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APPENDIX

3.8.1-25

SCREENING STUDIES

FOR

FUTURE INDUSTRIAL AUDIT

- Foster Wheeler Energy Corporation
- Stanley Consultants Incorporation
- Hagler, Bailly & Company, Incorporation

FOSTER WHEELER USA CORPORATION
110 SOUTH ORANGE AVENUE • LIVINGSTON, NEW JERSEY 07039 • PHONE 201-533-1100

March 7, 1986

Mr. Marshall Monarch
Argonne National Laboratory
Building 362
9700 South Cass Avenue
Argonne, Ill. 60439

Subject: Plant Selection Report for O.E.P.

Dear Marshall:

Enclosed, as you requested in our telephone conversation of March 6, 1986, is a copy of the Plant Selection Report, dated September 9, 1985, which we prepared for O.E.P. following our visit to eleven (11) plants in Cairo and Alexandria last August.

We understand that you have just been requested by O.E.P. to ask us for our report, and also the ones prepared by Stanley Engineering and Bagler Bailey, in order to provide O.E.P. with your recommendations for future audit work before the end of this month, when your contract expires.

You will note that our report strongly recommends that the best possible approach is to have the next RFP written to include four separate work orders of two audits each, in order both to schedule and proceed with the work in the most efficient manner possible, without any additional loss of time.

After you have had an opportunity to read our report , we would be pleased to discuss it with you and to answer any questions which you may have.

Very truly yours,

FOSTER WHEELER USA CORPORATION

Howard M. Feintuch

Howard M. Feintuch
Manager, Process Design Services
Process Plants Division

HMF:sb
Enclosure
cc: R. L. Godino - Divisional Vice President - Process Plants Division
R. Bery - Vice President and Sales Manager - Washington, D.C.

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ORGANIZATION FOR ENERGY PLANNING

(OEP)

ENERGY AUDITS AND AUDIT TRAINING

IN

EGYPT

PLANT SELECTION REPORT

F.W. REFERENCE No. 10-35862

SEPTEMBER 9, 1985

FOSTER WHEELER USA CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N.J. 07039

6

FOSTER WHEELER USA CORPORATION
110 SOUTH ORANGE AVENUE • LIVINGSTON, NEW JERSEY 07039 • PHONE 201-533-1100

September 9, 1985

Dr. Hussein Abdallah
Chairman and Chief Officer
Organization for Energy Planning
1, Aisha El-Talmorya - Garden City
Cairo, Egypt

Subject: Energy Audits and Audit Training
Plant Selection Report
FW Ref. 10-35862

Dear Dr. Abdallah:

Mr. Phair and I would like to thank you and your entire OEP staff for the kind hospitality which you showed to us during our recent trip to Egypt. We would like to especially thank Dr. Sobhi who accompanied us on the visits to the Cairo plants and Dr. Hani and Dr. Ibrahim who accompanied us on the visits to the Alexandria plants for their excellent efforts in seeing to it that all of the details of the plant visits and of our overall trip were perfectly planned, scheduled and executed.

After having just completed our visits to eleven (11) plants in Cairo and Alexandria with your OEP staff and also having visited eight (8) other Egyptian plants with your staff during last December's Screening Study, we are now quite confident that OEP is thoroughly familiar with all of the necessary procedures required to do future plant screening evaluations on its own.

Attached are two bound copies and one unbound reproducible copy of our Plant Selection Report, dated September 9, 1985. Since eight (8) of the eleven (11) plants visited are clearly in need of an audit, it is our recommendation that this screening exercise serve as a basis for selecting the pairs of plants to be audited for Work Orders 2, 3, 4 and 5. Our report contains all of the details of the plant selection, but as a convenience to the reader, we briefly summarize our selection as follows:

Work Order No.	2	3	4	5
1986 Starting Date for Work in Egypt	January 15	By OEP	By OEP	By OEP
Plant Name (Nearest Large City)	El Nasr Fert.Plant (Cairo)	Portland Cement (Cairo)	El Nasr Pharm. (Cairo)	Egypt Starch (Alexandria)
Plant Name (Nearest Large City)	Alex. Petrol. Co. (Alexandria)	Cairo Oil & Soap (Cairo)	Kaha Food (Cairo)	Edfina Food (Alexandria)
Audits to be Executed in:	Series	Parallel	Parallel	Parallel

Should you require any further information or explanation regarding our plant selection, beyond that already provided in our report, or should you desire our input in evaluating the merits of other possible plant selection alternatives, please let us know and we will be most pleased to further assist you in this matter.

We look forward to receiving your RFP for Work Orders 2, 3, 4 and 5 at the end of this month and to continuing our close working relationship with you for future work orders, as well as the associated implementation.

Very truly yours,

FOSTER WHEELER USA CORPORATION

Dr. Howard M. Feintuch
Manager, Process Design Services
Process Plants Division

HMF:db
Enc.

cc: R.L. Godino - Divisional Vice President
R. Bery - Vice President and Sales Manager - Washington, D.C.
D.N. Phair
C.E. Kastner

FOSTER WHEELER

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SECTION I - INTRODUCTION

This report presents the results of the plant selection effort executed by Foster Wheeler USA Corporation with assistance from the Organization for Energy Planning (OEP) for the purpose of selecting suitable plants to be audited as part of Work Orders 2, 3, 4 and 5. The work carried out in this task includes all of the following:

- Review of OEP data for eleven (11) Egyptian plant facilities, six (6) in Cairo and five (5) in Alexandria.

- Performance of a one-day walk-through inspection visit of each of the selected plant facilities, working with OEP personnel.

- Preparation of a Plant Selection Report in which each of the eleven (11) plants is evaluted and given a priority rating.

Recommendations, conclusions, and discussion of the logic for the overall task, along with supporting documentation are included herein, and capsulated with a brief summary in Section II.

SECTION II - SUMMARY AND RECOMMENDATIONS

Foster Wheeler USA Corporation, together with the Organization for Energy Planning, have completed the screening of eleven (11) Egyptian industrial plants in the Cairo and Alexandria areas.

The types of plants covered by this screening study include the basic industrial areas of chemicals, petroleum, foods, fertilizers, synthetic detergents, cement, pharmaceuticals and edible oils production, with at least one candidate plant screened in each area.

Screening was conducted with a carefully planned and systematic technique, this permitting the development of a consistent scoring-system for the evaluation of each candidate plant. From among the eleven (11) plants visited, eight (8) of the plants were clearly in need of an audit.

The plants selected for audit in Cairo and Alexandria for Work Orders 2, 3, 4 and 5, based on their high scores in accordance with the point rating of the scoring system, are:

Work Order No.	2	3	4	5
1986 Starting Date for Work in Egypt	January 15	By OEP	By OEP	By OEP
Plant Name (Nearest Large City)	El Nasr Fert.Plant (Cairo)	Portland Cement (Cairo)	El Nasr Pharm. (Cairo)	Egypt Starch (Alexandria)
Plant Name (Nearest Large City)	Alex. Petrol. Co. (Alexandria)	Cairo Oil & Soap (Cairo)	Kaha Food (Cairo)	Edfina Food (Alexandria)
Audits to be Executed in:	Series	Parallel	Parallel	Parallel

The advantages of conducting the pre-audit and audit on these companies are as follows:

1. These companies are representative of basic industries in the industrial sector in Egypt.

2. These companies reflect the opportunity to save energy with no cost/low cost energy conservation measures, as well as with capital improvement energy conservation measures.

3. The current energy consumption of these companies is significant, and the resultant energy conserved, when our recommendations are implemented, will be adequate to demonstrate a meaningful result.

SECTION III - DISCUSSION

This section of the report will present the details of the plant screening activity, the methods of analysis, and the resulting selection of the plants for audit.

A. Objectives

The objectives of the plant screening activity are multifold:

- To review those plants already pre-screened by the OEP engineering staff.
- To select those plants from the pre-screened list which will provide meaningful examples of energy conservation measures, and to recommend these plants for the full audit as part of Work Orders 2, 3, 4, and 5.
- To provide "on the job" training for OEP engineers, such that they are later able to perform this screening activity with personnel from within the OEP organization.

B. Method of Approach

In order that all results obtained are consistent, and that a uniform method of plant selection is obtained, a questionnaire was developed, to be used as a basis of decision (example as included in Section IV). The questionnaire permits the compilation of specific data as required to evaluate the industrial complex, and as required to summarize the results into the point scoring system. Elements covered by the questionnaire are general data, production detail, energy consumption information, equipment and process specifics, and energy conservation information.

Each screening activity was conducted through the same set of four steps, as follow:

1. Prescreening Plant Selection

OEP, through its staff in Cairo, contacted a wide variety of plants in both the Cairo and Alexandria areas, through the public sector, and determined which might be advantageously served by an energy audit. From this long list of plants, OEP established a "short list," based on proximity to Cairo and Alexandria, industrial sector, and plant management interest. Data was then accumulated for each plant on the "short list," and this data made available to the FW plant screening team.

2. Plant Scheduling

OEP, through its plant screening personnel for this project, developed a list of plants to be visited and scheduled six (6) one day visits to plants near Cairo and five (5) one day visits to plants near Alexandria.

3. Plant Visit(s)

The FW plant screening team, together with representatives from OEP, visited each plant in turn, with a one day visit as set by the schedule. During each visit, three action items were accomplished, namely:

a. Discussions with plant personnel needed to complete the questionnaire.

b. Inspection of technical data files.

c. Plant tour and inspection.

Results, as obtained from each visit are presented by the eleven (11) completed plant questionnaires included in this report in Section IV, Appendix A.

4. Plant Scoring

Scores for each plant were assigned after each visit in accordance with a previously developed scoring system (as later described). At the completion of the plant screening activity, a review of each score level was made, and the plants with the highest scores were selected for audits in Work Orders 2, 3, 4 and 5.

C. SCORES AND DESCRIPTION OF THE SCORING SYSTEM

The scoring system for the plant prescreening activity was developed to permit a mechanism which would inter-relate the various aspects of a potential plant audit candidate's particular circumstances.

A series of guidelines, as displayed by Exhibit 1 below, describe the weighted points to be assigned to any category, and, as mentioned earlier in the text, the complete results of each questionnaire are included in Section IV, Appendix A of this report.

Actual scores assigned in each category for each of the plants screened are shown in Exhibit 2 and summarized in Exhibit 3.

Exhibit 1

Explanation of Appraisal Form for Plant Selection

1. Type, Process Units, Equipment: Is the process equipment of the type which is unique only to this plant or of the type which can be found commonly in most industrial plants or in other plants producing the same products? "unique" gets a low score. "common" gets a higher score.

2. Export of Domestic Products: A plant that exports some or all of its products gets a higher score than one which does not. Roughly, the score should relate to the percentage of product exported. With 5 points equal to 25% exports.

3. Age (Last Modernization): A plant that is either very old, so that it is more difficult to justify an investment for add-on equipment, or that is currently in the midst of a modernization would, in either case, get a low score. An ideal plant would be approximately 25 years old or less with little or no modernization, and would receive the highest score.

4. Existing Installed Instrumentation: The greater the amount of existing instrumentation, the higher the score, with consideration also given to its operating condition.

5. Energy Consumption: The greater the amount of energy consumed, the higher the score. Scores will allow for the type of energy used, and for other considerations which involve judgement, i.e., alternate uses of the fuel, ease of export of the fuel, etc. All of the plants visited used mazout (no. 6 fuel oil) and electricity. In addition, some of them also used sular (diesel fuel) and/or natural gas.

6. Availability of Technical Data: The greater the availability of Technical Data, the higher the score. This is due to the need for original design conditions, flow rates, and process arrangement for proper analysis of energy conservation opportunities.

7. Potential Energy Conservation Improvements: The score for this category is broken up into two parts, half for no cost/low cost items and half for items requiring an investment. The greater the potential for improvement, the higher the score.

   A plant operating with first class maintenance and a process which relates well to the current states-of-the-art would receive a maximum of 5 points in each category, while a poorly maintained plant with old, inefficient processes would receive up to 30 points.

Some Examples of No Cost/Low Cost Items are:

- steam leaks
- poor combustion efficiency
- little or no insulation
- equipment running when not needed
- better maintenance and operations
- improved scheduling

Some Examples of Investment Items are:

- recovery of waste heat from:
  - stack gases
  - process streams
  - condensate
  - blowdown
  - hot water/hot oil belts
- power factor improvement with capacitors
- variable speed motors
- cogeneration
- condensate recovery system

EXHIBIT 2

APPRAISAL FORM FOR PLANT SELECTION

Plant Characteristics	Appraisal Computation %	Plant 1 Cairo Oil & Soap	Plant 2 El Nasr Pharm.	Plant 4* Portland Cement	Plant 5 Kaha Food	Plant 6 El Nasr Fert.
Type, Process Units, Equipment	5	3	2	4	3	4
Export of Domestic Products	5	0	1	0	1	1
Age (Last Modernization)	10	7	5	5	7	8
Existing Installed Instrumentation	10	2	2	5	0	7
Energy Consumption	20	10	10	20	8	18
Availability of Technical Data	20	15	20	15	15	20
Potential Energy Conservation Improvements	30	22	10	16	21	18
TOTAL	100	59	50	65	55	76

Plant Characteristics	Appraisal Computation %	Plant 7 Egypt. Starch	Plant 9* Edfina Food	Plant 10 Misr Chem.	Plant 11 Alex. Petrol.
Type, Process Units Equipment	5	2	3	4	4
Export of Domestic Products	5	0	2	0	1
Age (Last Modernization)	10	7	7	8	8
Existing Installed Instrumentation	10	0	0	8	7
Energy Consumption	20	6	7	18	20
Availability of Technical Data	20	15	2	20	20
Potential Energy Conservation Improvements	30	15	19	15	22
TOTAL	100	45	40	73	82

* Plants 3 and 8 do not have scores shown, since an energy audit would not be appropriate for these plants.

Exhibit 3

The following is a listing of the eleven (11) plants in order of decreasing score. These scores then provide the basis for selection of the principle candidates for plant pre-audit, and for subsequent audit. From among the eleven (11) plants visited, eight (8) are clearly in need of an audit.

Rank	Name	Score
1.	Alexandria Petroleum Co.	82
2.	El-Nasr Company for Coke and Basic Chemicals (Fertilizer Plant)	76
3.	MISR Chemical Industries Co.	*73
4.	The Portland Cement Company	65
5.	Cairo Oil and Soap Co.	59
6.	Kaha Food Canning Co.	55
7.	El-Nasr Pharmaceutical Chemical Co.	50
8.	Egyptian Starch, Yeast and Detergent Co.	45
9.	Edfina Food Canning Co.	40
10.	Abu Zabaal Chemical and Fertilizer Co.	**
11.	Abu-Qir Fertilizer Co.	**

* Not selected for an audit at the present time, due to the audit work already completed at this plant by Alexandria University.

** Not given a score, since an audit is not appropriate.

D. CONCLUSIONS AND RECOMMENDATIONS

The scoring system has been used as a basis to select the plants for pre-audit, and subsequent audit in Work Orders 2, 3, 4 and 5. The plants selected for audit in these Work Orders are:

Work Order Number	2	3	4	5
1986 Starting Date for Work in Egypt	January 15	By OEP	By OEP	By OEP
Plant Name	El-Nasr Fert. Plant	Port. Cement Co.	El-Nasr Pharm.	Egypt. Starch
(Nearest Large City)	(Cairo)	(Cairo)	(Cairo)	(Alexandria)
Plant Name	Alex. Pet. Co.	Cairo Oil & Soap	Kaha Food	Edfina Food
(Nearest Large City)	(Alexandria)	(Cairo)	(Cairo)	(Alexandria)
Audits to be Executed In:	Series	Parallel	Parallel	Parallel

1. These companies are representative of basic industries in the industrial sector in Egypt.

2. These companies reflect the opportunity to save energy with no cost/low cost energy conservation measures, as well as with capital improvement energy conservation measures.

3. The current energy consumption of these companies is significant, and the resultant energy conserved, when our recommendations are implemented, will be adequate to demonstrate a meaningful result.

SECTION IV - PLANT QUESTIONNAIRES

In order to prepare an evaluation which would be consistent for each plant visited, Foster Wheeler developed a questionnaire which formed the basis of discussions with plant management and which was completed immediately following each visit. The questionnaire specifically covered the following topics:

- GENERAL INFORMATION
- PRODUCTION
- ENERGY CONSUMPTION
- EQUIPMENT/PROCESS
- ENERGY CONSERVATION

The completed questionnaires for each of the eleven (11) plants visited are included at the end of Section IV in Appendix A.

The following is a brief summary of our overall impression of each of the eleven (11) plants which we visited:

Overall Impression of Each Plant Visited

1. Cairo Oil and Soap Company. At the location visited, this plant does not produce a finished soap product, but instead produces soy bean oil, chicken feed and animal feed. Seventy (70) percent of the steam produced by the plant is used for the processing areas of extraction and refining of the soy beans. It would be relatively easy to recover condensate from these two processing areas. The boiler area needs to be improved from a standpoint of heat recovery, insulation and instrumentation. A wide variety of both no cost/low cost energy conservation opportunities (ECO's) and investment ECO's could be readily identified for this plant.

2. El-Nasr Pharmaceutical Chemical Co. This plant produces fifty (50) different products all in batch operation from eleven (11) different operating units. The consumption of steam is fairly equally spread out among all of the various units, without any really large individual consumers. Some energy conservation opportunities do exist, however, due to the complexity of the plant and its relatively low energy usage, as compared to other plants, a large amount of effort would be required to achieve what would be considered relatively low energy savings.

3. Abu Zabaal Chemical and Fertilizer Co. This plant is extremely modern and up-to-date in terms of its energy usage and efficiency. Because of this, there is no current need or anticipated future need to conduct an audit. The plant does have

a specific problem in terms of its difficulty in arranging for the power company to both accept its generated electricity and/or provide temporary electricity, as required. OEP should look into this specific problem and assist this company, as well as other affected companies, in resolving this matter.

4. The Portland Cement Company With the exception of the petroleum refinery, this plant consumes much more energy than any of the other plants visited. There is not a wide variety of energy conservation opportunities (ECO's) in this plant; however, if only a relatively few ECO's prove to be attractive, an unusually large amount of energy could be conserved. These successful ECO's could then, in turn, be applied to other cement companies in Egypt, which represent a major user of energy. The management of this plant was not as cooperative as in other plants in terms of answering our questions and showing us around the operating units.

5. Kahe Food Canning Company This plant produces a wide variety of seasonal canned products from fruits and vegetables. Because of the seasonal nature of its business, its energy consumption varies widely from month to month. The largest energy consumption is in the period from April through July when tomatoes are processed. There is a great deal of visible, obvious waste in terms of leaks and uninsulated pipe and unrecovered energy. Instrumentation is virtually non-existent. A great deal of investment work needs to be done around the boiler area. Compared to many of the other plants visited, its total energy consumption is quite [illegible]. The representatives of this company had a great deal of trouble in understanding and speaking English, much more so than in any other plant visited. This made it somewhat more difficult to obtain required information; nevertheless, they were extremely cooperative.

6. El-Nasr Company for Coke and Basic Chemicals: Fertilizer Plant Due to the overall complexity of both the Coke and the Fertilizer plants, it was agreed to limit the scope of energy conservation work, at this time, to only the Fertilizer plant. The Fertilizer plant and its associated boilers consume large quantities of electricity (15 megawatts) and mazout (approximately 30,000 tons/year). It appears that a considerable amount of energy can be saved through both no cost/low cost and investment ECO's in the boiler area. A more thorough investigation into the rather complex processing area should also serve to produce attractive ECO's. Unlike most other plants visited, the complexity of this plant is such that it would not be appropriate to conduct an energy audit for another plant in parallel with this effort. This plant received the second highest score of all eleven (11) plants visited.

7. Egyptian Starch, Yeast, and Detergent Company (Sioof Factory) This plant is a rather low overall consumer of energy. It does, however, have a full range of typical no cost/low cost and investment ECO's. The plant's biggest problem is that of frequent power failures which cause them to continuously run an emergency diesel generator for electric power generation. The most important ECO in the plant is the potential for generating electrical power by letting down the pressure of the 15 bar steam to approximately 6 - 8 bar across a turbine and

reusing the lower pressure steam for process use. The plant needs to eventually have an energy audit, but at the present time, due to its low energy consumption, it must be given a low priority.

8. Abu-Qir Fertilizer Co. This plant produces urea using the latest most modern technology available. Its energy consumption is in accordance with all international standards. In terms of appearance, good maintenance, and absence of any sizable energy waste, this plant far exceeds all other plants visited and can serve as an excellent role model for other plants. This plant does not presently need an energy audit, nor would it appear that one could be justified in the foreseeable future. We would recommend, however, that a study be made of the plant's steam system for the dual purpose of generating more electricity from steam which is currently being let down in pressure and also for making better use of the 20 tons/hr. of 2.5 bar steam which is currently being vented to the atmosphere.

9. Edfina Food Canning Company. This plant is similar in many ways to the Kaha Food Canning Company. It produces seasonal canned products from fruits and vegetables and has a wide variation in its energy consumption depending upon the particular season. The energy consumption data available at the time of our visit was incomplete, inconsistent and conflicting, but it appears that this plant does consume somewhat less energy than Kaha and also has somewhat less production. The largest energy consumption should be during the last two weeks of July when both tomato paste and mango juice are produced. This would be the best time of year for an audit to be carried out. In terms of power factor, voltage variation and power failures, this plant has much fewer problems than does Kaha. In terms of visible waste, need for instrumentation and need for investment around the boiler area they are essentially identical. This plant was the poorest of all the plants visited in terms of availability of technical data.

10. MISR Chemical Industries Co. This plant is a large consumer of energy and would have been an excellent choice for an audit by OEP, except for the very important fact that an audit was already completed for the plant by Alexandria University in July, 1985. This being the case, it would seem highly inappropriate for a second audit to be performed on this plant while so many other worthy Egyptian plants have not yet had a first audit. Since the audit already performed did not include any investment costs or economic evaluations, it may be possible for OEP to do this work for the plant some time in the future. This possibility should be explored by OEP, after first reading the completed audit report prepared by Alexandria University. The plant's biggest problem is that of repeated power failures which severely interrupt their electrolytic production of chlorine from brine. One such failure was witnessed during the visit and four others occurred the day before the visit. If an audit were carried out for this plant, its complexity would be such that it would not be advisable to do it in parallel with an audit on another plant.

11. Alexandria Petroleum Company. This plant is a very large consumer of energy consisting specifically of 157,682 tons/year of Mazout for its 4 boilers and 9 furnaces, and 26 million KWHR. per year of electricity for its large motor driven compressors and pumps. During our visit and discussions with plant personnel it quickly became evident that there is a very wide variety of both no cost/low cost and investment ECO's which could be readily identified for this refinery. Many of these ECO's could each potentially save a great deal of energy and their attractiveness should be evaluated as part of an energy audit. Due to the complexity of the refinery, it is recommended that when an audit is carried out it not be done in parallel with another plant. Based upon its high consumption of energy, long list of potentially attractive ECO's and ease in availability of technical data, this plant received the highest score of all eleven (11) plants visited.

Cooperation of Plant Management

Except for the problems noted in the discussion above for plants 4. and 5., the management and representatives of each of the plants visited were extremely helpful and cooperative and clearly proved that they would continue to be so, should they be selected for an audit.

APPENDIX "A"

PLANT QUESTIONNAIRES

FOSTER WHEELER

Plant Number: 1 Date: August 8, 1985

Name of Plant: Cairo Oil and Soap Co.

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

Batch Edible Oil Refining - 1955
Animal Feed Plants (2) - 1965
Old Chicken Feed Unit - 1965
New Chicken Feed Unit - 1984
New Extraction Unit - 1983
Continuous Edible Oil Refining - 1975
Boilers: Capacity, Tons/Hr 6(Two) 8 12
(4 Total) Year 1971/73 1980 1985

2. The design or process was developed by whom?

Belguim, West Germany, Others

3. Any major expansions or modifications? When?

None

PRODUCTION

1. What products do you produce?

Soy Bean Oil
Chicken Feed
Hull Animal Feed

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

- 300 Tons per day of feed (Soy Bean Feed) - Typically 7,000 Tons per month
  50 Tons per day of Soy Bean Oil
  210 Tons per day of Chicken Feed
  Undetermined quantity of Fowl Animal Feed

3. What are your starting materials?

   Soy Bean Seed
   (Sometimes Cotton Seed)

4. Do you produce the same type and amount of products all year long or does it vary?

   The amount varies

5. What records or summaries do you have of this production?

   Daily Records

6. May we briefly see these records?

   Yes, (Not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Domestically only

8. What is the percent of each?

100% Domestic

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

3 shifts a day, 7 days a week, but operating only 75% of the year and shutdown other times for maintenance.

10. How many total days per year does it typically operate?

275 Days (Recheck again later)

11. Are there any factors which cause seasonal effects and what are these?

Availability of seed

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

No

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

Not available at time of visit, but can be obtained from main office.

2. Does the amount spent vary much each month?

Probably yes, to be confirmed later.

3. What are the various types of energy that you use?

Mazout (No. 6 Fuel Oil)
Electricity

4. Do you have monthly records of consumption?

Yes, estimates available for each unit on steam.
Measured overall consumption for Mazout and Electricity

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Not available at time of visit

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Boilers (Mazout)
Motors on Hammermill and Flakers (Electricity)
Steam users in extraction and refining

2. What items of equipment contribute adversely to your power factor and demand factor?

Not known
Power factor approximately 0.76 to 0.78

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes, for new equipment only.

4. Do you have an equipment list?

No

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

English

6. May we briefly see this information?

Yes, not available at plant site, only in main office.

7. What unit(s) or section (s) of the plant are the biggest users of energy?

Extraction and Refining

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes, Process Flow and P&I drawings for new units,
Only Process Flow for old units.

9. Are plotplan drawings available?

No

EQUIPMENT/PROCESS (Continued)

10. May we briefly see these drawings?

Not available at plant site

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

Need for more instrumentation
Some interruptions in power supply during the summer

2. Have any steps yet been taken in your plant to try to conserve energy?

No

3. Is there presently any recovery of steam condensate?

No (Condensate from extraction is contaminated with Hexane)

Note: Condensate can be recovered at one location in extraction unit and two locations in batch refining unit.

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

Do not know

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Do not know

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   Yes, especially in old units and around boilers.

7. Do you vent any steam to the atmosphere?

   No

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   No

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   No

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

Yes, but not best possible way.

FOSTER WHEELER

Plant Number: 2 Date: August 11, 1985

Name of Plant: El Nasr Pharmaceutical Chemical Co.

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

Initial plant startup - 1963 with continuous development and expansion to the present time.

2. The design or process was developed by whom?

Initially Russian with much technology from Brown in Sweden

3. Any major expansions or modifications? When?

Yes, continually

PRODUCTION

1. What products do you produce?

50 Different products produced in 11 batch processing units covering areas of:

1) Biological Fermentation
2) Synthetic Chemistry
3) Pharmaceutical Chemicals
4) Veternarian and Lab Chemicals

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

1963 - Production 300,000 Lb/Yr
1980/81 - 11,000,000 Lb/Yr
1984/85 - 35,600,000 Lb/Yr

3. What are your starting materials?

34 different materials

4. Do you produce the same type and amount of products all year long or does it vary?

The amount varies.

5. What records or summaries do you have of this production?

Daily records.

6. May we briefly see these records?

Yes, (Not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Domestic mostly.

8. What is the percent of each?

98% Domestic
2% International (Germany, France, Sudan, Jordan)

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

3 shifts a day, 7 days a week

10. How many total days per year does it typically operate?

365 (No scheduled downtime for maintenance)

11. Are there any factors which cause seasonal effects and what are these?

Variations in demand.

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

Not available at time of visit but can be obtained from Finance Department.

2. Does the amount spent vary much each month?

Probably yes, to be confirmed later.

3. What are the various types of energy that you use?

Mazout (No. 6 Fuel Oil)
Electricity
Sular (For boiler startup)

4. Do you have monthly records of consumption?

Yes, measured total with estimated consumption for each product line.

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Not available at time of visit.

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Boilers
Air Compressors
Ammonia Compressors

2. What items of equipment contribute adversely to your power factor and demand factor?

Not known.
Power factor approximately 0.8

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes

4. Do you have an equipment list?

Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

Mostly English, some Russian.

6. May we briefly see this information?

Yes (Information seen and seemed to be in good order)

7. What unit(s) or section (s) of the plant are the biggest users of energy?

All 11 units use approximately the same quantity of energy but energy study should begin with aspirin and plastic molding unit (injection molding).

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes

9. Are plotplan drawings available?

Yes

ENERGY CONSUMPTION (Continued)

10. May we briefly see these drawings?

Yes, but didn't see Plot Plan.

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

No large problems, but many small ones. Difficult to trace due to lack of instrumentation.

2. Have any steps yet been taken in your plant to try to conserve energy?

No. Visual checking of steam traps and repair of insulation and leaks only.

3. Is there presently any recovery of steam condensate?

No, but recovery system in place. Not used for following reasons:

1) Acid in condensate
2) Insufficient pressure to recover condensate

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

Do not know

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

Do not know

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

Yes, especially around boiler area

7. Do you vent any steam to the atmosphere?

Yes, from blowdown drum

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

Economizer and superheater on each boiler

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

No

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

Manual

FOSTER WHEELER

Plant Number: 3 Date: August 12, 1985

Name of Plant: Abu Zabaal Chemical and Fertilizer Co.

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

   Initial plant startup 1948, with continuous development, expansion and modernization to the present time.

2. The design or process was developed by whom?

   French, Rumanian, American and others

3. Any major expansions or modifications? When?

   Yes, within the last year.

PRODUCTION

1. What products do you produce?

   Fertilizers: Single super phosphase and triple super phosphate
   Sulfuric Acid (98%)
   Phosphoric Acid

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

Sulfuric Acid, 650 Tons/day from new No. 6 plant (No. 4 & 5 currently shutdown for modernization).
Phosphoric Acid, 200 Tons/day from new plant
Fertilizers, 1,000 Tons/day

3. What are your starting materials?

Sulfur from Iraq
Phosphate rock from mines in Luxor

4. Do you produce the same type and amount of products all year long or does it vary?

Essentially the same all year long

5. What records or summaries do you have of this production?

Daily and monthly records.

6. May we briefly see these records?

Yes, (not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Domestically only

8. What is the percent of each?

100% Domestic

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

3 shifts a day, 7 days a week.

10. How many total days per year does it typically operate?

335 (30 days scheduled maintenance during the summer)

11. Are there any factors which cause seasonal effects and what are these?

None

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

   Not available at time of visit, but can be obtained later.

2. Does the amount spent vary much each month?

   No, except for summer maintenance shutdown.

3. What are the various types of energy that you use?

   Mazout
   Electricity
   Sular for startup

4. Do you have monthly records of consumption?

   Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

. Yes, but not seen at time of visit.

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Air blower for No. 6 Sulfuric Acid Plant
Grinding Mills for Phosphoric Acid
Boiler in Phosphoric Acid Plant, grinding in Fertilizer Plants.

2. What items of equipment contribute adversely to your power factor and demand factor?

Power factor is currently approximately 0.87
No real problem

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes

4. Do you have an equipment list?

Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

All in English

6. May we briefly see this information?

Yes

7. What unit(s) or section (s) of the plant are the biggest users of energy?

See 1. above

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes

9. Are plotplan drawings available?

Yes

ENERGY CONSUMPTION (Continued)

10. May we briefly see these drawings?

Yes

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

Voltage of national grid varies by 20% and frequency is not constant.
6 Megawatts of electricity is currently produced by No. 6 H_2SO_4 plant from waste heat boiler steam.

There is difficuly, however, is arranging for power company to both accept generated electricity and/or provide temporary electricity as required.

2. Have any steps yet been taken in your plant to try to conserve energy?

Currently arranging to run steam line from No. 6 H_2SO_4 plant to new phosphoric acid plant. This will enable one boiler in phosphoric acid plant to be shut down periodically.

3. Is there presently any recovery of steam condensate?

Yes, completely recovered.

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

No

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Relatively constant

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   No

7. Do you vent any steam to the atmosphere?

   No (Small amount from blowdown drum in No. 6 H_2SO_4 plant)

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   Yes, completely recovered

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   Yes

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

Yes, automatic

FOSTER WHEELER

Plant Number: 4 Date: August 13, 1985

Name of Plant: The Portland Cement Co.

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

1929 (Kiln #1)

2. The design or process was developed by whom?

All kilns wet or dry process by F.L. Schmidt (Denmark)

3. Any major expansions or modifications? When?

Now 3 plants

Kiln # 1 (1929)	Kiln #4 (1950)
Kiln # 2 (1937)	Kiln #5 (1951)
Kiln # 3 (1940)	Kiln #6 (1957)
White kiln #1 (1961)	New dry process kiln 1 (1982)
While kiln #2 (1974)	New dry process kiln 2 (1985 Sept.)

PRODUCTION

1. What products do you produce?

Portland cement	80%
Rapid hardening	10%
Slag or blended	10%

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

About 6,500 metric tons per day (before new day process kiln 2)
About 11,000 metric tons per day (after new day process kiln 2)

3. What are your starting materials?

Lime stone (1,000 TPH conveyor capacity on 3 shifts)
Clay (500 TPH conveyor capacity on 1 shift)
1% sand, 0.2% hemitite

4. Do you produce the same type and amount of products all year long or does it vary?

Same all year

5. What records or summaries do you have of this production?

Hourly, daily, monthly

6. May we briefly see these records?

Yes, (not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Domestically only

8. What is the percent of each?

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

7 days per week, 3 shifts per day

10. How many total days per year does it typically operate?

365 days, (300 for operation, 65 for maintenance)
(Note: That maintenance is random and not at the same time for all plants)

11. Are there any factors which cause seasonal effects and what are these?

None

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

Yes, water, but normally directly shipped out

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

Information is available

2. Does the amount spent vary much each month?

No

3. What are the various types of energy that you use?

Mazout
Electricity
Natural Gas

4. Do you have monthly records of consumption?

Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Yes, (not seen at time of visit)

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Kilns
Big electric motors

2. What items of equipment contribute adversely to your power factor and demand factor?

Power factor is no problem, currently about 0.9 or greater
because of synchronous motor

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes

4. Do you have an equipment list?

Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

English

6. May we briefly see this information?

Yes (difficult to find information due to poor filing)

7. What unit(s) or section (s) of the plant are the biggest users of energy?

See 1. above

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes

9. Are plotplan drawings available?

Yes

ENERGY CONSUMPTION (Continued)

10. May we briefly see these drawings?

Yes

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

Need reliable instruments to control the air to fuel ratio on each of the kilns. Would like to add chemicals to wet processing to reduce the amount of water from 38 to 25%. Also possible change of wet processing to dry.

2. Have any steps yet been taken in your plant to try to conserve energy?

No (Japanese firm currently evaluating feasibility of converting wet kilns 5 and 6 to dry operation)

3. Is there presently any recovery of steam condensate?

Yes, the steam condensed in the turbines generating electricity is returned to the boilers.

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

No

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Relatively constant, but can perhaps be improved scheduling mainly for old plant.

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   Kiln outside surfaces are 150° to 300°C.
   If outside were insulated, one could not tell when the inside refractory is damaged and the outside metal of the kiln could melt.

7. Do you vent any steam to the atmosphere?

   No

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   Yes, heat from new dry process kiln No. 1 and 2 used to dry raw materials to the dry kilns.

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   This was installed on each kiln approximately 8 years ago, but could not be maintained and is currently not operational on any of the kilns. Instruments used are more suitable for boilers than for dusty services.

ENERGY CONSERVATION (Continued)

J.0. Is there manual or automatic trim of the air/fuel ratio?

Only on the new dry process.

FOSTER WHEELER

Plant Number: 5 Date: August 14, 1985

Name of Plant: Kahu Food Canning Company

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

   1976

2. The design or process was developed by whom?

   Italian and European technology.

3. Any major expansions or modifications? When?

   Some production as 1976 except added one additional - 10 ton/hr feed line for tomato paste and vegetable machine.

PRODUCTION

1. What products do you produce?

   Juice (Mango, Guava, Orange, Apricot)
   Jams
   Tomato Paste
   Frozen Vegetables

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

   Tomato Paste - 4 months (April to July) @ 200 tons/day tomatoes yielding 40 tons/day of paste from 2 units (Each, 10 ton/hr feed)
   Other units - no production units

3. What are your starting materials?

   Raw fruits and vegetables

4. Do you produce the same type and amount of products all year long or does it vary?

   Continuously varies by harvesting season. For example, tomatoes processed four months/year and mangoes three months/year.

5. What records or summaries do you have of this production?

   Daily and monthly

6. May we briefly see these records?

   Yes, not seen at time of visit

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Mostly domestic

8. What is the percent of each?

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

3 months/year - 3 shifts, 7 days a week
9 months/year - 2 shifts, 7 days a week

10. How many total days per year does it typically operate?

Operates all year with different product lines of different durations

11. Are there any factors which cause seasonal effects and what are these?

Availability of seasonal raw material

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

   Not available at time of visit, but can be obtained

2. Does the amount spent vary much each month?

   Yes

3. What are the various types of energy that you use?

   Mazout
   Electricity
   Sular

4. Do you have monthly records of consumption?

   Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Not available at time of visit

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Mazout for boilers
Steam for tomato paste evaporators
Sular for electric generators

2. What items of equipment contribute adversely to your power factor and demand factor?

Power factor stated as maybe 0.8, but not sure.

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes

4. Do you have an equipment list?

Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available ?

English mostly, tomato paste equipment - Italian

6. May we briefly see this information?

Yes, sample seen for 1982 tomato paste line

7. What unit(s) or section (s) of the plant are the biggest users of energy?

See item 1. above

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Processing scheme, but no instruments

9. Are plotplan drawings available?

Yes

ENERGY CONSUMPTION (Continued)

10. May we briefly see these drawings?

Yes

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

300 volts from National Grid instead of 380 volts, requiring operation of 3 in-house electric generators (1 - 750 Kva, 1 - 1000 Kva, 1 - 620 Kva). Rapid scaling of boilers requires continuous blowdown and treatment.

2. Have any steps yet been taken in your plant to try to conserve energy?

No

3. Is there presently any recovery of steam condensate?

Currently only from tomato paste evaporators, other areas under study.

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

Do not know

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   It fluctuates

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   Yes, many steam lines and mazout storage tanks.
   Many leaks of steam and water noted.

7. Do you vent any steam to the atmosphere?

   Steam venting from uncovered tanks.

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   No, stacks very corroded

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   No

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

No, only instrumentation noted on boilers is pressure gauge.

FOSTER WHEELER

Plant Number: 6 Date: August 15, 1985

Name of Plant: El-Nasr Company for Coke and Basic Chemicals: Fertilizer Plant

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

1971 start-up

2. The design or process was developed by whom?

Licensor - Stamicarbon for gas plant and NH_3 Synthesis

3. Any major expansions or modifications? When?

Conc. Nitric acid unit - pure ammonium Nitrate unit - CO_2 production unit.

PRODUCTION

1. What products do you produce?

Calcium ammonium nitrate 35.5% N_2, HNO_3 conc.
Pure ammonium nitrate explosive grade, NH_3 liquid and gas, liquefied CO_2
NH_3 is obtained both from coke oven gas recovery and synthesis by partial oxidation

PRODUCTION (Continued)

2. What is the total quantity or number of unts per year of these products?

65,000 ton calcium ammonium nitrate and HNO_3 conc. 1500 ton (280 tons/day) (83/84)
NH_3 is produced in two parallel trains, each 85 tons/day.

3. What are your starting materials?

Coke oven gas

4. Do you produce the same type and amount of products all year long or does it vary?

The same all year long

5. What records or summaries do you have of this production?

Daily, monthly and yearly records since 1971.

6. May we briefly see these records?

Yes

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Mainly domestically, only the pure ammonium nitrate internationally.

8. What is the percent of each?

Less than 1% (for products sold internationally)

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

7 days/week, 3 shifts/day

10. How many total days per year does it typically operate?

300 days (This value needs to be confirmed)

11. Are there any factors which ca[illegible] seasonal effects and what are these?

No

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

Yes

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

5,680,000 LE/year including 2,880,000 LE for the coke oven gas, as a feed stock.

2. Does the amount spent vary much each month?

No

3. What are the various types of energy that you use?

Electric energy
Fuel oil
Gas fuel

4. Do you have monthly records of consumption?

Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Yes (Not seen at time of visit)

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Boilers, synchronous motors for two ammonia compressors, refrigeration

2. What items of equipment contribute adversely to your power factor and demand factor?

None, power factor greater than 0.9.

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes

4. Do you have an equipment list?

Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

English

6. May we briefly see this information?

Yes, not seen at time of visit.

7. What unit(s) or section (s) of the plant are the biggest users of energy?

Boilers, ammonia synthesis, nitric acid, air separation

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes, Process Flow and Block Flow.

9. Are plotplan drawings available?

Yes

ENERGY CONSUMPTION (Continued)

10. May we briefly see these drawings?

Yes, not seen at time of visit

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

15 Megawatts of electricity are used and only 3 Megawatts are produced within the plant
Shortage of measuring instruments
Faulty steam traps

2. Have any steps yet been taken in your plant to try to conserve energy?

Started to recover some of the condensate.

3. Is there presently any recovery of steam condensate?

See 2. above

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

Have a high power factor about 0.9 and do not pay any penalty.

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Remains constant

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   Some insulation need repairs

7. Do you vent any steam to the atmosphere?

   No

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   No, with respect to the stack gases, but we have waste heat boilers in the system and also we produce pure CO_2 from tail gases.

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   In some combustion equipment (New boiler No. 4)

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

Yes, only for New Boiler No. 4

FOSTER WHEELER

Plant Number: 7 Date: August 18, 1985

Name of Plant: Egyptian Starch, Yeast and Detergent Co. (Siouf Facotry)

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

Detergent (Synthetic) 2 units, 1955 and 1973
Starch, 1955
Specialty Chemicals, 1955
Sodium sulfate, 1976

2 Boilers
Egyptian 1974 8 ton/hr
German 1982 10 ton/hr

2. The design or process was developed by whom?

Detergent, 1955 unit-Italian, 1973 Allied Chemical
Sodium Sulfate - Dutch

3. Any major expansions or modifications? When?

No

PRODUCTION

1. What products do you produce?

Synthetic Detergent
Starch
Specialty Chemicals
Refined Sodium Sulfate

PRODUCTION (Continued)

2. What is the total quantity or number of unts per year of these products?

Synthetic Detergent, 1955 unit 7,000 - ton/yr, 1973 unit - 13,000 ton/yr
Starch - 10,000 ton/yr
Specialty chemicals - 3,000 ton/yr
Sodium Sulfate - 15,000 ton/yr
Total = 48,000 ton/yr

3. What are your starting materials?

Synthetic detergent - Sulfuric acid or sulfur, alkyl benzene and other chemicals
Starch - rice
Specialty chemicals - from oils and fats
Sodium sulfate - raw sodium sulfate

4. Do you produce the same type and amount of products all year long or does it vary?

Yes, same type and amount

5. What records or summaries do you have of this production?

Daily, monthly and yearly

6. May we briefly see those records?

Yes (Not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Domestically only

8. What is the percent of each?

100% Domestic

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

7 day/week - 3 shifts except specialty chemicals, 8 hrs/day for 6 day week. Average 340 days/year production.

10. How many total days per year does it typically operate?

340

11. Are there any factors which cause seasonal effects and what are these?

No

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

No

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

Not available at time of visit, but can be obtained

2. Does the amount spent vary much each month?

No

3. What are the various types of energy that you use?

Mazout
Electricity
Sular (Diesel)

4. Do you have monthly records of consumption?

Yes, available for electricity currently. Can be obtained for other energy sources at a later time.

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Not available at time of visit.

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Boilers (Mazout)
Spray dryers (Mazout) Total 4 (2 sodium sulfate and 2 detergent)
Flash dryer and turbo tray dryer - Mazout) (Starch Plant)

2. What items of equipment contribute adversely to your power factor and demand factor?

P.F. = 0.6 approximately
Not known

3. Do you have equipment specifications, manufacturer's data and/or drawings?

For sodium sulfate and new synthetic detergent only

4. Do you have an equipment list?

See item 3.

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

English

6. May we briefly see this information?

Yes (Seen at time of visit)

7. What unit(s) or section (s) of the plant are the biggest users of energy?

Synthetic detergent and starch

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

See item 3

9. Are plotplan drawings available?

See item 3

ENERGY CONSUMPTION (Continued)

10. May we briefly see these drawings?

    Yes, seen at time of visit.

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

   Frequent power failures
   Problems with steam traps
   Need for more instrumentation

2. Have any steps yet been taken in your plant to try to conserve energy?

   Starting to form energy conservation committee, but no action as yet.

3. Is there presently any recovery of steam condensate?

   No

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

   Not yet

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Constant

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   Yes

7. Do you vent any steam to the atmosphere?

   No

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   No

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   No

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

Only on new German boiler.

FOSTER WHEELER

Plant Number: 8

Date: August 19, 1985

Name of Plant: Abu-Qir Fertilizer Co.

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

   1979 start-up

2. The design or process was developed by whom?

   Ammonia - Udhe
   Urea - Stamicarbon

3. Any major expansions or modifications? When?

   No

PRODUCTION

1. What products do you produce?

   Urea
   Ammonia

PRODUCTION (Continued)

2. What is the total quantity or number of unts per year of these products?

   1,550 tons/day of urea
   1,000 tons/day of ammonia (90% of which goes to making urea)

3. What are your starting materials?

   Natural gas from nearby offshore location.

4. Do you produce the same type and amount of products all year long or does it vary?

   Same all year

5. What records or summaries do you have of this production?

   Daily, monthly, yearly

6. May we briefly see these records?

   Yes (Not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Both domestically and internationally

8. What is the percent of each?

40% International
60% Domestic

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

3 shifts a day, 7 days a week

10. How many total days per year does it typically operate?

Current plan is to operate for 18 months continuously without a shutdown. Next scheduled shutdown is September 1986.

11. Are there any factors which cause seasonal effects and what are these?

No

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

No

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

Not available at time of visit, but can be obtained in the future.

2. Does the amount spent vary much each month?

No

3. What are the various types of energy that you use?

Natural Gas (for feed and fuel)
Small quantity of electricity (most is self-generated)

4. Do you have monthly records of consumption?

Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Yes (Not seen at time of visit)

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Natural gas to primary reformer (8,000 M^3/hr)
Natural gas to auxiliary boiler (12,000 M^3/hr)

2. What items of equipment contribute adversely to your power factor and demand factor?

Not known
Power factor approximately 0.82

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes

4. Do you have an equipment list?

Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

English

6. May we briefly see this information?

Yes (Not seen at time of visit)

7. What unit(s) or section (s) of the plant are the biggest users of energy?

National gas usage in ammonia plant

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes

9. Are plotplan drawings available?

Yes

ENERGY CONSUMPTION (Continued)

10. May we briefly see these drawings?

Yes (Not seen at time of visit)

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

Venting of 20 tons/hour of 2.5 bar steam to atmosphere

2. Have any steps yet been taken in your plant to try to conserve energy?

Will be installing Monsanto Prism Hydrogen Recovery Unit from Purge gas in September, 1985.

3. Is there presently any recovery of steam condensate?

Yes

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

No

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Relatively constant, presently generating 7 Megawatts of electricity and purchasing 1 Megawatt.

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   No

7. Do you vent any steam to the atmosphere?

   Yes, see 1. above

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   Yes, in accordance to the most current technology.

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   Yes

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

Yes, automatic

FOSTER WHEELER

Plant Number: 9

Name of Plant: Edfina Food Canning Plant

Date: August 20, 1985

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

   1958

2. The design or process was developed by whom?

   Italian, American and European technology.

3. Any major expansions or modifications? When?

   1981 new tomato paste line.

PRODUCTION

1. What products do you produce?

   Juice (Mango is largest selling product)
   Jams
   Canned Vegetables (Tomato paste is biggest steam consumer)
   Frozen Vegetables

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

Tomato paste - 2 months (June and July) at 150 tons/day of tomatoes yielding 30 tons/day of paste
5,000 tons of Mango juice per year

3. What are your starting materials?

Raw fruits and vegetables

4. Do you produce the same type and amount of products all year long or does it vary?

Continuously varies by harvesting season, for example tomatoes processed two months in June and July and mangos processed two months a year from Mid July to Mid September

5. What records or summaries do you have of this production?

Daily, monthly, yearly

6. Many we briefly see these records?

Yes (not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Both domestically and internationally.

8. What is the percent of each?

20 to 25% of juice in sold internationally.

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

3 Shifts a day, 6 days a week (closed Fridays)
Closed 2 or 3 weeks a year in July before start of Mango Juice.

10. How many total days per year does it typically operate?

300 (operates with different product lines throughout the year).

11. Are there any factors which cause seasonal effects and what are these?

Availability of seasonal raw material.

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

Not available at time of visit, but can be obtained.

2. Does the amount spent vary much each month?

Yes

3. What are the various types of energy that you use?

Mazout
Electricity
Solar

4. Do you have monthly records of consumption?

Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Not available at time of visit.

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Mazout for boilers.
Steam for tomato paste evaporations.
Electricity for frozen vegetables ammonia refrigerant compressor..

2. What items of equipment contribute adversely to your power factor and demand factor?

Power factor is currently 0.8 three new capacitors will be added on main line of transformer house in three months to improve power factor to 0.97.

3. Do you have equipment specifications, manufacturer's data and/or drawings?

No

4. Do you have an equipment list?

No

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

No

6. May we briefly see this information?

Not available.

7. What unit(s) or section (s) of the plant are he biggest users of energy?

Tomato paste line.
Mango juice production.
Frozen vegetables.

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

No

9. Are plotplan drawings available?

No

EQUIPMENT/PROCESS (Continued)

10. May we briefly see these drawings?

Not available.

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

No steam condensate improvement.

2. Have any steps yet been taken in your plant to try to conserve energy?

No

3. Is there presently any recovery of steam condensate?

No

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

No

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

It fluctuates

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

Yes, many major steam lines and mazout storage tank. Many leaks of steam and water noted. Ice noted in refrigeration system.

7. Do you vent any steam to the atmosphere?

Steam venting from uncovered tanks and from idle equipment associated with tomato paste evaporation system.

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

No

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

No

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

No, only instrumentation noted on boilers is pressure gauge.

FOSTER WHEELER

Plant Number: 10 Date: August 21, 1985
Name of Plant: Misr Chemical Industries Co.

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

   1959 (original caustic soda and chlorine plants)

2. The design or process was developed by whom?

   Italian, Germany and other European countries.

3. Any major expansions or modifications? When?

   1962 Hydrogen peroxide plant
   1972 New caustic soda and chlorine plants
   1974 Sodium carbonate and caustic soda
   1985 Increase in capacity of sodium carbonate

PRODUCTION

1. What products do you produce?

   Chlorine and associated products such as HCl and sodium hypochlorite
   Caustic soda
   Sodium carbonate, sodium bicarbonate

Plant Number: 10 Name of Plant: Misr Chemical Industries Co.

Questions Used to Aid in Plant Selection

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

   Caustic Soda: 15.5 to 17.5 thousand tons/year from 1959 plant
   12,000 tons/year from 1972 plant
   Sodium Carbonate: 80,000 tons/year
   Chlorine: 100 tons per day

3. What are your starting materials?

   Common salt, limestone, coke.

4. Do you produce the same type and amount of products all year long or does it vary?

   Same all year.

5. What records or summaries do you have of this production?

   Daily, monthly, quarterly

6. Many we briefly see these records?

   Yes (not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

Mostly domestically (beginning to try to export some).

8. What is the percent of each?

Almost 100% domestic.

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

3 shifts a day, 7 days a week
Closed about 2 weeks a year for maintenance

10. How many total days per year does it typically operate?

340 days

11. Are there any factors which cause seasonal effects and what are these?

No

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

No

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

Not available at time of visit, but can be obtained at a later date.

2. Does the amount spent vary much each month?

No

3. What are the various types of energy that you use?

Mazout
Coke (from coal for kilns)
Electricity

4. Do you have monthly records of consumption?

Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

Yes (not seen at time of visit)

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

Chlorine Electrolysis: 20 Megawatts, 10 for each plant
Soda Ash: 4 Megawatts
Boilers for mazout, kilns for coke

2. What items of equipment contribute adversely to your power factor and demand factor?

Soda Ash has 0.75 power factor
Electrolysis has 0.95 power factor

3. Do you have equipment specifications, manufacturer's data and/or drawings?

Yes

4. Do you have an equipment list?

Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

English

6. May we briefly see this information?

Yes

7. What unit(s) or section (s) of the plant are he biggest users of energy?

See 1. above. Also CO_2 compressor consumes 30 tons/hr of steam and caustic soda heat exchange consumes 30 tons/hr of steam.

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes

9. Are plotplan drawings available?

Yes

EQUIPMENT/PROCESS (Continued)

10. May we briefly see these drawings?

Yes

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

Frequent power failures is biggest problem
Maintenance of instruments

2. Have any steps yet been taken in your plant to try to conserve energy?

Alexandria University performed comprehensive study of entire plant for the purpose of conserving energy.

Report was completed in July 1985.

3. Is there presently any recovery of steam condensate?

There is partial recovery of some condensate.

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

No

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Constant

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   Yes, there is a need for better insulation of lines and insulation is falling off the boilers.

7. Do you vent any steam to the atmosphere?

   Many large discharges of steam to atmosphere were clearly visible during the visit.

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   Yes: air preheat, economizer, superheater

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   Yes, but not always working

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

. Yes, automatic, but not always working.

FOSTER WHEELER

Plant Number: 11
Name of Plant: Alexandria Petorleum Co.

Date: August 22, 1985

Questions Used to Aid in Plant Selection
(Plants in the Industrial Sector)

GENERAL

1. What year was this plant built?

   1957 (Atmospheric Distillation Unit 1)

2. The design or process was developed by whom?

   Various European, American and Egyptian companies.

3. Any major expansions or modifications? When?

   Yes, A.D.U. 2 1962
   A.D.U. 3 1970
   A.D.U. 4 1982
   Lube Oil Complex 1983

PRODUCTION

1. What products do you produce?

   LPG, motor fuel, Naphtha, Kerosene, gas oil, Fuel oil, Petroleum solvents, lube oil (Bright stock only), Micro crystalline wax, Bitumen.

PRODUCTION (Continued)

2. What is the total quantity or number of units per year of these products?

5,000,000 Tons/year of petroleum products
60,000 Tons/year of bright stock
4,000 Tons/year of micro crystalline wax
150 000 Tons/year of 60/70 bitumen

3. What are your starting materials?

Egyptian Crude oils, mixed Morgan, Alamein, Balaym

4. Do you produce the same type and amount of products all year long or does it vary?

Same type and amount is produced all year long.

5. What records or summaries do you have of this production?

Daily, monthly, and yearly records.

6. Many we briefly see these records?

Yes, (not seen at time of visit)

PRODUCTION (Continued)

7. Are your products sold domestically or internationally?

All products are sold domestically except for some fuel oil and naphtha which is exported.

8. What is the percent of each?

Is accordance to EGPC plan (varying from 5-10%).

9. Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

Yes, 3 shifts a day, 7 days a week.
Approximately 2 weeks per year for maintenance.

10. How many total days per year does it typically operate?

340 days/year.

11. Are there any factors which cause seasonal effects and what are these?

Fuel oil: Viscosity 1500 RI (Redwood No. 1 seconds) in winter at 100°F and 2000 RI in summer at 100°F.

PRODUCTION (Continued)

12. Are products sensitive to environmental factors in storage?

Normally the heated tanks are insulated to keep the product fluid and minimize heat losses.

ENERGY CONSUMPTION

1. About how much money do you spend per year for energy?

2,000,000 LE/year

2. Does the amount spent vary much each month?

No

3. What are the various types of energy that you use?

Electricity: 96×10^6 K.w.hr per year
Fuel Oil: 137,682 Tons per year
Refinery: 18,541 Tons per year
Fuel Gas

4. Do you have monthly records of consumption?

Yes

ENERGY CONSUMPTION (Continued)

5. May we briefly see these records?

   Yes (not seen at time of visit)

EQUIPMENT/PROCESS

1. What items of equipment are your biggest individual users of energy?

   Furnaces and boilers for mazout, steam ejectors in vacuum unit, two compressors in MEK unit (electric motors).

2. What items of equipment contribute adversely . your power factor and demand factor?

   Pumps, compressors (P.F. = 0.85)

3. Do you have equipment specifications, manufacturer's data and/or drawings?

   Yes

4. Do you have an equipment list?

   Yes

EQUIPMENT/PROCESS (Continued)

5. In what language is the above information available?

English

6. May we briefly see this information?

Yes (Not seen at time of visit)

7. What unit(s) or section(s) of the plant are he biggest users of energy?

Distillation units and lube oil complex.
Furnaces and boilers.

8. Do you have drawings showing the processing scheme used in the plant, including instrumentation?

Yes (Block flow diagram is also available to show interrelation of various refinery units).

9. Are plotplan drawings available?

Yes

EQUIPMENT/PROCESS (Continued)

10. May we briefly see these drawings?

Yes (Not seen at time of visit)

ENERGY CONSERVATION

1. Are there any major energy conservation related problems in your plant that you are currently aware of?

Frequent power failures
Combustion efficiency
Maintenance of instrumentation.

2. Have any steps yet been taken in your plant to try to conserve energy?

Have begun to recover some condensate.

3. Is there presently any recovery of steam condensate?

There is a recovery system for the lube oil complex and a system is under construction for the Distillation units.

4. Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

No

ENERGY CONSERVATION (Continued)

5. Does your demand for electricity fluctuate greatly or remain relatively constant?

   Relatively constant

6. Are there any hot lines, tanks or other hot surfaces which are not presently insulated?

   No

7. Do you vent any steam to the atmosphere?

   No

8. Do you recover any heat from the hot stack gases leaving your combustion equipment?

   Yes, air preheaters for lube oil complex furnaces, but not for Boilers and other furnaces.

9. Is there any monitoring of the excess air in the stack gases from your combustion equipment?

   Yes, at Lube oil complex only.

ENERGY CONSERVATION (Continued)

10. Is there manual or automatic trim of the air/fuel ratio?

Manual at Atmospheric Distillation Units and automatic at lube oil complex.

STANLEY CONSULTANTS, INC.
STANLEY BUILDING
MUSCATINE, IOWA 52761

Mr. Marshall Monarch
Argonne National Laboratories
Building 362
9700 South Cass Avenue
Argonne, Illinois 60439

DATE March 6, 1986

SUBJECT

Dear Marshall:

Please find enclosed "Stanley Consultants' Final Screening Report of O.E.P. Plant Candidates for Energy Audit and Evaluation by W. E. Lowthian and William Liegois," as you requested.

Sincerely,

STANLEY CONSULTANTS, INC.

Richard L. Lord

BY

DATE

SIGNED

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STANLEY CONSULTANTS' SCREENING
OF
O.E.P. PLANT CANDIDATES
FOR
ENERGY AUDIT AND EVALUATION

Note: These remarks and notes are only for O.E.P.'s internal use to screen the plants and evaluate Stanley Consultants' (Inc.) suitability for the audit work. The contents shall not be transmitted in any way, written or verbal, to any third party without written permission from Stanley Consultants. Any use contrary to the above constitutes grounds for payment to Stanley Consultants based on its time invested and expenses beyond those reimbursed by the Organization for Energy Planning.
W. E. Lowthian 9/10/85

I. Introduction

II. General Observations

III. Plant Ranking

Section 1 Kaha Company

Section 2 Helwan Portland Cement Company

Section 3 El-Nasr Pharmaceutical Chemical Company

Section 4 Abu Zaabal Fertilizer Company

Section 5 Cairo Company for Oil and Soap

Section 6 El-Nasr Company for Coke and Chemicals

Section 7 Alexandria Refinery

Section 8 Misr Chemical Company

Section 9 Egyptian Company for Starch and Yeast

Section 10 Abu Kier Fertilizer Company

Section 11 Edfina Food Company

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I. Introduction

The purpose of this screening exercise is to allow potential energy audit contractors an opportunity to evaluate plant data and inspect the candidate plants. Stanley Consultants, Inc., (SCI) was selected by O.E.P. to participate in the plant screening procedure. As a result of that selection, SCI and its subcontractor, Kinetics Consulting Group, Inc., (KCG) has visited eleven industrial plants located in the Cairo and Alexandria areas. This screening report presents the results of the plant visits and our discussions with O.E.P. covering the period from September 1, 1985, to September 10, 1985.

Energy Conservation Categories

The subject of energy conservation can encompass a wide range of subjects. To better understand and evaluate energy conservation techniques, six categories for energy conservation have been established:

- Combustion
- Steam
- Other Utilities
- Scheduling and Handling
- Process Equipment and Process Changes
- Alternate Fuels

All energy conservation ideas can be placed in one of these categories. The importance of this list is to show the wide variety of ideas and concepts that can be included in any energy conservation program. A brief discussion of each of these categories will provide a better idea of the importance of each.

- Combustion: This category can include such items as equipment efficiency and operation, equipment maintenance and replacement, heat recovery, and heat confinement.

- Steam: This category covers equipment upgrading and repair, steam changes, and steam balances.

- Other Utilities: Cooling towers, chillers, refrigeration plants, and electrical usage would be covered by this category.

- Scheduling and Handling: This category emphasizes the importance of plant capacity and production scheduling to the idea of energy conservation.

- Process Equipment and Process Changes: This category deals with equipment maintenance, repair, and replacement; operation and process design; process heat recovery projects; and process heat confinement to name a few.

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- Alternate Fuels: This category includes the concepts of cogeneration, solar energy, and waste or by-product fuels.

Energy conservation ideas in any of these categories can result in significant savings, depending on the plant or process under evaluation. It is imperative that preconceived ideas do not influence or direct the audit process. All forms of energy conservation must be examined in at least a preliminary manner to determine if they apply to an individual plant or facility. All six of these categories were included in our screening process; however, only major energy conservation opportunities will be discussed.

II. General Observations of Industry in Egypt

The eleven plants visited during this screening procedure represent a broad spectrum of engineering technology and varying degrees of sophistication. In general, the design of the utility systems is rather straightforward and uncomplicated. Most of the systems were designed with ease of operation and maintenance in mind. In spite of this, several of the plants had equipment which was continuously a problem and in need of repair.

The process systems design showed a much wider range of technologies used. An example of this is in the food processing plants where the processes were very labor intensive and exhibited a very low level of technological advancement. On the other hand, the two fertilizer plants displayed the most current designs in use anywhere in the world. We did not identify any processes which were totally outdated. All of the plants appear to be serving a useful purpose in Egyptian industry.

The qualifications and skill of the plants' maintenance and operating staffs varies widely. Plants which have taken the time to train the staff and who have spent the necessary money to maintain the plant have been rewarded. The lack of a good maintenance and operating staff can quickly reverse any energy conservation measures implemented.

III. Plant Ranking

Basic Criteria

The basic criteria for ranking the plants was established in a meeting with O.E.P. and are listed below:

- Major energy savings
- Need for foreign expertise
- Low audit cost/energy savings
- Ease of installation

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Plant Ranking

The results of the screening process indicate that two of the plants visited are in very good shape and would not warrant an audit at this time. These are the two fertilizer plants, one at Abu-Kir and the other at Abu-Zeable. These plants are both using modern technology and have trained maintenance and operating staffs. Therefore, the level of energy savings at these plants will be low. Contact should be maintained with these facilities to determine if they can continue this excellent performance. Programs and procedures used at these plants may also be useful to other facilities.

Five plants are all very similar in many ways. Edfina Co., Kaha Co., Egyptian Company for Starch and Yeast, Cairo Company for Oil and Soap, and El-Nasr Company for Coke and Chemicals, all have relatively low-energy consumption in comparison with the other plants audited. Their production lines are either of the batch type or are continuous for short periods of time. Most of these plants have small fire-tube boilers and little or no condensate return. Their basic size and process similarities indicate that they should be grouped together.

Based on the ranking criteria established, these five plants should have a low priority. The amount of energy that can be saved at any one of them is small in comparison to the other four plants. However, these plants are probably typical of a very large number of industrial plants in Egypt. Therefore, even though the energy savings are low for any one plant when multiplied by many industries, the total can be significant. The potential savings for all five plants together are at the same general magnitude of the larger plants. The energy audits for these facilities should be relatively simple.

The remaining four plants are ranked as follows:

1. Helwan Portland Cement Company
2. Alexandria Refinery
3. Misr Chemical Company
4. El-Nasr Company for Coke and Chemicals

These plants appear to have the most potential for energy savings. Foreign expertise is also most likely to be required. It is felt that all of these plants have potential for major energy conservation projects. A special note should be made regarding the El-Nasr plant. The economics of operating a small fertilizer plant are usually not favorable. There does not appear to be any technical reason for closing the facility; however, the economics of continuing to operate this facility should be examined before an energy audit is performed.

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Section 1

Kaha Company

9/2/85

Products: Canned fruits and vegetables, fruit juices, and tomato sauce or paste. Frozen vegetables (?)

Notes by: Lowthian

1.0 SUMMARY

This relatively large facility has most of the operations associated with food processing. Therefore, it is a good instructive candidate. It exhibits operating and energy problems which are typical, if somewhat extreme. Finally, there are a number of energy conservation opportunities. These range from basic operating improvements to somewhat sophisticated changes. Based on the apparent receptivity by the plant representatives we would anticipate that a, say, 5-year plan of improvements taken in several steps would significantly decrease energy usage as well as improve overall operations.

According to the O.E.P. questionnaire the 1984/85 energy usages were:

- electricity 2.3×10^6 KWH
- mazot 4011 tons (metric)
- solar 475466 liters
- 133328 Kg. natural gas (or LPG)
- 1.44×10^6 m^3 water

2.0 PLANT DESCRIPTION

The process portion of the plant consists of a receiving dock which unloads trucks to several parallel process lines. The lines typically include washing followed by preparation (juicing, slicing, seed removal, skin removal, and the like which may or may not include a heating step) followed by a process step (cooking, evaporation, etc.) followed by canning and autoclaving and cooling on a continuous or batch basis. Fruit jams were also produced by addition of sugar, etc. followed by packaging (type not known).

The process lines we observed were:

- tomato sauce or paste - including 2 stage vacuum evaporation
- mango juice
- mango canning - a hand pack operation
- potatoes
- other vegetables - batch autoclaving
- jams

The tomato sauce (paste?) line with its vacuum evaporation was the most complex operation.

Two utilities were inspected: the boilers and the refrigeration/freezer system. These are described in Section 4.0. Dedicated cooler towers exist for the refrigeration condensers and the vacuum evaporation flash system. Water treatment for the cooling towers and boilers is limited to water softening. Water is supplied to the plant via wells; it is not known if these wells are owned by the plant or are part of a government system. Compressed air is used in the plant; however, we did not inspect the compressors.

3.0 OVERALL IMPRESSION

The people (workers and technical people) are friendly and open. The plant representatives readily shared information, spoke of problems they had, and earnestly sought to help as well as requesting aid. Because of this, the plant would seem to be a good location for O.E.P. to work with.

It seems apparent that a number of chronic general problems are costing considerable time and money. Most apparent is the need for improved water treatment for cooling water and, especially, the boiler feed water. A second general problem is the apparent process losses (e.g., juice splashing to the floor.) It would not be surprising if 2 to 5% of the production were lost because of various ill-fitting operations. It is the author's opinion that chronic problems such as these should be resolved before or in conjunction with improvements specifically relating to energy. In other words, the whole operating condition of the plant should be improved as a part of the energy program in addition to specific energy projects. This improvement in the operating condition can be achieved partly by upgrading various equipment and systems, but attention also should be directed to training, developing quality goals, and providing the resources for resolving problems.

Finally, within this section, the author feels that improving housekeeping and the general maintenance level of the buildings (e.g., floors) and grounds will encourage personnel to do the same while demonstrating the company's determination to improve the general operating condition of the plant.

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4.0 SYSTEMS CONDITIONS AND OPERATION

4.1 Boilers and Steam System

Four fire tube boilers exist, a fifth is being built. Two six ton (metric) per hour (12,192 lb/hr) boilers are operating. A 6-ton and a 12-ton unit are being retubed. The unit under construction is rated at 11 tons/hour. There is no heat recovery (economizer or air preheater.)

Although a softening system has been installed, it is not operating. No other water treatment exists. Consequently, severe scaling and solids build-up is occurring. There is some indiction that tubes are replaced largely because of the uncontrolled scaling although some waterside tube corrosion (e.g., pitting) apparently is occurring even with the scaling. There is no deaeration and no boiler water heating. No condensate is returned to the boilers. Unfortunately, information on blowdown methods was not obtained.

An attempt was made to measure the flue gas temperature and oxygen content. Since the location was not good, the reliability of the data is similarly not good. However, the temperature was about 205 degrees Centigrade (400 degrees Fahrenheit) and the oxygen content 6.8% (indicating about 45% excess average and about 86.1% efficiency.) (A "perfect" reading would be about 2½% oxygen indicating about 7½% excess around 88.3 - 88.4% efficiencty.) Given the current operation this is not bad; no attempt should be made by the plant to improve this using the current controls. However, an energy audit should collect rigorous data on these units in order to provide a reliable evaluation. The tops of the flue stacks for the two operating boilers were corroded away.

The boilers were fabricated by an Egyptian firm, El Nasar Co.; the burner and combustion controls were Hamworth A. W. Poole, England. Fuel/air ratio is fixed by a mechanical linkage; rate is controlled by header pressure. A pressure range of 8 to 12 bar (120 to 180 psig) is maintained; the boilers were at 10 - 10½ bar when observed. The boiler appears to be forced draft, positive pressure.

Steam is used to preheat the fuel, mazot (No. 6 fuel oil) to about 65 degrees Centigrade (149 degrees Fahrenheit) in the boiler day tanks. Neither the steam line nor the tanks or fuel lines are insulated. It was not determined if the fuel oil storage tanks are heated.

The steam system in the plant is reasonably well laid out. Most of the insulation is in good repair. However, some lines, especially smaller ones, are completely uninsulated. Some leaks and cracked valves exist.

Steam is used in the plant for:

- Cooking and can heating - open atmospheric
- Kettle heating - trapped and open condensate valve

- For steam turbine pump drive on vacuum evaporation - exhaust used to supply evaporation heat.
- Autoclaving - pressure not known
- Sparging operations?
- Other?

It is evident that most of the steam pressure requirements are well below the boiler output pressure.

4.2 Refrigeration System

This system provides refrigeration and freezing of vegetables. The purpose apparently is for process storage, not production of a frozen food product--although this must be confirmed. Approximately 1,500 tons of refrigeration is installed, produced by 8 reciprocating 2-stage compressors (data sheet says single-stage.) Two compressors are for refrigeration, six are for freezing. The six freezer compressors are manifolded into a system which includes a condenser and an expander so that a 3-stage system exists. The refrigerant is Freon 22. Cooling water is supplied at about 30 degrees Centigrade (86 degrees Fahrenheit) and experiences a 4 degree Centigrade rise. Freon is supplied to the freezer room at -30 to -40 degrees Centigrade (-22 to 40 degrees Fahrenheit). The desired temperature is not known. The system operates about 20 hours/day. It is shut down 1 hour per shift for maintenance. The system is losing refrigerant; leak identification has not been successful. The system was built by Technofrig Europa, Bologna, Italy. According to the O.E.P. questionnaire the installed motor sizes are: 4 @ 70 hp, 2 @ 110 hp, and 2 @ 45 hp.

4.3 Evaporation Systems

There are two process evaporation systems. One was working; it was inspected, the other was not. The system was built in 1982 by Vettori and Manshi, Parma, Italy. It was processing tomatoes. It is a double effect two-stage unit, each unit consisting of a wetted wall column for evaporation, a centrifugal separator, and a high volume pump for circulating the tomato fluid. The steam turbine exhaust from one of the pump drives is used to heat stage #1. Vapor from stage #1 heats stage #2. Vapor from stage #2 is quenched in a barometric condenser supplied with cooling tower water. Stage #1 pressure is at 0.8 bar (12 psig) and stage #2 is at -0.8 bar (-12 psig or 2.7 psia).

None of the surfaces is insulated. This may be for process reasons, but is still somewhat surprising. Cooling tower water is delivered to a sump which supplies the quench suction pipe. The sump was frequently overflowing in large amounts to the plant drain.

4.4 Various Cooking and Can Heating Systems

There were a number of cooking (or blanching) and can heating systems which relied on bathing the food or can with live steam inside a covered conveyor. Large and small steam plumes spewed out the ends of this equipment. Hot cans then were immersed in cooling water.

Some kettles appeared to be operating on atmospheric steam; however, no steam plumes of substantial size were exiting from the bottom (condensate) valves.

4.5 Bean Cooking

Bean cooking is accomplished by heating a mixture of beans and water in large (about 2 foot diameter) aluminum flasks which are set on metal racks above LPG burners. The whole operation is conducted in an open room.

4.6 Batch Autoclaving

Newly closed cans are batch autoclaved at --? bar (--? psig) for about 20 minutes. The autoclave is than flooded with cool water; cooling lasts about 20 minutes also. The water is dumped to the floor and a pit below the tanks.

4.7 Electrical

Electricity is mostly purchased. Only when the supplied voltage drops substantially, as it often does for several hours at a time, are the plant diesel driven generators turned on. Plant generating capacity is one 1000 KVA and two 750 KVA units, one of which is dedicated to the refrigeration system. Disconnect from the utility system is manual. Information on connected load, peak demand, normal demand, seasonal demand variation, power factor, etc. was not available. In addition, the rate structure is not known. Based on a reported annual consumption of 2.35×10^6 kwh (OEP 1982/83) and an assumed 4380 hours/yr (50% on-stream) the average electrical load is 0.54 MW.

4.8 Water and Water Treatment

The water system was not inspected. It apparently consists of well-supplied water (treatment unknown) and cooling towers dedicated to the evaporator and the refrigeration. The refrigeration cooling tower water receives softening. Presumabley the other tower does too. No other chemicals are added according to the plant representative. A large water softening system was installed in 1984 or 1985 for the boilers, but it is not working. The problem may be the lack of a booster pump.

According to the plant representative scale build-up inside of pipes and on condenser exchange surfaces is a significant problem. Build-up on boiler tubes is worse. The author inspected removed tubes and agrees the problem is severe.

5.0 ENERGY CONSERVATION OPPORTUNITIES (ECO's)

The Kaha plant has three levels (or categories) of opportunities:

- those associated with establishing good plant operation and condition
- those associated with modest design improvements
- those associated with more sophisticated system additions

It seems probable that the first category would be implemented within the next 2 years, the second in 2 to 5 years, and the third in 5+ years.

5.1 Upgrade Plant Operation and Condition

In the first category, it is absolutely necessary to upgrade water treatment, particularly boiler water treatment to prevent extensive scaling. The present situation is causing operating problems, requires excessive maintenance and replacement, and wastes energy. In fact, proper water teatment may be the single most important ECO available in the plant, and it is certainly the most achievable large one.

Secondly, the entire steam system should be reviewed for design and condition. Excessive steam pressure wastes money. In the short run pressure should be dropped. In the long run (category 3 ECO) high pressure steam fed to a turbine generator which exhausts at the desired lower pressure may be the desirable solution. Insulation should be repaired, duplicate lines removed, and leaks repaired.

Another possible candidate in this is the refrigeration system. Not enough is known about the system to make an evaluation. However, refrigeration systems typically do not operate optimally unless the installed system is carefully tested and "tuned." This includes assuring that the system does not over refrigerate and that controls are properly set up. It also includes assuring that heat rejection (to the condensers and cooling tower) is efficient. Finally, a review would evaluate the heat gain of the refrigerated/freezer areas and how they are used; these factors can increase the refrigeration needs substantially.

A fourth area in this category concerns process losses. Processed food which has been heated and lost represents a lost energy investment.

Finally, an energy audit will identify those plant conditions (e.g. faulty insulation) which can be quickly corrected.

5.2 Modest Design Improvements

The energy audit program should include an evaluation and "brainstorming" segment so as to identify and take advantage of ECO's via design modifications.

Examples of such modifications might include improved containment of atmospheric steam for blanching, cooking, etc. Or, some plants have turned to waterless cooking (we are unsure of Kaha's process) to save energy. Other plants have made use of hot condensate, hot water from can cooling, and "top off" water used in can filling. Another improvement might involve the insulation of portions of the evaporator equipment.

Several "modest design improvements" might be implemented on the boilers. These include deaeration, boiler feed water heating, air preheating and improved combustion controls. Given improved boiler feed water treatment, selected condensate could be returned.

Bean cooling in the aluminum flasks might be made much more efficient by enclosing the flasks or altering the flask design.

5.3 Sophisticated System Additions

Just where the dividing line is between "modest design improvements" and "sophisticated system additions" is, is difficult to say. But, there are a number of possible major changes which may be attractive ECO's.

One such is co-generation. Normally, in this plant it would probably not offer much advantage, because electrical loads are low. However, the fact that 2,500 KVA of diesel generator back-up is necessary to provide adequate voltage when the central utility falls short, causes one to consider co-generation more closely.

Another major possible ECO concerns the use of the biomass wastes as fuel to replace mazot. There are several possible routes to achieve this; all are major projects. An attractive feature is the rduction or elimination of waste-disposal.

Depending on plant needs and system design, it may be possible to recover heat from the refrigeration system.

Solar energy could be used to provide lower temperature steam or pressurized hot water. Given the solar availability, the ability to use a limited collector area at 100% of its capacity, and the advances in, say, parabolic trough collectors, this may be an attractive ECO.

Aseptic packaging can reduce energy costs substantially as well as reduce packaging costs.

A number of improvements can be made to improve the energy efficiency of retorts.

If product quality does not suffer, a process called "dehydro-freezing" can reduce refrigeration costs. Essentially, the process dehydrates the food partially before freezing, reducing the refrigeration load and achieving a net energy cost savings.

6.0 ECO CANDIDATE EVALUATION

According to 1984/85 data, the combined annual use of mazot (4011 metric tons/year) and solar (16 metric tons/yr) is about 167 x 10^9 KJ (158 x 10^9 BTU). A rough guess is that 30% of this can be saved by relatively simple measures. While this is only a tenth of probable savings at larger plants, the improvements can be copied fairly closely in many, if not most, other food facilities. It also appears that Kaha can produce all of its own electricity if it desires, and have a surplus for exporting to the national grid. The average plant need is about 0.5 MW while present steam rates could develop about 1.3 MW using new boilers.

The Kafa plant appears to be a particularly good ECO candidate because it contains several common unit operations and processes, because there are no doubt many other similar food processing operations in Egypt, and because the near term and long term potential for improvements is quite good. O.E.P. should expect considerable success with this plant given its potential and the apparent receptivity by Kafa to improve its operation. It could become an impressive demonstration facility.

Section 2

Helwan Cement Co.

9/3/85

Products: Various portland cements based on gray and white cements.

Notes by: Lowthian

1.0 SUMMARY

This large cement facility (over 3 million tons/year capacity) has operating units ranging from 56 years old to 2 weeks old. The bulk of the capacity is contained in the new dry processing facility (over 2.4 million tons/year). The remainder is in the older wet processing facilities. If the wet processing is to be retained, energy usage can be improved via design changes. The dry process evidently requires more thermal energy than international standards indicate. In the very quick tour it was not obvious why this is so.

The facility faces one chronic problem--nearly daily requests to reduce the electrical load for ½ to 4 or 5 hours. During this idle period the kilns continue to operate, requiring both fuel and electricity. Co-generation or stand-alone additional power generation may be an attractive way to eliminate these outages and the resulting inefficiency. The plant already has some generation.

It appeared that none of the exhaust gas electrostatic precipitators were working. The explanation for this condition is not known. The resulting product losses, and consequent inefficiency, were not determined.

Plant representatives appeared knowledgeable and helpful. We have no indication beyond that about plant receptivity to O.E.P input.

2.0 PLANT DESCRIPTION

The plant consists of three process areas:

- wet process, gray cement (six kilns)
- wet process, white cement (two kilns)
- dry process, gray cement (two kilns)

The wet process, gray cement consists of material preparation (blending, slurrying, grinding, etc.) calcining in kilns having planetary coolers (except #4) and grinding the resulting clinker. Natural gas is the fuel. Production is about 650,000 tons/year of clinker.

The white cement process is essentially the same as the wet gray process, except for two process details. (Please see Section 4.2.) The fuel is mazot (No. 6 fuel oil.) Two ½ ton/year boilers are used to heat the fuel oil. Production is about 100,000 tons/year.

The dry process, gray cement area is new: line #1 is about 3 years old and line #2 is just starting up. The plant appears to incorporate the most modern suspension preheating and flash calcining plus a large recuperative cooler in addition to the kiln. The fuel is mazot. Three 4 ton/hour boilers provide steam to heat the oil for firing. Design capacity of each of the cement lines is 1.5 million tons/year. To date line #1 has achieved a rate of about 1.2 million tons/year. Line #2 is just starting up. This plant is modern and large. A very large well designed control room provides detailed operating information continuously.

One major utility exists, the power house. This consists of two old field erected boilers, a package boiler, two old steam turbine-generator sets, and three deisel driven generators. A company representative stated that the steam generating capacity is 4.2 MW. Name plate information indicates that the diesel generators are 400, 800, and 500 KW and the steam generators are 3150 KVA and 1538/1925 KVA. The diesels evidently are for standby, while the steam units operate continuously. The electrical use is not known.

3.0 OVERALL IMPRESSION

This plant is being run relatively hard, achieving credible capacity. The level of maintenance is relatively good as is the apparent technical capability. The quality of the installations is good, and there appears (based on the quality) to be a willingness to spend capital when it is justified. Only one chronic problem came to light, the necessity to shut off selected electrical machinery when requested by the central (state) utility as a utility load shedding measure. All in all, this is a vigorous plant.

4.0 SYSTEMS CONDITIONS AND OPERATION

4.1 Wet Process, Gray Cement

Six kilns ranging from 55 years to about ----? years old produce about 650,000 tons/year of clinker. Except for specifics the kilns are basically the same. The facility reportedly operates only 250 days per year. It is not known why this is so. Although not confirmed, it appears that none of the units have working electrostatic

precipitators. In at least one case the precipitator was by-passed. Instrumentation is not in good shape. Combustion analysis either does not exist or does not work. It appears that two primary operating criteria exist: clinker quality and exhaust gas temperature. It appears that a kiln is fired more or less at a set rate (or is fed raw materials more or less at a set rate) so that operating conditions have become a tradition rather than using measured and controlled parameters. This is not an unusual condition in a plant of this sort. This condition is encouraged by a tendency not to invest capital or repair anything but the essential because of the age and comparative efficiency of the plant. Efficiency and condition, therefore, tend to slowly become worse. The author suspects this is the situation here.

Each kiln appears to be 12 to 15 feet in diameter and 300 to 450 feet long (the size and length vary.) All but one have planetary coolers. The firing heads are about 3 feet deep and the burners extend in about 20 feet. All equipment is by F. L. Smith, Copenhagen. Drives are D.C. Some planetaries have chains; others have lifters.

Generally speaking, however, the equipment is in good shape and is well run even though firing is somewhat crudely controlled. These kilns are fired with natural gas. (The other two processes use mazot.) With the exception of the use of standard planetary coolers, nothing has apparently been done to reduce fuel use. Fuel usage and rate figures provided by company representatives are:

- 200 Kg fuel/metric ton (about 7.20 million BTU/short ton U.S.)
- 200 m^3 natural gas/metric ton (about 7.07 million BTU/short ton U.S.)
- 348,000 m^3 natural gas/day (about 94 million BTU/hour per kiln)

These usage rates (7.20 and 7.07 million BTU/short ton) are fairly good for a wet process. Average U.S. usage 1969-1979 was about 8.25. However, numerous improvements can reduce the usage.

Exhaust gas temperatures were not checked, but a fan casing temperature on the #6 kiln exhaust fan was about 180 degrees Centigrade, indicating perhaps 200 degrees Centigrade exhaust gas (392 degrees Fahrenheit).

4.2 Wet Process, White Cement

The white process is similar to the gray, but designed for a lower capacity. Two kilns are run about 300 days per year producing about 100,000 tons of clinker.

The comments in Section 4.1 generally apply here, also.

Fuel usage is 230 Kg. mazot/metric ton (about 8.3 million BTU/short ton, US) which is relatively poor performance. Fuel use is (230 Kg/metric ton) (100,000 metric ton/yr) = 23.0 million Kg or about 0.91×10^{12} BTU/yr.

Combustion analyzers are installed but not working.

The exhaust gas temperatures indicated on the control panels were:

#1 375 degrees Centigrade at time of observation; 300-450 degrees Centigrade variation on chart

#2 315 degrees Centigrade

A check of #2 through a fan casing hole indicated a temperature of about 215 degrees Centigrade. The explanation for the full difference is not known.

Water is sprayed onto the white clinker prior to entering the planetary cooler. The purpose is not known although a company representative indicated it relates to the production of white cement using mazot. Likewise the purpose of a cyclone system on the clinker discharge end is not known.

4.3 Dry Process, Gray Cement

As stated earlier, this is essentially a brand new plant. It is large and well built. The equipment (and construction?) is by F. L. Smidth, Copenhagen. The thermal portion of the plant consists of four stages of flash preheating and one of pre-calcining, the rotary kiln, and a rotary cooler-combustion air heater. Exhaust gas is also passed through the raw mill to dry the feed. It would take several days to properly assess the ECO. Some information and data was recorded but since it has no bearing on this report it is not included.

Fuel usage for line #1 is reported to be about 140 Kg mazot/metric ton (about 5.26 million BTU/short ton, US) which is only fair performance for a plant of this design and age. Fuel use for line #1 is about (140 Kg/mt) (1,200,000 mt/yr) = 168 million Kg or about 6.65×10^{12} BTU/yr.

The electrical load for line #1 is estimated at 15 - 18 MW.

4.4 Power Station

Power generation is provided by:

1 -1 diesel 400 KW
1 - diesel 800 KW
1 - diesel 500 KW

None of the above were running at the time; they are probably standby. No exhaust heat recovery exists.

1 - steam turbine 3.1 MW
1 - steam turbine 1.5 MW

Byorn? Bovery? ASEA Vasteras? Sweden. P = 19 bar

The turbine generators develop 525 volts, 50 cycle. Condensing is by once-through river water. Steam is provided by two field erected water boilers and one package water tube boiler. The field erected units are John Thompson (England) and have 4 burners each and an i.d. fan. They have no air preheater. Each of the three boilers raises 16 t/hr steam at 19 bar and 400 degrees Centigrade; all steam is for electric generation. Normally, a total of 4.2 MW is produced. No stack temperature or oxygen data were available; it is doubtful these have been looked at.

Unfortuantely the notes on electrical consumption are confusing. Total consumption (rate) was reported at 4.0 MW generated inside and 10.0 MW purchased. However, line #1 of the new dry process is reported to use 18 MW.

4.5 Other Boilers

Five other boilers exist for heating mazot. Three 4 t/hr. units supply 8 bar saturated steam for the dry process lines #1 and #2; two ½ t/hr units supply the two white cement kilns.

5.0 ENERGY CONSERVATION OPPORTUNITIES (ECO'S)

5.1 Wet Process, Gray Cement

The author is not an expert in cement making, but does have similar experience in rotary kiln drying and calcining of raw and processed clays. The following comments are based on that experience.

First, while the author does not know the specific configuration of the "cool end" internals of the kiln, he can state without reservation that they can be improved so that the exhaust gas temperature is decreased significantly --say to 100 degrees Centigrade or below -- saving on the order of 0.5 million BTU/ton.

Second, the excess air may be high since the O_2 is unknown.

Third, obviously reduced water in the feed will save considerable energy. The author knows of no reason why the feed slurry cannot be filtered to form a dryer cake for feeding. For that matter it may be economical to introduce additives to permit higher solids content; e.g., the porcelin ware industry achieves clay slips having over 82% solids. Assuming that the cement slurry feed is 62% solids (a figure

provided by O.E.P. personnel, an improvement to 72% solids would reduce the amount of water evaporated per ton by about 448 lb. This is theoretically worth about 0.5 million BTU, but actually 1½ to 2 times that due to actual thermal efficiencies. So, the removal of this water could save 3/4 to 1 million BTU/ton.

Fourth, a small amount of energy can be saved by alternate planetary cooler design.

Fifth, a portion of the cool end of the kiln can be insulated or altered internally to reduce sensible heat losses.

Sixth, the middle portion of the kiln can be altered internally and painted with aluminum paint to reduce sensible heat losses.

Seventh, a portion of the hot end of the kiln can be used to preheat combustion air for the kiln, thereby recovering heat.

Eight, a considerable amount of dust is lost from the stacks. Especially in the wet process, this represents a considerable investment of energy. It seems likely that it would be economically worthwhile to capture the dust.

In any event, this list provides some indication of the thermal ECO possibilities of the existing process. An energy audit would be necessary to quantify existing conditions, but the key is to provide the process design evaluation which can lead to actually implementing the suggested design changes. Design development may also be required to achieve a workable design.

The electric drives on the grinding operations and exhaust fans, as well as the smaller electric motors were not inspected. No comments can be made regarding possible ECO's.

5.2 Wet Process, White Cement

The comments in Section 5.1 apply here.

In addition, it is suggested that the water spray and firing end cyclone be evaluated as to their impact on energy and the necessity for the process.

5.3 Dry Process, Gray Cement

It seems inconceivable that this new facility could offer ECO's. However, the fuel usage is given as 140 Kg/metric ton (about 6.1 million BTU/short ton, US) which is average for new plants of all types and well above what the best plants do. So, there may well be opportunities. It is suggested, however, that the approach to be taken should not be simply a classic energy audit. Instead, an expert process review--of the design and actual operation--may discover areas of inefficiency.

5.4 Powerhouse

The two older boilers could use a good mechanical upgrade and revision to incorporate heat recovery exchangers. Modern burner controls would increase efficiency. The turbine system may present some opportunities for increased efficiency, also.

6.0 ECO CANDIDATE EVALUATION

There are clearly a number of thermal ECO's in the wet process areas of the plant. A closer look at the dry process may reveal some thermal ECO's since the heat rate is not good. Thermal savings on the order of 10% of present usage should be available in each of the three major plant areas.

On the electrical side the principal possible improvement appears to be to generate more electricity in order to avoid the frequent curtailments. The only apparent possible co-generation opportunity would be in the dry processing facility making use of the 1st stage preheater exhaust (about 300 - 350 degrees Centigrade, 572 -662 degrees Fahrenheit) However, the large dust load probably would make this impractical.

In the author's opinion, the principal factor for O.E.P. to determine is the plant's capital plans over the next few years and to detrmine it attitudes about various possible changes before an extensive audit program is planned. While this sort of comment may be made about any facility, it is especially applicable in this plant. For example, if the plant is determined to shut down the wet gray process because of its age or other factors, it would obviously be a waste to do an audit in this area unless it were valuable as a training exercise.

Section 3

El Nasr Company for Chemicals and Pharmaceuticals

9/4/85

Co. Representatives: Eng. Mohamed Tewfithe Gad

Products: Chemical pharmaceuticals, antibiotics, veterinary medicines, lab chemicals

Notes by: Lowthian

1.0 SUMMARY

For various reasons only three of the 10 or 11 "factories" or production facilities were toured and one of these was a non-process tablet and capsule production area. However, based on general viewing, the two process areas were typical of the plant. The boiler house, one of five electric substations, the refrigerated brine house, and the refrigeration cooling tower were also toured.

Technically, a great deal can be done in this facility to reduce energy consumption. However, the author feels the plant will be slow to accept change, and will probably refuse to alter anything in the process area even though the energy changes would not be process related.

The principal energy use is in steam raising, distribution, and use. The next major one is the production, distribution, and use of chilled brine. Off hand, electrical appears to offer little energy conservation opportunity although power factor correction (PF is not known) and load shedding are probably desirable.

2.0 PLANT DESCRIPTION

The plant is a modest sized one with ten or eleven process facilities mostly housed in two-story concrete buildings arranged along streets like a campus. Most of the processes are small batch operations although one or two (e.g., alcohol distillation) are continuous. Chemicals appear to be handled largely or entirely in drums, etc., not in bulk. Steam is distributed over the rather spread out campus, as is chilled brine, water, electricity and (probably) compressed air from a central facility. The plant operates 24 hours/day, all year. The oldest portion of the plant was built around 1962.

3.0 OVERALL IMPRESSION

The author has the impression of a plant which was built reasonably well, but run over the years without much understanding or care. Judging by the general condition of the plant and the amount of used equipment discarded along the sides of the central plant street leading to the cooling tower, the level of maintenance effort is low, restricted no doubt to simply keeping particular production operations running.

This general situation, if truly correct and indicative of practice, does not lend itself to the implementation of much of the program which is likely to be recommended for energy conservation in the plant. While the technical opportunities exist, it is doubtful how much the plant will accept.

4.0 SYSTEMS CONDITIONS AND OPERATION

4.1 Process Areas

Two process areas (of ten) were visited, one for producing ampicylin, and one for producing aspirin. Based on these, this is a plant consisting of dozens of small batch chemical production operations.

A great deal of the thermal energy use (probably most of the purposefully used energy) is in the jackets and walls of numerous small reactors (50 - 250 gallons --189-946 liters -- estimated size.) It is not unusual to supply four different heat transfer media to such a reactor. For example in the production of chloramphenicol, a reactor with a split jacket is used. First, steam is run through the jacket in order to acheive the required reaction temperature. Then, in the same jacket, ambient water, followed by chilled water is used to cool the reactor. Cold brine is then pumped through the other jacket half to complete the cooling. There was very little insulation on any of the equipment or piping in this production area. Not only does this waste energy, but considerable piping corrosion is occurring due to condensation.

Another typical unit operation is drying of pharmaceutical powders. At least a half dozen small tray dryers and one batch fluid bed dryer were noted. All use once-through or recirculated air heated by steam coils. Drying in the tray dryers is a several-hour process. The one example we saw involved covering the powder with paper to prevent product loss. (However, it was evident that product was entrained and lost out the exhaust.) The whole process as observed is horribly inefficient, but probably constitutes a small total energy loss.

The alcohol distillation area, an open structure, was observed briefly from the street. The source of the alcohol and purpose of distillation is not known. The operation appeared to consist of several small distillation columns and would include steam heated reboilers and water cooled condensers.

4.2 Boiler and Steam Distribution

Three 10 ton/hour water tube field constructed (British?) boilers supply steam to the plant through a long distribution system. Only two boilers are operated at any time. Based on reported fuel use for 1982/83 (7886 metric tons of mazot) and a 0.9 on-steam factor, the steam rate is about 30,000 pounds /hour @ 10 bar (about 150 psig) saturated.

The boiler has an induced draft fan. Feed water which has been clarified, filtered (?) and chlorinated at the central water treatment plant (check that this is true) is softened via three manually operated zeolite beds, preheated in a flue gas economizer, and deaerated prior to entering the boiler. The boilers evidently operate well. Blow down is continuous through a "cracked" valve.

Instrumentation was minimal. Firing is controlled by steam header pressure and fuel/air ratio. Flue gas temperature and oxygen are not measured and could not be measured during the visit. Reportedly, steam loads vary sharply.

Steam is distributed to the plant through a long spread-out overhead pipe system. Three pipes leave the boilerhouse on the same rack, probably the result of successive plant expansions. The outside insulation is in fair to poor shape, missing in some places. Insulation inside the buildings is often missing; the same is true for steam heated equipment. A crude guess is that half the steam produced is condensed due to the length and poor maintenance of the steam distribution system.

Condensate is not returned because of the fear of contamination. Given the maintenance levels, the fear is probably justified. In any event, the runs are so long, it would be of little thermal value.

The reported steam and fuel rates are 334 metric tons/day steam per 20 metric tons of mazot. Using 18,000 BTU/pound mazot, this yields 1077.8 BTU/pound of steam, which is impossibly low. Therefore, the data is not good.

4.3 Refrigeration and brine distribution system

Apparently there are several small local freon systems.
However, the main source of cold is a Russian built ammonia refrigeration system which chills brine which is circulated through an overhead pipe network to the various buildings in the plant.

The refrigeration system consists of six, ?-stage, ammonia compressors, a common condensor, and common expander. The condenser is cooled with recirculated cooling tower water. No additional data was taken.

The brine distribution system is, like the steam system, long, scattered, and in need of insulation. Very likely even the intact insulation is not in good shape.

4.4 Electrical Systems

One of five enclosed substation/switch gear stations was visited. All equipment is Russian. Two utility feeders supply each substation, a primary and a backup. Name plate information on the transformer seemed to indicate:

In	Out
I. 11,000 volts 55 amps	
II. 10,500 volts 55 amps	400 volts 1445 amps
III. 10,000 volts 55 amps	

A plant representative indicated that the nominal voltage in and out was 13,000 and 380.

According to the OEP 1982/83 sheet annual usage was 2 x 10^6 kwh. Assuming an on-steam factor of 0.9 (7884 hours/yr.) the average load is 0.25 MW.

5.0 ENERGY CONSERVATION OPPORTUNITIES (ECO's)

5.1 Process Areas

Based on the two process areas observed three sorts of ECO's exist:

- Insulation of piping and equipment
- Revision of a unit operation (e.g., drying)
- Revision of operating procedures and practices.

Insulation of piping and equipment is straightforward and obvious. All existing insulation should be examined for mechanical and water damage. Damaged and missing insulation should be replaced as required. Careful attention should be given to the materials and design of the insulation system so as to insure long life. The selection should be based on long life and life cost rather than first cost.

The recommendation to consider revision of unit operations (in the classic chemical engineering sense) is based on the inspection of some tray dryers and the rapid observation of a distillation system. Based on these two, it appears likely that the unit operations use far more energy than is necessary. A typical revision might involve replacement of the tray dryers with other equipment, or revising the operating conditions and procedures in the existing units so that less product is lost and less steam is used. Another typical revision might be to assure that distillation systems are run properly; it is very easy without proper instrumentation to produce too good a product and thereby use more steam than necessary.

Revising of operating procedures and practices would involve considerable changes in attitude and habits on the part of management as well as operators. Training programs, development of measurable objectives, etc. would be as important as any technical changes. This sort of program might be implemented once savings are seen from upgrading the steam system and insulating the process piping and equipment.

5.2 Boiler and Steam System

While the boilers appear to be in fairly good condition, some upgrade is in order. Controls should be modernized and preferably based on oxygen analysis. Air preheat would be desirable; better boiler water heating may be possible. The water treatment program and effectiveness should be checked and probably upgraded. All these steps will increase the efficiency of raising steam.

However, the most important first step is to upgrade the steam distribution system. Pipe routing should be improved where practical and economical. Insulation is currently in bad repair; moreover, it appears to be a low resistance type. Probably, all steam lines should be reinsulated once the routing upgrade is finished. Finally, the required steam pressures should be minimized. If a great deal of steam must unavoidably be let down in pressure, turbine-generator sets should be installed.

5.3 Refrigeration and brine distribution

Probably the primary ECO is improved insulation and routing of the brine distribution lines. Insulation of process equipment and altered procedures could also reduce brine usage substantially. A close study of the required brine temperature could raise this somewhat while improved cooling water treatment may decrease the condenser temperature somewhat. Both temperature changes would increase the efficiency of the refrigeration cycle.

5.4 Electrical system

The author's notes do not indicate the power factor. Unless it has been corrected, it should be in the 0.7 range; correction would probably be economical. Based on the amount of steam currently produced, it is estimated that roughly MW could be co-generated. Since MW is required, the surplus could be put into the national grid.

6.0 ECO CANDIDATE EVALUATION

According to the 1982/83 OEP data sheet the following annual energy is used:

7886 tons mazot	328×10^9 kJ	(311×10^9 BTU)
455,000 litres solar	16×10^9 kJ	(15×10^9 BT)
$2,000 \times 10^3$ kWh electrical		

A rough guess is that at least 30% of the fuel can be saved. In addition, the plant could be self-sufficient in electrical.

The boiler and steam system improvements are, for the most part, easy: the economics are currently unknown. In any event, several good projects should be available.

Co-generation may be beyond the current technical capability of the plant. Good training and the provision of better maintenance should suffice to correct this possible deficiency. The average plant electrical load is about 0.25 MW based on 1982/83 data and 7884 operating hours per year. The present steam usage (which should be reduced by ECO implementation) could provide about 1.7 MW given the right equipment.

The closer the changes are to the process, the less likely (the author feels) that the plant will want to participate. Nevertheless, there may be substantial ECO's here.

The author's subjective feeling rates this plant as a fair candidate overall. The necessary desire and will for implementing and maintaining the changes seems questionable.

Section 4

Abu Zaabal Fertilizer and Chemical Co.

9/5/85

Co. Representatives: Medhat Kamel Abbas, Electrical and Instrumentation Manager, and Mohamed El Hefirawi (sp?), Plant Director

Products: Single super phosphate, triple super phosphate, sulfuric acid (98%), and oleum (25%). Phosphoric acid (50% P_2O_5 equiv.) is produced as an intermediate for the production of the super phosphates.

Notes by: Lowthian

1.0 SUMMARY

This large, well-run facility should soon be a showpiece among Egyptian industry. Because of its success at building and maintaining a quality plant, here appears to be little in the way of readily available ECO's.

A thorough process review could reveal ECO's, in which case it seems likely that the investment would be made. However, it is probable that the improvements would be relatively small unless the phosphoric acid facility could be revamped to eliminate acid concentration via evaporation.

Besides the general quality, the plant is noteworthy in two other ways: 1) it apparently has solved all its water treatment problems and 2) it is nearly self-sufficient in electrical power. The first is important because it is atypical of Egyptian industry; severe scaling problems are frequent. This plant shows that these problems are not inevitable.

The second, power self-sufficiency, and perhaps the ability to put power into the utility grid is important to Egypt as a test case. O.E.P. may want to pursue this ECO.

2.0 PLANT DESCRIPTION

This large facility has been operating since the early 1960's. However, all the old acid processes (H_2SO_4 and H_3PO_4) have been replaced by very new technology, and two of the older sulfuric acid plants are being rebuilt.

The sulfuric acid area consists of three units:

- #6: 1984 620 t/day, (98% H_2SO_4) equivalenc acid
  ? t/day, (25% oleum) equivalent acid
  30 t/day, (65% oleum) equivalent acid (future)
- #5: 1986 250 t/day (a 1970's U.S. design being rebuilt)
- #4: late 1985 300 t/day (a 1970's Romanian design being rebuilt)

The phosphoric acid facility began startup in late 1984; it has yet to reach the design capacity of 218 t/day P_2O_5 equivalent at a 50% concentration of P_2O_5 equivalent.

The phosphate rock grinding and production of superphosphates were not visited.

3.0 OVERALL IMPRESSION

This facility is truly impressive. The plant is undergoing extraordinary rebuilding, and has installed essentially the latest technology in the sulfuric acid plant and nearly as good in the phosphoric acid plant. The plant is well set up for maintenance and appears to have an excellent technical staff.

The two sulfuric acid rebuilds (and redesigns) are being carried out by plant personnel.
While this plant has relatively low potential for additional energy savings, it has very good potential as a model for other plants to emulate. Plant personnel show a lot of enthusiasm for what the plant is doing.

4.0 SYSTEM CONDITIONS AND OPERATION

4.1 No. 6 Sulfuric Acid Plant

This is a brand new, French designed facility. It is well built, well maintained, and from all appearances, well run. The process is based on sulfur and is double absorption achieving a claimed 99.8% conversion, which is quite good. The heat from the exothermic reactions is used to raise steam (60 bar, 450 degrees Centigrade, superheated) to run a turbine-generator (exhaust pressure -0.8 bar) to produce about 6 MW. Since the plant uses 2.3 MW a surplus is available to the rest of the plant.

4.2 No. 4 Sulfuric Acid Plant

This Romanian plant is being completely rebuilt along the lines of the No. 6 plant. The original plant had many design, material, and equipment problems. The existing turbine-generator set will be left intact. It will produce an estimated 2.3 MW whereas the plant will require about 1.8 MW.

4.3 No. 5 Sulfuric Acid Plant

This plant is being rebuilt from pieces of a previous plant plus new equipment. Reportedly a backpressure turbine will be used to generate power as well as provide process steam to the phosphoric acid plant about 700 meters away.

4.4 Phosphoric Acid Plant

This Lurgi designed plant was finished in 1984. Various "small" problems have kept the plant from achieving design, but they are being overcome. The plant represents traditional technology using phosphate rock as the raw material. It therefore includes single effect evaporation to concentrate the phosphoric acid from the approximately 26% produced by the action of sulfuric acid on the rock to about 50% (P_2O_5 equivalent.) Steam is produced for this purpose by two ---? tph package boilers using mazot. The steam pressure required for the heat exhangers (about 90% of the steam load) is about 5 bar whereas the ejectors consuming the rest of the steam require 9 - 10 bar. Time did not permit exploring the means of providing these two pressures.

4.5 Water Treatment

This topic is treated separately because of the apparent success which the plant has had, contrary to many other plants. Water is taken from the Ismailia Canal. Treatment (floculents and settling?) removes turbidity; chlorine is added (at least to potable water.) Boiler water is demineralized by ion exchange. Cooling tower water (for the turbine condensors) is treated with chemicals (not identified.) No boiler, steam line, turbine, or cooling tower fouling or scaling occurs. Compared to other plants visited, this is quite an achievement.

4.6 Electrical System

The sulfuric acid plant power factor is reportedly 0.93, while the whole plant is 0.87. By the end of 1986 the plant should be essentially self-sufficient regarding electrical, except that it will choose to remain connected to the grid and must, therefore (apparently) purchase a minimum amount of power. Here is an example where the apparent utility policy runs counter to the apparent national interest.

5.0 ENERGY CONSERVATION OPPORTUNITIES (ECO's)

Because of the apparent quality of the design, operation, and maintenance of the facilities, there are no readily apparent "easy ECO's'. This is not to say that a careful process review would not uncover some.

Discussing with the Lurgi engineer revealed that there are phosphoric acid processes in various stages of commercialization which eliminate the need for evaporation. However, they are more complicated and very dependent on the type and quality of phosphate rock. In theory the evaporation could be multiple effect, but scaling is such a difficult problem that the industry simply doesn't use multiple effect evaporation. A small reduction in steam usage could be gained by replacing the evaporator jets with mechanical pumps; however, this is likely to be unattractive.

6.0 ECO CANDIDATE EVALUATION

The Abu Zaabal Fertilizer and Chemical Co. plant is a perfect candidate to work with in terms of a knowledgeable, aggressive organization. However, on the other hand, they have little likely energy improvement available. However, this plant is very close to being able to produce power to be exported to the utility grid. Since it is a well run facility with a good technical base, this may be the plant to explore industrial power sales to the grid. If that is to be pursued, this may be an excellent candidate.

The other "ECO" value in this plant is its showpiece valve. This plant demonstrates that Egyptian industry can be second to none.

Section 5

Cairo Company for Oils and Soaps

9/7/85

Products: Refined soybean, safflower, and cottonseed oil; by-product stearine from winterization of cottonseed oil; animal feeds and food based largely on the seed pulp, but having corn, molasses, vitamins, antibiotics, etc. added, depending on the product; and by-produce raw soap which is processed elsewhere.

Notes by: Lowthian

1.0 SUMMARY

This plant was not operating when visited.

The plant ranges from very up-to-date to old and in poor shape.

A number of good Energy Conservation Opportunities exist. Included in the list would be:

- boiler upgrade
- steam system upgrade
- winterizing cooling upgrade
- possibly adding seed pressing prior to extraction
- instituting a motor replacement program

Many other ECO's would be identified in an audit program.

2.0 PLANT DESCRIPTION

The plant consists of the following process areas (sections):

- seed preparation and crude oil extraction
- a batch refini. ea for cottonseed and safflower oil (#1 oil)
- a continuous refining area for soybean oil
- a winterizing facility for cottonseed oil
- the animal feed and food production area

The utilities consist of:

- purchased power
- a boiler house and steam distribution system
- a cooling tower for the extraction plant condensers
- freon/brine refrigeration for the winterization
- local compressed air systems for controls and some tank agitation

There is also a plastic (polyethylene?) bottle blowing plant using plastic pellets as the feed. We did not visit this.

The seed preparation/oil extraction (and associated equipment) and the animal feed processes are rather new and in very good shape. The continuous refining area is about 10 years old and in fair shape. The batch refining area is about 34 years old and in very poor shape. The boilers and steam system range from fair to poor shape.

The plant shut down its old extraction process when the new one came on line. The plant is in the process of installing a new 12 ton/hr boiler (to augment the present 20 ton/hr capacity.) It hopes to add refining capacity as well as bleaching and deodorizing steps to the continuous process soon. A small pilot plant for removing lecithin is also in the works.

Production rates are:

- extraction - 50 tons/day of crude oil (based on soy beans)
- refining - about 49½ tons/day of refined oil (1% loss)
  - about 15 - 20 tons/day £1 (edible) oil from cotton seed

The amount of oil in the seed is 17 - 20% of the seed weight.

3.0 OVERALL IMPRESSION

This plant presents a mixed image ranging from good to fairly poor. It looks like, given a good design, they can keep the plant up. However, the older areas are suffering badly from poor practices. The technical and managerial people seem anxious to improve the situation, however. There is no apparent reason why substantial strides cannot be made.

4.0 SYSTEM CONDITIONS AND OPERATIONS

4.1 Seed Preparation and Oil Extraction

This plant started up in early 1984. It was designed (and built?) by De Smet, Antwerp, Belguim. The essential features of the plant are that it lacks presses for removing oil, it removes all oil by extraction with cyclohexane, and it produces a dry cake free of cyclohexane. Being a new design, it is unlikely that significant energy gains can be achieved--except, for example, that the use of presses might increase capacity and thermal efficiency.

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4.2 Batch Refining of Oil

This plant is literally a mess due to decades of oil spillage. If a fire ever started, the plant would be an utter loss, and would endanger property around it. The plant is unsafe to personnel because of a number of hazards. While the process undoubtedly works, it has reached a minimal level of sophistication--very manual. Energy usage (steam) is not controlled or thought out. There is very little insulation in the facility.

4.3 Winterization of Oil

This is a batch process also. Cottonseed oil is cooled to about 6 degrees Centigrade to allow crystals of stearine to form. These are filtered out so that the oil no longer has the tendency to become cloudy. Cooling is provided by a freon based brine system.

4.4 Continuous Refining of Oil

This facility was significantly cleaner than the batch facility. The essential feature is that contacting of oil with caustic and water is done by inline mixers and separation is done by centrifuges. As in the batch plant steam is used. This plant does not have bleaching and deodorization steps yet; the plant hopes to add them soon.

4.5 Boiler House and Steam Distribution

The boiler house contains two 6 ton/hr and one 8 ton/hr fire tube boilers built by El Nasr Boiler Co. They are natural draft units. Control is based on steam header pressure. Given the condition, the lack of control, and probable procedures, there is no credible way that these boilers could be expected to provide steam efficiently.

The steam is distributed to two systems one from the two 6 ton/hour boilers, one from the 8 ton/hour. Slightly different pressures (11 bar and 13 bar respectively) (160 to 189 psig) are maintained, but for no apparent reason. Although the lines were not checked, we were told that the 13 bar supplied the extraction plant while the 11 bar supplied the refining area. Since these are geographically separate, having two systems is not redundant. Inside the boiler house there is very little pipe insulation; outside what we saw was in fair condition. The extraction plant piping is well insulated while the batch refining plant is largely missing. We observed one 1" pipe blowing steam like there was no valve in the line; there are probably other leaks.

The older insulation in the plant appears to be braided hemp rope wound around the pipe and covered with canvas and a sealer.

4.6 Electrical System

All power is purchased. No power factor correction is installed. All motors are induction. Power availability is fairly good. Occasional 15-second interruptions occur. Some low voltage problems occur occasionally. According to the 1982/83 OEP sheet the annual usage is 9.7 x 10^6 kwh. Assuming an on-steam factor of 0.8 (7008 hours/yr) the average load is about 1.4 MW.

5.0 ENERGY CONSERVATION OPPORTUNITIES (ECO's)

The following is an example of some obvious possible approaches. Note that some are oriented toward the "utility" system and some toward the process.

5.1 Seed Preparation and Oil Extraction

The one "obvious" possibility is the introduction of seed pressing prior to extraction. Presses will require electrical power (undesirable) but will reduce the amount of stream used in hexane evaporation and recovery by perhaps half. A process review may turn up other possibilities.

5.2 Batch Refining of Oil

There are two primary approaches to reducing steam usage in this area. One is to insulate. The second is to review and upgrade the process and process practices. The steam savings should be significant--perhaps sufficient to eliminate the need for a new boiler.

From an electrical standpoint, it seems likely that the high vacuum system is leaking significantly, requiring far more electrical power than necessary. There may be other such examples.

5.3 Continuous Refining of Oil

The steam usage comments are similar to those for the batch plant except that the situation is nowhere near so severe.

5.4 Winterization of Oil

If the plant is reviewed this system should be checked out, if for no other reason than refrigeration is notoriously inefficient. Piping insulation should be replaced because it is an inefficient sort (wound hemp rope with a canvas cover.) Operating procedures should be checked to assure that the oil is transferred to the tanks at as low a temperature as possible; the reported 45 degrees Centigrade (113 degrees Fahrenheit) is excessive. Perhaps additional cooling via cooling tower and incoming plant water should be considered; reducing the starting temperature to 29 degrees Centigrade (85 degrees Fahrenheit) reduces the load by over 40%.

5.5 Boiler House and Steam Distribution

It seems probable that boiler upgrades (primarily in the form of controls and insulation, but perhaps including i.d. fans, better water treatment, economizing and air preheating) would make a significant difference in steam production and fuel efficiency. In addition, upgrading the steam distribution system and use via insulation, proper trapping, and improved process procedures will make a large difference. With these things done, a new boiler would not be required to provide additional capacity.

Given the obvious quality of the new crude oil extraction plant, there is no reason why the boiler house cannot be upgraded and properly run. The resulting energy and cost savings will be large.

5.6 Electrical System

Power factor correction is probably desirable. A careful review of plant motors and the connected equipment would enable a reduction of electrical usage via a planned motor replacement program and by increasing the efficiency of the particular connected equipment (e.g. fan).

Co-generation would be a possibility in this plant. Based on staem use, the rough estimate for electrical generation is 2.6 MW. Since the average plant use is about 1.4 MW, 1.2 MW would be available for putting into the national grid. Training and improved maintenance capability would be essential to co-generation.

6.0 ECO CANDIDATE EVALUATION

From a technical standpoint this is a good plant to work with. There are several types of opportunities, and the effect will be significant.

The key question in this plant is whether capital would be spent. The desire on the part of the company would seem to be there. And, based on recent capital additions, the general willingness appears to be present also.

Based on the 1982/83 OEP data sheet, the following is used:

12,700 t mazot	332×10^9 kJ	(315×10^9 BTU)
$9,702 \times 10^3$ KWH		

It is roughly estimated that steam usage can be decreased by 20%.

Section 6

El-Nasr Company for Coke and Chemicals

Fertilizer Manufacturing Plant

9/8/85

Products:
- Ammonia - 40,000 metric tons/yr (t/y) (It is not clear whether this figure is plant production (most of which goes on to make nitric acid and ammonium nitrate) or ammonia sales beyond that produced for nitric acid and nitrate.)
- Calcium ammonium, nitrate - 700,000 t/y
- Ammonium nitrate (explosive grade) - 3,000 t/y
- Concentrated nitric acid (98%) - 1,500 t/y
- Liquid carbon dioxide - 10,000 t/y

A separate facility produces:

- 225,000 m^3 O_2 as a liquid
- 200,000 m^3 N_2 as a liquid (the rest is vented)

Notes by: Lowthian

1.0 SUMMARY

Only the fertilizer portion was visited, the coke ovens and liquified gas facilities were not.

This is a large integrated chemical plant with many types of energy conservation opportunities and a good potential for significant savings.

Based on conversations with the plant manager, the desire and ability to implement ECO's exists.

This is a relatively small fertilizer plant (especially the ammonia portion). The economics may or may not be favorable, depending directly on the value assigned to the coke oven gas feed stock. (Check this.)

2.0 Plant Description

The plant consists of four basic process areas:

- ammonia production from coke oven gas
- nitric acid production from "burning" ammonia
- ammonium nitrate production (reaction of ammonia and nitric)
- prilling and formulation of ammonium nitrate

The ammonia plant was built in 1971. The rest of the plant looks to be the same vintage. The plant presents a weary image. Maintenance has been fair. While the plant appears to be in basically good shape (i.e., no serious equipment failures) it needs a good overhaul to return it to decent operating condition.

The plant clearly has the ability to do better than it has inasmuch as the basic level of maintenance required just to keep the plant running is reasonably sophisticated. What is lacking is the additional "10%" which makes the difference between running and running well.

3.0 OVERALL IMPRESSION

While the plant is not in good shape, it appears to be fundamentally sound, and therefore worth working with. The level of expertise in the plant is good. Based on comments by the plant manager, there is a desire and willingness to improve product rates, efficiency, etc. The plant manager also exhibited a "larger view" of the potential--speaking of the possibility of revamping processes and producing enough electrical power to be independent of the grid, if possible.

4.0 SYSTEM CONDITIONS AND OPERATION

4.1 Process Areas

Since the plant is reasonably large and complex, and time was short, a detailed examination was not possible. The overall assessment is given above. Given the age of the plant there are surely process modifications which are now current practice which will reduce energy usage.

The insulation, repair, quality, and type can be improved significantly. Numerous steam leaks, some quite large, were noted.

The amount of nitrous oxide being vented was quite high (visual determination) and numerous leaks exist. The reported conversion efficiency for the nitric plant is 87% vs. about a 98% design. This is blamed on ingesting iron particles (dust) which poison the catalyst; the source of the iron is a nearby sinter plant.

Lack of cooling water is a production constraint. Winter production rates are higher than summer. Reportedly the cooling systems experience corrosion, scaling, sedimentation, and biological fouling.

Heat is reportedly recovered from the dilute nitric acid section in the form of 10-13 tons/hour of 34 bar steam which is let down through a ? MW turbine generator.

4.2 Boiler Area

Four water tube boilers exist, two of which are currently being rebuilt.

#1 6½ t/h 34 bar (500 psig) 400 degrees Centigrade (752 degrees Fahrenheit) West German 1969. Being rebuilt.

#2 6½ t/h 34 bar (500 psig) 400 degrees Centigrade (752 degrees Fahrenheit) West German 1969. Will be rebuilt.

#3 30 t/h 16 bar (235 psig) 350 degrees Centigrade (662 degrees Fahrenheit) Italian. Being rebuilt.

#4 30 t/h 34 bar (235 psig) 400 degrees Centigrade (662 degrees Fahrenheit) West German 1983.

We inspected only the #4 boiler; even that inspection was minimal due to lack of time and the presence of a large, painfully loud high pressure steam leak. The boiler is a forced draft, pressurized unit having two burners; the top main access doors were leaking combustion gasses badly. The boiler looked old before its time. This is typical of the whole area; the maintenance level is poor.

Reportedly the Italian boiler developed serious problems (corrosion, etc.) within the first four months of operation. It will be retained as a back-up boiler.

A fifth boiler is under consideration because of insufficient steam supply.

A 1½ MW turbine exists; it develops 0.6 - 0.7 MW normally because there is insufficient 34 bar steam according to the boiler area manager.

Boiler and combustion controls are based on steam header pressure. There is no on-stream oxygen monitoring. The boiler area manager said that oxygen on the flue gas was 3 - 5%. The minimum for good performance should be 2½% which, assuming a flue gas temperature of 250 degrees Fahrenheit and good boiler condition, corresponds to a combustion efficiency of about 91.4%. The 3 - 5% O_2 corresponds to 91.3 and 90.9% efficiency. So there is little room for improvement if the oxygen readings are correct.

The steam system is at three pressures: 34, 16 and 3 bar. Some of the steam is let down through the turbine, some across pressure reducing valves.

5.0 ENERGY CONSERVATION OPPORTUNITIES (ECO's)

5.1 Process Areas

General maintenance (e.g., repair of steam leaks and replacement of insulation) will save quite a bit of energy. From what we could see the reform furnace (ammonia section) had no waste heat boiler; a significant amount of steam could be produced here. The stripping, absorbing, and acid concentration columns probably use far more energy than necessary due to lack of up-to-date controls and (likely) poor procedures. Since the processes are nearly 15 years old, one can expect that several process modifications can be made to bring the plant into line with current practice, thereby producing the product more efficiently and saving energy.

An energy audit/process review would doubtless develop a very large number of ECO's.

5.2 Boiler Area and Steam System

In a sense, the same type of comments can be said about the boilers as for the process area. The steam demand in the plant is relatively high, yet the supply of steam is provided in a piecemeal way. A complete system review looking at the production, distribution, and use of steam is required in addition to simply auditing and upgrading existing system components. Included in this analysis should be an evaluation of process requirements and the production of electrical via steam let down turbines. Significant energy savings should be available.

5.3 Water Treatment

Based on comments by the plant manager and the boiler area manager, as well as observation, the cooling water and boiler water systems should be carefully reviewed. Good water treatment should increase thermal efficiency and production capacity as well as reduce maintenance in boilers and heat exchangers.

6.0 ECO CANDIDATE EVALUATION

Based on the 1982/83 OEP data sheet, the following is used

33,000 tons mazot (1300 x 10^9 BTU) 1372 x 10^9 KJ

14,984 M^3 coke oven gas *

*Note: it is not clear if this is fuel only or fuel and feed stock.

A rough guess is that mazot usage (all for steam raising) could be reduced by 15 %.

Since the process needs are unknown it is impossible to even guess the co-generation opportunity.

This is a good large plant candidate. A wide range of improvements can be made, each providing a significant energy savings as well as being an instructive model for other industries. There are opportunities in the traditional energy savings area, savings which will accrue from improved maintenance and production scheduling, and savings from process optimization. It is likely that potential process improvements will also be identified, although these will probably be beyond the scope and intent of the O.E.P. work.

Location: Alexandria Refinery
Date: September 2, 1985
Engineering Team: SCL - William Liegois
OEP - Dr. Hani A. Alnakeeb
Corporate Representative: Gebaly Gabr
Products: LPG, Naptha, Kerosene, Gasoline, Reduced Fuel Oil

1.0 Summary: The basic plant design appears to conform to designs based on a much lower price for crude oil and its primary products. It did not appear that any major energy conservation work was underway. The process heaters appear to be a major point for heat recovery or energy conservation projects. The newest plant was designed by Egyptians, and foreign technology and engineering should be able to provide meaningful savings.

2.0 Plant Description: The plant has three major production units. Unit No. 2 was built in 1962 with a capacity of 1.5 million tons per year. Unit No. 3 was built in 1970, and also has a capacity of 1.5 million tons per year. Unit No. 4 was built in 1980 with a capacity of 2.0 million tons per year. Unit No. 4 also contains a lube oil recovery system and a vapor recovery system that serves all three plants. All units were designed for light Arabian crude but are operating on local crude. Two 40-ton-per-hour boilers serve the entire complex. Crude oil is received by pipeline. All products are shipped to distributors by pipeline.

3.0 Overall Impression: The plant staff was pleasant and cooperative. They had made a few process modifications to improve operation of the system. They answered questions freely, but had difficulty producing specific information. They stated a central office contained design drawings. It is doubtful that these have been kept current and may be of little value. It did not appear that any energy related projects were underway; continuous plant operation was the primary concern. This could be because of limited staff.

4.0 System Condition and Operation: The plant was fully operational with new construction underway on a hexane unit. Unit No. 2 was temporarily shut down but Units No. 3 and No. 4 were in operation. A planned maintenance outage is scheduled annually and lasts 7-10 days. This doesn't include tower inspection which is done every three years. Daily log sheets are kept showing key process parameters. All process heat exchangers are installed with 100% capacity spare units. When operating parameters indicate, the dirty unit is taken offline for cleaning and the spare is placed in operation. The cleaned unit is then placed back in service as the spare backup unit.

Very little information was obtained about the steam system. The plant can produce 80 tons per hour with both boilers in operation, but only has a need for 60 tons per hour. The boilers operate at 17 bar, but the pressure of the boiler battery is 14 bar, and the pressure falls to 11 bar in the operating units. The steam system operates with three steam pressures, 12 bar, 9 bar, and 3 bar. The operating staff was not able to provide any information on how much steam is used in each of the steam systems. Letdown valves are evidently used to generate the lower pressure steam. Condensate recovery systems only exist in the lube oil plant.

A plant tour of the boiler area was not possible. The units, however, are equipped with economizers but no air preheaters. Several process heaters were examined. These are very large units and may be of greater interest than the boilers. Stack temperatures of 375°C and 285°C were reported. Oxygen content of the flue gas was said to be 20%.

5.0 Energy Conservation Opportunities:

5.1 Optimize the cleaning cycle of the heat exchangers. Perform heat and material balances around each unit, and determine the most cost-effective cleaning cycle.

5.2 Prepare a steam balance for the entire facility. Look at condensate recovery systems to improve efficiency. Determine the quantity and pressure required for all users. Look at options to produce the necessary steam without using steam letdown valves. Evaluate producing low-pressure flash steam from high pressure steam traps.

5.3 Improve losses to flaring system. Determine sources of flare gas and eliminate any unnecessary vents or leaks. Determine if a need still exists for a continuous flare, and if so, look at the use of recovery compressors back to the boilers or process heaters.

5.4 Evaluate opportunities for further heat recovery from the hot process streams. A heat exchanger audit will produce the necessary information. This audit will determine the level and quantity of heat transferred for each unit. The results of this can be graphed for easier interpretation and identification of further heat recovery options.

5.5 Determine efficiency of boilers and process heaters. Examine options to improve efficiency such as air preheaters, improved combustion control, or additional heat recovery sections.

SECTION 8

Location: Misr Chemical Company
Date: September 3, 1985
Engineering Team: SCI - William Liegois
OEP - Dr. Hani A. Alnakeeb
Corporate Representative: Mahmoud Borham
Products: Sodium Hydroxide, Chlorine, Hydrogen, Peroxide, Soda Ash, Sodium Bicarbonate, Lime

1.0 Summary: This plant is unique from an energy standpoint because it has two major processing areas, the chlorine plant where electricity is the primary energy and the soda ash plant which uses most of the steam. Balancing these two needs without tieing the plant together is difficult. The plant is currently installing a turbine generator to produce electricity for the soda ash plant only. Future plans call for a larger turbine generator to serve both processing areas. The plant is currently working on energy conservation measures; however, there are still several major areas to be examined.

2.0 Plant Description: The plant has two main process areas. The first is the electrolytic plant for the production of chlorine gas. This plant requires large amounts of electricity and much smaller amounts of other energy types. Due to time constraints, this plant was not visited.

The second process area is the soda ash plant. This unit starts by producing carbon dioxide from the calcining of limestone. The by-product, lime, is either sold directly or hydrated and sold as either a dry material or a diluted liquid. The carbon dioxide produced is reacted with caustic to form sodium carbonates and bicarbonates. These products are concentrated in evaporators before shipping.

The plant auxiliaries include the boiler area, cooling towers, and a refrigeration unit. Four boilers provide the plant with 50 tons per hour of steam, each. Normally the plant can be run with only two units. The other two units will be on standby. When the new turbine generator is installed, three boiler operations will be required. Two three-cell cooling towers were observed on the tour. No capacity numbers were available. Time did not permit the examination of the refrigeration system.

3.0 Overall Impression: Mr. Borham was very knowledgeable about the operation of the facility. The plant has begun to look at energy conservation and take some action. The scheduled installation of a turbine generator later this year is an indication of this. They were also aware of shortcomings such as poor boiler design and poor maintenance of instruments. The plant staff appeared to be willing and capable of working with outside engineers to improve their facility.

4.0 System Condition and Operation: The portions of the plant visited were all in need of maintenance work. Instrumentation was unreliable and, in many cases, nonfunctionable. All of the equipment appeared old, even the newest boiler which was installed 3-4 years ago. Most of the instrumentation on this new boiler was not operating. The boiler was being run totally by hand. This unit was smoking considerably when we visited the boiler area. This situation was only corrected when the U.E.P. team member asked the operator to take corrective action.

Even with the plant requiring only two of the four boilers for normal operation, steam shortages have limited production. With the new turbine generator, this problem will increase because a third boiler will be needed to supply the turbine.

Plant independence from the power grid is one motive for installing electric generating capacity. This plant operates continuously and power outages can cause major problems. Production of their own electricity would eliminate the problem of losing all power. Currently, the plant uses about 30 MW. Most of this (20 MW) goes to the chlorine plant. The remainder is for the soda ash plant.

The vertical kilns used to produce carbon dioxide appear to be in fairly good shape. On the other hand, the evaporators for concentrating the sodium carbonate need work. The insulation is poor and the system has been modified by the plant. One of the three third-stage evaporators has been changed to a second-stage unit, thus resulting in four second-stage units. The steam used in these evaporators is 13 bar. Condensate is recovered to the boiler.

5.0 Energy Conservation Opportunities:

5.1 Improve boiler operation through either better maintenance of existing controls or through the installation of new controls which can be maintained.

5.2 Examine the potential for expanding the condensate recovery system to all parts of the facility. Once this work is completed, evaluate the operation of the boiler feedwater system. Determine if some of the boiler problems are the result of poor feedwater quality.

5.3 Prepare a plant steam balance to establish plant requirements. Look at using lower pressure steam for some operations. Prepare this balance for all future cases which include both the single condensing turbine operation and the extraction back pressure turbine.

5.4 Evaluate the performance of the multiple effect evaporators. Determine if they are achieving maximum production capacity. Additional insulation will be necessary in this portion of the plant.

5.5 Perform efficiency calculations on the chiller plant. Evaluate the use of absorption chillers in place of the existing compression systems. It may be possible to operate these using low-pressure steam produced from the new back pressure turbine. This will also reduce the electric load.

SECTION 9

Location: Egyptian Company for Starch and Yeast
Date: September 3, 1985
Engineering Team: SCI - William Liegois
OEP - Dr. Hani A. Alnakeeb
Corporate Representative:
Products: Starch and Detergent

1.0 Summary: This is a very small plant with only two major steam users. While the opportunity exists for large improvements on a percent basis, the total energy saved will be very small. It is also questionable whether the current staff could maintain any new or more sophisticated equipment.

2.0 Plant Description: Only the starch plant was visited because it was the only major consumer of energy. Broker rice is first washed to remove sand, grit, and loose hulls. It is then soaked in a weak sodium hydroxide solution to soften and dissolve approximately one-half of the protein. This water is drained to the sewer after eight hours. The rice is then ground and sieved in a caustic solution. Now nozzle type washing centrifuges separate the heavy insoluable starch from the light alkali solution of protein. The protein concentration in the finished product must be less than 1%. The starch is then dewatered in one of the two batch centrifuges. It is then dried either in a flash drier or in a tubular pan drier and packed.

3.0 Overall Impression: The process is very simple and is carried out in batches. There is virtually no instrumentation and the process is operated by hand. Energy consumption is concentrated in the drying operation. All other areas use relatively small electrical motors. The staff was very pleasant and seemed interested in our visit.

4.0 System Condition and Operation: The boiler house had two fire tube packaged boilers, an Egyptian boiler with a capacity of 8 tons per hour at 10 bar and a German boiler with 10 tons per hour capacity at 15 bar. Because of permit problems, the German boiler is currently not in service. The Egyptian boiler runs in manual with the firing rate controlled by the steam pressure. Flame color is used to control the forced draft fan. The German boiler was installed in 1983 and is capable of running in automatic. Zeolite softeners are used on the boiler feed water and no condensate is returned to the boiler. The tubular pan drier is in need of major repair and is currently out of service. Both the tubular pan drier and the flash drier have exhaust gas temperatures of approximately 50°C. Both units require steam at about 150°C.

5.0 Energy Conservation Opportunities:

5.1 Install a condensate return system from the two major users, the flash drier and the tubular pan drier.

5.2 Completely rebuild the tubular pan drier, sealing all of the holes in the unit. The steam tubes should be cleaned and the entire unit insulated.

5.3 The new German boiler should be put in operation as soon as the appropriate permits are received. The Egyptian boiler can be used for standby.

SECTION 10

Location: Abu Kier Fertilizer Company
Date: September 5, 1985
Engineering Team: SCI - William Loegois
OEP - Dr. Hani A. Alnakeeb
Corporate Representative:
Products: Urea, Ammonia

1.0 Summary: This plant is in excellent condition. The operating personal are keeping a close watch on production as well as energy data. The plant is also expending money to further train its staff in energy conservation. It appears there is little opportunity for energy conservation at this plant.

2.0 Plant Description: The plant produces 1,550 tons per day of urea from 900 tons of ammonia. The ammonia plant produces 1,000 tons per day from 1.2 million m^3 of natural gas. The excess ammonia is sold as a by-product of the urea production. The ammonia plant is of German design, and the urea plant was designed in the Netherlands. Start-up was in mid-1979. The ammonia process is very standard with methane and water being combined at high temperatures and pressure to yield carbon monoxide and hydrogen. Air is mixed into the secondary retainer to provide the necessary nitrogen. Any remaining carbon monoxide is then converted to carbon dioxide with steam to make economical use of raw materials. A potassium carbonate absorption tower is used to remove the carbon dioxide from the gas stream. A stripping tower is used to recover the carbon dioxide for use in the urea plant. A methanation step removes any remaining carbon dioxide prior to ammonia synthesis. The synthesis gas of nitrogen and hydrogen is now compressed and heated to produce ammonia. The ammonia is now combined with the carbon monoxide produced earlier to yield urea. This is done in high-pressure reactors. The urea is now concentrated and dried in a prilling tower.

3.0 Overall Impression: The plant appeared to be extremely well run and maintained. All of the instruments in the control room were operational and most were in automatic. The corporate representative was very knowledgeable of the plant operation, and had been with the plant since early in the construction phase. The plant prepared steam balances regularly, and were very interested in energy efficiency as well as total plant efficiency. The plant staff is planning on attending an upcoming energy conservation program in France.

4.0 System Condition and Operation: In general, the plant was in excellent condition. Full-time maintenance staff is available for both mechanical and instrumentation needs. Routine maintenance is done continuously. This includes regular calibration of instruments. A scheduled plant maintenance shutdown occurs yearly. The plant staff is continuing to make process modifications to improve the plant's operation and capacity.

5.0 Energy Conservation Opportunities:

5.1 Conduct a survey of all heat exchangers using either steam or cooling tower water. Through a heat exchange audit program, determine if the quantity and level of heat being removed in any of the cooling water exchangers can be recovered.

5.2 Examine the amount of insulation used on the process equipment. Special attention should be given to the high temperature areas such as the primary and secondary reformers.

5.3 Check product conversion and efficiency. Determine if process or equipment modifications can increase plant capacity.

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SECTION 11

Location: Edfina Food Company
Date: September 7, 1985
Engineering Team: SCL - William Liegois
OEP - Dr. Hani A. Alnakeeb
Corporate Representative:
Products: Variety of Seasonal Fruits and Vegetables

1.0 Summary: This is a small food processing facility. Steam usage is very disorganized and inefficient. A steam balance for the facility should be prepared. Tightening up of equipment and the liberal use of insulation will also prove helpful.

2.0 Plant Description: The plant's production capacity is contained in two buildings, A and B. Both plants have several operating lines, any of which can be operated independently of the others. Building A has several special items, three evaporators, two chillers, and hot water heating equipment. Both plants have steam sterilizers; they are of several different designs. There are several moving bed design units for sterilizing cans. Plant B has six autoclaves.

The units are supplied with steam from two 12-ton-per-hour boilers. Both units are needed during the peak season (May - September), while one unit is kept as a standby the rest of the year. The boilers burn 4,000 tons per year of No. 6 fuel oil.

The plant also has a can manufacturing facility. Both soldered and electrically welded cans are produced. All necessary parts are manufactured from sheet stock. A printing press line is also present.

3.0 Overall Impression: The plant engineer and staff have worked very hard to improve the plant's energy consumption. Their primary efforts to date have been in the electrical area. By improving the plant's power factor from 0.7 to 0.9, they have reduced the plant's electrical bill by 35%. They are interested in help on steam conservation. They were not interested in an energy audit at the can manufacturing facility.

4.0 System Condition and Operation: All of the plant's systems were operational. Both boilers were Egyptian made and of fire tube design. Purchase of a new boiler to replace the older of the existing two units is being considered. The current steam header pressure is 9-10 bar at the boiler house area.

Steam lines have been run on an as-needed basis throughout the plant. This has resulted in a large number of steam branches from the main system as equipment has been modified and relocated. The steam line sizes need to be checked against current needs and projected future requirements. Steam line insulation is poor or nonexistent. Condensate is only returned from the evaporators. Other condensate is run to the floor drains. In many areas, steam is directly sparged onto the cans for sterilization.

Little of the process equipment is insulated. In many areas, steam is escaping from either piping leaks or leaks from poor sealing of process equipment.

The plant would greatly benefit from an integrated energy program. Up to now, if heat were needed, a steam line was run to the area. Chillers and cooling towers were installed for cooling. No effort has been made to coordinate these two needs for heating and cooling.

5.0 Energy Conservation Opportunities:

5.1 Perform a system steam balance to determine the amount and level of steam (pressure) required in the different plant areas. Check line sizes and routing to eliminate unnecessary pressure losses due to piping.

5.2 Look at the processing operation. Determine if lower level energy source can be substituted for steam (using warm water for some operations which previously used steam).

5.3 Determine how many steam users really require 10 bar steam. Explore the use of a low-pressure steam header (1-2 bar) for as many users as possible. Investigate the use of a small back pressure turbine for generating low-pressure steam from high-pressure steam. This may require increasing the high-pressure steam header to 15 bar or so.

5.4 Extend the audit to the can manufacturing facility. Natural gas is consumed in several process areas, and combustion efficiency appears low.

5.5 Prepare an audit of actual operating hours. Improving system output without increasing energy requirements is quite feasible for this facility.

5.6 Look at storage of low-energy heat for other systems, for example, install a large water storage tank. The water in this tank could be heated by low-level heat rejection systems and saved for future use in say a warm water washing operation. This type of a surge tank can be used to recover heat from different processing lines which may even operate several hours apart.

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March 7, 1986

Mr. Marshall Monarch
Argon National Laboratories
Building 362
9700 South Cass Avenue
Argon, IL 60439

Dear Marshall,

I enclose the documents on the Egypt Screening Report for your internal use only. As I mentioned on the telephone, I would appreciate your treating these documents as confidential since they represent the product of 10 days of "free" consulting in Egypt.

Sincerely,

/afm

enc.

INDUSTRIAL ENERGY AUDITING IN EGYPT

SCREENING REPORT

FOR

PREPARATION OF OEP's TASK ORDER Nr. 2

Prepared By:

HAGLER, BAILLY & COMPANY
WASHINGTON DC U.S.A.

ARTHUR D. LITTLE Inc.
CAMBRIDGE, MA, U.S.A.

Prepared For:

THE ORGANIZATION FOR ENERGY PLANNING (OEP)
CAIRO, EGYPT.

September 10, 1985.

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INDUSTRIAL ENERGY AUDITING IN EGYPT

This report addresses the three issues raised by OEP during the introductory meeting held on 9/1/1985:

- ranking of the eleven candidate plants
- elimination of those not deserving an audit under their present conditions
- management attitudes toward energy conservation.

To address these issues, we carried out the following steps:

1. Visit of plant sites and preliminary analysis of the collected data in close cooperation with OEP staff. These visits provided us with some insights into the attitudes of the technical managers met in the plants regarding practices affecting energy utilization. The results of this step are summarized briefly for each plant and are attached to this report as appendices.*

2. Rough estimation of the potential energy savings at each plants. These estimates were based primarily on a comparison of estimated specific energy consumption at each plant to " international standards" (in ton of oil equivalent / ton of product). The relative difference in specific energy consumption provided a measure of the "technical potential" for energy savings. Using our observations during the plant visits of the energy efficiency of major equipment coupled with our experience gained in other countries for similar plants and using international oil prices, we estimated roughly the "economic potential", i.e. those savings which are likely to be achieved by implementing projects with pay back of three years or less. Similarly, we estimated the saving practices achievable from implementing low cost/ no cost conservation measures. The results are presented in Table 2.

3. Assessment of the likelihood of capturing the economic potential. We selected four key criteria to assess this likelihood:

   - technical feasibility
   - replicability
   - suitability for training
   - management support

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* These plant visits revealed that a number of generic low-cost energy conservation measures were applicable to most plants (See Table 1).

Based on judgement, we assigned a score on a scale from 1 to 3 to each criteria for each plant. The sum of the four scores for each plant provided a relative measure of the likelihood of capturing the economic potential. This measure was expressed in high/medium / low categories (See Table 3). Note that comments on management attitudes at each plant are given in the attachments.

4. Composite Screening. By comparing the economic potential at each plant (result of step 2) to the likelihood of capturing this potential (result of step 3), we identified three energy audit categories:

   - category A : top candidate plants
   - category B : good candidate plants
   - category C : plants not needing an energy audit at this stage.

5. Plant Grouping. In view of the approximate and preliminary nature of the data collected in these one-day plant visits, we found little basis for ranking the plants within each category. Instead, a grouping of the plants within each category appeared reasonable because of:

   - similarities in the products / processes of some of the plants
   - dissimilarities in the size and complexity of the plants.

   This grouping provide a basis for our implementation strategy (See Table 5).

In conclusion, we found that nine out of the eleven plants deserve an energy audit and are likely to yield substantial energy savings.

Table 1. Need for Low - Cost Energy Conservation Measures: A Generic Problem in Egypt.

Plant	Thermal			Electrical		Others			
	Improve Boiler (or furnace) efficiency	Improve steam distribution and Utilization	Insulates pipes and tanks	Improve load Management	Increase power factor	Instrumentation	Preventive Maintenance	Training	Data Logging
CAIRO									
Oil & Soap Co.	H	H	M	M	H	H	H	H	H
Helwan Cement	L	L		M	M	L		L	L
Abu Zabal Fertilizer	L	L	L		L	L	L	L	L
El Nasr Coke	M					H		M	M
El Nasr Pharma Chem. Co.	H	H	H	H	H	H	H	H	H
Kaha Food	H	H	H	M	H	H	M	H	H
Alex									
Abu Kir Fertilizer	L			L	M				
Refinery	L(H)					M			
Misr Chem.	H	L	H		M	H	H	H	H
Starch & Yeast	H	H	H			M	H	H	M
Edfina	M	H	H			M	H	M	M

Key: H = High Need M = Medium L = Low

TABLE 2. PRELIMINARY ESTIMATE OF POTENTIAL ENERGY SAVINGS BY PLANT

(Based On 1983/84 Data and Plant Visits)

Plant Name	Annual Energy Cons. Fuel (TOE)	Elec (KWH)[1]	Tot TOE[1]	Production	Specific Energy Cons[2] Fuel/ Unit toe/ton	Elec/ Unit kwh/ton	Toe/ Unit ton/hour	Savings Technical[3] (%)	Economic[4] %	Toe/year
A. CAIRO										
1. Helwan Cement	211,200	189,6	258,600	1,525 10^3t	.138(.070)	124.(110)	.170.(.097)	43	20-30(10)	50,000-75,000[5]
2. Abu Zabal Fert.	0(5)	0(see)	Not sign	220,000 t est	0(0)	0 (0)	0 (0)			
3. El Nasr Coke	53,750	160	68,750	44,000 t(NH_3)	1.22(.70)	1,360.(45)	1,56(.715)	54	40-50(10)	20,000-35000
4. El Nasr Pharm.	8,400est	8est	10,400est	Not Sign.	N/A	N/A	N/A	50	20-40(15)	2,000-4,000
5. Kaha Food	4,500	2.3±	5,100	20,000t (?)	.225(.16)	115(100)	.254(.125)	50	25-35(10)	1,000-2,000
6. Dil & Soap Co.	2,475	9.7	4.900	12,000t (oil)	.206(.114)	800(800)	.406(.314)	23	15-20(10)	800-1,300
B. ALEXANDRIA										
7. Refinery	172,000	.97	196,000	4.910^{6}t	.035(.030)	20(15)	.39(.032)	20	15-15(5)	10,000-30,000
8. Abu Kir Fert.	198,000	(8.7)	198,000	277.000 t(NH_3)						
9. Misr Chemicals	66,000	99	91,000	Not sign.	N/A	N/A	N/A	20-30	10-20(10)	9,000-18,000
10. E. Starch & Yeast	8,000	19.4	12,890	38,000t (4prod)	0.21(.13)	510(N/A)	.24(.2)	40	25-35(15)	3,200- 4,500
11. Edfina Food	3,400	6.4	5,000	N/A	N/A (.11)	145(115)	N/A	40	25-35(10)	1,300- 1,800

Source: Ragler Bailly & Co & A. D. Little Inc. September 1985

1. 1 GWH = 250 TOE
2. A (B), with A = estimated SEC at plant, and B = international standard
3. Defined as difference between A and B above % A.
4. Rough estimate using world energy prices, site analysis and experience gained in other countries and similar plants. Number in ( ) indicates fractor achievable from low cost / no cost measures and projects.
5. With major plant rehabilitation
6. With brand new line of production from natural gas.

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TABLE 3. LIKELIHOOD OF CAPTURING THE POTENTIAL ENERGY SAVINGS

Criterian Plant name	A Technical Feasibility (1 to 3)	B Replicability of Audit (1 to 3)	C Suitability For Training (1 to 3)	D Management Attitude (1 to 3)	TOTAL Score (Max = 12)	Ranking
CAIRO						
Helwan Cement	1	1	2	2	6	Medium / Low
Abu Zabal Fertilizer	1	1	1	3	6	Medium / Low
El Nasr Coke	1	1	1	2	5	Low
El Nasr Pharmaceuticals	3	3	3	1	10	High
Kaha Food	2	3	3	2	10	High
Oil & Soap Co.	3	3	3	2	11	Very high
ALEXANDRIA						
Refinery	2	2	2	2	8	Medium
Abu Kir Fertilizer	1	1	1	2	5	Low
Misr Chemicals	2	1	2	2	7	Medium
Egypt Starch & Yeast	3	3	2	3	11	Very High
Edfina Food	3	3	[illegible]	2	11	Very High

Key : A: Technical feasibility = Technical easiness to achieve saving potential - A measure of foreign technical assistance needed.
Score: 3 means little / limited foreign assistance required.

B: Replicability depends on type of projects identified and number of possible applications in Egypt.

C: Suitability for training diversity of opportunities, technical contents and losses environment means high score.

D: Management attitude : Good support provides high score.

TABLE 4. COMPOSITE SCREENING

Plant Name	Potential Savings (TOE)	Likelihood of Capturing potential	Audit (1) Category	
A: CAIRO				
Helwan Cement	50,000-75,000	Medium	A	
Abu Zaabal	Insignificant	Low	C	Eliminated
El Nasr Coke	30,000-35,000	Medium Low	B	
El Nasr Pharm.	2,000-4,000	High	B	
Kaha Food	1,000-2,000	High	B	
Oil & Soap	800-1,300	Very High	B	
B: ALEXANDRIA				
Refinery	10,000-30,000	High	A	
Abu Kir	Insignificant	Low	C	Eliminated
Misr Chemical	9,000-13,000	Medium	B	
Egypt Starch & Yeast	3,000-4,500	Very High	B	
Edfina	1,000-2,000	High	B	

Key
A = Top candidates
B = Good candidates
C = Not candidates

TABLE 5: A Strategy for Implementation - Grouping the Plants

GROUP	PLANTS	Approximate possible cumulative Savings (TOE)/year (rounded)	Comments
1.	Helwan Cement El Nasr Coke	30,000-110,000	Similar process (high temp. Transformation of mineral raw materials, size and type of work to be performed in energy audit and engineering.
2.	El Nasr Pharmaceuticals Kaha Food Co. Cairo Oil & Soap Co. Egypt Starch & Yeast Edfina Food.	8,000-14,000	Individually, these plants are relatively small energy users, but collectively, they constitute an homogeneous group of plants from the stand points of product, process, size and energy utilization
OTHER	Alexandria refinery	20,000-30,000	Can be studied independently
	Misr Chemicals	9,000-18,000	