0.00	0.00	.00	.0000	16.90	5492.50	325.00	7.676	1112292
APR	0.00	0.00	1779383	163703.24	0.0920	26.964	3312.41	800940.74	241.800	6.257	0.00	0.00	.00	.0000	23.30	7572.50	325.00	7.676	972216
MAY	0.00	0.00	1765938	162466.33	0.0920	26.964	3005.01	726611.42	241.800	6.257	0.00	0.00	.00	.0000	18.55	6028.50	325.00	7.676	895095
JUN	0.00	0.00	1472074	135430.81	0.0920	26.964	2887.95	698306.31	241.800	6.257	0.00	0.00	.00	.0000	14.30	4647.50	325.00	7.676	838185
ANNUAL TOTALS	0.00	0.00	22329402	2054304.98			35365.89	9518911.58		6.257	0.00	0.00			233.90	76017.50			11649234
ANNUAL AVERAGES					0.0920	26.964			241.800	6.26			0.00	0.0000			325.00	7.676	

ELECTRICITY 3412 BTU/KWH OIL: 6 2 [illegible] BTU
OIL: 6 6 38.646 PER M. TON GAS [illegible] BTU/CUBIC MTR OTHER [illegible] BTU/TON

SHEET IS #2

CLIENT NATIONAL METAL INDUSTRIES COMPANY

PLANT ABOU JAARAL TABLE 8 PAGE 1 OF 7

DATA, YEARS 1983/84

ENERGY CONSUMPTION PER PRODUCTION UNIT WORLDWIDE PRICING

DATE JAN.10,1985
REV MAR.30,1985

MONTH	PRODUCTION UNITS PRODUCED X 1000	BTU TOT (MM BTU)	ELECTRICITY COST/UNIT (L.E.)	ELECTRICITY BTU/MONTH (MM BTU)	ELECTRICITY BTU/UNIT (MM BTU)	ELECTRICITY % OF BTU/MO	OIL,8 & COST/UNIT (L.E.)	OIL,8 & BTU/MONTH (MM BTU)	OIL,8 & BTU/UNIT (MM BTU)	OIL,8 & % OF BTU/MO	NATURAL GAS COST/UNIT (L.E.)	NATURAL GAS BTU/MONTH (MM BTU)	NATURAL GAS BTU/UNIT (MM BTU)	NATURAL GAS % OF BTU/MO	OTHER SOLAR COST/UNIT (L.E.)	OTHER SOLAR BTU/MONTH (MM BTU)	OTHER SOLAR BTU/UNIT (MM BTU)	OTHER SOLAR % OF BTU/MO	TOTAL COST PER UNIT (L.E.)
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
JUL	9.27	87260	15345.709	5276	569.126	6.00	55446.018	62148	8061.732	93.50	0.00	0.00	0.00	0.00	361.11	436	47.044	0.50	71157.838
AUG	15.13	127286	12368.637	6940	458.715	5.45	49387.131	119427	7893.362	93.83	0.00	0.00	0.00	0.00	466.13	919	60.726	0.72	62221.894
SEP	12.93	148087	18632.363	6944	691.757	6.04	66925.116	138304	10696.394	93.39	0.00	0.00	0.00	0.00	497.68	838	64.836	0.57	86075.159
OCT	15.35	121557	9517.379	5418	352.971	4.46	47063.191	115461	7521.921	94.79	0.00	0.00	0.00	0.00	338.76	677	44.133	0.56	56919.243
NOV	11.22	140211	16934.706	6672	594.678	4.76	74013.859	132725	11829.361	94.66	0.00	0.00	0.00	0.00	536.15	813	72.453	0.58	90604.715
DEC	13.46	155772	12453.519	6217	461.863	3.99	69106.656	148667	11045.061	95.44	0.00	0.00	0.00	0.00	507.06	889	66.058	0.57	82067.233
JAN	14.54	126734	12448.068	6713	461.661	3.50	51247.763	119094	8190.773	93.97	0.00	0.00	0.00	0.00	489.51	927	63.772	0.73	64185.503
FEB	13.37	169533	12263.579	6081	454.819	3.59	75876.912	162140	12127.126	95.64	0.00	0.00	0.00	0.00	753.55	1313	98.171	0.77	88674.044
MAR	14.50	155179	12318.985	6807	456.874	4.39	62003.362	147656	9509.768	95.15	0.00	0.00	0.00	0.00	368.62	716	48.023	0.46	74690.972
APR	15.75	135069	10393.856	6071	385.476	4.49	50853.380	128011	8127.708	94.77	0.00	0.00	0.00	0.00	480.79	987	62.636	0.73	61728.030
MAY	11.60	122940	14005.715	6025	519.429	4.90	62618.915	116132	10011.346	94.46	0.00	0.00	0.00	0.00	318.32	783	67.525	0.64	77162.949
JUN	9.27	117236	14609.580	5023	541.875	4.28	75329.699	111608	12039.667	95.20	0.00	0.00	0.00	0.00	501.33	605	65.314	0.52	90440.628
ANNUAL TOTALS	156.79	1607464	**********	76188	**********	********	**********	1521372	**********	********	**********	0.00	**********	********	**********	9903	**********	********	906143.25
ANNUAL AVERAGE		133955.31	13367.67	6349	495.77	4.74	61637.68	126781	9024.52	94.64	0.00	0.00	0.00	0.00	486.59	825.28	63.39	0.62	75511.94

TABLE 8 PAGE 2 OF 2

MONTH	TOTAL BTU PER UNIT (MM BTU) 41	42
JUL	9477.90	
AUG	8412.80	
SEP	11452.99	
OCT	7519.02	
NOV	12496.49	
DEC	11572.98	
JAN	8716.21	
FEB	12689.12	
MAR	10414.67	
APR	8575.82	
MAY	10598.34	
JUN	12646.81	

ANNUAL

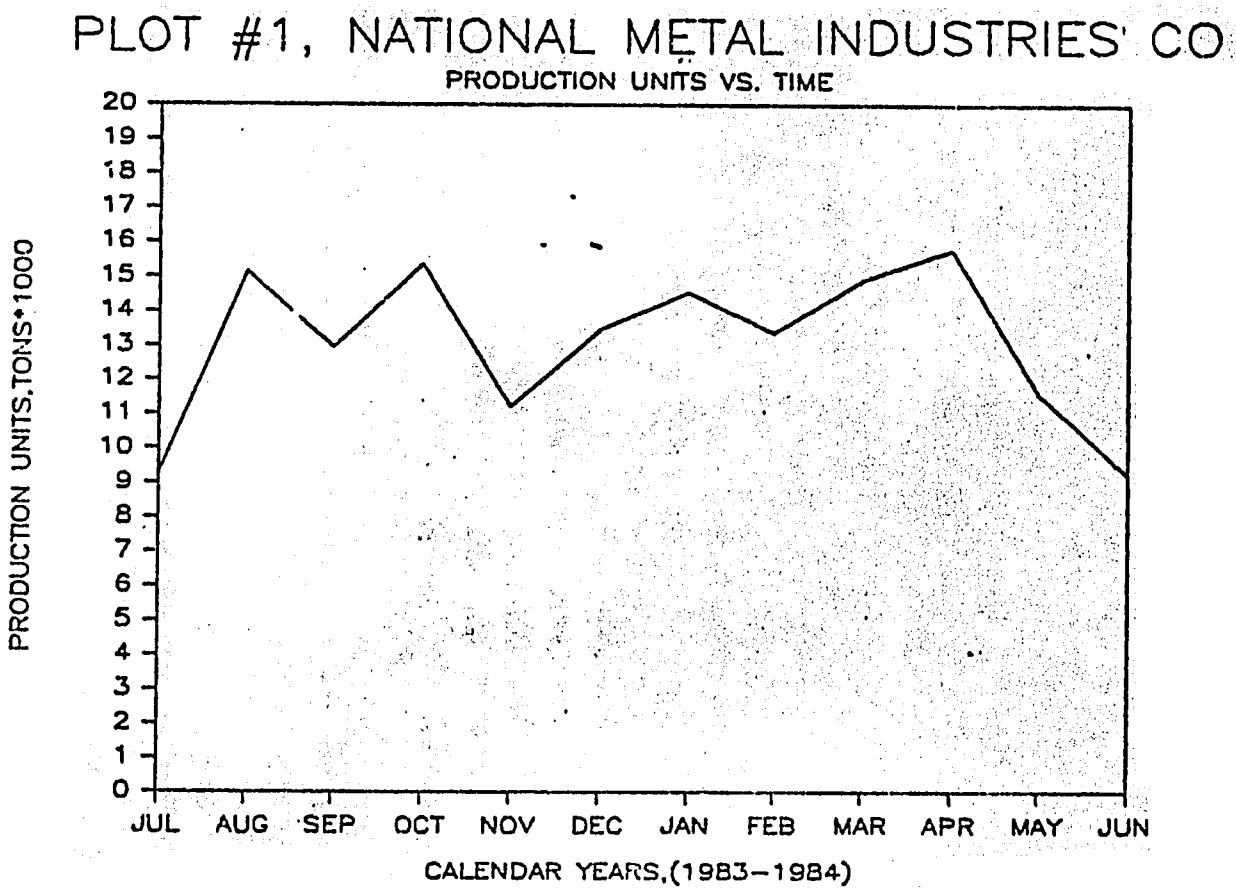
TOTAL 124964.11 MM BTU PER UNIT

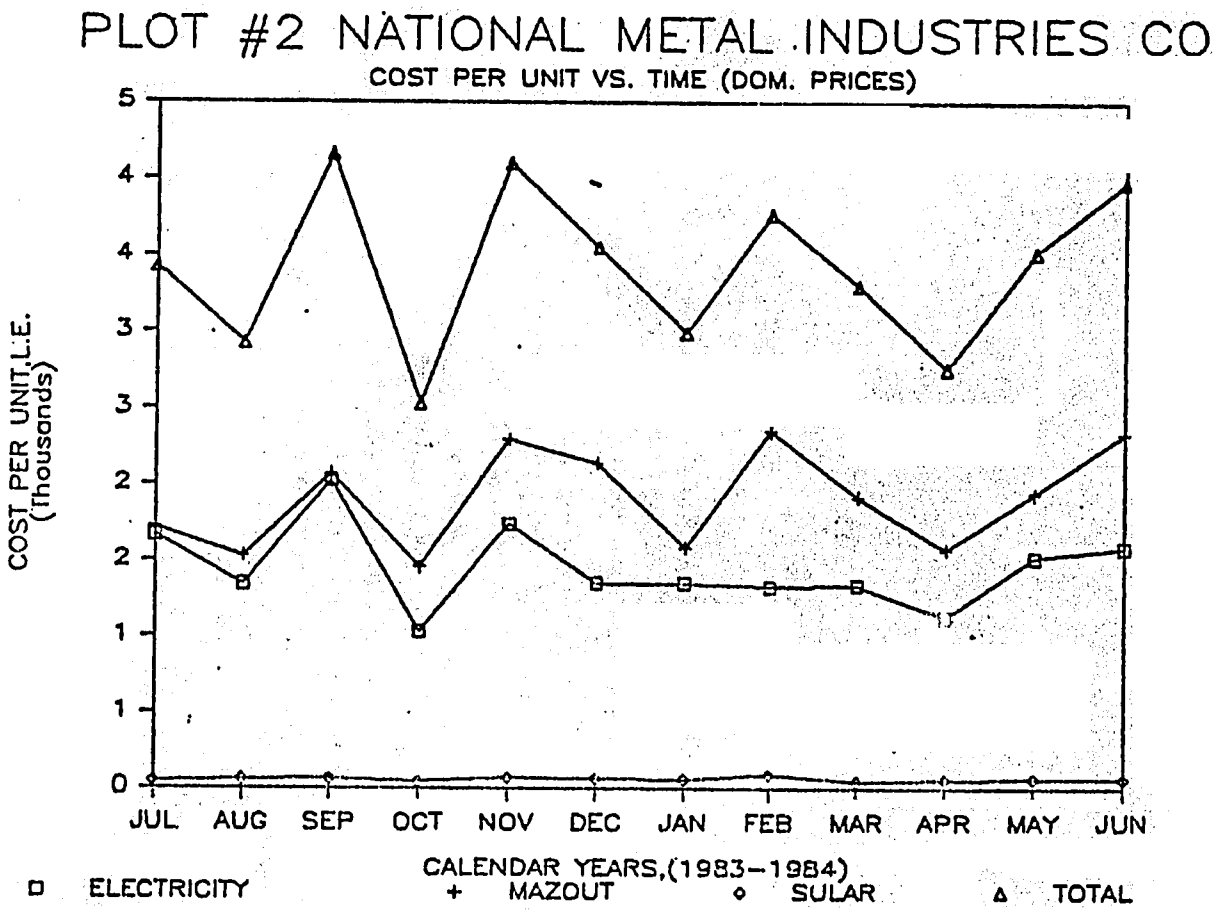
ANNUAL

AVERAGE 10413.68 MM BTU PER UNIT

ABBREVIATIONS

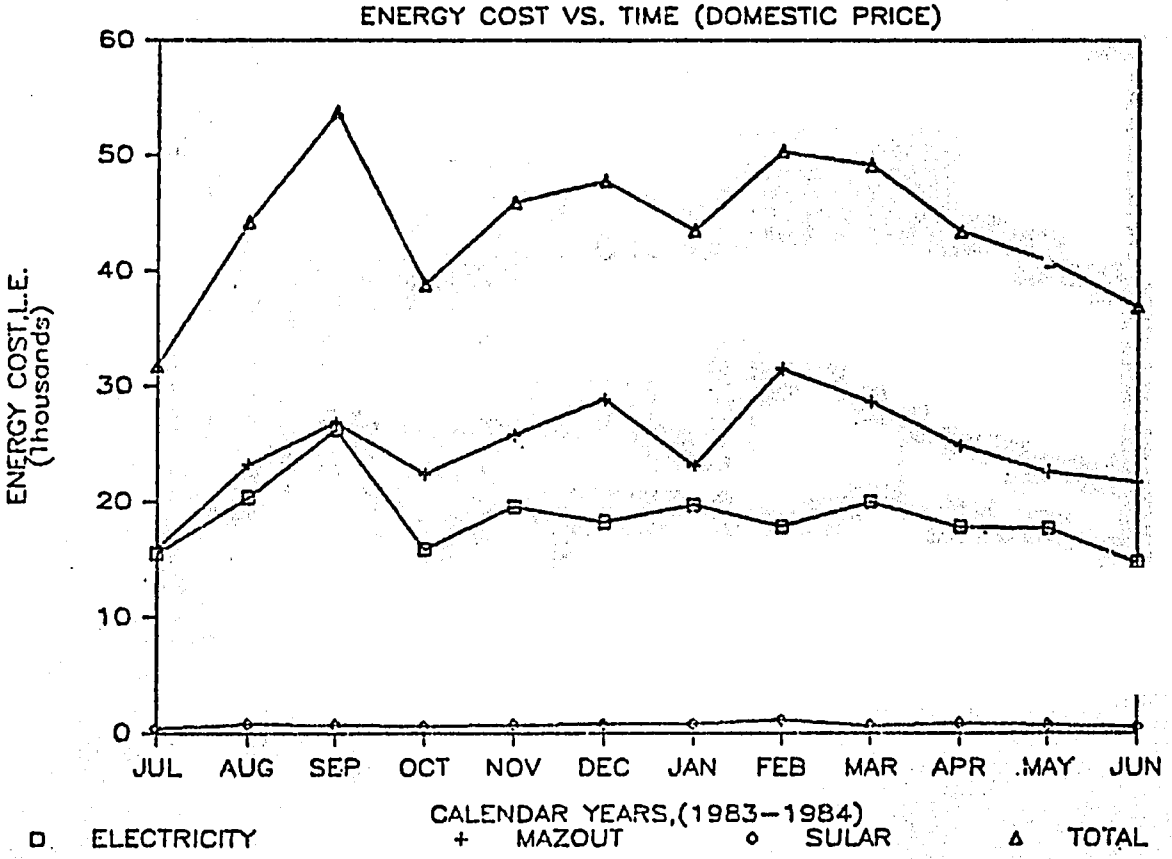
MM BTU	MILLIONS OF BRITISH THERMAL UNITS
KWH	KILOWATT HOURS
L.E.	EGYPTIAN POUNDS
MCM	THOUSANDS OF CUBIC METERS

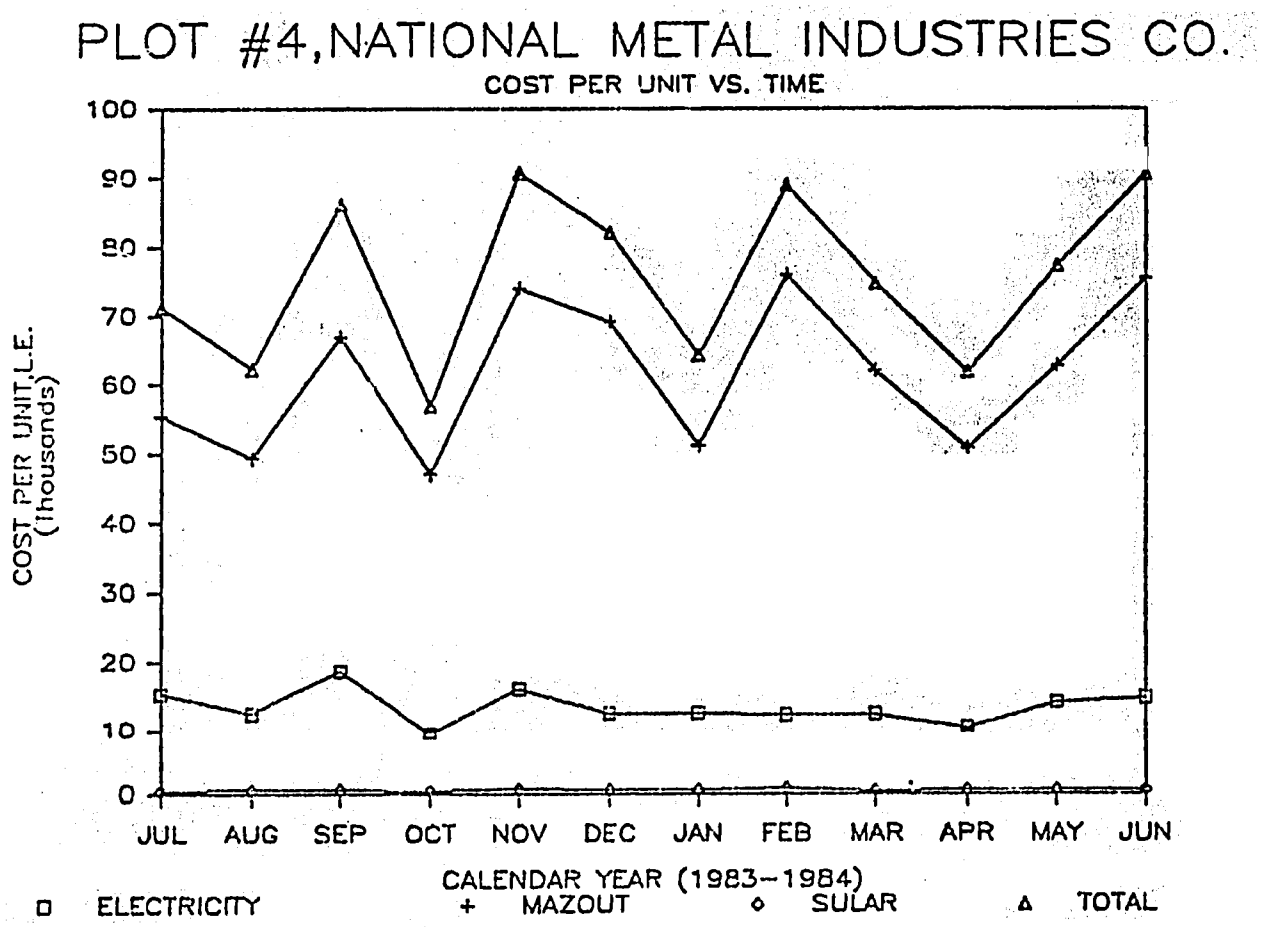

PLOT #1, NATIONAL METAL INDUSTRIES CO
PRODUCTION UNITS VS. TIME
PRODUCTION UNITS,TONS*1000
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
CALENDAR YEARS,(1983-1984)

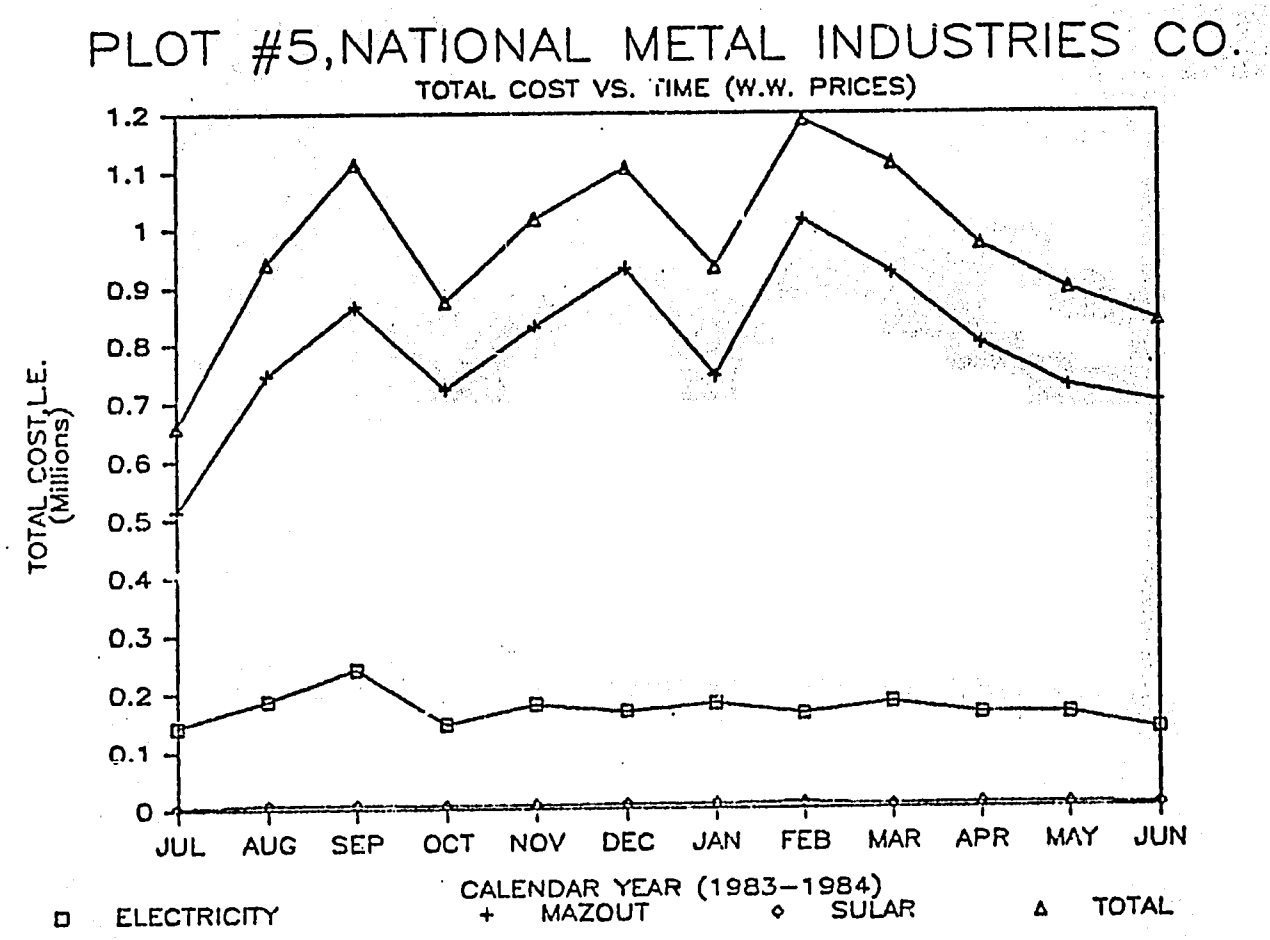

PLOT #2 NATIONAL METAL INDUSTRIES CO
COST PER UNIT VS. TIME (DOM. PRICES)
COST PER UNIT,L.E. (Thousands)
5
4
4
3
3
2
2
1
1
0
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
CALENDAR YEARS,(1983-1984)
ELECTRICITY
MAZOUT
SULAR
TOTAL

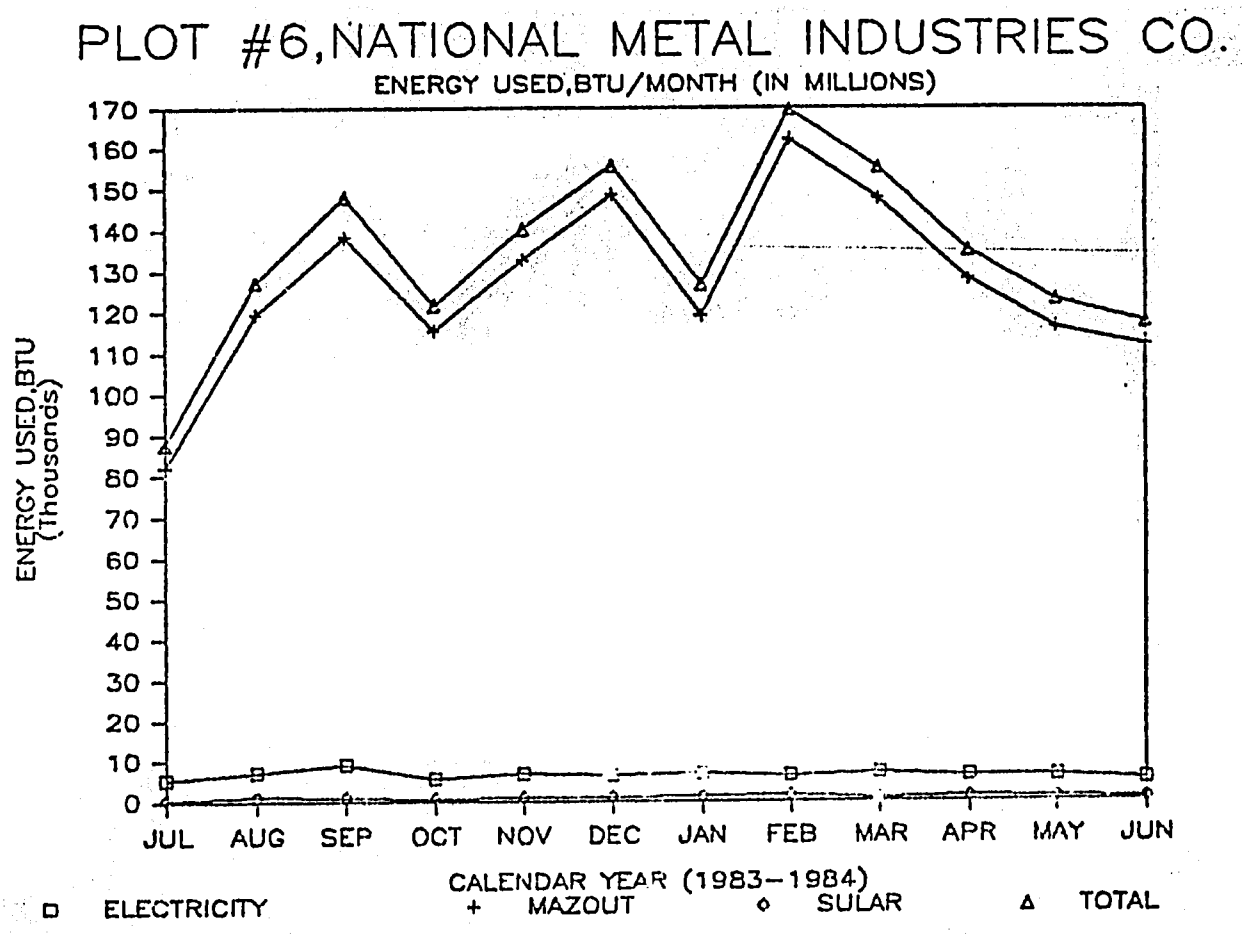
PLOT #3 NATIONAL METAL INDUSTRIES CO

ENERGY COST VS. TIME (DOMESTIC PRICE)




PLOT #4,NATIONAL METAL INDUSTRIES CO.
COST PER UNIT VS. TIME
COST PER UNIT,L.E.
(Thousands)
100
90
80
70
60
50
40
30
20
10
0
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
CALENDAR YEAR (1983-1984)
ELECTRICITY
MAZOUT
SULAR
TOTAL


PLOT #5,NATIONAL METAL INDUSTRIES CO.
TOTAL COST VS. TIME (W.W. PRICES)
TOTAL COST,L.E. (Millions)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
CALENDAR YEAR (1983-1984)
ELECTRICITY
MAZOUT
SULAR
TOTAL


PLOT #6,NATIONAL METAL INDUSTRIES CO.
ENERGY USED,BTU/MONTH (IN MILLIONS)
ENERGY USED,BTU (Thousands)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
CALENDAR YEAR (1983-1984)
ELECTRICITY
MAZOUT
SULAR
TOTAL

ECONOMIC EVALUATION

In carrying out economic evaluations for each of the potential energy conservation opportunities involving an investment, the following steps must be taken:

- Establish utility costs/economic criteria
- Develop energy savings
- Estimate investment cost
- Decide if project is attractive

For this energy audit the utility costs are defined in the Basic Engineering Data contained in Appendix "A".

The worldwide cost of the utilities involved are used, in each case being evaluated, in order to establish a realistic value for the energy savings. The criteria for evaluation which is used in each case is simple payout, defined as estimated investment cost divided by annual savings. This criteria is simple to use and is very effective in establishing a priority listing for a group of potential projects.

As a part of the evaluation a simplified design is developed which contains enough detail to establish an estimated investment cost. The key information needed for any evaluation is an estimate of the energy saved and an estimate of the investment cost. Since these two topics are so crucial to an effective audit, each of them are discussed separately in the sections which follow.

3.5.1. Value of Energy Saved

The first step in predicting the value of the energy saved for any energy conservation opportunity (ECO) is to establish the energy consumption of the current operation or the so called "base case". Once the base case is established, the ECO must be compared to it to determine exactly what energy savings would take place, if the ECO were to be implemented. The savings are normally first calculated on an hourly basis in terms of the units of energy normally used, for example KWH per hour for electricity or tons/hr for mazout.

The next step is to calculate the energy savings on an annual basis taking into account the number of days per week the plant operates, shutdowns for maintenance, and the number of shifts used for each operating day. Once this is done, the annual energy savings is converted into Egyptian pounds (LE) through the use of the world wide cost data for utilities given in Appendix "A".

3.5.2 ESTIMATING INVESTMENT COST

Each ECO which requires the expenditure of money regardless of whether it is a low cost or an investment ECO has been provided with an individual estimate of costs. These estimates are of a budgetary nature and have a degree of accuracy of plus/minus twenty-five percent.

The majority of the estimates, especially those which are well defined, are estimated using a "definitive" type formate enumerating and quantifying, where possible, each discipline of work. Material and installation manhours are estimated separately. In those cases in which the process equipment represents the large majority of the cost, and the bulk materials can not be accurately defined, the estimate was done using a factored technique for bulk materials and labor.

Engineering data and technical information used in preparation of each estimate is based on the equipment list and technical description provided for each E.C.O. as prepared by the responsible engineer and shown with sketches or schematic drawings when required. A site visit, for familiarization purposes, was made by the estimator to the existing facility.

The CHEMCOST computerized estimating Program has been utilized, where possible, for estimating equipment cost, especially on larger or more well defined equipment.

The estimates are done using United States material pricing and United States standard construction manhours as a base line. The material costs are

adjusted for a world wide pricing basis and then the dollar (US) value has been converted to Egyptian pounds at the rate of 1.30 LE = $1.00(US). The worldwide pricing adjustment is based on historical data and experience in worldwide procurement and construction. It represents a sampling of purchased materials from Engineering offices in England, France, United States, Italy and Spain which includes Far East manufactured materials purchases from these locations.

Construction manhours have been adjusted from a base line representing a U.S. Gulf coast location to the productivity realized in previous Foster Wheeler projects carried out in Egypt. Once again world wide experience was used as the primary determinent on productivity adjustment. Other factors were considered such as the size and complexity of each item of work, the amount of engineering that will be provided, the amount and type of supervision and who will be executing the work (in plant personnel, contractor etc.).

Labor rates for construction crafts in Egypt were obtained from Foster Wheeler's Labor Relations Dept., local egyptian contractors, and rates published in Engineering News magazine.

Each estimate includes:

a) indirect costs which include construction supervision, major tools; temporary facilities, subcontractor's requirements, and
b) home office costs which include engineering, purchasing, drafting and project management. Home office costs were estimated on a factored basis.

A contingency has been applied to each estimate commensurate with good industry practice for a budget estimate. The contingency ranges from ten to twenty percent depending on the definition of engineering and accuracy of material pricing.

All estimates are based on instant execution (No escalation has been applied). Labor is based on a straight time normal work week. It has been assumed that all construction work can proceed with continuity and without interruption or delay due to plant operation interference. It is anticipated that plant shutdowns of sufficient duration will be available, when necessary.

No provision is made for import duties or taxes, as these items require detailed information which is normally not available until the project (or ECO) execution plan is developed.

All estimates for engineering assume execution by local Egyptian engineering contractors, with engineering supervision and/or assistance from an international contractor's staff. This assistance will involve local supervision on all projects, and a "front end" engineering package as a technical basis, on major projects.

3.6 Energy Conservation Opportunities (ECO'S)

General. The audit, as it proceeds from concept to conclusion, brings to light several energy conservation opportunities which can be readily attained.

In the process of execution of this audit, two such ECO's were identified, and acted upon by Nametin management immediately. These ECO's NM-A-1a (leaks) and NM-A-12 (oxygen plant insulation), although moderate in total savings, reflect the interest in energy conservation and cooperation of the Nametin.

3.6.1 Summary List

A. No Cost/Low Cost

Under the category of no cost/low cost ECO'S, are items requiring better maintenance, better operations and improved scheduling. In developing a list of these items, attention was paid to leaks of steam, air, condensate and water, poor combustion efficiency of various fired devices, poor insulation of hot or very cold (refrigerated) lines or equipment, operating procedures, instrumentation, etc. Given below is a comprehensive summary list of the no cost/low cost items identified during the preaudit activity which were further studied and evaluated during the audit. It should be noted that upon completion of the investment estimation activity of the audit it became apparent that some of the ECO'S originally identified as no cost/low cost were in reality investment items instead. Because of this an investment cost of 40,000 LE or below was established as the criterian for which items included in Table 1.1 of section 2 are characterized as no cost/low cost.

3.6.1. Summary List (continued)

No Cost/Low Cost Items:

1. a) Repair all steam, compressed air, mazout and cooling water leaks. Replace all missing insulation.
   b) Add insulation on hot bare pipes.
   c) Add insulation on bare tanks.
2. Clean exhaust ducting from furnaces to chimney for both the number 1 and number two rolling mill reheating furnaces.

3. Establish procedures for shutting down cooling water when the equipment serviced is not in operation. Install pressure gages and flowmeters in all cooling water supply lines at pump discharges. Install regulating valves in individual CW subheaders to permit shutting down when not needed.

4. Clean all mazout filters periodically and replace any broken parts.

5. De-energize excess electrical transformer capacity at all times that secondary load is zero.
6. Repair and/or replace refractory bricks (insulation) on furnaces to minimize heat losses.

7. Clean air inlets (remove debris) to both open hearth furnaces.

8. Add air atomizing to reheating furnace #1 (old mill).

9. Add air atomizing to reheating furnace #2 (old mill).

10. Install meters and flow indicators in all mazout and combustion air lines, where not existing.

11. Repair or modify all instruments that are not in operation.

12. Insulate expansion engine in oxygen plant. (to reduce heat absorption).

13. Check and improve before possible replacement by new steam generator(s) boiler combustion efficiency. Add atomizing steam or air, if required. Provide instrumentation (fuel, air, boiler feed water, steam). Review capacity of combustion air system (air/fuel ratio). (Item a, is boiler combustion, item b. is open hearth furnace, item c. is automatic rolling mill furnace.)

14. Install temperature indicators where missing on mazout lines to reduce steam requirements.

15. Form a committee responsible for the planning and implementation of energy conservation measures. This committee must be chaired by an energy conservation coordinator.

16. Use publicity, memos, newsletters, etc. to make all employees aware of the importance of energy conservation and its implementation.

17. Repair blowers to automatic mill reheat furnace (now high pressure compressed air is being let down to low pressure).

18. Improve lance (sular) on tap flume heater(s)

19. Investigate decreasing excess air to OHF and/or using oxygen, to achieve higher flame temperature, and subsequent energy saving.

20. Install windshields for all reheating furnaces.

21. Develop and implement a formal equipment maintenance program.

22. Evaluate the use of 1 of 2 spare new air compressors in service to eliminate inefficient old ones.

23. Investigate instrumentation for measurement of quantity of mazout actually received from barge(s).

24. Replace cutters on cold shear (dull).

25. Review improvement to level measuring system at automatic rolling mill mazout tanks (2).

26. Investigate instrumentation to evaluate/quantify leakage from recuperator into exhaust stream at automatic mill reheat furnace.

3.6 Energy Conservation Opportunities ECO'S (Cont'd)

3.6.1 Summary List (cont'd)

B. Investment

Under the category of investment ECO'S are items for which the investment made must be paid for, as quickly as possible, by the savings in energy cost resulting from the implementation of the ECO. Given below is a comprehensive summary list of the potential capital investment items identified during the preaudit activity. Each of these items have been studied further during the audit in order to determine the potential energy savings and estimated investment. This has allowed for each potential item to be categorized and listed in terms of attractiveness and resulting priority as shown in Section 2.1. It should be noted that upon completion of the investment estimation activity of the audit it became apparent that some of the ECO's originally identified as investment items were in reality no cost/low cost items instead. Because of this an investment cost of 40,000 LE or greater was established as the criterian for which items included in table 1.1 of section 2 are charac terized as investment items.

Items Requiring Capital Investment

1. Install automatic (temperature controller) switching system for open hearth furnaces burners.

2. Install instrumentation in oxygen plant to control purity, temperature and pressure. (Refer also to 12, below).

3. Install heat recuperator, for which space and partial piping is provided, for semiautomatic rolling mill No. 1, reheating furnace.

4. Investigate installing a heat recuperator for semi-automatic rolling mill No. 2 reheating furnace.

5. Install steam generators in either one or two of the open hearth furnaces exhaust flue gas system, as well as perhaps in automatic mill reheating furnace exhaust system, to generate steam, so that it is possible to permanently shutdown the existing inefficient steam boiler.

6. Investigate the installation of capacitors to improve the overall power factor which is currently below 0.7. Additionally, review other aspects of electrical billing, such as excess lighting or demand factor.

7. Consider the use of a demand controller to reduce peak demands of electricity.

8. Consider the possibility of adding seals around doors of the steel making and reheating (for both semiautomatic mills #1 & 2) furnaces, to reduce amount of heat loss to ambient air.

9. Investigate the possibility of charging hot ingots from steel shop to reheating furnaces (possibly for new continuous casting machine feeding the automatic rolling mill).

10. Investigate the replacement of refractory in reheating furnaces No. 1 & 2 with "electrofused" alumina (or Al_2O_3) or "Z" block type insulating refractory.

11. Insulate runners in all reheat furnaces to minimize heat loss to coolant.

12. Obtain extra bottles, to avoid "blowing" of oxygen, if excess exists.

13. Improve performance or replace steam cranes in steel making plant.

14. Install automatic air/fuel ratio controls on some or all furnaces.

15. Install automatic door controls (both doors) in sequence with pushers, on reheating furnaces.

16. Investigate use of electric heat or oil/oil exchanger system to replace steam, for fuel oil preheat.

17. Investigate scrap and pig iron preheat.

18. Review transportation of billets from cold shear.

19. Investigate heat recovery from cast iron supports in reheat furnace #2.

20. Investigate a mechanical charge system for reheating furnace #2.

21. Investigate variable speed drive motors.

22. Investigate new flywheel to decrease motor overload and thereby increase operating time of motor without maintenance on semiautomatic mill #1.

23. Investigate handling of small billets from old rolling mill direct to #2 reheat furnace (similar to #9 above).

24. Investigate at automatic rolling mill fuel pump suction problems (tank contamination).

25. Investigate other materials or techniques for recuperator on automatic mill to deal with high sulfur dioxide content of exhaust, with resulting short recuperator life. (both combustion air and atomizing air).

3.6.2 Detailed ECO Presentation

For each of the no cost/low cost and each of the investment ECO's included in the "Summary List" given above in Section 3.6.1, a detailed ECO description and evaluation has been developed. All of this information is now presented in the pages which follow.

Note that each ECO is given an identification number, as NM-A-1 which ties it directly to the list of ECO's, as shown in section 3.6.1. Additionally, each ECO is written in such a way that it can be "self standing", and contains, at the bottom of each of its pages, an identifier and page number for that ECO alone. This step is taken so that the full text which defines that ECO, including its technical description, investment cost, savings, and payback can be removed for easy use elsewhere in project definition documents, financing discussions, and the like.

REPAIR ALL LEAKS

Annual Savings LE:	45,000
Investment Cost LE:	3,300
Payout, Years:	0.07 (27 days)

ECO #NM-A-1a

1.0 PURPOSE

This is an overall set of measures, meant to assure a more efficient utilization of energy through the repair of all visible leaks noted in the plant. The leaks are mostly steam, although two cooling water leaks were observed as well.

2.0 PROCESS DESCRIPTION

The leaks observed and in need of repair are as follows:

Steam Leaks

a) Steam leak in steam line to Open Hearth Furnaces.
b) Steam leak in steam line to Reheat Furnace #1.
c) Steam leak in steam line to Reheat Furnace #2.
d) Leaking steam valves in Boiler House.

Water Leaks

Several leaks were observed especially close to the boiler house in a 4" line leading to the new boiler (not operational) and in another 3" water line.

3.0 EQUIPMENT LIST/SIZE

Following is a table of instruments and repairs which are required for this ECO:

Item	Size/Range	Quantity	Remarks
Repair Steam Leak	1½" Flanged	1	
Repair Steam Leak	1 1/4" Flanged	1	
Repair Steam Leak	1 1/4" Hole	1	
Repair Water Leak	4"	1	Corroded Pipe
Repair Water Leak	3" Hole	1	Corroded Pipe
Steam Valve	4"	1	7 Bar
Steam Valve	2"	1	7 Bar
Blow Down Steam Valve	1½"	1	7 Bar

4.0 PREDICTED ENERGY SAVINGS

For the steam leaks enumerated in paragraph 2.0, we estimate the following quantities:

a)	Steam leak in 1 1/2" pipe	52 kg/hr
b)	Steam leak in 1 1/4" pipe	79 kg/hr
c)	Steam leak in 1 1/4" pipe	35 kg/hr
d)	Steam valves leaking	243 kg/hr
	Total	409 kg/hr

The total yearly leaks are estimated at 3,579 tons of steam. Based on worldwide pricing of LE 12.308/ton, we arrive at a yearly savings of 44,000 LE.

The water leaks from two damaged sections of 4" and 3" pipe (boiler house area) estimated at about 2.4 imperial gpm. The yearly savings will be (at 0.0008 LE/imperial gallon for worldwide pricing) 1,000 LE. Total savings 45,000 LE/year.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

For the estimated investment of LE 3,300 (which includes also the replacement of a leaky blowdown valve and other 2 steam valves in the boiler house) the payout is 27 days.

6.0 CONCLUSIONS

Good maintenance always pays back quickly. The payout for this ECO, which is only 27 days, is very attractive.

7.0 RECOMMENDATION

We recommend rapid implementation of this ECO.

ADD INSULATION ON
HOT BARE PIPES AND TANKS

	Piping	Tanks
Annual Savings LE:	10,200	52,300
Investment Cost LE:	13,562	203,895
Payout, Years:	1.33	3.99

ECO #NM-A-1b & 1c

1.0 PURPOSE

This ECO concerns the insulation of all hot non-insulated lines and tanks in the plant. Steam is used solely to maintain the temperature of mazout. Presently some lines and tanks are not insulated, while many others have missing sections of insulation.

2.0 PROCESS DESCRIPTION

2.1 The steam system in the plant is composed of one boiler which provides all of the steam required to keep the mazout at a temperature suitable for pumping. The steam generated is at a pressure of about 6-7 Bar.

All mazout lines have a companion steam line. These two lines are insulated together in a metal shroud filled with fiberglass. There are many places where the insulation is either in bad condition or totally missing.

Two major mazout/steam lines are now being repaired (to the automatic rolling mill and to the loading dock) due to relocation of equipment. The mazout/steam lines, where insulation is in poor condition should be repaired under overall maintenance (see ECO #NM-A-21).

For this ECO only new insulation for bare pipes will be considered.

2.2 In the open hearth furnace section both "atomization" air and mazout are preheated against flue gases. These pipes (with a wall temperature of 145-150°C) are not insulated.

The pipe sizes and lengths to be insulated were estimated. The required insulation thicknesses were then determined by use of the "Heatalyzer" Economic Insulation Thickness computer program. For both steam and compressed air the temperature was assumed to be 150°C.

2.3 The mazout system in the plant contains several day tanks, one (75t) intermediate storage tank at the automatic rolling mill, two underground tanks (20t) at the distribution station, and finally three large (600t) storage tanks. None of these tanks are insulated. While the day tanks for the open hearth furnaces, semiautomatic mill reheating furnaces 1 and 2 and the boiler, are in semi-enclosed somewhat sheltered areas and the two distribution station tanks are underground, both tanks in the automatic mill, as well as the three large storage tanks, are totally exposed. Their insulation will be investigated.

In order to maintain the mazout in a pumpable condition the mazout must be maintained at 49°C Heat loss calculations were performed using the "Heatalyzer" Economic Insulation Thickness computer program. The economic insulation thickness based on the installation of fiberglass blanket insulation is 1.5 inches (40 mm).

3.0 EQUIPMENT LIST/SIZE

The following tabulation lists the insulation requirement by pipe size, length and service:

	Size, Inch	Estimated Length, meters
Steam Piping	6	12 m
	4	
	1 1/2	18 m
	1 1/4	37 m
Compressed Air Piping	3	122 m

Fiberglass blanket insulation of 1 1/2" thickness (40 mm) shall be provided on the sides and top of each tank. Galvanized steel jacketing shall cover the insulation.

4.0 PREDICTED ENERGY SAVINGS

a) Piping

The Heatalyzer program determines the heat saved in LE/ft of pipe for various line types and at different operating temperatures when also calculating the economic insulation thinkness. The yearly heat savings are summarized as follows based on worldwide costs:

	LE	Insulation Thickness
6" pipe	1,228	65 mm
4" pipe	748	65 mm
3" pipe	6,744	65 mm
1 1/2" pipe	554	40 mm
1 1/4" pipe	944	40 mm
Total	10,218	

b) Tanks

Based on the output of the computer program, the yearly value of the heat saved by installation of 1 1/2 inches (40 mm) of insulation is LE 0.786 per square meter for the sides of the tank and

LE 0.935 per square meter for the top of the tank:

Yearly Heat Savings	LE
16 m³ vertical tank	
(top)	296
(side)	1,303
	1,599
75 m³ elliptical tank	2,895
600 tons tank (3 existing)	
(top)	10,873
(side)	36,984
Total for tanks	52,351

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated total investment for applying the economic thickness of insulation to the piping and tanks listed above is:

Piping LE:		
	6"	1,190
	4"	879
	3"	9,040
	1 1/2"	853
	1 1/4"	1,600
	Total	13,562

The payout for insulation of piping is 1.3 years.

Tanks LE:		
	16 m³ tank	6,244
	75 m³ tank	11,650
	3 × 600 tons tanks	186,000
	Total	203,894

The payout for 1 1/2" (40 mm) insulation installed on the sides and top of each of the above mazout tanks is 3.9 years.

6.0 CONCLUSIONS

The insulation of piping which has a payout of 1.33 years appears to be an attractive investment. The insulation of tanks while not having such a favorable (3.89 years) payout, is nevertheless going to save energy in the long run.

7.0 RECOMMENDATION

This ECO should be implemented.

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OEP / FWEC
FOR: NAMETIN

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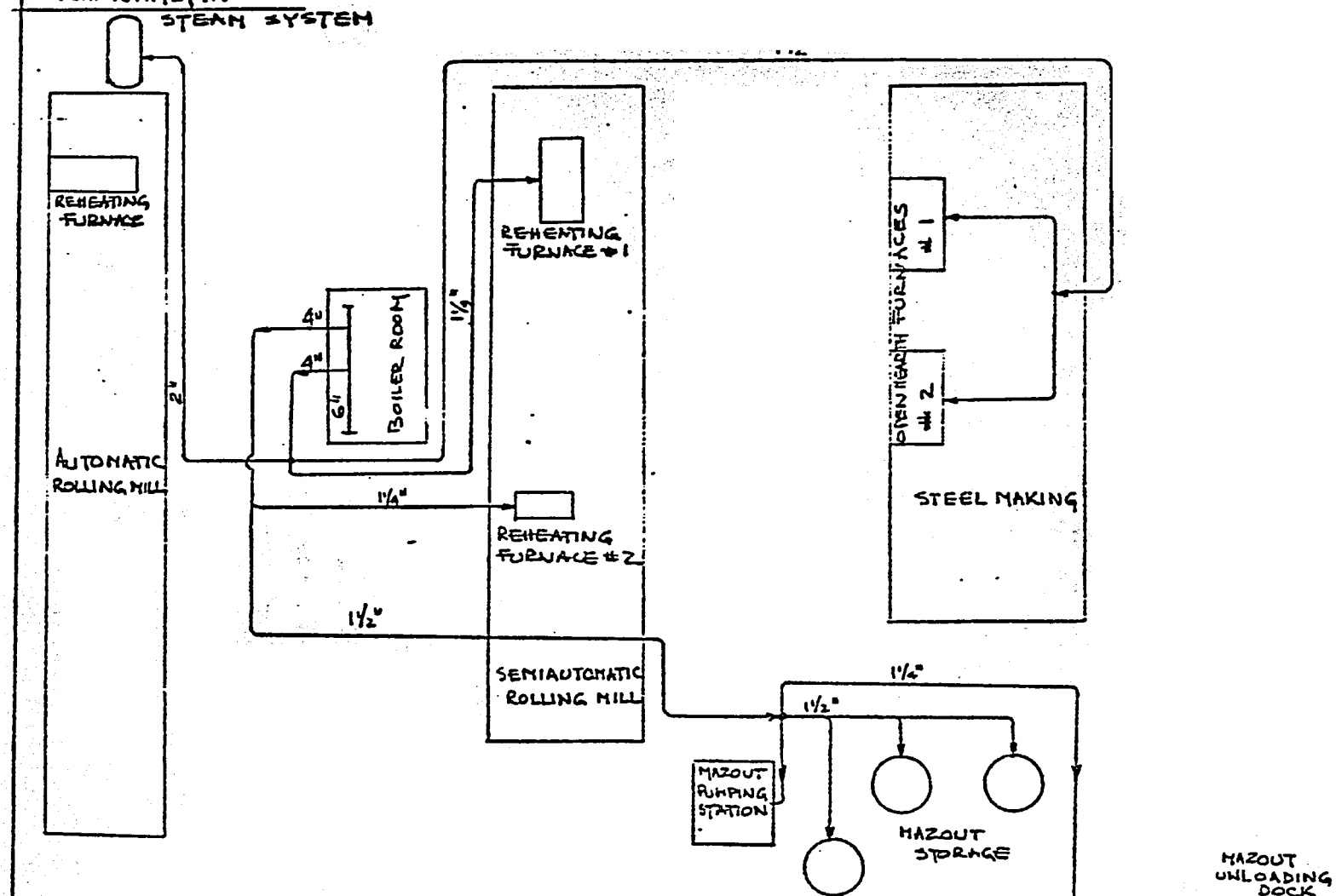

LEGEND

EXISTING EQUIPMENT

NEW EQUIPMENT

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNITY

ECO # NM-A-1b

ADD INSULATION ON
HOT BARE PIPES AND TANKS

PLANT NAMETIN

LOCAT[illegible] SAMBAL

SCHEMATIC OF EXISTING
[illegible]

Page 3 of ECO #NM-A-1b

EXHAUST DUCTING CLEANOUT
FOR THE
REHEATING FURNACES #1 AND 2

Annual Savings LE : 20,700
Investment Cost LE: 1,100
Payout, YRS : 0.05
(19 days)

ECO #NM-A-2

1.0 PURPOSE

The purpose of this ECO is to clear the exhaust ducting of dirt and debris, such that the full suction capabilities of the stack (and the induced draft fan in the case of the semiautomatic rolling mill #1) are available for proper combustion conditions.

Note that blockage (or pressure drop) in the ducting increases the load on the forced draft fans, and results in excessive hot gas (fire) leakage and resulting energy loss through the doors and openings in the furnace(s).

2.0 PROCESS DESCRIPTION

2.1 General

The exhaust gases from each furnace are drawn through exhaust ducting at relatively high temperatures, and subsequently discharged through a smoke stack to atmosphere. Each of the two furnaces are slightly different, and are thus discussed separately, as follows:

2.1.1 #1 Semiautomatic Rolling Mill Reheat Furnace

This furnace, of all reheat furnaces, has the greatest difficulty with exhaust gas conditions. The furnace was designed with

an induced draft (I.D.) fan and waste heat recovery. The waste heat exchanger, however, failed several years ago and was removed to permit continued operation of the furnace, but could not be replaced for various fiscal reasons.

After removal of the heat exchanger, gas temperatures to the stack were excessive, and overheating occurred at the I.D. fan.

To avoid repeated damage to the fan, air, for cooling, was admitted to the duct, thus further reducing its effectiveness in drawing off the hot gas.

The ducting should be cleared of debris (if any) and of excess carbon from incomplete combustion to open the path to the maximum degree. After cleaning, all random air inleaks shall be sealed, and the stack inlet fitted with a temperature indicator. As a short term temporary solution, the duct itself should then be fitted with a bypass to the ID fan, and a simple air inleak with a hand valve, such that the gas may be air cooled prior to entering the stack with a target temperature of nominally 260°C. Care must be taken in cooling the gas, to insure that it is not cooled below its dewpoint temperature, because this can result in corrosion problems from the resulting H_2SO_4.

The long term solution <u>must</u> include the implementation of an energy saving

heat recovery device, as per ECO #NM-B-3, and subsequent deletion of the air injection system.

2.1.2 #2 Semiautomatic Rolling Mill Reheat Furnace.

The #2 semiautomatic rolling mill reheat furnace has been modified in years past to exhaust to a tall mansonry stack, without the use of an induced draft fan. (The use of the original stack was discontinued.)

Conditions in the underground exhaust flue are uncertain, since no access is available, largly due to continued operation. Draft conditions appear acceptable, but an inspection is required to insure cleanliness at the next downtime opportunity.

The installation of a waste heat recovery device for the #2 semi automatic rolling mill reheat furnace is desirable from an energy conservation standpoint but is not an operational necessity as in the case of the #1 furnace. See ECO #NM-B-4.

3.0 EQUIPMENT LIST/SIZE

No equipment items are required, although some instrument and piping materials are required. The major materials are:

The I.D. fan bypass duct, small material items as necessary to seal the duct and a stack temperature indicator (no thermowell required).

4.0 PREDICTED ENERGY SAVINGS

4.1 #1 Reheat Furnace

The energy savings realized from cleanout of the ducts are mostly indirect, since the cleanout will permit proper operation and draft control of the furnace. Without withdrawal of the furnace exhaust through the duct located below the billet loading door, gases must escape through the loading door, or other openings in the furnace.

Savings on the #1 furnace are also realized from elimination of the fan power requirement, and from fan maintenance, since a fan bypass is provided to avoid damage to the ID fan. These savings will amount to LE 20,700 per year, and are the basis for temporary modifications to the #1 reheat furnace exhaust system.

4.2 #2 Reheat Furnace

Savings for the #2 reheat furnace are low, since the stack normally operates with excessive draft and they are thus negligible for this evaluation

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment to install the bypass and to clean the #1 reheat duct is 1,117 LE.

Savings, as obtained from removal of the I.D. fan are LE 20,700 per year thus providing a payout of 0.05 years.

6.0 CONCLUSIONS

The cleanout/temporary modification of the exhaust duct on the #1 reheat furnace will save energy, reduce maintenance, and facilitate operation of the furnace.

Inspection and cleanout of the #2 reheat furnace ducting will be consistent with good maintenance and will assure the existence of the best possible operating conditions.

7.0 RECOMMENDATIONS

It is recommended that the #1 furnace ducting be cleaned and modified as described above.

The #2 furnace duct should be inspected as operational conditions (normal shutdown) permit.

ESTABLISH PROCEDURES FOR COOLING WATER SHUTDOWN	Annual Savings LE:	30,100
	Investment Cost LE:	60,800
	Payout, Years:	2.02

ECO #NM-A-3

1.0 PURPOSE

The purpose of this ECO is to conserve energy by establishing a procedure to shut down cooling water to various sections of the plant, when they are not in operation.

2.0 PROCESS DESCRIPTION

2.1 Existing System

The cooling water network in the plant is composed of two separate pumping stations. The attached simplified sketches show both systems, with pumps and users, as gathered from existing drawings and information supplied by plant personnel.

a) Old Pumping Station

The old system consists of seven centrifugal pumps, each of which take suction directly from the Ismailia Canal, through individual suction lines. These seven pumps are arranged in two separate circuits. Circuit one has two motor driven 180 m^3/hr pumps and one motor driven 100 m^3/hr pump. One of the 180 m^3/hr and the 100 m^3/hr pump are in continuous use, serving the two semiautomatic rolling mills furnaces, rolling mill #1, as well as the Oxygen Plant. This circuit is also used for firewater. The remaining 180 m^3/hr pump is a spare.

The second circuit has two motor driven 300 m^3/hr and two motor driven 180 m^3/hr pumps. One of each capacity is in use, while the remaining two are spares. This circuit serves the two (and in the future also the third) open hearth furnaces, while at the same time pumping up to an elevated tank, which feeds the boiler plant with untreated raw boiler feed water.

b) New Pumping Station

This station has 5 vertical pumps, taking suction from a channel which is connected to the Ismailia Canal. All seven pumps (five 450 m^3/hr and two 600 m^3/hr pumps) discharge into a 24" common header.

Two motor driven 450 m^3/hr and one motor driven 600 m^3/hr are operating, while the remaining are spares. This station supplies the automatic rolling mill, with two secondary branches taken off, one serving the new compressor station and the second for the rolling mill #2 cooling water supply.

2.2 Proposed Improvements

A uniform procedure to shut down the various cooling water users (i.e. to reduce cooling water flow to equipment which is not in use), will have to be studied and then developed into a plan for implementation by both plant operation and maintenance personnel. From this implementation plan, certain measures will emerge which shall reduce energy consumption to a considerable extent.

Presently there are no valves at the various users. The only block valves are at the pump discharges.

The large pumps in the new pumping station also have check valves at the pump discharge. Shutdowns will involve mainly the rolling mill equipment, which unlike the furnaces, need not be cooled for periods after stoppage.

As far as the furnaces are concerned, valves coupled with simple dial thermometers on cooling water outlets will significantly reduce cooling water requirements and improve operational reliability. Subsequently, this can be followed by the partial shutdown of cooling water pumps.

The proposed changes and additions are as follows:

a) Install flow metering devices for all individual water users at or close to the point of use. These users are as follows:

1. Open Hearth Furnace #1.
2. Open Hearth Furnace #2.
3. Boiler.
4. Reheating Furnace #1.
5. Roughing Stand #1.
6. Finishing Train #1.
7. Reheating Furnace #2.
8. Finishing Train #2.
9. Automatic Mill Reheating Furnace #3.
10. Roughing Stand #1.
11. Roughing Stand #2.
12. Intermediate Train.
13. Finishing Train.
14. New Compressor Building.
15. Oxygen Plant.

b) Return cooling water lines, shall have temperature indicators, as follows:

Open Hearth Furnaces

1. Return line from each burner.
2. Return line from each furnace section.

Reheating Furnaces

1. Return lines from each furnace section.

As a consequence of the above measures, it is to be expected that in case of equipment shutdown or stoppage due to exceed one hour, one or more cooling water pumps could be stopped, thus saving electrical energy.

3.0 EQUIPMENT LIST/SIZE

All required new equipment are instruments (such as temperature and flow measurement devices) and a set of globe (or gate) valves to isolate (shutdown) various subheaders. An approximate listing follows: 30 temperature indicators (10-100°C), 16 pressure gages (0-10 kg/cm²), 36 throttling valves (various sizes) and 27 water flow meters (various sizes).

4.0 PREDICTED ENERGY SAVINGS

As a basis for expected energy savings, the average number of hours that each section of the plant is operating, as reported by NAMETIN, was used.

Old Pumping Station

Circuit One

Semiautomatic rolling mills No. 1 and No. 2 have a common header, however, the larger part is used for mill No. 1, since mill No. 2 is supplemented from the new pumping station. As a conservative approach, we assume that one 180 m^3/hr pump can shut down for 20 days. On a yearly basis this corresponds to 18,270,000 imperial gallons.

Circuit Two

Open hearth furnaces are operating approximately 7,500 hrs/year. This leaves 1,260 hours during which the furnaces are shut down (53 days). Assuming that yearly maintenance is performed during 20 days, for 20 days each year water could be shut down to each furnace. During this time, the 300 m^3/hr pump could be kept operating, shutting down only the 180 m^3/hr pump. On a yearly basis this corresponds to 18,270,000 imperial gallons.

New Pumping Station

Circuit Three

The furnace has 400 hours (17 days) down time. The quantity of 1,500 m^3/hr, is provided by three pumps. If during those 17 days only one of the two 450 m^3/hr pumps were shut, the plant would still have 1,050 m^3/hr available. On a yearly basis this corresponds to 38,805,000 imperial gallons.

The total amount for the three circuits adds up to 75,346,000 imperial gallons yearly.

To be on the conservative side, we will assume only half this quantity to be actually saved.

For a cost of LE 0.0008/imp. gal. (on a worldwide price basis) the yearly savings are LE 30,100.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

Based upon the analysis shown above which predicts an annual savings of LE 30,100 and an estimated investment of LE 60,800 for the required instrumentation, the calculated payout is 2.02 years.

6.0 CONCLUSIONS

If the instruments that are recommended above will be installed, then the orderly shutdown of cooling water capacity can be achieved, which will result in an expected savings of LE 30,100 annually which will pay for the cost of the instruments within 2.02 years.

7.0 RECOMMENDATIONS

We recommend that this ECO be implemented, since it has clearly beneficial effects.

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OEP / FWEC
FOR: NAMETIN COOLING WATER SYSTEM

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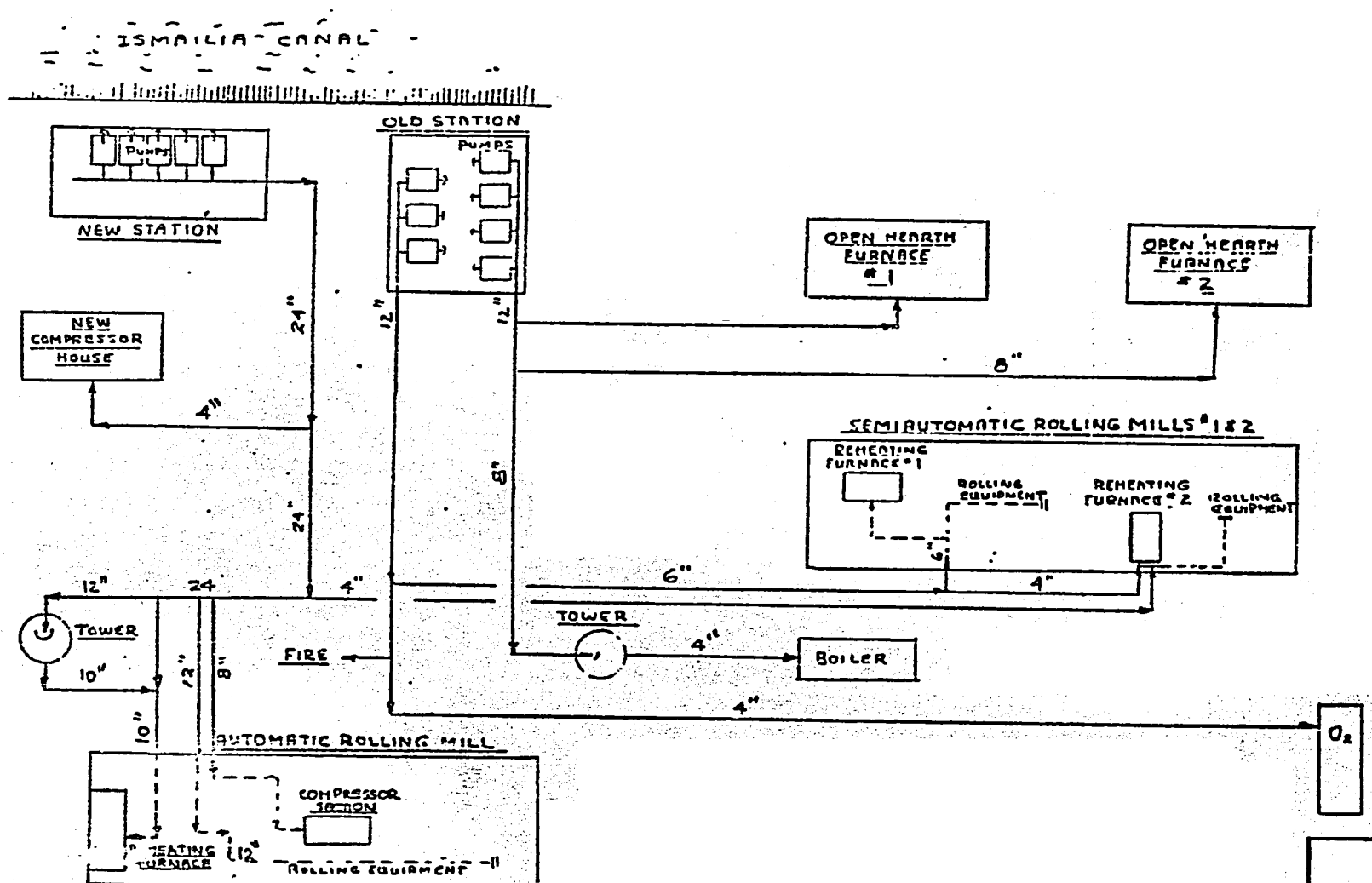


LEGEND

EXISTING EQUIPMENT

NEW EQUIPMENT

70.

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNITY

ECO NM-A-3

ESTABLISH PROCEDURES FOR COOLING WATER SHUTDOWN

PLANT NAMETIN

LOCATION ABOU ZABAL

EXISTING COOLING WATER DISTRIBUTION SYSTEM

MAZOUT FILTER
CLEANOUT/MAINTENANCE

Annual Savings LE : 2,600
Investment Cost LE: 17,200
Payout, YRS : 6.6

ECO #NM-A-4

1.0 PURPOSE

The purpose of this ECO is to decrease the energy loss which results from poor suction conditions on the mazout pumps, resulting from high inlet pressure drops. These high inlet pressure drops are caused by grit and debris strained from the mazout, and may be further aggravated by high viscosity at low mazout temperatures.

2.0 PROCESS DESCRIPTION AND SKETCH

The mazout feed sybsystem from the storage tank to the burner consists of a suction line, a wire cloth filter(s), a pump(s) and a discharge line.

In any circumstance in which the pressure drop of the pump suction in increased above the normal design value (actually beyond the value which exists at the best available clean conditions), pump energy is unecessarily lost.

The proper way to correct this situation is to install a suction differential pressure drop instrument on each filter (system) to measure the filter's condition. (i.e. increasing levels of filter contamination, will show an increasingly high pressure drop). Additionally, a local temperature indicator is required, to insure that the increased pressure drop does not come from cold (cooler than desired) mazout, which will also

reflect suction pressure losses. Temperature indicators will be installed under ECO #NM-A-14. Please refer to the sketch which follows for additional details.

2.1 Work Required

The implementation of this ECO will require the addition of two pressure taps on the line, if not already existing. After provision of the physical openings, calibrated instruments are to be installed.

Each instrument will be numbered in accordance with a master list, and its calibration requirement entered into the master log. Additionally, the allowable conditions of pressure drop and temperature must be indicated on an engraved plate permanently fixed to the filter.

3.0 EQUIPMENT LIST/SIZE

Materials required to implement this ECO, consist of a pressure differential gage on each filter. Steam tracing and insulation are required on the piping to the pressure gage.

4.0 PREDICTED ENERGY SAVINGS

Energy savings result from improved mazout pump performance.

4.1 Filter on Pump Discharge

If the filter is on the discharge side of the pump, the effect seen is simple pressure drop, resulting in a higher pump discharge

pressure to meet the end user conditions, and thus a horsepower loss.

This loss is maximum immediately prior to clearing of the filter(s) by plant personnel, essentially on a routine basis on three month intervals.

Assuming a typical grit loading the filter pressure drop is assumed to increase from typically 0.1 kg/cm² when clean, to 1.0 kg/cm² when dirty. The average then is 0.55 kg/cm² lost energy or in terms of pump HP, approximately 1300 HP. (Based on pumping the total plant throughput only once, i.e neglect pumping to storage)

The energy savings are therefore 88 LE/yr. based on the worldwide cost of electricity with an operating year of 7500 hours.

4.2 Filter on Pump Suction

If the filter is on the pump suction, its drop decreases the amount of fluid which can actually reach the pump suction, to meet the pump's required net positive suction head (NPSH). In this event, the flow quantity delivered is decreased, and additional pumps may be required to meet the design capacity of the first pump.

The energy savings in this circumstance is difficult to predict without extensive data. It can, however be assumed to be about 1/3 of the pump horsepower. Assume that for 5 pumps (at 3 HP each) with suction filters this amount to 5 horsepower (equivalent to

28,000 kw/yr) or 2,600 LE/yr, based on the worldwide cost of electricity and 7,500 hours of operation per year.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment cost for any filter regardless of size or pressure conditions is 1,720 LE.

Based on the above savings value, for suction filters (assuming there are 10 filters) the payout is about 6.6 years, while for discharge filters there is seems to be no reasonable payout at all.

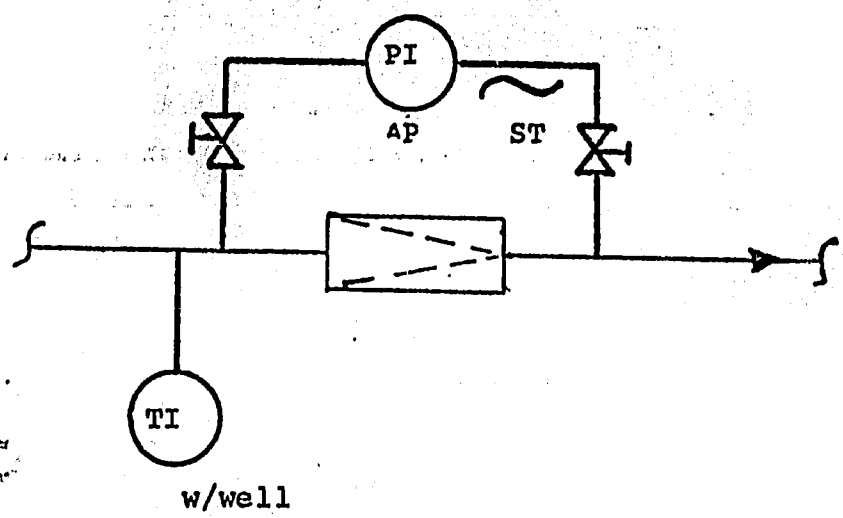
6.0 CONCLUSIONS

Based on energy savings calculated, the payout for this ECO is not favorable.

7.0 RECOMMENDATIONS

We cannot recommend implementation based on energy savings, however this could nevertheless be a worthwhile item for plant maintenance improvement.

Mazout Filter Contamination Indicator



LEGEND

EXISTING EQUIPMENT
NEW EQUIPMENT

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNITY:
ECO NM-A-4
MAZOUT FILTER CLEANOUT/MAINTENANCE
PLANT National Metal
LOCATION Various

DE-ENERGIZE EXCESS ELECTRICAL TRANSFORMER CAPACITY FOR STEEL PLANT	Annual Savings LE:	37,000
	Investment Cost LE:	0
	Payout, Years:	Immediate

ECO #NM-A-5

1.0 PURPOSE

The purpose of this ECO is to reduce electrical energy by de-energizing oil immersed transformers in the steel plant when their power is not required.

2.0 PROCESS DESCRIPTION

The steel plant consists of two plants, the old plant and the semi-automatic steel plant. There are a total of seven 1000 kva, (two 1000 kva not used), two 1400 kva and two 1600 kva (1 spare) transformers with 380 volt secondary in the old plant. In the automatic steel plant there are a total of five 1600 kva, 380 volt secondary (1 spare) and three 3150 kva, 6.6 kv secondary (1 spare) transformers.
The 380 volt transformers in the old plant average load varies from 40 percent to 90 percent. The average load for 6.6 kv and 380 volt transformers in the automatic mill is 60 percent.

It is proposed by this ECO to show the energy savings by changing the load on some transformers making spare transformers and then turning these transformers off to save energy.

3.0 EQUIPMENT LIST/SIZE

No new equipment is required for this ECO.

4.0 PREDICTED ENERGY SAVINGS

The approximate load loss for transformers in the old plant is as follows:

Location	Quanity	Size kva	Load Percent	Load Loss
Emergency Station Sub.	2	1000	40 each	6 kw each
Compressor Station Sub.	2	1600	50 each	8 kw each
Turbine Sub.	1	1000	80	12 kw
Mazout Sub.	1	1000	60	9 kw
Rolling Mill No. 1	2	1400	90	15 kw
Rolling Mill No. 2	1	1000	70	10 kw
Station No. 8	2	1000	off	--

De-energize Transformers for Energy Saving

Location	Quantity	Energy Saving
Emergency Sub.	1- 1000 kva	6 kw
Compressor Sub.	1- 1600 kva	8 kw
	Total =	14 kw Energy Saving old plant

If any of the above plants such as Rolling Mill No. 1 or Rolling No. 2 were not operating and the transformers were de-energized, then there would be additional energy saving as indicated.

The approximate load loss for transformers in the automatic mill is as follows:

Location	Quanity	Size kva	Load Percent	Load Loss
Automatic Rolling Sub.	3	3150	60	8 kw each
Automatic Rolling Sub.	5	1600	60	9 kw each

De-energize Transformers for Energy Saving

Location	Quanity	Energy Saving	
Automatic Rolling Sub.	1- 3150 kva	8 kw	
Automatic Rolling Sub.	2- 1600 kva	24 kw	(see note)
	Total =	32 kw	energy saving Automatic Rolling Mill

NOTE

By raising load to 90 percent on two of the 1600 kva and having one spare, energy saved is as indicated. Load changed would be by switching couplers on 380 volt bus.

If any of the above transformer units in the automatic rolling mill were shut down, when the rolling mill is not operating then there would be additional savings as indicated.

The total annual electrical saving for de-energizing transformers is as follows, based on the worldwide price of LE 0.092 per kwh.

Old Plant kw Energy Saving	14 kw
Automatic Rolling Mill Energy Saving	32 kw
Total Steel Plant Energy Saving	46 kw

Based on the plant operating 365 days per year and 24 hours per day, this ECO will save 8.760 hours X 46 kw = 402,960 kwh.

402,960 kwh times LE 0.092 = LE 37,000 predicted annual energy saving.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

No investment is required for this ECO. As indicated in paragraph 4.0 above, the total predicted annual energy saving would be LE 37,000 and the payout would then be immediate.

6.0 CONCLUSIONS

Based upon the analysis indicated above, if the unused power transformers were de-energized the predicted annual saving would be a minimum of LE 37,000.

7.0 RECOMMENDATION

This ECO should be implemented without any delay.

REPAIR AND/OR REPLACE OUTSIDE BRICKS (INSULATION) ON FURNACES TO PREVENT EXCESSIVE HEAT LOSS	Annual Savings LE:	207,700
	Investment Cost LE:	134,500
	Payout, Years:	0.65

ECO #NM-A-6

1.0 PURPOSE

Conserve energy by tightening (sealing) furnace and reducing heat loss by conduction through the walls.

2.0 PROCESS DESCRIPTION

Fuel consumption can be reduced by sealing openings in the furnace sidewalls and roof, repairing "hot spots" and providing additional insulation to reduce heat loss through the walls by conduction.

2.1 Physical Work Required

A super duty castable refractory having adequate strength, volume stability and good resistance to thermal shock should be used for general maintenance purposes to seal the furnace enclosure, closing obvious holes and cracks. This can be applied by casting or gunning.

After repairs to the refractories, the application of a ceramic fiber veneer to the hot face of the furnace walls will reduce heat loss. Ceramic fibers reduce heat loss by conduction through the walls because of their low thermal conductivity. A ceramic fiber veneer will also reduce furnace heat-up time, as much as 50 percent.

3.0 EQUIPMENT LIST/SIZE

The principal material required for this ECO is sufficient quantities of ceramic fiber veneer to blanket each of the three reheat furnaces. This will include side walls, front wall, back wall and roof. The veneer is held in place with metal clips.

4.0 PREDICTED ENERGY SAVINGS

On the basis of 7,500 operating hours per year for reheating furnace No. 1 and the automatic mill reheating furnace, and 5,000 operating hours for reheating furnace No. 2, we calculate an annual fuel savings of about 860 tons.

This is a predicted savings of 207,706 LE/yr, using a worldwide price of 241.8 LE/metric ton.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated investment cost for this ECO is LE 134,500 which, based on a predicted annual savings of LE 207,700, will provide a payout of 8 months.

6.0 CONCLUSIONS

Based on the process description and summarization stated above, the predictable annual savings obtainable by insulating each of the reheat furnaces is 207,700 LE/year, even without accounting for savings in heat-up time.

7.0 RECOMMENDATION

This ECO should be implemented.

AIR INLET CLEANOUT
ON OPEN HEARTH FURNACE

Annual Savings LE: 0
Investment Cost LE: 0
Payout. Years: Not Applicable

ECO #NM-A-7

1.0 PURPOSE

The purpose of this ECO is to reduce the pressure drop on the air inlet resulting from bricks and other material accumulated in the open hearth furnace air inlet, thus permitting better control of air flow.

2.0 PROCESS DESCRIPTION

Air enters the ducting for the open hearth furnace through a rectangular opening adjacent to the checker block stored heat exchanger. At the opening, excess material impairs the flow of air to which ever air passage (i.e. left or right heat exchanger), thus placing additional load on the air feed system.

Cleanout of the inlet, and related passages back to the walls will permit improved air flow, with greater flow control.

3.0 EQUIPMENT LIST/SIZE

No equipment or material are required to implement this ECO.

4.0 PREDICTED ENERGY SAVINGS

There are no savings which can be attributed directly to this ECO.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

There is no investment cost, only regular maintenance should be carried out. When ECO #NM-A-13b will be implemented, then this ECO becomes part of it.

6.0 CONCLUSIONS

There is no energy incentive for this ECO, except that it will help implementation of ECO #NM-A-13b.

7.0 RECOMMENDATIONS

We recommend implementation as part of good plant maintenance.

IMPROVE COMBUSTION IN REHEATING FURNACE #1 (Semiautomatic Rolling Mill)	Annual Savings LE:	158,000
	Investment Cost LE:	45,800
	Payout, Years:	0.29

ECO #NM-A-8

1.0 PURPOSE

The purpose of this ECO is to improve combustion in the reheating furnace #1 located in the semiautomatic rolling mill by installing new burners and decreasing the oxygen content in the flue gas from 12 volume % to 7 volume %.

During the energy audit this furnace was not in operation. Therefore specific measurements of temperature and oxygen content in flue gases could not be obtained. The approach being taken then was to assume that data measurements taken for reheating furnace #2 are also applicable to the reheating furnace #1.

2.0 PROCESS DESCRIPTION

At present, combustion air is being delivered by two forced draft fans and is not preheated. There are no inlet dampers and the air quantity is not controlled. The original design provided also for atomizing air, which at present, is not operational. In addition, the flue gas ducting is in a state of disrepair. The latter one and its repair is addressed by ECO #NM-A-2.

The intent of this ECO is to install new burners, repair (or replace) the atomizing, air blowers, and install a damper at the suction of the forced draft air fans, as well as required instrumentation.

3.0 EQUIPMENT LIST/SIZE

3.1 Equipment

a) 6 new burners with the required fuel and atomizing air piping.

b) 2 atomizing blowers (under the assumption that the existing ones are not operational).

c) 1 damper with positioner mechanism.

3.2 Instruments

a)	Air flow meter	30 - 300 Nm^3/min
b)	Fuel flow meter	0-1.5 m^3/hr
c)	Flue gas oxygen analyzer	0-20%
d)	Stack temperature indicator	150 - 550°C

4.0 PREDICTED ENERGY SAVINGS

Presently the furnace operates with an excess air which surpasses 100 percent and the combustion efficiency does not exceed 65 percent. With control of the combustion air quantity and new burners, the efficiency is estimated to be approximately 75 percent.

The difference between the two, or ten percent, when converted into yearly fuel oil savings, based on the furnace operating about 7,500 hours/year, amounts to LE 158,000 at worldwide prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment required for this ECO (which in order to be conservative includes the cost of 2 new blowers for atomizing air) amounts to LE 45,800. This results in a payout of 3.5 months.

6.0 CONCLUSIONS

The good payout makes this ECO attractive.

7.0 RECOMMENDATION

We recommend speedy implementation of this ECO for its payout and also because the new burners, damper and installed instrumentation will facilitate further energy recovery through implementation of ECO #NM-B-3.

IMPROVE COMBUSTION IN REHEATING FURNACE #2 (Semiautomatic Rolling Mill)	Annual Savings LE:	44,700
	Investment Cost LE:	36,780
	Payout, Years:	0.82

ECO #NM-A-9

1.0 PURPOSE

The purpose of this ECO is to improve combustion in reheating furnace #2 located in the semiautomatic rolling mill by installing new burners and decreasing the oxygen content in the flue gas, from a measured value of 12 volume % to 7 volume %.

2.0 PROCESS DESCRIPTION

At present combustion air is being delivered by a forced draft fan. This air is not preheated. There is no inlet damper, and the inlet air quantity is not controlled. There is no fuel atomization air provided. The flue gas is diverted from its original stack, bypassing the old stack and induced draft fan. That part of the combustion equipment is addressed in ECO #NM-A-2. The intent of this ECO is to install new burners and atomizing air blowers, provide damper at the suction to the forced draft fans, as well as all the required instrumentation.

3.0 EQUIPMENT LIST/SIZE

3.1 Equipment

a) 4 new burners with the required fuel and atomizing air piping.
b) 2 atomizing air blowers, one operating, one spare.
c) 1 damper with positioner mechanism.

3.2 Instruments

a)	Air flow meter	30-300 Nm^3/min
b)	Fuel flow meter	0-1.5 m^3/hr
c)	Flue gas oxygen analyzer	0-20%
d)	Stack temperature indicator	150-550°C

4.0 PREDICTED ENERGY SAVINGS

Presently the furnace operates with an excess air which surpasses 100 percent, and the combustion efficiency is around 65 percent. With new burners and control of the combustion air quantity, the efficiency will be around 75 percent. The difference between the two, or ten percent, when converted into yearly fuel oil savings, based on the furnace operating about 5,000 hours per year, amounts to LE 44,700 at world-wide prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment required for this ECO amounts to LE 36,700. This results in a payout of about 0.82 years.

6.0 CONCLUSIONS

The satisfactory payout makes this ECO attractive.

7.0 RECOMMENDATION

We recommend implementation of this ECO for its good payout and also because the new burners, damper and installed instrumentation will facilitate further energy recovery through implementation of ECO #NM-B-4

INSTALL NEW INSTRUMENTS IN MAZOUT AND COMBUSTION AIR LINES, REPAIR OR MODIFY INOPERATIVE INSTRUMENTS	Annual Savings LE:	56,100
	Investment Cost LE:	29,900
	Payout, Years:	0.53

ECO #NM-A-10 and 11

1.0 PURPOSE

The purpose of this ECO is to provide new instruments or repair existing ones to assure a more energy efficient operation of this plant. Most of the instruments related to mazout and combustion air were provided under ECO's A-8, A-9, A-13a, b, and c.

2.0 PROCESS DESCRIPTION

Instruments which are part of other ECO's will not be listed. In order to be able to identify the needs of each plant section, the instruments will be grouped by location rather than by type or service. This ECO includes only instruments which are related to efficient energy utilization.

3.0 EQUIPMENT LIST/SIZE

Below is a listing of required instruments, new or in need of repair, which have been identified during our survey:

a) Steel Making Shop

Repair fuel temperature indicator in control room.
Repair fuel pressure indicator in control room.
Repair fuel flow indicator in control room
Provide two temperature indicators in the preheated atomizing air lines to each furnace.

Provide three pressure gages for mazout pumps for the two furnaces..

b) Semiautomatic Rolling Mill

Provide four pressure gages for mazout pumps, two for each furnance.

c) Old Compressor Station (Steel Making Shop)

Provide four pressure gages at the discharge of each compressor, installed upstream of block valve.
Provide flow meter in compressed air line to open hearth furnaces.

d) New Compressor Station

Check and repair six pressure gages (at outlet of each stage, for all three compressors).
Repair six temperature indicators on cooling water outlet for each interstage cooler and after cooler.
Repair two leaking cooling water valves.

e) Old Cooling Water Station

Provide seven pressure gages at discharge of each pump, upstream of block valves.

f) Steam Boiler

Provide flow indicator on outlet of boiler (6" header).and portable instrumentation for efficiency measurement which can be used for all combustion devices.

g) Mazout Distribution Station

Repair two mazout flow meters.
Provide three pressure gages at discharge of each pump, upstream of block valves.
Provide two mazout flow meters (totalizer).
(These flow meters will monitor effective mazout consumption throughout the whole plant.)

h) Oxygen Plant

Provide one meter to record electrical consumption.

i) Automatic Rolling Mill

Repair instruments in control room, as follows:
Atomizing air flow indicator,
Hot flue gases temperature indicator,
Atomizing air and combustion air pressure indicators.
Provide two mazout pressure gages at pump(s) discharge.

j) Automatic Mill Compressor Station

Provide one totalizing meter for compressed air.
Repair two pressure gages (outlet from second stage) for both compressors.
Repair two cooling water temperature indicators (outlet from interstage coolers).
Provide three flow meters for compressed air individual users.

k) Automatic Mill Cooling Water Station

Repair flow totalizing meter at common discharge header (24") (control room).

Repair pressure indicators on discharge of three pumps.
Revamp pressure indicator in common discharge header.
Install low pressure alarm in control room.

4.0 PREDICTED ENERGY SAVINGS

Since this ECO covers the plant in its entirety, there is no specific energy saving that can be pinpointed. It is, however, a conservative assumption to infer that proper instrumentation can reduce the yearly energy consumptions by at least one half of one percent. This would amount to LE 56,100 based on worldwide prices and the 1983/1984 energy consumption.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated investment for this ECO amounts to LE 29,900, which results in a payout of less than 6 months.

6.0 CONCLUSIONS

This ECO has a satisfactory payout.

7.0 RECOMMENDATION

This ECO should be implemented for both its payout and also because it will help in the efficient running of the plant.

OXYGEN PLANT INSULATION

Annual Savings LE: _____
Investment Cost LE: _____
Payout, Years: Immediate

ECO #NM-A-12

1.0 PURPOSE

The purpose of this ECO is to insulate the expansion chamber in the Oxygen Plant, to prevent ice formation.

2.0 PROCESS DESCRIPTION

The expansion chamber in the air liquefaction unit operates at very low temperature. If left uninsulated the humidity present in the ambient air will lead to ice formation, which is a form of energy loss.

The intent of this ECO is to provide insulation in order to prevent the ice formation. The plant, prudently decided to implement this ECO immediately, thus no temperature measurements could be taken and no energy savings could be calculated.

3.0 EQUIPMENT LIST/SIZE

Since this ECO has been implemented, there are no equipment or materials required.

4.0 PREDICTED ENERGY SAVINGS

Because of the prompt implementation of this ECO, no energy is currently being lost, thus no savings are calculated.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

No investment is required.

6.0 CONCLUSIONS

The ECO has already been implemented.

7.0 RECOMMENDATION

No further action is required, since this ECO has already been implemented.

IMPROVED BOILER
COMBUSTION EFFICIENCY

Annual Savings LE:	180,000
Investment Cost LE:	16,200
Payout, Years:	0.09 (33 days)

ECO #NM-A-13a

1.0 PURPOSE

The purpose of this ECO is to improve combustion in the boiler, by decreasing the oxygen content in the flue gas from a measured value of 9 volume % to 3 volume % and replace the burner tips, as well as provide steam atomization.

2.0 PROCESS DESCRIPTION

At present combustion air is delivered by a draft fan that has been designed to supply several boilers. The air to the boiler is supplied by a pipe from a larger duct. The flow of air is not controlled, the remaining blower output is vented. There are no controls on either boiler feedwater or fuel oil feed streams.

The intent of this ECO is to provide new burner tips, a fuel atomization system (with steam) as well as the required instruments to monitor boiler operation. It is the intent of this Energy Audit Report, under Capital Investment ECO's, to completely eliminate the full-time use of the steam boiler and use it only as a spare for emergency situations.

Waste heat boilers installed in the exhaust flues of the open hearth furnaces, shall deliver all of the steam required by the plant.

3.0 EQUIPMENT LIST/SIZE

3.1 Equipment

a) 2 new burner tips with the required fuel and steam atomizing piping.

3.2 Instruments

a)	Air butterfly valve	3"
b)	Fuel flow meter	0-1.5 m^3/hr
c)	Flue gas oxygen analyzer	0-20%
d)	Stack temperature indicator	150-550°C

4.0 PREDICTED ENERGY SAVINGS

Presently the boiler operates with an excess air which surpasses 70 percent and the combustion efficiency (based on actual measurements which detected a presence of CO) has been calculated to be only 60 percent.

By adopting the measures listed above, the expected boiler efficiency will be approximately 77 percent. This improvement of 17 percent, when converted into yearly fuel oil savings, based on the boiler operating 8760 hours/year, amounts to LE 180,000 at worldwide prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment required for this ECO, amounts to LE 16,200. This results in a payout of 33 days.

6.0 CONCLUSIONS

The rapid payout makes this ECO very attractive.

7.0 RECOMMENDATIONS

We recommend implementation of this ECO for its quick payout.

IMPROVE COMBUSTION IN OPEN HEARTH FURNACES	Annual Savings LE:	433,200
	Investment Cost LE:	31,000
	Payout, Years:	0.07 (26 days)

ECO #NM-A-13b

1.0 PURPOSE

The purpose of this ECO is to improve the combustion in Open Hearth Furnaces #1 and 2 by decreasing the oxygen content in the flue gas from a measured value of 12-15 volume % to 6 volume %.

2.0 PROCESS DESCRIPTION

At present combustion air is drawn into the "checkers" (heat recuperators) through a wide open intake channel. There is no control on the air quantity (secondary combustion air). The intent of this ECO is to repair the existing dampers at the air inlet and with proper instrumentation, set the air quantity that will yield the required flue gas oxygen concentration of approximately 6 volume percent and improve the combustion efficiency of the furnaces accordingly. (See also ECO #NM-A-2.)

3.0 EQUIPMENT LIST/SIZE

The inlet damper has to be repaired and the following instrumentation installed:

	Range
1) Air flow meter	150-450 Nm^3/min
2) Fuel flow meter	0-3 m^3/hr
3) Flue gas oxygen analyzer	0-20%
4) Stack temperature indicator	150-550°C

The above are required for each of the two furnaces.

4.0 PREDICTED ENERGY SAVINGS

Presently the furnaces operate with an excess air which surpasses 100 percent, and the combustion efficiency does not exceed 62 percent. With control of the combustion air quantity, the efficiency will be around 76 percent. The difference between the two, or fourteen percent when converted into yearly fuel oil savings, based on both furnaces operating about 7,500 hours (year), amounts to LE 433,200 at worldwide prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment required for this ECO amounts to LE 31,000. This results in a payout of about 26 days

6.0 CONCLUSIONS

The rapid payout makes this ECO very attractive.

7.0 RECOMMENDATIONS

We recommend speedy implementation of this ECO for it's attractive payout and also because the repairs and the installed instrumentation will facilitate further energy recovery through implementation of ECO #NM-B-5.

IMPROVE COMBUSTION EFFICIENCY IN AUTOMATIC ROLLING MILL REHEATING FURNACE	Annual Savings LE:	101,600
	Investment Cost LE:	77,500
	Payout, Years:	0.76

ECO #NM-A-13c

1.0 PURPOSE

The purpose of this ECO is to improve combustion in the Reheating Furnace located in the Automatic Rolling Mill, by repairing and calibrating existing instruments, adding one new instrument and through better operation to reduce the oxygen content in the flue gases from 11 volume % to 5 volume %.

2.0 PROCESS DESCRIPTION

At present secondary combustion air is being supplied by two (instead of one) forced draft fans. The air is preheated through six metallic tubular recuperators, before entering the different furnace zones. It is expected that after the fan(s) are repaired, and the recuperator leaks are eliminated, the air required will be supplied by one blower only. (See also ECO #NM-B-25.)

The intent of this ECO is to improve combustion efficiency. If it proves possible to operate the furnace with only one fan, the oxygen content is expected to be within the acceptable range (around 5 percent). If both fans are required (for flame length, etc.), then an air damper shall be installed at the outlet of the forced draft fan to regulate the oxygen content in the flue gas, which will require installation of an oxygen analyzer in the stack.

3.0 EQUIPMENT LIST/SIZE

a) Damper in forced draft fan exhaust duct.
b) Stack oxygen analyzer (0-20%)
c) Repair and calibration of instruments.
d) Two (2) new forced draft fans and motors (See 5.0 for discussion)

4.0 PREDICTED ENERGY SAVINGS

Presently the furnace operates with an excess air that exceeds 100 percent, and the combustion efficiency calculated is around 76 percent. Taking into account the air inleaks (through the recuperator) into the exhaust gases, we recalculate the efficiency to be in effect 78 percent. The control of secondary combustion air, without any additional heat recovery, will result in an efficiency of 81.2 percent.

The difference between the two, or 3.2 percent, when converted into yearly fuel oil savings, based on the furnace operating about 7,500 hours per year, amounts to LE 101,600 at worldwide fuel costs.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment required for this ECO, which includes calibration and repair of existing instruments as well as two new forced draft fans (one operating and one spare) is LE 77,500 and the payout becomes 0.76 years.

6.0 CONCLUSIONS

Even with the investment including two new forced draft fans, the payout is still only 9 months.

7.0 RECOMMENDATIONS

The payout of this ECO is quite good, and we recommend implementation.

INSTALL TEMPERATURE INDICATORS ON MAZOUT LINES

Annual Savings LE : 23,900
Investment Cost LE: 6,900
Payout, YRS : 0.29
(3.5 months)

ECO #NM-A-14

1.0 PURPOSE

The purpose of this ECO is to reduce the amount of steam used to heat and maintain the mazout temperature. In order to achieve this, temperature indicators shall be installed at the inlet to each of the five furnaces and the boiler, as well as at the pumps in the distribution station and the dock.

2.0 PROCESS DESCRIPTION

The mazout system is depicted in the attached sketch.

Briefly, mazout is brought to the plant dock by barges. A set of two 40 t/hr pumps (one operating and one spare) are used to transfer the mazout to three 600 ton tanks. From these tanks (which are maintained warm by steam coils at the bottom), the oil is pumped to its various destinations in the plant by two 20t/hr (two operating, one spare) pumps. Basically there are two major destinations for the mazout. One 4" line feeds the Steel Making Shop (open hearth furnaces) via two day tanks. The second 4" line branches off to the two semiautomatic rolling mills (to respective day tanks) to the boiler day tank, and continues to the automatic rolling mill intermediate storage tank.

It should also be mentioned that at the distribution station there are two underground tanks holding

20 tons each, which are filled by tank trucks (when the main tanks are empty).

All mazout lines have a "companion" steam line, and are insulated together in a metal shielding.

3.0 EQUIPMENT LIST/SIZE

As described in 1.0 and 2.0 above, each mazout line has a companion steam line. In order to reduce the steam consumption (and thus save overall energy) temperature indicators for the mazout shall be installed at each user, as follows:

a) Reheat Furnace #1
b) Reheat Furnace #2
c) Autom. Mill Furnace
d) Boiler
e) Steel Making Shop (two)
f) Pumping Station (Dock)
g) Pumping Station (Distribution)

The exact locations are to be determined by plant maintenance, and are also a function of the mazout preheat system (where existing).

The instruments shall measure the temperature close to the pumps, since steam heating is meant to keep the oil properly flowing at a temperature which for safety typically should be about 48°C, but never less than 38°C.

The instruments shall be simple dial thermometers, placed permanently inside the mazout pipe (in thermo-wells). In addition, 7 (seven) steam throttling valves will be installed (one for each line where temperature is measured).

4.0 PREDICTED ENERGY SAVINGS

The steam production in the plant is about 4-5,000 Kg/hr

Since all its use is to heat mazout in both pipes and tanks, an accurate temperature reading of the mazout temperature, would reduce the quantity of steam (if proper valving is installed) sent to various users.

Assuming that during the 6 hot months of the year, the steam quantity can be reduced by ten percent, this would result in a yearly saving of 1,944 tons of steam. At the worldwide price of LE 12.308/ton, the total savings are LE 23,900/year.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated installed price for the required instruments is LE 6,900.

The payout is thus 3.5 months or 0.29 years.

6.0 CONCLUSIONS

The payout for this ECO, is very attractive, the assumpions made are reasonable and on the conservative side.

7.0 RECOMMENDATIONS

Because of the rapid payout of this ECO, we recommend that it be implemented.

JOINT ENGINEERING GROUP
OEP / FWEC
FOR: NAHETIN MAZOUT DISTRIBUTION SYSTEM

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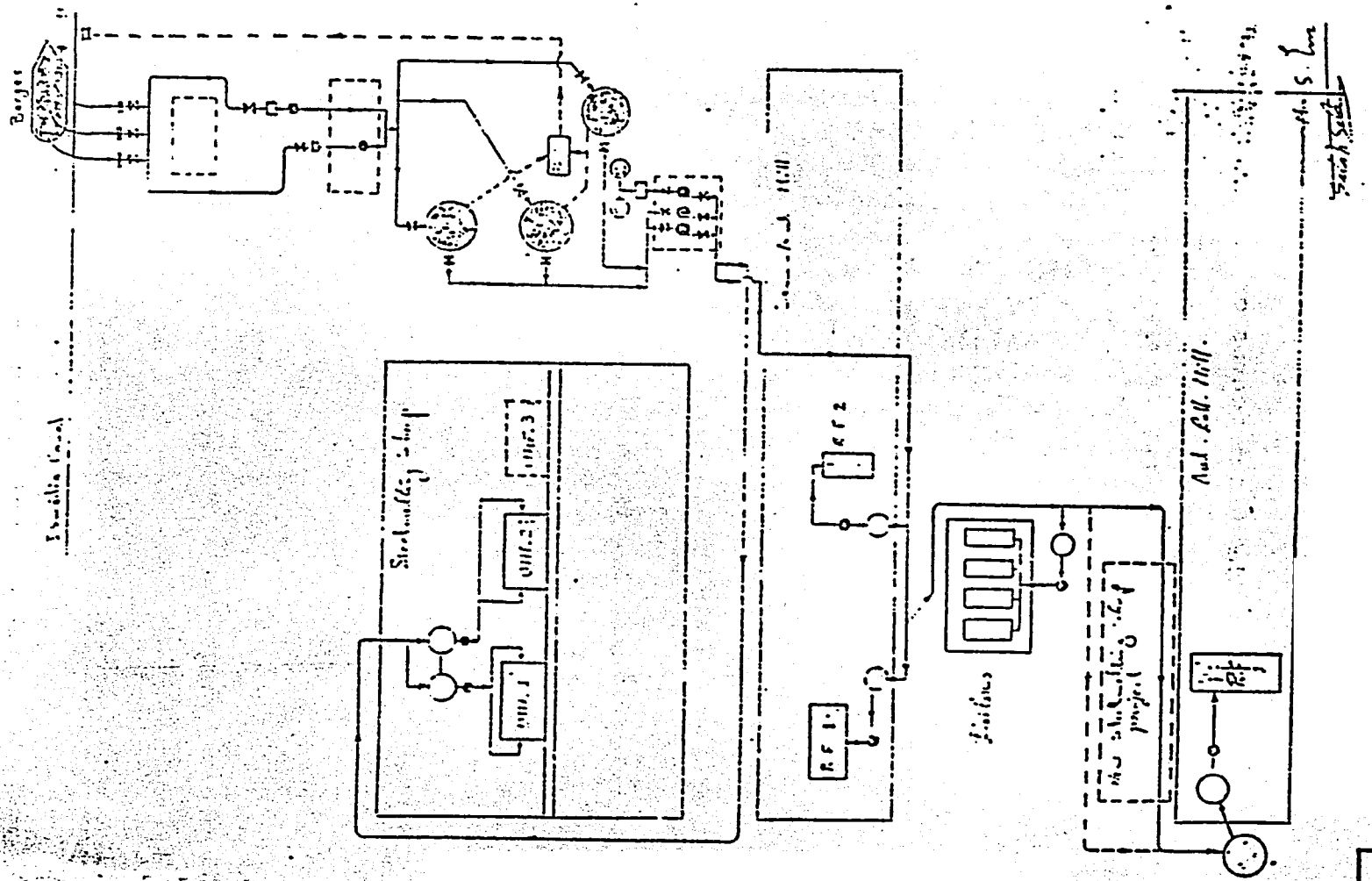

LEGEND

- EXISTING EQUIPMENT
- NEW EQUIPMENT
- FUTURE, TO BE BUILT

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNITY:

ECO NM-A-14

INSTALL TEMPERATURE INDICATORS ON MAZOUT LINES

PLANT NAHETIN

LOCATION ABOU ZAABAL

MAZOUT DISTRIBUTION SYSTEM

FORM COMMITTEE TO PLAN AND IMPLEMENT ECO's	Annual Savings LE:	Extensive
	Investment Cost LE:	0
	Payout, Years:	Immediate

ECO #NM-A-15

1.0 PURPOSE

The purpose of this ECO is to insure that the conclusions and recommendations contained within the Audit Report are implemented in a timely manner through the formation of a committee who will be given the responsibility to establish short range and long range plans to implement both the no cost/low cost and the investment ECO's.

2.0 PROCESS DESCRIPTION

Plant management must show its commitment to energy conservation by appointing a committee consisting of representatives from each department of the plant. The chairman of the committee is the energy coordinator for the plant, who should report directly to plant management.

The committee must meet at least once a month (more frequently when it is first getting started) to establish a concrete plan for energy conservation implementation. Its first priority is to begin implementation of no cost/low cost ECO's and to develop a plan and a budget for the implementation of investment ECO's.

The recommendations and priorities established in the audit report must be carefully studied by the committee to help formulate the most reasonable and effective plan possible for implementation.

Once implementation is begun the committee must continue to closely monitor the results and compare the savings actually achieved to those originally predicted. In this way the effectiveness of the program and the achievement of previously established goals for reduction in energy consumption can be firmly substantiated.

An example of the systems and methods used to implement this ECO is included in the Appendix.

3.0 EQUIPMENT LIST/SIZE

No new equipment and no new personnel are needed to form the committee.

4.0 PREDICTED ENERGY SAVINGS

This will be a function of the committee's effectiveness in seeing to it that the ECO's recommended in the Audit Report are implemented in a timely manner.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

None, not applicable to this ECO.

6.0 CONCLUSIONS

Formation of the committee and appointment of the energy conservation coordinator are truly a crucial initial step in the establishment of an effective program of energy conservation.

7.0 RECOMMENDATION

Formation of the committee and appointment of the energy conservation coordinator should proceed without delay as the first completely implemented no cost/low cost ECO.

PUBLICITY TO MAKE EMPLOYEES AWARE OF IMPORTANCE OF ENERGY CONSERVATION

Annual Savings LE:	Extensive
Investment Cost LE:	0
Payout, Years:	Immediate

ECO #NM-A-16

1.0 PURPOSE

The purpose of this ECO is to make all employees of the company aware of the importance of energy conservation, through the use of publicity, memos, newsletters, etc. Doing this will help insure that each employee will contribute toward making the overall energy conservation program a success.

2.0 PROCESS DESCRIPTION

In any effective energy conservation program, ideas must flow in two directions, from management to the employees and from the employees up to management. Management must take the first step by showing its commitment to energy conservation through publicity such as posters, memos, newsletters, suggestion boxes, and contests/awards for the best energy conservation ideas submitted by employees. Once all employees see that energy conservation is being treated as a serious and important matter by their company, they in turn will act in the same way.

Responsibility for seeing that employees are made aware of the importance of energy conservation must be shared by both plant management and by the committee responsible for energy conservation implementation.

An example of the systems and methods used to implement this ECO is included in the Appendix.

3.0 EQUIPMENT LIST/SIZE

No new equipment and no new personnel are needed to implement this ECO.

4.0 PREDICTED ENERGY SAVINGS

Not applicable to this ECO.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

A modest annual budget of approximately LE 1,000 should be established to pay for the publicity material (posters, newsletters, etc.) needed to implement this ECO.

6.0 CONCLUSIONS

Although it may not be possible to precisely measure the effectiveness of an employee awareness program, it is nevertheless a most necessary step in establishing the proper mental attitude needed to initiate an effective and comprehensive energy conservation program.

7.0 RECOMMENDATION

Immediately following the formation of the energy conservation committee, a program of employee awareness should be initiated as the second implemented no cost/low cost ECO.

BLOWER REPAIR ON
AUTOMATIC MILL FURNACE

Annual Savings LE:	33,000
Investment Cost LE:	48,400
Payout, Years:	1.47

ECO #NM-A-17

1.0 PURPOSE

The purpose of this ECO is to repair and/or modify the blowers which provide atomizing air to the burners on the reheat furnace for the automatic rolling mill. Operating requirements appear to exceed the current capabilities of the equipment (2 motor driven blowers, each rated at 52 HP), thus requiring the plant to obtain additional air by "letting down" a portion of the high pressure air from the mill system to 1.0 atmosphere.

2.0 PROCESS DESCRIPTION

The original design provided an energy efficient system, consisting of mechanical roots type blowers, to provide atomizing air for the burners on the automatic rolling mill reheat furnace. These blowers could not meet their load conditions, apparently due to being undersized, and kept failing due to overheating.

Due to a shortage of spares, and in order to maintain schedule, plant personnel piped compressed air, from the nominal 10 Bar automatic mill system to the blower discharge, and used a considerable pressure drop to achieve the required operating pressure.

This method of operation, while quite effective, and an excellent expedient to keep the plant onstream, ties up a significant portion of the automatic mill's

compressor capability, and causes a net loss in horsepower, which is represented by the difference between the cost to pump air to the required pressure of 1.0 Bar, and the cost to pump the same weight flow to 10 Bar (subsequently "let down" to 1.0 Bar).

A possible explanation for excessive overheating could be that under certain wind conditions, furnace heat contributed to the high inlet air temperature at the suction. To eliminate this possibility, a suction inlet duct extension, to draw air from a cooler location, approximately 50 feet away, must be installed.

3.0 EQUIPMENT LIST/SIZE

New blowers are required for the primary service and for 100% spare position. Since failure appears to occur primarily in the summer, according to plant personnel, particular attention must be paid to the new specification of inlet air temperature and ambient operating conditions. In addition an inlet duct extension shall be provided.

4.0 PREDICTED ENERGY SAVINGS

The predicted energy savings, based on a straight engineering calculation of the horsepower lost by letting down a flow, equal to the output of 1 (one) blower (1000 cubic meters/hour), from 10 Bar (the shear compressor rating) to 1 Bar (the injection air blowers rating), results in the loss of 47 KW or 352,500 KWH annually, if run for 7500 hours. This corresponds to an annual cost of LE 194,000 on worldwide pricing.

This savings (or loss) is not realized under current conditions, however, since the load on the compressor

puts its discharge pressure at 7 Bar, and the actual demand appears to be less than 1000 cubic meters/hour, since that quantity of compressed air is not available at the compressor house. If, then, the letdown differential is reduced to the actual rate of 6 Bar (i.e. the compressor system never operates at rated conditions) and the flow is taken conservatively at 25% of the blower's rating (i.e. 250 cubic meters per hour), the savings reduce to 33,000 LE/yr, based on the worldwide cost of electricity.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment cost for the replacement of the blower, with its 100% spare, and including the cost of revised inlet ducting, (if used) is LE 48,400, providing a payout of 1.47 years.

6.0 CONCLUSIONS

The payout of 1.47 years is considered acceptable since it also frees the compressed air system from a load not included in its design.

7.0 RECOMMENDATIONS

We recommend implementation of this ECO.

Annual Savings LE: Not applicable
Investment Cost LE: Not applicable
Payout, Years : Not applicable

ECO #NM-A-18

1.0 PURPOSE

The purpose of this ECO is to improve the combustion efficiency of the flume heating lance, as used on the tap hole flume of the two open hearth furnaces.

2.0 PROCESS DESCRIPTION

The existing flume heating lance consists of an orificed nozzle fed with pressurized sular, and partial secondary air provided by a compressed air supply, with additional air induction through entrainment by the liquid stream.

A more efficient burner is to be provided, fed from the same pressurized sources.

3.0 EQUIPMENT LIST/SIZE

A piping item, the lance, will be used to replace the existing lance.

4.0 PREDICTED ENERGY SAVINGS

The exact flow rate of the lance is not readily available, nor is any direct measure of efficiency possible on the open flame.

The lance is used intermittently, prior to tapping the furnace, and its flow rate is small in terms of total consumption per year.

With these considerations the savings are judged as too small to justify the expenditure of any investment monies at this time.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC ANALYSIS

The replacement of the lance is judged uneconc this time.

6.0 CONCLUSIONS

This ECO is judged uneconomical for implementation.

7.0 RECOMMENDATIONS

The recommendation is made that the lance be omitted from the list of ECO's to be implemented.

EFFICIENCY IMPROVEMENT TO THE OPEN HEARTH FURNACE	Annual Savings LE:	309,400
	Investment Cost LE:	Not Applicable
	Pavout. Years:	None

ECO #NM-A-19

1.0 PURPOSE

The purpose of this ECO is to improve the efficiency of the Open Hearth Furnace by control of excess air and/or oxygen enrichment of the combustion air.

2.0 PROCESS DESCRIPTION

The Open Hearth Furnace, operating as a batch process on a four-hour cycle, begins with steel (scrap or pig iron) at ambient temperature, and continues to heat the charge until it achieves its tapping temperature of 1600°C. At the start of the cycle, flame temperature exceeds the fresh charge by a significant amount, thereby providing good heat transfer and a relatively low gas exhaust temperature out of the furnace.

As burn time proceeds, however, the metal temperature rises toward the tapping temperature, and the differential between the burner flame temperature and the metal temperature decreases considerably, thus transferring less heat to the metal and discharging a much higher temperature exhaust gas.

2.1 Actions to Increase Flame Temperature (Decrease Melt Time)

In practice, three methods exist to raise the flame temperature, to cause the metal to heat faster at the end of the heat. These methods are:

- Preheat the incoming air (already accomplished in large part bv the checker block stored heat exchanger).

- Eliminate the nitrogen from the combustion air (about 80% by weight) since the heating of the nitrogen is non-productive in the overall heat balance.

- Decreasing excess air to the optimum value.

In examining each of these options, the following comments are applicable:

2.1.1 Air Preheat

Air preheat is already accomplished in a conventional and relatively convenient way by the cycli use of exhaust gas to heat refractory in a stored heat exchanger, and the reverse side of the cycle removing heat to preheat combustion air. Some additional recovery improvement may be experienced by the use of a programmed cycle, with trigger conditions to vary with heat temperature (refer to ECO #NM-B-1).

2.1.2 Oxygen Enrichment

The removal of nitrogen from the combustion air, or more accurately, the increase in oxygen content by addition of pure oxygen,permits rapid increases in flame temperature easily exceeding 2,750°C for nominally 100% oxygen, even without the benefit of preheat of the oxidizer.

2.1.3 Optimum Excess Air

The open hearth furnace exhaust gases, at the stack, contain excess oxygen. Reducin this value to 2-6% would improve flame temperature, and thus increase the system efficiency.

2.2 Selected Improvement

The options, mentioned above, to preheat air, and to reduce excess air to a minimum, are covered by other ECO's, and are assumed to be already in place. This ECO, then, is concerned with the improvement of overall efficiency by the enrichment of the combustion air by direct mixing with gaseous oxygen.

Initially, and for purposes of discussion, the point of addition of the oxygen is taken to be upstream of the checkerblock recuperator, and the amount of oxygen added is to increase its volume percent from 20.9% to nominally 25%.

Three direct effects are immediately seen from this addition of oxygen, namely:

- The combustion air temperature increases slightly (since its total mass flow decreased).

- The flame temperature increases, since less parasite nitrogen is carried through the combustion process (note that the oxygen to fuel ratio remains approximately constant, despite the drop in "air" to fuel ratio, therefore, holding constant the amount of oxidizer required for combustion).

The amount of flue gas decreases in weight flow, while the stack temperature remains equal to or slightly greater than prior to oxygen addition (i.e. draft increases, since draft pressure drop is decreased),

The benefits obtained by the enrichment of air with oxygen are as follows:

a) Greater heat input to the molten steel, since this transfer occurs primarily as radiation heat transfer, and that mode is controlled by the radiating and absorbing body temperatures, to the fourth power. Flame temperature increases, then, significantly affecting the rate of heating of the steel, particularily as the end of the heat is approached. Heating time is decreased, combustion tends to be more complete in the melting chamber, and specific fuel consumption is reduced.

b) Detrimental effects on furnace operation and component life are reported to be negligible.

2.3 Physical Work Required

Several locations are available for oxygen injections into the open hearth process, to be specifically selected in detail design. This ECO, however, envisions the addition of cold oxygen (nominally ambient temperature) into the air inlet, at a rate which will bring the total oxygen percentage, by volume, to 25%. Working with cold oxygen, in this manner, will permit the use of an uncooled diffuser for mixing, and minimizes the possibility of damage to the equipment from an oxygen fed source.

The physical installation of this system, taken as a temporary installation for evaluation, could utilize bottled oxygen with a common valve, shut-off valve, and related piping and wiring. Such an evaluation, taken on one furnace for a selected series of heats, would verify the benefits in this location without a capital investment.

3.0 EQUIPMENT LIST/SIZE

No specific equipment items are required for this ECO. Installation and material items primarily include:

- A major oxygen supply, capable of delivery of nominally 900 normal cubic meters per hour of typically 95% pure oxygen, delivered at about 1 to 2 bar at the duct.
- Control valving.
- Piping.

4.0 PREDICTED ENERGY SAVINGS

Predicted savings, based on information in the literature, indicates a decrease in melt time, and an improvement in combustion efficiency, which may be expected to decrease fuel consumption by 10 to 15%.

Using 10% as a basis, and negligible benefits obtained from shorter cycle time, this savings could be 309,400 LE/year, based on worldwide costs for both furnaces.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

Experience in the use of oxygen in the NAMETIN open hearth furnace design at other locations was not available during the audit, thus leaving the application the status of a development project. Additionally, the probable oxygen consumption considerably exceeds the capacity of the existing oxygen plant.

With these considerations, payout is unlikely within 3 years, and further review is not planned.

6.0 CONCLUSIONS

This application really has the status of a development project and can not be presently implemented.

7.0 RECOMMENDATION

This ECO can not be implemented at this time.

INSTALL WINDSHIELDS FOR ALL REHEATING FURNACES	Annual Savings LE;	20,000
	Investment Cost LE:	36,200
	Payout, Years:	1.81

ECO #NM-A-20

1.0 PURPOSE

The purpose of this ECO is to install windshields at the charging end of reheating furnaces No. 1 and No. 2.

2.0 PROCESS DESCRIPTION

The installation of windshields are considered for reheating furnaces No. 1 and No. 2 in the semi-automatic rolling mill. The windshields are necessary to minimize the cooling effect of outside air that can lower the efficiency of the reheating furnaces.

For reheating furnace No. 1, the area in front of the charging end of the furnace is covered by an open steel framed roof. It is understood that roof panels were originally installed on the steel frames, however, they were removed to lower the temperature in the area in front of the furnace for personnel comfort. This lowering of the furnace temperature due to outside airflow results in energy losses occurring during the operation of the furnace. Energy losses are further increased due to the fact that the charging door is often open.

To minimize energy losses from outside air flow, galvanized metal panels should be installed on the existing steel roof framing and on the existing end wall framing opposite the charging end of the furnace. In addition, short wing walls should be installed on

the end wall to further block outside air flow. The sides of the structure remain open, otherwise. In addition circulating fans should be provided to increase air flow.

For reheating furnace No. 2, the area in front of the charging end of the furnace is currently open. To minimize the flow of outside air a steel framed structure 4 meters deep, 8 meters wide and 12 meters high should be constructed on the outside of the present building. The roof and the outside wall facing the furnace shall be covered with galvanized panels. Short wing walls shall be installed from the end wall, but the sides are otherwise open.

3.0 EQUIPMENT LIST/SIZE

The following material should be furnished:

a) For reheat furnace No. 1, provide galvanized metal roof and end wall panels. In addition, steel framing and galvanized panels are required for two short wing walls. Circulating fans are to be provided as well as lighting for twenty-four operation.

b) For reheat furnace No. 2, provide a steel framed structure 4 meters by 8 meters and 12 meters high complete with galvanized metal panels for the roof and end wall. In addition, short wing walls of steel framed galvanized metal sheets are also required. Lighting is also required.

4.0 PREDICTED ENERGY SAVINGS

By minimizing the effect of outside air flow on the performance of the two reheat furnaces, it is estimated

that the efficiency of each furnace can be improved by approximately one percent. For reheating furnace No. 1, this results in a savings in mazout fired of approximately 65 tons/yr. For reheating furnace No. 2, this results in a savings of mazout fired of approximately 18.5 tons/yr. On the basis of worldwide prices, the total annual savings for both furnaces is LE 20,000.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The cost to furnish and install the materials as described above is LE 36,200. Based on a yearly energy savings of LE 20,000, the payout on the basis of worldwide prices is 1.81 years.

6.0 CONCLUSIONS

By the installation of windshields for both the reheating furnaces No. 1 and No. 2, significant energy savings can be realized resulting in a 1.81 year payout

7.0 RECOMMENDATION

This ECO should be implemented.

DESCRIBE A FORMAL EQUIPMENT MAINTENANCE PROGRAM

Annual Savings LE : Extensive
Investment Cost LE: 0
Payout, Years : Immediate

ECO #NM-A-21

1.0 PURPOSE

The purpose of this ECO is to outline some basic elements of a formal equipment maintenance program for a steel plant, such as that of National Metal Industries.

2.0 DESCRIPTION

Maintenance is a very important and essential adjunct to efficient and profitable operations in a steel plant. If maintenance is neglected, unexpected and untimely failures occur with costly interruptions to plant operations. It has been demonstrated by world class steelmakers that the availability of operating facilities producing a premium product can be increased to a very high level, approaching 100 percent, with a well planned preventive maintenance program. This remarkable achievement has been brought about in part by careful inspection and meticulous documentation of operating hours, service life and failures. With a quantitative data base and the application of statistical analysis, breakdowns or component failure are accurately predictable, and scheduled repairs are made in a minimum amount of time without interruption to operating schedules and unnecessary delays. These efforts payback in terms of superior product quality, performance and profitability.

ADMINISTRATION

There are a few basic elements that makeup an effective maintenance program. For one, it is assumed that a structured organization is in place to provide the administrative and supervisory skills required on a day-to-day basis. As a separate and distinct administrative unit, the maintenance organization generally functions independently, but cooperatively with operating management to achieve cost and production standards as well as mutually satisfactory scheduling requirements.

SPARE PARTS

At the heart of any maintenance program is an adequate complement of spare parts, which can be provided either as in-house spares or by immediate access to pre-arranged vendor stocks. Spare parts should be categorized as critical spares and consumable spares. Critical spares are those long delivery items identified with key operating units, whereas consumable spares are those components with a predictable or rated service life, such as bearings and the like that are usually available "off the shelf" from suppliers. It is obvious that it is the critical spare part that must be ordered well ahead and kept on hand in the event of an unscheduled maintenance failure.

SPARES CONTROL

All spares should be cataloged, using something as simple as a manually maintained card index file, where the spare part is completely identified

and, where appropriate, related to a bill of material on an engineering drawing. This kind of system will allow for inventory control and repurchases. A more sophisticated system would store this type of information in a computer along with a drawing index for each facility. It is vital that management knows what spares are on hand and their location to avoid the time consuming search for a missing part.

CENTRAL SPARES STORAGE

It has been demonstrated that a central storage area for plant-wide spares is very cost effective, as opposed to scattering spares all over the plant in unprotected and poorly secured environments without any particular control. A central spares concept avoids duplication of parts, thereby minimizing the number of spares on hand with consequent savings in inventory costs. A central spares storage enhances the ability to control disbursements and purchase of replacement parts. Typically, a central spares storage area is a warehouse type of structure equipped with numerous bins and racks for such items as gears, couplings, shafts, motor coils, contactors, relays and many other such items. Central spares functions separately and independently of the plant storehouse. It is usually manned around-the-clock with clerical type workers who maintain spare part records as well as dispense spare parts on a shift-by-shift basis. As an example, many steel plants maintained spares on a departmental basis, with each department handling its own procurement and storage. It was found that this practice resulted in much duplication from one department to another. For instance, each department kept its own complement of spare motors, when many of the motors were

duplicated in other areas. With the consolidation of spare motors into a central pool, the total plant inventory could be reduced by as much as 50 percent with consequent savings. This same principle generally holds true for every commodity used in the plant. It is apparent that the central spares concept allows for better housekeeping and the protection of an expensive inventory of spare sparts.

STANDARDIZATION

There are inherent advantages and cost savings associated with standardizing equipment and component design throughout the plant. This is primarily an engineering responsibility working with maintenance and operating personnel on new designs or rearangements as well as procurement. A standardization program will facilitate the training of maintenance personnel and technicians because there are fewer dissimilar types of equipment to work with, which should reduce the total amount of work. Over time, a standardization program will reduce the amount of spares required to support the operations, but it must be remembered that any standardization program must be tempered by the usual competitive nature of purchasing. It is unlikely that anyone would want a single source of supply for any commodity, except in very unusual situations.

TRAINING

One important but often neglected facet of a maintenance program is training a work force. Acquainting maintenance personnel with proper job procedures and making them familiar with

operating facilities is facilitated by formal classroom instruction, using competent teachers, service manuals an as much hands-on experience as a classroom can provide. This is particularly important where new and more sophisticated facilities are introduced into the plant, such as a continuous caster. This type of facility can only operate at any acceptable level of performan and product quality with adequate routine maintenance of the machine and instrumentation. This can best be achieved by taking the time to train the whole work force, because the same philosophy pertains not only to maintenance personnel but to operating crews as well.

TOOLS

Together with trained workers and adequate spares it is equally important to have sufficient tools and supplies for effectively accomplishing the routine maintenance tasks or repairing major breakdowns. Many times, tools and supplies are housed in an attended maintenance tool room to provide close control. Tool repairs are usually done in this type facility, also.

INSPECTION

Inspection programs implemented on a regular basis are vital to an ongoing plant maintenance activity. This enables work to be scheduled in an orderly manner, and many times, potential problems can be uncovered before breakdowns occur or resources wasted. This is the antithesis of the "don't fix it until it's broke"

philosophy. Periodic inspections and good records lay the groundwork for a viable preventive maintenance program.

LUBRICATION

Lubrication schedules should be established for all operating facilities, including overhead cranes. Catastrophic failures can occur through simple neglect of lubrication.

HOUSEKEEPING

Cleaning schedules are setup, particularly for rotating electrical equipment. Motor and generators are blown clean with air, thoroughly checked and painted, many times on annual basis. This is done to remove a buildup of metallic dust, common in steel plants, that can cause motors to fail. Housekeeping standards are enforced for motor rooms and substations and most other areas of the plant.

With a dedicated maintenance organization in place, supported by the factors discussed above, good maintenance becomes a ritual or accepted philosophy, particularly when the benefits become visible to senior plant management.

2.1 Physical Work Required

It is not expected that there will be any quantifiable amount of physical work associated with the initial implementation of this ECO. However, as the plant expands in the coming years, additional maintenance facilities will be required for

spares storage, specialized repair areas, tools and miscellaneous test instruments for maintenance of new facilities, particularly the continuous billet caster to be constructed at National Metals Industries.

3.0 EQUIPMENT LIST/SIZE

No new equipment required for the initial implementation of this ECO.

4.0 PREDICTED ENERGY SAVINGS

Good maintenance practices will unquestionably yield generous cost savings. Although the savings may be unquantifiable, as viewed in total scope. However, as individual cost reduction projects are undertaken, they can be individually evaluated in terms of payout.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

Not applicable.

6.0 CONCLUSIONS

Good maintenance practices should be adopted immediately as a matter of course, because sophisticated machinery like continuous casters which are planned for National Metal Industries will not operate, if neglected. Controllers and instrumentation must be regularly calibrated and adjustments continually made to items such as water spray systems and roll gaps. The sooner new practices are adopted and old habits abandoned, the greater the likelihood of high levels of performance and profitability, as new facilities come on stream.

7.0 RECOMMENDATION

The ECO should be implemented.

EVALUATE REPLACING	Annuel Savings LE:	None
EXISTING OLD COMPRESSORS	Investment Cost LE:	Not Applicable
WITH EXISTING SPARE MACHINE	Payout, Years:	Not Applicable

ECO #NM-A-22

1.0 PURPOSE

The purpose of this ECO is to investigate the possibility of replacing several smaller old compressors with a presently unused spare compressor with the intent of retiring some old and inefficient machines and replacing them with more energy efficient ones and at the same time simplifying the compressed air system.

2.0 PROCESS DESCRIPTION

The compressed air network in this plant, as has been gathered from available information,records and physical inspection, consist of three systems, as follows:

a) An old compressor station for the steel making shop. This compressed air is used, after preheat against flue gases to atomize fuel oil. Inspite of the fact that the purpose of the compressed air is fuel oil atomization, upon inspection of the existing system, it was found that the fuel oil pumps deliver a pressure between 12 and 16 kg/cm². This pressure is higher than that of the compressed air. The fuel oil is thus mechanically atomized, the so called atomization air being educted by the higher pressure fuel oil. The system as currently operating, is functional, and according to our combustion expert, needs no modification.

The system consists nominally of two 300 Nm^3/hr and two 670 Nm^3/hr machines, which are operational either as two 300 Nm^3/hr for a total of 600 Nm^3/hr, with the two 670 Nm^3/hr machines on standby, on one 670 Nm^3/hr with the other 670 Nm^3/hr and the two 300 Nm^3/hr machines on standby. The delivery pressure is about 6-7 kg/cm^2.

b) A new compressor station consisting of three 1,500 Nm^3/hr machines, with one operational and two on standby. This system serves the cold shear in the semiautomatic mill and a part of the air is joined with the discharge of the old compressor station to satisfy the needs of the steel making section. The discharge pressure is about 7 kg/cm^2.

c) Automatic mill compressor station consisting of two 1000 Nm^3/hr machines, one operational and one on standby, dedicated exclusively to the automatic rolling mill. The planned users are the cold shear and the two flying shears. Due to the outage of the blowers providing atomizing air to the furnace, a portion of this compressor's output is let down to serve as atomizing air. The discharge pressure could (nominally 10 kg/cm^2) only be measured at the tank (6-7 kg/cm^2).

The solution envisioned by this ECO is, to completely eliminate the old compressor station, which is less efficient and use one of the 1,500 Nm^3/hr compressors to compensate for the old machine(s).

No flow measurements or other indications of air quantities required for either the steel making furnaces, or the cold shears are available.

From the attached sketch, it is apparent that some new piping is required. This however, would mean a under-utilization of the 1,500 Nm^3/hr compressor, since it is supposed to replace a 670 Nm^3/hr machine. The nameplate power of the 1,500 Nm^3/hr compressor is 234 KW whereas for the 670 Nm^3/hr it is only 90 KW.

3.0 EQUIPMENT LIST/SIZE

Piping modifications and additions are shown as dark lines, on the sketch which follow later in this section.

4.0 PREDICTED ENERGY SAVINGS

As described in the previous paragraph the new compressor of a larger capacity would replace a smaller compressor and provide more air than is required and use more power. This ECO would probably be valid when the third open hearth furnace is installed and a second 1,500 Nm^3/hr machine will have to be used, however at this time there is no predicted energy saving.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

This ECO has not been priced, since no energy savings can be identified.

6.0 CONCLUSIONS

This ECO does not provide any energy savings.

7.0 RECOMMENDATION

We recommend that this ECO not be implemented.

JOINT ENGINEERING GROUP
OEP / FWEC
FOR: NAMETIN SEMIAUTOMATIC ROLLING MILL
COMPRESSED AIR SYSTEM

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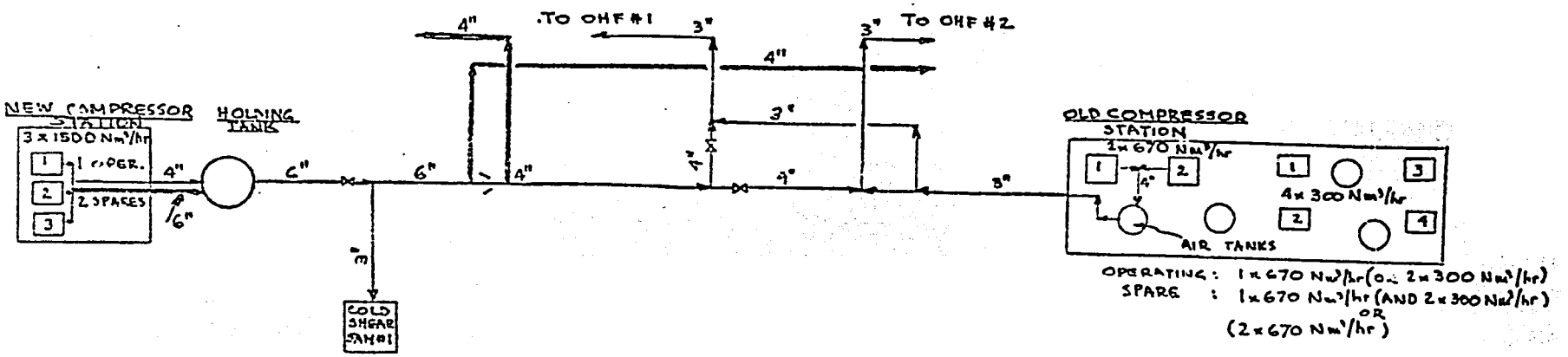
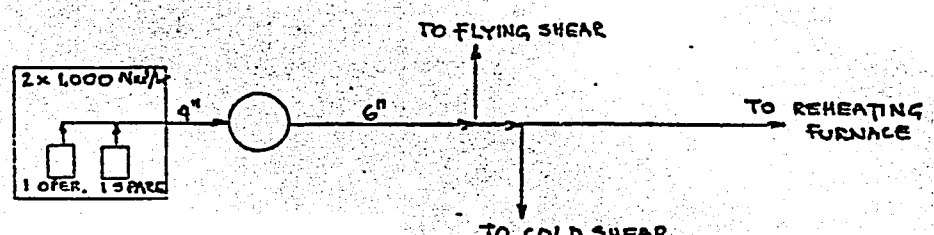


NAMETIN AUTOMATIC ROLLING MILL
COMPRESSED AIR SYSTEM



LEGEND

EXISTING EQUIPMENT
NEW EQUIPMENT

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNITY
ECO NM-A-22

PLANT NAMETIN
LOCATION ABOU ZAABAL
COMPRESSED AIR SYSTEM

EVALUATE REPLACING EXISTING OLD COMPRESSOR WITH EXISTING SPARE MACHINE

INVESTIGATE MEASUREMENT OF MAZOUT UNLOADING FROM BARGES	Annual Savings LE:	88,500
	Investment Cost LE:	3,500
	Payout, Years:	0.04 (15 days)

ECO #NM-A-23

1.0 PURPOSE

The purpose of this ECO is to investigate a suitable measuring system for the mazout, delivered to the plant dock by barges.

2.0 PROCESS DESCRIPTION

The major portion of the mazout used in the plant is delivered by barges to the plant dock situated on the Ismailia Canal.

The present unloading facility is scheduled to be move inland, since the Canal will be enlarged. The new unloading station, further from the Canal, is under construction. The equipment to be installed (moved), are two pumps (40 t/hr each) which discharge to three 600 tons storage tanks. The tanks are not insulated, a steam coil at the bottom of each tank is used to maintain the mazout at a temperature suitable for pumping.

The plant does not have a temperature measurement of the mazout being pumped. The operation is based on letting all the available steam through the coil. ECO #NM-A-14 recommends the installation of dial thermometers for mazout lines. One of the temperature instruments will be in the unloading station.

In order to prevent spills due to overfilling of tanks, either due to a faulty level reading or other

factors such as human error, the installation of a flow meter is necessary.

3.0 EQUIPMENT LIST/SIZE

Required equipment is one flow meter of the positive displacement type, with a 100% spare (complete back-up unit). This flow meter should be of the same type that will be installed in the rest of the plant. (See also ECO's #NM-A-8, 9, 10, 11 and 13.)

4.0 PREDICTED ENERGY SAVINGS

As with many other ECO's, it will certainly help in the accounting of mazout comsumption and also add incentives to plant personnel for energy savings. In addition, a more accurate accounting of mazout quantities delivered (cross-checking of barge readings or invoices), will be achieved.

Assuming one percent error in deliveries due to inaccuracies of metering on barges, this quantity can be assumed to be saved, by accurate metering. The total amount of mazout delivered to the plant (for the year 1983/1984) was 36,784 tons.

Thus if only one percent had been erroneously charged to the plant and can now be saved, this will amount to LE 88,500 per year based on the worldwide price for mazout.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated investment cost of installing the instrumentation (with a warehouse spare) is LE 3,500. Thus the payout is 15 days.

6.0 CONCLUSIONS

The importance of proper fuel accounting for profitable operation can not be overstressed, the payout of 15 days is attractive.

7.0 RECOMMENDATIONS

We recommend quick implementation of this ECO.

SHEAR CUTTER REPLACEMENT

ECO #NM-A-24

Annual Savings LE : -
Investment Cost LE: -
Payout, Years : Immediate

1.0 PURPOSE

The purpose of this ECO is to conserve electric power by the use of sharp cutter inserts on the cropping shears.

2.0 PROCESS DESCRITPION

Shearing operations require sharp cutters with a proper clearance to operate at minimum horse power At such time as normal wear begins to round the cutting edge, the load on the machine increases, and the total electrical power required per cut increases.

The actual effect on energy consumption varies with the shear, although it is probable that a guide should be established for replacement and resharpening. Quite likely, this should be expressed as an allowable radius along a given length of cutter, say, as an example, to 2 mm radius over 50 mm of blade length.

3.0 EQUIPMENT LIST/SIZE

Additional sets of cutters are required to permit rotation of cutters to stop for sharpening (assumed available).

4.0 PREDICTED ENERGY SAVINGS

The predicted energy savings for this ECO are estimated at 5 HP per shift and 50 weeks/year, and assumed dull cutters 50% of the time. (i.e sharp to dull averaged). On this basis, the

savings per year, based on world wide pricing, are 342 LE.

If desired, actual losses can be established for a specific shear by recording current draw (representative of power consumption at constant voltage) to cut say 50 Bars in a given length of time with dull cutters and the same number of bars in the same time with sharp cutters. A comparison of the two recordings will then provide a direct measure of the power which can be conserved.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC ANALYSIS

A three months life is taken for each resharpened cutter set, and includes amortization of the cutters.

The cost per year for sharp cutters is then LE 148, thus providing a payout in 0.5 years.

6.0 CONCLUSIONS

National Metal Industries has included replacement of the shear cutters in their preventive maintenance program, and the savings available to this ECO are already being realized.

7.0 RECOMMENDATIONS

The cutters on the shear, and on other major tools should be kept sharp, not only for convenience in use but to conserve operating energy.

REVIEW IMPROVEMENT TO LEVEL MEASUREMENTS AT MAZOUT TANKS IN AUTOMATIC ROLLING MILL	Annual Savings LE:	None
	Investment Cost LE:	Not Applicable
	Payout, Years:	Not Applicable

ECO #NM-A-25

1.0 PURPOSE

The purpose of this ECO is to look into ways of improving the level measuring devices presently in place at the mazout storage tanks.

2.0 PROCESS DESCRIPTION

There are two tanks at the automatic rolling mill. One horizontal storage tank with a capacity of 75 m^3 and a smaller, vertical day tank with a capacity of 16 m^3.

The level measurement in the day tank is achieved by two float and counterweight systems. The one system originally installed is not operating. The second, a makeshift arrangement is not functioning properly (counterweights are not calibrated, cable is rusty). The large horizontal tank, has no level measurement. It is a railroad type tank, and filling is done by visual inspection.

The level measurements in the day tank are important, the transfer from the larger tank is done by a portable pump which is shut when the level reaches 15 m^3 (the quantity is approximately necessary for one shift). A malfunctioning level instrument, can result in spillage of mazout.

There are no present plans to add level measuring to the 75 m^3 tank, and the operation seems adequate, no spills have been noticed.

3.0 EQUIPMENT LIST/SIZE

The requirement for a better operation is a new level instrument for the day tank.

4.0 PREDICTED ENERGY SAVINGS

The energy savings to be achieved can be assumed to be only spills that would result from a faulty level instrument. This can, however, not be classified as an energy saving item, but rather as a maintenance item.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment required to replace the present level instrument can not be justified based on energy savings.

6.0 CONCLUSIONS

There is no direct energy savings associated with this ECO.

7.0 RECOMMENDATION

While it would certainly be desirable to replace this instrument, the funds required can not be charged to a direct energy conservation item. It is however part of the overhaul and repair of all instruments recommended in ECO NM-A-11.

INVESTIGATE INSTRUMENTATION TO QUANTIFY AIR LEAK INTO AUTOMATIC ROLLING MILL FURNACE EXHAUST GASES

Annual Savings LE: : 3,600
Investment Cost LE: 1,800
Payout, Years : 0.5

ECO #NM-A-26

1.0 PURPOSE

The purpose of this ECO is to install instrumentation which shall quantify the leakage of fresh air into the exhaust stream from the automatic mill reheating furnace.

2.0 DESCRIPTION

The (secondary) combustion air to the automatic mill reheating furnace is supplied by two blowers, one operating and one spare which can deliver up to 30,000 m^3/hr at 500 mm water column. Exhaust gases from the furnace exchange heat against the fresh air in 6 metal U-tube exchangers and are then directed to a 50 m brick chimney which provides the necessary draft (200 mm WC are measured now).

Due to leaks in these exchangers fresh air enters into the exhaust stream, reducing the amount of air available for combustion.

Presently, both air blowers are running to compensate for the air leaks, which are depriving the furnace of secondary combustion air.

From visual inspection it appears that one of the two blowers is not working efficiently, air is being blown out through the suction, moreover it draws more power than its nameplate (this has been verified by measurements).

3.0 EQUIPMENT LIST/SIZE

In order to monitor the system and to be able to detect the presence of combustion air in the flue gases, a Venturi type flow meter shall be installed at the outlet from the recuperator, prior to the flue gas entry into the chimney.

Instrumentation to monitor the oxygen content of the flue gases, which might be installed (if ECO #NM-B-14 will be implemented in its entirety) shall certainly contribute to verify the flow indication.

4.0 PREDICTED ENERGY SAVINGS

Presently due to air leaks (see 2.0 above) both blowers are running. If the system were to operate at design conditions, one blower is sufficient. In the event of leaks or other malfunction, leading to a poor flame, plant personnel switch on the second blower.

The presence of the flowmeter will confirm if the malfunction is due to air leaks into the flue gas by registering a higher flow. If combustion difficulties are due to other causes, switching on the second blower will not improve combustion, but will waste power.

Energy savings for one month of running the second blower (at its nameplate 55 kwh) are LE 3,600, based upon the worldwide price for electricity.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated cost of the required instrument is LE 1,800. The payout is thus 6 months.

6.0 CONCLUSIONS

The instrument pays out in only 6 months and should lead to a better operation of the combustion equipment.

7.0 RECOMMENDATION

We recommend implementation of this ECO.

AUTOMATIC AIR SWITCHING
FOR THE OPEN HEARTH FURNACES

Annual Savings LE : 15,400
Investment Cost LE: 10,100
Payout, Years : 0.66

ECO #NM-B-1

1.0 PURPOSE

The purpose of this ECO is to provide for an automatic control system to switch the combustion air/exhaust gas path from the #1 stored heat exchanger to the #2 stored heat exchanger and the reverse, as necessary for most efficient operation.

2.0 PROCESS DESCRIPTION

The existing system consists of a remotely operated, mechanically linked valve system, which is manually controlled. The function of this valve system is to reverse the flow through opposite stored heat exchangers, such that one is always being heated by flue gas, on its way to the I.D. fans and the stack, while the other is heating combustion air on its way to the furnace.

Currently, the valves are signalled to switch by the operator, visually observing the brick temperature pyrometer at the top of the stored heat exchanger and switching at 1300°C, or a 20 minute interval, whichever occurs first. The process will be removed from human control by installing a control instrument such that cycle control is automatic, initially, based upon the same criteria as previously used.

The existing valve operator(s) will remain in service.

Instrumentation is to be added, however, to record:

- o Brick temperature in each exchanger
- o Cycle time for each exchanger
- o Mazout temperature at the flue gas/mazout heat exchanger and at the burner(s)
- o Combustion air (burner primary/secondary) temperature at the flue gas/air heat exchanger and at the burner(s)

This instrumentation will permit adjustment to the switching cycle either by temperature, time, or both.

Insulation will be added to the hot compressed air and hot mazout lines to conserve the benefits obtained from the heat exchanger, under ECO #NM-A-1b.

3.0 EQUIPMENT LIST/SIZE

No new major items of equipment are required for this installation, only instrumentation.

The following instrument items are required, for each open hearth furnace:

A temperature recorder, 0 to 1500°C, to display the signal from the existing optical pyrometer, and to provide a contact close signal at typically 1300°C.

A cycle timer, to control maximum cycle time.

A temperature indicator with selector for nominally 4 thermocouples.

4.0 PREDICTED ENERGY SAVINGS

The automatic air switching controller is expected to provide better control of the stored heat exchanger(s since the system will respond immediately to the input conditions, while the operator, in making a manual

proper value in an untimely manner.

This saving is expected to be nominally ½% of the annual fuel cost for the furnace.

This saving amounts to a total of LE 15,400 annually or 7,700 LE/year/furnace, based on 1330 batches per year per open hearth furnace and the world wide cost of fuel.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment cost to implement this ECO is LE 10,100 per open hearth furnace, thus resulting in a simple payout of 0.66 years.

6.0 CONCLUSIONS

The attractive payout of this ECO as well as the improvement of operations are good incentives for implementation.

7.0 RECOMMENDATION

We recommend implementation of this ECO.

INSTALL NEW INSTRUMENTATION IN OXYGEN PLANT	Annual Savings LE:	4,900
	Investment Cost LE:	11,900
	Payout, Years:	2,43

ECO #NM-B-2

1.0 PURPOSE

The purpose of this ECO is to improve the operation of the Oxygen Plant by making its operation more energy efficient, and also increasing the purity of the finished oxygen product.

2.0 PROCESS DESCRIPTION

The Oxygen Plant is a package type, self-contained air liquefaction plant. It uses the conventional expansion/air separation process. The oxygen product is stored in steel bottles at 120-130 kg/cm², while the nitrogen by-product is vented.

3.0 EQUIPMENT LIST/SIZE

Based on our survey of plant requirements, the following instruments are defective or missing and are required for energy efficient operation as listed below:

- 2 pressure gages 0-60 kg/cm
- 2 vacuum gages 0-1.6 kg/cm²
- 4 temperature indicators 0-250°C
- 8 thermocouples (Ni/NiCr)
  length 50 cm. wire ø 1mm
- 5 rectifiers 220 VAC/6 VDC 1A

4.0 PREDICTED ENERGY SAVINGS

The main energy consumption in this unit is ele trical energy. There is no separate meter, thus the quantity

electricity specifically consumed only by the Oxygen Plant can not be measured.

However, the operation with full and improved instrumentation will become more efficient and will result in a higher purity of the finished oxygen product. This in turn will save more energy by reducing the quantity of total oxygen product required for various users.

In absence of electrical energy figures, we will use the nameplate data for electrical motors.

Air compressor	84 KW
Oxygen compressor	30 KW
Expansion engine	7.5 KW
Blower	4 KW
Total	122.5 KW

If we assume that as a result of complete instrumentation we will realize an energy saving of five percent, the annual saving will be 4,900 LE, based on worldwide pricing.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The total cost of new instruments is estimated at LE 11,900. Payout is thus 2.43 years.

6.0 CONCLUSIONS

The five percent energy reduction is probably on the conservative side, the payout is still less than three years.

7.0 RECOMMENDATION

We recommend implementation of this ECO.

INSTALL RECUPERATOR ON
#1 REHEAT FURNACE IN
SEMIAUTOMATIC ROLLING MILL

Annual Savings LE : 197,000
Investment Cost LE: 44,200
Payout, Years : 0.22
(80 days)

ECO #NM-B-3

1.0 PURPOSE

Significant fuel savings can be achieved through preheating combustion air used for a metallurgical furnace by means of a recuperator.

2.0 PROCESS DESCRIPTION AND FLOW SCHEMATIC

Preheating combustion air for a metallurgical furnace is typically accomplished through the application of a recuperator designed for use within a refractory lined flue or duct carrying the heating medium to the stack. This type facility is widely used on reheat furnaces where the gases are relatively clean.

A wide variety of basic designs are available for recuperators, and it should be recognized that manufacturers rarely produce a standard design or off-the-shelf product. Each application is always custom-designed based on the following parameters of the flue gas: flow rate, gas composition (CO_2 water vapor, N_2, O_2, particulates, corrosive trace elements), inlet flue gas temperature, combustion air flow rate, combustion air preheat temperature required.

2.1 PHYSICAL WORK REQUIRED

The #1 reheat furnace for the semiautomatic mill was originally designed and installed with a recuperator for preheating combustion air. The recuperator was

subsequently taken out of service and physically removed from the flue, but this situation provides a relatively simple means for replacing the recuperator, essentially in kind.

During the energy audit this furnace was not in operation. Therefore, specific measurements of stack temperature and excess oxygen could not be obtained. The approach being taken then to design the recuperator is to assume that the data measurements taken on the #2 reheat furnace are also applicable to the #1 reheat furnace. When this is done the parameters for the new recuperator are a present flue gas temperature of 395°C with 7 percent oxygen in the flue gas at an efficiency of 73 percent after improving combustion control. With the new recuperator, the efficiency is improved to 85 percent with an exit flue gas temperature of 176°C and 7 percent oxygen. This amounts to an improvement in efficiency of 12 percent, based on oil consumption of 0.87 tons per hour equivalent to 870 kg/hr. The flue gas generated is approximately 1,830 kg/hr of gas. On a calculated basis, the recuperator duty is 4,000,000 BTU/hr.

The existing refractory lined flue must be modified to accommodate the newly designed recuperator (new foundation and refractory lining), with cleanup and repair of flue gas and combustion air systems. Although it appears that the furnace oil burners are designed for preheated combustion air, in final engineering design, the combustion air system and burners should be evaluated and the existing burners replaced with high efficiency hot air baffle burners for mazout.

It is also necessary that certain steps be taken to establish and maintain temperature profiles in the furnace. This can be accomplished by equiping the furnace with a fuel-air ratio system that can hold

a pre-determined amount of excess air through the operating range, a reasonable furnace pressure control system, and a temperature control system for each zone of control.

3.0 EQUIPMENT LIST/SIZE

This ECO will require the purchase of a new recuperator, stack damper, combustion air damper, oil regulating valve and an oil mass flow meter. The refractory flue must be modified to accept the new recuperator and relined. The combustion air system must be repaired as future detailed inspections and final engineering design dictates. Bypasses with dampers should be provided in both the exhaust gas stac and the combustion air duct. .
New combustion control and burner replacement is covered by a companion ECO #NM-A-8.

4.0 PREDICTED ENERGY SAVINGS

The present fuel consumption for the #1 reheat furnace is 0.87 t/hr. Based on operating three (3) eight hour shifts per day at six days per week for 52 weeks per year, the total operating hours per year are approximately 7500 hours. It follows that the annual oil consumption is 6515 ton/year. Based on the hourly consumption and annual operating hours stated above

With a 12 percent improvement in furnace efficiency attributed to heating the combustion air by the installation of a recuperator, the fuel oil consumption will be reduced to 5,700 tons/year, or a net savings of 815 tons/year of mazout. This represents in annual savings of approximately 197,000 LE/year based on a worldwide price of 241.8 LE/metric ton for #6 fuel oil.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

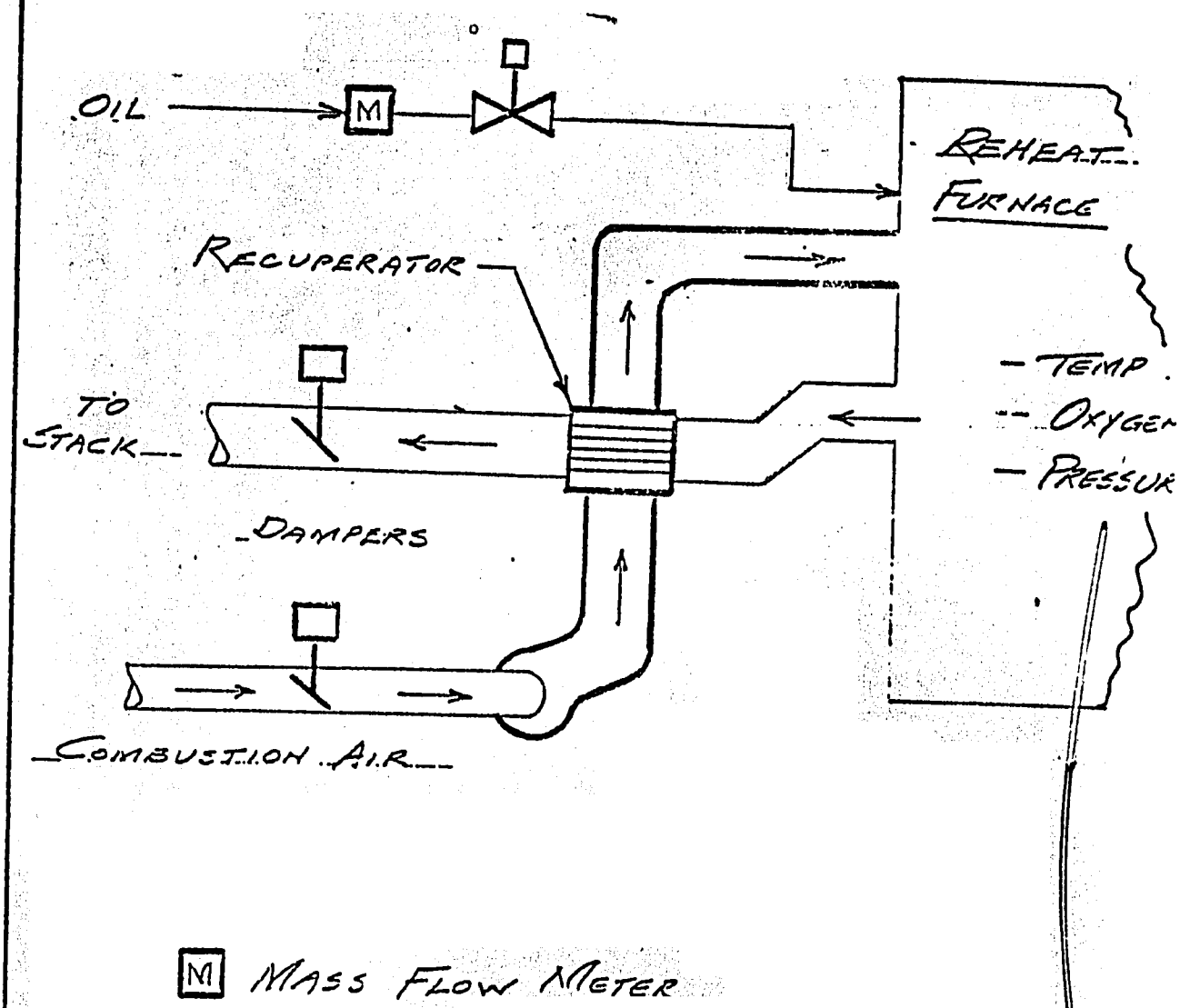
The total predicted annual savings for this ECO is LE 197,000. Based on an investment of LE 44,200 the project will payout in less than 3 months.

6.0 CONCLUSIONS

Based on the analysis shown above, pre-heating the combustion air by installing a new recuperator will yield a total predicted annual savings of LE 197,000 and a payout of 0.22 years.

7.0 RECOMMENDATION

This ECO should be implemented without delay.



LEGEND

EXISTING EQUIPMENT
NEW EQUIPMENT

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNIT
ECO # NS-B3

PLANT NAMETIN

LOCATION ABOU-ZAABAL

INVESTIGATE INSTALLING A HEAT RECUPERATOR FOR SEMIAUTOMATIC ROLLING MILL #2 REHEATING FURNACE

Annual Savings LE : 53,000
Investment Cost LE: 79,000
Payout, Years : 1.49

ECO #NM-B-4

1.0 PURPOSE

The purpose of this ECO is to investigate installing a heat recuperator for the semiautomatic rolling mill #2 reheating furnace.

2.0 PROCESS DESCRIPTION

Preheating combustion air for a metallurgical furnace is typically accomplished through the application of a recuperator designed for use within a refractory lined flue or duct carrying the heating medium to the stack. This type facility is widely used on reheat furnaces where the gases are relatively clean.

A wide variety of basic designs are available for recuperators, and it should be recognized that manufacturers rarely produce a standard design or off-the-shelf product. Each application is always custom-designed based on the following parameters of the flue gas: flow rate, gas composition (CO_2 water vapor, N_2, O_2, particulates, corrosive trace elements), inlet flue gas temperature, combustion air flow rate, combustion air preheat temperature required.

2.1 PHYSICAL WORK REQUIRED

Measurements were taken on the #2 reheating furnace that indicate that the present flue gas temperature was 395°C with 7 percent oxygen. This calculates to

an efficiency of 73 percent after improving the combustion control which is covered by ECO #NM-A-9. After installation of a heat recuperator the efficiency is improved to 85 percent with an exit flue gas temperature of 176°C and 7 percent oxygen. This amounts to an improvement in efficiency of 12 percent. The oil consumption is 0.37 tons/hr. which is equivalent to 370 kg/hr. The flue gas generated is approximately 7,700 kg/hr. On a calculated basis, the recuperator duty is 1,680,000 BTU/hr.

The existing refractory lined flue must be modified to accommodate the newly designed recuperator (new foundation and refractory lining), with cleanup and repair of flue gas and combustion air systems. Although it appears that the furnace oil burners are designed for preheated combustion air, in final engineering design, the combustion air system and burners should be evaluated and the existing burners replaced with high efficiency hot air baffle burners for mazout.

It is also necessary that certain steps be taken to establish and maintain temperature profiles in the furnace. This can be accomplished by equiping the furnace with a fuel-air ratio system that can hold a pre-determined amount of excess air through the operating range, a reasonable furnace pressure control system, and a temperature control system for each zone of control.

3.0 EQUIPMENT LIST/SIZE

This ECO will require the purchase of a new recuperator, stack damper, combustion air damper, oil regulating valve, and an oil mass flow meter. The refractory flue must be modified to accept the new recuperator and relined. The combustion air system must be repaired as future detailed

inspections and final engineering design dictates. Bypasses with dampers should be provided in both the exhaust gas stack and the combustion air duct.

New combustion control and burner replacement is covered by a companion ECO #NM-A-9.

4.0 PREDICTED ENERGY SAVINGS

The present fuel consumption for the #2 reheat furnace is 0.37 t/hr based on operating two (2) eight hour shifts per day at six days per week for 52 weeks per year, the total operating hours per year are approximately 5,000 hours. It follows that the annual oil consumption is 1,850 metric ton/year, based on the hourly consumption and annual operating hours stated above.

With a 12 percent improvement in furnace efficiency attributed to heating the combustion air by the installation of a recuperator, the fuel oil consumption will be reduced to 1,630 tons/year, or a net savings of 220 tons/year of mazout. The represents an annual savings of approximately LE 53,000 per year based on a worldwide price of 241.8 LE/metric ton for mazout.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The total cost to purchase and install the facilities described above is LE 79,000.

The payout on a worldwide basis is 1.49 years.

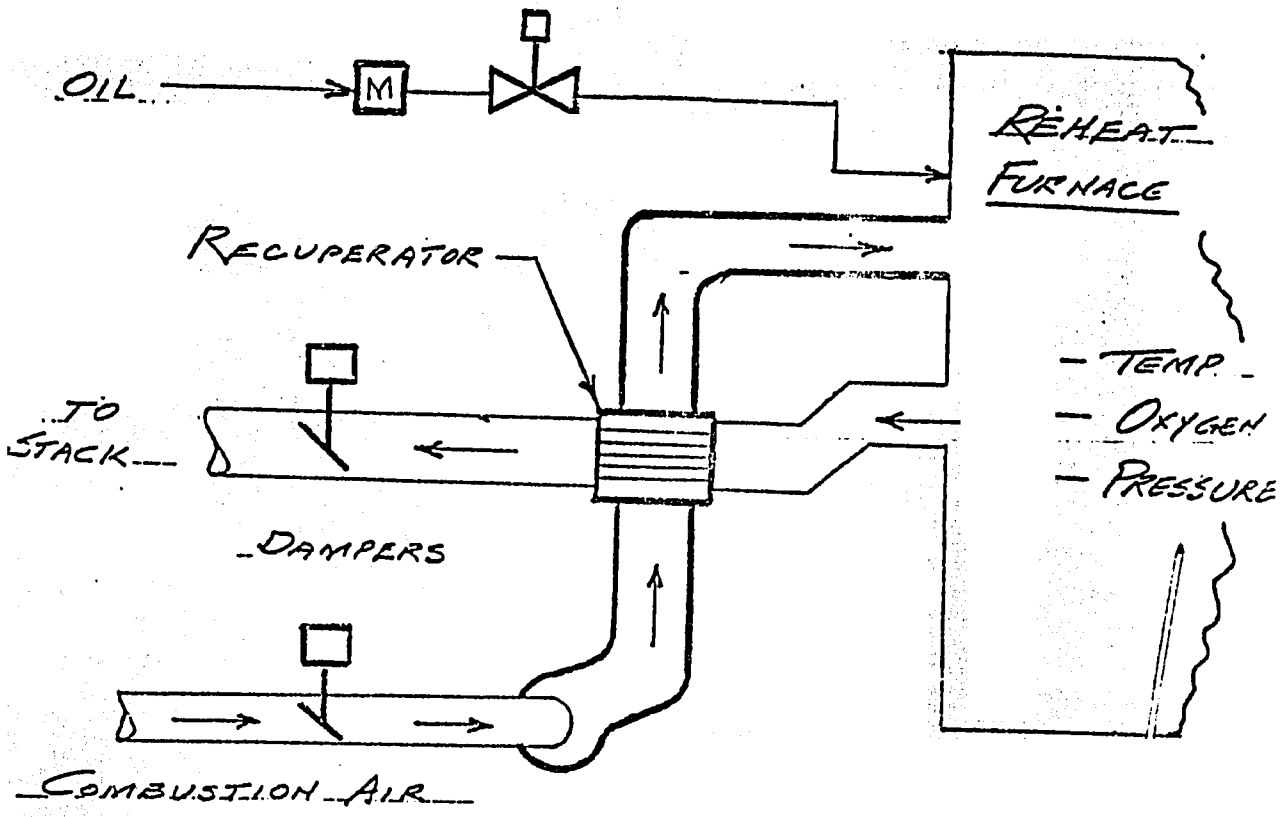
6.0 CONCLUSION

Based upon the analysis shown above, preheating the combustion air by installing a new recuperator will

yield an annual savings of LE 53000 and a payout of 1.49 years.

7.0 RECOMMENDATION

This ECO should be implemented.



M MASS FLOW METER

LEGEND

EXISTING EQUIPMENT
NEW EQUIPMENT

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNITY
ECO # NS-B.4

PLANT NAMETIN

LOCATION ABOU ZAABAL

INSTALL STEAM GENERATORS	Annual Savings LE:	520,000
IN OPEN HEARTH FURNACE	Investment Cost LE:	898,800
EXHAUST FLUE GAS SYSTEM	Payout, Years:	1.73

ECO #NM-B-5

1.0 PURPOSE

The purpose of this ECO is to install a steam generator in each of the two open hearth furnace exhaust flue gas systems.

PROCESS DESCRIPTION

Presently, the stack temperatures of the exhaust gases leaving the two open hearth furnaces, No. 1 and No. 2, were measured in the range of 370 to 400°C in one stack and 365 to 432°C in the other stack. This energy can be recovered by a waste heat boiler and used to generate steam. The purpose of generating steam is to eliminate the use of the presently installed steam boiler. It is believed that this steam boiler is currently producing approximately 4 tons/hr of steam. The exact capacity will have to be confirmed later, after instrumentation is installed to measure the actual steam and boiler feed water flow rate currently being used. The steam produced is used only to heat mazout.

For the design of a waste heat boiler that can be located on each furnaces' exhaust flow, an inlet flue gas temperature of 370°C and an outlet temperature of 177°C was used. Boiler feed water from a new deaerator can be preheated in the waste heat boiler from 120°C and superheated steam produced at 7 Bar and 225°C. With a duty for each furnace of 4,375,000 Btu/hr, 2 tons/hr of steam would be generated from each waste

heat boiler. The total of 4 tons/hr of steam produced by the two waste heat boilers is approximatley equal to what is currently believed to be the output of the existing steam boiler. If this output is later found to be different, this ECO must be revised accordingly.

Since no deaerator and water treating facilities are currently installed, it is recommended that a new deaerator and water treating facility be provided as part of this ECO. Boiler feedwater pumps will be furnished taking suction from the deaerator. There is currently enough pressure from the elevated water tank to supply water through the water treating unit to the deaerator.

If this ECO is implemented, then the existing boiler will serve as a spare for whenever one or more of the new waste heat boilers are shut down.

3.0 EQUIPMENT LIST/SIZE

The following new equipment and material must be furnished and installed:

a) Two (2) waste heat boilers of 4,375,000 Btu/hr duty each. Flue gas will be cooled from 370°C to 177°C to generate 2 tons/hr of steam from each boiler at 7 Bar and 225°C.

b) One (1) deaerator for the combined boiler feedwater flow of 5.7 m^3/hr. The deaerator shall be a vertical drum of 1 m diameter and 2 m height which will be supported on a 1.2 m diameter and 4 m long storage drum.

c) One (1) water treating unit sized for 5.7 m^3/hr to filter and soften the incoming water.

d) Two (2) boiler feedwater pumps, each 1.5 hp 5.7 m^3/hr gpm, 4 Bar head

e) Necessary piping.

f) Ducting shall be provided to bypass the exhaust gas flow around each waste heat boiler.

4.0 PREDICTED ENERGY SAVINGS

By installing a waste heat boiler in each of the open hearth furnace exhaust flue gas systems a total of 4 tons/hr of steam can be generated in both boilers at 7 Bar and 225°C. This will allow the existing steam boiler to be shutdown and will result in a yearly savings of approximately 2200 metric tons per year of mazout. At a worldwide price of LE 241.8 per metric ton. This is a savings of LE 534,000 per year. The yearly cost to soften the feedwater and pump it to the boiler is approximately LE 14,000 resulting in a net savings per year of LE 520,000.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

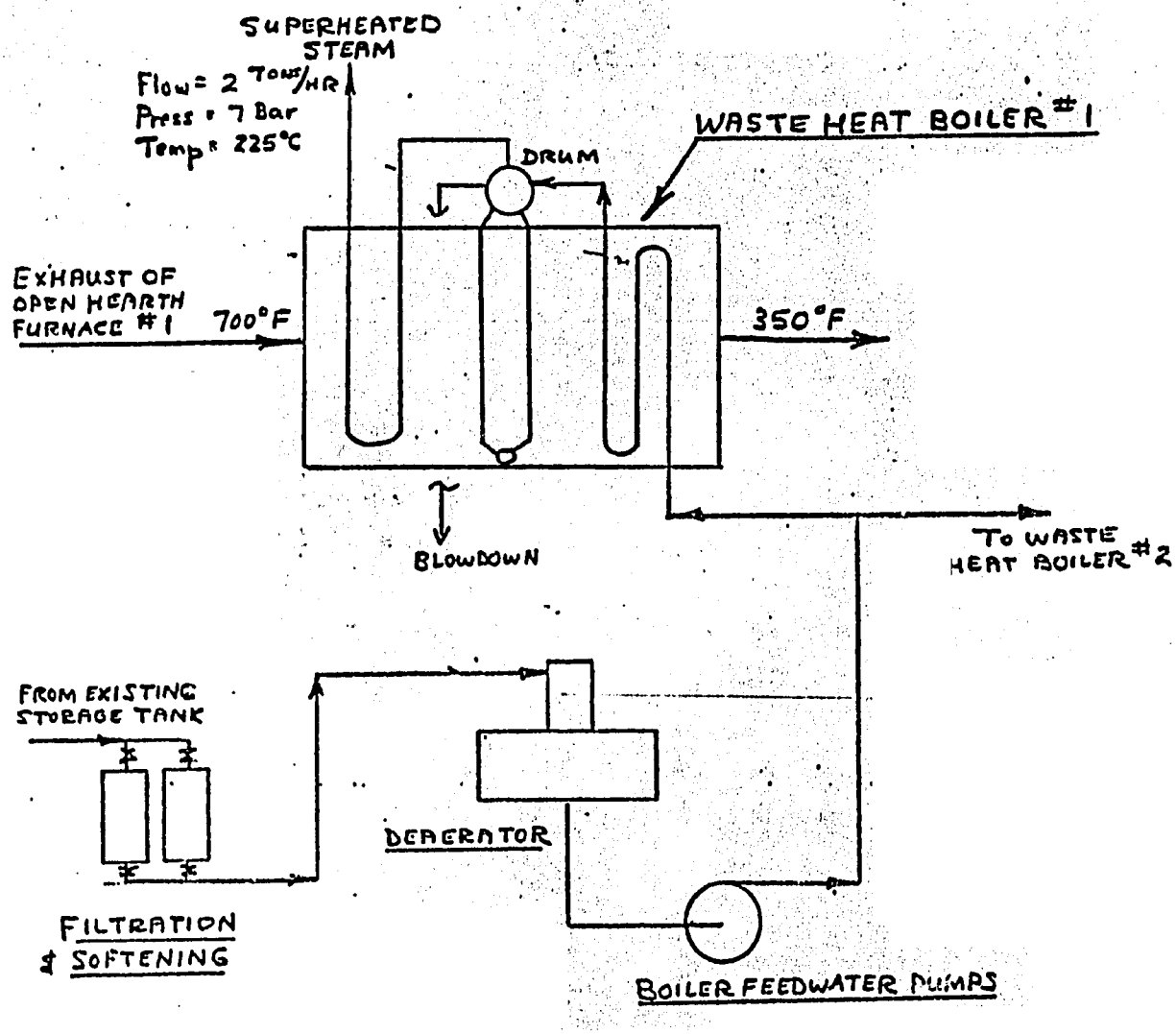
The total cost to supply and install the facilities described above is LE 898,800. The payout on a worldwide basis is 1.73 years.

6.0 CONCLUSIONS

The installation of a waste heat boiler on each of the open hearth furnace exhaust flue gas systems is an attractive ECO with a payout of 1.73 years.

7.0 RECOMMENDATION

This ECO should be implemented.



LEGEND

EXISTING EQUIPMENT
NEW EQUIPMENT

PROCESS SKETCH

ENERGY CONSERVATION OPPORTUNITY:
ECO# NM - B - 5

PLANT NAMETIN

LOCATION ABOU ZAABAL, EGYPT

CAPACITOR INSTALLATION TO IMPROVE POWER FACTOR FOR STEEL PLANT

Annual Savings LE : 404,300
Investment Cost LE: 847,100
Pavout. Years : 2.1

ECO #NM-B-6

1.0 PURPOSE

The purpose of this ECO is to raise the power factor from a current value reported to be 60 percent to alternate evaluation cases of 80 percent, 90 percent and 96 percent to reduce the cost of the monthly electrical billing rates.

2.0 PROCESS DESCRIPTION

The steel plant, consisting of the old plant and the Automatic Rolling Mill plant has a power factor which is now reported to be approximately 60 percent.

It is proposed by this ECO to indicate the annual energy savings by raising the power factor to 80 percent, 90 percent and 96 percent. The capacitors will be installed in the 380 volt and 11 kv substations of the old plant and in the automatic rolling mill substation.
Capacitor banks will be connected by cable to either existing or new 380 volt switchgear circuit breakers or existing 6.6 kv or 11 kv switchgear circuit breakers, installed high on the back wall behind switchgear to provide safety for personel in the elctrical substation.

The proposed capacitor installation will provide a higher power factor, which will reduce wasted energy consumption.

3.0 EQUIPMENT LIST/SIZE

The electrical equipment required for this ECO will be capacitor banks of different rating kVar and voltages, with rack installed, power cables, circuit breakers or fused switches as required.

4.0 PREDICTED ENERGY SAVING

Based on the old plant and the automatic rolling mill plant having an existing power factor of 60 percent, the predicted energy savings on an annual basis is as follows based on a world wide price of LE 0.092 per KWH:

Total steel plant annual savings.

Steel Plant Section 3.4 of this report

Annual KWH	Raise P.F. percent	Annual cost		Annual Saving Percent	Annual LE saving
24,414,000	80	2,246,088.00	x	10	224,600.00
	90	2,246,088.00	x	15	336,913.00
	96	2,246,088.00	x	18	404,295.00

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The total investment for electrical components, as indicated in paragraph 3.0 above, is as follows for the steel plant:

Total investment for steel plant:

Raise P.F. percent to	Investment LE
80	541,600
90	703,602
96	847,100

6.0 CONCLUSIONS

Based on the analysis indicated above in paragraph 5.0 the payout time for raising the power factor percent to 96 is most attractive since it has a slightly better payout than the 90 percent case, for a relatively small increase in investment. Therfore this ECO recommends that the power factor be raised to 96 percent.

In addition to the above electrical energy saving there are three important additional benefits, when the power factor is raised to 96 percent for the Steel plant:

1. The release of electrical system capacity which provides more available electric power.

2. The voltage will rise a percentage which may require the changing of taps on transformers to lower the voltage to correct rating.

3. Improve the power system I^2R loss which can be calculated to be 61 percent. This improves cable ampacity, transformer, switchgear and other electrical component efficiency.

7.0 RECOMMENDATION

This ECO should be implemented without any delay.

DEMAND CONTROLLER FOR	Annual Savings LE:	57,000
REDUCING ELECTRIC POWER	Investment Cost LE:	73,800
DEMAND FOR STEEL PLANT	Payout, Years:	1.29

ECO #NM-B-7

1.0 PURPOSE

The purpose of this ECO is to reduce peak demand of electricity by automatically shutting down Steel plant machinery when electrical power reaches a pre-determined electrical peak to minimize the cost of the "Constant Annual Charge."

2.0 PROCESS DESCRIPTION

The steel plant consisting of old plant and the automatic rolling mill now has a contract specifying a "maximum stated demand" of 2400 kw and a normal electrical estimated demand of 3200 kw as is supported by 1984 consumption data.

It is proposed by this ECO to automatically reschedule the use of non-essential electrical loads to automatically turn off, when the peak demand reaches a pre-set amount in the steel plant. A demand controller with relays will be installed in the electric power substation, set for this duty in the automatic rolling mill substation and two demand controllers for old plant, one located in the turbine substation and one located in the mazout substation.

This will provide savings for reduced peak demand during 24 hour plant electrical operation because the electrical kw will not be permitted to reach the pre-set peak kw value.

3.0 EQUIPMENT LIST/SIZE

The equipment required for this ECO is three demand controller instruments, varying amounts of control relays in junction boxes, depending on electrical equipment location and some small control wire.

4.0 PREDICTED ENERGY SAVINGS

Based on the demand controllers automatically preventing the steel plant from reaching 3200 kw demand and not exceeding the 2400 kw contract by automatically stopping non-essential units, the predicted annual saving would be as follows, based upon a saving in "Constant Annual Charge" due to a reduction in "Maximum Stated Demand" from 3200 kw to 2400 kw.

"Constant Annual Charge" for 3200 kw
= 3200 kw x LE 71.35 = LE 228,320.

"Constant Annual Charge" for 2400 kw
= 2400 kw x LE 71.35 = LE 171,240.

Predicted Annual Savings = LE 57,000.

The "Constant Annual Charge factor" LE 71.35 is based upon the current Egyptian factor of LE 7.756 adjusted for the ratio of worldwide to Egyptian electricity costs.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The total investment for electrical components as indicated in paragraph 3.0 above, is LE 73,800 for the steel plant installation. The predicted annual energy savings in paragraph 4.0 is LE 57,000, which yields a payout in 1.29 years.

6.0 CONCLUSIONS

Based on the analysis indicated above if the electrical peak demand controllers and their associated components were installed in the steel plant, the annual saving would be LE 57,000, which corresponds to a payout of 1.29 years.

This ECO will provide an excellent payout provided that a sufficient number of non-essential or reschedulable loads can be identifi

7.0 RECOMMENDATION

This ECO should be implemented without any delay.

CONSIDER ADDING SEALS AROUND DOORS OF REHEATING FURNACES NO. 1 AND NO. 2	Annual Savings LE:	20,000
	Investment Cost LE:	40,900
	Payout. Years:	2.05

ECO #NM-B-8

1.0 PURPOSE

The purpose of this ECO is to consider the possibility of adding seals around the doors of reheating furnaces No. 1 and No. 2 to minimize heat losses.

2.0 PROCESS DESCRIPTION

Currently the doors to both furnaces are very loose fitting thus allowing excessive leakage on all sides. The doors are opened in an upward direction by a manually operated counterweight assembly.

To provide a better seal around the doors, steel channels should be welded to the outside of each furnace on each side of the doorway. It is recommended that new doors be furnished that would have a good fit with the permanently mounted channels. Also, a new door still should be installed that will provide a good fit with the door. This is the most practical method of sealing the doors.

3.0 EQUIPMENT LIST/SIZE

For each reheating furnace provide the following:

a) One (1) steel framed door, refractory lined and convered with castable.

b) Two (2) fixed steel channels for the sides of the door.

c) One (1) steel door sill.

All of the above material should be fabricated and furnished as a unit to insure proper fit.

4.0 PREDICTED ENERGY SAVINGS

By providing a better seal around the door of reheating furnaces No. 1 and No. 2, it is estimated that the efficiency of each furnace will improve by one percent. For reheating furnace No. 1, this results in a savings in mazout fired of approximately 65 tons/year. For reheating furnace No. 2, this results in a savings in mazout fired of approximately 18.5 tons/year. On the basis of worldwide prices, the total annual savings for both furnaces is LE 20,000.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The cost to furnish and install the materials as described above is LE 40,900. Based on a yearly energy savings of LE 20,000, the payout on the basis of worldwide prices is 2.05 years.

6.0 CONCLUSIONS

By improving the sealing around the doors of reheating furnaces No. 1 and No. 2, moderate energy savings can be realized, resulting in a 2.05 year payout.

7.0 RECOMMENDATION

This ECO should be implemented.

CHARGING HOT INGOTS
FROM THE STEELMAKING SHOP
TO THE REHEATING FURNACES

Annual Savings LE: Not Applicable
Investment Cost LE: Not Applicable
Payout, Years: Not Applicable

ECO #NM-B-9

1.0 PURPOSE

To investigate the possibility of charging hot ingots from the steelmaking shop to the reheat furnaces or for the new continuous casting machine feeding the automatic rolling mill.

2.0 PROCESS DESCRIPTION

In steel plants that have a means of obtaining hot steel billets or slabs and delivering them to a reheat furnace, an effective way of reducing fuel usage is to charge the billets or slabs into the reheat furnace, as soon as possible, while they are still hot, usually over 550°C. Because there is a considerable amount of thermal energy stored in the steel at this step of the operation it will take less energy to reheat the steel to rolling temperature and thereby reduce the amount of fuel consumed in the reheat furnace. This practice is called "hot charge" and today is being utilized or developed in particular for those plants that have continuous casters.

The first consideration undertaken when developing a plan for hot charge is to study the logistics for transporting hot semi-finished steel from a continuous caster or rolling mill to the reheat furnace. The question arises as to the physical location of the reheat furnace with respect to the producing unit, which is almost always a continuous caster. The

question that follows is the means of transporting th hot steel and method of charging it into the reheat furnace. In preparing layouts for new casting machin an attempt is made to locate the continuous caster as close to the downstream rolling operation as physical possible.

In some cases, the caster is close-coupled to the rolling mill and discharges directly onto the entry table of the rolling mill. This arrangement allows for "direct charge" with the hot steel bypassing the reheat furnace altogether and moving directly into th first roughing pass of the rolling mill. Designers try to settle on this arrangement even if there are no immediate plans for direct charge, because it will allow for the practice at some future date. Unless the caster and rolling mill are close-coupled, a direct charge practice is impossible. It is no doubt apparent that a close-coupled arrangement of caster and rolling mill provides the easiest means of accomplishing "hot charge", also.

The layout and operating practices in the steelmaking shop at National Metal Industries Co. does not lend itself to the concept of "hot charge" in any practica or reasonable way. The steelmaking shop is not in th most favorable location with respect to #1 reheat furnace but even so, ingot transport is not impossible, although it is logistically undesirable. But moving steel ingots out of the open hearth shop t the rolling mill is a minor problem compared to other obstacles, if for the moment it is assumed that the molds will ride on a railroad car without falling over.

To name a few of the obstacles, the first that ust be overcome is the bottom pour teeming practic on

the pit side floor. This does not permit moving the molds until the steel is relatively cold, which subtracts from any hot charge advantage.

Another major problem is the stripping operation conducted in the pit after the ingots are cold. The mold stripping is done manually except for the help of the overhead crane, and this kind of operation can only be done "cold". It would be impossible for ingots to be stripped "hot" under these conditions. Obviously, this negates any potential for hot charge without a practice change.

The size of the steel ingot presents a problem for transporting them in an upright position. These ingots are reported to be 155 mm square, and although the height is variable, the maximum height is roughly 1400 mm. There are about 170 ingots per heat, with each ingot weighing nominally 200 Kg. The ingots are not free standing when stripped.

Furthermore, there are no transportation facilities existing between the open hearth pit and the semi-automatic rolling mill. This situation can be overcome at a cost.

Looking at the overall concept of hot charging ingots from the open hearth shop to #1 reheat furnace, radical changes are dictated, some of which are suggested below.

It would seem that the relatively small size of the molds and ingots mandates a bottom pour practice, but in a way so that the molds can be moved after teeming while still hot. This conceivably could be accomplished by making up the refractory bases and headers on special railroad cars in order to move the hot molds

with ingots to a remote stripper or strippers in close proximity to the reheat furnaces. This is similar to a standard bottom pour practice in modern shops where large ingots are handled by railroad and subsequently stripped, reheated in soaking pits and then rolled into slabs or blooms. Railroads and rolling stock would have to be provided at National Metal Industries Co. to do this.

Any stripping operation for this plant must be mechanized because the steel would be hot. This could no doubt be accomplished with a redesigned mold and the provision of stripper cranes, runways, buildings, railroads and the like.

Once the problems mentioned above are overcome, handling the hot ingots to the reheat furnace should be relatively straightforward by comparison to other problems. Conventional equipment like cranes and tongs could be utilized, which of course will require runways and buildings.

The concept spelled out here is certainly not without great risk. The teemed molds probably could not withstand being transported by railroad in an upright position because of their small base and high center of gravity. If they fall over, the concept is not viable, and the likelihood is that they will fall over. It is conceivable that some scheme could be thought through to overcome this problem also, but at a cost.

Taking everything into consideration, and recognizing the drastic facility changes required to accomplish hot charging ingots from the steelmaking shop to #1 reheat furnace, it is clear that huge investments are required with extended outages for

construction. From a physical and economic point of view, the project is definitely beyond the scope of this work, and does not lend itself to energy conservation evaluation.

On the other hand, every consideration should be given to "hot charge" for the automatic rolling mill as part of the planning for the new electric steel shop and continuous caster. As pointed out in the beginning, hot charge is an easy and effective way of reducing fuel consumption and certainly should be undertaken in the design of new facilities.

3.0 EQUIPMENT LIST/SIZE

No new equipment is required for this ECO as it pertains to charging hot ingots from the steelmaking shop to #1 reheat furnace, since the project is not recommended.

Facilities to provide hot charging of ingots from the new caster to the automatic rolling mill should be seriously considered for the electric furnace/continuous caster project.

4.0 PREDICTED ENERGY SAVINGS

Energy savings for this ECO, apply only to the new electric furnace/continuous caster project and should be developed as verifiable savings in that appropriation.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

No investment has been developed for this ECO as far as charging hot ingots from the steelmaking shop to #1 reheat furnace.

6.0 CONCLUSIONS

Hot charging ingots to #1 reheat furnace from the existing open hearth shop does not appear economically viable.

Hot charging blooms to the automatic mill reheat furnace from the new continuous caster is a worthwhile undertaking and should be pursued as an integral part of the new facility expansion program.

7.0 RECOMMENDATION

Hot charging billets from the new continuous caster to the automatic rolling mill reheat furnace should be implemented.

		RHF #1	RHF #2	ARHF
INVESTIGATE THE REPLACEMENT	Annual Savings, LE:	105,000	39,500	257,800
OF REFRACTORY IN ALL THREE	Investment Cost, LE:	92,100	50,200	203,400
REHEAT FURNACES	Payout, Years:	0.88	1.27	0.79

ECO #NM-B-10

1.0 PURPOSE

The purpose of the ECO is to investigate the replacement of refractory in the plant's three reheat furnaces with the aim of upgrading these refractory systems, when the next replacement is undertaken, as routine maintenance.

2.0 PROCESS DESCRIPTION

From available plant information, the refractory in the furnaces are replaced yearly. The primary requirement for refractory materials is both chemical and physical stability at high temperatures, while at the same time providing maximum possible insulation, to reduce the outside metal temperature, i.e., reduce heat losses to the atmosphere.

For the reheating furnaces considered, our intent is to make a selection between the following three choices, i.e., hard refractory and ceramic fiber Z-block positive attachment modules, or Z-block veneered modules.

Listed below are the advantages and disadvantages of the three selected choices:

Hard refractory:

Advantages:

1) Will withstand mechanical abuse.
2) Lower material cost.
3) Slightly lower ongoing maintenance.

Disadvantages:

1) Very little BTU savings.
2) High cold face temperature.
3) Subject to thermal shock (spallings).
4) Extremely high heat storage.
5) Longer start-ups and shutdowns.
6) Uneven furnace temperature - cold spots or hot spots.

Ceramic Fiber, Z-block positive attachment modules:

Advantages:

1) High BTU savings - 25 to 30 percent.
2) Low cold face temperature.
3) No thermal shock.
4) Very little heat storage
5) 4 - 8 hours less on startups and shutdowns.
6) Even heat distribution.
7) Fast installation.
8) Lightweight.
9) Heavily supported with bolt through attachment.
10) Resists water.
11) Thickness up to 12 inches standard, over 12 inches are special order.

Disadvantages:

1) Will not withstand better than average mechanical abuse.
2) Higher maintenance.
3) Slightly higher ongoing maintenance costs.
4) Will not accept certain fuels or chemicals.

Ceramic Fiber, Z-block veneered modules:

It should be kept in mind that while the advantages of the veneered modules are the same as the positive attachment modules, it is to a much lesser degree that they are advantageous. Also, veneered modules over hard refractory do not require a total tear-out of hard refractory, as the attachment modules do.

The preparation for veneered modules would include sandblasting, gunniting, flat troweling, curing time, and re-sandblasting, in addition to installing the veneered module. This is providing the refractory lining is structurally sound. If not, it has to be repaired or replaced. You will also experience a module loss of 10 - 15 pct. per year, which can be quite costly in material costs, maintenance costs and Btu loss. Maximum thickness is 4 inches, which reduces insulation value compared to the positive attachment module.

Because of the above listed disadvantages for the veneered modules, we will limit our choice between hard refractory and positive attachment modules.

3.0 EQUIPMENT LIST/SIZE

A full refractory replacement will require that a survey be made for all three reheat furnaces. This survey will dictate the quantity of bricks and/or volume of refractory and necessary shapes to be purchased. In addition to the refractory brick, as well as gunniting mixes where required for the quick (hard) refractory type installation.

4.0 PREDICTED ENERGY SAVINGS

Based on available data developed in the United States, the differences in heat losses and outside metal wall temperatures for the two types of refractory analyzed, are as follows

Material	Thickness	Average furnace temperature	BTU loss	Cold wall temperature
Z-Block	230 mm	1,280°C	392 $\frac{BTU}{Ft^2 HR}$	100°C
Hard Refractory	230 mm	1,280°C	1,970 $\frac{BTU}{Ft^2 HR}$	268°C

Considering the above temperatures for losses (wall temperatures measured in the plant for reheating furnace #2, were actually between 250-260°C, while those for the automatic furnace were higher) we calculate the following savings, based on overall furnace dimensions:

Reheat furnace #1: 2,237,604 BTU/hr
Reheat furnace #2: 1,262,400 BTU/hr
Autom. Reheat furnace: 5,493,018 BTU/hr

This heat loss expressed savings in LE/years amount to 105,002 (RHF #1), 39,493 (RHF #2) and 257,765 (ARHF), based on 7,500 hours operation for RHF #1 and ARHF and 5,000 hours for RHF #2, at worldwide energy prices.

5. INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated investment for new Z-block installation versus the present cost for hard type refractory (as

reported by Nametin) and approximate payout are listed in the table below:

	NEW REFRACTORY ESTIMATED COST, Z-BLOCK	REFRACTORY REPLACEMENT PRESENT COST	ADDITIONAL INVESTMENT FOR Z-BLOCK, LE	YEARLY SAVINGS	PAYOUT YEARS
RHF #1	128,100	36,000	92,100	105,000	0.88
RHF #2	75,200	25,000	50,200	39,500	1.27
ARHF	306,400	103,000	203,400	257,800	0.79

6. CONCLUSIONS

Based on the information detailed in paragraph 2.0 and the superior overall performance of Z-block the payout shown above is attractive.

7. RECOMMENDATIONS

We recommend implementation of this ECO.

INSULATE WATER-COOLED "RUNNERS" ON ALL REHEAT FURNACES

Annual Savings LE:	1,725,200
Investment Cost LE:	173,900
Payout, Years:	0.10 (37 days)

ECO #NM-B-11

1.0 PURPOSE

One of the methods of significantly reducing energy usage in a metallurgical furnace is to improve the insulation practice. One generally accepted and effective way to reduce fuel rate is to insulate the water-cooled pipes inside the furnace. Those who have observed the large heat losses caused by bare water-cooled pipes recognize the need for this type pipe insulation.

2.0 PROCESS DESCRIPTION

Material processed in a pusher-type metallurgical furnace, such as a reheat furnace, is supported throughout the length of the furnace on "wet" or water-cooled skid pipes. This supporting system must be cooled to preclude distortion and rapid destruction due to elevated furnace temperatures that frequently approach the melting point of steel, which would cause the supporting structure to collapse under load.

The fuel rate can be significantly reduced by insulating these water-cooled piping systems by several commonly used methods.

One of the earlier insulating mediums for skid pipes is a special high alumina castable which is cast in place. This technique is still in common use.

An alternative to using a "cast in place" insulation system is to use a pre-cast reinforced high alumina refractory which provides an easy, practical way to improve furnace efficiency. This technique involves some welding, but special shapes are available that require no welding and only minimum mortar joints. This technique is recommended.

There is also a totally new non-welded refractory insulation system (Patent Pending) for skid pipes in steel plant reheat furnaces. This system was developed through extensive application trials in steel reheating furnaces. The insulation is manufactured from moldable plastic materials and is available in a lightweight insulating tile for normal use and a dense refractory tile for additional protection when slag attack and excessive temperatures are factors. Since these tiles grip the pipe tightly, they are resistant to furnace vibration. At the present time, this insulation system is not available outside the western hemisphere.

2.1 Physical Work Required

Castable skid pipe insulating systems are cast in place, similar to concrete with formwork.

The system recommended for this ECO is 2 inch pre-cast reinforced insulating tile which is held in place by clips welded to the pipe with other shapes available requiring no welding. The insulation can be installed on skid pipes and cross-overs so that only the skid bar itself is exposed, which is estimated to be about 10 percent of the surface area.

The non-welded insulation system is designed for easy installation to reduce furnace downtime. It

is installed by using an expander tool and the joints are then caulked

3.0 EQUIPMENT LIST/SIZE

This ECO requires the purchase and installation of sufficient 2 inch thick insulating tile to obtain at least 90 percent coverage of the water-cooled piping systems in each of the three reheat furnaces in operation at National Metal Industries Company. It is desirable to get 90 percent coverage, and the evaluation has been made on this basis.

4.0 PREDICTED ENERGY SAVINGS

No. 1 Reheat Furnace

No. 1 reheat furnace has four (4) water-cooled skid pipes, each 4 inches in outside diameter and 52.5 feet long. The surface area of all four of the pipes is 195.8 sq. ft. at 90 percent coverage. With a furnace temperature of 2100°F, the bare pipe heat loss is 8,223,600 Btu/hr, while the insulated pipe heat loss is 1,116,000 Btu/hr. This is a net savings in heat loss of 7,107,600 Btu/hr, equivalent to 180 kg of mazout per hour. Using 7500 as the annual operating hours for No. 1 reheat furnace, the savings of mazout is 1,340 metric tons/year. At a worldwide price of mazout at 241.8 LE per metric ton, this represents a savings of approximately 324,000 LE/year at 90 percent insulation coverage

No. 2 Reheat Furnace

No. 2 reheat furnace has three (3) water-cooled skid pipes, each approximately 3 1/2 inches in outside diameter and 12 meters long. The surface area of all three of the pipes is approximately 9 m^2 at 90

percent pipe coverage. With a furnace temperature of 1050°C, the bare pipe heat loss is 3,110,400 Btu/hr, while the insulated pipe heat loss is 495,700 Btu/hr. This is a net savings of 2,614,700 Btu/hr, equivalent to 66 kg of mazout per hour. Using 5,000 as the annual operating hours for No. 2 reheat furnace, the savings of mazout is 330 metric tons/year. At a worldwide price of mazout at 241.8 LE/metric ton, this represents a savings of approximately 80,000 LE/year at 90 percent insulation coverage.

No. 3 Reheat Furnace (Automatic Mill)

No. 3 furnace has four (4) water-cooled skid pipes, each approximately 4.5 inches in outside diameter and 19 meters long. The surface area of these four pipes is 27.5 m^2.

There are also twelve (12) transverse pipes approximately 5.27 inches in outside diameter, each 5 meters long. The total surface area of all twelve of these pipes is 25.3 m^2.

The total exposed area of the water-cooled piping support system is about 47.4 square mtrs at 90 percent pipe coverage. At a furnace temperature of 1250°C, the bare pipe heat loss is 29,138,400 Btu/hr. The insulated pipe heat loss is 3,220,500 Btu/hr. This is a net savings of approximately 25,918,000 Btu/hr, equivalent to 653 kilogm of mazout per hour. Using 7500 as the annual operating hours for No. 3 reheat furnace, the savings of mazout is 4,875 metric tons per year. At a worldwide price of mazout a 241.8 LE/metric ton, this represents a saving of approximately 1,178,000 LE/year at 90 percent insulation coverage.

In summary, the savings for all three furnaces at 90 percent coverage of the piping systems:

No. 1 Furnace	324,000 LE/Yr
No. 2 Furnace	80,000 LE/Yr
No. 3 Furnace	1,178,000 LE/Yr
	1,582,000 LE/Yr

Additionally, there is an estimated 30 percent savings in water usage which amounts to LE 143,200 per year at worldwide prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The total predicted annual savings for this ECO is LE 1,725,200. Based on an investment of LE 173,900 the project will pay out in 37 days.

6.0 CONCLUSIONS

Based on the analysis shown above, insulating the water-cooled skid pipes in all three reheat furnaces with 90 percent coverage results in a predicted savings of approximately 1,725,200 LE/year and a very rapid payout in 37 days.

7.0 RECOMMENDATION

The ECO should be implemented.

OBTAIN EXTRA OXYGEN BOTTLES

Annual Savings LE:	63,100
Investment Cost LE:	24,000
Payout, Years:	0.38

ECO #NM-B-12

1.0 PURPOSE

The purpose of this ECO is to provide extra bottles to store temporary excess production in the Oxygen Plant, in order to prevent the loss of energy through the discharge of useable oxygen to the atmosphere.

2.0 PROCESS DESCRIPTION

The design capacity of the oxygen plant is 63 Nm^3/hr. Actual average consumption as recorded by NAMETIN for 1983/1984 is 38 Nm^3/hr, which results in an oxygen surplus of 25 Nm^3/hr. This amount is lost (it has to be vented), unless stored and used when actual consumption exceeds 63 Nm^3/hr.

At present oxygen consumption is above normal due to various maintenance work, and also due to the usage of oxygen in cutting billets from reheating furnace #1 by oxygen-butane flame. The latter might be eliminated when the hot shears will be repaired. At present however, the plant complains of an inadequate oxygen bottles supply. If the use of oxygen for cutting billets were discontinued, and a regular schedule of returning empty bottles on time to the Oxygen Plant were monitored, the number of bottles presently on hand are sufficient to store all available production.

3.0 EQUIPMENT LIST/SIZE

75 bottles of 5.7 Nm^3 capacity (200 scf) are required.

4.0 PREDICTED ENERGY SAVINGS

There is energy saving to be gained provided the excess capacity is no longer vented at any time. If we assume that at present, venting occurs 20 days a year, at a rate of the design excess of 25 Nm^3/hr, and if we take the value of the oxygen at LE 32 per bottle (at worldwide cost), then we are venting the equivalent of 63,100 LE per year.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

If the price of one empty bottle is LE 320 the acquisition of nearly 200 bottles could be paid for from only one year of predicted savings.

Since the cutting of billets consumes 60 bottles per day, a total of 75 bottles at a total cost of 24,000 LE should cover the plant's need for excess storage. Using our projection of 20 days per year the payout would be in slightly over 4.5 months.

6.0 CONCLUSIONS

Since the assumption of only 20 days venting per year is conservative, the payout, in order to save energy (which was used to manufacture oxygen), is attractive

7.0 RECOMMENDATION

We recommend the purchase of 75 bottles, which should relieve the venting required.

IMPROVE PERFORMANCE OR REPLACE STEAM CRANES IN STEEL MAKING SHOP

Annual Savings LE : 41,000
Investment Cost LE: 7,000
Payout, YRS 0.17
(62 days)

ECO # NM-B-13

1.0 PURPOSE

The purpose of this ECO is to improve the performance of the two steam cranes in the steel making shop, or to replace them.

2.0 PROCESS DESCRIPTION

The steam cranes presently used are very old inneficient pieces of equipment. The stationary boilers generate 4-5 Bar low pressure steam. The fuel burned is sular The intent of this ECO is either to improve the thermal (energy) efficiency of the two boilers, by installing new burner packages, or based on the rather inefficient operation, recommend the purchase of new equipment (electrically operated cranes).

3.0 EQUIPMENT LIST/SIZE

Alternate "a". Improve existing operation by providing two new burner packages.

Alternate "b": Replace existing equipment with two new electric cranes.

4.0 PREDICTED ENERGY SAVINGS

For alternate "a" according to available information, the fuel consumption is at present about 25 liters/hr/crane of sular. Based on our survey, the present efficiency does not exceed 30 percent. If we install new burner assemblies the expected efficiency will be

70 percent, an increase of 40 percent. Based on 7,500 hours per year operation, the total amount of fuel saved annually will be LE 20,500 per crane, at worldwide cost.

For alternate "b", taking the total present sular consumption per crane for 7,500 hours per year, we calculate a yearly cost of LE 51,200 per crane based on worldwide prices. Conversely, using a 50 KW motor for the electric crane, the yearly energy cost amounts to LE 34,500, based on worldwide prices. Thus, the yearly savings when switching from sular to electricity amount to LE 16,700 per crane.

5.0 INVESTMENT AND ECONOMIC EVALUATION

The investment required for alternate "a" is LE 7,000 for each crane, which results in a payout of 0.17 days.

For alternate "b" the investment is approximately LE 137,400 per crane which yields a payout of over 8 years.

6.0 CONCLUSIONS

The revamp of the existing burners is certainly very attractive, however new electric cranes, can not be justified solely for energy savings, since the payout exceeds 8 years.

7.0 RECOMMENDATIONS

We recommend implementation of this ECO, based upon the attractive payout shown for alternate "a".

AUTOMATIC AIR/FUEL RATIO CONTROLS

Annual Savings LE:	See Table
Investment Cost LE:	39,000
Payout, Years:	See Table

ECO #NM-B-14

1.0 PURPOSE

The purpose of this ECO is to provide automatic fuel/air ratio controllers on each furnace or major combustion device in the National Industries plant.

This would include the two open hearth furnaces, the three reheat furnaces, and the boiler.

2.0 PROCESS DESCRIPTION

The process description for all of these combustion devices will be the same, and they will therefore be discussed in a single process description. (Note, however, that pricing will vary slightly for the sensing transducers, as size varies. The controller, and the control panel will be standard, however, and do not vary with the installation size.)

Essentially, in a modern air/fuel controller, the required heat input would be preset, thus fixing the fuel (mazout) flow.

The controller will then adjust air flow to meet a preset value, which would normally result in an excess oxygen content of 2 to 6%. This value will vary slightly with the installation, to allow for less than optimum mixing, oxygen interchange with the steel surface, particularly in the open hearth, and the like.

Additionally, consideration must be given to increasing the overall plant yield by running the reheat furnaces at low excess oxygen conditions, not only to save fuel, but to reduce oxidation of the billets.

3.0 EQUIPMENT LIST/SIZE

The implementation of this ECO will require:

a) Transducers for fuel and air flow
b) An oxygen analyzer in the exhaust gas*
c) A control panel
d) A control valve in the fuel line
e) A control damper in the air feed duct*
f) Miscellaneous wiring, supports, etc

*If ECO's #NM-A-8, A-9, A-13a, A-13b and A-13c have been implemented, then an appropriate reduction in investment costs will be taken.

4.0 PREDICTED ENERGY SAVINGS

The automatic air/fuel ratio controller is expected to provide better control of air/fuel ratio, since the system will respond immediately and finitely to the need, while the operator, making a manual adjustment "after the fact" will normally track the proper value in a tardy manner. This saving is expected to be nominally 1/2% of the annual fuel cost for the furnace.

Savings calculated for each furnace/boiler are:

	LE/Year
a) Open hearth furnace #1	7,700
b) Open hearth furnace #2	7,700
c) Reheat furnace #1	7,900
d) Reheat furnace #2	2,200

	LE/Year
e) Reheat furnace (automatic rolling mill)	15,900
f) Boiler, steam	5,300

These figures are based on worldwide prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The investment cost for each of the above furnaces (boiler) has been estimated at LE 39,000.

Thus the payout varies from 2.5 years in the most favorable case (Autom. Reh. Furnace) to almost 18 years (reheat furnace #2). Even with the reductions mentioned under 3.0, the payout will be favorable for only the automatic rolling mill furnace.

	Savings	Payout, Years
a)	7,700	5.06
b)	7,700	5.06
c)	7,900	4.94
d)	2,200	17.73
e)	15,900	2.45
f)	5,300	7.36
Avg.	7,800	5.00

6.0 CONCLUSIONS

The payout for this ECO does not look attractive except for the automatic rolling mill furnace.

7.0 RECOMMENDATION

We do not recommend implementation of this ECO, except for the automatic rolling mill reheat furnace.

INSTALL AUTOMATIC DOOR CONTROLS ON REHEAT FURNACES	Annual Savings LE:	25,000
	Investment Cost LE:	12,100
	Payout, Years:	0.48

ECO #NM-B-15

1.0 PURPOSE

The purpose of this ECO is to install automatic door controls for all three reheat furnaces that operate in sequence with the mechanical pushers installed in front of the furnace charging doors.

2.0 PROCESS DESCRIPTION

In principle, the scheme for automating the doors on each of the three reheat furnaces is the same. The objective is to keep the doors closed, except for those periods when product is being charged into the furnace or when it is being discharged.

This can be done by providing motor driven operators on each of the furnace doors, both on the charging and discharging sides, which are interlocked with the mechanical pushers. Relays and limit switches will be installed that sense door position as well as the action of the pusher.

The sequence will be initiated by pushing a start button to open the door. When the door is open the pusher will automatically start immediately to move into the furnace. Another start button will be pushed to withdraw the pusher. The controls will automatically close the door when the pusher has been extracted from the furnace.

This ECO applies to three charging doors and two discharge doors. Reheat furnace No. 2 does not have a door on the discharge.

3.0 EQUIPMENT LIST/SIZE

a) Five (5) motor driven activators to open the furnace doors.

b) Switches and relays for door and pusher operation.

4.0 PREDICTED ENERGY SAVINGS

By providing automatic controls to open and close the furnace doors, as well as to actuate the motion of the mechanical pushers, the total length of time that the furnace doors are open for charging and discharging is minimized. It is estimated that the efficiency of the No. 1 and No. 3 furnaces can be improved by approximately one half percent and by approximately 1/3 percent for furnace No. 2. For reheating furnace No. 1, this results in a savings in mazout fired of approximately 33 tons/year. For reheating furnace No. 2, the savings would be approximately 6 tons/year and for reheating furnace No. 3, the savings would be approximately 65 tons/year. On the basis of worldwide prices, the total annual savings for the three furnaces is LE 25,000.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The cost to furnish and install the materials as described above is LE 12,100. Based on a yearly energy savings of LE 25,000, the payout on the basis of worldwide prices is 0.48 years.

6.0 CONCLUSIONS

By installation of automatic door controls for all three reheat furnaces that operate in sequence with the mechanical pushers, significant energy savings can be realized resulting in a 6 month payout.

7.0 RECOMMENDATION

This ECO should be implemented.

INVESTIGATE USE OF ELECTRIC HEAT OR OIL/OIL EXCHANGER TO REPLACE STEAM IN MAZOUT HEATING

Annual Savings LE: none
Investment Cost LE: none
Payout, Years: not applicable

ECO #NM-B-16

1.0 PURPOSE

The purpose of this ECO is to investigate the replacement of steam heating of mazout with an electric system, or some oil/oil heat exchange system where part of the oil has been heated to a higher temperature.

2.0 PROCESS DESCRIPTION

The mazout system has been described in ECO #NM-A-14. Presently electric heat is used to preheat the mazout being fed to the automatic rolling mill reheating furnace. All other mazout lines and tanks are heated with steam.

The system involves long lines, large (600t) storage tanks as well as day tanks. The movement of mazout through pipes requires that its temperature stay suitably above its pour point temperature of 38°C. Since the existing system is in place and operating, a switchover to another heating system, would involve a revamp of the whole plant. Three large storage tanks of 600 tons each (presently heated by steam coils) would have to be refurbished with electric heaters.

One major problem would be the line coming from the dock, where the mazout is being unloaded, which is in intermittent operation. In the absence of the steam

companion pipe, a flushing system for this line with some lighter hydrocarbon (such as sular) would have to be installed. Due to the frequently occurring power failures, an electrical heating system would not be reliable enough for this service.

It appears that electric heating could be applied to day tanks and to the suction of pumps. If the boiler is to be revamped, fuel preheat could also be included. This, however, can also be easily achieved with steam.

The open hearth furnaces have a fuel oil preheat system (to about 80-90°C) with exhaust gases. The old mill reheating furnaces have no preheat system, but the fuel oil pipes leading to the burners are piped along the furnace wall, thus getting preheated.

3.0 EQUIPMENT LIST/SIZE

In view of the conclusions reached in the following paragraph, 4.0, no equipment has been priced.

4.0 PREDICTED ENERGY SAVINGS

a) Electric Heating of Mazout

From the energy consumption summary tables published in the Preaudit Report, we find that the price per MM Btu for electricity is about 5 (five) times higher than the price of No. 6 fuel oil (mazout). Thus, the boiler which generates steam used entirely for the heating of mazout consumes roughly 1/2 ton/hr of mazout. If we consider the efficiency of the boiler (60%) and add another 10% for various losses, we arrive at a consumption of 500 kg/hr mazout for heating. This corresponds to 19.32 MM Btu/hr or based on the worldwide cost of mazout,

121 LE/hr, the corresponding cost for electricity would be 521 LE/hr. Thus electrical heating is unattractively five times more expensive. This does not even include the new equipment for electrical mazout heating which would have to be installed.

b) Oil/Oil Heating

This alternate would preheat the bulk of the oil with hot flue gases, to a temperature in excess of the one required for adequate flow conditions, and thus exchange the overheated mazout with cold mazout.

The heating of fuel oil with flue gases has been done successfully in some petroleum refineries. It is, however, a rather dangerous practice, in which the potential risk of fire should a tube rupture, can not be excluded. Even many refiners, who have extensive experience with the handling of hazardous hydrocarbon streams, are fearful of using this type of system. We cannot recommend such a system for a steel plant.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

There is no investment contemplated for this ECO.

6.0 CONCLUSIONS

In view of the problems described above, further study of this ECO is not warranted.

7.0 RECOMMENDATIONS

We do not recommend further work on this ECO.

INVESTIGATE SCRAP AND PIG IRON PREHEAT

Annual Savings LE: None
Investment Cost LE: Not Applicable
Payout, Years: Not Applicable

ECO #NM-B-17

1.0 PURPOSE

The purpose of this ECO is to investigate the feasibility of preheating scrap and pig iron, before it is charged to the furnaces.

2.0 PROCESS DESCRIPTION

Preheating of scrap aluminum is being done in a plant in the United States. However, it requires the installation of a preheating furnace that utilizes direct firing and the use of waste heat from other furnaces. For the Nametin plant it is not a practical and economic ECO.

3.0 EQUIPMENT LIST/SIZE

This is not applicable for this ECO

4.0 PREDICTED ENERGY SAVINGS

If waste heat can be used to preheat the scrap, energy savings could be realized. However, based on the experience in the United States, direct firing is also required. This direct firing is better accomplished in the furnaces presently installed. Also, better use can be made of the waste heat as covered by ECO #NM-B-5.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The cost to furnish and install a new preheating furnace is very large as compared to any energy savings that might be accomplished.

Since the payout period would be very long, no further work on this ECO was justified.

6.0 CONCLUSION

A very long payout period is necessary if facilities to preheat the scrap and pig iron are installed.

7.0 RECOMMENDATION

This ECO should not be implemented.

REVIEW TRANSPORTATION OF BILLETS FROM COLD SHEAR TO AUTOMATIC ROLLING MILL REHEATING FURNACE

Annual Savings LE: 75,000
Investment Cost LE: 71,600
Payout, Years: 0.95

ECO #NM-B-18

1.0 PURPOSE

The purpose of this ECO is to review the transportation of billets from the cold shear to the automatic rolling mill reheating furnace.

2.0 PROCESS DESCRIPTION

In the automatic rolling mill, after the billets pass through the cold shear, they are loaded onto an open flat top car. This car is moved to the vicinity of the reheating furnace by the use of a large diesel engine. It is proposed that a "car puller" be installed to move the car both ways on the track instead of using the diesel engine. The "car puller" is a two drum winch located near the furnace area. The cable on one drum hauls the loaded car to the furnace while the cable on the other drum moves the empty car back to the vicinity of the cold shear. The cable on the loaded car is connected to the front of the car while the other cable is carried around a sheave and attached to the rear of the car. The winch is controlled remotely by a push button station located where the operator can watch for the safe operation of the car.

3.0 EQUIPMENT LIST/SIZE

Provide one (1) two drum "car puller" with remote push button operator. The "car puller" is to be

provided with brakes on both drums. Approximately 200 yards of cable should be provided on each drum.

4.0 PREDICTED ENERGY SAVINGS

Energy savings will result from replacement of a high energy cost diesel engine by the electric motor driving the winch. Also, since the diesel engine will be taken out of service, the maintenance costs on the engine will be saved.

It is estimated that the annual fuel savings shall be approximately LE 60,000, based on worldwide prices, and the annual savings on maintenance approximately LE 15,000. The total yearly savings on this basis would be LE 75,000. This figure must be verified by the plant. Further, it has been assumed that a 50 HP electric motor is required. The actual motor horsepower required must be developed based on the actual load.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The total cost to purchase and install the facilities described above is LE 71,600. The payout on a worldwide basis is 0.95 years.

6.0 CONCLUSIONS

Based upon the savings reported above, the replacement of the diesel engine by an electric motor driven car puller will yield an annual savings of LE 75,000 and a payout of 0.95 years.

7.0 RECOMMENDATION

This ECO should be implemented.

INVESTIGATE HEAT RECOVERY FROM CAST IRON SUPPORTS IN REHEATING FURNACE NO. 2	Annual Savings LE:	None
	Investment Cost LE:	Not Applicable
	Payout, Years:	Not Applicable

ECO #NM-B-19

1.0 PURPOSE

The purpose of this ECO is to investigate the feasibility of recovering heat from the cast iron supports used in reheating furnace No. 2; or replacing them with a system which does not require such supports.

2.0 PROCESS DESCRIPTION

Cast iron supports are used to support the material charged to reheating furnace No. 2. These supports, each approximately one half meter in length, are placed on the fixed supports in front of the charging door. Since the material to be charged to the furnace is of various lengths and is randomly placed for charging, it is necessary to support this material on the moveable cast iron supports. The material and the supports are pushed into the furnace each time the furnace is charged.

As material is charged to the furnace, the cast iron blocks already in the furnace are pushed out the rear of the furnace. The blocks exit the furnace at high temperature and accumulate in a pile until they are cool enough to handle. The blocks are then moved manually to the charging end of the furnace. The purpose of this ECO is to investigate the feasibility of recovering heat from the hot cast iron blocks at the rear of the furnace.

To recover a significant amount of heat, the hot blocks should be retained for a period of time in a

closed chamber where air might be preheated. Since hot blocks exit from the furnace every several minutes, a mechanical method of movement of these blocks as they cool must be provided so that the blocks could exit the chamber at a cool enough temperature to manually handle them.

After further review of this ECO, it is evident that it is not practical to recover this heat.

An alternate to the use of the cast supports would be a conveyer system which did not use transient support. This system would be similar to a "walking beam" conveyer, as used in large furnaces in the U.S., and elsewhere. Such a system would require extensive rework of the furnace, however, and is not economic for the current application.

3.0 EQUIPMENT LIST/SIZE

This is not applicable since this ECO is not practical to implement.

4.0 PREDICTED ENERGY SAVINGS

This ECO is not practical to implement.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

This ECO is not practical to implement.

6.0 CONCLUSIONS

This ECO is not practical to implement.

7.0 RECOMMENDATION

This ECO should be cancelled.

INVESTIGATE A MECHANICAL CHARGE SYSTEM FOR REHEATING FURNACE NO. 2	Annual Savings LE:	None
	Investment Cost LE:	30,500
	Payout, Years:	Not Applicable

ECO #NM-B-20

1.0 PURPOSE

The purpose of this ECO is to mechanize the handling system at the entry end of the No. 2 Reheat Furnace in order to charge cold (or hot) billets into the pusher-type furnace.

2.0 PROCESS DESCRIPTION

Feedstock for the No. 2 Semi-automatic Rolling Mill, which is a finishing operation for manufacturing smaller size reinforcing concrete bars, is supplied by both the old No. 1 Semi-automatic Rolling Mill and the newer No. 3 Automatic Rolling Mill. This feedstock or semi-finished product is in the form of 36mm to 38mm squares. It is produced in more or less random lengths about 2 meters long from the No. 1 semi-automatic mill, whereas the cut length from the No. 3 automatic mill is dimensionally consistent. Under current operations, this product is "cropped" to charging length, manually stacked and fed into the No. 2 Reheat Furnace in a physically "cold" state.

The present manufacturing process, as it relates to the finishing operation associated with the No. 2 semi-automatic mill, starts with charging cold ingots into the No. 1 Reheat Furnace, reheating the steel to rolling temperature, and then reducing the ingot in the No. 1 mill rougher to a 36mm to 38mm square bar. At this point, the square bar is diverted to a hot shear where, if the shear worked properly, the bar

would be cut to a proper length. Because there are problems with the existing hot shear, the bar is now cut by hand with a torch. The next step is to discharge the finished bars to an area where they are subsequently cooled. After that, the bars are moved to a cold shear for cutting to a length suitable for charging into the furnace. Then the cold bars are once again stacked on a buggy and moved by hand to the furnace area, where they are unloaded and manually stacked on the table ahead of the furnace.

The process just described is inefficient and labor intensive, and extremely uncomfortable for the workers loading the steel onto the furnace table for charging because of the heat and weight of the bar.

It is proposed that the charging operation be mechanized. This proposal contemplates constructing a V-shaped receptacle or basket-like arrangement to replace the flat-topped buggy at the furnace. This basket or piler will be designed so that when it is loaded, the ends of the semi-finished bars hang out on each side. This will permit unloading the piler with tongs. It is visualized that these tongs are suspended from a pendant operated monorail crane which will be used for moving the load from the piler to the furnace for charging.

3.0 EQUIPMENT LIST/SIZE

This ECO contemplates tne construction of a V-shaped receptacle or piler for receiving cold billets from the crop shear. Additionally, it is proposed that a pendant operated crane equipped with motorized tongs be provided for unloading the piler and moving the load to the furnace for charging.

4.0 PREDICTED ENERGY SAVINGS

There are no energy savings associated with this ECO. The potential energy savings associated with this project require the implementation of ECO #NM-B-23, which is a companion project.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated investment for this project is LE 30,500 The investment is non-recoverable without implementing ECO #NM-B-23.

6.0 CONCLUSIONS

Based on the description shown above, the project has considerable merit because it upgrades a very inefficient manual operation. If installed, it will facilitate the implementation of the proposal outlined in ECO #NM-B-23.

7.0 RECOMMENDATION

The ECO should be implemented, not based on energy savings, but rather on its merit for upgrading a presently very inefficient operation.

INVESTIGATE VARIABLE SPEED DRIVE MOTORS

Annual Savings LE: None
Investment Cost LE: None
Payout, Years: Not Applicable

ECO #NM-B-21

1.0 PURPOSE

The purpose of this ECO is to investigate the installation of variable speed drive motors in the rolling mills to decrease the electrical power consumption of the large motors.

2.0 PROCESS DESCRIPTION

An indepth technical study of this proposed ECO, revealed that variable speed drive motors are used in large steel mills when the rolling speed is changed during the processing of one billet. The billets in the Nametin mill are short, however, and the speed during the rolling (both in roughing and finishing) process is kept constant.

The conclusion reached was that variable speed drive motors are not an appropriate technical application for this mill.

3.0 EQUIPMENT LIST/SIZE

No further attemps were made to study this matter.

4.0 PREDICTED ENERGY SAVINGS

No energy savings could be calculated.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

No investment costs could be developed.

6.0 CONCLUSIONS

This ECO has no application for the Nametin Mill.

7.0 RECOMMENDATION

The recommendation is to delete this ECO.

INVESTIGATE NEW FLYWHEEL IN ORDER TO INCREASE OPERATING TIME OF MOTOR

Annual Savings LE: None
Investment Cost LE: Not Applicable
Payout, Years: Not Applicable

ECO #NM-B-22

1.0 PURPOSE

The purpose of this ECO is to investigate installing a new flywheel in the drive train for the roughing line of semiautomatic Mill No. 1 in order to decrease the motor overload and thereby increase the operating time of the motor.

2.0 PROCESS DESCRIPTION

The roughing line in the semiautomatic mill No. 1 consists of one stand with 3 rolls that are driven by a 1400 horsepower electric motor. Initially the rolls were driven by a single cylinder steam engine through a large diameter flywheel. Due to the age of the steam engine, the engine was taken out of service in recent years. A new motor and reduction gear were then installed and their output shaft was connected to the original flywheel. The study of this ECO was initiated since the motor has experienced failures due to overload. It was believed that a new flywheel could alleviate the situation.

Upon further study, it is now believed that the motor failures due to overload is attributable to three possible causes. These are:

a) Cold billets
b) Loose foundations
c) Dirty billet ends

Items numbers 1 and 3 can be reduced or eliminated by a more careful control of the rolling operation. Item 2 can be corrected by reanchoring the foundations of the rolling equipment, and the utilization of self locking nuts or bellville spring washers on the bolts.

Despite a careful control of the plant operation, a more positive solution should also be instituted to safeguard the motor. It is proposed that a break-flange be installed between the flywheel and the gear box serving the roll . This break flange will utilize a pair of flanges secured by several bolts designed to fail before the motor is damaged by overload. Also the shaft between the flywheel and break flange should be of larger diameter than presently installed.

If an abnormally large load is transmitted through the flywheel and the bolts of the break flange shear, it is a relatively simple repair to replace the bolts. A small amount of time will be lost making this repair.

3.0 EQUIPMENT LIST/SIZE

a) A pair of flanges with through bolts designed to shear prior to motor overload.

b) Shaft between break flange and flywheel of larger diameter than currently installed designed to withstand the load required to shear the bolts in the break flange.

4.0 PREDICTED ENERGY SAVINGS

While the above described equipment will protect the motor and better insure that the roughing line will not break down due to motor overload, credit cannot be taken for energy savings resulting from this.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

Since energy savings cannot be claimed for this ECO, the determination of the investment costs for a new break flange and shaft has not been done.

6.0 CONCLUSIONS

While energy savings cannot be credited to this ECO, it is recommended that a new break flange be installed to safeguard the motor from overload.

7.0 RECOMMENDATION

It is recommended that the break flange be installed between the motor and flywheel to protect the motor from overload.

INVESTIGATE HANDLING OF SMALL BILLETS FROM THE OLD ROLLING MILL DIRECT TO #2 REHEAT FURNACE

Annual Savings LE : 55,000
Investment Cost LE: 655,000
Payout, YRS : 11.9

ECO #NM-B-23

1.0 PURPOSE

The purpose of this ECO is to investigate handling billets from the old semiautomatic rolling mill direct to the #2 reheat furnace and charging these billets into the furnace while they are still hot. "Hot charge" is an effective way to reduce fuel usage with a resulting savings, since it takes less energy to heat the "hot" steel to its rolling temperature.

2.0 PROCESS DESCRIPTION

Feedstock for the #2 semiautomatic rolling mill, which is a finishing operation for manufacturing smaller size reinforcing concrete bars, is supplied by both the old #1 semiautomatic rolling mill and the newer #3 automatic rolling mill. This feedstock or semi-finished product is in the form of 36 mm to 38 mm squares. It is produced in more or less random lengths about 2 meters long from the #1 semiautomatic mill, whereas the cut length from the #3 automatic mill is dimensionally consistent. Under current operations, this product is "cropped" to charging length, manually stacked and fed into the #2 reheat furnace in a physically "cold" state.

This ECO pertains to the #1 and the #2 semiautomatic rolling mills only, and its objective is to examine ways to automate the operation so that "hot" billets can be cut to a length within dimensional tolerances

and delivered from the #1 mill to the holding table ahead of the #2 reheat furnace in a way that they can be mechanically charged into this pusher type furnace. This sort of facility revamp, if successful, will eliminate the present labor intensive manhandling operations involved with stacking, cooling, cold shearing and unloading before manually assembling the product at the furnace for charging. In addition to fuel savings attributable to hot charging the #2 furnace, there should be a significant improvement in product yield performance, which provides another substantial savings in energy consumption, as far upstream in the plant operation as the open hearth.

The present manufacturing process, as it relates to the finishing operation associated with the #2 semiautomatic mill, starts with charging cold ingots into the #1 reheat furnace, reheating the steel to rolling temperature, and then reducing the ingot in the #1 mill rougher to a 36 mm to 38 mm square bar. At this point, the square bar is diverted to a hot shear where, if the shear worked properly, the bar would be cut to a proper length. Because there are problems with the existing hot shear, the bar is now cut by hand with a torch. The next step is to discharge the finished bars to an area where they are subsequently cooled. After that, the bars are moved to a cold shear for cutting to a length suitable for charging into the furnace. Then the cold bars are moved by hand to the furnace area, where they are unloaded and manually stacked on the table ahead of the furnace.

The process just described is inefficient and labor intensive, and surely can be upgraded to a more economical operation. To do this, it is proposed that the existing hot shear be replaced with a hot

flying shear whose operation is synchronized with mill speed to obtain dimensionally accurate cut lengths. It will also be necessary to install a holding or surge table to allow for delays at the reheat furnace. A new motorized roller conveyer is included in this scheme for moving the bars away from the #1 mill area and delivering the product to #2 reheat furnace.

At #2 furnace, the conveyor will discharge into a V-shaped trough like piler or basket like arrangement near the entry side of the furnace, where the steel can be picked up with tongs suspended from an overhead monorail crane which will move the charge into position for pushing into the furnace.

The operation of these tables and conveyors would be basically push button controlled from operator stations from where the movement of product could be monitored in a reasonably comfortable environment The monorail crane can be pendant operated.

To insure the integrity of this concept, the scheme should be logistically simulated during the preliminary engineering design phase in order to coordinate operating rates of the individual production units and to identify bottlenecks in the system. The simulation model will confirm the feasibility of the proposal.

3.0 EQUIPMENT LIST/SIZE

This ECO contemplates the purchase and installation of a new or reconditioned hot flying shear to replace the existing hot shear. It also calls for replacing a part of the existing mill table, adding a holding table for accumulating product during surges, and provides for a new roll line or motorized conveyor to the #2 furnace area.

It is possible that existing mill tables can be reused in final engineering design.

The new conveyor discharges into a V-shaped trough where the hot product can be accumulated for charging the furnace. For purposes of evacuating this ECO, it is assumed that this trough or piler arrangement, as well as the overhead monorail crane, will be furnished on ECO #B-20 which spells out a mechanical charge system for the #2 reheat furnace.

4.0 PREDICTED ENERGY SAVINGS

The #2 reheat furnace operates two (2) eight hour shifts per day, six days per week for 52 weeks per year. This is equivalent to approximately 5000 operating hours per year.

The output of the #2 furnace is on the average about 7 metric tons per hour, equivalent to 15,435 lbs. per hour.

If the ambient air temperature is taken as 27°C, the absorbed duty for this temperature differential is 1,189,000 BTU/hr with a fired duty of 1,841,000 BTU/hr. This is equivalent to a savings of 230 tons of mazout per year. At a worldwide price of 241.8 LE/ton of mazout, the annual savings is estimated to be approximately 55,000 LE per year labor savings.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The total predicted annual savings for this ECO is LE 55,000. Based on a preliminary pricing, the estimated investment cost is LE 655,000 corresponding to a payout of 11.9 years.

6.0 CONCLUSIONS

Based on the descriptions and analysis shown above, delivering hot billets to the #2 reheat furnace, ready for charging, results in a predicted savings of approximately 55,000 LE per year, and a payout which exceeds 3 years.

7.0 RECOMMENDATION

This ECO should not be implemented.

INVESTIGATE PUMP SUCTION AT AUTOMATIC ROLLING MILL MAZOUT DAY TANK	Annual Savings LE:	1,544
	Investment Cost LE:	5,600
	Payout, Years:	3.63

ECO #NM-B-24

1.0 PURPOSE

The purpose of this ECO is to investigate the problems at the suction of the mazout pump(s) feeding the automatic mill reheating furnace.

2.0 PROCESS DESCRIPTION

The fuel oil (mazout) day tank (Ø 2600mm 3,400mm) is a vertical tank receiving mazout (from the 75 ton storage tank), as required. The level in the tank is registered by a float/counterweight system. The tank is not insulated, and is situated on a pedestal, in a location at the edge of the plant, where it is exposed to wind.

The contents of the tank are heated by an electric heater. The temperature of the outside wall was measured to be 36°C. Plant personnel are complaining that the suction to the mazout pump(s) is frequently clogged, creating problems. In order to assure a sufficient quantity of mazout, both pumps are kept running.

The tank has no manhole on the shell, the only entry is through the roof.

3.0 EQUIPMENT LIST/SIZE

In order to alleviate the problems described above, a set of measures have to be taken.

a) During a shutdown of the furnace, when it is maintained at low heat, the pumps have to be disconnected and temporary facilities (such as a tank truck) have to be used to provide fuel to the burners.

b) The tank has to be emptied (flushed out with sular) and the bottom thoroughly cleaned, as well as the suction piping and filters.

c) If possible, a manhole should be installed in the bottom part of the shell so as to permit entry for periodic cleaning.

d) At least the bottom half of the tank must be insulated.

e) The level system must be at least repaired (presently it appears that it is not functioning properly), or better, replaced.

ECO #NM-A-14 has provided a temperature measuring instrument in the suction line. The temperature in the tank shall be maintained close to 45-50°C, by adding insulation, as proposed in ECO #NM-A-1b.

During our survey, it became evident (through actual tests) that the output of both the presently installed mazout pumps are too small, since when switched on individually neither developed more than about 60% of the required flow.

4.0 PREDICTED ENERGY SAVINGS

If suction problems removal result in one pump being sufficient, the obtained savings amount to LE 1,544/ year based on worldwide energy prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated price of implementing all the measures proposed in par. 3.0 is LE 5,600. Yet except for a new manhole, all other items proposed could be implemented as a result of other ECO's. For the total cost the payout is 3.6 years.

6.0 CONCLUSIONS

This ECO does not really relate only to a particular energy saving opportunity, but is also an operational/ maintenance item.

7.0 RECOMMENDATION

We recommend implementation because there is an apparent energy savings involved.

INVESTIGATE OTHER MATERIALS OR TECHNIQUES FOR RECUPERATOR IN AUTOMATIC MILL	Annual Savings LE:	63,500
	Investment Cost LE:	42,000
	Payout, Years:	0.66

ECO #NM-B-25

1.0 PURPOSE

The purpose of this ECO is to investigate other materials or different techniques for the heat exchange between hot flue gases and cold primary and secondary combustion air, at the automatic rolling mill reheating furnace.

2.0 PROCESS DESCRIPTION

The hot flue gases from the reheating furnace exchange heat with cold secondary combustion air in six metallic U-tube bundle type exchangers. The combustion air is heated to approximately 400°C while passing through the exchanger. The atomizing (primary) combustion air is preheated about 280°C in two small exchangers of a similar type. While there were obvious corrosion problems in the atomizing (small) exchangers, the large recuperators show little damage from corrosion. Their failure at or near the tubesheet junction being of a mechanical nature, probably due to thermal stress or vibration.

The smaller exchangers, which are corroded may have experienced the effects of flue gases being cooled below their SO_3 dewpoint. This is rather unusual, since the temperature measured at the stack (after the corroded exchangers have been removed) is at least 300°C, which is at least 100°C above the SO_3 dewpoint for this type of fuel. A more likely explanation is

that the damage arose from oxygen corrosion of the metal when exposed to the flue gases without internal (atomizing) air flow.

The purpose of this ECO is to recommend the replacement of the two small carbon steel exchanger bundles with 300 series stainless steel units, thus improving their resistance to either type of failure. Additionally, wall thickness should be increased to nominally 4mm.

As for the large exchangers, the recommendation is to improve the design of the tube attachment to the tubesheet. This redesign is assumed to include a gusset or collar, to minimize stresses which occur at this junction.

Materials of construction appear to be adequate for this exchanger. Repairs as necessary to existing units should probably include the addition of a collar on the tube, and the welding of the tubes to the tubesheet.

3.0 EQUIPMENT LIST/SIZE

Provide two new bundles (heat transfer area approximately 6.0 m^2).

Weld and reseal six (6) heat exchangers, total heat exchange area being 550 m^2 (3 x 110 m^2, and 3 x 73 m^2).

4.0 PREDICTED ENERGY SAVINGS

The energy savings for this ECO are the two percent in combustion efficiency lost due to air inleaks (see ECO #NM-A-13c). This amounts to LE 63,500 annually based on worldwide prices.

5.0 INVESTMENT AND ASSOCIATED ECONOMIC EVALUATION

The estimated investment for this ECO is LE 42,000 which generates a payout of 0.66 years.

6.0 CONCLUSIONS

The good payout and the fact that combustion will also improve due to the preheat of atomizing air (which is now being sent cold to the burners) makes this ECO attractive.

7.0 RECOMMENDATION

We recommend implementation.

22817

ORGANIZATION for ENERGY PLANNING

جهاز تخطيط الطاقة

سري للغاية

AUDIT

FINAL REPORT

VOLUME 2 OF 2 (APPENDIX)

BY

JOINT ENGINEERING GROUP

* ORGANIZATION FOR ENERGY PLANNING (OEP)
* NATIONAL METAL INDUSTRIES COMPANY (NAMETIN)
* FOSTER WHEELER ENERGY CORPORATION (FWEC-USA)

April 4, 1985

O.E.P. تلكس دولى ٢٣٤٠٤ تليفون : ٩٢٦٣٤٢ أو ٩٢٧١٨٩ ١ شارع عائشة التيمورية – جاردن سيتي – القاهرة
1, Aisha El-Taymorya – Garden City, Cairo Phone 926342 or 927189 Telex. 23404 O.E.P.

APPENDIX "A"

BASIC ENGINEERING DATA

Basic Engineering Data:

The Basic Engineering Data (B.E.D. Sheets) which will be used during the audit and subsequent design of the various ECO's is given in the pages which follow:

The source of the data listed below is as follows:

Utility Cost (Paragraph 3.0)

Fuels - Per Egyptian General Petroleum Corporation.

Electric Power - From Organization for Energy Planning (OEP).

Steam - Developed by FWEC from data furnished by Chemical Process Economics Center for Stanford Research Institute and modified to reflect the energy cost used in this report.

Water - Developed by FWEC from data furnished by Chemical Process Economics Center for Stanford Research Institute and modified to reflect the energy cost used in this report.

Meteorological Data (Paragraph 4.0)

As developed from data provided by Egyptian Meteorological Authority for a five year period (1978 through 1982).

Minimum Dry Bulb Temperature is average of mean minimum temperatures.

Design Dry Bulb Temperature is average of mean maximum temperatures.

Design Wet Bulb Temperature is determined from Psychrometric Chart using an average relative humidity of 64 percent.

Utility Information (Paragraph 5.0)

Fuel oil specifications - Per Egyptian General Petroleum Corporation.

Sular specifications - Per Egyptian General Petroleum Corporation.

Rules from Electric Billing

Specified by contract between the plants and the Electric Authority.

Organization for Energy Planning

REF. Energy Conservation
DATE Jan., 1985
PAGE 1
Revised Feb. 28, 1985
Revised April 4, 1985

ENERGY CONSERVATION PROJECTS

BASIC ENGINEERING DATA

PLANT: NATIONAL METAL INDUSTRIES CO., ABOU ZAABAL

1.0 General:

This form defines the basic engineering data which will provide the technical and economic basis for the evaluation of energy conservation opportunities (ECO's) for the above named industrial complex.

2.0 Economic Guidelines:

2.1 Operating Time: (Overall Plant)

2.1.1 Number of operating days per year 365
2.1.2 Number of shifts per day 3
2.1.3 Normalized number of operating hours per year 8,760

2.2 Operating Time: (For Analysis)

2.2.1 Open Hearth Furnace 7,500 Hrs/Yr
2.2.2 #1 Reheat Furnace 7,500 Hrs/Yr
2.2.3 #2 Reheat Furnace 5,000 Hrs/Yr
2.2.4 #3 Reheat Furnace 7,500 Hrs/Yr

2.3 Economic Evaluation Basis:

2.3.1 Payback priority list, simple basis Yes
2.3.2 Discounted cash flow No
Taxes
Inflation
Interest
Required R.O.I. (if known)

3.0 Utility Cost:

Utility	Units	Public Sector Domestic Cost, LE	World Cost, LE
Fuels			
Mazout (#6)	LE/met. ton	7.500	241.8 (1)
Sular	LE/met. ton	36.000	325.000 (1)
Electric Power (3)	LE/kwh	0.010	0.092 (5)
Steam (2)			
High Pressure (4)	LE/met. ton	0.516	16.632
Medium Pressure (4)	LE/met. ton	0.454	14.636
Low Pressure (4)	LE/met. ton	0.384	12.308
Water			
Raw	LE/1000 Imp. Gal.	0.086	0.80
Cooling (circulated)	LE/1000 Imp. Gal.	0.007	.067

Notes

(1) Based on value FOB* Italy (Feb. 21, 1985) with a conversion of 1.3 LE to 1 USD
(2) Note HP. 35 Bar or more
MP. 10 to 35 Bar
LP. 0.3 to 10 Bar
(3) High voltage (11,000 volts)
(4) The cost of condensate or boiler feed water is 10 percent c the steam cost.
(5) Marginal cost for electricity with fuel component valued at world wide price.

* "Free on board"

4.0 Meteorological Data:

4.1 Meteorological Data: (Cairo Area)

Temperatures:

Minimum Dry Bulb	6°C
Design Dry Bulb	34°C
Design Wet Bulb	28°C

Note: For insulation calculations use dry bulb temperature at 20°C.

Wind Velocity and Direction: 0-15 km/hr Random Direction.

Winterization Area Classification: None

Allowance for Earthquake Forces: None

Rainfall: Less than 10 cm/yr.

Design Humidity (relative) = 64% (34°C/28°C)

5.0 Utility Information:

5.1 Fuel Oil (mazout #6):

Temperature (pour point), °F	100.0
Specific Gravity @ 60°F/60°F	0.99
Viscosity, Redwood No.1 @ 100°F	2000.0
Viscosity, Redwood No. 1 @ 210°F	115
Sulfur, % by wt.	2.5
Heating Value, HHV, BTU/metric ton	38,646,000

5.2 Light gas oil (sular):

	minimum
Specific Gravity @ 15/4°C	0.82
Viscosity, Redwood No. 1 @ 100°F	30
Sulfur, % by wt.	1.5
Heating Value, HHV, BTU/metric ton	42,340,000
Flash Point Penske-Martens closed, °C	55

NOTE: Sular is light gas oil, minimum figures are suitable.

6.0 Rules for Electric Billing

The following rules for electric billing (or application of rates) will apply to economic analysis of ECO'S which relate in depth to the cost of power. These rules assume a consumption at more than 625 KVA (500 kw), at a voltage level of 380 volts, for industrial uses other than limited lighting.

6.1 Demand Factor

The demand factor envisions a base load for this complex, which is 2,400 kw, and allows excursions beyond the base load for a period not to exceed zero minutes per excursion. If this excursion limit is exceeded, the electric bill is calculated on the basis of this maximum load condition for the entire billing year (5% grace is allowed).

6.2 Power Factor

The target power factor for all users is 1.0. Two price variations exist, however, based on an acceptable power factor of 0.8. These are respectively, an incentive, and a penalty, as well as a shutdown clause.

6.2.1. Power Factor Incentive:

An incentive of a discount on the electric bill is offered, at a rate of 0.5% discount (factor of 0.005) on each percent of power factor greater than 0.8 (i.e. a maximum of 20 steps at 1% to achieve a P.F. = 1.0).

6.2.2. Power Factor Penalty:

A penalty of an increase on the electric bill is mandated, at a rate of 0.5% increase (factor of 0.005) on each percent of power factor less than 0.8 (i.e. a penalty of 10 x 0.5% or 5% for a PF equal to 0.7).

Additionally, if the power factor is 0.6 or less, a second 0.5% increase per 1% of P.F. is additive, for a total penalty of 1% of P.F. below 0.6.

6.2.3. Shutdown for Power Factor

The billing system provides a clause to shutdown any user who has a power factor of less than 0.6, who does not correct this adverse power factor within 3 months.

6.3 Billing Rates:

The following rates are based upon a yearly billing basis, and normally apply to a fiscal year from July to June.

The bill is based upon the sum of several elements, which consist of three major categories, thereafter ratioed up or down by the power factor rate adjustment.

The three major elements are:

a) constant annual charge, based on the maximum stated demand, and priced at 7.756 LE/year for each kw.

b) a cost per KWH consumed, on a sliding scale, in accord with table #1.

c) taxes, which are the sum of:

- o broadcast tax, @ 0.001 LE per KWH for lighting*.
- o consumption tax, @ 0.005 LE per KWH for lighting*.
- o power tax, @ 0.0001 LE per KWH for 90% of KWH.

See Table #1 on next page.

7.0 Currency Conversion Rate:

The conversion of US Dollars to Egyptian Pounds (L.E.) is accomplished by multiplication of USD by 1.3 to obtain LE.

* assumed to be 10% of total.

KWH Rate Table #1

Range	1 Time (hours)	2 Maximum Rate (KW)	3 Total Power (measured) (KWH)/year	4 Total Power (calculated) (KWH)	5 Power Remaining (KWH)	6 Rate (LE)	7 Cost (LE)
1	1000	( )	( )			0.013942	
2	500	"				0.013114	
3	1000	"				0.011458	
4	1000	"				0.009802	
5	1500	"				0.007456	
6	*					0.006352	
						Total	

Notes:

1. column 1 represents hours at the stated demand rate, i.e. first 1000 hours, next 500 hours, etc. Range 6 does not have an entry, since the power at rate range 6 is found by difference.

2. column 2 is the maximum rate, as determined from short term maximum during the year (not applicable to range 6).

3. column 3 is measured power at the meter, in KWH, for the billing year. (enter at range 1 position only).

4. column 4 is total power calculated, as the product of column 1 & 2.

5. column 5 is remaining power, as column 3 - column 4 for range 1, and thereafter the entry for the previous range minus the entry in column 4 for the current range, i.e. power in KWH not yet accounted for.

   The calculation is repeated by range until the power remaining is less than the power calculated.

6. column 7 is the product of columns 4 & 6, until such time as the power remaining is less than the power calculated. When this occurs, column 7 is the product of the power remaining (column 5) and column 6. Note that this occurs always at range 6, if not before.

* (Maximum hours which could exist in column one would be: 365 x 24 - 5,000 = 3,760 hours).

APPENDIX "B"

NEW DATA COLLECTED

PORTABLE INSTRUMENTS

The audit team was provided with a complete set of various portable instruments to permit field measurement of data parameters, as necessary to carry out the engineering calculations associated with the audit.

These instruments, as described by the attached list, were carefully selected to provide a well rounded set, able to measure those parameters which are basic to a broad range of audit types.

The instruments will permit any conceivable audit, to a significant depth, to include the following typical plant systems:

- Combustion devices, including boilers, furnaces, kilns, heaters, ovens etc.
- Steam systems, including traps
- Electrical systems, with demand and power factor
- Heating, ventilating, and air conditioning
- Lighting

Where required, instruments are multiple range, and specified to be compatable with the power sources found in Egypt.

Each instrument is provided with a calibration record card and a stick-on label, physically attached to the instrument, to show calibration period data.

Each instrument was rechecked, after receipt in Egypt, using standard calibration techniques, to insure that no damage had occurred in transit.

PORTABLE INSTRUMENTS USED BY THE ENERGY AUDIT TEAM

REF. #	MANUFACTURERS NAME INSTRUMENT TYPE	SERIAL NO.	QUANTITY	PART NO.	BRIEF DESCRIPTION
1	Thermo Electric Temperature Indicator	110984-1-11	1	351153 000000	Digital temperature device,w/accessories
2	Transcat Thermometer 0/220F	None	1	PT1/220	Temperature Indicator
3	" " 40/160F	None	1	PJ1/160	"
4	" " Glass Tube	None	1	6907T/300	Mercury Thermometer
5	MC Products Infrared Temperature	011270	1	LT-100	Hand held digital temperature measuring device
6	[illegible]rach Boi[illegible] Test Kit	10-8001	1	10-8001	Kit of materials to test boiler efficiency
7	Bacharach Sample Test Cooler	None	1	11-7046	Accessory to Boiler Test Kit
8	MC Products Combustion Analyzer	10500	1	M-50	Digital Combustion Gas Analyzer
9	Davis Instrument Anemometer	508782	1	A/2-4"	Propeller Driven Air Flow Indicator
10	Dwyer Instrument Air Velocity Meter	5449	1	400-10	Red Oil manometer and accessories
11	Taylor Instrument Sling Psychrometer	1330	1	TA 16301	Device to measure relative humidity
12	Sonic Instrument Stethoscope	407620	1	Sonic 3000	Ultrasonic Device to locate/measure sound levels with accessories
13	Cole-Palmer Stopwatch	None	1	R-8672-20	Measuring device to measure seconds
14	YEW Tachometer	03012M	1	3632-00	Optical device with digital readout to measure rotational speed

REF.#	MANUFACTURERS NAME INSTRUMENT TYPE	SERIAL NO.	QUANTITY	PART NO.	BRIEF DESCRIPTION
15	General Electric Lightmeter	154	1	214	Device to measure light output
16	Epic Inc. Power Factor Meter	45172	1	COS 051	Meter to indicate power factor
17	Epic Inc. KW Meter	45172A	1	KW 480Z	Meter to indicate power in kilowatts
18	Transcat Ammeter	140903	1	7405-E50	Meter to indicate line current in amperes
19	Fluke Multitest Meter	3500067	1	8021B	Meter for various electrical measurements
20	Transcat Recording Ammeter	36535AE 36536AE 36532AE 36534AE	4	7816E	Recording meter to indicate current consumption in amperes with accessories

ELECTRICAL FIELD MEASUREMENTS

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY..... DATE..... SUBJECT Plant Measurements 3-3-1995 SHEET NO. 1 OF 2

CHKD. BY..... DATE 320 V. Switchgear Steel Plant JOB NO. —

0 = Operating

UNIT NO.	O.C. L1	O.C. L2	O.C L3	O.KW L1	O.KW L2	O.KW L3	O.T. KW	O.V. L1-L2	O.V. L2-L3	O.V L1-L3	REMARKS
1.1											
1.2											SG-1 Motor C.
1.3											SG-2 Motor C.
1.4 A											
1.4 B	60.1	53	82	7.4	6.3	6.9	20.6	419	419	415	
1.4 C	27.5	26.3	27.1	3.4	3.4	3.2	10	417	418	417	
2.1											
2.2											
2.3											
2.4 A											Lighting
2.4 B											Lighting
2.4 C											Spare
2.5 A											Sheer
2.5 B											Spare
2.5 C											Furnace Equip
2.5 A											Pusher Furnace
2.6 B	68.8	88.9	90	22	3.2	3.4	28.6	417	418	416	Overhead Crane
2.6 C											Spare
2.6 D											Spare
3.1											
3.2											
3.3											
3.4 A	54.1	59.4	59.2	4.5	5	5	14.5	420	420	419	M. Shop
3.4 B	25.2	31.2	9.8	3.2	3.8	1.4	8.4	421	418	420	Roll W. Shop
3.4 C	182	200	202	10	11	10	31	422	420	419	Elect. W. Shop
3.5 A	14.3	1.2	.1	3	.13	.2	3.15	418	417	418	Elect.W.Shop
3.5 B											Spare
3.5 C											Spare
3.6 A	17	16.5	17.5	2	2.1	2.1	6.2	419	419	420	Water Pumps
3.6 B	30	2.9	21	11.3	0.1	3.3	14.61	419	420	417	Power Sockets
3.6 C											Spare
3.6 D											Spare
4.1											
4.2											
4.3											

LEGEND On Next Page

FORM 0551-47

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY ..... DATE ..... SUBJECT Plant Measurements 3-3-1985 SHEET NO. 2 OF 2

CHKD. BY ..... DATE ..... 380 V. Switchgear Steel Plant JOB NO. —

0 = Operating

UNIT NO.	O.C. L1	O.C. L2	O.C. L3	O.KW L1	O.KW L2	O.KW L3	O.T. KW	O.V. L1-L2	O.V. L2-L3	O.V. L1-L3	REMARKS
4.4 A	9.8	4.9	3.7	5.6	2.3	8.9	16.8	419	423	422	Feed Stock.S:
4.4 B	143		14	22	14.7	22	58.7	425	418	422	Scale Pump
4.4 C	29.7	44.4	58.5	4.4	5.8	6.8	17	421	422	422	R.&.F.F. Stores
4.5 A											Spare
4.5 B											Spare
4.5 C											Aux.W.S. Lighting
4.6	348	369	366	34	40	35	109	422	424	422	Comp.Station
5.1											
5.2											
5.3											Canal Water
5.4 A	150	153	150	24	25	24	73	422	420	421	P. Station
5.4 B											Spare
5.4 C	70.2	77.9	44.9	8.5	10.5	5.4	24.4	421	422	421	Roll in front of Furnace
5.5 A											Spare
5.6	Used For Large Motor Start.										

F.L.C. - Full Load Current

KW - Kilowatt

P.F. - Power Factor

L_1 - Single wire identification on a multi line circuit

L_2, L_3 - As L_1

KVar - Kilo Volt Amperes reactive

O.C. - Operating Current

O.V. - Operating Voltage

O.K.W. - Operating KW.

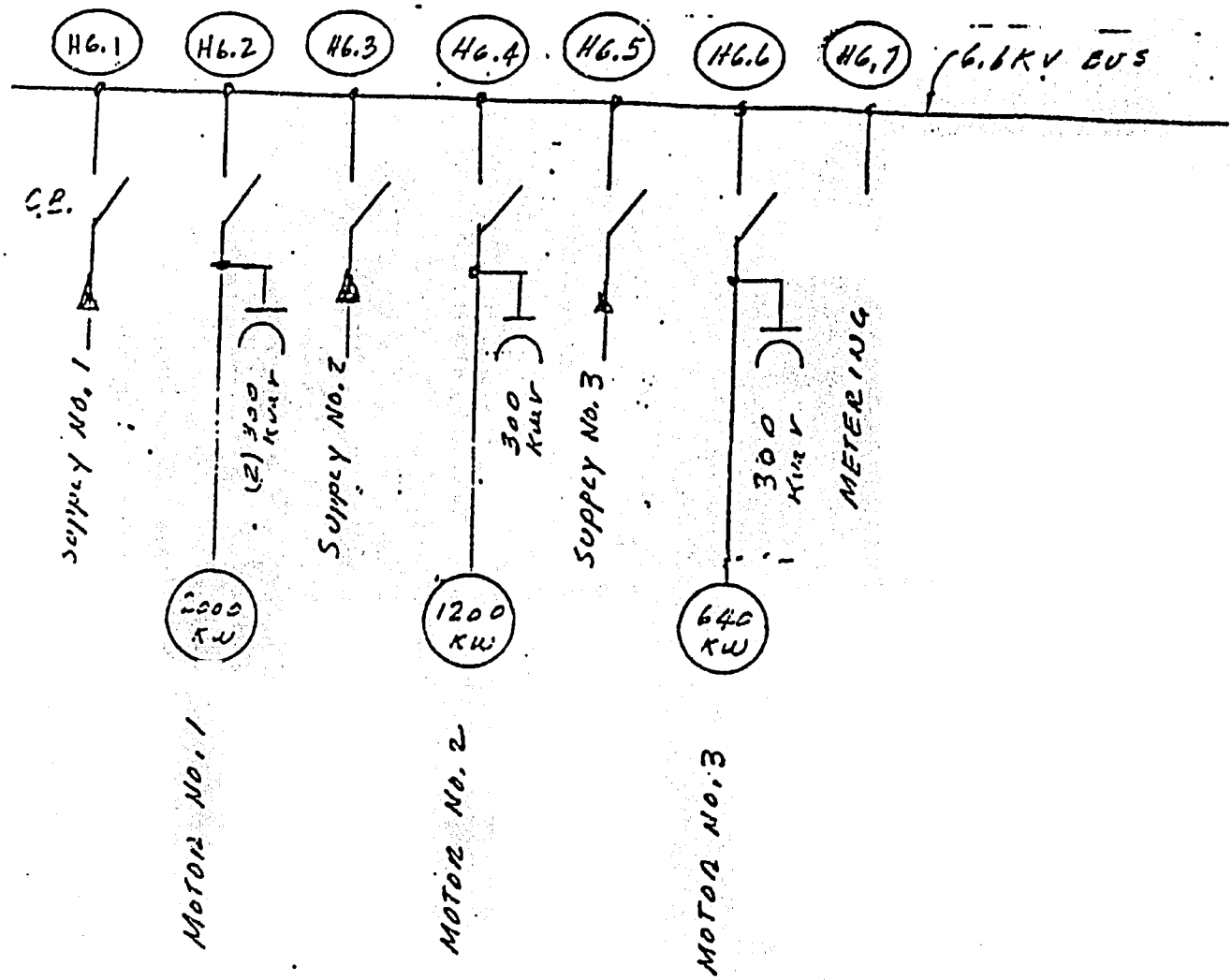
ELECTRICAL ONE LINE DIAGRAMS

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY ..... DATE ..... SUBJECT Electric Power - Steel Plant SHEET NO. 1 OF 4

CHKD. BY ..... DATE 6.6KV Motors - Automatic Mill JOB NO. .....

REFERENCE STEEL PLANT ONE LINE DWG. 807.06 7665-010



MOTOR NO. 1
NAMEPLATE DATA
VEM TEWC
6000V., 254A=F.L.C.
P.F. .80
594 RPM

MOTOR NO. 2
NAMEPLATE DATA
ASEA TEWC
6000V. 145A=F.L.C.
P.F. .83
740 RPM
1609 HP.

MOTOR NO. 3
NAMEPLATE DATA
ASEA TEWC
6000V. 80 A.=F.L.C.
P.F. .82
858 HP.

CORRECT P.F. TO .92 P.F.

MOTOR NO. 1
2000 KW = 1600KW @ .75PF
80% LOAD.
1600 KW X .75 = 1200 KW
1200 KW X .427 MULT. 584
KVAR = (2) 300 KVAR UNITS

MOTOR NO. 2
1200 KW / 85% LOAD = 1020 KW @ .75 P.F.
765 KW X .487 = 372 KVAR
= (1) 300 KVAR UNIT.

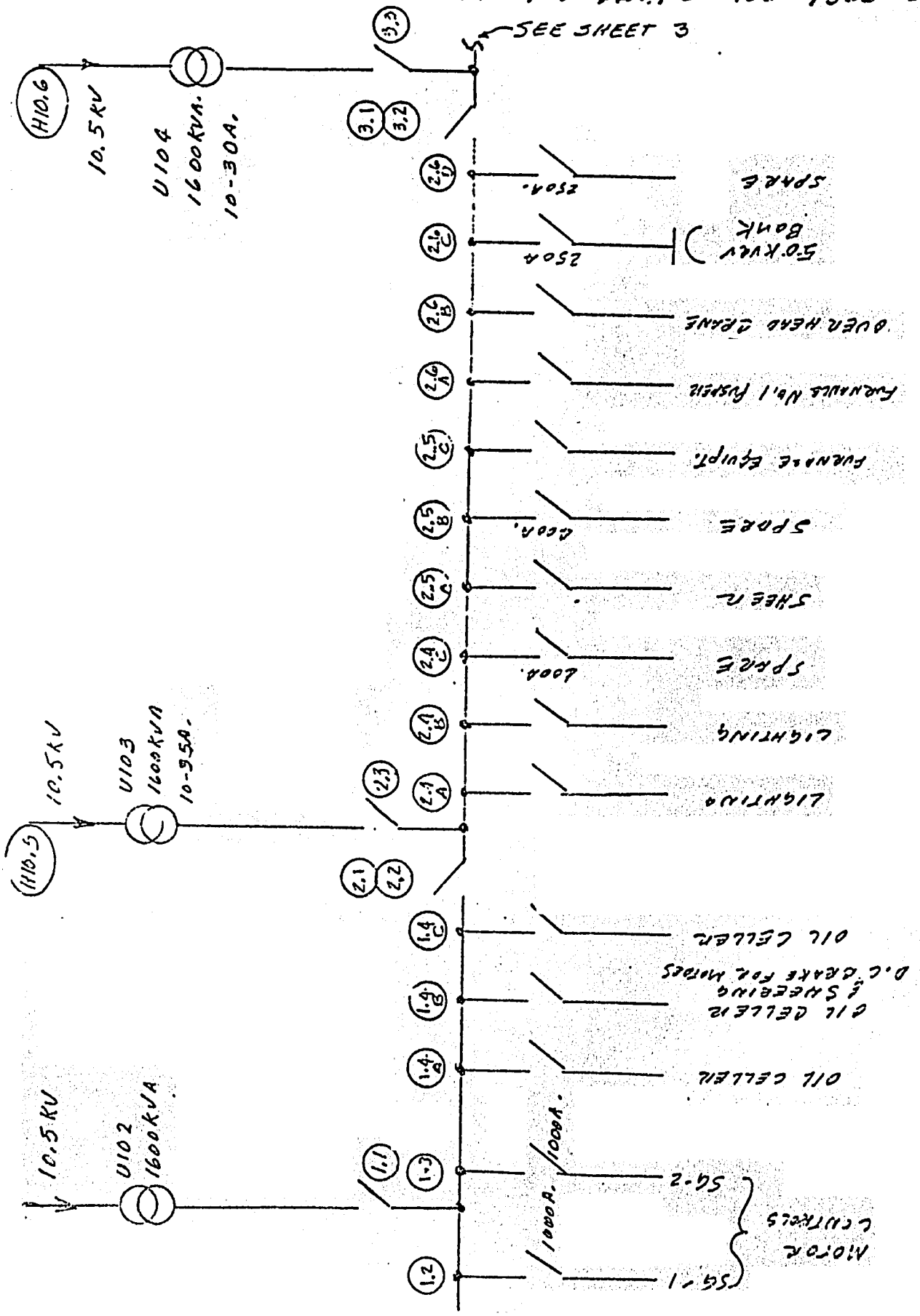
MOTOR NO. 3
640 KW = 525 KW
82% LOAD
525 KW @ .75PF
525 KW X .487 = 256
KVAR = (1) 250
KVAR UNIT.

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY..... DATE..... SUBJECT Electric Power - Steel Plant SHEET NO. 2 OF 4

CHKD. BY..... DATE 320 V. Switchgear - Automatic Mill JOB NO.

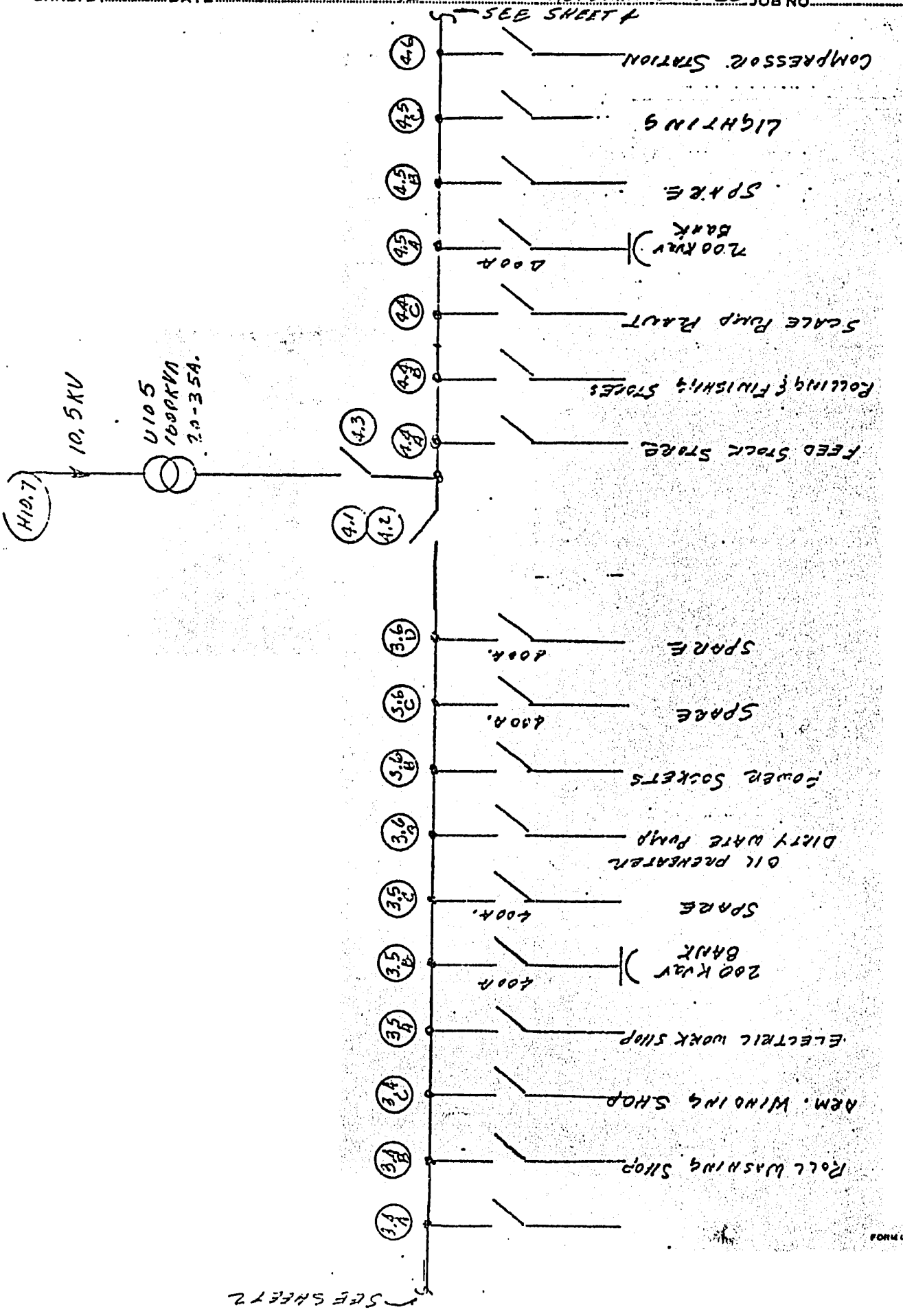
Reference Steel Plant One Line Dwg. 207.06-7665-010



FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY..... DATE..... SUBJECT ELECTRIC POWER - STEEL PLANT SHEET NO. 3 OF 4

CHKD. BY..... DATE 380V. SWITCHGEAR - AUTOMATIC MILL JOB NO.....

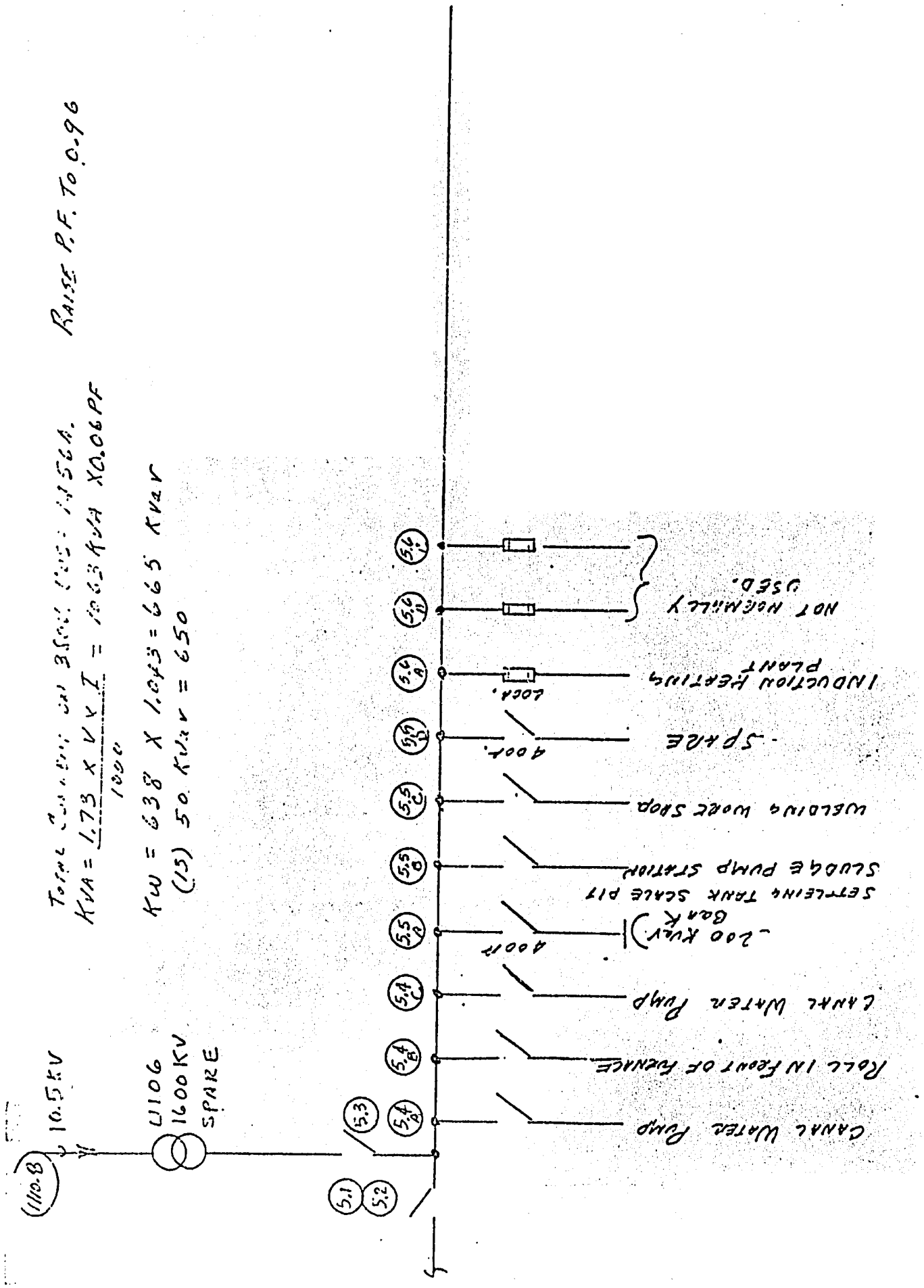


FORM 13851-47

STER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY..... DATE..... SUBJECT ELECTRIC POWER - STEEL PLANT SHEET NO. 4 OF 4

CHKD. BY..... DATE 380V. SWITCHGEAR - AUTOMATIC MILL JOB NO.....



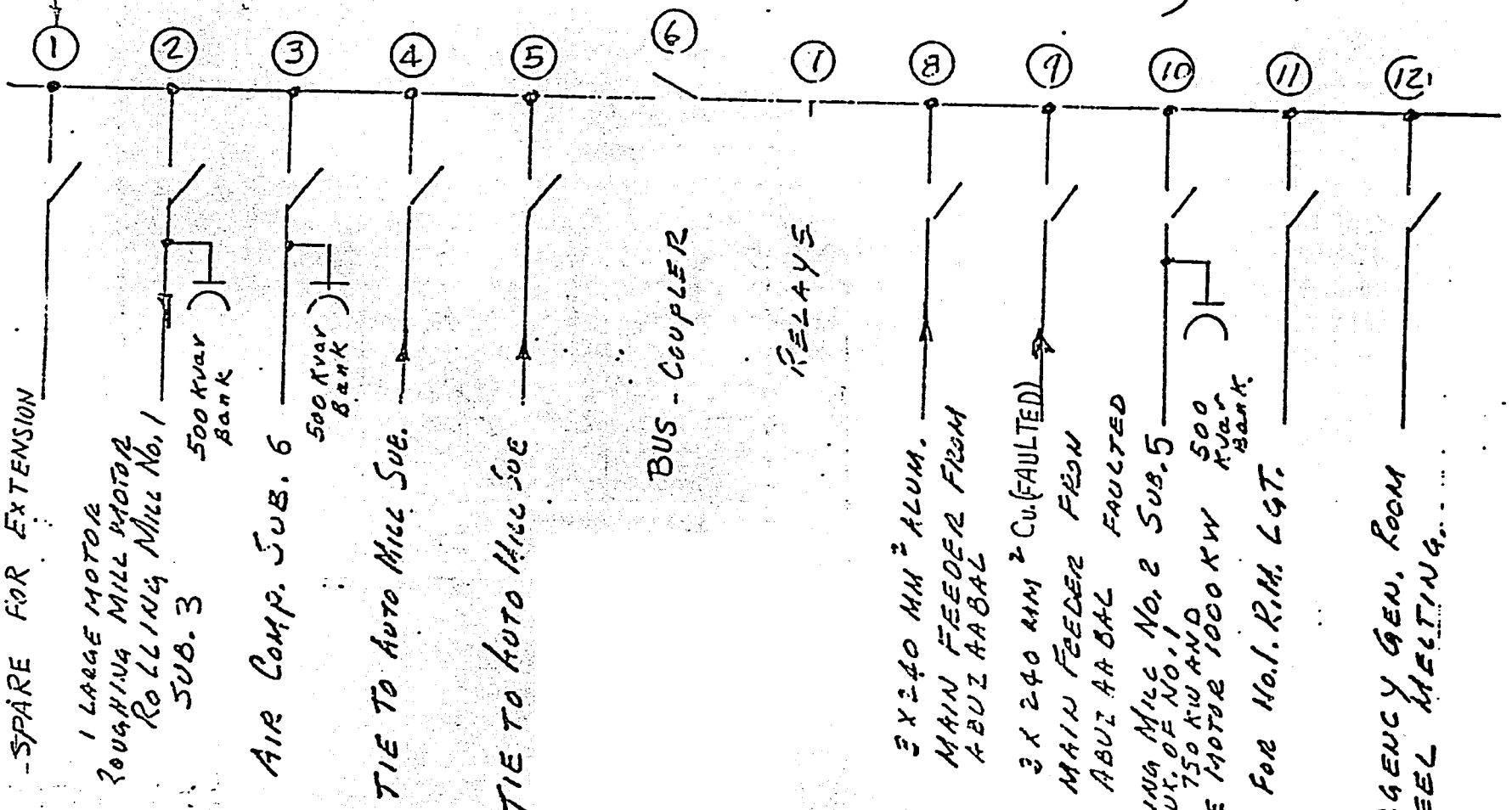
FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY _____ DATE _____ SUBJECT ELECTRIC POWER SHEET NO. 1 OF 5

CHKD. BY _____ DATE MAIN SUB. 10.5KV, OLD STEEL PLANT JOB NO. _____

MAIN SUBSTATION OLD PLANT

UNIT NO. 7-2-85 REALYNG 10.5 KV, 300 AMPS. MAX., 200 AMPS. NORMAL



RAISE P.F. TO .85

$$KVA = \frac{1.73 \times E \times I}{1000} = \frac{1.73 \times 10.5KV \times 200}{1000} = 3633 \times 0.60 PF$$

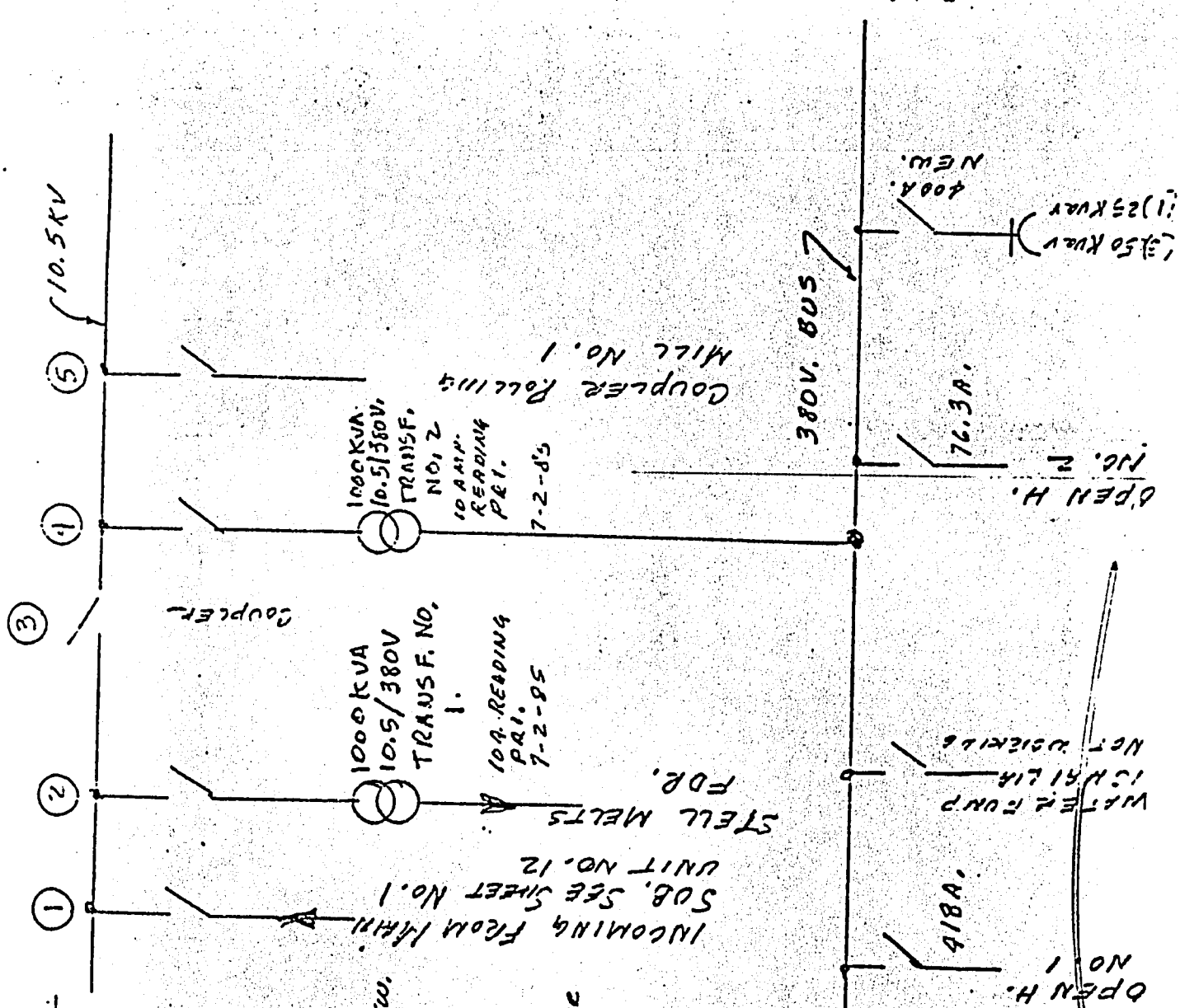
$$KW = 2180 \times .714 = 1556 \text{ KVAR.}$$

FORM 0884-7

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY..... DATE..... SUBJECT Electric Power - SHEET NO. 2 OF 5

CHKD. BY..... DATE Emergency Gen. Sub-1 - Steel Mill Old Plant JOB NO.....



Emerg. Gen. Room

Steel Melting

Sub. 1

Measured 380V. Amps
7.54 X 20% = 88.1A.

Operating
Voltage = 382

VA = 582 X P.F. .60 = 349 KW.

Correct P.F. To .96

349 X 1.043 = 364 KVAR

364 KVAR = (6) 50 KVAR.
(2) 25 KVAR

$\frac{364 \times .062}{1000} = 0.02\%$ Voltage Rise
= R. Loss Reduction = 61%

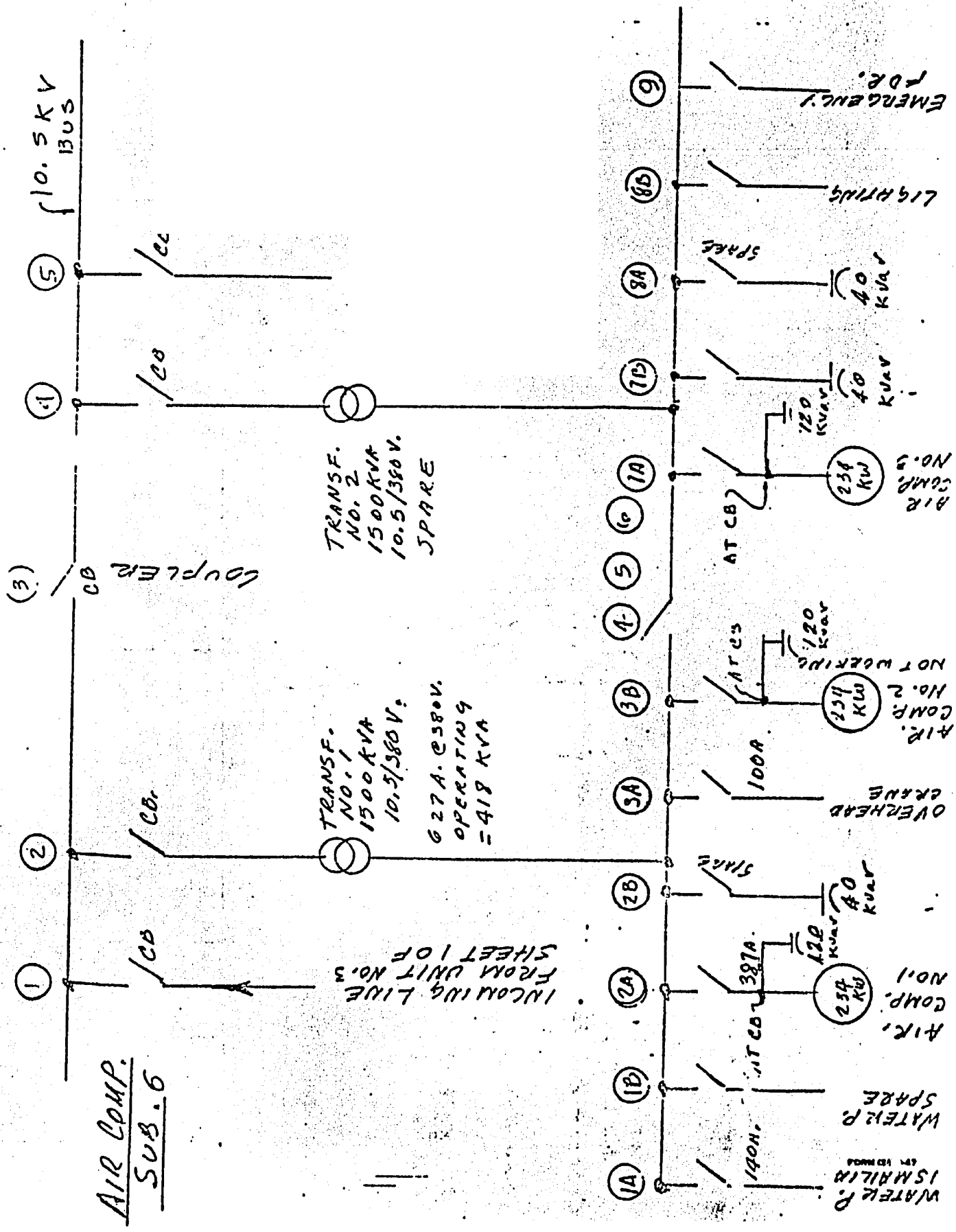
FORM G 2 8-47

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY..... DATE..... SUBJECT ELECTRIC - POWER - SHEET NO. 3 OF 5

CHKD. BY..... DATE AIR COMP. SUB 6 - STEEL MILL OIL PLANT JOB NO.

FOR CALCULATIONS - SEE SHEET 3A.



AIR COMP. SUB. 6

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N

BY ..... DATE ..... SUBJECT Electric Power - Steel Plant SHEET NO. 2

CHKD. BY ..... DATE Turbine Sup - 10.5KV For. No. 5 ..... JOB NO. .....

$KVA = \frac{1.73 \times E \times I}{1000}$

$= \frac{1.73 \times 9.8\,KV \times 75}{1000}$

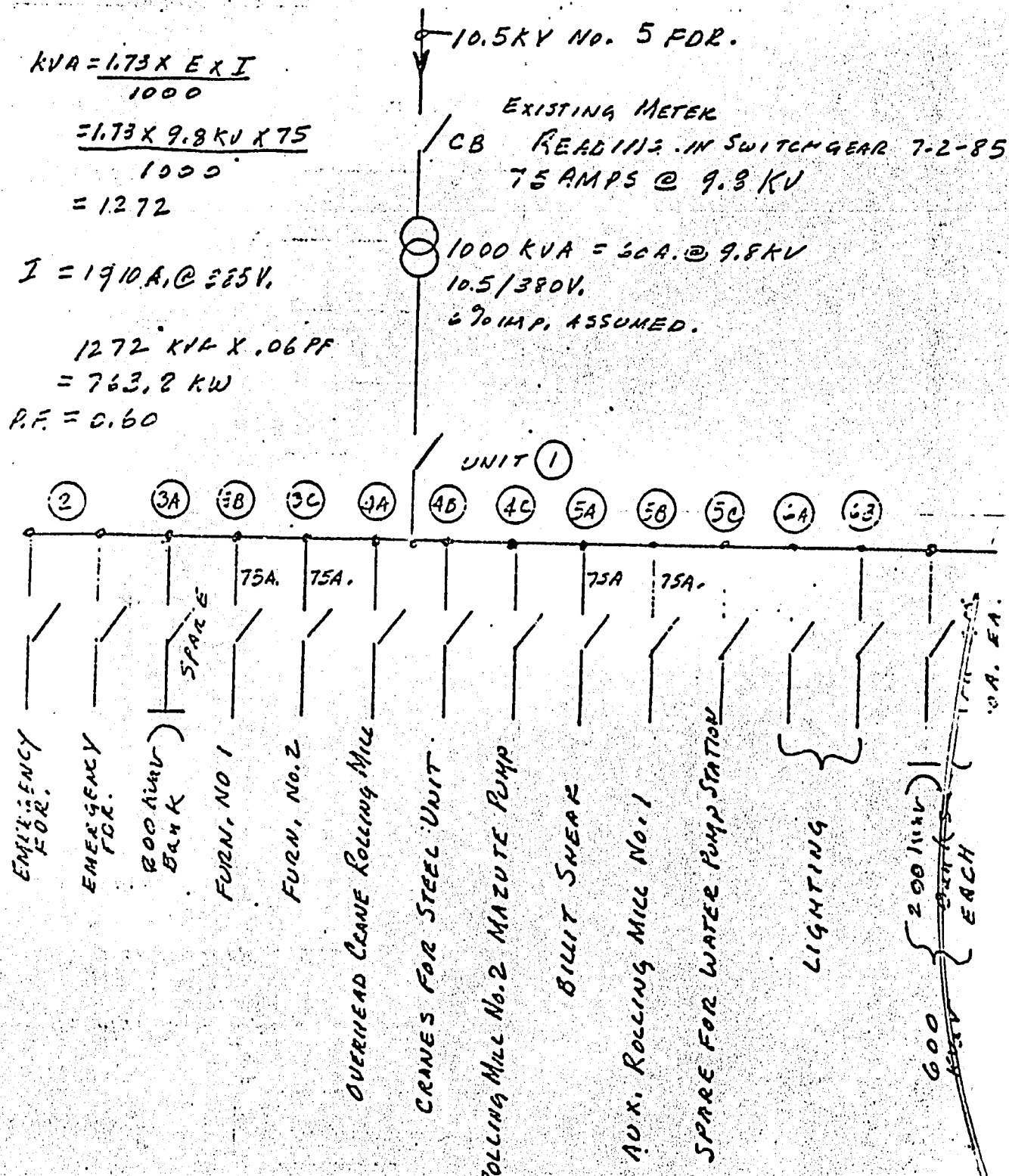
$= 1272$

$I = 1910\,A.$ @ 385 V.

1272 KVA X .06 PF

= 763.2 KW

P.F. = 0.60



Correct Bus P.F. To 0.96

763.2 X 1.043 = 796 KVar = (16) 50 KVar. Units = 800 KVar

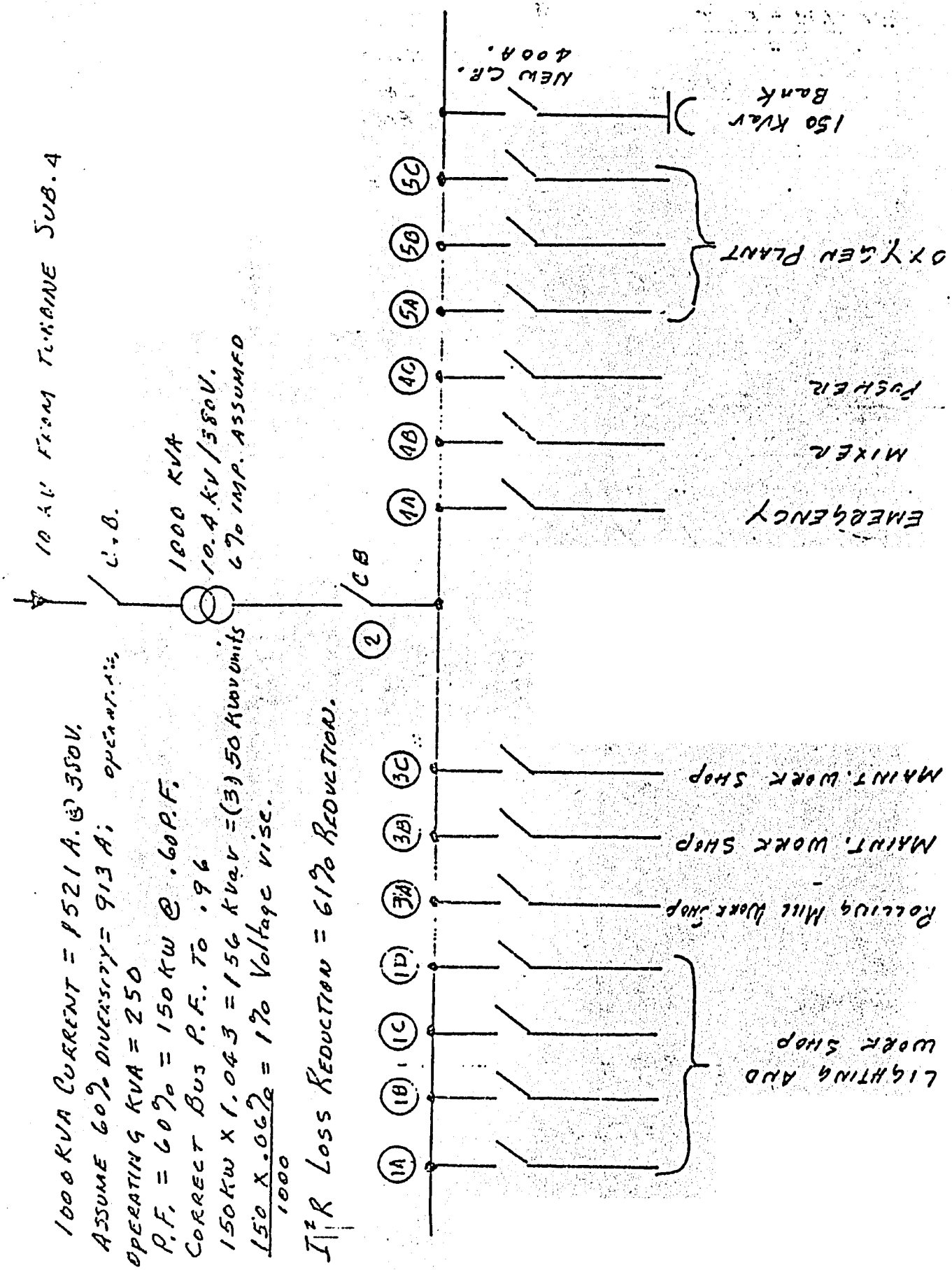
$\frac{796 \times .06\%}{1000} = 05\%$ System Capacity Power Improvement. Voltage rise

I^2R-Loss Reduction $= 1 - \left(\frac{0.60\ PF}{0.96\ PF}\right)^2 = 1 - .39 = 61\%$ Reduction.

FOSTER WHEELER ENERGY CORPORATION 110 SOUTH ORANGE AVE., LIVINGSTON, N.J.

BY..... DATE..... SUBJECT Electric Power - Steel Plant SHEET NO. 5 OF 5

CHKD. BY..... DATE Mazute Sub. 4 - 10 KV Feed From Turbine Sub. JOB NO.....



1000 KVA Current = 1521 A. @ 350V.

Assume 60% Diversity = 913 A. operating

Operating KVA = 250

P.F. = 60% = 150 KW @ .60 P.F.

Correct Bus P.F. To .96

150 KW × 1.043 = 156 KVAr = (3) 50 KVAr units

$\frac{150 \times .06\%}{1000}$ = 1% Voltage rise.

I^2R Loss Reduction = 61% Reduction.

COMBUSTION MEASUREMENTS

NATIONAL METAL INDUSTRIES COMPANY

COMBUSTION ANALYSIS AND EVALUATION

MEASUREMENTS

EQUIPMENT ITEM TESTED	STACK TEMP.OF	O_2 PERCENT IN STACK	CO_2 PERCENT IN STACK	CO PRESENT	CURRENT EFFICIENCY PERCENT	NOTES
Open Hearth Furnace No.1	570	15.6	4.3	No	-	(1)
	775	13.5	5.9	No	62.5	(2)
	812	12.0	7.1	No	60.0	(2)
	688	14.0	6.0	No	-	(2)
Open Hearth Furnace No.2	710	15.0	3.0	No	-	(2)
	745	11.8	5.6	No	63.0	(2)
Automatic Reheat Furnace	572	11.0	5.3	No	78.0	(3)
Old Reheat Furnace	744	11.9	7.2	No	64.6	
Steam Boiler	800	9.4	9.0	Yes	60	(3)

Notes: 1) Measurements taken at stack

2) Measurements taken at I.D. Fan

3) Efficiency calculated.

TEMPERATURE MEASUREMENTS

TEMPERATURE MEASUREMENTS

National Metal Industries Company

Description	Surface/ Location	Temperature °C	Remarks
A. Cooling Water			
Open Hearth Furnace #1 Return Cooling Water	Return from support cooling	9 points Avg. 46 (37-38 at ends) 48-54 mid	
	burner cooling	61	
Open Hearth Furnace #2 Return Cooling Water	Return from support cooling (right)	5 points Avg. 43	
	(left)	6 points Avg. 43	
		53 mid 35-38 ends	
	Burner cooling (right)	66	*Apparent obstruction in pipe
	(left)	96*	
Semiautomatic Rolling Mill #2 Reheating Furnace	Return from support cooling	Avg. 53	Unsteady Operation
Automatic Mill Reheating Furnace	Return from cooling discharge end including door	15 points Avg. 23	Apparent water excess
	Return cooling mid furnace supports	6 points Avg. 40	
	Return cooling charging end	5 points Avg. 33	
B. Compressed Air			
Open Hearth Furnaces	#1 Furnace after exchanger	148-149	Outer pipe wall temperature
	#2 Furnace after exchanger	130-140	

Description	Surface/ Location	Temperature °C	Remarks
C. Mazout			
Open Hearth Furnace #2	After exchanger	71	Outer pipe wall temperature
Automatic Mill Day Tank	At suction to pump before heater	36	Outer pipe wall temperature
D. Steam			
To Open Hearth Furnaces	In trench	136	Outer pipe wall temperature
Reheating Furnace #1 Semiautomatic Mill	At mazout tank heater outlet	105	Outer pipe wall temperature
To Automatic Mill	In trench	110	Outer pipe wall temperature
To Dock	In trench	91	Outer pipe wall temperature
E. Furnace Outside Walls			
Open Hearth Furnace #1	Brickwork	377	
	Door	461	
Checker	Flame	641	
	Wall	90	
Open Hearth Furnace #2	Brickwork	254	
	Door	607	
Checker	Flame	398	
	Wall	18	
Semiautomatic Mill Reheating Furnace #2	Outside wall (loading end)	360	
	(middle)	250-260	
	(burner)	115	

Description	Surface/ Location	Temperature °C	Remarks
Automatic Mill Reheating Furnace	Outside wall		
	(at discharge end)	380-440	
	(center)	250-200	
	(at brick covered opening)	566	
	(at metal covered opening)	538	
	(at cast iron door)	178	
	(at back end)	100	
F. Oxygen Plant Expansion Chamber	(at non-insulated part)	-100	

NOTE: All measurements for paragraphs A through D and F were made with contact instruments. Measurements listed under E were made with an optical pyrometer.

INSULATION MEASUREMENTS

INSULATION MEASUREMENTS

National Metal Industries Company

Description	Fluid	Pipe Ø, In.	Estimated Length, Ft.
Boiler House Steam Headers	Steam	6	40
		4	35
Reheating Furnace #1	Steam	1 1/2	60
Reheating Furnace #2	Steam	1 1/4	120
Open Hearth Furnace #1	Compressed Air	3	200
Open Hearth Furnace #2	Compressed Air	3	200

MISCELLANEOUS MEASUREMENTS

MISCELLANEOUS MEASUREMENTS

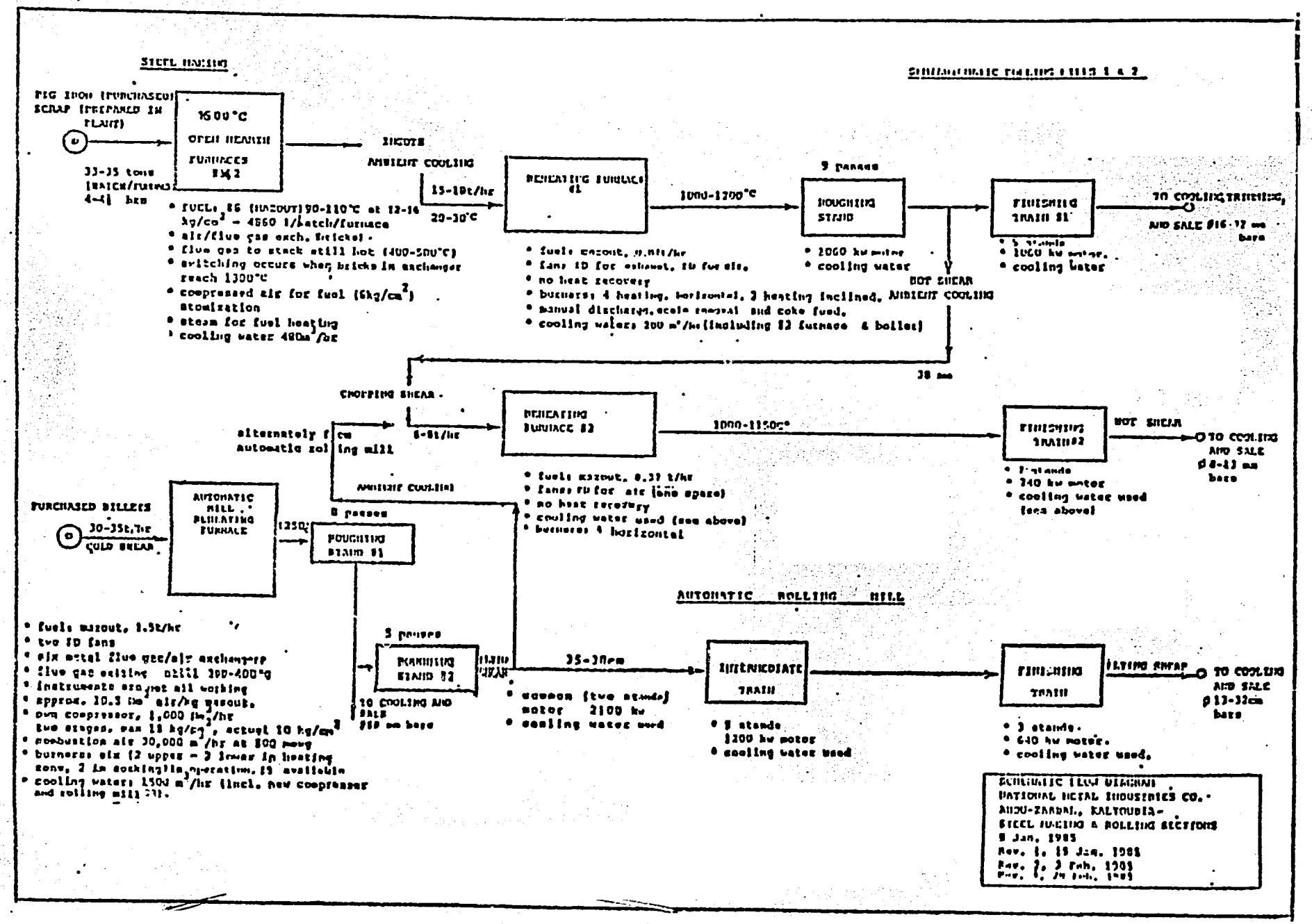
National Metal Industries Company

All measurements listed below were taken with existing plant instruments.

Description	Location	Value Read	Remarks
A. Pressure Measurements in kg/cm² (except where noted)	Old Cooling Water Pumping Station	2.7	
	New Cooling Water Pumping Station	5	Gage is supposedly not working, real value, 2.7
	Boiler (Steam)	6-7	
	Mazout (to burner)	3	
	Mazout to Automatic Mill Furnace	6	
	Old Compressor Station	7	(At air tank)
	New Compressor Station	7	
	Automatic Mill Compressor Station	6.2	
	Oxygen Plant Compressor Outlet	320	
	Air to Chimney at Automatic Mill Furnace Exhaust	200	(mm WC)
B. Flow Measurements in kg/hr	Mazout to Automatic Mill Furnace	1,750	(Total of 3 meters)
	Mazout to Automatic Mill Furnace when each of the two pumps is shut down	1,400	(Total of 3 meters)

APPENDIX "C"

SCHEMATIC FLOW DIAGRAMS


STEEL MAKING
SEMI-AUTOMATIC ROLLING MILLS 1 & 2
PIG IRON (PURCHASED)
SCRAP (PREPARED IN PLANT)
1600°C
OPEN HEARTH FURNACES
33-35 tons
4-4½ hrs
INGOTS
AMBIENT COOLING
15-18t/hr
20-30°C
REHEATING FURNACE #1
1000-1200°C
9 passes
ROUGHING STAND
FINISHING TRAIN #1
TO COOLING TRENCHES, AND SALE
HOT SHEAR
AMBIENT COOLING
38 mm
CROPPING SHEAR
REHEATING FURNACE #2
1000-1150°C
FINISHING TRAIN #2
HOT SHEAR
TO COOLING AND SALE
PURCHASED BILLETS
30-35t/hr
COLD SHEAR
AUTOMATIC MILL REHEATING FURNACE
8 passes
ROUGHING STAND #1
AUTOMATIC ROLLING MILL
5 passes
FINISHING STAND #2
TO COOLING AND SALE
35-38mm
INTERMEDIATE TRAIN
FINISHING TRAIN
FLYING SHEAR
TO COOLING AND SALE
SCHEMATIC FLOW DIAGRAM
NATIONAL METAL INDUSTRIES CO.
AMMU-ZABBAL, KALYOUBIA
STEEL MAKING & ROLLING SECTIONS
9 Jan. 1985

APPENDIX "D"

EQUIPMENT LIST

FOSTER WHEELER ENERGY CORP.
PROCESS PLANTS DIVISION

CONTRACT:
SECTION:

EQUIPMENT LIST

NAME OF UNIT: NATIONAL METAL INDUSTRIES CO

CLIENT:
LOCATION: ABOU ZAABAL, KALYOUBIA

REVISION	ORIGINAL	1	2	3	4	5
DATE	JAN. 85					

CLASS	ITEM NO.	DESCRIPTION	MAJOR ITEMS WHERE ECO'S ARE IDENTIFIED	REV
SCRAP PREPARATION		Scrap press	Preheat of pressed scrap	
STEEL MAKING		Open hearth furnace #1	Fuel system (burners)	
			Air/flue gas (exchanger, fans)	
			Cooling water	
			Instrumentation	
			Combustion (draft)	
			Steam generation	
		Open hearth furnace #2	Same items as above	
SEMIAUTOM. ROLLING MILL #1		Reheating furnace #1	Burners	
			Exhaust gas/air recuperator	
			Cooling water	
			Combustion (draft)	
			Seals	
		Roughing stand	Motor (power factor)	
			Cooling water	
		Finishing train	Motor (power factor)	
			Cooling water	
SEMIAUTOM. ROLLING MILL #2		Reheating furnace #2	Burners	
			Exhaust gas/air recuperator	
			Cooling water	
			Combustion (draft)	
			Runners	
			Seals	
			Mechanical improvement	

FOSTER WHEELER ENERGY CORP.
PROCESS PLANTS DIVISION

CONTRACT:
SECTION:

EQUIPMENT LIST

NAME OF UNIT

CLIENT:

LOCATION: ABOU ZAABAL, KALYOUBIA

REVISION	ORIGINAL
DATE	Jan 85

1	2	3	4	5

CLASS	ITEM NO.	DESCRIPTION	MAJOR ITEMS WHERE ECO'S ARE IDENTIFIED	REV
OXYGEN PLANT (IN PLANT)		Finishing train	Motor (power factor), speed	
			Cooling water	
		Expansion loop	Instrumentation	
			Insulation	
			Additional bottles	
AUTOMATIC ROLLING MILL		Reheating furnace	Burners,	
			Steam generator	
			Insulation	
			Cooling water	
			Combustion (draft)	
		Roughing stand	Motor (power factor)	
			Cooling water	
		Intermediate train	Motor (power factor)	
			Cooling water	
		Finishing train	Motor (power factor)	
			Cooling water	
BOILERS		Boiler house	Heat recovery	
			Instrumentation	
			Combustion	

APPENDIX "E"
SUPPLEMENTARY ECO DATA

1. FORM A COMMITTEE TO PLAN AND IMPLEMENT ECO'S PAGES 269 TO 326
   SEE ECO #NM-A-15

2. PUBLICITY TO MAKE EMPLOYEES AWARE OF IMPORTANCE OF ENERGY CONSERVATION
   PAGES 327 TO 331
   SEE ECO #NM-A-16

Section 2

ENERGY CONSERVATION PROGRAM IMPLEMENTATION

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2. ENERGY CONSERVATION PROGRAM IMPLEMENTATION

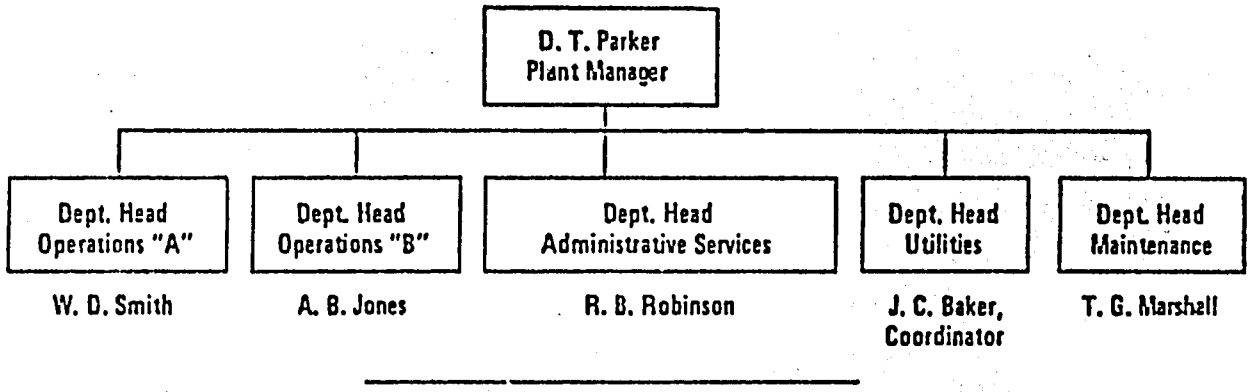
2.0 INTRODUCTION

This section of the kit describes the initiation and implementation of an energy conservation program. Section 2.1 is an outline of the elements of a program. It may be used as a guide to design your own program, tailored to your company's requirements and capabilities.

For those interested in more detail, the remainder of Section 2, starting with 2.2, illustrates the important steps in the program by a series of memoranda based on the internal correspondence generated in several actual energy conservation programs. Many of these communications could be accomplished verbally at staff meetings and committee meetings and then be documented in minutes. All of your needs may not be anticipated and some of the actions illustrated may not be necessary or appropriate for your management structure but you will find illustrated in this section most of the necessary communications. Suggested methods and forms for recording and reporting plant survey data and for tracking the progress of the program are included.

The memoranda are based on a hypothetical company, the ECONERGY Company, which has two production departments, a utilities department, a maintenance department, and an administrative services department responsible for the purchasing, accounting, shipping, and receiving functions.

The formal organization chart for the ECONERGY Company is shown below for reference. The names shown beneath the department blocks are the names of members of the Energy Conservation Committee.



2.1 PROGRAM OUTLINE

	Reference Section
I. TOP MANAGEMENT COMMITMENT	
A. Inform line supervisors of:	2.3.1
1. The economic reasons for the need to conserve energy	
2. Their responsibility for implementing energy saving actions in the areas of their accountability	
B. Establish a committee having the responsibility for formulating and conducting an energy conservation program and consisting of:	2.3.1
1. Representatives from each department in the plant	
2. A coordinator appointed by and reporting to management	
Note: In smaller organizations, the manager and his staff may conduct energy conservation activities as part of their management duties.	
C. Provide the committee with guidelines as to what is expected of them:	2.3.1
1. Plan and participate in energy saving surveys	
2. Develop uniform record keeping, reporting, and energy accounting	

Reference Section

3. Research and develop ideas on ways to save energy
4. Communicate these ideas and suggestions
5. Suggest tough, but achievable, goals for energy saving
6. Develop ideas and plans for enlisting employee support and participation
7. Plan and conduct a continuing program of activities to stimulate interest in energy conservation efforts

D. Set goals in energy saving:
1. A preliminary goal at the start of the program
2. Later, a revised goal based on savings potential estimated from results of surveys

E. Employ external assistance in surveying the plant and making recommendations, if necessary — 6.2

F. Communicate periodically to employees regarding management's emphasis on energy conservation action and report on progress — 2.8.1, 2.3.2

II. SURVEY ENERGY USES AND LOSSES

A. Conduct first survey aimed at identifying energy wastes that can be corrected by maintenance or operations actions, for example: — 2.5.2, 2.6.1, 2.6.2, 2.6.3
1. Leaks of steam and other utilities
2. Furnace burners out of adjustment
3. Repair or addition of insulation required
4. Equipment running when not needed

B. Survey to determine where additional instruments for measurement of energy flow are needed and whether there is economic justification for the cost of their installation — 2.5.3

C. Develop an energy balance on each process to define in detail: — 2.5.3
1. Energy input as raw materials and utilities
2. Energy consumed in waste disposal
3. Energy credit for by-products
4. Net energy charged to the main product
5. Energy dissipated or wasted

Note: Energy equivalents will need to be developed for all raw materials, fuels, and utilities, such as electric power, steam, etc., in order that all energy can be expressed on the common basis of Btu units. — 2.5.4

D. Analyze all process energy balances in depth: — 2.5.3
1. Can waste heat be recovered to generate steam or to heat water or a raw material?
2. Can a process step be eliminated or modified in some way to reduce energy use?
3. Can an alternate raw material with lower energy content be used?
4. Is there a way to improve yield?
5. Is there justification for:
   a. Replacing old equipment with new equipment requiring less energy?
   b. Replacing an obsolete, inefficient process plant with a whole new and different process using less energy?

E. Conduct weekend and night surveys periodically — 2.7.5, 2.5.2

F. Plan surveys on specific systems and equipment, such as: — 2.5.3
1. Steam system
2. Compressed air system
3. Electric motors
4. Natural gas lines
5. Heating and air conditioning system

III. IMPLEMENT ENERGY CONSERVATION ACTIONS

A. Correct energy wastes identified in the first survey by taking the necessary maintenance or operation actions — 2.6.3

B. List all energy conservation projects evolving from energy balance analyses, surveys, etc. Evaluate and select projects for implementation:

	Reference Section
1. Calculate annual energy savings for each project	
2. Project future energy costs and calculate annual dollar savings	
3. Estimate project capital or expense cost	
4. Evaluate investment merit of projects using measures, such as return on investment, etc.	
5. Assign priorities to projects based on investment merit	
6. Select conservation projects for implementation and request capital authorization	
7. Implement authorized projects	
C. Review design of all capital projects, such as new plants, expansions, buildings, etc., to assure that efficient utilization of energy is incorporated in the design.	2.7.2
Note: Include consideration of energy availability in new equipment and plant decisions.	
IV. DEVELOP CONTINUING ENERGY CONSERVATION EFFORTS	
A. Measure results:	2.5.7
1. Chart energy use per unit of production by department	2.5.6
2. Chart energy use per unit of production for the whole plant	
Note: The procedure for calculating energy consumption per unit of product is presented in "How to Profit by Conserving Energy"	2.5.7
3. Monitor and analyze charts of Btu per unit of product, taking into consideration effects of complicating variables, such as outdoor ambient air temperature, level of production rate, product mix, etc.	
a. Compare Btu/product unit with past performance and theoretical Btu/ product unit	
b. Observe the impact of energy saving actions and project implementation on decreasing the Btu/unit of product	
c. Investigate, identify, and correct the cause for increases that may occur in Btu unit of product, if feasible	
B. Continue energy conservation committee activities	2.7.5
1. Hold periodic meetings	
2. Each committee member is the communication link between the committee and the department supervisors represented	
3. Periodically update energy saving project lists	
4. Plan and participate in energy saving surveys	
5. Communicate energy conservation techniques	
6. Plan and conduct a continuing program of activities and communication to keep up interest in energy conservation	
7. Develop cooperation with community organizations in promoting energy conservation	
C. Involve employees	2.7.5
1. Service on energy conservation committee	2.7.4 2.6.4
2. Energy conservation training course	
3. Handbook on energy conservation	
4. Suggestion awards plan	
5. Recognition for energy saving achievements	
6. Technical talks on lighting, insulation, steam traps, and other subjects	
7. "savEnergy" posters, decals, stickers	
8. Publicity in plant news, bulletins	
9. Publicity in public news media	
10. Letters on conservation to homes	
11. Talks to local organizations	
D. Evaluate program	
1. Review progress in energy saving	
2. Evaluate original goals	
3. Consider program modifications	
4. Revise goals, as necessary	

2.2 FORMAT AND CONTENTS

Throughout this section, the letters, reports, forms, and meeting agendas are in time sequence. Where appropriate, there are comments or explanations which relate to the following memoranda.

Energy costs and cost projections, quantities of energy, and equivalent energy factors for utilities have been left as blanks, rather than stated numerically, in order to avoid any implication that the figures are typical. Such numbers will vary from industry to industry, plant to plant, and region to region. Each plant must make its own determination of these figures.

Names of individuals and of the company are, of course, fictitious.

Please note the definitions of the following symbols used in this section:

k = thousand or kilo
M = million or mega

2.3 PLANT MANAGER TAKES FIRST ACTION

The plant manager has decided that energy conservation must become a specific part of the company management program. He takes action by appointing an energy conservation coordinator and requesting the head of each department to select someone to work with the coordinator. His actions are expressed in the following memoranda.

2.3.1

ECONERGY COMPANY **INTER-OFFICE CORRESPONDENCE**

Date: January 7, 1974

To: Department Heads

From: D. T. Parker, Plant Manager

Subject: Formation of Energy Conservation Committee

The rising costs of energy and the allocations brought about by shortages have become a problem of increasing concern. The need for energy conservation has been discussed in previous staff meetings, but frankly we are not getting the results we want.

Many companies achieved 5 to 10% savings in energy usage last year by implementing formal energy conservation programs. Our plant uses _____ million Btu of energy yearly and our annual bill for purchased fuel and electric power is about $_____ at current energy prices. If we could achieve, for example, a 10% cut in our annual consumption, that would be a saving of $_____-- an appreciable amount of money. Consider also that energy costs are rising at a rate of about _____% per year.

We must initiate an aggressive energy conservation program at once. We need to establish a committee with the responsibility for formulating and conducting the program. I am appointing J. C. Baker to the fulltime responsibility as committee coordinator, reporting directly to me, and I am asking that by one week from today each of you assign someone to represent your department on the committee. That person should be knowledgeable and influential. He will be the communication link between the committee and the key supervisors in your areas. Appointment to this committee will be considered a major assignment requiring a significant amount of time, particularly during the early stages of the energy conservation program.

savEnergy

We expect the committee to research and come up with ideas, to establish an energy conservation goal, to communicate suggestions on ways of achieving that goal, to develop a common economic base to work from, and to do some record keeping. The committee will need to compile lists of energy conservation projects, their costs and benefits so that we can plan our expenditures. It will be the line supervisors, however, who must see to it that actions are taken to accomplish energy conservation.

I suggest that a good way to kick off the program would be to conduct surveys throughout our plant - tracing out the energy streams to identify where our energy is used so that wasted energy can be reduced or eliminated. Fixing leaks of steam and other utilities, adjusting furnace burners, repairing steam traps, and repairing or adding insulation are some of the maintenance and operating actions we can take immediately to start realizing energy savings. The Energy Conservation Program Guide for Industry and Commerce (EPIC) published by the U. S. Department of Commerce will provide the guidance for developing our program.

I am thoroughly convinced that the continuing success of our company requires that we use our energy supplies as effectively as possible. The success of our program will depend upon the support and interest that we, as management, demonstrate.

I think we should set a tough, achievable goal for ourselves. Let's set an initial target of 10% savings in energy this year. This goal can be revised after we conduct our surveys and estimate the actual potential savings.

2.3.2

ECONERGY COMPANY

EMPLOYEE BULLETIN

Date: January 15, 1974

To: All Employees

From: D. T. Parker, Plant Manager

Subject: Initiation of Energy Conservation Program

Television, radio and newspapers are filled with reports on the energy shortages. This problem has implications far beyond the inconvenience we experience at our local gasoline service stations. This energy problem has a potentially serious impact on American industry, including the ECONERGY Company.

Not only are the costs of purchasing electricity and fuels soaring but the availability of our vital raw materials is declining as a result of the energy shortages. To avoid production disruptions which may result from these shortages, the ECONERGY Company is initiating a far-reaching Energy Conservation Program (ECP) to identify and eliminate inefficient, unnecessary, or wasteful uses of energy throughout the plant.

To accomplish this task I have appointed Mr. J. C. Baker, Utilities Department, to head the Energy Conservation Committee. This Committee will formulate a program which will enable us to reduce our energy consumption without disruption to our production flow. The support and active participation of every employee is essential if we are to achieve our goal of 10% savings in energy use this year.

You will soon be seeing signs that say "savEnergy." This is more than a catchy slogan: it is a reminder that energy will always be available at home and at work if we are careful in the ways we use it.

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2.4 FIRST MEETING OF ENERGY CONSERVATION COMMITTEE

As soon as the committee coordinator learns of his new assignment, he starts planning how the committee can go about accomplishing the tasks set forth in the plant manager's letter (2.3.1). When he has the names of all members of the committee and a plan in mind, he calls a meeting of the committee and submits to them the proposed plan in the following letter.

For simplification, we are assuming that the plan and assignments were accepted by the committee and no additional topics were discussed. However, if the committee agreed on some changes to the plan and/or talked about other matters, minutes of the meeting would be written and copies given to committee members.

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 18, 1974

To: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: J. C. Baker
Energy Conservation Coordinator

Subject: Committee Assignments

D. T. Parker's letter dated January 7, 1974 outlines the formation of the Energy Conservation Committee, to which we have been appointed, and indicates some of the actions we are to undertake. As he suggests, each of us should become thoroughly familiar with the program suggestions and energy conservation opportunities described in EPIC.

We must get started on several of the tasks immediately, so I have developed a plan for dividing these duties among us. The first priority is to conduct a survey of present energy usage and to begin reducing or eliminating waste. Because of their familiarity with these problems, our operations representatives, W. D. Smith and A. B. Jones, should be responsible for developing a plant-wide plan for energy saving surveys.

Another area that requires early attention is the establishment of a common economic base from which to work. There will be energy saving projects that will involve dollar expenditures which require financial justification. We need a uniform method of calculating the value of savings for our various forms of energy - electric power, fuel, steam, and compressed air. As Utilities representative, I will undertake this task.

I would appreciate it if R. B. Robinson of Administrative Services could obtain from Accounting data on the quantities of purchased fuel and electric power used monthly last year and this year. A continuing plot of energy consumption per unit of production is necessary to help us monitor the progress in our plant-wide energy conservation effort.

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In addition, we need to consider projected energy costs. So, would R. B. Robinson also please ask the Purchasing Section if they can develop fuel and electric power cost projections for this year, three years and five years into the future.

We are going to need to communicate ideas and suggestions on energy conservation techniques applicable to our plant. Since T. G. Marshall of Maintenance has had broad experience throughout the plant, I am asking that he assume responsibility for coordinating this function. To start with, we have several literature references and the Energy Conservation Opportunities (ECO's) in EPIC. As time goes along, we surely will have generated additional ideas deserving of broad communications through our committee.

If all of you are in agreement with this plan, I suggest that each of us meet with the key supervisors in our areas this week to inform them of our program plans and to ask them to come up with energy saving projects.

Let us meet again in my office one week from today, at the same time, to report our progress. If you are unable to attend that meeting or any future meeting, please ask an alternate to attend in your place.

cc: D. T. Parker
Plant Manager

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2.5 SECOND MEETING OF ENERGY CONSERVATION COMMITTEE

The week passes and the committee holds its second meeting. The coordinator gives each member a copy of the agenda shown on the next page. Then, in the sequence of the agenda, each member presents his report, giving a copy of his letter and attachments to all present. The following six letters document the reports and proposals submitted at the meeting. It is assumed that all these matters were accepted or approved by the committee.

Note that in Section 2.5.4, and elsewhere in EPIC, a ratio of 10,000 Btu/kWh is used for illustrative purposes for the energy used by a utility to generate electricity. According to the Federal Power Commission, the national average for 1972 was approximately 12,000 Btu/kWh. This figure will vary from region to region, however.

2.5.1

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 25, 1974

To: Energy Conservation Committee

From: J. C. Baker, Coordinator

Subject: Agenda for Second Meeting of the Energy Conservation Committee

1. Report of plans for energy saving surveys
2. Energy equivalents for plant utilities
3. Present and projected future costs of energy
4. Monthly energy use for 1973 and 1974
5. Proposed forms:
   a. Calculation of Btu per unit of production
   b. Tracking chart

cc: D. T. Parker
Plant Manager

2.5.2

ECONERGY COMPANY **INTER-OFFICE CORRESPONDENCE**

Date: January 25, 1974

To: J. C. Baker, Energy Conservation Coordinator
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: Energy Saving Survey Team
W. D. Smith, Operations "A"
A. B. Jones, Operations "B"

Subject: Plans fc First Energy Saving Survey

The first survey will be aimed at identifying energy wastes that can be corrected by maintenance or operations actions. The attached survey form indicates the types of wastes we will be looking for. In addition, we will refer to the Energy Conservation Checklist in EPIC. All process areas and buildings will be included in the survey. The main part of the survey will be conducted during normal daytime work hours, but one or more night visits will be required to search for excess nighttime lighting and HVAC (heating, ventilating, and air conditioning), as well as equipment running when not needed. Areas or buildings that are in a full or partial shutdown condition on weekends will warrant weekend visits to look for energy use that is not necessary.

The survey team proposes to conduct the survey of each area in cooperation with and accompanied by a foreman, supervisor, or engineer designated by the department head. Findings of the survey of each area will be recorded on the attached form and copies will be made available to the department head, the maintenance department, and the Energy Conservation Committee.

Work orders for correction of energy wastes will be prepared by department supervisors, as is the case for any other maintenance work.

This week, the survey team will prepare a timetable for visits to the various areas and communicate the schedule to department heads.

By copy of this letter to Mr. Parker we are requesting management endorsement of our plans for this first energy survey.

cc: D. T. Parker, Plant Manager

ENERGY SAVING SURVEY

Department: _____ Surveyed by: _____

Date: _____

Fuel Gas or Oil Leaks	Steam Leaks	Compressed Air Leaks	Condensate Leaks	Water Leaks	Damaged or Lacking Insulation	Excess Lighting	Excess Utility Usage	Equipment Running & Not Needed	Burners Out of Adjustment	Leaks of or Excess of HVAC	Location	Date Corrected

2.5.3

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 25, 1974

To: J. C. Baker, Energy Conservation Coordinator
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

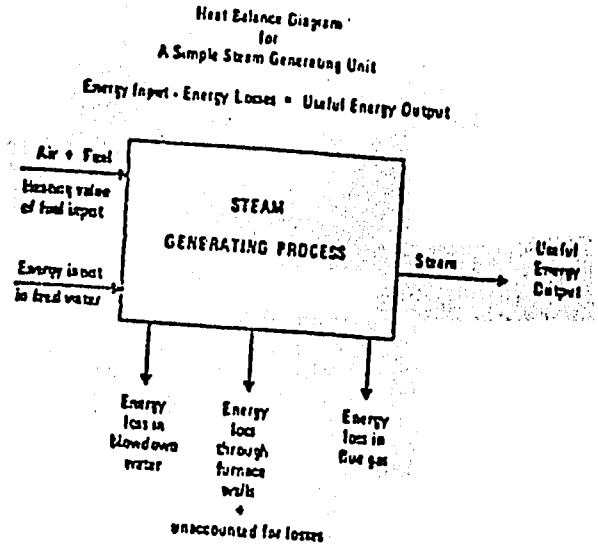
From: Energy Saving Survey Team
W. D. Smith, Operations "A"
A. B. Jones, Operations "B"

Subject: Future Energy Savings Surveys

After our first energy saving survey, which is aimed at correction of the more obvious energy losses, there are other surveys which we feel certain will reveal additional ways to reduce energy consumption but which probably will require capital investment.

1. The Energy Balance

The basic data needed for energy conservation efforts is an energy balance on each process and department. This study can be done by an engineer in the department concerned, who is thoroughly familiar with the process flow sheet or the building energy uses. The object is to define in detail the energy input, energy utilized, and energy dissipated or wasted. In some areas this will require improving measuring capability. The cost of this additional measuring capability must be weighed against the potential savings. An example is shown on the following energy flow diagram for a steam generating unit. Having identified the individual energy wastes, the engineer can then determine methods for reducing or using these energy wastes. (The ECO Checklist in EPIC can be helpful.) The engineer's next task is to evaluate the alternate methods and recommend the best one.



2. Energy Surplus Survey

After the energy balances have been completed, some coordination by the survey team is indicated. The survey team can contact the engineers who have prepared the energy balances to determine if there are energy wastes that could be recovered economically but have no use within their process area. Let's say that there is potential for recovering waste heat from furnace flue gases by using it to (a) preheat combustion air or (b) generate low pressure steam. Suppose that air preheat is impractical because of furnace construction and there is no use for low pressure steam within that department. The survey team can communicate through the energy conservation committee to other departments and perhaps find a use for the low pressure steam.

3. Survey of Pressure Reducing Stations

Determine location of all steam and high pressure gas, pressure-reducing valves, upstream and downstream pressures, and flow rates. Evaluate feasibility of letting pressure down by flowing through an expander driving some equipment, such as a pump or compressor.

4. Survey of Compressed Air Pressure Requirements

Survey all users of plant air to find minimum pressure levels required. Lowering compressor discharge pressure saves energy. If all but one or two users can be satisfied with a lower pressure, an evaluation of the feasibility of installing a separate compressor or a booster to supply these higher pressure users should be made.

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5. Steam System Survey

a. Traps

Review all steam trap installations. Are there too many traps on a line? Or too few? Of an efficient type? Or inefficient? Are traps sized properly? Installed properly? Are they functioning as they should? Should traps receive special maintenance attention?

b. Increase Condensate Return to Boilers

Loss of condensate is a waste of heat and of valuable high purity water. Identify all sources of condensate and evaluate economic feasibility of installing pump and insulated piping to return condensate to boiler feedwater tank. If condensate is contaminated, evaluate possible clean-up.

c. Use of Lower Pressure Steam

Search for situations where use of high pressure steam can be switched over feasibly to lower pressure steam. It is advantageous to use the lower pressure steam where the higher pressure is not needed. This is particularly true when the lower pressure steam is being supplied from extraction or back-pressure turbines or a low pressure boiler separate from the high pressure boiler. Of course, lowering pressure by a pressure reducing valve offers no savings in energy.

6. Survey for Oversized Electric Motors and Equipment

Electric motors and equipment, such as centrifugal pumps, operate with best efficiency at rated load. If they are operating at reduced load, efficiency suffers. Take ampere readings on motors and compare to rating. Evaluate replacement of oversized motors and equipment with proper sizes.

7. Insulation

Inspect insulation and furnace walls with infrared scanners to detect excessive heat losses. Repair insulation and walls where needed.

8. Combustion Survey

Determine combustion efficiency in all furnaces. Evaluate economic feasibility of replacing burners with more efficient type and installing oxygen and combustibles analyzers on flue gas along with improved combustion control system to maintain optimum excess air.

cc: D. T. Parker
Plant Manager

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ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 25, 1974

To: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: J. C. Baker, Energy Conservation Coordinator

Subject: Energy Equivalents and Costs for Plant Utilities

We need a uniform method for calculating the value of our energy savings for our various utilities and I recommend we institute an accounting system based on Btu usage. For our purchased electric power, dollar accounting is simply a matter of using the $/kWh rate(s) we pay the utility company. The matter is more involved, however, for our Btu accounting of electric power. One kWh is capable of producing 3412 Btu of heat. But due to power plant inefficiency, approximately 10,000 Btu of fuel are burned by the utility company to generate one kWh. Therefore, the "energy equivalent" for electric power is:

10,000 Btu/kWh

Following this example then, an "energy equivalent" may be defined as the number of Btu of fuel that are consumed in generating a unit of utility, such as a kWh of electricity or 1000 lb of steam. Defined this way, the "energy equivalent" is the factor we can use across the board to put all projects on a common base in our energy conservation program.

Next let us consider the fuels that we purchase. The energy equivalent is the heat of combustion. The unit cost comes from accounting.

Fuel	Cost	Energy Equivalent	Cost/MBtu
Natural Gas	$_____/1000 cu ft	_____Btu/cu ft	$_____/MBtu
Fuel Oil	$_____/gal	_____Btu/gal	$_____/MBtu
Coal	$_____/ton	_____Btu/lb	$_____/MBtu

The costs of our generated steam, compressed air, water and treated boiler make-up water published by our accounting department include depreciation, maintenance and operating costs, etc., and therefore cannot be used in figuring dollar value of energy saving. When we save these utilities we save only the fuel or electric power that was used to generate, compress or pump the utilities. In our boilers generating 400 psig and 150 psig steam, the energy equivalents of steam are the fuel Btu used in generating steam based on the boiler efficiencies. The steam costs to be used in energy saving accounting are, therefore, the costs of the energy equivalents.

Steam	Cost	Energy Equivalent
400 psig	$_____/1000 lb	_____Btu/1000 lb
150 psig	$_____/1000 lb	_____Btu/1000 lb

With regard to compressed air, water and treated boiler make-up water, the costs are for electric power used for compressing or pumping. The energy equivalents take into account 10,000 Btu/kWh.

Utility	Cost	Energy Equivalent
Compressed Air	$_____/1000 cu ft	_____Btu/1000 cu ft
Water	$_____/1000 lb	_____Btu/1000 lb
Boiler Make-Up Water	$_____/1000 lb	_____Btu/1000 lb

When we save condensate and return it to the boilers, we reduce the boiler make-up water requirement and save the Btu difference between the heat content of the condensate at _____F and of fresh water at its temperature. Thus, our energy equivalent for condensate is _____Btu/1000 lb and its cost is $_____/1000 lb.

cc: D. T. Parker
Plant Manager

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2.5.5

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 25, 1974

To: J. C. Baker, Energy Conservation Coordinator
W. D. Smith, Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance

From: R. B. Robinson, Administrative Services

Subject: Fuel and Power Cost Projections

The Purchasing Section has provided the following information:

	Cost at Present	Estimated Cost 3 Years	Estimated Cost 5 Years
Electric Power	$____/kWh	$____/kWh	$____kWh
Natural Gas	$____/1000 cu ft	$____/1000 cu ft	$____1000 cu ft
Fuel Oil	$____/gal	$____/gal	$____/gal
Coal	$____/ton	$____/ton	$____/ton

Purchasing has agreed to advise our committee whenever these costs are revised.

cc: D. T. Parker, Plant Manager

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 25, 1974

To: J. C. Baker, Energy Conservation Coordinator
W. D. Smith, Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance

From: R. B. Robinson, Administrative Services

Subject: Monthly Use of Fuels and Power - 1973 and 1974

The attached form was developed and submitted to Accounting. They hope to have the information compiled within a few days.

cc: D. T. Parker, Plant Manager

MONTHLY PLANT ENERGY USE

	ELECTRIC POWER			NATURAL GAS			FUEL OIL			COAL			TOTAL Btu	Number of Units Produced	Btu Per Ur of Productio
1973	kWh	Btu/kWh	Btu	k cu ft	Btu/k cu ft	Btu	gal	Btu/gal	Btu	TONS	Btu/lb	Btu			
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															
1974															
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 25, 1974

To: W. D. Smith Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: J. C. Baker, Energy Conservation Coordinator

Subject: Department Energy Unit Ratio and Tracking Chart

Attachment A is a copy of the do-it-yourself kit "How to Profit by Conserving Energy" by the Sub-Council on Technology of the National Industrial Energy Conservation Council. The form in the kit details a suggested procedure for calculating the energy content (Btu) of a product.

In our particular operations, we have no by-products, and our energy use for waste disposal is negligible. Therefore, our prime concern is raw material energy and conversion energy. Conversion energy is the energy equivalent of utilities used in manufacturing the product. Raw material energy content can be somewhat more involved. The raw material suppliers may be able to provide this number, or an approximation is available for most materials from the U. S. Department of Commerce. If unavailable from these sources, it can be estimated as the heat of combustion of the material. This estimate is always low. Any energy spent on the raw material in getting it to the point of use should be considered - for example, mining, crushing and sizing, and transportation. Bear in mind that less energy intensive raw materials should escalate less in price as energy costs increase. Having determined the energy content of raw materials, and given a choice, a better raw material selection should be possible.

Attachment B is a three page form for tabulating monthly department use of raw materials and utilities, for calculating Btu content of these quantities, and for determining the total Btu and the energy/production unit ratio in Btu per unit of production. As this information is developed we will probably find that there is a need to install additional metering and to rehabilitate some existing meters, if economically justified.

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Attachment C is a graph for plotting the monthly Btu per unit of production for 1973 and 1974. This graph can be used for charting the energy used by individual production departments and also by the total plant.

If you have any questions, see me. These records are important to our on-going program.

cc: D. T. Parker, Plant Manager

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ATTACHMENT A

HOW TO PROFIT BY CONSERVING ENERGY

A Do-It-Yourself Kit

SUB-COUNCIL ON TECHNOLOGY OF THE NATIONAL INDUSTRIAL ENERGY CONSERVATION COUNCIL

OBJECTIVE. Encourage industrial firms to set measurable goals for reducing energy consumption per unit of product produced.

GOAL. X-percent reduction in energy content* expressed in BTU'S per unit of product.

PROCEDURE Use the energy calculator on page two to determine the current energy content in BTU'S per unit for any kind of manufactured or processed product.

With this yardstick, measure progress to determine if energy reduction goals are being met, exceeded or missed.

*Energy content per unit of product includes energy content of the raw material plus energy spent in converting or upgrading and in waste disposal.

"DO IT YOURSELF KIT" For Calculating The Energy Content of A Product

GUIDELINES OF THE NATIONAL INDUSTRIAL ENERGY CONSERVATION COUNCIL
SUGGESTED PROCEDURE FOR CALCULATING ENERGY CONTENT (BTU'S) OF A PRODUCT

FOR THE PERIOD BEGINNING January 1, 1974, PERIOD ENDING February 1, 1974.

COMPANY: The Dow Chemical Co.
RESPONSIBLE MANAGER: I. G. Snyder, Jr.
1 PRODUCT
2 PRODUCT I.D. NO.
3 TOTAL UNITS PRODUCED
UNITS OF PRODUCTION (LB, GAL, PIECE, ETC.)

RAW MATERIAL ENERGY (LIST MAJOR RAW MATERIALS)

4 RAW MATERIAL	5 TOTAL UNITS	X 6 BTU'S UNIT	= 7 TOTAL BTU'S
A:			
B:			
C:			
D:			
E:			

TOTAL BTU'S 8

CONVERSION ENERGY (LIST ALL MAJOR UTILITIES)

9 UTILITY	10 TOTAL UNITS	X 11 BTU'S UNIT	= 12 TOTAL BTU'S
A:			
B:			
C:			
D:			
E:			

TOTAL BTU'S 13

WASTE DISPOSAL ENERGY

14 WASTE	15 TOTAL DISPOSAL BTU'S	17 TOTAL WASTED UNITS
A:		
B:		
C:		
D:		
E:		

TOTAL BTU'S 16

GROSS ENERGY CONTENT OF PRODUCT (SUM OF ITEMS 8, 13 AND 16) BTU'S 18

BY-PRODUCT ENERGY CREDIT (LIST ALL MAJOR BY-PRODUCTS)

19 BY-PRODUCT	20 TOTAL UNITS	X 21 BTU'S UNIT	= 22 TOTAL BTU'S
A:			
B:			
C:			
D:			
E:			

TOTAL BTU'S 23

NET ENERGY CONTENT OF PRODUCT (ITEM 18 LESS ITEM 23) 24 BTU'S

ENERGY CONTENT PER UNIT OF PRODUCTION (ITEM 24 DIVIDED BY ITEM 3) 25 BTU'S UNIT

GOAL (TARGETED ENERGY CONTENT FOR THIS PERIOD) BTU'S UNIT 26

IF ITEM 26 IS EQUAL TO ITEM 25, GOAL WAS MADE (CHECK ITEM 27) 27 ☐ MADE GOAL

IF ITEM 26 IS NOT EQUAL TO ITEM 25, COMPUTE DEVIATION FROM GOAL:

ITEM 26 LESS ITEM 25 28

ITEM 28 DIVIDED BY ITEM 26 29

MULTIPLY ITEM 29 BY 100 30

IF ITEM 26 IS GREATER THAN ITEM 25, COPY ITEM 30 HERE 31+ % BEAT GOAL

IF ITEM 26 IS LESS THAN ITEM 25, COPY ITEM 30 HERE 32− % MISSED GOAL

GUIDE FOR FILLING OUT FORM ON OPPOSITE PAGE

1 Finished product ready for shipment.

2 Product I.D. No. is the numerical identification of the product.

3 Units of the product (item 1) made during this time period.

4 The material that goes into producing and packaging the product (includes fuels used as raw material).

5 Units of the raw material (item 4) that were used during this time period.

6 Every material has a specific energy content. Energy content is measured in terms of BTU'S. Raw material supplier may provide this number or an approximation is available for most materials from the U. S. Department of Commerce. If unavailable from these sources, it can be estimated as the heat of combustion of the material. This estimate is always low.

7 (Item 5) multiplied by (item 6).

9 Utilities include primarily electricity, fuel oil and natural gas.

10 Units of utility (item 9) used during this time period.

11 For fuel, this is the heat of combustion of the fuel. This number is available from supplier. For other utilities, this is the energy necessary to generate one unit of the utility (e.g., 1 KWH). Use 10,000 BTU'S per KWH unless your supplier has a better number.

12 (Item 10) multiplied by (item 11).

14 Waste is that material which has no economic value and which requires additional BTU'S to dispose of.

15 Estimated energy to dispose of the waste (item 14). This may be the energy to truck away and bury a solid, the energy to burn some scrap or the energy to run a waste disposal plant.

17 Units of waste produced during this time period. Units of waste is not needed for the calculation, but may be recorded for later reference.

19 By-products are those saleable materials which are made incidental to the production of the desired product or products.

20 Units of by-product (item 19) made during this time period.

21 The usable energy in the by-product. As an approximation, use the ratio of the value of the by-product to the value of the product multiplied by the gross energy content of the product (item 18).

22 (Item 20) multiplied by (item 21).

"DO IT YOURSELF KIT" For Calculating The Energy Content of A Product

GUIDELINES OF THE NATIONAL INDUSTRIAL ENERGY CONSERVATION COUNCIL
SUGGESTED PROCEDURE FOR CALCULATING ENERGY CONTENT (BTU'S) OF A PRODUCT

FOR THE PERIOD BEGINNING January 1, 1974 PERIOD ENDING February 1, 1974

COMPANY: The Dow Chemical Co.
RESPONSIBLE MANAGER: I. G. Snyder, Jr.
1 PRODUCT: Ethylene
2 PRODUCT I.D. NO.: P27-23-1

RAW MATERIAL ENERGY (LIST MAJOR RAW MATERIALS)

4 RAW MATERIAL	5 TOTAL UNITS	x 6 BTU'S/UNIT	= 7 TOTAL BTU'S
A: Ethane	52.29×10^6	22,304/lb	1166.3×10^9
B: Caustic Soda	252×10^6	12,500/lb	3.2×10^9
C: Hydrogenation Cat.	6.048×10^3	75,000/lb	5×10^9
D: Desiccant	1.117×10^3	50,000/lb	1×10^9
E:			
TOTAL BTU'S 8			1170.1×10^9

3 TOTAL UNITS PRODUCED: 42,000,000

UNITS OF PRODUCTION (LB., GAL., PIECE, ETC.): Pounds

CONVERSION ENERGY (LIST ALL MAJOR UTILITIES)

9 UTILITY	10 TOTAL UNITS	x 11 BTU'S/UNIT	= 12 TOTAL BTU'S
A: Steam, 150 psig	181.31×10^6	1077/lb	195.3×10^9
B: Electricity, KWH	0.71×10^6	10000/KWH	7.1×10^9
C: Natural Gas, ft.³	269.4×10^6	1030/ft.³	277.5×10^9
D: Cooling Water, gal.	1.764×10^6	10/gal.	17.6×10^9
E: Process Water, gal.	1.074×10^6	15/gal.	[illegible]
TOTAL BTU'S 13			497.5×10^9

WASTE DISPOSAL ENERGY

14 WASTE	15 TOTAL DISPOSAL BTU'S	17 TOTAL WASTED UNITS
A: Oily, Caustic Water	Disposal Plant 1.8×10^9	Water: 5.92×10^6 gal.
B:	Muriatic Acid 4.9×10^9	Oil in water: 11,200 lbs.
C:		Muriatic Acid to neutralize
D:		Caustic: 699,120 lbs.
E:		
TOTAL BTU'S 16	6.9×10^9	

GROSS ENERGY CONTENT OF PRODUCT (SUM OF ITEMS 8, 13 AND 16) BTU'S 18 1673.5×10^9

BY-PRODUCT ENERGY CREDIT (LIST ALL MAJOR BY-PRODUCTS)

19 BY-PRODUCT	20 TOTAL UNITS	x 21 BTU'S/UNIT	= 22 TOTAL BTU'S
A: Residue Gas	6.048×10^6	20,000	121.0×10^9
B: Pyrolysis Gas	1.722×10^6	17,986	31.0×10^9
C: C_3-C_4 Fraction	2.436×10^6	20,823	50.7×10^9
D:			
E:			
TOTAL BTU'S 23			202.7×10^9 BTU'S

NET ENERGY CONTENT OF PRODUCT (ITEM 18 LESS ITEM 23) 24 1470.8×10^9 BTU'S

ENERGY CONTENT PER UNIT OF PRODUCTION (ITEM 24 DIVIDED BY ITEM 3) 25 35,019 BTU'S/UNIT

GOAL (TARGETED ENERGY CONTENT FOR THIS PERIOD) BTU'S/UNIT 26 35,000

IF ITEM 26 IS EQUAL TO ITEM 25, GOAL WAS MADE (CHECK ITEM 27) ..... 27 ____ MADE GOAL

IF ITEM 26 IS NOT EQUAL TO ITEM 25, COMPUTE DEVIATION FROM GOAL:

ITEM 26 LESS ITEM 25 ..... 28 481

ITEM 28 DIVIDED BY ITEM 26 ..... 29 .0135

MULTIPLY ITEM 29 BY 100 ..... 30 1.35

IF ITEM 26 IS GREATER THAN ITEM 25, COPY ITEM 30 HERE ..... 31 +1.35 % BEAT GOAL

IF ITEM 26 IS LESS THAN ITEM 25, COPY ITEM 30 HERE ..... 32 – % MISSED GOAL

2

4 All significant input materials are listed even though they may not appear in the final product.

5 These quantities of materials were used during January, 1974. The desiccant may be purchased only once every six months, but a proportional amount is allocated to this month.

6 The energy content of ethane is the heat of combustion which is available from several reference books.

The energy content of caustic was estimated from literature sources.

The heat content of the hydrogenation catalyst and the desiccant are educated guesses. The quantities of these materials used are so small that the error introduced by an incorrect guess is insignificant.

11 The BTU'S per unit of steam are available from steam tables. In this case credit was taken for the hot water returned to the steam plant. 10,000 BTU'S/KWH was used since this is close to the energy that an average utility uses to generate a KWH of electricity.

1030 BTU'S/ft³ of gas was provided by the gas supplier. The energy in the cooling and the process water is the power necessary to pump the water. The power in KWH'S/gallon was multiplied by 10,000 BTU'S/KWH to arrive at the BTU'S per gallon.

15 The oily, caustic water was neutralized and then treated in a bio-oxidation plant. The total disposal BTU'S include the energy to run the bio-oxidation plant plus the energy in the neutralizing agent, muriatic acid.

21 All of the energy contents here were assumed to be equal to the heat of combustion since these materials may be readily burned as fuel. Residue gas was assumed to be the same as light fuel oil, pyrolysis gas was assumed to be the same as toluene and the C_3–C_4 fraction was assumed to be butene.

The basic information in this example was taken from the Stanford Research Institute report on "Ethylene" dated August, 1967, page 219.

WHY MEASURE ENERGY

As energy is used more effectively, product costs can be reduced and profits improved. This can be accomplished even in the face of sharply increasing energy costs. Since industrial energy consumption accounts for approximately 40% of total energy used in the United States, significant contributions can be made to the national effort.

The first step to meaningful energy conservation is measurement of all the energy that enters and leaves a plant during a given period. This measurement will probably be an approximation at first but should improve with experience.

To calculate the energy content of your products, use the attached form, and then set goals for improvement. The filled in example is for ethylene; but the procedure applies equally well to any manufacturing operation, be it a grain mill pulp mill, steel mill, furniture factory, or assembly line.

Though time consuming and challenging to make the initial calculations, it will be worth the effort. Raw materials which contain, and manufacturing processes which use large amounts of energy will be pinpointed.

What To Expect – Once BTU content is determined, products can be ranked by BTU'S per unit, BTU'S per dollar of sales, and BTU'S per dollar profit. Then, as energy availability becomes more limited, it will be possible to quickly focus on the most profitable products.

Equipment associated with the large energy consuming steps will be identified. Once the energy-hogging equipment is isolated, efforts can be focused on replacing old machinery and equipment, using more energy-conscious designs, and improving maintenance programs.

Less energy-intensive raw materials should escalate less in price as energy costs increase. Having determined the energy content of raw materials, and given a choice, a better raw material selection should be possible.

Stressing the importance of BTU'S per-unit-of-production to plant operating people should provide the incentive for them to chase down where all of the input BTU'S actually end up. Often, the first attempt will account for less than 50% of the input BTU'S. Simply the act of identifying the other 50% will reveal many opportunities for improvement. For example:

1. A reduction in scrap or an improvement in yield will often be the most significant energy reduction that can be accomplished.
2. Leaking water, steam, inert gas or raw material may seem quite small as it escapes into the air, but over time this can represent a sizeable quantity of energy.
3. Heat loss from equipment can sometimes be reduced with more insulation once the losses are identified.
4. Sometimes energy lost to the environment, either through cooling water or through air, can be used advantageously to heat inlet raw materials or process equipment.
5. The energy content of waste may be recovered in part or in total by treating and recycling the waste back through the manufacturing process. In some instances, it may be possible to burn the waste and use the recovered heat in the process.
6. Temperature control equipment may be alternately heating and cooling. This problem is often corrected by a simple adjustment of the controls.
7. Recognizing that it takes 10,000 BTU'S to generate one KWH may suggest using less electricity for heating since this same KWH is capable of producing only 3,413 BTU'S of heat.
8. It may be possible to combine some manufacturing steps so that the product does not cool down between steps and subsequently have to be reheated before it is processed further.

The energy shortage is a national concern. It can also be viewed as an exciting challenge. Those companies that move quickly to meet the challenge will contribute substantially to the solution of a national problem – and make money at it.

The first step is measurement.

DEPARTMENT _____

MONTHLY DEPARTMENT ENERGY USE

1973	ELECTRIC POWER			NATURAL GAS			FUEL OIL			COAL			COMPRESSED AIR		
	kWh	Btu/kWh	Btu	k cu ft	Btu/k cu ft	Btu	gal	Btu/gal	Btu	TONS	Btu/lb	Btu	k cu ft	Btu/k cu ft	Btu
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															
1974															
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															

DEPARTMENT _____

MONTHLY DEPARTMENT ENERGY USE

	psig STEAM			psig STEAM			CONDENSATE USED OR LOST			WATER			TOTAL CONVERSION Btu	NUMBER OF UNITS PRODUCED	CONVERSION Btu PER UNIT OF PRODUCTION
1973	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu			
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															
1974															
Jan.															
Feb.															
Mar.															
Apr.															
May															
June															
July															
Aug.															
Sep.															
Oct.															
Nov.															
Dec.															

DEPARTMENT _____

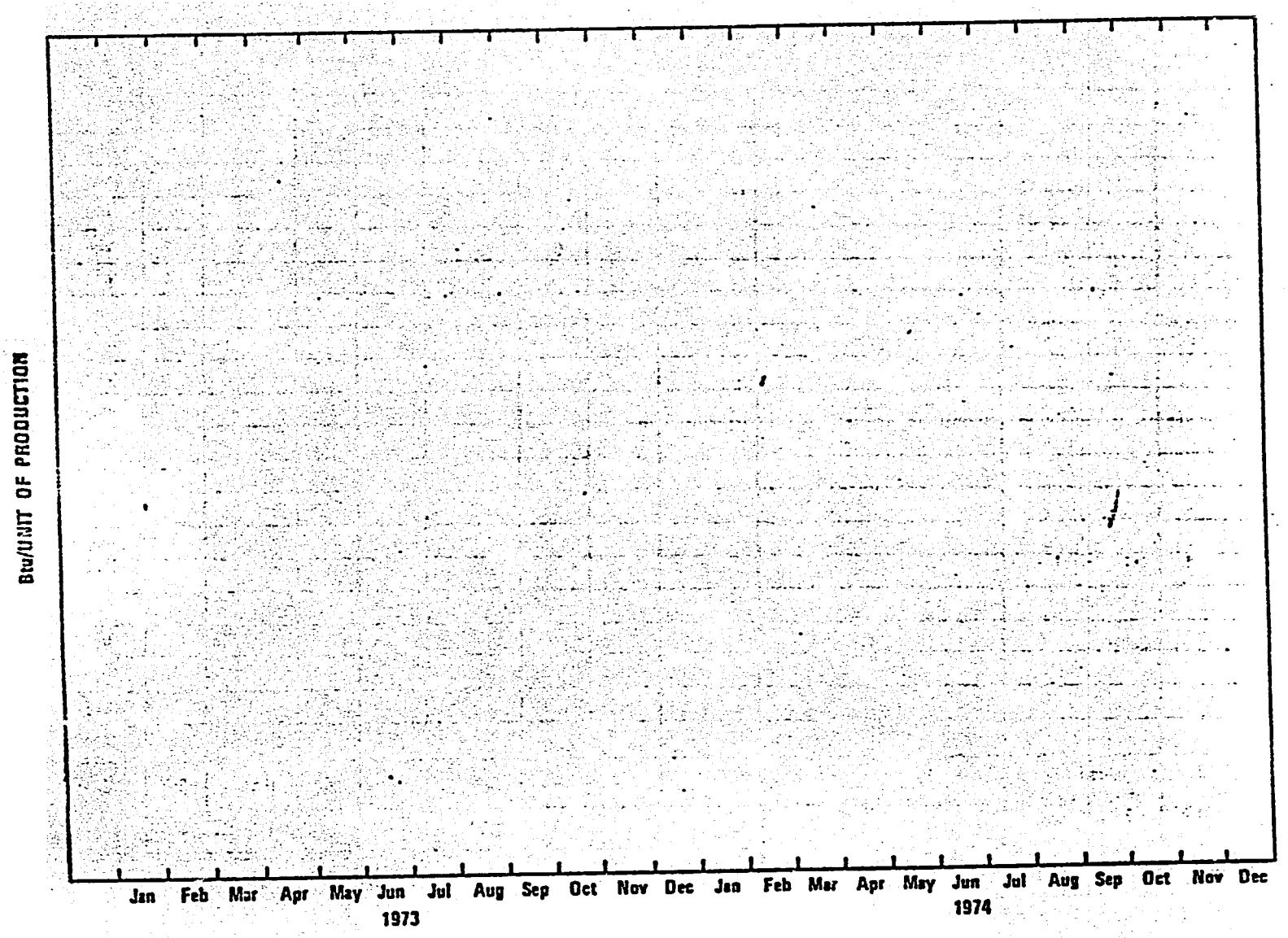
MONTHLY DEPARTMENT ENERGY USE

	RAW MATERIAL "A"			RAW MATERIAL "B"			RAW MATERIAL "C"			Total Raw Material Btu	Raw Material Btu Per Unit of Production	Total Conversion & Raw Material Btu Per Unit of Production
1973	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu	k lb	Btu/k lb	Btu			
Jan.												
Feb.												
Mar.												
Apr.												
May												
June												
July												
Aug.												
Sep.												
Oct.												
Nov.												
Dec.												
1974												
Jan.												
Feb.												
Mar.												
Apr.												
May												
June												
July												
Aug.												
Sep.												
Oct.												
Nov.												
Dec.												

Tracking Chart

Energy Use Per Unit of Production

Attachment C



2.6 First Energy Saving Survey

The survey team's plan for the first survey was approved by the Energy Conservation Committee, you recall. Now we have a sequence of four letters regarding the survey. The manager endorses the survey plan. The team submits their timetable to department heads. Findings of the survey are reported. Finally, the team suggests the need for foreman training in energy conservation. Note the application of:

- Survey
- Employee involvement
- Top management commitment

2.6.1

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: January 29, 1974

To: Department Heads

From: D. T. Parker, Plant Manager

Subject: First Energy Saving Survey

You each have a copy of the January 25, 1974, letter from W. D. Smith and A. B. Jones detailing their plans for the survey aimed at energy wastes that can be corrected by maintenance or operations actions. These are the types of energy losses that can be stopped or reduced right away, or fairly soon, and at little or no expense.

Smith and Jones will contact you in the near future regarding a time-table for the survey. Each of you should inform them of the name of the person you designate to accompany them and participate with them in the survey of areas under your responsibility.

Everyone's cooperation in this program is important. I urge that you put some real priority on this survey and on taking corrective actions as soon as practical.

cc: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"

2.6.2

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: February 1, 1974

To: Department Heads

From: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"

Subject: First Energy Saving Survey

The timetable for this survey is given below. If any of these dates are not convenient, please contact us so that other times can be arranged.

Area	Date
Furnaces	February 11
Shop	February 12
Heat Treating	February 13
Shipping	February 14
Receiving	February 15
Laboratory	February 19
Utilities	February 20
Chemicals	February 21
Administrative Building	February 22

cc: D. T. Parker, Plant Manager

2.6.3

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: February 28, 1974

To: Department Heads

From: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"

Subject: Results of First Energy Saving Survey

Attached are the findings of the survey. Some of the operating items have already been corrected by operations personnel. Department supervisors have already written work orders for a number of the maintenance repairs. Those operating or maintenance items that require process shutdown for correction have been added to the lists of jobs to be done at the first shutdown opportunity by department supervisors.

It is important that we monitor the progress of work on correcting these energy wastes by keeping up-to-date records; therefore, it is essential that we are advised when each job is completed.

If there are any questions concerning the survey, please contact us.

As a result of the survey and some energy conservation projects being proposed, we have developed an estimate of potential savings and we suggest that our goal be increased to 12% savings in energy this year.

cc: D. T. Parker, Plant Manager
Energy Conservation Committee

ENERGY SAVING SURVEY

Department: _____

Date: _____

Surveyed by: W.D. SMITH
A.B. JONES

Fuel Gas or Oil Leak	Steam Leaks	Compressed Air Leaks	Condensate Leaks	Water Leaks	Damaged or Lacking Insulation	Excess Lighting	Excess Utility Usage	Equipment Running & Not Needed	...ters Out of Adjustment	Leaks of or Excess of HVAC	Location	Date Corrected
		near #1 furnace									Furnaces	
					#2 furnace lining						Furnaces	
						Parts Storage					Shop	
										Broken Window	Shop	
#3 furnace									#1 furnace		Heat Treating	
								#2 furnace			Heat Treating	
								#1 conveyor			Heat Treating	
	Bldg. Heat-or Trap										Assembly	
						Storage Area					Assembly	
											Shipping	
										Doors need weatherstrip	Shipping	
								Man cooler fan			Receiving	
						Above Shelves					Receiving	
								Fume hood fan			Laboratory	
				safety shower							Laboratory	
						Chemical Storage					Laboratory	
	#1 boiler										Utilities	
					#2 steam line						Utilities	
		#2 compressor									Utilities	
	#1 reheater										Chemicals	
			#2 reheater								Chemicals	
							steam jets				Chemicals	
						Hallways					Administration Building	
										return air condition	Administration Building	
				Men's rm. faucet							Administration Building	

2.6.4

EC ONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: February 28, 1974

To: J. C. Baker, Energy Conservation Coordinator
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"

Subject: Need for Supervisor Training Program

During our first energy savings survey we had opportunities to discuss energy conservation with the foremen accompanying us. We learned that these foremen should be made more aware of the costs of utilities, the potential of savings through conservation, and the methods for saving energy.

Therefore, we recommend that the Energy Conservation Committee design a course on energy conservation to be included in the Supervisor Training Program.

cc: D. T. Parker
Plant Manager

2.7 THIRD MEETING OF THE ENERGY CONSERVATION COMMITTEE

This meeting is the last to be recorded in this section. On the following pages are four memoranda dealing with the topics shown on the agenda. The last memorandum presents plans for special activities each month for the rest of the year. At this point an active, effective program should be well into the process of implementation.

2.7.1

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: Energy Conservation Committee

From: J. C. Baker, Coordinator

Subject: Agenda for Third Meeting of the Energy Conservation Committee

1. Capital project reviews
2. Energy saving project lists and project evaluation summary
3. Communication of ways to save energy
4. Continuing program

cc: D. T. Parker
Plant Manager

2-2

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: Department Heads

From: D. T. Parker, Plant Manager

Subject: Capital Project Reviews

As you know, in our authorization procedure every capital project must be reviewed and approved with regard to safety, fire protection, pollution abatement, and additional utility requirements. As of this date, we are adding energy conservation to this checklist.

Every capital job will be reviewed by the Coordinator of the Energy Conservation Committee. On large jobs the interested committee member will also participate with the coordinator and project team. The purpose of these reviews is to assure that there is efficient utilization of energy in the design. If the project has to do with production, the design Btu per unit of production will be calculated and compared with the historical Btu unit ratio. More efficient use of energy is expected.

cc: Energy Conservation Committee

2.7.3

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: W. D. Smith, Operations "A"
A. B. Jones, Operations "B"
T. G. Marshall, Maintenance
R. B. Robinson, Administrative Services

From: J. C. Baker, Energy Conservation Coordinator

Subject: Energy Saving Project Lists and Project Evaluation Summary

Some of our energy conservation projects will require capital; others can be done on expense. Therefore, we should have two separate lists of projects. In order to have the lists in a uniform format, the two attached forms for capital and expense projects are provided for use by all departments.

The ratio of energy savings/year per dollar invested is an indicator of how good a project is, compared to other projects. The higher the number, the better the project. In the forms, a column for percent return on investment is also included as an aid in assigning priorities on projects.

Also attached is an evaluation summary form to be used for each project.

Please submit copies of these forms to the key supervisors in your area and request that they enter their project information and return completed copies (lists and evaluations) before our next meeting one month from today.

Our manager, Mr. Parker, has requested that we continue working on the lists, revising and updating them monthly, adding new projects that evolve and additional maintenance jobs that become necessary.

cc: D. T. Parker, Plant Manager

ENERGY CONSERVATION
CAPITAL PROJECTS

Department: _____

Date: _____

Project Number	Project Description	Energy Savings Btu/Year	Capital Cost $	Ratio Btu/Year Saving / $ Capital	Percent ROI	Priority	Status

ENERGY CONSERVATION
EXPENSE PROJECTS

Department: _____

Date: _____

Project Number	Project Description	Energy Savings Btu/Year	Expense Cost $	Ratio Btu/Year Saving / $ Expense	Percent ROI	Priority	Status

ENERGY CONSERVATION PROJECT
EVALUATION SUMMARY

Capital _____ or Expense _____

Department _____

Date _____

Project No. _____ Person Responsible _____

Project Title: _____

Description of Project: _____

_____

_____

_____

_____

Location: _____

Financial Evaluation

Estimated

Energy saving (electric power kWh/yr steam lb/yr etc.)

Utility or Raw Material	Saving
_____	_____ /yr
_____	_____ /yr
_____	_____ /yr
Total energy saving	_____ MBtu/yr
Total energy cost saving	_____ $/yr
Other cost saving due to:	
_____	_____ $/yr
Additional cost due to:	
_____	_____ $/yr
Net cost saving	_____ $/yr
Cost of project	_____ $

ENERGY CONSERVATION PROJECT
EVALUATION SUMMARY

Calculated

Return on investment _____ %

Pay back period _____ months

Other _____ _____

Btu/unit of production: Now _____ After project implemented _____

Benefits/Problems

Product quality _____

Product yield _____

Production rate _____

Safety _____

Pollution _____

Maintenance-manpower/materials _____

Utilities _____

Working conditions _____

Employee attitude _____

Community _____

Other benefits/problems connected with implementation:

_____

_____

_____

Comments: _____

_____

Project rating: _____

_____

_____

Planned authorization request date: _____

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: Energy Conservation Committee

From: T. G. Marshall, Maintenance

Subject: Communication of Ways to Save Energy

I have assembled a group of ECO's from EPIC, which are particularly applicable in our operation, along with a few good articles from the literature. I propose that we publish this as a booklet for plant wide use by supervisors. A copy of the list of ECO's chosen is attached hereto. After each of you has looked over the copy and indicated your approval, I will proceed with publication and distribution.

May I suggest that this booklet could be a useful tool in a training course as suggested in the recent letter from W. D. Smith and A. B. Jones.

cc: D. T. Parker
Plant Manager

LIST OF SUGGESTED ENERGY CONSERVING OPPORTUNITIES

	ECO
Building and Grounds	
Reduce Warehouse Ventilation Air	3.2.1
Reduce Outside Lighting	3.13.1
Reduce Air Conditioning During Non-Working Hours	3.2.5
Electric Power	
Schedule to Minimize Electrical Demand Charge	3.3.1
Steam	
Insulate Bare Steam Lines	3.4.1
Return Steam Condensate to Boiler Plant	3.4.3
Stop Steam Leaks	3.4.5
Inspect and Repair Steam Traps	3.4.6
Other Utilities	
Eliminate Leaks in Combustible Gas Lines	3.5.1
Lower Pressure of Compressed Air to Minimum Necessary Level	3.5.2
Eliminate Leaks in Compressed Air Lines	3.5.3
Use Fan for Personnel Cooling — Not Compressed Air	3.5.5
Combustion	
Replace Worn and Obsolete Controls	3.8.2
Daily Monitoring of Boiler Efficiency	3.8.4
Flue Gas Analysis as a Maintenance Tool	3.8.5
Scheduling	
Standby at Reduced Temperature	3.9.1
Shut Down Idle Heating Equipment	3.9.2
Process Specifications as a Source of Energy S	3.9.3
Schedule Equipment for Maximum Utilization	3.9.4

2.7.5

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 8, 1974

To: Energy Conservation Committee

From: J. C. Baker, Energy Committee Coordinator

Subject: Continuing Program

At this point we have our program well underway, but I believe you will agree that we need a continuing program to maintain our momentum. Periodic energy saving surveys are one important activit Communication and education also need emphasis to develop awareness. I thought it would be well to list the elements in this area, some of which we already have in the mill and others we may wish to include in plans for the future.

1. Monthly meetings of Energy Conservation Committee.
2. Monthly meetings of each committee member with key supervisors in the area he represents.
3. Booklet on ways to save energy.
4. Energy conservation course to be included in Supervisor Training program.
5. Periodic bulletins or features in the Plant News publicizing energy saving achievements and recognizing individuals responsible.
6. Posters on energy saving to be used in much the same way as safety posters.
7. "savEnergy" decals for placing at light switches, typewriters, and on hard hats.
8. Technical talks on energy saving aspects of steam traps, lighting, insulation, etc.
9. Letters to employees and their families giving energy saving tips for the home.
10. In public relations, company ads stressing energy conservation on radio and in newspaper, talks on energy saving before civic groups.

Attached to this letter is the outline of a proposed program of activities for each month for the rest of the year.

cc: D. T. Parker, Plant Manager

savEnergy

Planned Activities in Energy Conservation for Remainder of 1974

The following activities will take place each month and will not be repeated in the plans for individual months:

1. Meeting of Energy Conservation Committee
2. Meeting of each Committee Member with the key supervisors in his area
3. Updating of energy saving project lists
4. Communicate progress with updated plot of Btu/unit of production
5. Department supervision will conduct weekend audit

Month	
April	1. Distribute booklet of selected ECO's 2. Review status of corrective actions regarding first energy saving survey 3. Publish bulletin on energy saving tips for driving 4. Technical talk on steam traps
May	1. Energy conservation course in Supervisor Training 2. Departments develop energy balances 3. Distribute "savEnergy" decals 4. Technical talk on economics of insulation 5. Letter to employees at home with energy saving tips for the home
June	1. Trained foremen start holding monthly meetings with their people on energy conservation 2. Publish bulletin on air conditioning tune-up 3. As a result of energy balances, committee will conduct energy surplus survey 4. Coordinator gives talk at high school
July	1. Poster contest 2. Bulletin on energy saving during vacations 3. Survey of steam pressure reducing stations 4. Technical talk on lighting
August	1. Publicize poster contest winner in plant and community newspaper 2. Distribute posters 3. Survey compressed air requirements 4. Bulletin - "Don't use compressed air for cooling"
Sept.	1. Bulletin - "Tune up space heating systems" 2. Survey steam condensate system 3. Coordinator prepares talk with slides for local technical society meeting 4. Committee rides through plant at night and suggests corrective action on lighting
October	1. Demonstration of infrared survey to detect excessive heat losses 2. Steam trap survey 3. Bulletin on steam tracing systems 4. Technical talk on combustion

November 1. Survey oversized electric motors and equipment
2. Bulletin - Recognize someone's energy saving achievement
3. Second course in Supervisor Training
4. Technical talk on electric motors and power factor

December 1. Bulletin - "Use reflectors and reduce Christmas lighting"
2. Report achievements in reductions of energy use and announce goal for next year
3. Survey use of low pressure steam
4. Plan program activities for next year

2.8 CONCLUSION

This section on program implementation began with a discussion of the importance of management interest and support. It seems appropriate to include in the conclusion a letter from the manager to his staff demonstrating his *continuing concern* about energy conservation. His request for a contingency plan is then answered by his department heads with a report on the status of the contingency planning in each deparment.

2.8.1

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 20, 1974

To: Department Heads

From: D. T. Parker, Plant Manager

Subject: Request for Energy Curtailment Contingency Plan

You should all be aware that energy supply is a very real and serious problem to our operations. Briefly, our anticipated allocations of fuel oil, natural gas, electric power, and gasoline are insufficient to support our operation as they have in the past. Our ability to eliminate unnecessary use of these commodities and to allocate fuel to vital functions will ultimately determine how severely our operations are curtailed

Even more serious is our inability to secure adequate quantities of coal to meet anticipated needs. Efforts during the past two months have failed to increase deliveries, and inventories are currently at a low level. Current fuel suppliers are operating at their ultimate capacity and they face problems associated with weather, fuel shortages for their mining equipment and ever increasing strip mine regulations. To date, we have been unable to secure additional suppliers as those who are mining coal are sold out beyond their production capabilities.

At this time it appears that some production curtailments may be necessary. Each supervisor should review his operations: those pieces of equipment which are operating at less than desired efficiency with respect to energy consumption should be identified and plans made to restrict or curtail their operation. The basic factors which influence fuel efficiency and/or energy utilization in all processes should be identified and immediate steps taken to minimize our energy requirements.

In anticipation of possible short term reductions in energy supply, for instance electric power, we need a contingency plan. This should include a list of the equipment that would be shut down and the sequence of shut down in your department in case of 25%, 50%, 75% and 100% energy curtailments.

Your plan for reducing energy requirements in your area should be formalized and available for review by me one week from today. Remember - NO SAVING IS TOO SMALL TO BE CONSIDERED.

cc: Energy Conservation Committee

savEnergy

2.3.2

ECONERGY COMPANY

INTER-OFFICE CORRESPONDENCE

Date: March 27, 1974

To: D. T. Parker, Plant Manager

From: Department Heads

Subject: Reduction of Energy Requirements and Contingency Plan Status

Significant reductions in energy use have been achieved in our operating units as follows:

Utilities

It has been our operating practice to fire all three boilers even though steam requirements could be provided by two boilers fully loaded. In this way, a forced outage of one boiler could be handled without decreasing steam output and causing interruption of operations of steam users.

We have shut down #1 boiler, the oldest and least efficient boiler, and the result is a fuel saving of ____M Btu/hr. In case of a forced outage of one of the two operating boilers, we have set up a communication procedure to curtail steam to certain units that can be shut down safely and quickly with the least impact on other operations in the plant and re-started with a minimum loss of productivity.

Operations "A" and "B"

Similarly, in both departments, we have been able to shut down one of three furnaces by rescheduling throughput. The schedule is extremely tight at our present production rate, and on occasion we may need to fire up the third furnace in order to meet commitments. Fuel saving at present is _____M Btu/hr.

savEnergy

Contingency Plan Status

1. Electric Power

In general, during any curtailment of power, air conditioning thermostats in all buildings will be reset to ____F. System interlocks have been provided to avoid inadvertant operation of the heating system, except in those situations where the controlled lower humidity is required.

If a "brown out" occurs (voltage reduction in excess of 10%), certain motors trip off automatically and others must be tripped manually to avoid damage. We are surveying all motors to identify the ones that require manual tripping. Utilities will set up a communication procedure to inform the appropriate people when a "brown out" occurs.

Following is a tabulation of shutdowns sequence for curtailments of electric power:

Curtailment	Shutdown Section
25%	1
50%	1,2
75%	1,2,3
100%	1,2,3,4

We have designated a number of units that will be included in each of the four sections but the plan is not complete yet.

2. Fuels

For each fuel, we will have a tabulation like the one for electric power. We are holding meetings this week to complete the designation of units in each section for each tabulation. We hope to submit the detailed plan to you next week.

In general, when fuel curtailment causes a cut-back in steam generation, all steam heated buildings will have thermostats reset to ____F. Again, system interlocks will prevent inadvertant operation of the cooling system, except where the controlled lower humidity is required.

savEnergy

EMPLOYEE MOTIVATION AND COMMUNICATION METHODS

David H. Heller
Air Products and Chemicals, Inc.
Paulsboro, New Jersey

ABSTRACT

This paper discusses the compelling reasons for involving all employees in the plant energy conservation effort, offers suggestions on how to implement and maintain a plant-wide, people oriented conservation program and provides examples to illustrate the methods involved and benefits possible. Three areas will be stressed: publicity, or communicating down the ladder, through newsletters and the use of distinctive logos; communicating up the ladder, by means of employee suggestion programs and discussion forums; and training, necessary to free employees from a pre-Embargo approach to manufacturing.

Current technical literature is full of information on how to reduce energy use. Consider energy management systems, waste heat recovery or heat pumps - all the facets of the design, construction, and operation of such equipment and many other new devices takes up an ever-increasing amount of our time. No one can deny the benefits achievable through capital investment and new technologies, but there are other, oft-neglected aspects of energy conservation to be considered. The development and use of an effective energy management organization and the involvement of the entire plant in the conservation effort can and should go hand-in-hand with the physical improvement of the operation.

I'd like to share with you my experiences as a member of one very successful energy management organization - explaining how we are set up to implement energy conservation and detailing a number of programs we have found effective.

ORGANIZATION FOR ENERGY CONSERVATION

I am employed as Technical Supervisor at Air Products and Chemicals' Paulsboro, New Jersey plant. The Paulsboro Plant is part of the Chemicals Group of Air Products. We are located in Southern New Jersey, in the Greater Philadelphia area. Of our employees, 25 are exempt and the balance hourly or non-exempt. We produce various types of industrial catalysts, with our major product being DABCO, a urethane foam catalyst.

The Paulsboro Plant has seen sharply spiraling energy costs over the last few years, as we all have. From 1978 to 1981, our average cost for energy rose by more than 90 percent. The impact of these costs

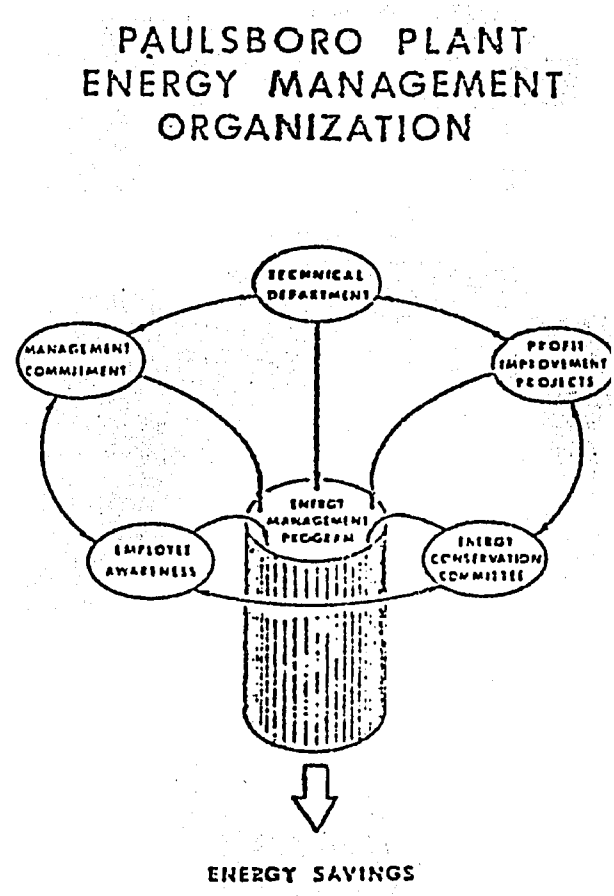


FIGURE 1

forced us to re-evaluate our conservation efforts and two conclusions came to light. First, conservation projects once glossed over because of a low rate of return now looked more attractive. It became necessary to refocus our technical efforts towards auditing our process flows and examing heat and material balances with the proverbial 'fine tooth comb.' Secondly, we came to realize that in order to be successful in reducing energy costs it made sense to involve the entire plant in the effort, not just a handful of engineers and technicians. The Paulsboro Plant conservation effort was thus or-

USE ENERGY WISELY

PAULSBORO ENERGY REPORT

NUMBER 10
20 JULY 1981

ENERGY USAGE REMAINS DOWN

Through June, plant energy usage was 4.0% less than the same period last year. Remember to keep your eyes open for energy waste.

THIRD QUARTER SUGGESTION DRAWING

Bud Johnson was picked as this quarter's winner of a $25 gift certificate for energy suggestions. Thanks to everyone who submitted suggestions over the last three months.

STEAM TRAP CAPS

During the next round of steam trap inspections, Dave DiPietro will be adding caps to all steam traps. The caps insulate the traps by providing a layer of dead air around the trap and protecting it from rain. We'll save about $4,500 a year on our steam bill. Plant steam traps are inspected every three months.

OXIDIZER SAVINGS

The oxygen controls on the Thermal Oxidizer saved $20,000 in natural gas last quarter, or $80,000 over the entire year. A few bugs cropped up or savings would have been even greater.

SEE THE LIGHT

Flourescent lamps produce up to five times as much light for the same energy as incandescent lamps and last 10 to 15 times longer.

Wattage does not measure the amount of light - it measures the energy needed to light the bulb. The amount of light is measured in Lumens. Example - you need six 25-watt bulbs to equal the light from one 100-watt bulb.

It's an old wive's tale that there is a surge of power when you turn on a light. If you leave a room, even for a minute, turn off the light.

IF YOU HAVE ANY SUGGESTIONS FOR IMPROVING THIS NEWSLETTER, DROP THEM IN THE SUGGESTION BOX. I'D APPRECIATE YOUR IDEAS. THANKS.

FIGURE 2

ganized along the lines shown in Figure 1.

The Technical Department and Technical Supervisor have major responsibility for the program. The Technical Supervisor serves as Plant Energy Conservation Coordinator; a part-time function at Paulsboro, but a position that requires full-time attention at larger facilities. The Conservation Coordinator's responsibilities include: developing and communicating conservation techniques and ideas to the employees, monitoring and reporting plant energy consumption, developing plant programs, goals and budgets and maintaining a plant environment conducive to energy conservation.

The Profit Improvement Program is a suggestion program for our technical people. This program encourages new ideas and recognizes the contributors.

The Energy Conservation Committee is composed of representatives from Production, Maintenance, Technical and Project Groups. The Committee meets monthly to discuss and evaluate the status of the plant conservation program. The Committee feeds information to the employees and communicates employee's concerns to management. The most important function of the Committee is to serve as a place where inter-departmental problems involving conservation projects or programs can be resolved.

Management commitment is a major component of our overall effort. Management communicates standards and goals and measures performance. Group and Corporate management provide support through people and capital, and acts as a clearing house for ideas. On the plant level, management communicates directly with the employees through our newsletter and letters sent to the homes.

The position of Energy Coordinator, the PIP program, and the Conservation Committee have all been active for a number of years. I believe the fact that we have organized specifically for the conservation of energy has helped us keep the effort alive and has resulted in a number of outstanding innovations. Now, I'd like to focus on the last box in our organization diagram - employee awareness.

INVOLVE THE ENTIRE PLANT

Proper motivation of operating, maintenance, laboratory and clerical personnel can be one of the most cost-effective energy conservation techniques. Hourly employees have the closest contact with the operating equipment and are often the most knowledgeable about production problems and unit idiosyncracies. They will see things that you as an engineer or manager might overlook and they will extend your eyes and ears to round-the-clock coverage.

These people are just as concerned as you are about the continued escalation of energy costs and the implications of dependence on foreign oil. Our responsibility is to direct them to utilize on the job the same resourcefulness they demonstrate in dealing with home energy problems.

What kind of results can be expected? The effects of improved operations and maintenance are often difficult to quantify - a steam leak reported a few days before a supervisor notices it, a spare pump turned off, a steam tracing line insulated rather than ignored. Then again, an operator might suggest a process modification that could yield large savings. There are also a number of intangibles - an improved morale, an esprit de corps, a spirit of cooperation. The point is that the benefits will far outweigh the costs of organizing the program and maintaining the effort.

There are many methods that can be used to motivate and communicate with your employees. The approach should be one of common-sense, stressing facts, with just enough pizzazz so they are noticed, without being laughed at. I'd like to stress three areas - publicity, or communicating down the ladder, communicating up the ladder, and training.

PUBLICITY

The "Paulsboro Energy Newsletter, (Figure 2) was developed to publicize the plant program. The Newsletter has been published monthly since October, 1980 and is posted on plant bulletin boards. A variety of items are presented - updates on plant conservation projects, recognition of outstanding contributions, progress toward conservation goals, and home energy tips.

The Newsletter has been very well received by our employees. One comment I often hear is that they feel better about their jobs and relations with the plant when they're told what's going on. Now that we've established an energy conservation presence at the plant, I find employees asking me if I have any information on air conditioner sizing, solar heating, and other items discussed in Newsletters.

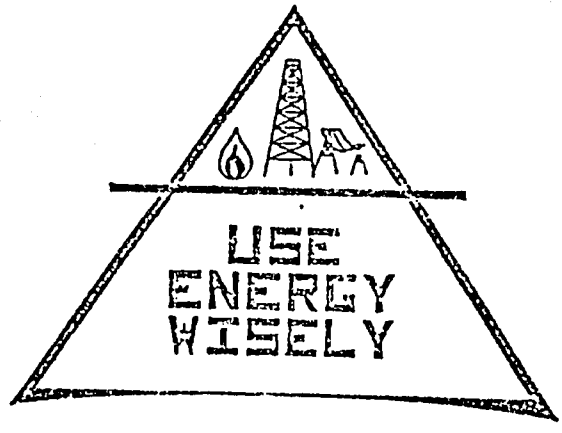


FIGURE 3

Please notice the emblem in the top left corner of the Newsletter (Figure 3). One of the first steps in publicizing Paulsboro's program was the development of an energy logo. This is a recognition tool used on all our conservation literature. We based ours on our corporate logo, adding the simple phrase "USE ENERGY WISELY" and adding a gas flame, an oil derrick, and electrical transmission

lines to illustrate our plant energy sources. One excellent way to kick off a conservation program is to hold a logo design contest among employees, or their children.

The types of publicity vehicles you employ will depend on your imagination, and your ability to judge what will be effective at your location. Handouts and pay envelope stuffers can present useful news, especially home conservation tips. These items can be obtained at a nominal price from public and private energy conservation organizations. Your local utility companies should also be a good source of information. This material is usually presented on a seasonal basis - heating tips in January, air conditioning ideas in July.

LISTENING TO EMPLOYEES

While communication down the ladder has been stressed to this point, input from the hourly employees should not be ignored. The programs already mentioned will help promote a spirit of cooperation at your location and employees will feel better about approaching their supervisors with their thoughts and ideas. And the number and quality of those ideas would probably surprise many of you.

To help tap this source of information, an Energy Conservation Suggestion Program was begun at Paulsboro. Our capital expenditure consisted of a short form and a suggestion box. Each suggestor receives a personal reply thanking him and explaining what the follow-up action will involve. The reply is most important, unfeasible and even absurd suggestions are acknowledged in order to show we appreciate the interest and respect the input. Responsibility for acting on worthy suggestions is assigned at Conservation Committee meetings. (Figure 4).

During the first full year of operation twenty-five percent of our hourly personnel submitted suggestions and total suggestions numbered sixty. Qarterly a randomly drawn suggestion wins a $25 gift certificate at a local department store and a $50 certificate is given each year for the best suggestion. After completion of all projects and work orders resulting from last year's suggestions total savings are expected to be $25,000. The suggestions have included items such as: installation of light switches in under-utilized rooms, installation of skylights to reduce the need for light fixtures during the day, and lists of areas requiring insulation that were overlooked during energy audits. We have received only a few worthy process improvement suggestions to date. Process improvements could of course save many times over the $25,000 figure.

There are pros and cons on the question of prizes. One of the most-voiced complaints - when prizes are discontinued the signal is given that the program is ended. This is a valid point, and the answer must be decided at each location, based on

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ENERGY CONSERVATION SUGGESTION

TO SAVE ENERGY IN THE PLANT, I SUGGEST:

SHUT OFF GLYCOL CIRCULATING PUMP FOR DARCO II STILL WHEN NOT IN USE.

PUMP RAN 22 DAYS DURING JANUARY WHILE STILL WAS DOWN.

SUGGESTOR D. MAGATH DEPT. OPERATIONS DATE 2/4/81

SEND SUGGESTION TO: DAVE HELLER

(Figure 4)

past experiences. Any publicity or motivational program is going to slack off after the first flush of enthusiasm. This can be discouraging and help put a damper on everyone's conservation spirit. Let me suggest that this slackening off is a signal to transfuse some new ideas into your program.

I have always had an aversion to the use of competition between shifts as a means of promoting energy conservation. The key point in any awareness program should be cooperation, and competition, as friendly as you might try to make it, will often ruin any cooperative spirit. As an example, at a plant where I was formerly employed, we were interested in seeing which shift could produce the highest percentage of on-spec product. It was discovered that the operators on one shift would come in and rearrange the settings on a number of critical instruments to settings they knew worked well. Just before the shift ended, they would return the settings to those in use before they came on. Of course, after running lined-out for seven and one-half hours at one set of conditions the unit would go to pieces and the next shift would require several hours to get lined-out again. We decided after that to stick to softball for inter-shift competition.

ENERGY CONSERVATION TRAINING

Back in the good old, pre-Embargo days, it was not uncommon for operators in the chemical industry to use a little extra energy to maintain a safety margin on product quality. Increasing the reflux rate on a distillation column is one example. More often than not, supervisors shared the blame for wasting energy since they took the lumps if the product was off-spec. Unfortunately, old habits die hard. Employees must be re-trained to respect energy costs.

As I mentioned earlier, an "energy-awareness" is a necessary first step. But specific training will also be required.

One of the first things our supervisors did at Paulsboro was to re-read and where necessary, revise operating procedures to focus on conservation. There is no point in purifying a product way beyond its specification. We also expanded our preventive maintenance program in the hopes that it would help us eliminate energy-intensive startups and shutdowns.

This year, we plan to introduce energy training sessions for all employees, similar to a program we now use for safety training. A typical session could include an explanation of the operation of a new piece of equipment, information on how much a steam leak can cost and how to report one, and a question-and answer period on energy issues.

Currently, we are developing an energy conservation slide show or presentation to all employees at upcoming training sessions. The program will use photographs shot at our plant to explain our energy usage, showing plant utility tie-ins, the operation of energy users, examples of energy wasters - such as steam leaks, and uninsulated lines, methods for reducing energy use and a review of plant utility costs. The slides will be accompanied by a tape recorded narration. Employees relate well to this type of program since it is specific to their activities. At a cost of twenty to thirty dollars per show,"homemade" training aids are less expensive and more effective than commercially available programs.

A number of equipment vendors present short training seminars for operating personnel. Recently we had a steam trap manufacturer present information on trap inspection and repair techniques to our maintenance men.

Instruction in conservation techniques should be included in the training of new employees, but if experienced men are used to train the newcomers, as is often the case, be sure the experienced ones are not going to hand down a pre-embargo approach to manufacturing.

In summary, I've tried to present a "punch-list" of techniques and tools to increase the effectiveness of your energy conservation programs. Consider organizing for energy conservation. And try to find one person in your organization who shows an interest in conservation and formalize that interest into the position of conservation coordinator. Many methods are available that will pull your entire organization into the effort - newsletters, handouts, posters. Remember to listen to your employees too, through suggestion programs and forums. And retrain your people to appreciate the impact that energy is having on the cost of going business.

The mix of methods you use will of course, vary with the type and size of the audience and the resources available, but I hope you have discovered one or two techniques that might be worth a try.