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ENERGY SAVING IN FERTILIZER PLANTS TA/86/14

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SUMMARY AND CONCLUSIONS

The objectives of this work are to show how SAPEC managed to reduce energy at its Setubal Complex, mainly relating to oil and steam utilisation in ammonium phosphate and sulphate plants, by means of no cost or relatively low cost measures.

Intending improvements and integration in phosphoric, granulation and sulphuric acid plants will be referred. The sulphuric acid plant has also been liable to a study in progress about the use of heat from pyrites roast-ting producing steam or electricity.

Both SAPEC Saving Energy Team instituted in 1983 and FEC - Fuel and Energy Consultants, an English company supported by LUSOTECNA when working in Portugal on the SAPEC assignment, in 1984, have performed this work.

In the field of alternative energy, boilers and the problem owing to their centralization at the Complex will be given particular attention.

Finally, we shall refer savings achieved in 1984 and 1985, including electrical energy that is '84' costs ECU .36 x 10^6 (Esc. 55 x 10^6) representing about 10 % of the real account that SAPEC has payed to EDP - Energia de Portugal and to GALP - Petrõleos de Portugal, in 1983 and 1984, for fuel and electrical energy consumptions, that is ECU 3.6 x 10^6 representing about 95/96 % of the total account of energy.

These savings are indicated in the table of the Appendix no. 1.

The way in proceeding with the work, difficulties where was the case, just as today's policy and foresights will be also referred.

SAPEC DECISION TO CARRY ON THE ENERGY SAVING PROGRAMME AND THE MANAGEMENT SYSTEM. ORGANIZATION CHART.

Last year, in Paris, at the time of the IFA Congress, we presented a work entitled "Engrais Compactés" telling SAPEC is a Belgium company devoted to several activities in Portugal and abroad, as follows :

- mining (pyrites)
- metallurgy (hard metals)
- fertilizers
- pesticides
- feeds

We emphasized how SAPEC has been fiting in both international market and Portuguese market, the dimension of which is relatively poor (about 900 000 tonnes per annum).

At the Setubal Complex (45 km southwards Lisbon) SAPEC owns the following plants:

GENERAL DATA ON SAPEC PLANTS

PLANTS	PROCESS	NOMINAL CAPACITY (t/y)
Boiler plant (2 boilers)	Babcock & Willcock	120 000 7 kg/cm2 sat.
Sulphuric acid (2)	Lead chambers Kachkaroff	50 000 40 000
Phosphoric acid (2)	Prayon	20 000 t P_2O_5
Ammonium sulphate and phosphate	Kestner evaporators	65 000 (AS) 35 000 (DAP)
Phosphate grinding	Poittmill	330 000
Single or triple superphosphate	Kuhlman	200 000 SSP or 150 000 TSP
Granular Complex fertilizers : nº I nº II nº IV	 TVA type with drum granulator TVA type Compacting NPK granulating plant	 60 000 120 000 60 000
Feeds plant (granulated and powder)	Russelle (pre-grinding)	230 000
Pesticides and sulphur plants	Sulphur Pesticides liquids Pesticides powder	20 000 4 500 9 000

These plants are the aim of the present study which regards energy conservation, saving and management.

Deciding to carry on the management system.

As is well-known, in the field of consumptions and energy savings there are established rules and methods, since followed and correctly used in industrial plants or other consumers, promote savings evaluated from 5 to 20 % general limits. This became particularly interesting to SAPEC which never had carried out such studies before.

The several reasons that induced SAPEC to head for this work are in common with other companies. So :

- Reduce the energetic account and therefore maximize benefits reducing the needless expenses.
- Energetic high costs, even Portuguese consumptions are 20/25 MWh per capita.
- The knowledge of energetic audits and works on energy saving and management carried out to Europe.
- Several companies specialized in this field got in touch with SAPEC.
- The Portuguese government emphasized in limiting consumptions in fertilizers plants.
- It has not been forgotten that "study after study reaches the same conclusion : the cleanest, least expensive and least vulnerable energy option today is to use less by being more efficient".

. Competitivy and the quality of life, which are directly connected with energy savings.

. The duty in saving energy seeing that "once a barrel of oil is burned it is gone for ever".

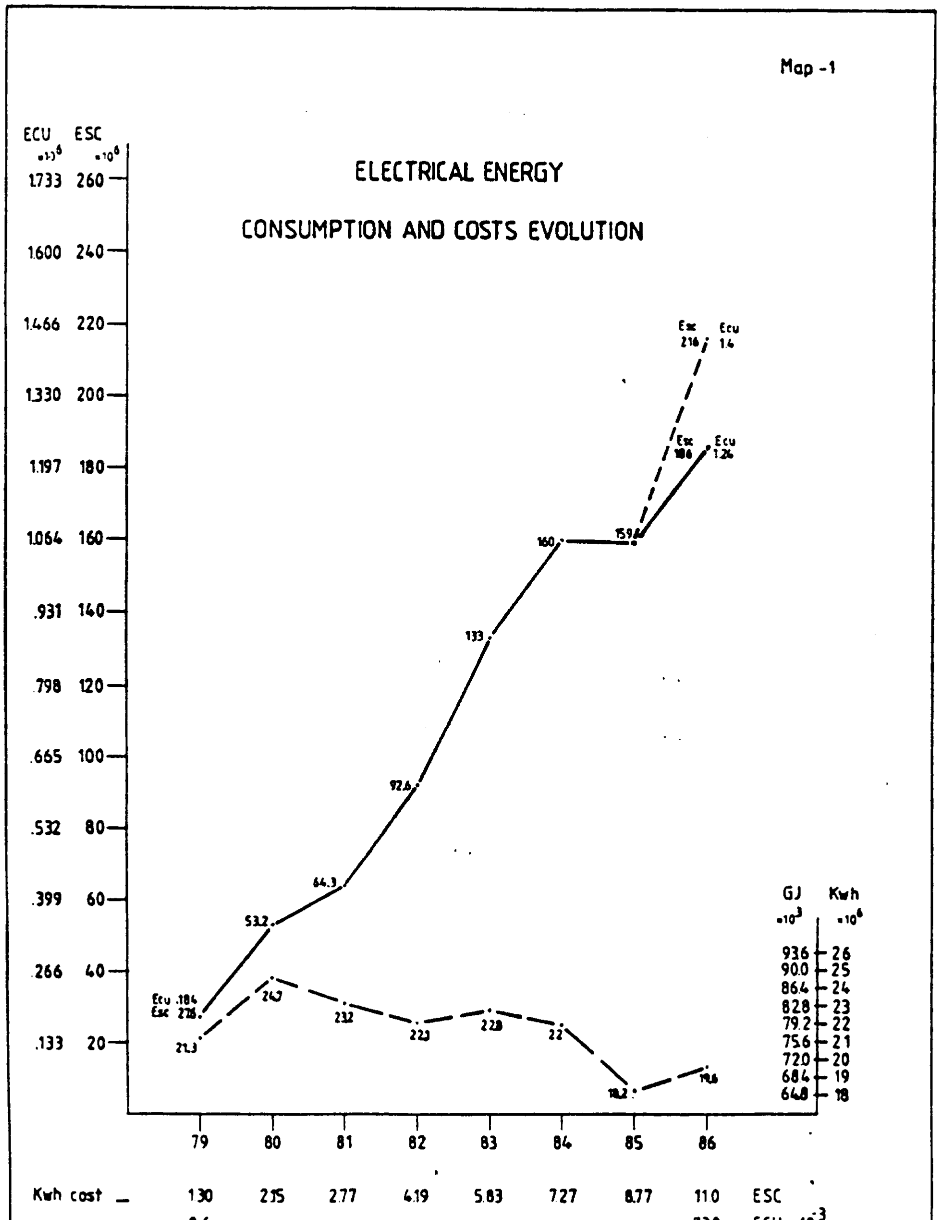
Therefore, it would not be possible to quit following a way which promoted :

- an effective energy saving
- identify potential savings
- actuations

We shall refer, seeing the increasing costs of the crude, the total account of electrical power consumed by SAPEC was in 1979 ECU .184 x 10^6 and in 1984 ECU 1.07 x 10^6 per year.

Refer to map no. 1.

The evolution of the thick-fuel oil cost was similar.



Seeing the general causes of the crude rise and its consequences, the industrialized world responds in saving and identifying alternative sources. The approximate historical data which have indicated typical stages in crude life are the following :

1973/1974	Arab oil embargo : OPEC quadrupled the crude-oil costs. Instead of \$ US 3 a barrel the price suddenly rise to \$ US 12.
1979	Iranian revolution.
1980	War between Iran and Irac : Base cost of crude = US 32.
1981	Conservative estimates projected a price of \$ US 80 a barrel even if peace was restored to the Persian Gulf.

This way, SAPEC has promoted in 1982/1983 an Energy Saving Commitee (CCE) able to resort if necessary to another companies or services specialized in this field.

It is to be noted we decided to resort to another companies because exterior elements often prevail in persuading, asking support and quickly carrying out works.

Map no. 2 presents the organization chart of CCE team supported by the Managing directors as follows :

. 2 Managing directors in the presence of whom the team was responsible even working under the responsability of the Director of the Complex

. 1 Director of the Complex

. 1 co-ordinating manager of the team and the actuations

. 1 co-ordinating manager assistant of the team at full-time work

. 4 representative of the different areas and utilities of the Company who had the say in the management and production of :
- fertilizers
- feeds
- pesticides
- energy and fluids.

WORK SYSTEM. IN-PLANT STUDIES AND AUDITS

The principles to which obeys such study are well-known. We will start in referring the main areas involved.

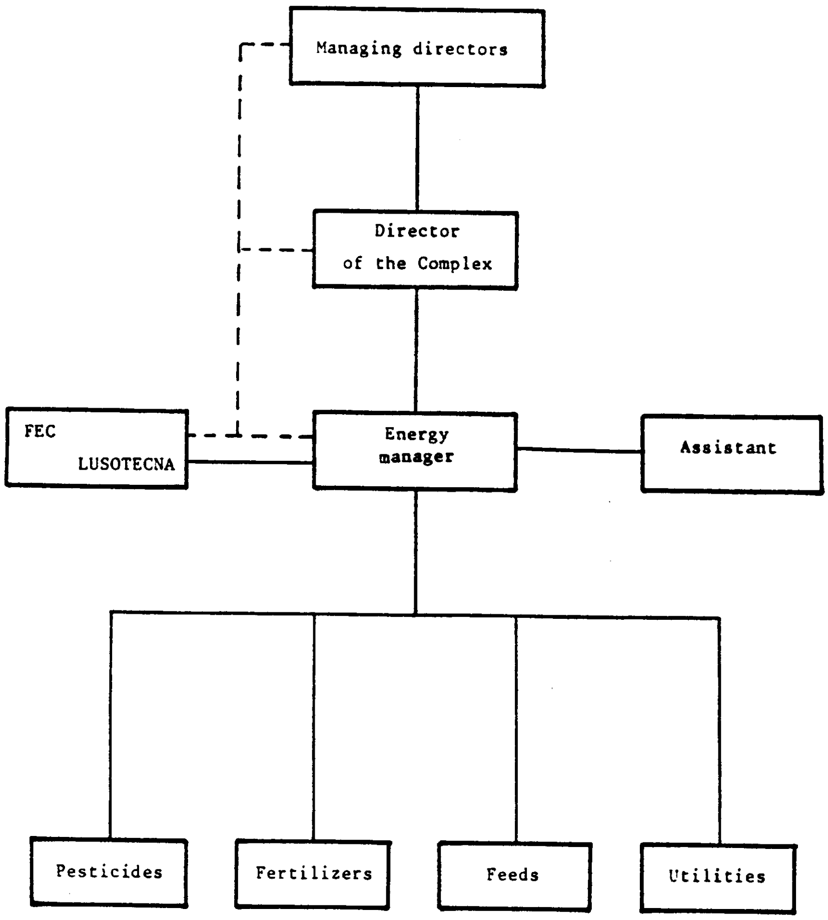
A management system focuses :

(1)
. power factor correction
. the power control related to empty and fully hours
. energetic stocks control; minimum safety values
. all kinds of energy and raw-materials handling

(2)
. the rationalized utilization without losses in existing plants
. new equipments and units
. climatisation
. insulations
. process optimization

MAP 2

ORGANIZATION CHART



(Production managers)

. utilities
. dryers and furnaces

(3) . handling of intermediate and finished products
. environment and effluents
. expeditions
. final stocks

The start-up of an analysis system including audits, critical evaluations, measures, targeting and monitoring does not consist of an individual working. It involves the existing organized and organizer team, noy only supported by other elements of several departments of the Company, as the Financial Department, but followed by Managing directors, workers and services, including the maintenance.

This involved recommendations which had to be listed more than 6 months before FEC/LUSOTECNA co-operation and promoted the evaluation of :

- no cost measures
- low cost measures
- high cost measures.

Current expenditure in energy reduction was expected to be 5 %, but we managed to get a higher value, although housekeeping measures are the most effective quick payback measures.

Indeed we based ourselfs in the following critical recommendations :

. evaluate the use of all kinds of energy

. evaluate critical capacities in the units

. Check if all pressure and temperatures variations are often detected.

. Identify heat losses areas.

. Re-use economically this heat.

. See that cost savings do not result in doubles or increase costs in another area.

. To make possible the use of alternative sources.

. Motivate all the workers to modify or optimize energetic consumptions.

. Promote environment efforts.

. See to the maintenance.

. Keep up all sintetized areas.

. Identify, in a first stage, the most relevant items.

. Perform energetic audits.

To carry out the Energy Management Project the CCE team resorted to both specialized FEC and LUSOTECNA which already made another works on energy savings in Portugal.

One year before FEC/LUSOTECNA co-operation, SAPEC was dealing with two projects :

. Energy Management Project

. Acid Sulphuric Plants Reconversion Project including heat recovery from pyrite roasting gases and steam production. This Project which was to be studied by another team will be referred again.

To start energy management before our co-operators were arrived we had to consider :

. historical data (1981, 1982 and 1983) covering
  - units productions and specific consumptions
  - steam productions and all energetic consumptions
  - costs
. mass and energetic balances
. stacks losses, after purchasing the appropriate equipment for isocinetic samples of particulate matter in stacks gases and evaluating other compounds as the chemical gases composition.
. utilities lines and electrical panels, to identify consumers, how, when and why are they consuming on crediting them with their consumptions
. steam, oil and raw-materials meters purchase
. a brain-storm to get the staff to give informations

Owing to this, we carried out measures which answered to an immediately saving of ECU 100 000 (Esc. 15 x 10^6) per year as follows :

	contos (Esc. 10^3)	ECU
. Contractual power	1 300	8 700
. Monthly tax power	300	2 000
. Oil tanks insulation	1 200	8 000
. Phosphate grinding	700	4 700
. Steam piping insulation	2 000	13 300
. Re-use of the available heat in the ammonium sulphate plant	10 000	67 000
	15 500	104 000

Refer to Appendix no. 2.

The cost of this Project including FEC and LUSOTECNA remuneration just as some metering was :

ECU .1 x 10^6 (Esc. 15 x 10^6)

When including all the raw-materials and utilities meters (steam, electrical energy, salt and well water, oil, phosphoric acid, etc.) it would be :

ECU 0.19 x 10^6 (Esc. 28 x 10^6)

This way, the recommendations considered before we have worked together with FEC/LUSOTECNA would pay the Project.

It is to be noted that :

AN ENERGY CONSERVATION PROGRAMME MOBILIZES ALMOST ALL THE DEPARTMENTS OF THE COMPANY

THAT MEANS A DIFFICULT TASK DEMANDING TENACITY AND A CONTINOUS WORKING IN WATCH.

BEING A TASK OF A GROUP, NOT OF A PERSON, IT NEVER BRINGS VAINGLORY.

We always had monthly meetings with our Managing directors and the five elements of the CCE team always met weekly.

AMMONIUM SULPHATE AND PHOSPHATE UTILITIES AND BOILER PLANT. PRACTICAL ACHIEVEMENTS.

Achieved energy savings in nitrogen and boiler plants agree with quick payback measures.

When considering a production of 33 000 tonnes per year ('84' budget), the optimization of the use of steam would promote a potential saving about ECU .26 x 10^6 (40 000 contos) utilising 4 re-heaters with steam exported from the ammonium sulphate plant.

Refer to flow-sheet no. 4.

The map no. 3 indicates the available steam in the ammonium sulphate plant using 98 % sulphuric acid.

MAP 3

NITROGEN FERTILIZER PLANTS
PRODUCTION AND CONSUMPTION OF STEAM

	AMMONIUM PHOSPHATE	AMMONIUM SULPHATE	BOILERS STEAM
Production (tpy)	33 000	37 000	-
Days of work Production (tpd)	300 110	185 200	-
Available heat	-	6.7	-
Production (tph/2 saturators)	4.6	8.3	-
Necessary heat (Kcal/h)	2 000 000	-	-
Available heat (Kcal)	-	3 600 000	-
Available heat (GJ/h)	-	15	-

This way, the heat needed in the ammonium phosphate plant, comparising with the ammonium sulphate plant available heat the value of which is almost double, would be enough to made ammonium phosphate plant re-heaters work.

Also, steam piping are not insulated producing heat losses and a lesser utilisation of the available heat.

Several correlations were carried out from regression analysis with a microcomputer. In maps nos. 5 and 6 is shown the monthly DAP plant production, just as the oil consumption in boiler plants, in 1982 and 1983. The '82' line is the most representative (R squared = .92).

This regression quickly proved how the oil consumption level was answering to the DAP production since other consumers are constant and lesser.

The variable oil consumption was about 60 to 70 kg of oil per tonne DAP, what is the m in the following equation :

$$y = .07x + 121$$

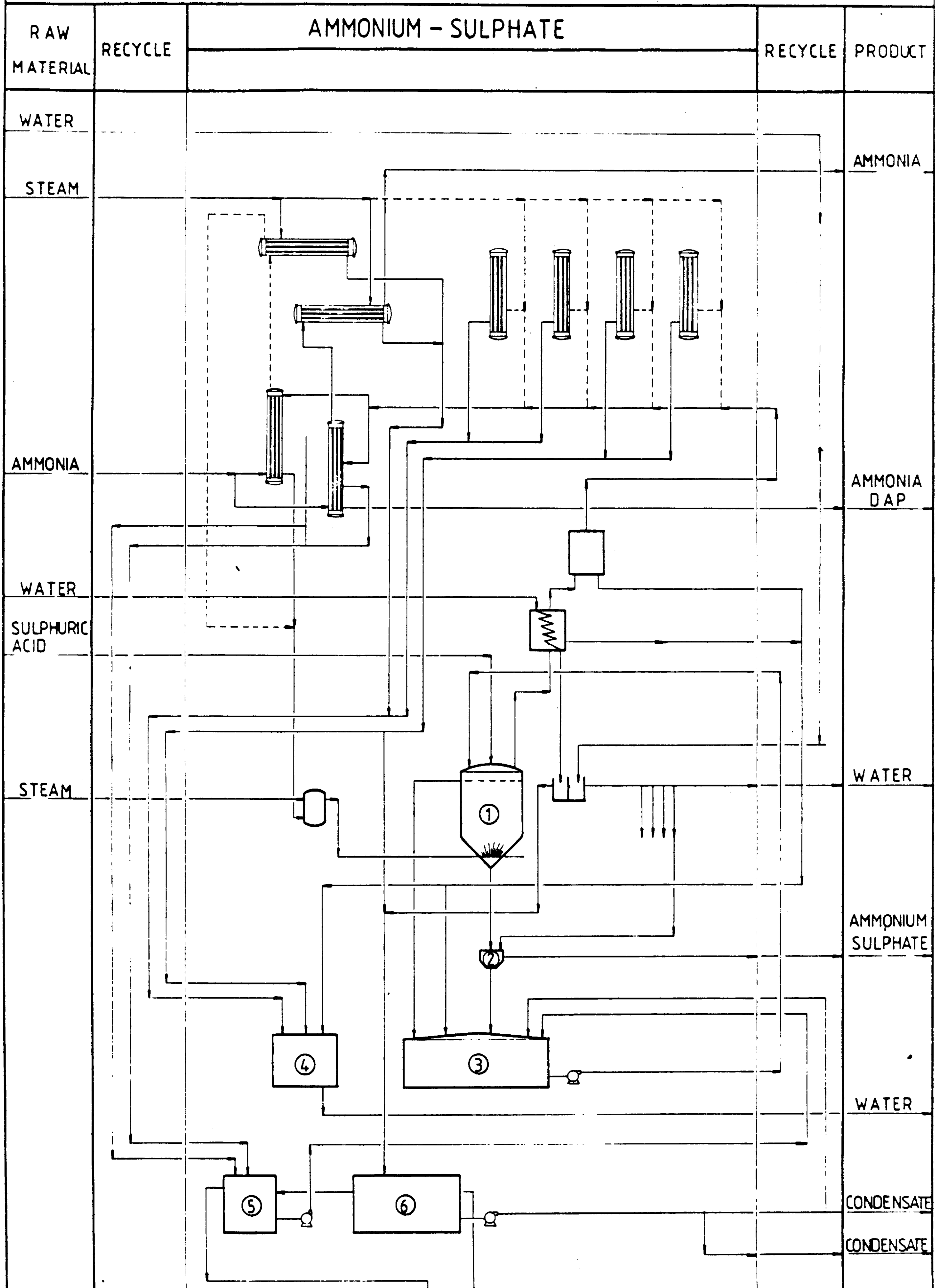
As soon as DAP output commences, the additional oil is consumed and the slope of the line deriving from the correlation represents the additional oil input to the boiler to produce the extra steam required by the DAP process.

To making the conversion from fuel to steam we used the number obtained from a 3 week test period to convert it to a variable steam required :

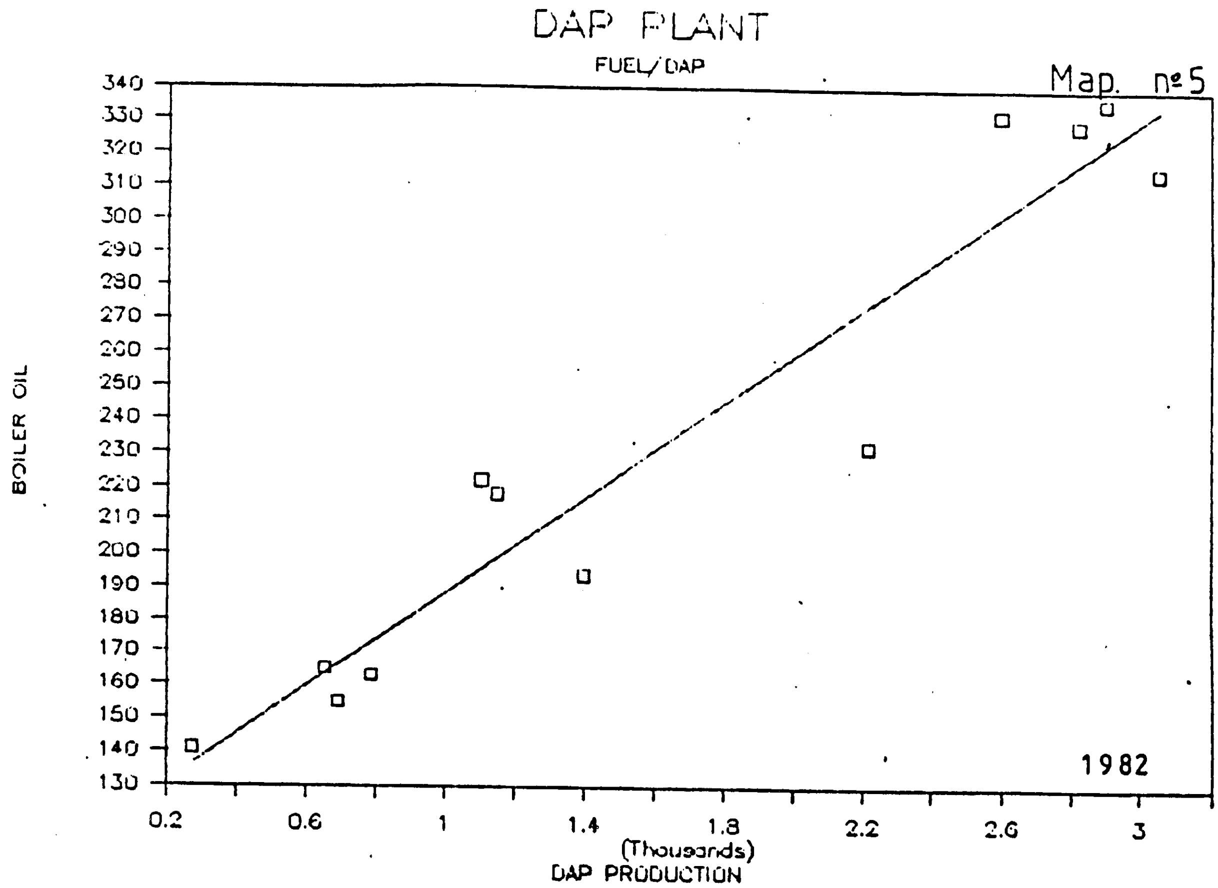
12.8 kg steam/kg fuel

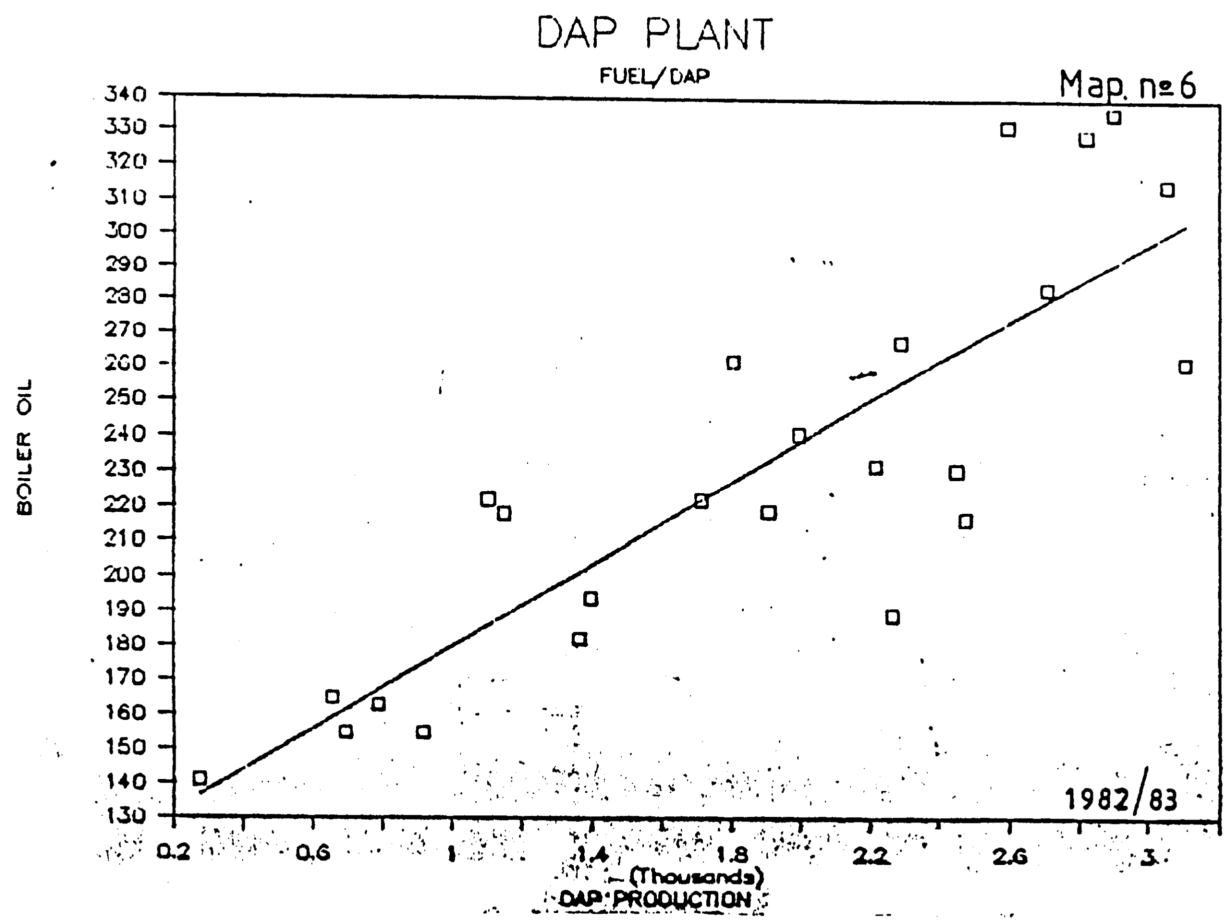
So, we obtained the number of 770 kg steam per tonne DAP which approaches the energetic balances in the DAP plant.

FLOW-SHEET 14 - 9



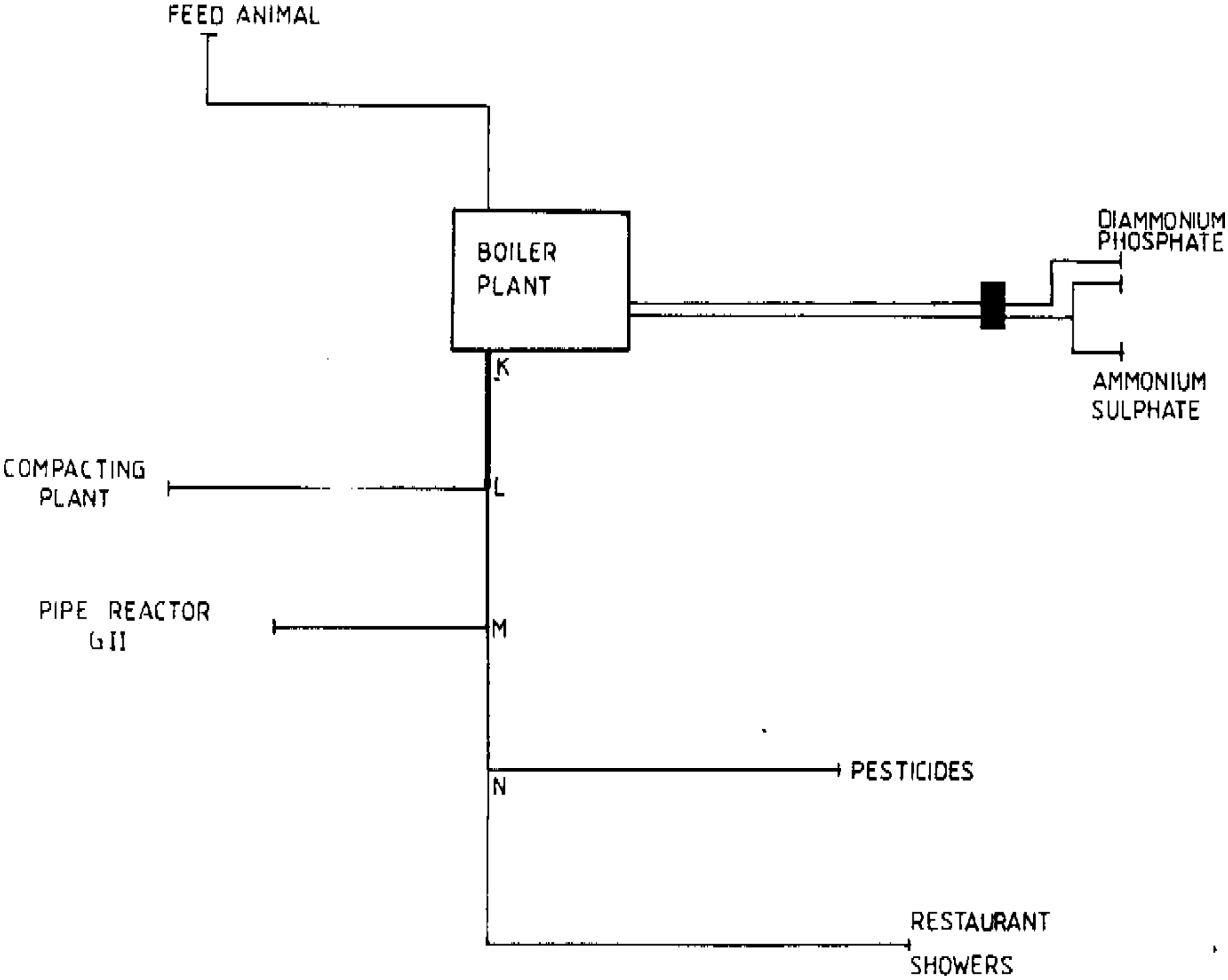
① - SATURATOR
② - CENTRIFUGE
④ - CONDENSATES


DAP PLANT
FUEL/DAP
Map. nº5
BOILER OIL
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
0.2
0.6
1
1.4
1.8
2.2
2.6
3
(Thousands)
DAP PRODUCTION
1982


DAP PLANT
FUEL/DAP
Map. nº6
BOILER OIL
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
0.2
0.6
1
1.4
1.8
2.2
2.6
3
(Thousands)
DAP PRODUCTION
1982/83

Map - 7

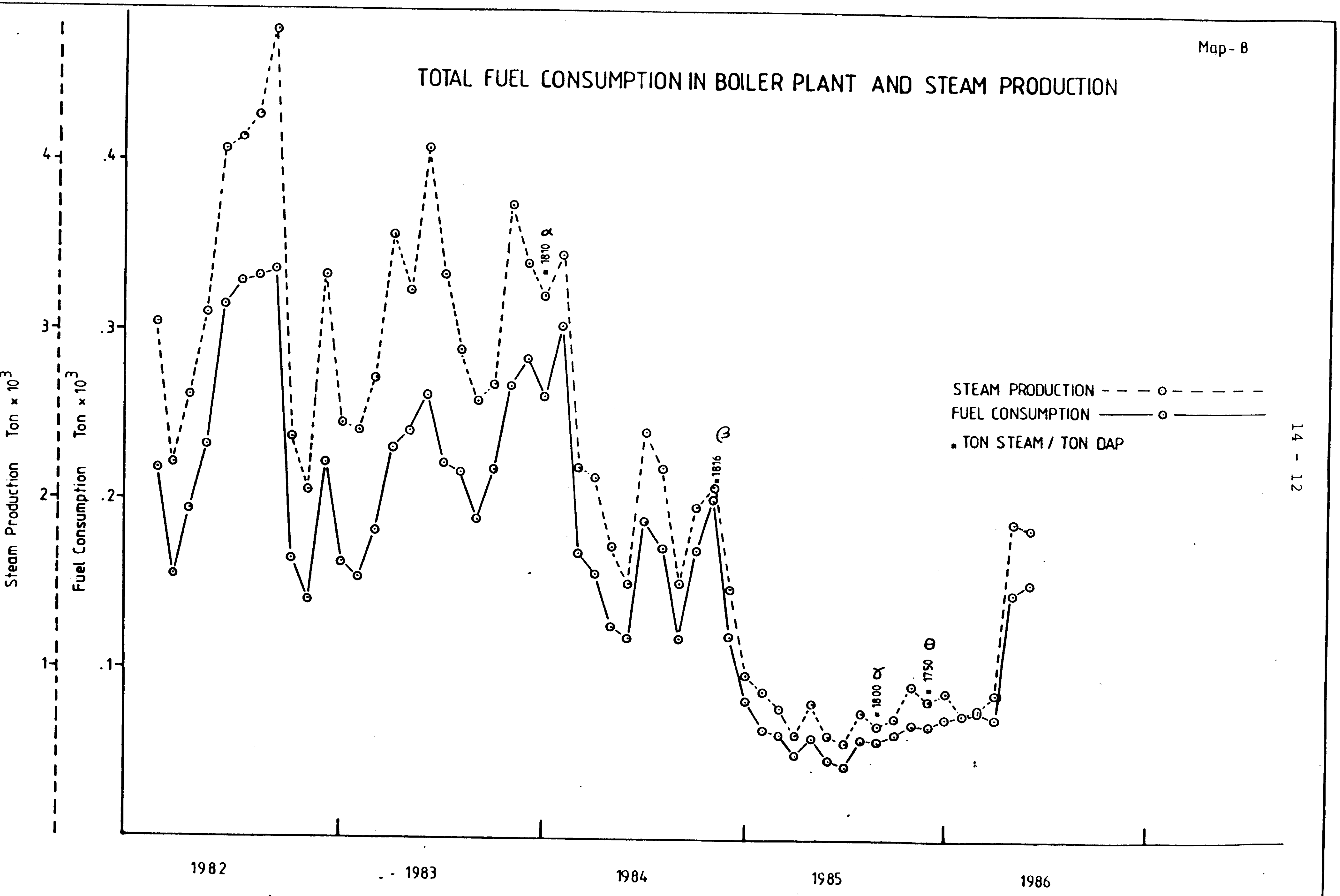
STEAM DISTRIBUTION LINES



KL;LM;MN - COMMON LINES TO P, GII, GIV, RESTAURANT AND SHOWERS

Map- 8

TOTAL FUEL CONSUMPTION IN BOILER PLANT AND STEAM PRODUCTION



Adding fixed losses in the boiler plant and steam distribution lines as also inside the plant, we obtained the total steam requirement of 875 what remotes the 1 300 kg steam per tonne DAP allocated budget, before 1983, which became 800 in 1985 by decision of the Production Department.

This way, the main measures were as follows :

. Maximize the utilisation of the process steam from AS plant in DAP plant.

. Check the balance each year to decide if any modification is required in order to meet the maximum required of 200 kg steam/ tonne DAP.

. Insulate the plant as fully as possible if the AS production is lower and plan a steam make-up system.

. Control salt and fresh water.

. Isolate the 150 mm and use only the 100 mm lines.

. Stop with ammonia superheating.

. Isolate the distribution lines within the unit which supplies the AS plant except if necessary for start up. Use steam via a small duties in the AS plant.

. Switch-off motors when circulation systems are not required.

. Fix balances sheets.

Also, the Production Department decided to buy phosphoric acid meters and CCE/FEC/LUSOTECNA insisted in buying new steam meters and in rectifying the existing ones.

Management, meters and results in AS, DAP and boilers plants.

To isolate lines in plants which are not on working may be considered a typical case of energy management including training.

Refer to map no. 7.

Steam meters are essential to carry out an energy management system. Therefore, existing steam meters which were of use to perform steam reductions had been displaced and we bought two others with lesser capacity.

We shall say :

WHENEVER CARRYING OUT A SYSTEM IN AN ENERGETIC FIELD THERE IS TO BE A HUMAN RESPONSE, MINIMIZING COSTS AND CONSUMPTIONS, WHAT TURNS IN A LARGER ENTROPY PENDING A NEW STABILIZATION.

Map no. 8, points α, β, γ, and θ , shows that in spite of decreasing productions in oil consuming plants, the same DAP plant productions have answered to different oil and steam consumptions which always decreased.

It is to be noted, in 1986, the DAP plant promoted increasing steam and oil consumptions on working with more alive steam.

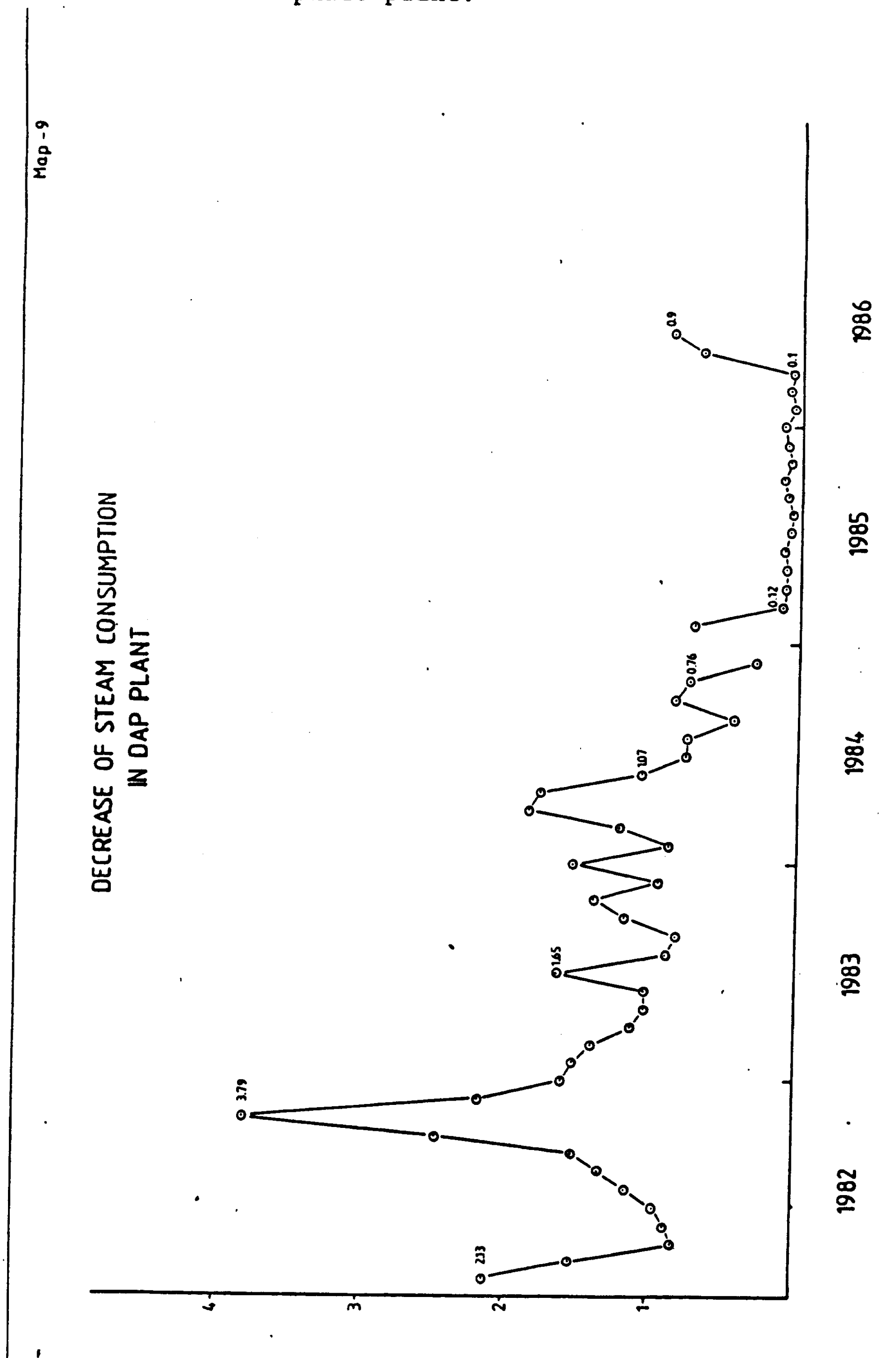
Map no. 9 presents the decreasing steam consumptions in the DAP plant.

In terms of energy reductions this was one of the main results in the nitrogen fertilizer plants. But more than that, as for the boiler plant, instead of 6 and 10 tph boilers, only the 6 tph boiler began to work

Steam boilers production.

1981	48 000	tonnes
1982	38 500	"
1983	38 000	"
1984	24 000	"
1985	23 000	"

The 6 tph boiler will be sufficient to the Complex, even if plants as the DAP plant are working at full capacity and without the steam exported from the ammonium sulphate plant.



The result of a multi-regression analysis system accounting for the steam and fertilizers production decrease will be referred during the Conference.

Other utilities and steam; fuel in NPK plants.

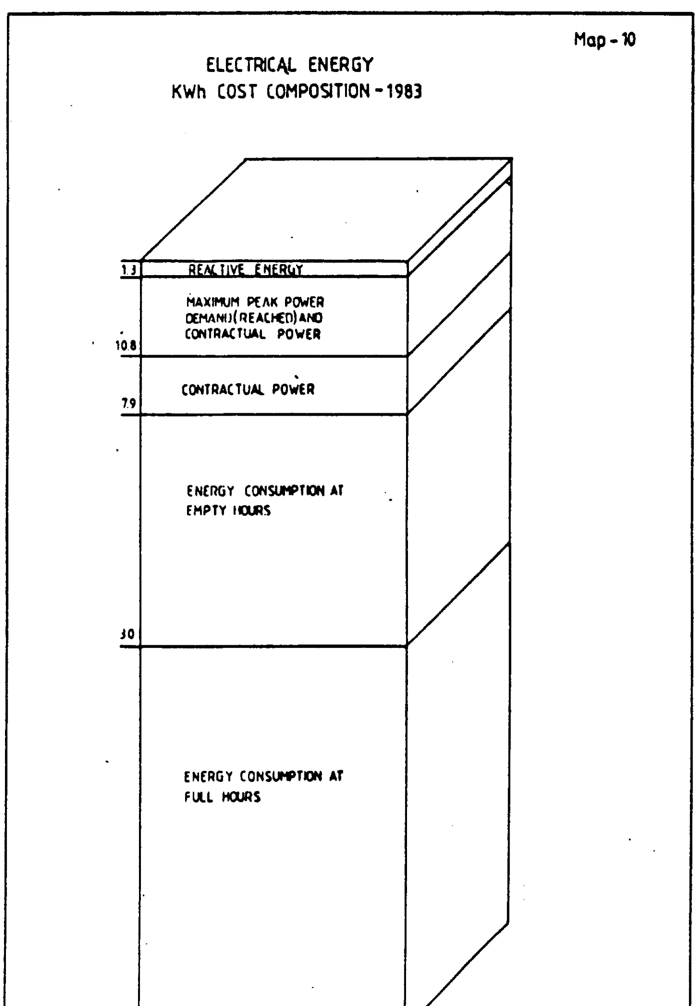
To examine the kWh compound cost we have carried out the following measures :

(1) Electrical energy.

. Study high and medium voltage
. Reduce reactive energy cost
. Disconnect electrical transformer
. Reduce in a first stage maximum contractual power from 3 900 KW to 3 700 KW and in a second stage to 3 625 KW
. Maximize the phosphate grinding plant work in empty hours, what was carried out by the Production Department before the CCE performance
. Normalize the charge factor

Refer to map no. 10.

Note : An electrical energy management system has been aiming a study in progress.



(2) Steam.

The whole steam production system including boilers, showers, the animal feed plant, just as steam line losses was studied from several calculation methods.

Real consumptions in animal feed plant compactors were established analysing the raw-materials and products water evaporated.

This way, a real steam and oil management was carried out crediting the consumers with real steam and oil consumptions including line losses, which are function of the work time.

(3) NPK granulation plants.

Since oil consumption is higher than boiler consumption (2 350 tph against 1 850 tph, in 1985), measures improving drying efficiency just as mass and energy balances have been in progress.

(4) Plant integration.

Measures improving final and intermediate products maximizing available heat utilisation including compacting and NPK granulation plants became essential.

It is understanding that the pyrites mines are the main Portuguese carbon mines seeing that the available heat from pyrites roasting is 1 500 Kcal/kg.

Sulphuric acid.

The sulphuric acid plants reconversion was about to be studied before CCE performance.

SAPEC has been producing about 100 000 tonnes per year of sulphuric acid from pyrites roasting in 28 small herrschoff furnaces, what does not carry the available heat recovery. This means SAPEC has been consuming about 60 kWh/t H_2SO_4 in an unit likely to be self-sufficient and producer.

In reverse, this situation promotes an essential reduction of existing furnaces, considering, in the case of pyrites consumed in SAPEC, an available heat of 52.8 GJ/H (12.6 x (10) 6 KCAL/H) theorically produced.

SAPEC has been studying a roasting furnaces reconversion project which includes energy recovery foreseeing the replacement of the existing 28 herrschoff furnaces by a fluidized bed furnace. In this case, energy recovery would be 3.15 GJ/t H_2SO_4 (37.6 GJ/h) as 410º C superheated 40 bar steam (11.6 t/h).

This steam would feed a steam turbine generator, accounting to the two following situations :

- all the steam goes through a condensing turbine producing electric power (2.1 MWh/h)
- steam goes through a back pressure turbine producing electric power (850 kWh/h) and 4 bar steam to be used at the complex.

The project would promote an energy saving considering the actual consumptions which are about 1 140 kWh/h or 95 kWh/t H_2SO4 (first situation).

As concluding the preliminary feasibility study we obtained the following costs :

(1)	Roasting, recovery boiler, turbine and electric power station (Esc. 1.3 x 10^9)	ECU 8.7 x 10^6
	Contact sulphuric acid plant (Esc. 1.06 x 10^9)	ECU 7.06 x 10^6
(2)	Roasting, boiler, turbine and electric power station (Esc. .95 x 10^9)	ECU 6.3 x 10^6
	Contact sulphuric acid plant	ECU 7.06 x 10^6

Since these costs regard the plant in work, the second situation offers the best return on investment.

. Mother liquor and pipe cross.

The ammonium phosphate is produced on form of crystal. This promotes the control of the content of solids in suspension in the mother liquor slurry, considering salt crystallization in the DAP plant. To control contents, purges of mother liquor which are stocked and sent to the NPK granulation must be performed.

Tests have been carried out to optimize the pipe reactor and mother liquor system, considering that mother liquor has an approximate composition corresponding to an ammonium phosphate (map no. 11).

Mother liquor is advantageous to the NPK plant by promoting the granulation. In the other hand, it introduces more liquid phase into the granulator. This means it is essential to study the system seeing that SAPEC 70/75 % sulphuric acid is also likely to be used in phosphoric acid and ammonium sulphate plants or in the pipe cross.

The steam exported from the sulphuric acid plant at low costs could be important to the DAP plant or mother liquor drying. However, tests carried out on the mother liquor and estimations based on results of May and June 1986 showed that the 50 % pipe utilisation would be more economical in using all the ammonium phosphate plant mother liquor in the granulator and all the ammonium sulphate steam in the ammonium phosphate plant.

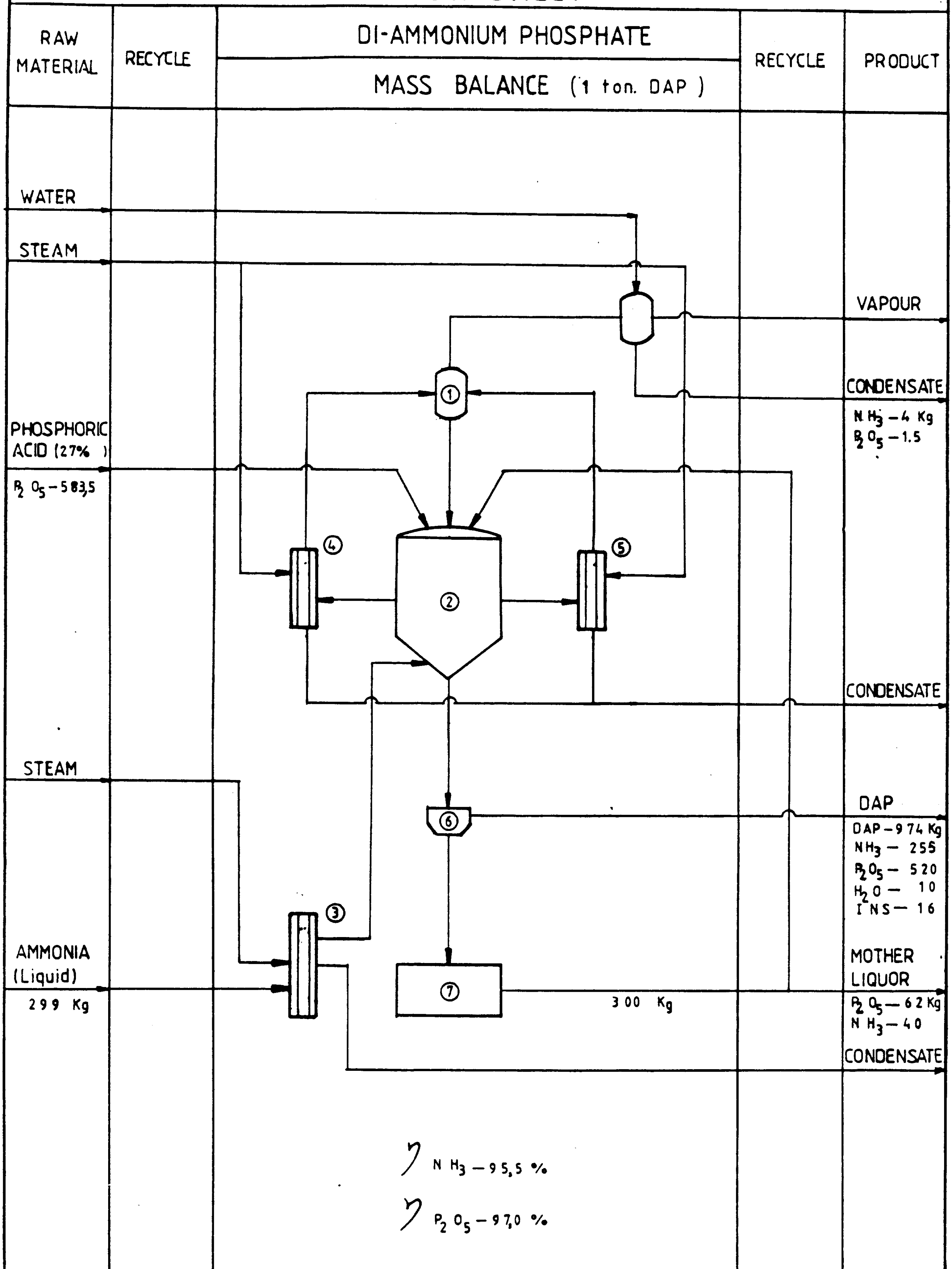
JOB PROGRESS AND ENERGY MANAGEMENT AND SAVINGS

To perform the recommendations, we have listed them as follows :

. no investment measures
. payback time (gross payback) measures within one year
. payback measures within one to three years
. management measures

Refer to Appendix no. 3.

FLOW-SHEET



LEGEND:

1 - EVAPORATOR
2 - SATURATOR
3 - AMMONIA HEATER
4 e 5 - RE-HEATERS
6 - CENTRIFUGE
7 - MOTHER LIQUOR TANK

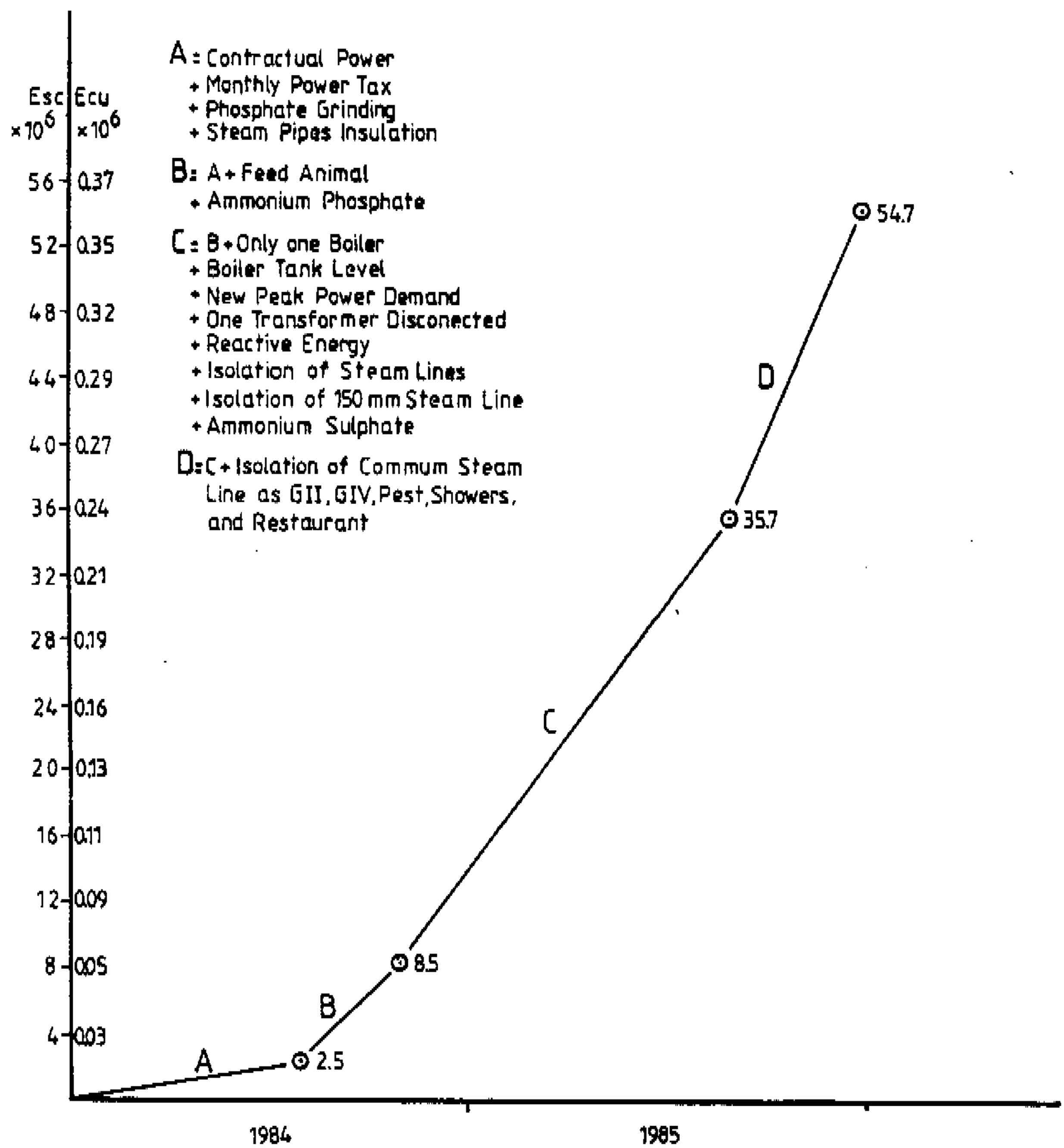
Measures proceeed with the replacement of the 6 tph boiler (7 kg/cm2 steam), that would stay on stand-by, by a burning wood-chips boiler at the same capacity.

It is expected this investment to be payed within 2,4 years, since we are able to buy wood-chips at Esc. 3$70/kg (ECU 0,025). This means about ECU .09 x 10^6 (Esc. 13.5 x 10^6) including the warehouse.

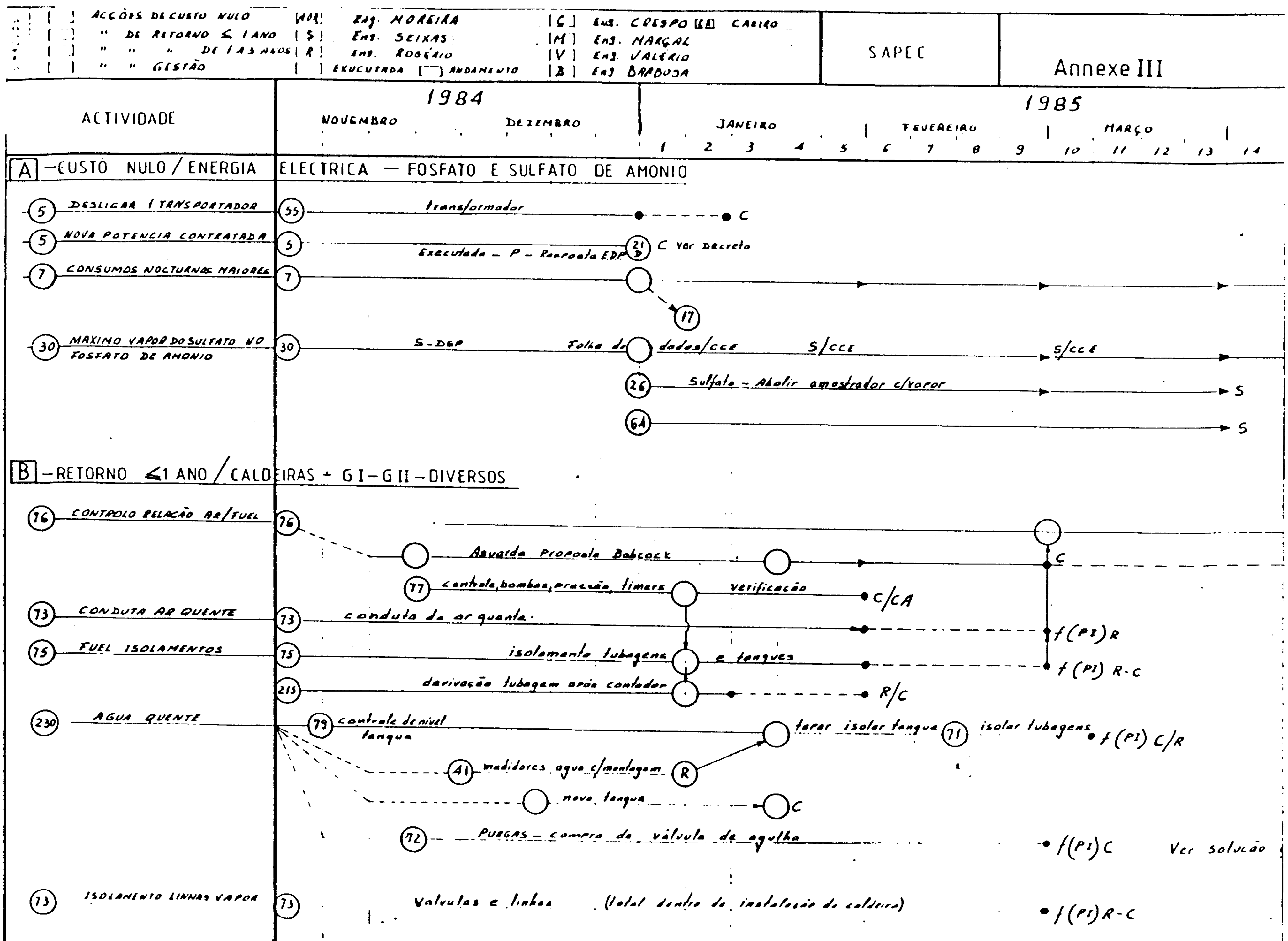
Energy saving.

Appendix no. 1 summarises the measures and resulting achievable savings from 1984 to 1985, at '84' costs, beeing 10 % of the SAPEC energy account (ECU 3.6 x 10^6).

ENERGY SAVINGS
(1984 BASE)

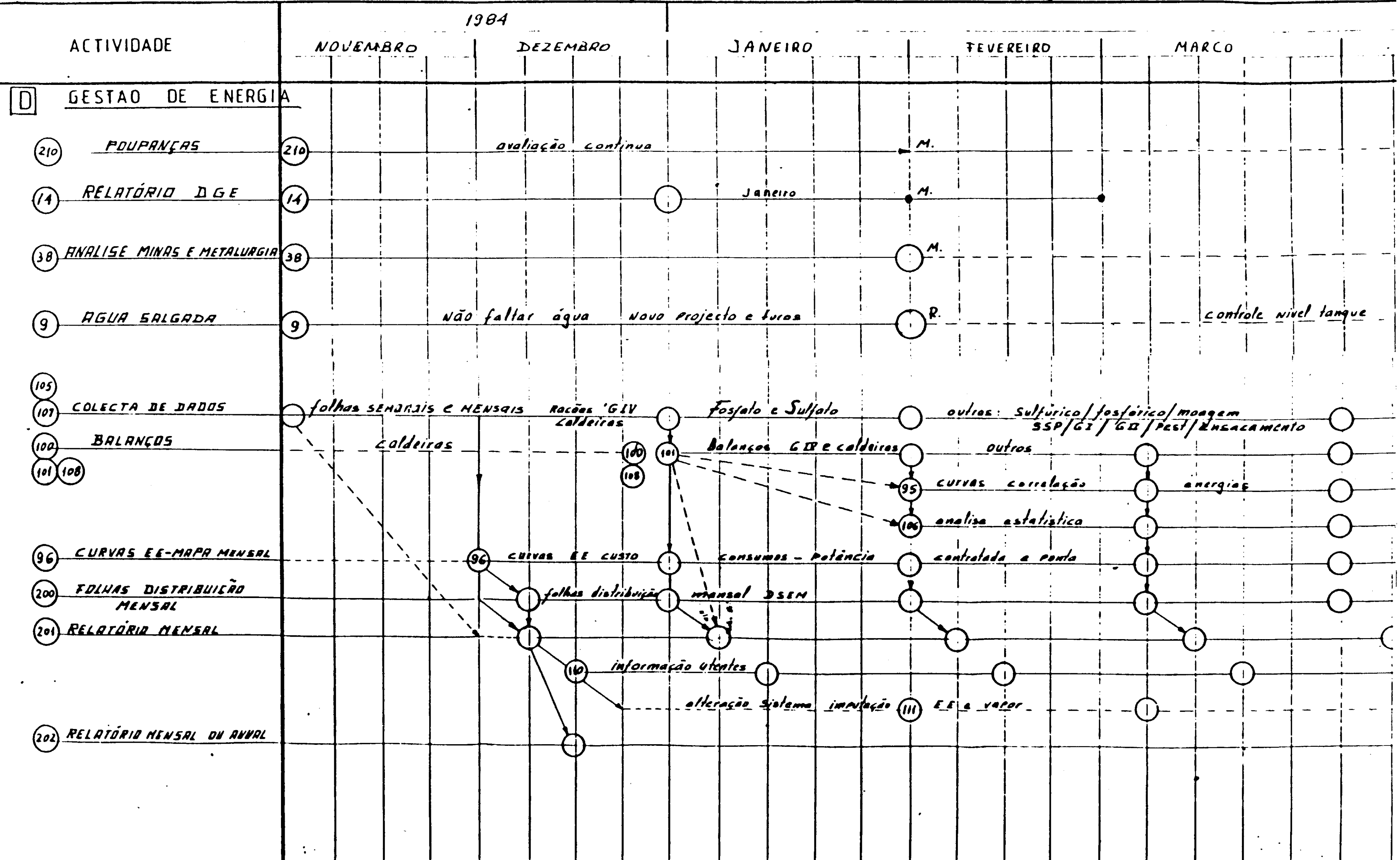


Re.	Measures	Responsible	Period		Results
			I	F	
01	Define, purchase, follow-up and fit metering	VALERIO			
02	Detect all the necessary insulation and steam lines	LEICHSERING			
03	High and medium voltage tariffs	CRESPO			
04	Reactive energy and EDP bill	CRESPO			
05	Peack power demand limitation	CRESPO			
06	Stabilization of electricity consumption	CRESPO			
07	Study of salt water pumping system	VALERIO R. CARVALHO			
08	Showers heating study	VALERIO			
09	List the trop-lines	SEIXAS			
10	Furnace burning chamber : burning study and insulation in NPK granulation plant nº 1	SEIXAS			
11	Involving people in energy conservation	MARÇAL			
12	Monthly report and distribution	MARÇAL			
13	Grinding plants : working on empty hours	SEIXAS			
14	Electrical lines : installed power, connections, meters, panels, etc.	VALERIO			
15	Decision on starting project data	MARÇAL CCE			
16	FEC/LUSOTECNA Contract	MARÇAL CCE			
17	Metering : steam, oil, water, etc.	CRESPO R. CARVALHO			
18	NAPP - Isocinetic samples and gases analyses	MARÇAL			
19	First report to the Board	MARÇAL CCE			
20	Colect data on utilities to FEC / / LUSOTECNA	VALERIO			
21	Stop with steam consumption on AS plant	SEIXAS			
22	Study of reconversion fuel and oil boilers to gas and carbon	R. CARVALHO			
23	Study the possibility of motivate the reduction in energy consumption through the allocation of lower costs for those Departments which have an effective reduction in energy	MARÇAL			
24	Supply the DAP plant with the steam from AS plant	SEIXAS			



[ ] ACÇÕES DE CUSTO NULO
[ ] " DE RETORNO ≤ 1 ANO
[ ] " " " DE 1 A 3 ANOS
[ ] " " GESTÃO
[M] Eng. MOREIRA
[S] Eng. SEIXAS
[R] Eng. ROGÉRIO
[ ] EXECUTADA [ ] ANDAMENTO
[C] Eng. CRESPO [CA] CAEIRO
[M] Eng. MARÇAL
[V] Eng. VALÉRIO
[B] Eng. BARBOSA
SAPEC
Annexe III
ACTIVIDADE
1984
NOVEMBRO
DEZEMBRO
1985
JANEIRO
FEVEREIRO
MARÇO
1 2 3 4 5 6 7 8 9 10 11 12 13 14
A – CUSTO NULO / ENERGIA ELECTRICA – FOSFATO E SULFATO DE AMONIO
5 DESLIGAR 1 TRANSPORTADOR
55 transformador C
5 NOVA POTENCIA CONTRATADA
5 Executada – P – Resposta EDP 21 D C Ver Decreto
7 CONSUMOS NOCTURNOS MAIORES
7 17
30 MAXIMO VAPOR DO SULFATO NO FOSFATO DE AMONIO
30 S-DEP Folha de dados/CCE S/CCE S/CCE
26 Sulfato – Abolir amostrador c/vapor S
6A S
B – RETORNO ≤1 ANO / CALDEIRAS + G I – G II – DIVERSOS
76 CONTROLO RELAÇÃO AR/FUEL
76 Aguarda Proposta Babcock C
77 controlo, bombas, pressão, timers verificação C/CA
73 CONDUTA AR QUENTE
73 conduta de ar quente f(PI) R
75 FUEL ISOLAMENTOS
75 isolamento tubagens e tanques f(PI) R-C
215 derivação tubagem após contador R/C
230 AGUA QUENTE
79 controle de nivel tanque tapar isolar tanque 71 isolar tubagens f(PI) C/R
A1 medidores agua c/montagem R
novo tanque C
72 PURGAS – compra de válvula de agulha f(PI) C Ver solução
73 ISOLAMENTO LINHAS VAPOR
73 Valvulas e linhas (total dentro da instalação da caldeira) f(PI) R-C

[ ] ACÇÕES DE CUSTO NULO	[MOR] Eng. MOREIRA	[C] Eng. CRESPO [CA] CAEIRO	SAPEC
[ ] " DE RETORNO ≤ 1 ANO	[S] Eng. SEIXAS	[M] Eng. MARÇAL	
[ ] " " " DE 1 A 3 ANOS	[R] Eng. ROGÉRIO	[V] Eng. VALÉRIO	
[ ] " " GESTÃO	[ ] EXECUTADA [ ] ANDAMENTO	[B] Eng. BABOSA	



OBSERVAÇÕES

14 - 23

TA/86/14 Energy saving in fertilizer plants by J.D.R. Marçal, SAPEC, Portugal

DISCUSSION : (Rapporteur B. Christensen, Superfos, Denmark)

Q - Mr. J.D. CRERAR, Norsk Hydro Fertilizers Limited, United Kingdom

1. Can you give some more details of how the waste steam from the ammonium sulphate plant is used in the DAP-plant, and how this steam was used before?

   What actual modifications have been implemented?

2. Can you tell us how the co-generation project is proceeding?

   Is it possible for SAPEC to export electric power to the utility company and to what price?

A - 1. 5 years ago we did not use steam from the AS-plant even if the equipement in the DAP-plant was installed from the beginning. The operators did not pay attention to the high cost of energy. By simple measurement of the steam balance we found the waste. Since then the DAP-plant has utilized most of the AS-steam and fuel oil has been saved in the boilers.

2. For utilizing the waste steam from the sulphuric acid plant appr. six solutions with co-generation have been studied. The study shows that the project is worthwhile. The project will produce 110-115 kWh/t H_2SO_4 which can further reduce the use of the boilers. Electrical energy price in Portugal is about 10 Esc/kWh (0,067 $/kWh).

Q - Mr. M. BARLOY, SCPA, France

1. When you invest to save energy, what pay back time do you then consider as reasonable.

2. I think you are installing a new Kaltenbach-GTF granulation system.

   Is this done as a result of your energy saving policy?

A - 1. Normally about 3 years pay-back time is required.

2. The main reason for this project is for improving the product quality by using some steam in the granulation drum. Energy conservation is always important but not the primary factor in this case.