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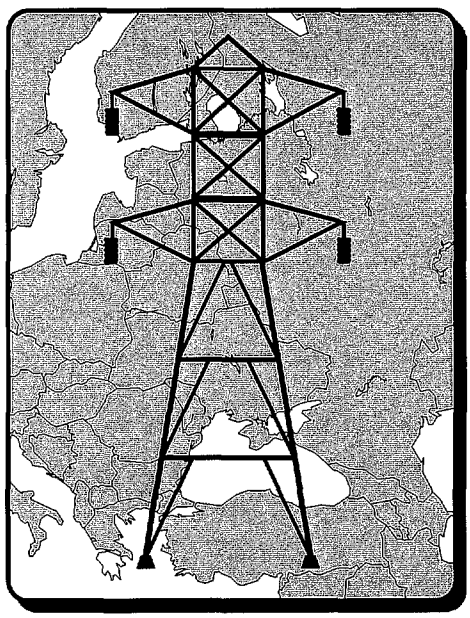
Central and Eastern Europe Regional Energy Efficiency Project EUR-0030-C-00-2053-00



Energy Pricing, Energy Efficiency, and Energy Sector Restructuring Component

Final Report
December 1996

Volume XI

Prepared for:
U.S. Agency for International Development
Bureau for Europe and NIS
Office of Environment, Energy, and Urban Development
Energy and Infrastructure Division

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

Energy Pricing, Energy Efficiency, and
Energy Sector Restructuring Component

Bulgaria
Equipment Procurement
Task Completion Memorandum

Prepared for:

U.S. Agency for International Development
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August 1996

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CENTRAL AND EASTERN EUROPE
REGIONAL ENERGY EFFICIENCY PROJECT

Task Completion Memorandum

Bulgaria - Equipment Procurement

Summary Task Description

This project builds upon the results of the 1993 Energy Efficiency and Market Reform Project in which energy market development programs were carried out with sixteen energy services companies (Certified Energy managers) and ten industrial enterprises in Bulgaria. In the 1993 project, the primary objective was to achieve training and capacity building among private energy service companies, and to assist these companies with developing their business through energy efficiency projects at ten industrial enterprises. Hagler, Bailly had primary responsibility for organizing and managing the program. The Energy Efficiency Market Development (EEMD) project included concentrated attention to management and organizational issues, and primary responsibility for the field work was placed upon multiple Bulgarian private sector enterprises.

The Equipment Procurement (EP) Project is structured to expand the procurement of energy efficiency equipment, first for the existing participating plants, and second for additional plants if sufficient applications cannot be developed at the first plants. The expanded procurement will enable the installation of additional equipment, expand the technological base of the EEMD program, and assist the energy service companies in developing their experience with new energy efficient equipment and technologies.

The Bulgaria Equipment Procurement Task is a follow on activity to the Energy Efficiency Market Development (EEMD) task which was initiated to serve as a catalyst to assist private Bulgarian firms to develop a market for energy efficiency services, and to develop their capability to serve this market. This effort is well underway and the Bulgarian firms are in the process of completing energy audit reports, specifying equipment, and preparing the participating plants for installation. Concurrently, Hagler Bailly is in the process of procuring the initial round of equipment and preparing for shipment to Bulgaria.

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The major activities in the Bulgaria EP task are:

1. To work with the participating Bulgarian Certified Energy Managers and plants to identify approximately $ 445,000 in energy efficiency equipment (including service contracts and shipping costs) for procurement by USAID.

2. To continue the process of technical and economic evaluation in the selection of this equipment.

3. Specify, procure, and ship the equipment to Bulgaria.

4. Follow-up with technical assistance as required in start-up and commissioning.

5. Monitor the equipment performance and report annually on its use.

Specific Goals and Objectives

The general objective of the EP project will be to support the initial EEMD tasks for development of a market for an energy efficiency industry in Bulgaria, and to assist firms in the private sector to develop their capability to serve this market.

The specific objectives of the EEMD project are:

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

2. Continue with improving energy efficiency in specific pilot sites (especially industrial enterprises), through provision of additional energy-saving equipment;

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

Expected Outputs

The expected outputs of the Equipment Procurement project are:

1. Equipment Specifications - Augment the planned energy audits and prepare, based on the Tasks of the workplan, specifications and justification for the purchase of energy efficiency equipment that will help improve the effectiveness, impact, and demonstration benefits of the Tasks.

2. Procurement Management - Manage the procurement of the equipment in accordance with USAID regulations. Proposed purchases and justifications indicating the cost/benefits (including environmental) of the introduction of the equipment will be submitted to the USAID project officer who will provide written recommendation to the USAID contracts officer who will authorize equipment procurement.

3. Service Capability - Agreement will be reached with the supplying company on servicing for the equipment installed in Central and Eastern Europe.

4. Disposition Agreements - Written agreements will be concluded with organizations receiving equipment that clearly specifies its use and responsibility for the equipment, and this documentation will be provided to USAID.

5. Equipment Installation - The equipment will be insured, shipped, and installed at its final destination exempt from customs duties and taxes. USAID will assist if needed with the host government if a USAID bilateral assistance agreement is not in place.

6. Monitoring and Reporting - Periodically monitor the use and condition of the equipment and prepare at least annually reports on functioning of the major installation and the estimated energy and environmental savings including the equipment in place under the emergency project

Deliverables:

Hagler Bailly provided short term consultants and technical assistance to aide the ten original Bulgarian enterprises with identifying, procuring, installing, and monitoring energy efficiency equipment. The nine plants who participated in the follow-on equipment program were:

- Lev Gabrovo, leather tannery
- Silikatkeram Plodiv, red clay and silica brick factory
- KMH Belovo, tissue paper
- Zlatna Panega, cement plant
- Crystal Pernik, glass factory
- Petar Karaminchev Russe, PVC product factory
- Varna Shipyard, ship construction and repair
- ZMM Sofia, machine tool plant
- RUNO Gabrovo, wool plant

A walk-thru energy audit was completed by Hagler Bailly at each plant and a roster of potential energy efficiency measures developed and discussed with plant management. Based on the findings and plant needs, a number of measures and equipment were selected for implementation.

The following table denotes the energy efficiency measure and equipment that was implemented for each plant:

Bulgarian Energy Efficiency Measures & Equipment	
Plant	Measure/Equipment
Lev Gabrovo	Air Compressor Heat Exchangers
Silikatkeram Plodiv	Moisture Analyzer power Factor Controllers power Loggers Computers Mazut Burner/Flow Meter
KMH Belovo	Air Compressor Control valve Boiler Blowdown
Zlatna Panega	Gas Analyzer
Crystal Pernik	Air Compressors
Petar Karaminchev Russe	Condensate Pumping Stations
Varna Shipyard	Waste Heat boiler
ZMM Sofia	Lighting Valves Controllers Computers
RUNO Gabrovo	Air Compressor

All of this equipment was procured, delivered, installed, and commissioned during the life of the project.

Results and Next Steps

The program has achieved positive results: both in terms of technical results (energy and cost savings) and the broader institutional issues of creating a market in Bulgaria for energy services.

The final monitoring report for each plant is attached to this task completion memorandum. These reports summarize the results of the monitoring program and the equipment procurement and installation process.

As for next steps, the following recommendations are made:

- The monitoring program should be continued so that additional information can be gathered on the results of each energy efficiency measure.
- Each CEM and plant should use the results of the monitoring program to further implement energy efficiency measures at the respective plant, and for the CEM to develop further business prospects.
- The CEMs should pursue institutional reform (e.g. energy rate restructuring, import duty exemptions on energy efficiency equipment, etc.) with the appropriate government agencies and use the collective influence of the AEE chapter, and other Bulgarian associations, to promote energy efficiency market development policy.

The results of the monitoring program yielded the following performance indicators:

Bulgaria - Summary of Energy and Cost Savings
USAID Energy Market Development Project
Industrial Energy Efficiency

Plant/CEM	Energy Efficiency Measure	Energy Saved	Project Cost (USD $)	Cost Savings (USD $)	Payback (yr)	Notes:
Petar Karaminchev	Steam Regulators	40,441 m3-NG/yr	2,884	3,841	0.75	Estimated
Russe Bulgaria	Combustion Analyzer	117,953 m3-NG/yr	4,742	11,205	0.42	Estimated
Raina Zlatareva	Condensate Pumps	168,505 m3-NG/yr	36,243	16,008	2.26	Estimated
	Steam Traps	623,468 m3-NG/yr	86,500	59,227	1.46	Estimated
	Other Measures	111,213 m3-NG/yr	7,500	10,565	0.71	Estimated
	Subtotal	**1,061,580 m3-NG/yr**	**137,869**	**100,846**	**1.37**	
KMH	Air Compressor	761,481 KWh/yr	83,790	54,394	1.54	
Belovo Bulgaria	Boiler Blowdown	5,813 GJ-NG/yr	8,255	19,850	0.42	Estimated, installation not complete, savings include 5,742 t-H2O/yr
Georgi Rampov	**Subtotal**	**768,481 KWh/yr** **5,813 GJ-NG/yr**	**92,045**	**74,244**	**1.24**	
Varna Shipyard	*Waste Heat Boiler*	320 t-FO/yr	19,966	52,640	0.38	Estimated, installation not complete
Varna Bulgaria	Steam Traps		22,300	16,900	1.32	Includes $2,820 savings in treated water
Deian Yordanov	**Subtotal**	**320 t-FO/yr**	**42,266**	**69,540**	**0.61**	
ZMM	Lighting Lamps/Fixtures	106,940 KWh/yr	26,662	11,216	2.38	
Sofia Bulgaria	Energy Monitoring & Control	914 Gcal/yr	41,891	24,984	1.68	Estimated (454 Gcal-Hot Water, 460 Gcal-Steam)
Dimitar Baev	*Power Factor Improvement*	*N/A*	*6,200*	*26,029*	*0.24*	*Savings in power factor penality*
	Thermal Power Station	982 t-FO/yr	246,056	221,000	1.11	Estimated
	Subtotal	**106,940 KWh/yr** **914 Gcal/yr** **982 t-FO/yr**	**320,809**	**283,229**	**1.13**	Estimated
RUNO	Air Compressor	141,944 KWh/yr	36,101	14,286	2.53	
Gabrovo Bulgaria						
Nikola Kaloyanov	**Subtotal**	**141,944 KWh/yr**	**36,101**	**14,286**	**2.53**	
Crystal-Pernik	Air Compressor	240,000 KWh/yr	37,410	16,514	2.27	
Sofia Bulgaria	Air Supply Modifications	171,420 m3-NG/yr	20,570	12,600	1.63	
Yordan Katzarov	**Subtotal**	**240,000 KWh/yr** **171,420 m3-NG/yr**	**57,980**	**29,114**	**1.99**	
Zlatna Panega	Gas Analyzer	11,200 GJ-NG/yr	72,000	33,600	2.14	
Bulgaria						
Dimeter Shivkov	**Subtotal**	**11,200 GJ-NG/yr**	**72,000**	**33,600**	**2.14**	

Bulgaria - Summary of Energy and Cost Savings
USAID Energy Market Development Project
Industrial Energy Efficiency

Plant/CEM	Energy Efficiency Measure	Energy Saved	Project Cost (USD $)	Cost Savings (USD $)	Payback (yr)	Notes:
LEV	Heat Exchanger	414 Gcal-Steam/yr	13,998	10,955	1.28	Savings includes 2,453 t-condensate/yr
Gabrovo Bulgaria	Air Compressor	85,778 KWh/yr	25,375	11,806	2.15	Savings includes 3,000 m3-H2O and 950 l/yr lube oil
Nikola Kaloyanov						
	Subtotal	**414 Gcal-Steam/yr** **85,778 KWh/yr**	**39373**	**22761**	**1.73**	
Silkatkeram AD	Mazut Flowmeter	40 t-FO/yr	17,993	10,435	1.72	Estimated, installation not complete. Savings include 73.5MWh/yr
Plovdiv Bulgaria	Power Logger		(INCL)	(INCL)		
Boris Petkov	Computer System		(INCL)	(INCL)		
	Mazut Burners	127 t-FO/yr	17,900	8,921	2.01	Estimated, installation not complete
	Moisture Analyzer	146 t-FO/yr	4,500	10,196	0.44	Estimated, installation not complete
	Power Factor Improvement	N/A	7,289	3,960	1.84	Estimated, installation not complete
	Subtotal	**313 t-FO/yr** **73.5 MWh/yr**	**47,682**	**33,512**	**1.42**	
SUMMARY			**$846,125**	**$661,132**	**1.28**	

Legend:

FO - Fuel oil
Gcal - Gigacalorie
GJ - Gigajoule
KWh - Kilowatt-hour
m3 - Cubic Meter

NG - Natural Gas
t - Tonne
yr - year

MONITORING & EVALUATION REPORT PETAR KARAMINCHEV

P R O J E C T F O R E N E R G Y E F F I C I E N C Y

I N E A S T E R N E U R O P E

INDUSTRIAL ENERGY EFFICIENCY COMPONENT

RCG/HAGLER BAILLY - U S A I D

" P E T A R K A R A M I N C H E V " - Ltd

Russe, BULGARIA

F I N A L R E P O R T

CONSULTANT: Raina Zlatareva, Ph.D.

September, 1996

Sofia, BULGARIA

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C O N T E N T S

1.Principal objective

2.Energy efficiency measures

2.1.Equipment,supplied by USAID

2.2.Equipment,supplied by "Petar Karaminchev"-Ltd

2.3.Additional measures

2.4.Realization

3.Heat energy measurments before energy efficiency measures

4.Heat energy measurments after energy efficiency measures

5.Final results - technical and economical analyses

1.PRINCIPAL OBJECTIVE

This report includes a description of the all heat energy efficiency measures,concerning heat energy house of "Petar Karaminchev"-Ltd,Russe,BULGARIA.These measures was realized with the equipment,supplied by USAID and "Petar Karaminchev".

The final results showed clear the usefulness of the measures, reflected on the reducing of the fuel consumption for heating and production process.

2.ENERGY EFFICIENCY MEASURES

2.1.Equipment,supplied by USAID

The equipment,supplied by USAID is described on Table 1.

TABLE 1

first stage of the project	
1.Steam temperature regulating valves 2" - 2pcs	$ 2 135,00
2.Portable combustion analyzer model 300,spare parts	$ 4 392,25
second stage of the project	
1.Pressure-powered condensate pumping trap 1"PPEC - 2pcs 2.Pressure-powered condensate pumping trap 2"PPC - 2pcs 3.Pressure-powered condensate pumping trap 3"x2"PPC - 8pcs	$ 34 272,78

2.2.Equipment,supplied by "Petar Karaminchev"-Ltd

The equipment,supplied by "Petar Karaminchev"-Ltd includes:

- inverted bucket steam traps for all heating and technological consumers,
- reducing valves,
- temperature regulators.

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2.3.Additional measures

The additional measures include:

- setting of heat insulation,
- revision of the all steam and condensate armature,
- revision of the all steam consumers.

2.4.Realization

- portable combustion analyzer is used every week for the control and adjustment of the boiler combustion processes,
- the steam temperature regulating valves are mounted,
- the reequipment of the condensate system with the new pressure-powered condensate pumping traps is finished,
- the setting of the heat insulation is finished,
- the steam and condensate armature and the steam consumers are revised.

3.HEAT ENERGY MEASURMENTS BEFORE ENERGY EFFICIENCY MEASURES

These measurments are realized after the mounting of the all new inverted bucket steam traps,reducing valves and temperature regulators,supplied by "Petar Karaminchev"-Ltd.

- average energy efficiency of the boilers - 84%,
- returned condensate/period of time-May-June/ - 1 600 m^3,
- steam production /period of time-May-June/ - 2 100 t ,
- fuel consumption/period of time-May-June/-157 000nm^3natural ga

4.HEAT ENERGY MEASURMENTS AFTER ENERGY EFFICIENCY MEASURES

- average energy efficiency of the boilers - 87-88%,
- - returned condensate/period of time July-August/- 1 952 m^3,
- steam production/period of time-July-August/ - 2 100 t,
- fuel consumption/period of time-July-August/-146 740nm^3.

5.FINAL RESULTS - TECHNICAL AND ECONOMICAL ANALYSES

- increasing of the heat efficiency of the boilers /average/ - 3,5%,

- reduction of the fuel consumption after the mounting of the temperature regulators - 1,2%,
- increasing of the returned condensate after the mounting of the pressure-powered condensate pumping traps - 22%,
- reduction of the fuel consumption after the mounting of the inverted bucked steam traps,reducing valves and temperature regulators - 18,5%,
- reduction of the fuel consumption after realization of the additional measures - 3,3%,

The economical analyses are described on Table 2.They are based on the annual natural gas consumption for 1995 - 3 370.10^3nm^3, and a price of natural gas - 95 $/1 000 nm^3.

TABLE 2

ENERGY EFFICIENCY MEASURE	SAVINGS %	SAVINGS USD/year	COST OF THE MEASURE USD	PAYBACK PERIOD, YEARS
Using of gas analyzer	3,5	11 205	4 742	1,37
Mounting of temperature regulators	1,2	3 841	2 884	
Mounting of pressure-powered condensate traps	5,0	16 008-fuel 1 494-water	36 243	
Mounting of steam traps, reducing valves, temperature regulators	18,5	59 227	86 500	
Additional measures	3,3	10 565	7 500	
T O T A L	31,5	100 846	137 869	

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MONITORING & EVALUATION REPORT KMH

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INDUSTRIAL ENERGY EFFICIENCY
MONITORING & EVALUATION PROGRAM

USAID ENERGY EFFICIENCY MARKET DEVELOPMENT PROJECT
INDUSTRIAL ENERGY EFFICIENCY TASK
BULGARIA

Phase II Measure Monitoring and Evaluation Report

Deliverable 3

Responsible Energy Consultants:

Nicola Stankov, PhD, CEM: .....

Georgi Rampov, CEM .....

Sofia, 20.11.1996

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General Information

As a conclusion of the improvement of the energy efficiency of the plant, the plant management has decided to support the Phase II of the USAID Energy Efficiency Program with the measures proposed by the CEM's as follows:

- Compressed air system energy efficiency improvement;
- 35 t/h boiler blowdown system energy efficiency improvement.

Measure I - Compressed air energy efficiency improvement

1. Rational for the measure

The KMH Belovo has a widely distributed compressed air system, supplying the tissue parer machines and control systems. The compressed air was produced by 6 existing reciprocal air compressors (RAC), bulgarian made, each producing 20 Cu m/min. After the energy audit, made by the CEM's, the plant management has decided to purchase a new rotary screw compressor (RSC), german made, producing 15 Cu m/min.

So the operating units were - 4 RAC's and 1 RSC. Due to maintenance problems, 2 RAC's are always in repair.

The background for the proposed energy efficiency measures was:

1.1 Existing condition

- - 4 RAC's bulgarian made;
  - each one producing - 20 Cu m/min @ p=7 bar
  - motor power - 145 kW/unit
  - yearly operation time - 7000 h/y
  - monthly oil consumption - 320 l/unit
  - cooling water consumption - 10 cu m/h each
  - type of operation - base mode at full load without control

  Remark: it is estimated, that the power factor of these compressors is to low.

- - 1 RSC - type Hafi - german made
  - production - 15 cu m/min @ p=7 bar
  - motor power - 75 kW
  - yearly operation time - 7000 h/y in on/off mode of operation
  - yearly oil consumption - approx. 70 l/y
  - air cooled

2. Description of the measure

2.1 Reduction of the air losses

In order to reduce the high moisture and oil content of the compressed air, produced by the old RAC's, a continuous air lines purging was made by the operation people. To avoid this, air drain traps were purchased and installed in the Phase I project. For further decreasing, an Ingersoll-Rand air refrigerant dryer is provided in this measure.

2.2 Reduction of the operation and maintenance expenses for compressed air production

For this purpose was purchased and installed a new 20 cu m/min RSC from Ingrsoll-Rand, donated from USAID in this project, with following main characteristics:

- production	- 20 cu m/min @ 7 bar
- motor power	- 115 kW
- yearly operation time	- 7000 h/y at modulating mode of operation
- yearly oil consumption	- < 80 l/y
- air cooled	

2.3 New conditions

Operating:	- 2 RAC's	- 2x20 cu m/min
	- 1 RSC	- 1x15 cu m/min
	- 1 Ingersoll-Rand RSC	- 1x 20 cu m/min

3. Implementation schedule

• Design	30.04.1995
• List of equipment proposals for Phase II	30.05.1995
• Procurement and delivery	march 1996
• Design and construction of a new compressor house for Ingersoll-Rand compressor and air dryer.	30.09.1996
• Start up	14.10.1996

4. Monitoring method and used equipment for:

- Evaluation of electrical consumption costs
- Evaluation of maintenance and operation costs
- Operation modes
- Total project costs and evaluation of the pay-back period
- Measuring equipment specification.

4.1 Evaluation of electrical consumption costs

The compressors are situated in the compressor house and are fed by an auxiliary transformer 6 kV/380 V - 3 ph. Rail supply system is used. The dimensions of the rail are not suitable for measurement with Rustrak II Power Logger current clamps. So the direct measurement of the compressor house total electrical consumption is not possible. That's why a separate unit consumption measurement is used, for short time @ constant load. It is possible when the air pressure in the main line varies in narrow limits. Due to the on/off control mode operation of the Hafi RSC (N 7), the air pressure is maintained within 5.8-6.2 bar g.

This permits to compare total power consumption of different compressor types and to analyze the profits of the substitution of old RAC's with the new RSC one (Ingersoll-Rand).

The Total Power Consumption P_t (kVA) is calculated as follows:

$$P_t\,(kVA) = P_a\,(kW) / PF,$$

where P_a (kW) - Active Power measured,
PF - Power Factor (cos φ), considers the Reactive Power P_r (kVAR) too.

The difference between P_{t1} of the RAC unit and P_{t2} of the new RSC one is the power reduction:

$$\Delta P_t = P_{t1} - P_{t2}\,.$$

ΔP_t^y is the annual power reduction for Z hours / year operation is calculated as:

$$\Delta P_t^y = \Delta P_t \,.\, Z\,.$$

The annual Active Power ΔP_a^y is obtained from:

$$\Delta P_a^y = \Delta P_t^y \,.\, PF_2\,.$$

PF_2 is the mean value of PF for the new RSC.

The annual savings from power reduction are:

$$\Delta S_p^y = \Delta P_a^y \,.\, p_e\,.$$

p_e is the mean price value for the different tariffs - approx. 11.2 BGL/kWh (at exchange rate 250 BGL/$ p_e = 0,045 $/kWh). The compressors work continuously 24 h/day.

4.2 Evaluation of maintenance and operation costs

- Oil expenses
- Cooling water expenses
- Repair expenses
- Total operation expenses

All expenses are compared on annual consumption base for operating units configuration and calculated at present prices.

4.3 Operation mode

Two operation configurations are compared in order to estimate the real cost benefits at the existed load:

- Old one, consisting of 4 RAC's.
- New one, consisting of 2 RAC's + Hafi RSC + Ingersoll-Rand RSC.
  The Hafi RSC is in on/off control mode.

4.4 Total Project Costs and evaluation of pay-back period.

The Total Project Costs consists of :

- Equipment procurement costs
- Transport costs
- Design and installation costs

The simple pay-back period calculation is used. The Total Savings are the sum of the annual savings from power, maintenance and operation costs reduction.

4.5 Measuring equipment specification.

For estimation of the power consumption the RustrakII Power Logger was used. For the other costs estimation are used accounting department reports from the plant.

5. Results of Measurements and Monitoring.

- Baseline energy consumption data

Operating or spare old RAC were: N 1, 2, 3 and 5. The test results are shown on Fig. 1(compr. N 1), Fig. 2 (compr. N 2), Fig. 3 (compr. N 3) and Fig. 4 (compr. N 5).

The average values of the Total Power P_t , Active Power P_a , Reactive Power P_r and the Power Factor PF for each operating compressor are given on Table 1.

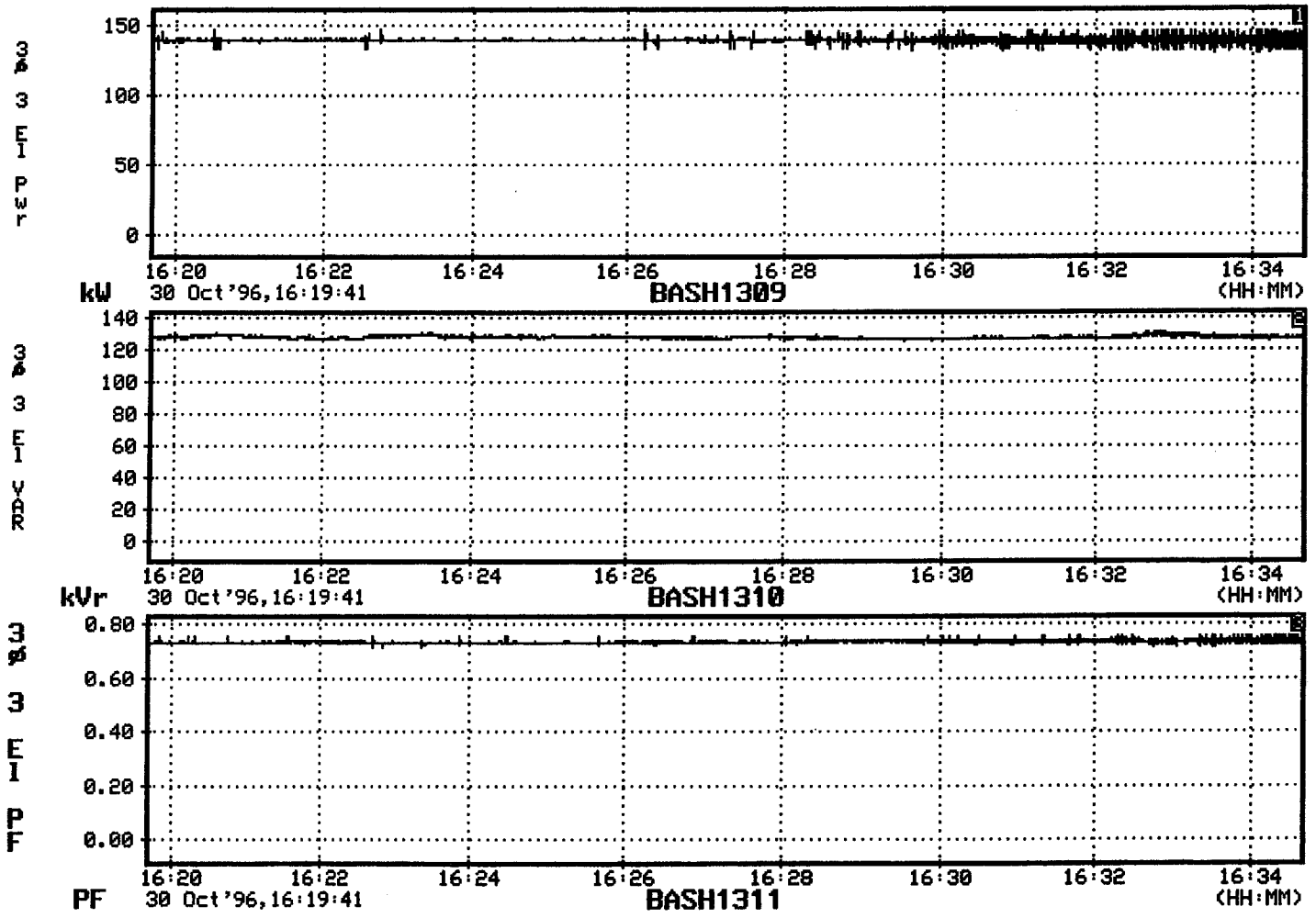

3 Φ 3 EI PWR
150
100
50
0
16:20 16:22 16:24 16:26 16:28 16:30 16:32 16:34
kW 30 Oct'96,16:19:41 BASH1309 (HH:MM)
3 Φ 3 EI VAR
140
120
100
80
60
40
20
0
16:20 16:22 16:24 16:26 16:28 16:30 16:32 16:34
kVr 30 Oct'96,16:19:41 BASH1310 (HH:MM)
3 Φ 3 EI PF
0.80
0.60
0.40
0.20
0.00
16:20 16:22 16:24 16:26 16:28 16:30 16:32 16:34
PF 30 Oct'96,16:19:41 BASH1311 (HH:MM)

FIG. 1

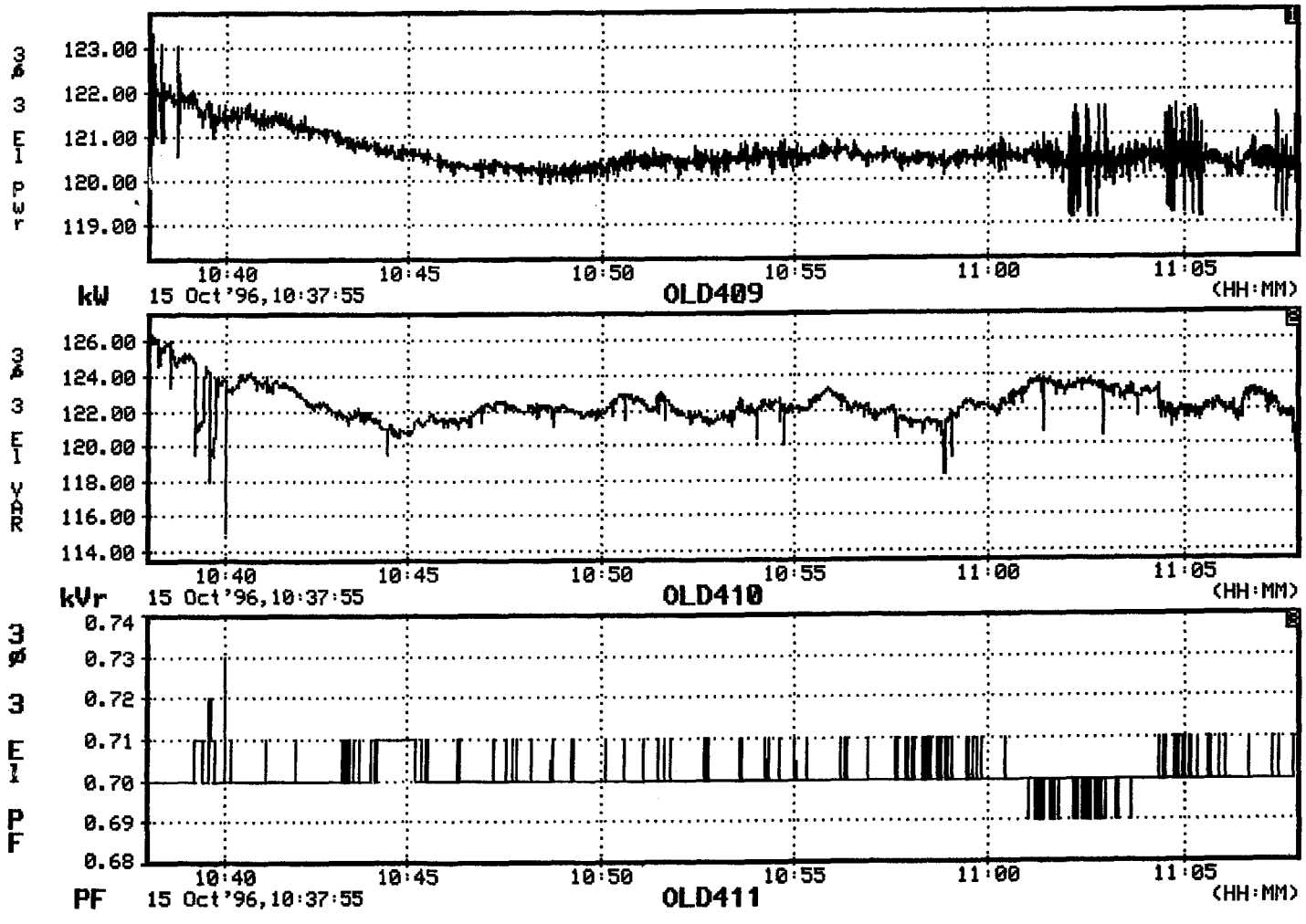

3 ϕ 3 E I pwr
123.00
122.00
121.00
120.00
119.00
10:40
10:45
10:50
10:55
11:00
11:05
(HH:MM)
kW
15 Oct'96,10:37:55
OLD409
3 ϕ 3 E I VAR
126.00
124.00
122.00
120.00
118.00
116.00
114.00
10:40
10:45
10:50
10:55
11:00
11:05
(HH:MM)
kVr
15 Oct'96,10:37:55
OLD410
3 ϕ 3 E I PF
0.74
0.73
0.72
0.71
0.70
0.69
0.68
10:40
10:45
10:50
10:55
11:00
11:05
(HH:MM)
PF
15 Oct'96,10:37:55
OLD411

Fig. 2

26

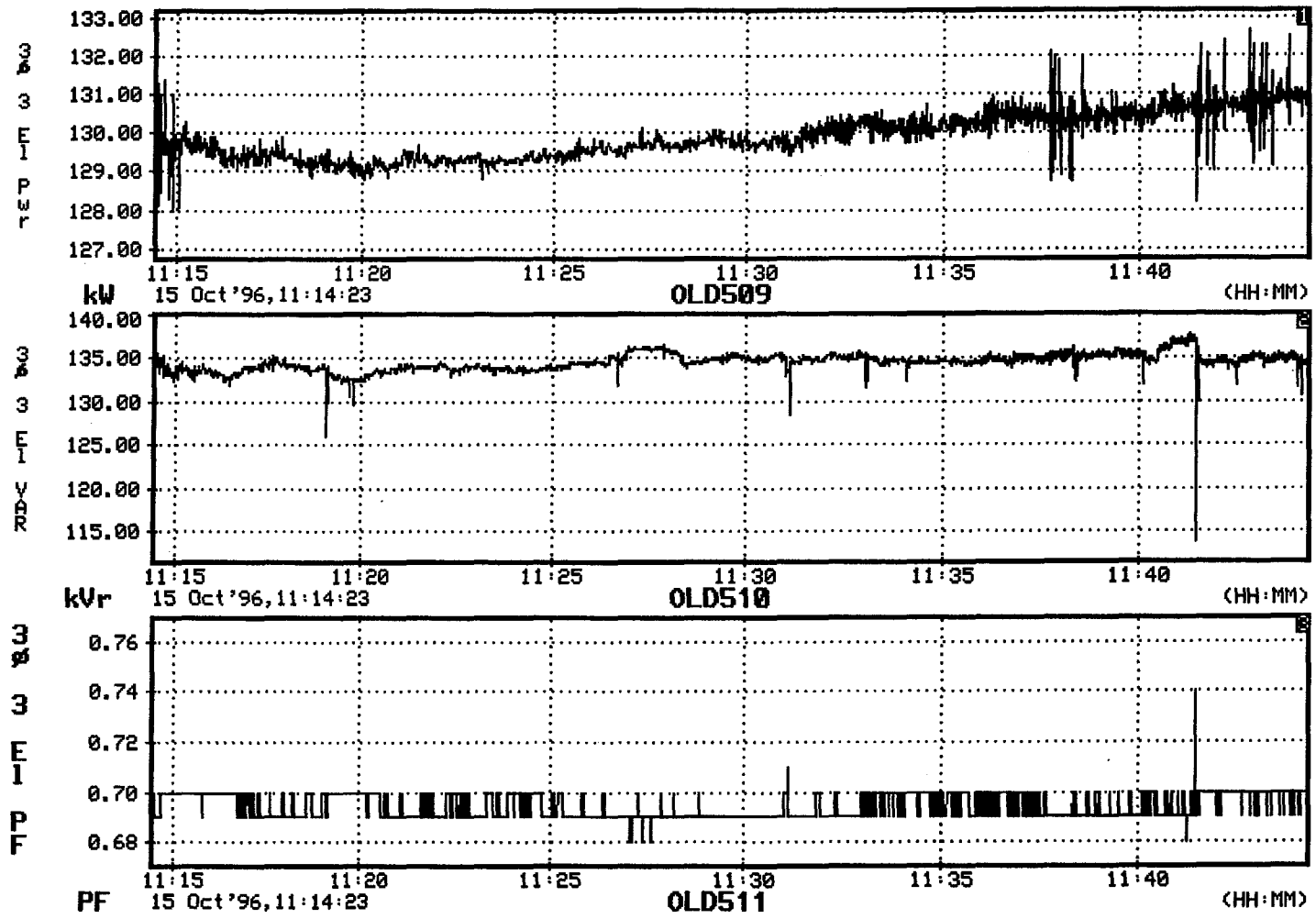

3 ϕ 3 El Pwr
133.00
132.00
131.00
130.00
129.00
128.00
127.00
11:15
11:20
11:25
11:30
11:35
11:40
kW
15 Oct'96,11:14:23
OLD509
(HH:MM)
3 ϕ 3 El VAR
140.00
135.00
130.00
125.00
120.00
115.00
kVr
15 Oct'96,11:14:23
OLD510
(HH:MM)
3 ϕ 3 El PF
0.76
0.74
0.72
0.70
0.68
PF
15 Oct'96,11:14:23
OLD511
(HH:MM)

FIG. 3

27

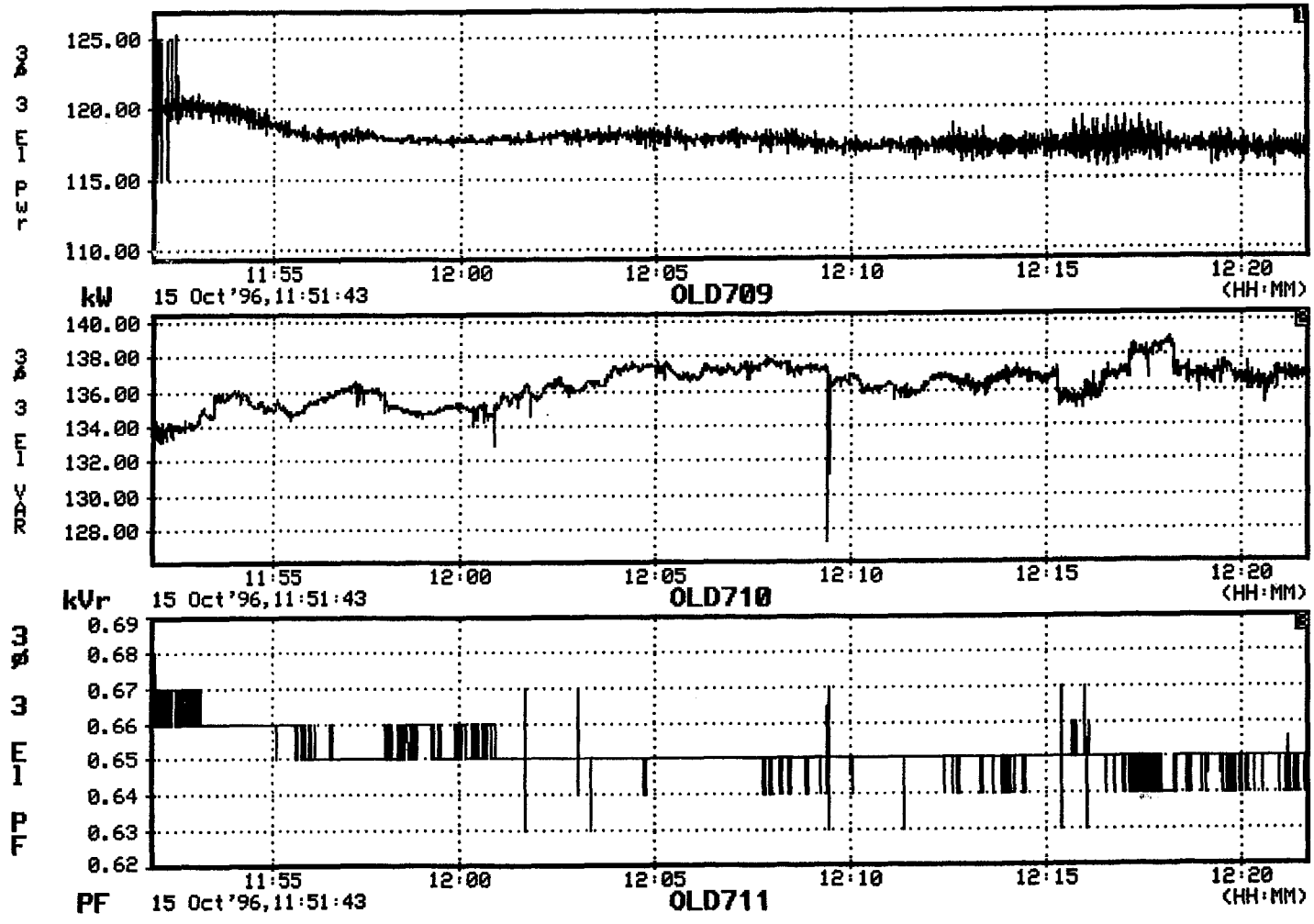

3 ϕ 3 EI PWR
125.00
120.00
115.00
110.00
11:55
12:00
12:05
12:10
12:15
12:20
(HH:MM)
kW
15 Oct'96,11:51:43
OLD709
3 ϕ 3 EI VAR
140.00
138.00
136.00
134.00
132.00
130.00
128.00
kVr
15 Oct'96,11:51:43
OLD710
3 ϕ 3 EI PF
0.69
0.68
0.67
0.66
0.65
0.64
0.63
0.62
PF
15 Oct'96,11:51:43
OLD711

FIG. 4

28

Table 1.

	BASELINE (p = 5.8-6.2 bar g.)			
Compressor	1	2	3	5
Active Power kW	140	120.6	129.9	117.9
Reactive Power kVAR	129.7	122.3	134.5	136.2
Power Factor	0.73	0.7	0.69	0.65
Total power kVA	191.8	172.3	188.3	181.4

Remarks: - The average value of the Total Power for old RAC's is 183.4 kVA .
- The average value of the Power Factor is 0,693 .

- New Ingersoll-Rand RSC N 8 test results

They are shown on Fig. 6 and Fig. 7 (for two tests at different unit configuration). The average values of the Total Power P_t , Active Power P_a , Reactive Power P_r and the Power Factor PF for this compressor are given on Table 2.

Table 2

	Ingersoll-Rand (p=5.8-6.2 bar g.)		
	Test N 1	Test N 2	Average
Active Power kw	127.5	123.5	125.5
Reactive Power kVAR	88.4	92.2	90.3
Power Factor PF	0.82	0.8	0.81
Total Power kVA	155.5	154.4	154.9

Remarks: - Test 1- operating compressors N 2,3,7 and 8 (Ingersoll-Rand)
- Test 2 - operating N 1,5,7 and 8.

- Actual energy consumption data

Operating 2 RAC's (two average of N 1,2,3 and 5) + 1 Hafi RSC N 7 + 1 Ingersoll Rand RSC N 8 (average from table 2). The test result of N 7 (Hafi RSC) is shown on fig. 5.

The average values of the Total Power P_t , Active Power P_a , Reactive Power P_r and the Power Factor PF for the actual operating compressors after the implementation of the measure is shown on table 3.

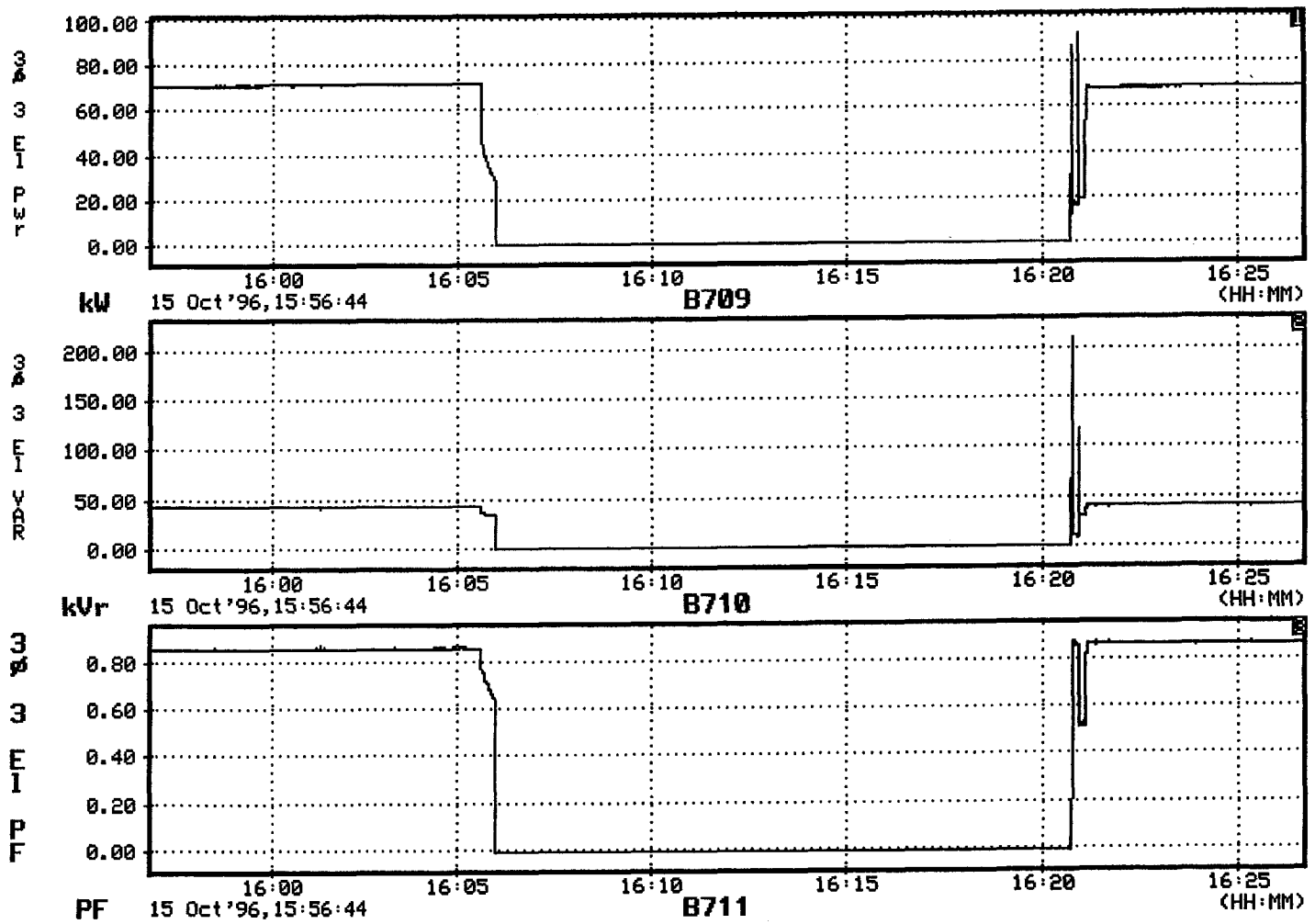

3Φ 3 EI PWR
100.00
80.00
60.00
40.00
20.00
0.00
16:00
16:05
16:10
16:15
16:20
16:25
(HH:MM)
kW
15 Oct'96,15:56:44
B709
3Φ 3 EI VAR
200.00
150.00
100.00
50.00
0.00
16:00
16:05
16:10
16:15
16:20
16:25
(HH:MM)
kVr
15 Oct'96,15:56:44
B710
3Φ 3 EI PF
0.80
0.60
0.40
0.20
0.00
16:00
16:05
16:10
16:15
16:20
16:25
(HH:MM)
PF
15 Oct'96,15:56:44
B711

FIG. 5

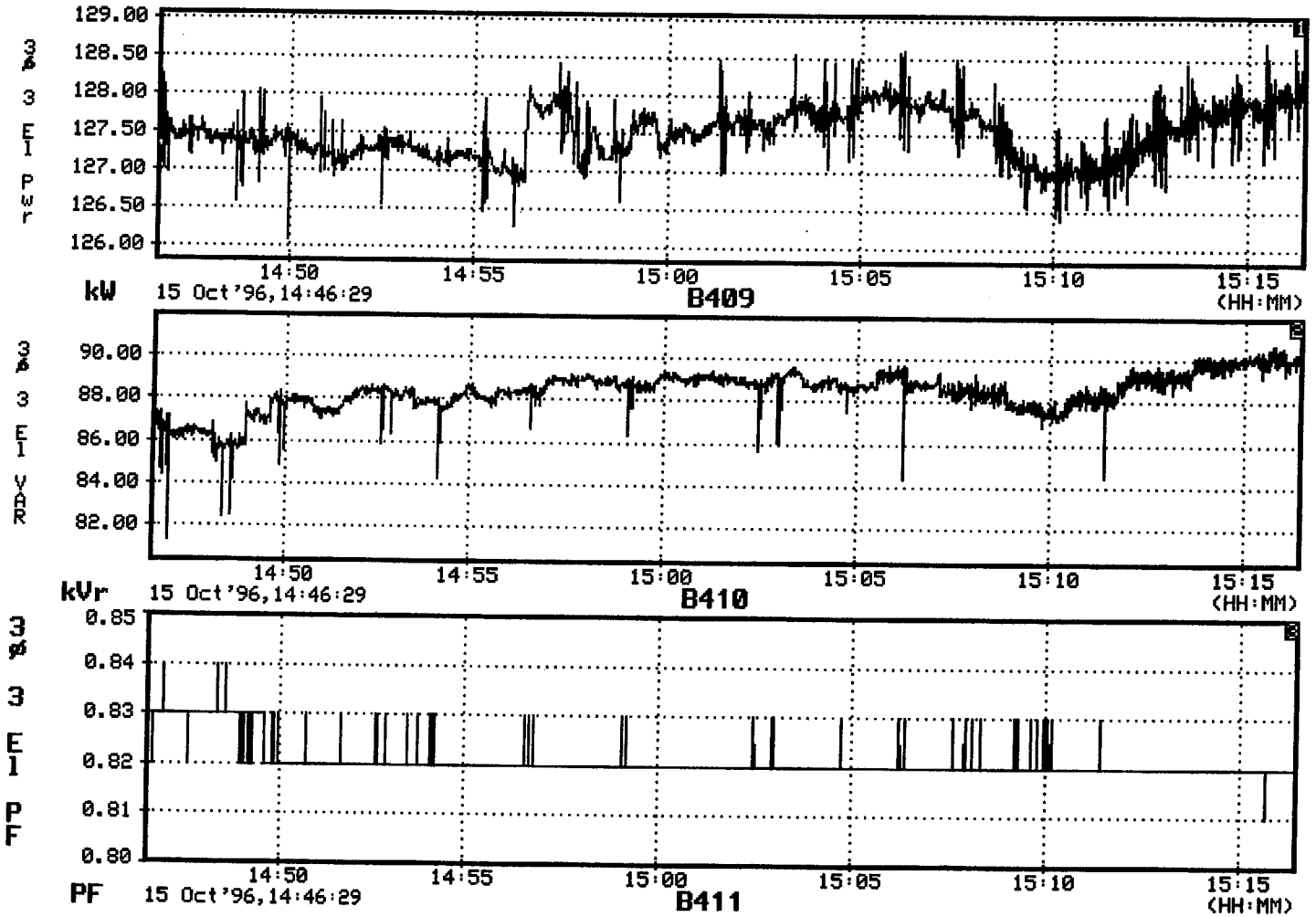

3 Φ 3 El Pwr
129.00
128.50
128.00
127.50
127.00
126.50
126.00
kW
15 Oct'96,14:46:29
B409
14:50
14:55
15:00
15:05
15:10
15:15
(HH:MM)
3 Φ 3 El VAR
90.00
88.00
86.00
84.00
82.00
kVr
15 Oct'96,14:46:29
B410
3 Φ 3 El PF
0.85
0.84
0.83
0.82
0.81
0.80
PF
15 Oct'96,14:46:29
B411

FIG. 6

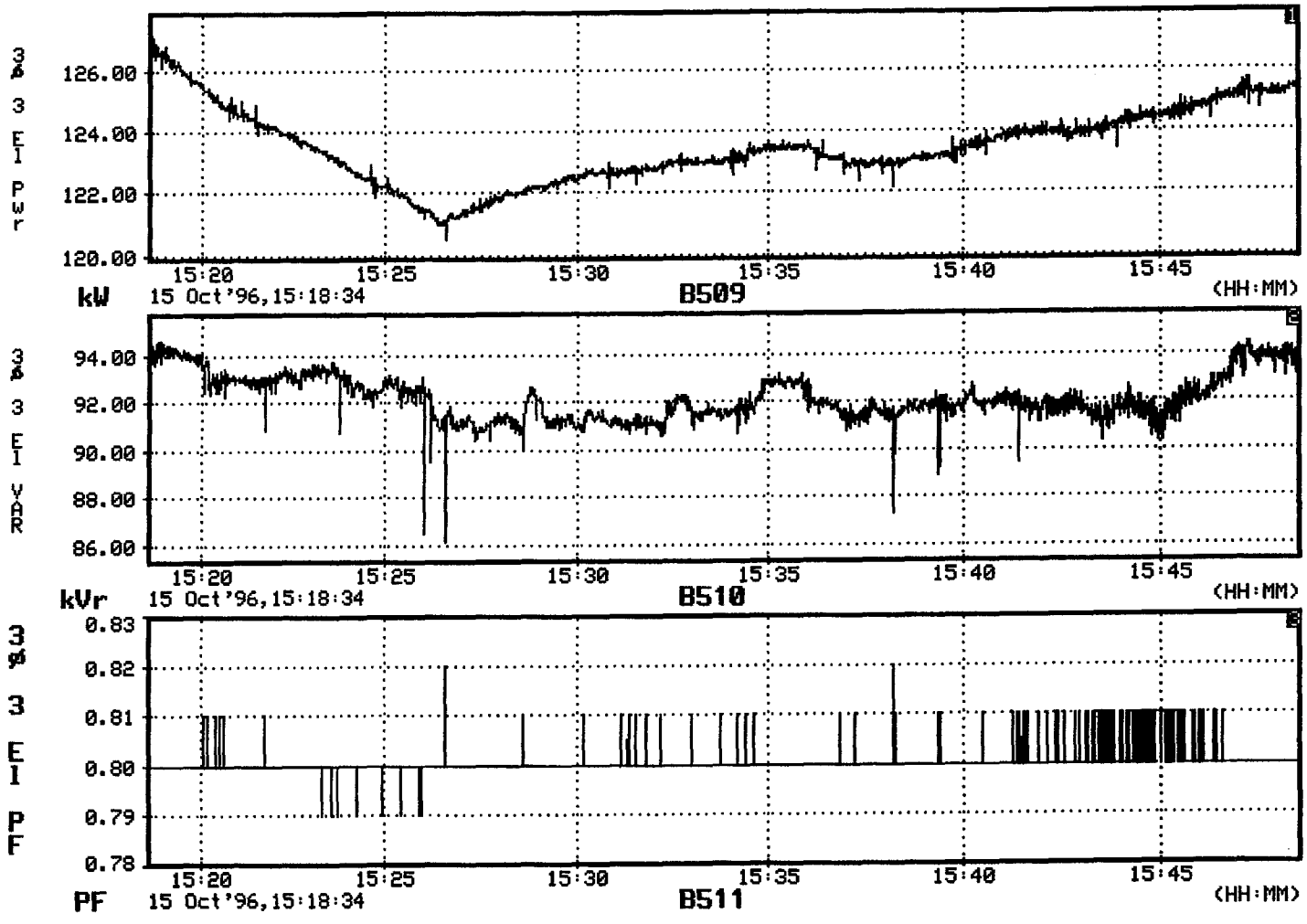

3 φ 3 EI Pwr
126.00
124.00
122.00
120.00
15:20
15:25
15:30
15:35
15:40
15:45
kW
15 Oct'96,15:18:34
B509
(HH:MM)
3 φ 3 EI VAR
94.00
92.00
90.00
88.00
86.00
15:20
15:25
15:30
15:35
15:40
15:45
kVr
15 Oct'96,15:18:34
B510
(HH:MM)
3 φ 3 EI PF
0.83
0.82
0.81
0.80
0.79
0.78
15:20
15:25
15:30
15:35
15:40
15:45
PF
15 Oct'96,15:18:34
B511
(HH:MM)

FIG. 7

Table 3

	New condition		
	2 old RAC's	Hafi RSC	Ingersoll Rand RSC
Active Power kw	254.2	66.7	125.5
Reactive Power kVAR	261.4	39.7	90.3
Power Factor PF	0.693	0.86	0.81
Total Power kVA	366.8	77.6	154.9

- Analysis of factors affecting the test results

The data shows, that the Total Power Consumption of the old compressors does not differ significantly at base mode of operation. The old compressors work continuously in this mode. For evaluation of the benefits of implementation the Ingersoll-Rand compressor and previously implemented Hafi RSC, the substitution of 2 average reciprocal units Total Power by the average value for the Ingersoll-Rand and Hafi RSC's is made. The new compressor works in modulating mode of control. The control function for the system in the experiment is taken by the Hafi RSC, operating in on/off mode, due to the smaller power and more efficient control.

6. Review of Economics of the Measure - Substitution of one 1 RAC with the new Ingersoll-Rand RSC.

6.1. Energy savings calculated on the base of point 5.

- Total energy power reduction per year:

  P_{t1} = 733,6 kVA

  P_{t2} = 599,3 kVA

  $\Delta P_t^y = (P_{t1} - P_{t2}) . Z = (733,6 - 599,3). 7000 = 940\ 100$ kVAh

  $\Delta P_a^y = \Delta P_t^y . PF_2 = 761\ 481$ kWh/y.

- The annual savings from power reduction are:

  $\Delta S_p^y = \Delta P_a^y . p_e =$ 8 528 597 BGL/y = 34 114 $/y.

6.2. Other Benefits.

- The annual savings from oil consumption:

  Annual oil expenses for the baseline condition:
  4 RAC's . 320 l/mth . 12 mth/y = 15 360 l/y . 500 BGL/l = 7 680 000 BGL/y = 30 720 $/y.

  Annual oil expenses for the new condition:
  2 RAC's . 320 l/y . 12 mth/y = 7 680 l/y . 500 BGL/l = 3 840 000 BGL/y = 15 360 $/y.
  Hafi + Ingersoll Rand RSC's = 70 + 80 = 150 l/y . 3000 BGL/l = 450 000 BGL/y = 1 800 $/y.
  Total 4 290 000 BGL/y = 17 160 $/y.

  The annual savings ΔS_{oil}^y are:
  7 680 000 - 4 290 000 = 3 390 000 BGL/y = 13 560 $/y.

  Remark: The different price of the oil is due to the different kind of lubricant used in the compressors.

- Annual water consumption savings from the 2 non-operating RAC's (there is no water consumption for the RSC's):

  2 RAC's . 10 Cu m/h . 7000 h/y . 12 BGL/Cu m = 1 680 000 BGL/y = 6720 $/y.

- Annual savings from spare parts - there are not significant sparings from spare parts.

6.3. Overall cost savings

8 528 587 + 3 390 000 + 1 680 000 = 13 698 587 BGL/y = 54 394 $/y.

6.4. Total project costs:

Engineering and design	2 000 USD
Equipment procurement	
■ Hafi RSC	30 000 USD (paid by the plant)
■ Ingersoll Rand	34 240 USD (donated by USAID)
■ refrigerated air drier	12 550 USD (donated by USAID)
Equipment installation, transport, startup	5 000 USD
Total costs	83 790 USD = 20 947 500 BGL.

6.5. Simple payback period

Payback period = 83 790 / 54 394 = 1,5 years.

Remark: *The difference between the planned payback period (0,7 years) and the actual estimated (1,5 years) is due to the still not completely implemented measures for compressed air savings in the air distribution system by the plant. These measures (installation of additional air drain traps, automatic air drain system, additional air dryers, etc.) are planned by the plant management for the next future execution.*

Measure II - 35 t/h boiler blowdown system energy efficiency improvement

1. Rational for the measure.

There are 2x35 t/h boilers in KMH Belovo. There is no automatic system for conductivity and blowdown rate control. The present Total Dissolved Solids (TDS) is maintained about 200 - 350 mg/kg, but the rated value, according to the Boiler producer must be 1500 mg/kg.

2. Description of the measure.

Installation of an Automatic boiler blowdown control system, maintaining the TDS at the rated value - 1500 mg/kg. - FIG. 8

3. Expected results:

Reduction of the heat and feed water losses.

- Baseline (existing conditions):

heat losses - 6686 GJ/y at 206 BGL/GJ	≅	1 380 000 BGL/y
feed water losses-6689 t/y at 20 BGL/t	≅	130 000 BGL/y
total losses cost	≅	**1 510 000 BGL/y**

- After recommended action:

heat losses - 873 GJ/y	≅	180 000 BGL/y
feed water losses - 947 t/y	≅	20 000 BGL/y
total losses cost	≅	**200 000 BGL/y**

- Total cost net reduction: ≅ 1 310 000 BGL/y
  ≅ 19 850 USD/y

Remark: The evaluation of the heat losses cost is made at boiler efficiency - 90 % and gas fuel cost - 6.3 BGL/Cu m and exchange rate 66 BGL/$. Now the exchange rate is much higher, but the fuel price has also risen.

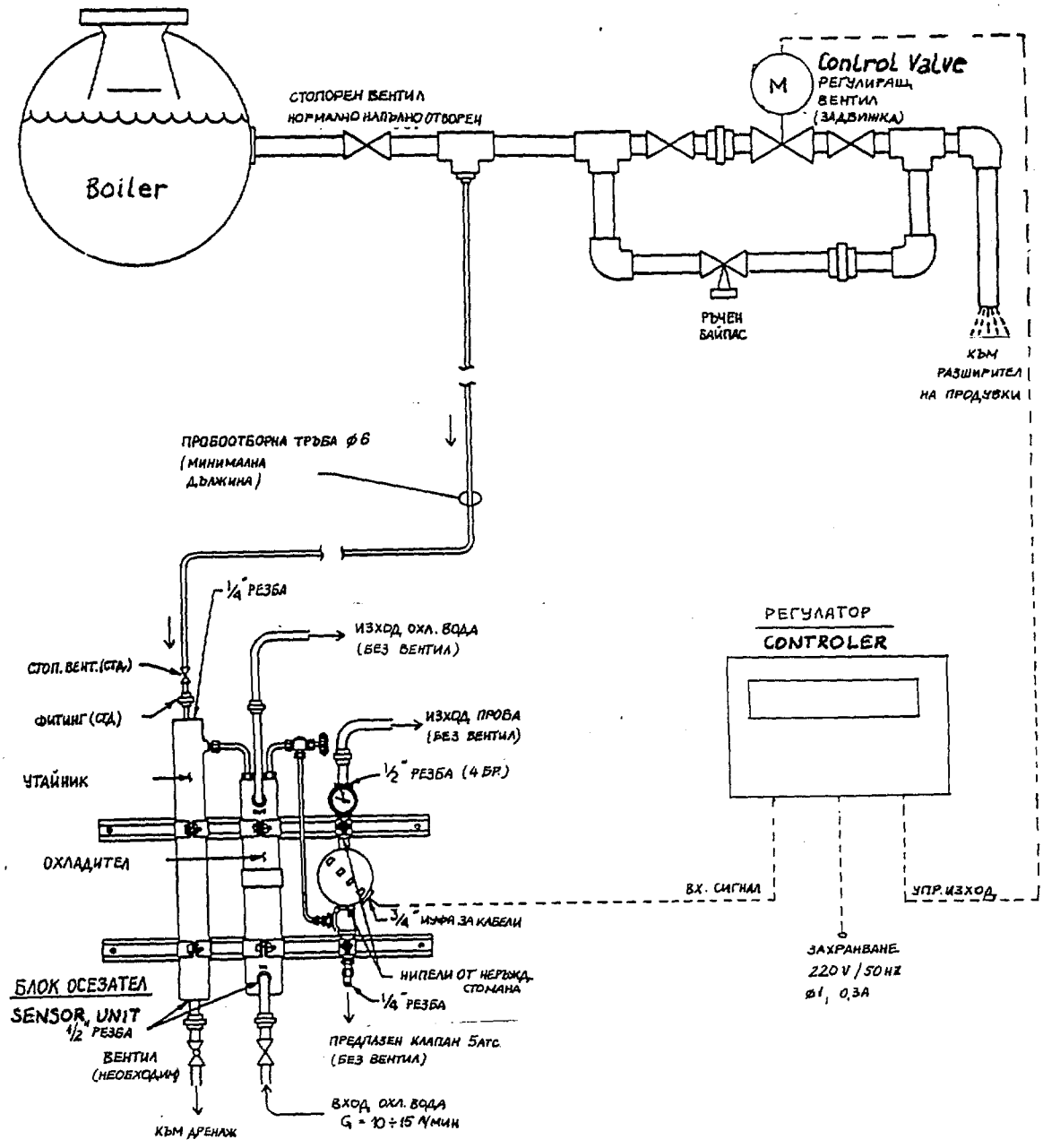

Boiler
СТОПОРЕН ВЕНТИЛ
НОРМАЛНО НАПЪЛНО ОТВОРЕН
Control Valve
РЕГУЛИРАЩ ВЕНТИЛ (ЗАДВИЖКА)
M
РЪЧЕН БАЙПАС
КЪМ РАЗШИРИТЕЛ НА ПРОДУВКИ
ПРОБООТБОРНА ТРЪБА ϕ6 (МИНИМАЛНА ДЪЛЖИНА)
1/4" РЕЗБА
ИЗХОД ОХЛ. ВОДА (БЕЗ ВЕНТИЛ)
СТОП. ВЕНТ. (СТД.)
ФИТИНГ (СТД.)
ИЗХОД ПРОВА (БЕЗ ВЕНТИЛ)
1/2" РЕЗБА (4 БР.)
УТАЙНИК
ОХЛАДИТЕЛ
РЕГУЛАТОР
CONTROLER
ВХ. СИГНАЛ
УПР. ИЗХОД
3/4" МУФА ЗА КАБЕЛИ
НИПЕЛИ ОТ НЕРЪЖД. СТОМАНА
1/4" РЕЗБА
ЗАХРАНВАНЕ 220 V / 50 Hz ϕ1, 0,3A
БЛОК ОСЕЗАТЕЛ
SENSOR UNIT
1/2" РЕЗБА
ВЕНТИЛ (НЕОБХОДИМ)
ПРЕДПАЗЕН КЛАПАН 5 atc. (БЕЗ ВЕНТИЛ)
ВХОД ОХЛ. ВОДА G = 10 ÷ 15 l/мин
КЪМ ДРЕНАЖ

FIG. 8

4. Project cost:

Engineering design	- USD	2 000
Equipment procurement	- USD	5 755
Equipment installation	- USD	500
Total installed cost	**- USD**	**8 255**

Payback period = 8255/19850 = 0.4 years (5 months)

Remark: Taking in account the results of the implementation of Phase 1 actions, with expected savings of USD 12 570, the total saving from the present action, will be reduced to USD 7 280. In this case, the payback period will be = 8255/7280 = 1.1 years=14 months.

5. Implementation schedule.

This automatic blow-down system is installed, but not put in operation yet, due to the not proper operation of the deaerator and the necessity of rebuilding the heat recovery system, connected with blow-down flash tank. The whole system was redesigned and now is under reconstruction. At the end of January 1997 this system and the connected with it blow-down control equipment and the flash tank level control system from Phase I project, are expected to be put in operation.

Plant-wide Results

The proposed two measures are very important for the total energy efficiency of the plant, especially measure N.1. The test results for measure N.1 illustrate the significant benefit from this proposal which was predicted during the energy audit. The purchase of new RSC Hafi was energy efficient measure taken by the plant, outside the scope of the USAID project. After the implementation of Ingersoll-Rand RSC the plant management became aware of the need of purchasing an additional unit in order to replace old RAC's.

Recommendation

It is necessary to improve the compressed air distribution system in order to decrease the big amount of leakages. This statement is proved by the audit results. The difference between estimated pay-back periods in the project submission and actual results obtained here is due to the lack of air compressor distribution improvement from the plant energy management.

Significance of the projects

1. For the CEM

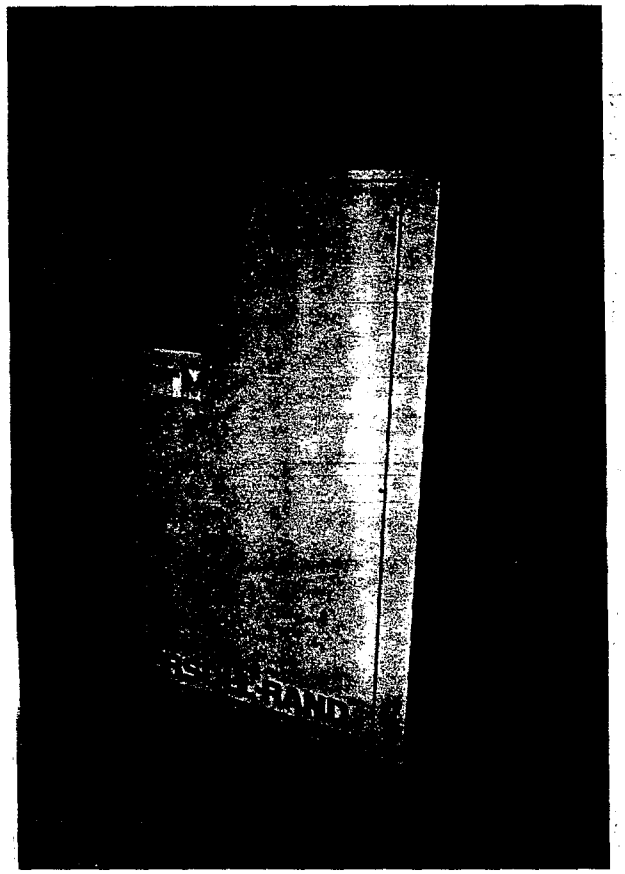
- They have got the CEM certificate,
- The CEMs learned more about audit preparation, performance contracting and american business style,
- Solved practical engineering problems,
- Earned self confidence and plant management trust,
- Made 5 engineering contracts,
- New clients.

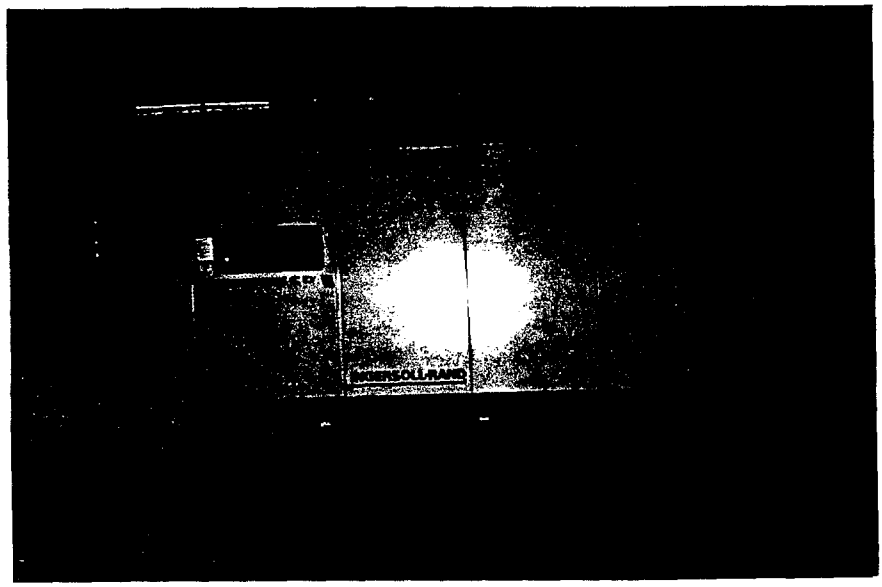
2. For the plant

- The plant management became aware of the importance of their own energy efficiency problems,
- They got energy efficiency equipment donated for over 60 000 USD,
- After project termination the plant will decrease the energy consumption with more than 110 000 $/y.

3. For Bulgaria

This is the first practical energy efficiency program that leaves not only files of paper but operating energy saving equipment and human potential of well trained and certified technical specialists.





MONITORING & EVALUATION
REPORT
VARNA SHIPYARD

A review has been made over the 2 stages of contract EUR-00-2053-00 between "Varna Shipyard" and USAID. Since 1994 66 steam traps and a pressure reducing valve were delivered as equipment for the I stage of the contract. The total sum of delivery was 10 000 $. Another 12 300 $ were invested by the Shipyard in order to prevent damages of the delivered equipment. Since April 1996 an economy of 14080 $ from fuel savings and 2 820 $ from treated water savings were made. For the second stage a waste heat boiler was delivered. According to preliminary calculations it had to supply steam to the most distant consumers, which are consuming fuel for 658 $ daily, 80 days out of the heating season. The equipment price is 16 966 $ and another 2 000 $ are invested from the Shipyard to the moment. Due to the differences between Bulgarian and American Standards concerning the boiler documentation, it has not been put into operation, but a procedure has been established on how to proceed in order The Pressure Vessel Inspector to put the boiler in operation. It is expected the payback period to be not more than 29 days out of the heating season.

Re: USAID Industrial Energy Efficiency Project in Bulgaria II phase

Plant name: Varna Shipyard

Consulting company: Argus '91, Varna, Bulgaria

Waste Heat Steam Boiler

Since 1994, 66 steam traps and a pressure reducing valve were delivered as equipment for the I[st] stage of the contract. The total sum of delivery was 10 000 $. Another 12 300 $ were invested by the Shipyard mainly in order to prevent damages of the delivered equipment. Since April 1996 an economy of 14 080 $ from fuel savings and 2 820 $ from treated water savings were made.

For the second stage a waste heat steam boiler was purchased and delivered. According to preliminary calculations it had to supply steam to the most distant consumers, which are consuming fuel for 658 $ daily, 80 days out of the heating season. It comes from 4 tons of heavy oil burned in 12 ton boiler, 3 hours daily for 80 days. It means 320 tons at price of 165 $/ton at the moment, or 52 800 $ for 80 days. These data are collected for the last 3 years from the shipyard's staff and were thoroughly checked by an experiment in 3 different days by a representative from consulting firm and the Energy Manager of the Shipyard. The results proved the preliminary figures.

Keeping in mind that the steam is used mainly for presses and vanes (but not simultaneously), it was assumed that a quantity of steam of 220 kg/h can be obtained from stack gas of a forge, in near vicinity of all these consumers, so that the 12 ton boiler would not be operated at all. The consumption of the steam is divided among:

- 3 timber dryers consuming 210 kg/h steam each
- 1 press consuming 160 kg/h steam and one more, consuming 94 kg/h
- 2 degreasing vanes consuming 105 kg/h each

The steam is used mainly for the presses and very rear for the vanes. The timber dryers are working only through the heating season, because it would be very expensive to spend 4 tons of heavy oil for drying only. For the heating season, the steam will be used for heating some of the offices that are not heated at the moment.

The equipment price is 16 966 $ and another 2 000 $ are invested from the Shipyard to the moment. Due to the differences between Bulgarian and

American Standards concerning the boiler documentation, it has not been put into operation, but a procedure has been established in order The Pressure Vessel Inspector to put the boiler into operation. So the installation procedure consisted of a project design carried out by the plant's staff, for 2 months - May and June. Making a steel rig and installing it on site, installation of the necessary pipelines and connecting them to the boiler - from August to the middle of September.

Another kind of activity was to take a permission from the Pressure Vessel Inspector. A new passport of the boiler was made, which is according to the Bulgarian Standard, using a state laboratory. It took from June to December, and is not finished yet, because meanwhile the Energy Manager of the Shipyard was changed and in this way the last member of the team that started the project left the plant.

In order to establish the correct figures of the payback period, a procedure was negotiated between the plant's managers and the consulting company-Argus '91. It is assumed that the main impact over the shipyard's economy is because of the saved fuel. As it is already established, the fuel consumption when the presses are working is 4 tons per 3 hours working day, so each day when they are under operation and the boiler is not fired, a saving of 658 $ is made. In this way the only measurement is of time. As there is a diary in the boiler house, in which every operation is noted and on another hand a similar diary exists for the work of the presses, no additional measures were necessary. As for the timber dryers and degreasing vanes, when they need a steam, a personnel from the boiler house has to operate the system, as it is under pressure, changing the steam direction, and he is obliged to put a remark in the diary, so again it is only the time which has to be measured - i.e. taken from the notes. If meanwhile a boiler is operated for some reason, in order to supply steam to any of these consumers, this operation has to be noted in the diary and it is clearly seen, so this period will not be taken as an economy. Because of the long distance between the boiler house and the three consumers, when they need steam, the boiler works at full load and at maximum consumption of 1.3 tons of heavy oil per hour, so it is not possible to make a mistake in calculations of used fuel.

As it was already shown, the main consumer - the presses were working for 80 days out of the heating season, because of the big fuel consumption. The timber dryers were not operated at all out of the heating season, and the degreasing vanes work using electricity. It is expected that after obtaining steam from the waste heat boiler, the working day of the presses will become a normal 8 hours day, in which one of the presses will work for 4 hours and the other one - the other 4 hours. It could reduce the engaged personnel as it would not be necessary to work on the both machines simultaneously like nowadays, because of the steam supply. On another hand, when the smaller press is working, its consumption is 94 kg/h, so half of the steam could be given to one of the vanes. In the days when the presses are not working, the whole amount of steam could be pointed to the dryers and depending on their

needs, a timetable could be made about the working time of the different pieces of equipment.

Considering the payback period for the II stage of the contract, all the calculations are made on the basis of the working time of the presses - 80 days out of the heating season, 3 days daily, at consumption of 4 tons of heavy oil daily. If the machines are working without firing the boiler, and the daily production is the same, (in fact it is expected to increase, because the working time of the both presses would be 4 hours each, instead of 3 hours up to now) a saving of 658 $ daily is guaranteed. If the working days remain the same number - 80, (they depend on the Shipyard's needs) an annual savings of 52 640 $ for one season. The expected expenses are as follows:

16 966 $ Equipment from USAID - waste heat boiler
2 000 $ Expenses for Project designing, pipelines and metal works
1 000 $ Expenses for a passport of the boiler

Total expenses to the moment 19 966 $. If a calculation is made on the basis of daily savings of 658 $, it means that the payback period will be 30 days. If the reference figure is the seasonal saving based on the work of the presses only - 52 640 $, the payback period will be for 0.37 x 6 = 2 months and 6 days. For the moment the dryers and degreasing vanes are not using steam as it is very expensive for the purpose, but as it is planned to obtain steam from waste heat, they will use it. So the first figure of payback period for 30 days seems to be more realistic, but in any case, the second one - for 2 months and 6 days out of the heating season is the longest possible.

As it is difficult to estimate the energy savings through the heating season, they have not been included in the main balance. The intention of the Shipyard's managerial staff is to use the waste heat steam for heating some of the offices in the departments nearby, as at the moment they are using electricity for the purpose. A special measuring equipment would be necessary in order to give reliable data for energy savings through winter time, and it was estimated that the expenses for equipment and people involved in this measurement would not be adequate to the results, as there is no data available for the electricity used for heating. The electric wire network is not divided in branches according heating and technological equipment, so a lot of measuring devices would be necessary to gather reliable data. That's why the winter savings could be added as a bonus to the summer once and maybe the non financial benefits of the waste heat usage in the winter time will be much more valuable. It will reflect in warmer working places, connected with increased working time, less sick-leaves and possibly increasing of productivity.

As a whole the measures of first and second stages in "Varna Shipyard" proved to be reliable basis for a future energy savings. The fact that for the first stage the plant invested almost the same quantity of money in order to prevent damages of the delivered equipment and after that a program started to repair and continue the condense pipeline in order to build a new closed

loop system is a good indicator for future activity. As the prices of all kinds of energy increased 4.5 times in 1996, a lot of new measures are under discussion now. They vary from changing the burners to buying a heat pump for hot water supply but it is extremely difficult now to buy an equipment from abroad, as the national currency lost its value 7 times and this is a kind of restriction about using only home made equipment which is not always efficient enough.

As for the significance of this project to the plant, it is obvious that a payback period of 2.2 months is much more an exception rather than a rule, but it was a good example to the managerial staff for how efficient measures could be. Several other measures that were discussed for possible second stage, like changing the heating media from steam to hot water, using geothermal water for heating the condensers in the Liquid Oxygen plant, and several other are now under discussion for implementation. May be it is not clear the connection between two stages of the contract and the discussed measures, but the discussions over these problems and the initial estimation of the possible savings under the changing conditions in the country, proved the increasing potential of this approach. As a direct consequence of the first stage it is the condense system, which is under construction now.

The biggest problem for the project were the frequent changes in the managerial staff. They had very negative influence on all activities, as it was necessary to start everything from the beginning as a new person becomes the new head of the department. Unfortunately it happened 2 times for the Energy Department, not mentioning the higher level changes, which reflected in more than 4 months delay for the second stage.

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MONITORING & EVALUATION REPORT ZMM

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PHASE II MEASURE MONITORING AND EVALUATION REPORT
(Deliverable 3)

of ZMM ENERGY EFFICIENCY PROJECT

Prepared for: *USAID*
Hagler Bailly Consulting, Inc.

Prepared by: *Dimitar Baev, Consultant*

DECEMBER 1996

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1. General introduction

The audit was carried out on the base of contract No 12 from 07.12.1993 between ZMM Inc. - Sofia and ET "Dimitar Baev - DBC". It is implemented as a part of the Project of the US Agency of International Development (USAID) for energy efficiency in Bulgaria and includes the participation of an expert-consultant of the Hagler Bailly Consulting, Inc. and the gratuitous supply of suitable energy-conservation equipment to the plant.

The audit had been reported, discussed and approved by the Energy Efficiency Commission of the plant on June 1994. The list of the equipment to be donated to the plant was approved in August 1994 and delivered to the plant in April 1995.

The medium term energy saving program, based on the proposed measures in the audit was approved by the Board of Directors of the plant. The decision was taken to support the most effective measures. A new contract was signed between the plant and DBC team in December 1994 for development of a Technical project for the following measures:

- Lighting Systems of Shop-floors 03 and 06 Improvement;
- Extension of the Energy Monitoring and Control System.
- Power Factor Improvement;
- Local Thermal Power Station;

The issues of this project were used for the application of ZMM to the Phase II of USAID Program. The first two proposals were approved to be sponsored by USAID Program. The plant decided to finance the development and implementation of the local station and power factor improvement. The Technical project was developed and approved by the plant management in October 1995. The specified energy saving equipment for the first two systems has been delivered to the plant during the period of time May - September 1996. The installation of the Local thermal power station imposed some changes in the locations of the heatmeters and in the schedule of implementation of the Extension if the Energy Monitoring and Control System.

The plant is in very difficult financial situation and there in no available funds to cover the orders, to support the operations and to invest in innovations.

2. Measure presentations

2.1 Lighting systems of shop-floors 03 and 06 improvement

2.1.1 Rationale for the measure

See the applied Table 1.1 in Appendix **1**

2.1.2 Description of the measure

Existing conditions

The size of each shop floor is 18m x 132m. There are four rows of machines and two passages between them. In each shop-floor area 210 x 400 W mercury lamps are installed.

A. Recommended actions according to the Energy Audit and the Technical Project

- To replace the mercury lamps by 200 x 150 W high pressure sodium lamps. For local lighting to install compact lamps with high frequency supply. The reduction of the demand in each shop-floor section is 54 kW.

- Lighting control system installation with daylight sensors; turns lights at schedule time, preset light level. The number of separately controlled zones in each shop-floor section is 8.

Required costs

Capital investments

N	Equipment	Type	number	producer	supplier	price/ unit $ US	Total price $ US
1	High pressure sodium lamps	150 W	400	SVETLINA - Sliven	SVETLINA - Sliven	15	6 000
2	Reactor coils	150 W	400	Plant for reactor coils - Sliven	Plant for reactor coils - Sliven	11	4 400
3	Starting device	150 W	400	DENIMA-Sofia	DENIMA-Sofia	7	2 800
4	Capacitors	16 mF 250 V	400	CONIS - Ltd. Kjustendil	CONIS - Ltd. Kjustendil	3	1 200
5	Lighting control system	Infinity	1	Andover Controls	IVEL - Ltd. Plovdiv	4 000	4 000
6	Local lighting		40			54	2 160
7	**Total**						**20 560**

Projects, engineering and installations

- engineering design - $ 2 000
- installations - $ 1 846
- Total - $ 3 846

Total costs: $ 28 252

Expected results - effect of recommendation

- Installed demand savings - 270 000 kWh
- Savings from automation control - 100 000 kWh
- Total savings - 370 000 kWh

Annual cost savings - $ 11 385

Payback period - 2.48 years or 2 years and 6 months.

Implementation schedule - 1996

B. Measures approved after receiving of the proposals of the suppliers

After receiving of the proposals of the suppliers and comparison and evaluation of the proposed options the following option has been approved:

To install 64 new fixtures and sources 400W HPS in each of the shop-floors. The advantages of this proposal are:

- completely new installation, ensuring high quality light;
- no need of lamp assembly, only installation;
- more cost / effective project;

The following equipment has been delivered to the plant (for more detailed information see the table of the letter of acceptance of the equipment in Appendix 1):

N	Qty.	Part #	Description	Total Price $US
1	128	BL-400 SE-LB1	Industrial lighting fixtures, Hubbell	17,024
2	156	LU 400, E -40	High pressure sodium lamps, Hubbell	1,872
3	2	LCX 810	Lighting controllers, Andover Control	2,960
4	8	MK7-BCCS-1/5	Light sensors for skylight, Andover Control	960
5	Total			22,816

2.1.3 Implementation

After the development of the design project the equipment has been installed according to the following schematic (Fig. 1.1).

Timetable of the implementation process:

N	Implementation process	Time period
1	Technical project	March-September'95
2	Technical specifications approval	October'96-May'96
3	Equipment procurement	August-September'96
4	Installation in the shop-floor 06	October-November'96
5	Installation in the shop-floor 03	November-December'96
6	Automation control system installation	December'96-January'97

2.1.4 Monitoring methodology and procedures

Monitoring methodology and procedures are based on the following;

- Calculated installed demand before and after implementation of the measure;
  For each of the shop-floors:
  before installation demand = 210 x 400 W = 84,000 W
  after installation demand = 64 x 400 W = 25,600 W
  saved demand = 146 x 400 W = 58,400 W
- Counting of the working and non-working lamps;
- Corrective calculations for taking in consideration non-working lamps;
- Measurements of lighting energy consumption before and after implementation of the measure - 24- hour load patterns of the energy consumption;
- Parallel measurements and comparison of the consumption and lighting in absolutely equal shop-floors - 06 (with installed new system) and 03 (with old system) - 4 x 24-hours load patterns of the energy consumption in November - the most representative month for winter;
- Electricity Energy prices:
  Winter prices
  Daily consumption - 11.95 BGL/kWh (6-7 h, 11-17 h, 21 h)
  Night consumption - 5.91 BGL/kWh (1-5 h, 22-24 h)
  Peak consumption - 22.16 BGL/kWh (8-10 h, 16-20 h)
  Summer prices
  Daily consumption - 10.43 BGL/kWh (6-7 h, 11-17 h, 21 h)
  Night consumption - 5.20 BGL/kWh (1-5 h, 22-24 h)
  Peak consumption - 19.21 BGL/kWh (8-10 h, 16-20 h)
- Calculations of the winter (6 months) and summer (6 months) consumption according to the corresponding tariff zones
- Measurements and comparison of the quality of lighting.

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Monitoring and Implementation Program

N	Action	Time period
1	Baseline data gathering from records	September-December'95 September-December'96
2	Measurements before implementation	September-Octoberer'96
3	Implementation in shop-floor 06 (start-up)	October-November'96
4	Parallel measurements in shop-floors 06 and 03	November'96
4	Measurements after implementation	November-December'96
5	Implementation in shop-floor 03	November- December'96
6	Validation of data and adjustments	December'96

Monitoring equipment specification:

- Electrometers installed according to the schematics (Fig 1.2 and Fig.1.3) applied in Appendix 1;
- Portable Electricity Kit for corrective measurements;
- Rustrac Ranger II Power Harmonic Analyzer for corrective measurements;
- Lightmeter.

Monitoring equipment locations - control blocks of the lighting systems in shop-floors 03 and 06.
The methodology, procedures and program are approved by plant management in September 15, 1996.

2.1.5 Results of Measurements and Monitoring

(a) Baseline energy data before implementation of the measure;

The results of 24-hours load pattern measurements performed in October 30 are shown in Table 1.2 in Appendix 1.

- The daily consumption is 381.0 kWh.
  Cost of the consumed electricity energy: 381.0 kWh x 11.95 BGL = 4,552.95 BGL
- The night consumption is 13.6 kWh
  Cost of the consumed electricity energy: 13.6 kWh x 5.91 BGL = 80.38 BGL
- The peak consumption is 219.6 kWh
  Cost of the consumed electricity energy: 219.6 kWh x 22.16 BGL = 4,866.37 BGL

- **The total 24-hours consumption is kWh**

Cost of the consumed electricity energy: kWh x 22.16 BGL = 9,499.67 BGL

(b) Energy data after implementation of the measure;

The results of 4 x 24-hours parallel load pattern measurements in shop-floors 03 and 06 performed in November 13-16 are shown in Table 1.2 and Table 1.3 in Appendix 1. The average value of the load patterns are shown in Fig. 1.4 and Fig. 1.5.

For shop-floor 03 with the old lighting system (210x400W mercury lamps):

- The number of not-working lamps: 62 (29.5 %)
- The average daily consumption is 367.5 kWh.
  Cost of the consumed electricity energy: 367.5 kWh x 11.95 BGL = 4,499.2 BGL
- The average night consumption is 14.4 kWh
  Cost of the consumed electricity energy: 14.4 kWh x 5.91 BGL = 85.1 BGL
- The average peak consumption is 219.4 kWh
  Cost of the consumed electricity energy: 219 4 kWh x 22.16 BGL = 4,861.9 BGL

Cost of the consumed electricity energy for 24-hours: 9,446.2 BGL

For shop-floor 06 with the new light system(64 new fixtures and 64x400W HPSL):

- The number of not-working lamps: 0
- The average daily consumption is 150.15 kWh.
  Cost of the consumed electricity energy: 150.15 kWh x 11.95 BGL = 1,794.3 BGL
- The average night consumption is 13.60 kWh
  Cost of the consumed electricity energy: 13.60 kWh x 5.91 BGL = 80.4 BGL
- The average peak consumption is 88.50 kWh
  Cost of the consumed electricity energy: 88.50 kWh x 22.16 BGL = 1,961.2BGL

Cost of the consumed electricity energy for 24-hours: 3,835.9 BGL

Savings:

For winter months (October-March) based on the performed measurements:

- For daily zone - 2,704.90 BGL (60.0%)
- For night zone - 4.72 BGL(5.5%)
- For peak zone - 2,900.00 BGL(59.4%)

Total savings for 24-hours- 5,609.62 BGL(59.3%)
Savings for 1 month - 123,428 BGL

For summer months (April-September) based on the assumption that the consumption is 10% less:

- For daily zone - 2,122.60 BGL (60.0%)
- For night zone - 4.20 BGL (6.2%)
- For peak zone - 2,272.40 BGL (59.6%)

Total savings for 24-hours- 4,399.20 BGL (59.4%)
Savings for 1 month - 96,782 BGL

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Savings for 1 year in shop-floor 06:
(123,428 x 6) + (96,782 x 6) = 740,568 + 580,692 = 1,321,260 BGL

Savings for 1 year in shop-floor 06 and 03:
1,321,260 x 2 = 2,642,520 BGL; Exchange rate in November 30 - 355 BGL = 1 $US

Savings in $US: 2,642,520 : 355 = 7,444 $US / year

(c) Analyses of the factors affecting the baseline data but not taken into account in the calculations;

The baseline data do not take into account the fact that 30% of the mercury lamp did not work, the light level was lower than specified requirements and as a result the consumption was reduced.

The average value of the light level of the old system is 140 lx.
The average value of the light level of the new system is 340 lx.

This difference could be explained by:

- 30% not working lamps;
- depreciation of the old lamps;
- better lighting parameters of the new lamps.

In order to avoid the influence of the not working lamps, corrective calculations have been done, following the approved methodology. The total savings under the assumption that 100% of lamps in the old system work are:

- **106,940 kWh / year;**
- **1,990,704 BGL / year = 5,608 $US / year for shop-floor 06**
- **11,216 $US / year for shop-floor 06 and shop-floor 03**

2.1.6 Review of the Economics of the Measure

Financial analysis of the measure based on the comparison of baseline data and results of the measurements after implementation is given in the following tables. Data for real material costs and reduced cost for installation works as a result of a complex delivery of fixtures and lamps are used.

Financial Analysis:

a) real situation - 30% not working lamps

Material Costs	Installation/ Design Costs	Total Project Costs	Annual O&M Costs
22,816	3,246	26,062	

Benefits Energy Savings	% Savings from base case	Physical Savings	Money Savings in $US
Fuel (MBTU)			
Electricity (kWh)	59.4	88,737	7,444
Total Savings	59.4	88,737	7,444
Payback (years)			3.50

b) corrective calculations under assumption of 100% working mercury lamps (see also Table 1.4)

Material Costs	Installation/ Design Costs	Total Project Costs	Annual O&M Costs
22,816	3,846	26,662	

Benefits Energy Savings	% Savings from base case	Physical Savings	Money Savings in $US
Fuel (MBTU)			
Electricity (kWh)	70.3	106,940	11,216
Total Savings	70.3	106,940	11,216
Payback (years)			2.38

This estimation of the results is more realistic and take into account the improved quality of lighting in accordance with the requirements of working in manufacturing environment. These results are close and a little bit better than the expected ones because of the better cost /effective ratio of the donated equipment. The expectations are that after the start-up of the automation control system the saved energy and costs will be additionally improved by 10%.

2.2 Extension of the Energy Monitoring and Control System

2.2.1 Rationale for the measure

To extend the existing Energy Monitoring and Control system adding new functions (information and control) and increasing the scope of the system. The delivered equipment is in process of installation. The summary of the expected results, based on the real estimation of the costs is shown in the following table.

Material Costs	Installation/ Design Costs	Total Project Costs	Annual O&M Costs
$ 32,816	$ 9,500	$ 41,891	$ 3,500

Benefits Energy Savings	% Savings from base case	Physical Savings Gcal)	Money Savings in $US
steam	7	460	13,650
hot water	5	454	11,334
Electricity (kWh)			
Total Savings		914	24,984
Payback (years)			1,67

2.2.2 Description of the measure

Existing conditions

The first phase of Energy Monitoring and Control System has been implemented in the plant. It is based on the System "ImPac 500", produced and delivered by Bulgarian company "INLOG". The following is included in this phase:

- Operator station (OS) InPac 400 - 1 unit - monitoring of the electrical energy consumption of the electrical and thermal energy, information processing, flowcharts and energy balances preparation. Hardware configuration includes PC AT 386, printer LC 15 - STAR and communication module CNC 210 (ARCNET).
- Electrical Energy Consumption Controller InPac 200 - 1 unit - acquisition and storing of data from 54 electrometers for active and reactive electrical energy.
- Conventional Heat Meter InPac 100 - 4 units - measuring of the heat and velocity of steam.
- Heatmeters - 3 units - measuring of the heat and velocity of hot water.

All devices are connected in network by twisted pair. The total distance is 1 500 m, the rate of information exchange - 125 Kbit / sec.

A. Recommended actions according to the Energy Audit and the Technical Project

To expend the existing thermal monitoring system of 4 heatmeters for steam and 3 heatmeters for hot water with the following:

For steam distribution system

To add in 2 of the points with existing heatmeters 2 control modules and 2 controlled valves. These 2 points are:

- the diversion to the galvanic shop-floor - diameter of the pipe 89 mm, flow 1 t/h, pressure 8 atm., temperature 200 C.
- the diversion to the shop-floor 05 - diameter of the pipe 57 mm, flow 1 t/h, pressure 8 atm., temperature 200 C.

To add 2 new heatmeters in the diversion to the painting shop-floor and to the restaurant.

For hot water distribution system

To add 2 new heat meters, 2 control modules and 2 controlled valves in the following points:

- the diversion to the shop-floor 01 - diameter of the pipe 219 mm, flow 6 100 kW/h, pressure 6 atm. nominal and 16 atm. max., temperature 72 C.
- the diversion to the FMS - PKD - diameter of the pipe 133 mm, , flow 6 100 kW/h, pressure 6 atm. nominal and 16 atm. max., temperature 72 C.

To add 1 new heatmeter in the diversion to the painting shop-floor.

The purpose of the Monitoring and Control System is:

- To improve the information of real consumption of the different consumers and to develop standard norms of consumption;
- To improve the control of distribution and supply of steam and hot water to the consumers, according to the time schedule and limitations.

Proposal for equipment

N	Equipment	Type	number	producer	supplier	price/ unit $ US	Total price $ US
1	Heat consumption controller	InPac 200	5	INLOG - Bg	INLOG - Bg	1 300	6 500
2	Chamber connection and diaphragm <50 mm.		2	INLOG - Bg	INLOG - Bg	490	980
3	Chamber connection and diaphragm <100 mm.		3	INLOG - Bg	INLOG - Bg	490	1 470
4	Thermometer	TCPT	8	Pribor - Bg	INLOG - Bg	40	320
5	Transducer P / I	Sapfir - 22DD	5	Electron - Bg	INLOG - Bg	720	3 600
6	Transducer P / I	Sapfir - 22D	2	Electron - Bg	INLOG - Bg	700	1 400
7	Additional control module	InPac - 200 - C	4	INLOG - Bg	INLOG - Bg	500	2 000
8	Valves		4			appr. 4 000	16 000
10	Personal computer	IBM PS/VP 6382	1	IBM	Prima Soft Ltd. Bg	1 900	1 900
11	Application software for energy accounting and monitoring	Faser and CU - SUM Sw.	1	Omni - comp USA		appr.2 000	2 000
	Total:						**36 170**

Expected results - effect of recommendation

Thermal part - steam

The annual consumption of steam is 7,300 Gcal. 90% of the consumption will be measured - 6,570 Gkal. and 30% will be controlled. The expected savings are 7 % or 460 Gkal. The expected cost savings are $ 13,650 / year.

Thermal part - hot water

The annual consumption of hot water is 16,500 Gcal. 55% of the consumption will be measured - 9,075 Gkal. and 35% will be controlled. The expected savings are 5 % or 454. The expected cost savings are $ 11,334 / year.

Payback period - 1,6 years

B. Measures approved after receiving of the proposals of the suppliers

After receiving of the proposals of the suppliers and comparison and evaluation of the proposed options and the budget limitations, the following equipment has been delivered to the plant:

N	Qty.	Part #	Description	Total Price $US
1	2	859108-1Â20-1À1-ITFJ5E	Steam control valves, - 3" and 2", Honeywell	6,103
2	2	859108-1Â20-2BJ è 2AJ	Hot water control valves - 6" and 5", Honeywell	8,535
3	4	InPac 200-C InPac 200	MPU Heat control module Heat meter/controller	3,720
4	3	InLog 100	Heat meter	2,520
5	1	5/50 VE2 Model 640	Computer system, Hewlett Packard	4,658
Total				25,536

The plant management agreed to share the investment and to cover the costs of the rest of the required equipment (connecting chambers, thermometers, transducers, etc.) . After the delivery of the major part of the equipment the hole required cost is estimated at 32,816 $US.

2.2.3 Implementation

The donated equipment has been delivered to the plant. The installation of the equipment is scheduled after implementation of the new Local Thermal Station which has been done by December 15, 1996.. The additional equipment has not been delivered in planned terms because of the financial troubles of the plant. The computer system helped very much for the extension of the energy information system. Samples of some of the applications (the influence of the shifting of the working hours on the load pattern in order to decrease peak consumption, time schedule for the local station) are presented in Application 2.

Timetable of the implementation process:

N	Implementation process	Time period
1	Technical project	March-September'95
2	Technical specifications approval	October'96-May'96
3	Equipment procurement	August-September'96
4	Planned installation	December'96-January'97
5	Planned implementation	January'97-March'97

2.2.4 Monitoring methodology and procedures

Monitoring methodology and procedures are based on the following;

- To use the records of the existing information thermal part of the Monitoring and Control System (existing 7 heatmeters) for 1995 and 1996 as baseline data before the installation of the system (see the location of the heatmeters in the applied schematics in Appendix 2);
- Additional calculations for determination of heat consumption in the diversion points;
- To use the records of the new installed heatmeters for determination of heat consumption in the diversion points after implementation of the measure.

Monitoring and Implementation Program

N	Action	Time period
1	Baseline data gathering from records	1995-1996
2	Measurements before implementation	Decebber'96-January'97
3	Implementation	December'96-March'97
4	Measurements after implementation	March'97-April'97
6	Validation of data and adjustments	April'97

Monitoring equipment specification:

- Constantly installed thermal part of the Monitoring and Control System;
- 3 installed hot water heatmeters;
- 4 installed steam heatmeters;
- Ultrasonic flowmeter;

The methodology, procedures and program are approved by plant management in September 15, 1996.

2.2.5 Results of Measurements and Monitoring

(a) Baseline energy and production data before implementation of the measure;

The existing thermal part of the Monitoring and Control System registrates the steam and hot water rate, heat consumption and temperature in every 1 hour. Samples of these 24-hours measurements are applied in Appendix 2. Data for steam and hot water consumption in 27 representative days in 1995 including 2 groups of 5 consecutive days are given in Table 2.1 and Table 2.2 in Appendix 2. Aggregate data for heat consumption by months of 1995 are given in Table 2.3 in Appendix 2. The supply of hot water and steam from the Central Thermal Station has been stopped from the beginning of 1996. The data of this transition period of introducing of the new local thermal station are not representative because of the reduced supply of energy for heating. After the start-up of the new system new additional baseline data from the installed heatmeters will be collected.

Measures identified in the Energy Audit and the Technical Project, performed by the project team of DBC and funded by ZMM

2.3 Power Factor Improvement

2.3.1 Rationale of the measure

See Table 3.1 in Appendix 3

2.3.2 Description of the measure

Existing conditions

There is no power factor correction system in the plant. 2, 221,100 BGL ($ 40,384) penalty were paid in 1993 when the penalty system was applied all the time.

A. Recommended actions according to the Energy Audit and the Technical Project

Required costs

Capital investments:

N	Equipment	Type	number	producer	supplier	price/ unit $ US	Total price $ US
1	Capacitors	MKP 93	150	KONIS Ltd. Kjustendil	KONIS Ltd. Kjustendil	54	8 100
2	Controllers and commutations		5 panels	Electrical equipment plant - Plovdiv.	Electrical equipment plant - Plovdiv.	769	3 846
3	Cables						796
4	Total						12 742

Project, engineering and installations

- project development $ 2 615
- checking and taking apart of the existing capacitors- $ 2 308
- installations $ 2 615
- cables installations - $ 932
- adjustment and implementation - $ 1 230
- Total: $ 9 700

Total costs: $ 22 442

Expected results - effect of recommendation - $ 33, 846/year
Payback period - 0.66 year or 8 months.
Planned implementation schedule - by 30.10.1995.

The plant management agreed to cover the costs of the required equipment, project and installation works.

2.3.3 Implementation

After the inspection and testing of the existing in the plant capacitors and switching equipment the possibility to use them in the new system has been accepted. The costs for new equipment has been reduced.

Timetable of the implementation process:

N	Implementation process	Time period
1	Technical project	March-September'95
2	Technical specifications approval	October'96-May'95
3	Equipment inspection and testing	August-September'95
4	Installation and implementation in shop-floors 03 1n 06	September'95-December'95
5	Installation and implementation in all TPs	September-October'96

2.3.4 Monitoring methodology and procedures

Monitoring methodology and procedures are based on the following;

- To use the records of the existing information electrical part of the Monitoring and Control System, collecting and processing the readings from 54 electrometers for active and reactive energy;
- To use retrospective bills information containing penalty data for bad power factor;

Monitoring and Implementation Program

N	Action	Time period
1	Baseline data gathering from records	1995-1996
2	Measurements before implementation	September-October'96
3	Implementation	October'96
4	Measurements after implementation	October'96-November'96
6	Validation of data and adjustments	October'96-November'96

Monitoring equipment specification:

- Constantly installed Monitoring and Control System;
- Portable Electricity Kit;

The methodology, procedures and program are approved by plant management in September 15, 1996.

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2.2.5 Results of Measurements and Monitoring

(a) Baseline energy data before implementation of the measure;
Data for monthly average value of power factor the paid penalty and penalty percents from the total electricity cost from September'95 to September'96 are shown in Table 3.2 and Fig. 3.1 The total electricity energy consumption costs for this period are 9,247,880 kWh and 36,585,241 BGL respectivly. The total value of the penalty costs for this period is 2,295,066 BGL (26,029 $US).

(b) Energy data after implementation of the measure;
Data for every day measurements of the total electricity consumption (kW, kVar, kWh, kVarh and cosϕ) during the period of installation of the system - September 23-29 are shown in Table 3.3 and Fig. 3.2. Starting from September, 28 when the system has been switched on the power factor is more than the limited mim. 0.90. There were no changes in the technological processes and in the level of the production during this period. In October and November'96 after implementation of the system there is no penalty for ZMM.

2.3.6 Review of the Economics of the Measure

Financial analysis of the measure based on the comparison of baseline data and results of the measurements after implementation is given in the following table (see also Table 3.4 in Appendix 3):

Financial Analysis:

Material Costs	Installation/ Design Costs	Total Project Costs	Annual O&M Costs
1,500 $US	4,700 $US	6,200 US$	
Benefits Energy Savings	% Savings from base case	Physical Savings	Money Savings in $US
Fuel (MBTU)			
Electricity (penalty)			26,029
Total Savings			26,029
Payback (years)			0.24

The savings in US$ are less than the planned ones. The main reason is that the $US exchange rate increased much more than the level of penalty. At the same time the costs for implementation were substantially decreased mainly because of the usage of the available in the plant capacitors. As a result the real payback period is 3 times less than the planned one.

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2.4 Local Thermal Power Station

2.4.1 Rationale for the measure

To build a local thermal station because of the unregular supply and low temperature of the supplied hot water from the Centralized heating system.

2.4.2 Description of the measure

Existing conditions

The annual consumption for the period of 1993-94 is 7170 Gcal for steam and 20100 Gcal for hot water. All costs for 1995 are 38 millions BGL.

The following problems exist:

- The pressure drop in the points of connection to the main thermal transmission network is not enough;
- Accepted direct scheme of heat exchange;
- The low temperature of the incoming heat carrier.

Despite the considerable expenses, which dramatically continue to grow up, the temperature in the shops and the rooms is below the required norms.

A. Recommended actions according to the Energy Audit and the Technical Project

Construction of a local thermal supply station. The existing demand for steam and hot water cab be covered by one steam-boiler PKM 6.5 and two water-heating boilers VKGM 4 produced in Bulgaria. The steam-boiler will serve and the subsidiary equipment for fuel heating in the main and the daily reservoirs.

Required costs

Capital investments:

• Equipment	$ 255 833
• Installations	$ 52 824
• Constructions	$ 84 923
• Engineering design	$ 13 282
• Total:	$ 406 846
• VAT (+18%)	$ 480 078

Annual operating costs:

• Electrical energy consumption	$ 4 621
• Water consumption	$ 1 500
• Chemical treatment	$ 4 154
• Personnel (10 persons)	$ 15 286
• Maintenance	$ 12 308
• Total:	$ 47 869

The main component in the annual operating costs is the fuel - 81.1%. For it determination during the next 15 years the forecast of the fuel prices according to the World Bank is used.

Expected result - effect of recommendation

The effect estimation is based on the comparison of the alternatives - existing centralized thermal supply and new local thermal supply station. The costs in $ US are compared in order to avoid the inflation factor. The new alternative is based on constant operational costs except the costs of the fuel which are determined in accordance with the forecast of the World Bank.

The comparison of the annual costs of both alternatives during the next 10 years is made in the project. The sum of the costs for the first 3 years for the first alternative is $ 2,031,700 and for the new alternative - $ 1,281,030.

Payback period

The costs and effect for 1997 are compared.

- Costs: $ 480 078
- Annual effect: $ 246 550

Simple payback period: 1.95 years or approximately 2 years.

Implementation schedule - 1995-96

2.4.3 Implementation

- After the development of the design project the following basic equipment has been delivered and installed:
  - Boilers KBG-4 - 2 pcs. (4 Gcal/h);
  - Boiler PKM-2 - 1pc. (2t/h);
- The total cost of the delivered equipment is 160,000 $US.

- The cost of the installation works is 13,000 $US;
- Annual operating costs are estimated at 48,00 $US;

Timetable of the implementation process:

N	Implementation process	Time period
1	Technical project	March-September'95
2	Technical specifications approval	October'96-May'96
3	Equipment procurement	September'95- September'96
4	Installation of the first boiler KBG-4	October-November'95
5	Installation of local station	September-December'96
6	Test start-up	December'96
7	Implementation	January'96

2.4.4 Monitoring methodology and procedures

Monitoring methodology and procedures are based on the following;

- To use retrospective information for heating requirements and from bills for heating - 1993 and 1994;
- To use retrospective information for production level in BGL taking into account the inflation rate - 1993 and 1994;
- To use the information about all cost related with the operation of the local thermal station - fuel, annual operating costs, etc.
- To compare the costs for heating of old and new systems, the costs of supplying of 1 Gcal, the energy costs for 1,000,000 BGL production.

Monitoring and Implementation Program

N	Action	Time period
1	Baseline data gathering from records	1993, 1994
2	Data gathering before implementation	September-October'96
3	Implementation	October-December'96
4	Measurements after implementation	December'96-December'97
5	Determination of savings	December'97
6	Validation of data and adjustments	December'97

Monitoring equipment specification:

- Constantly installed Energy Monitoring and Control System

The methodology, procedures and program are approved by plant management in September 15, 1996.

2.4.5 Results of Measurements and Monitoring

(a) Baseline energy data before implementation of the measure;

The heating load determined in the energy audit and the technical project is considered as baseline for comparison - 7,170 Gcal steam demand and 20,100 Gcal hot water demand. Total baseline demand - 27,270 Gcal. According to the energy prices in December'96 - 8, 174 BGL (18 $US)/ Gcal the estimated costs for heating presuming centralized supply is 222,904,980 BGL (490,500 $US).

(b) Energy data after implementation of the measure (estimation);

Using the fuel prices in December'96 - 112,000 BGL (249 $US) / t, the costs for fuel in 1997 are estimated at 110,000,000 BGL (244,444 $US). The operating costs are estimated at 48,000 $US.

2.4.6 Review of the Economics of the Measure

Financial analysis of the measure based on the comparison of baseline data and estimated results of the measure after its implementation is given in the following table:

Financial Analysis:

Material Costs	Installation/ Design Costs	Total Project Costs	Annual O&M Costs
$ 160,000	$ 13,000	$ 173,000	$ 48,000

Benefits Energy Savings	% Savings from base case	Physical Savings	Money Savings in $US
Fuel (kCal)	50.7%	13,846	246,056
Electricity (kWh)			
Total Savings			198,056
Payback (years)			0.87

This estimation is more optimistic because a substantial part of the material costs, construction and installation costs ware covered by the plant.

3. Plant-wide results

3.1 Interaction of measures

The measures "Local Thermal Station Construction" and "Extension of the Monitoring and Control System" are mutually related. The first measure requires some radical changes in the system of production and distribution of steam and hot water and should have to be implemented before the second. The three month delay of installation works of the local station caused the same delay in the schedule of implementation of the Monitoring and Control System.

The implemented electrical part of the Monitoring and Control System, collecting and processing data from all installed electrometers for active and reactive energy, is an information basis for the Power Factor Improvement System.

3.2 Summary of results for all Phase II energy efficiency measures

Summary of the implemented ECMs

ECO Nr.	Name	Invest-ment Total $	Savings from total building Kcal.	%	kWh	%	$	Pay-back years
C-2	Lighting System Improvement							
	Total:	26,662			106,940	70.3	11,216	2.38
C-3	Power Factor Improvement							
	Total:	6,200					26,029	0.24
	Total for Selected ECMs:	32,862					37,245	0.88

Summary of ECMs in process of implementation

ECO Nr.	Name	Invest-ment Total $	Savings from total building Gcal.	%	kWh	%	$	Pay-back years
B-1	Extension Of Monitoring and Control System							
	Total:	41,891	914	6			34,984	1.67
B-6	Local Thermal Station							
	Total:	173,000	13,846	50.7			198,056	0.87
	Total for Selected ECMs:	214,891	14,760				233,040	0.92

Summary of the investment costs funding from USAID and ZMM

N	Proposed measure	Costs funding from USAID $ US	Costs shared by ZMM - Inc. $ US	Status of the measure
1	Lighting systems improvement.	22,816	3,843	implemented
2	Extension of the Monitoring and Control System.	25,536	16,780	in process of implementation
3	Power factor improvement.		6,200	implemented
4	Local Thermal Supply Station.		173,000	test start-up
5	**Total**	**48,352**	**199,832**	

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3.3 Other improvements at the plant

The purpose of the developed Energy Audit was to integrate all different energy saving projects and to propose to the management of the plant medium and long-term complex energy efficiency program. Following this approach, the decision has been made to develop and implement not only the two supported by USAID measures but the other two - Local Thermal Station and Power Factor Improvement, identified as cost/effective by the project team.

There are improvements in the energy management practices in the plant. The management has more complete and systematic information about energy consumption and costs and a complex energy saving program, containing both low-cost measures and measures requiring capital investments and recommendations for their priority. Energy management department uses more detailed, regular and complete information about energy consumption. The director, responsible for energy efficiency and capital investments is involved in high level decision making.

3.4 Baseline plant-wide energy consumption and energy intensity

The energy consumption and production data for 1993,1994, 1995 and 1996 are shown in the following Tables and Fig. 5.1 an Fig.5.2 in Appendix 5.

Year	Hot water consumption Gcal/yr.	Steam consumption Gcal/yr.	Electricity Consumption kWh/yr.	Total energy costs th. BGL/yr.	$US/yr
1993	16,574	7,352	8,904	21,948	627,085
1994	8,837	6,070	7,233	26,276	525,520
1995	11,010	4,895	8,297	47,613	793,550
1996	1,369 (up to 30.04.)	4,295 (up to 30.04.)	6,373 (up to 30.09.)	53,018	(331,360) (up to 30.09.)

Year	1992	1993	1994	1995
Energy costs/ production	7.19%	10.4%	11.89%	22.71%

Energy costs as a part of all production costs has increased almost 3 times from 1993 to 1995.

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The following specific fitters of ZMM production conditions make the analysis of these data and energy intensity factors difficult:

- the level of production is not constant;
- the production list is changing during these years;
- the type of the products is complex, containing parts and assemblies;
- the production cycle varies from one to several months;
- there is no regular production operating reports for the different production areas;
- the energy consumption is not measured for all of the different production areas separately;
- the measures have been implemented in October- November'96 and there is no representative enough information for comparison of annual results.

3.5 Comparison of project estimated costs and payback with actual results

N	Measure	Project estimated costs ($US)	Actual costs ($US)	Project estimated payback (years)	Actual payback (years)
1	Lighting System Improvement	28,252	26,662	2.48	2.38
2	Extension of Monitoring and Control System	42,500	41,891	1.60	1.67
3	Power Factor Improvement	22,442	6,200	0.66	0.24
4	Local Thermal Station	480,078	173,000	1.95	0.87

4. Recommendations

Even having serious financial troubles to put the energy efficiency problems in the highest priority and:

- To find the required financial resources for the additional equipment, design and installation works for implementation of the extenuation of the Monitoring and Control System;
- To install and implement automation control of lighting system;
- To implement production and energy accounting system for all state alone production areas;
- To update every year the Energy Efficiency Program;
- To continue the common works with the team of DBC developing the energy audit, energy saving projects and implementation of the measures.

5. Significance of the project

a) for the CEMs

They have received a good experience working as a team in accordance with the methodology of AEE and Hagler Bailly Consulting, Inc. and together with their experts. They are professionally satisfied having the possibility to install and implement energy saving equipment produced by leading manufacturers and to obtain real results in relatively short terms. They have proved their possibilities not only to perform energy audit but to implement the most effective energy saving measures;

b) for the plant

The plant has received a lot of information concerning energy consumption and energy saving opportunities and what is the most important - real energy savings as a result of implementation of the most effective of these measures. These results are based in a very large extent on the donated energy saving equipment. The management of the plant and the energy related staff understood better the real opportunities and possibilities to save energy in their plant and the advantages to work together with private energy consulting company.

c) for Bulgaria

The developed demonstration projects have shown the real possibilities to implement cost/effective energy saving measures and to repeat most of them in other industries. The Program contributes very much in development of the private energy services market in Bulgaria.

6. Appendices

Appendix 1

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Table 1.1.

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USIAD and Hagler Bailly Consulting, Inc.

ACTION NO. C.2.1.-2

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994.

ACTION NO. AND BRIEF DESCRIPTION:
Lighting system improvement.

AREA OF THE PLANT AFFECTED:
Production areas - shop-floors 03 and 06;

FINDINGS CONCERNING EXISTING CONDITIONS:

In each production area section (module) 210 x 400 W mercury lamps are installed.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:
In each of the shop-floors - 03 and 06:
* To replace the mercury lamps by 200 x 150 W high pressure sodium lamps. The reduction of the demand in one section is 54 kW

• Lighting system automation control implementation - time schedule and switching on/off depending on the light level

CURRENT STATUS OF MEASURE: PLANNED IMPLEMENTATION; DATE OF IMPLEMENTATION:30.06.1996.

The measure is included in the second Phase of the USAID Project. The equipment to be donated is specified
The final approval and shipment to the plant will be done by the 15.04.1996.
There is a contract for design and installation works between ZMM and DBC.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy kWh/year				$ US/yr	
Baseline -existing conditions	84.00						
After recommended action	30.00						
Net reduction	54.00	306,000				9,415	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	2000	
Equipment procurement	20560	
Equipment installation	1846	
Equipment commissioning		
TOTAL INSTALLED COST	24406	(b)

Estimated increase in annual (non-energy) operations and maintenance cost	0	(c)

PAYBACK PERIOD:

$$\frac{b: 24,406}{a: 9,415 - 0} = 2.59 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 30.12.1995.

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Table 1.2 Load patterns - shop-floor 03

Hours	Dates					**Average value P, kW**
	30.10.96 P, kW	13.11.96 P, kW	14.11.96 P, kW	15.11.96 P, kW	16.11.96 P, kW	
1	1.7	1.8	1.8	1.8	1.9	1.8
2	1.7	1.8	1.8	1.8	1.9	1.8
3	1.7	1.8	1.8	1.8	1.9	1.8
4	1.7	1.8	1.8	1.9	1.8	1.8
5	1.7	1.8	1.8	1.8	1.9	1.8
6	4.4	4.5	4.5	4.5	4.6	4.5
7	65.9	65.8	65.7	65.8	65.8	65.8
8	65.9	65.8	65.7	65.8	65.8	65.8
9	65.9	65.8	65.7	65.8	65.8	65.8
10	65.9	65.8	65.7	65.8	65.8	65.8
11	65.9	65.7	65.8	65.8	65.8	65.8
12	11.9	12.0	12.1	12.0	12.0	12.0
13	65.9	65.8	65.7	65.8	65.8	65.8
14	65.9	65.8	65.7	65.8	65.8	65.8
15	65.9	65.8	65.7	65.8	65.8	65.8
16	15.9	16.0	16.0	16.2	15.9	16.0
17	7.9	8.1	7.9	8.1	8.0	8.0
18	7.9	8.1	8.1	7.9	8.0	8.0
19	7.0	6.9	7.0	7.0	7.1	7.0
20	7.0	6.9	7.0	7.0	7.1	7.0
21	7.0	6.9	7.0	7.0	7.1	7.0
22	1.7	1.7	1.9	1.9	1.8	1.8
23	1.7	1.7	1.9	1.9	1.8	1.8
24	1.7	1.9	1.7	1.9	1.8	1.8
TOTAL	609.8	610.0	609.8	610.9	611.0	610.3

Table 1.3 Load patterns - shop-floor 06

Hours	Dates				Average value P, kW
	13.11.96 P, kW	14.11.96 P, kW	15.11.96 P, kW	16.11.96 P, kW	
1	1.7	1.7	1.6	1.8	1.7
2	1.7	1.7	1.7	1.7	1.7
3	1.7	1.7	1.6	1.8	1.7
4	1.7	1.7	1.7	1.7	1.7
5	1.7	1.7	1.7	1.7	1.7
6	2.5	2.5	2.4	2.6	2.5
7	26.0	23.5	23.5	26.2	24.8
8	26.0	23.5	23.5	26.2	24.8
9	26.0	23.5	23.5	26.2	24.8
10	26.0	23.5	23.5	26.2	24.8
11	26.0	23.5	23.5	26.2	24.8
12	4.2	4.2	4.1	4.3	4.2
13	27.0	27.0	24.7	25.3	26.0
14	27.0	27.0	24.7	25.3	26.0
15	27.0	27.0	24.7	25.3	26.0
16	6.6	6.6	6.5	6.7	6.6
17	5.3	5.3	5.5	5.1	5.3
18	5.3	5.3	5.3	5.3	5.3
19	5.3	5.3	3.9	6.7	5.3
20	5.3	5.3	3.9	6.7	5.3
21	3.9	3.9	3.9	3.9	3.9
22	1.7	1.7	1.7	1.7	1.7
23	1.7	1.7	1.7	1.7	1.7
24	1.7	1.7	1.8	1.6	1.7
TOTAL	263.0	250.5	240.6	261.9	254.0

Table 1.4

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USIAD and Hagler Bailly Consulting, Inc.

ACTION NO. C.2

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 10.12.1996.

ACTION NO. AND BRIEF DESCRIPTION:
Lighting system improvement.

AREA OF THE PLANT AFFECTED:
Production areas - shop-floors 03 and 06;

FINDINGS CONCERNING EXISTING CONDITIONS:

In each production area section (module) 210 x 400 W mercury lamps are installed.

IMPLEMENTED ACTION TO IMPROVE EFFICIENCY:
In each of the shop-floors - 03 and 06:
- The existing mercury lamps (210 x 150 W) have been replaced by 64 high pressure sodium lamps. The reduction of the demand in one section is 54 kW.
- Lighting system automation controls are in process of installation - time schedule and switching on/off depending on the light level.

CURRENT STATUS OF MEASURE: IMPLEMENTED NEW FEXTURES AND HPS LAMPS.

The installation of the automation control system is in process and the start-up is planned for 31.01.1997.

EXPECTED RESULTS - EFFECT OF RECOMMENDATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy kWh/year				$ US/yr	
Baseline -existing conditions	84.00	304,048					
After recommended action	30.00	90,168					
Net reduction	54.00	213,880				11,216	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	2000	
Equipment procurement	22,816	
Equipment installation	1,846	
Equipment commissioning		
TOTAL INSTALLED COST	26,662	(b)

Estimated increase in annual (non-energy) operations and maintenance cost	0	(c)

PAYBACK PERIOD:

$$\frac{b: 26,662}{a: 11,216 - 0} = 2.38 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: 31.01.1997 for the automation control system

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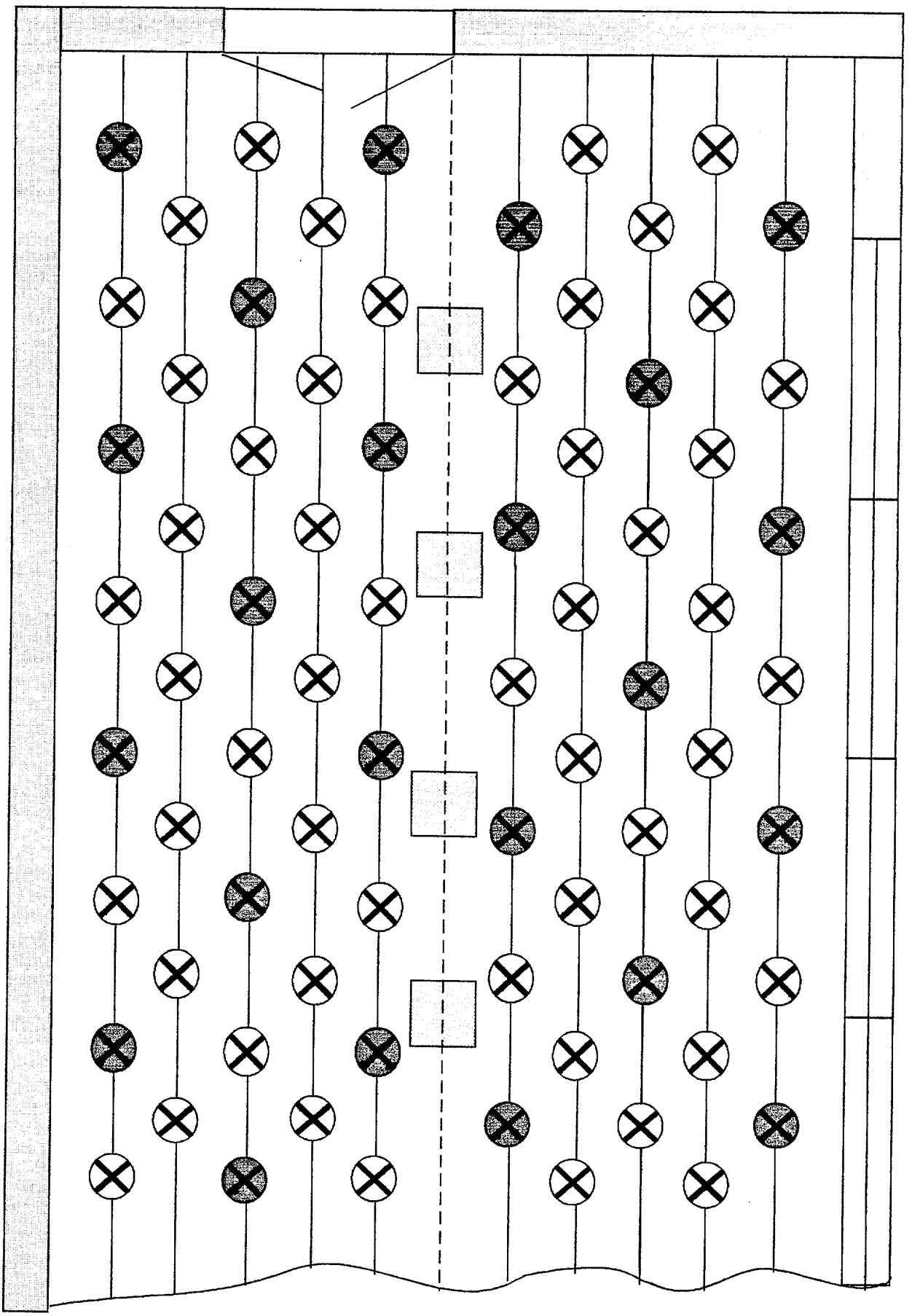


Fig.1.1

Fig.1.2 Mesurement of the electricity consumption in shop-floor 03

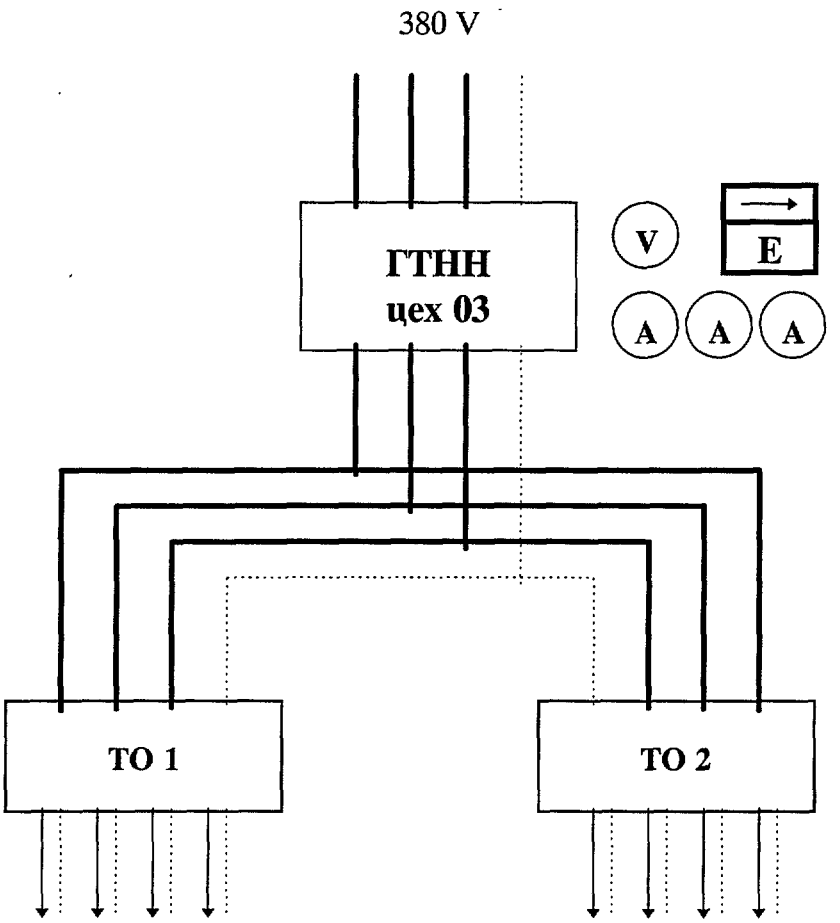


Fig . 1.3 Lighting control system

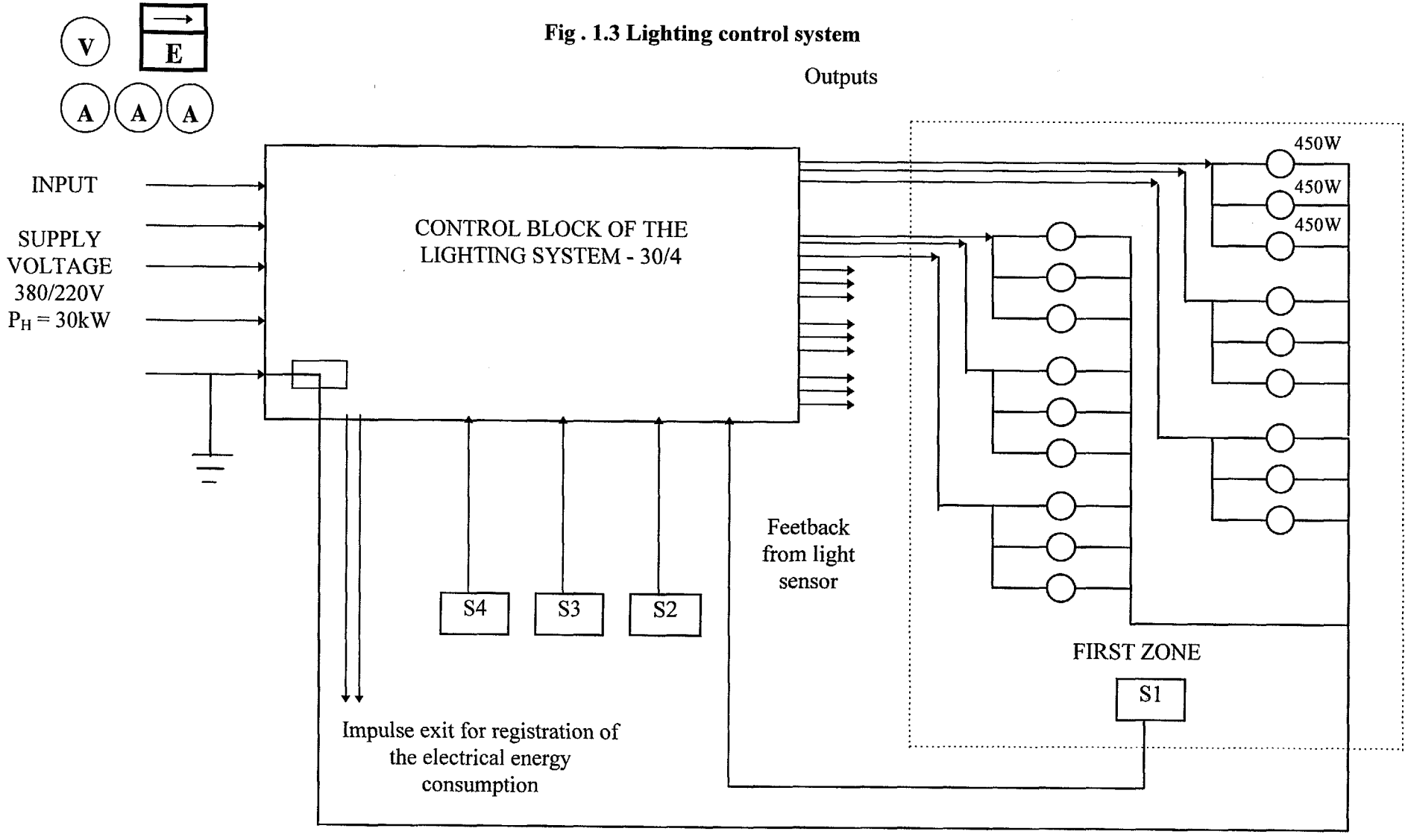


Fig.1.4. Average load pattern - old system

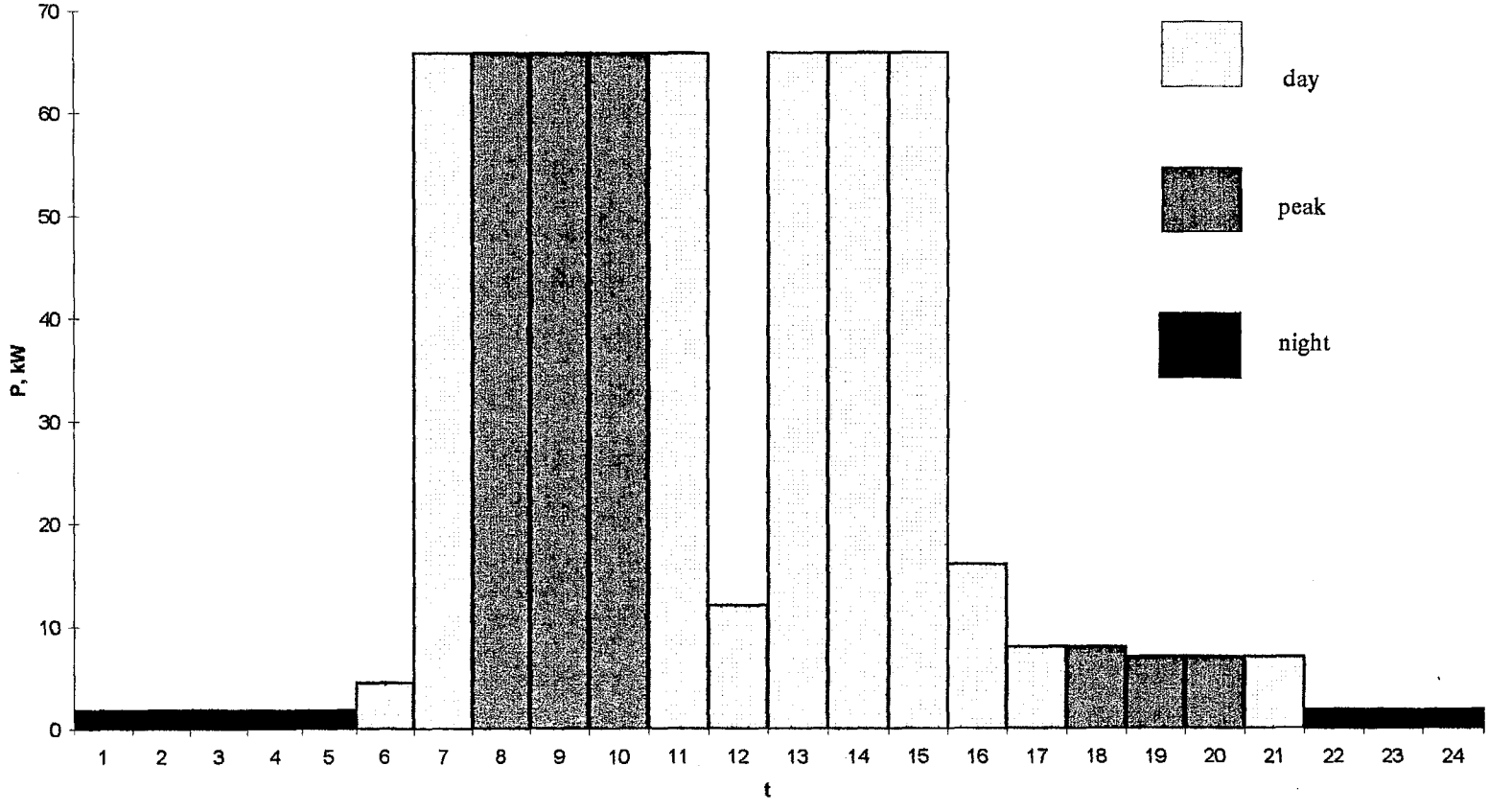
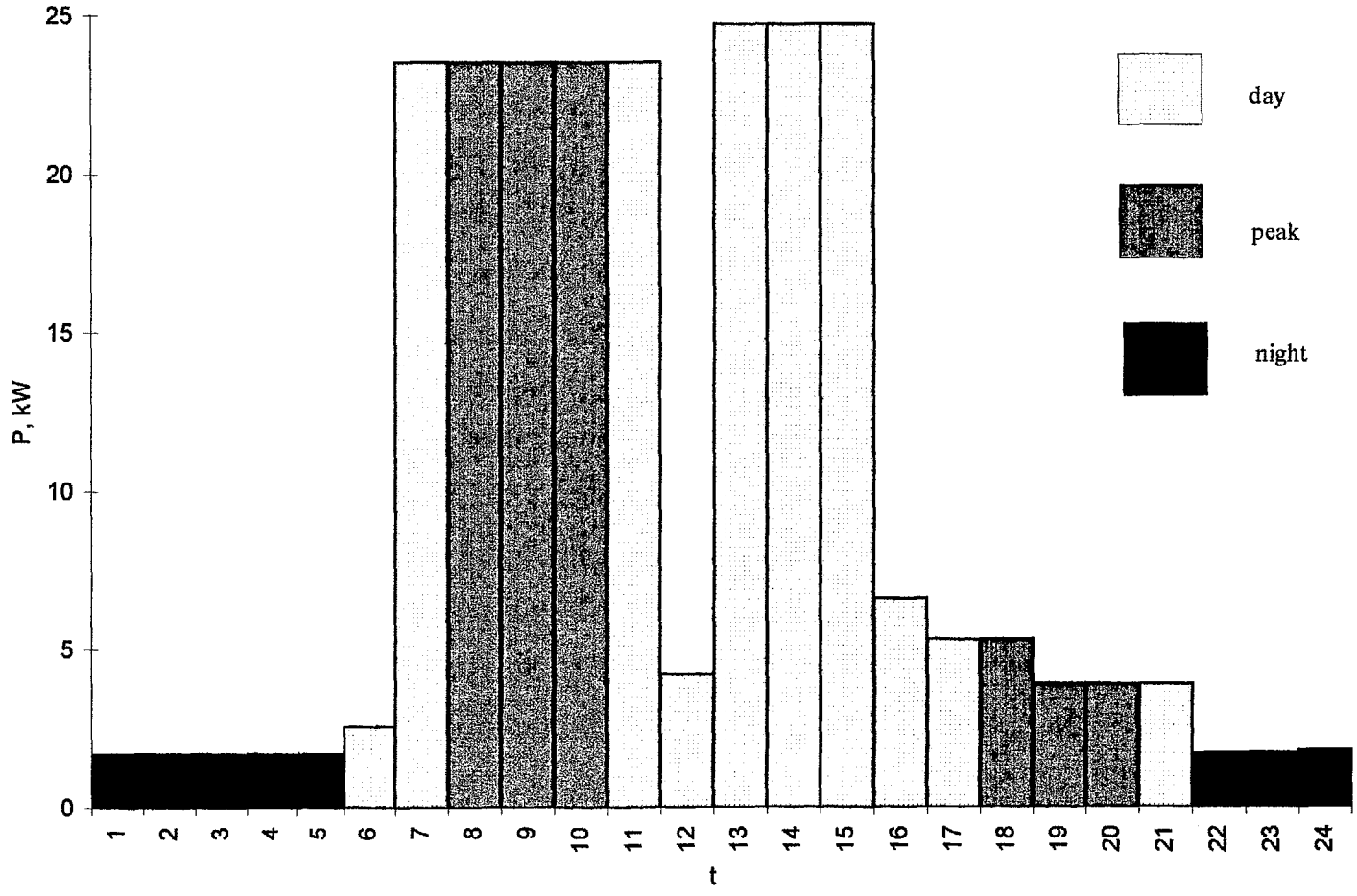


Fig 1.5. Average load pattern - new system



Qty. Item	Comp	Description Item / Component	Part #	Manufacturer	Vendor	Unit Price	Total Price
1	128	Industrial low bay lighting fixtures	#BL-400 SE-LB1	Hubbell	Maurexco	$17,024.00	$17,024.00
1	156	High-pressure sodium vapor lamps, E-40 base	LU 400, E-40 base	GE	Maurexco	$1,872.00	$1,872.00
2		Lighting Control Systems		Andover Controls	Engineered Services		$3,920.00
	2	Lighting controllers	LCX 810			$1,480.00	
	8	Celestial ambient light sensor for skylights.	MK7-B-CCS-1/5			$120.00	
4		Thermal Control Valves		Honeywell	Jobe		$14,638.00
	1	Steam control valve	859108-1B20-1A1-1T-FJ5E			$3,310.00	
	1	Steam control valve	859106-1B20-1A1-1T-FJ5E			$2,793.00	
	1	Hot water control valve	85810B-1B20-2BJ-1T-FJ5E			$4,380.00	
	1	Hot water control valve	85810A-1B20-2AJ-1T-FJ5E			$4,155.00	
1		Thermal Metering & Control System		Inlog	Inlog		$6,240.00
	2	MPU Heat Control Module	InPac 200-C			$520.00	
	2	Heat Meter/Controller	InPac 200			$1,340.00	
	3	Heatmeter	InPac 100			$840.00	
1		Computer System		Hewlett Packard	Naturella		$4,658.00
	1	HP Vectra Pentium CPU, 16KB cache, 8 MB RAM, 640 MB HD, Enhanced Latin-Cyrillic keyboard, mouse, DOS 6.22 & Windows 3.11	5/100 VE2 Model 640			$2,351.00	
	1	8 MB HP EDO RAM				$518.00	
	1	15" Monitor	HP Ergo Ultra VGA 15"			$636.00	
	1	HP InkJet color printer with cartridges	HP DeskJet 850C			$707.00	
	1	MS Word wordprocessor, with Bulgarian manuals	MS WinWord v. 6.0			$223.00	
	1	Spreadsheet software in Bulgarian	MS Excel v. 5.0			$223.00	

On behalf of ZMM, I acknowledge receipt of the equipment listed in the above table.

Signature: _____

Name: Vladimir Hranov

Title: Director, Modernization & Reconstruction

Date: _____

Appendix 2

Table 2.1

Steam 1995

Date	Heat consumption	Consumption	Temperature
	mwh	t	T° C
20.02.	34.3	44.7	160.1
24.02.	26.8	34.9	163.3
27.02.	24.8	32.4	158.1
14.03.	32.2	41.6	173.5
15.03.	53.2	69.3	184.8
16.03.	51.5	66.3	179.2
17.03.	49.8	63.4	169.7
18.03.	13.7	17.9	163.8
02.04.	33.6	43.6	165.0
04.04.	35.6	46.4	167.8
26.04.	19.6	25.5	169.2
26.05.	10.8	14.0	172.2
29.05.	9.1	11.8	170.5
30.05.	9.2	12.0	173.8
06.06.	10.3	11.4	172.9
13.06.	9.6	12.5	168.5
27.06.	9.4	12.3	169.5
06.07.	8.6	11.2	170.5
12.07.	7.8	10.2	166.7
21.07.	8.7	11.3	168.8
14.11.	29.1	38.1	160.1
20.11.	43.5	56.8	164.6
30.11.	51.8	67.5	165.9
03.12.	37.0	48.3	165.8
04.12.	37.4	48.9	150.1
05.12.	45.1	59.0	153.5
06.12.	44.1	57.8	154.3
07.12.	39.3	51.6	147.4

Table 2.2

HOT WATER 1995

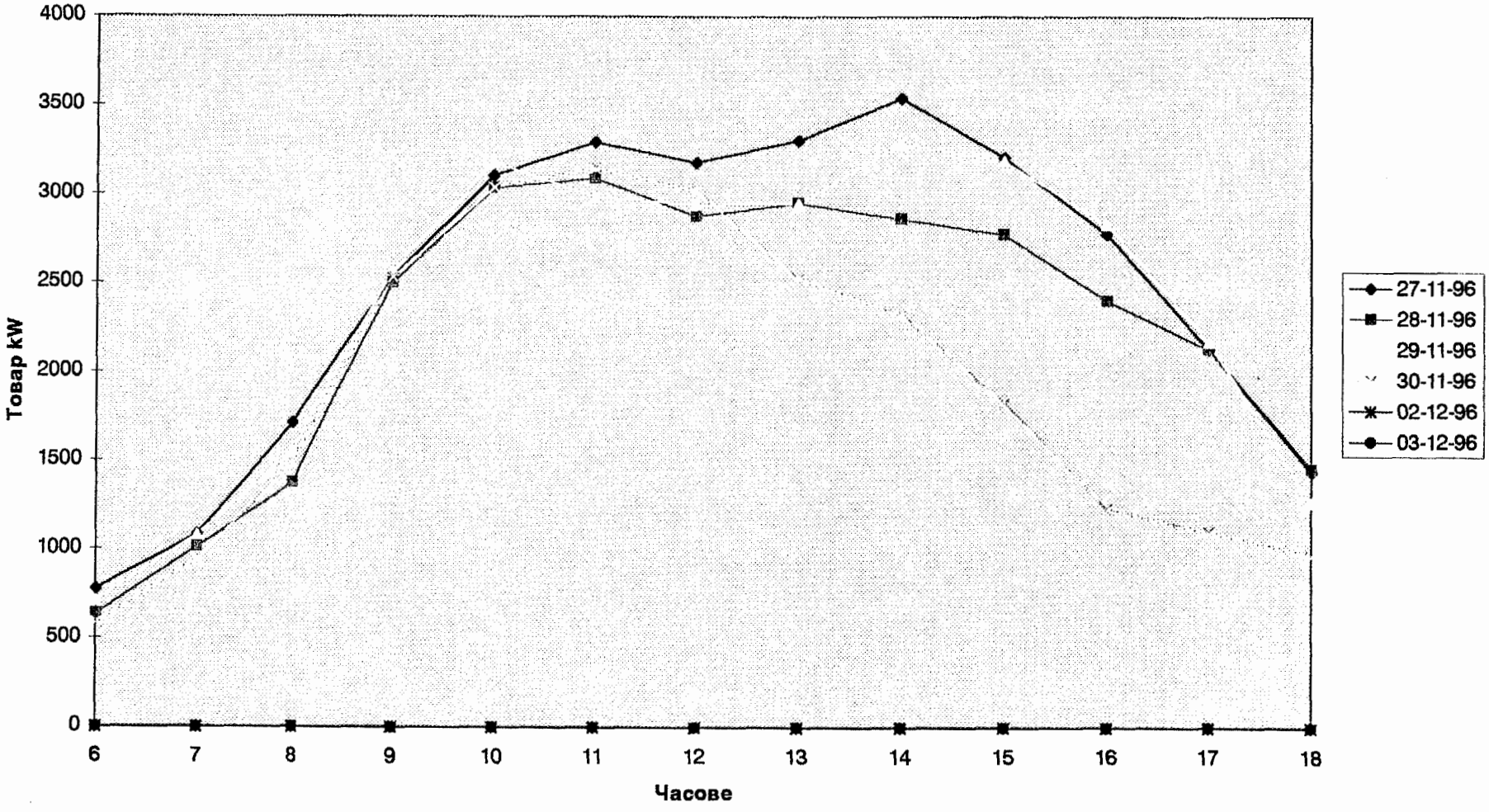
Date	Heat consumption	Consumption	Temperature
	mwh	m^3	T° C
22.02.	37.0	3132.5	54.8
23.02.	37.4	3287.2	54.6
24.02.	21.3	1803.5	52.4
14.03.	88.0	9124.1	73.4
15.03.	107.9	9364.7	75.5
16.03.	83.9	9420.1	69.2
17.03.	75.8	9489.9	64.2
18.03.	54.8	9490.2	66.7
12.11.	112.7	10710.0	70.3
20.11.	147.6	13597.3	76.5
28.11.	134.7	16219.3	65.2
02.12.	147.3	17459.7	68.2
11.12.	178.4	17043.3	73.4
12.12.	132.6	14100.4	71.8
15.12.	148.4	14193.5	65.5
16.12.	160.4	13890.7	70.8
17.12.	146.2	13726.1	69.2
18.12.	142.1	13398.2	69.7
19.12.	140.7	13664.6	69.4

Table 2.3

Heat energy consumption - 1995

Month	Hot water Gkal	Steam Gkal
January	3343.19	1130.12
February	1477.78	840.08
March	996.67	510.69
April	0.00	490.68
May	0.00	108.14
June	0.00	185.18
July	0.00	141.62
November	1691.91	551.34
December	2926.19	937.39
Total:	10435.74	4895.24

Товаров график



Товаров график

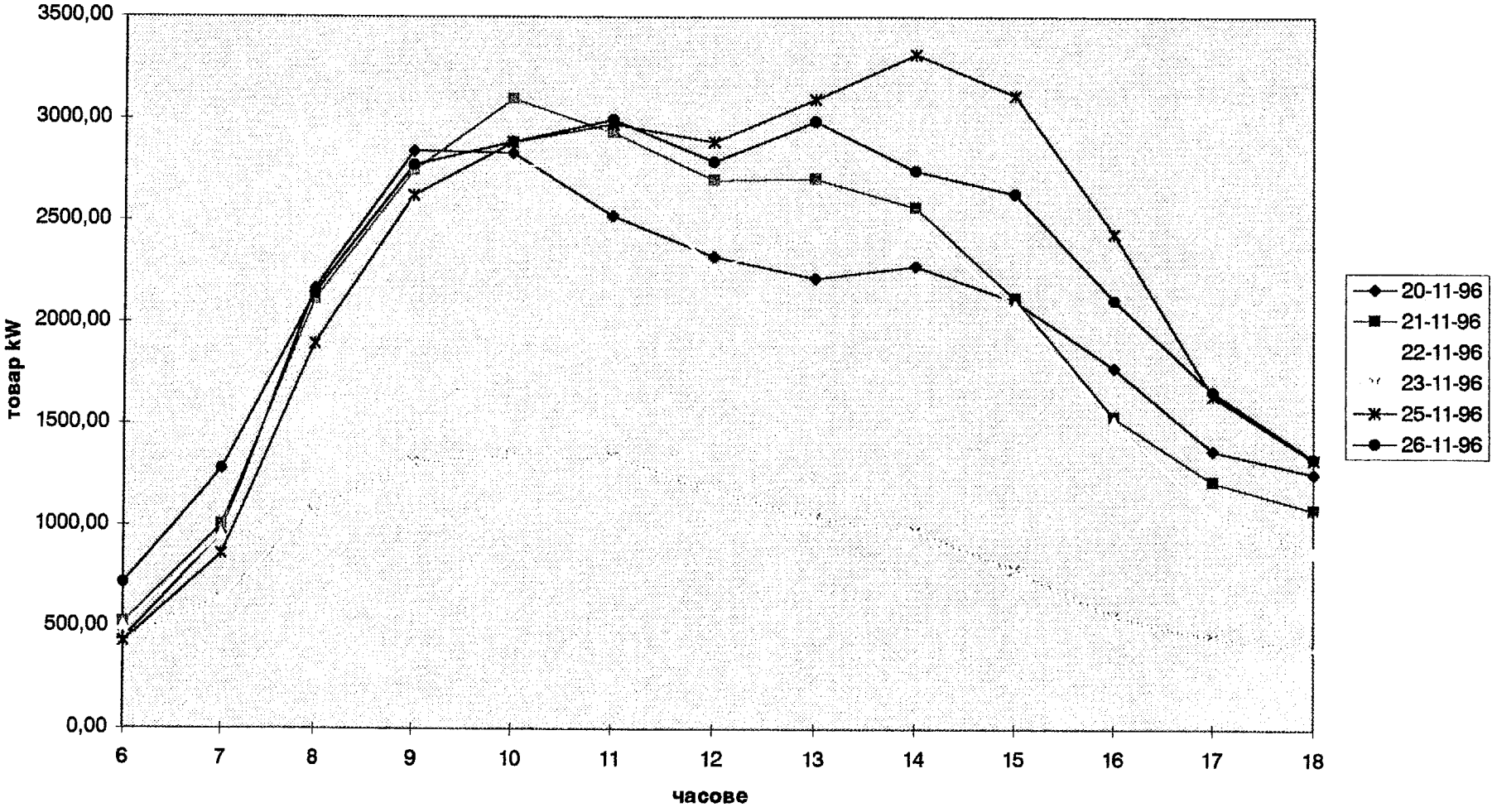


График за работа на котелно - отоплителна централа

Час	Външна T° - [°C] на въздуха									
	–25° ÷ –5°		–5° ÷ 0°		0° ÷ 5°		5° ÷ 10°		10° ÷ 15°	
	I кот.	II кот.	I кот.	II кот.	I кот.	II кот.	I кот.	II кот.	I кот.	II кот.
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										
16										
17	включва се при T° на водата под 25°C за 1 час		включва се при T° на водата под 25°C за 1 час		включва се при T° на водата под 25°C за 1 час					
18										
19										
20										
21										
22										
23										
24										
01										
02										
03										
04										

- I степен - Часов разход - 250 л/ ч

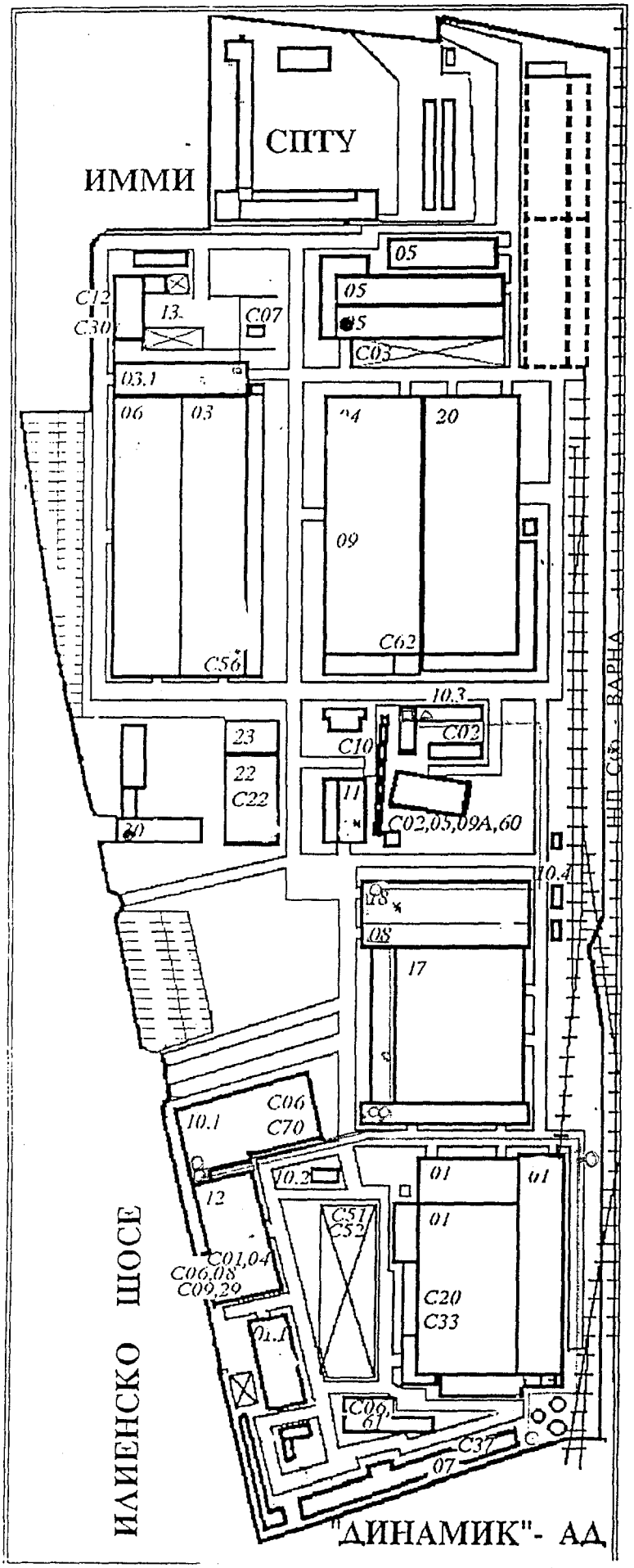
- II степен - Часов разход - 480 л/ч

Забележка:

Понеделник при температура под 0°C котлите да се включват в 04 ч

95

ГЕНЕРАЛЕН ПЛАН НА ЗММ-АД - СОФИЯ



ОСНОВНО И СПОМАГАТЕЛНО ПРОИЗВОДСТВО

01 - леярен цех
01.1 - груба обработка
03 - монтажен цех
03.1 - бояджиен цех
04 - агрег. пр-во, механичен цех
05 - заготвителен цех
06 - механичен за ПКД цех
07 - моделен цех
08 - сервиз
09 - агрегатно пр-во монтажен цех
10 - инвестремонт
10.1 - механоремонт
10.2 - ремонт и строителство
10.3 - електроремонт
10.4 - пречиствателна станция
11 - компресорна станция
12 - инструментален цех
13 - транспортен отдел
17 - механичен РСД цех
20 - механичен ГАПС-ПКД цех
22 - столова и кухня
23 - търговски комплекс
30 - административна сграда

СКЛАДОВО СТОПАНСТВО

Склад 01 - Вносна окомплектовка
Склад 02 - Фитинги
Склад 03 - Стомани
Склад 04 - Инструментални стомани
Склад 05 - Бои, химикали
Склад 06 - Кабели, ремъци, лагери
Склад 07 - ГСМ
Склад 08 - Ел. метериали
Склад 09 - ЦИС
Склад 09А - за абразиви
Склад 10 - домакин
Склад 12 - на гаража
Склад 17 - на капит. стр-во
Склад 20 - инструменти
Склад 22 - кухненски блок
Склад 30 - на гаража
Склад 33 - за облекло
Склад 37 - за модели
Склад 51 - за отливки
Склад 52 - за отливки
Склад 56 - за окомплектовка
Склад 60 - рез. части и окомпл.
Склад 61 - кооперирани дет-ли
Склад 62 - инструменти за АМ
Склад 70 - рез. части и полуфабр-ти

○ - installed heatmeters
△ - concentrator of data
□ - operating station

ZMM general layout

ДЕНОНОЩЕН ТОВАРОВ ГРАФИК НА ВХ-АС1 ЗА ДАТА: 04-04-95
ДАТА НА ИЗДАВАНЕ: 05-04-95 ЧАС: 15:33:35

No.	ВРЕМЕ		ОБЕКТ ВХ-АС1 Кон.Топл [MWh]	ВХ-АС1 Разход [t]	ВХ-АС1 Темпер.1 [°C]
1.	04-04-95	01:00:00	1.0	1.3	166.8
2.	04-04-95	02:00:00	1.0	1.3	166.6
3.	04-04-95	03:00:00	1.0	1.3	166.7
4.	04-04-95	04:00:00	1.0	1.3	166.5
5.	04-04-95	05:00:00	1.0	1.3	166.4
6.	04-04-95	06:00:00	1.0	1.3	166.4
7.	04-04-95	07:00:00	1.2	1.5	165.4
8.	04-04-95	08:00:00	1.5	2.0	163.1
9.	04-04-95	09:00:00	2.0	2.6	169.4
10.	04-04-95	10:00:00	2.1	2.7	167.9
11.	04-04-95	11:00:00	2.0	2.7	168.6
12.	04-04-95	12:00:00	2.0	2.6	170.1
13.	04-04-95	13:00:00	2.0	2.6	170.4
14.	04-04-95	14:00:00	1.9	2.5	171.2
15.	04-04-95	15:00:00	1.8	2.3	173.7
16.	04-04-95	16:00:00	1.9	2.4	172.7
17.	04-04-95	17:00:00	1.9	2.5	169.2
18.	04-04-95	18:00:00	1.0	1.3	151.5
19.	04-04-95	19:00:00	1.5	1.9	165.7
20.	04-04-95	20:00:00	1.4	1.8	169.2
21.	04-04-95	21:00:00	1.4	1.8	169.9
22.	04-04-95	22:00:00	1.4	1.8	169.9
23.	04-04-95	23:00:00	1.4	1.8	169.9
24.	04-04-95	23:59:59	1.4	1.8	169.6
ОБЩО			35.6	46.4	4026.8
МАКСИМУМ			2.1	2.7	173.7
Време на максимума			10:00:00	10:00:00	15:00:00
МИНИМУМ			1.0	1.3	151.5
Време на минимума			06:00:00	01:00:00	18:00:00
СРЕДНО НА ЧАС			1.5	1.9	167.8

BEST AVAILABLE COPY

ДЕНОНОЩЕН ТОВАРОВ ГРАФИК НА ВХ-ТЕЦ ЗА ДАТА: 11-12-95
ДАТА НА ИЗДАВАНЕ: 13-12-95 ЧАС: 12:39:20

No.	ВРЕМЕ		ОБЕКТ ВХ-ТЕЦ Кон.Топл [MWh]	ВХ-ТЕЦ Разход [m3]	ВХ-ТЕЦ Темпер.1 [°C]
1.	11-12-95	01:00:00	7.2	755.0	72.9
2.	11-12-95	02:00:00	7.2	751.4	73.2
3.	11-12-95	03:00:00	7.2	753.1	73.3
4.	11-12-95	04:00:00	7.1	742.5	73.3
5.	11-12-95	05:00:00	7.2	747.3	73.5
6.	11-12-95	06:00:00	7.1	744.3	73.5
7.	11-12-95	07:00:00	7.6	744.4	73.3
8.	11-12-95	08:00:00	7.5	701.8	72.6
9.	11-12-95	09:00:00	7.4	677.7	71.5
10.	11-12-95	10:00:00	7.3	680.8	70.5
11.	11-12-95	11:00:00	7.1	681.1	70.1
12.	11-12-95	12:00:00	7.4	682.3	70.5
13.	11-12-95	13:00:00	8.0	684.5	71.5
14.	11-12-95	14:00:00	8.1	683.5	73.0
15.	11-12-95	15:00:00	7.9	688.1	73.8
16.	11-12-95	16:00:00	8.2	701.0	74.5
17.	11-12-95	17:00:00	8.1	704.9	75.0
18.	11-12-95	18:00:00	7.5	700.4	75.1
19.	11-12-95	19:00:00	7.3	700.4	75.2
20.	11-12-95	20:00:00	7.3	701.6	75.1
21.	11-12-95	21:00:00	7.1	700.8	74.7
22.	11-12-95	22:00:00	7.3	700.2	74.8
23.	11-12-95	23:00:00	7.3	706.5	74.9
24.	11-12-95	23:59:59	7.3	709.6	74.9
ОБЩО			178.4	17043.3	1760.8
МАКСИМУМ			8.2	755.0	75.2
Време на максимума			16:00:00	01:00:00	19:00:00
МИНИМУМ			7.1	677.7	70.1
Време на минимума			11:00:00	09:00:00	11:00:00
СРЕДНО НА ЧАС			7.4	710.1	73.4

Appendix 3

Table 3.1

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and Hagler Bailly Consulting, Inc.

ACTION NO. C.3.

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 30.06.1994.

ACTION NO. AND BRIEF DESCRIPTION:
Power factor improvement.

AREA OF THE PLANT AFFECTED:
All the plant

FINDINGS CONCERNING EXISTING CONDITIONS:

There was no power factor correction system in the plant. 2,221,000 BGL penalty were paid in 1993.

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To design and implement automation controlled power factor correction system.

RESULTS - EFFECT OF IMPLEMENTATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy kWh/year				$ US/yr.	
Baseline -existing conditions - penalty Sptem.'95-Septem.'96						33846	
After recommended action							
Net reduction						33846	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	2615	$ US
Equipment procurement	12742	
Equipment installation	7085	
Equipment commissioning		
TOTAL INSTALLED COST	22442	(b)

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

PAYBACK PERIOD:

$$\frac{b: 22,442}{a: 33,846 - c: 0} = 0.66 \text{ years}$$

RECOMMENDED IMPLEMENTATION SCHEDULE: To implement the whole project by 30.06.1996.

Table 3.2 Power fector and penalty (September'95-October'96)

Months	cos φ	Penalty BGL	Penalty $US (current rate)	Penalty % from el. costs
September'95	0.76	150,177	2,503	+12
October'95	0.82	52,123	869	+3
November'95	0.83	74,203	1,142	+3
December'95	0.78	236,084	3,632	+10
January'96	0.81	141,277	2,173	+7
February'96	0.79	209,847	2,998	+10
March'96	0.80	133,927	1,786	+7
April'96	0.81	118,660	1,483	+7
May'96	0.76	182,983	1,830	+12
June'96	0.77	236,971	1,580	+12
July'96	0.74	3947541	1,973	+15
August'96	0.78	482,276	2,143	+10
September'96	0.70	593,906	1,980	+15
October'96	0.90	0	0	0
Total		**2,995,066**	**26,029**	

Table 3.3 ZMM electricity energy consumption (September 23-29)

Date	P, kW	Q, kVAr	Wa, kWh	Wr, kVArh	cos φ
23. 09	881.2	602.5	21150	14459	0.825
24. 09	917.0	632.2	22008	15173	0.823
25. 09	845.5	595.5	20292	14293	0.818
26. 09	933.6	659.2	22405	15821	0.817
27. 09	1012.1	646.7	24289	15521	0.843
28. 09	270.0	62.0	6480	1488	0.975
29. 09	267.2	73.5	6413	1763	0.964

P_{CP} = 732.4 kW Q_{CP} = 467.4 kVAr **cos** φ_{av} = 0.843

Table 3.4

RECOMMENDED ACTION - ENERGY EFFICIENCY OPPORTUNITY
Prepared for USAID and Hagler Bailly Consulting, Inc.

ACTION NO. C.3.

Plant name: ZMM Inc. - Sofia
Address: 8 Iliensko shousse str. 1220 Sofia, Bulgaria

Auditor's name: DBC - Dimitar Baev

Report date: 10.12.1996.

ACTION NO. AND BRIEF DESCRIPTION:
Power factor improvement.

AREA OF THE PLANT AFFECTED:
All the plant

FINDINGS CONCERNING EXISTING CONDITIONS:

There was no power factor correction system in the plant. 2,221,000 BGL penalty were paid in 1993.
In the period od September'95-September'96 the penalty was 2,295,066 BGL (26,029 $US)

RECOMMENDED ACTION TO IMPROVE EFFICIENCY:

To design and implement automation controlled power factor correction system.

CURRENT SITUATION: The system has ben implemented from October'96.

RESULTS - EFFECT OF IMPLEMENTATION:

	Electricity		Fuels, heat and steam:			Total cost	
	Peak kW	Energy kWh/year				$ US/yr.	
Baseline -existing conditions - penalty Sptem.'95-Septem.'96						26,029	
After recommended action						0	
Net reduction						26,029	(a)

COST-BENEFIT ANALYSIS:

PROJECT COST ESTIMATE:	Cost	Notes
Engineering design	2500	$ US
Equipment procurement	1500	
Equipment installation	2200	
Equipment commissioning		
TOTAL INSTALLED COST	6200	(b)

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

PAYBACK PERIOD:

$$\frac{b:6,200}{a:\ 26,029 - c:0} = 0.24 \text{ years}$$

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Fig. 3.1

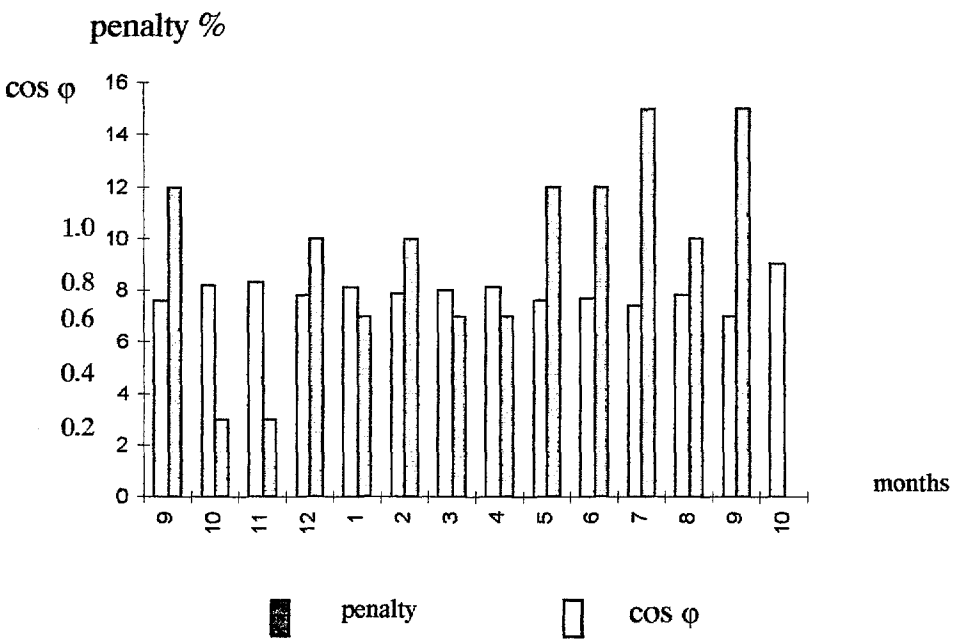
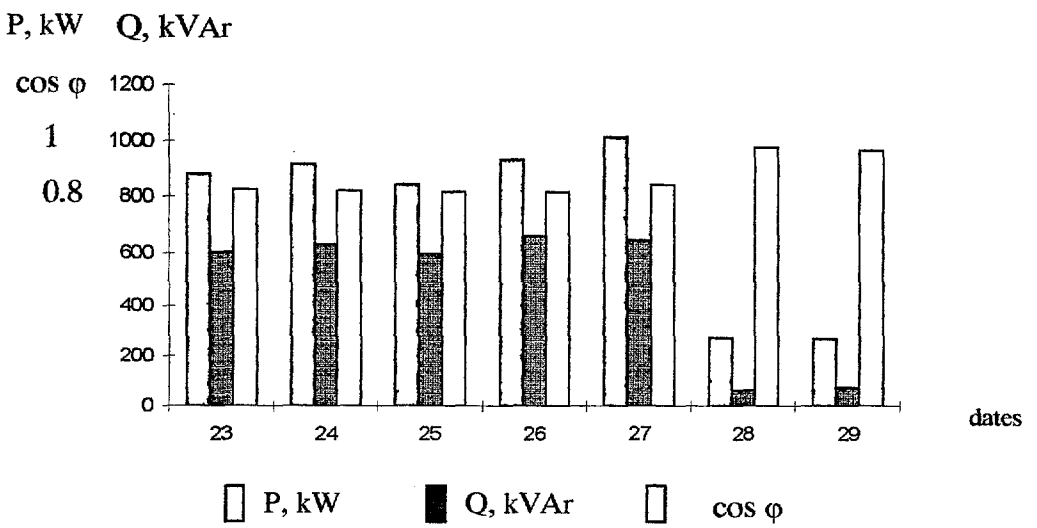

penalty %
cos φ
16
14
12
1.0
10
0.8
8
0.6
6
0.4
4
0.2
2
0
9
10
11
12
1
2
3
4
5
6
7
8
9
10
months
penalty
cos φ

Fig.3.2


P, kW
Q, kVAr
cos φ
1200
1
1000
0.8
800
600
400
200
0
23
24
25
26
27
28
29
dates
P, kW
Q, kVAr
cos φ

Appendix 4

Appendix 5

Fig.5.1.

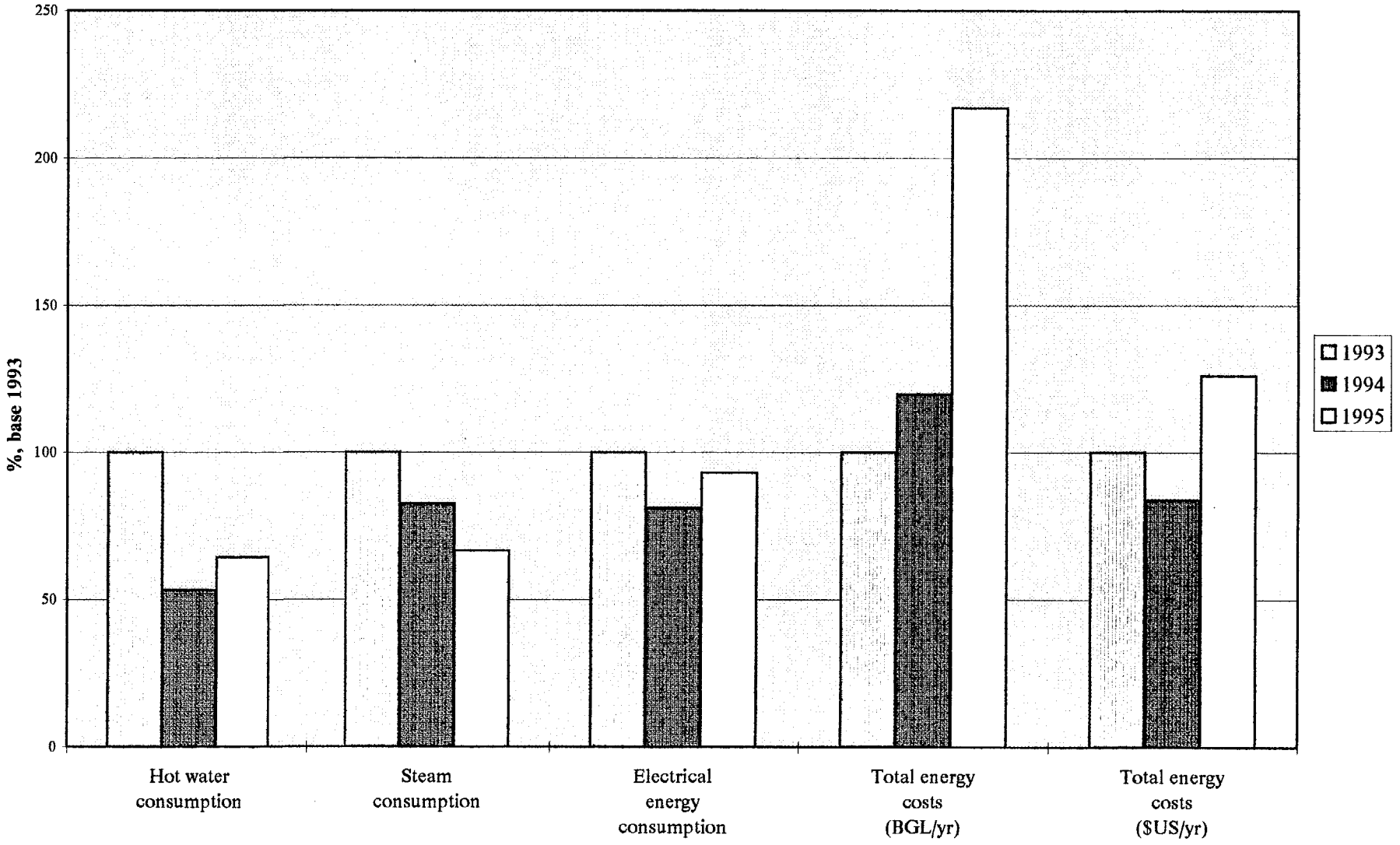

250
200
150
100
50
0
%, base 1993
1993
1994
1995
Hot water consumption
Steam consumption
Electrical energy consumption
Total energy costs (BGL/yr)
Total energy costs ($US/yr)

Fig.5.2

25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
1992
1993
1994
1995
energy costs /production

MONITORING & EVALUATION REPORT RUNO

PHASE II
MEASURE MONITORING AND EVALUATION REPORT

"RUNO - G" Ltd.

WOOL SCOURING PLANT

GABROVO , BULGARIA

Prepared for:

Hagler Bailly Consulting Inc.

1530 Wilson Boulevard , Arlington , Virginia, 22209 USA

Prepared by:

Dr. Nikola Kaloyanov

Sofia , BULGARIA

December 1996

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1. General Introduction

This report presents the results of Phase II of the Industrial Energy Efficiency Project for the Primary Wool Processing plant "RUNO - G" in Gabrovo, Bulgaria, funded by the United States Agency for International Development (USAID).

Phase II of the Project included activities directed on specification, procurement and installation of larger energy saving equipment as follows:

- An air-cooled rotary screw air compressor
- A refrigerating air dryer

both for replacement of one of the existing water-cooled reciprocating compressors in plant.

In this phase all the equipment provided by USAID costs 29,673 $.

The report is structured following the requirements of the personal contract between Hagler Bailly Inc. and Dr. Nikola Kaloyanov, dated 15 th March 1996.

2. Measure - by - Measure Presentation

REPLACEMENT OF THE RECIPROCATING WATER COOLED AIR COMPRESSOR

2.1. Rationale for the Measure

Compressed air accounts about 30% of all electricity used in the plant.

The existing reciprocating air compressors (two water-cooled : one of nominally 145 kW, 20 l/min at 8 bar pressure and one of 75 kW, 10 l/min at 8 bar pressure) are not reliable and expensive for maintenance. Their capacity is double the real needs of compressed air. Usually only one of them is in operation.

The total annual operating costs, including electricity, water, oil and repairs were estimated as 17,366 USD. More over the compressed air has poor quality due to the low effective air drying and purification features of the existing system which affects the quality of the produced wool materials. That is why it was proposed the existing bigger compressor to be replaced by a rotary screw one and to keep the smaller one as reserve.

2.2 Description

After approval of the proposal the following equipment was delivered to the plant:

1. One Ingersoll-Rand EP75 air-cooled rotary screw air compressor - 20,605 USD
- **380V/50 Hz**
- **rated maximum capacity of 320 cubic feet/min (9 cubic meters/min)**
- **rated for a maximum pressure of 125 psig (8.5 bar gauge)**
- **3340 lbs (1515 kg)**

2. One Ingersoll-Rand TM 600 refrigerated air dryer - 9,068 USD
- **380V/50 Hz**
- **dries a maximum of 498 cubic feet/min (14 cubic meters/min)**
- **1750 lbs (794 kg)**

The equipment was received in Gabrovo in March 1996.

2.3. Implementation

The implementation process was done by the Ingersoll-Rand representative in Bulgaria - the company ''Kirov Representations" in May 1996 . The compressor was installed in the existing room and the dryer in a new separate one.

Some pictures of the system are shown in fig.1. Since 1 June 1996 the compressor with the dryer are in use.

2. 4. Monitoring Methodology and Procedure

The monitoring program included measurements of the current in the two regimes - ''loaded'' and ''unloaded'' as well as the working time. The measurements were performed by the Energy Manager of the plant Mr. Ivan Bantchev in June, September and October 1996.

2. 5. Results of Measurements and Monitoring

From 1 st of June to 25 th October the new compressor was in operation 703 hours 513 of which in regime "loaded". The average current in the ''loaded'' regime was found to be 110 A and in ''unloaded'' regime 90 A.

During this period the power calculated was:

- in regime ''loaded'' 52.5 kW:
- in regime ''unloaded'' 35 kW.

The monthly production/electricity data for the period March 1996 - September 1996 obtained from the official plant documents are presented in Table 1 .

a) Baseline energy and production data before implementation of the system

The baseline was derived for the period of March 1996 - May 1996. As it can be seen from Table 1 the total production was 344942 kg whereas the electricity consumption measured by the electricity meter was 102314 kWh which determines specific consumption of 0.2966 kWh/kg.

b) Energy and production data after implementation of the system

After implementation of the new compressor from June 1996 to September 1996 the baseline is formed by total production of 466498 kg and electricity consumption measured by the electricity meter of 86753 kWh which determines specific consumption of 0.1860 kWh/kg.

2. 6. Review of Economics of the Measure

The energy savings are calculated in two ways:

- on the base of the specific electricity consumption after and before the implementation(Tabl.1): Thus it is obtained :

  466498 kg x(0.2966 - 0.1860) = 51594.7 kWh /4months = 141944 kWh/11 months.

  This forms 37.3 % annual savings of electricity comparing to the baseline before implementation the measure.

- The second way is based on the calculations done on the base of compressor parameters measurements:

  the rotary screw compressor:

  24 hours x 0.73 x 52.5 kW = 919.8 kWh in the "loaded" regime

  24 hours x 0.27 x 35 kW = 226.8 kWh in the "unloaded" regime

  Total consumption per month (average 21.7 days) : (919.8+226.8)x21.7 = 24881.22 kWh.

  the existing reciprocating compressor:

  24 hours x 75 kWh x 21.7 = 39060 kWh.

  Then the monthly savings of electricity are equal to 39060- 24881.22 = 14179 kWh or annual savings of 159968 kWh. This number determines 36.3% of the existing compressor electricity consumption. The two independent results are very closed. For the economic evaluation the lover (141944 kWh) was accepted as representative savings.

- Overall cost savings

		USD	Lvs
Original estimated implementation costs:	.....	30347	

		USD	Lvs
Actual Implementation Costs	Equipment cost (C.I.F. Bulgaria)	29 673	2 314 494
	Freight in Bulgaria	128	10 000
	Taxes		
	Design cost		
	Installation costs.....	1500	117 000
	Other costs	4800	374 400
	TOTAL :	***36 101***	***2 815 878***

Actual Annual Savings	Electricity	141944 kWh x 0.06 $/kWh	= 8517
	Water	16500 m3x0.1$m3	= 1650
	Oil	1100 l x1.74$/l	= 1914
	Repair costs (as 1994)		= 3205
		TOTAL :	***15286***

Operational costs :	Oil: 52.9 $/gallon	=	1100
		TOTAL :	***1100***

PAYBACK PERIOD = 36101 / (15286 - 1100) = 2.54 years

3. Plant-wide results

3.1 Possible interaction of measures

3.2 Summary of results for all the energy efficiency measures above

The results of the Phase II of the project can be summarised as follows:

- reduction of the electricity consumption with 36.3% due to the replacement of the old reciprocating compressor.
- Improvement of the air quality as well as savings of water and significant repair costs.

3.3 Other improvements at the plant

3.4 Baseline plant-wide energy consumption after implementation of the USAID/CEM program

The measures implemented in the plant during the project from 1994 to 1996 have affected significant the baseline plant-wide energy consumption. This can be seen from fig. 2,3,4 and 5, presented in the Appendices .

3.5 Comparison of estimated and actual results from all the measures implemented

ECM	Title	Annual En. Savings, Gcal		Savings	Plant Costs	USAID	TOTAL	Payback
No		Estimated	Actual	USD	USD	USD	USD	years
A.1	Institute Steam Trap Management Program	870	520	10660	927	-	927	0.09
A.2	Improve Insulation of Pipes and Water Heating Tanks .	450	408	8370	2830	-	2830	0.34
A.3	Control of the Wool Drying Process	200	156	3200	176	4794	4970	1.55
B.1	Implement New Steam Measuring System	820	1300	26600	9812	-	9812	0.37
C.2	Replacement the reciprocating compressor	50200 kWh	141944 kWh	14186	6428	29673	36101	2.54
			TOTAL	63016	20173	34467	54640	0.87

***** Measure C.1 Implementation of Condensate Heat Utilising System, planned for Phase I of the project, for which the plant received one water-water plate heat exchanger is delayed, because of the reconstruction of the heat supply system in the plant. It has to be completed by August 1997.**

4. Recommendations

5. Significance of the project for the CEM, the plant and Bulgaria

The project was of great significance for me both in my work as a lecturer at the Technical University of Sofia and as a Consulting Engineer. It has increased my knowledge, skills and experience in analysis of combined energy transfer and conversion systems from systematic point of view. Working on the project I learned some very practical ways of sailing my knowledge in the new market oriented conditions in Bulgaria.

The contribution for the plant can be presented from two points of view. First - the received equipment, which mobilised the Plant Managers to find some other ways of funding. Second - to encourage them in looking for potential energy saving opportunities.

As the plant is one of the several primary wool processing plants in Bulgaria there is no doubt that the results achieved will have multiplicable effect.

APPENDICES

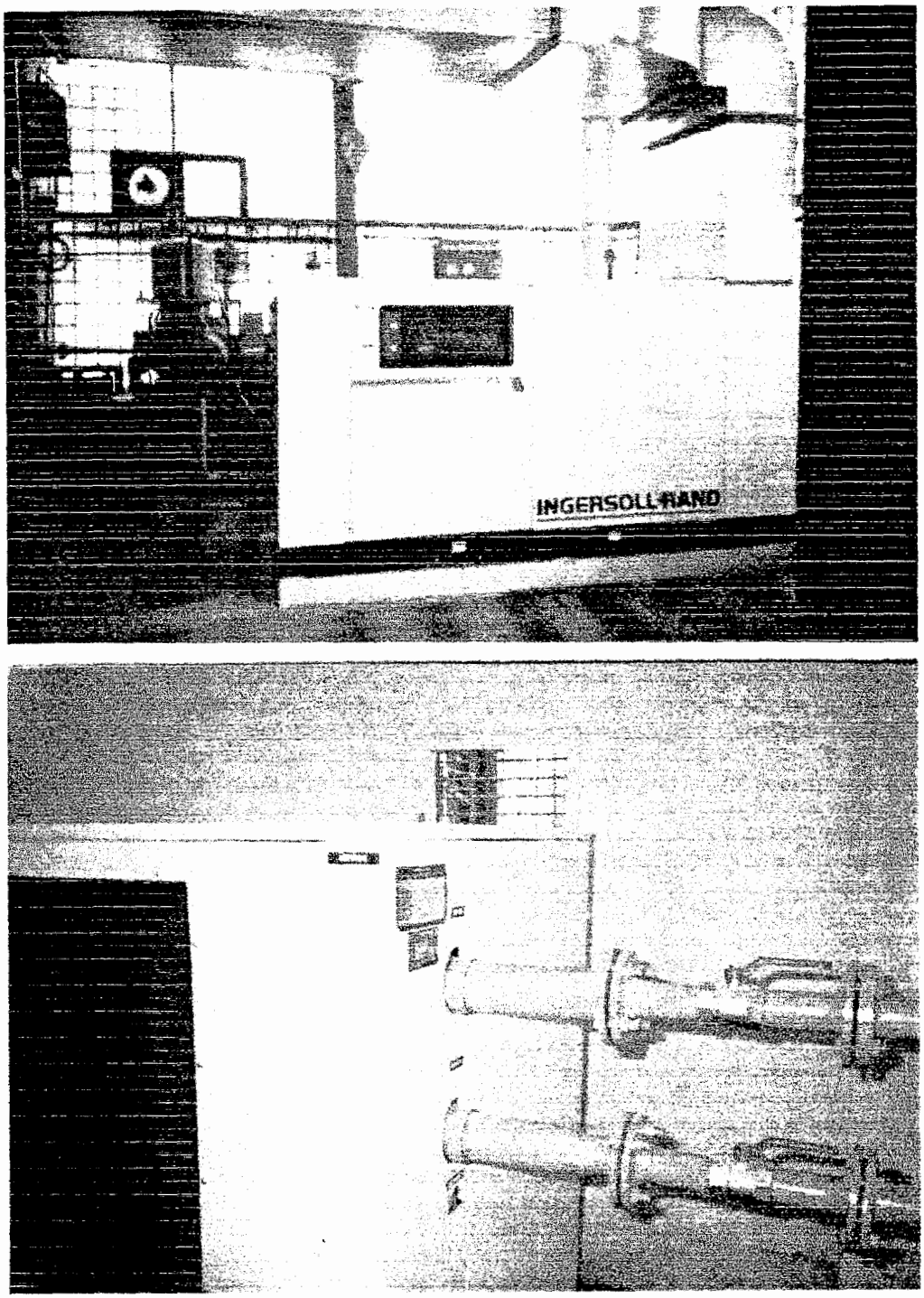


Fig.1 View from the installed new rotary screw air compressor and the air dryer

Table 1. Production and electricity consumption (1996)

Month	PROD.	Electricity	
	kg	kWh	kWh/dm^2
3	157609	26691	0.1693
4	142306	28500	0.2003
5	45027	47123	1.0465
6	107593	17268	0.1605
7	148265	27883	0.1881
8	76463	13984	0.1829
9	134177	27618	0.2058
Total	811440	189067	0.2330
Mar-May	344942	102314	0.2966
June-Septl	466498	86753	0.1860
Total savings =		**51615.99**	
Total per month =		**12904**	
Total per year =		**141944**	
Relative savings =		**%**	**37.30**

TABLE : PRODUCTION and ENERGY CONSUMPTION in RUNO

Year	Month	Total Produc. kg	Electr. kWh	Steam Gcal	Steam kWh	Sp.Steam Gcal/kg	Sp.Steam kWh/kg	Sp.Electr. kWh/kg
1991	1	276457	53360	1578	1835214	0.00571	6.63833	0.193014
	2	243432	76200	1720	2000360	0.00707	8.21733	0.313024
	3	108299	40740	1257	1461891	0.01161	13.4987	0.376181
	4	63000	18920	624	725712	0.0099	11.5192	0.300317
	5	100910	32200	648	753624	0.00642	7.46828	0.319096
	6	99262	41560	744	865272	0.0075	8.71705	0.41869
	7	58056	17080	335	389605	0.00577	6.71085	0.294199
	8	77051	25680	556	646628	0.00722	8.39221	0.333286
	9	40508	25660	368	427984	0.00908	10.5654	0.633455
	10	77560	62400	448	521024	0.00578	6.71769	0.804538
	11	69919	37240	1186	1379318	0.01696	19.7274	0.532616
	12	88473	93000	1417	1647971	0.01602	18.6268	1.051168
1992	1	182170	54000	1190	1383970	0.00653	7.59713	0.296426
	2	168218	87000	1625	1889875	0.00966	11.2347	0.517186
	3	154754	67500	1553	1806139	0.01004	11.671	0.436176
	4	183198	67500	1279	1487477	0.00698	8.1195	0.368454
	5	137405	61500	973	1131599	0.00708	8.2355	0.447582
	6	200764	67500	1433	1666579	0.00714	8.30118	0.336216
	7	167791	70800	816	949008	0.00486	5.65589	0.421954
	8	151601	58500	642	746646	0.00423	4.92507	0.385881
	9	158188	55500	657	764091	0.00415	4.83027	0.350848
	10	153140	67500	576	669888	0.00376	4.37435	0.440773
	11	150643	60000	1243	1445609	0.00825	9.59626	0.398293
	12	137475	82500	1617	1880571	0.01176	13.6794	0.600109
1993	1	125889	30885	1052	1223476	0.00836	9.71869	0.245335
	2	120383	50055	1498.8	1743104	0.01245	14.4797	0.415798
	3	140444	46860	1470.5	1710192	0.01047	12.177	0.333656
	4	65978	33600	529.6	615925	0.00803	9.33531	0.509261
	5	113564	35160	565.3	657444	0.00498	5.78919	0.309605
	6	122970	42000	486.15	565392	0.00395	4.59781	0.341547
	7	131719	38500	594.49	691392	0.00451	5.24899	0.292289
	8	11375	22050	158.74	184615	0.01396	16.2299	1.938462
	9	122014	48300	335.42	390093	0.00275	3.19712	0.395856
	10	121731	22480	394.7	459036	0.00324	3.77091	0.184669
	11	114797	32100	1520.3	1768109	0.01324	15.402	0.279624
	12	111608	35400	1016.7	1182422	0.00911	10.5944	0.317182
1994	1	133733	46500	757.92	881461	0.00567	6.5912	0.347708
	2	108383	68254	853.926	993116	0.00788	9.16302	0.629748
	3	109285	46500	719.278	836520	0.00658	7.65448	0.425493
	4	123400	63000	495.482	576246	0.00402	4.66974	0.510535
	5	112210	13500	421.821	490578	0.00376	4.37196	0.12031
	6	106525	10500	408.439	475015	0.00383	4.45918	0.098568
	7	44356	7500	159.211	185162	0.00359	4.17446	0.169086
	8	78046	10000	210.291	244568	0.00269	3.13364	0.12813
	9	120581	10500	387.221	450338	0.00321	3.73473	0.087078
	10	100661	15000	514.551	598423	0.00511	5.94493	0.149015
	11	129582	13500	712.235	828329	0.0055	6.39232	0.104181
	12	121317	16500	859.934	1000103	0.00709	8.24372	0.136007
1995	1	132959	16500	810.9	943077	0.0061	7.09299	0.124098
	2	130010	18000	725.155	843355	0.00558	6.48685	0.138451
	3	98357	19500	536.383	623813	0.00545	6.34234	0.198257
	4	108119	13500	765.195	889922	0.00708	8.23095	0.124862
	5	130863	13500	465.92	541865	0.00356	4.1407	0.103161
	6	132648	42000	473.021	550123	0.00357	4.14724	0.316627
	7	176598	84000	575.53	669341	0.00326	3.7902	0.475657
	8	105201	22800	421.77	490519	0.00401	4.66268	0.216728
	9	181341	91440	593.059	689728	0.00327	3.80348	0.504243
	10	96454	43383	446.975	519832	0.00463	5.38943	0.449779
	11	163539	73363	895.185	1041100	0.00547	6.36607	0.448596
	12	98365	84249	655.473	762315	0.00666	7.74986	0.856494
1996	3	157609	26691	965.951	1123401	0.006129	7.12777	0.169349
	4	142306	28500	726.701	845153	0.005107	5.93899	0.200273
	5	45027	47123	184.824	214950	0.004105	4.77381	1.04655
	6	107593	17268	374.445	435480	0.00348	4.04747	0.160494
	7	148265	27883	522.036	607128	0.003521	4.09488	0.188062
	8	76463	13984	253.186	294455	0.003311	3.85095	0.182886
	9	134177	27618	428.205	498002	0.003191	3.71153	0.205833

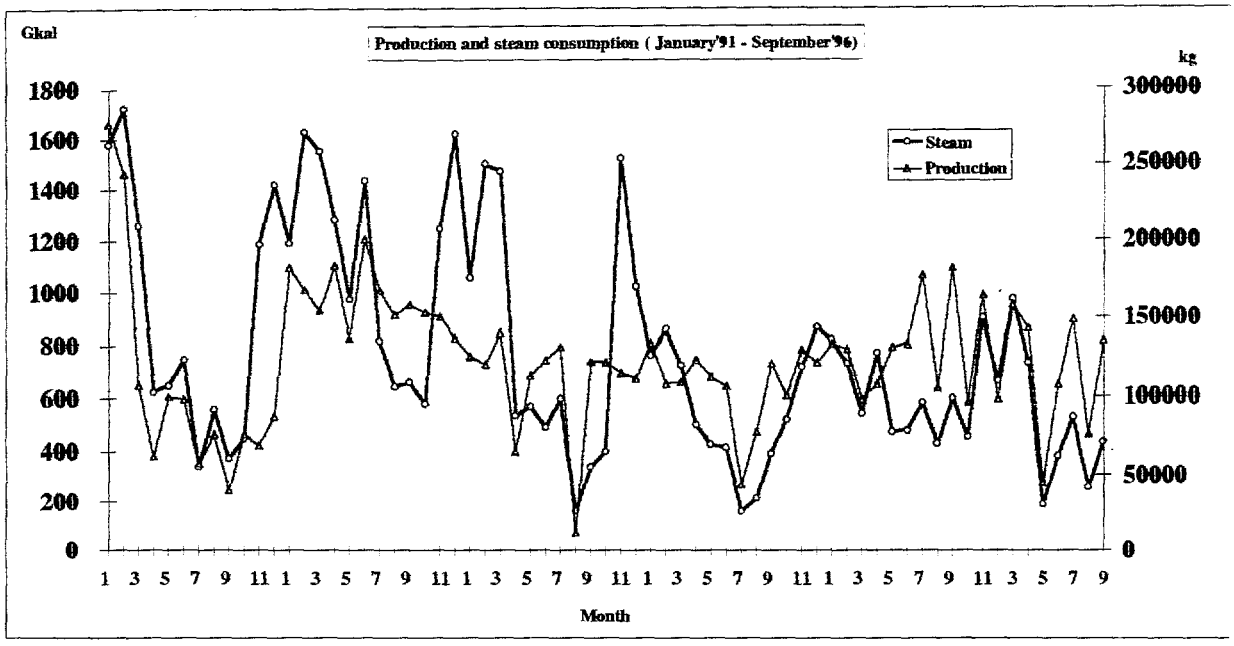

Gkal
Production and steam consumption (January'91 - September'96)
kg
Steam
Production
1800
1600
1400
1200
1000
800
600
400
200
0
300000
250000
200000
150000
100000
50000
0
1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 3 5 7 9
Month

Fig. 2

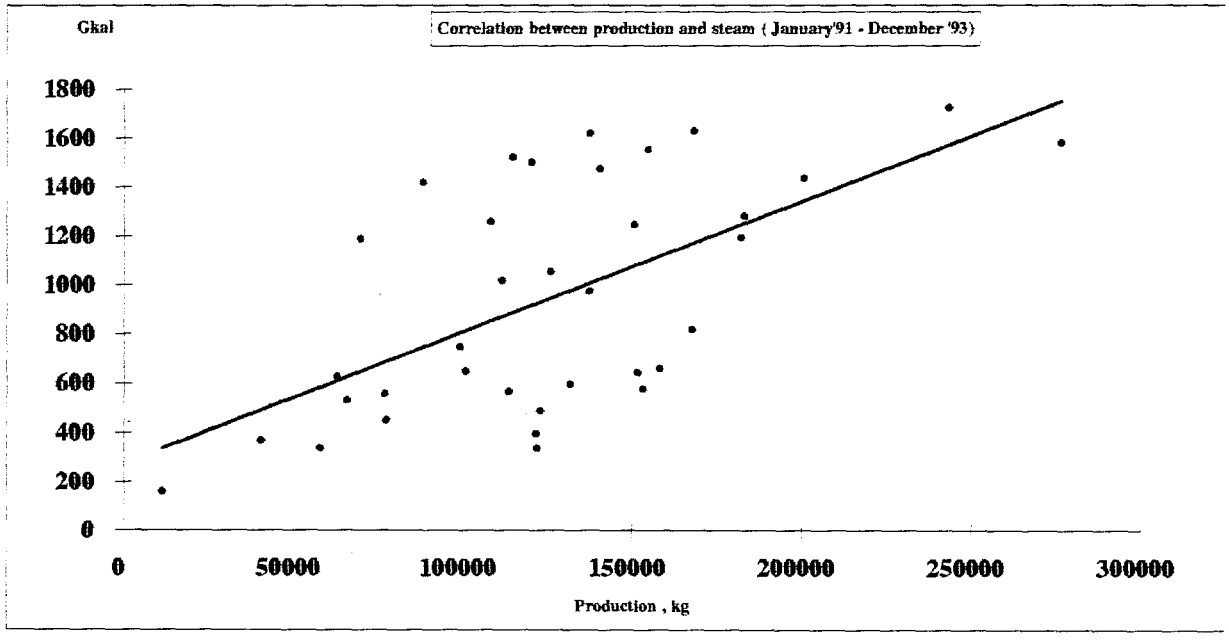

Gkal
Correlation between production and steam (January'91 - December '93)
1800
1600
1400
1200
1000
800
600
400
200
0
0
50000
100000
150000
200000
250000
300000
Production , kg

Fig.3

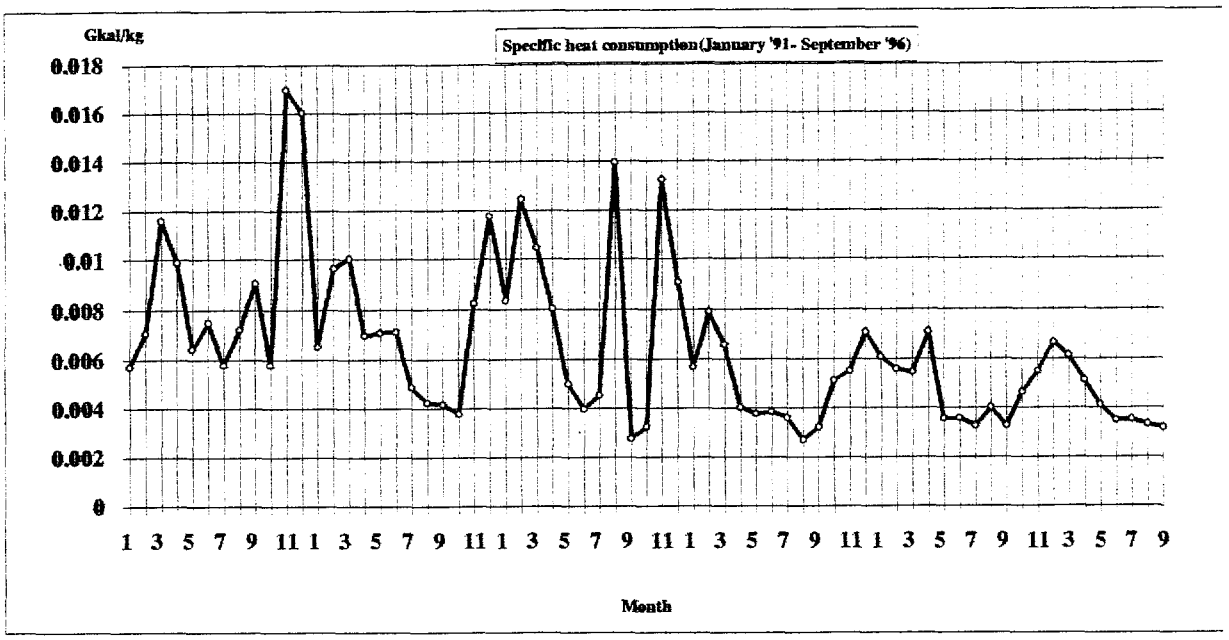

Gkal/kg
Specific heat consumption (January '91- September '96)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 3 5 7 9
Month

Fig.4

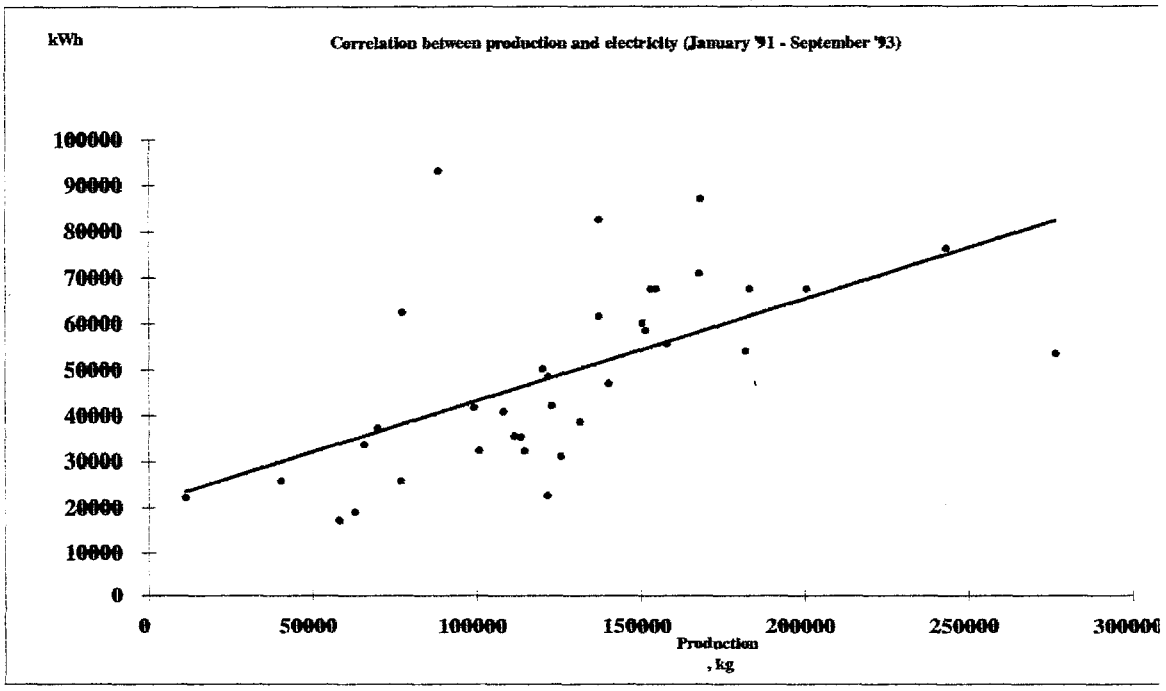

kWh
Correlation between production and electricity (January '91 - September '93)
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0
50000
100000
150000
200000
250000
300000
Production
, kg

Fig.5

MONITORING & EVALUATION REPORT
CRYSTAL PERNIK

Risk Engineering Ltd, 1606 Sofia POB4, Bulgaria, tel:+(359 2) 521217

INDUSTRIAL ENERGY EFFICIENCY

MONITORING & EVALUATION PROGRAM

USAID ENERGY EFFICIENCY MARKET DEVELOPMENT PROJECT

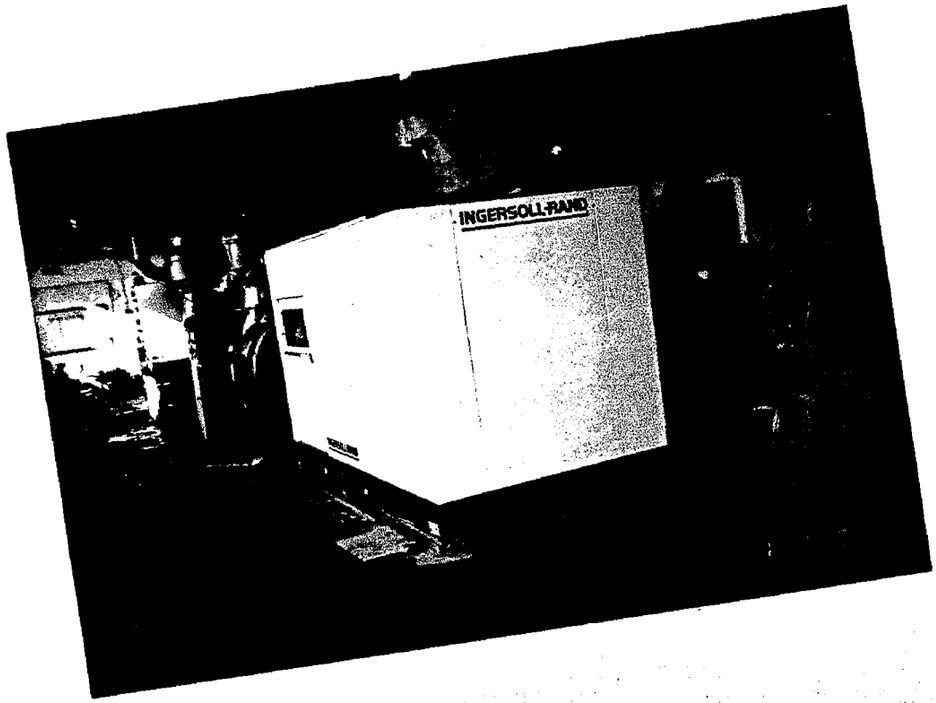
PHASE II MEASURE MONITORING AND EVALUATION REPORT

Deliverable 3

Consultant Yordan Katzarov, CEM

123

INGERSOLL-RAND


INGERSOLL-RAND

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General Information

The management of Crystal - Pernik take decision to support following two measures proposed by the consultant for II phase project under USAID Energy Efficiency Program:

- Replacement of the existing air compressors.
- Modernization of air supply to the control systems.

The goals of these measures are:

- Direct savings from less consumption of el. energy, oil and water.
- Indirect savings expressed by improvement of control system operation of glass furnace giving as result less outages of the equipment and so decreasing the costs for the production of sheet glass.

• *MEASURE I*

1. Replacement of the existing air compressor

1.1 Rational for the measure

The installed total power in Crystal Pernik is 1842 kW. (here are not included the motors less than 7 kW, the motor of one mill and the motor of the new rotary screw compressor). The average month consumption of el. energy for 1994 is 350 000 kWh. From available data is clear that the bigger consumer of electrical energy in the factory are the air compressors. The reciprocal compressors type VP 250 80/30 are more than 30 years old.

In the factory exist 5 reciprocal compressors (2 of them are out of work since they are physically wearing out).

This type reciprocal compressor has the following technical characteristics:

- Nominal pressure - 6 bars;
- Nominal flow - 30 cubic meters per minute
- The power of the motor is 200 kW plus additional 10 kW for inciter because the motor is synchronous.

The old compressors are oversized because one big manufacturing department of the factory (production of jars) is destroyed. For next 5 years are not expected new extensions in the production. With enough reserves it was estimated that the capacity for one compressor of 20 cubic meters per minute is sufficient for all functions. Because of the safety importance the number of the compressors must be 3. One works continuously, one is in stand by mode and the third is in reservation.

The first energy saving measure is the replacement of the reciprocal type compressors by new rotary screw compressors.

1.2 Existing condition

- 5 reciprocal compressors type VP 250 80/30
  - unit production 30 cu m/min.
  - design pressure of the net 7 bar
  - motor power 210 kW/unit
  - yearly operation time 7000 h/y
  - monthly oil consumption:
    - compressor oil 204 l/unit
    - casing oil 104 l/unit
  - cooling water consumption 6.33 l/h
  - type of operation base mode at full load

1.3 New condition

5 reciprocal compressors type VP 250 80/30

- unit production 30 cu m/min.
- design pressure of the net 7 bar
- motor power 210 kW/unit
- yearly operation time 7000 h/y
- monthly oil consumption:
  - compressor oil 204 l/unit
  - casing oil 104 l/unit
- cooling water consumption 6.33 l/h
- type of operation base mode at full load

1 rotary screw compressor type FX150

- production 20 cu m/min

- design pressure of the net 7 bar
- motor power 115 kW
- yearly operation time 7000 h/y
- yearly oil consumption - approx.
- air cooled

2. Description of the measure

The new compressor FX150 is delivered and mounted in the compressor hall. It is started and 72 hour operational test was fulfilled successfully. The compressor proved it's design capacity and operated in the limits of accepted sound level.

2.1 Savings from oil

The savings of oil are based on the difference of the quantity of oil consumption of 30 years old compressors type VP 250 80/30 and the oil consumption of the new rotary screw compressor FX150.

The primary cost estimation for oil for one unit reciprocal compressor was based on the data shown on the following table:

Kind of the oil	price of 1 l oil (1994)	Oil consumption per year in liters	Cost for oil per liters
Compressor oil	66.68 levs (1.02 USD)	1200	194,400 levs (2,972 USD)
Casing oil	162 levs (2.48 USD)	288	164,016 levs (2,507 USD)

The updated price for compressor oil is 0.824 $/l and updated price of casing oil is 0.57 $/l. The changes in the prices are due to the use of cheaper oil bought in big quantity in the beginning of the year. Another change came from the bigger real oil consumption than this which was accepted preliminary. The compressor oil consumption is 2075 l/y and casing oil consumption is 1040 l/y.

The assumed data for economical analysis did not change so to destroy essentially the results of calculations for the saving from oil.

2.2 Savings from water

The savings from water is based on the considerations that the reciprocal old compressors are cooled by water but the new FX15 compressor is cooled by air.

The quantity of cooling water for old compressor was estimated preliminary on theoretical calculation for the heat which should be removed by the cooling water - 63292 kcal/h (26500 kJ/h)

This means that for cooling is needed 6.33 cubic meters per hour service water.

The real consumption of water is very high and is 10 cu m/h. The difference is due to the mode of operation for all compressors. All three old compressors are supplied by cooling water independently if they are in operation or not.

The water price preliminary was estimated to 0.1875 $/cu m. The price of water at last quarter of 1996 is 0.092 $/l.

The assumed data for economical analysis did not change so to destroy essentially the results of calculations for the saving from water.

2.3 Saving from electricity

The saving from electricity is based on the difference between installed power of old type compressor and the new FX150:

- reciprocal compressor type VP 250 80/30 210 kW
- rotary screw compressor FX150 115 kW

The price of electricity preliminary was accepted 0.0234 $/kWh. Now the price of el.energy is 0.046 $/kWh. The price is averaged for 24 hours price of electricity taking into account different tariffs for pick, day and night electrical loads.

The assumed data for economical analysis are changed essentially and the results based on this data would show less saving than real.

2.4 Savings from maintenance

The savings from maintenance is based on the difference of costs for maintenance of one unit old compressor VP 250 80/30 and one FX150.

The existing air compressor need overhaul repair including replacement of the pistons, segments, flaps, basic bearings and cylinders. The costs for these spare parts are 400,000 levs. The repair of the electrical parts including control panel, motors (synchronous and inciter I&C is estimated from previous similar repair and accepted conservatively as 200,000 levs. The maintenance work of the staff is accepted on the local basis very cheaper for 6 man months 50,000 levs. The total cost of overhaul repair is estimated of 400,000+200,000+50,000=650,000 levs or 9,938 USD. Such overhaul repair is made every 3 years.

The costs for one year maintenance are aproximately 2000$ for the first 5 years.

3. Implementation schedule

• Design	15.04.1995
• List of proposed equipment for Phase II	15.05.1995
• Procurement and delivery	March 1996
• Construction of new air pipe lines and mounting of Ingersoll-Rand compressor FX150	30.09.1996
• Start up	10.10.1996

4. Monitoring method and used equipment

Monitoring and equipment were used for:

- Evaluation of maintenance and operation costs
- Evaluation of electrical consumption costs
- Operation modes
- Evaluation of total project costs and pay back
- Measuring equipment

4.1 Evaluation of operation and maintenance costs

The costs were estimated on the base of following groups of expances:

- Oil expancies
- Water expances

- Maintenance expances
- Total operatiion expances

The comparison is made for two oportunities. First oportunity preview configuration of old reciprocal compressors. Second oportunity preview configuration of existing reciprocal compressors and one new FX150. All prices are updated to November 1996.

4.2 Evaluation of electrical consumption costs

The comparison of the consumption of el.enegy is made for two configuration. In the first configuration operates one reciprocal compressor type VP 250 80/30 and another one is in stand by mode. In the second operates FX150 and again one reciprocal compressor is in stand by mode.

The observations for the mode of the glass furnace shows that two experiments should be made at approximately equal production of glass for same term of time. The measurment was made in the transformer station. The auxilary transformer is 6 kV/380 V a.c. 3 ph. For the old compressors exists separate feeding. Rustrak II Power Logger connected on the cables and clamps after the braker on supply line for compressor was used.

The air pressure was kept in the limits for normal operation approximately constant. The Total Power Consumption was compared for the two configuration of compressors.

$P_t=P_a/PF$

where

P_t - Total Power Consumption (kVA)

P_a - Active Power (kW)

PF - Power Factor (%)

We assume an experiment avaraged to one hour.

For one year the savings from the different consumption can be calculated as follow:

$$S=(P_{t,1} - P_{t,2})xZxp$$

where

S - Savings for one year ($/y)

$P_{t,1}$ - Total Power Consumption per hour for first configuration (kVA/h)

$P_{t,2}$ - Total Power Consumption per hour for fsecond configuration (kVA/h)

Z - annual time of operation for compressor (h)

p - mean price for different tariffs of el. energy

The annual time of operation can be accepted 8000 h because the process of glass furnace is continuous and the compressors operate 24 hours per day. The mean price of el. energy is 0.046 $/kWh (November 1996)

4.3 Operation mode

On/off mode of operation was used in the first configuration of the reciprocal compressors. Available for operation for now are compressors #1,#2 and #5. Compressors #3 and #4 are stopped for repair. The lack of spare parts and funds for overhaul on one hand and the age of compressors (more than 30 years) on another hand put suspicion for their restoration.

The available compressors operate on circulating order, one in operation, second in stand by mode and the third in reserve, so one compressor is included every time to supply air for glass furnace and other consumers. The compressor substitution is fulfilled manually. Air for control system is supplyed by the basic type VP 250 80/30 compressor.

In the second configuration FX150 is included in the circulating order of operation as basic compressor. On/off mode of operation is realized by signal from pressure gauge. Control system for glass furnace is supplied by air from separate compressor type EP-7.5.

4.4 Evaluation of total project costs and pay back

For calculation of simple pay-back period are used all data for expanses during the fulfillment of the project and all savings from energy and materials and labor. All annual savings from different ingredients (oil savings, water savings,el.energy savings etc.) are summarized to form Total Annual Savings.

The total Project costs enclose:

- Design costs
- Equipment costs
- Procurement costs
- Transport costs
- Mounting costs
- Commissioning costs

4.5 Measuring equipment

For experiments, evaluation of savings and liquidation of some air losses were used on one hand I&C of the installed equipment (manometers, ampere meters, voltmeters) and on the other hand portable equipment delivered by USAID (Rustrak II Power Logger, Ultra sonic detector)

136

5. Measurments and Monitoring

Several experiments were made for determination of base line consumption of energy and the consumption of energy for FX150 compressor.

- Base line parameters

All measured electrical parameters for compressor #1 for one hour term are shown on the figures:CA101 to CA111

All measured electrical parameters for compressor #1 for one hour term are shown on the figures:COMP2101 to COMP2111.

The average active power for compressor #1 is aprox.157 kW. The average active power is aprox. 150 kW. The high power factor is due to compressor's synchronous el. moters. The Total Power Consumption for compressor #1 at avarage PF=0.98 is 160 kVA. The Total Power Consumption for compressor #2 at avarage PF=0.995 is 161 kVA

- FX150 el. parameters

All measured electrical parameters for rotary screw compressor FX150 for oneshort time term are shown on the figures:CA301 to CA311

The average active power for this compressor is aprox.115 kW The average PF=0.85. The Total Power Consumption is 131kVA.

- Analysis

Prelimenary experiments showed that the new rotary screw compressor could not support the needed operational pressure at full load. The obsevations on the air pipe lines discover big losses originated by not organized streams of air. For these short comings of the air system was not taken measures because operational staff works almost continiously in "on mode". Utilizing ultrasonic detector the air losses were localized and the managment of the

glass plant ordered maintenance staff to repare air pipe lines and to close opened continuously drain valves. The fulfilment of these measures will permit rotary screw compressor FX150 to operate in real on/of mode and to realize additional savings in holidays when the furnace for car glass is out of operation.

6. Economics of the measure - Replacement of the existing air compressor

6.1 Annual saving

On the following table are summarized the resource prices and the anual expances for operation and maintenance of one old reciprocal compressor and one rotary screw compressor FX150.

	Price at 01.10.1996	VP 250 30/80 $/y	FX150 $/y
el.energy	0.046 $/kWh	58880	47840
Casing oil	0.824 $/l	1710	
compressor oil	0.570 $/l	593	
coolant oil	52.9 $/galon		1323
servise water	0.092 $/m^3	2134	
maintenance& operation		2000+1610	1610
TOTAL		66927	50773

The total anual saving is 16154$.

6.2 Total costs for the measure

- price of equipment 34200$
- engineering and design 1600$
- annual operation costs 1610$

6.3 Pay-back period

Simple pay-back period =(34200+1600)/16154=2.2 y

Remark: If the operational costs are taken into account pay-back period would be 2.5 y.

MEASURE II

1. Modernization of air supply to the control systems

1.1 Rational for the measure

The existing control of the technological process of production of glass is based of hybrid system: electrical and pneumatic parts. Some of the controllers (e.g. controller for relation of gas to air) are out of operation mainly from the wet and dirty air.The air to the control system before implementation of tthis measure was supplied from the main air pipe without keeping the requirements for oil content in air. There were often forced decreasing in the load of furnace as result of bad operation of some control devices. It's happened to miss important information because some indications are from pneumatic devices. It is impossible to improve the operation by replacement of the pneumatic system components without to change the existing unreliable way of supply of air to control systems.

1.2 Description of the measure

Two rotary screw comressors type EP-7 are installed. One is operating in base load and the second is in stand by mode. In the pneumatic scheme is included automatic condensate drainage, air drying, oil separating filters and receiver of air.

Technical specification of the new third compressors:

- Nominal pressure - 7 bars (100 PSIG)
- Nominal flow (capacity) - 14 cubic meters per hour (8.5 cf/m)
- Motor 220-1-50

The compressors are installed close to control room of the glass furnace in saparate room here they could be verified for their operation by the chief operators. .

1.2 Savings from the installation of new compressors

The restoration of the supply of air to control systems will permit to be decreased some faults of the controllers and in supported mode of operation of the glass furnace. It is estimated that the over consumption caused by such reasons is as minimum 2%. The average annual gas consumption for 1994 was $8.5 \cdot 10^9$ cubic meters. The price of the natural gas in the end of 1994 was 100\$/10^3 normal cubic meters.

The annual savings from the installation of the 3 new compressors was prelimenary estimated to 17,000 USD. Now (November 1996) the price of the netural gas is 120 \$/10^3 normal cubic meters so the expected savings are 20570 \$/y.

3. Implementation schedule

• Design	15.04.1995
• List of proposed equipment for Phase II	15.05.1995
• Procurement and delivery	March 1996
• Construction of new air pipe lines and mounting	30.09.1996
• Start up	10.10.1996

141

4. Monitoring method

Monitoring will be made periodically by checking of emergency event log of the plant. The events will be analyzed and we expect not to be found description for decrease of furnace load from faults of pneumatic devices

5. Economics of the measure - Modernization of air supply to the control systems

On the following table are shown the economical results for the second measure:

price of equipment	design and installation	annual operational expances	annual savings
11940	320	340	20570

6. Pay back period

Pay-back perod =20570/(11940+320+340)=7.2 months

PLANT WIDE RESULTS

- The results of the implemented measures showed high efficiency of the new rotary screw compressors.

The management of the plant signed frame agreement with "Risk Engineering" Ltd. for cooperation in energy saving projects in the plant.

142

By USAID program the factory received contemporary eqipment with high reliability

RECOMMENDATION

It is necessary operational staff to be trained to operate with the new compressors. The air system should be verified and all leakage to be plugged. The electricity supply for the two small screw compressors should be independent.

SIGNIFICANCE OF THE PROJECTS

1. For the CEM

- All participants refreshed their knowledge in energy savings.
- CEM took participation in all phases of the projects: audits, technical specifications, design, procurement, installation and commissioning.
- Good advertisment for their companies
- Establishment of international relations
- CEM certification

2.For the plant

- Cooperation with consulting companies
- The plant received modern energy saving equipment as grant

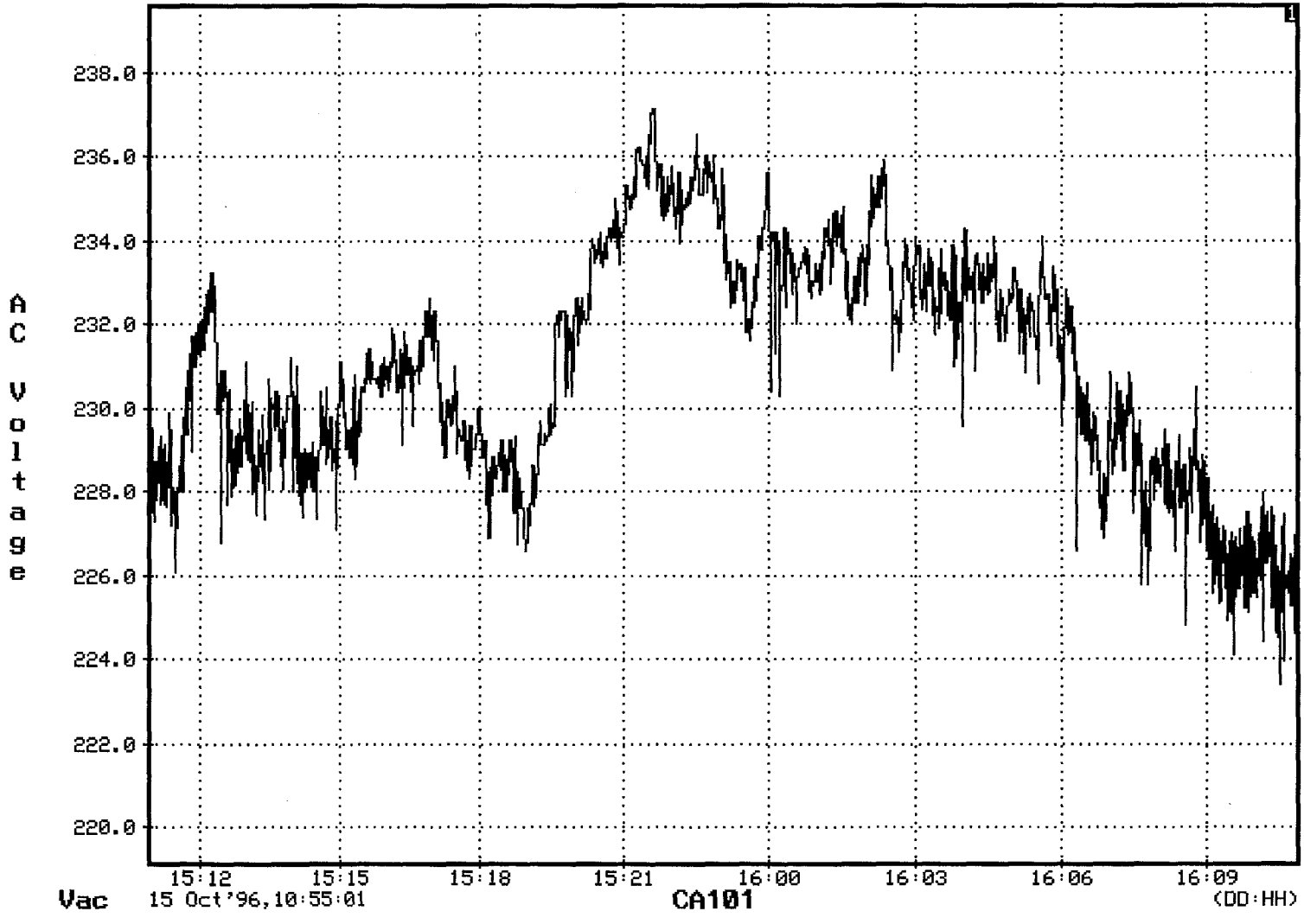
- The energy savings which will be realized in the next several years will make the plant more compatible, because the energy part in the vakue of the production is more than 50%.

3. For Bulgaria

- **The energy saving company market is realized**
- **International pilot program for energy saving with practical results.**
- **Example for energy saving policy in practice**

144

ANNEX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15:15
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16:03
16:06
16:09
Vac
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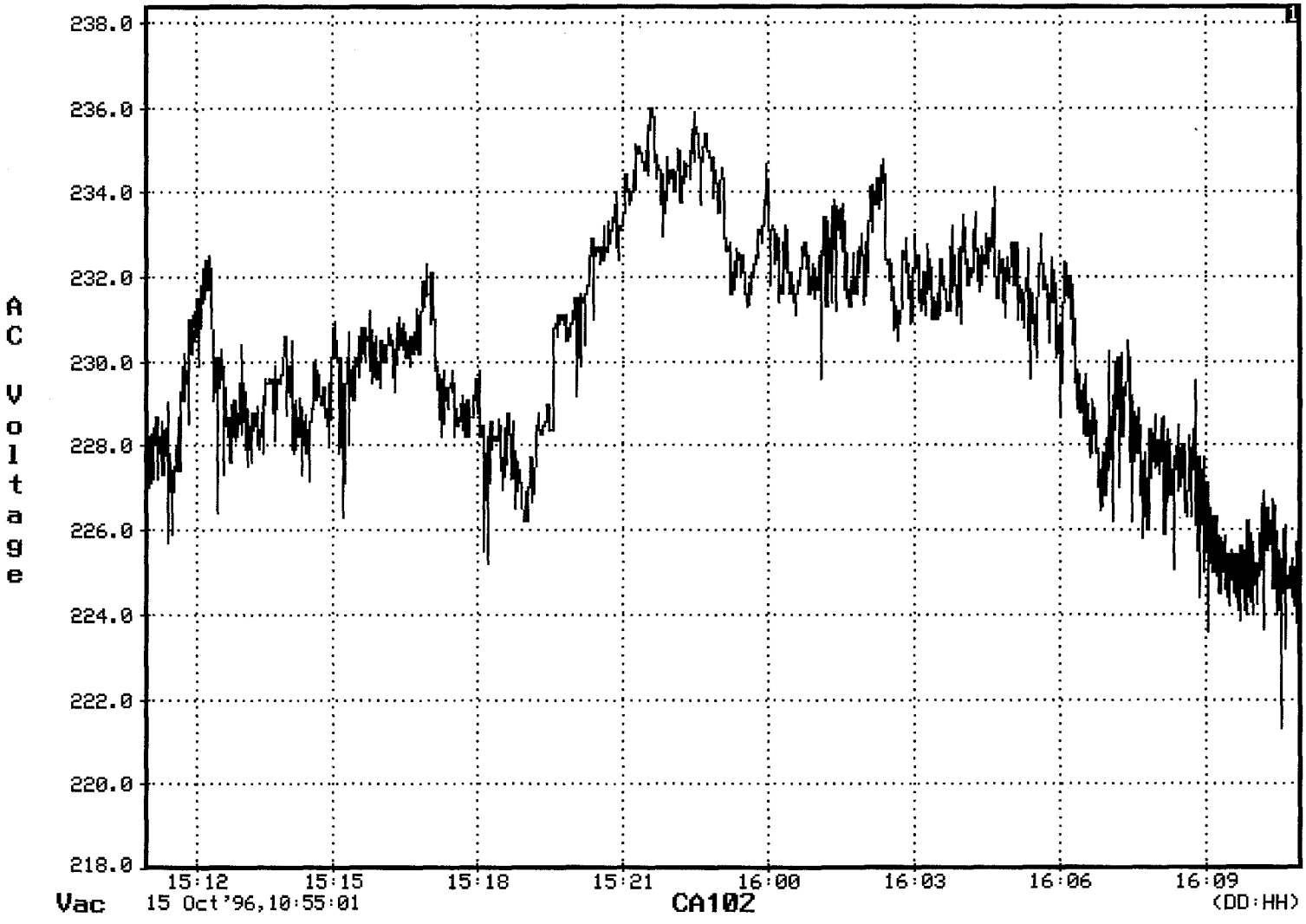
CA101
(DD:HH)

1/6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16:03
16:06
16:09
Vac
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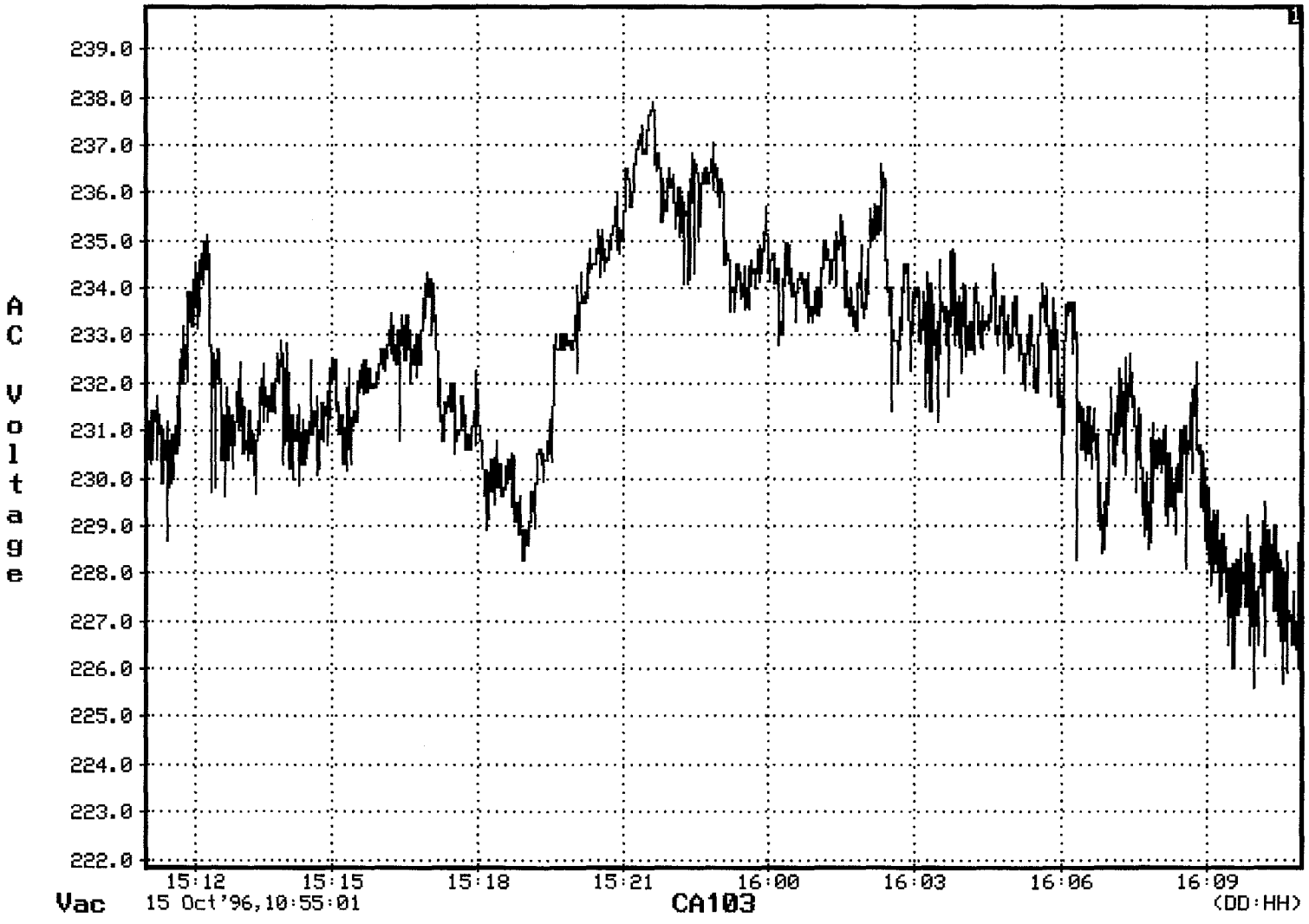
CA102
(DD:HH)

147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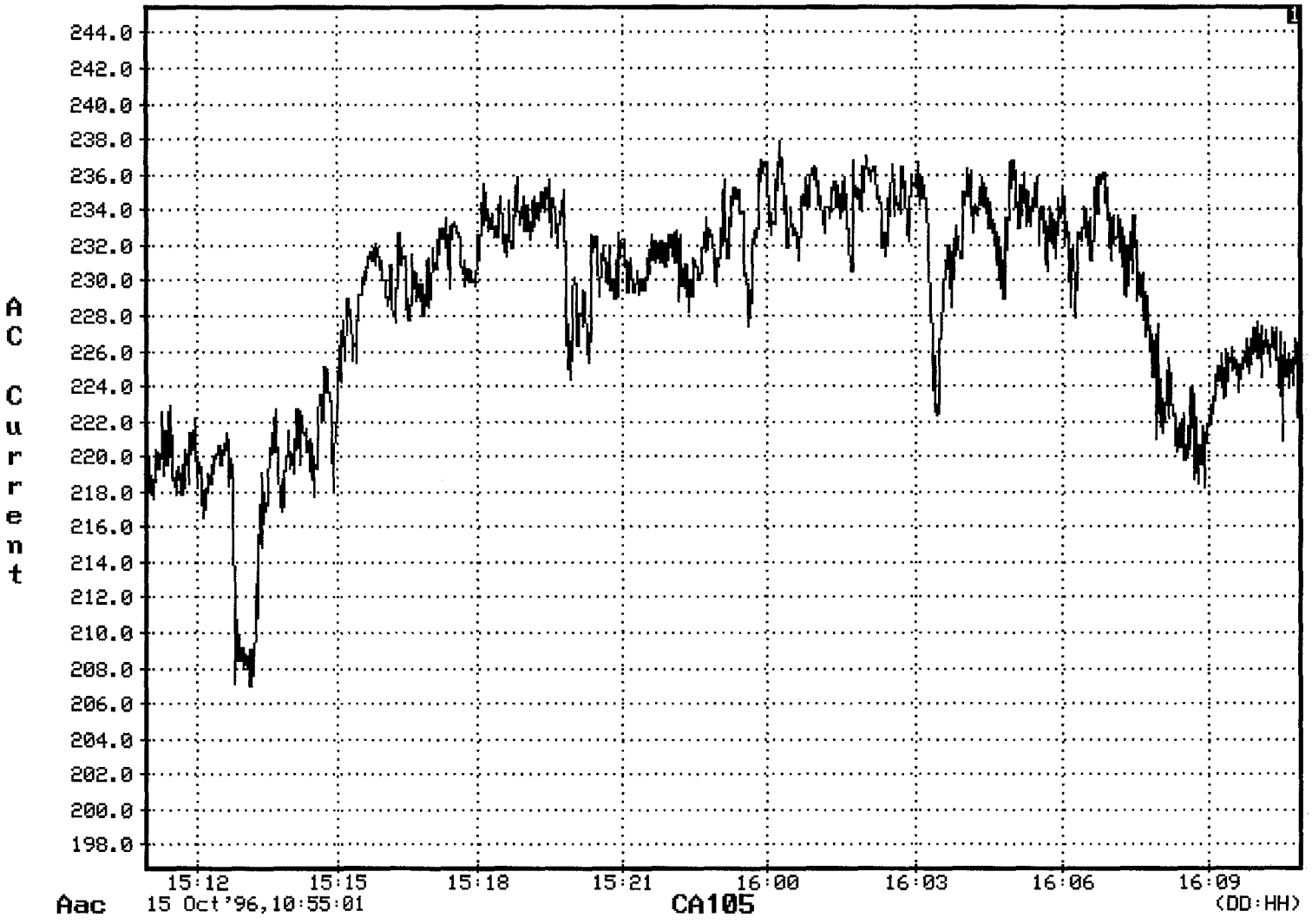
CA103
(DD:HH)

148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202.0
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198.0
15:12
15:15
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Aac
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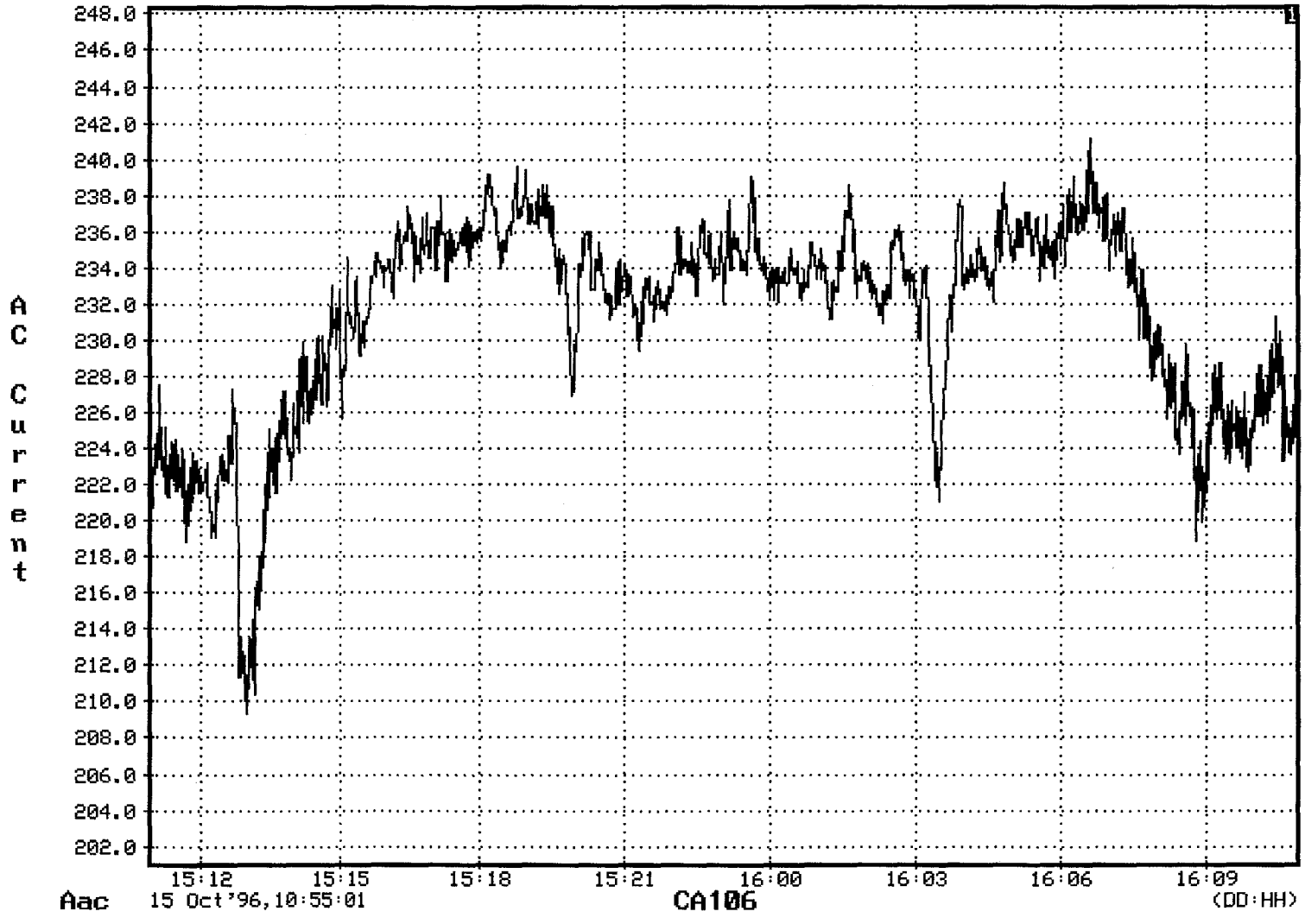
CA105
(DD:HH)

69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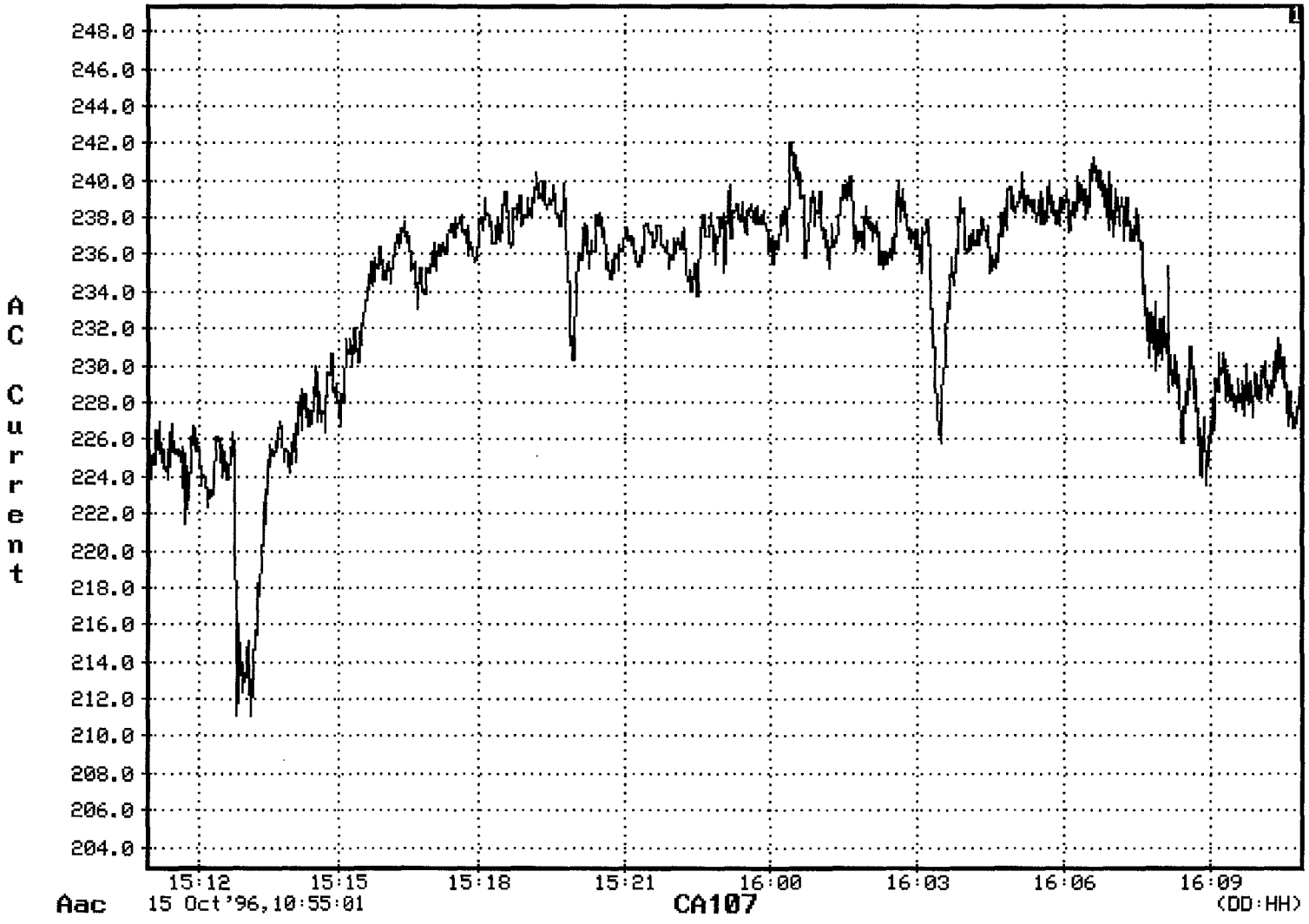
60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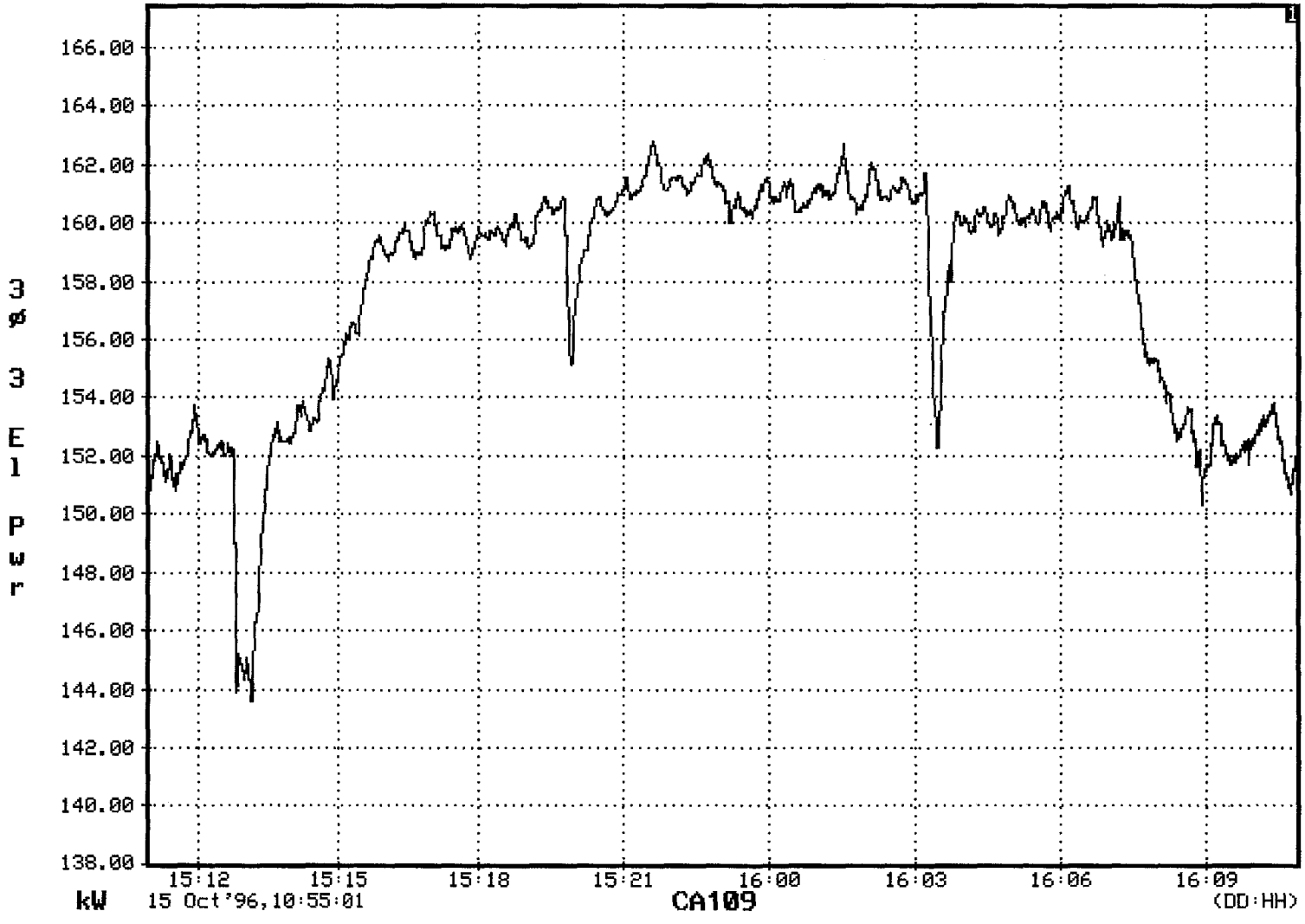
CA107
(DD:HH)

151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138.00
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kW
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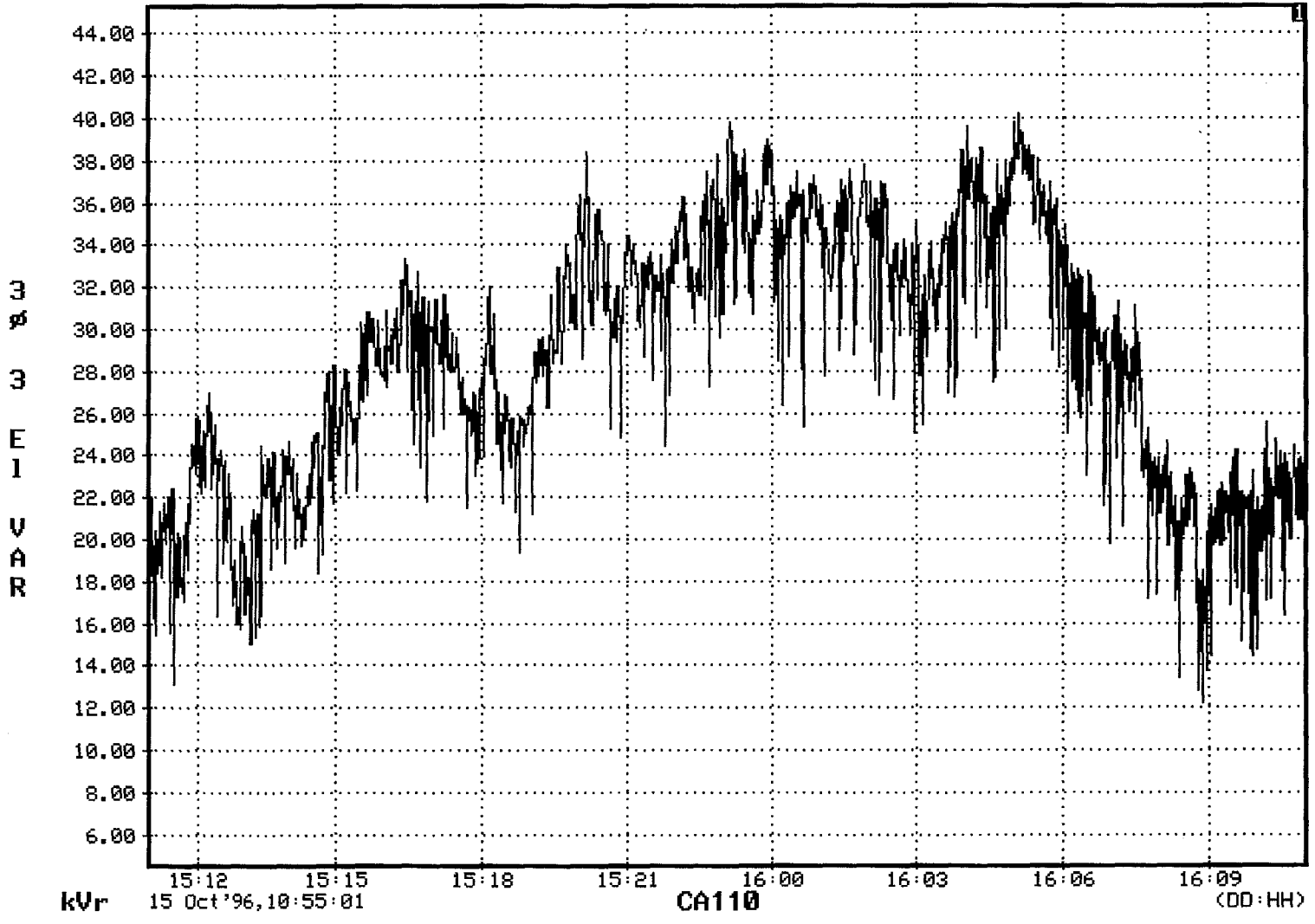
16:06
16:09
(DD:HH)
CA109

25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20.00
18.00
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10.00
8.00
6.00
kVr
15:12
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15:21
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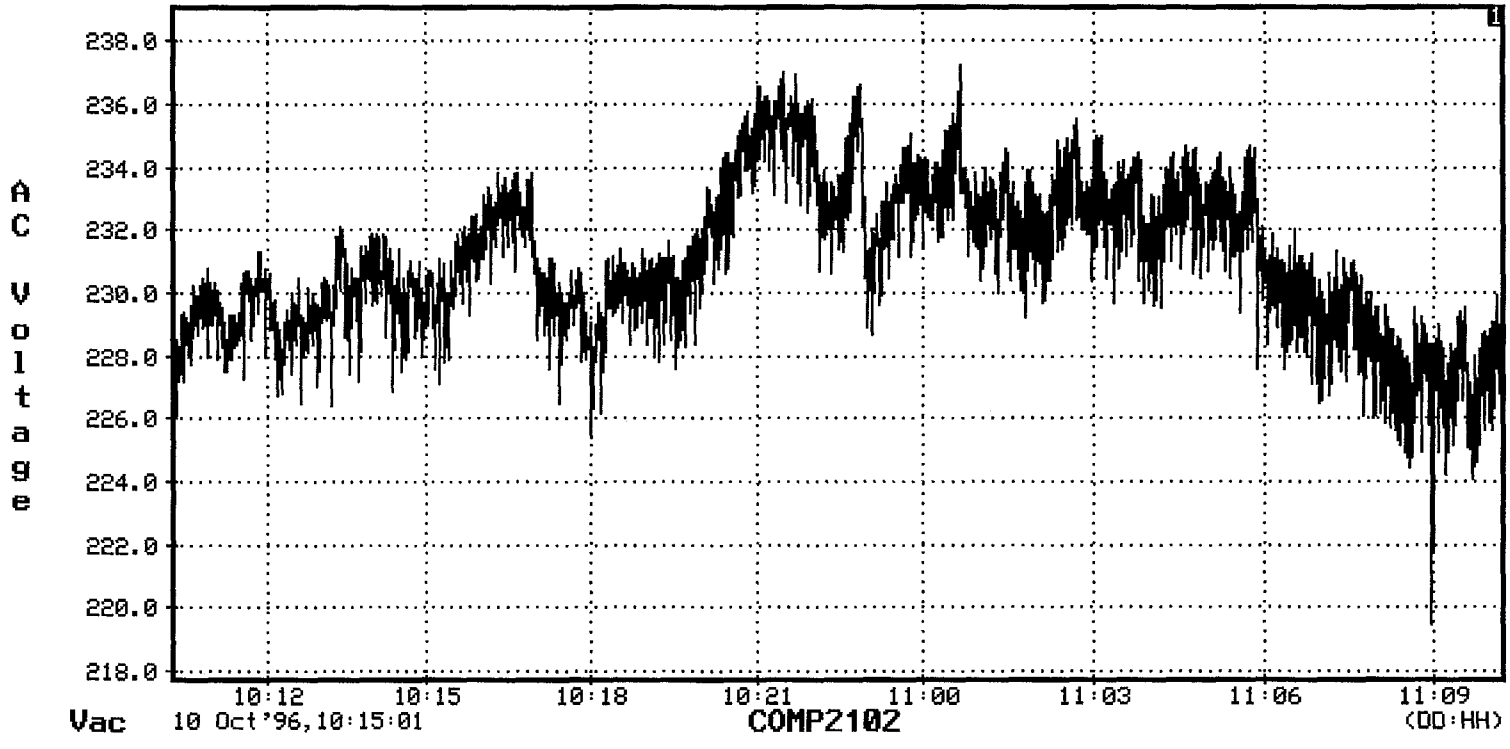
16:09
(DD:HH)
15 Oct'96,10:55:01
CA110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(DD:HH)
Vac
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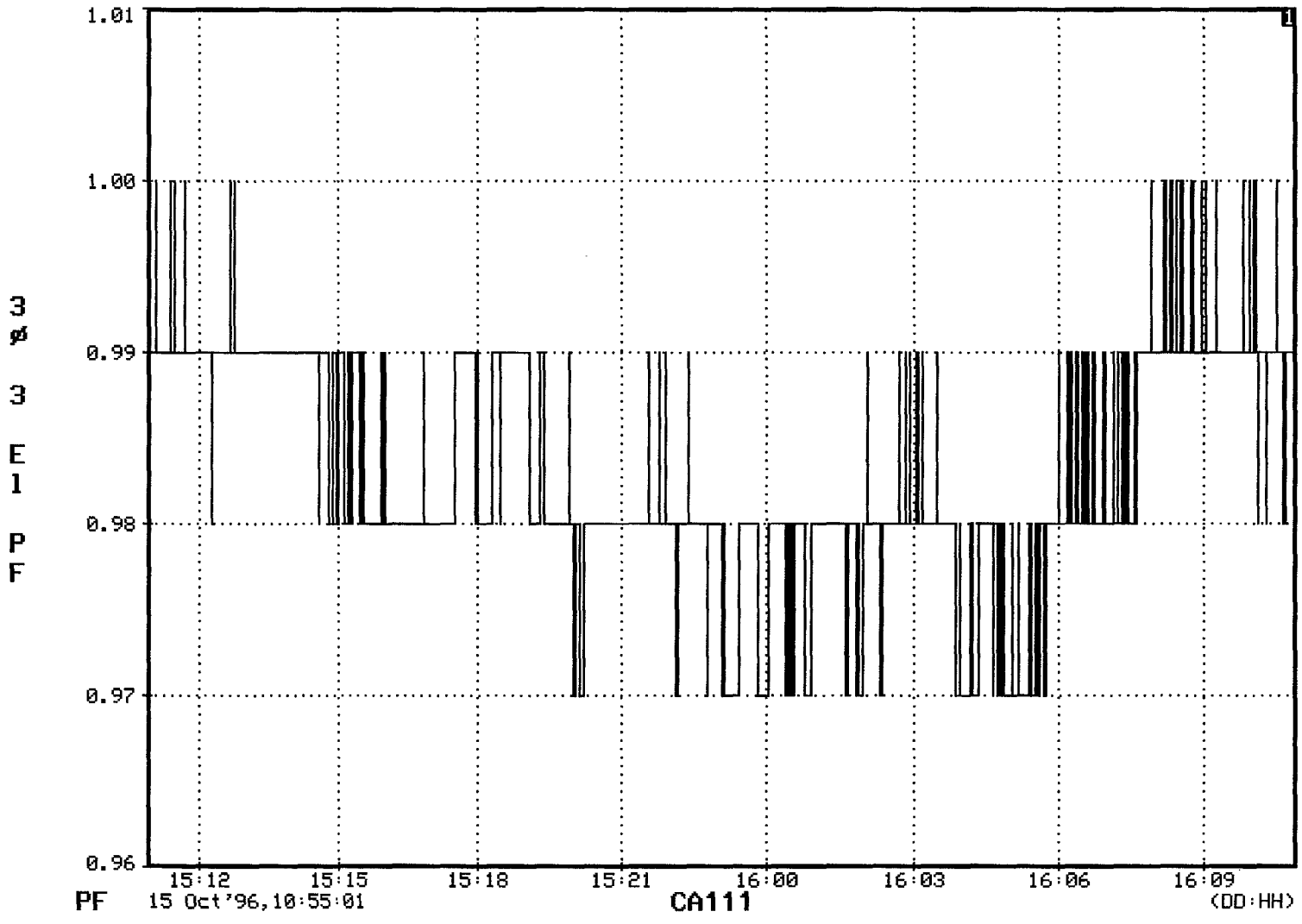
COMP2102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E
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P
F
15:12
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16:00
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16:06
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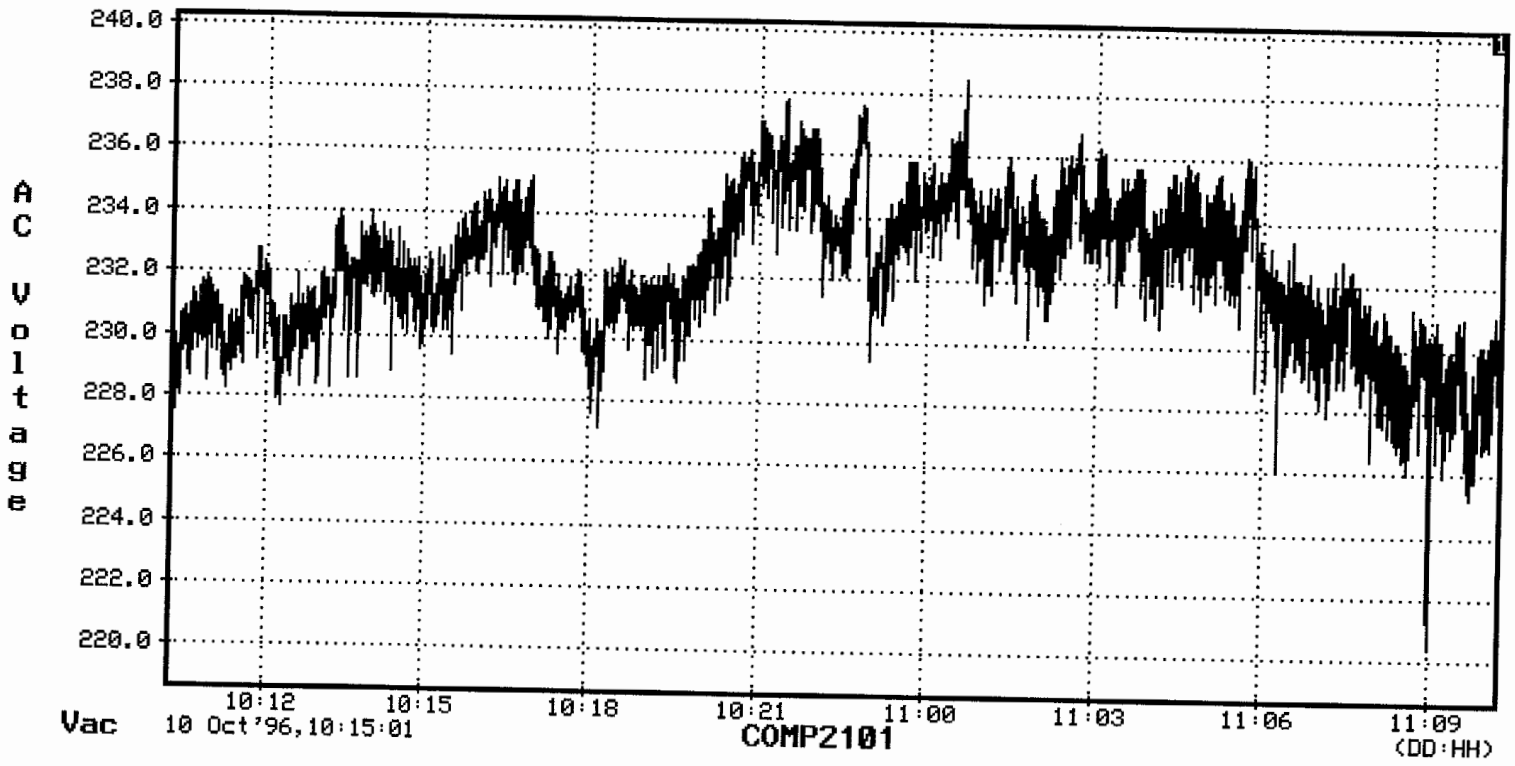
PF
15 Oct'96,10:55:01
CA111
(DD:HH)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Vac
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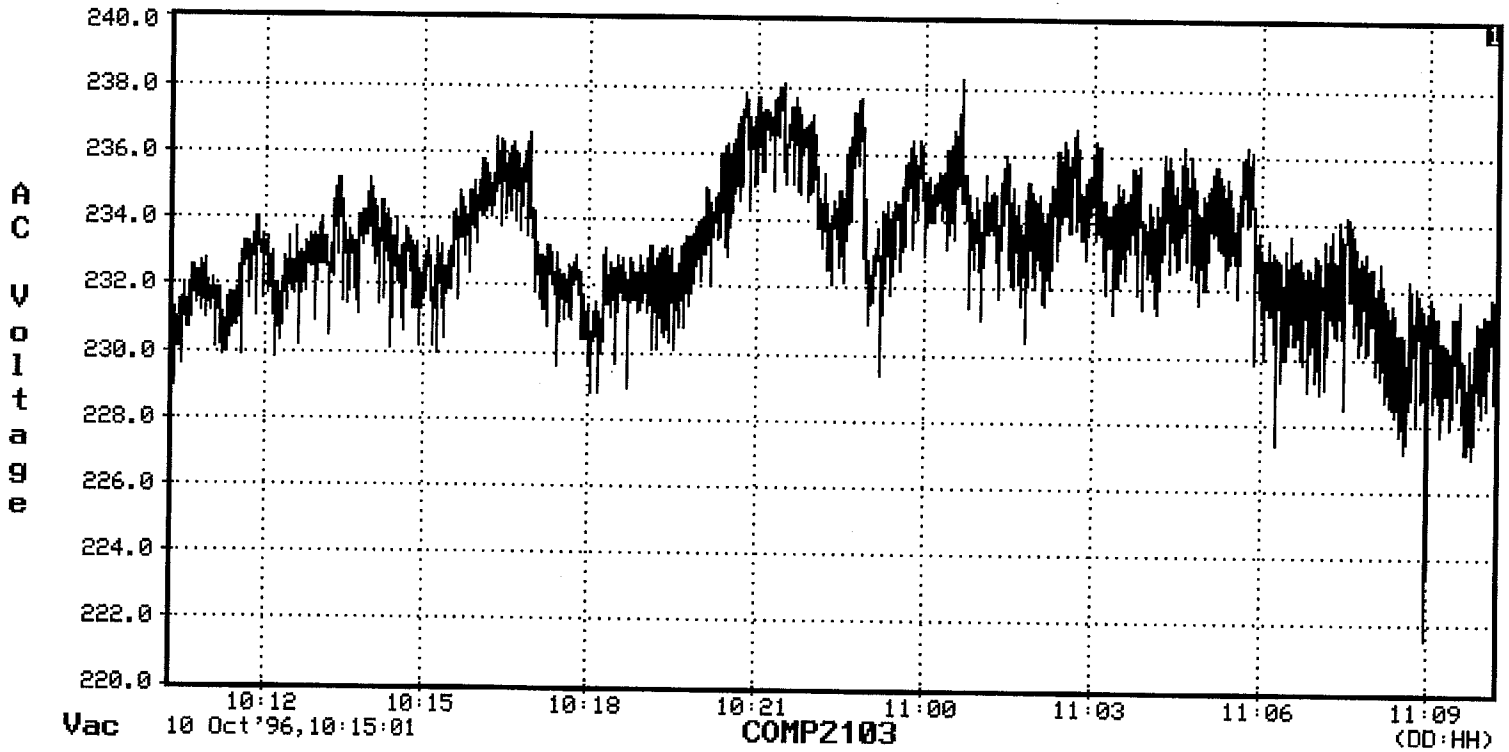
11:09
(DD:HH)
COMP2101

156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(DD:HH)
Vac
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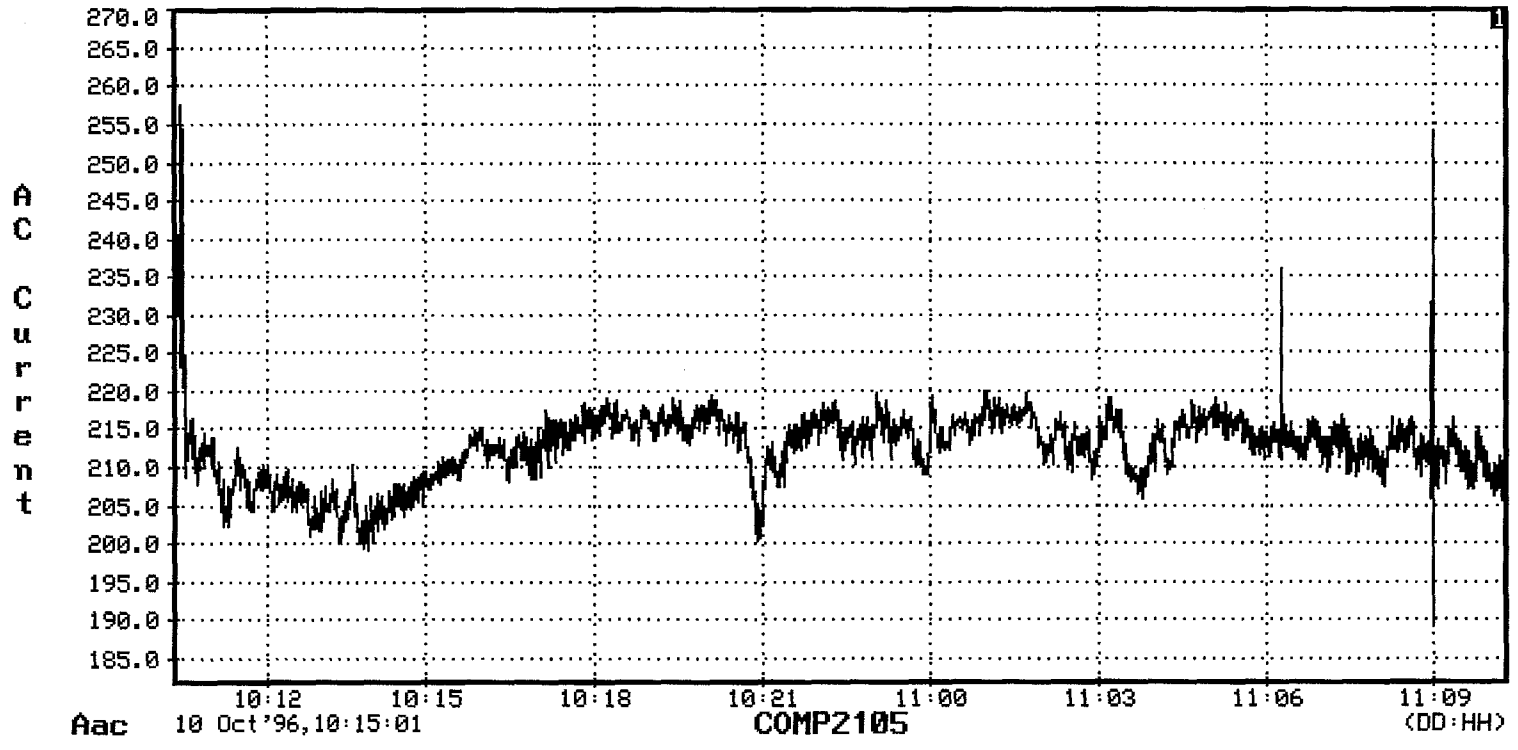
COMP2103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195.0
190.0
185.0
10:12
10:15
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(DD:HH)
Aac
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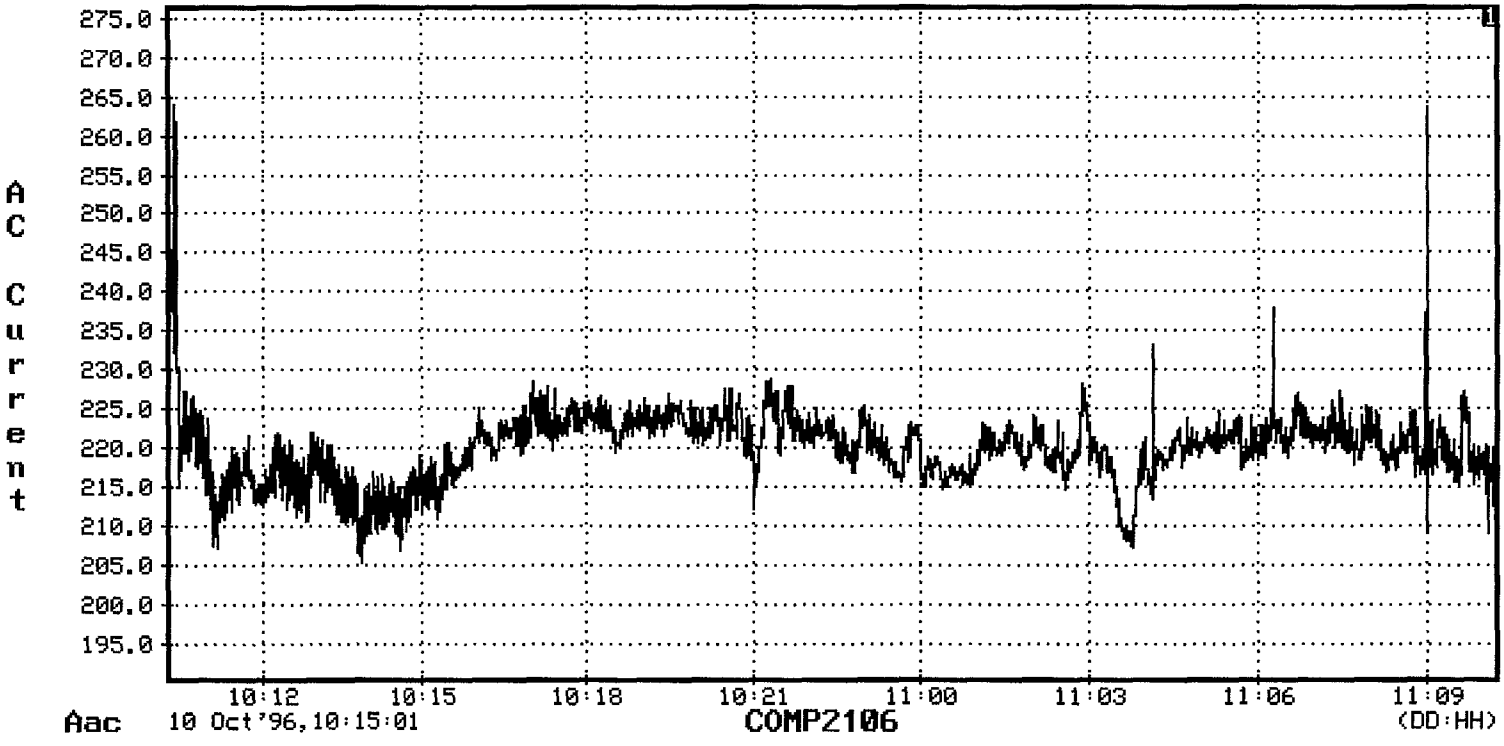
COMP2105

15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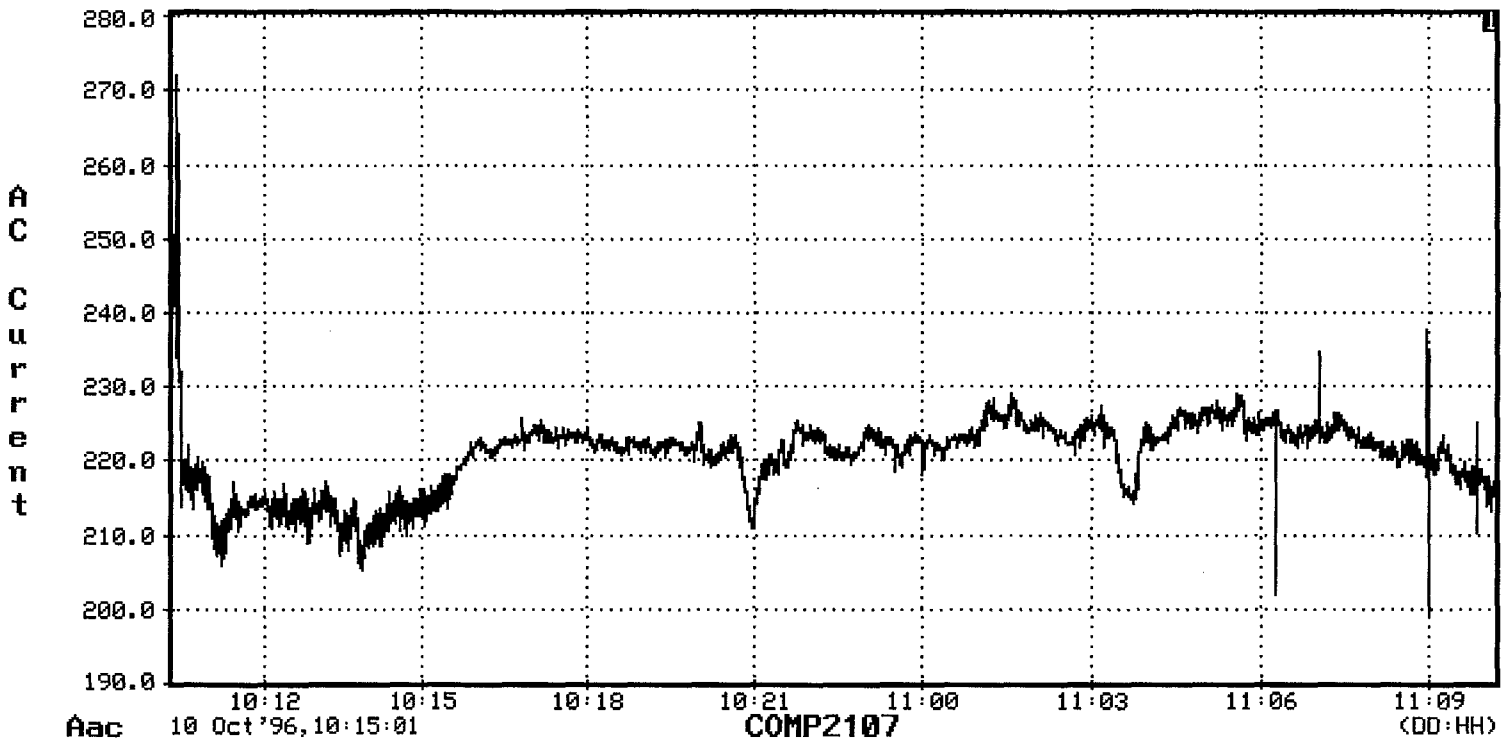
159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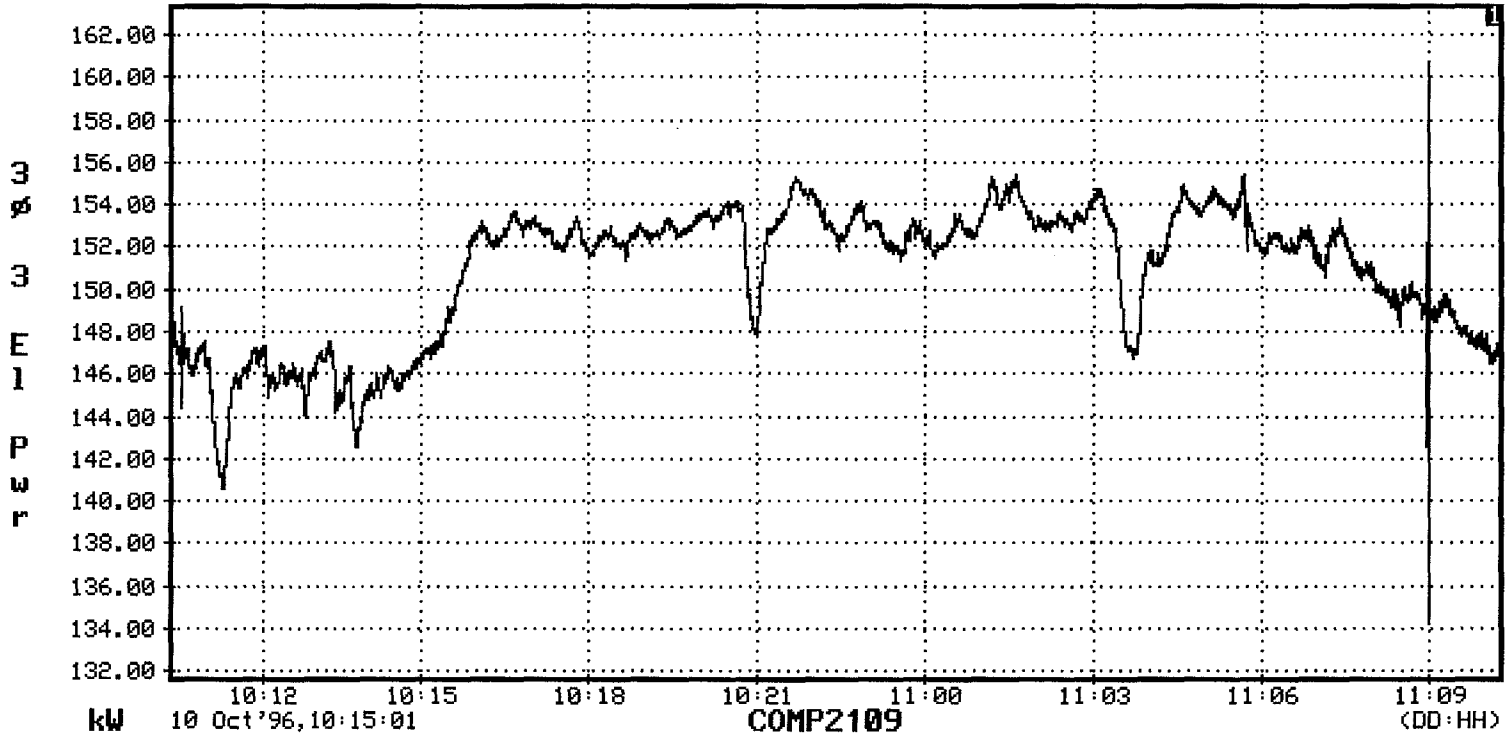
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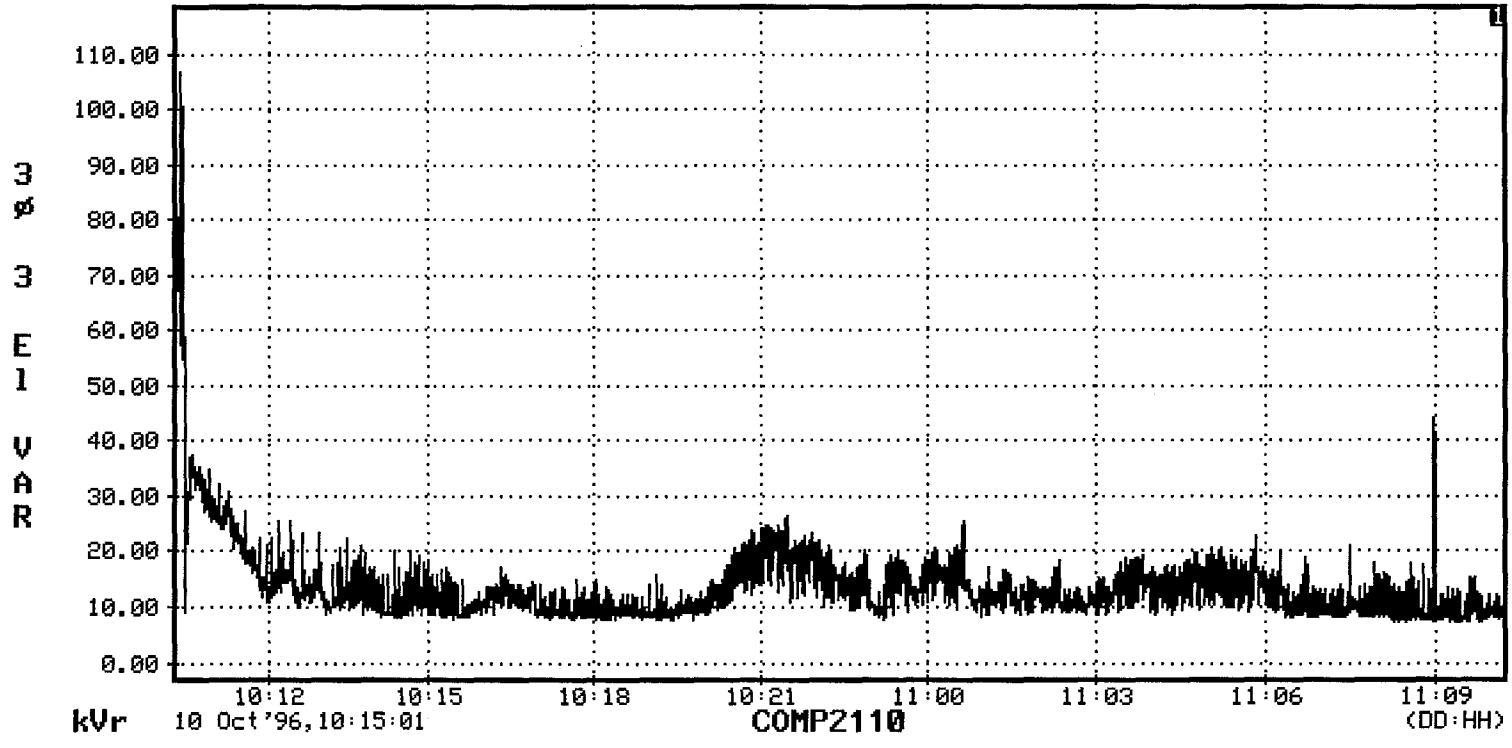
COMP2109
(DD:HH)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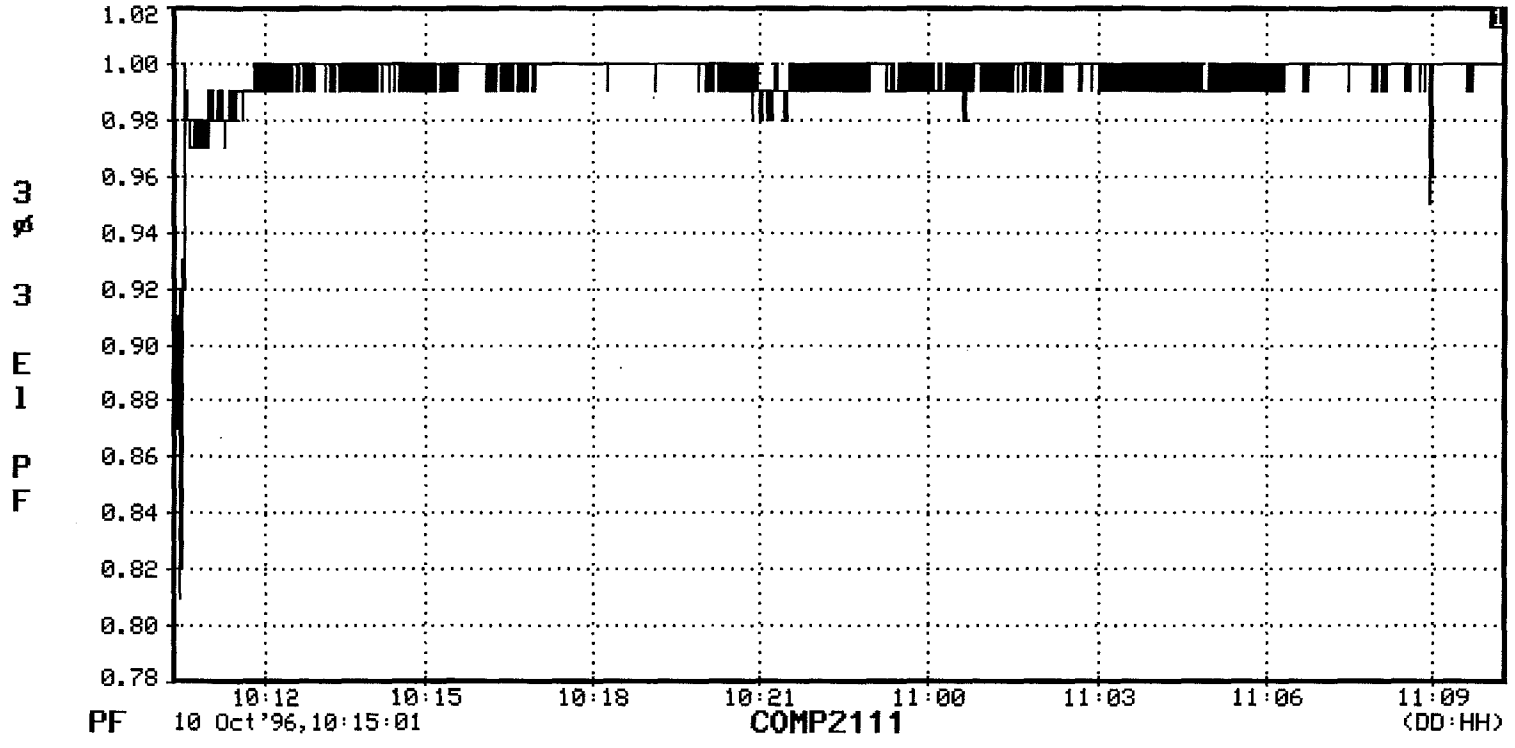
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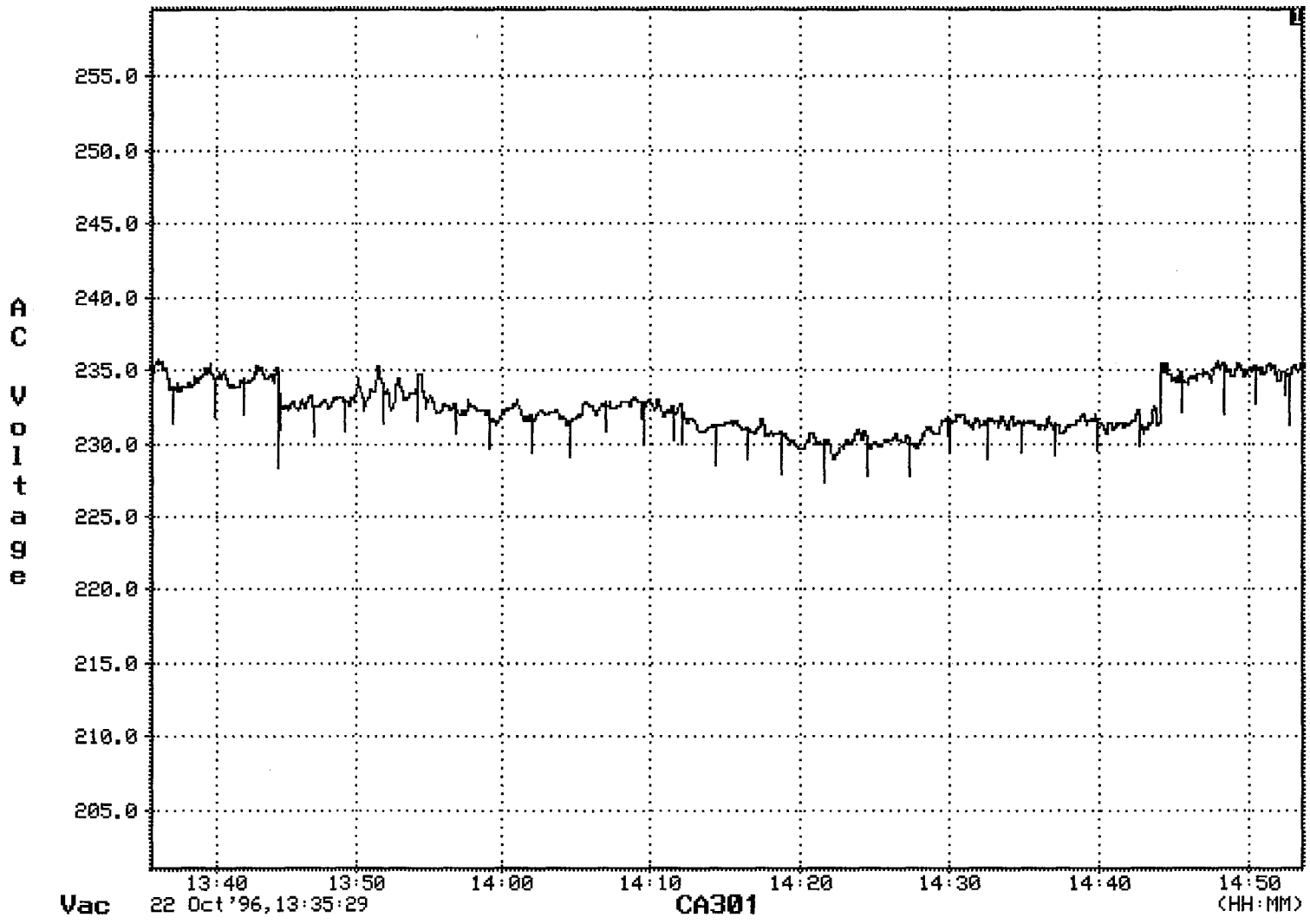
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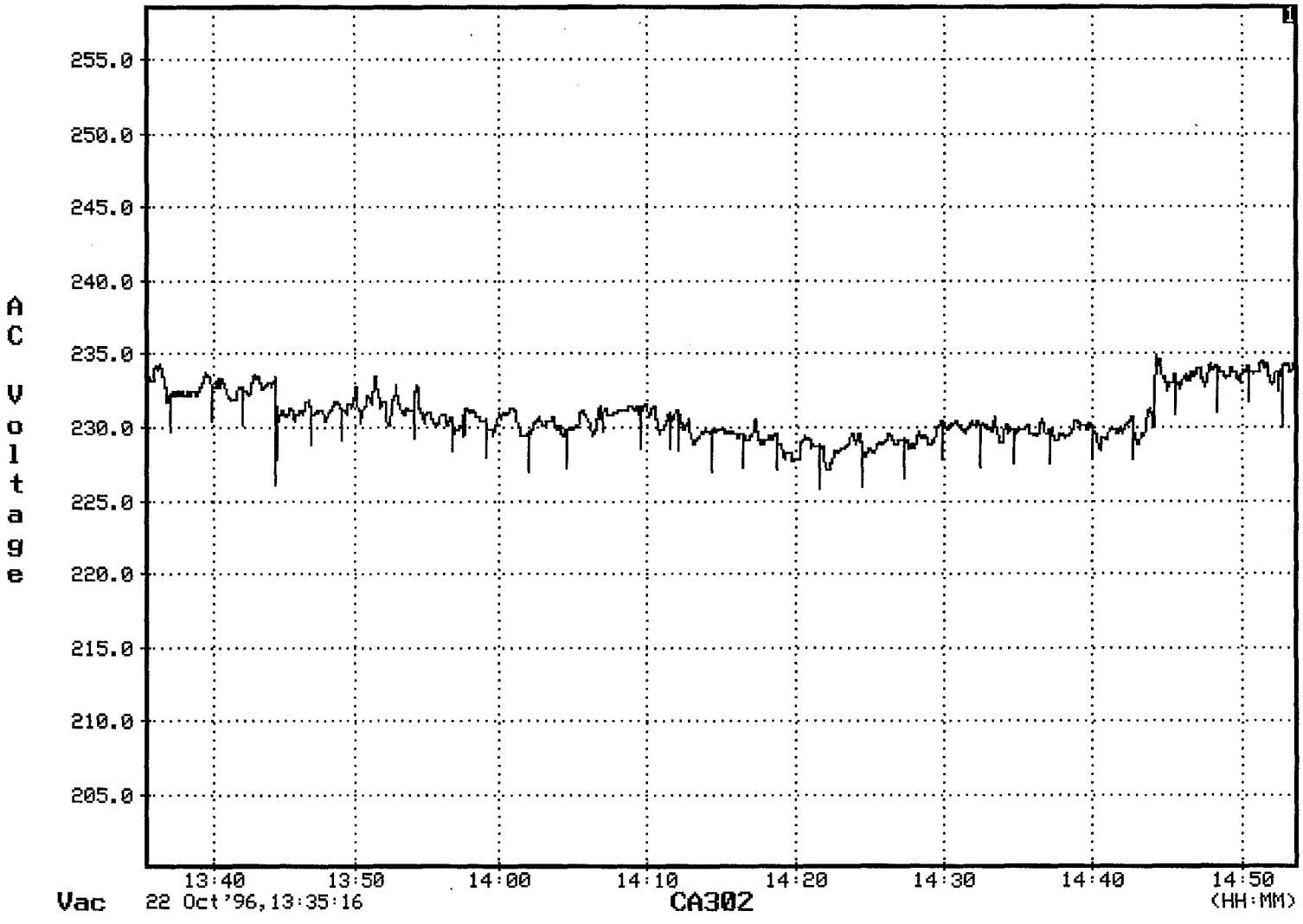
CA301

164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Vac
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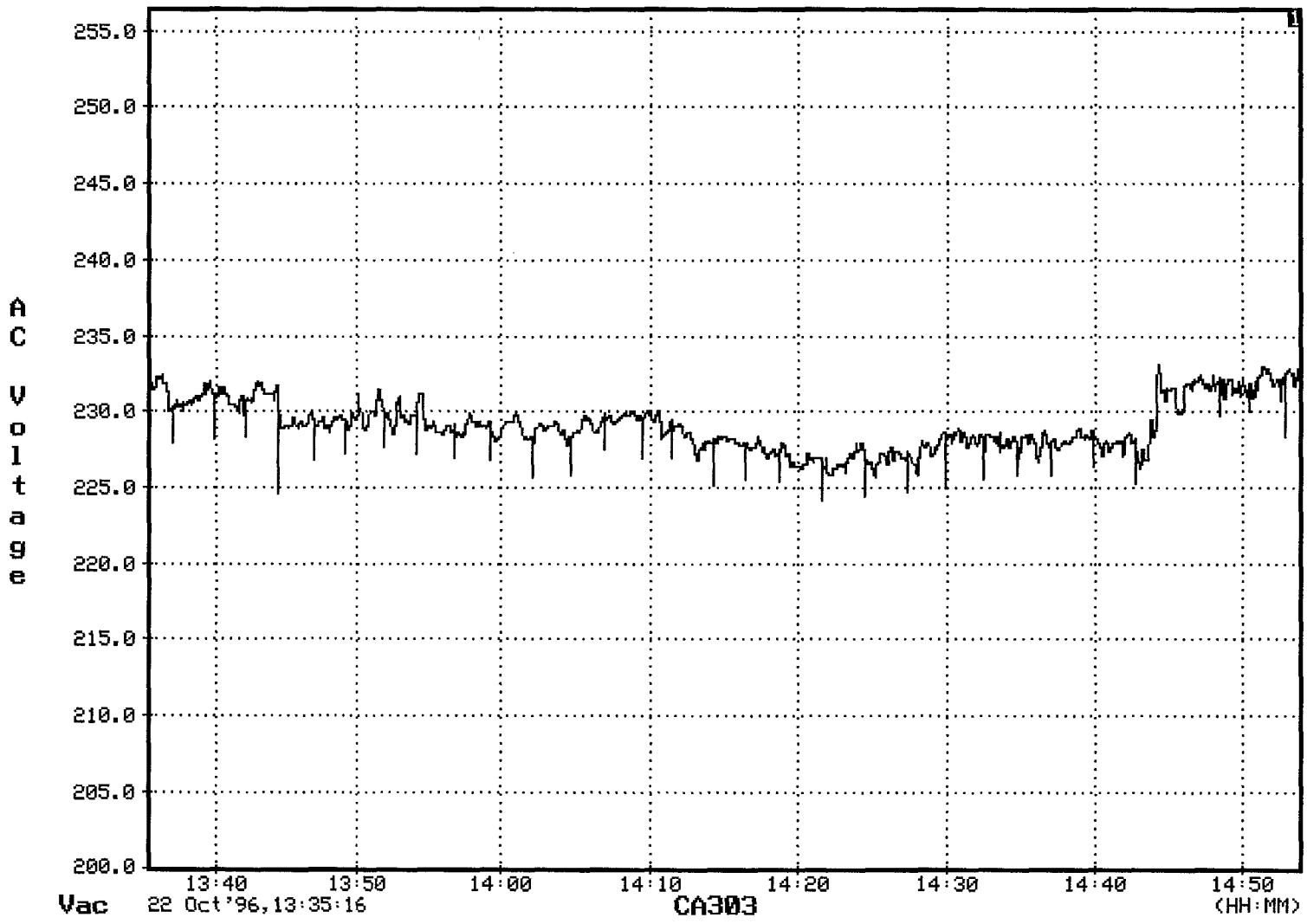
CA302

16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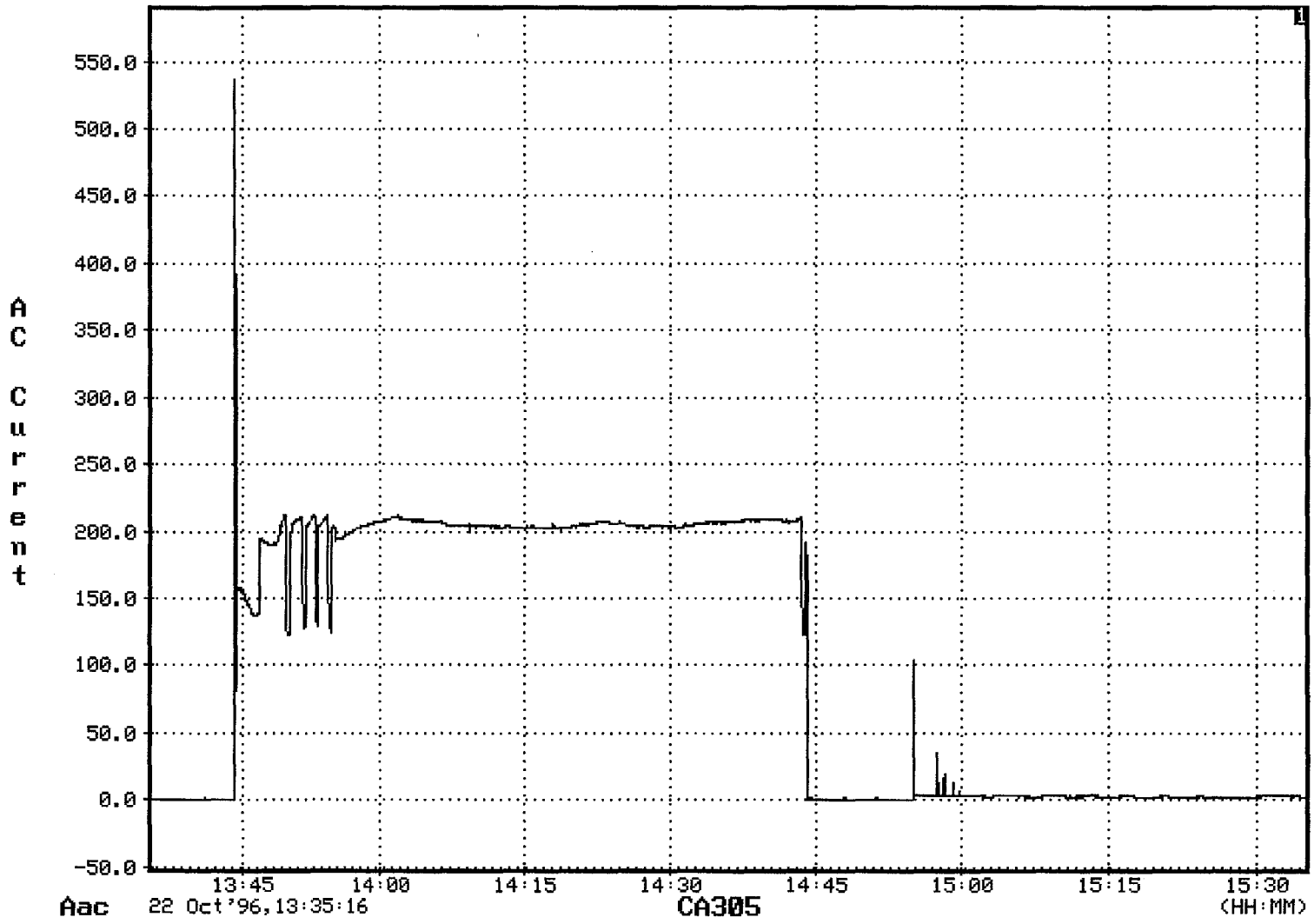
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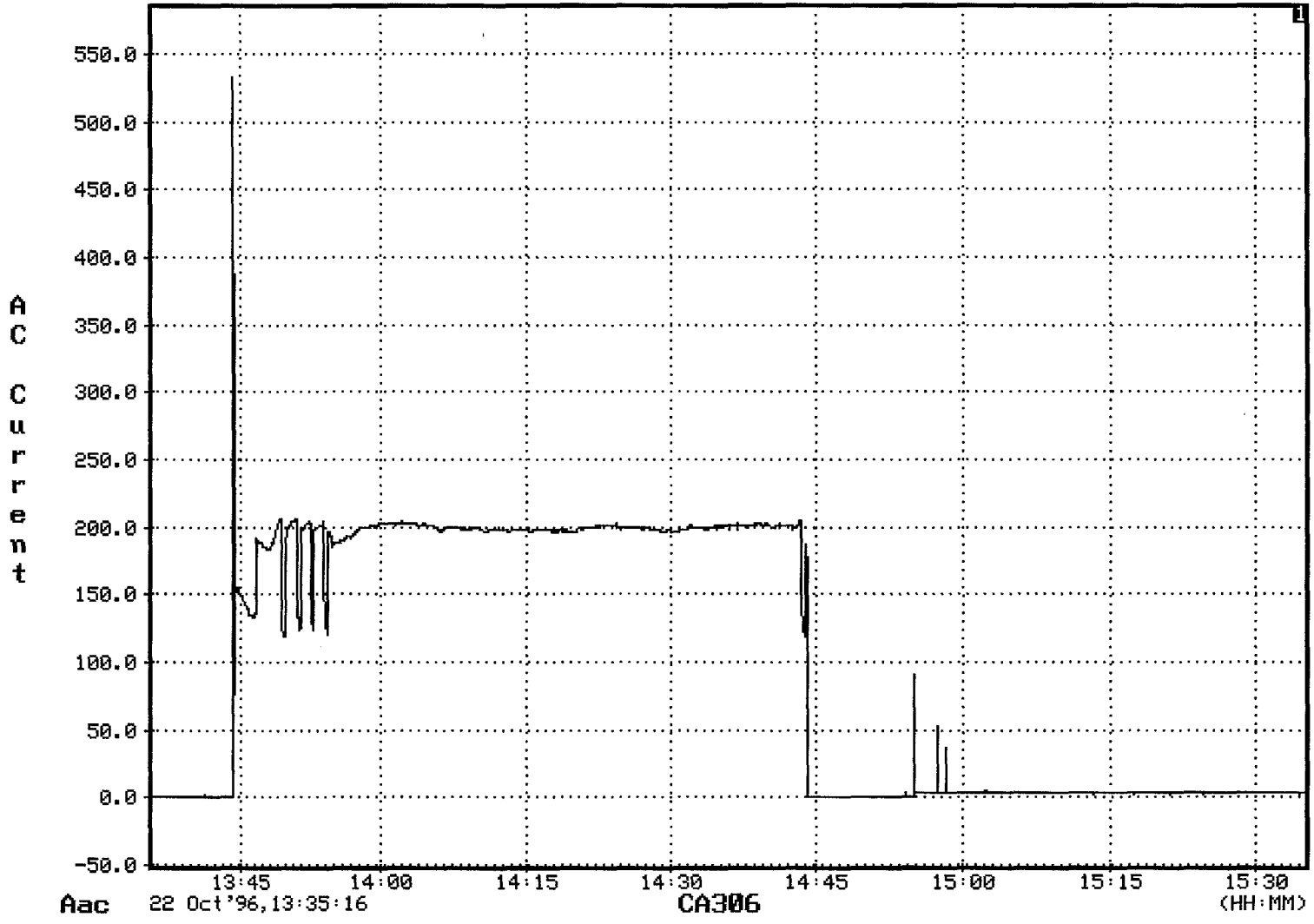
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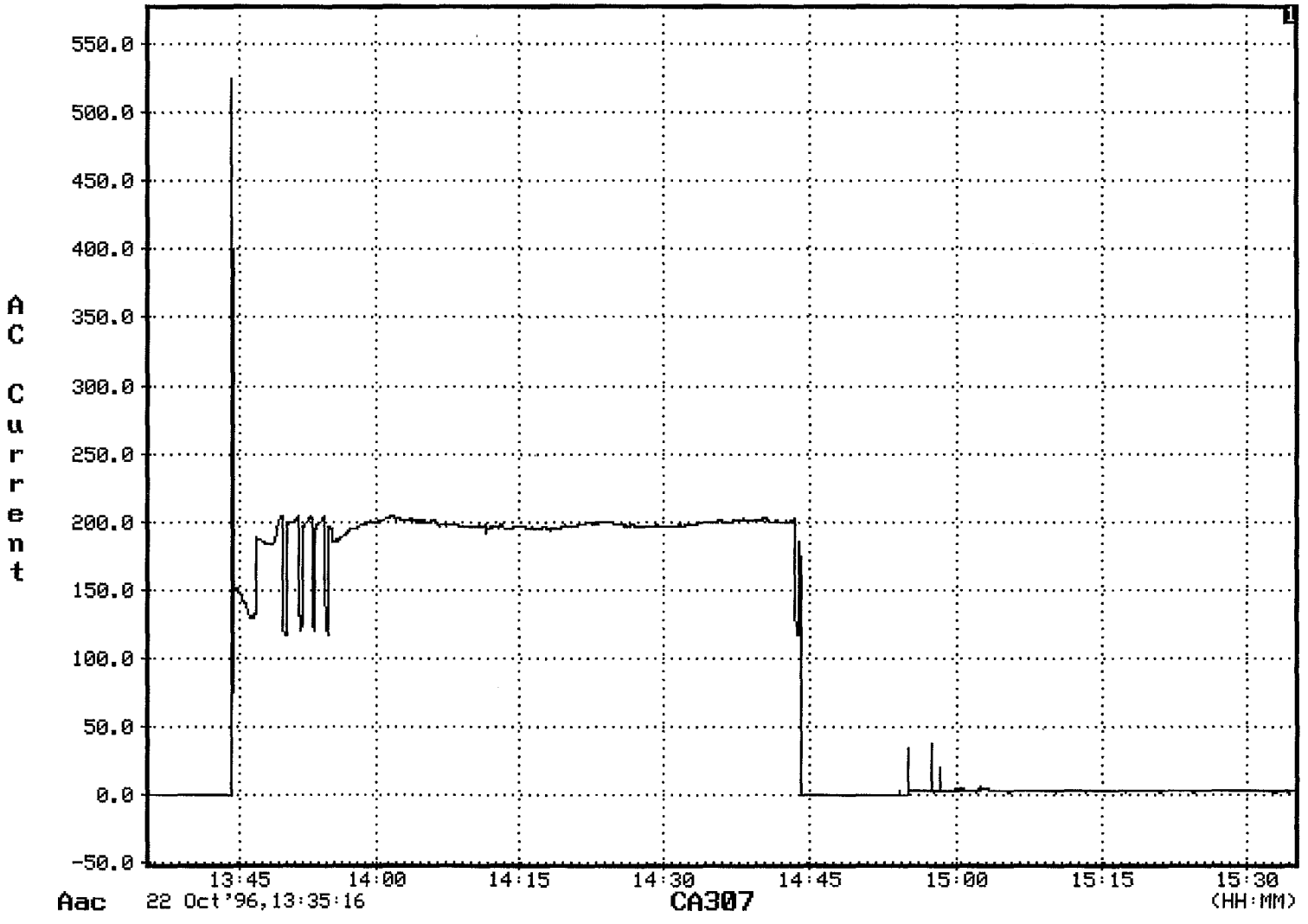
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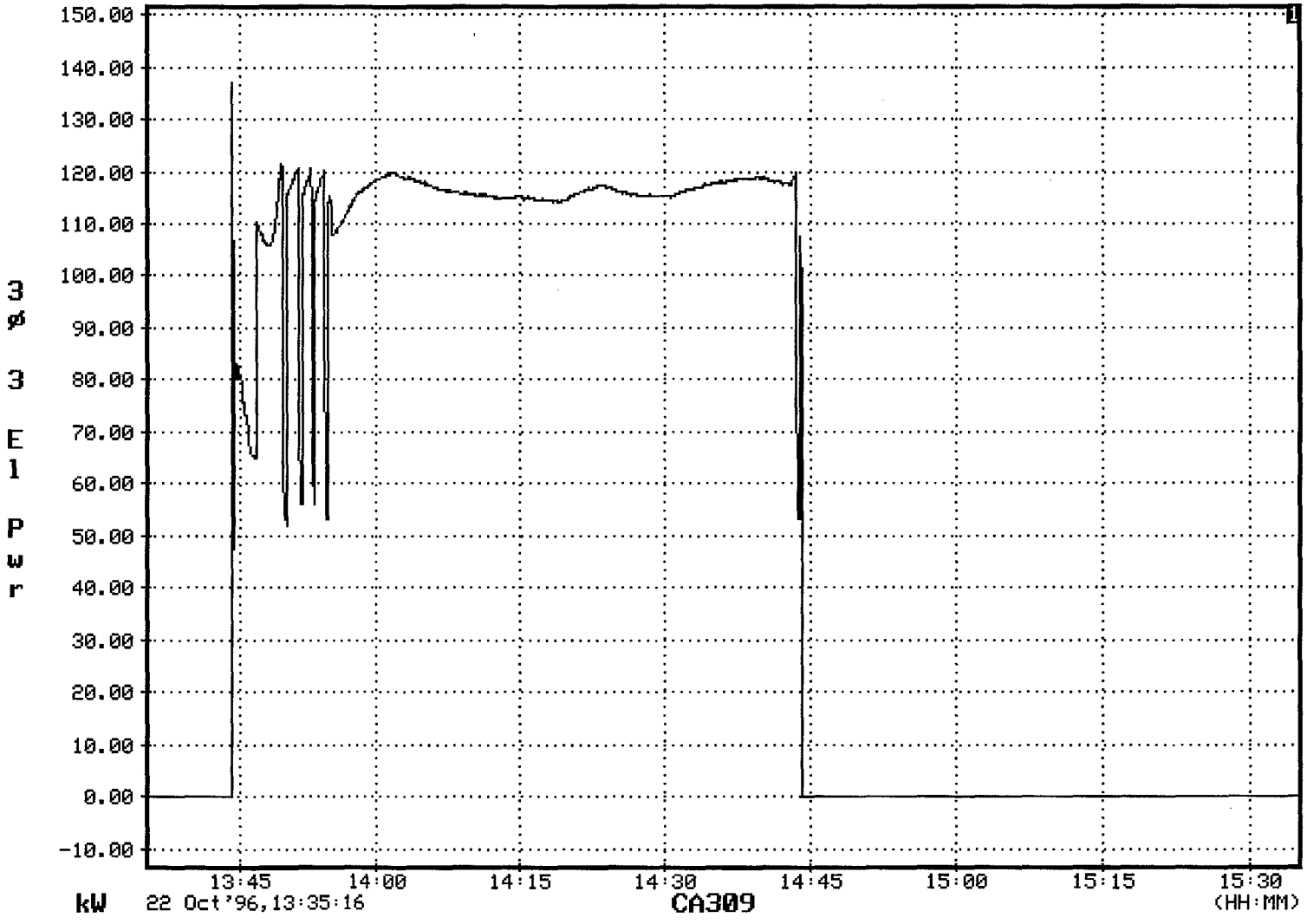
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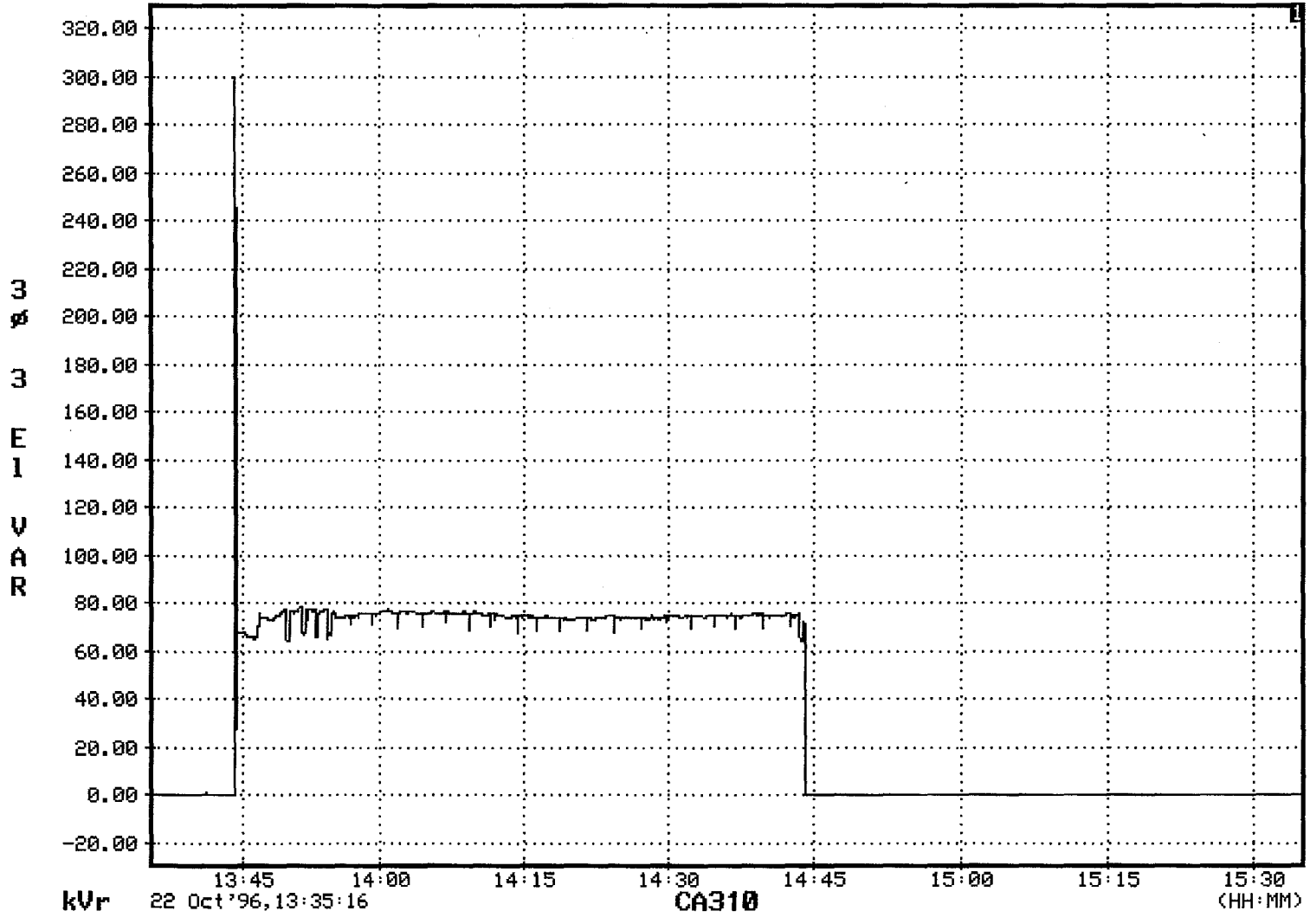
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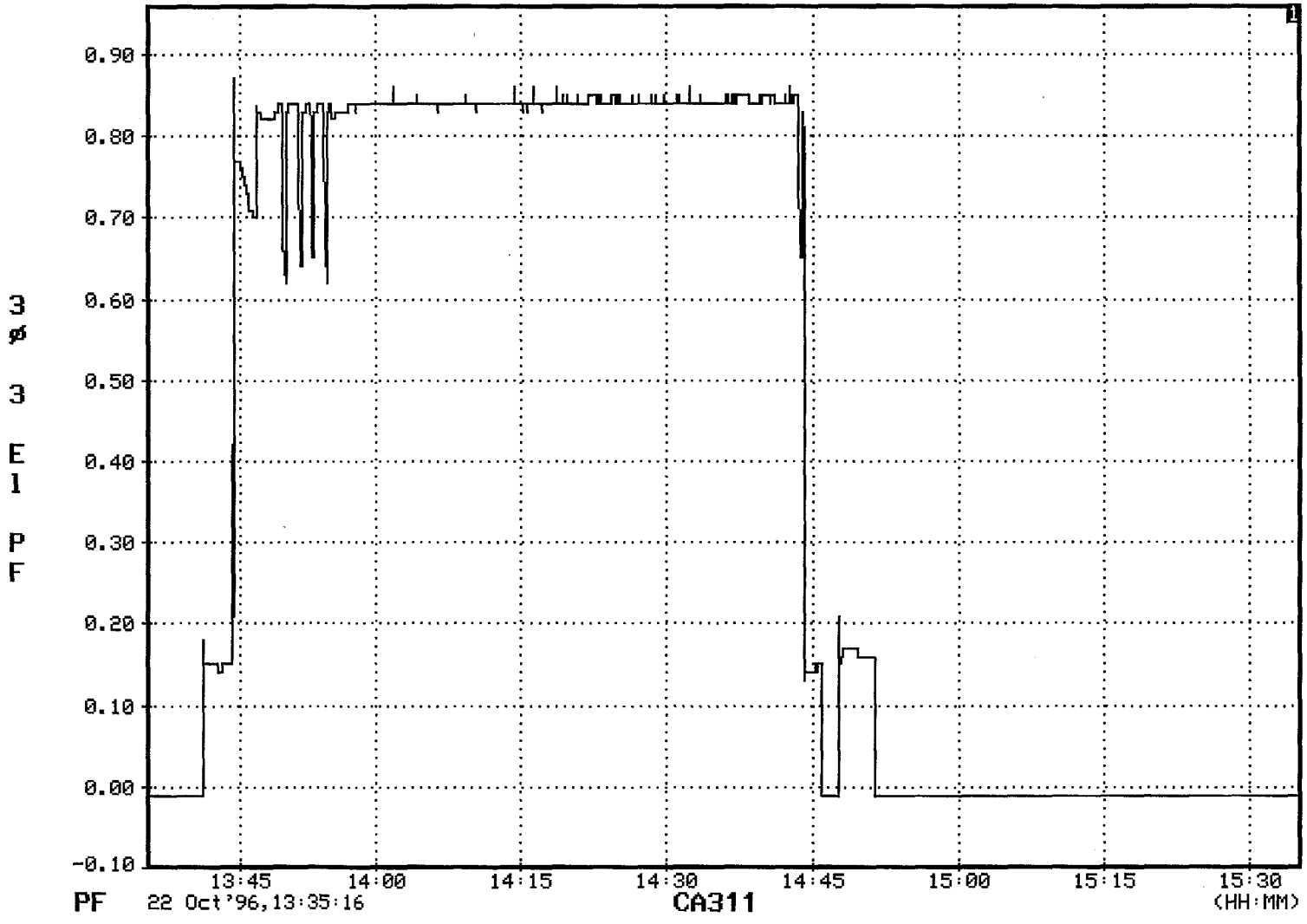
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MONITORING & EVALUATION REPORT
ZLATNA PANEGA

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Effective use of the fuel and energy resources in Zlatna Panega

Abstract

Dr. Angel Dangov - Techtsem Ltd. Sofia
Eng Penka Koleva - Zlatna Panega

The tools and systems for control of the quality and volume of the energy consumption have leading role in the concept for the Energy Management in Zlatna Panega. The following improvements in the plant were designed and implemented (to a different extend) with the cooperation of the USAID :

1. Laboratory equipment for control of burning processes (fully implemented).

2. Computer station for the energy consumption data analysis as a base for the development of Energy Management System (in off-line phase).

3. Gasanalysing station for burning processes control of a turnable cement oven (in stage of development).

Having in mind the big reseves for economy of energy the systems for Energy Management are very effective - decrease of the expences for electric energy by 0.1% repays the expences for the Computer System for Energy Consumption Data Analysis for one year.

MONITORING & EVALUATION REPORT LEV

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PHASE II
MEASURE MONITORING AND EVALUATION REPORT

"LEVE" JOINT STOCK COMPANY

LEATHER PROCESSING PLANT

GABROVO , BULGARIA

Prepared for:

Hagler Bailly Consulting Inc.

1530 Wilson Boulevard , Arlington , Virginia, 22209 USA

Prepared by:

Dr. Nikola Kaloyanov

Sofia , BULGARIA

December 1996

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1. General Introduction

This report presents the results of Phase II of the Industrial Energy Efficiency Project for the Leather Processing plant "LEVE" in Gabrovo, Bulgaria, funded by the United States Agency for International Development (USAID).

Phase II of the Project included activities directed on specification, procurement and installation of larger energy saving equipment as follows:

- Four plate heat exchangers for restructuring of the existing direct steam-water heating system in Department 5;
- An air-cooled rotary screw air compressor and a refrigerating air dryer for replacement of the existing water-cooled reciprocating compressor in Department 1.

In this phase all the equipment provided bu USAID costs 33,697 $.

The report is structured following the requirements of the personal contract between Hagler Bailly Inc. and Dr. Nikola Kaloyanov, dated 15 th March 1996.

2. Measure - by - Measure Presentation

A. IMPLEMENTATION OF INDIRECT WATER HEATING SYSTEM

2.A.1. Rationale for the Measure

The main technology processes for leather treatment in LEVE JSCo. use hot water with temperatures in the range from 25 to 84 °C. As the results of the energy audit performed shown water was heated by means of direct steam in large tanks separated in two subsystems :

- for preliminary leather treatment - one tank of 15 m^3 in volume ;
- for base leather treatment - two tanks of 30 m^3 in volume total.

Following the technology requirements water with at least three different temperatures must be supplied by the water heating system at the same time.

All the water (100 to 250 m^3 per day) was heated to the temperature level of 60 - 70 °C when the different water flow temperatures were reached by mixing with cold water. It was found that as a

result of the thermal inertia of the tanks 1.5 to 2 hours were necessary for heating the water between two technological cycles.

The tanks are placed outside of the building and keeping the hot water causes additional heat losses.

The not returned condensate to the steam supplier (the Thermal Power Station of Gabrovo) was found to be a significant part of the annual steam consumption. For Department 5 it was :

- 1993 - 66.5 %
- 1994 - 71.09 %
- 1995 - 62.18 %.

After functional analysis performed of the water demand and its non-steady state behaviour it was clearly determined that the water heating process can be reorganised by restructuring of the existing system.

First of all the direct scheme can be replaced by indirect one with plate heat exchangers. Nevertheless the direct heating is more efficient from thermodynamic point of view, there is a way for combining some structural and parametric solutions and thus restructuring the system to a level with improved efficiency.

The heating process can be organised in two stages:

- heating to temperature level of 30 to 40 oC in the existing accumulating tanks and
- reheating the water to the temperature level required by means of plate steam-water heat exchangers when necessary.

There is a large amount of condensate stored in the condensate tank with temperature of 98 oC (naturally cooled and ''producing'' secondary steam) which waste heat can be utilised and reduce the losses.

2.A.2 Description

After approval of the proposal the following equipment was delivered to the plant:

1. One Alfa Laval water-water plate heat exchanger Model M3 - VG, 500 kW - 1680 USD
- rated to 150 psig (10 bar gauge)
- rated to 205 deg. F (96 deg.C)
- 100 lbs

2. Three Alfa Laval steam-water plate heat exchangers
Model M10-MFG, 1000 kW. - 8610 USD
- rated to 150 psig (10 bar gauge)
- rated to 298 deg. F (148 deg.C)
- 790 lbs

The equipment was received in Gabrovo in March 1996. The Plant Managers decided to use the equipment for reconstruction of the water heating system for base leather treatment.

Simple sketch of the restructured system is shown in fig.A1.

The cold water enters the system through tank1 where it is heated by means of the water-water heat exchanger utilising the condensate heat. When the water temperature in the tank is higher the inlet water will pass direct trough the heat exchanger. This option is to be completed.

From tank 2 the water is supplied to the three technological users after reheating by steam-water heat exchangers. One of the heat exchangers supplies heat to tank 2 when necessary.

In order to utilise the heat of the secondary steam it is mixed with the recirculating water from the users in an existing heat exchanger.

2.A.3. Implementation

The system has been designed by ALPHA-PRO Consulting together with the Technical Director of LEVE.

Due to the fact that the installation procedure had to interrupt the technological process it was decided the reconstruction of the system to be completed in August 1996.

The implementation process was organised and done completely by the staff of the plant under the supervision of the Technical Director Mr. P.Baev.

Some pictures of the system are shown in fig.A2. Since 2 nd September 1996 the system is in use.

2.A.4. Monitoring Methodology and Procedure

As the system operates in non-steady state conditions, in order to determine the optimal flow rate of the circulating water through the pumps as well as to evaluate the system parameters it was necessary to model and simulate the system performance.

The plate heat exchangers were modelled by steady state balance and heat transfer equations. As the storage tanks are placed horizontally it was accepted that the ''fully mixed''dynamic model for them is convenient. The solving procedure is completed as an iterative one.

For model calibration hourly measurements on site were performed on Friday 4 th October .

The parameters which were measured are listed bellow:

- total steam consumption measured by the main steam heat meter ;
- hourly amount of condensate returned to the TPS;
- steam pressure;
- steam temperature;

- condensate temperature in the main condensate tank as well as in the additional tank;
- hourly amount of hot water supplied to the three users;
- water temperature in tank1 and tank 2;
- wall temperatures of tank1 and tank2;
- inlet and outlet temperatures of the four heat exchangers.

The hourly amount of hot water supplied was measured by the existing computerised mixing devices. The water temperature in the tanks was measured by the existing thermometers installed, whereas the wall temperatures and the inlet/outlet ones were measured by the portable thermometers of the Bulgarian Chapter of AEE.

The measurements were performed by ALPHA-PRO and staff from the Energy Department of the plant.

In order to evaluate the real energy savings due to the implementation of the system it was necessary to collect daily and monthly data for the steam consumed, the condensate returned and the leather treated. This information was collected by staff from the Energy Department of the plant.

2.A.5. Results of Measurements and Monitoring

Part of the data obtained during the experiment is shown in Table A1 and some results of the numerical simulations are presented in fig.A3 in the Appendices.

The monthly production/steam/condensate data for the period 1991-1996 obtained from the official plant documents are presented in Table A2.

a) Baseline energy and production data before implementation of the system

In order to determine the correct baseline before the reconstruction of the system two periods were taken into account : September - November 1995 and March-May 1996, as shown in the table bellow.

Period	Production	Steam consumption			Not Ret.Condensate	
-	dm^2	kg	Gkal	$Kcal/dm^2$	tons	%
09-11' 1995	18976671	2610990	1817.13	95.76	1606.84	61.33
03-05' 1996	17407188	2721044	2002.22	115.02	1708.08	63.00
09-11' 1996	20396633	2519681	1840.28	90.22	1058.66	42.00

The difference in the specific steam consumption between these two periods is due to the different bulding heating load. The degree days for the second period were 599 whereas for the first period they were 501.

b) Energy and production data after implementation of the system

For the three months after the implementation of the system it can be seen from the table above that the specific steam consumption is decreased to 90.22 Kcal/dm^2 and the not returned condensate to 42%.

More details can be seen from Table A2 shown in the Appendices.

c) Factors that affect the baseline

Two major factors affects the baseline. First of all the bulding heating load, for which exact evaluation it is necessary to have a separate heat meter. Taking into account the existing pipelines distribution it is impossible.

The second factor is the structure of the production. Part of the leather is processed only to the stage ''wet blue'', which means ''half of the process''. The "wet blue" processing does not include drying of the leather. The production structure for the month of September (95 and 96) is shown in the table bellow .

September	PRODUCTION					Steam consumption	Steam consumption	Specific steam heat	Not returned condensate
	Full process		WET BLUE		Total				
	dm2	%	dm2	%	dm2	Gcal	t	Gcal/t	t
1995	2726783	47.7	2992888	52.3	5719671	464.08	650	0.71	396.5
1996	2744542	44.7	3391180	55.3	6135722	539.74	756.6	0.71	325.34

2.A.6. Review of Economics of the Measure

- The energy savings are calculated on the base of comparing the specific steam consumption during the period September-November 1995 with the same period of 1996.

  Thus it is obtained :

  20396633x(95.76 - 90.22) = 113 Gcal /3months = 414.32 Gcal/11 months.

  This is in fact the lowest level of savings because during the winter the amount of condensate available is expected to be significant due to the building heating system operation.
- Implementing the recuperative steam-water heat exchangers the water is heated at the time when needed without delay.
- The not returned condensate is reduced by 55.6%. The subsystem for preliminary leather treatment still uses water heated by direct steam.

Using the same base as energy savings are calculated, from the condensate it is obtained :

20396633 x (8.47E-5 - 5.19E-5) = 669 tons/3 months more condensate returned to the TPS = 2453 tons/11 months.

- Overall cost savings

		USD	Lvs
Original estimated implementation costs:	.....	6 849	376720

		USD	Lvs
Actual Implementation Costs	Equipment cost (C.I.F. Bulgaria)	10 290	802620
	Freight in Bulgaria	128	10000
	Taxes		
	Design cost	700	54600
	Installation costs.....	1800	140400
	Other costs	800	62400
	TOTAL :	***13718***	***1070004***

Actual savings:	Heat : 414.32 Gcal x 20.52 $/Gcal	=	**8502**
	Condensate: 2453 tons x 1$/ton	=	**2453**
	TOTAL :		***10955***

Operational costs :	Water : 2453 tons x 0.1 $/ton	=	**245.3**
	Electricity : 580 kWh x 0.06 $/kWh	=	**34.8**
	TOTAL :		***280.1***

PAYBACK PERIOD = 13718 / (10955 - 280.1) = 1.29 years

B. REPLACEMENT OF THE RECIPROCATING WATER COOLED AIR COMPRESSOR IN DEPARTMENT 1

2.B.1. Rationale for the Measure

The existing air compressor installed in Department 1 was water-cooled reciprocating one (made in Bulgaria).

Its parameters were as follows:

- capacity 10 l/min ;
- pressure 8 bar;
- 360 V/50 Hz , 75 kW.

It was found to be bigger than required in capacity and in pressure. The real needs were estimated as 6 l/min and 7 bar pressure. Unfortunately such a compressor is not made in Bulgaria.

The existing compressor was very expensive for maintenance. The annual operating costs, including electricity, water, oil and repairs were estimated as 11886 USD.

That is why it was proposed the existing compressor to be replaced by a rotary screw one.

2.B.2 Description

After approval of the proposal the following equipment was delivered to the plant:

1. One Ingersoll-Rand EP60 air-cooled rotary screw air compressor - 17,329 USD
- 380V/50 Hz
- rated maximum capacity of 237 cubic feet/min (6.7 cubic meters/min)
- rated for a maximum pressure of 125 psig (8.5 bar gauge)
- 2090 lbs (948 kg)

2. One Ingersoll-Rand TM 300 refrigerated air dryer - 6,078 USD
- 380V/50 Hz
- dries a maximum of 249 cubic feet/min (7 cubic meters/min)
- 1015 lbs (460 kg)

The equipment was received in Gabrovo in March 1996.

2.B.3. Implementation

The implementation process was done by the Ingersoll-Rand representative in Bulgaria - the company ''Kirov Representations" in May 1996 . The equipment was installed in a separate room. Some pictures of the system are shown in fig.B1. Since 16 May 1996 the compressor with the dryer are in use.

2.B.4. Monitoring Methodology and Procedure

The monitoring program included measurements of the current in the two regimes - ''loaded'' and ''unloaded'' as well as the working time. The measurements were performed by the Technical Director of the plant together with staff from the Energy Department in July and September 1996.

2.B.5. Results of Measurements and Monitoring

From 16 th May to 9 October the new compressor was in operation 399 hours 137 from which in regime "loaded". The average current in the ''loaded'' regime was found to be 84 A and in ''unloaded'' regime 48 A.

During this period the power calculated was:

- in regime ''loaded'' 42 kW:
- in regime ''unloaded'' 24 kW.

The monthly production/electricity data for the period January 1996 - November 1996 obtained from the official plant documents are presented in Table B1 and in fig.B2.

a) Baseline energy and production data before implementation of the system

The baseline was derived for the period January 1996 - April 1996. As it can be seen from Table B1 the total production was 7805366 dm^2 whereas the electricity consumption measured by the Department electricity meter was 250800 kWh which determines specific consumption of 0.035547 kWh/dm^2.

b) Energy and production data after implementation of the system

After implementation of the new compressor from June 1996 to November 1996 the base line is formed by total production of 8402281 dm^2 and electricity consumption measured by the Department electricity meter of 188400 kWh which determines specific consumption of 0.026609 kWh/dm^2.

c) Factors that affect the baseline

The major factor that affects the baseline is the non-production component of the energy consumption due to the fact that the Department is connected to the administrative building and the electricity bills are common.

2.B.6. Review of Economics of the Measure

The energy savings are calculated in two ways:

- on the base of the specific electricity consumption after and before the implementation(Tabl.B1): Thus it is obtained :

8402281x(0.035547 - 0.026609) = 75099.6kWh /5months = 165219 kWh/11 months.

This forms 25.14 % annual savings of electricity.

- The second way is based on the calculations done on the base of compressor parameters measurements:

  the rotary screw compressor:

  8 hours x 0.34 x 42 kW = 114 kWh in the "loaded" regime

  8 hours x 0.66 x 24 kW = 126.7 kWh in the "unloaded" regime

  Total consumption per month (average 21.7 days) : (114+126.7)x21.7 = 5222 kWh.

  the existing reciprocating compressor:

  8 hours x 75 kWh x 21.7 = 13020 kWh.

  Then the monthly savings of electricity are equal to 13020-5222 = 7798 kWh or annual savings of 85778 kWh. This number was accepted for further economic evaluations. Additional savings from utilising the hot air for heating the nearest garage are not included in the economic analysis.

- Overall cost savings

		USD	Lvs
Original estimated implementation costs:	.....	20840	1 417 000

		USD	Lvs
Actual Implementation Costs	Equipment cost (C.I.F. Bulgaria)	23407	1 825 746
	Freight in Bulgaria	128	10 000
	Taxes		
	Design cost		
	Installation costs.....	1000	78 000
	TOTAL :	***24535***	***1913730***

Actual savings:	Electricity : 85778 kWh x 0.06 $/kWh	=	**7800**
	Water : 3000 m3 x 0.1$/m3	=	**300**
	Oil: 950 l x 1.74 $/l	=	**1656**
	Repair costs (as 1994)	=	**2050**
	TOTAL :		***11806***
Operational costs :	Oil: 52.9 $/galon	=	**840**
	TOTAL :		***840***

PAYBACK PERIOD = 24535 / (11806 - 840) = 2.24 years

3. Plant-wide results

3.1 Possible interaction of measures

The measures implemented in the Phase II of the project are independent and there is no interaction between them.

3.2 Summary of results for all the energy efficiency measures above

The results of the Phase II of the project can be summarised as follows:

- after reconstruction of the water heating system 20.9 % of the heat used (or 7.77% from the annual heat consumption in 1995) was reduced which is due to the reduction of the heat losses and the utilisation of the waste condensate heat. The implementation of the measure shows Payback period of 1.29 years.
- reduction of the electricity consumption with 16 to 25% (or 12.5% from the annual electricity consumption in 1995) due to the replacement of the old reciprocating compressor. Improvement of the air quality as well as savings of water and significant repair costs.
- the summary economic results are shown in the table bellow

EXISTING CONDITIONS	STEAM	ELECTRICITY	WATER	TOTAL	
Annual Energy Consumption(1995)	6869.84Gcal	689700 kWh			
Economic Value of Energy	20.52 $/Gcal	0.06$/kWh			
Economic Cost of Energy	140969 $	41382 $		290863 $	
ESTIMATED BENEFITS (annual savings)	STEAM	ELECTRICITY	WATER	OTHER SAVINGS	TOTAL
Recuperative water heating system	484 Gcal				
annual cost savings	9928 $				9928$
Rotary screw compressor		30000 kWh	11000 m3	oil - 1656 $	1656$
annual cost savings		1730 $	4230 $	labor costs-1076 $	7036$
				repair costs-2050$	2050$
ACTUAL SAVINGS (annual)	534 Gcal	85778 kWh	3000 m3		
annual cost savings	10957$	5147$	300$	3706$	20110$
percent savings	7.77%	12.50%			
ECONOMIC COSTS AND BENEFITS	COST SAVINGS	USAID Cost	PLANT Cost-sharing	TOTAL COST	PAYBACK
Recuperative water heating system	10675$	10290$	3428$	13718$	1.29 years
Rotary screw compressor	10966$	23407$	1128$	24535$	2.24 years
TOTALS	21641$	33697$	4556$	38253$	1.77 years

3.3 Other improvements at the plant

3.4 Baseline plant-wide energy consumption after implementation of the USAID/CEM program

The measures implemented in the plant during the project from 1994 to 1996 have affected significant the baseline plant-wide energy consumption. This can be seen from fig. A4,A5,A6,A7,A8 and A9 presented in the Appendices .

3.5 Comparison of estimated and actual results from all the measures implemented

ECM	Title	Annual En. Savings, Gcal		Savings	Plant Costs	USAID	TOTAL	Payback
No		Estimated	Actual	USD	USD	USD	USD	years
A.1	Institute Steam Trap Management Program	720	480	9850	910	-	910	0.09
A.2	Reconstruction of the condensate system	260	248	5087	4196	-	4196	0.82
A.3	Insulate Hot Water Tanks	665	470	9640	5790	-	5790	0.60
A.4	Repair steam leaks	216	180	3692	450	-	450	0.12
B.1+B.2	Improve the Temperature Control of the Drying Process	780	650	10500	1077	8962	10039	0.96
B.3	Implementation of Indirect Water Heating System	580	534	10675	3428	10290	13718	1.29
B.5	Replacement the reciprocating compressor	30000 kWh	85778 kWh	10966	1128	23407	24535	2.24
			TOTAL	60410	16979	42659	59638	0.99

4. Recommendations

5. Significance of the project for the CEM, the plant and Bulgaria

The project was of great significance for me both in my work as a lecturer at the Technical University of Sofia and as a Consulting Engineer. It has increased my knowledge, skills and experience in analysis of combined energy transfer and conversion systems from systematic point of view. Working on the project I learned some very practical ways of sailing my knowledge in the new market oriented conditions in Bulgaria.

The contribution for the plant can be presented from two points of view. First - the received equipment, which mobilised the Plant Managers to find some other ways of funding. Second - to encourage them in looking for potential energy saving opportunities.

As the plant is one of the several leather processing plants in Bulgaria there is no doubt that the results achieved will have multiplicable effect.

APPENDICES

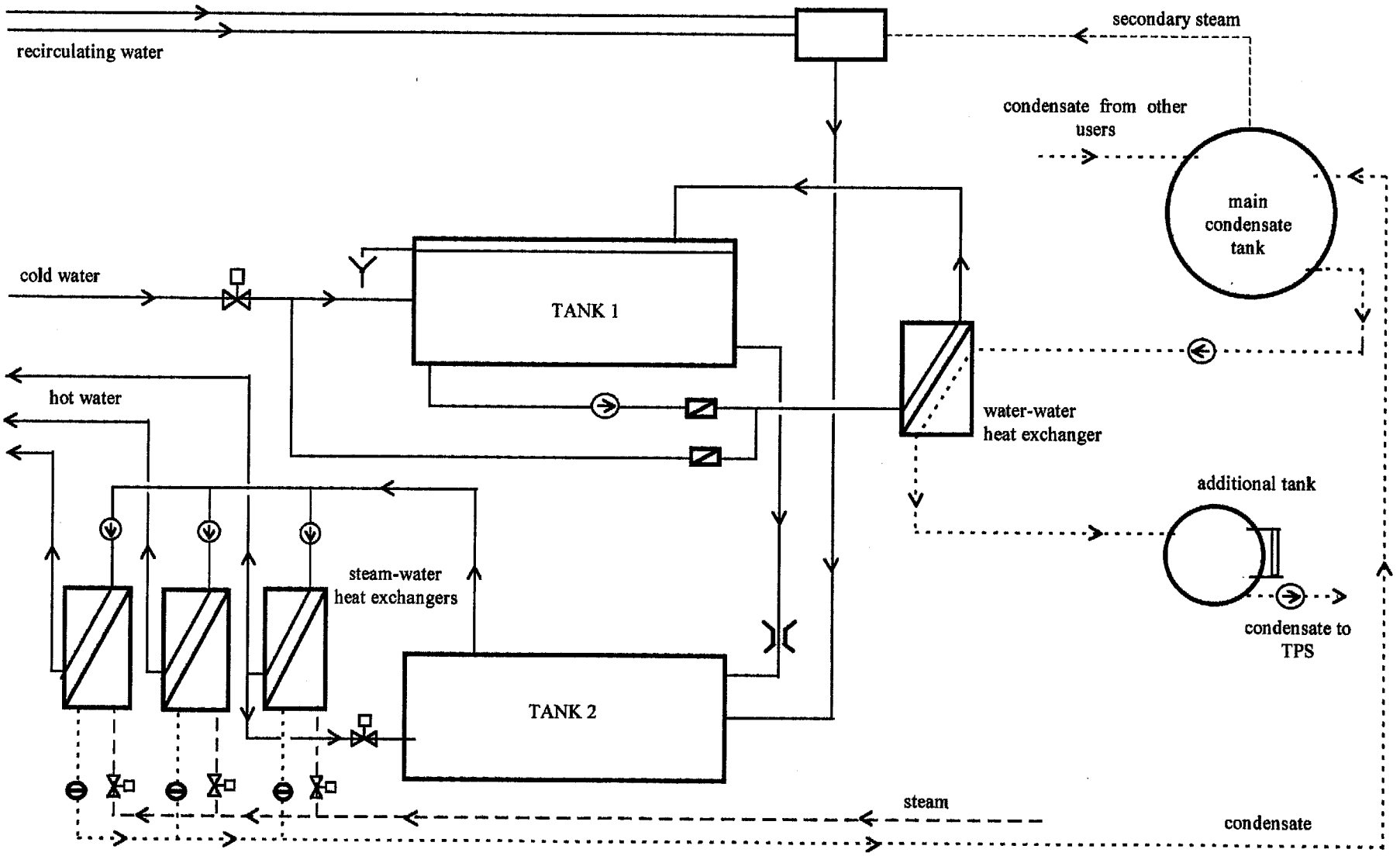

Fig.A1. Simple sketch of the restructured water heating system

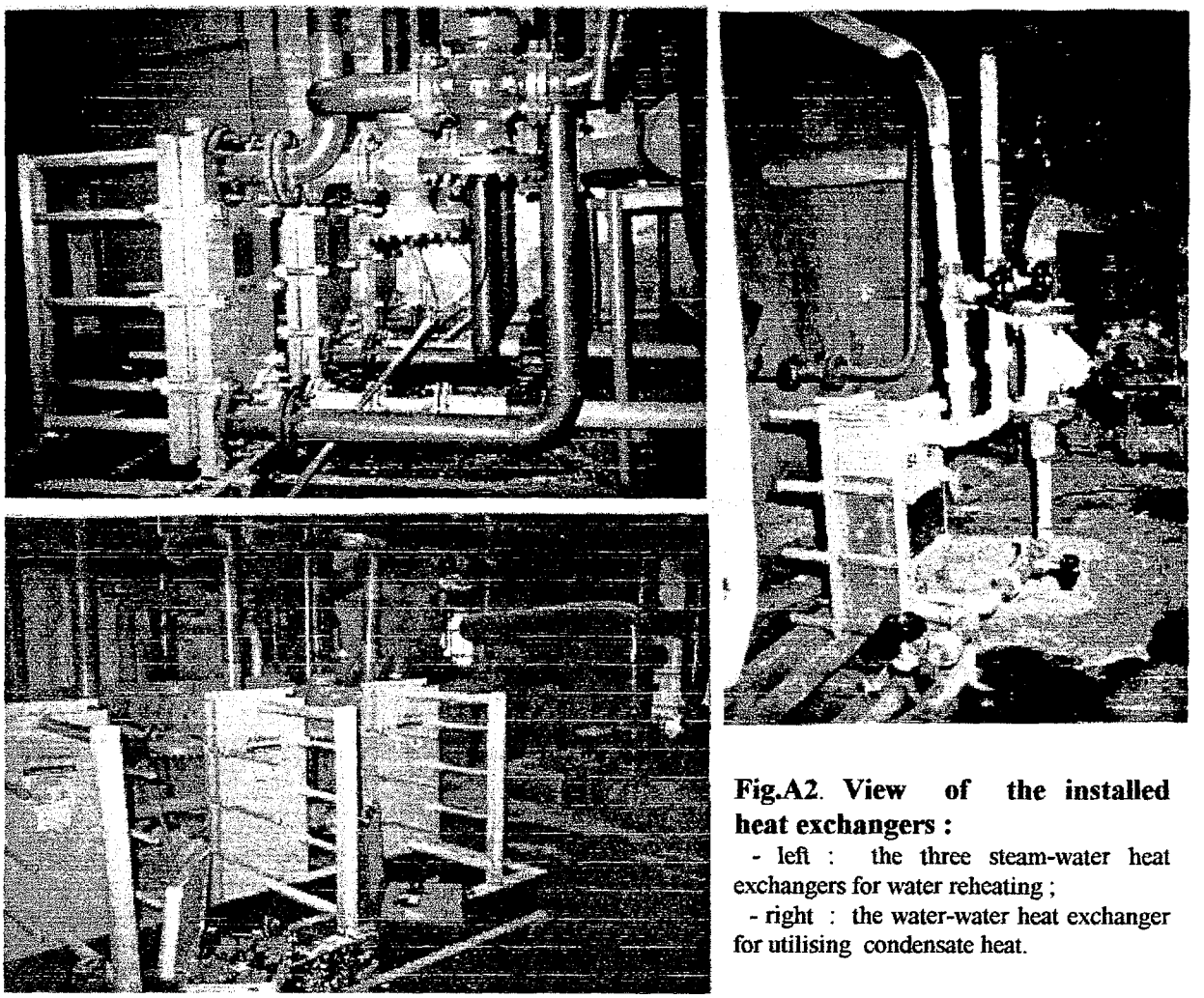

Fig.A2. View of the installed heat exchangers :

- left : the three steam-water heat exchangers for water reheating ;
- right : the water-water heat exchanger for utilising condensate heat.

Table A1 . Data from the measurements on site

Hour	Ambient temperature	Heat meter readings	Steam consumption	Steam pressure	Steam temperature	Condens. meter readings	Returned condens.	Temp. in heat exch. 1	Temp. in heat exch. 2	Temp. in heat exch. 3	TANK 1		TANK 2	
	Tвн			*P*	*T*			*steam/water*	*steam/water*	*steam/water*	*Tв*	*Tв*	*Tв*	*Tв*
-	*°C*	*Gkal*	*Gkal/h*	*MPa*	*°C*	*m³*	*m3*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*	*°C*
6:45	7.4	7212	-	0.185	130	15694	-	-	120/98 40/54	-	40	12	35	12
7:00	7.4	7213	4	0.205	128	15694	0	-	120/98 35/48	-	35	12	35	12
8:00	9.8	7217	4	0.19	160	15694	0	152/100 32/63	-	152/73 32/54	32	8	30	9
9:00	10.5	7220	3	0.201	170	15698	4	-	-	-	27	6	30	8
10:00	10.9	7222	2	0.38	160.8	15701	3	-	-	-	42	10	35	11
11:00	11.0	7224	2	0.44	181.8	15701	0	-	161/100 41/62	-	41	12	38	11
12:00	11.5	7225	1	0.49	156.4	15706	5	-	143/101 26/51	-	26	13	32	12
13:00	11.2	7228	3	0.29	180.3	15710	4	-	145/104 35/64	-	35	16	30	15
14:00	11.0	7231	3	0.352	185.5	15713	3	-	-	-	49	13	40	11
15:00	9.5	7234	3	0.39	179.7	15713	0	-	-	-	40	13	40	11
				0.3123	163.25									

Total dayly heat consumption: 22 Gkal
Total dayly steam consumption: 33.0157706 t
Total returned condensate : 19 t

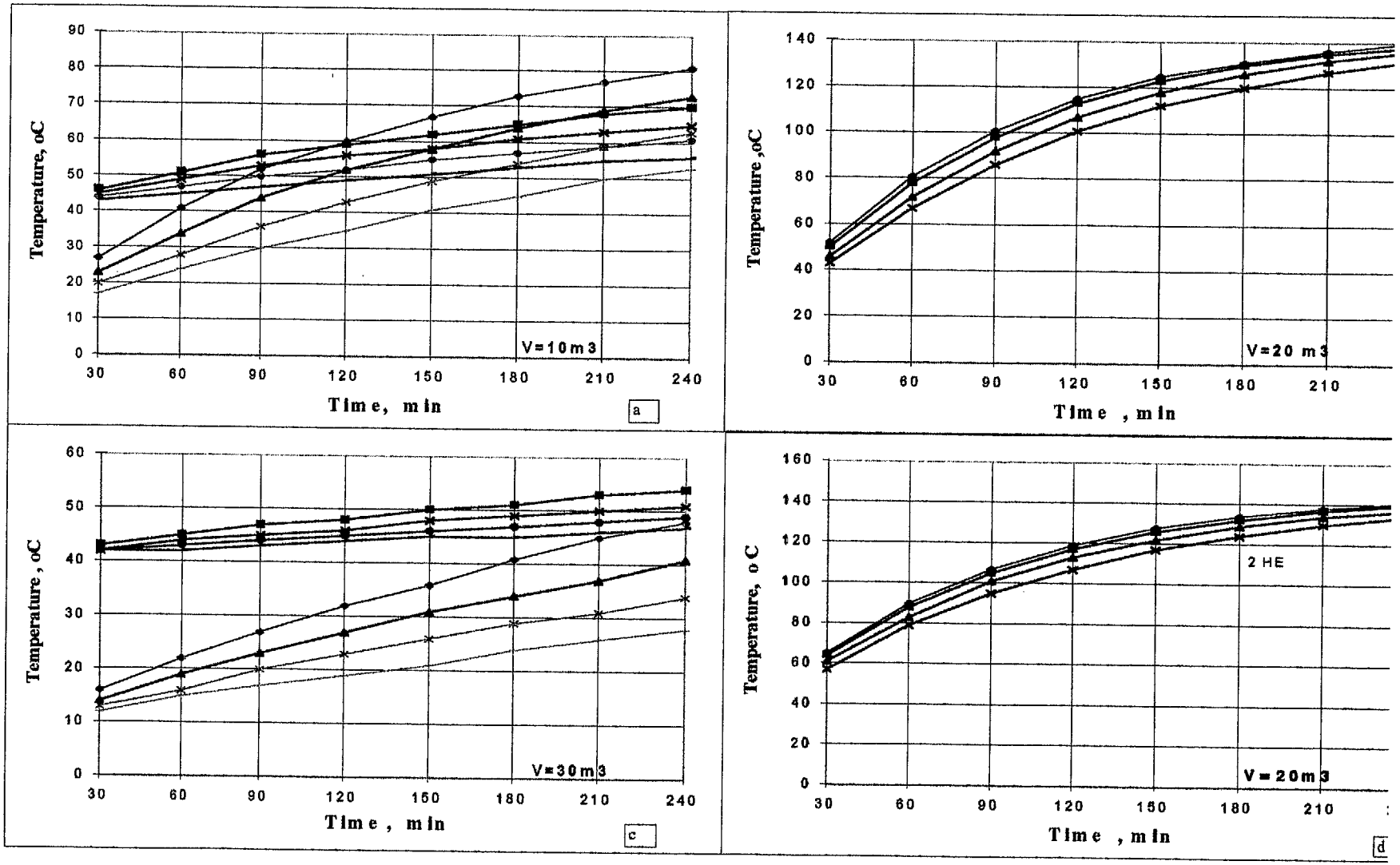

Fig.A3. Influence of the flow rate, the initial conditions and the volume at :
(a-b) using the water-water heat exchanger with nominal capacity of 500 kW
(c-d) using two steam-water heat exchangers each with nominal capacity of 1000 kW

TABLE A2 : PRODUCTION AND STEAM CONSUMPTION DATA for Department 5

YEAR	MONTH	PROD.	STEAM	STEAM	MONTH	SP.STEAM	Condensate	Condensate	Condensate
-	-	DM2	kg	GCAL	-	kcal/dm2	t	GCAL	%
1991	1	8825515	5207000	3385.00	1	383.55	-	-	-
	2	7398581	5716000	3718.00	2	502.53	-	-	-
	3	9539182	5224000	3426.00	3	359.36	-	-	-
	4	7115802	5324000	3494.00	4	491.02	-	-	-
	5	6571452	4190000	2752.00	5	418.78	-	-	-
	6	8124748	4010000	2625.00	6	323.09	-	-	-
	8	3870153	3063000	2005.00	8	518.07	-	-	-
	9	5290451	2244000	1463.00	9	276.54	-	-	-
	10	7023378	3808000	2492.00	10	354.82	-	-	-
	11	8983342	5303000	3491.00	11	388.61	-	-	-
	12	6052303	6390000	4196.00	12	693.29	-	-	-
1992	1	7460256	3052000	1987.00	1	266.34	-	-	-
	2	6680314	2225000	1462.00	2	218.85	-	-	-
	3	6805169	2167000	1424.00	3	209.25	-	-	-
	4	7714529	1521000	1007.00	4	130.53	-	-	-
	5	8082880	1249000	833.00	5	103.06	-	-	-
	6	6498604	1445000	933.00	6	143.57	-	-	-
	8	3747950	687000	437.00	8	116.60	-	-	-
	9	6124974	747000	518.00	9	84.57	-	-	-
	10	7074617	879000	887.00	10	125.38	-	-	-
	11	8014042	961000	954.00	11	119.04	-	-	-
	12	5643035	1961000	1394.00	12	247.03	-	-	-
1993	1	4882108	958000	976.00	1	199.91	-	-	-
	2	6333682	1609000	1108.00	2	174.94	-	-	-
	3	7773798	2147000	1440.00	3	185.24	-	-	-
	4	8424033	1225756	842.43	4	100.00	735.45	44.10	60.00
	5	8495788	1112333	848.80	5	99.91	689.65	41.40	62.00
	6	12721686	990082	754.62	6	59.32	613.85	36.78	62.00
	7	3728432	272352	207.49	7	55.65	168.84	10.10	61.99
	8	3728432	856051	656.55	8	176.09	539.31	32.40	63.00
	9	9056763	1144136	855.77	9	94.49	709.36	42.60	62.00
	10	13111155	1234892	919.78	10	70.15	765.63	46.00	62.00
	11	12301384	1819470	1740.41	11	141.48	1487.00	89.40	81.73
	12	10734129	1544245	1808.10	12	168.44	1286.44	95.20	83.31
1994	1	9129982	1678733	1129.94	1	123.76	1007.24	60.40	60.00
	2	10980621	1852212	1255.33	2	114.32	1185.42	71.10	64.00
	3	10687124	1567469	1084.42	3	101.47	1003.18	60.10	64.00
	4	8115257	1037102	769.45	4	94.81	705.23	42.40	68.00
	5	6159748	836000	604.85	5	98.19	635.46	38.20	76.01
	6	5991944	811159	567.07	6	94.64	616.48	37.00	76.00
	7	5406738	543714	397.32	7	73.49	413.22	25.00	76.00
	9	5116085	671171	493.20	9	96.40	510.09	30.60	76.00
	10	9579135	901006	666.34	10	69.56	684.77	41.10	76.00
	11	9008000	1093033	767.10	11	85.16	797.91	47.90	73.00
	12	7009082	1195010	857.81	12	122.38	872.36	52.40	73.00
1995	1	7784551	1343753	969.06	1	124.49	980.94	58.90	73.00
	2	8428055	1252202	891.32	2	105.76	751.32	45.00	60.00
	3	7358724	1256130	909.22	3	123.56	791.36	47.48	63.00
	4	7302814	1078001	759.31	4	103.97	679.14	40.75	63.00
	5	4292663	424136	331.29	5	77.17	296.90	17.81	70.00
	6	3149306	415000	325.10	6	103.23	290.50	17.43	70.00
	7	7140004	341831	259.20	7	36.30	239.28	14.36	70.00
	9	5719671	650000	464.08	9	81.14	396.50	23.79	61.00
	10	5762711	836000	575.19	10	99.81	501.60	30.10	60.00
	11	7494289	1124990	777.86	11	103.79	708.74	42.52	63.00
	12	3679891	915940	608.22	12	165.28	283.94	17.04	31.00
1996	1	4363110	1327405	935.37	1	214.38	663.70	39.82	50.00
	2	4298403	1504560	1084.42	2	252.29	932.83	55.97	62.00
	3	4627009	1143450	828.27	3	179.01	708.94	42.54	62.00
	4	5747982	876650	658.06	4	114.48	543.53	32.61	62.00
	5	7032197	700944	515.90	5	73.36	455.61	27.34	65.00
	6	6987701	692740	509.08	6	72.85	401.79	24.11	58.00
	7	7524976	566756	447.06	7	59.41	367.19	22.03	64.79
	9	6135722	756601	539.74	9	87.97	325.34	19.52	43.00
	10	7561309	827700	607.18	10	80.30	331.11	19.87	40.00
	11	6599602	935380	693.36	11	103.49	402.21	24.13	43.00
Total	1991	78794907	50479000	33049.00		428.15	0.00	0.00	
	1992	73846370	16894000	11836.00		160.38	0.00	0.00	

TABLE A2 : CONTINUE

YEAR	MONTH	PROD.	STEAM	STEAM		SP.STEAM	Condensate	Condensate	Condensate
-	-	DM2	kg	GCAL	-	kcal/dm2	t	GCAL	%
Total	1991	78794907	50479000	33049.00		428.15	0.00	0.00	
	1992	73846370	16894000	11836.00		160.38	0.00	0.00	
	1993	1.01E+08	14913317	12157.96		127.14	6995.54	437.98	66.45
	1994	87183716	12186609	8592.83		97.65	8431.36	506.20	71.09
	1995	68112680	9637983	6869.84		102.23	5920.23	355.18	62.18
	1996	60978011	9332186	6818.44		123.75	5132.25	307.94	54.98

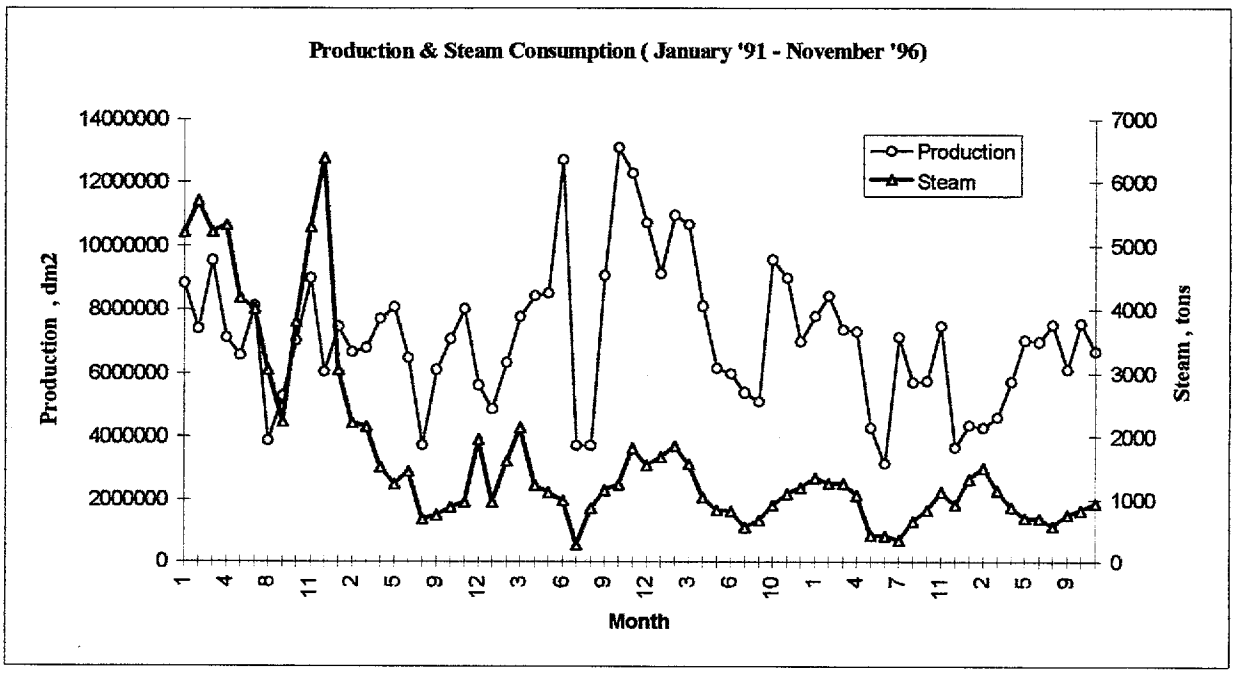

Fig.A4.

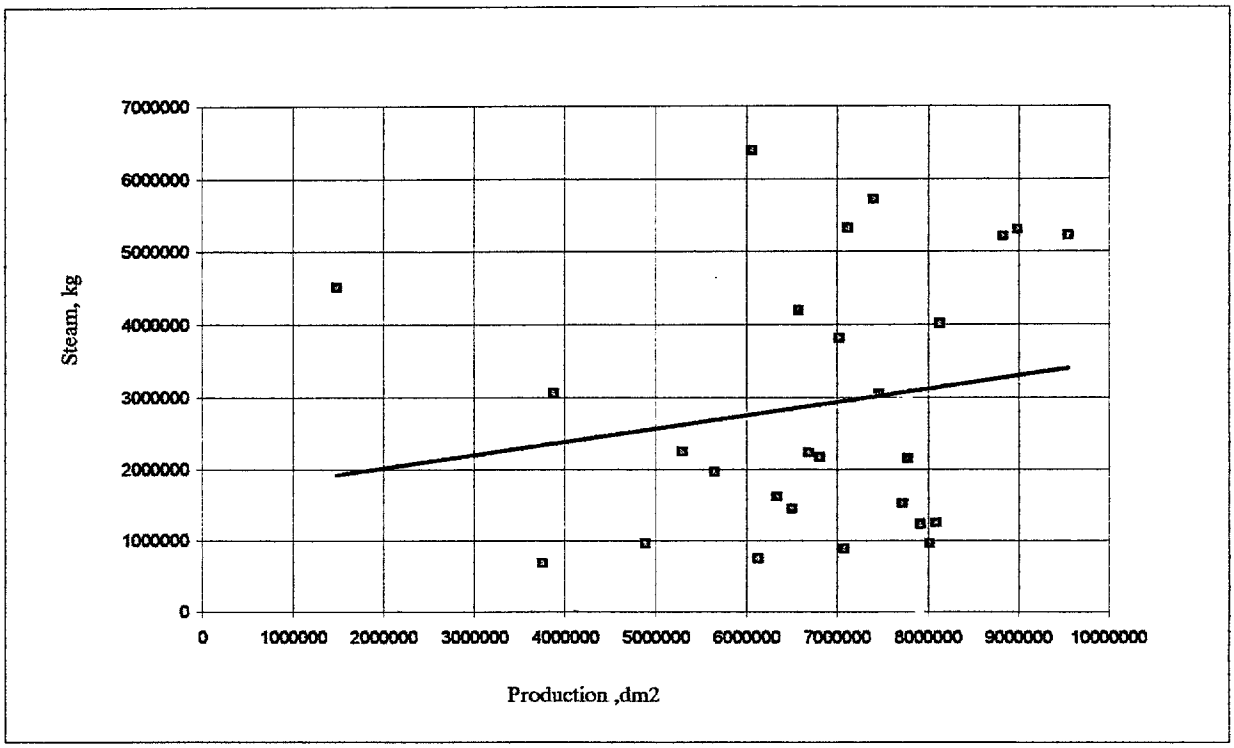
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
Steam, kg
0
1000000
2000000
3000000
4000000
5000000
6000000
7000000
8000000
9000000
10000000
Production ,dm2

Fig. A5

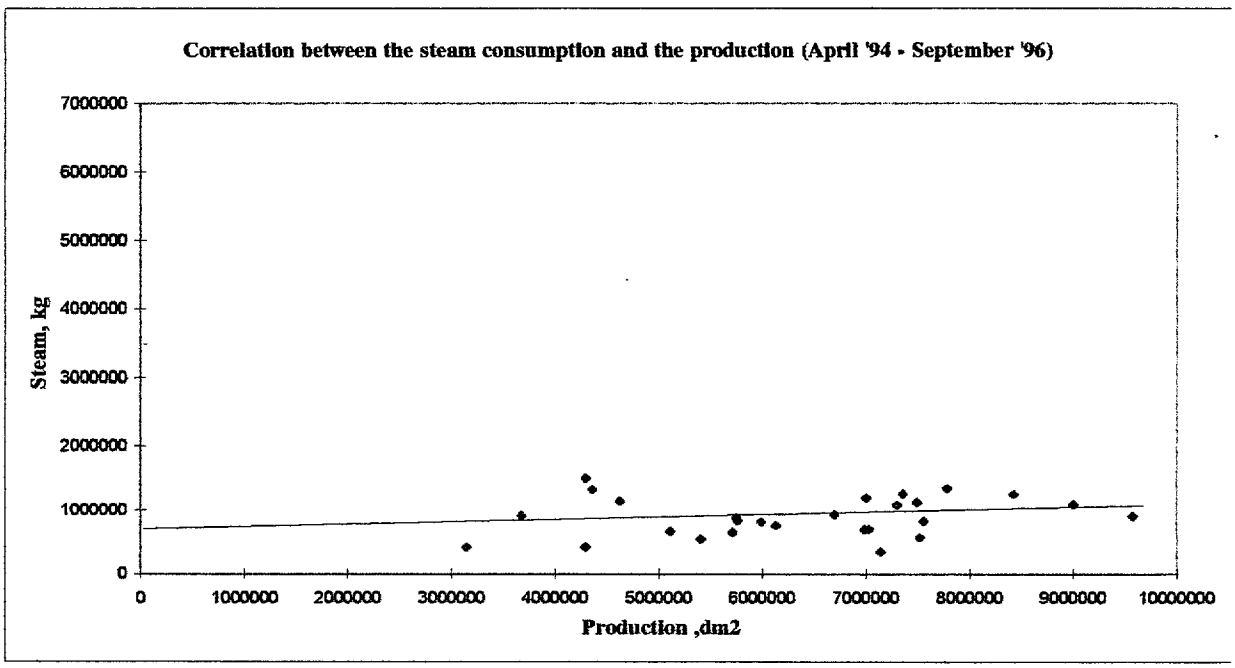
Correlation between the steam consumption and the production (April '94 - September '96)
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
Steam, kg
0
1000000
2000000
3000000
4000000
5000000
6000000
7000000
8000000
9000000
10000000
Production ,dm2

Fig. A6

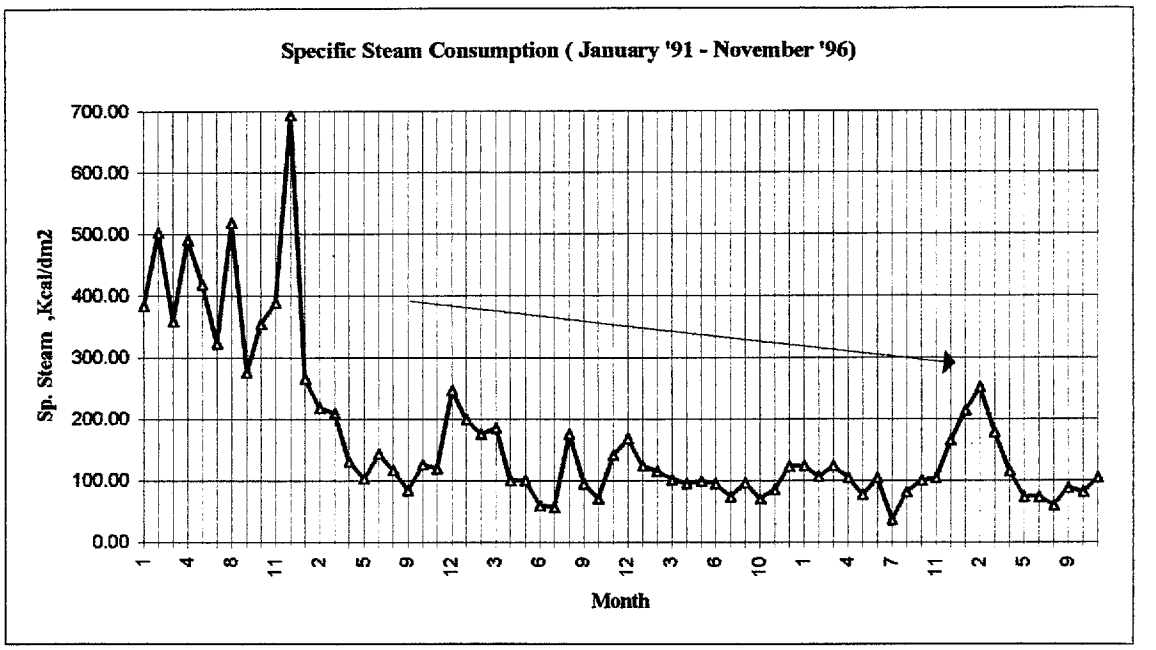
Specific Steam Consumption (January '91 - November '96)
Sp. Steam ,Kcal/dm2
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
1 4 8 11 2 5 9 12 3 6 9 12 3 6 10 1 4 7 11 2 5 9
Month

Fig. A7

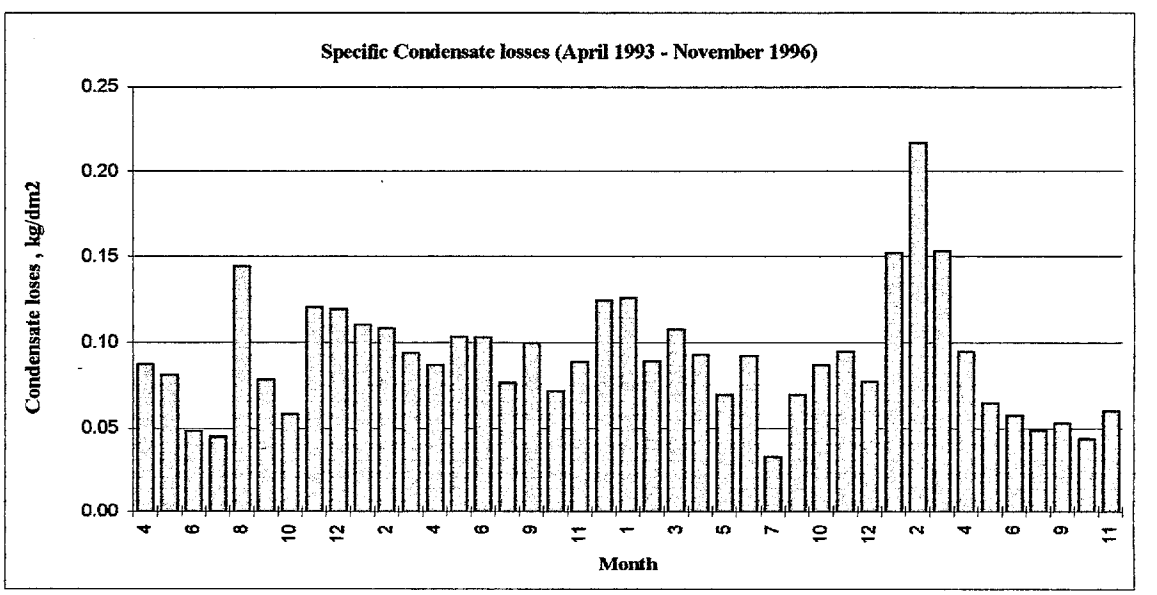
Specific Condensate losses (April 1993 - November 1996)
Condensate loses , kg/dm2
0.25
0.20
0.15
0.10
0.05
0.00
4 6 8 10 12 2 4 6 9 11 1 3 5 7 10 12 2 4 6 9 11
Month

Fig. A8

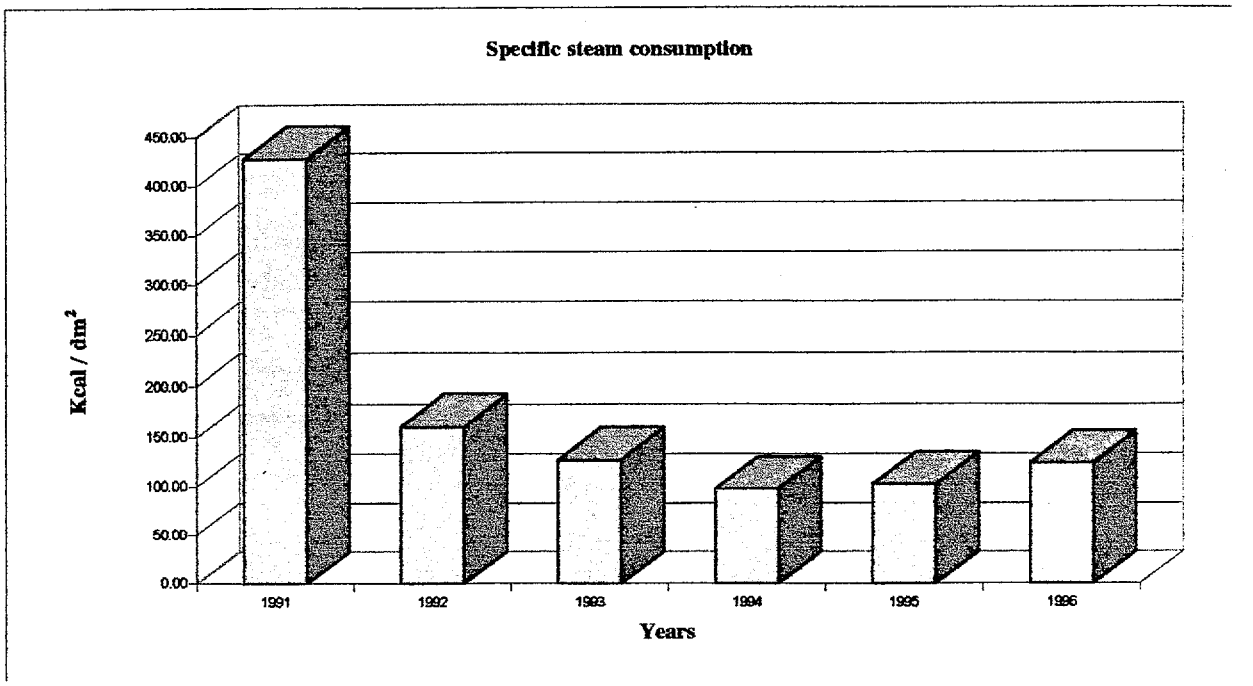

Fig. A9

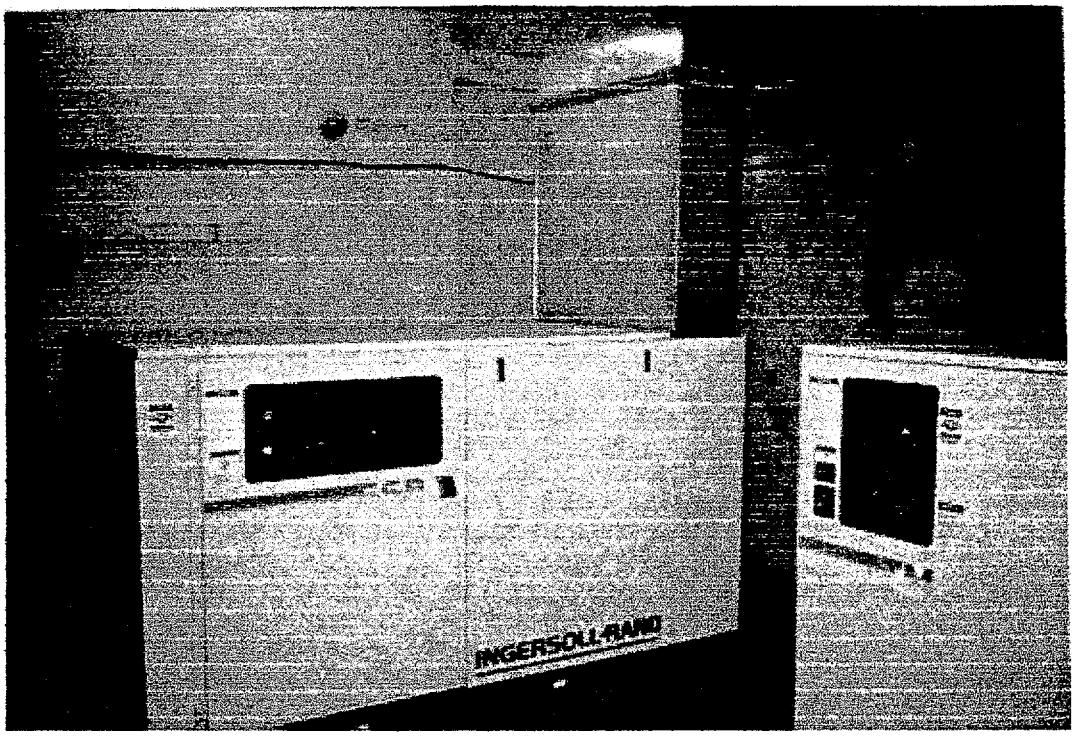

Fig. B1. View of the installed rotary screw compressor and the air dryer

Table B1. Production and electricity in Department 1 (1996)

Month	PROD.	Electricity	
	dm^2	kWh	kWh/dm^2
1	1390103	61200	0.0440
2	1391777	70800	0.0509
3	2521781	61200	0.0243
4	2501705	57600	0.0230
5	2051618	28800	0.0140
6	2202601	30000	0.0136
7	826215	28800	0.0349
9	1201116	48000	0.0400
10	2547611	25200	0.0099
11	1624738	56400	0.0347
Total	18259265	468000	0.028927
Jan - April	7805366	250800	0.035547
June-Nov	8402281	188400	0.026609
Total savings =		**75099.56**	
Total per month =		**15019.91**	
Total per year =		**165219**	
Relative savings =		**%**	**25.14**

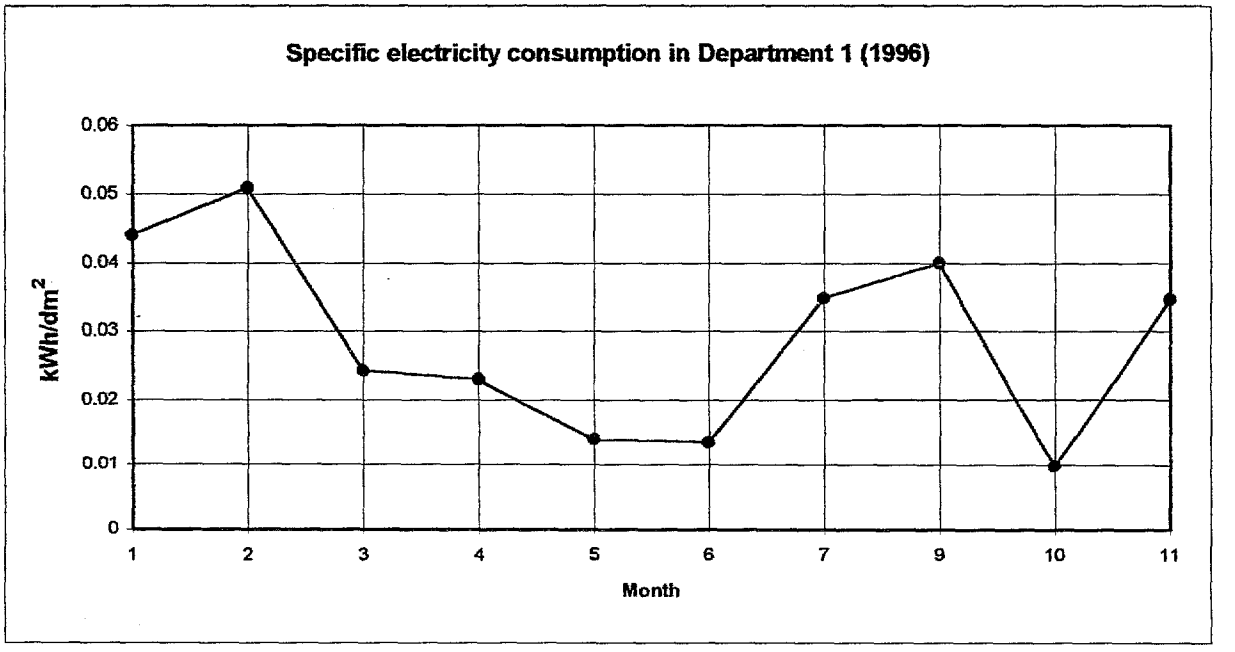

Fig. B2

MONITORING & EVALUATION REPORT SILIKATKERAM

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Deliverable 3: Phase II Measure Monitoring and Evaluation Report

Prepared for RCG/Hagler Bailly

by Boris Petkov
IVEL Ltd., Bulgaria

1. General Introduction

Under the USAID Industrial Energy Efficiency Project in Bulgaria energy management program has been carried out in Silkatkeram AD - a brick-making enterprise. This program included an energy audit report, implementation of energy conservation measures using USAID donated energy efficiency equipment of approximately $10,000 (Phase I), and further activity (Phase II) to evaluate and implement more energy conservation measures. In Phase II, equipment worth approximately $ 40,000 was specified, procured and installed in Silikatkeram AD.

This report aims at assessing the actual cost, benefits, and energy savings of the energy efficiency measures implemented in Phase II.

2. Measure-by-measure presentations

Title of Measure N 1: **INSTALL ENERGY MONITORING INSTRUMENTATION AND IMPROVE ENERGY MANAGEMENT**

RATIONALE FOR THE MEASURE AND DESCRIPTION:

Energy management improvement actions are an important category of potential savings in a fast changing economic environment. However, in order to obtain these savings and to make optimal decisions, a more reliable base of information is needed at Silicatceram. Currently, the data of number of produced and sold bricks is collected every day. There are no logs or other records on mazout (oil 6), steam, electricity and water consumption. Monthly mazout consumption is estimated by measuring the level in the mazout tank once a month. Electric use is not monitored and managed. The management cannot accurately allocate energy costs and cannot introduce any energy management programs. It has been recommended by the consultants to install or rehabilitate meters on autoclaves steam header line (1 steam meter), boiler fuel line (1 fuel meter), kiln burners fuel line (1 fuel meter), feed water line (1 water meter), install local electric meters (or use portable power logger), establish energy management procedures.

CURRENT STATUS OF MEASURE:

Energy management procedures were introduced; the water meter was installed; two fuel meters and a steam meter donated by USAID (Phase I and II) were mounted but have not been commissioned yet. (The installation of this equipment has been impeded due to the company's financial problems.) Using the power logger and the computer system, donated by USAID - Phase II, a load management program has been introduced in the middle of October 1996. The power logger is very useful for on-line monitoring of the power factor and improvement of power factor management. It has been recommended to the plant manager to implement electric management program which comprises of electric load monitoring, data base compiling and making decisions on load scheduling, motor efficiency improvement and power factor management.

MONITORING METHODOLOGY AND PROCEDURE

The consultant monitored the results of the implementation of the electric management program by reviewing the electric bills and the production data over four months (10.09.96 - 10.12.96).

RESULTS OF MONITORING

	week 37	week 39	week 40	week 41	week 42	week 43	week 44	week 45	week 46	week 47	week 48	week 49
Red bricks, in thousands	311	325	305	297	316	255	262	244	226	210	197	110
Silica bricks, in thousands	327	341	311	289	265	244	191	102	42	0	0	0
Electric Use, MWh (red bricks)	18.4	17.9	17.7	17.8	16.4	13.1	13.9	12.7	12.2	11.3	10.8	6.3
Electric Use, MWh (silica bricks)	17	17.4	16.2	15.6	13	12.2	9.6	5.26	2.3	0	0	0
Electric Use per unit, (red bricks), Wh	59	55	58	60	52	51	53	52	54	54	55	57
Electric Use per unit, (silica bricks) Wh	52	51	52	54	49	50	50	52	54	0	0	0

EQUIPMENT COST

List of equipment	number	unit cost (USD)
Mazut flowmeter	1	4,995
Power Logger	1	4,998
Computer system	1	2000

Total cost is estimated at 11,993

OTHER IMPLEMENTATION COST

equipment and measures	number	design costs (BGL)	consult. costs (BGL)	installation cost (BGL)	start-up cost (BGL)	Total costs (BGL)
other existing equipment rehabilitation measures						60000
TOTAL:						60000

ENERGY CONSUMPTION PRIOR TO IMPLEMENTATION OF MEASURE

average base electric use per unit (red bricks): 58 Wh

average base electric use per unit (silica bricks): 52.2 Wh

ENERGY CONSUMPTION AFTER IMPLEMENTATION OF MEASURE

average electric use after implementation of energy management program per unit (red bricks): 53.5 Wh

average electric use after implementation of energy management program per unit (silika bricks): 51.5 Wh

There is a decrease of around 10% in electric use in terms of kWh. Substantial reduction of penalties have been achieved in respect of reduced time-of-use of equipment in peak hours and reduced power factor penalties. Due to the high inflation these benefits cannot improve the cash flow much that is why it has not been evaluated.

PROBLEMS ENCOUNTERED IN IMPLEMENTATION OF MEASURE

The management of Silikatkeram has not been fully committed to the implementation of Full Energy Program and the consultant has been pushing the project to move further. Mazout flowmeters and steam meter are still not commissioned due to a lack of in-house skills and spare cash to hire an outside consultant. As a result of the stagflated Bulgarian economy the plant is currently operating at almost 10% of it is rated capacity. It is very likely that the plant will have to close for the coming winter months.

Title of Measure N 2: IMPROVE EFFICIENCY OF MAZOUT BURNER FOR THE BOILERS "ECONOMIC" TYPE

RATIONALE FOR THE MEASURE AND DESCRIPTION:

Of four boilers installed in the plant one is operating with a capacity of 4.5 t/h of saturated steam at 13 -15 bar. The boilers are not in good condition and the burners are with very low efficiency. Air-to-fuel ratios are adjusted visually by the experience of the operators; Boiler efficiencies are generally low due to 2 main reasons: 1/high stack temperatures; high air-to-fuel ratios. The measured boiler combustion efficiencies ranged from 80 to 82% for the Polish boilers. The audit team found that the boiler operators rarely change the boiler firing rate. If the existing low efficient Polish mazout burner is replaced with new modern automated efficient burner, savings of at least 10 % could be achieved.

CURRENT STATUS OF MEASURE:

The burner, type Iron Fireman - donated by USAID, is installed but not commissioned yet due to company's financial problems. Currently there is no boiler in operation. Due to the low demand of silica bricks at the moment they have not been produced over the last two months so no process steam has been generated over this period.

IMPLEMENTATION COST

List of equipment	number	cost (USD)
Mazout burners	1 pcs	15900
Commissioning costs		2000

Total cost is estimated at: 15900

ENERGY CONSUMPTION PRIOR TO IMPLEMENTATION OF MEASURE

Mazuot: 355 kg/ hour

ENERGY CONSUMPTION AFTER IMPLEMENTATION OF MEASURE

It can be monitored by the flowmeter donated by USAID after commissioning.

Expected mazouth consumption: 320 kg/hour

PROBLEMS ENCOUNTERED IN IMPLEMENTATION OF MEASURE

The new efficient mazout burner is still not commissioned due to a lack of in-house skills and spare cash to hire an outside consultant. As a result of the stagflated Bulgarian economy there is no production of silica bricks.

Title of Measure N 3: QUALITY IMPROVEMENT MEASURES LEADING TO REDUCTION OF ENERGY CONSUMPTION AND THE NUMBER OF REJECTS

RATIONALE FOR THE MEASURE AND DESCRIPTION:

Bricks not meeting the proper quality standard cannot be sold for the full price, and under many conditions, cannot be sold at all. This rejected product implies a significant waste of energy, since 50 to 60 % of the production cost is energy.
If moisture levels in raw materials are carefully controlled then the number of rejects can be reduced.

CURRENT STATUS OF MEASURE:

The moisture analyzer, donated by USAID is extensively used at the moment. The moisture control program has been introduced in the middle of October 1996.

MONITORING METHODOLOGY AND PROCEDURE

The consultant monitored the results of the implementation of the moisture control program by reviewing the number of rejects due to poor raw material moisture control over four months (10.09.96 - 10.12.96).

RESULTS OF MONITORING

	week 37	week 39	week 40	week 41	week 42	week 43	week 44	week 45	week 46	week 47	week 48	week 49
Red bricks, in thousands	311	325	305	297	316	255	262	244	226	210	197	110
Silica bricks, in thousands	327	341	311	289	265	244	191	102	42	0	0	0
Red brick rejects, in thousands	34.4	33.1	32.2	29.8	31.6	21.2	22.4	20.7	20.1	19.1	18.8	8.9
Silica brick rejects, in thousands	24.2	25.9	22.4	28.6	18.5	17.3	13.1	7.1	3.3	0	0	0
Red brick rejects as % of total	11	10.2	10.6	10	10	8.3	8.5	8.4	8.9	9.1	9.5	8.1
Silica brick rejects as % of total	7.4	7.6	7.2	9.8	7	7	6.8	6.9	7.9	0	0	0

EQUIPMENT COST

List of equipment	number	unit cost (USD)
Moisture analyzer		4,500

Total cost is estimated at 4,500

There is a decrease of around 2% of total energy use due to a decrease in rejects of around 16%.

Title of Measure N 4: POWER FACTOR IMPROVEMENT

RATIONALE FOR THE MEASURE AND DESCRIPTION:

The National Electric Company imposes power factor penalties to Silkatkeram AD. Silicatkeram has condenser banks, manually switched, that need to be rehabilitated. If the banks are rehabilitated and power factor controllers implemented Silikatkeram AD will not have to pay any power factor penalties.

CURRENT STATUS OF MEASURE:

The power factor correction system is not commissioned yet due to company's financial problems to pay the outside consulting firm.

IMPLEMENTATION COST

List of equipment	number	cost (USD)
Condenser bank rehabilitation		3000
Commissioning costs		2000
Power factor controllers	3 pcs	2289

Total cost is estimated at: 7,289

AVERAGE MONTHLY POWER FACTOR: 800 USD

AFTER IMPLEMENTATION OF MEASURE: 0 USD

PROBLEMS ENCOUNTERED IN IMPLEMENTATION OF MEASURE

The power factor system is still not commissioned due to a lack of in-house skills and spare cash to pay the outside consultant to complete the job.

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

Energy Pricing, Energy Efficiency, and
Energy Sector Restructuring Component

Bulgaria
Independent Private Power Assessment

Task Completion Memorandum

Prepared for:

U.S. Agency for International Development
Bureau for Europe and NIS
Office of Environment, Energy,
and Urban Development
Energy and Infrastructure Division

Prepared by:

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October 1996

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CENTRAL AND EASTERN EUROPE
REGIONAL ENERGY EFFICIENCY PROJECT

Task Completion Memorandum

Bulgaria - Independent Private Power Assessment

Summary Task Description

Bulgaria has a peak demand of 7,500 MW and installed capacity of 12,000 MW, yet low unit availability led to sustained load-shedding in recent winters. The annual electricity generation is from the following sources: about one-third from the Kozloduy nuclear power station, one-third is from thermal plants firing indigenous coal and lignite, one-quarter from thermal power stations firing imported coal, and the remainder hydroelectric. Imports make up 10% of the electricity balance. The environmental impact of the electricity sector appears to be severe, with substantial sulfur and particulate emissions from the lignite-fired thermal power stations. The risk of serious problems with the older units at Kozloduy also appear to be higher than the newer Soviet-designed pressurized water reactors. Substantial investments will be required.

The power sector was reorganized in 1991. The Committee of Energy (COE) is a government organization that controls the National Electric Company (NEK), which is a joint-stock company wholly owned by the government. Bulgaria's electricity sector is coming under increasing pressure to improve efficiency. These pressures are building from within the country, resulting from democratic reforms, the transition to a market economy, the privatization process, and higher electricity tariffs. Several opportunities exist for participation of the private sector in independent power production (IPP) to expand or strengthen power supply, such as:

- expansion of supply from existing industrial plants and district heating stations;
- investment in rehabilitation of existing thermal units, to improve availability and reduce environmental emissions;
- new, greenfield projects using gas turbines, cogeneration or other advanced

technologies.

The potential benefit of IPP to Bulgaria is greater economic efficiency, obtained in the following ways:

- additional capital;
- competition in power generation, creating incentives to minimize costs;
- access to cogeneration and other low-cost generation sources;
- transfer of modern technology, safety and environmental standards, and improved business management and accounting practices.

This activity is proposed to explore the applicability of an expanded role for Independent Power Production (IPP) in Bulgaria. An assessment would be made of the potential for IPP development to provide a common source of information for Bulgarian decision-makers, and a workshop would be held in Bulgaria for a limited group of Bulgarian government, electricity, financial, industrial, and district heating officials to address this issue together with U.S. IPP experts.

Specific Goals and Objectives

The objective of the activity was to carry out an assessment of the potential for independednt power development in Bulgaria, evaluate measure that need to be implemented to improve the investment framework, and to conduct a workshop to inform key decision makers about what is required to attract investment into the power sector..

Final Delivered Outputs

This project had the following outcomes:

- improved awareness among Bulgarian energy sector decision-makers about what is needed to promote independent power development in Bulgaria;
- action plan for:
  - -- review of laws and regulations which support IPP development.
  - -- review of technical, economic and financial conditions required for IPP development.
  - -- review of legal contracts required for IPP development.

- workshop that informs Bulgarian energy sector decision makers about the policy, legal, institutional, and market conditions that are necessary to attract private investments in the power sector.

Deliverables

The following deliverables were produced under this task:

Trip reports
Detailed assessment report
Workshop agenda
2 day workshop
Workshop proceedings and attendee list

Results and Next Steps

The independent private power assessment, legal assistance, and workshop were well received by the Bulgarian energy sector decision-makers; more than a year later comments were received on the usefulness of the exercise. At the time of implementation, all that could have been done was accomplished, given the level of effort and the local conditions.

Market and political conditions in Bulgaria, however, have limited the ability of NEK (the electric utility) and other energy sector decision-makers to implement all the recommendations. A major barrier to private power has been the subsidized low prices for electricity that limites the ability of NEK to enter into long-term power purchase agreements with independent power producers at acceptable power purchase prices. While electricity tariffs have been increased substantially in nominal terms, the real increases still fall short of what is require for full cost-recovery. The decline in economic output has also reduced the demand for electricity and thus the need for new generation capacity. In addition, the macro-economic situation in Bulgaria has worsened in 1996, with high inflation, dramatic devaluations of the Lev, high interest rates, a major banking sector crisis, and low levels of economic output. As a result of World Bank and IMF pressures, various Bulgarian energy sector institutions (e.g., NEK, Sofia District Heating Company, etc) have been put on a list of institutions to be isolated from the banking sector as a result of mounting bad debts. This categorization has therefore limited the ability of NEK to borrow money and further complicates its financial situation.

Given the current high level of country risk in Bulgaria and the poor credit rating of NEK, it would be difficult to attract private investment at this time. The Bulgarian government's unwillingness to provide sovereign guarantees and their limited value at this time also limits the

possibilities. In the coming years, as the situation turns around and the economy shows real growth, the opportunities for following through on the recommendations and attracting private investment will emerge.

Given the decreasing AID budget and involvement in Bulgaria's energy sector, there appears to be few next steps that can be proposed. The framework for private investment has been defined. Broader conditions need to improve to implement them. As the market improves, the needs will be more project and transaction specific, which are measures usually performed by private sponsors and commercial banking insitutions.

INDEPENDENT POWER GENERATION IN BULGARIA: ASSESSMENT OF POTENTIAL, IMPEDIMENTS, AND OPTIONS

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List of Acronyms

ADB	The Asian Development Bank
AyE	Agua y Energia Electrica (Argentina)
BLT	Build, Lease, and Transfer
BOO	Build, Own, and Operate
BOOT or BOT	Build, Own, Operate and Transfer
CAMME	The Compania Administradora del Mercado Mayorista Electrico (Argentina)
CDC	The Commonwealth Development Corporation
CMEA	The Council of Mutual Economic Assistance
CNEA	The National Atomic energy Commission (Argentina)
COE	The Committee of Energy
COM	The Council of Ministers
COP	The Commission on Prices
EBRD	The European Bank for Reconstruction and Development
EC	European Community
"EEE"	An Evaluation of the Effect on the Environment
ENDESA	Empresa Nacional de Electricidad (Spain)
ENRE	The Ente Nacional Regulador de la Electricidad (Argentina)
EWG	Electricity Wholesale Generators (EWG)
EX-IM	US Export Import Bank
FERC	The Federal Energy Regulatory Commission
FSU	The former Soviet Union
GOB	Government of Bulgaria
HIDRONOR	Hidroelectrica Norpatagonica (Argentina)
IFC	The International Finance Corporation
IMF	International Monetary Fund
INI	Instituto Nacional de Industria (Spain)
IRP	Integrated Resource Planning
IPP	Independent Power Producers
MIE	The Ministerio de Industria y Energia (Spain)
MLC	The Municipal Land Commission
MOE	The Ministry of Environment
MOF	The Ministry of Finance
NCW	National Council on Water
NEK	The Natsionalna Elektricheska Kompania
NPC	National Power Corporation (Philippines)
OPIC	US Overseas Private Investment Corporation
PUHCA	Public Utility Holding Company Act
PURPA	The Public Utility Regulatory Policies Act of 1978
QFs	qualified facilities

List of Acronyms

REDESA	Red Electrica (Spain)
SAL	Structural Adjustment Loan
SE	The Secretariat of Energy (Argentina)
SEGBA	Servicios Electricos del Gran Buenos Aires (Argentina)
SIN	Sistema Interconectado Nacional (Argentina)
T&D	Transmission and Distribution
TDA	US Trade and Development Agency
TPA	Third Party Access
UEFSA	Union Fenosa (Spain)
UNESA	The Unidad Electrica, SA (Spain)
WEM	The Wholesale Electric Market (Argentina)
WASP	Wien Automated System Planning Package

I EXECUTIVE SUMMARY

Assessing the potential impediments and options for independent power in Bulgaria requires reviewing the international experience, evaluating the local independent power market potential, examining the existing policy, regulatory, and institutional conditions, and suggesting approaches to policy and institutional development.

1) The International Experience with Independent Power

Independent power production, or the privately-financed and central utility-independent generation of power, has become a rapidly expanding industry not only in the United States but in many countries in Asia, Latin America, and Europe. In 1992, independent power contributed 62% (or 3,848 MW) of all new capacity additions in the United States. As of 1991, there were about 3,000 independent power projects in the U.S. totaling more than 40,000 MW. It is estimated that of the 542 GW of capacity additions planned in 131 non-North American countries between 1993 and 2000, independent power projects could claim between 80 and 115 GW. The economic and financial advantages of independent power are the driving force behind this expanding new industry: access to private capital, minimized costs due to competition, shift of project risk to the private sector, more rapid integration of optimal power technologies, and expanded use of renewable energy and cogeneration.

The international experience (e.g. in such countries as Poland, Argentina, and Spain) with developing an independent power market provides lessons that should be considered in Bulgaria. As the experience in the United States and emerging economies has shown, the process of attracting private capital into the power sector essentially involves the reduction and management of both country and project risks. The Bulgarian government, the Committee of Energy (COE), and the electric utility (NEK) will have to play an active role in reducing and controlling those risks that a private investor and developer cannot control. Establishing key elements of the policy, institutional, and regulatory framework for independent power plays an important role in the risk mitigation and management process. The contractual commitments that the Government and NEK are willing to offer to private developers are also critical to attracting private financing, because they also reduce the investor's exposure to risk. Ultimately, a private developer and investor must be assured through the policy and contractual framework that NEK is offering a fair power purchase price under fair contractual terms and that the process of selecting a developer will also be fair and transparent.

The international financing of independent power involves structuring and managing both country and project risks in a way that is competitive regionally and globally. Given the current high level of country risk and the lack of a developed capital market in Bulgaria, power projects with international participation will initially require a major role for the multilateral and bilateral financial institutions and a Bulgarian government guarantee of utility

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performance. For instance, the European Bank for Reconstruction and Development (EBRD), the World Bank, the International Finance Corporation (IFC), export credit agencies (e.g. US Export Import Bank (EX-IM) or the US Overseas Private Investment Corporation (OPIC)), equipment vendors, and to a small extent, commercial banks could supply the debt financing. The equity investment would come from the foreign investor/developer, a local Bulgarian partner, equipment manufacturers, and possibly the EBRD and IFC. As Bulgaria's independent power market matures and NEK's creditworthiness improves, the need for multilateral and bilateral support and government guarantees will diminish.

2) Independent Power Market Potential in Bulgaria

Independent power in Bulgaria faces clear barriers that will complicate the process of attracting private capital in the power sector:

- Difficult economic structural adjustments: Bulgaria's economic output has experienced a major decline as it tries to make the transition from central planning and communist block markets to free enterprise and international markets.

- Declining power demand and unreliable capacity: The demand for power has also declined leaving surplus capacity, with much of this capacity being unreliable and in considerable need of reconditioning.

- Poor utility financial performance: Electricity tariffs on average still do not reflect the full costs of generation, transmission, and distribution; as a result the electric utility (NEK) is currently not a financially-sound institution.

- Inadequate policy and institutional framework: The policy and institutional framework for independent power is not in place and the legal framework for private investment still requires further modifications.

- High level of commercial risks: Bulgaria is facing high inflation, high interest rates, major unemployment, and unresolved commercial debt negotiations such that most private investors and lenders will be unwilling to make the long-term investment needed by the power sector.

Despite these challenges, various positive conditions and trends in Bulgaria could encourage independent power generation in the coming years:

- Economic adjustment developments: Bulgaria's economic distortions and commercial risks are gradually being reduced through the structural-adjustment loans of the World Bank and International Monetary Fund (IMF) and commercial bank debt negotiations.

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- Electric utility financial improvements: NEK is raising its tariffs to reflect the full costs of generation, transmission, and distribution and expects to be financially viable by 1995.

- Foreign investment laws instituted: Bulgaria has enacted laws that establish far reaching rights for private investors, including 100% foreign ownership, national treatment of foreign firms, and free repatriation of profits.

- Investment opportunities in existing capacity: There is a definite need for private investment to rehabilitate or repower existing power plants and cogeneration facilities.

- New capacity needs: When Bulgaria's economy begins to grow again, additional capacity will be needed, including thermal and hydro power plants.

- Independent power policy formulation: The Government has expressed a commitment to encouraging independent power and has begun the process of developing the necessary policy and institutional framework.

Recognizing the difficult economic conditions, sources of financing can be found if the policy and project framework is properly structured. The key components for developing a viable independent power program in Bulgaria will involve two parallel activities: policy development and project development, as discussed below.

Attractive power project development opportunities exist in Bulgaria in various sectors. While Bulgaria has an installed capacity of 12,074 MW, over the last several years the utility, NEK, has had difficulty meeting a system peak of 7,200 MW. This poor performance has been due to aging or technologically-outdated power plants and unreliable supplies of coal. There is a major need for investment to rehabilitate or repower the existing central power and industrial and district heating cogeneration plants. In addition, as power demand increases in the coming decade, major opportunities for building new thermal and hydro power plants will exist. Potential power projects that could attract foreign investors and a preliminary market estimate include:

- Industrial Cogeneration: Rehabilitating one or more major industrial cogeneration projects, such as Chimco Vratsa, Burgas, Vidin, or Kremikovtzi; [600 MW - 2,600 MW]

- District Heating Cogeneration: Rehabilitating one or more of the major district heating plants, such as Sofia or Pernik; [600 MW - 2,500 MW]

- Hydro Power: Private development of one or more of the mini or major hydro sites, such as the sites at Gorna Arda or Sredna Vacha. [400 MW - 2,600 MW]

- Coal-Fired Power Plants: Rehabilitating one or more of the existing coal-fired power plants, such as Maritsa East 1, 2, or 3, Varna, or Russe; [200 MW - 4,500 MW]

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- New Generation: Construction of a new combined cycle gas or coal-fired power plant. [1993 - 2000: ~ 880 MW (assuming the intermediate demand growth scenario)]

Feasibility analysis of some of these projects is already underway, and an initial priority ranking of these projects will be included in the least-cost plan that is currently under development.

3) Existing Policy, Regulatory, and Institutional Conditions

The existing policy and institutional framework in Bulgaria is undergoing major changes. Only one statute, the Law on the Environment, has any significant implementing regulations. The power sector regulatory institution is also in a formative stage. The prospects for a broad independent power program will be greatly enhanced as Bulgaria's policy and institutional framework becomes more developed. The key power sector issues that need to be addressed are:

- Energy Legislation: There currently is no comprehensive energy law that addresses the rights of independent generators. A Law on Electrical Energy is being drafted that appears favorable to independent power, however, this Law has yet to be approved by the Parliament.

- Implementing Regulations: Once the Law on Electrical Energy is passed, implementing regulations clearly defining the Law will need to be drafted. These regulations could play an important role in defining such issues as power pricing, project solicitation, etc.

- Legal Recourse: The extent to which there is a reliable system of legal recourse in Bulgaria will also affect the attractiveness of investing Bulgarian power projects. It may be necessary for all parties to an independent power contract to submit to binding dispute resolution by an independent third party, which can be implemented in Bulgaria or in a foreign country.

- Institutional Priorities: An institutional structure and policy favorable to independent power is only beginning to emerge at COE and NEK. There is a need to set specific objectives for COE and NEK against which actual progress can be measured. Other ministries with an important role in power project approval, such as the Ministry of Environment, need to be included in the process in a complementary manner.

- Project Review Process: At present, there is not a clear project approval process that an independent developer can understand and follow. The procedure for project prioritization, selection, negotiation, and permitting will need further definition.

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A preliminary assessment of the power sector institutions and the energy bill currently being drafted indicates that a potentially favorable policy and institutional framework is under development.

4) Suggested Approaches to the Introduction of a Policy and Institutional Framework for Independent Power

The Government of Bulgaria, the Committee of Energy (COE), and NEK will need to continue their progress in establishing the necessary policy, regulatory, and institutional framework for independent power. Some of the necessary activities are already underway, particularly electricity pricing reform, energy legislation, Integrated Resource Planning (IRP) analysis, and project feasibility assessments. Additional suggestions are summarized below:

- Strengthen Legislation: Strengthen components of energy and foreign investment legislation to facilitate independent power;
- Establish Regulatory Institution: Establish an independent regulatory institution that addresses independent power and ensure staffing by qualified regulators;
- Draft Regulations: Develop and publish detailed regulations based on the energy law;
- Establish Information Clearinghouse: Establish a central information clearinghouse for Independent Power (IPP) developers;
- Implement Integrated Resource Planning: Use Integrated Resource Planning to establish long run marginal cost and power purchase pricing to guide project selection;
- Define Government Guarantees and Incentives Offered: Establish consistent policy regarding government incentives and guarantees covering utility performance, fuel supply, etc.;
- Define Solicitation Process: Establish the procedure for soliciting independent power;
- Train Negotiations Team: Establish and train a multi-disciplinary review and negotiation team;
- Prepare Standard Small Power Contracts: Provide standard offer contracts for small renewable and cogeneration projects;
- Prepare Terms for Large Power Contracts: Provide standard non-price terms for large projects.

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While all elements of the policy and institutional framework described above are necessary in order to enable an active long term independent power market, not all components are essential to develop the initial projects. Independent power projects can potentially move forward in an incomplete policy and institutional framework. In fact, experience in other countries (such as the Philippines, Poland, and Argentina) has shown that promoting specific projects early on can in fact help refine the policy development process.

In order to implement a parallel policy and project development strategy, certain priority elements of the policy and institutional framework need to be developed early on in order to ensure that any proposed independent power projects have an adequate institutional and contractual framework. The near-term key power sector policy framework that needs to be implemented includes the following elements from the above list: establish a consistent policy regarding government guarantees and incentives; establish and train a multi-disciplinary review and negotiation team within NEK, and provide standard non-price terms for large, central, hydro, or cogeneration projects. It may be desirable to also prepare standard offer contracts for small renewable and cogeneration projects. With these basic elements in place, it should be possible to attract independent power investments.

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II THE INTERNATIONAL EXPERIENCE WITH INDEPENDENT POWER

1) The Definition of Independent Power

a) Basic Legal and Financial Structure

Independent power represents the financing, construction, and operation of a power generating facility by a company that is independent from the central power purchasing electric utility. The central utility can either be private or government owned, but in both cases is a regulated monopoly. The independent power generator is usually owned by a private company. It is typically an unregulated facility that enters into a clearly-defined power purchase agreement with the utility. By this definition, Bulgaria already has various examples of independent industrial cogeneration and district heating plants at government-owned corporations.

An independent power project (IPP) can: (1) exclusively serve the captive power needs of a particular factory or load (thereby reducing the power requirements of the central utility); (2) meet captive power needs and also generate surplus power and energy for sale to the grid; or (3) be a dedicated power plant for bulk power sales to the grid. Categories 1 and 2 involve some form of cogeneration while category 3 include central power plants ranging in scale from small decentralized generators (e.g. mini-hydro, geothermal, wind, solar, etc.) to large power plants (e.g. coal, oil, gas fired units).

IPPs can be introduced in different ways. At one end of the spectrum, independent power has involved a major restructuring of the power sector, the breakup of generation, transmission, and distribution, and the sale of government-owned power generation and distribution assets to the private sector (as for instance has been implemented in the United Kingdom and Argentina). At the other end of the spectrum, some countries have retained government-control over the main generation, transmission, and distribution system, and have simply entered into power purchase agreements with selected independent power generators (as has been implemented in the Philippines and Spain). Given Bulgaria's expressed near-term requirement to work with the existing government utility, NEK, and the clear objective to attract private capital into the power sector, the focus of this report will be on the latter model for independent power.

Privately financed IPPs are structured as separate companies that involve limited or non-recourse project financing. This method serves to mobilize private capital more effectively by limiting the liabilities of the project owners. In the event of default or bankruptcy, the lenders and investors have no right to the assets of the owners of the company; the only collateral they have is in the assets of the specific project company. As a result, however, lenders require more assurances in the form of contractual agreements, including iron-clad power purchase contracts, and attractive internal rates of return before they are willing to lend to independent power projects.

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b) The Process of Independent Power Project Development

The life of an independent power project involves three major phases: development, construction, and operation. Within these phases, some ten distinct steps can be defined.

(1) The electric utility determines the amount and type of capacity needed in its expansion plan through a planning process;

(2) the electric utility obtains and evaluates proposals from prospective developers that are either unsolicited or solicited through a competitive bidding process;

(3) The utility and developer may decide to negotiate an initial letter of intent or memorandum of understanding to define the basic parameters of the proposed project;

(4) The developer performs a detailed feasibility study to define the precise technical and economic characteristics of project;

(5) Detailed legal agreements are negotiated for the purchase of power, fuel supply, construction services, operation & maintenance, etc.;

(6) The developer proceeds to obtain all the necessary permits required, including such issues as land use, environmental emissions, taxes, etc;

(7) Short-term and long-term debt and equity financing is obtained for both construction and long-term capital requirements;

(8) A detailed engineering design of the project is completed;

(9) The power plant is constructed or rehabilitated and commissioned;

(10) The plant is operated, the debt is serviced, and the equity investors earn their return.

Each of these steps represent a milestone or hurdle in the process of developing the independent power project. As shown in Figure 1, at each stage of this process the costs of developing the project increase while the risks of the project failing decrease.

Private Power Project Development Risk and Cost Phases

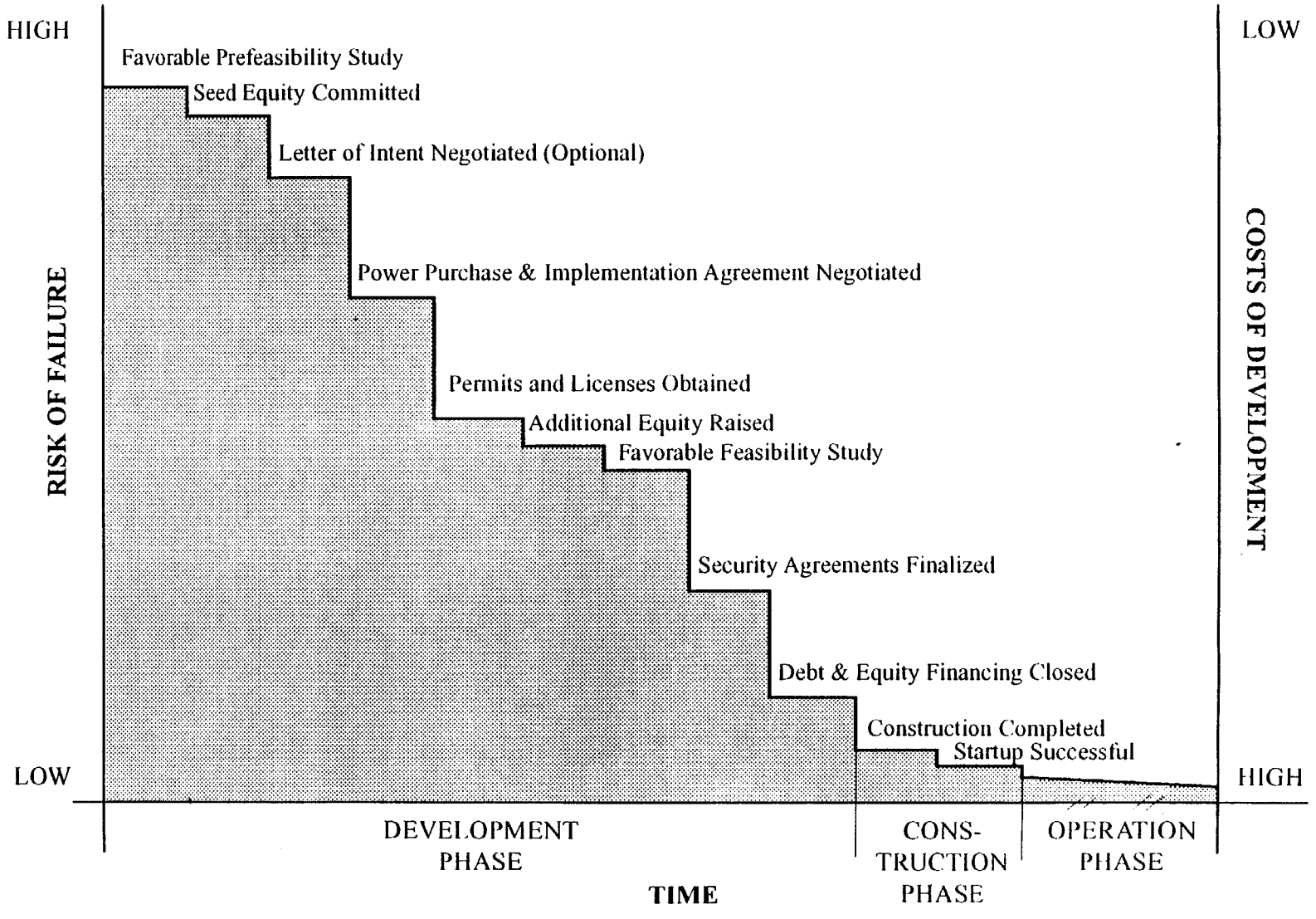

Figure 1

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2) The Evolution of Independent Power in the United States

a) Introduction

The U.S. power sector is characterized by a wide array of players, including investor-owned or private utilities, state and municipal utilities, cooperatives, and Federal utilities. Investor-owned utilities provide most of the electric power generated in the U.S., focusing on sales to ultimate customers and secondly on bulk power sales. Federal utilities, on the other hand, focus on bulk power sales to utilities.

The U.S. power sector is regulated at two levels. The Federal Energy Regulatory Commission (FERC) regulates at the federal level, while state public utility commissions in each of the 50 states regulate at the state level. FERC has the responsibility to administer federal laws affecting the electric as well as the gas industry and the transfer of these energy supplies across state borders. The public utility commissions in each state has responsibility for regulating, among many items, the prices of retail sales by electric utilities. There are, in addition, 2,000 local entities which regulate pricing and resource use issues affecting municipal power authorities. In total, there are about 2,050 regulatory entities affecting, in one way or another, the actions of over 3,200 electric utilities.

The Public Utility Regulatory Policies Act of 1978 (PURPA) has had a dramatic impact on the US power sector. The statistics speak for themselves. Over the last ten years after the passage of PURPA, close to 2,500 non-utility projects with a total capacity over 30,000 MW came into operation in the United States. In the next ten years, another 55,000 MW of non-utility power generation could come on line, providing over 40% of all new capacity additions before the end of the century. PURPA allowed non-utilities to invest in qualified facilities (QFs) using cogeneration or select renewable or waste fuels. At this point, over 100 non-utility companies are actively involved in this form of private power generation. In fact, some of these companies are utility subsidiaries because the Congress of the United States allowed utilities to own up to 50% of any QF project, as a quid pro quo for opening the door to non-utilities. The story of how this revolution in the power sector evolved is worth exploring to draw lessons for the development of independent power in Bulgaria.

b) The History of PURPA and Non-Utility Generation

In the late 1970s, the U.S. Government was faced by the energy crisis resulting from the oil price shocks. In an effort to reduce oil imports by eliminating energy waste and promoting the use of indigenous energy sources, PURPA was passed in 1978. The specific objective of this law was to promote the non-utility development of cogeneration and renewable sources of energy. While primarily aimed at fostering energy conservation, PURPA

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also put an end to the power generation monopoly of US utilities and opened the door to the de-regulation of that sector.

Prior to PURPA, no unregulated plant could sell power to the grid. The only non-utility-owned power plants were self-generation facilities generally concentrated in chemical production complexes, pulp and paper mills, and some steel mills. These projects produced power for themselves and did not interface with the grid, except in emergency situations. About 7,000 MW of self-generation was in place prior to PURPA, including nearly 5,000 MW of gas-fired or coal-fired capacity; the balance consisted of mostly black liquor units in pulp and paper mills.

PURPA stipulated two conditions that opened up the US power generation sector:

- **First**, it allowed non-utilities (e.g., private companies, equipment suppliers, construction firms) to build and operate certain types of qualifying facilities (QFs) and sell their power output to the grid without being regulated as a conventional utilities.

- **Second**, it required utilities to buy the power from these QFs under certain price conditions.

First, PURPA explicitly exempted QF owners from the regulatory requirements of the Public Utility Holding Company Act (PUHCA). QF owners thereby escaped the burdensome regulatory, reporting, legal, and accounting requirements of PUHCA. Furthermore, QFs were exempted from the rate regulation and other financial reporting regulations of the Federal Power Act. Finally, PURPA exempted QFs from the financial and organizational requirements of the state public utility commissions. These special rights granted to QF owners allowed them to earn an unregulated return on their projects, in contrast to utilities that were subject to rates of returns set by their state public utility commissions.

PURPA allowed non-utilities to build two types of QFs designed to either use an energy-efficient technology (i.e. cogeneration) or help diversify the US power generation mix:

- Cogeneration Projects which simultaneously produce two or more useful forms of energy (process steam, hot water, or process heat) and electricity. Cogeneration projects are energy-efficient since they generate electricity on the margin for as little as 4,000 to 6,500 btu/kWh compared to 9,500 Btu/kWh for a conventional power plant. To qualify as a QF, a cogeneration project must produce at least 5% of its total energy output in the form of useful thermal energy. If that requirement is met, a QF cogeneration project can be of any size and can use any type of fuel.

- Small power projects which produce only electricity but use waste fuels (for example, waste coal, industrial process wastes, or biomass) or renewable energy (for example, geothermal energy, wind power, hydropower or solar energy). To qualify as a QF, a small power project must be below 80 MW.

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Second, PURPA stipulated that utilities had to buy the power produced by QFs and had to provide non-discriminatory interconnection and back-up service to these QFs. QFs generally sell power under long-term (20 to 25 year) contracts at rates negotiated or competitively bid with utilities and in compliance with avoided cost and other requirements of relevant state regulatory agencies. The approval of the power sale contract and the normal siting and permitting approvals are generally the only extent to which QFs are regulated. As a quid pro quo for "opening up" the power generation monopoly that electric utilities had, PURPA allowed utilities to own up to 50% of QFs provided they did contract to sell power to themselves.

c) The Implementation of PURPA

Several implementation issues quickly arose which had to be dealt with both at the Federal level and at the local level:

- At the Federal level, the Federal Energy Regulatory Commission (FERC) was put in charge of the broad implementation of PURPA and, as such, issued in February 1980 its Order 69. This order, however, left a lot of details to state public utility commissions.

- At the state level, public utility commissions retained jurisdiction over the implementation of PURPA, including deciding:

  - the methodology to be used to set rates for sales and purchases of QF-power;
  - the responsibilities for QF interconnections;
  - the standards for QF system safety and reliability; and
  - the process by which these commissions would resolve disputes between utilities and QF owners.

Nonetheless, some states still felt that PURPA was one more instance of Federal interference. The State of Mississippi challenged the constitutionality of the new law in April 1979. It was not until June 1982 that the Supreme Court of the United States ruled that PURPA was constitutional. Consequently, there was little QF market development between 1978 and 1983.

The most important issue, then, became how to determine the price that utilities should pay for QF power. PURPA just said that utilities should pay no more than their "avoided-cost", a new and vague concept which FERC clarified by stating that the avoided cost should be "an administratively-determined approximation of the incremental costs to an electric utility of electric energy and capacity or both, which, but for the purchase from QFs, such utility would generate itself or purchase from another source." At first, this was interpreted to mean the full marginal cost of building the next power plant, which was generally construed as a large,

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expensive, utility-owned power plant. In some cases, this meant paying 10-11 cents/kWh of QF power -- almost twice what utilities would pay for power bought from neighboring utilities.

Although some utilities challenged FERC's "administrative" interpretation, the Supreme Court upheld FERC's authority to endorse the avoided cost approach, stating that the "basic purpose of ....PURPA was to increase the utilization of cogeneration ... and to reduce reliance on fossil fuels" and that "at this early stage of implementation of PURPA, it was reasonable for FERC to prescribe the maximum rate authorized by Congress and thereby provide the maximum incentive for the development of cogeneration and small power production."

Even upheld, the FERC guidelines remained unclear and state commissions developed different methodologies which in some cases were legally challenged as well. For example, New York State declared that there should be a floor of 6 cents per kWh for QF power, a decision which was later repealed. Several states (e.g. Pennsylvania) also said that contracts signed between utilities and QFs were to approved even if they did not quite follow the commission guidelines. Commissions also reacted at different speeds as they faced various utilities with diverse demand and supply situations and different levels of sophistication. In addition, some state commissions (e.g., California and Ohio) had large staffs while others did not have the in-house engineering and financial expertise needed to administer PURPA issues. As a result, only 16 states had issued their regulations by March 1981, the deadline set by FERC. By March 1983, two years later, six states still had no PURPA regulations in place.

While regulators were searching for the best approach, most US utilities were resisting non-utility generation because they resented having to purchase high-priced power from QFs that could be located anywhere and operated by anybody. For most utilities, this smacked of anarchy and, in numerous instances, utilities counteracted by offering discount rates or deferral agreements to industries that were potential cogenerators or by imposing high standby and interconnection rates.

Finally, the pressure of state regulators and the activism of non-utility companies overcame the utilities's opposition in some key states such as California, Texas and Pennsylvania. In these states, non-utility offers started to pour in on a "first-come, first served" basis to take advantage of high-avoided costs. In addition, QFs built then could be amortized over a 5 year period as the result of a new tax law passed under the first term of the Reagan administration. By the mid-1980s, some of these states were swamped by QF offers. For example, over 6,000 MW of offers were signed up in California alone in 1984 and 1985. At that point, utilities and regulators started to search for ways to regain control of the situation by reducing the amount of QF capacity offered with queuing systems and capacity auctions. In essence, utilities were concluding that when there is a high level of QF offers, the avoided cost could be defined as the cost of purchasing additional power from the most competitively priced QF project. In 1984, the idea of issuing requests for QF proposals that could compete against each other emerged in the states of Maine and Massachusetts.

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While regulators and utilities were getting their act together, the demand for power was growing in several regions of the United States. Utilities were reluctant to build their own plants for several reasons. Utilities feared major cost overruns; the major failures they had experience in nuclear construction caused some of them to re-examine the assumption that bigger plants were better. They also did not like the high fuel prices and interest rates that were in effect at the time and their balance sheets were often not in a favorable position to take on the risk of new construction.

In this context, US utilities came to realize the advantages of QFs compared to conventional power plants:

- **First**, QFs are small compared to central utility stations. Therefore, QFs better fit the gradual increased demand faced by most US utilities. Being smaller, QFs are also easier to site and permit. In most states, permit reviews are simpler for projects below 100 MW, 75 MW or 50 MW. In addition, industrial cogeneration projects are generally built on existing sites where the incremental water, community, and socio-economic impacts are minimal.

- **Second**, being smaller and easier to site and permit, QF projects can be constructed faster than conventional plants with less chances of incurring cost overruns. A QF project generally can be built in less than 3 years under turnkey contract with price ceilings.

- **Third**, easier to site and less risky, QFs are accepted by financial institutions which are willing to provide project financing by extending highly-leveraged debt on a non-recourse basis. With this type of financing, financial institutions loan the necessary funds against the sole assets of the project, without having recourse to the equity owners of that project. For the lenders, the single most important asset in a QF project is its long-term power sale agreement because it is signed by a utility that is generally considered as a most credit-worthy institution. In the 1980s, QF projects were leveraged up to 85-95%, thus enabling them to produce power at lower costs and still generate higher returns than utility projects leveraged at less than 50-60%. In addition, cogeneration projects, with their higher energy efficiencies, are more cost-efficient than central power plants.

- **Finally**, utilities came to accept that there were knowledgeable, entrepreneurial and efficient non-utility organizations that could run their QFs as reliably as utility-plants. The was a growing recognition that increased competition in power generation led to more innovation in technology, more fuel diversity, and better diversification of risk.

As the need for new power kept growing, FERC proposed a ruling in early 1988 that would have standardized competitive bidding for QF plants. However, several states resisted saying that they wanted the flexibility to design their own QF selection processes and continue

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to use them as needed in case-by-case negotiations. Although it failed, the proposed ruling sent the message that competitive bidding was the way to go.

Currently, most US utilities issue requests for competitive bids for a certain amount of non-utility capacity that has to meet certain size, fuel and operation criteria and must come on line within a specified time window. Such bids can be either open or closed bids:

- In open bids, the request for proposal provides an explicit scoring system which is being used throughout the project selection and negotiation process.

- In closed bids, there is no scoring system, although the utility may provide some indications as to the types of projects it prefers.

In both cases, however, utilities are learning how to improve their bid selection process by evaluating QF offers not only on price but also on "quality". To judge the quality" of a QF offer may call for looking at up to 15 - 20 factors such as the use of certain local fuels; the impact on the local environment and economy; the type and reliability of the technology proposed; the timing of the project; its transmission fit; the quality of the planned operation and maintenance contract; and the reputation and track record of the sponsors behind each project. In some cases, the utility will bid its own plant or use as a benchmark a potential contract to purchase bulk power from a neighbor utility.

In this new competitive bid environment, QFs generally sell power at rates between 6 and 8 cents per kWh. At these rates, rates of return on QF projects can range between 15% and 25% depending on the degree of risk, location, and size of the project. To date, over 65 competitive bids have been issued by 48 utilities to request over 19,000 MW of non-utility generation capacity. The market response to these bids has been tremendous: over 1,950 projects were bid for a total in excess of 148,000 MW, that is almost 8 times what was being asked. These bids were issued by all types of utilities, including investor-owned utilities, public utilities and rural cooperatives.

d) The Success of Non-Utility Generation in the US

The combination of increasing capacity needs, the utilities' reluctance to build new plants, and a growing acceptance of QFs by utilities, explains the emergence of a strong non-utility generation industry which has grown by 15% per year over the last ten years. The US QF market took off in 1985 and, since then, annual increases of 3,500 to 4,000 MW per year have been recorded. Year 1990 was a record year with over 6,000 MW of new operational capacity: this included 224 projects for a total investment in excess of $ 8.5 billion.

Overall, more than 30,000 MW of new QF capacity has been developed since 1980, representing over $ 40 billion in investments. QFs have provided about 15% of all the new

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power generation capacity installed in the United States since 1980. This proportion has subsequently increased from 25% in 1985 to 53% in 1990.

Today there are close to 3,000 non-utility generation projects in operation, representing a total generation capacity of more than 40,000 MW. This accounts for roughly 6 per cent of the total installed generation capacity in the United States. In 1990, QFs produced the equivalent of $9 billion in electricity sales. At this point, over 85 utilities purchase significant amounts of independent power.

QFs are very diverse in size and type of fuels. Gas-fired cogeneration, however, dominates with 45% of the total non-utility generation capacity in place. Next comes coal-fired cogeneration (15%). Small power projects account for 23% of the existing QF capacity, including projects with a broad slate of energy sources: biomass, waste fuels, hydroelectric power, municipal solid waste, and geothermal, wind and solar energies.

In addition, some 1,500 QF projects were identified as under development, representing potential capacity additions of nearly 70,000 MW, most of which will come on line between 1992 and 1995. This includes over 34,000 MW of gas-fired capacity, 11,200 MW of coal-fired capacity and some 6,000 MW of capacity that will use biomass or waste fuels; the balance (16,700 MW) will rely on renewable energy resources. Note that not all the projects forecasted will succeed; it is estimated that about 50% of all projects initiated eventually fail to be constructed due to their inability to meet various regulatory, permitting, or financial requirements.

In terms of applications, small power projects (most using renewable energy) account for the largest share of QF projects, both operating and under development. The next most intensive QF markets are cogeneration projects found in the chemicals, pulp and paper, and petroleum refining industries; these three industries combined host 18,000 MW of operational non-utility generation and could attract another 17,000 MW of additional QF capacity in the next five years.

Non-utility generation, with its flexibility and quick-on-line capability, will help US utilities meet their capacity needs across the entire country. Up to 200 competitive bids may be issued through 2000, requesting over 45,000 MW of non-utility generation capacity, first on the East Coast, but then spreading to the Southeast and Midwest of the United States, as the demand for new power generation shifts round the country. In most cases, utilities will solicit between 200 MW and 450 MW at a time.

In that context, it is projected that 54,700 MW of non-utility generation capacity will develop through 1999, including 26,200 MW of gas-fired capacity; 15,400 MW of coal-fired capacity industrial cogeneration; 6,500 MW of biomass- and waste fuel-fired capacity; and 6,500 MW of capacity relying on diverse types of renewable energy resources.

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Over 9,000 MW of non-utility generation capacity may therefore be in place by 2000. Through 1999, non-utility generation will provide about 46% of the total generation capacity that is expected to come on line. This bodes well for this new industry which is attracting more and more players. As the industry grows at 10% per year, some-non-utility companies will grow large in the 1990s. By 2000, leading players may control the equity of some 3,000 MW of non-utility project. By being involved in up to 40-50 projects in 20-30 states; the portfolios of this major players could then be worth $ 1 billion or more and their annual power sales are likely to exceed $ 1.5 billion.

e) The New Energy Policy Act

A new national energy law, entitled the Energy Policy Act of 1992, which substantially expanded the scope of independent power in the US. This Act signals a new era by offering the following new terms:

- A new category of power plants, Electricity Wholesale Generators (EWG), are exempt from PUHCA and thus have similar status as Qualifying Facilities under PURPA, while they are still subject to the Federal Power Act and state regulatory commissions. There are no explicit fuel or size restrictions for EWGs and they have fewer restrictions on utility ownership.

- Transmission access will be broadened for wholesale power exchanges between utilities and independent power plants. This broader access to the grid will give independent power generators greater rights and opportunities to wheel power to utilities and major customers.

This new law is likely to result in a wide variety of new EWGs emerging on the market. EWG size will at first be limited by the realities of the power plant siting and the sizes of power capacity additions being required by utilities. Thus, most EWGs being developed in the United States over the next four years will likely still be below 400 MW, with 150 MW to 300 MW being quite popular. The competitive market conditions in the U.S. are also leading many developer to pursue major project overseas.

In addition, under the new Act, FERC can order wheeling between utilities, or between QFs or EWGs and utilities, or between QFs or EWGs and major industrial customers as long as the transaction meets four conditions: (1) it involves wholesale power only; (2) it is in the public interest, (3) it does not jeopardize the reliability of the grid, and (4) it involves wholesale power that is transacted at a "just and reasonable" price.

With this new Energy Policy Act, the independent power market in the US is opening a new chapter that will lead to a wider variety of opportunities for independent power generators.

f) Lessons Learned from the US Independent Power Experience

In conclusion, we can say that PURPA has had a positive effect on energy efficiency since cogeneration has inherently higher thermal efficiencies than power-only technologies. In some cases, utilities were forced to purchase relatively expensive power typically from renewable energy power plants; the responsibility for this situation being largely due to poor decisions made by the utilities themselves. PURPA, however, had a good impact on diversity of technology and fuel supply and it has reduced the probability of a single large outage. The impact has also been positive on reducing oil dependence, although the use of indigenous gas has increased. More importantly, however, PURPA has brought on power that was badly needed in some key states and has reduced the capital requirements of several utilities that were not willing to build or were not in a good financial situation to do so. Other points have been learned in the last ten years:

- Non-utility plants can be integrated into a utility system with a reasonable set of interconnection and dispatchability requirements, although dispatchability can remain a problem in some cases.

- Once on line, non-utility plants can be quite reliable.

- Utilities are getting better at calibrating proposals from non-utility generation companies through better negotiations, more thorough due diligence, and by using monetary incentives such as imposing fees for entering the bidding process and imposing penalties for failure to meet operating requirements.

- It is useful to develop clearly defined requests for non-utility power to allow a good negotiation climate.

- It is preferable to adopt standardized power purchase contracts to facilitate negotiations and project financing.

- Utilities need to balance price and quality factors to arrive at the right avoided cost and reflect possible changes in future capacity conditions.

Overall, the non-utility generation experience in the United States is a unique experience of unmatched magnitude in the world. Yet it did not emerge as the result of a drastic and definite intent to deregulate the US power generation sector, but rather as a long-term simmering spin-off of a law aimed at promoting energy conservation in a marginal way. PURPA, however, did succeed in making the US electric industry more competitive, although this process has been long and tortuous in the minds of several non-utility companies.

Looking back over the US experience, one can conclude that to be successful, an independent power promotion program has to meet three conditions:

- It must be clear in its objectives: what level of diversification or privatization is sought? What type of projects are being preferred? Where should these projects be built and when would be the best time to build them? How can power pricing and Integrated Resource Planning be best implemented to meet both economic and social objectives?

- It must foster a climate of trust between the utilities and the private power developers so that projects do proceed on a timely basis and that precedents can be taken for granted. In addition, the sharing of risks must be defined: for example, who is taking the risk for fuel price changes, environmental permit failures or over building capacity?

- It must be accompanied with the right incentives for utilities to participate fully and help contribute to the objectives set forth by the private power program.

These lessons from the US context have played an integral part in the evaluation of Bulgaria's policy and legal framework, as reviewed in Chapters III, IV, and V.

3) Relevant Case Studies of Independent Power Programs in Transitional and Emerging Economies

Three countries have been selected to profile the development of the independent power policy and institutional framework and the commercial market: Poland, Argentina, and Spain. The experience from these countries in combination with the US experience will provide valuable lessons for developing independent power in Bulgaria.

a) Poland

The power system of Poland had a total capacity of 31,390 MW in 1989, composed of some 400 power plants and generating over 125 billion kWh. Eighty-five percent of total power generation comes from coal-fired power plants. The power sector is comprised of 28 power generation companies, 33 electricity distribution enterprises, 4 lignite mining companies, and a wide variety of equipment manufacturers, maintenance organizations, and engineering firms. It is estimated that about 5,100 MW of capacity will be needed by the year 2000 and an additional 8,000 MW to 12,000 MW by the year 2010, with much of this capacity being in the form of rehabilitation and repowering of existing power plants.

Until 1990, the entire power sector in Poland was state-owned, with the exception of a few small hydro power stations. After beginning the transformation of the Polish political and economic system in 1989, it was decided to privatize the state-owned power companies. In 1990, the Parliament liquidated the Power and Lignite Board and began the process of converting all the power companies into independent joint-stock companies. In addition, a new joint-stock company, PSE-SA, was formed to own and operate the high voltage transmission system and the pumped storage power stations. PSE-SA also dispatches the

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power stations, prepares load forecasts, and purchases power from the generating companies. The Polish Government will initially own 100% of all the joint-stock companies. It plans to sell off most of the generation companies, but will always maintain a 51% shareholding in PSE-SA.

The regulation of the power sector is expected to be conducted both at the local and central government levels. The activities of the distribution companies are to be under the jurisdiction of local provincial governments, while the PSE-SA will be under central government control. A national regulatory body is to be established to license generation and distribution companies and set wholesale power rates. The legislation implementing this scheme is still under consideration by the Parliament. More recently, the Polish Government has established new policies for energy pricing in order to improve the efficiency of energy supply and use and to mobilize additional capital for investment.

Substantial efforts are underway to eliminate subsidies in the energy sector. The Polish Government has already reduced the subsidies paid to coal miners and transporters. Similarly, the wholesale prices paid to producers of power and heat are being increased. The first energy pricing study has been completed in order to estimate the long-term tariffs. Ultimately, bulk power prices may be regulated by competitive bidding, even on an hourly basis. There is a major commitment to increase retail electricity and heat rates and to eliminate cross subsidies.

With these reforms underway, the Polish Government has begun implementing a program to encourage private investment in the power sector. Several generating companies have already been transformed into joint-stock companies and are now negotiating with foreign companies that propose to form joint ventures with the joint-stock power companies and invest in the rehabilitation of power plants. The joint-stock companies will contribute the value of their plants and the foreign investors will raise new capital on a project finance basis.

In order to finance independent power projects, it is essential that these joint ventures secure long-term revenue from the sale of power (and steam, if any). Therefore, with the assistance of USAID, PSE-SA has developed a model power purchase agreement to govern its purchase of power from the joint ventures. Several power purchase contracts are in the process of being negotiated with different joint ventures. US AID consultants are also representing district heating companies in their negotiations with the joint ventures and advising various ministries of the Government with respect to government guarantees being requested by foreign investors.

The major issues that have arisen in Poland are the same issues that are likely to arise elsewhere in Eastern Europe. The valuation of the joint stock company's existing assets has proven to be a very difficult problem because the public treasury desires a high valuation and the foreign investors fear a high valuation will undermine the bankability of the projects. As a result, independent experts are usually asked to conduct this valuation.

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The uncertainty of the future pricing arrangements throughout the power sector has complicated the process. PSE-SA, for example, does not want to agree to a wholesale power purchase price which is higher than that it can collect from the sale of power to the distribution companies. For their part, the joint ventures do not want to invest time and money in the negotiation of "non-price" terms in the power purchase agreement until the purchase price of power is known.

Similarly, the on-going restructuring of the power sector and the possibility of further changes in the regulatory environment have also created difficulties. The Polish Government naturally seeks to avoid undertaking obligations in the various agreements that may be inconsistent with the subsequently imposed rules, and the joint ventures cannot assess the risks which they confront. For example, there is a concern that more stringent environmental laws may be enacted in the near future. Because compliance with these laws could be costly, the joint ventures have asked for protection against such increased costs. The Polish Government, however, does not know if these laws will be applied retroactively, and, if they are, it is unclear which governmental agency should offer protection. Such problems can be minimized if restructuring is completed and a stable regulatory environment is established early.

Assuming these problems are overcome, there will remain a question concerning the availability of Government guarantees. Because the bankability of independent power projects depend on the revenue stream from one or more Government-owned entities, the joint ventures have closely examined the creditworthiness of these entities. To ensure that they receive payment, the joint ventures have requested that the Government guarantee the obligations of the Government-owned companies. Unfortunately, the Government has limited capacity to guarantee obligations, and it must allocate this limited capacity among many different public purposes. This issue is still unresolved in Poland.

As is evident, the independent power policy and institutional framework in Poland is still in the early stages of development. A variety of independent power developers and equipment vendors from the US and Europe have been negotiating joint ventures with the joint stock companies to develop specific projects. While various joint-ventures and power purchase agreements are in various stages of completion, no independent power project in Poland has been successfully financed to date.

b) Argentina

The Secretariat of Energy regulates the power sector and has owned the major utilities. The Secretariat of Energy (SE) is under the jurisdiction of the Ministry of Economy and Public Works and Services. SE regulates electricity supply throughout most of the country and grants and controls electric concessions through the National Directorates for Coordination and Regulation of Prices and Rates for Electricity Planning. The Federal Board of Electric Energy is an advisory body for SE and is made up of representatives from each of the provinces. Under SE, the Ente Nacional Regulador de la Electricidad (ENRE) is responsible for

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establishing the basis for tariff calculations, defining the terms for awarding concessions, and safeguarding public safety, environmental protection, and property rights. The government-owned electric utilities that have operated under the jurisdiction of SE are: Agua y Energia Electrica (AyE) (4,818 MW of both thermal and hydro); Servicios Electricos del Gran Buenos Aires (SEGBA) (2,703 MW entirely thermal); and Hidroelectrica Norpatagonica (HIDRONOR) (2,770 MW entirely hydro). The government is in the process of privatizing the generating assets owned by all three of the above utilities.

The President's Office manages the nuclear capacity while provincial utilities are managed by local governments. The National Atomic Energy Commission (CNEA) oversees the construction and operation of Argentina's 1,018 MW of nuclear capacity involving two power plants located in the Central and Lotral regions of the country. Provincial governments own and operate the provincial companies and cooperatives, which represent a total of 729 MW of capacity. The national grid is extensively interconnected. The national electricity grid Sistema Interconectado Nacional (SIN) is based on a network of 500 kV and 200 kV lines that interconnects 90% of the entire power systems (1990), with only the provinces in the far northeast and the south being separate.

The demand for electricity increased by an average of 4.0%/yr over the period of 1970 and 1990, reaching about 40,481 GWh in 1990. Between 1992 and 2000, electricity demand is expected to grow between 4% and 8% per year, depending on economic growth. Total installed capacity is expected to increase from 11,865 MW to 17,421 MW between 1992 and 2000. Some new nuclear capacity and little new thermal capacity is planned. Major improvements in the poor capacity factor for some thermal power plants is expected. The vast majority of the increased capacity will come from three new hydro complexes. This capacity expansion is expected to call for between $6.8 and $10.2 billion dollars of new investment, not even taking into account the privatization investments in existing capacity.

Argentina has come out of a period of hyperinflation that exceeded 5,000%/yr and negative GDP growth of -4.0%/yr or less during the late 1980s; a failed war with Britain over the Falkland Islands; and a transition from military to democratic government. President Carlos Menem and his economy minister, Domingo Cavallo, dramatically revamped and stabilized the economy by 1991 through an ambitious economic restructuring involving anti-inflationary monetary policies; deregulation of commerce and financial markets; successive agreements with the IMF; opening of domestic markets to international competition; and extensive privatization of government-owned corporations.

Argentina's privatization program has completed the sale of the telecommunications (ENTel), airline (Aerolineas), and steel (SOMISA & Altos Hornos) corporations as well as various chemical, television, shipyards, subway, financial, and railway companies. In the energy sector various oil and gas companies and electric power and transmission facilities have been privatized. The decision to privatize most of the government-owned companies is designed to attract badly-needed private capital, reduce the government's public debt, encourage competition, and promote economic and technical efficiency.

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The process of demonopolizing the power sector was initiated by the Menem regime, which came to power in 1989. This program is based on various pieces of key legislation: Executive Decree #634, the Proyecto de Ley #15336, the Resolution 38/91, and the new Resolution 61/92. The objective of these laws and regulations are to transfer ownership of government-owned utilities and power projects to the private sector, encourage competition where possible, adjust power prices to reflect actual cost of generation, and protect consumers by regulating the tariffs, power quality, and rate of return earned by power companies.

The pace of privatization has been dramatic. As of the end of 1992, 3,115 MW or about 26% of the installed capacity in 1992 largely owned by the government had been privatized. The government is aggressively pushing its power sector privatization program and would like to complete the entire power sector privatization program before the end of 1993. While this timetable is likely to slip somewhat, the pace is nonetheless dramatic.

The competitive pricing of power is administered by the new entity, CAMME. The Argentine government set up the Compania Administradora del Mercado Mayorista Electrico (CAMME) as an operational company in August, 1992 to perform a range of power plant dispatching and electric tariff coordinating functions for the Wholesale Electric Market (WEM). While ENRE of the Secretariat of Energy performs the tariff regulatory functions, CAMME is charged with the actual implementation of rate setting. Its key responsibilities include determining the spot market prices based on market and regulatory guidelines, supervising and monitoring the electric system, programming the supply of electricity on a daily, weekly, seasonal, and mid term basis, controlling the system of power plant dispatching, distributing the payments between generation and transmission companies, and administering contracts. The Board of Directors of CAMME is composed of representatives from government, generators, transmitters, and major customers, thereby giving most of the key players in the power sector a role in decision-making.

Power pricing is based on separate spot and bulk contract markets. There are two parallel markets for power, the spot and bulk contract market. Large industrial customers have begun to enter into long-term contracts with specific generation companies. The remaining power is supplied on the spot market, where prices are determined by the mean fuel cost of the most expensive unit in operation and the cost and probability of a loss of load at any given time. The economic dispatch priority will tend to favor hydro generation first (when available), then nuclear, and finally fossil generation. In the first few years since its inception in 1992, the spot market will account for a major volume of power flowing between generator and consumer. It is expected, however, that the system will eventually mature to consist mostly of long-term power contracts and that the spot market will be limited to the purchase and sale of contingency service and surplus power, as is developing in the newly privatized power system in the United Kingdom.

Five power projects have been privatized to date. As of the end 1992, seven major power projects have privatized: Puerto (1,009 MW gas and fuel oil), Costanera (1,260 MW gas and fuel oil), Alto Valle (97 MW, gas), Guemes (245 MW, gas), Pedro de Mendoza (67 MW,

gas and diesel oil), Dock Sud (211 MW, gas and diesel oil), and Sorrento (226 MW, gas and fuel oil). All of these project have been thermal plants located in the greater Buenos Aires, Neuquen, Salta, and Sante Fe regions. A total of 3,115 MW or about 26% of the total 11,865 MW installed in 1992 have been privatized. Foreign developers from Europe and the US have made major power investments. Power project bids often required assuming repair and debt liabilities as well as allowing for a small share of employee ownership. The percent of the project sold never exceeded 90%, since 10% was always reserved for the employees. In some cases such as with Puerto, Costanera, and Guemes, the government retained 20% for possible later sale. In addition to the cash investment, developers also sometimes agreed to make investments in repair and assume certain amounts of outstanding debt.

Selection of winning bids has been based on price and qualifications. While the particular terms for each power project sale is confidential, it would be fair to say that the most important criteria for the selection of winning bidders was (a) the technical and managerial capabilities of the bidder to operate the project (so as to qualify for a short list of bidders) and (b) the price offered. In setting the offering price, bidders would naturally have examined the age, efficiency, reliability, and other performance characteristics of each unit as well as the personnel requirements, fuel costs, generation cost, dispatch potential, potential sales price, etc. Interestingly, the bidders came up with a wide range of offering prices. Bids for Puerto ranged from between US $43 and $92 million, for Alto Valle ranged between US $12 and $22 million, for Guemes ranged between US $53 and $87 million. In all cases the highest bid won. These wide spreads in the offering price indicate there were major differences in the bidders' estimated value for these projects.

There are no major constraints to accessing financing. Many investors have quickly responded to the favorable business climate in Argentina. In 1992 alone, over US$ 1.4 billion of direct investment in Argentina's electricity generating and transmission/distribution assets have been made by broad range of international and domestic investor and lender groups. The political and financial risks in Argentina have declined markedly since the unstable periods of the 1980s. Foreign commercial and investment banks such as the Bank of Boston, Citibank, J.P. Morgan, Chase Manhattan, First Boston Group, Paribas, ING, etc. are all players in this rapidly developing power project privatization market. Nonetheless, there is a note of caution. Obtaining long-term debt financing will probably require credit support from government agencies or multilateral development banks. While capital is quickly returning to Argentina, only three to five year terms are currently available; it may be several more years before long-term debt becomes available. Local financial markets are not particularly familiar with non-recourse project financing terms, so presently most investment capital is coming from outside the country.

c) Spain

The power sector in Spain is centrally regulated by the Ministerio de Industria y Energia (MIE). In 1985, the government nationalized the main high-voltage grid, creating Red

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Electrica (REDESA) which is 51% controlled by the government. As owner of the main grid, REDESA and the government control the central dispatching system, determining which plants will generate power and when. In theory, dispatching is based on cost of generation and availability criteria, while in practice preference is given to domestic coal fired-plants. All the electric utilities in Spain (both government and privately owned) are members of a central utility industry organization, called the Unidad Electrica, SA (UNESA). While power planning is initiated by each individual utility, considerable coordination is managed by MIE and UNESA. MIE determines the uniform electricity price throughout the country based on a standard cost recovery methodology, regulating revenue transfers between utilities to make up for differences in the cost of generation.

Spain had a total installed capacity in 1990 of 43,490 MW, with 16,103 MW of hydro, 7,363 MW of nuclear, 9,362 MW of domestic coal, 1,314 MW of imported coal, 6, 574 MW of oil, 1,320 MW of gas, and 1,454 MW of self-generation. The Spanish power sector was originally composed of a relatively dispersed group of some 21 largely privately-owned companies that generated and distributed power in respective territories. Since 1985, a consolidation began with a government-sponsored asset swap, where some of the financially strong utilities acquired assets in the weaker companies. In the past two years, this consolidation has accelerated when most independent utilities were subsumed by Empresa Nacional de Electricidad (ENDESA) or the Iberdrola group through mergers, takeovers, and share acquisitions. The 100% government-owned Instituto Nacional de Industria (INI) owns 75% of ENDESA (with the remainder being publicly traded). Proposals that the government sell off more of its share in ENDESA to reduce the national debt are unlikely to take place and certainly would not lead to the government reducing its ownership share below 51%. Iberdrola, on the other hand, is an investor-owned consortium (involving the merger of Iberduero and Hidroelectrica Espanola). Two smaller independent power companies also remain, Union Fenosa (UEFSA) and Hidroelectrica del Cantabrico. In terms of 1991 installed capacity, ENDESA has 43.8%, Iberdrola has 36.4%, UEFSA has 11.9%, and Hid. del Cantabrico has 3.4%.

The primary motivation for the above-mentioned consolidation has been to make the Spanish power sector more financially viable and competitive in the unified European market. With the EEC's new policies regarding Third Party Access (TPA) and a general opening of the power markets to greater competition, the Spanish power sector recognizes that it needs to consolidate into larger companies to compete against the large mostly government-owned utilities on the continent.

Between 1991 and 2000, the National Energy Plan calls for the addition of 8,377 MW. Total installed capacity in 1990 was 43,490 MW and the expected installed capacity in 2000 will be 51,450 MW. This expansion plan assumes an annual growth in power demand (adjusted for the energy program) of 4.03% between 1990 and 2000, with the major increase being in the transport, residential, and commercial sectors. This growth in demand and capacity expansion is regarded by some to be optimistic, given the slowdown that has been taking place in the Spanish economy (real GDP growth has declined from 5.2%/yr in 1988 to an estimated

1.7%/yr in 1992). This expansion plan expects there to be a substantial increase in the relative share played by gas-fired and self generation and a decline the relative role for nuclear and oil.

National policy on the development of private power has only focused on promoting hydroelectric power and industrial cogeneration. The government has not encouraged or even permitted private development of independent thermal power plants. Between 1982 and 1988 various laws and regulations have been passed that actively promote industrial cogeneration. A national law has been established that gives cogenerators the right to sell power back to the grid if the cogeneration facility exceeds a combined electricity and thermal heat rate of 5700 kJ/kWh or an efficiency of about 63%. The law establishes a simple equation for calculating the buy-back rate at between 85% and 95% of the industrial rate, depending on whether firm capacity is guaranteed or not.

About 2,450 MW of industrial cogeneration expansion is anticipated between 1990 and 2000. The rapid expansion of cogeneration is due to: (a) an ambitious new policy to promote industrial cogeneration, (b) high industrial tariffs , and (c) limited installed cogeneration capacity to date in Spain (i.e. only about 3% of total electricity production versus about 15% in most industrialized countries).

Prior to 1986, only 750 MW of cogeneration capacity was installed in Spain. Very few of these projects are selling electricity back to the grid. Between 1986 and 1992, there have been 85 new industrial cogeneration projects with a total capacity of 871 MW installed, more than doubling the capacity in as little as six years. Seventy five percent of these projects have a capacity of less than 10 MW while only 3 projects or 4% of all projects have a capacity in the range of 50 to 80 MW. A substantial number of these new projects have involved incremental sales of electricity to the grid. Of the 871 MW installed between 1986 and 1992, 54 projects or 63.5% of all projects involve simple gas turbines with 16.5% involving combined cycle systems, and 13% steam turbines. This trend is a reflection of the overall trend in Europe and Spain towards using gas to reduce environmental emissions and to capitalize on the low costs and high efficiencies of new combustion technology.

Unlike its neighbor, Portugal, where large scale BOT power projects have been tendered, the Spanish government and electric utilities have traditionally been opposed to opening the market to major independent power projects. With the government owning a majority of the power sector and there being entrenched political and economic interests, the general assumption has been that the IPP market is unlikely to develop any time soon. A recent announcement, however, by the Secretary of Energy, Ramon Perez Simarro, has shed more light on the Ministry of Industry and Energy's (MIE) plan to submit an ambitious new law to the parliament that would call for an opening of the power sector to bulk independent power generation. Secretary Perez Simarro proposes in the new electric power law to maintain the existing central power planning system, to separate generation from transmission and distribution (T&D) in a way that maintains the government monopoly control over the main transmission and dispatching network, and introduce greater competition in the

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generation sector by allowing independent bulk power generators to undercut the electricity tariffs established by the MIE. If independent producers can profitably sell power at prices lower than the established tariff, the Secretary Ramon Perez would like to give them the right to access the grid.

The European Commissions proposal for Third Party Access (TPA) is a key component of the European government's plan to open the market to competition. Strong opposition to the European Commission's TPA proposal has been mounted by the continental members of Eurelectric (the European electric power industry association). The major case against TPA forcefully argued by Eurelectric is that free competition will threaten the reliable supply of power, could lead to greater volatility in electricity prices, would require a wide array of burdensome new regulations, and could possibly compromise efforts to reduce the environmental impact of power generation. While it is acknowledged that competitive power markets could lead to lower prices in the near-term for large (e.g. industrial) customers, opponents charge that a free power market would raise electricity prices for small (e.g. residential) customers (as has occurred in the United Kingdom). Opponents try to cast the independent power experience in the United States and the United Kingdom in a negative light, citing these markets as not being examples worth emulating.

The free market proposal in this pending new Spanish electricity legislation will need to pass parliament and could face stiff opposition. In the Spanish market, the government-owned ENDESA and other elements of the government are opposed to opening the market to bulk independent power generation. On the other hand, the privately-owned Iberdrola supports an opening of the market; they see free competition as in their best interest since the current rate-setting and dispatching system is regarded as favoring ENDESA. The submission of the new electricity law has been delayed for many months, it is unclear whether the law will be submitted and voted on before the general election the government must call before October, 1993. Even if the law is largely accepted, it is unlikely that the market will result in the open competition found in the United Kingdom or lead to truly competitive large tenders.

The Spanish economy, the eighth largest of the industrialized countries, experienced real GDP growth of 5.2%, 4.8%, 3.6%, and 2.4% from 1988 to 1991, respectively. This growth was approximately 1% higher than the average economic growth in the European Community. In 1992 the estimated growth rate is lower, but still a positive 1.7%. Moderating growth in 1992 and in the future reflects weaker international conditions as well as specific Spanish monetary policies. There are no appreciable shortages or barriers to raising capital for projects with an attractive return on investment, due to a favorable investment climate and continued strong economic growth (GDP growth: estimated at 1.7%/yr for 1992). While short-term prime lending rates were in the 16% range in 1990 (due to efforts to restrain an economy and credit supply that has been expanding too rapidly) these rates have been declining to reaching 13.8 in 1992.

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Given the high electricity prices in Spain (e.g. 1989 industrial rate for 10 MW, 50 GWh/yr load is 8.7 Pesetas/kWh or ~ 9.3 cents/kWh), returns on investment in cogeneration projects are very attractive. The government cogeneration development company, IDAE, has estimated internal rates of return between 20% and 65% for cogeneration projects and has been aggressively developing projects to capitalize on these attractive opportunities. The major utility groups, ENDESA and Iberdrola, are both expanding into the cogeneration business as well.

4) Structure and Sources of Independent Power Financing

Privately financed IPPs typically are structured as separate project companies that raise their capital on a non-recourse project financing basis. This method serves to mobilize private capital more effectively by limiting the liabilities of the project owners. In the event of default or bankruptcy, the lenders or investors have little or no right to the assets of the owners of the company; the only collateral they have is in the assets of the specific project company. For this reason, the financing of independent power involves carefully defining and structuring a project so as to properly manage and minimize its risk of failure. With an effectively defined and structured power project, it is possible to attract the investors that would be willing to accept the risk and reward profile of their particular investment.

a) Independent Power Ownership and Financial Structures

The structure of a non-recourse financed independent power project is shown in Figure 2. According to this widely-applied model, a developer would establish a project company in Bulgaria dedicated to the financing, construction or repowering, and operation of a specific power project. The sources of financing would be from senior and subordinated debt and from equity in the form of preferred and common stock (as discussed below). In the international market, various types of loan guarantees and risk insurance are often required by lenders and investors.

As shown in Figure 2, this project company would enter into a clearly-defined power purchase contract with NEK that spells out NEK's power purchase rate over a period of approximately 20 to 25 years. Power purchase rate, fuel price, inflation adjustments, terms for penalties or bonuses, etc. would be specific elements of this contract. Given NEK's limited creditworthiness at the present time, it is highly likely the developer would seek specific Bulgarian government guarantees of NEK's financial commitments to pay under this power purchase agreement. The power purchase contract and guarantees are part of a carefully structured security package (with the government, lenders, fuel suppliers, plant operators, contractors, etc), as shown in Figure 3. The developer would need to obtain these agreements to reduce and distribute the project's risk so that financing can be obtained. [See Chapter V, Recommendation 6]

Private Power Project Financing

For a Build, Operate and Transfer (BOT) Power Project

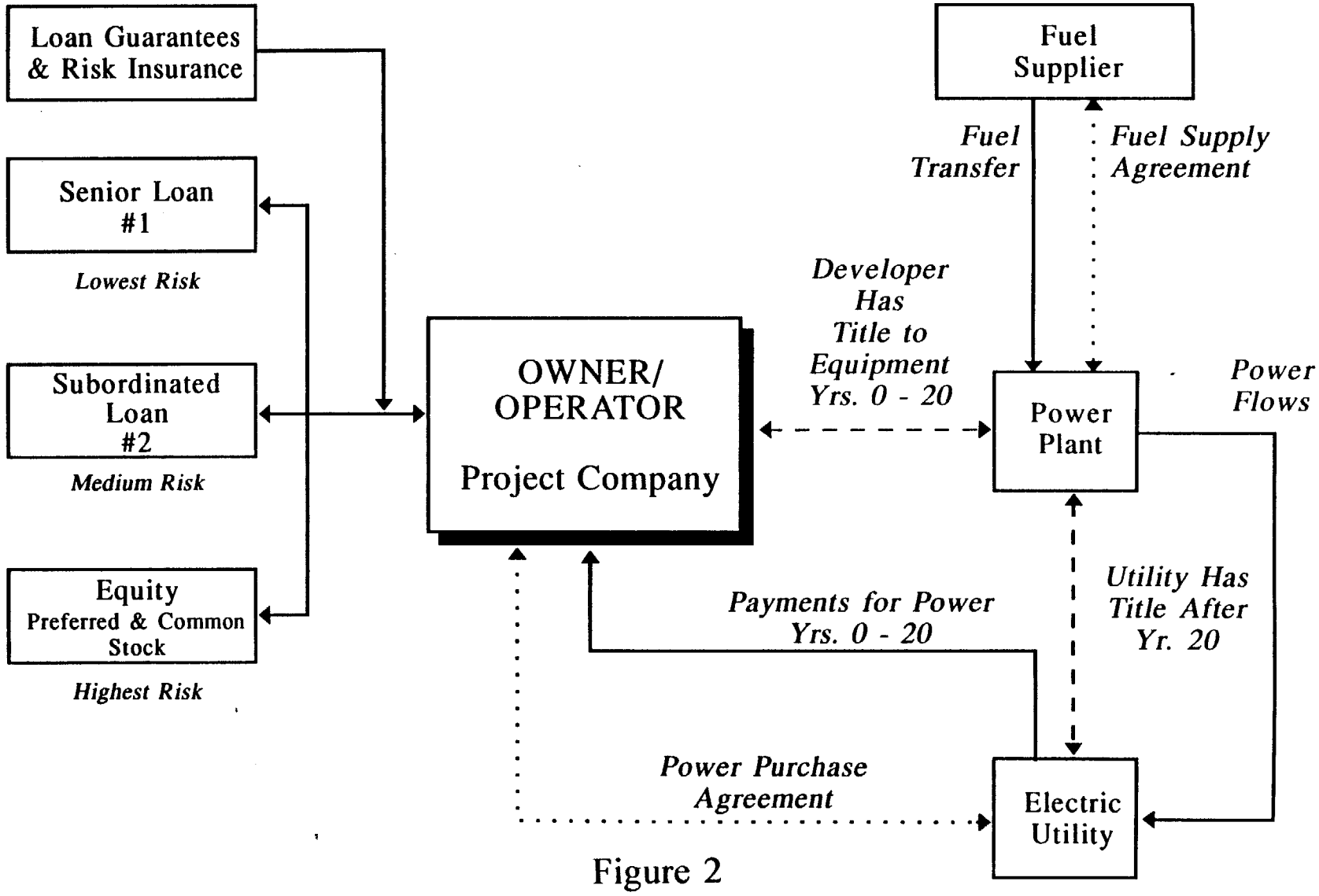

Figure 2

Security Package for a Private Power Project

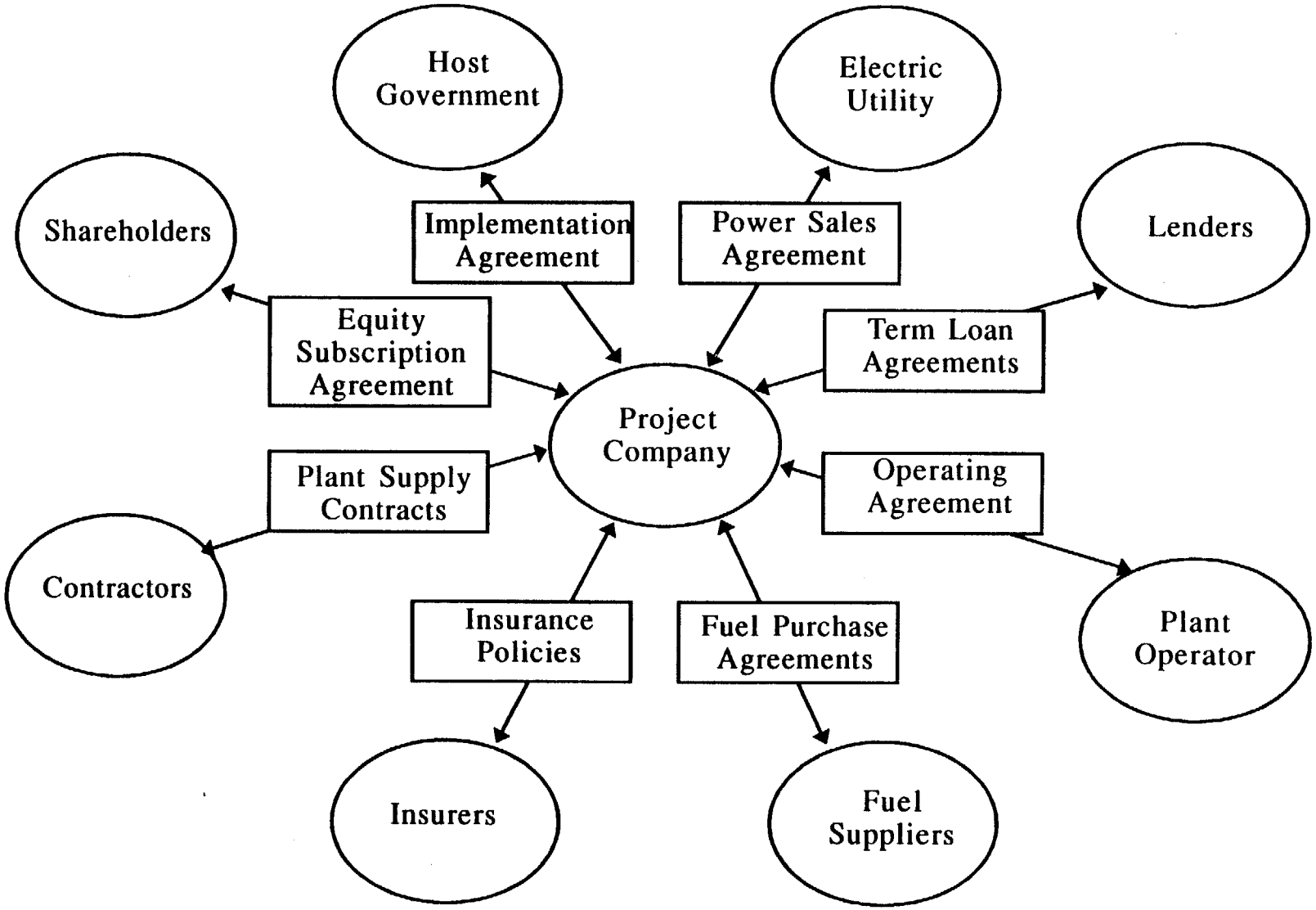

Figure 3

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The long-term ownership structure of international independent power projects has been based on different models commonly called BOO, BOT, and BLT.

* **Build, Own, and Operate (BOO)**: The private developer finances, builds, owns, and operates the project for the entire serviceable life of the power plant without ever transferring ownership to the utility.

* **Build, Own, Operate, and Transfer (BOOT or BOT)**: The private developer finances, builds, owns, and operates the power project for a prescribed term of about 20 years. After this period in which the debt has been serviced and the equity investors have earned their return, the ownership of the project is transferred from the private developer to the electric utility.

* **Build, Lease, and Transfer (BLT)**: The project developer finances and builds the project and then leases it to the utility in exchange for an agreed upon rent or lease payment. Leasing is particularly favored in those countries which have constitutional restrictions on private ownership of a power plant.

The most common models being applied to independent power projects in emerging and transitional economies is the BOO and BOT framework.

b) Sources of Financing

With thorough analysis of a good power project and a favorable power purchase contract and other agreements in hand, the developer should be able to raise capital necessary to finance the project. The two sources of capital for financing any project are equity and debt capital:

* **Equity Capital**: Internationally, equity investors typically supply about 20% to 30% of the project investment requirements. The equity investor takes on a major portion of the project's risk because his return on investment over the life of the project is a function of the project's financial performance.

* **Debt Capital**: Debt capital is supplied by a bank through a loan or from the sale of bonds and typically supplies about 70% to 80% of the project's capital requirements. The debt investors take less risk because they have first rights to any liquidated collateral in the event of project failure. For their lower risk exposure, debt investors are offered only a lower fixed return over a typical 10 to 20 year term.

The scrutiny a proposed power project receives in raising the equity and debt financing is the most critical phase in the development of an IPP. There typically are two stages of financing a power project: construction and operation. Construction financing covers the one to four years typically required to complete the construction of a conventional thermal or

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hydro power plant. During this phase the project is not earning a return, since it is not selling any power. A turn-key construction contractor is typically required to take on the construction risk and commit to completing the project on a fixed price basis. Once the power project has been commissioned, the operation phase of the project is financed over a period of 10 to 20 years. At this stage, the owner and operator of the project assume the operation risk and are earning the revenues needed to service the debt and pay a return to the equity investors.

One of the major hurdles of successfully financing an independent power project is satisfying the requirements of the lenders. The ratio of debt to equity varies based on the risk in a particular market. During the highly favorable US independent power market conditions of the 1980s, some projects were financed with 100% debt. Today in the US market, at least 10% equity is required, with 20% being common. In the riskier markets of the developing and transitional economies, equity requirements of 20% to 30% can be expected. In these riskier markets, developers will require higher returns on equity than is currently earned in the US. Given that lenders are supplying between 70% to 80% of the financing, they will subject any project to very close scrutiny before agreeing to lend.

Given the size and complexity of many independent power projects, financing often involves the syndication of debt from multiple sources. For sizeable power projects, it is not uncommon for various multilateral, bilateral, and commercial financial institutions to syndicate their debt financing into a carefully structured package. While these arrangements serve to diversify the risk across multiple institutions and leverage each bank's limited resources, the process of structuring the financing can be significantly delayed. As it is often said, "time is money." If the process of negotiating a project and raising financing is unduly burdensome, the ability to successfully implement projects will be constrained. Many of the policy and institutional recommendations raised in Chapter V of this report will facilitate independent power by reducing real and perceived risks and procedural delays in raising financing.

The main question is what sources of capital would be interested in investing in a Bulgarian IPP. Two major risk factors are typically considered: country risk and project risk. Country risk typically involves such political risks as war, insurrection, expropriation of assets, inconvertibility of currency, and exchange rate volatility. Project risk typically involves construction cost overruns or delays, poor power plant performance, non-compliance with power purchase or fuel supply contract, etc. With the necessary legal contracts, project risk is usually considered manageable by a developer. Country risk, on the other hand, represents a danger of failure that the investor has much greater difficulty controlling. Country risk ranking services such as Euromoney and Institutional Investor grade most of the countries worldwide according to a range of economic and financial indicators. For instance, Euromoney uses 9 criteria that include economic data, political risk indicators, debt indicators, access to bank finance, access to short-term finance, access to international bond and syndicated loan markets, access to and discount on forfeiting, credit ratings, and debt in default. For instance, Bulgaria had a listing of 118 out of 169 countries in the March 1993

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edition of Euromoney. This rating reinforces the earlier conclusion that Bulgaria's credit risk would be regarded as unacceptable for most commercial banks at this time.

In emerging and transitional economies, the primary source of debt and some equity capital is from the multilateral and bilateral institutions. Commercial banks are often very hesitant to take on the risk in these markets without a major involvement of the multilateral and bilateral institutions. The International Finance Corporation (IFC) (which is part of the World Bank Group) and the European Bank for Reconstruction and Development (EBRD) are two key contenders for providing debt financing for independent power projects in Bulgaria. Bilateral institutions such as the Export Import Banks of such countries as the US and Japan have been involved in financing independent power projects. Political risk insurance (against expropriation, insurrection, and inconvertibility) and loan guarantees are typically sought from bilateral agencies, such as the US Overseas Private Investment Corporation (OPIC) and the US Export-Import Bank (EX-IM). Foreign and domestic commercial banks are likely to play only a small role in the early independent power projects in Bulgaria, particularly with current Bulgarian interest rates (greater than 60%) and short terms (less than one year).

To illustrate how independent power projects are financed, it would be worth providing an example. Given the rapidly growing demand for power and the major financial constraints, Asia in general and the Philippines in particular has been the site for some of the first major IPPs. A newly-financed project of particular note is the 700 MW coal-fired Pagbilao power project in the Quezon Province of the Philippines. This project is jointly being developed by Hopewell Holdings of Hong Kong (an infrastructure project developer), Mitsubishi Corp of Japan (a power equipment vendor), and Black & Veatch International of the US (an engineering construction company). This project is being built under a 25 year Build, Operate, and Transfer (BOT) agreement with the Philippine National Power Corporation (NPC). The NPC agrees to buy power from the developer under a take-or-pay power purchase agreement, with NPC also supplying all the fuel (coal) for the project.

The financing of the Pagbilao power project is of particular interest. The total project cost is $888 million, with about 75% being financed from debt sources and 25% equity. $535 million of the debt financing is being jointly supplied by the Export Import Banks of the US and Japan. This project could be a trend setter in that it is the first time the US and Japanese export credit agencies have jointly-financed a major project. The remaining debt is being furnished by the International Finance Corporation (IFC), the Asian Development Bank (ADB), and the Commonwealth Development Corporation (CDC). The project developer, Hopewell is supplying $200 million or 77% of the equity financing, with the IFC, ADB, and CDC also providing some equity.

As will be the case in Bulgaria, multilateral and bilateral sources of financing played an important role in the Pagbilao power project development. While developers and equipment suppliers are willing to put their capital at risk, commercial banks will likely be slow

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to participate in the early stages of an independent power market in emerging or transitional economies.

5) Independent Power Lessons Applicable to Bulgaria

a) Benefits of Independent Power

The policy motivation behind promoting independent power in different countries can vary significantly. In developed countries, the objective has typically been to promote competition, efficiency, and the integration of a more diverse array of generation technologies and fuels. In developing and transitional economies, the goal has included the above objectives but has been primarily to attract private capital into a financially constrained power sector. The benefits of independent power to Bulgaria are at least fourfold.

i) Access to Private Capital. The attraction of both foreign and domestic private capital will increase investments in Bulgaria and reduce the debt burden of the NEK. By integrating Bulgaria's power sector into the international capital markets, the ability of NEK to modernize and meet its expansion plans will be enhanced.

ii) Transfer of Optimal Technologies. With the infusion of foreign investment will come the application of state-of-the art technologies that will enable the Bulgarian electric company (NEK) to improve the quality of service and operate in a more efficient and environmentally-sound manner. In addition, with private investments will come improved business management and accounting practices and expanded training and development of Bulgarian workers.

iii) Expanded use of Renewable Energy and Cogeneration. An independent power policy framework will induce private companies and industry to cost-effectively expand Bulgaria's indigenous renewable energy and cogeneration capacity in a way that could reduce Bulgaria's dependence on imported energy and hard currency requirements. These facilities could provide electricity at a price that is below NEK's avoided costs and would offer environmental benefits.

iv) Competition Leading to Minimized Costs. The competition fostered by independent power not only induces private developers to generate power at competitive costs but also provides important benchmarks for the NEK in determining the costs of new generation capacity.

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The effective restructuring of the Bulgarian power sector from central planning and subsidies to market economics and financial viability will be greatly facilitated by the above benefits.

b) Essential Independent Power Policy and Institutional Conditions

The transmission of electric power represents a naturally-monopolistic market that must be subject to government regulation to prevent a utility from earning excessive monopoly profits. The policy and regulatory framework defined by the government and the electric utility are critical factors in establishing the price of electric power and therefore the return on investment in power projects. Independent power developers and investors therefore examine the policy, institutional, and regulatory framework before making investments in a particular country's power sector. On a contractual basis, individual projects can be developed without the entire policy and institutional framework being in place. Nonetheless, in order to develop a mature and competitive independent power industry with a diverse array of participants, this framework will be essential.

In the increasingly global marketplace, countries must compete against each other to attract the necessary capital and power project development capability. The independent power policy and institutional framework of Bulgaria relative to other countries worldwide will play a critical role in determining the success of Bulgaria's independent power program. The key lessons learned from the experience in other countries in general and the specific case studies described above point to three important independent power policy conditions.

- **Fair Process:** The process of selecting specific developers and projects needs to be as fair and transparent as possible. The developer and investors should be given a clear idea of who the key decision makers are and what specific requirements must be met. If the process is overly confused or political, it is unlikely that NEK will attract the kind of quality developers and investors it wants.

- **Fair Price:** The power purchase price offered by the utility needs to be fair and reflect the market price for generation. Unlike a government-owned utility, an independent developer cannot subsidize or reallocate costs of generating power. Without a fair market rate for the power, the independent generator will not be able to earn the revenues needed to service its debt and earn the required return to its investors.

- **Fair Terms:** The terms of the power purchase contract and other agreements need to incorporate certain other key elements necessary to reduce risks that the investors or lenders are unable or unprepared to take. The contract term needs to be of sufficient length (typically 20 - 25 years for a thermal project, and longer for a hydro project) in order to enable the project owner to service its debt. The structure of the buy-back rate and the energy and capacity commitments need to be spelled out clearly. The developer needs to be given appropriate guarantees that the government and utility will honor all its contractual and incentive commitments.

These three points summarize the essential elements of an effective independent power policy and institutional framework. These issues will be addressed in greater detailed and applied to the Bulgarian context in Chapters IV and V.

III. INDEPENDENT POWER MARKET POTENTIAL IN BULGARIA

1) Status of Bulgaria's Economy

a) Macro-Economic Conditions

During the communist era between World War II and the fall of the Soviet Union in 1989, Bulgaria made a major transition from an agricultural to an industrial economy. This economy, however, was largely dependent on subsidized energy from, and on markets in, the former Soviet Union (FSU). The collapse of the old communist order and the Council of Mutual Economic Assistance (CMEA) has hit Bulgaria with a double crisis. As energy prices quickly approached world market levels, Bulgaria's highly-inefficient economy has been hit with a dramatic increase in energy-related costs. At the same time, the markets for Bulgaria's traditional products have dropped precipitously, as the economies of the FSU and the Eastern Bloc have experienced economic decline. Bulgaria has been forced to follow the pattern throughout much of the Eastern Bloc, i.e. a dramatic decline in GDP. In 1990, Bulgaria's GDP declined 11.3% and in 1991, GDP declined a further 22.9%. These GDP figures, however, should be used with caution. The true size of Bulgaria's GDP is in question; estimates are that some 20% - 40% of total economic output is in the informal sector, and thus is not officially recorded.

According to US Department of Commerce statistics, inflation was around 50% in 1990 declining to around 35% in 1991, only to rebound to an estimated 65% in 1992. According to the EBRD, it is estimated that inflation will increase to between 80% and 120% in 1993. A large part of this inflation, however, is due to price increases mandated by the government to reduce or eliminate subsidies. This type of inflation is regarded as temporary and should result in a subsequent decline in inflation. Given the high inflation rates, commercial banks are only lending over short terms not to exceed one year and at high interest rates of over 60%.

A distortion exists in the freely floating Bulgarian leva exchange rate. Despite strong inflation, the leva has not devalued appreciably. Between 1991 and 1993, the leva has only depreciated from around 18 levas/US$ to around 25 levas/US$, despite annual inflation of between 35% and 80% during this same period. This distortion in the exchange rate is in part attributed to a low demand for dollars resulting from Bulgaria's economic downturn, the lack of disposable income on the part of many Bulgarians, and the high Bulgarian interest rates. Under these current conditions, foreign companies have had no problem repatriating profits or revenues in hard currency. When the economy turns around, however, a significant correction in the exchange rate could occur.

Bulgaria's foreign debt had doubled between 1985 to 1990, reaching about US$ 11 billion in 1991. Over 80% of this foreign debt is owed to commercial banks. Bulgaria has successfully renegotiated its sovereign debt with the Paris Club, but remains at an impasse regarding its commercial debt with the London Club (primarily to banks from European

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countries such as Austria, Germany, etc. and with only a small US bank component). Bulgaria's commercial debt is currently trading at around $0.18 to the US dollar. To date, a major impasse exists between the debt price the commercial banks want and what the Government of Bulgaria is willing to agree to. In the absence of a resolution of these debt negotiations, commercial banks will be very reticent to lend beyond the usual short-term trade financing.

The major multilateral lending institutions are active in Bulgaria. As part of a radical and comprehensive reform program launched by the coalition government in 1991, the IMF provided a US$ 279 million Stand-by Arrangement for an external contingency mechanism to maintain crude oil and natural gas prices. Also in 1991, the World Bank agreed to a US$ 250 million Structural Adjustment Loan (SAL) and a Technical Assistance Loan of US$ 17 million. Total IMF and G-24 financial support in 1991 was about US$ 1.6 billion. The IMF is negotiating with the Government of Bulgaria on further assistance that will help it in its negotiations with the London Club on the commercial debt. The IMF is pushing the GOB to keep the inflation rate below 50% - 60% and the GDP decline below 5%, which is well below the 80% - 120% inflation and 10% to 15% GDP decline expected for 1993.

In April 1993, the Bulgarian Cabinet approved a three year investment program totaling 93,499 million leva (approximately US$ 3.6 billion) between 1993 and 1995. Approximately 60% (59,106 million leva) of this budget will come from external sources, with the World Bank, EBRD, and European Investment Bank making substantial commitments. This program has identified 49 priority projects in bridges, water supply, rail transport, health care, environmental protection, electric power engineering, etc.

b) Overall Business Climate

Over the past two years, the difficulties of converting an inefficient industry based on former communist block markets to markets in the West, the ensuing decline in Bulgaria's GDP, the high inflation and interest rates, the unresolved commercial bank debt negotiations, and the very limited and short term commercial lending clearly pose formidable barriers to investment. The general recession in the world economy and the Gulf and Yugoslavian wars have also particularly hurt Bulgaria's prospects for a quicker transition to a market economy.

While the current business investment climate is facing difficulties, Bulgaria has very attractive prospects in the future. Bulgaria has enacted laws that establish far reaching rights for private investors, including 100% foreign ownership, national treatment of foreign firms, and repatriation of profits (these laws are discussed in greater detail in Chapter IV). Bulgaria is endowed with a strategic trading position on the Balkan Peninsula, a well educated and skilled work force, certain elements of a good infrastructure, rich agricultural land, and attractive tourist resorts in the mountains and along the Black Sea.

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Like most Eastern European countries, Bulgaria has embarked on a privatization program. The Privatization Agency has been established with a staff dedicated to identifying and packaging the most attractive companies for public sale. The focus of this privatization program has been on those light manufacturing and agricultural industries (e.g. food processing, electronics, textile, etc.) that are potential export businesses which would earn the foreign exchange needed by foreign investors. As is true throughout Eastern Europe, the progress in privatizing companies is proceeding more slowly than hoped. Nonetheless, the first recent privatization of a "maize" (corn chip) products company, Tsarevichni Produkti, was sold to the Belgian company G.R. Amylum N.V. (80%), the United Bank of Bulgaria (18%), and company employees (1%) for US$ 45 million. This first privatization is seen as a promising development that hopefully will set a trend. The Privatization Agency expressed a particular interest in expanding industrial cogeneration at specific steam requiring industries being privatized. It has been reported that this maize company just privatized in fact has a cogeneration plant that the new owners do not want to use and which they would be willing to sell to an independent developer.

2) Overview of Bulgaria's Power and Energy Sector

a) Existing Energy Resources

Bulgaria is endowed with limited energy resources and has typically had to import about 80% of its total energy needs. The country has only a very limited amount of oil, significant reserves of low grade brown coal, and some hydro resources.

Reserves of oil and gas have been declining and are currently at an estimated 3 million tonnes of oil equivalent, which would provide only about 3 months coverage at Bulgaria's current consumption levels. Exploration for oil around the Black Sea coast holds some hope of expanding these reserves.

Coal reserves at currently active coal mines are at about 2.6 billion tonnes, with lignite accounting for about 90% and sub-bituminous and bituminous coal comprising about 10%. The bituminous coal is dispersed and generally uneconomic to extract. The lignite reserves, on the other hand, are mostly concentrated at Maritsa East (southeastern Bulgaria). These reserves are found in relatively favorable mining conditions: easily accessible terrain, low overburden to lignite ratio, thick seams, and no groundwater problems. These lignite reserves are sufficient to meet the fuel requirements of 2,300 MW of power generating capacity at three power plants (Maritsa East 1 - 3) and a briquette factory for about another 75 years. This lignite, however, is of poor quality with a heating value of 1,500 kcal/kg and 2% sulfur. The Bobov Dol 630 MW power plant is located at an indigenous brown coal mine south of Sofia. Imported black coal from the Ukraine currently supplies the Varna (1,260 MW) and Russe (400 MW) power plants, with other sources being explored.

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There are significant hydropower resources that remain to be exploited. With 1970 MW of current installed hydro capacity, Energoproekt estimates that this represents only about 33% of the total exploitable resource. It is estimated that about 2,800 MW of economically exploitable capacity remain to be developed at various micro, mini, and large hydro sites. As is typical with hydro, this capacity experiences seasonal fluctuations due to rainfall and has limited dispatchability. Nonetheless, the availability of precipitation is heaviest during the NEK's highest winter power demand period.

Oil, gas, and coal prices were heavily subsidized during the old communist era. While these subsidies have been reduced substantially, particularly for oil, some level of subsidy still exists. The World Bank in its 1992 Energy Strategy Study points out that the price for the most economic Maritsa East coal is $0.6/GJ, while the real cost of production is about $1.1/GJ. On the other hand, the cost of imported natural gas from Russia is considered to be higher than the world market price. The World Bank points out that Bulgargaz was paying US$104 per thousand cubic meters for gas from Russia in 1991, when the world price was closer to $90 - $95 / 1000m3. This distortion is attributed to a non-cost based mechanism for pricing gas that is vulnerable to fluctuations in index prices based on fuel oil and the dollar/leva exchange rate. The World Bank views these continuing distortions and subsidies in energy prices as not sending the right price signals in the Bulgarian energy sector.

b) Existing Power Capacity

The Natsionalna Elektricheska Kompania (NEK) is responsible for generating, transmitting, and distributing electricity to the entire country of Bulgaria. The Committee of Energy (COE) is the Bulgarian government committee which overseas NEK, the district heating companies, and the coal mining sector. Although the NEK is still wholly-owned by the government, efforts are being made to make it a profitable, financially independent organization that could be privatized in the future.

NEK provides electric power from a diverse fuel mix that in 1991 included 3,760 MW of nuclear power, 2,440 MW of indigenous lignite power, 1,970 MW of hydropower, 1,660 MW of imported coal power, and 630 MW of indigenous brown coal capacity. A listing of the name, size, and fuel of the major power plants is found in Table 1. Of the total installed electric generating capacity in Bulgaria, 86.6% is owned by NEK (10,460 MW); 4.8% by independent, limited liability district heating companies (1045 MW); and 8.6% by industry (577 MW). In all, a substantial proportion of NEK's generating capacity (over 13%) is provided by independent power producers (IPP's).

While NEK has 12,074 MW of total installed capacity at its disposal, over the last several years it has had difficulty meeting a system peak load of 7,200 MW. Most thermal plants are aging and poorly maintained, resulting in production at only 60 - 80% of their design output. Coal supplies from the former Soviet Union have been unreliable, as have been supplies from Bulgaria's own coal mines. Safety problems at the Kozloduy nuclear plant have

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NEK INSTALLED AND OPERATIONAL POWER CAPACITY 1992			
Thermal Plants	**Fuel**	**Operational Capacity (MW)**	**Installed Capacity (MW)**
Maritsa East I	lignite	172	200
Maritsa East II	lignite	1,080	1,230
Maritsa East III	lignite	780	840
Varna	imported coal and gas	1,260	1,260
Bobov Dol	brown coal	570	630
Russe	imported coal	310	400
Total Thermal Plants		4,172	4,560
Kozloduy Nuclear Plant		1,811	3,760
Hydropower		1,600	1,970
Total Capacity		7,583	10,290

SOURCE : NEK, 1993

Table 1

required the shutdown of two units so that new safety equipment can be installed. And finally, production from hydro plants has been affected by a period of dry weather. In 1992, a total of 38.24 TWh was generated. NEK generated 30.88 TWh. District heating plants and industrial generators produced 4.66 TWh and the remainder, 2.70 TWh, was imported from other countries.

c) District Heating and Industrial Cogeneration

Most major cities and towns in Bulgaria have well-developed district heating systems. These systems provide steam and hot water to industries and households. Like the power plants, many of the systems are old, poorly maintained and have inefficient boilers and distribution systems. Boilers in the larger systems run on natural gas, fuel oil or coal and associated generators provide electricity to the grid under contracts with NEK. A summary list of the 10 major district heating plants that have power generation facilities is found in Table 2.

Likewise, there are some 9 major industrial cogenerators with a capacity greater than 10 MW, as shown in Table 3. These include large petroleum and petrochemical plants, two chemical plants, a metallurgical plant, a tire and fabric plant, and a fertilizer plant. Fuels for these cogeneration plants include gas, coal, and fuel oil. These cogeneration facilities primarily produce steam for the thermal loads of the factories and generate power as a byproduct for reducing part or all of the power demand from NEK. Some of these cogenerators sell surplus electricity back to the grid.

A visit to two of the cogenerators (i.e. the Kremikovtzi steel mill and the Chimco Vratsa chemical plant) revealed that some cogenerators only meet part of the captive electricity needs with no sales to the grid. Kremikovtzi is able to generate power cheaper than NEK due to the availability of low cost gas byproducts from steel production. Expanding cogeneration to generate excess power for sales to the grid was deemed presently uneconomic at Kremikovtzi, since it would require supplementing the limited by-product gas supplies with high-priced imported gas. At Chimco Vratsa the economics of cogeneration just to meet captive needs is barely viable given the high natural gas prices, possible generation inefficiencies, and the relatively low NEK tariffs. Nonetheless, NEK indicated that some of the cogenerators are delivering surplus power to the grid. These cogenerators include Burgas, Devnia, Svishtov, NHK Pleven, and Vidin.

The current power sales terms between NEK and industrial or district heating cogenerators are not sufficiently attractive to induce investments in new cogeneration capacity. The power purchase contracts are for no longer than one year and offer prices below NEK's full cost of generation (these contract terms are discussed in greater detail in Chapter IV). Under these one year contracts, the district heating or industrial cogenerators are not obliged contractually to meet availability or reliability criteria or to generate minimum levels of

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BULGARIAN DISTRICT HEATING PLANTS WITH ELECTRIC POWER GENERATING CAPACITY	
Town	**Installed Capacity (MW)**
Sofia	95
Plovdiv	65
Russe West	3
Pleven	24
Shumen	12
Traicho Kostov	132
Sliven	22
Kazanlak	10
Gabrovo	12
Republika	88
TOTAL	463

SOURCE : COMMITTEE OF ENERGY, 1992

Table 2

MAJOR INDUSTRIAL COGENERATION PLANTS IN BULGARIA - 1991

No.	Name of Power Plant	Fuel (MW)	Installed Capacity (MW)	Maximum Available Capacity (MW)	Annual Electricity Output (GWh)	Annual Heat Output (Tcal)	Annual Fuel Consumption Thous.tce
1	NHK - Burgas	residual, natural gas	257	160	949	3046	568 119
2	Devnia	imp.coal, residual	219	100	634	3200	207 18
3	Swishtov	imp.coal	120	60	498	435	250
4	Kremi-kovtzi	natural gas	112	80	527	795	282
5	NHK - Pleven	residual, natural gas	60	45	291	1194	127 50
6	Vidin	imp.coal	60	50	273	567	283
7	Vratza	natural gas	60	40	200	1258	198
8	Stara Zagora	lignite, natural gas	48	32	52	835	67 84
9	St.Kara-zhiev	residual	26	10	43	703	92

SOURCE : NEK, 1992

Table 3

energy. Under these conditions, these facilities could not be regarded as firm capacity that is dispatchable by NEK and thus could not expect payments for capacity delivered.

d) Expected Needs for Electricity and Capacity

i) Electricity Demand Forecast

As occurred in many of the planned economies of Eastern Europe and the former Soviet Union, there was rapid development of the power sector in Bulgaria through the mid to late 1980's to accommodate an expanding but inefficient heavy industrial base. The sudden transition to market economics, the collapse of former communist bloc markets, and the wars in the Gulf and Yugoslavia have led to a dramatic decline in economic and industrial output and electricity demand over the past several years. Electricity demand is expected to "bottom out" in 1992 and 1993 and then begin increasing slowly.

The graph found in Figure 4 shows NEK's different demand forecasts scenarios based on projections made in 1984 (under the old communist order), 1990, and minimum, intermediate, and maximum projections in 1992. As this graph shows, there was a dramatic decline in electricity demand below the 1984 projections, with two precipitous drops around 1985 and 1990. The forecast of electricity demand found in Table 4 (which was prepared by the World Bank and accepted by NEK) is very close to the intermediate demand forecast shown in Figure 4 and appears to be a reasonable forecast of electricity and peak power capacity demand between 1992 and 2010. Therefore, we have used the 1992 intermediate demand forecast is used in the capacity expansion plan discussed below.

Load forecasts should be used with caution. Economic predictions are especially hazardous for Bulgaria and other Eastern European countries because there is no experience with large scale conversions from planned to market economies. It is too early to know whether various industries could become competitive on the world market. Major shifts could occur from energy-intensive industries like chemicals and metallurgy to lighter industries that are less energy-intensive. Furthermore, the current forecast does not account for price elasticity and so the impact of household consumption on load could be overestimated. In addition, the potential impact of demand-side management or energy efficiency programs is uncertain. Use of these forecasts for investment decisions involves considerable risk, which both NEK and IPP developers must consider.

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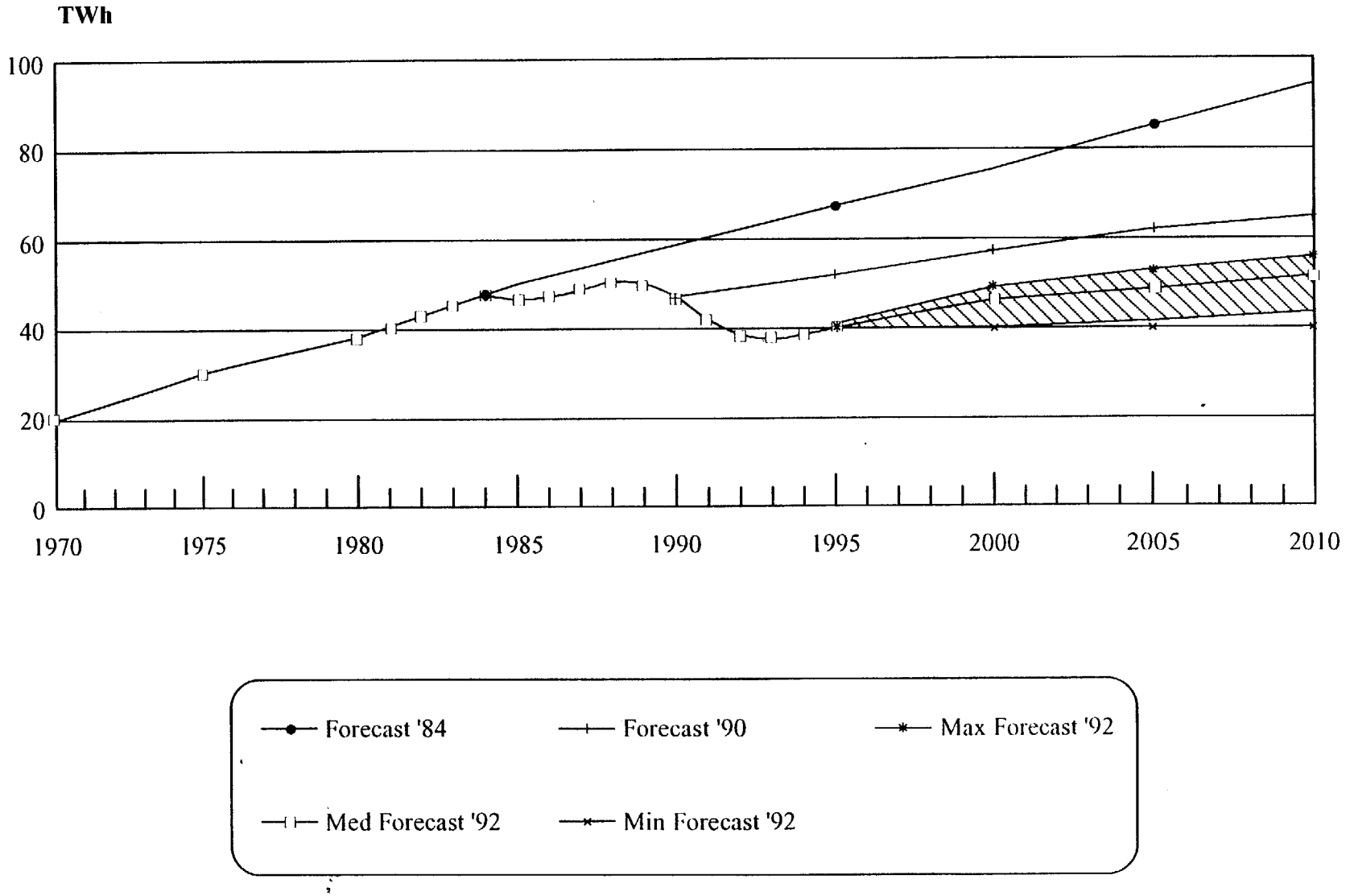
Bulgaria Electricity Demand Forecasts



Source: NEK, 1992

Figure 4

HISTORY AND MEDIUM FORECAST OF ELECTRICITY DEMAND		
YEAR	TWh	MW
1989	48.64*	8332*
1990	45.91*	NA
1991	41.00*	NA
1992	38.22*	6870
1993	38.30	6840
1994	38.50	6870
1995	40.50	7230
2000	46.00	8070
2005	49.00	8600
2010	52.00	9120
* Actual		

Table 4

ii) Capacity Expansion Plans

NEK has prepared an expansion plan projecting capacity installations and needs between 1993 and 2010, as shown in Table 5. This expansion plan is based on the intermediate electricity and peak power demand forecast accepted by the World Bank and NEK, as discussed above. This capacity expansion includes projects currently being implemented by NEK, including the completion of the Chaira pumped storage facility which will provide 864 MW of peaking capacity and the Maritsa East II, (Unit 8) coal plant which will provide 210 MW of base load capacity. These two projects have been funded by the World Bank and the European Bank for Reconstruction and Development, respectively.

Based on the medium demand forecast, NEK's current generation expansion plans forecast the need for 880 MW of new capacity by the year 2000 and 3,940 MW by 2010. Options for meeting these capacity requirements include the use of indigenous coal, indigenous hydro, imported coal, imported gas, and nuclear. Specific options will be discussed in the next section. After the year 2000, NEK's alternate plan recommends that consideration be given to construction of a new nuclear facility and a major hydropower facility on the Danube River.

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Capacity Balance Forecast for Bulgaria Power System

(Megawatts)

Source Types	Year					
	1993	1994	1995	2000	2005	2010
Electricity demand (TWh)	38.0	38.5	39.5	46.0	49.0	52.0
Peak load (MW)	7100	7000	7180	8210	8750	9280
Existing NPP	2600	2600	2600	2600	2600	2600
Existing TPP	4937	4917	5226	5195	5155	5145
Existing HPP	1200	1200	1200	1200	1200	1200
Chaira project	200	400	400	800	800	800
Required new construction	0	0	0	880	1620	2320
Total available capacity	8937	9117	9426	10675	11375	12065
Reserve compared to peak load MW	1837	2117	2246	2465	2625	2785
Reserve compared to peak load %	25.9	30.2	31.3	30.0	30.0	30.0

NPP: nuclear power plants
TPP: thermal power plants
HPP: hydro power plants

Source: NEK, 1992

Table 5

The World Bank recently prepared a report entitle Bulgaria Power Demand and Supply Options (May 1993) with the International Energy Agency for the G-7. This study was requested by the G7 in 1992 to examine alternative energy sources for replacing the less safe nuclear plants (VVER 440 model 230s) in Eastern Europe and the former Soviet Union. Bulgaria has 4 VVER 440 model 230 units # 1 - 4 at its Kozloduy plant with a capacity 1,760 MW out of the total plant capacity of 3,760 MW. The possible phase out of nuclear power capacity has significant implications for electric power planning and the potential role of independent power. Independent power developers are unlikely to have a role in nuclear generation. The phase out of some fraction of the nuclear capacity will create a greater demand for alternative power, which could open up significant IPP opportunities.

In this study, the World Bank developed various capacity expansion and investment projections using the Wien Automated System Planning Package (WASP) least cost expansion planning model. These forecasts were based on three different electricity demand projections and six difference nuclear power scenarios, ranging from shutting down all six units at Kozloduy immediately (Scenario 0) to keeping all units operational through the end of their designed life (Scenario 5). The scenarios involving continued nuclear power plant operation require between $678.0 and $1,566.8 million investments to upgrade the safety and performance of these units. The Bulgarian government has agreed to reduce its dependency on nuclear power over the long term.

The least cost alternative to nuclear power and option for capacity expansion involves the addition of new gas-fired combined cycle generating units at existing or new district heating and industrial cogeneration facilities. The installed cost for this new combined cycle capacity at existing cogeneration sites is projected to be between about $200/kW and $500/kW. The Government of Bulgaria has been concerned about the increased reliance on imported gas that these facilities would require. At their request, this study ran a scenario that limited gas imports for power and district heating to about 2 billion cubic meters per year (approximately current levels) and thus effectively eliminated the least cost expansion option involved gas-fired combined cycle systems. According to the World Bank analysis, this restricted gas consumption scenario effectively increased the cost of supplying power by about 3% - 8% (depending on demand and nuclear phaseout assumptions). The Government of Bulgaria will need to decide whether this possible increase in the cost of capacity expansion is justified to reduce dependence on imported gas.

The World Bank analysis concludes that the least cost alternative in the near-term involves investments in rehabilitating and repowering existing thermal power plants and district heating and industrial cogeneration facilities. Bulgaria's demand and capacity balance between 1993 and 2010 is shown in Figure 5 under two difference scenarios: (1) for a complete nuclear shut down (Scenario S-0) and (2) a complete nuclear rehabilitation (Scenario S-5). As is evident in these charts, by the year 2000, power and cogeneration plant rehabilitation/repowering could potentially contribute between 2,000 and 3,000 MW. In contrast, only 0 to 1,000 MW of new capacity additions are indicated.

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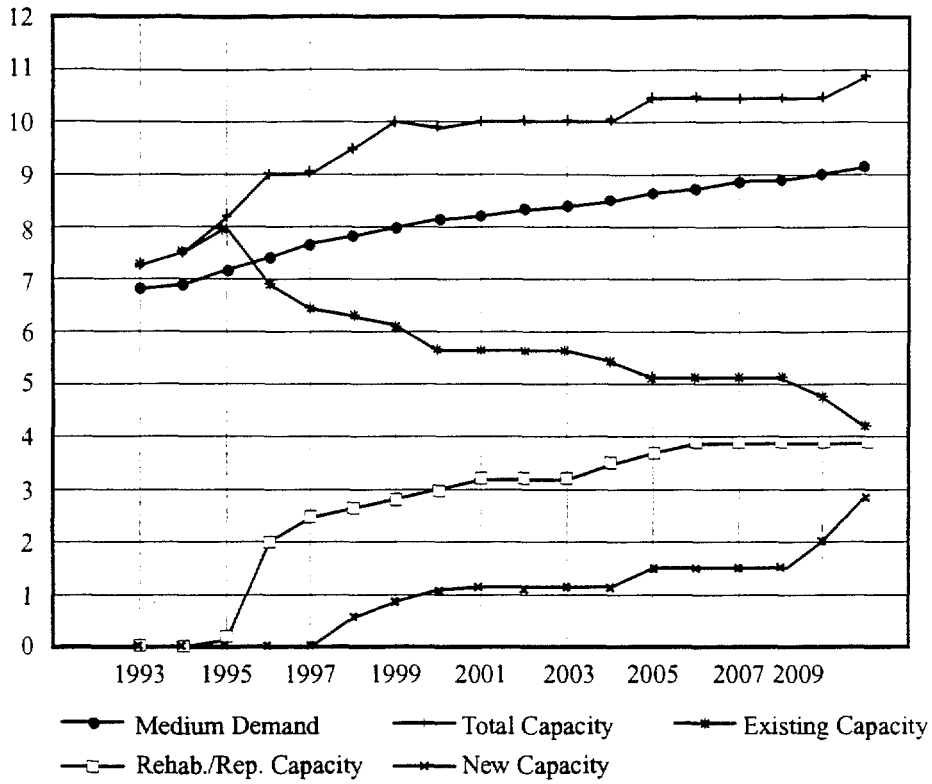
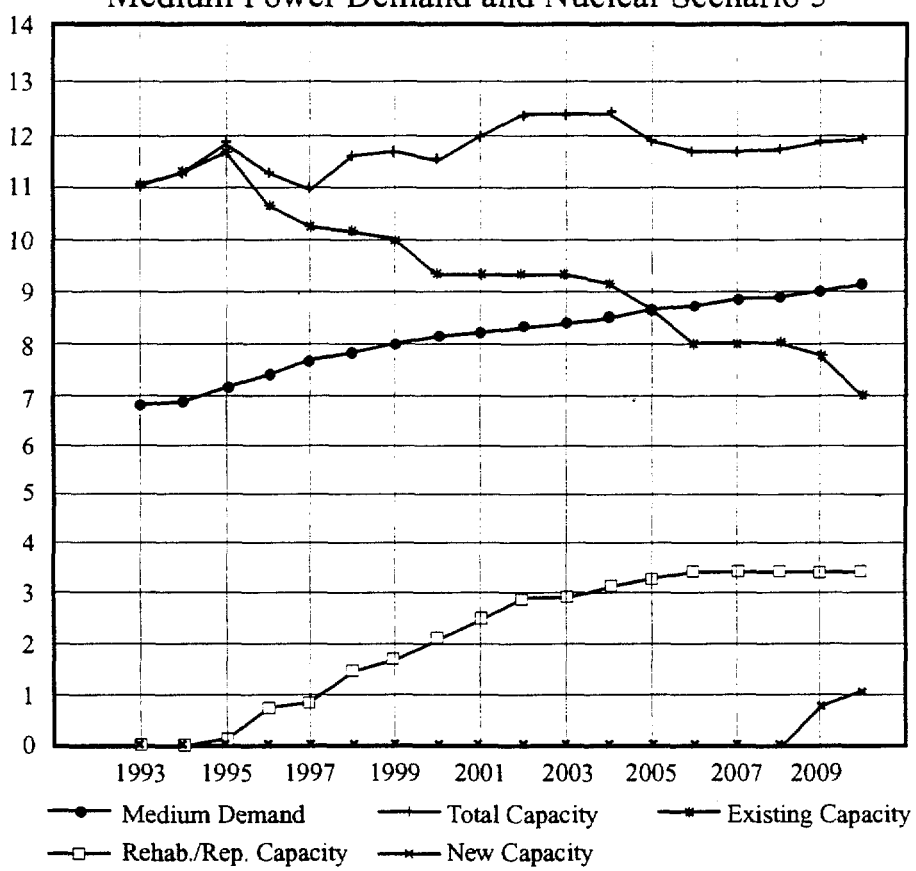
Bulgaria: Demand - Capacity Balance

Medium Power Demand and Nuclear Scenario 0



Bulgaria: Demand - Capacity Balance

Medium Power Demand and Nuclear Scenario 5



Source: World Bank, *Bulgaria Power Demand and Supply Options*, May 4, 1993.

Figure 5

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The analysis prepared by the World Bank is preliminary and will be refined by additional demand side and least cost utility planning being implemented. US AID and the European Community (EC) are currently cooperating in the development of a least-cost power supply plan for Bulgaria. This study will bring together a number of studies in an effort to provide a more comprehensive plan for generation expansion and demand-side management. A clear definition of the least cost expansion options will result from this ongoing analysis.

One of the studies that will be included in the least-cost plan is a detailed feasibility analysis of the rehabilitation of six thermal power plants. This study is funded by the US Trade and Development Agency (TDA) and is being implemented by Bechtel. The upcoming report will provide useful information on potential rehabilitation, repowering, and retirement of the major central thermal power plants.

When it is completed, the least-cost plan will provide a very detailed analysis of electricity demand and options for capacity expansion and demand-side management. It is important to note that if Bulgaria experiences low economic growth, demand-side management and energy efficiency measures prove effective, and some 450,000 households are successfully converted from electricity to gas heating (i.e. the low demand forecast scenario), no additional capacity expansion will be required until the year 2000 and possibly as late as 2005. The uncertainty in the demand forecast and expansion plans requires that such plans be continuously updated to reflect current economic and electricity demand data. The focus under most scenarios will be on the rehabilitation and repowering of existing thermal units, whether they be central power plants or industrial and district heating cogenerators.

e) Financial Status of Power Sector

i) electricity pricing

The average electricity tariff is set by the Council of Ministers (COM), with the Commission on Prices (COP) and the Committee of Energy (COE) defining the structure of the tariffs (for a further discussion of these institutions, see chapter IV). In May 1990, a uniform tariff structure was instituted that is consistent with the principles of marginal cost pricing. This tariff differentiates customers on the basis of high (> 35 kV), medium (10 kV - 35 kV), and low voltage (< 10 kV) levels and according to different times of the year (winter and summer) and different times of the day (peak, day, and night).

There have been major increases in the average tariff from 0.0524 leva/kWh in late 1990 to 0.64 leva/kWh in January 1993. In May 1993 a further tariff increase was instituted as shown in Table 6. According to the World Bank, this May 1993 increase has raised the average tariff to about 2.9 cents/kWh. This rate is still considered too low. The World Bank and NEK have agreed that before September 1, 1993 the average price will be increased to 3.5 cents/kWh. After more detailed financial and cost analysis has been performed (which is expected before September 1994), the average price will be set at the greater of the long run

NEK ELECTRICITY TARRIFS MAY 1993 (leva/kWh)						
Time of Day	**Winter Period**			**Summer Period**		
	Level of Voltage			**Level of Voltage**		
	hv	mv	lv	hv	mv	lv
Peak	1.472	1.527	1.598	1.284	1.324	1.389
Day	0.799	0.826	0.863	0.691	0.716	0.750
Night	0.359	0.407	0.427	0.340	0.351	0.369
One-scale Measurement	1.187	1.225	1.285	1.032	1.064	1.116
The approximate exchange rate in May 1993 was is 26.4 Leva per US$						

SOURCE : NEK, 1993

Table 6

marginal cost or the average price necessary for NEK to achieve a debt service coverage ratio of 1.5.

Residential household tariffs are substantially lower than for all other customers due to a major subsidy. While industrial tariffs have approached NEK's cost of generation, residential tariffs have been significantly lower. In the May 1993 tariff increase, residential rates were increased 50% while industrial rates were only raised 5.5% to partially reduce this cross subsidy. Household consumers, however, are being hard hit by these rate increases, given the low wages of many Bulgarians (particularly senior and other citizens on fixed incomes). There are discussions of providing some kind of social safety net to help those residential customers most in need. Given the very limited financial resources of the government, the source of funds for such a program is hard to identify.

ii) utility financial performance

In the long term, the government may consider privatizing NEK. Currently, however, the financial performance of NEK and the lack of an appropriate energy policy and institutional framework would make NEK less attractive to investors. Over the past few years, NEK has been operating with inadequate cash flows and high current liabilities. In 1992, NEK had losses of 2.45 billion leva on total revenues of 15.40 billion leva. In 1991, losses were around 1.39 billion leva on total revenues of 9.56 billion. These losses are being covered through state support. The Ministry of Finance (MOF) has given NEK a timetable in which to eliminate this need for state subsidies. The goal agreed to between the MOF and NEK is that by 1995, NEK will be earning a positive net income and that state subsidies will end. The World Bank and NEK are working together closely to achieve this objective.

Given the recognized inability of NEK to service its debt, most of its earlier liabilities were forgiven and removed from its books. Without having to service its debt on the amortization of previous installed capacity, it will be significantly easier for NEK to turn a profit in the near-term. However, as additional investments in repowering, rehabilitation, or new capacity are required over the coming years, NEK will need to raise its tariffs to reflect the capital recovery costs. Even after all of the tariff increases made so far and contemplated before the end of 1993, an independent power purchase rate based at or below the existing industrial tariff may not be sufficient to enable an independent power developer to recover the full capital, operating and maintenance, and fuel costs of a new power installation. This actual cost of generation issue will need to be examined closely as COE's and NEK's independent power policy framework is developed.

The current goal is to establish the needed policy and regulatory framework so that appropriate tariffs and price signals can be established in the market place. In addition, assistance is being provided to COE and NEK in applying market-oriented financial and accounting principles. The schedule of these activities should put NEK in a relatively attractive condition by early 1995. By developing a favorable independent power policy

program in parallel with these activities, it is very conceivable that independent power projects could be successfully initiated within this time frame.

3) Review of Potential Independent Power Configurations

There are various configurations and options for independent power development that could occur in Bulgaria. These include:

- **Industrial Cogeneration**: Those industries that particularly require substantial quantities of steam or hot water for their production process (e.g. pulp & paper, petro-chemical, steel, food processing, etc.) are prime candidates for cogeneration and independent power.

- **District Heating Cogeneration:** District heating plants that supply steam and hot water to municipalities and industry are also prime candidates for cogeneration and independent power.

- **Thermal and Hydro Plant Repowering**: Existing thermal and hydro power plants that are in need of considerable rehabilitation or repowering could be sold in part or in their entirety to private developers, who will make the necessary improvements and/or expansions.

- **New Thermal and Hydro Power Projects**: New capacity requirements could be supplied by private developers building new thermal and hydro power projects.

District heating systems and industrial cogenerators may offer the opportunity for providing increased capacity and energy to the grid either through repowering existing facilities with expanded power output capacities or through construction of new generating plants at new industrial sites. Industries could be encouraged to self-generate and reduce power demand through appropriate power pricing terms. The viability of cogeneration projects clearly depends on the commercial viability of the underlying industrial or district heating business and on the power purchase contract terms offered by NEK (i.e. buyback rate and contract term).

Some of the existing thermal power plants are in major need of rehabilitation or repowering in order to optimize their technical and financial performance. The Government of Bulgaria is severely constrained in its ability to finance these improvements and may want to attract private capital for this purpose. In order to induce the private sector to invest, NEK may wish to consider selling all or part of some of these thermal power plants. A joint venture between NEK and a private developer could be proposed or the power plant could be sold to

the private sector outright. New stand-alone independent power plants built by private developers, when needed, could sell electricity to NEK or directly to large retail customers.

The development of Bulgaria's substantial indigenous hydro resources could also present attractive opportunities for independent power developers. Energoproekt's Hydropower Division has performed an extensive study of the potential for new hydro development. There are major hydro sites being developed such as the Chaira pumped storage hydro plant being completed with funding from the World Bank. Energoproekt has identified about 155 mini-hydropower sites totaling 2,599 MW and 738 micro hydro sites totaling 215 MW. Some of these sites have as much as 1000 feet of head, which could result in a very attractive installed cost per kiloWatt.

The long term need for major new central station power capacity using coal, oil, gas, and hydro after the year 2000 will also lend itself to independent power development. By this point, some smaller IPPs should have been developed thus establishing the procurement, contractual, and permitting precedent.

4) Estimate of Bulgaria's Independent Power Market Potential

The ability to make a market estimate for independent power is constrained by two major uncertainties. First, the demand for electricity and the power expansion needs are unclear due to Bulgaria's difficult economic transition. With the recent declines in electricity demand and surplus capacity of variable reliability, Bulgaria could possibly postpone making major new investments in the non-nuclear power sector for a few years. Within the next 5 to 10 years, however, major new investments in cogeneration and power plant rehabilitation and expansion will be required. Second, the extent to which a favorable business investment climate for independent power will develop is unclear. Independent power developers will only play a role in new capacity investments if the Government of Bulgaria, COE, and NEK implement policies and pursue strategies that encourage and facilitate private investment (as explored in Chapters IV and V). Given that these policies are in the formative stage, there is considerable uncertainty as to their outcome.

Given these caveats, it nonetheless is possible to provide an estimate for the independent power market and describe the potential independent power opportunities that could potentially develop. As discussed in the capacity expansion plan section and shown in Figure 5, the World Bank estimates that between 0 and 1,000 MW of new capacity will be added between 1993 and 2000 and between 2,000 MW and 3,000 MW will need to be rehabilitated or repowered (based on the extremes of nuclear power scenarios 0 through 5). Assuming the most likely moderate nuclear power scenario # 3, this report estimates that investments totaling about $ 521 million will be required for power capacity rehabilitation and repowering and $474 million investments will be need for new capacity between 1993 and 2000.

Given the capital constraints of the GOB, it is fair to assume that some proportion of those additions will be offered to the private sector. The extent to which private investors will respond will depend on government policy, the overall investment climate, and the extent to which Multilateral Banks and Export Credit Agencies join the private sector in enabling the first precedent-setting independent power projects. A summary of these potential opportunities is discussed below and is provided in Table 7.

a) District Heating and Industrial Cogeneration

Private cogeneration could play an important role meeting the expanded capacity requirements in the near-term. In addition, as Bulgaria considers its economic development future, cogeneration could play an important part in improving the economic viability of certain industries and the district heating sector. For example, agricultural and food processing products are expected to be a major export industry for Bulgaria. Food processing and fertilizer plants both have a strong potential for cogeneration which could make these industries more competitive internationally.

Preliminary analysis is being conducted to determine the repowering and expanded cogeneration potential at the existing industrial and district heating cogeneration sites. In the World Bank G7 report, preliminary analysis has been performed based largely on the application of fluidized bed or combined cycle technology. This report indicates the potential for expanding the installed industrial cogeneration capacity to be around 560 MW to about 2,570 MW at the Burgas refinery, Kremikovtzi steel mill, Chimco Vratsa chemical plant, and the Stara Zagora fertilizer plant.

At the major district heating plants, the potential for expanding cogeneration from a total of about 610 MW to about 2,460 MW has been identified, with particular focus on the Sofia, Kostov, Pernik, Plovdiv, Avram Stoianov, Pleven, and Shumen district heating plants. Through US Trade and Development Agency funding, Gilbert Commonwealth of the US is currently undertaking feasibility studies of three district heating plants. This analysis will be a valuable first step in determining the potential for private investment. There has been discussion of transferring ownership of some district heating plants from COE to the respective municipalities. Given the major rehabilitation and repowering needs of these plants and the financial constraints at both the federal and municipal levels, private investment and management could be greatly needed.

If all these industrial and district heating cogeneration projects proved feasible, the potential for expanded cogeneration at these existing plants would total around 3,800 MW. This additional capacity would be able to supply most of the 4,820 MW of new capacity that the intermediate growth expansion plan calls for between 1993 and 2010. However, the expanded use of natural gas that many of these cogeneration projects call for has generated substantial debate. Many utility officials interviewed want to avoid increasing dependence on imported Russian gas, particularly at the current high price in Bulgaria. In addition, NEK

BULGARIA POWER PROJECT INVESTMENT OPPORTUNITIES

Estimates: June 1993

Power Facility Name	Existing Installed Capacity (MegaWatts)	Potential New or Repowered Capacity (MegaWatts)
Thermal Power Plants		
Maritsa East 1	200	200 – 250
Maritsa East 2	1,245	1,245 – 1,455
Martisa East 3	840	840
Varna	1,260	1,260
Russe	400	400
Bobov Dol	630	630
District Heating Cogeneration Plants		
Russe	270	340
Sofia	125	345
Kostov	186	870
Pernick	155	130
Plovdiv	60	260
Pleven	36	295
Shumen	18	160
Industrial Cogeneration Plants		
Burgas	220	1,082
Kremikovtzi	60	486
Chimco Vratsa	60	284
Stara Zagora	48	720
Devnia	60	616
Hydro Power Plants		
Danube River		400
Gorno Arda		175
Sredna Vacha		100

Source: World Bank, Bulgaria Demand & Supply Options, May, 1993; Energoproekt

Table 7

would prefer to see imported gas used to convert 450,000 residential homes from electric to gas heating (thereby reducing their winter peak demand).

b) Coal-Fired Power Plant Rehabilitation and Repowering

Power project rehabilitation involves repairing and replacing components of an existing design, while repowering involves a substantial reconfiguration and possible expansion of a power plant using improved technology. Major opportunities for both rehabilitation and repowering exist in Bulgaria.

Most of the major thermal (coal-fired) power plants in Bulgaria are in need of some form of rehabilitation or repowering, as is being studied by Bechtel in a Trade & Development Agency (TDA) funded feasibility study. This need is partially based on the age of the units and particularly on the type of technology used and the conditions they have had to operate under. Assuming that the useful life of these Bulgarian coal-fired units is 30 years, units totaling roughly 370 MW would need to be retired between 1993 and 2000. While thermal plants in the US can have a longer useful life, the Bulgarian coal-fired units have been subject to much harsher conditions and involve technology that is less well adapted to the efficiency and environmental criteria Western countries are stipulating as conditions for power sector loans. The power plant units that will exceed a 30 year life between 1993 and 2000 are 4 lignite-fired units totaling 200 MW at the Maritsa East 1 power plant and the 3 lignite-fired units totaling 170 MW at the Maritsa 3 power plant.

The coal-fired power plants that could be considered for replacement and repowering between 2000 and 2010 would add up to over 1,400 MW (again assuming a 30 year life). The power plant units that will exceed a 30 year life between 2000 and 2010 and thus are major candidates for retirement or repowering are 4 lignite-fired units totaling 600 MW at the Maritsa East 2 power plant, 3 imported coal and gas fired units totaling 630 MW at the Varna power plant, and 3 imported coal fired units totaling 170 MW at the Russe power plant. Clearly, the results of the TDA Bechtel study will better clarify the options regarding retirement and repowering of these units.

In order to attract private capital into rehabilitating/repowering existing power plants, NEK may need to consider selling off part or all of particular power plants or entering into joint ventures as is being implemented in Poland. Private developers and investors are unlikely to want to invest in a power plant that they do not have sufficient ownership and management control over. Selling part or all of a power project could also be a way for NEK to raise capital for various purposes.

The indigenous lignite burning power plants at the Maritsa complex (Maritsa 1 -3 power plants) are in considerable need of reconditioning and repowering. The poor quality of the lignite at Maritsa and the labor problems at the coal mines could be addressed by a

Bulgarian government / private investor partnership that would provide the appropriate clean-coal technologies and labor management plan.

The two coal-fired power plants that are burning imported anthracite coal from the Ukraine, Varna (1,260 MW) and Russe (400 MW), are in better condition but still call for significant repowering. The reliability of coal supplies from the Ukraine has been a problem so analysis is being conducted on converting the boilers to burn imported sub-bituminous coal from Africa or Asia. If a reliable supply of coal is found that matches the boiler configuration, private investors might be more interested in these facilities.

The Maritsa East 1 power plant (200 MW) presents an interesting repowering case because it also supplies steam to the country's only major briquette factory. The Bobov Dol power plant (630 MW) has depleted its local source of coal and is being considered for boiler modification to burn blended coal or low sulfur imported coal.

A summary of the three power projects, Maritsa East 2, Varna, and Bobov Dol that the World Bank study identified as prime candidates for repowering is found in the Appendix. When TDA and Bechtel publish the results of their feasibility studies of repowering of all six thermal plants, the results of this analysis will reveal which projects have the best return on investment.

c) Hydropower

It is not expected that any of the existing hydro plants will be retired (some are about 30 to 35 years old) but investment in upgrading to increase efficiency could be attractive. Energoproekt has identified about 2,800 MW of new, potentially-exploitable hydro resources. These new sites could offer some interesting investment opportunities. The NEK is interested in jointly developing with the Rumanians 400 MW of hydro capacity at Nikopol-Turnu Magurele and Silistra Kalarash on the Danube River. Other major hydro sites to be developed include about 175 MW at Gorna Arda and about 100 MW at Sredna Vacha. Given that the hydro generation would typically be during the peak winter demand months, these projects may fit into the least cost plan in an optimal way.

Given the high costs of developing a power project, foreign developers are likely to be primarily interested in the mini-hydro and larger hydro projects exceeding 5 MW to 10 MW. Many of the pre-closing development costs are the same for small projects as they are for larger projects, while the profits and revenues earned are a function of size. Developing a micro-hydro project on the scale of 100 kW would not generate the revenues typically required by a foreign investor to justify the project development costs.

d) New Capacity Additions

As discussed in the previous section, NEK has prepared an expansion plan based on low, intermediate, and high demand growth scenarios. Given the uncertainties in the world and the Bulgarian economy and power sector, these expansion projections are uncertain and will require careful examination and updating. These new capacity projections, nonetheless, do provide an estimate of the possible opportunities for new independent power project development.

If the intermediate demand growth scenario proves correct, 880 MW of new capacity will be required between 1993 and 2000. There is a range of options on how to supply this new capacity, if needed. One option for NEK would be to expand the capacity at the Kozloduy nuclear power plant. Given the difficulty Bulgaria will have in obtaining the financing for this expansion and the fact that it is unlikely that nuclear power could be developed under an independent power scheme, the focus of this discussion has been on conventional thermal and hydro facilities. The most attractive opportunities could be for expanded coal-fired, combined cycle gas-fired, and hydro project development both at central power plants and cogeneration facilities in industry and at district heating plants.

Over the long term, increased electricity demand and more plant retirements will definitely require the construction of new generating facilities. If the intermediate electricity demand growth scenario proves correct, the NEK expansion plan calls for 3,940 MW of capacity between 2000 and 2010. It is very likely that the Bulgarian economy will be on a sound market-based footing by this period and that economic growth could be strong.

There is a wide range of options for supplying these longer-term capacity requirements. At a later date, nuclear power may have found greater favor in the international community, given the growing air pollution concerns. Given the extensive development of Russia's large reserves of oil and gas, the expanded power capacity using these relatively clean fossil fuels may well be increased. Bulgaria's coal reserves and poor coal quality could well inhibit a significant expansion beyond current capacity levels with further imports of higher grade coal.

e) Power Export Markets

Over the long term, COE and NEK might consider the potential market for exporting power to those neighboring countries that are deficient in power. The Bulgarian power transmission system is interconnected with all neighboring countries, including the Ukraine, Romania, Turkey, Greece, and Yugoslavia. Given the existing 750 kV and 400 kV link with the Ukraine, and the 400 kV links with all other neighbors, the basic infrastructure is in place (while transmission capacity may need to be expanded).

Bulgaria occasionally has been importing about 800 MW of capacity from the Ukraine during periods of peak demand, with about 4 - 5 TWh of electricity being imported yearly.

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Trade with Romania remains limited given this country's economic and power sector problems and power exchanges with Yugoslavia has been stopped by the current international embargo. Bulgaria is currently negotiating with Greece and Turkey for enhancing their cross-boarder interconnections, expanding exchanges of power, and possible synchronization. Preliminary indications are that Greece and Macedonia could be potential power markets, if Bulgaria is able to develop capacity at a competitive price in the Balkan market.

f) Power Project Prioritization

The procedure for evaluating power project investments should utilize a rigorous Integrated Resource Planning (IRP) process. In this manner, the most appropriate and least cost options will be developed. A key determinant for project selection will be how the power plant meets the load profile in terms of supplying peaking, intermediate, or base load capacity. The installed capacity ($/kW) and life cycle power costs ($/kWh) for each power project opportunity will also be essential factors in project selection. A summary of the installed capacity and life cycle costs of different power technologies based on the US and international market is found in Table 8.

Given the installed and generation costs of different technologies, it is likely that the first investment to consider will be demand side management options under $300/kW, then possible cogeneration and thermal plant repowerings in the range of $200/kW to $400/kW. For new generation options, hydro may provide economic generation at particular sites identified by Energoproekt. While hydro in the US ranges from between $2,000 to $3,000/kW, the high head sites in Bulgaria could reduce capital costs significantly. The choice of the optimal technologies and fuels will become clear after the IRP process has been implemented.

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GENERATION SUPPLY OPTIONS ESTIMATES OF INSTALLED AND LEVELIZED COSTS		
	RANGE $/KW	TOTAL LEVELIZED COST ¢/KWH
Combustion Turbine	275 - 500	11-16
Diesel Generator	375 - 1,005	9-26
Combined Cycle	500 - 800	5-6
Pulverized Coal w/ Flue Gas Desulferization	1,420 - 2,410	6-9
Atmospheric Fluidized Bed Combustion	1,600 - 2,600	6-8
Wood Fired Steam	2,700	7-8
Conventional Hydro	1,945 - 3,300	N/A

Source: Central Maine Power, Stone & Webster, and Electric Power Research Institute, 1993

Table 8

IV. EXISTING POLICY, REGULATORY AND INSTITUTIONAL CONDITIONS AFFECTING INDEPENDENT POWER DEVELOPMENT IN BULGARIA

1) Overview of the Existing Policy and Regulatory Framework

The existing statutory framework in Bulgaria is undergoing major changes. Only one statute, the Law on the Environment, has any significant implementing regulations. The prospects for a broad independent power program will be enhanced as the Bulgaria's laws and regulations become more developed. Nevertheless, a preliminary assessment of the power sector institutions and the energy bill currently being drafted indicates that a favorable policy and institutional framework is under development.

While it is important for the long term development of an active private power market in Bulgaria that the legislative and regulatory framework evolve from the current transitional phase to a more stable system, that evolution can be aided and even accelerated by the parallel development of specific projects. At this early stage, if NEK were to implement an informal developer selection process involving negotiations with about 3 or 4 different companies, it could ensure that these first projects are relatively competitive. By proceeding with one or more IPPs, actual experience is gained that will contribute to improving the policy and institutional framework. This issue is discussed in the conclusions to this section and the recommendations in Chapter V.

An overview of the principal Constitutional provisions and statutes affecting private power development is provided below with comments on what changes might improve the overall policy and legal framework.

a) Relevant Constitutional Provisions

i) Private Property Article 17 provides that the right to property shall be guaranteed by law and that private property shall be inviolable. Expropriation can be done only after fair compensation is assured in advance. A bilateral investment treaty with the US signed in September, 1992 should provide additional assurance to US investors.

ii) Energy Sector Article 18 identifies the activities which are to remain as Governmental monopolies. Water resources, mineral resources and parks, for example, continue to be under the exclusive control of the national government. With the exception of the use of nuclear energy, the energy sector is not so identified.

iii) Environmental Protection Article 15 states that Bulgaria shall ensure the protection of the environment and the conservation and sensible utilization of the country's natural and other resources. In addition, Article 5 provides that international instruments ratified by and in force with respect to Bulgaria have the effect of domestic legislation, and

they supersede any domestic legislation stipulating otherwise. Bulgaria is a party to a number of international agreements on environmental issues, as discussed in Section IV(1)(b)(ii) below.

iv) Site Acquisition Article 21 of the Constitution restricts the use of arable land to agricultural purposes, absent exceptional circumstances and need, and Article 22 prohibits foreign individuals and entities from owning land in Bulgaria (but Bulgarian companies with up to 100% foreign ownership apparently can own non-agricultural land; see Section IV(1)(b)(iii) below). Leasehold interests and ownership of structures by foreign individuals and entities are not prohibited.

b) Relevant Legislation

i) The Law on Electrical Energy (currently in discussion draft)

This Law would require the "State Body on Energy," referred to in this report by its current name, the Committee of Energy or COE, to oversee the generation, transmission, distribution and use of electrical energy by the NEK. The Law contemplates that the COE will be charged with the protection of consumers and of the public interest, including determinations of need and of the cost effectiveness of generation expansion plans. Regulation of prices to consumers, however, is proposed to be made by a "Commission on State Energy Regulation" made up of representatives of several Ministries and other entities with an interest in energy prices. The "Inter-institutional Commission on State Energy Regulation," a temporary commission which would be responsible for the fairness of retail prices pending enactment of the law, is being authorized as of the date of this report. These entities are described in greater detail in Section IV(2)(a) below.

The current version of the draft Law indicates that a favorable policy framework in terms of power purchase pricing and terms will be offered to independent power generators to fill future needs for additional capacity. It requires the COE to create conditions to enhance competition in the generation of electric power and to create preferential conditions for the production of power by IPPs. The law contemplates a certification process for IPPs, in which applicants will be required to demonstrate that:

(1) they are compatible with the approved long term plan for production and transmission of energy;
(2) they have coordinated their planning with the local authorities, the Ministry of Environment (MOE) and the National Council on Water (NCW);
(3) their pricing is in the interest of consumers; and
(4) the public has been informed (detailed requirements for public involvement in the environmental review process, described in subsection (ii) below, will presumably satisfy this criterion).

Clearly, the manner in which these requirements are applied will have an important effect on the commercial environment for private power in Bulgaria.

Given the short history of the institutions which would be involved with the implementation of this statute and the evolving and dynamic nature of regulation in this sector in countries throughout the world, it is reasonable to expect that international sources of capital will be concerned about arbitrary or capricious administration of the Law's policies. A number of the recommendations in Chapter V of this report are intended to address these concerns.

While the current draft does not distinguish between small power producers, cogenerators and other independently-owned generators, if so desired, such a distinction can be made in either the implementing regulations under the Law or in the Law itself. A number of jurisdictions, including the United States, has incorporated such a provision in its legislation. Such a distinction would encourage small independent power production through standard offers that conform to least cost planning principles but establish a standard avoided cost rate and simplify the contracting process for projects under 100 MW. [See Chapter V, Recommendation 9]

ii) The Environmental Protection Act

The Environmental Protection Act was passed in 1991 and amended in 1992. It is a comprehensive environmental statute of broad applicability which establishes the rights of the citizens to a clean environment, to information on issues affecting the environment (Article 9), and to environmental impact assessments prior to construction, reconstruction or expansion of a wide range of projects, including power projects (Article 20).

As discussed in greater detail below, the Law affords the Ministry of the Environment (MOE) substantial authority to achieve its goals. No construction can be started until the MOE has approved the form and substance of the associated environmental impact assessment. Article 28(2) provides that the Minister of the Environment may suspend the regulations of other Ministries and Municipalities when they contravene the prescriptions of the Law, and Article 28(1) authorizes the Minister or the Regional Environmental Inspectorates to suspend or stop industrial activities which impact assessment established as damaging or threatening damage to the environment.

Point Source Emissions -- Air: Bulgaria has adopted emission standards for stationary sources. The standards for power generating facilities are not technology-specific, but rather are based on size categories (in MW) and fuel type. The Law requires sources to pay user charges in proportion to their emissions at or below the published standards for the emitting facility. Emissions exceeding the standards are subject to penalties in amounts up to 30 million Leva (approximately $1.2 million) per month.

Ambient Standards -- Air: In addition to source emissions standards, Bulgaria has stringent ambient air quality standards modeled on those of Germany. They stipulate maximum allowable concentrations, over 30 minute and 24 hour averaging periods, for 171 categories of pollutants. The standard for particulates is comparable to that of the US, but the standards for SO2 and CO are almost an order of magnitude more stringent. Bulgaria is a signatory to the Helsinki Protocol on SO2 and a Sofia Protocol on NOx, and the Vienna convention and the Montreal Protocol on protection of the ozone layer. It is, for example, required by the Helsinki Protocol to reduce its SO2 emissions by 30% from 1980 levels by the end of 1993. Bulgaria's ambient standards govern a wide range of pollution in addition to air quality, including noise and odor pollution. MOE, however, has not yet established a permit system for air pollution discharges.

Because the ambient air quality standards are generally perceived as unrealistic, and given the current state of the economy, there is now little or no effort to enforce them. However, in addition to the penalties described above, there is authority for the assessment of civil penalties against individuals for the violation of environmental laws and regulations (Article 32). Moreover, Article 29 of the statute requires a polluter to remedy any damage it causes with compensation at least equal to the cost of repair. Article 353bis of the Penal Code, which provides that persons who conceal or falsify information resulting in material damage to the environment or to human health will be liable to fine and imprisonment for up to five years, applies only to government officials.

Ambient Standards and Point Source Emissions -- Water: Ambient water quality standards have also been established for three classes of receiving waters, Class I for drinking water quality, Class II for recreation and fishing, and Class III for irrigation. Direct discharges to surface waters must meet the Class II standards. The MOE is currently putting in place a permitting system for discharges to waters. There are also two standards for the discharge of waste to sewerage systems, depending on whether they are served by treatment facilities.

Environmental Impact Assessment: While most existing sources have not yet felt the impact of the Environmental Protection Act and associated regulations, the MOE has established a detailed environmental impact assessment procedure, called an Evaluation of the Effect on the Environment ("EEE") study, pursuant to Article 20 of the Environmental Protection Act. It will serve for all practical purposes as a comprehensive permit review procedure. Most importantly, it gives the MOE great discretion and final authority over the approval of new power generation facilities. It requires the evaluation of the effect of a broad spectrum of activities (including the construction, expansion, reconstruction and conversion of power generation facilities) on air, water, land, flora, fauna, "protected areas," landscape, people, residential settlements and cultural heritage.

Thermal power stations with 300 MW or greater capacity are under the exclusive jurisdiction of the MOE. Other "industrial" electrical generation facilities, hydroelectric facilities and overhead transmission lines are under the MOE's jurisdiction if their impact extends beyond the Regional Environmental Inspectorate in which they are located, if they

discharge more than 30 liters per second of waste water, if they burn more than 750 kg of waste (averaging period not specified), or if the value of the project exceeds 50 million Leva ($2 million). Otherwise, they are under the jurisdiction of the Regional Environmental Inspectorate. Article 20 requires that assessments of "large" polluting facilities must be made at least once every five years.

EEEs must be prepared by experts, who must certify that they are professionally competent and that they have no direct interest in the facility and have not participated in its design. Article 23 requires that the MOE, or the Regional Environmental Inspectorate if it has jurisdiction, review the EEE and organize a public meeting on at least one month's notice to interested parties. It will issue its decision within three months of the hearing. Appeals may be lodged within 14 days, or within 30 days for projects of national significance. The statute requires the reviewing authority to prohibit the implementation of projects for which the assessment is not complete or is negative, or which are not equipped with the necessary pollution control equipment. Finally and importantly, the statute provides that the state is responsible for the cost of remediation of pre-existing pollution at industrial sites.

It should be noted that this Law does not supersede the many other environment-related statutes, dating back to the 1950's, which remain on the books. It has been estimated that over 120 of such laws are in force, including seven of potentially direct relevance to independent power development. However, the relationship of the new statute to the old statutes is not yet clear. In addition, other new environmental statutes dealing specifically with air, water and soil pollution are now being prepared. It is expected that they will expressly supersede some, but not all, of the prior legislation. Regulations dealing with environmental audits of existing facilities are also being prepared.

iii) Property and Resource Rights Legislation

Law on the Ownership and the Use of Agricultural Lands: Articles 31 and 33 of this Law establish the Ministry of Agriculture and the Municipal Land Commissions as the jurisdictional authorities over land ownership issues. This law's primary thrust is the restitution of farmland to those owning it prior to collectivization, or to their heirs. It also prohibits the ownership of (but not the lease of) arable land by foreign individuals, foreign companies and domestic entities with more than 50% foreign ownership. However, the use of arable land for other than agricultural purposes is strongly discouraged by both the statute and the Constitution (Article 221bis of the Penal Code provides for fines and up to three to five years' imprisonment for persons, presumably but not explicitly government officials, permitting non-agricultural uses of agricultural land). Therefore, the development of new power facilities on land which is classified as arable is unlikely. However, the definition of arable land in Article 2 of the law specifically excludes land within community boundaries, forest domains (which should be distinguished from agricultural land which has been reforested), and land on which industrial, commercial, and energy facilities and their yards and ancillary facilities have been built.

There is an expectation that the Parliament will soon consider the enactment of similar legislation for the restitution of expropriated forest land. Although forest land is not afforded the same constitutional status as arable land, use for industrial or commercial purposes is strongly discouraged.

In the past decades, many of the industrial facilities now being privatized were sited on agricultural land. Apparently they are now properly classified, along with the underlying real property, as state assets under the Law on Conversion and Privatization of State Owned Enterprises. The definitional provisions of the two statutes, however, leave some ambiguity on this issue. The boundaries between the industrial and agricultural properties also are likely to be subject to some dispute.

Several other laws for the purpose of restitution have also been enacted: for nationalized immovable property; certain nationalized property; and certain shops, workshops, warehouses and pharmacies. There are other laws, such as the 1951 Law on Contracts and Obligations, which have potential relevance to site acquisition. An exhaustive review of such laws is beyond the scope of this report, and in any event this law and many others are expected to be repealed if and when a new law on the same subject is passed by the Parliament.

iv) Privatization and Investment Legislation

Foreign Persons' Business Activity and Foreign Investment Protection Act: This law provides foreign individuals and foreign domiciled entities the right to do business in Bulgaria on equal terms with Bulgarian entities. Article 7 further provides that foreign persons are entitled to most-favored-nation treatment if an international agreement so provides (the U.S Trade Agreement became effective in 1991 and includes a most-favored-nation clause).

Foreign individuals and entities can freely open bank accounts, deal in securities, convert leva into dollars and repatriate both income and capital. Under Article 5 they can own improvements to real property and they can lease land, but neither foreign persons nor domestic entities with majority foreign ownership can own agricultural land. There is no apparent restriction on the percentage of foreign ownership in a Bulgarian company owning non-arable land. A 100% foreign-owned company with Bulgarian domicile should therefore be able to own industrial assets, including the real property.

Article 12 provides that claims can be secured by pledge or by mortgage, although Article 11 also requires foreigners to register their investments assets, and changes thereto, with the Ministry of Finance.

The provisions of this Law also govern labor and social insurance issues. They stipulate that an employment contract will provide the basis for the relationship between employer and employee, and, to the extent issues are not covered in the contract, the Bulgarian legislation

shall govern. However, certain basic contractual issues (hours, minimum wage, termination notice and payment, occupational hazard protection) must conform to Bulgarian Law.

Law on Transformation and Privatization of State-Owned and Municipal Enterprises: The scope of this law is the privatization of industrial, commercial, construction and transportation companies. It therefore is relevant mainly to IPP participation in industrial cogeneration. It may also be relevant to investments in refurbishing utility-owned plant. It provides for privatization through the sale of state enterprises, either before or after their conversion into commercial companies.

Large state-owned (as distinguished from municipally-owned) companies whose book value of fixed assets is over 10 million Leva will be privatized by the Privatization Agency, with the approval of the Council of Ministers in the case of book fixed assets over 200 million Leva. Companies with a book value of fixed assets at or below 10 million Leva are privatized through the relevant ministry. These smaller companies can also be acquired through lease-purchase arrangements, management contracts with purchase options, installment sales and conditional sales. Municipal companies of any size will be privatized by the Municipality in question.

Decree No. 105 of the Council of Ministers regulates the process for enterprises which are put up for auction, and foreign persons may participate freely in auctions subject to the restrictions on ownership of land.

In principle, it should not be difficult for investors in, and lenders to, independent power projects to obtain clear title to project assets, even those subject to claims of restitution, as sales of property under this statute will in most cases be without encumbrance. However, it appears that Article 18 provides claimants a preemptive right to shares in enterprises built on expropriated or collectivized land, in some cases limited to two months after the promulgation of the privatization decision. A transitional provision also makes voidable a "disposal transaction" of state or municipal property under "apparently unfavorable conditions" after 1989. Land ownership and lien records are addressed in Section IV(2)(e) below.

The first of three parts of a **Commercial Code** has also been enacted by the Parliament. It defines the permissible organizational forms for transacting business in Bulgaria and the associated obligations, rights and procedures. It is generally consistent with western European practice.

v) Conclusions on the Policy and Regulatory Framework

Bulgaria has made a positive effort to establish a favorable legal framework for attracting international capital. The passage of the Law on Electrical Energy will be another important step in that direction. Whether the preference for IPPs contained in the draft Law will attract a broad spectrum of potential investors and thereby create long-term active competition in the power generation sector will depend on several additional factors. These

factors are also relevant, but of less concern, to project sponsors negotiating specific projects in parallel with the efforts recommended below.

The content of the implementing regulations will be an important factor. If those regulations provide prospective independent power investors with an expectation of equitable treatment and reasonable certainty of a rational selection process, one important leg of the policy and regulatory framework for IPP development will be in place. See the Conclusions to the following Section on institutional issues, and Recommendation 3.

A final recommendation concerns the consolidation of the project review process. In light of the uncertainties surrounding existing statutes and their administration, it would be helpful to consolidate the authority for project approval as much as possible. The Certificate of Need does not incorporate the considerations of other concerned agencies. It would be helpful if the COE's statutory authority were expanded to enable it to become a central clearing house for all or most of the permits required, as described in Recommendation 1 of Chapter V.

Most important, it will depend on investors' confidence in a rational and consistent legal and regulatory system. Bulgaria's economy is in a transitional phase, and so are its legislation, regulations and policies. The direction of the policies has become clear, but the legislative basis for implementing those policies is still in a formative stage. A great deal of pre-1989 legislation remains in force, including some which is still relevant to concerns of potential investors. Examples include the 1951 Law on Contracts and Obligations and a series of environmental laws on water, air and land pollution. How those laws relate to recent legislation will require clarification. As noted in the text of this section, a number of the new laws also contain provisions which are also likely to concern potential investors.

The Parliament is currently working on legislation to replace the earlier statutes, and much other new legislation is also in preparation. These efforts are still in a relatively early stage, so it cannot be concluded that a rational and consistent system of laws and regulations is yet in place. The associated uncertainties will make it difficult to attract international capital to the broad power sector in the near term. However, every effort should be made to promptly incorporate the newly enacted statutes and the prior legislation into a consistent framework. [See Recommendation 1 of Chapter V]

To attract international capital there should also be an established and reliable system of legal recourse. A detailed evaluation of the Bulgarian legal system is beyond the scope of this report. However, as with the economy and the legislation, the judicial system in Bulgaria is in transition from serving as an arm of the state to acting as an independent judiciary. It will therefore probably be necessary for all parties to an independent power contract to submit to binding dispute resolution by an independent third party in a neutral jurisdiction, possibly outside of Bulgaria. Such a Provision should be included in the contract forms suggested under Recommendations 9 and 10 of Chapter V.

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2) The Existing Institutional Structure

a) Committee of Energy, NEK, and Energoproekt

The COE is appointed by and reports directly to the Council of Ministers. The Parliament also has a **Commission on Energy and Energy Resources**, a 13 member body which provides legislative oversight of the COE and the energy sector generally. The COE is the governmental department charged, among other things, with general oversight of utility operations and encouragement of the independent power sector. In addition to responsibility for the generation, transmission, distribution and use of electric power it is responsible for oversight of the coal industry and the district heating sector, although some of the latter facilities are expected to be transferred to Municipal control. Its functions do not include mineral exploration or oil and gas exploration or production, which are under the jurisdiction of the Ministry of Geology, nor oversight of the petroleum, natural gas or petrochemical sectors, which are under the Ministry of Industry.

A recent organization chart showing the responsibilities and functions of the COE and other agencies with involvement in the energy sector is found in Figure 5. The World Bank recommended, in their April 30, 1992 study of the energy sector, that other energy-related organizations operating under the jurisdiction of the Ministry of Industry and the Committee of Geology (see below), be consolidated under the jurisdiction of a single energy agency. It also recommended that the district heating companies be subjected, along with NEK and Bulgargaz, to the regulatory authority of a newly created energy regulatory authority.

The general functions contemplated for the COE were described in the section "Relevant Legislation -- The Law on Electrical Energy." Specifically, the draft statute provides that the COE will be charged, among other things, with assuring that the electrical energy needs of the nation are met, with stimulating efficiency and economy in the sector, with creating conditions for competition in the production and distribution of power, with creating preferential conditions for IPP supply, and for protecting the interests of consumers, citizens, and the environment.

The draft Law also contemplates the creation of a "Commission on State Energy Regulation" which will be delegated certain of the COE's responsibilities to protect consumer interests. That nine-member commission would consist of three members from the COE (with one serving as Chairman), the Ministers of Finance, Industry, Transportation, Commerce and Social Welfare, along with a representative of the Council of Consumers. Pending passage of the legislation creating this commission, the Council of Ministers recently decided to establish a temporary group called the **Inter-Institutional Commission on State Energy Regulation.** This four-person organization, comprised of the Deputy Ministers of Finance, Industry, Social Welfare and Prices, are delegated the COE's responsibility to protect consumers' interests with regard to the price and reliability of electric energy.

NEK, The Natsionalna Elektricheska Kompania, currently owns over 85% of Bulgaria's electric generating resources and essentially all of its transmission and distribution facilities. Its distribution system serves NEK's consumers through 28 branch organizations. NEK was formed as a joint-stock company in 1991. Its shareholders (currently the sole shareholder is the State, with voting power exercised by the Council of Ministers) elect a Chairman and six members to the Company's Supervisory Board. The Supervisory Board then appoints the six-member Managing Board, including the Company's President and Vice President.

NEK is now, and will be, the purchaser of all power sold to the grid by independents. It has negotiated parallel generation agreements with ten cogenerators and nine district heating plants, aggregating approximately 1000 MW of currently available capacity (a number of small hydroelectric facilities have also signed contracts with the utility, but they do not have consistent provisions). The agreement is a standard form of contract effective for one year. Prices currently paid to the independent suppliers are negotiated within a narrow band equal to NEK's own industrial tariff rate, less 15% to 18% for unavoidable administration costs and losses. A twenty percent premium is due to independent generators when they generate power at the request of NEK and would not otherwise be generating thermal energy for their own needs.

The NEK standard power purchase agreement (as found in the Appendix) contains many terms familiar to independent power developers in the US The provisions of Article 12, which requires payment by the utility on the day following receipt of the invoice, is less familiar. Other provisions commonly required by IPPs and utilities in the US and international market are not included, for several reasons.

First, the complexities associated with mobilizing international capital have been addressed in an earlier section. They obviously have not been relevant to NEK's negotiations with Bulgarian cogenerators to date.

Second, the price structure of the energy sector has historically provided no incentive to the Bulgarian industrial and district heating cogenerators to generate excess energy, and any such energy has been a necessary byproduct of each facility's own energy needs (see, for example, PPA Article 5). NEK should include more stringent dispatch and equivalent availability requirements in future cogeneration contracts.

Third, capital investment at cogeneration plants has been made independent of external power sales considerations, and the retail tariffs (and therefore the buyback rates) of the utility have been set without regard to capital recovery. This has resulted in negotiations based on variable cost-based pricing, adjusted annually to reflect changes in such costs. The determination of the utility's long-run marginal cost, including a capital recovery component, will provide a more realistic price signal to prospective sellers. Those sellers will also require more certainty of capital recovery than can be realized by annual renegotiations, with the associated potential for reductions in capital recovery factors. Independent generators will therefore require contracts with a fixed price component (normally the capacity portion of a

two-part tariff) for a term at least sufficient to retire debt obligations associated with the project.

In developing a new model agreement the utility may require much more detailed information about the design, financing, construction, and operation of an IPP than has been the case in the past. In addition it may require development and operational security deposits from the developer. It should establish clear performance milestones and dispatch, operating reliability, and availability targets which are tailored to the characteristics of the IPP and the needs of the utility. A system of penalties for deficient performance and bonuses for superior performance may also be considered. While the temperature- and part-load-dependent operating characteristics of the IPP's technology are not of direct concern to the utility, dispatch and variable pricing provisions should reflect operating reality. Likewise, capacity and reliability testing and evaluation should be done on a consistent basis for utility plants and IPPs.

One of the most difficult issues to incorporate into the IPP contract in any context is excuse of performance for force majeure, and particularly excuse for fuel interruptions. Again, the IPP should be required to perform with the same assurance of reliability as the utility would reasonably expect from its own units, if similarly situated. One of the primary advantages to a utility of contracting for independent power is the shifting of construction and (usually, non-fuel) operating risk to the IPP. The associated risks are readily controlled by the IPP, so the cost to the utility of that service should be quite small and outweighed by the benefits. It is not recommended, however, to allocate risks to IPPs which are beyond their control or beyond their expertise. The IPPs will then price the risk conservatively, either increasing the real price of power to the utility or leaving the market, leaving the risk with the utility in any event.

While US and international contracts are normally much more complex in structure than the current NEK form of agreement, in most fundamental respects the two are similar. With the above-noted elaborations to define the additional obligations and assumptions of both project as well as certain aspects of political risks by the parties, the NEK form should be readily adapted to future use. [See Chapter V, Recommendation 10]

Energoproekt, established in 1948, has acted as the planning, research, engineering and design group for the COE and NEK. It is in effect a fully integrated design and engineering firm organized into 7 divisions, including hydropower, thermal power, transmission and distribution, nuclear energy, automation, research, and engineering investigations. It has extensive domestic and international experience, having involvement with the design, construction or execution of over 100 major projects around the world.

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b) Ministry of Industry

The Ministry of Industry has responsibility for a substantial number of energy-related sectors. The organizational chart found as Figure 6 illustrates the organization of the Ministry. It has Neftochim, which operates a large refinery at Bourgas, and two smaller refineries under its jurisdiction. It also controls petroleum products distribution and transportation fuel marketing through Petrol, and controls natural gas transportation through Bulgargaz, the state pipeline company. Finally, it controls the marketing of household fuels (briquettes, LPG and coal) through Toplivo. Mineral, oil and gas exploration is under the jurisdiction of yet another energy-related organization, the Committee of Geology. The Ministry of Industry has authority over a number of facilities which have a significant thermal load and might prove to have economic cogeneration potential, including the Bourgas petrochemical facility, the Kremikovtzi steel facility, and the Chimco Vratsa fertilizer plant.

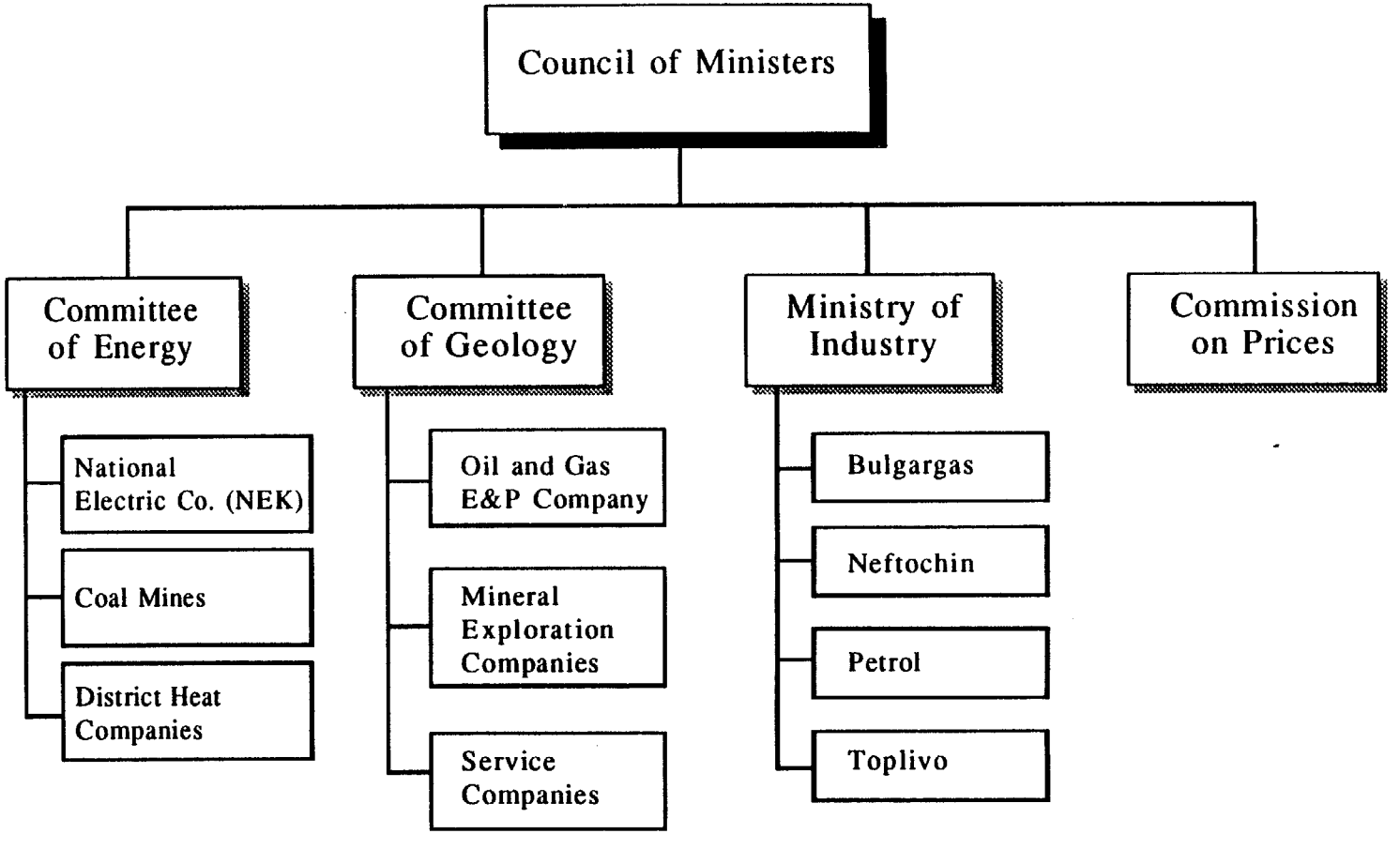
c) Ministry of the Environment

The Ministry of the Environment (MOE) has a broad Constitutional and statutory mandate to establish a clean and healthy environment in Bulgaria. As described earlier, it also has a great deal of discretion under the Law on the Environment in the review of proposed construction or modifications. It maintains headquarters and a research center in Sofia and is organized into six departments, including water, air and soil protection. The Monitoring, Research and Information Center collects and publishes ambient data from its monitoring activities and other sources (the Ministry of Health and the Institute of Hydrology and Meteorology also collect environmental data) in a quarterly bulletin. The MOE is divided for administrative purposes into sixteen regions, called "Regional Environmental Inspectorates," which are responsible for surveillance and enforcement of the Law on the Environment. The regional division boundaries are not coterminous with the administrative Districts described in Section (e) below.

Ambient air data is collected at over 100 sampling locations, 60 of which are operated by the MOE, and almost all of which are located adjacent to urban and industrial complexes. In addition, the MOE has a mobile monitoring lab. Historical data are of questionable value due to irregular or inconsistent sampling and testing procedures. However, the European Community's PHARE program is providing substantial funding for new equipment and training programs and data quality is expected to improve accordingly. However, it will remain difficult to integrate information collected by the various agencies as the nine administrative oblasts, the 16 Regional Environmental Inspectorates and the 28 districts used by the Ministry of Health all have different boundaries.

Water quality data are collected for surface waters at approximately 200 sampling points and at 276 groundwater monitoring points. A hydrogeology yearbook is published by the MOE. The MOE also periodically monitors point source discharges.

Bulgaria: Current Organization of the Energy Sector



Source: World Bank, 1992

Figure 6

The process for obtaining environmental approvals was discussed earlier in this report, as were the EEE regulations stipulating the lead jurisdiction for review of environmental impact. Whether it is the headquarters or the Regional Inspectorate, prospective investors should expect significant delays in review due to the enormous responsibilities which are assigned to the MOE staff and the limited resources available to them.

Upon approval of the EEE, application for a construction permit can be made to The Ministry of Construction and Regional Development, which has overall responsibility for building codes and authorizations. For smaller projects of primarily local concern, MOE will likely delegate its authority to the Municipality concerned. For projects of national significance, review and approval will be coordinated from Sofia.

It was noted in the prior section that in addition to the Law on the Environment there are more than 120 older statutes regulating environmental matters, including seven which may be of direct relevance to a proposed power project. While they do not have the strong enforcement provisions of the new law, they technically remain in effect and should be reviewed by prospective investors.

d) National Council on Water

The primary role of the National Council on Water (NCW), which has 12 members representing the large water users of the nation, currently is the preparation of monthly water allocation plans for water resources from 22 multiple purpose dams in Bulgaria. The COE, which controls the impoundments, is responsible for implementation of the plan. The priority of use is as follows: human consumption, livestock consumption, industrial needs, agricultural needs, and power generation. There are recent instances of shortages even for human consumption purposes, and, in fact, in early summer 1993 reservoir levels are critically low.

The issuance of a Certificate of Need by the COE will be conditioned on coordination with the NCW. The siting and design of new thermal plants will certainly have to take into account the occasional scarcity of water for power generation uses. It is unlikely that the NCW would have any objection to a run-of-river hydroelectric facility, or to an impoundment for which the operation would not interfere with downstream allocations. On the other hand, subordination of operation of a new project to the NCW's priorities might well reduce the value of the facility for power generation purposes.

e) Local District and Municipal Governments

Bulgaria is divided into approximately 250 Municipalities, or "Obshtina," each of which has a popularly elected Municipal Council and Mayor. The Municipal Council in turn appoints an administrative staff to perform executive functions for the Municipality. Each Municipality has a property office which maintains records of land divisions and ownership

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within its boundaries. However, recordation of mortgages is accomplished at Notarial registries which are maintained in conjunction with, and are located at, the local court for the jurisdiction. While investigations of ownership records should be relatively straightforward in most Municipalities, mortgage records are sometimes incomplete and often not maintained in any systematic fashion.

The Municipal Council has jurisdiction over matters of local interest other than those relating to the restitution of agricultural land. It collects local taxes. It also has the authority to issue bonds. Municipalities are responsible for providing local utility services such as water, waste water and solid waste disposal. They can aggregate themselves to form a special purpose district, or "okolija," which can provide inter-Municipal services such as water supply, waste water disposal, or public transport.

Restitution of agricultural land is under the local jurisdiction of the Municipal Land Commission (MLC), the members and Chairman of which are appointed in each Municipality by the Minister of Agriculture. Each MLC is required by the Law on the Ownership and the Use of Agricultural Lands to maintain a register for all applications for restitution and for all decisions rendered by the MLC.

The Municipalities outside Sofia are aggregated into eight regions, or "Oblasts," which serve as administrative units of the national government. The Governor of the Oblast is appointed by the Council of Ministers for a four year term. The Municipalities comprising Sofia are considered a special region and have a popularly elected Mayor, rather than an appointed Governor.

As noted earlier, the Municipalities may soon be the owners of the district heating plants, They would then be responsible for management or privatization of those assets. The transfer of the district heating plants to the Municipalities is under active debate in Parliament, since most Municipalities are ill-equipped to manage them.

f) Conclusions to the Institutional Structure Evaluation

As noted in the conclusions to the previous section, Bulgaria has taken a number of positive steps in establishing the necessary IPP policy and institutional framework, as found in the leadership being taken by COE and NEK and the draft Law on Electrical Energy. The passage of the Law on Electrical Energy by the Parliament will be an important step in developing an IPP market, particularly with regards to the establishment of an independent regulatory body, but the effectiveness of the draft Law in creating an active long term market will depend on the policy and regulatory factors already cited. IPP developers negotiating specific projects will be equally concerned with institutional attitudes and competence.

The success of independent power will depend to a large extent on the attitudes of the institutions involved. In the US independent power industry development experience, utilities

initially had a bias in favor of building their own plants. Over time they developed an appreciation for role of independent generation. The extent to which the independent power industry develops in Bulgaria will depend on whether NEK sees it in its own interest to encourage this competitive generation market. It is recommended that NEK develop an institutional policy in favor of independent power and specific goals be set for NEK and its negotiating team against which specific progress can be measured. [See Recommendations 6 and 7 of Chapter V]

The use of integrated resource planning techniques to establish pricing and to evaluate proposals will also demonstrate NEK's commitment to a rational and equitable selection process. [See Recommendation 5 of Chapter V]. Further comfort would come from the development of a model contract for large projects addressing the principal non-price terms of concern to investors. [See Chapter V, Recommendation 10; this issue, and the related issues addressed in recommendations 6 and 8, are the most critical for sponsors of specific projects prior to the establishment of a stable and favorable regulatory framework.]

Long term success will also depend on the attitude and authority of the COE. It is ultimately the regulatory authority which must define the policies of the utility sector, and then encourage or enforce compliance with those policies. The development of detailed regulations by or under the supervision of the COE will be an essential element in defining the policies, but the application of those regulations will be crucial to the confidence of the international markets.

To that end, the staff of the regulatory body should be selected and trained to provide full understanding of all issues which may affect utility policy or influence the analysis and decisions of the NEK negotiating team. [See Chapter V, Recommendation 2] Similarly, the NEK negotiating team should be selected and trained to assure their familiarity with the principles and practices of utility operations and power contract negotiations. [See Chapter V, Recommendation 8]

Lastly, the attitudes and capabilities of other governmental institutions will be important. The MOE, in particular, will undoubtedly play an active role in the review of power plant projects. The control of environmental impacts from power plants is a complex and technical matter and is likely to strain the limited resources of that staff. It is in the interest of all concerned to include representatives of other agencies in educational processes which will increase their understanding of the potential and the limitations of power plant emissions controls. Close cooperation between different government agencies on the various permitting requirements for power projects (e.g. environmental, water rights, land use, etc.) will greatly facilitate the process of developing a commercial independent power market.

V. SUGGESTED APPROACHES FOR THE INTRODUCTION OF A POLICY AND INSTITUTIONAL FRAMEWORK TO PROMOTE INDEPENDENT POWER AND PRIVATE INVESTMENT

Bulgaria is currently evolving from a centrally-planned economy to a market economy with a democratic government. The vast majority of relevant statutes and regulations are either newly created or do not yet exist. Even for those which do exist, the institutions which will administer the statutes and regulations are either newly created or are assuming new responsibilities. There is no history, therefore, which prospective investors can evaluate in order to gain confidence in the impartiality of the decision-making process. As a result, it would be desirable to strengthen the policy and institutional framework according to the recommendations discussed below.

1) Strengthen Components of Legislation to Facilitate Independent Power

The current draft of the Law on Energy will, when enacted, establish a favorable policy for the development of independent power in Bulgaria. In particular, it establishes a policy of favorable conditions for independent power, authorizes the execution of long-term power purchase agreements by the utility and establishes relatively clear conditions for the issuance of Certificates of Need.

However, the current draft does not provide for any governmental agency to have authority to issue a final approval on behalf of the Government of Bulgaria. In the US, the state regulatory commission's issuance of a Certificate of Need (or the FERC's issuance of a hydroelectric license) typically signals the satisfaction of all governmental review requirements other than emissions permits and local construction permits. In Bulgaria, there may be Ministries and governmental organizations which have authority over one or more aspects of a proposed project but which are not easily identified by prospective investors. The consolidation of many project review functions through the Evaluation of the Effect on the Environment ("EEE") process is helpful, although that process does not result in a final, determinative authorization to proceed with the project from any organization other than The Ministry of the Environment. It is, therefore, recommended that the EEE determination be made binding on any agency consulted or notified during the EEE process. It is further recommended that one government agency have the responsibility both to identify and coordinate with all jurisdictional authorities not included in the EEE process, and to make a final determination that the governmental approval process is complete. This coordination could logically be accomplished by staff of the regulatory body with the issuance of the Certificate of Need, which would signal the final approval of the project.

Similarly, as noted in the body of this report, there are other statutes which have ambiguities which could inhibit development of an independent power sector in Bulgaria. The privatization law, for example, apparently provides to former landowners preemptive rights

in state or municipal enterprises built on expropriated land, and makes voidable certain "disposal transactions," presumably sales, under "unfavorable conditions." Ambiguities also exist in other statutes, for example the Law on Ownership and Use of Agricultural Lands, which may make it difficult to assure clear title to prospective purchasers of formerly agricultural land. It is, therefore, recommended that a comprehensive review of all Bulgarian laws affecting the environment or property rights be undertaken, with the goal of identifying and clarifying any potential conflicts or inconsistencies.

2) Establish Power Sector Regulatory Institution and Ensure Staffing by Qualified Regulators

The absence of any history of utility regulation in Bulgaria makes it imperative that any such regulatory body be established both with clearly defined functions and authorities, with qualified staff and with resources adequate to fulfill their responsibilities. As the Bulgarian Government completes its deliberations over the regulatory model to be used, a study of necessary resources will need to be performed. Issues to be addressed at a minimum would be:

- Staffing and training of regulatory commission personnel in generation expansion planning and integrated resource planning;
- training of regulatory commission personnel in finance and accounting;
- hardware and software necessary to monitor and corroborate the integrated resource plans of the franchised utilities; and
- training of regulatory commission personnel in utility operational issues.

3) Develop and Publish Detailed Regulations

The evolving and dynamic nature of regulation in the power sector in countries worldwide, combined with the unaccustomed responsibilities of the entities implementing Bulgaria's utility regulatory systems, will give rise to concern by prospective investors about arbitrary or capricious administration of the regulatory policies. It is, therefore, important that the implementing regulations define with precision the requirements, for example, for timing and approval of generation expansion needs. It is recommended that the regulatory body consider requiring significant detail in utility IRP submittals while allowing NEK enough flexibility to optimize the process over time. Such details might include, in addition to the usual procedural guidelines, substantive technical requirements for type, format and availability of data, and modeling protocols, analyses and results.

The regulations will need to also set out detailed requirements for solicitations or proposals to supply additional capacity. These requirements should assure that capacity expansions and renovations are consistent with the Integrated Resource Plan and other policies of the Bulgarian government. Such regulations might prohibit the recovery of capital

investments made by NEK without authorization of the regulatory body and require the solicitation and analysis of alternative proposals prior to authorizing the utility to proceed with its own construction.

4) Establish Central Information Clearinghouse for IPP Developers

In order to counteract the unfamiliarity of many potential investors with Bulgaria and its institutions, it is recommended that the Committee of Energy (COE) or NEK assemble and make available information on the institutional framework, as well as technical data, such as hydrology at prospective hydroelectric sites or thermal demand at cogeneration facilities, which would be of interest to project developers.

COE or NEK would be advised to consider making the information on the utility's least-cost plan assumptions, modeling methodology and results available to prospective investors. Most importantly, this would allow project developers to optimize their project configurations to the needs of (and the benefit of) the utility system. It would also give investors added comfort that the technical and economic evaluation process is handled equitably.

Finally, it is recommended that an information package providing potential power developers with relevant details about conditions in Bulgaria be prepared and distributed on request and at industry conferences.

5) Use Integrated Resource Planning (IRP) to Establish Long-Run Marginal and Avoided Cost pricing and Project Selection

One goal of the IRP planning process should be to establish the power project costs from which project developers as well as utility planners can evaluate the cost-effectiveness of their proposals. It should be recognized that these cost figures will change over time based on the state of technology and market conditions. In the face of uncertainty, the fair estimation of such costs is an essential component of rational utility and IPP decision making. It is also necessary to provide independent suppliers with a fair price for their production while protecting the utility from paying windfall profits to those suppliers.

Proposed projects large enough to have an impact on system economics should be evaluated in the utility's model and compared to the utility's base case plan with respect to economics and reliability.

6) Establish Consistent Policy Regarding Government Guarantees of Utility Performance

Given the limited experience of NEK and other Bulgarian public and private entities in operating as financially sound and independent institutions, it is highly likely that a foreign

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investor and developer would require the Government of Bulgaria (GOB) to provide guarantees and other incentives. For instance, the GOB may need to guarantee that NEK will honor its commitments in the power purchase agreement with a developer. Should NEK, for whatever reason, not be able to pay the developer according to the terms of a signed power purchase agreement, the GOB would provide the financial resources necessary to honor the contract. Developers may also seek guarantees from the GOB regarding the performance of government-owned fuel suppliers and the National Bank of Bulgaria. Finally, it is likely that the GOB will be asked for support with respect to foreign exchange availability, force majeure, and other related issues.

Based on the requirements in the international independent power market, the GOB will need to develop a policy regarding what types of guarantees and incentives it is willing to provide. In the early phases of developing Bulgaria's independent power market, it may be necessary to provide substantial guarantees and assistance, but as the IPP market matures and the perceived risks diminish, it would be possible to reduce the type and scope of support offered.

7) Establish Policy for Soliciting Independent Power

NEK may chose to negotiate with the proponents of unsolicited proposals in the early phases of IPP market development in order to overcome the unfamiliarity of project sponsors with conditions in Bulgaria. In more mature market phases and when project precedents have been established, it may be desirable to move to a competitive bidding format. The advantage of competitive bidding is that it can result in lower electricity rates and more favorable terms for the utility and the consumer. Given the substantial costs of preparing an independent power proposal, however, competitive bidding can slow down the project selection process and discourage participation by developers.

8) Establish and Train a Multi-Disciplinary Review and Negotiations Team

In order to protect the purchasing utility's interest while allowing for expeditious selection of project proposals and resolution of unresolved contract issues with their sponsors, it is recommended that a multi-disciplinary review and negotiation team be established at NEK. The team should be comprised of engineers with experience in generation, transmission and distribution operations, fuel procurement, planning and central dispatch. It would also include lawyers specialized in Bulgarian administrative law and procedure. All members of the team would receive training in the principles of contract law and international and project finance.

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9) Provide Standard Offer Contracts for Small Renewable and Cogeneration Projects

The development of smaller projects can prove significant to Bulgaria by expanding the use of indigenous energy resources and renewable fuels. However, the transaction costs associated with extended negotiations of price and terms with a purchasing utility can be a major deterrent to potential investors. The elimination of this deterrent through establishment of a "Standard Offer" is recommended.

To implement this recommendation, it will be necessary to establish a class of favored generation technologies and a maximum size for each project which will permit economic development of the resource and the project without adversely affecting NEK's planning or operating characteristics. It will also be necessary to establish a purchase tariff (including terms and conditions) which is structured to assure reliable operation of the facility and pricing which fairly reflects avoided costs. Energy price indexing should be considered, as should capital cost indexing. The terms of the Standard Offer would be non-negotiable; nonetheless the project sponsor would create an effective long-term contract by merely signing and delivering the offer.

10) Provide Standard non-Price Terms for Large Projects

For larger projects it is not recommended to provide "Standard Offer" contracts. NEK will need to have much more detailed contract provisions and project information because large IPPs can have a material effect on utility system economics and reliability. The non-price terms and conditions under which the purchasing utility proposes to buy power are just as important as the price. The preparation by NEK of a model contract which addresses the principal non-price concerns of investors (such as discussed in Recommendation 6) and allocates risk fairly, could only serve to promote the rapid development of independent power in Bulgaria.

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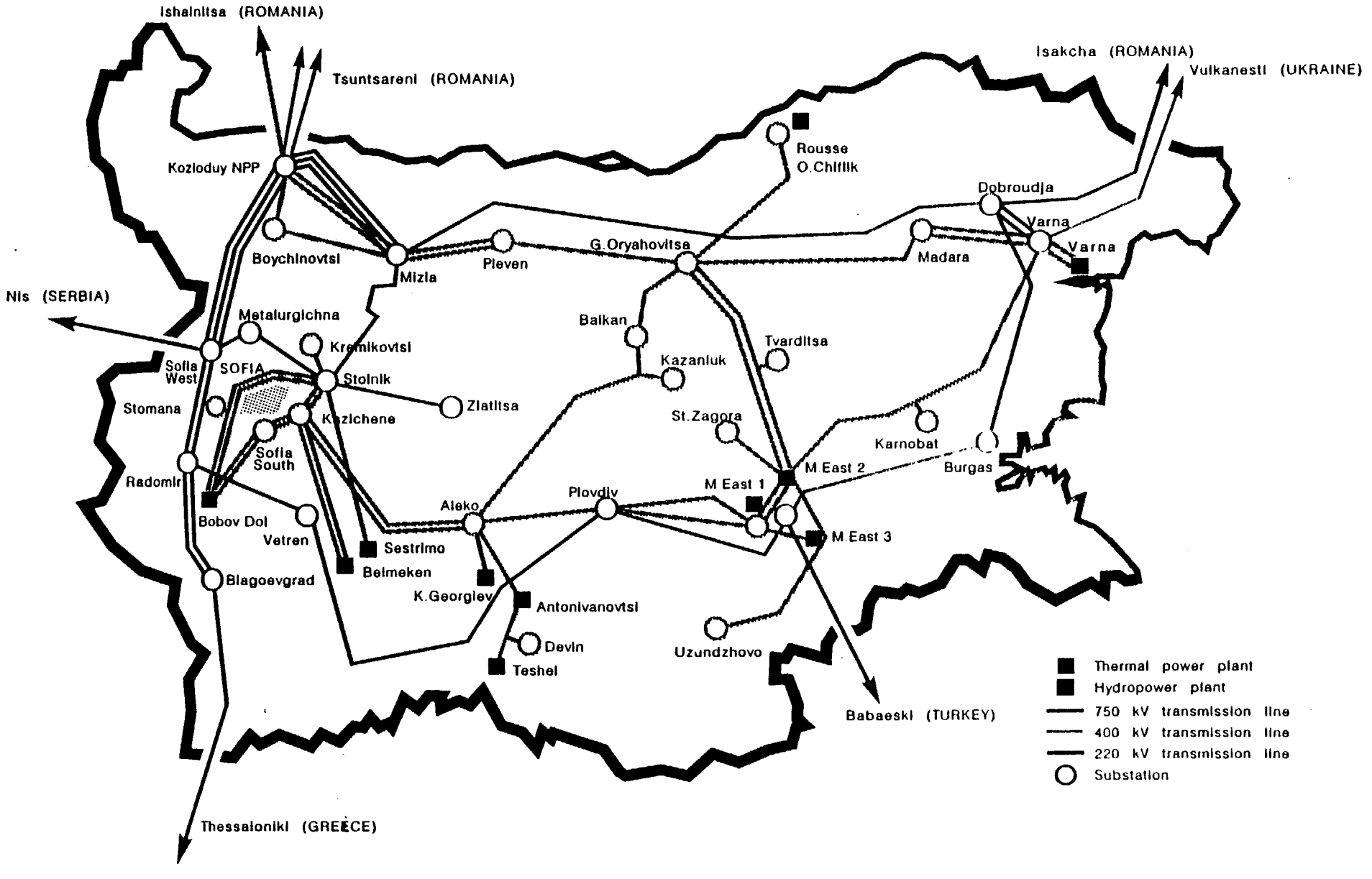
Appendix A

Map of Bulgaria Power System

Electric power system of Bulgaria



Source: NEK

Appendix B

Statistics on Major Power Project Rehabilitation and Repowering Opportunities in Bulgaria

BULGARIA DISTRICT HEATING PLANT REHABILITATION/REPOWERING OPTIONS

District Heating Plant	Retirement Year	Rehab Year	Power After Rehab (MW)	Increase in MW	Rehab Cost $/kW
Sofia					
Unit 4	1994				
Unit 5	1994				
Unit 6	2010	1995	104	99	300
Unit 8	2011	1996	240	220	300
Tsaicho Kostov					
Unit 1	2010	1995	142	122	275
Unit 2	2010	1995	142	122	275
Unit 3	2011	1996	142	122	275
Unit 4	2011	1996	142	122	275
Unit 5	2011	1996	312	257	275
Russe					
Unit 1	1998				
Unit 2	2000				
Unit 3	2010	1995	110	25	225
Unit 4	2011	1996	110	25	225
Unit 5	2013	1998	60	10	315
Unit 6	2015	2000	60	10	315
Shuman					
Unit 1	2010	1995	54	50	482
Unit 2	2011	1996	82	78	488
Unit 3	2011	1996	46	42	472
Republica, Pernick					
Unit 2	1993				
Unit 3	2009	1994	30	10	50
Unit 4	2009	1994	25	5	50
Unit 5	2010	1995	55	15	50
Unit 6	2026				
Pleven					
Unit 1	2012	1997	83	75	466
Unit 2	2012	1997	94	86	473
Unit 3	2013	1998	118	110	486
Plovdiv					
Unit 1	2005				
Unit 2	2011	1995	119	99	308
Unit 3	2009	1994	142	122	275

Source: World Bank, Bulgaria Power Demand and Supply Options, May 4, 1993

BULGARIA INDUSTRIAL PLANT REHABILITATION/REPOWERING OPTIONS

Industrial Plants	Retirement Year	Rehab Year	Power After Rehab (MW)	Increase MW	Rehab Cost $/kW
Burgas					
Unit 1	2012	1997	498	398	300
Unit 2	2012	1997	584	524	289
Devnia					
Unit 2	2010	1995	332	292	340
Unit 3	2011	1996	162	152	344
Unit 4	2011	1996	122	112	357
Kremikovtzi					
Unit 1					
Unit 2	2013	1998	238	193	306
Unit 3	2013	1998	238	228	307
Vratsa	2013	1998	284	244	274
Stara Zagora					
Unit 2	2013	1998	236	224	356

Source: World Bank, Bulgaria Power Demand and Supply Options, May 4, 1993

MAJOR BULGARIAN POWER PLANT CANDIDATES FOR REHABILITATION

Plant	Retirement Year	Rehab Year	Power After Rehab Gross MW	Increase in Output MW	Rehab Cost $/kW
Maritsa East 2					
Unit 1	2010	1995	150	30	141
Unit 2	2011	1996	150	30	141
Unit 3	2012	1997	150	30	141
Unit 4	2013	1998	150	30	141
Unit 5	2014				
Unit 6	2015				
Unit 7	2018				
Unit 8	2022				
Varna					
Unit 1	2010	1995	210	0	221
Unit 2	2010	1995	210	0	221
Unit 3	2010	1995	210	0	221
Unit 4	2011	1996	210	0	141
Unit 5	2011	1996	210	0	141
Unit 6	2012	1997	210	0	141
Bobov Dol					
Unit 1	2009	1994	200	20	173
Unit 2	2010	1995	200	20	173
Unit 3	2011	1996	200	20	173

Source: World Bank, Bulgaria Power Demand and Supply Options, May 4, 1993

Appendix C

Standard Power Purchase Contract Between NEK and District Heating or Industrial Cogenerators

Standard 1993 Contract
Between NEK and
District Heating or Industrial Cogenerators

Today, 1993, in Sofia, between:
_____, represented by
_____, hereafter called "IPP", on the one side
and Natzionalna Elektricheska Kompania - Joint Stock Company, represented by the Chairman of the Board of Directors DYANKO DOBREV, hereafter called "NEK" concluded this contract, as follows:

I. SUBJECT OF THE CONTRACT

Article 1. Subject of this contract is the insurance of parallel work of the generating capacity of the IPP with the country's electricity system and the purchase of electricity during 1993.

NEK maintains the electricity system in normal condition of parallel work and ensures the supply to the consumers of the IPP in case of failure.

II. TECHNICAL AND ORGANIZATIONAL CONDITION

Article 2. The electricity is scheduled by quarters, months and tariff zones according to the specification which is an integral part of this contract.

In case a change in the quantities of electricity is needed, the parties make the required amendments of the contract not later than 5 days before the end of the respective quarter.

Article 3. The Maintenance and Repair Program of the generators of the IPP with fixed starting dates and length is coordinated with NEK. The changes should be coordinated in writing 5 days before small-scale repairs or 30 days before capital repairs.

Turbogenerators or stream generators can be disconnected and repairs can be conducted after approval of an operational application by the District Dispatch.

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Article 4. When requested by the Central Dispatch, the IPP is obliged to change the reactive power of the generators within the limits of their technical specifications.

Compliance with this obligations is ascertained by monthly revision of the meters for reactive energy on the generators of the IPP and of the hourly records of the reactor power in the operational journals of the IPP.

Article 5. The IPP will sell the agreed electricity on the basis of load on the steam extraction according to the characteristics of the turbogenerators which are an integral part of this contract.

Article 6. On request by the Central Dispatch for greater quantities of electricity than produced by the IPP according to the steam extraction by taking into operation additional spare equipment for a definite period of time, NEK pays the additional quantities at a price 20% higher than the average for the month, against an invoice according to the provisions of Article 12.

The two parties are obliged to fix the beginning and the end of such an event in the respective operational journal of the District Dispatch and the IPP.

The quantity of electricity under this article is determined by a bilateral protocol between the respective District Dispatch of NEK and the IPP, which is prepared on the basis of the records in the operational documentation.

Article 7. The IPP is obliged to keep the equipment in good condition, to exercise control and to notify NEK immediately in case of switch-on of the relay protection, automation and signalization of the equipment, related to the functioning of the electricity system, as well as of the communication means and telemechanics.

Article 8. The IPP is obliged to keep in good condition the devices for automatic frequency disconnection and the other automatic regulation devices, so that its own demands, the demands of the clients of the IPP and some important clients of the electricity system are met in case of disconnection of the IPP.

The set-up of the relay protection and automatics, ensuring the combined work of the IPP with the electricity system in normal and emergency regimes, is in the competence of the NEK's bodies and is carried out against payment when caused by changes in the IPP.

The IPP is obliged to follow all NEK's instructions with regard to the relay protection and automatics, including the after-failure tests of these devices.

Article 9. The IPP is obliged to execute the orders, issued by the District Dispatch or NEK, related to the functioning of the equipment which is operationally linked with the District Dispatch and the Central Dispatch, in compliance with the instructions for operational management of the electricity system.

III. MEASURING AND PAYMENT OF ELECTRICITY

Article 10. The purchased electricity will be measured by means of electrometers for active and reactive energy, provided and installed by the IPP on the property borderline between the equipment of the two parties.

The reading of the electrometers is done at 0 a.m. on the first date of each month by authorized representatives of the contracting parties, who draw up a protocol for the purchased during the month electricity.

Testing, regulation and replacement of the electrometers, according to which the electricity is measured and purchased, is carried out at the request of one of the parties in the presence of representatives of both parties.

Article 11. The IPP sell to NEK the contracted quantity of electricity according to the indications of the three-tariff electrometers for the respective month for the tariff zones.

Article 12. The payment for the electricity is effected by direct bank remittance by payment order at prices according to the actual Electricity Tariff.

The IPP is obliged to submit to NEK an invoice for the quantity of electricity sold during the previous month not later than the fifth day of the current month.

NEK submits a payment order to the servicing bank on the day following the day of receipt of the invoice.

In case of delayed payment, NEK pays the central interest rate on the amount due.

IV. PENALTIES

Article 13. In case of violation of Art. 3, Art. 4, Art. 8 and Art. 9 the IPP pays NEK a penalty amounting to 0.05% of the value of the quantity of electricity contracted for the respective month.

Violation of the contract are ascertained by a commission, comprising members of both parties.

Article 14. In case the purchased electricity exceeds or is less by more than 5% than the contracted amount, the IPP pays NEK a penalty for the difference, amounting to 10% of its value.

The IPP assumes no liability for electricity not supplied because of damages in the transmission equipment of NEK.

In cases of natural disaster (acts of God), both parties are exempted from liability.

V. GENERAL PROVISIONS

Article 15. The parties are obliged to exchange lists of the names of the officials, authorized to take operational decisions, as well as of those, responsible for measuring the purchased electricity.

Article 16. The addresses and the bank accounts of the parties are:

VENDOR:
Company: _____
Headquarters Address: _____
Court of Registration: _____
Number of Registration: _____
Bank Account: _____

BUYER:
NEK Joint Stock Company
Sofia, 8 Triaditza Street
Registered with the Sofia District Court
Number of Registration: 196, volume 5, register II, p. 98
Bank Account: 421 130 165 - 001 - 5, Commercial Bank "Sofia"

If changes in the registration , addresses or bank accounts occur, the parties are obliged to send notification in writing within a period of 5 days.

Article 17. This contract can be amended, supplemented and extended by bilateral written agreement between the parties.

Article 18. Issues not addressed by this contract will be subject to the existing normative acts.

Article 19. Disputes between the parties concerning the implementation of this contract shall be solved by negotiations. When no agreement is reached, the dispute shall be decided upon by voluntary arbitration at the Bulgarian Chamber of Commerce and Industry.

Integral part of this contract are the specification, the repair program, and the regime characteristics of the turbogenerators.

This contract has been prepared in two uniform copies, one for each party, and takes effect on the day of signature.

VENDOR:

_____

_____

BUYER:
NEK
Chairman
/D. Dobrev/

INDEPENDENT POWER IN BULGARIA WORKSHOP

Sponsored by:

U.S. Agency for International Development
Committee of Energy (COE) of Bulgaria
Natsionalna Elektricheska Kompania (NEK)

Borovets, Bulgaria

June 23 - 24, 1993

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WORKSHOP AGENDA

INDEPENDENT POWER IN BULGARIA WORKSHOP

June 23 - 24, 1993
Borovets, Bulgaria

Workshop Objectives:

(1) provide overview of U.S. and international experience with independent power;
(2) examine the applicability of independent power in Bulgaria;
(3) identify possible plan for developing the necessary policy, regulatory, and institutional framework for independent power in Bulgaria

Wednesday, June 23rd

Bus leaves Sofia for Borovets: Wednesday, June 23, 7:00 a.m.
Check-in Hotel Rila in Borovets: 9:00 - 10:00 a.m.
Workshop Registration: 10:00 - 10:30 a.m.

10:30 - 11:00	Introductory Remarks:	Nikita Shervashidze (COE) Dianko Dobrev (NEK) Gerald Zarr (USAID)
11:00 - 12:00	Overview of U.S. Independent Power Experience: Electric Utility Perspective, speaker: Rick Woodruff(CMP) Private Developer Perspective, speaker: Peter Lalor (MP)	
12:00 - 12:30	Questions and Answers	
12:30 - 2:00	Lunch, Overview of International Experience with Independent Power, speaker: John Sachs (L&W)	
2:00 - 2:45	Assessment of Independent Power in Bulgaria: Preliminary Findings, speaker: Matthew Buresch (RCG/HBI) and Peter Lalor (CP)	
2:45 - 3:00	Questions and Answers	
3:00 - 3:45	Bulgaria's Power Sector Overview, speaker: Andrej Markov (COE)	
3:45 - 4:00	Questions and Answers	
4:00 - 4:30	Coffee Break	

4:30 - 5:15	Existing Independent Power Practices in Bulgaria, speaker: [illegible]ha Siromahov (NEK)
5:15 - 5:30	Questions and Answers
5:30 - 7:00	Free Time
7:00 - 9:00	Dinner

Thursday, June 24th

7:30 - 8:30	Breakfast
8:30 - 9:15	IPP Legal Requirements: Power Purchase, Implementation, and oth Project Agreements and Contracts, speaker: John Sachs (L&W)
9:15 - 9:30	Questions and Answers
9:30 - 10:15	Financing International Independent Power Projects, speaker: Matthe Burresch (RCG/HBI)
10:15 - 11:00	International Finance Panel, comments and discussion (U.S. investme banker, Bulgarian banker, EBRD, and World Bank)
11:00 - 11:30	Coffee Break
11:30 - 12:15	Review of Generic District Heating Cogeneration Independent Power Project Case Study, speaker: Tsoko Nehrizov (COE) and Matthew Bures (RCG/HBI)
12:15 - 1:30	Lunch
1:30 - 2:00	Small Working Group Meetings (e.g. developer, utility, banker, & government)
2:00 - 4:00	District Heating Cogeneration Case Study Practice Negotiation Exercise
4:00 - 4:30	Coffee Break
4:30 - 5:30	Workshop Conclusions and Proposed Next Steps

Checkout and Board Bus, June 24th, 5:30 - 6:00 p.m.
Bus leaves Borovets for Sofia, 6:00 p.m.
Bus arrives back in Sofia, 7:30 p.m.

INVITEES TO BULGARIA INDEPENDENT POWER POLICY WORKSHOP
Borovec, Bulgaria
June 23 - 24, 1993

Committee of Energy (COE)

1. Nikita Shervashidze, Deputy Chairman of COE -
2. Lazar Petkanchin, Deputy Chairman of COE -
3. Andrey Markov, Head Generation & Distribution -
4. Tzoko Nehrizov, Chief District Heat Department -
5. Boyan Dimitrov, Senior Counsel -
6. Boyko Hristov Nedyalkov, Senior Legal Advisor -
7. Dimitar Bouchkov, Head Foreign Relations Department -

National Electric Company (NEK)

8. Dianko Dobrev, President of NEK -
9. Ivan Sotirov, Vice President -
10. Bozhan Siromahov, Vice President Finance -
11. Krassimir I. Kanev, Head Corporate Finance -
12. Krassimir D. Kanev, Head Power Generation -
13. Liulin Radoulov, -
14. Dobrinka Dobreva, Head Legal Department -
15. Stefan Kanchovski, Expert in R&D Department -

EnergoProject

16. Boris Ivanov, Director -
17. Vladimir Miladinov -
18. Peter Petrov, Director Hydropower Division -
19. Rossitsa Gueorgieva -
20. Stoyan Stoikov, Expert Hydropower Division -

Council of Ministers (CM)

21. Malina Novkirishka, Senior Legal Advisor in CM -

Parliamentary Commission on Energy

22. Natasha Tacheva, MP, Lawyer -
23. Fidel Kossev, MP, economist -

Ministry of Finance

24. Simeon Dimitrov, Senior Expert on Power Sector Financing -

Ministry of Environment

25.Liliana Maslarova, Expert Legal Department -

Anti-Trust Commission

26.Alexander Milev, Head Legal and Financial Enforcement Mechanisms -
27.Dimiter Stanoev,Member of the Anti-Trust Commission -

National Commission on Prices

28.Ivan Ivanov, Head of Department -

Privatization Agency

29.Alexander Bozhkov, Executive Director -
(with driver)

Bulgarian Industry Association

30.Dikran Tebeian, Chief Expert for Investment & Privatization -

National Bank of Bulgaria

31. Georgi Alexandrov, Expert on World Bank -

United Bulgarian Bank

32.Penka Nedyalkova, General Director Bank Policy -

World Bank

33.Peter Zhotev
34.Edward Quicke - Wednesday

European Bank for Reconstrution and Development (EBRD)

35.Nicholas Stancioff, Deputy Resident Representative -

36.Denka Dobreva, Bulgarian Academy of Sciences -
Institute of Economics

Cogenerating Industry

37.Yanko Yankov, Deputy Director Energy Part -
Kremikovtsi Corp. (steel mill)

38.Alexander Oboushtarov, Manager Town Heating Company Sofia -
Only for the first day.

39.Tsvetanka Kambourova, Deputy Manager Finance -
Town Heating Company, Sofia

EVOLUTION OF THE INDEPENDENT POWER MARKET

IN THE UNITED STATES

By

Peter Lalor

and

Frederick Woodruff

At the

INDEPENDENT POWER IN BULGARIA WORKSHOP

JUNE 23 - 24, 1993

Borovets, Bulgaria

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EVOLUTION OF THE INDEPENDENT POWER MARKET IN THE UNITED STATES

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VIII. THE NEGOTIATION PHASE

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X. LESSONS LEARNED

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I. INTRODUCTION

Independent power represents the financing, construction, and operation of a power generating facility by a company that is independent from the central electric utility. The independent power producer is usually privately owned and is not subject to utility regulation. It sells power to the utility under the terms of a clearly defined power purchase agreement.

There have been changes in the process for purchasing independent power in the U.S. over the last ten years.

The changes have been driven both by

- innovations in regulation of purchasing utilities, and
- experience in independent power transactions.

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The changes have ha a major impact on

- solicitation
- evaluation
- negotiation
- administration
- utility participation

of independent power contracts

The "U.S." experience is not uniform:

- it varies over more than fifty jurisdictions
- the mistakes are as important as the successes
- need to be selective in applying any specific conclusion to Bulgarian context
- Federal/state jurisdictional complexities generally not relevant to Bulgaria

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II. THE ORIGINAL CONCEPT

"A Brave new world."

In 1978, PURPA (Public Utilities Regulatory Policy Act of 1978) was enacted in reaction to the oil crisis, utility construction programs which favored large central station nuclear units, and increasing environmental concerns.

PURPA gave birth to a protected class of non-utility generation or "QFs" (Qualifying Facilities). PURPA:

* Defined the requirements for QF status.
  Small indigenous renewable resources
  Energy efficiency through cogeneration

* Exempted QFs from utility regulation

* Required utilities to purchase "QF" output

* Established the avoided cost concept as the ceiling price

* Provided measures to prevent utility resistance such as the requirement to interconnect and antidiscrimination statutes

III. EVOLUTION OF THE CONCEPT

Many utilities resisted the implementation of PURPA. The State of Mississippi even challenged its constitutionality.

Avoided costs became a pivotal issue. PURPA defines avoided costs as those costs that would have been incurred by a utility but for the QF.

Varying approaches to avoided cost interpretation included several which overstimulated the market, caused retail rate problems, and provided excess returns to some developers.

Generous tax credits also contributed to the surplus.

Competitive bidding was introduced in response to the overpayment problems.

As a result of PURPA, the independent power in the form of QF's has blossomed. In the last 10 years, over 2,500 independent power prospects with generating capacity of over 30,000 MW have come into operation.

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The next step in this evolution was The Energy Policy Act of 1992 which:

* Lowered entry barriers to the IPP market by removing utility ownership limitations and PURPA regulation of wholesale generating companies

* Authorized FERC to compel wholesale transmission access

IPPs or independent power producers are now a class of wholesale electricity suppliers who are not burdened with utility regulation and are no longer restricted by artificial qualification requirements.

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IV. POTENTIAL BENEFITS OF INDEPENDENT POWER

The opening of the generation monopoly to independent suppliers had a number of motivations:

* reduce reliance on expensive and unreliable imported fuels through increased efficiency and use of indigenous resources
* utilize renewable resources to displace fossil fuel combustion
* diversify fuel mix (especially by utilizing waste products) and decentralize generation sites
* shift certain project risks (especially construction and operation) to third parties
* establish a competitive market to provide a benchmark for utility rate increase requests
* rapid integration of optimal power technology
* access to broader capital markets

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V. UTILITY CONCERNS ABOUT INDEPENDENT POWER

IPPs require long-term binding contracts which can lead to perverse results if, for example:

1) The price is too high relative to the market,

2) New, more competitive, technologies evolve,

3) Power system conditions/requirements change, or

4) Unanticipated project costs make it uneconomical.

Many utilities feel they have paid too much for their purchased power.

Some utilities cost of money has increased as a result of their heavy involvement in IPPs

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With IPPs, the purchasing utility loses control of

1) Project development, including schedule

2) Plant maintenance program and schedule

3) Plant operation and dispatch, and

4) Project long-term viability.

There is an administrative burden associated with insuring that the terms and conditions of each contract is being followed.

<u>Prudency</u>. In some states the utilities' decision to purchase power from an IPP is not reviewed until after the contract is signed.

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VI. THE SOLICITATION PHASE

Solicitation of IPP proposals may take one of several forms. There is a general, but not exact, correlation of the forms with the progressive evolution of the IPP market. Standard offers were most common in early market phases, followed by competitive negotiations in intermediate market phases, and finally by competitive bidding in more mature markets. These concepts are discussed in greater detail in this section.

<u>Standard Offers</u> are form contracts, including price schedules, which prospective developers need only sign and return to the utility to create a binding long-term contract. They are administratively the easiest, but

1) they should be limited to smaller projects
   a) which have little impact on system economics or reliability, and
   b) which cannot afford project-specific negotiations with the purchasing utility

2) pricing, as noted above, must be carefully structured to avoid perverse incentives

3) dispatch capability is not economic for smaller projects, so capacity reliability is less certain

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Standard offers were used extensively in the early evolution of many U.S. jurisdictions for large and small projects. However,

4) accurate estimation of "avoided costs" has been a recurring problem

   a) overestimation in some jurisdictions has resulted in oversubscription or overpayment
   b) underestimation in other jurisdictions has resulted in suppressing the market.

Standard Offers using administratively determined "avoided cost" continue to be widely used for small projects satisfying criteria 1(a) and (b) above. Contracts for larger projects result from project-specific negotiations described below.

<u>Competitive</u> <u>Negotiation</u>, in which the utility does not issue any formal bid request, but selects one or more project proposals for detailed contract negotiations (this might include BOT proposals for specific pre-engineered projects) has certain advantages:

1) there is much less administrative burden on the purchasing utility

2) the purchasing utility has a great deal of discretion in selecting prospective projects for negotiation

3) it is particularly well adapted to systems which
   a) have few suitable sites
   b) are considering purchase of significant increments relative to the size of the existing system
   c) for other reasons the purchasing utility needs significant control over the implementation of the independent project

This form is particularly well suited to intermediate phases of independent power development programs for the above reasons, and also because the developers of the project(s) selected for negotiation have greater comfort that the purchasing utility is serious.

However, this form of solicitation also has drawbacks:

4) it does not encourage an active market due to concerns over the fairness of the evaluation and selection process

5) it requires a good working relationship between the utility and the regulatory commission, because there is no objective market discipline on which the regulators can rely for confirmation of competitive price levels.

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Competitive negotiation has been successful in numerous U.S. jurisdictions but is not now as widely used as competitive bidding, by reason of the foregoing drawbacks.

<u>Competitive</u> <u>Bidding</u> can take a variety of forms

1) the utility can identify the type, size and other characteristics of desired generating resource additions, or

2) it can identify a number of MW of incremental capacity needed, then optimize the set of responses meeting the utility's threshold criteria

System (2) is theoretically and practically preferable to system (1), as the pre-selection of generation alternatives limits the flexibility of developers to propose other alternatives which are more cost-effective than the assumptions used by the utility in the optimization. Whether the utility uses system (1) or system (2), it can identify the most promising projects (using the criteria described in the following section) either by:

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3) use of a more or less mechanical "self-scoring" system, or

4) use of a more subjective scoring system, with accordingly greater discretion in the utility.

System (3) imposes great constraints on the purchasing utility's flexibility in selecting beneficial projects; on the other hand, the more subjective systems share the drawbacks of competitive solicitation systems.

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VII. EVALUATION BASICS

"There is no answer in analysis, only information."

Define your objectives in purchasing from IPPs. Typical objectives include:

1) Least net present value cost over the term of the contract

2) Project viability, both short and long-term

3) Fuel, geographic and size diversity

4) Operational control - AGC, economic dispatch, turn-down ratio, maintenance scheduling, etc.

5) Options to advance or retard project development schedule. Buyout options.

Define the criteria fc measuring each IPP's ability to meet your goals. Such criteria may be highly quantitative or qualitative. Examples include:

1) Lowest net present value of <u>total</u> revenue requirements

2) Project viability criteria, such as sponsors experience building and operating plants, sponsors financial capability, site acquisition status, project licensibility, technical feasibility and fuel supply

3) Project impact on local economy and potential for creating jobs

4) Loss of load probability, a large project with a high forced outage rate can jeopardize system reliability and lead to the need for high installed resources

5) Environmental impact, including air and water emissions and waste disposal requirements, and

6) Amount of dump power.

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Put together an interdisciplinary team to evaluate each project. Members of this team should have experience in economics, finance, plant engineering and operatives, power system engineering, licensing and environmental assessment, and power system planning.

The basic tools for project evaluation include:

1) Resource planning optimization models

2) Production cost simulation models, and

3) Risk assessment or decision analysis models.

VIII.A THE NEGOTIA.ION PHASE

"Those who live by the contract, die by the contract."

Negotiation is highly desirable for projects of any significant size. It allows the parties to optimize the needs of the utility and the abilities of the project.

As with any negotiation, know what you want and what you can live with, and, just as important, know your suppliers business as well as he does.

The negotiators must fully understand all of the associated risks and how they are to be shared. A brief list of risks include:

Financial	Operational
Economic	Equipment Failure
Construction	Fuel Supply
Licensing	Fuel Price Escalation

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The purchaser needs an enforceable contract.

* Lowest price that will yield a fair return to the supplier recognizing the risks he is assuming

* Clear performance standards and appropriate penalties for non-performance. Performance standards include:

1) Milestone schedules
2) Capability audits
3) Unit availability
4) Posting of security
5) Maintenance of licenses, etc.

* Penalties that fairly compensate the utility for the damages resulting from non-compliance

* Security in the eventuality of penalties or to protect against over-payment in the early years of the contract

* As much dispatchability and control over unit operations as is feasible

* Clear metering, intermediate and relaying requirements

VIII.B NEGOTIATION PHASE

The developer needs an enforceable contract.

* clearly defined and technically feasible obligations to perform; reasonable penalties for failure to perform
* fair price
* purchaser obligation to pay if developer meets his obligations
* assurance that return on and of investment capital can be converted and repatriated
* excuses to performance for force majeure events
* fair allocation of risk
* fair process of evaluation and negotiation

IX. OPERATIONAL CONSIDERATIONS

"Someone's got to be in control."

Seek out contracts that allow economic dispatch wherever possible.

Define need for automatic generation control and be sure that IPPs provide it to the extent needed.

Seek control of maintenance scheduling

- Provide for emergency operations
- Maximum output during high loads or loss of generation

VAR support during voltage problems

Be sure there are good communication links between central dispatch and the IPP operators.

Be sure that operators of IPPs are trained in all aspects the IPPs operational obligations.

X. LESSONS LEARNED

"Beauty is in the eyes of the beholder and first impressions aren't always correct."

IPPs can be reliable power suppliers. IPP availability and dependability has not been a serious problem.

We paid too much for our early contracts. You will need to balance the need for high prices to stimulate IPP development against minimizing the price you pay.

Competition works. In the long-run, a fully developed competitive IPP market will produce the least cost power supply.

Negotiate. Both the buyer and seller must fully understand each others objectives and capabilities to fully optimize the project.

Identify and address all of the risks. Be sure that they are appropriately and fairly distributed between the buyer and seller to produce an optimal contract that will be viable over the long-term.

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OVERVIEW OF INTERNATIONAL EXPERIENCE WITH INDEPENDENT POWER

By

John L. Sachs
Partner
Latham & Watkins

At the

INDEPENDENT POWER IN BULGARIA WORKSHOP

JUNE 23-24, 1993

Borovets, Bulgaria

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OVERVIEW OF INTERNATIONAL EXPERIENCE WITH INDEPENDENT POWER

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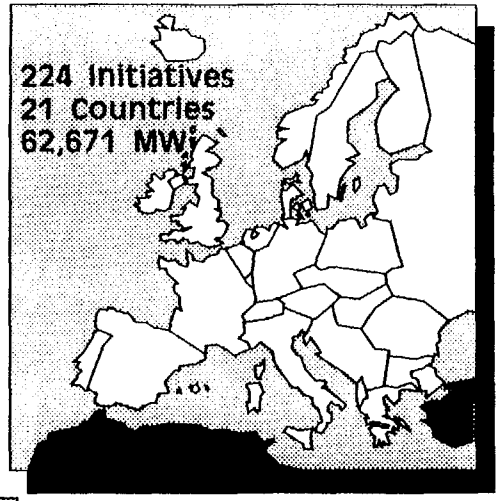
- B. Pakistan
- C. Argentina
- D. Poland

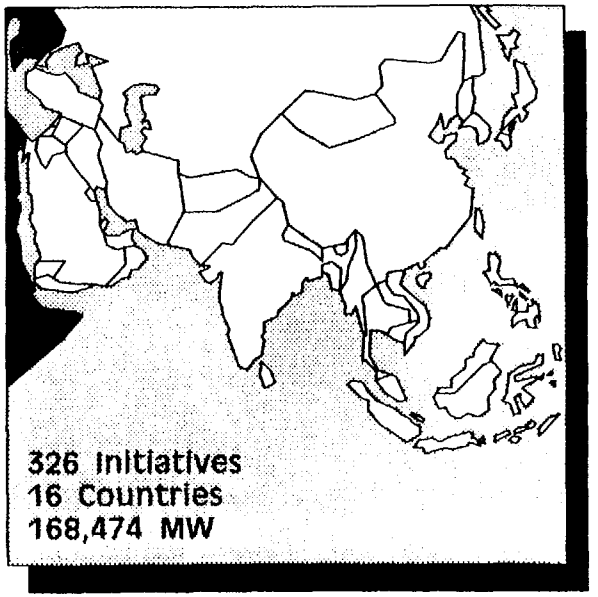
III. Lessons from that Experience

Independent Power Market Abroad



TOTAL

654 Initiatives
68 Countries
272,620 MW



Source: RCG/Hagler, Bailly, Inc., February 1993. Reflects announcements over last 36 months.

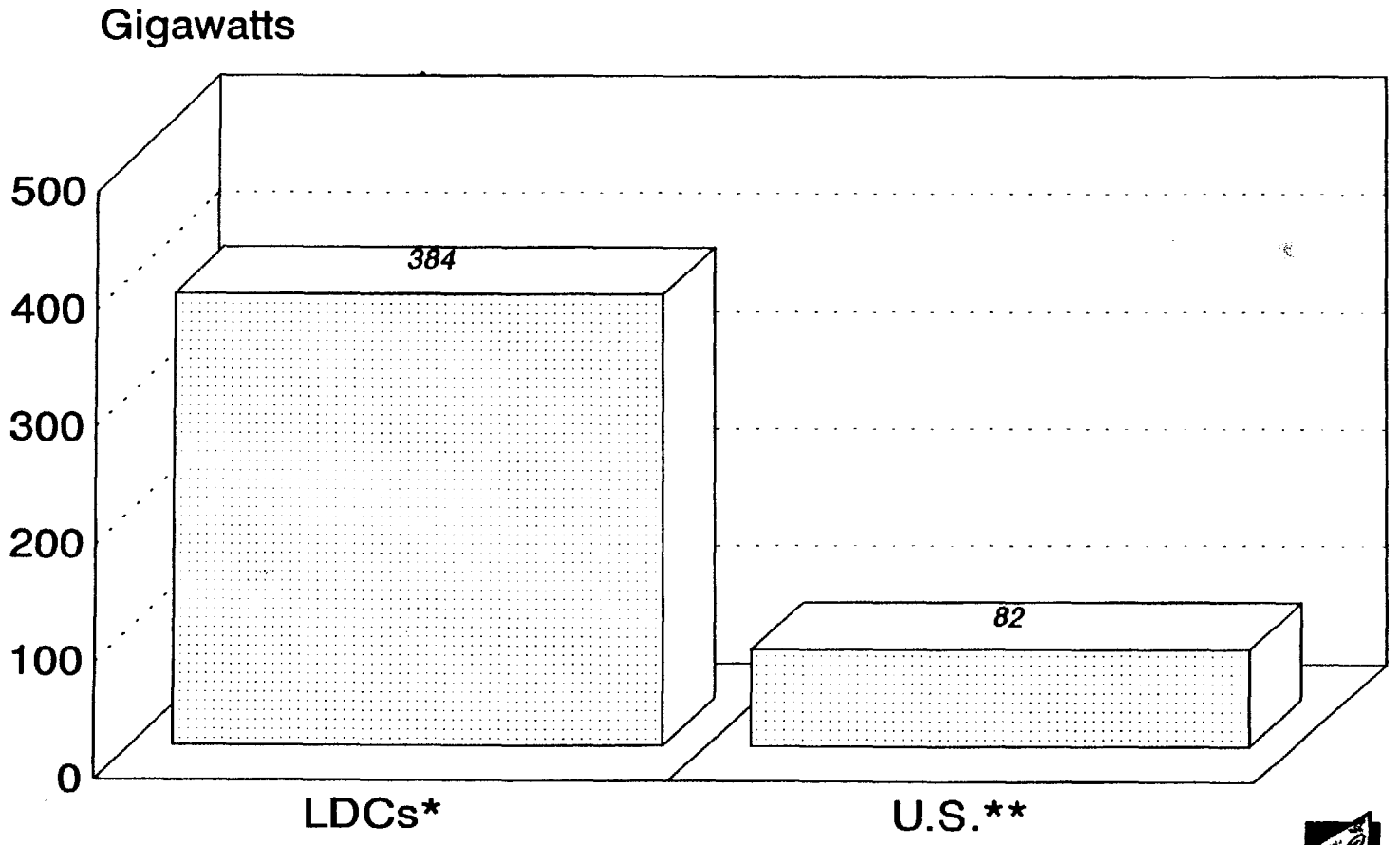
REASONS FOR GROWTH OF IPPs

There are at least three reasons that the number of IPPs has increased dramatically in recent years.

1. The governments of the world cannot borrow enough money to build all of the new capacity that is required so they must rely on private investment.

TOTAL PROJECTED ADDITIONS

1990 - 2000

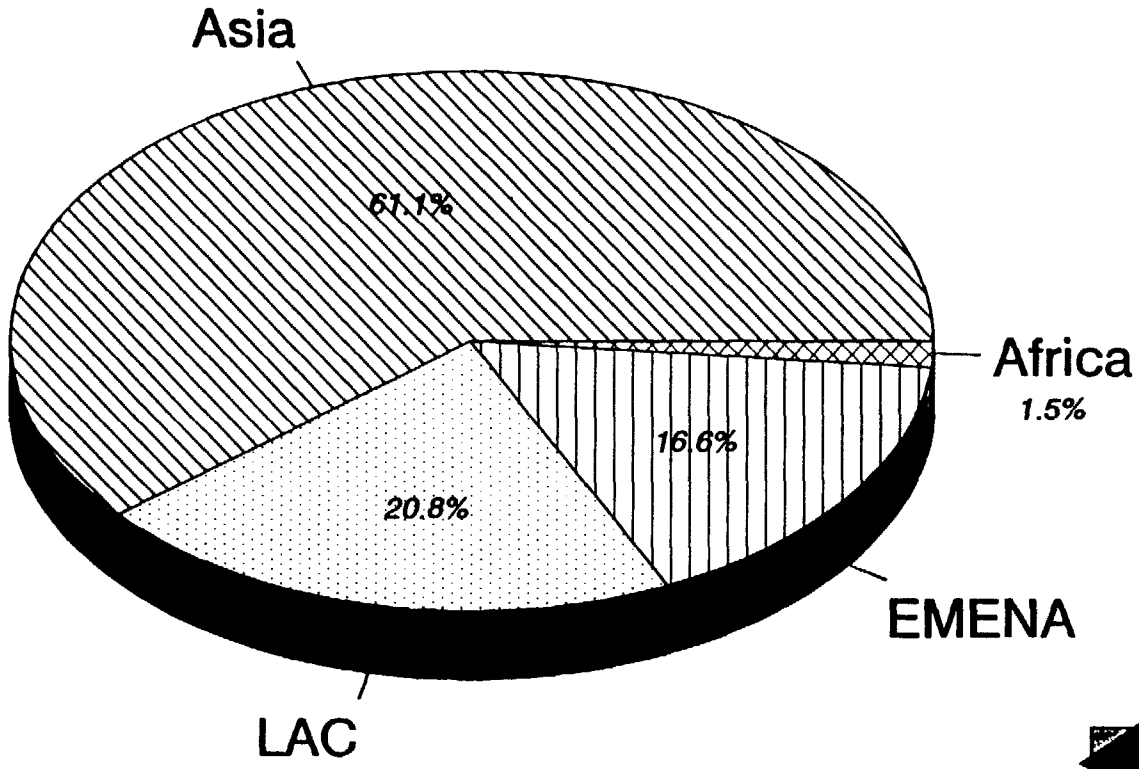


* World Bank, Capital Expenditures for Electric Power in the Developing Countries in the 1990s, pg. i, February 1990.

** DOE, Annual Outlook for U.S. Electric Power 1990, estimates expenditure of $100 - 200 billion.

REGIONAL BREAKDOWN OF LDC

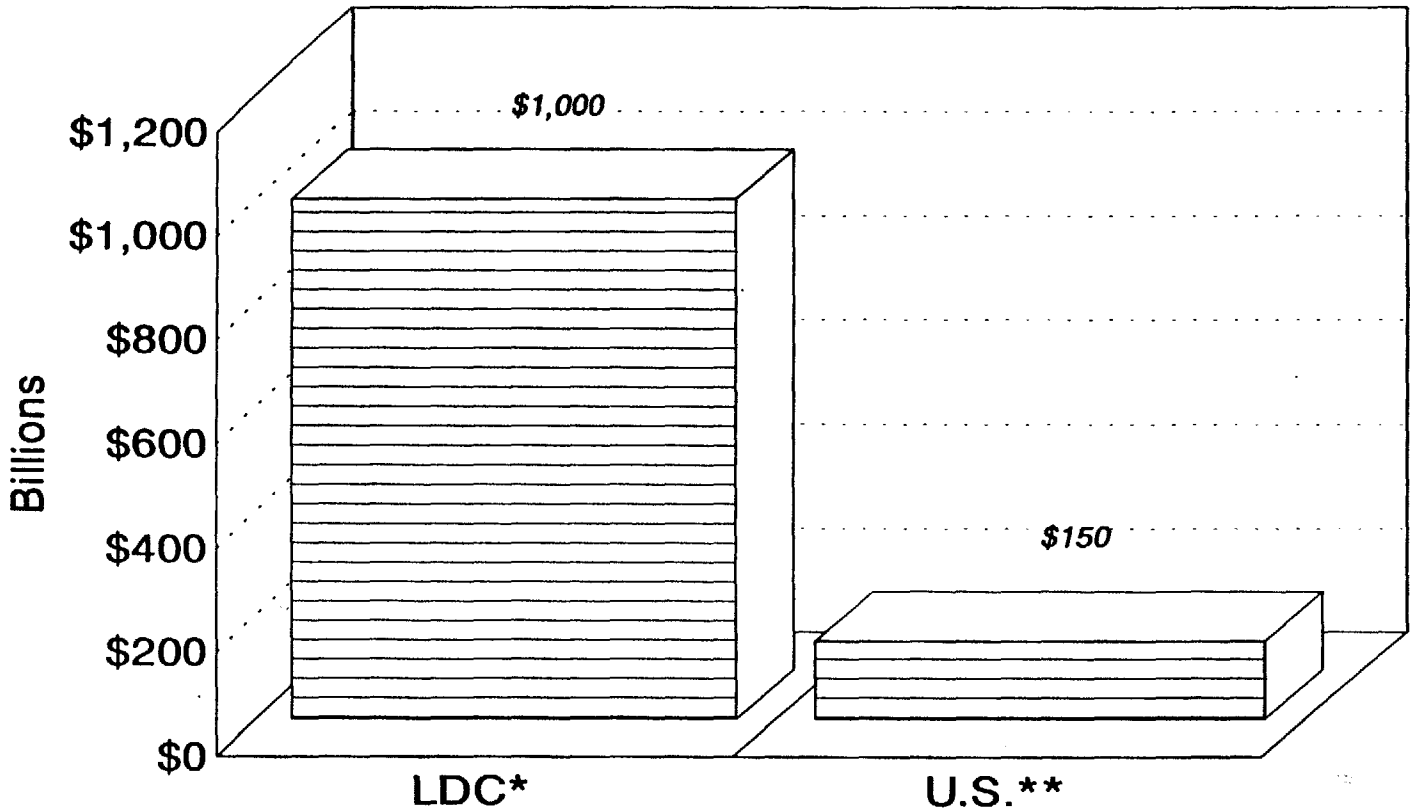
CAPACITY ADDITIONS (1990 - 2000)



World Bank, Capital Expenditures for Electric Power in the Developing Countries in the 1990s, pg. 13, February 1990.

DOLLAR INVESTMENT NECESSARY

1990 - 2000



* World Bank, Capital Expenditures for Electric Power in the Developing Countries in the 1990s, pg. I, February 1990.

** DOE, Annual Outlook for U.S. Electric Power 1990, June 1990, estimates expenditure of $100 - 200 billion.

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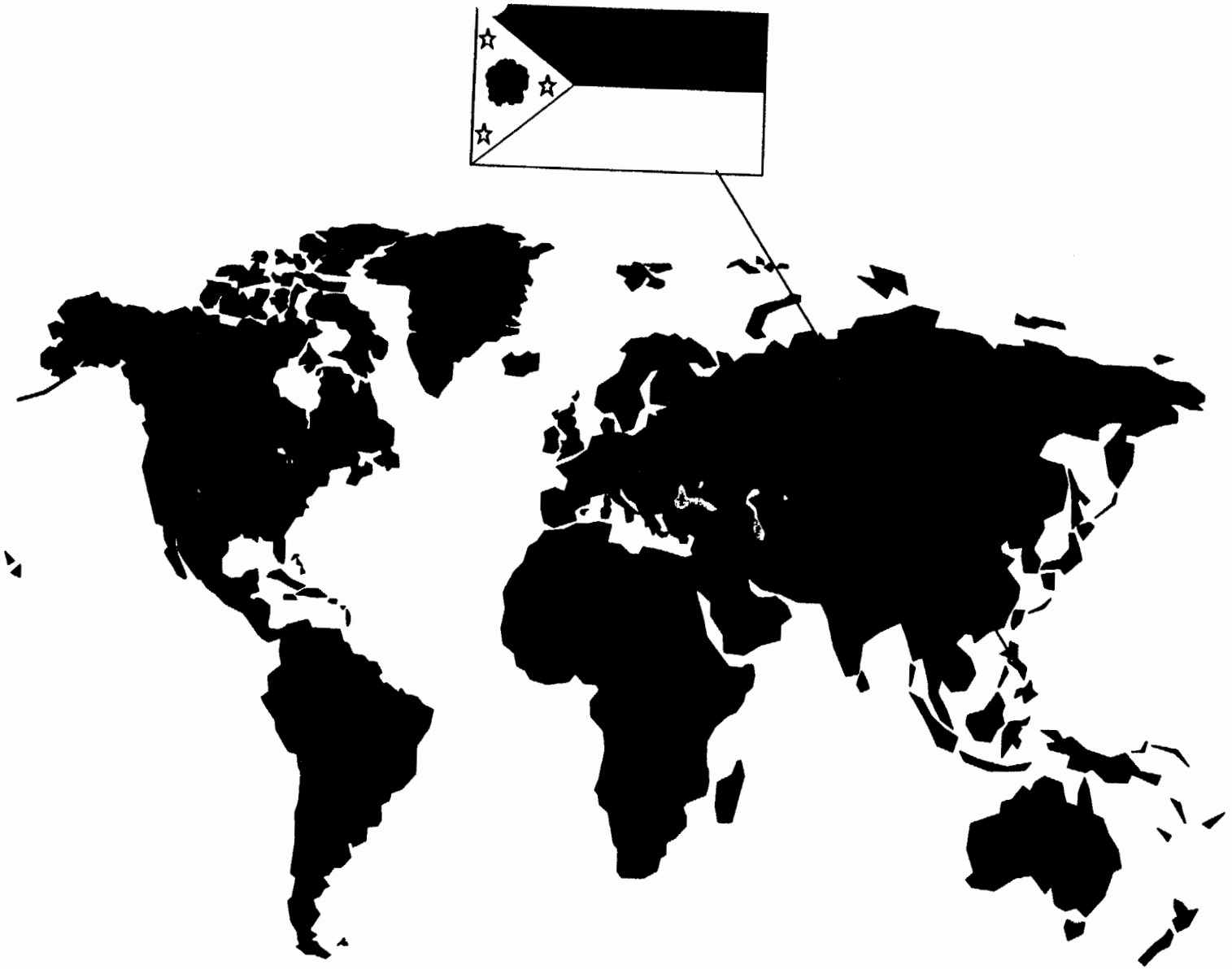
REASONS FOR GROWTH OF IPPs (cont.)

2. Even if there is no need for new capacity, the increasing concern for the environment requires major expenditures to retrofit existing powerplants, and governments cannot borrow this money either.

3. Many experienced developers looking for opportunities because U.S. and European markets are increasingly competitive.



LEGAL REFORM IN THE PHILIPPINES

The Philippines made the decision to rely on private power in 1987 and first changed the existing law to accommodate the development of IPPs.

Executive Order 215 ended the monopoly of the national utility, NPC, and allowed private generation of electricity by cogeneration and small power projects for sale to NPC.

In 1989, new regulations allowed the private sector to develop major block powerplants.

Finally, in 1990, the Philippine Congress passed Act No. 6957 which authorized private entities to finance, construct, operate and maintain infrastructure projects and offered the following incentives:

- removed foreign ownership limitations;
- permitted repatriation of profits; and
- granted tax holidays.

PHILIPPINES BOT PROJECTS

Plant Name	Developer	Capacity (MWe)	Commercial Operation
Navotas I	Hopewell Holdings	210	Jan. 1991
Navotas II	Hopewell Holdings	100	Apr. 1993
Mindinao I	Tomen/Alsons	58	June 1993
Mindinao II	Tomen/Wartsila	40	Sept. 1993
Batangas	Enron Power	105	May 1993
Bauang	First Philippines Power Corp.	190	Jan. 1994
Subic Diesel	Enron Power	105	Jan. 1994
Pagbilao Coal	Hopewell Holdings	350	Feb. 1996 May 1996
Sual Coal	Under solicitation	900	Jan. 1998
Mindinao Coal	Under solicitation	200	Jan. 1998

Source: National Power Corp. September 1992.

HOPEWELL NAVOTAS PROJECT

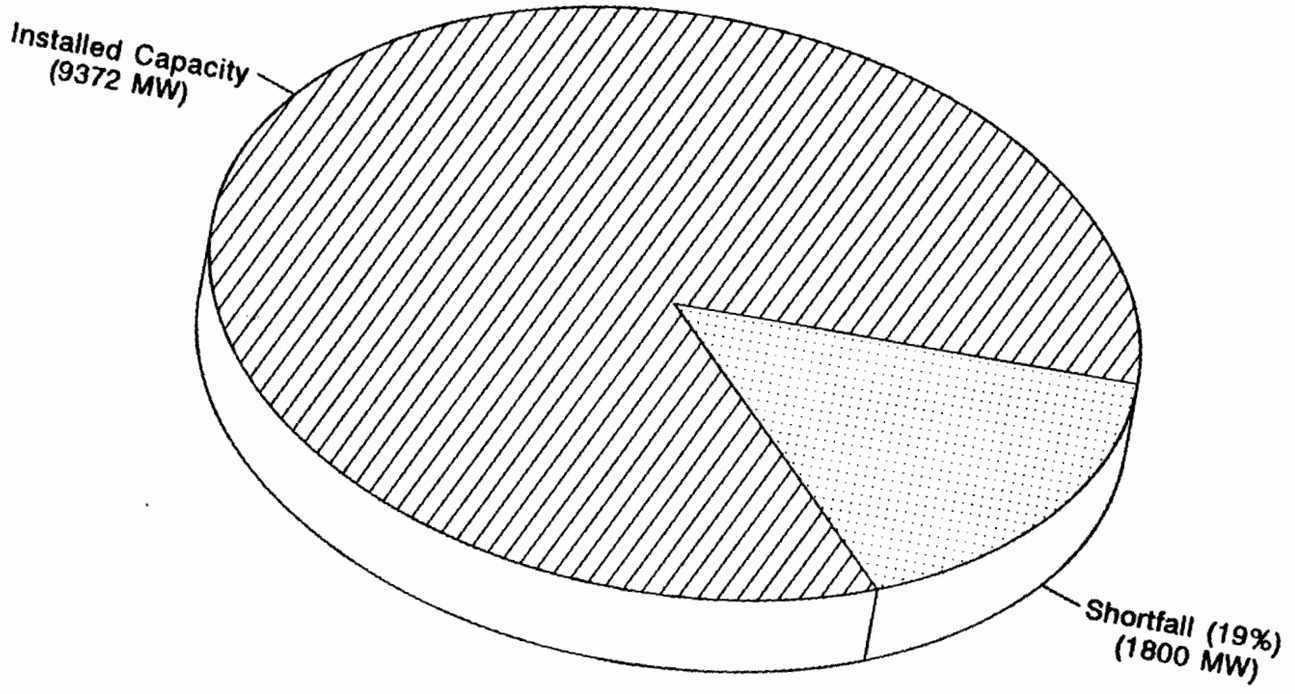
The only IPP operating in the Philippines today is the Hopewell Navotas Project, a 200 MW gas turbine facility.

It was completed in 1991 at a cost of US$41 million.

Among the most significant aspects of the project were that:

- NPC provided land and fuel to the developer for the life of project;
- NPC made all payments for power in U.S. dollars; and
- the Government guaranteed all of NPC's payment obligations.

Pakistan Load Shedding
(11,172 MW Maximum Peak Demand)



HUB TIMELINE

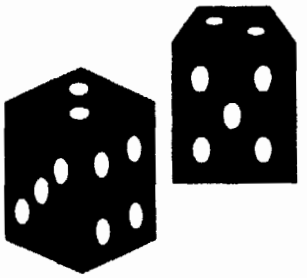
1985
Invitation

LOI's
Issued
1987

Earnest Negotiation
February 1989

Key Agreements
December 1989

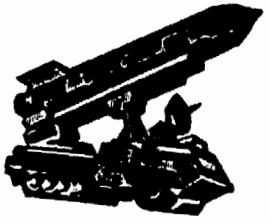
Rebid TKC
1990



HUB TIMELINE

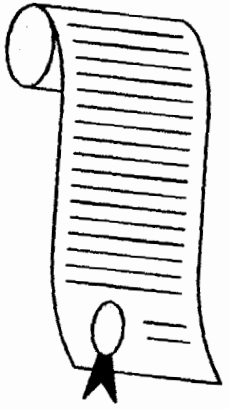
Bank Diligence 1990

Gulf War Feb. 1991



Shariat Decision Nov. 1991

Final Agreement Aug. 1992



Groundbreaking Sept. 1992

FINISH

PROPOSALS IN PIPELINE
BY FUEL TYPE

	NUMBER	TOTAL MW
Oil	4	2182
Hydro	3	116
Coal	2	1206
Gas	2	549
Solar	1	300
TOTAL	12	4353

FUTURE RESTRUCTURING OF ENERGY SECTOR IN PAKISTAN

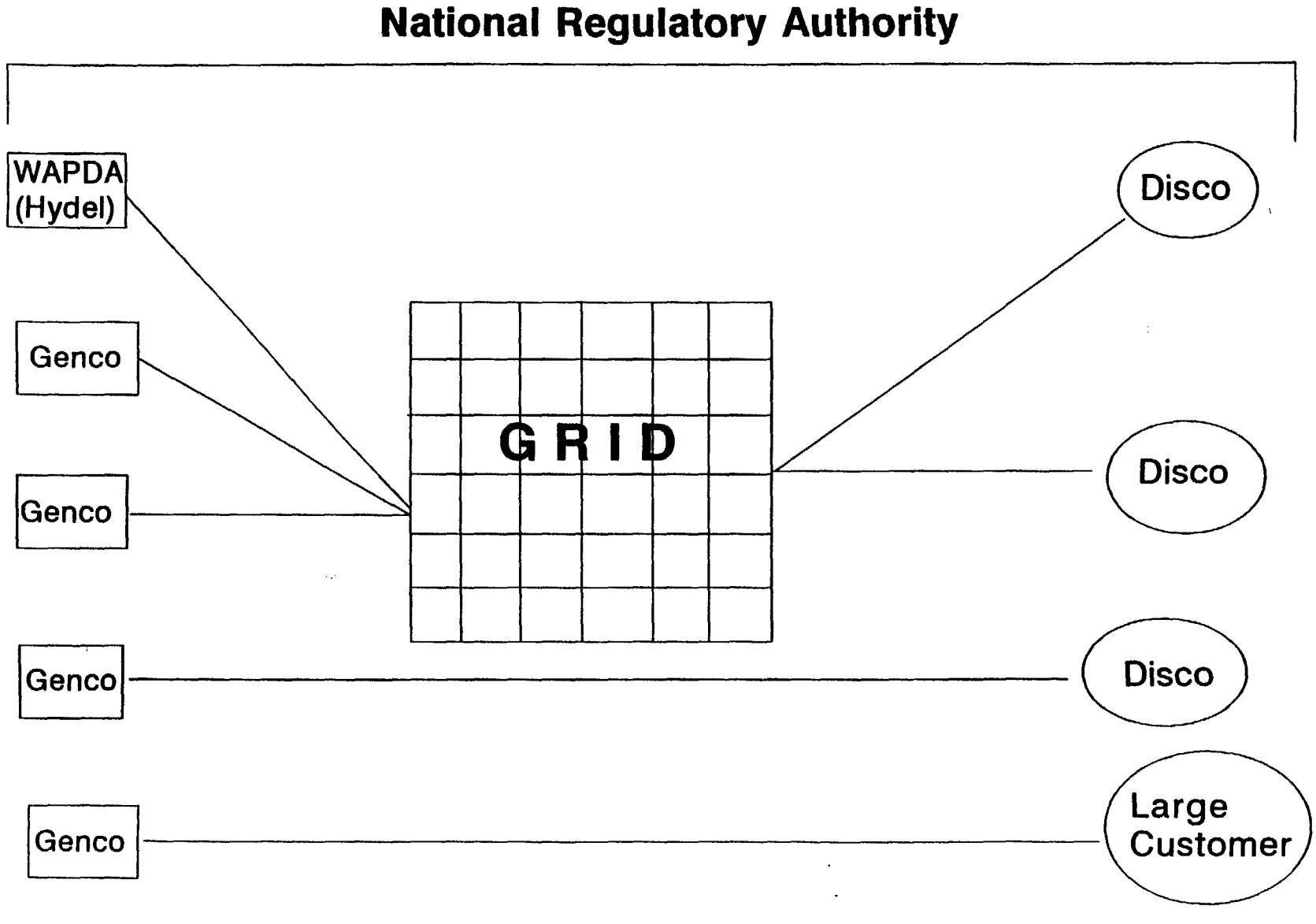
It is important to note that all of this interest in IPPs in Pakistan was generated without any change in the law.

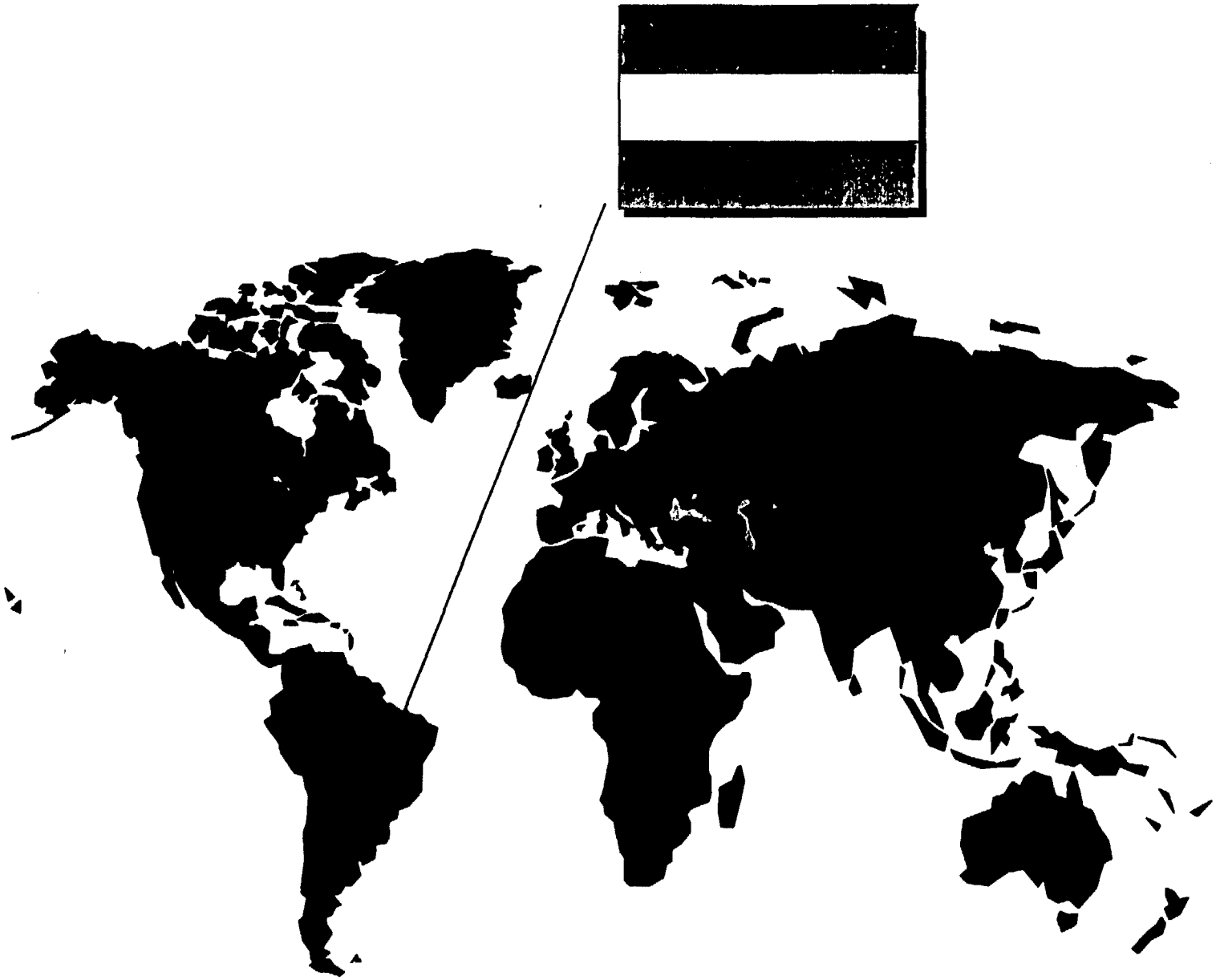
Only after three years of work on the Hub Power Project did the Pakistani Government begin to consider restructuring the industry and creating a new regulatory structure.

The plan is to disaggregate and privatize generation, privatize the existing distribution companies and to permit directe sales from generators to distribution companies and large customers.

A new national regulatory authority will also be established to regulate prices and other terms of those continuing monopoly services such as transmission, to license plants and to approve purchases and mergers with possible anti-competitive effects.

NEW ENERGY SECTOR





ARGENTINA AND PRIVATIZATION

In the 1980's, Argentina was in very poor condition:

- suffering from hyperinflation of 5,000% per year;
- recently lost a war with Great Britain over the Falkland Islands; and
- making the transition from a military to a democratic government.

A new government took power in 1989 and corrected the situation by stabilizing the economy, deregulating commerce and the financial markets, and privatizing many government-owned corporations.

More specifically, the Argentine Government passed several laws which permitted the transfer ownership of government-owned utilities to the private sector.

In just 3 years, Argentina has completed the privatization of 3,115 MW of existing powerplants, 26% of the total installed capacity in Argentina.

ARGENTINA POWER PROJECT PRIVATIZATIONS			
Powerplant	MWe	Fuel	Sales Price (Million $)
Puerto	1009	gas/oil	92
Costanera	1260	gas/oil	Unknown
Alto Valle	97	gas	22
Guemes	245	gas	87
Pedro de Mendoza	67	gas/oil	Unknown
Dock Sud	211	gas/diesel	Unknown
Sorrento	226	gas/oil	Unknown

PRIVATIZATION PROCEDURE

The Argentine Government requested bids for each of these powerplants.

The bids were evaluated primarily on the basis of price and the technical/managerial skills of the bidders.

In many cases, the winning bidder agreed to assume outstanding debt relating tot he powerplant and to make investments in the repair of the powerplant.

The Government has not sold more than 90% of any powerplant; at least 10% has been retained for employee ownership.

POWER PRICING IN ARGENTINA

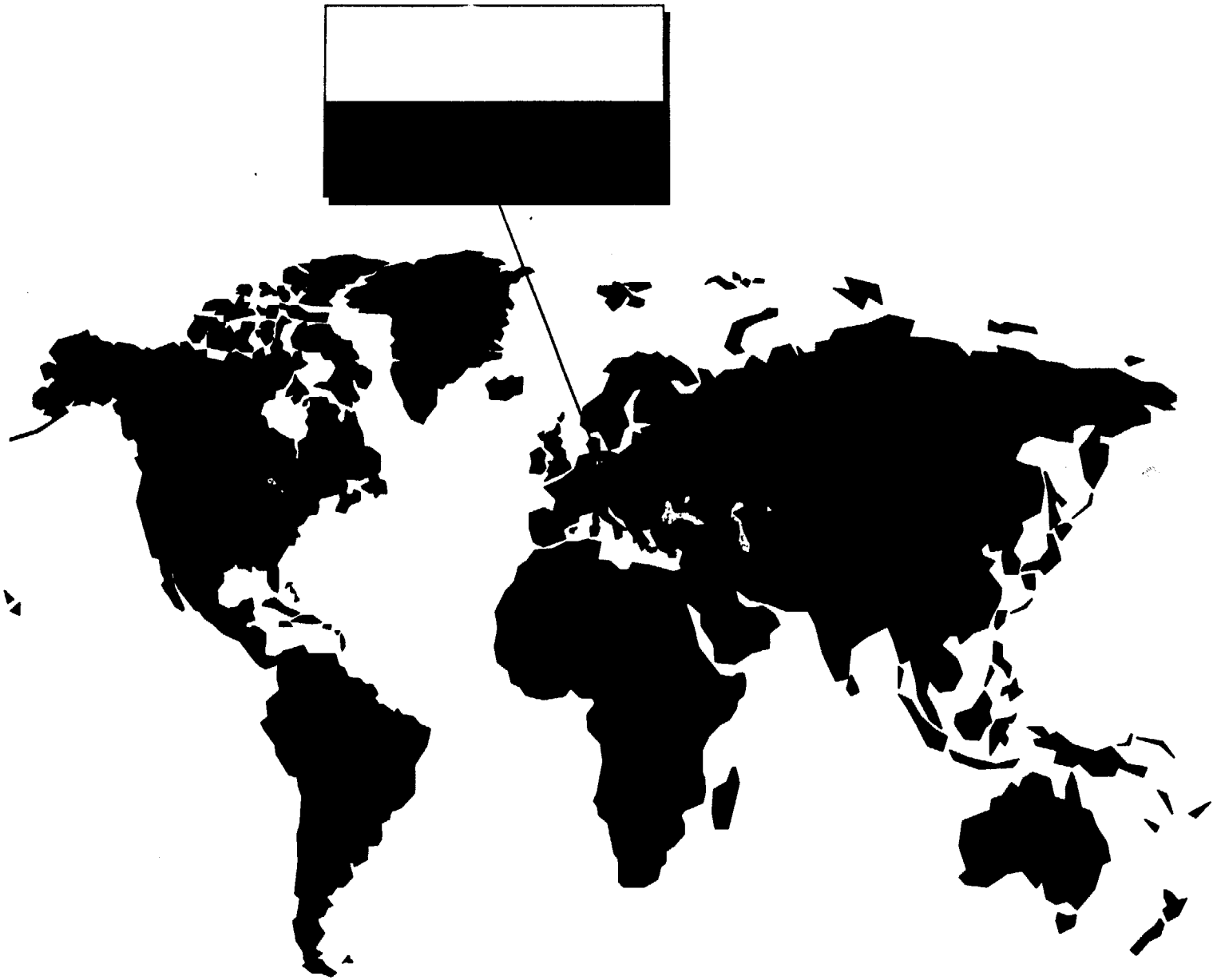
At the same time, Argentina instituted a new system for power pricing based on separate spot and bulk contract markets.

Generating companies are entering into long-term contracts with large industrial customers.

The remaining power is sold on spot market where prices are based on the mean fuel cost of the most expensive unit in operation and the cost and probability of a loss of load at any given time.

The spot market will account for most power sales in the next few years.

Long-term contracts are expected to dominate as the system matures, and the spot market will be limited to contingency service and surplus power.



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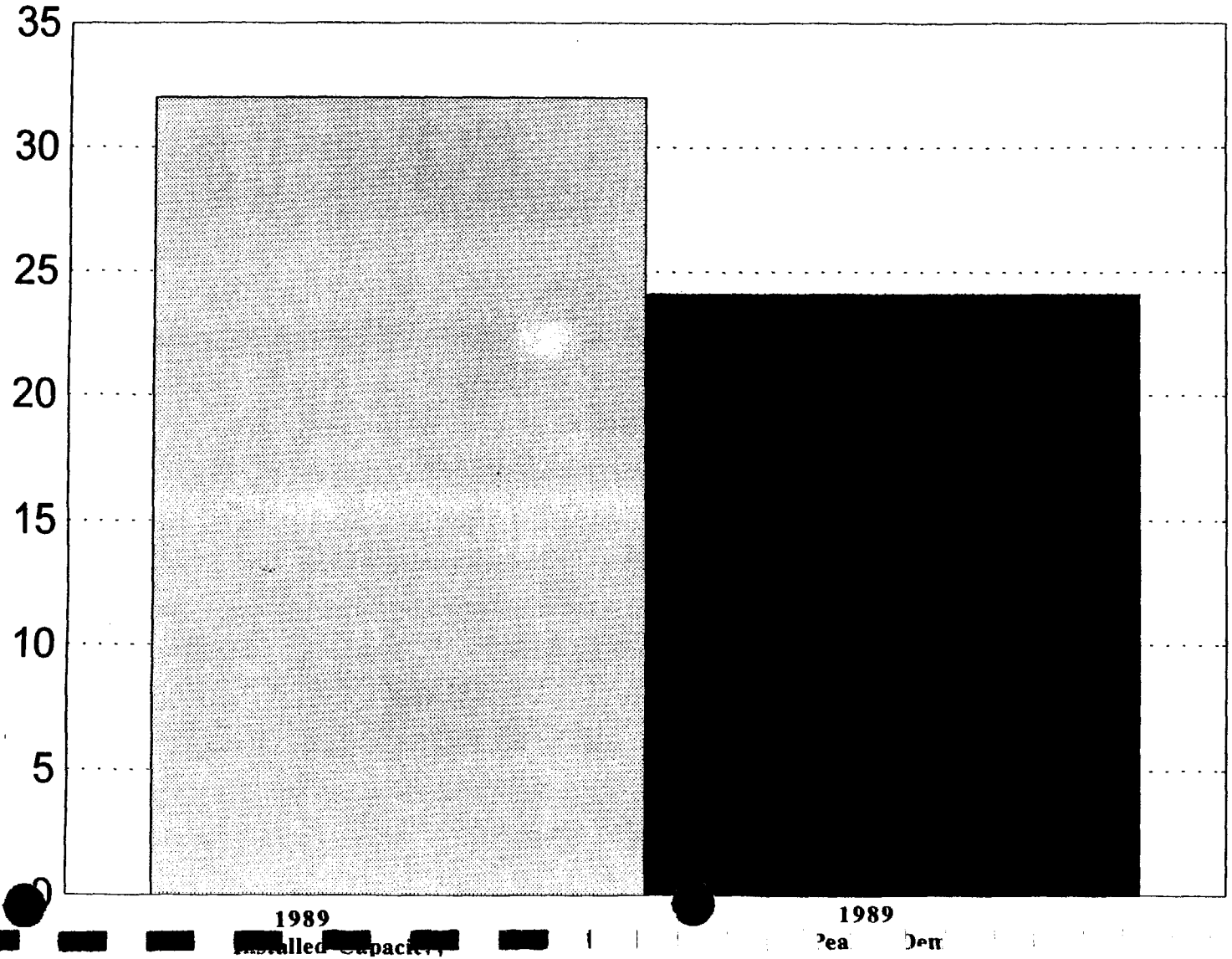
POLAND EXCESS CAPACITY



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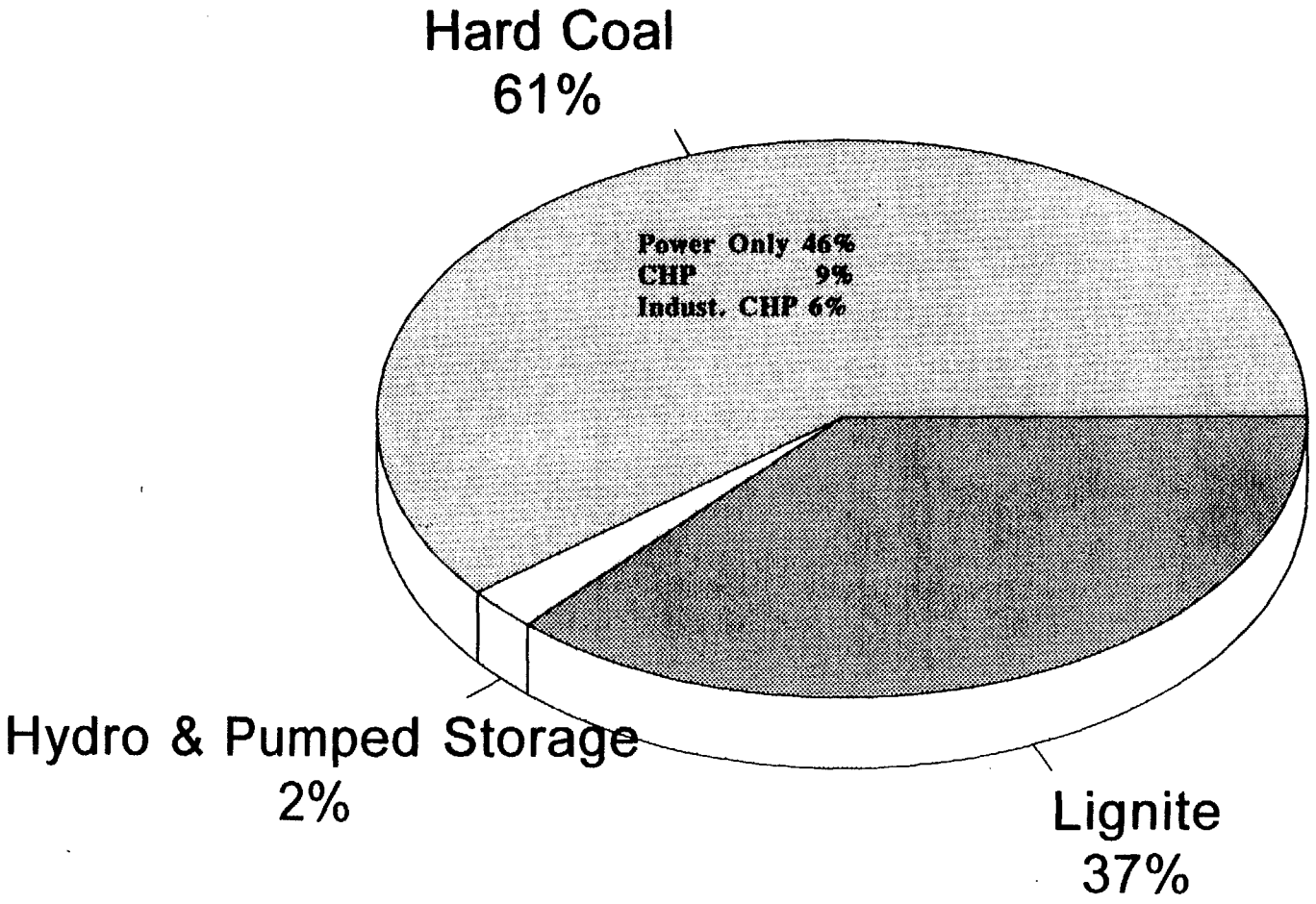
POLAND POWER GENERATION

1989 FUEL USE



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POLISH ENERGY SECTOR BEFORE 1990

Until 1990, two government agencies had responsibility for the entire energy sector in Poland.

- The Power and Brown Coal Board owned all the power generation companies, the electricity distribution companies, the lignite mines and related equipment manufacturers, engineering firms, and maintenance organizations.

- The Hard Coal Board operated all of the hard coal mines.

None of these facilities carried any debt and none paid a significant return on equity.

Coal prices and retail electricity prices were heavily subsidized.

POLISH ENERGY SECTOR AFTER 1990

In 1990, both Boards were liquidated.

- the mines and generators were spun off as separate entities
- several generators have already been transformed into joint stock companies.
- a new joint stock company known as the Polish Power Grid Company was formed to (a) own and operate the transmission system and the pumped storage plants; (b) purchase power from the generators; and (c) dispatch the power stations.

And the subsidies for coal and retail electricity prices have been substantially reduced so prices are approaching international levels.

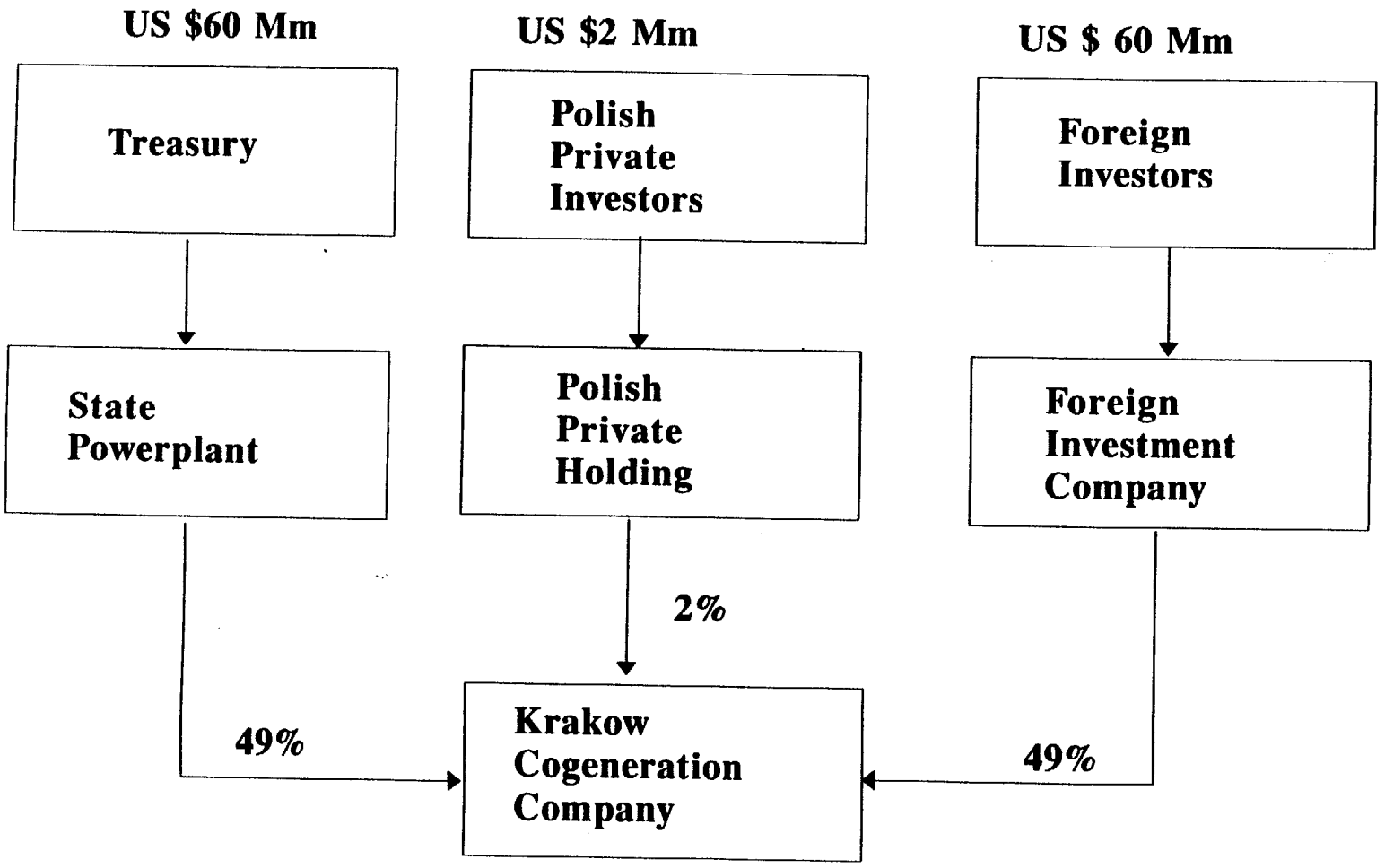
TRANSFORMATION OF POLISH POWERPLANTS

In order to finance the rehabilitation and environmental-retrofitting of existing facilities, Government began to encourage private power in 1991.

Several joint stock generating companies have been negotiating with foreign partners to form joint ventures.

One of the first is Krakow-Leg, the third largest CHP plant in Poland (capacity of 450 MWe and 1400 MWt) which provides 85% of district heat to city of Krakow.

KRAKOW COGENERATION COMPANY STRUCTURE



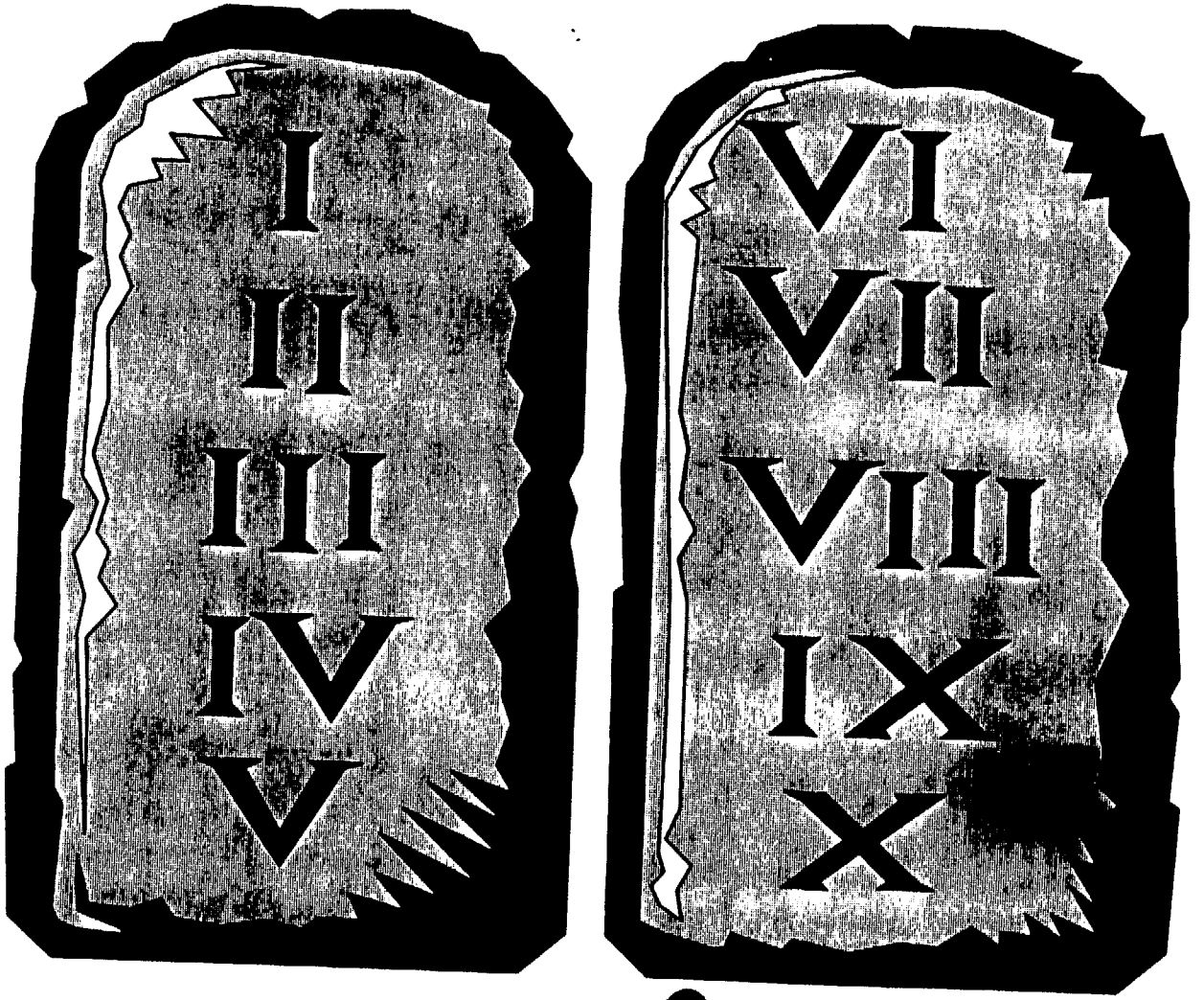
POLISH JOINT VENTURES			
Powerplant	Fuel	Type	MWe
Krakow-Leg	Coal	CHP Rehab	450
Patnow II	Lignite	Power Only Rehab	400
Gorzow	Gas	New CHP	50
Chorzow	Coal	CHP	195
Lublin	Gas	New CHP	50-100
Dolna Odra	Coal	Power Only Rehab	400

MAJOR ISSUES IN EASTERN EUROPE

These projects have each confronted several major issues that may well appear elsewhere in Eastern Europe:

- Valuation of existing assets;
- Uncertainty of prices throughout sector;
- Possible changes in law; and
- Availability of Government guaranties.

TEN COMMANDMENTS



TEN COMMANDMENTS

1. Thou Shall Not Underestimate
2. Thou Shall Organize
3. Thou Shall Field A Good Team
4. Thou Shall Downplay The LOI
5. Thou Shall Prepare In Advance
6. Thou Shall Be Consistent
7. Thou Shall Not Covet Thy Neighbor's Money
8. Thou Shall Divide Risks
9. Thou Shall Not Dawdle
10. Thou Shall Trust Thy Developer

ASSESSMENT OF INDEPENDENT POWER IN BULGARIA: PRELIMINARY FINDINGS

by

Matthew Buresch

RCG/Hagler, Bailly, Inc.

at the

INDEPENDENT POWER IN BULGARIA WORKSHOP

Borovets, Bulgaria

June 23 - 24, 1993

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ASSESSMENT OF INDEPENDENT POWER IN BULGARIA: PRELIMINARY FINDINGS

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II International Independent Power Experience and Implications for Bulgaria

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VI Status of Policy & Institutional Framework for Independent Power

VII Suggested Approaches to Policy & Institutional Development

VIII Recommendations: The Simultaneous Project and Policy Development Strategy

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I INTRODUCTION: ASSESSMENT OBJECTIVES

The objectives for performing this assessment of independent power in Bulgaria is fourfold:

- Summarize the U.S. and international experience with independent power and lessons learned for Bulgaria;
- Perform a preliminary assessment of the independent power market potential at central power, cogeneration, and small power facilities;
- Evaluate the policy, regulatory, and institutional framework for independent power;
- Suggest both policy and project development strategies for attracting private capital in Bulgaria's power sector.

These issues are addressed in different presentations at this workshop. This presentation will focus primarily on the last three points.

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II INTERNATIONAL INDEPENDENT POWER EXPERIENCE AND IMPLICATIONS FOR BULGARIA

The extensive experience with independent power in the United States and in many countries in Asia, Latin America, and Europe provides the following lessons:

- **The 15 year US experience has resulted in a major role for IPPs: in 1992, 62% (or 3,848 MW) of all new capacity went to IPPs; as of 1991, 3,000 projects or more than 40,000 MW of installed capacity have been developed as IPPs;**

- **Independent power is taking off in over 60 countries worldwide; of a projected 542 GW capacity additions outside North America between 1993 and 2000, IPPs could claim as much as 80 to 115 GW;**

- **The key elements for attracting private capital into the power sector involves offering independent developers a (1) <u>fair price</u> and (2) <u>fair terms</u> in the context of a (3) <u>fair process</u> for project selection;**

- **Establishing a mature IPP market takes time; in the US, for instance, the market did not begin to take off until 5 years after passage of the PURPA law. International projects are also slow to develop.**

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III OVERCOMING BULGARIA'S BARRIERS TO INDEPENDENT POWER

Independent power in Bulgaria faces clear barriers that will complicate the process of attracting private capital in the power sector:

- **Difficult economic structural adjustments**
- **Declining power demand and unreliable capacity**
- **Insufficient utility financial performance**
- **Inadequate policy and institutional framework**
- **High level of commercial risk**

Despite these challenges, a clear strategy for developing independent power could yield the desired result of attracting private investment and developers in Bulgaria's power sector.

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OVERCOMING BULGARIA'S BARRIERS TO INDEPENDENT POWER

Various positive conditions and trends in Bulgaria could enable independent power generation in the coming years:

- **Economic adjustment developments**
- **Investment opportunities in existing capacity**
- **Projected New capacity needs**
- **Independent power policy developments**
- **Electric utility financial improvements**

Recognizing the difficult economic conditions, sources of financing can be found, if the policy and project framework is properly structured.

IV THE MARKET POTENTIAL FOR INDEPENDENT POWER IN BULGARIA

Potential power projects that could attract foreign investors are:

- **<u>Industrial Cogeneration:</u> Rehabilitate or repower major industrial cogeneration projects;**
- **<u>District Heating Cogeneration:</u> Rehabilitate or repower major district heating plants;**
- **<u>Coal-Fired Power Plants:</u> Rehabilitate or repower existing coal-fired power plants;**
- **<u>Hydro Power:</u> Develop mini or major hydro sites;**
- **<u>New Generation:</u> Construct a new combined cycle gas or coal-fired power plant**

Feasibility analysis of some of these projects is already underway, and a priority ranking of these projects will be included in the least-cost plan under development.

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POWER PROJECTS FOR INDEPENDENT POWER CONSIDERATION

Preliminary Estimates: May, 1993

Power Facility Name	Existing Installed Capacity (MegaWatts)	Potential New or Repowered Capacity (MegaWatts)
Thermal Power Plants		
Maritsa East 1	200	200 – 250
Maritsa East 2	1,245	1,245 – 1,455
Martisa East 3	840	840
Varna	1,260	1,260
Russe	400	400
Bobov Dol	630	630
District Heating Cogeneration Plants		
Sofia	125	689
Kostov	186	870
Pernick	155	130
Plovdiv	60	260
Avram Stoianov	30	54
Pleven	36	295
Shumen	18	160
Industrial Cogeneration Plants		
Burgas	220	1,082
Kremikovtzi	60	486
Svishtov	60	
NHK Plevin	60	
Vidan	60	
Chimco Vratsa	60	284
Stara Zagora	48	720
Hydro Power Plants		
Danube River		400
Gorno Arda		175
Sredna Vacha		100

Source: World Bank G7 Study Draft; Energoproekt

Table 7

V PROJECT PRIORITIZATION AND SELECTION

The procedure for evaluating power project investments should utilize a rigorous Integrated Resource Planning (IRP) process. Key evaluation factors are the type of power required (peak, intermediate, or base load) and the installed and levelized costs. Based on the experience in other countries, the potential ranking could be as follows:

- Demand-side management investments
- Industrial/district heating cogeneration rehabilitation or repowering
- Thermal plant rehabilitation or repowering
- New combined cycle cogeneration power
- New high-head hydro power

By applying an economic ranking of potential power investments, COE and NEK can ensure that the projects that they tender for private development will fit into their overall least cost expansion plan.

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ESTIMATES OF INSTALLED AND LEVELIZED COSTS FOR DEMAND SIDE AND GENERATION SUPPLY OPTIONS		
	INSTALLED COST ($/KW)	TOTAL LEVELIZED COST (¢/KWH)
Demand Side Management Bids		3.2-6.5
Combustion Turbine	275 - 500	11-16
Diesel Generator	375 - 1,005	9-26
Combined Cycle	500 - 800	5-6
Pulverized Coal w/ Flue Gas Desulferization	1,420 - 2,410	6-9
Atmospheric Fluidized Bed Combustion	1,600 - 2,600	6-8
Wood Fired Steam	2,700	7-8
Conventional Hydro	1,945 - 3,300	N/A

Source: Central Maine Power, Stone & Webster, Electric Power Research Institute, RCG/Hagler, Bailly, Inc., 1993

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VI STATUS OF POLICY & INSTITUTIONAL FRAMEWORK FOR INDEPENDENT POWER

The existing policy and institutional framework in Bulgaria is undergoing major changes. The key issues that need to be addressed are:

- **Lack of Energy Legislation**
- **Need for Implementing Regulations**
- **Inadequate Legal Recourse**
- **Unclear Institutional Priorities**
- **Insufficient Project Review Process**

A preliminary assessment of the power sector institutions and the energy bill currently being drafted indicates that a potentially favorable policy and institutional framework is under development.

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VII SUGGESTED APPROACHES TO POLICY & INSTITUTIONAL DEVELOPMENT

The Government of Bulgaria, the COE, and NEK will need to continue their progress in establishing the necessary policy, regulatory, and institutional framework for independent power. Some of the necessary activities are already underway. Overall suggestions are summarized below:

- **<u>Strengthen Legislation:</u> Strengthen components of energy and other legislation to facilitate independent power;**

- **<u>Establish Regulatory Institution:</u> Establish an independent regulatory institution that addresses independent power and ensures staffing by qualified regulators;**

- **<u>Draft Regulations:</u> Develop and publish detailed regulations based on the energy law;**

- **<u>Establish Information Clearinghouse:</u> Establish a central information clearinghouse for Independent Power (IPP) developers;**

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- **Implement Integrated Resource Planning:** Use Integrated Resource Planning to establish long run marginal cost and power purchase pricing to guide project selection;

- **Define Government Guarantees Offered:** Establish consistent policy regarding government guarantees and agreements relating to such issues as utility performance, fuel supply, etc.;

- **Define Solicitation Process:** Establish the policy for soliciting independent power;

- **Train Negotiations Team:** Establish and train a multi-disciplinary review and negotiation team;

- **Prepare Standard Small Power Contracts:** Provide standard offer contracts for small renewable and cogeneration projects;

- **Prepare Terms for Large Power Contracts:** Provide standard non-price terms for large projects.

Some of the necessary activities that are being implemented are electricity pricing reform, energy legislation drafting, IRP analysis, and project feasiblity assessment.

VIII RECOMMENDATIONS: THE SIMULTANEOUS PROJECT AND POLICY DEVELOPMENT STRATEGY

While all elements of the policy and institutional framework described above are necessary in order to enable an active long term independent power market, not all components are essential to develop the initial projects.

- **Independent power projects can potentially move forward in an incomplete policy and investment framework.**
- **In fact, experience in other countries (such as the Philippines, China, and Argentina) has shown that promoting specific projects early on can in fact help refine the policy development process.**

In the uncertain investment climate that now exists in Bulgaria's power sector, the Bulgarian government, COE, and NEK, however, may need to agree to certain concessions in terms of power price and guarantees to attract the first IPP developers.

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A SIMULTANEOUS PROJECT AND POLICY DEVELOPMENT STRATEGY

In order to implement a parallel policy and project development strategy, the following priority elements of the policy and institutional framework need to be developed early on in order to ensure that any proposed independent power projects have a minimum necessary institutional and contractual framework:

- Establish a consistent policy regarding government guarantees of utility performance;
- Establish and train a multi-disciplinary review and negotiations team;
- Provide standard non-price terms for large, central, hydro, or cogeneration projects;
- It may be desirable to also prepare standard offer contracts for small renewable and cogeneration projects.

These basic elements provide the initial framework for attracting private capital in the power sector. Nonetheless, continuing to make progress on the entire strategy will be important for creating a mature IPP market.

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BULGARIAN ELECTRIC ENERGY SECTOR - PRESENT AND FUTURE

Prepared by Andrey MARKOV

Head, Department of Electric Production

and Electric Supply

Committee of Energy

The report on the potential of independent electric energy producers in Bulgaria, prepared by RCG/HBI and delivered to you by Mr. Bouresh contained a detailed and extensive review of the electric energy sector in Bulgaria. This to a great extent has eased my task, because I do not intend to repeat what has already been said about electric energy industry. This would not be necessary. I would rather draw your attention, and this was the preliminary aim of this report, to some specific matters connected with the electric energy system, which for some reasons were barely commented, or not commented at all. In this way I hope to achieve a more complete picture of the present state and to outline even better the future trends of development of the electric energy sector in the country. At the same time, the conditions and possibilities for the independent energy producers in Bulgaria will be defined more clearly and logically.

From the stand point of today it is seen that for decades the economy of the country has been directed to energy consuming industries and technologies, which has caused continuous growth of energy consumption. Energy consumption of the gross national product (GNP) significantly exceeded those in the countries with market economy. For this reason intensive building of new generating capacities was required. While the installed capacities in the energy system amounted to 8,810 MW in 1980, they were already equal to 11,309 MW in 1988, and reached 12,074 MW with the introduction of Unit 6 in the Kozloduy atomic power plant in 1991. At the same time the gross domestic production of electric power, which amounted to 34.8 TWh in 1980, reached its peak in 1988 with 45.0 TWh produced, and the gross consumption amounted to 49.2 TWh. And all this in a country with scarce own energy resources, importing near 80% of them, mainly from the ex-Soviet Union, including electric power.

The energy ties with Russia and Ukraine continue at present. The existing thermal electric power plants using imported coal are designed to burn anthracite coal from the Donbas field in fluid slag emission boilers. Natural gas flows over the only gas pipeline from Russia. The electric power system of Bulgaria operates in parallel with those of the ex-socialist countries, within the United Energy System. The nuclear fuel is supplied from Russia.

The efficiency of energy use at the planned economy was only formally an objective of the energy strategy. The unrealistically low price of energy resources, including those of electric energy, invariably state-subsidized, did not stimulate their efficient use. A confirmation of that inappropriate policy is the significant share of heating electric power in the total consumption - a fact confirming by itself the extremely inefficient use of primary resources.

The recent few years marked a decline in the electric energy consumption. However, this is due to the recession in industry, while there has been an increase of consumption in everyday life, the commercial and service sphere, mainly for heating purposes. This is confirmed by the circumstance that at a GNP decline of 28.4% from 1988 to 1992, the decline in electric energy consumption was 23% for the same period.

In spite of the multiple increase of electric energy price, it still remains more attractive than oil products of heating (gas oil, propane-butane). And there is a considerable part of the population that has no other option for technical reasons (e. g. lacking even chimneys in residential buildings).

The significant share of electric energy for heating causes additional peaking of the load diagram at certain hours of the day during the heating period. This can explain the preservation of peak loads of the system in the range from 7,000 to 7,100 MW in the recent few winters, regardless of the total decline of electric consumption.

The specificity of the load diagram requires greater maneuverability (flexibility) of the energy system, which is insufficient and generates a number of problems at present. Only water power capacities can be successfully used for load diagram control. This proves to be insufficient, since these are merely 10 to 12% of the generating capacities, because of the limited quantities in their water basins. Technical solutions have to be sought in order to increase the energy system maneuverability using thermal power plants and due to the fact that at certain moments the atomic capacities operating in basic mode amount to 35 to 45% of the generating capacities in the system.

It is also important to note that the existing thermal power plants have different records of operation. Some 20% of them have been operated for more than 25 years, and some 30% - for 20 to 25 years.

With the cooperation of the Trading and Development Agency (TDA) and Agency of International Development (AID) of the United States, as well as the European Community through the PHARE program, extensive investigations have been carried out on all thermal and water power plants in Bulgaria. These investigations will result in relevant assessments and recommendations related to the future of each one of them.

The stated above also implies the logical definitions of part of the main guidelines in the future development of the electric energy sector in Bulgaria. The government policy conducted by the Committee of Energy and the remaining institutions concerned in the business will be directed to the implementation of a number of vital issues for the country, which are connected to energy industry, among them the achievement of:

1. Greater energy-related independence
2. More rational and efficient use of primary and secondary energy resources
3. Optimal structure of generating capacities in the energy system, which should allow for minimum production costs of electric energy production
4. Greater maneuverability and reliability of the energy system
5. Ecologically compliant energy production
6. Favourable conditions for the conversion of the electric energy to the grounds of market economy.

For the achievement of greater energy-related independence of the country, priorities will be granted to local energy resources for electric energy production, where economic efficiency has been proved. The electric energy production based on local lignite and brown coal, water and atomic energy will retain its share against the background of declined electric power consumption. The implementation of projects for utilization of combined steam-gas cycles in some of the existing heating and factory power plants will increase the share of natural gas in electric energy production. Simultaneously, projects of direct gasification of households of entire greater or smaller settlements will be implemented. One of the forecasted versions of electric energy consumption has been developed even at the assumption that 450,000 households will

be gasified by year 2000. Generally, redirecting part of the natural gas quantities mainly consumed by industry so far, will lead to positive restructuring of the energy balance, increasing the energy efficiency, creating an alternative and competitor to heat supply, and in electricity production - introducing highly maneuverable peak-moment electric capacities. Through the reconstruction of some existing power plants (Varna, Rousse), or through the construction of new thermal capacities on imported coal, appropriate technologies can be selected, allowing the use of a wider range of imported coal available on the international market. One of the most-attractive for this purpose is the ecological coal from Indonesia, with ash content of 1 to 2% and sulphur content below 0.3%. There is also a theoretical possibility, still to be proven, to use a mix of local high sulphur content coal and low sulphur content imported coal without the need of building expensive sulphur-purifying facilities (FGD).

The efficiency of energy production and energy consumption will be promoted as a national policy and will be one of the main duties and functions of the Committee of Energy. A detailed program consisting of individual projects for rehabilitation or replacement of existing capacities will be developed on the basis of extensive studies of operating power plants, in order to increase their potential, on the one hand, and to improve their efficiency, on the other hand. At the same time, a series of projects will be implemented in heat supply industry for reducing the heat losses over the heat transfer networks. The implementation of other programs for reducing the heat losses in residential facilities is forthcoming. The introduction of new advanced technologies and restructuring of part of the industry will also reduce the energy consumption in the GNP. The relation between efficiency and ecology is unambiguous. Reduced energy consumption means reduced environment pollution.

The priorities at the implementation of projects related to rehabilitation and reconstruction of the existing capacities or building new ones will be adopted by the principle of minimum costs, which will allow the creation and use of optimum structures of the generating capacities in the energy system, leading to minimum production costs in electric energy production.

Introducing new technologies in electric energy production (combined steam-gas cycle, circulating boiling layer) or carrying out a reconstruction of boilers while changing the fuel base (Varna, Rousse, Bobov Dol) will create the technical potential for changing the electric power of the units in a wider range, which, together with the

introduction of the 840 MW of capacities in the Chaira pumped-storage plant will increase the maneuverability of the energy system. Expansion of the international transfer systems will be provided in order to increase the reliability and potential of the system, by seeking opportunities of faster association of Bulgaria with the West European energy system (UCPTE). In this way conditions will be created for more successful export of electric energy to neighbouring countries.

Along with the stated above, the Committee of Energy also performs activities related to the creation of the required pack of acts, norms, regulations and tariffs needed for the conversion of electric power industry to the grounds of market economy and the resolution of a number of other important issues.

The first one of a number of bills related to the energy sector has been prepared and submitted for discussion and adoption by the National Assembly.

The purpose of the prepared bill of electric energy is to transform the energy industry from a losing business into an economically balanced and state-regulated business.

The principles on which this bill has been built are:

- Market economy and state regulation
- Demonopolization by means of which the interests of the state and the users are distinguished from those of the electric energy organizations
- Protection of the legal rights and interests of the parties participating in the process of production, sale and utilization of electric energy
- Protection of the interests of the society.

The functions of conducting the state electric energy policy have been assigned to the Committee of Energy as a state energy institution, in order to:

- Encourage the efficient and economic production, transfer, supply and utilization of electric energy, as well as combined production of electric and heat energy
- Create privileged conditions of production of electric energy by reusable energy sources (water, sun, wind, geothermal energy) as well as energy from recycling of waste and biomass
- Create conditions for competition at the production and transfer of electric energy and electric power supply
- Protect the interests of the consumers related to the price and quality of the supplied electric energy and reliability of electric supply, etc.

The Committee of Eergy has been assigned the rights to grant licenses to organizations concerned with electric energy production, transfer, supply for a specific region, as well as combinations of these activities. Besides, it resolves electric energy import and export, etc.

A similar issue related to heat supply will be the Act of heat supply.

The bill of energy efficiency shall provide conditions for:

- Encouraging efficient utilization of primary energy resources in industrial facilities and household appliances

- Economical utilization of electric energy through realistic tariffs of charging

- Protection of socially incapable persons from the increase of electric energy prices

- Creating privileged conditions for independent producers from reusable energy sources and energy from recycling of waste and biomass sources, as well as for the combined production of electric and heat energy.

At the end, may I be allowed to conclude my report in a non-traditional way, by communicating something interesting to the audience. Following the enforcement of the Restitution Act, three small water power plants are already in the hands of their owners or owners' heirs. Five more are to be handed soon. The turn of the Rila Cascade Chain is coming next. So the number of independent electric energy producers will grow.

A couple of companies have approached the Committee of Energy for resolution on building and exploitation of new electric power plants: one of the projects provides building a combined steam-gas cycle on natural gas in the existing heating plant in the town of Yambol with a total power of 108 MW (four gas turbines of 27 MW and 4 boilers-utilizers of 63 tons per hour; another project provides building the Kaliakra electric power plant near the village of Bulgarevo, Kavarna municipality, with a total power of 20 MW (40 wind units of 0.5 MW), and the third project concerns thermal power of 120 MW on imported fuel, in the region of Elin Pelin and Ihtiman.

Time will not wait. Nor will independent producers.

INDEPENDENT POWER GENERATION IN BULGARIA - EXISTING PRACTICE

Prof. Bozhan Siromahov, Ph.D - Executive Director "Development and Investments" of NEK

1. Actual Situation

During the period following the nationalization of industry in December 1997 until the establishment of the Natzionalna Elektricheska Kompania (NEK) by a Decree of the Council of Ministers of the Republic of Bulgaria, independent power generation in Bulgaria was virtually non-existent. With the exception of the co-generation facilities of several large industrial enterprises, the economic and administrative management of all power plants was centrally performed by the Committee on Energy (or by its modifications - ministry, association, etc.). But even the industrial co-generation facilities at that time, by their character, had almost nothing in common with the contemporary concept of "independent power generation".

The generation facilities operating at present outside NEK could only at a high degree of approximation be considered as representing independent power generation, given that some important aspects of their legal status and of their interrelations with the company, which has the exclusive transmission and distribution rights, are not settled. According to the type of generation, the generators outside NEK at present could be classified in **three groups**:

(a) **industrial** -- power generation, related to and resulting from the primary production activities (Neftochim, Polimeri-Devnya, Kremikovtzi, Sviloza, etc.);

(b) **heating** -- combined generation of heat for central heating and electricity;

(c) restituted and newly built small hydro power plants.

All above mentioned generation facilities (the share of the third group being insignificant) account for 5.19 percent of the annual volume of electricity

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purchased in 1992, with capacity ranging between 3 and 13 percent of the peak system's load.

2. Problems of the independent power generation in Bulgaria

The unregulated status of the independent power generation and the unsettled interrelations with NEK cause problems in its functioning and development.

The major problems of the functioning independent power facilities are economic - setting a price higher than the production costs, and lack of normal and stable technical and economic conditions for sustained generation.

At present the regulatory function of determining the electricity prices is performed by the Council of Ministers in an administrative way through a less than perfect procedure which does not take into account a series of important factors while overrating others. For the time being, conditions for market-based prices do not exist.

By normal technical and economic conditions for sustained generation we mean here conditions which make feasible the technical subsistence of generation (technical personnel, maintenance, supply) at acceptable cost. The lack of such conditions forces some owners of restituted small hydro power plants to give up their ownership, to offer the facilities to NEK or to stop generation.

Factors impeding the development of independent power generation, other than the above mentioned, are:

-- lack of a legal status and of a licensing system;

-- lack of lasting legal guarantees for return of capital;

-- lack of access to low interest long-term credits;

-- risk factors - unstable political environment, strong pressure by the trade-unions, crisis state of the economy.

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3. Reasons for promotion of independent power generation

The motivation for promoting independent power generation is easily comprehensible, and is generally determined by the public interest in:

-- utilization of local energy resources, therefore, in limitation of GNP export needed for import of energy resources;

-- cost reduction resulting from the establishment of internal electricity market;

-- attracting local private capital;

-- opening of new job opportunities.

Perhaps the attraction of local private capital is the only reason that needs to be commented on.

Local private investments in independent power generation would:

-- alleviate the financial burden on NEK (the state sector) for providing investments;

-- lessen the pressure of "hot money" in other sectors of the economy;

-- balance the eventual foreign investments in the energy sector;

-- saturate energy sector niches which are unattractive for state investments.

4. Conclusions

Given the current state of the independent power generation in Bulgaria and the world global tendency towards its promotion and development, a conclusion could be drawn that immediate and energetic measures are needed so that conditions and incentives for stimulation and development of local independent power generation be created. Should we agree that the impediments to independent power generation are substantial, the realization of

our being behind the world tendency, as well as the needs of the Bulgarian energy sector and economy in general, impose upon us the obligation to undertake immediate and vigorous measures for determined and prompt solution. This goal could be specified by formulating the following priority national tasks:

4.1. Establishing in the shortest possible term of normative (legislative) environment (law, regulations, ordinances), which would make legitimate and would guarantee the existence and development of independent power generation in Bulgaria. This environment should include licensing, regulation and provisions for return of developers' capital through lasting long-term legal norms. It should be established and made operational in a way which could reinforce faith in the legal guarantees for doing business in the energy sector and enhance the formation of an internal electricity market.

4.2. Developing of stable, state guaranteed incentives for independent power generation through preferential prices and taxes, state guaranteed long-term purchase contracts, and state guaranteed long-term loans from foreign financial institutions at lower interest rates. Part of the expenses of local investors for conducting research and development for such projects could be covered by the National Energy Fund (fund "Energy Resources").

4.3. Starting a broad spectrum of information and promotion activities among the Bulgarian businessmen and their organizations aimed at encouraging and attracting investments in the independent power generation.

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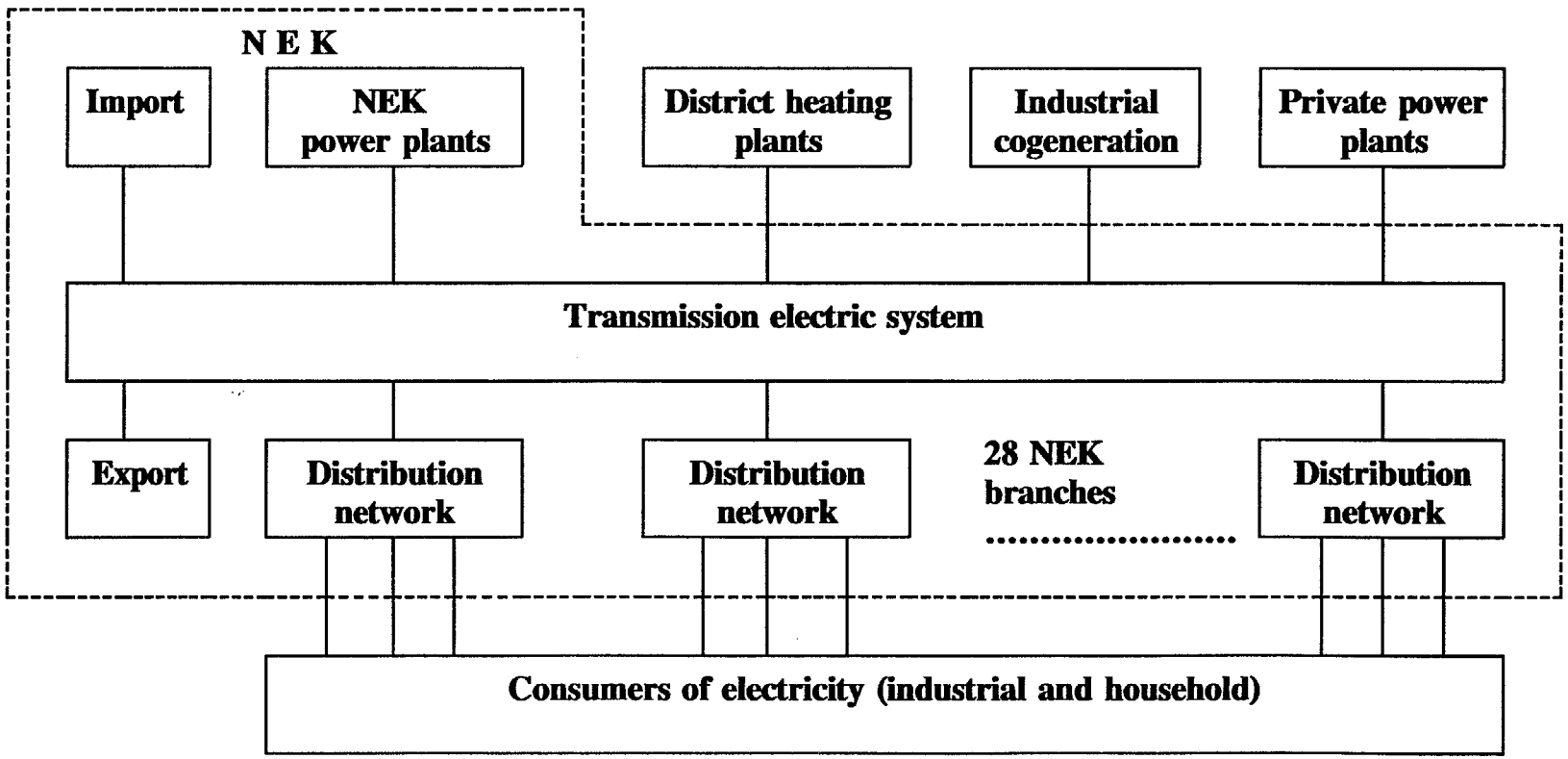
S C H E M E

for generation, transmission and distribution of electricity



IPP LEGAL REQUIREMENTS:

POWER PURCHASE, IMPLEMENTATION AGREEMENT AND OTHER PROJECT AGREEMENTS AND CONTRACTS

By

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Latham & Watkins

At the

INDEPENDENT POWER IN BULGARIA WORKSHOP

JUNE 23-24, 1993

Borovets, Bulgaria

IPP LEGAL REQUIREMENTS:

POWER PURCHASE, IMPLEMENTATION AGREEMENT AND OTHER PROJECT AGREEMENTS AND CONTRACTS

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I. Project Finance

II. Power Purchase Agreement

III. Security Package

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V. Political Risk

VI. Implementation Agreement

PROJECT FINANCE

Most IPPs are financed on a project finance basis.

- The developer borrows money on the basis of revenues he expects to receive under long-term contract with utility.
- The lender takes a security interest in this long-term contract with the utility.
- The lender may also take a security interest in the physical assets of the project, but these assets are of little value without the long-term contract.
- The lender has no recourse against the other assets of the developer.

POWER PURCHASE AGREEMENT

Developer's Obligations

obtain land, secure permits and obtain financing by certain date

build powerplant by certain date

operate and maintain powerplant

Utility's Obligations

interconnect IPP with grid by certain date

purchase power from IPP at fixed price for 20-30 years

Utility's Remedies

impose penalties for failures

hold security deposit to ensure payment

terminate long-term contract

right to operate/right to purchase

Developer's Remedies

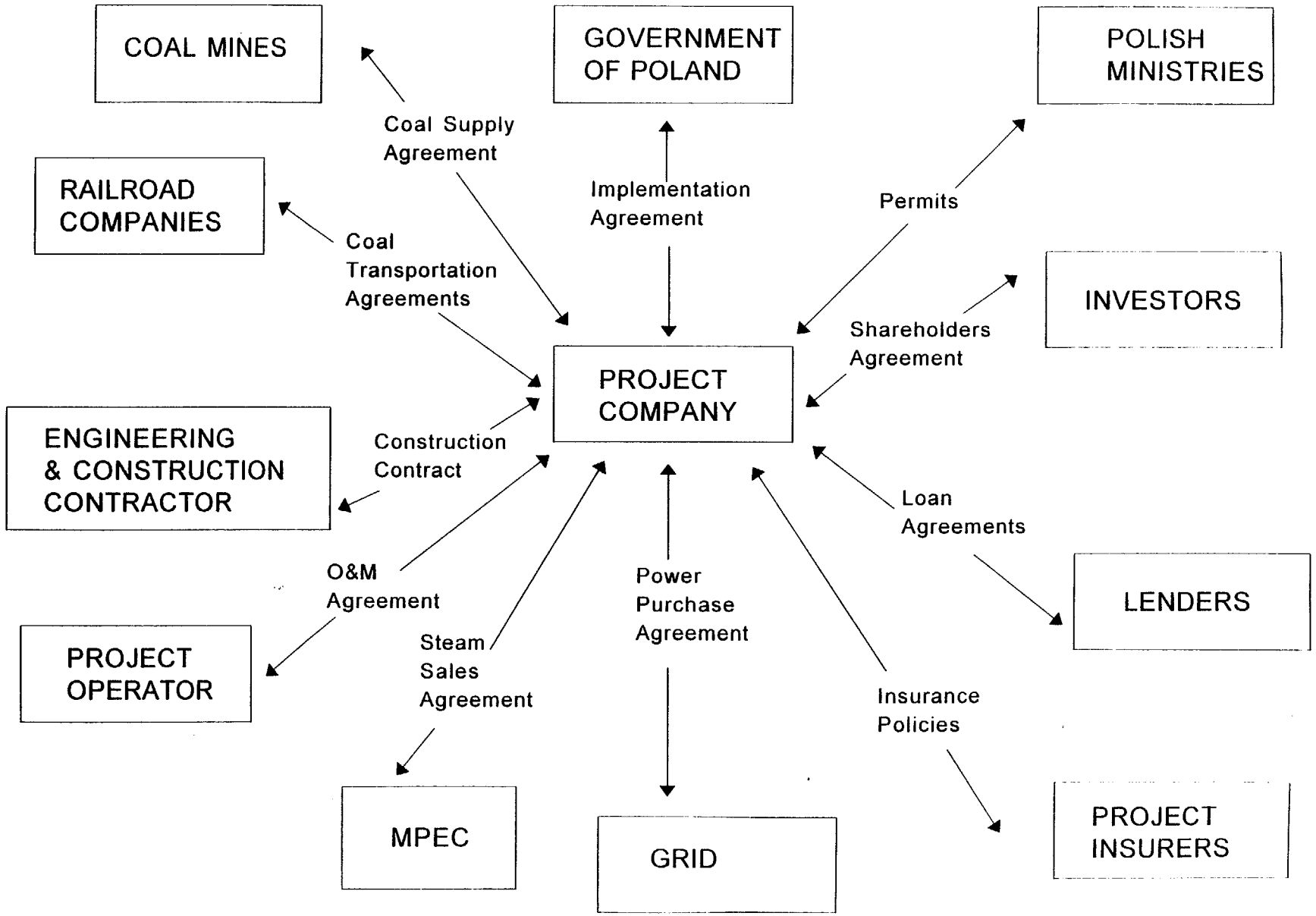
deemed commissioning

sue utility for damages

terminate long-term contract

transmit power to another buyer

POLISH SECURITY PACKAGE



EXAMPLES OF COMMERCIAL RISK

- Increase in construction costs.
- Delay in completion of powerplant.
- Poor performance after completion of powerplant.

DELAY IN COMPLETION

Problem: Developer fails to complete project by PPA deadline. Developer suffers following consequences:

a. Generation of revenue delayed.

   (1) More interest during construction.

   (2) No return on equity.

b. Liquidated damages under PPA for harm to generation planning.

c. Liquidated damages under FSA for carrying costs of new coal producer investments.

d. Termination of IA, PPA and FSA by Government.

DELAY IN COMPLETION (Cont.)

Allocation:

a. Developer hires experienced contractor to ensure timely completion.

b. Contractor pays liquidated damages to developer sufficient to cover developer's debt service and liquidated damages under PPA and FSA.

   (i) Contractor obtains insurance against natural force majeure events, but political force majeure events uncovered.

   (ii) Shareholders receive no return.

   (iii) Limit on maximum liquidated damages contractor will pay.

c. Beyond contractor's limit, developer commits additional capital and arranges standby credit facilities of 15-25%.

d. Utility may pay for increases caused by utility change orders.

DELAY IN COMPLETION (Cont.)

Allocation (Cont.):

e. Government or utility may pay for increases caused by entirely unpredictable events or political force majeure events.

f. Termination postponed long enough for developer to rebuild plant if entirely destroyed.

EXAMPLES OF POLITICAL RISK

- Inability to obtain governmental permits and approvals.
- Fluctuations in foreign exchange rates, unavailability of foreign exchange, inability to transfer foreign exchange abroad.
- Political force majeure.
- Expropriation or other Government default.

PERMIT RISK

Problem: Developer must obtain all required permits, but Government agencies withhold issuance of permits. Developer suffers following consequences:

a. Fails to complete plant on time or operate as required under PPA.

b. Shortfall in revenue.

c. Liquidated damages under PPA and FSA.

d. Termination of IA, PPA and FSA.

PERMIT RISK (Cont.)

Allocation:

Upon receipt of an application from the developer, the Government:

a. Could waive the permit requirement but risk violation of law.

b. Could pay the developer for any increased costs if problem can be solved with money, but Government unwilling to pay more.

c. Could guarantee issuance of permit:

(1) Identify permits required in advance and review for problems.

(2) Require complete and accurate application from developer.

(3) Retain the power to revoke the permit.

PERMIT RISK (Cont.)

Related Problems:

a. Government imposes adverse terms and conditions on permit after issuance.

b. Government refuses to renew permit issued for limited time.

c. Additional permits are required later.

FOREIGN EXCHANGE RISK

Problem: Developer must pay foreign lenders, investors, contractors and suppliers in foreign exchange, but payments for power made in local currency.

a. Exchange rate fluctuates after amount of payment in local currency agreed or paid.

b. Insufficient foreign exchange reserves to convert local currency.

c. Foreign exchange not allowed to be transferred out of country.

FOREIGN EXCHANGE RISK (Cont.)

Allocation:

a. Fluctuation in exchange rates.

   (1) Pay developer in foreign exchange, but utility receives revenue from sales in local currency.

   (2) Index the amount of local currency agreed or paid.

   (3) Sell the developer exchange risk insurance.

b. Insufficient foreign exchange reserves.

   (1) Reduce foreign participation in the project.

   (2) Tie the powerplant business to an export business that generates foreign exchange.

FOREIGN EXCHANGE RISK (Cont.)

Allocation (Cont.):

(3) Grant the developer priority access to available foreign exchange reserves.

(4) Government guarantee of availability.

c. Restrictions on transferability

(1) Government guarantee of right to transfer.

(2) Protection against breach of guarantee by creditworthy lender.

FORCE MAJEURE

Problem: How does the developer meet debt service obligations when an uninsured event occurs?

Allocation:

a. Developer maximizes insurance coverage, although cost will increase tariff.

b. Developer takes risk if fails to get available insurance or utility procures for developer.

c. If the event is uninsurable:

   (1) Utility continues payments to the developer, but these payments may not pay for repairs and utility may not collect from ratepayers.

   (2) Government lends money to the developer.

d. Developer terminates IA, PPA and FSA, but Government must repay loans at a minimum.

EXPROPRIATION RISK

Problem: The Government expropriates the developer's assets or shares or resorts to "creeping expropriation" rendering the developer incapable of performing.

EXPROPRIATION RISK (Cont.)

Allocation:

a. Developer purchases insurance against outright expropriation, but there are limits on coverage.

b. Government lends money to the developer, but unlikely if Government has engaged in expropriation.

c. Developer terminates IA, PPA and FSA and attempts to collect damages.

   (1) Expensive and slow to collect damages through a lawsuit or arbitration.

   (2) Government must waive sovereign immunity and consent to the enforcement of judgments against it.

   (3) Agree in advance to amount of damage.

IMPLEMENTATION AGREEMENT

1. Exclusive right to build powerplant
2. Assistance with permits
3. Relief from taxation and customs duties
4. Foreign exchange commitments
5. Government guarantees of the performance of government agencies \
6. Protection against Force Majeure
7. Definition of defaults and remedies
8. Dispute resolution procedures

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FINANCING INTERNATIONAL INDEPENDENT POWER PROJECTS

by

Matthew Buresch

RCG/Hagler, Bailly, Inc.

at the

INDEPENDENT POWER IN BULGARIA WORKSHOP

Borovets, Bulgaria

June 23 - 24, 1993

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FINANCING INTERNATIONAL INDEPENDENT POWER PROJECTS

I THE LINK BETWEEN RISK AND REWARD

II ISSUES AND STRATEGIES IN REDUCING PROJECT RISK

III MECHANISMS AND SOURCES FOR PROJECT FINANCING

IV RECOMMENDATIONS

THE LINK BETWEEN POLITICAL AND ECONOMIC RISK AND THE REQUIRED RETURN ON INVESTMENT

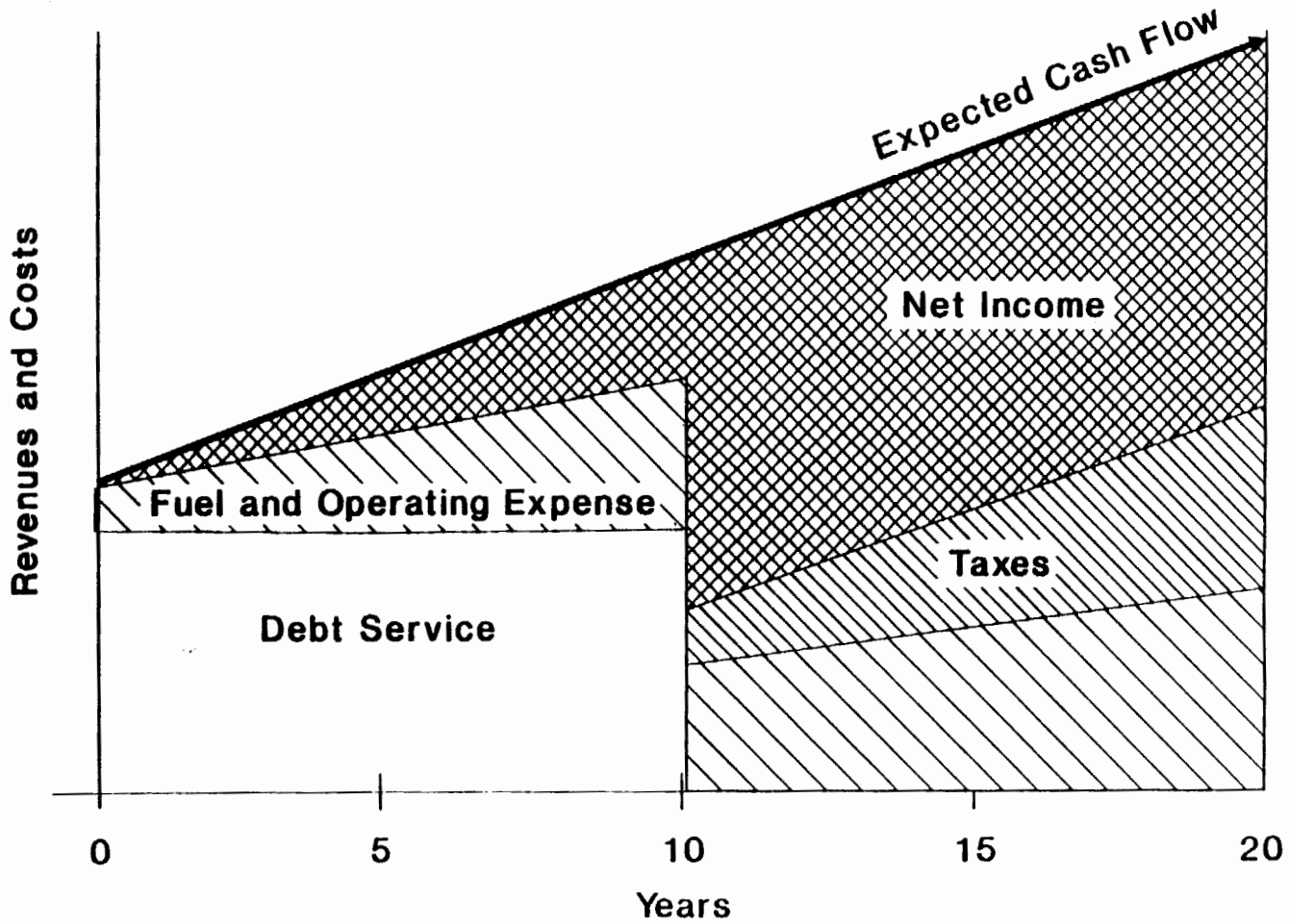
The level of political and economic risk determines the return on investment that investors will require for project financing. Countries with very high levels of political and economic risk (e.g. Lebanon or Iraq) would require such high returns that only equipment sales for cash would normally be feasibly, while countries with very low levels of risk (e.g. United States, Germany, and Japan) present attractive opportunities for long term investment. Risk is typically broken down into the following categories:

Political Risk:Political conditions that lead to (1) political violence, (2) expropriation of assets, (3) inconvertibility of local currency, and (4) legal unpredictability have a major impact on the investment climate for both domestic and foreign businesses.

Economic Risk:The credit risk of a country is measured by such economic indicators as (1) GDP/capita, (2) GDP growth, (3) country debt, (4) trade balance, (5) months of imports coverage, (6) international reserves, (7) current account balance, and (8) government budget balance.

Country risk ranking services such as Euromoney and Institutional Investor grade most of the countries worldwide according to a range of economic and financial indicators. For instance, Euromoney uses 9 criteria that include economic data, political risk indicators, debt indicators, access to bank finance, access to short term finance, access to international bond and syndicated loan markets, access to and discount on forfaiting, credit ratings, and debt in default. Bulgaria had a listing of 118 out of 169 countries in the March 1993 edition of Euromoney. This rating means that most commercial banks would regard Bulgaria as having an unacceptable level of country risk at this time.

PRIVATE POWER PROJECT CASH FLOW



THE RISK THAT THE PROJECT'S ACTUAL CASH FLOWS DO NOT MEET EXPECTATIONS PRESENTS A MAJOR CONCERN FOR INVESTORS

The expected cash flow of a project must cover the debt service payments, the fuel and operating expenses, taxes, and the net income (after taxes) required to satisfy the equity investors. Typically, debt is serviced over about a 10 year period. The key events that could effect project cash flow are:

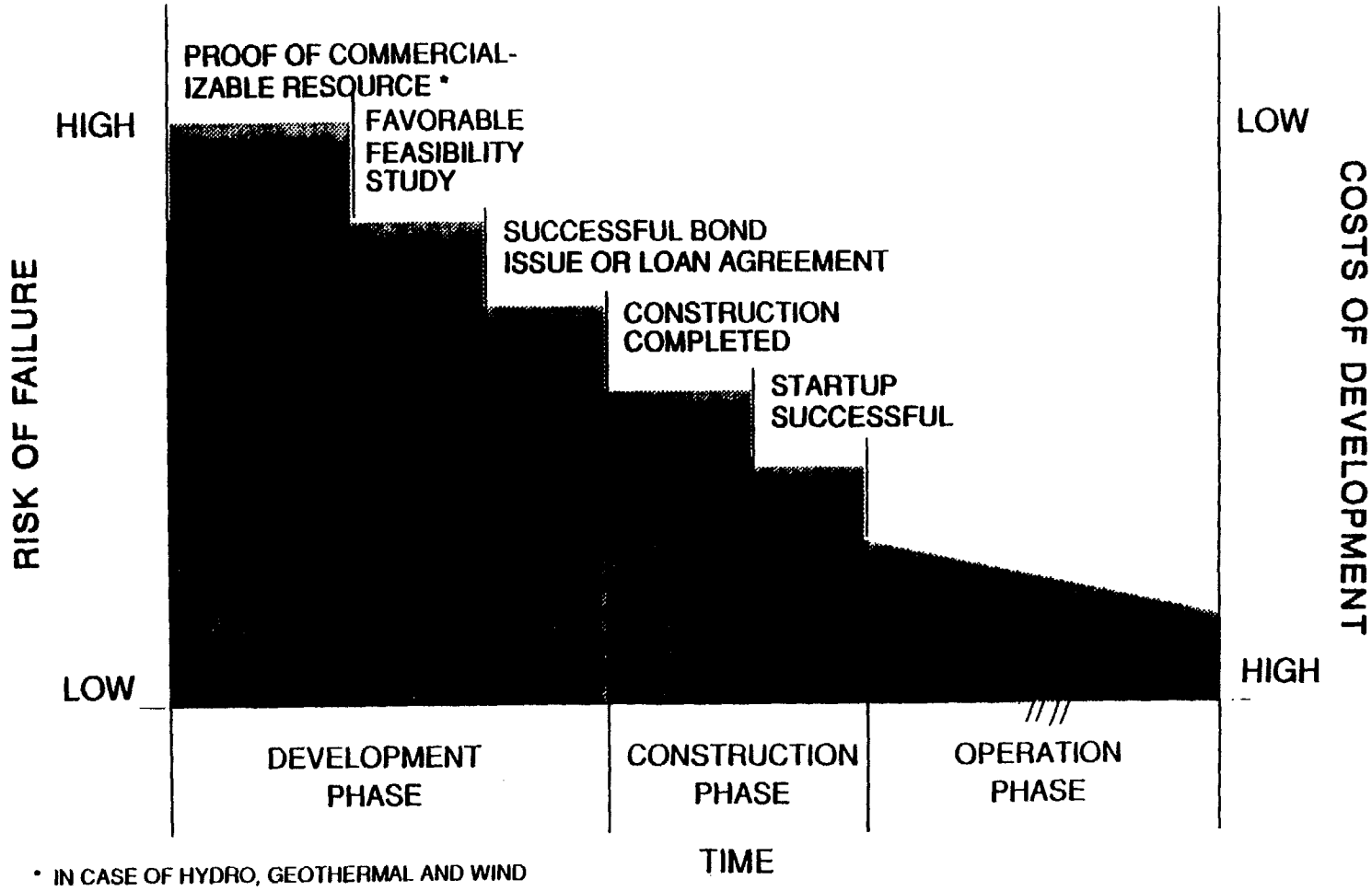
Development Risk: Problems and delays in siting the project, obtaining the necessary permits and licenses, negotiating the power purchase agreement, obtaining the required fuel and other security agreements, and securing the financing affect the capital cost and thus the debt service required for the project.

Construction Risk: Problems and delays with managing the construction, management/labor disputes, construction financing, cost increases, performance failures or discrepancies, and force majeure may result in major cost overruns.

Operation Risk: Problems with performance shortfalls, operating cost overruns, fuel price volatility, electricity payment delays, exchange rate volatility, legal changes, new environmental standards, force majeure catastrophes all influence the fuel and operating expenses and thus the level of net income earned.

Failure to generate the expected cash flows could prevent the project owners from delivering an adequate return to the equity investors, paying taxes, meeting operating expenses, or servicing the debt.

GOVERNMENT UTILITY POWER PROJECT DEVELOPMENT RISK AND COST PHASES



* IN CASE OF HYDRO, GEOTHERMAL AND WIND

THE GOVERNMENT'S LEVEL OF RISK AND COSTS ARE AFFECTED BY KEY MILESTONES IN THE DEVELOPMENT OF A PUBLIC SECTOR POWER PROJECT

As a government utility power project evolves through the development process, there are various key events that serve to reduce the risk of project failure but also increase the level of time and money that has been invested in the project. When the project is no more than a concept in the mind of planners, the risks that the project will never generate power are high, but the costs invested are minimal. As a successful project development proceeds, the following major events occur:

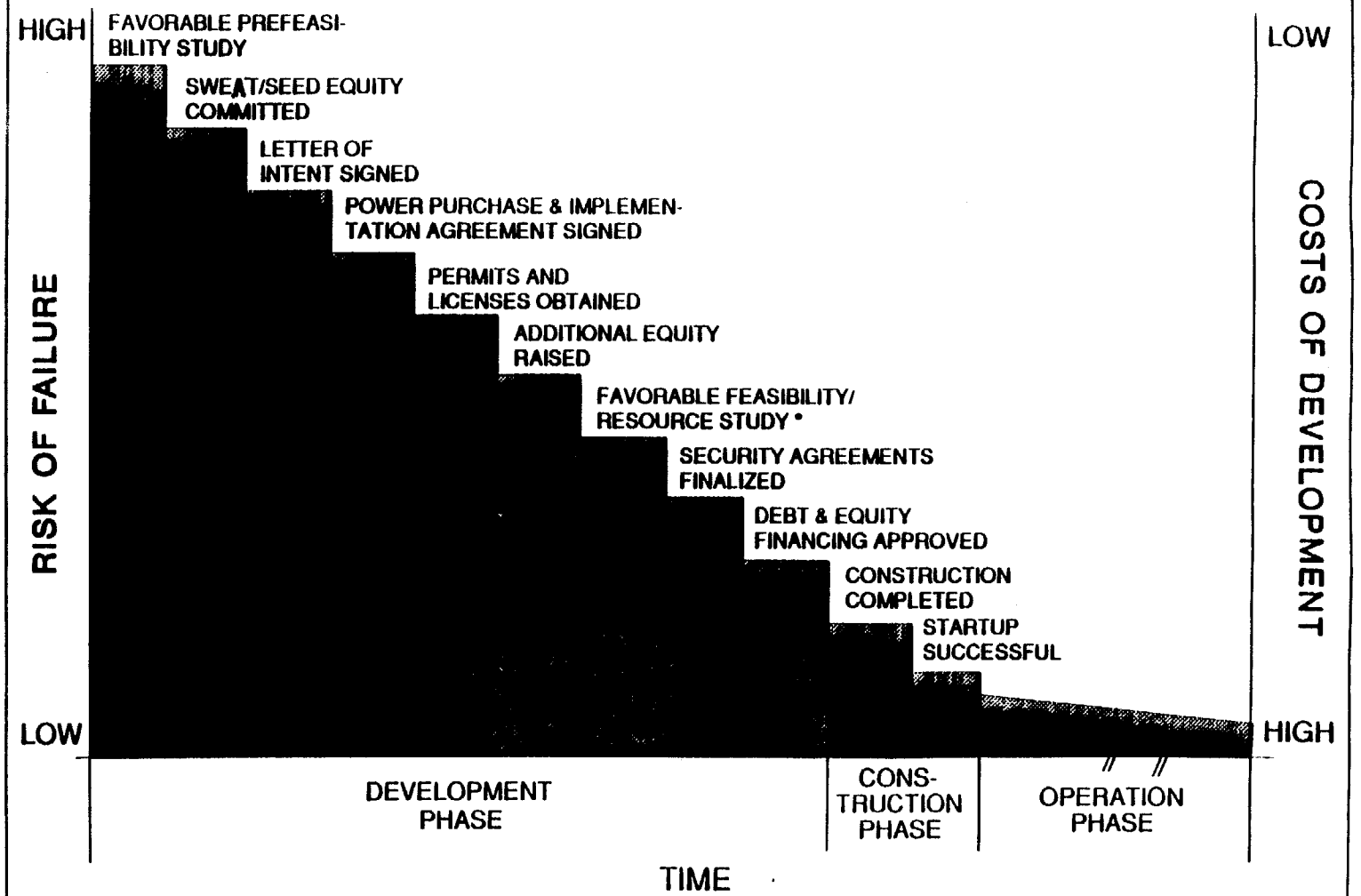
Development Phase: A favorable energy resource assessment and feasibility study and a successful bond issue or loan agreement are the key risk reducing milestones in the development phase.

Construction Phase: Construction completion on schedule and on budget followed by a successful start-up with on-specification performance are critical.

Operation Phase: Successful plant operation on budget and without unaccounted for fuel or operating cost increases and disasters over 20 to 30 years is essential.

Given that the government owns most if not all of the relevant institutions and resources needed for power generation (e.g. electric utility, grid, primary energy resources, central bank, environmental and other regulatory bodies, etc.), the process of project development is relatively simple compared to what private developers face. In addition, the cost of capital for the government is the lowest in the national economy, thus putting the developer at a financial disadvantage.

PRIVATE POWER PROJECT DEVELOPMENT RISK AND COST PHASES



* RESOURCE STUDY APPLIES TO HYDRO, GEOTHERMAL AND WIND

A PRIVATE POWER DEVELOPER FACES A MORE RISKY PROCESS WHEN DEVELOPING POWER PROJECTS

The impetus for developing country government-owned utilities to consider private power and privatization is largely due to two factors: (1) a shortage of public sector capital for electric power capacity expansion, (2) inadequate performance of power plants leading to reliability, efficiency, and financial indicators below what can be achieved in the private sector. While private developers can often build and operate power plants more efficiently, reliably, economically, they generally face a higher cost of capital and a more complex and risky process for project development. In the project development phase, there are a larger number of important hurdles that a private developer faces:

- **Pre-Feasibility Assessment (preliminary internal analysis)**
- **Sweat/Seed Equity Commitment (to finance initial development work)**
- **Letter of Intent (optional) (between government and developer)**
- **Power Purchase Agreement (locking in buy back rate and term)**
- **Permits and Licenses (for construction, environment, resource rights, etc.)**
- **Full Feasibility Study (complete technical and financial analysis)**
- **Security Package (for power purchase, construction, operation, insurance, fuel, etc.)**
- **Financing Arrangement (covering both equity and debt)**

The process of satisfactorily completing these development stages is both time-consuming and costly. The greater number of hurdles, the higher the probability that the project will fail at some point and the investors/developers will lose all their investments up until that point. A greater number of hurdles also increases the chances for delays that will drive up project costs.

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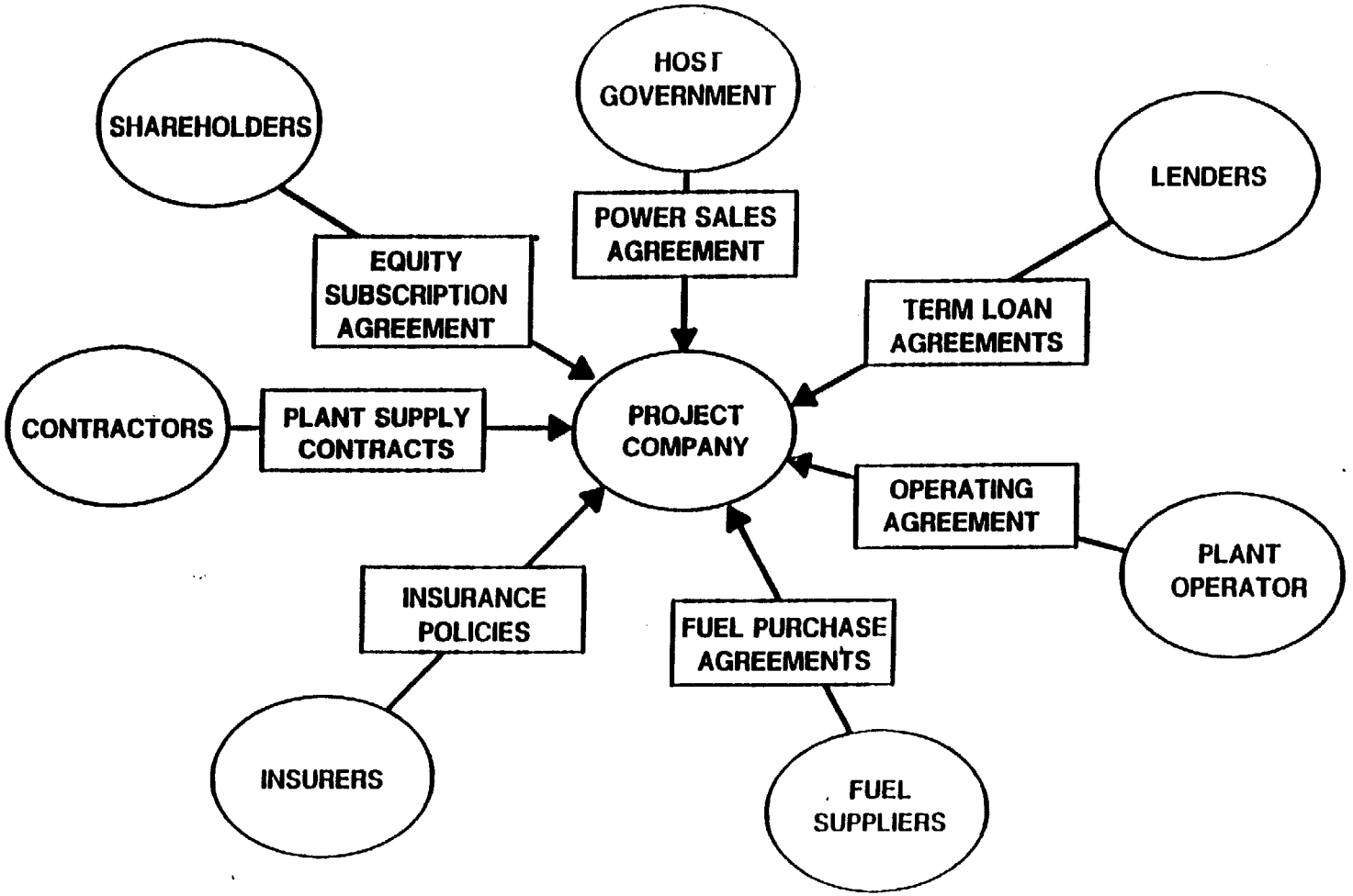
SECURITY AGREEMENTS FOR A PRIVATE POWER PROJECT



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THE FORMATION OF A PROJECT COMPANY AND THE NEGOTIATION OF SECURITY AGREEMENTS IS THE WAY THE DEVELOPER REDUCES PROJECT RISK

In order to reduce the risks involved in large private power project development, the private developer establishes a project company that is based on limited-recourse project financing and enters into a range of security agreements:

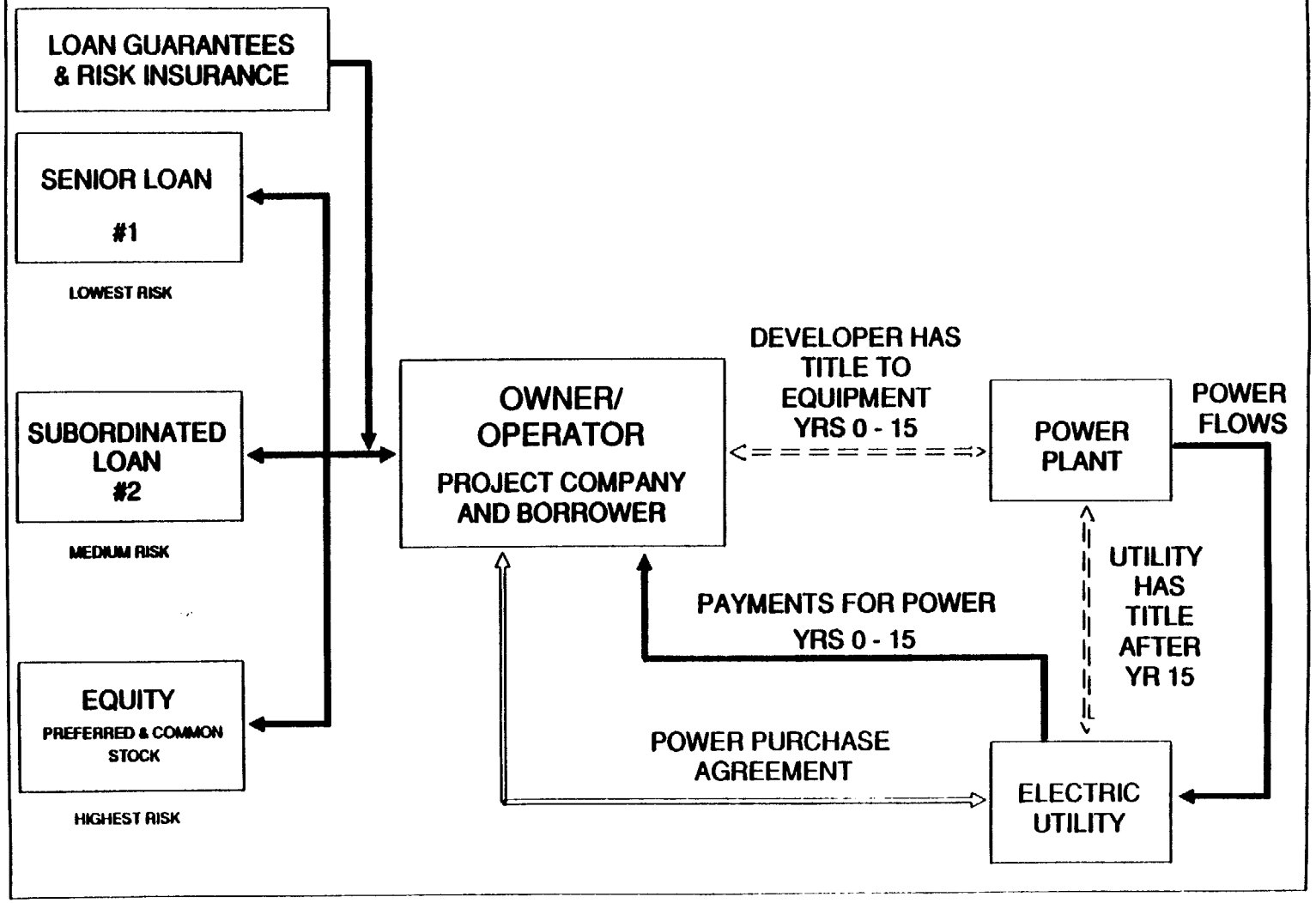
Project Financing: With project financing and the formation of a project company, the debt and equity holders in the power project have little or no recourse to the financial assets of the parent company. For this reason, project financing is often considered as "off balance sheet" financing, since it minimizes the project's impact on the balance sheet and creditworthiness of the parent company.

Security Package: An interlocking web of security agreements are negotiated to minimize the risk to the project's investors and to allocate parts of the project's risk to those parties that are best able to manage it. These agreements cover the purchase of power, supply of fuel, construction and operation, insurance, investors, etc.

Only through the security agreement process is the developer able to convince the equity and debt holders to invest while simultaneously limiting its own exposure.

PRIVATE POWER PROJECT FINANCING

FOR A "BOOT" POWER PROJECT



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POWER PROJECT FINANCING ULTIMATELY DEPENDS UPON RAISING ADEQUATE AMOUNTS OF DEBT CAPITAL

The successful implementation of a private power project is ultimately dependent upon raising sufficient quantities of debt capital. Private power financing in emerging economies typically requires about 20% to 40% equity and 60% to 80% debt. In developed countries, projects typically only require about 10% to 20% equity. Since the lenders provide the bulk of the capital, they represent the critical party whose interests must be satisfied.

Equity capital: The investors in common stock equity are the project owners and take the greatest risk because they are last to have any claim on the project's assets should it fail; in contrast they have the highest potential for reward should the project succeed. Preferred stock holders typically have no voting rights and earn a fixed dividend but are the first to earn dividends and have a higher claim on assets in the event of default.

Debt capital: The lenders or debt investors (particularly holders of senior debt) take less risk because they have first access to the assets or collateral of the project should it go bankrupt. As a result, they accept a lower rate of return typically in the form of a fixed interest charge.

Insurance and Guarantees: To reduce the risks of investing in a foreign developing country, developed country governments and multi-lateral banks provide insurance and guarantees for both debt and equity primarily against political risk.

The project lenders will scrutinize the company's performance, project financial projections, and country credit risk and will insist the project owners put equity into the project as a sign of confidence.

MECHANISMS FOR PRIVATE POWER PROJECT FINANCING PRESENT VARIOUS OPTIONS

Various ownership and financing mechanisms have been employed with private electric power projects. These different financial designs serve the different requirements of electric utilities and developers in terms of project ownership and operation.

Build, Own, Operate (BOO):	**The private power developer finances, builds, owns, and operates the power plant and sells power to the electric utility under a power purchase agreement. The developer retains title and ownership to the power plant during its entire life.**
Build, Own, Operate, Transfer (BOOT)	**The project developer finances, builds, owns and operates the project and sells power to the electric utility for an agreed upon term. After a specific period of typically 20 years, the developer transfers ownership and operation of the power plant to the electric utility.**

Build, Lease, Operate (BLO): The project developer finances and builds the power plant and then leases it to the utility in exchange for an agreed upon rent or lease payment. Leasing is particularly favored in those countries where the government or utility will not allow private and/or foreign entities to operate a major power plant. Leasing simply is a financing mechanism to employ private capital for a publicly operated power plant.

Debt/Equity Swap (DES): In a debt/equity swap, a sovereign debtor's foreign currency obligation to a commercial bank is exchanged at a discount for equity claims by an investor in the private sector. Debt/equity conversions have been endorsed by commercial banks as one means of reducing debt servicing burdens of highly indebted countries and increasing investments in the private sector.

These varied project financing mechanisms ensure that the equity and debt holders in the project earn their required return during the first 10 to 20 years of the project while meeting the utility's power and operational needs. Debt/equity swaps convert the excess debt that is unlikely to be repaid into productive equity investments.

PRIVATE POWER PROJECT SCALE AND CONFIGURATION

POWER PLANT CONFIGURATION

CENTRALIZED ⟷ DECENTRALIZED

POWER PLANT SCALE (MW)

> 50 MW	Power Plant Direct Sale To Utility; High Voltage Substation (BOO, BOOT, BLO, DES)			
5 - 50 MW		Power Plant Direct Sale To Utility; Lower Voltage Feeder (BOO, BOOT, BLO, DES)	Industrial Cogeneration: Utility-Interactive (BOO, BOOT, BLO, DES, BS)	
1 - 5 MW			Industrial Cogeneration: Captive Power (BS, EL)	Small Power Plant: Captive Power (BS, EL)

-- Build, Own & Operate (BOO)
-- Build, Own, Operate & Transfer (BOOT)
-- Build, Lease, Operate (BLO)
-- Debt/Equity Swap (DES)
-- Equipment Lease (EL)
-- Corporate Balance Sheet (BS)

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PRIVATE POWER PROJECT SCALE AND CONFIGURATION DICTATE FINANCING STRUCTURE

The size of the project and the degree to which it is centralized or decentralized plays a key role in defining the type of financing mechanism that will be used:

	OFF-BALANCE SHEET FINANCING
MEDIUM TO LARGE SCALE PROJECTS (> 5 MW)	**Build, Own, Operate (BOO)** **Build, Own, Operate, Transfer (BOOT)** **Build, Lease, Operate (BLO)** **Debt Equity Swaps (DES)**
	BALANCE SHEET FINANCING
MEDIUM TO SMALL SCALE PROJECTS (< 5 MW)	**Corporate Balance Sheet (BS)** **Equipment Lease (EL)**

The larger the project, the greater the tendency for project developers to pursue the formation of a project company and the use of limited recourse or off-balance sheet financing. The developer's and lender's transaction and due diligence costs are roughly the same regardless of the project's size. The larger projects therefore are more attractive to lenders, since their processing costs are spread across higher potential revenues.

IMPORTANT INTERNATIONAL SOURCES OF CAPITAL AND FINANCIAL SERVICES

The major international sources of capital and financial services are found in three distinct arenas:

- **Private Sector Investors provide both debt and equity and involve commercial banks, institutional investors (e.g. pension funds), venture capitalists, individual investors, and equipment suppliers.**

- **Multi-lateral Development Banks mainly provide loans to developing country governments, but increasingly have developed institutions such as the International Finance Corporation (IFC) and the European Bank for Reconstruction and Development (EBRD) which take both equity and debt positions in private sector projects. The World Bank (IBRD) can also provide financing for private sector projects by onlending through a government institutions.**

- **Government Export Trade and Investment Programs such as those provided by the U.S. government provide funds for feasibility studies (e.g. US Trade and Development Agency (TDA)), equity and debt investments, and political risk insurance and loan guarantees (e.g. US Export Import Bank (EX-IM) and US Overseas Private Investment Corporation (OPIC)). These programs help US companies selling equipment or making investments overcome some of the critical risk and financial hurdles to doing international business.**

By working together with these multiple sources of capital and financial assistance, private developers can assemble a financing package when the project and investment climate in Bulgaria are attractive.

PRIVATE SECTOR INVESTORS

	EQUITY INVESTMENT	DEBT INVESTMENT	DEBT/EQUITY SWAPS	PROJECT CO-FINANCING	EQUIPMENT FINANCING
COMMERCIAL BANKS		●	●	●	●
INSTITUTIONAL INVESTORS	●	●			
VENTURE CAPITALISTS	●				
INDIVIDUAL INVESTORS	●				●
EQUIPMENT SUPPLIERS	●				

MULTI-LATERAL DEVELOPMENT BANKS

	FEASIBILITY STUDIES	EQUITY INVESTMENT	DEBT INVESTMENT	INVESTMENT CO-FINANCING	LOAN GUARANTEES	LEASE GUARANTEES	POLITICAL RISK INSURANCE	TECHNICAL AND TRAINING ASSISTANCE
WORLD BANK (IBRD)	●		●	●				●
INTERNATIONAL FINANCE CORPORATION (IFC)	●	●	●	●				●
MULTILATERAL INVESTMENT GUARANTEE AGENCY (MIGA)					●	●	●	●
EUROPEAN BANK FOR RECONSTRUCTION AND DEVELOPMENT (EBRD)	●	●	●	●	●			●

U.S. GOVERNMENT TRADE ASSISTANCE PROGRAMS

	FEASIBILITY STUDIES	DEBT INVESTMENT	INVESTMENT CO-FINANCING	EXPORT EQUIPMENT FINANCING	LOAN GUARANTEES	LEASE GUARANTEES	POLITICAL RISK INSURANCE	TECHNICAL AND TRAINING ASSISTANCE
U.S. EXPORT-IMPORT BANK				●	●	●	●	
U.S. OVERSEAS PRIVATE INVESTMENT CORPORATION		●	●		●	●	●	●
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT	●	●	●					●
U.S. TRADE AND DEVELOPMENT	●							●

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MAJOR RECOMMENDATIONS FOR ATTRACTING FOREIGN INVESTORS INTO THE POWER SECTOR

In order for Bulgaria to increase the level of both domestic and foreign private investment in the private sector, there are various measures that can be implemented:

- **Understand the needs of the private sector so that the Bulgarian government can obtaining the best electricity price at the lowest cost to the country, while simultaneously satisfying the valid needs and concerns of the investor and developer.**

- **Establish a legal framework that responds to private sector concerns, is stable, and is relatively clear to understand and apply.**

- **Streamline the negotiation process between the government and private developers by reducing where possible the complexity involved in finalizing key agreements and contracts and obtaining the necessary permits and licenses.**

- **Provide incentives such as tax holidays and import tariff reductions that will reduce the project's costs in the critical early years. The first private power project may need extra incentives because it is the most risky and will set the stage for more to follow.**

The goal is to create a policy and business climate that is a win-win situation for both the country and the individual companies and investors engaged in the private power projects. In the early stages, most if not all debt financing and some equity will come from multilateral institutions such as the EBRD, IBRD, and IFC.

KALOYAN DISTRICT HEATING PLANT CASE STUDY

Independent Power in Bulgaria Workshop

June 24, 1993

This case study describes an independent power project development opportunity at the Kaloyan district heating plant in Central Bulgaria. An international power project developer has presented a proposal to the electric utility, NEK, the Government of Bulgaria, and the banking community for developing this project. While the names presented in this case are imaginary, the facts and data are based on a real district heating cogeneration opportunity in Bulgaria. The following profile of the project is provided for a preliminary project negotiation at the Independent Power Workshop.

1) Proposed Cogeneration Plant

The current management of Kaloyan is considering a major investment over the next two years in a 53 MW cogenerating power plant to sell power to Bulgaria's electric utility, NEK. Given that the electric power requirements of the district heating plant is only 1 MW, 52 MW of capacity will be available for sale to NEK. The cogeneration plant will operate about 11 months of the year and will be prepared to offer firm capacity to NEK during this period. A favorable feasibility study has been performed to determine the technical configuration and investment and operating costs for the cogeneration facility. Due to a major shortage of capital, the owners and managers of Kaloyan are interested in attracting private investors.

PROJECT INVESTMENT REQUIREMENTS: The total installed cost for the boiler and turbogenerator is 469 million Leva. The fuel used by the cogenerator facility will be natural gas at a 1993 price of 1900 Leva/m3. In order to earn an adequate return on this capital investment, it is estimated that the project will have to charge an average price of 1.25 Leva/kWh for the electricity it generates. Currently, NEK only offers cogenerators a power purchase rate of 10% - 15% below the industrial rate, which varies for different times of the day (peak, day, and night) and year (winter and summer). This price discount is to cover the administrative and transmission/distribution costs. Based on this power purchase price scheme and using the most recent power tariffs, it is estimated that NEK would only be willing to pay an average of about 0.92 Leva/kWh for Kaloyan's power. From this information, it is clear that the developer of the cogeneration plant must negotiate a contract with NEK at a higher price than is currently being offering.

PROJECT DEVELOPMENT OFFER: The American Power Company (APC), a well-established international developer of cogeneration projects, has taken a great interest in owning and operating the proposed 53 MW gas-fired cogeneration plant at the Kaloyan

district heating plant. APC has entered into preliminary negotiations with COE and the future owners of Kaloyan, the municipality of Transition, about developing this cogeneration plant. As part of these negotiations, APC has offered to enter into a joint-venture with the municipality of Transition, where APC would become an 60% owner and the full-time operator of the facility. A group of private Bulgarian investors have in principle agreed to subscribed to 20% of the proposed company's stock. The municipality of Transition would own the remaining 20% of the project company and thereby have an interest in its success. Given that the project will require 20% or 92 million Leva of equity financing, APC and the Bulgarian investors are prepared to invest 80% of this equity, or about 73 million Leva. With APC's extensive experience in developing cogeneration project in over 5 countries, it has a clear set of terms it requires before it is willing to invest in a power project in Bulgaria. In principle, the developer has three basic objectives: (1) a secure revenue stream, (2) clear performance obligations and requirements, and (3) the ability to avoid risks beyond its control. Specific terms sought from the three major parties involved in the project are:

a) **Terms Requested from NEK:** APC wants the utility to enter into a 25 year power purchase contract in which it agrees to buy the power at an average rate of 1.25 Leva/kWh in 1993 and escalating at a rate that reflects the costs of natural gas and labor over the coming 25 years. It would like NEK to consider setting up a two-part tariff to pay for its power, with a capacity payment for firm capacity it delivers and an energy payment for electricity sold. Based on the above average tariff, the capacity payment would be 3,500 LV/kW year and the energy payment would be 0.75/LV/kWh.

b) **Terms Requested from Government:** Given the uncertain financial condition of NEK, APC wants the Ministry of Finance to enter into an implementation agreement that will effectively guarantee NEK's payment for power under its power purchase agreement with APC. APC is prepared to obtain all the permits necessary to operate this power plant. Given the use of a clean fuel (i.e. natural gas), APC is confident the plant will meet all the environmental requirements of the Ministry of Environment.

c) **Terms Requested from the Banks:** APC and the municipality of Transition are prepared to jointly invest 92 million Leva in equity and are seeking 377 million Leva of debt financing. APC is talking with the European Bank for Reconstruction and Development (EBRD), the International Finance Corporation (IFC), the World Bank, and the United Bank of Bulgaria to obtain the most favorable financing terms. APC is seeking debt financing over at least 10 years.

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APC has been given assurances from the Ministry of Industry that it could obtain a long-term gas supply agreement. The gas will be imported from Russia and delivered to Kaloyan through the existing gas pipeline.

In order to advance this project, APC has been invited to enter into preliminary negotiations with the government, NEK, and the bankers on this project at the beautiful Rila Hotel in the mountain town of Borovets. It is hoped that these initial negotiations will clarify the acceptable terms for all the parties involved in this proposed project.

ELECTRIC UTILITY (NEK) CONDITIONS: NEK's overall objectives are to (1) deliver least cost and environmentally-clean power, (2) encourage independent power in a way that meets the above objectives, (3) procure power that is reliable, and (4) ensure that connected power plants meet its dispatching criteria. NEK projects that it will be needing about 350 MW of additional intermediate and base load capacity by the year 1996. Having recently completed a least cost utility plan, it has learned that industrial cogeneration capacity represents one of its least cost options. The average cost of generation estimated from this least cost plan is 1.32 Leva/kWh in 1994. NEK already has extensive experience with buying power from industrial and district heating plant cogenerators under 1 year contracts and at tariffs that are below its avoided cost of generation. These cogenerators have existed at government-owned facilities that have involved subsidies and investment criteria that generally would not be acceptable to private investors. NEK will need to considerably improve the terms it is willing to offer cogenerators in order to attract private capital.

GOVERNMENT OF BULGARIA CONDITIONS: The Government's major objectives are to (1) mobilize the private sector and international capital, (2) enhance tax revenues, (3) ensure the supply of electricity that is least cost, environmentally-clean, and reliable, and in the process (4) avoid offering sovereign guarantees and subsidies. The Ministry of Finance has traditionally been subsidizing NEK to cover its financial losses. NEK has agreed to eliminate its need for subsidies through tariff increases and management changes by the year 1995. The request by private investors for a government guarantee covering NEK's payment of power represents a problem for the Ministry of Finance. On the one hand, by agreeing to offer a guarantee, it would effectively assume financial liabilities in the event that NEK defaults on its power purchase agreement with the independent power generator. While it wants to support private investment in the power sector since it helps NEK to improve its financial performance, the Ministry of Finance is facing other requests for government guarantees in other sectors of the economy as well. It must weigh its options and priorities before issuing any such guarantee.

BANKER/INVESTOR CONDITIONS: The key objectives of investors and bankers are to (1) earn a return that is commensurate with the risk taken, (2) ensure that the risks are properly managed

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through the security package, and (3) confirm that the utility is sufficiently creditworthy. The multilateral banks (i.e. World Bank, IFC, and EBRD) are very interested in making investments in bankable independent power projects in Bulgaria. Both the IFC and the EBRD are willing to provide both debt and equity for attractive power projects. The World Bank is able to on-lend to such projects through a Bulgarian government institution that is willing to offer a government guarantee. Commercial banks however are very cautious in Bulgaria's current economic condition. With interest rates exceeding 60% and Bulgaria commercial debt negotiations still being unresolved, most foreign commercial banks will not be willing to make any investments at this time. Domestic banks in Bulgaria typically are only willing to lend for no more than 1 to 2 years at prevailing interest rates.

The above profile of a proposed independent district heating cogeneration project provides the framework for preliminary negotiations. Four working groups representing; (1) the developer, (2) the utility, (3) the government, and (4) the banks will each need to clarify their respective position in these negotiations.

2) District Heating Plant Background Profile

The Kaloyan District Heating Plant is located in the town of Transition, a community of 115,000 people in Central Bulgaria. This district heating plant was built on municipal land and put into operation in 1976 by the Government of Bulgaria. Presently, the district heating plant is the sole property of the Government under the Committee of Energy (COE). However, according to a decree of the Council of Ministers, ownership of the plant will be transferred to the Municipality of Transition in January, 1994.

OUTPUT CAPACITY: Kaloyan has the capacity to supply about 250 Gigacalories per year or about 200 tons/hr of thermal energy in the form of steam and hot water to industrial, commercial, institutional, and residential customers. The plant is configured with 8 boilers with a remaining useful life of between 7 and 15 years. The plant is in reasonably good condition with investments in upgrading of the distribution system being called for.

FUEL USE: At full capacity, the plant consumes about 32,100 tons per year of heavy fuel oil. Due to the economic slow down during 1991 and 1992, output has only been around 100 Gigacalories per year, with fuel oil consumption at 13,500 tons per year. A gas pipeline has already been built to the district heating plant for future use.

CUSTOMERS FOR STEAM AND HOT WATER: Currently Kaloyan supplies 95% of its thermal output in the form of steam to 27 industrial

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customers involved in the production processed foods, beer, and textiles. The remaining 5% of the thermal output is in the form of hot water sold to residential and administrative buildings involving over 24 apartment buildings (with about 4000 apartment units), one hospital, and two schools.

STEAM PRICES: Stream prices traditionally did not reflect the full costs of production. In May of 1993, however, the prices of steam for all COE district heating plants were increased to the point that at least industrial and commercial customers cover the costs of steam production. The new 1993 tariff levels depend on customer type: industrial customers: 610 LV/GCal; commercial customers: 488 LV/Gcal; administrative customers: 350 LV/Gcal; and residential customers: 238 LV/Gcal. It is estimated that the average cost of steam and hot water production in 1993 is about 500 LV/Gcal. Industrial and commercial customers, therefore, cover more or most of the costs of production, while administrative and residential customers pay well below the costs of production and are thus partially subsidized by the Ministry of Finance and by a cross-subsidy from industrial customers.

FINANCIAL STATUS: It is estimated that in 1993, total revenues from steam sales will be 44 million Leva. The total cost of producing steam for this period will be 62 million leva, representing a loss of 18 million Leva for the year. Even though 95% of the customers are industrial and recently started paying a steam price that more than covers the cost of production, during the first four high steam consuming Winter months of 1993 (January - April), the industrial steam prices were still subsidized. While there will be an overall loss for the year 1993, it is projected that the 1993 steam tariff increase will result in a total revenues of 69 million Leva in 1994, resulting in a net income before taxes of 5 million Leva for this year. This improved financial condition will also be affected by a planned 1994 increase in the traditionally subsidized steam prices for residential and administrative customers.

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DEVELOPER OBJECTIVES:

1) SECURE REVENUE STREAM

2) CLEAR PERFORMANCE OBLIGATIONS AND REQUIREMENTS

3) AVOIDANCE OF RISKS INVOLVING EVENTS BEYOND THE DEVELOPER'S CONTROL

KEY CONTRACT PROVISIONS

1) POWER PURCHASE AGREEMENT

   a) PRICE TERMS / REVENUE STREAM

   b) DISPUTE RESOLUTION

2) IMPLEMENTATION AGREEMENT

   a) GUARANTEE OF UTILITY PERFORMANCE

   b) TAX STABILITY

   c) CONVERTABILITY & PROFIT REPATRIATION

   d) PROTECTION FROM CHANGES IN THE LAW (e.g. Environmental Laws)

   e) DISPUTE RESOLUTION

UTILITY OBJECTIVES:

1) DELIVERY OF LEAST COST & ENVIRONMENTALLY-SOUND POWER

2) DEVELOPMENT OF THE INDEPENDENT POWER MARKET

3) DISPATCHABILITY

4) DEPENDABLE CAPACITY

CONTRACT PROVISIONS:

1) PRICE TERMS

   a) CAPACITY AND ENERGY SPLIT

   b) INDICES

2) DISPATCH AND OPERATIONAL CONTROL

3) CAPACITY AUDITS

4) MILESTONE SCHEDULES

5) SECURITY AND PENALTY PROVISIONS

6) DISPUTE RESOLUTION

INVESTOR AND BANKER OBJECTIVES:

1) EARN A RETURN COMMENSURATE WITH THE RISK TAKEN

2) ENSURE THAT RISKS ARE ALLOCATED TO THOSE PARTIES BEST ABLE TO MANAGE THEM

3) ENSURE THAT UTILITY MEETS CREDITWORTHINESS CRITERIA

CONTRACT PROVISIONS:

1) WELL STRUCTURED SECURITY PACKAGE

2) GOVERNMENT GUARANTEES

3) PROTECTIONS AGAINST CURRENCY AND INFLATION RISK

GOVERNMENT OBJECTIVES:

1) MOBILIZE PRIVATE SECTOR AND INTERNATIONAL CAPITAL

2) ENHANCE TAX BASE AND REVENUES

3) SUPPLY ELECTRICITY THAT IS LEAST COST, ENVIRONMENTALLY-CLEAN, AND RELIABLE.

4) AVOID HAVING TO OFFER SOVEREIGN GUARANTEES

5) AVOID OFFERING ANY SUBSIDIES

INDEPENDENT POWER GENERATION: OBJECTIVES, BENEFITS, AND IMPLEMENTATION PROCESS

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Independent Power Generation: Objectives, Benefits, and Implementation Process

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3) Essential Policy and Institutional Elements

4) The Process of Independent Power Project Development

5) Independent Power Ownership and Financial Structures

6) Sources of Independent Power Financing

7) Introducing the Policy and Institutional Framework for Independent Power

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1) Basic Legal and Financial Structure for Independent Power

Independent power represents the financing, construction, and operation of a power generating facility by a company that is independent from the central power purchasing electric utility. The central utility can either be private or government owned, but in both cases is a regulated monopoly. The independent power generator is usually owned by a private company. It is typically an unregulated facility that enters into a clearly-defined power purchase agreement with the utility. By this definition, many countries already have various examples of independent industrial cogeneration and district heating plants.

An independent power project (IPP) can: (1) exclusively serve the captive power needs of a particular factory or load (thereby reducing the power requirements of the central utility); (2) meet captive power needs and also generate surplus power and energy for sale to the grid; or (3) be a dedicated power plant for bulk power sales to the grid. Categories 1 and 2 involve some form of cogeneration while category 3 include central power plants ranging in scale from small decentralized generators (e.g. mini-hydro, geothermal, wind, solar, etc.) to large power plants (e.g. coal, oil, gas fired units).

IPPs can be introduced in different ways. At one end of the spectrum, independent power has involved a major restructuring of the power sector, the breakup of generation, transmission, and distribution, and the sale of government-owned power generation and distribution assets to the private sector (as for instance has been implemented in the United Kingdom and Argentina). At the other end of the spectrum, some countries have retained government-control over the main generation, transmission, and distribution system, and have simply entered into power purchase agreements with selected independent power generators (as has been implemented in the Philippines and Spain). Given the near-term requirement of most Eastern European countries to work with the existing government utility and the clear objective to attract private capital into the power sector, the focus of this report will be on the latter model for independent power.

Privately financed IPPs are structured as separate companies that involve limited or non-recourse project financing. This method serves to mobilize private capital more effectively by limiting the liabilities of the project owners. In the event of default or bankruptcy, the lenders and investors have no right to the assets of the owners of the company; the only collateral they have is in the assets of the specific project company. As a result, however, lenders require more assurances in the form of contractual agreements, including iron-clad power purchase contracts, and attractive internal rates of return before they are willing to lend to independent power projects.

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2) The Benefits of Independent Power

The policy motivation behind promoting independent power in different countries can vary significantly. In developed countries, the objective has typically been to promote competition, efficiency, and the integration of a more diverse array of generation technologies and fuels. In developing and transitional economies, the goal has included the above objectives but has been primarily to attract private capital into a financially constrained power sector. The benefits of independent power to Eastern European countries are at least fourfold.

i) **Access to Private Capital**. The attraction of both foreign and domestic private capital will increase investments in the country and reduce the debt burden of the utility. By integrating the power sector into the international capital markets, the ability of electric utilities to modernize and meet their expansion plans will be enhanced.

ii) **Transfer of Optimal Technologies**. With the infusion of foreign investment will come the application of state-of-the art technologies that will enable an electric company to improve the quality of service and operate in a more efficient and environmentally-sound manner. In addition, with private investments will come improved business management and accounting practices and expanded training and development of power sector workers.

iii) **Expanded use of Renewable Energy and Cogeneration**. An independent power policy framework will induce private companies and industry to cost-effectively expand indigenous renewable energy and cogeneration capacity in a way that could reduce a country's dependence on imported energy and hard currency requirements. These facilities could provide electricity at a price that is below an electric utility's avoided costs and would offer environmental benefits.

iv) **Competition Leading to Minimized Costs**. The competition fostered by independent power not only induces private developers to generate power at competitive costs but also provides important benchmarks for an electric utility in determining the costs of new generation capacity.

The effective restructuring of the power sector in Eastern Europe from central planning and subsidies to market economics and financial viability will be greatly facilitated by the above benefits.

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3) Essential Independent Power Policy and Institutional Conditions

The transmission of electric power represents a naturally-monopolistic market that must be subject to government regulation to prevent a utility from earning excessive monopoly profits. The policy and regulatory framework defined by the government and the electric utility are critical factors in establishing the price of electric power and therefore the return on investment in power projects. Independent power developers and investors therefore examine the policy, institutional, and regulatory framework before making investments in a particular country's power sector. On a contractual basis, individual projects can be developed without the entire policy and institutional framework being in place. Nonetheless, in order to develop a mature and competitive independent power industry with a diverse array of participants, this framework will be essential.

In the increasingly global marketplace, countries must compete against each other to attract the necessary capital and power project development capability. The independent power policy and institutional framework of a particular country relative to other countries worldwide will play a critical role in determining the success an independent power program. The key lessons learned from the experience in other countries in general and the specific case studies described above point to three important independent power policy conditions.

- **Fair Process:** The process of selecting specific developers and projects needs to be as fair and transparent as possible. The developer and investors should be given a clear idea of who the key decision makers are and what specific requirements must be met. If the process is overly confused or political, it is unlikely that an electric utility will attract the kind of quality developers and investors it wants.

- **Fair Price:** The power purchase price offered by the utility needs to be fair and reflect the market price for generation. Unlike a government-owned utility, an independent developer cannot subsidize or reallocate costs of generating power. Without a fair market rate for the power, the independent generator will not be able to earn the revenues needed to service its debt and earn the required return to its investors.

- **Fair Terms:** The terms of the power purchase contract and other agreements need to incorporate certain other key elements necessary to reduce risks that the investors or lenders are unable or unprepared to take. The contract term needs to be of sufficient length (typically 20 - 25 years for a thermal project, and longer for a hydro project) in order to enable the project owner to service its debt. The structure of the buy-back rate and the energy and capacity commitments need to be spelled out clearly. The developer needs to be given appropriate guarantees that the government and utility will honor all its contractual and incentive commitments.

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These three points summarize the essential elements of an effective independent power policy and institutional framework.

4) The Process of Independent Power Project Development

The installation of an independent power project involves three major phases: development, construction, and operation. Within these phases, some ten distinct steps can be defined.

(1) The electric utility determines the amount and type of capacity needed in its expansion plan through a planning process;

(2) the electric utility obtains and evaluates proposals from prospective developers that are either unsolicited or solicited through a competitive bidding process;

(3) The utility and developer may decide to negotiate an initial letter of intent or memorandum of understanding to define the basic parameters of the proposed project;

(4) The developer performs a detailed feasibility study to define the precise technical and economic characteristics of project;

(5) Detailed legal agreements are negotiated for the purchase of power, fuel supply, construction services, operation & maintenance, etc.;

(6) The developer proceeds to obtain all the necessary permits required, including such issues as land use, environmental emissions, taxes, etc;

(7) Short-term and long-term debt and equity financing is obtained for both construction and long-term capital requirements;

(8) A detailed engineering design of the project is completed;

(9) The power plant is constructed or rehabilitated and commissioned;

(10) The plant is operated, earns revenues from the sale of power, the debt is serviced, and the equity investors earn their return.

Each of these steps represent a milestone or hurdle in the process of developing the independent power project. As shown in Figure 1, at each stage of this process the costs of developing the project increase while the risks of the project failing decrease.

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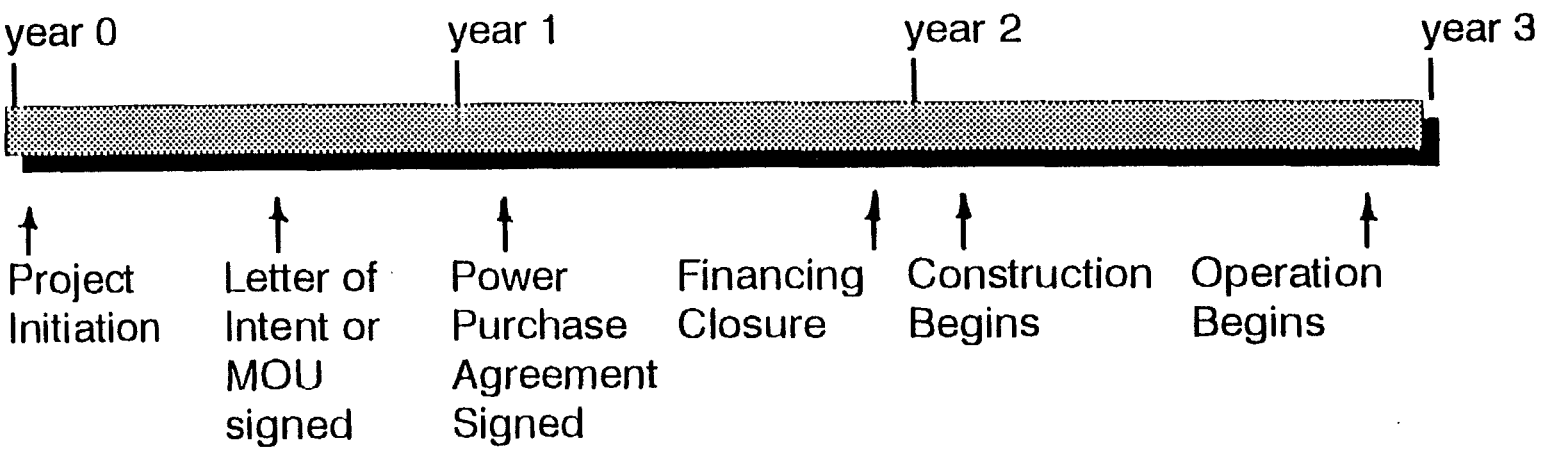
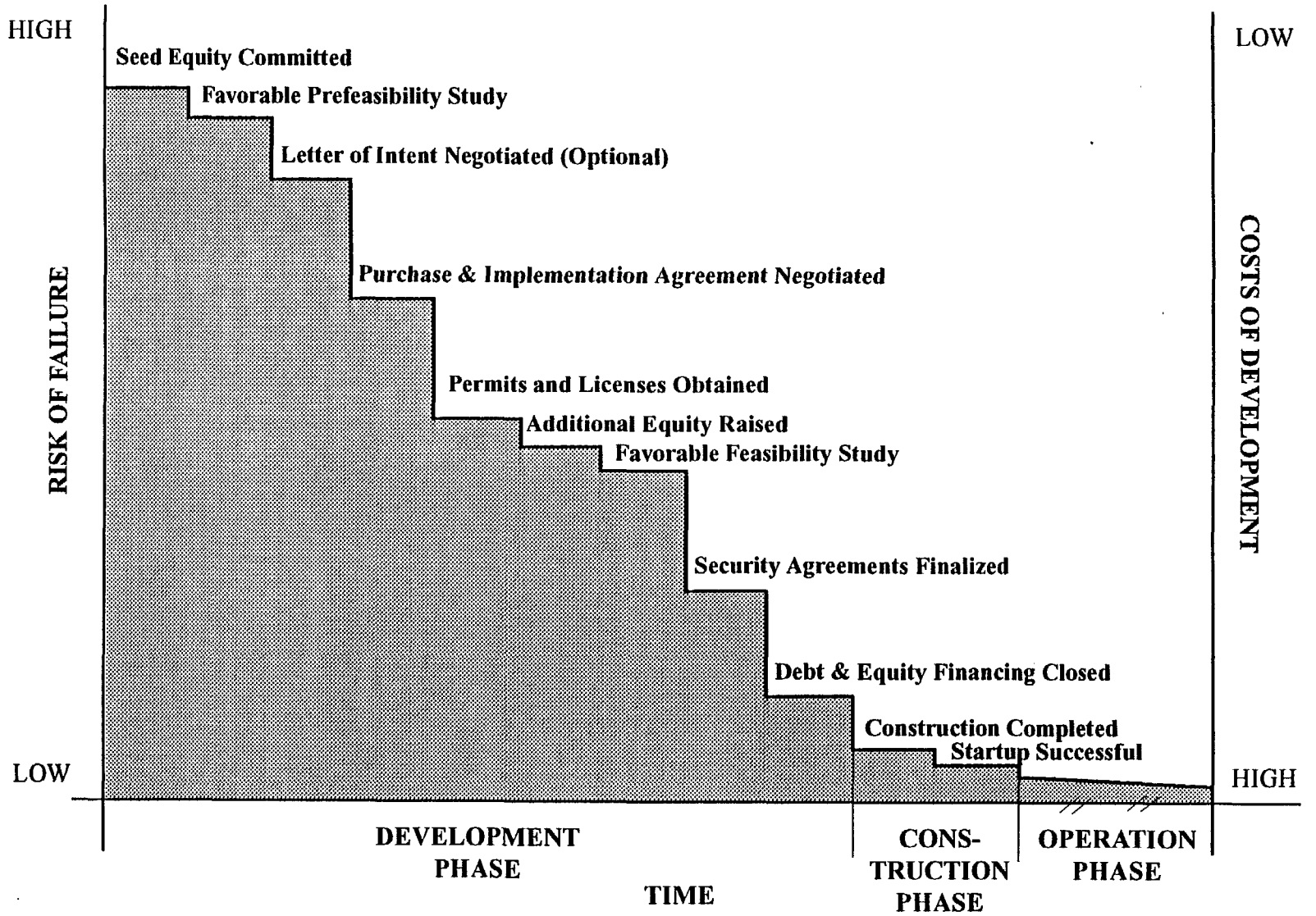
PROJECT/PRIVATIZATION DEVELOPMENT TIMELINE



PRIVATE POWER PROJECT DEVELOPMENT RISK AND COST PHASES



Source: RCG/Hagler Bailly, Inc. 1993

5) Independent Power Ownership and Financial Structures

Privately financed IPPs typically are structured as separate project companies that raise their capital on a non-recourse project financing basis. This method serves to mobilize private capital more effectively by limiting the liabilities of the project owners. In the event of default or bankruptcy, the lenders or investors have little or no right to the assets of the owners of the company; the only collateral they have is in the assets of the specific project company. For this reason, the financing of independent power involves carefully defining and structuring a project so as to properly manage and minimize its risk of failure. With an effectively defined and structured power project, it is possible to attract the investors that would be willing to accept the risk and reward profile of their particular investment.

The structure of a non-recourse financed independent power project is shown in Figure 2. According to this widely-applied model, a developer would establish a project company dedicated to the financing, construction or repowering, and operation of a specific power project. The sources of financing would be from senior and subordinated debt and from equity in the form of preferred and common stock (as discussed below). In the international market, various types of loan guarantees and risk insurance are often required by lenders and investors.

As shown in Figure 2, this project company would enter into a clearly-defined power purchase contract with an electric utility that spells out the power purchase rate over a period of approximately 20 to 25 years. Power purchase rate, fuel price, inflation adjustments, terms for penalties or bonuses, etc. would be specific elements of this contract. Given the limited creditworthiness of most Eastern European countries at the present time, it is highly likely the developer would seek specific government guarantees of the utility's financial commitments to pay under this power purchase agreement. The power purchase contract and guarantees are part of a carefully structured security package (with the government, lenders, fuel suppliers, plant operators, contractors, etc), as shown in Figure 3. The developer would need to obtain these agreements to reduce and distribute the project's risk so that financing can be obtained.

The long-term ownership structure of international independent power projects has been based on different models commonly called BOO, BOT, and BLT.

* **Build, Own, and Operate (BOO)**: The private developer finances, builds, owns, and operates the project for the entire serviceable life of the power plant without ever transferring ownership to the utility.

* **Build, Own, Operate, and Transfer (BOOT or BOT)**: The private developer finances, builds, owns, and operates the power project for a prescribed term of about 20 years. After this period in which the debt has been serviced and the equity

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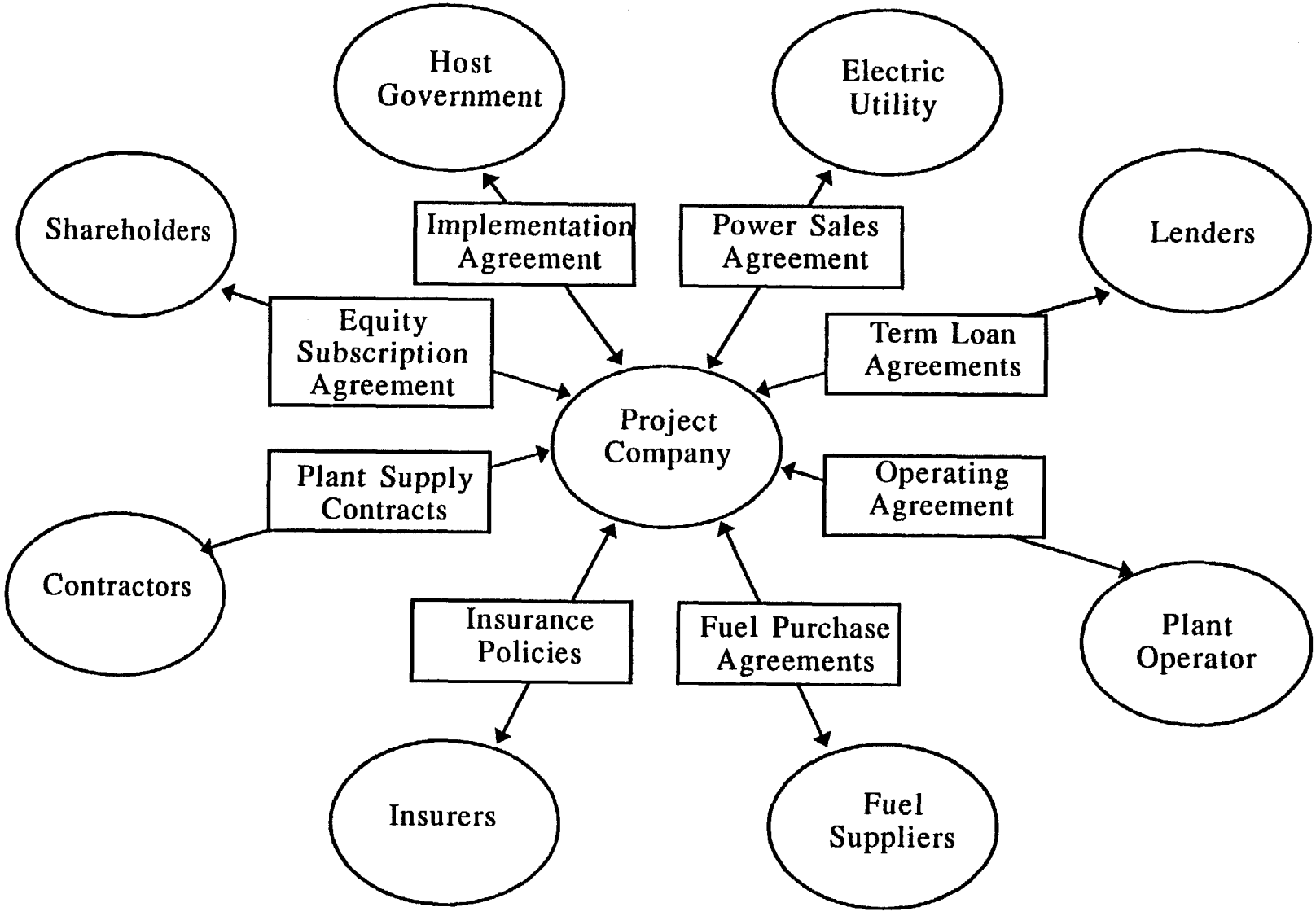
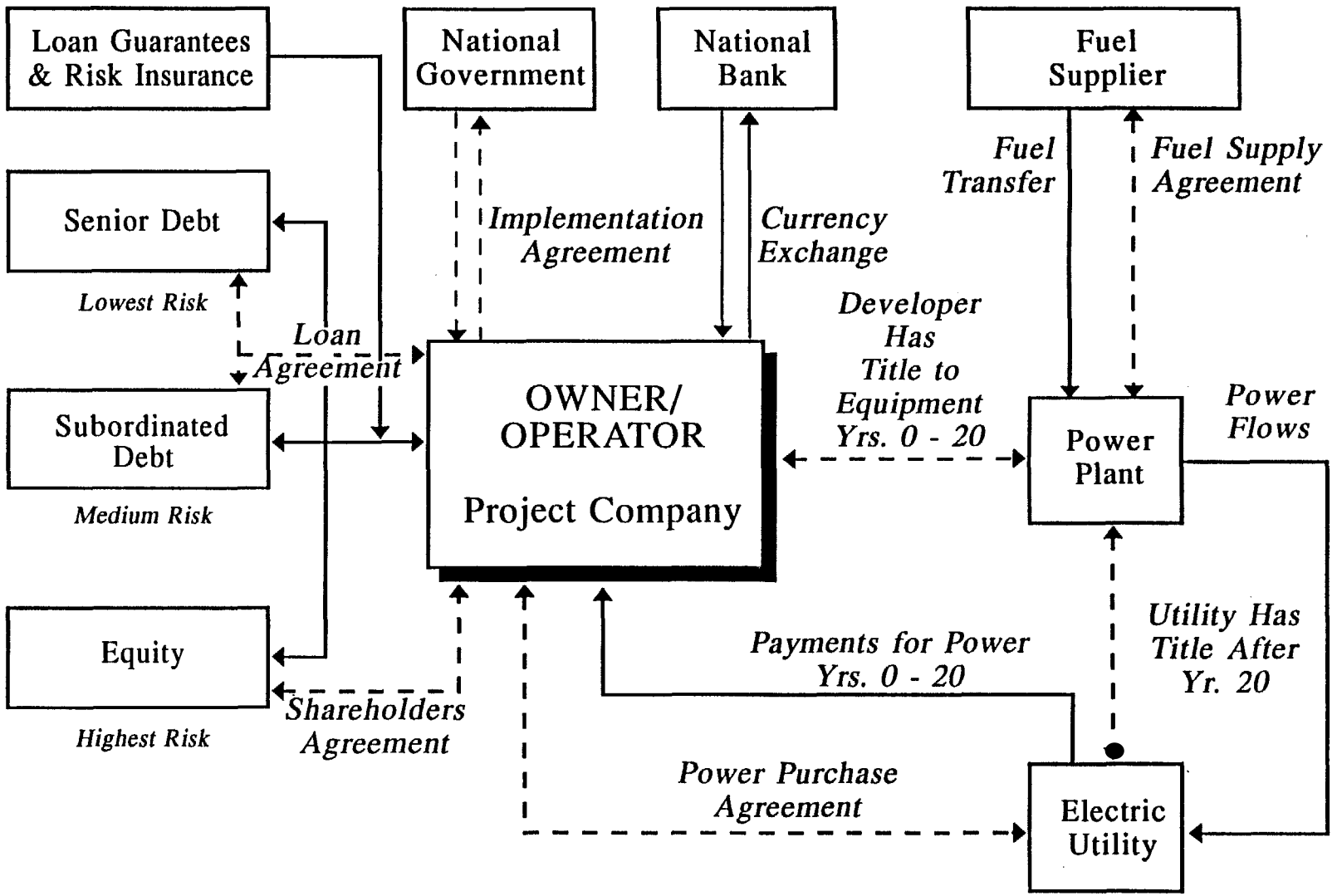
SECURITY PACKAGE FOR A PRIVATE POWER PROJECT



Source: RCG/Hagler Bailly, Inc. 1993

Private Power Project Financing

For a 20 year Build, Operate and Transfer (BOT) Power Project



RCG/Hagler Bailly, 1994

investors have earned their return, the ownership of the project is transferred from the private developer to the electric utility.

* **Build, Lease, and Transfer (BLT)**: The project developer finances and builds the project and then leases it to the utility in exchange for an agreed upon rent or lease payment. Leasing is particularly favored in those countries which have constitutional restrictions on private ownership of a power plant.

The most common models being applied to independent power projects in emerging and transitional economies is the BOO and BOT framework.

6) Sources of Independent Power Financing

With thorough analysis of a good power project and a favorable power purchase contract and other agreements in hand, the developer should be able to raise capital necessary to finance the project. The two sources of capital for financing any project are equity and debt capital:

* **Equity Capital**: Internationally, equity investors typically supply about 20% to 30% of the project investment requirements. The equity investor takes on a major portion of the project's risk because his return on investment over the life of the project is a function of the project's financial performance.

* **Debt Capital**: Debt capital is supplied by a bank through a loan or from the sale of bonds and typically supplies about 70% to 80% of the project's capital requirements. The debt investors take less risk because they have first rights to any liquidated collateral in the event of project failure. For their lower risk exposure, debt investors are offered only a lower fixed return over a typical 10 to 20 year term.

The scrutiny a proposed power project receives in raising the equity and debt financing is the most critical phase in the development of an IPP. There typically are two stages of financing a power project: construction and operation. Construction financing covers the one to four years typically required to complete the construction of a conventional thermal or hydro power plant. During this phase the project is not earning a return, since it is not selling any power. A turn-key construction contractor is typically required to take on the construction risk and commit to completing the project on a fixed price basis. Once the power project has been commissioned, the operation phase of the project is financed over a period of 10 to 25 years. At this stage, the owner and operator of the project assume the operation risk and are earning the revenues needed to service the debt and pay a return to the equity investors.

One of the major hurdles of successfully financing an independent power project is satisfying the requirements of the lenders. The ratio of debt to equity varies based on the risk in a particular market. During the highly favorable US independent power market conditions of the 1980s, some projects were financed with 100% debt. Today in the US market, at least 10% equity is required, with 20% being common. In the riskier markets of the developing and transitional economies, equity requirements of 20% to 30% can be expected. In these riskier markets, developers will require higher returns on equity than is currently earned in the US. Given that lenders are supplying between 70% to 80% of the financing, they will subject any project to very close scrutiny before agreeing to lend.

Given the size and complexity of many independent power projects, financing often involves the syndication of debt from multiple sources. For sizeable power projects, it is not uncommon for various multilateral, bilateral, and commercial financial institutions to syndicate their debt financing into a carefully structured package. While these arrangements serve to diversify the risk across multiple institutions and leverage each bank's limited resources, the process of structuring the financing can be significantly delayed. As it is often said, "time is money." If the process of negotiating a project and raising financing is unduly burdensome, the ability to successfully implement projects will be constrained. Many of the policy and institutional recommendations raised in Chapter V of this report will facilitate independent power by reducing real and perceived risks and procedural delays in raising financing.

The main question is what sources of capital would be interested in investing in an IPP in an emerging market. Two major risk factors are typically considered: country risk and project risk. Country risk typically involves such political risks as war, insurrection, expropriation of assets, inconvertibility of currency, and exchange rate volatility. Project risk typically involves construction cost overruns or delays, poor power plant performance, non-compliance with power purchase or fuel supply contract, etc. With the necessary legal contracts, project risk is usually considered manageable by a developer. Country risk, on the other hand, represents a danger of failure that the investor has much greater difficulty controlling. Country risk ranking services such as Euromoney and Institutional Investor grade most of the countries worldwide according to a range of economic and financial indicators. For instance, Euromoney uses 9 criteria that include economic data, political risk indicators, debt indicators, access to bank finance, access to short-term finance, access to international bond and syndicated loan markets, access to and discount on forfeiting, credit ratings, and debt in default. For instance, Bulgaria had a listing of 118 out of 169 countries in the March 1993 edition of Euromoney. This rating reinforces the earlier conclusion that Bulgaria's credit risk would be regarded as unacceptable for most commercial banks at this time.

In emerging and transitional economies, the primary source of debt and some equity capital is from the multilateral and bilateral institutions. Commercial banks are often very hesitant to take on the risk in these markets without a major involvement of the multilateral and bilateral institutions. The International Finance Corporation (IFC) (which is part of the

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World Bank Group) and the European Bank for Reconstruction and Development (EBRD) are two key contenders for providing debt financing for independent power projects in Eastern Europe. Bilateral institutions such as the Export Import Banks of such countries as the US and Japan have been involved in financing independent power projects. Political risk insurance (against expropriation, insurrection, and inconvertibility) and loan guarantees are typically sought from bilateral agencies, such as the US Overseas Private Investment Corporation (OPIC) and the US Export-Import Bank (EX-IM). Foreign and domestic commercial banks are likely to play only a small role in the early independent power projects in Eastern Europe, particularly with current high interest rates and short terms in much of the region.

To illustrate how independent power projects are financed, it would be worth providing an example. Given the rapidly growing demand for power and the major financial constraints, Asia in general and the Philippines in particular has been the site for some of the first major IPPs. A newly-financed project of particular note is the 700 MW coal-fired Pagbilao power project in the Quezon Province of the Philippines. This project is jointly being developed by Hopewell Holdings of Hong Kong (an infrastructure project developer), Mitsubishi Corp of Japan (a power equipment vendor), and Black & Veatch International of the US (an engineering construction company). This project is being built under a 25 year Build, Operate, and Transfer (BOT) agreement with the Philippine National Power Corporation (NPC). The NPC agrees to buy power from the developer under a take-or-pay power purchase agreement, with NPC also supplying all the fuel (coal) for the project.

The financing of the Pagbilao power project is of particular interest. The total project cost is $888 million, with about 75% being financed from debt sources and 25% equity. $535 million of the debt financing is being jointly supplied by the Export Import Banks of the US and Japan. This project could be a trend setter in that it is the first time the US and Japanese export credit agencies have jointly-financed a major project. The remaining debt is being furnished by the International Finance Corporation (IFC), the Asian Development Bank (ADB), and the Commonwealth Development Corporation (CDC). The project developer, Hopewell is supplying $200 million or 77% of the equity financing, with the IFC, ADB, and CDC also providing some equity.

Multilateral and bilateral sources of financing played an important role in the Pagbilao power project development. While developers and equipment suppliers are willing to put their capital at risk, commercial banks will likely be slow to participate in the early stages of an independent power market in emerging or transitional economies.

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7) Introducing the Policy and Institutional Framework for Independent Power

The process of introducing independent power in a country that traditionally has had the government own and operate most of the functions of power generation, transmission, and distribution requires multiple steps, some to be pursued in sequence and others in parallel, as itemized below:

- Strengthen Legislation: Strengthen components of energy and foreign investment legislation to facilitate independent power;
- Establish Regulatory Institution: Establish an independent regulatory institution that addresses independent power and ensure staffing by qualified regulators;
- Draft Regulations: Develop and publish detailed regulations based on the energy law;
- Establish Information Clearinghouse: Establish a central information clearinghouse for Independent Power (IPP) developers;
- Implement Integrated Resource Planning: Use Integrated Resource Planning to establish long run marginal cost and power purchase pricing to guide project selection;
- Define Government Guarantees and Incentives Offered: Establish consistent policy regarding government incentives and guarantees covering utility performance, fuel supply, etc.;
- Define Solicitation Process: Establish the procedure for soliciting independent power;
- Train Negotiations Team: Establish and train a multi-disciplinary review and negotiation team;
- Prepare Standard Small Power Contracts: Provide standard offer contracts for small renewable and cogeneration projects;
- Prepare Terms for Large Power Contracts: Provide standard non-price terms for large projects.

While all elements of the policy and institutional framework described above are necessary in order to enable an active long term independent power market, not all components are essential to develop the initial projects. Independent power projects can potentially move forward in an incomplete policy and institutional framework. In fact, experience in other countries (such as the Philippines, Poland, and Argentina) has shown that promoting specific projects early on can in fact help refine the policy development process.

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In order to implement a parallel policy and project development strategy, certain priority elements of the policy and institutional framework need to be developed early on in order to ensure that any proposed independent power projects have an adequate institutional and contractual framework. The near-term key power sector policy framework that needs to be implemented includes the following elements from the above list: establish a consistent policy regarding government guarantees and incentives; establish and train a multi-disciplinary review and negotiation team within the utility, and provide standard non-price terms for large, central, hydro, or cogeneration projects. It may be desirable to also prepare standard offer contracts for small renewable and cogeneration projects. With these basic elements in place, it should be possible to attract independent power investments.

The Privatization Mosaic: International Power Development Agendas and Opportunities

For many reasons that happen to have coincided, governments around the world are moving to open their electric utilities, generally government-owned, to competition — or even putting them up for sale. The scope of these changes varies sharply from country to country.

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Governments throughout the world increasingly share the common objective of expanding private investment in the electric power industry. At the same time, however, there is considerable diversity in the strategies being used to achieve desired levels of industry privatization.

I. Trends Towards Private Investment in Electric Power Systems

Government ownership of electric generation, transmission and distribution facilities is pervasive among the western industrialized countries as well as the former Soviet Union, Eastern European countries and lesser developed countries (LDCs) throughout Latin America, Africa and the Pacific Rim. Indeed, the U.S. model of privately-owned utilities providing the major portion of the nation's electric power needs is a relative anomaly and is mirrored in only a small number of countries, (e.g., Japan), with varying degrees of "mixed" public-private ownership arrangements preva-

narrow relaxation of a state-owned utility's monopoly on power generation to complete privatization and vertical disintegration of state-owned electric power systems.

The diverse approaches being taken by individual governments to privatization efforts in their electric power sectors can be grouped into four general categories (see **Figure 1**):

- **Purchase Surplus Power From Industrial Cogenerators.** Retain the state-owned utility monopoly while allowing limited opportunities for on-site cogeneration at industrial facilities with sale of "surplus" power to the grid.
- **Build-Own-Transfer (BOT) Arrangements.** Allow private-sector development of new generating facilities on a build-own-transfer (BOT) or build-own-operate (BOO) basis.
- **Private Development of New Powerplants.** Allow private sector development and ownership of cogeneration facilities and independent power projects specifically designed to sell capacity and energy to the state-owned utility under a government-approved pricing scheme.
- **Privatization and Sale/Lease of State-Owned Utility Systems.** Sale or lease to the private sector of vertically disintegrated properties of state-owned utility systems.

These generic approaches are being implemented in a variety of ways so as to be responsive to the unique set of economic, political and social considerations in each country motivating government efforts to attract foreign investment.

A. Purchase Power from Industrial Cogenerators

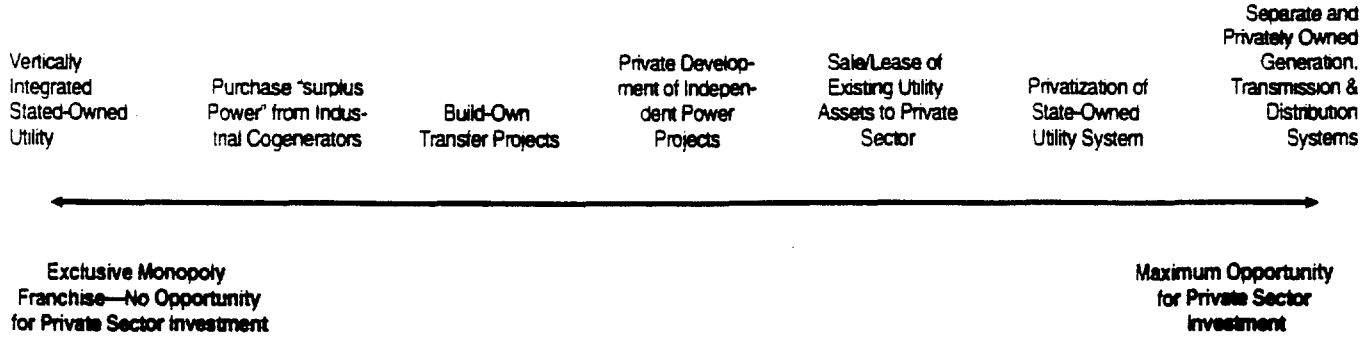
Purchasing surplus power from industrial cogenerators has been the starting point for privatization efforts in many countries with state-owned utilities. Under this approach, the government maintains state-ownership of the electric power supply system, while private sector participation is introduced on an incremental basis by exploiting opportunities for cost-effective cogeneration at existing and new industrial sites. These opportunities could involve two types of projects: (i) sale of energy only (i.e., sale of surplus power on an "as available" basis); or (ii) sale of energy and capacity (i.e., design the cogeneration facility with sufficient capacity for sales of firm power to the grid).

Mexico, South Korea and Thailand are among countries currently considering variations of this approach, whereby the government would adopt rules regulating utility purchases from industrial cogenerators and industrial power plants similar to the "PURPA-model" in the U.S. At a minimum, such rules would address eligible facilities and ownership arrangements, the price to be paid for capacity and energy, the extent of backup service obligations and the availability of standardized contracts.

B. Build-Operate-Transfer (BOT) Options

The BOT approach provides a vehicle for shifting much of the burden of investment in new generating capacity to the private sector, while retaining a vertically integrated, state-owned utility system. Under this approach,

Figure 1: Spectrum of "Privatization" Options in the Electric Power Sector



D. Privatization of State-Owned Utility Systems

The most comprehensive approach to expanding private sector investment in electric power is to "privatize" the state-owned utility including both service franchises and generation, transmission and distribution assets. There are two basic approaches to privatization. The first would maintain the vertically-integrated monopoly structure of the existing state-owned utility but transfer the system from public to private ownership. This might result in one of several outcomes: (i) a single national system; or (ii) multiple vertically-integrated systems serving designated regions; or (iii) either single or multiple vertically-integrated system(s) with options for selected generating assets (e.g. nuclear, hydro) to be retained under state-ownership. For example, the initial privatizations of state-owned utilities under consideration in Eastern Europe are likely to maintain some degree of vertical integration in the newly privatized systems.

A more aggressive approach to privatization combines vertical disintegration of the system together with transfer to private ownership, such as the recently completed privatizations in the UK and Argentina and those under consideration in Italy, Sweden, Norway, New Zealand, Australia and Brazil. This approach could result in various combinations of the generation, transmission and distribution functions (e.g., totally separate companies or combined generation and transmission companies) with limited functions (e.g. bulk transmission) being retained under public ownership.

The process of transferring a state-owned utility and its assets to private ownership can also be undertaken in several different ways. Some governments have negotiated or auctioned sales of their entire utility systems or selected assets to single or multiple purchaser(s) such as the consortia of local and foreign investors selected as the winning bidders in the recent Argentine privatization. A similar privatization approach, which will rely heavily on debt/equity swaps, is being contemplated for Brazil.

The main objectives of investors in foreign electric power systems are familiar: to minimize risk, while earning an attractive rate of return.

Other governments have used a public flotation of shares in newly privatized companies, with portions of the shares held by the government (such as in the UK and Malaysia with similar models being considered in Italy). A hybrid model involving a negotiated sale of a portion of a utility's assets to private parties and public flotation of the balance is under consideration in Venezuela. Several other governments, including Chile and Argentina, have distributed shares among employees of the privatized company, local financial institutions, "consumer trusts" and pension funds, etc. Similar types of public share distributions are contemplated for planned privatization of state-owned utilities in Eastern Europe and New Zealand.

III. Investor Objectives in Private Power Development and Utility Privatization

The principal objectives of investors in foreign electric power systems are essentially similar to those encountered in the domestic market: to minimize risk, while earning an attractive rate of return.

Potential investors include both those knowledgeable in the power industry who believe they can effectively manage the considerably higher risks and longer lead-times associated with foreign projects and those from outside the industry who see private power development as an attractive opportunity relative to their alternative investment options. Strategic alliances of several foreign utilities and local financial/industrial conglomerates are becoming a common feature in many recent privatizations.

Other objectives among those considering the electric power sector for investment may relate to achieving synergies with other investments and/or activities of the investor in a given country (e.g.,

PRIVATIZATION AND PRIVATE POWER IN EASTERN EUROPE

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International Private Power
Market Conference

May 5, 1992
New York City, N.Y.

[1]Hart Associates, Inc. is an international project development company specializing in the energy sector. Hart Associates is currently involved in the development of a private power project in Poland along with United Energy Partners, a partnership of six U.S. companies, and Imatran Voima Oy, the largest utility company in Finland.

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Introduction

In this paper, the geographic label Eastern Europe is meant to cover the nations of Albania, Bulgaria, Czechoslovakia, Hungary, Poland, Romania and Yugoslavia. The term "nations" is applied loosely, and is not meant to detract from the national identities of separate republics within the above nations, which are either seeking independence or have newly achieved it.

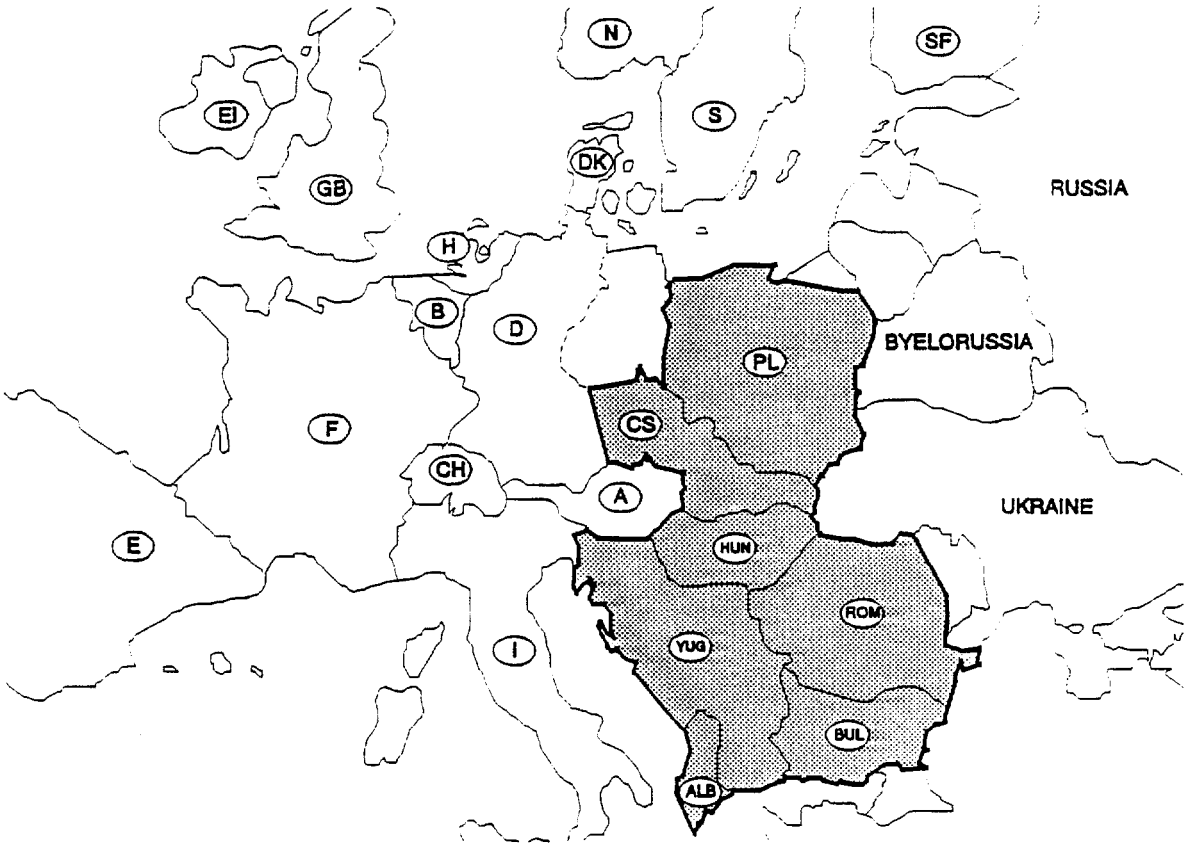

Figure 1: *Eastern Europe*

This paper focuses primarily on the triangle countries of Czechoslovakia, Hungary and Poland which, due to the progress of their transformation programs, have attracted interest and investment from abroad.

Private or independent power projects are certainly possible in some of the countries of Eastern Europe, particularly the triangle countries. The impetus for these projects results

have only recently shown any signs of abating. Inflation in the Eastern European economies remains high by any standards. The confusion and dislocation caused by the reform programs has also resulted in decreases in industrial production and GNP. Bulgaria. which relied heavily on CMEA trade. suffered an estimated 34 percent drop in industrial production in 1991. Poland and Hungary, which are farther along in their reform programs, experienced estimated drops of 12 and 19 percent respectively. Unemployment is climbing across the region and ranges from 4 percent in Bulgaria to over 20 percent in Yugoslavia.

The Power Sector in Eastern Europe

The power sector in Eastern Europe presents a picture of general reliance on low quality coal, with the expected detrimental effect on the environment. Nuclear power is in use in several of the countries. Following the Chernobyl accident in 1986, increased emphasis has been placed on safety upgrades but additional development has not been arrested in countries like Bulgaria and Czechoslovakia where the nuclear base forms a significant portion of the generating capacity.

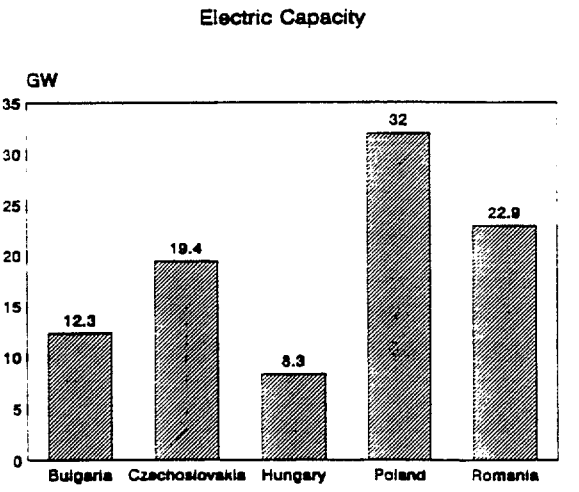

Figure 3: *Electric Capacity in Selected Countries*

Market size varies significantly from country to country, ranging from 2,700 megawatts in Slovenia, newly independent from Yugoslavia, to 32,000 megawatts in Poland. The total population in the region amounts to 123.5 million, with 52 percent of the total made up by Poland, Hungary and Czechoslovakia.

Poland

Installed electric generation capacity in Poland totals 32,000 megawatts with the bulk of capacity in hard coal fired thermal plants. Poland has an extremely unbalanced electricity generation mix, with over 85 percent of annual electricity production coming from coal fired plants. Construction of a nuclear station at Zarnowiec was shelved following the disaster at Chernobyl, and there are no further plans for addition of nuclear facilities.

The power sector consists primarily of 56 thermal power plants, 33 of which are combined heat and power plants (CHPs). The CHP stations consist of cogeneration blocks backed up by heat only boilers. There are also 4 pumped storage facilities and

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Czechoslovakia's Jaslovske-Bohunice nuclear facility currently generates 25 percent of its electricity, and this is projected to increase to approximately 40 percent by the year 2000.

Czechoslovakia has minimal natural gas reserves and until recently imported over 500 billion cubic feet (bcf) annually from the former Soviet Union. While over half of the natural gas consumption is for electricity generation, it still forms a relatively insignificant portion. Czechoslovakia also imported approximately 6,000 gigawatt hours of electricity from the former Soviet Union until recently. The uncertainty of this energy supply has prompted an energy policy which increasingly relies on nuclear power.

Hungary

The Hungarian power sector consists of 8,300 megawatts of capacity, with a balanced mix between coal, natural gas and nuclear power. Unfortunately, generation is highly unbalanced, with almost 50 percent of electricity being generated by a single nuclear power station. Coal and natural gas fired sources account for the balance of the generation in roughly equal proportions.

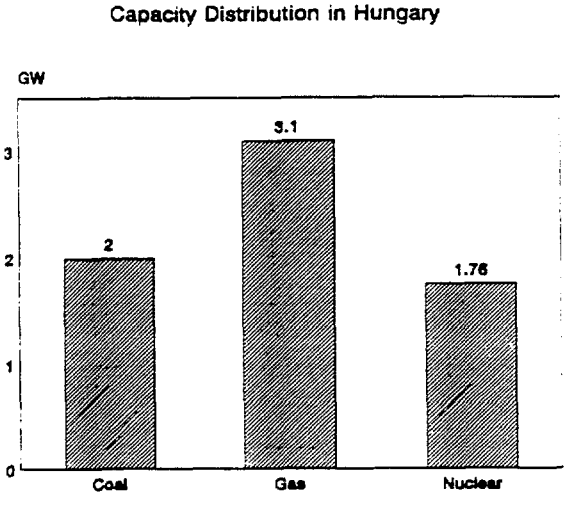

Figure 6: *Hungarian Electric Capacity*

Hungarian energy policy includes plans for the addition of at least 2,000 megawatts of additional capacity either in a single nuclear station or in a mix of hard coal, lignite and combined cycle gas stations. As with Czechoslovakia, this plan for addition of capacity appears to be driven by the necessity to reduce reliance on power imports from the former Soviet Union, which amount to approximately 30 percent of domestic consumption.

The Potential for Foreign Investment

The potential for foreign investment, generally, differs from country to country. Poland, Hungary and Czechoslovakia are farther along in their reform programs and are fairly stable politically. In 1991, the triangle countries saw growth in foreign investment. Hungary topped the list with $1.3 billion in total investment dollars flowing in last year, with Poland and Czechoslovakia receiving $700 million and $600 respectively.

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investment, requisite permits, rights and obligations of investors and concerned ministries, repatriation of income and capital, and availability of foreign exchange.

Moreover, the foreign investment laws have been tied into existing laws on taxation and business activity, which are surprisingly comprehensive. Poland, for instance, negotiated a tax treaty with the U.S. as long ago as 1974, which provides for relief from double taxation. Similar treaties exist with several European countries. New laws on the privatization of state owned enterprises outline the procedures for conversion of government owned companies into joint stock or limited liability companies which can then form joint ventures with foreign investors.

It is often surprising to note that the mainstay of the existing legal infrastructure, the civil and commercial codes, are still applicable and relevant in many instances. The prospective investor or developer will find qualified domestic attorneys and also Western law firms staffed with local personnel. A few of the larger accounting and management consulting firms have established offices and acquired expertise in East European legal systems. A few public relations firms have also started Eastern European operations.

(c) Educated Workforce

The East European countries offer a highly educated workforce which is still low cost by Western standards. Technical competence appears to be high, with a large percentage of the workforce being qualified in the pure and applied sciences.

(d) Existing Industrial Infrastructure

The existing industrial infrastructure, including factories, buildings, power plants, railway and road systems, and telecommunications may be old and in need of rehabilitation but it is still in working order. The presence of working infrastructure reduces some of the costs of establishing an investment base. Moreover, the possibility of acquiring existing facilities at attractive prices and modifying them for Western markets provides investors with viable opportunities.

(e) Multilateral and Bilateral Support

The World Bank, the International Monetary Fund (IMF), the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD) have pledged billions of dollars towards the reconstruction of Eastern Europe. At a conference in Washington in September 1991, it was reported that approximately 11 billion dollars in multilateral funding may be committed to projects in Eastern Europe over the next several years. The European Investment Bank, which during 1986-1990 lent over Ecu 9 billion to energy and infrastructure projects, has reported a commitment to the Eastern European countries of over Ecu 1 billion. Indications from the multilaterals are that

emissions of sulphur dioxide, nitric oxides and particulates have created a market for environmentally oriented projects.

(b) Lack of Own Funds

Coupled with the necessity for modernization and rehabilitation is an acute shortage of domestic funding for these projects. In the past, capital improvements were financed with grant funding from state treasuries, or out of operating funds by means of subsidies or inflated operating expense budgets. These sources of funding have now almost completely dried up, providing developers and investors with the opportunity to pick and choose among the best projects.

(c) Need for Rational Energy Prices

Energy prices in Eastern Europe, both electricity and district heat have been heavily subsidized, either directly by government agencies or by cross subsidies. In Poland, for instance, the price of electricity paid to combined heat and power plants by the Polish Power Grid averages roughly 2 cents per kilowatt hour, and yet the power plants are making profits. This has been possible for two reasons: (a) the power plants make minimal payments to the Polish treasury for "dividends" and have had no other financing costs, and; (b) mounting production costs have been passed on to district heat users. The district heating companies have, in turn, been subsidized by the state and local treasuries. Now that subsidies are drying up, the situation presents a critical impasse.

Developers and investors who are able to propose and implement structures for investments and joint ventures that would facilitate the financing of required improvements as well as the "commercialization" of the operations of the power generating or distributing entity, would be working within the stated policy of moving the energy sector towards rational pricing. "Commercialization", as distinct from privatization, does not require a majority private ownership but does require a rational cost structure and a rational risk/reward structure.

While the commercialization process results in the gradual increase of prices on the generation side, the success of the policy depends on the government's ability to free up energy prices on the retail side. The Polish government has thus far been the most aggressive in raising energy prices to end users, with the support of the IMF and the World Bank.

(d) Move Towards Energy Sector Privatization

In certain Eastern European countries, notably Poland, there is a movement towards freeing up the energy sector and encouraging private sector investment. This is being

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However, given the lack of rational pricing and the existence of subsidies, data on past energy consumption loses much of its forecasting value. Very little has yet been done in the way of market research, power system analyses and cost of service studies. The developer is thus operating without much of the standardized data available in the West. On the positive side, with the assistance of bilateral aid and support from international financial institutions, power sector administrators are making the necessary changes that would allow more standardized analysis.

(b) Inconvertible Currencies

At the present time, the currencies of the triangle countries are not fully convertible. Foreign investment laws include provisions for the repatriation of dividends, debt service and capital repayments. Some aspects of convertibility have been introduced and the expressed intention of the governments is to achieve full convertibility within a given time frame. However, at this time the future depth of the currency markets cannot be projected.

The Polish złoty, for example, is fully internally convertible. This means that residents can buy and sell foreign currency within specified limits. Large foreign currency transfers can be made only as part of a project involving foreign trade or investment, or else require a foreign exchange permit. The Government of Poland has expressed its intent to introduce full convertibility by the end of 1993. The Governments of Hungary and Czechoslovakia have expressed similar intents.

In the meantime, developers will have to be creative in the design of output sales contracts and link output sales prices to exchange rates in an effort to alleviate the risk of currency devaluations. To circumvent the possible lack of depth in currency markets for the domestic currency, developers may have to resort to barter type deals involving export of electricity, coal and other commodities.

(c) Insufficient Understanding of the Developer Role

Managers in the power sectors in Eastern Europe are quite unfamiliar with the role of the developer. In their prior experience, plant improvements have been financed primarily from government grants. The little experience with international financing has been in the form of equipment purchases financed through export credits backed by government guarantees. Developers are initially looked upon as deep foreign pockets and then may pass through several cognitive phases, including carpetbagger, as it is realized that their role does not come for free. In order to overcome this lack of understanding, the developer has to spend a fair amount of time and effort in frank discussion of the role and motivation of the development company and the value added by the developer.

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Features of a Likely Successful Project

(a) Good Fit With National Policy

Each of the triangle countries has developed or is in the process of developing policies covering foreign investment in general, and in the energy sector, in particular. These policies are, in turn, tied into the policies for economic reform and sector development and restructuring, and include references to privatization. It is vital that a private power project be planned and implemented within the scope of these policies.

(b) Good Fit With Local Development Plans

Local governments will invariably have their own development plans for the municipality in question. These plans are particularly important for power plants which are combined heat and power facilities delivering district heat and process steam to the locality. Local governments may also have environmental requirements which supercede national regulations. In Poland, for instance, the local governments are taking on increasing responsibility for environmental issues which were previously under the control of the national government. Several municipalities, Cracow among them, are particularly concerned with the removal of dispersed coal burning local boilers which have a particularly detrimental effect on the environment through low level emissions of sulphur dioxide and particulates. Removal of these local boilers would require alternative sources of heat. Well placed CHP plants with adequate modernization and environmental retrofit would be the logical replacement for local boilers.

(c) Well Informed Domestic Partner

While the managements of power plants in Eastern Europe are highly proficient in the technical aspects of power generation, they may not be at all knowledgeable about financial and legal structures involved in a joint venture and their implications. It is the responsibility of the developer to ensure that sufficient education and information dissemination takes place such that the domestic partner is as knowledgeable about the entire process as the foreign partner.

(d) Well Informed Government Agencies

A successful project requires that government officials be well informed regarding all facets of the project, particularly the structure, cost and pricing. Government agencies will be closely involved in the development of an energy project. It is important that government decision makers are supported with adequate information from the developer. This process requires continuous information dissemination in the form of a planned public relations campaign.

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International Private Power Market Conference

New York, USA

May 5, 1992

The World Bank View of Private Power

Presented by

Peter A. Cordukes
Industry and Energy Department
The World Bank

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International Private Power Market Conference
(New York, USA - May 5, 1992)

The World Bank View of Private Power

The World Bank has been financing electric power facilities in developing countries since 1948. Over the last 43 years, it has approved about $40 billion for this purpose or 15% of total lending by the Bank. Three quarters of the projects financed have been in Asia and Latin America. Two thirds of the lending in the last decade has been concentrated in six countries China, India, Indonesia, Brazil, Colombia and Turkey. The remaining loans have been provided to over 60 countries.

The basic objectives of World Bank lending in the power sector have been to:

(i) finance facilities that form part of a country's least-cost power development program;

(ii) strengthen institutions and efficiency in the sector;

(iii) improve local resource mobilization and catalyze co-financing; and

(iv) improve access to power supply especially to those living in rural areas or on low incomes.

One of the most pressing problems facing developing countries during the 90s is in obtaining adequate finance for power sector developments. At the start of this decade, it was estimated that developing countries would require about $100 billion every year for new developments[1] over 60% of which would be for new generation facilities. The growth in development of new facilities is expected to be focused mainly in Asia with (60%). Other developments planned would be in Latin America 21% and Europe 17% and Africa only about 1%.

Since these projections were first assembled by the Bank from estimates obtained from the countries, several developments have occurred which would suggest that funding requirements will be less than $100 billion a year.

Firstly, the slowdown in economic growth world-wide in the last 2 years will reduce the demand for new generation capacity since consumption will be less than projected.

Secondly, governments are responding to environmental pressure groups which are concerned to reduce the adverse impact of energy developments due mainly to emissions from oil and coal-fired thermal plant and damage to flora and fauna and disruption caused by human resettlement in the vicinity of large dams. These concerns have contributed to the swing away from capital intensive hydro and coal developments towards less expensive and cleaner technologies especially natural gas. As a result

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1 These estimates do not include the countries of the Commonwealth of Independent States.

conditions under which private producers and owners of captive plant can sell to the grid. The Bank managed and externally funded Energy Sector Management Assistance Program (ESMAP) has also been active in this area (e.g. in Bolivia, Colombia, Jamaica and Poland).

In Latin America, the Bank and OLADE arranged a high level conference of ministers from the countries of the region last year to discuss the need for restructuring their power sectors to improve efficiency and to attract additional finance from the private sector. The Bank is also actively assisting several countries in this respect, notably Argentina, Bolivia, Colombia, El Salvador, Peru and Venezuela.

In Eastern Europe (Poland, Hungary and Czechoslovakia), the formerly centralized power sector entities are being encouraged to be restructured as joint stock companies which eventually may be sold to the private sector or at least placed on a competitive footing to enable future competition with private producers. Distribution areas are likely to be managed as franchises or concessions which would be awarded on a competitive basis. Shortly, the former republics of the Soviet Union are expected to join the Bank. Already, the Bank is undertaking energy sector work in these countries in preparation for future lending operations.

In Asia, apart from the loans already mentioned in India, Malaysia and the Philippines, Indonesia is considering proposals for private sector generation but progress is constrained because electricity prices are so low that owners of captive plant, who are responsible for operation of almost half the country's installed capacity are not willing to sell to the public system run by PLN. Thailand is also considering establishing a generating corporation in competition with EGAT, the Electricity Generating Authority of Thailand. Elsewhere in China, joint venture developments with foreign investors are being encouraged as a result of central planners relinquishing responsibility for providing government budget allocations to provincial power bureau.

In the Middle East, the Bank is supporting long-term proposals for Iran to restructure the power sector and convert existing government owned corporations to joint stock companies. Substantial amounts of co-financing are being sought to finance new gas turbines and combined cycle plant.

In Africa, power utilities are being placed under private management through leasing and management contracts with foreign utilities (e.g. Cote d'Ivoire, Gambia and Guinea).

Expanded Cofinancing Operations

Fourthly, in July 1989, a program of Expanded Cofinancing Operations (ECOs) was authorized by the Bank's board of directors. This was intended to promote increased private financial flows but not to substitute for risks normally borne by private lenders.

The Expanded Cofinancing Operation for Hub River in Pakistan

Early this year, the Bank's board authorized negotiation of a partial guarantee of up to $240 million of a syndicated commercial bank loan of $360 million to the Hub Power Company in Pakistan. The Export-Import Bank of Japan agreed to provide a similar undertaking for the remaining $120 million equivalent on the Yen portion of the syndicated loan. These partial guarantees are intended to cover only principal payment due in the event the company fails to meet such payments. The Hub

entities, arm's length regulation between governments and power suppliers and to increase its support for private sector investments. Another initiative may involve greater use of the services of foreign utilities in managing utilities in developing countries especially in the Africa region.

Energy Efficiency and Conservation

Lastly, the Bank is also responding to the developed countries concerns that it should give more attention to energy efficiency and conservation through its energy lending. It is therefore, planning to maintain its efforts to improve energy efficiency especially through rehabilitation and improvement programs, loss reduction, restructuring of tariffs and switching to more economic fuels. Sharper focus will be given to aspects such as better integration of energy issues in the Bank's country policy dialogue and transfer of energy efficient technologies.

Implications for Private Power

So you all may be anxious to hear what all these developments may mean for those of you who are interested in private power development.

Clearly, there are positive policy changes taking place at the Bank which are likely to increase the pace of restructuring, corporatization and privatization of electric power in developing countries. Much attention will be given to the countries of Eastern Europe and the Commonwealth of Independence States but the Bank is not neglecting its traditional borrowers. Indeed, the Latin America and Caribbean countries in particular are also receiving (as I have mentioned previously) considerable attention once again by the Bank.

We have already seen that the Bank is increasing its lending to the private sector through loans either made directly to governments and onlent to companies owned largely by private investors, or directly to private companies with the government's guarantee. In other cases, it has participated and sponsored private sector energy development funds which are directly lending for private power investments. These activities of the Bank will continue to expand.

The restructuring of the power sectors in developing countries to increase efficiency and opportunities for competition is accelerating rapidly. Each country is developing its own approach based on experience of countries like U.K., New Zealand and Chile. Essentially, they all are seeking to reduce government involvement, minimize regulation and adopt commercial practices. Private investors, utilities and consultants will find many opportunities to supply plant, equipment and services. The prospects for independent producers depend greatly on the pace of reforms and how quickly electricity prices are adjusted to commercial levels. They are presently too low in many countries to encourage existing owners of captive plant or independent producers to sell to the grid.

Competition will grow in the segments of the industry that are now recognized not to be natural monopolies i.e. generation and distribution. However, a regulatory framework needs to be established to ensure adequate prices, standards and arrangements for self-generators such as access to the grid. In many countries, (e.g. Indonesia, Thailand, Malaysia) private sector proposals are being submitted to governments before such a framework is established. Prospects of private power generation projects being approved quickly in such circumstances are bleak.

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Double-Digit Growth

The global need for additional generating capacity continues to grow — at double-digit rates in some cases. Opportunities for partnerships and joint ventures vary considerably by country and region.

By Theodore Cartselos, William Meade and Luis Hernandez

In Indonesia, the need for power is rising at 13 percent to 15 percent annually. Real growth of the gross national product (GNP) was 5.5 percent annualy between 1980 and 1991. Mexico and India have passed new regulations which open the door to foreign investors in power plants. On a global scale, more than 150,000 MW of capacity is planned for construction by the end of the decade.

The pursuit of a share of the global power market continues to attract the interest of project developers. Each country or region in this expanding business offers a set of both challenges and opportunities. Understanding both is the first step toward success in those markets.

Independent Energy takes a closer look at five countries where the playing fields are increasingly tipping to favor outside partners in power project development — India, Indonesia, Malaysia, Thailand and Mexico. The focus of development concern continues to be the political and regulatory climates, the financing opportunities and players involved, the fuel options available, and the needs for capacity.

Despite the varying obstacles to outside development that may have been present in the past, each nation is making a concerted effort to open its doors to global investors. The need for capacity continues to drive this development trend. South Asia alone now accounts for nearly 30 percent of the world's population.

The need for outside financing and the need for partners willing to share both risk and experience are pushing governments to welcome foreign investors. In many cases, equipment vendors, industrial companies and developers are being asked to participate in joint ventures to help meet the demand.

INDIA

India has combined an attractive private power framework with broader economic reform measures in wooing international developers to help achieve capacity targets and attract foreign capital and know-how. To date, developers have proposed 41 projects totaling more than 20,000 MW of new capacity. More than one-half of the offers are from foreign investors. U.S. firms are particularly active, participating in 19 of the ventures.

Total installed capacity is 69,352 MW (68 percent thermal, 29 percent hydro, 3 percent nuclear), of which about 4 percent is owned and operated by licensed private companies such as Tata Electric Power, Bombay Suburban and Ahmedebed Electric. The present legal framework provides for three major categories of electricity suppliers: state electricity boards (SEBs), licensees, and generating companies or independent power producers. To expedite the process for approving independent power producers, the government

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has established the High Powered Board, comprised of the heads of the major ministries concerned with the power sector.

Energy Resources

Developers face fuel supply risks in India. Coal demand already outstrips production, supplies of natural gas are relatively inexpensive but not readily available, and hydropower is subject to variances in India's climate and irrigation priorities.

Coal is India's predominant fossil fuel resource, nevertheless. Mines and transport facilities are government-run operations that often experience strikes by government unions. The power sector currently consumes about two-thirds of all coal mined and its demand is growing at 15 percent per year. Private developers have been pressing for better, more reliable coal transport. Importing coal, especially for private power projects, is becoming more appealing not only because of the supply problem, but also because imported coal is cheaper and of better quality. Typical Indian coal exhibits low-sulfur and high-ash content.

In a recent policy move, India's Ministry of Coal has decided to develop mines at its own cost for power plants proposed by foreign investors when supplies from existing mines are either inadequate or inconvenient to transport to the plant. Foreign companies can either lease a mine and develop it, obtain supplies from mines already owned and developed by government-owned Coal India Ltd., or import coal directly.

Natural gas for the power sector is a relatively new phenomenon, having grown from 85 billion to 519 billion cubic feet a year in 10 years. At present, the government will supply gas only for baseload electric power plants. In fact, Gas Authority of India Ltd. announced last year it would not be able to supply the gas required for the 800 MW, combined-cycle plant near New Delhi.

Investment Climate

Since July 1991 the depth and speed of the overall reform process in India's trade and investment policy have been impressive, as the Rao Government steadily moves the country into the global economic mainstream. Of particular importance is the government's efforts to make the rupee convertible, thus making it easier for foreign developers to repatriate profits. In the past, Indian government policies have restricted potential foreign investment and placed considerable burden on foreign firms already operating in India.

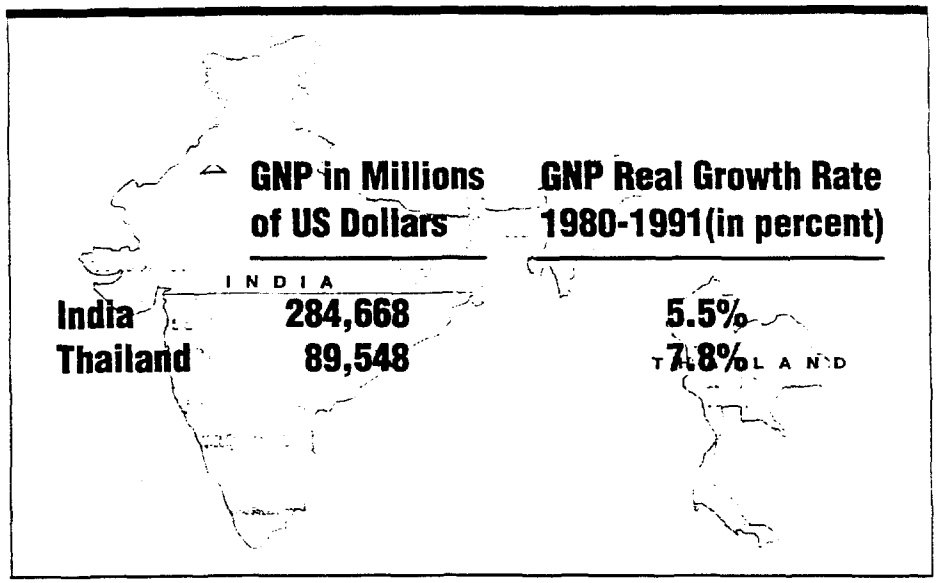
State governments play a vital role in promoting electricity projects and it is significant that the state governments have embraced private power. The central government will issue counter-guarantees, at the request of the state governments, on sales of bulk electricity by private generation companies to SEBs. If an SEB does not meet its bills, the central government would divert funds to the company from the state government's share of centrally collected taxes. To date, the central government remains opposed to an outright sovereign guarantee for power purchase payments.

This is particularly important, since many of the SEBs have incurred financial losses mainly because of low agricultural tariffs; poor collection; and losses due to extended rural electrification programs. The Andhra Pradesh SEB is one of the few state power boards to operate profitably and is in the forefront of encouraging private power projects. Other SEBs that have been consistently profitable include Maharashtra,Tamil Nadu and Gujarat and Madhya Pradesh.

Several new concessions were announced in early 1993 to encourage investment in private power. First, profits from private power projects receive a five-year tax holiday. Next, duty on imported power generation equipment is reduced to 20 percent, and excise duty on other capital goods and instruments is reduced to 5 percent. Also, 100 percent foreign ownership is allowed with full repatriation of profits. Joint ventures of private sector and state/central government are allowed to set up licensees or generating companies. The Investment Promotion Cell within the Department of Power was set up to directly work with prospective private ventures.

Regulatory Climate

India's policy to encourage private sector participation was introduced in 1991 through amendments to the Indian Electricity Act and Indian Electricity Supply Act. The private sector can set up coal/lignite or gas-based thermal, hydroelectric, wind, solar, and biomass energy projects. Companies can set up either as licensees, distributing power in a licensed area from their own generation or purchased power, or as gener-



GNP is calculated in national currency and is usually converted to US dollars at official national exchange rates for comparison across economies. The GNP real growth rate is described as an average, annual rate that has been determined from constant price data and averages adjusted to exclude inflation.

Source: The World Bank Atlas, 25th Edition.

ating companies, generating power for supply to the grid. Generation and distribution licenses are granted by the SEBs and state governments. Captive power plants serving industrial or other units may supply surplus electricity to the grid.

The Central Electricity Authority reviews the technical and economic feasibility of projects. The Planning Commission gives investment approval. The state/central pollution control board grants air and water pollution clearance. Fuel supply agreements are approved by the Department of Coal within the Ministry of Energy or the Ministry of Petroleum — natural gas and oil. The Department of Economic Affairs within the Ministry of Finance grants foreign investment approval. The Department of Power within the Ministry of Energy is responsible for guidance in project finance and overall coordination. An inter-ministerial High Powered Board was set up to resolve any remaining issues pertaining to project approvals.

Licenses of 30 years duration in the first instance and subsequent renewal of 20 years are now allowed. At present, developers are allowed to earn a rate of return on total project costs of 5 percent above Reserve Bank of India rate — currently the RBI rate is 11 percent. Developers also might guard against exchange rate fluctuations. This is accomplished by either setting a portion of the power purchase rate in foreign currency to cover foreign equity and debt or use a forward exchange-rate cover, building the cost of insurance into the tariff. There is no ceiling on rate of return on equity.

Financing Sources

Sources of financing include multilateral development banks (e.g., World Bank, Asian Development Bank), bilateral aid agencies, international commerical borrowing, domestic capital borrowing, internal resources of corporations, domestic institutional borrowing (e.g., Industrial Development Bank of India), direct budgetary support and capital issues.

Private generating companies can maintain a debt-equity ratio of 4 to 1. Public funds can be used to finance up to 20 percent of private power project costs. Developer equity should be a minimum of 1 percent, and not more than 40 percent of the project cost can come from Indian public sector financial institutions. Special appropriations are permitted to licensees for meeting debt obligations. Companies can sell power under a two-part tariff to protect against under demand of power. One part ensures recovery of fixed costs, while the other ties variable costs such as fuel and operations and maintenance.

Need For Power

India's economy grew at an average annual rate of 5.6 percent during the second half of the 1980s, however, it dropped to 2 percent in 1991 to 1992, due to the government's rising import bills caused by a simultaneous oil price hike from the Gulf War and a drop in dollar remittances from overseas workers. The demand for electricity grew at an annual rate of 9.4 percent between 1987 and 1991, and is expected to grow at more than 8 percent a year through 1997.

During the current five-year plan — 1992 to 1997, 30,538 MW are planned. Nearly one-third of the total is planned for the Northern Region. Based on government projections, this would still leave a 9 percent shortage of generation and peak demand shortfall of about 21 percent. The deficit for energy and peak demand is expected to reach 27 percent and 15 percent, respectively, by the year 2000. The current and expected shortfalls have given rise to an increasing number of industrial generation proposals. To date, 71 cogeneration and captive power projects totaling 27,324 MW have been proposed.

SEBs have solicited more than 24,500 MW of capacity from private developers. In Maharashtra, the SEB is offering 4,980 MW to the international development community. The Gujarat SEB has solicited 1,900 MW, on top of inviting private companies to assist through joint ventures in the completion of 2,365 MW of capacity that it currently has under development. Orissa SEB has solicited four, 500 MW coal-fired projects. Uttar Pradesh has solicited coal and gas projects totaling 3,540 MW.

The most encouraging outcome in India's new program is the enthusiasm among domestic firms for private power. Numerous large private industrials and investment houses have come forward looking for foreign partners or proposing projects on their own.

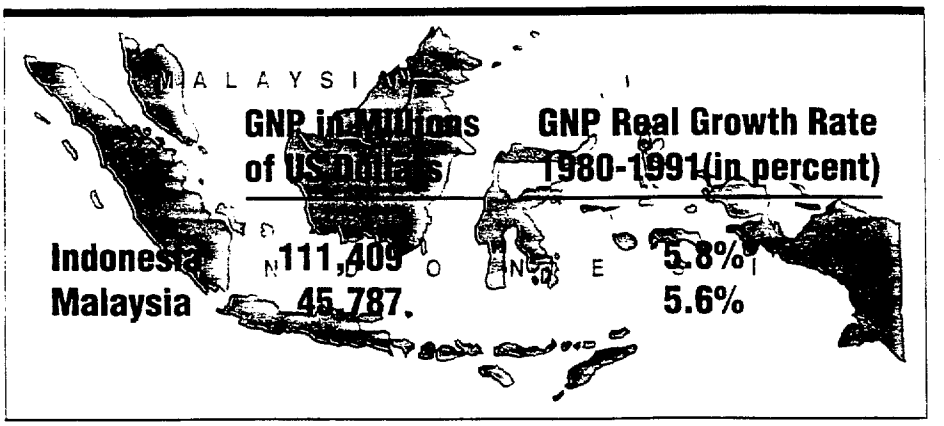
THAILAND

Thailand's economy has been enjoying an investment boom and rapid growth since the late 1980s. Electrical demand has been increasing at about 12 percent to 14 percent annually in recent years. Thailand has a reputation as a stable nation and government policies have been successful in attracting foreign investment.

Recently instability ensued, however, when a military junta seized power in a bloodless coup in early 1991. That government was forced to resign last year as a result of violent street demonstrations and personal intervention by the King. The current civilian regime is continuing the policy of privatizing state industries which began in the 1980s.

The electric utility industry in Thailand is owned by the government and consists of three companies: EGAT, the Electric Generating Authority of Thailand, which owns and operates all the generation facilities and long distance transmission lines in the country; the Metropolitan Electric Authority, which is the distribution company serving the Bangkok metropolitan area; and the Provincial Electric Authority, which sells and distributes power in the rest of the country. The Metropolitan and Provincial Electrical authorities do not own any power plants and purchase all their electricity from EGAT.

The industry is generally well-run and professionally managed. Tariff levels are adequate to provide EGAT with an operating profit, although the wholesale rates EGAT charges are cross-subsidized between the Metropolitan and Provincial Authorities. The Metropolitan Authority's ratepayers in Bangkok, who have lower costs of service than ratepayers in the rural regions of Thailand, pay more for their power so that Provincial authority's customers face lower tariffs than their economic costs of service.



EGAT currently operates about 9,000 MW of capacity. The Authority plans on adding more than 20,000 MW in new generating capacity during the next decade. Most of the rapid growth in electrical demand has been associated with industrial development around Bankok and increased commercial and residential load in the capital. The Thai government has made provision for private power production in its 1992 reform of the Electric Generating Authority Act of 1968, which originally established EGAT.

Under the Thai plan, EGAT will spin-off interests in select generating plants to a subsidiary company, called EGCO, or the Electric Generating Co. The EGCO facilities will have power sales contracts in place with EGAT and EGCO will act as operator and manager of these plants. EGCO will in turn offer 50 percent of its shares to private investors on the Bangkok stock exchange. EGAT plans to first partially privatize its Rayong gas-fired, combined-cycle power station in this manner by November of this year.

Credit Suisse First Boston has been retained as EGCO's financial advisor in the transaction. If the EGCO flotation is successful, plans call for additional EGAT plants, such as Khanom, to be spun-off and sold to investors. EGAT is also studying the possibility of soliciting a Build, Own, Operate (BOO) proposal from the private sector to construct a planned 150 MW, circulating fluidized bed unit at Mae Kham. During the longer term, EGAT may itself be privatized and seek a listing of its shares on the Bangkok exchange.

EGAT is also pursuing power purchases from industrial and cogeneration facilities. Last year EGAT issued a solicitation for 300 MW of excess power from industrial generators, to be purchased at preset prices. Proposals were sought for no more than 50 MW from any one project. However, the solicitation was under subscribed as critics indicated that EGAT's prices were inadequate to assure positive returns. EGAT and private companies are free to compete to supply electricity and process heat to industrial plants and developments. For example, a bid put together by a private consortium, the Thai Cogeneration Co., won over competing private offers and an EGAT proposal to supply process heat and clarified water at the Thai Olefins Co.'s National Petrochemical Complex Phase II expansion at Mab Ta Phud near Rayong. EGAT will be supplying most of the plant's electrical needs, however.

EGAT is relying heavily in the short- and medium-term on hydroelectric and gas combined-cycle technology. There are substantial gas reserves in the Gulf of Thailand, but there is also concern that the Thai gas resource base will not be adequate to supply electrical generation needs beyond 2010. The state owned oil company, the Petroleum Authority of Thailand, which supplies all of EGAT's oil and gas, is actively investigating the possibility of building pipelines to import gas from Malaysia, Myanmar and Vietnam. EGAT plans to develop 1,000 MW of hydroelectric capacity in the northern part of the country at Lam Takhong. EGAT is also discussing the possibility of importing electricity from several proposed hydro projects in Laos.

Plans for new coal-fired generation have been affected by a rising environmental movement in the country. Thailand does have indigenous coal resources, but they are largely low-rank brown coal or lignite with high-sulfur content. Thailand suffers severe air pollution problems and EGAT has had to modify its operating practices to counter environmental criticism. For example, EGAT was recently required to switch to low-sulfur fuel oil at its thermal plants in Bangkok.

EGAT's most controversial environmental problems concern its 11-unit 2,000 MW lignite burning complex at Mae Moe. Mae Moe's acid rain emissions have caused severe environmental damage downwind of the plant. Environmental groups have protested vocally and as a result, EGAT will be retiring 225 MW of capacity at Units 1 through 3 at the turn of the century and will probably retrofit Units 4 through 11 with scrubbers. All future capacity expansions at Mae Moe will be equipped with flue gas desulfurization systems. The controversy surrounding Mae Moe has made environmental impact a very sensitive issue for the Thai utility industry. Last year, EGAT was forced to withdraw and delay a proposed 700 MW coal thermal unit at Ao Phai. The plant was originally envisioned to burn imported, low-sulfur hard coal to mitigate acid rain emissions, but it will now be equipped with scrubbers to address the concerns of environmentalists.

INDONESIA

Indonesia is the world's fourth most populous country. It is an archipelago consisting of 13,000 islands stretching over 3,000 miles from western Sumatra to eastern Irian Jaya. Its population is more than 184 million, most of whom live on the island of Java. Indonesia has been an important oil producing country since the late 19th century and is the only Asian member of OPEC.

A Dutch colony until the end of the World War II, its first president, Sukarno, led the movement for independence in the 1940s. Indonesia was a turbulent nation during Sukarno's tenure as head of state. A failed coup attempt led to a period of instability and civil unrest between 1965 and 1966. General Suharto replaced Sukarno in 1967 and has been president of Indonesia ever since. In contrast to the Sukarno regime, Suharto's government has been very stable and has encouraged foreign investment and development in

Indonesia. With a per capita income of $600, however, the country still lags behind its neighbors in the region with the exception of the Philippines.

The Indonesian government owns the national electric utility, Perusahaan umum Listrik Negara (PLN). Currently, PLN serves one-third of Indonesia's population and operates as an integrated utility primarily on Java. About 10,000 MW of PLN's total 13,000 MW of installed generating capacity is on Java. In addition, PLN operates a 500 kV, high-voltage transmission line stretching across the northern part of the island. This line provides the backbone for Java's distribution grid. Much of PLN's service to the rest of the country provided one with isolated local loops powered by small diesel generators.

In spite of its large foreign debt of $48 billion, Indonesia has no policy or plans to privatize any of its state-owned enterprises, including PLN. As a result, the government's ability to finance critical infrastructure development for an economy growing at 5 percent to 7 percent, and electrical demand rising at 13 percent to 15 percent annually, is severely constrained. PLN itself estimates it will require $45 billion in investment during the next decade to add about 28,000 MW of capacity to meet expected demand. PLN expects to rely on internal operating cash flow to finance a good deal of its investment requirements. To supplement this, PLN is considering issuing and selling its own bonds internationally. Still, PLN's ability to raise the necessary capital is matter of some controversy and disagreement. Tariff reform would be needed in any event.

Fortunately, the government has made provision for private power in its development program. Private power producers already play an important part in Indonesia's electrical supply, with captive power installations at industrial estates generating about 40 percent of the country's electricity. The Indonesian government passed Law No. 15 in 1985 which permitted private power producers to sell power to industrial customers and interconnect with PLN's grid. Also, PLN is offering some of its planned capacity expansions directly to the private sector through build, own and operate arrangements. Mission Energy is currently negotiating such a contract to develop a total of 1,200 MW at PLN's coal-fired Paiton station on Java. Many private developers expect that there may be increased future reliance upon private sector initiatives beyond those already identified by the government.

Although Indonesia possesses good hydropower potential, has high-quality coal reserves and is known as a significant oil and gas producer, most of its energy resources are found in remote regions of the country such as Kalimantan, on the island of Borneo, and on Sumatra. Unfortunately, Indonesia's load centers are on Java, so fuel transportation and power transmission present difficulties. There are plans to provide limitied power interconnections between the islands. For example, PLN is investigating the construction of a 150kv high voltage DC submarine electrical transmission line between Sumatra and western Java to connect a proposed minemouth lignite plant at Banko to the Java grid.

Java does have limited resources of natural gas and some hydroelectric potential that will be used to supply about 6,400 MW of new capacity. However, coal-fired thermal plants are expected to provide most of PLN's generating expansions in the coming decade. PLN plans to build more than 15,000 MW of coal capacity, primarily at Paiton in eastern Java and at Suralaya, west of Jakarta. PLN will retire some of its older oil-fired thermal capacity on Java. The government is seeking to curtail the use of oil for electric generation in order to maintain petroleum exports. However, the Indonesian government has until recently subsidized the domestic price of fuel oil, providing few incentives to conserve oil or encourage the development of substitute fuels, such as natural gas.

Indonesia's planned reliance on coal capacity has raised some environmental concerns. PLN's operational and proposed coal plants do not utilize any pollution controls. The utility has urgued that its use of high-quality indegenous coals should be sufficient to minize emissions. However, the World Bank has been attempting to establish environmental standards which may require the installation of emissions control systems with attendant higher capital and operating costs.

Aside from Mission Energy, several other international private power developers have been active in Indonesia. British Gas is currently performing a feasibility study for a 400 MW, gas-fired project near Jakarta. Enron has also been developing plans for a gas-fired power plant on Java.

Probably the most successful developer to date has been Unocal Geothermal, which in February of this year announced that it had negotiated a power sales agreement with PLN. Unocal will build and operate up to 1,000 MW of capacity at its Sarulla geothermal field near the city of Medan in northern Sumatra. Indonesia sits astride the Pacific rim's volcanic '*Ring of Fire*' and is an active seismic and geothermal province. Unocal is also appraising another geothermal field at Salak in southwest Java for potential power development.

MALAYSIA

Malaysia is one of the most stable Southeast Asian countries and one of the fastest growing of the *tiger* economies. A former British colony, Malaysia's government has been a parliamentary democracy since independence was granted in the late-1950s. Malaysia's stability and progressive economic policies have made it one of the most open economies in Southeast Asia.

Malaysia has received more direct foreign investment in the past five years than any other country in the region, with the exception of Singapore. The regime of prime minister Dr. Mahathir Mohammad has adopted a policy referred to as *Vision 2020*, the goal of which is the transformation of Malaysia into a fully industrialized and developed country by the year 2020. The country is well-positioned to achieve its goals. Malaysia is endowed with significant energy and other sources, including hydropower, natural gas and oil. Still, the Malaysian gross domestic product will have to grow in excess of 7 percent per year for the next three decades in

490

order to realize this. Furthermore, electrical demand is expected to grow at even greater rates as personal incomes rise.

To encourage economic efficiency, the government has privatized many state-owned enterprises. Twenty-two percent of the national electric utility, Tenaga Nasional Berhard (TNB), was sold in a successful public offering in 1992. The government estimates that peninsular Malaysia will require between 5,000 MW and 10,000 MW of new generation capacity within the next decade. This growth has challenged the ability of the national utility to meet demand.

A number of recent power shortages, including a controversial blackout of all western Malaysia in September 1992 has increased pressure on the government to open the generation sector to private participation and development. In fact, an important part of TNB's privatization framework was the introduction of competition. The government is now implementing a fast-track, private power program, granting private entities licenses to build, own and operate central station independent power plants. However, there is currently no formal government policy regarding industrial cogeneration.

The Malaysian electric sector is under the direction of the Ministry of Energy, Telecommunications and Post, which issues these power plant licenses. The prime minister's office also maintains an advisory branch called the Economic Planning Unit (EPU) which studies strategic industries and makes policy recommendations. Tenaga Nasional itself is regulated by the Office of Electric Supply, a regulatory body established after the company's privatization in order to set tariffs and operate as an independent oversight commission.

The Malaysian government has established some rules and guidelines regarding private power development. Foreign ownership in an electric utility, such as TNB, or any power generating company, is restricted to 25 percent of the entity's equity. Although the Ministry of Energy may grant a private company a license to build a power plant, Tenaga Nasional is under no obligation to purchase any of its capacity or electrical output. In fact, Tenaga's management has protested loudly about losing its monopoly status. To address this criticism, the government has decreed that private developers must offer Tenaga the option to purchase up to 20 percent of their project equity.

Malaysia's economic reforms and privatization reflect the goverment's policy goals of increased financial reliance on the private sector and capital markets. Malaysian Energy Minister Samy Vellu is on record as saying that the goverment would like to see TNB and private developers share the market for new generation capacity equally. Analysts have observed, however, that Malaysia's financial markets would not have sufficient capacity to provide the scale of investment neccessary. They argue that the government should reform current foreign capital and ownership restrictions in the power sector to allow greater participation by international firms.

Malaysia has attracted considerable attention recently as an active market for independent power. Late this past year the government announced that it had granted a power plant license to the YTL Group, a local construction firm listed on the Kuala Lumpur stock exchange, to build two gas-fired, combined-cycle independent power projects totaling 1,170 MW at TNB'S existing plant sites at Paka in Terengganu and Pasir Gudang in the Malaysian state of Jahore near Singapore.

National Power of Britain was formerly a joint venture partner in the YTL developments, reportedly with a 10 percent interest in the projects. However, YTL recently announced that it had replaced National Power with Siemens of Germany. Siemens will build the combined cycle projects on a turnkey basis and operate and maintain them in association with YTL. In addition, another local Malaysian firm known as Sikap, in partnership with ABB, has obtained a government license to build a 1,000 MW gas project near Ipoh. The government reports it is in negotiations with at least 12 other groups seeking to obtain power plant licenses. The government is also currently considering the possibility of requiring TNB to use bidding and competitive tenders to purchase private power capacity.

MEXICO

Whether or not the North American Free Trade Agreement (NAFTA) is implemented by Jan. 1, 1994, President Carlos Salinas de Gortari will unilaterally make the kind of liberalization in trade and investment that is provided for under the

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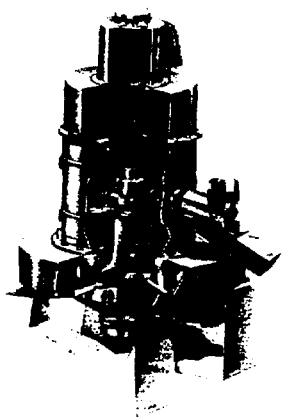

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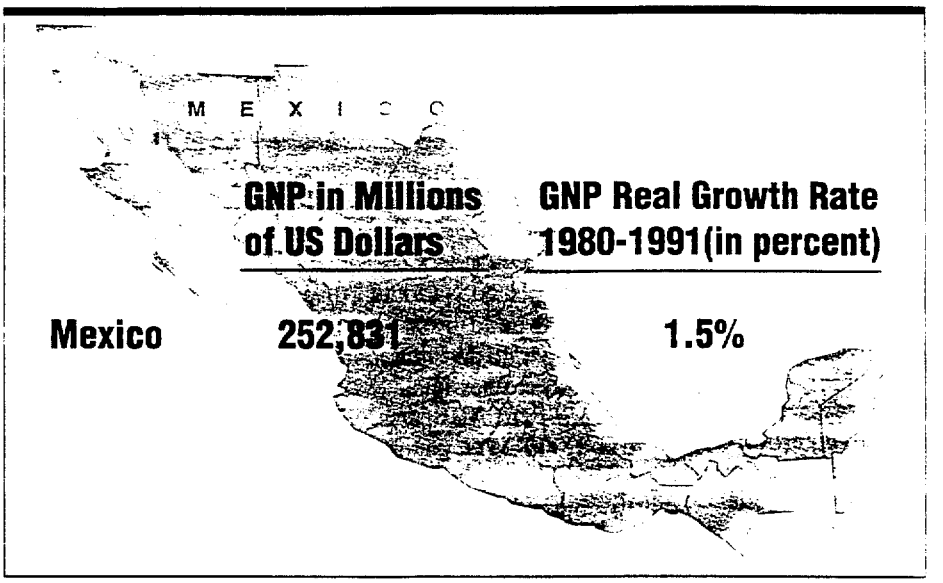

agreement. This includes the dramatic Electric Power Public Sector Law Regulations that open the door to foreign investors who wish to generate their own electricity, import or export it or sell power to the Mexican Comision Federal de Electricidad (CFE).

It is foreseen that the political climate in Mexico will remain stable. Presidential elections will be conducted next summer and President Salinas' successor will continue the market-oriented policy that has been pursued since the mid-1980s. However, Mexico's power industry, nationalized in August 1937 by then president Lazaro Cardenas, will, under the new regulations, maintain its monopoly of electric public distribution. CFE will be allowed to buy power from independent suppliers.

In the next 12 years, Mexico will need to increase its installed generation capacity from the current 28 gigawatts (GW) to about 56 GW. Of the extra capacity needed, 17 GW will come from planned thermoelectric plants, 4 GW from hydropower and geothermal plants and 5 GW from demand side management (DSM) and improved efficiency. Most of these projects will be carried out under an independent power scheme. It is estimated that a minimum of 40 units in the 350 MW range will have to be built in the next 10 years.

Regulatory Climate

The main goal of the newly released power regulations is to satisfy electricity demand at the lowest possible cost. These regulations create four main categories for private power generation: self-generation; cogeneration or small production; independent power production to be sold to CFE and generation for export or import for self-use emergency power supply.

Under these regulations, priority for electric power distribution will be given to low-cost resources. Private generators and excess capacity generators up to 20 MW will be given payments for both capacity and energy without participating in any bid programs. Payment premiums for availability are also included. Private generators will be entitled to build necessary transmission lines, provided that national standards are met. Transmission and distribution will remain the monopoly of CFE, and any facilities built by private investors must be transferred to CFE.

Under Electric Power Public Sector Law Regulations, CFE will be required to issue annual reports about Mexico's long-term power requirements, including demand projections by type of consumption and geographical location, information on existing generation and transmission capacity, expansion requirements for power generation and transmission, and potential DSM programs. The first of these reports will be published in 1994.

The Secretary of Energy Mines and Paraestatal Industries (SEMIP), a government office, will publish an outline of CFE's report and will solicit comments for a five-month period. SEMIP will determine what will be undertaken by CFE, while CFE will be responsible for assessing the private power proposal. Public bidding will be on an ongoing continuous process. Already this law has touched off a burst of activity and permits totaling $3.5 billion in privately funded power projects are in the works.

Projects In Progress

Private power units already under way as a result of public bids include the four unit coal or oil-fired Petacalco project in Lazaro Cardenas, Michoacan, being built by Mitsubishi; the twin, 700 MW, fuel oil-fired project in Tuxpan, Veracruz, being built by a joint venture of Alcatel Alsthom of France and Empresas ICA Sociedad Controladora S.A. de C.V.; and the twin, 320 MW Topolobambo 2 project in Sinaloa being built by a consortium of ABB, Mecanica De La Peña and Toshiba. Each will be in service in 1993 or 1994.

The first major market opening for U.S. companies is the $1.6 billion privatization of the Carbon II Plant. Mission Energy Co., a subsidiary of SCEcorp, acquired rights to complete, own and operate this 1,400 MW coal or oil-fired power plant in Piedras Negras, Coahuila on the U.S./Mexico border. Mission will hold 49 percent of the project for which it paid about $300 million. The rest will be held by Grupo Acerero del Norte. Output will be sold to local industrials and CFE will buy any excess capacity.

The contract includes an option that allows Mission to sell its interest back to CFE after 15 years. The plant will be operated by CFE personnel for the first six to nine months of the contract, after which Mission will operate the plant. The plant, now half completed, is being designed and built by a consortium of Foster Wheeler Iberia, Mecanica de la Peña S.A. of Spain and Bufete Industrial S.A. of Mexico.

A consortium of General Electric, Bechtel Enterprises, Inc., Coastal Pan American Co., El Paso Natural Gas Co. and Empresas ICA Sociedad Controladora S.A. de C.V. have signed a contract with CFE to build a $600 million, 700 MW, gas and oil-fired, combined-cycle power plant. The project, Samalayuca 2, in Chihuahua, 20 miles south of El Paso, Texas, is scheduled to start operation in 1995. The

plant is being built on a Build/Own Transfer (BOT) basis, operated by CFE personnel under the supervision of the partners, and transferred to CFE after 15 years.

GE Credit Corp. and the U.S. Exim-Bank are providing the major financing support for Samalayuca 2. GE Industrial and Power systems will do the conceptual plant design, and Bechtel will provide the detail engineering. ICA Industrial is responsible for the construction, and Coastal will provide the natural gas from the United States and El Paso Natural Gas will handle transportation. ICA will build the necessary gas pipeline in Mexico.

More than 40 firms from around the world have expressed interest in the next big CFE project in the Yucatan Peninsula. The Merida III project covers the expansion of existing capacity in Merida and includes the conversion of the plant from oil to gas. The final size has not yet been set. Pre-qualification documents were expected to be ready in August.

Petroleos Mexicanos (PEMEX) is Mexico's second largest power generator, with about 1,700 MW of installed capacity from 85 thermal units for self-generation at 22 sites. As the petrochemical sector of PEMEX is privatized and expanded, there will be numerous opportunities for additional power plants to be built.

Natural Gas

With the onset of NAFTA, as Mexico follows the example of the United States in regard to environmental regulations, it is estimated that the majority of the independent power projects will be natural-gas fueled. Because of the political and sovereignty issues involved, it will be difficult to negotiate U.S. gas supplies for these projects; therefore, gas supplied by PEMEX will continue to be the preferred option.

Mexico has natural gas reserves of about 72 trillion cubic feet. Annual production is about 3.6 trillion cubic feet, while another 165 million cubic feet per day are imported from the United States. Most of Mexico's untapped gas reserves are in the northern part of the country. The majority of the current gas produced is from the southern part of the country and is associated gas tied to crude oil production. By the end of the year, PEMEX will present financial information to the U.S. Securities and Exchange Commission, as a preliminary step to enable PEMEX to sell dollar denominated bonds in the United States. The goal is to raise $20 billion in new investment during the next five years to finance additional exploration and drilling for natural gas and increased production and transportation requirements.

Financing

Mexico has limited internal sources of financing. Nacional Financiera, S.A. (Nafinsa), a state-owned development bank, provides loans to companies in priority development areas and industries. This is mainly used to promote joint Mexican/foreign ventures for the production of capital goods. Nafinsa maintains several trusts to undertake co-investment with non-Mexican banks. In addition to Nafinsa, many Mexican states support development financing programs to attract industry. Incentives include exemption or reduction of several state taxes including income, real estate, and transfer and deed registration taxes.

To date, only a few projects have tapped the world capital markets for financing. It is difficult to predict with certainty how projects in Mexico will be financed. The situation is similar to the domestic independent power industry in the early 1980s when lenders and equity investors were learning the basics of independent power financing. Financing the acquisition of a power plant purchased from the government has to date been done with cash equity and the assumption of a relatively large amount of debt. An example would be the Carbon II plant acquired by Mission Energy.

In all the privatization undertaken to date, the long-term debt finance portion of the acquisition funds has not been obtained by issuing new debt but rather by assuming the existing debt. Compared to building a new plant, the financing of a privatized facility is now easier, as there is no need to make a case for loan approval to new lenders and/or multilateral financing agencies.

Power unreliability from the CFE has created a huge market in the industrial sector. In many cases, a disproportionately high share of electric system cost is charged to industrial consumers, which subsidizes commercial and residential consumers. As a result of these inequities, it is often beneficial for any industrial consumer to consider generating its own power, especially if a large steam load exists with the potential for industrial cogeneration.

The financing of these projects will be structured differently from that of a privatization project. As noted above, the development of a new private power plant will not have access to financing already in place. The developer must arrange all the financing for new projects from new sources, including equity cash investments, bank loans and financing from government and multilateral agencies.

The key role in financing Mexican power projects will be played by the specialized government agencies such as the World Bank, International Finance Corp., Inter-American Development Bank, Multilateral Investment Guarantee, Overseas Private Investment Corp., and the U.S. Agency for International Development. Other sources of financing include foreign and domestic banks, investment banks, insurance companies and credit companies. For example, GE Capital, a subsidiary of General Electric Co., has the largest portfolio of independent power projects in the world.

The Mexican private power market is promising, but the rapidly changing political and economic factors can affect many aspects of project development. Only patience and persistence will pay off in bringing the different legal, engineering, environmental and financial requirements together in a successful private power project.

While opportunities exist in these countries, the challenges also remain to find financing and companies that are willing to share the sometimes uncertain risks that exist with developing nations. The next several years will determine the true depth of these markets in terms of government and state-owned utility commitments. Developers should find project activities lively as they move to meet the world's energy needs. ■

Theodore Cartselos is a consultant specializing in international and domestic markets for independent power and natural gas. William Meade is a manager with RCG/Hagler Bailly Inc in Arlington, Va. Mr. Cartselos and Mr. Meade are also *Independent Energy* magazine contributing editors. Luis Hernandez is vice president, executive search, with CoEnergy Inc. of Houston, Texas. Amit Dalal of RCG/Hagler Bailly assisted in preparing this article.

The International Power Market: Myth and Reality

In assessing the exploding demand for new energy sources in the global marketplace, U.S. utilities and independents should not expect easy pickings in the project development game. Each situation holds its own perils and opportunities, which only a knowledgeable appraisal can sort out.

Henri-Claude Bailly and Elliot Roseman

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As the market for independent power (IP) explodes overseas, a number of companies that have been active in project development in the United States are looking hungrily abroad. Some developers view the international market as less competitive than in the U.S., and many are attracted by its size. The backlog of IP activity overseas has now reached over 140,000 MW, primarily in Asia and Europe (**Figure 1**).

The U.S. has about a ten-year head start on IP projects abroad, where project activity has taken off only in the past three years. In 1978, the Public Utility Regulatory Policies Act (PURPA) required U.S. utilities to purchase power from developers of qualified facilities (QFs), and in the process, created a business that has grown to over $10 billion in annual sales. Since 1985, IP has added over 35% of the new generating capacity in this country; in 1991, IP added as much new capacity as utilities. We project that in the 1990s, IP will add 45-50 GW of new capacity, or between 40%-50% of total U.S. capacity.

With nearly 3,200 IP projects (over 46,000 MW) on line in the U.S., many developers are hoping that their U.S. experience will serve them well in developing projects elsewhere. Moreover, many developers expect that such experience will give them a "leg

up" on foreign competitors, who have few, if any, megawatts on line.

Do these hopes reflect the emerging reality, or are they dangerous misinformation? As U.S. developers approach projects elsewhere, what are the key advantages and constraints their U.S. experience confers? This paper reviews five common myths about the international market for IP and compares the U.S. market with the opportunities abroad. In the process, we explore issues specific to IP, not general issues of doing business outside the U.S.

MYTH 1: U.S. Regulatory Experience Is Relevant to the Rest of the World

In the U.S., the regulatory environment is unique. When PURPA became law in 1978, its provisions on "avoided cost" payments to developers were left to be interpreted by hundreds of utilities and implemented by 50 states. There was no consensus on the "right" way to determine avoided costs, much less their levels, which depended largely on the utilities' widely varying capacity needs and resource mixes. Moreover, the regulatory commissions, air permitting boards, and siting approval and planning procedures differed among the states. The result was a *fragmentation* of the U.S. market into dozens of sub-markets. Many developers prospered by essentially "dividing and conquering," finding niches with individual utilities and project types within the overall context of PURPA.

In addition, PURPA's definition of IP was quite narrow, placing a premium on energy efficiency and fossil fuel reduction. In fact, QFs were only cogeneration projects with certain levels of efficiency and thermal use, and projects below 80 MW in size that utilized renewable energy (e.g., hydro, solar). As a result, U.S. IP projects have been small (an average size of only 14 MW) and highly diverse in fuel and technology (60% of the operating projects and 38% of the megawatts on line are *not* fueled by natural gas or coal).

In the mid-1980s, U.S. developers began testing the bounds of the IP market by introducing pure wholesale generators of power, called independent power producers (IPPs), which did not qualify for favored treatment under PURPA. The 500 MW Ocean State Power project developed by J. Makowski Associates, the 660 MW Doswell project developed by Diamond Energy, and the 210 MW Sun Peak project developed by Mission Energy are three of a small contingent of IPPs that have recently come on line.

It was not easy for these projects to make it. In addition to normal

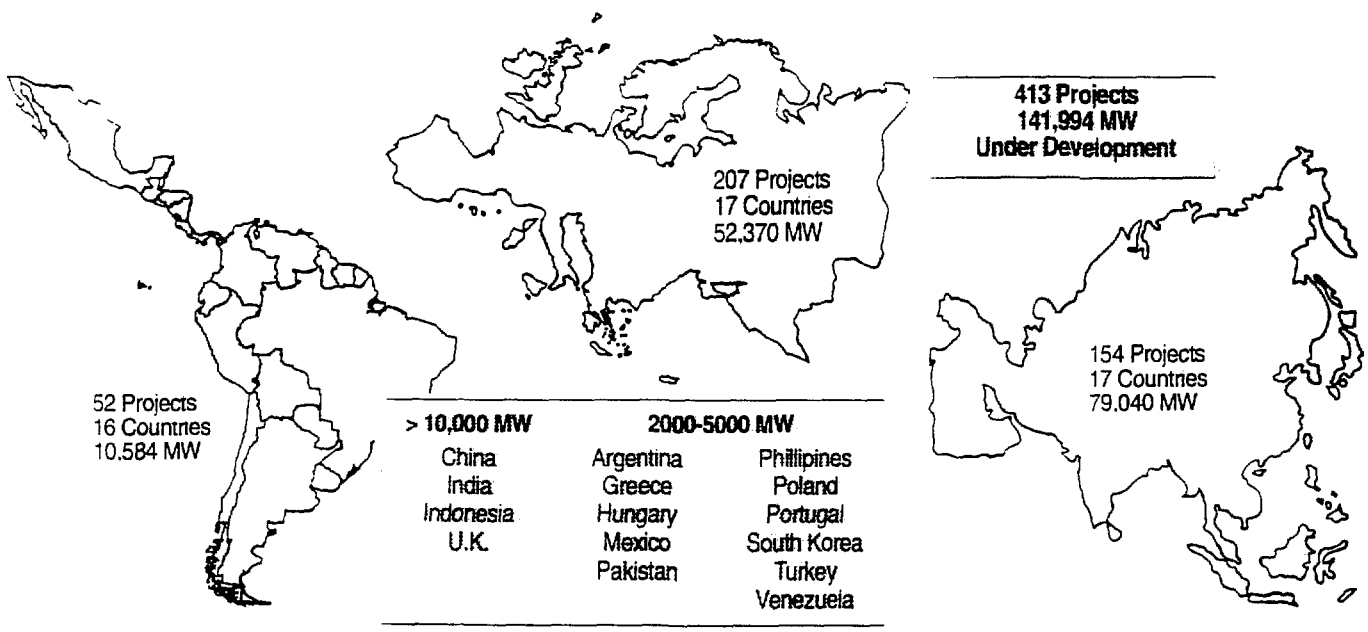


Figure 1: *The independent power market abroad. Reflects announcements over last 24 months. Source: RGC/Hagler, Bailly, Inc., September 1992.*

development risks, they underwent a complicated process of having the Securities and Exchange Commission approve their status as non-utilities, having the Federal Energy Regulatory Commission approve their rates, and structuring their ownership so as not to subject their parent companies to onerous registration requirements under the Public Utility Holding Company Act (PUHCA).

This situation should change, particularly if Congress amends PUHCA to allow unrestricted IPP development, both in the U.S. and overseas. We project that in the 1990s, IPPs will comprise 25%-35% of the U.S. market, compared to less than 5% today. However, until PUHCA is changed, the market for IPPs will be restricted to those willing to run the regulatory gauntlet for project approval.

Outside the U.S., the utility market and regulatory situation are far less fragmented. Most countries have only one national utility responsible for nearly all power generation (e.g., France, Mexico, Thailand, Indonesia, Korea). Even in India, where the numerous states possess significant autonomy over power projects, national legislation passed in October 1991 created a high powered board designed to fast-track such projects.

Also, other countries have different objectives from those of the U.S. when PURPA was passed; these will have a real impact on developers. Because their governments have little interest in restricting the market to cogeneration and renewable fuels projects, they are leaping directly to IPPs. Their interest is primarily in building power plants, either by adding megawatts to their system (e.g., much of Asia) or replacing existing megawatts with cleaner plants (e.g., much of Eastern and Central Europe).

In addition, other countries are selling off their existing under-construction plants to the private sector (e.g., Argentina, Australia). One implication of the desire to add or replace megawatts is that other countries favor fuels and projects that can help them achieve those goals as quickly as possible. Thus, over 80% of the projects and megawatts outside the U.S. are being fueled by coal or natural gas, and very few by renewable sources (**Figure 2**).

Rather than using the PURPA model, other countries are passing a patchwork of laws designed to categorize and encourage independent power. Spain, for example, has established three classes of self-generators, depending on their level of interconnection with the grid. In Pakistan, projects must be incorporated with at least 25% of capital as equity, and Dominican Republic legislation allows any foreign or domestic private company to apply to install new generating capacity.

Thus, rather than hope their U.S. regulatory knowledge is sufficient, developers should: (1) *not* expect to find a familiar regulatory context, either in terms of the type of regulation or the enabling legislation that allows IP to exist, (2) *not* expect countries to favor cogeneration or renewable projects, but rather to be more interested in wholesale power projects (IPPs in the U.S.), and (3) make sure they fully understand their legal rights and responsibilities in each country.

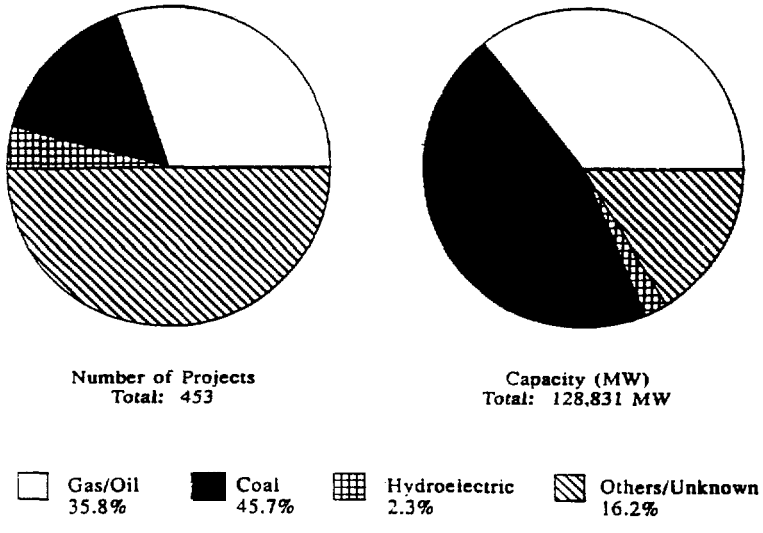


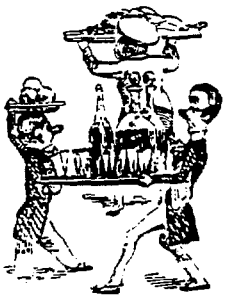
Figure 2: *Current Distribution of Independent Power Projects Worldwide by Energy Source*

MYTH 2: Foreign Utilities, Particularly in Developing Countries, Are Not Very Sophisticated and Are Thus "Easy Pickings"

The U.S. is the largest power market in the world. According to the Energy Information Administration, summer installed capacity in the U.S. reached nearly 700,000 MW at the end of 1991 (over one-third of the world's capacity). In this decade alone, the U.S. is projected to add roughly 100,000 MW of capacity.

By contrast, most developing countries' markets are small (likely exceptions include India and China). Hagler, Bailly found that about half of the nearly 140 countries it recently reviewed had 1990 installed capacities of less than 300 MW. Another 30-35 had markets for coal- and natural gas-fired projects of less than 500 and 100 MW, respectively. This left only about 25 countries with markets that would support more than one or two medium-sized IP projects, without considering whether their political and regulatory policies were favorable to such developments.

Developers must not underestimate the utilities abroad, however. They may be small by U.S. standards, but are often among the largest and most powerful institutions in their countries. Unlike most U.S. utilities, they are commonly government-owned, and have close ties to the country's executive, labor, legislative, and other key institutions. In Pakistan, for example, one utility (WAPDA) controls virtually all 8,500 MW of generating resources and is regarded as critical to Pakistan's economic development. Similarly, Indonesia's PLN controls virtually all of the country's 9,500 MW. Both firms have close ties to the executive and legislative branches, making them key players in the efforts to introduce independent power. In France, EdF has an installed capacity of 100,000 MW, annual sales of over $33 billion, and its top officials are directly appointed by the government. EdF International's new president, Gilles Ménage, is a former member of President Mitterand's Secretariat. Governments outside the U.S. recognize the central role electric power plays in the growth of their economies, and increasingly, in foreign investment. They have thus generally taken a strong interest in power projects, and ensure that their electric utilities have a large say in the country's IP decision-making framework.



As in the U.S., developers should not expect all utilities abroad to welcome IP with open arms. Even when national policies favor the use of IP, the prospect of having third parties (especially foreign) develop, build and operate power plants could mean a loss of control (and possibly authority) for utility executives. Furthermore, because of the authority foreign electric utilities wield in their countries, it may not be as easy or even possible to compel action on the utilities' part through the courts, as it was when U.S. utilities raised challenges to PURPA and the payment of avoided costs.

Utilities overseas are not naive; they are quickly becoming aware of developments in the U.S. electric power sector. For years, the U.S. Agency for International Development (USAID) and the World Bank have been holding conferences on IP, sponsoring study tours for utility executives to the U.S., and providing consultants to help develop institutions and regulations that encourage foreign investment and power sector growth. U.S. consultants, attorneys and bankers have been seeking clients overseas aggressively, and in the process, have educated quite a few utility managers and country ministers.

Governments and utilities overseas have been evaluating and implementing regulations and policies on competitive bidding, integrated resource planning, demand-side management, power plant emissions, and other facets of the U.S. electric power industry, and assessing the extent to which they make sense in their own contexts. For example, Greece, Argentina, and Indonesia have adapted a competitive bidding model to their needs. Also,

the State of Victoria. Australia is considering policies to incorporate the value of environmental externalities in its power acquisition policies.

In some ways, utilities overseas are *more* advanced than in the U.S. with respect to IP. For example, few U.S. utilities have even contemplated selling capacity to private developers. Yet Argentina, Korea, Poland, Hungary, and others are considering this option or already doing so. Utilities abroad have also pioneered the use of such innovative contracting techniques as build-own-operate (BOO) and build-own-operate-transfer (BOOT), which provide more contractual options than U.S. utilities use. In these ways, IP outside the U.S. is likely to be *more* complex and diverse, and require *more* creativity than developers are accustomed to here.

To compete effectively in this environment, developers should: (1) *not* expect utilities abroad to be a "soft touch," 2) expect country markets that are much smaller but less fragmented than in the U.S., and (3) become familiar with the contracting techniques needed to conduct business outside the U.S.

MYTH 3: Experience in the U.S. Gives U.S. Developers a Major Competitive Advantage

Developers have gained some valuable experience and established some important "truths" with regard to independent power in the U.S.

- ***IP projects can be effectively project-financed*** (over $45 billion since 1978, including participation by dozens of U.S. and foreign banks).
- ***IP projects can provide substantial additions to generating capacity*** (over 46,000 MW in place, providing over 6% of U.S capacity and half or more of U.S. incremental needs in both 1990 and 1991).
- ***IP can be reliable*** (regularly achieved availabilities of well over 90%, providing support to utilities in maintaining service when hit by natural disasters).
- ***Developers can negotiate acceptable power sales agreements with utilities*** (ways have been found to accommodate interconnection, payment for delivered power, and power plant dispatch).
- ***Natural gas is a desirable fuel from a cost, environmental and technological standpoint*** (fuels half the IP capacity on line in the U.S. and about 70% of new IP capacity brought on line in 1991).

*In some ways, utilities overseas are **more** advanced than in the U.S. with respect to IP.*

On the strength of this experience, U.S. developers might feel they are better equipped than non-U.S. developers to compete for projects overseas. However, competition abroad will differ in three ways from the U.S. experience.

First, relatively few U.S. developers have extensive experience with solid fuels (primarily coal), yet coal-fired projects constitute fully *half* of the megawatts under development outside the U.S. In some cases (e.g., Brazil, Argentina), the second-most important power generation resource is hydro power.

Second, U.S. IP projects (with an average size of 14 MW) are far smaller than typical projects overseas. Even excluding the 90% of U.S. projects that are under 10 MW, the average size is only about 55 MW. Overseas, however, the average project size is a full 280 MW. Several dozen international projects above 400 MW are being developed, and very few U.S. developers have experience in this size range.

One implication of the large size of projects is that more capitalization is required to bring them to fruition. The 1,300 MW Hab River project in Pakistan, for example, will likely require $450-500 million in equity and $1.3 billion in long-term debt. This leaves less room for the small entrepreneur that formed a large part of the U.S. IP industry in the early years.

Another is that consortiums will be increasingly important in projects overseas. To win awards abroad, U.S. developers often find that they must team with foreign utilities, equipment suppliers, fuel suppliers and local firms. For example, the refurbishment of the 450 MW Leg power plant in Poland is being developed by United Energy Partners, a consor-

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tium of United Energy International (a subsidiary of United Illuminating), ABB Combustion Engineering, the Finnish utility Imatran Voima Oy, and Derby Milford, a unit of Hubbell, Inc. The Polish government will retain control over 54% of the joint venture.

The international IP industry is fast being dominated by the "big boys," including such equipment suppliers as Siemens, ABB and Mitsui; such fuel suppliers as British Gas, Enron, and Exxon; and utility subsidiaries (see below). When they do succeed, pure developers such as Hopewell may have no U.S. project development experience whatsoever.

In addition, the larger debt requirements of these mega-projects will have unique financing arrangements with multi-lateral institutions and country credit agencies. The Shajiao B project in China, for example, was financed by a consortium of 46 banks led by Citicorp, Bank of China, and the Hong Kong & Shanghai Banking Corporation. The Hab River plant in Pakistan will require financing from commercial banks, the Japan Export-Import Bank, the Government of Pakistan, and local Pakistani banks, *plus* an unprecedented guarantee from the World Bank for the commercial banks' contribution. U.S. developers must thus learn new financing skills to assemble packages for their overseas projects.

Third, utility subsidiaries are aggressively participating in IP markets from the outset. In the U.S., these companies generally formed the "second wave" of project developers, leaving the field relatively open to pure developers for years. When they did participate, they were hamstrung by regulation: utilities were only allowed to own 50% of each project (pending the reform of PUHCA), and state commissions required them to transfer employees and resources from their parent company to the sub to use them in the IP side of the business.

But few such restrictions apply outside the U.S. For example, Belgium's Tractebel has capitalized its IP subsidiary (PowerFin) by giving it 22.8% ownership in its electric utility (Electrabel), thus providing PowerFin with revenues of $334 million and profits of $185 million in 1991 to invest in IP projects. EdF has signed nearly a dozen joint ventures to pursue different regions and IP projects, and could make its full complement of several thousand engineers, operators, and technicians available when an IP project comes along. Other formidable non-U.S. utility competitors could include Nordic Power Invest (a coalition of four Scandinavian utilities), Spain's Endesa, and the U.K.'s PowerGen. Further, some national utilities could set up subsidiaries to compete with developers in their home country, including China Power & Light and EGAT of Thailand.

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Thus, with regard to competition, U.S. companies should: (1) not expect that their U.S. experience will grant them a competitive advantage, (2) assemble effective consortiums and joint ventures early in project development, and (3) have "deep pockets" to develop projects outside the U.S.

MYTH 4: Returns on International Projects Will Be Much More Attractive than on U.S. Projects

In the early 1980s in the U.S., it was possible to find IP projects yielding internal rates of return of 30-50%. In California, utilities were compelled to sign ten-year "standard offer" contracts, where power payments were based on the assumption that fuel prices would escalate much more rapidly than they actually did, leading to highly lucrative projects. Further, a number of utilities signed contracts based on what it would have cost them to build a certain type of capacity, which was 10-25% higher than the developer's costs, leading to financially attractive ventures. Banks were anxious to lend money to such ventures, lending 90% or more of the project costs, leading to even higher returns on a relatively small piece of equity.

These "gold rush" days are over. The typical solicitation for new baseload capacity in this country now attracts offers for over ten times as much capacity as the utility has requested. Also, banks have become more conservative and require more project equity.

Some U.S. IP developers are hoping that they can realize abroad the substantial returns they once enjoyed in the U.S. But their expectations are likely to be misguided.

Risk-adjusted project returns are not likely to be any higher overseas than they are in the U.S. Bidders for international projects are facing competition from developers that are well-capitalized and experienced bidders on capital equipment and large construction contracts. They are also increasingly facing a "buyer's market," where formidable bidding teams are being assembled (e.g., for the Pego project in Portugal). Several countries (e.g., Korea, Pakistan) are seeking to control developers' rates of return. Pakistan, for example, is setting rates for the 840 MW gas/oil Jamshoro power plant on a cost-plus basis, including a fuel cost pass-through. The developer will be offered a guaranteed 18% return based on 60% availability with a bonus for higher availability. Returns will likely be further squeezed when developers must share their returns with their consortium partners (often including a share for a local partner, as in the Poland example cited above).

As in the U.S., most projects' internal rates of return are likely to be in the range of 15%-25% after tax, depending on the stage at which a developer gets involved (higher for pure greenfield projects, and lower for project acquisitions or for projects already under construction). However, country risk differentials could provide higher returns outside the U.S. Developers and banks may require higher returns to do business in countries that are unstable politically or economically, have foreign exchange shortages, or are subject to other unique risks. In these cases, developers may be able to command a premium, but they will generally have to accept higher risks in exchange. Developers should keep abreast of risk mitigation techniques that are designed to lower a given project's risk without necessarily lowering its expected return.

On the other hand, project returns can be narrowed abroad by

Risk/Return Relationships

In the United States, investors compare stock and bond yields to a benchmark risk-free rate (e.g., U.S. treasury bills) to calculate the risk premium for a particular investment. They can do this easily because daily trading information on capital and money markets is readily available and the quality of data is high. Outside the U.S., particularly in developing countries, the relationship between risk and return is not so readily apparent, and information on returns in local markets, if such markets or data exist, can be misleading.

A number of rating agencies and commercial banks provide country risk rankings and ratings based on assessments of political, economic, financial, and project-specific risks. Although valuable, these assessments can fall short when investors attempt to attach specific investment returns to the often-elaborate methodologies these firms use.

One way to begin quantifying country returns is to learn more about the capital markets in a country and to spend time searching for security issues that resemble the investment being considered. Once such securities are selected, they can be tracked over time and compared to similar securities in the U.S. This will be easier if the securities are traded in U.S. dollars because foreign exchange differentials are implicitly incorporated in the trading histories.

For example, in Mexico, Yankee bonds are traded daily in New York; such Mexican corporations as Telmex have issued common stock (ADRs) on the NYSE; closed-end country mutual funds trade on the NYSE; and Comision Federal de Electricidad, the Mexican utility, has issued bonds on the international capital markets. Any of these securities provides prospective investors with trading histories that quantify Mexican country risk in some way. Current returns on some of these securities are:

Government of Mexico Brady bonds	11.0% yield to maturity
Comision Federal de Electricidad bonds	8.31% yield to maturity
The Mexico Fund, Inc.	24.5% two-year return

Identifying international securities is a good way to get a feel for country returns over a broad number of countries, although it is not a substitute for country and project risk assessments. However, as international capital markets grow in trading volume and the number of issues traded, more analyses will be conducted on the relationship between risk and return on a country-specific basis.

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environmental standards and the need to maintain corporate image. In the U.S., developers have become accustomed to providing expensive, state-of-the-art environmental controls (e.g., fluidized bed boilers). However, other countries' standards may not be as stringent. Competing bidders can offer lower-cost projects that comply with local laws, but have higher emissions than U.S. projects. Thus, U.S. developers can lower their bids by removing stringent emissions controls or retain them but accept lower returns.

Even if a U.S. developer were to offer to construct a plant that was "dirtier" than those built in the U.S. and the foreign government accepted its offer, it could face opposition from local groups — which are becoming increasingly well-informed and organized — as well as criticism from environmental groups, shareholders, and others at home. The firm would thus suffer an erosion of its image in the U.S.

Developers seeking attractive returns should: (1) not go abroad to "make a killing," (2) be extremely sensitive to the environmental parameters of their projects, balancing local requirements with threats to their image, and (3) make sure that country and project-specific risks are well-understood and acceptable in light of expected returns.

MYTH 5: The International IP Market Is Developing Slowly, and There Is Ample Time to Become Established Abroad

In the U.S., the IP market took some time to develop. Although PURPA was passed in 1978, developer inexperience, utility recalcitrance, and challenges to avoided cost determinations kept the IP market at a low level for a number of years. Around 1985, more utility subsidiaries began to enter the market, utilities began to recognize the value of *not* having to build every capacity addition themselves, competitive bidding came into vogue (*circa* 1987), and the IPP concept was introduced, expanding the market's size and competitiveness. By the early 1990s, more than 15 years from the events that precipitated its introduction, the IP market reached relative maturity here (**Figure 3**).

Because most other countries have no legislation setting the methodology under which developers must be paid for the power they generate, for example, or laws that require the utilities to purchase power from developers' projects at all, U.S. firms might think they can wait and see how the regulatory and political frameworks develop before moving into international IP markets. This would be a mistake for several reasons.

First, there are several emerging models that other countries can use to jump-start the IP industry before putting all the required legislation in place, and a number of projects abroad are proceeding *without* the presence of a full slate of regulatory and legislative initiatives. Because the utility abroad often *is* the government, the *preferences* of the relevant utility executives and ministry can be sufficient to start up a project without an act of the legislature. For example, Indonesia recently selected Mission Energy to develop several 600 MW coal-fired plants at Paiton without having regulations on payments in place.

China illustrates how the lack of specific policies may create opportunities. In 1979, China promulgated its open door policy to decentralize administrative

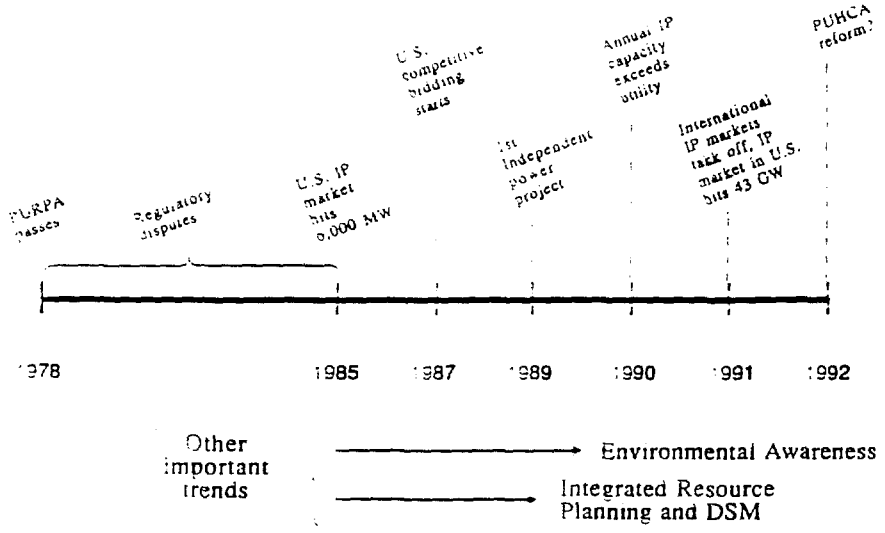

Figure 3: *U.S. Independent Power Timeline.*

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decision-making and offer foreign companies a more attractive target for investment. Since then, China has created investment trusts to assist investors; authorized special economic zones (SEZs) in five regions and 14 cities to offer incentives; provided tax holidays, custom duty exemptions and other general incentives; and passed over 100 laws encouraging the establishment, authorization, rights and protection of foreign-owned businesses. Moreover, China's Five-Year Plans for 1981-85 and 1986-90 placed high priorities on the reinforcement of the power generation and transmission system. There was never a clear "opening bell" for IP; rather, a *climate* emerged in China that entrepreneurial firms had to recognize and take advantage of in order to develop projects.

In the early 1980s, Hong Kong's Hopewell Holdings was developing the 1,200 room China Hotel complex in the Shenzen SEZ, which would have required a full 2% of the generating capacity in place. Gordon Wu, the firm's CEO, recognized low power reliability would severely reduce the profitability of his hotel. He thus embarked upon the development of the Shajiao B plant, a 2x350 MW coal-fired power station, to provide power to this SEZ, including his hotel. Mr. Wu and Hopewell knew the local officials, possessed tremendous local credibility and an excellent credit rating, and had the drive to bring Shajiao B to fruition. Although China had no legislation authorizing IP projects, Hopewell was able to sign an off-take agreement with the Shenzen SEZ in June 1984, build the plants in a record 22 months (winning a completion bonus in the process), and bring both plants on line by September 1987 (**Figure 4**).

In 1983, the Government of Pakistan (GOP) approved private investments in the power sector as part of its sixth Five-Year Energy Sector Development Plan. With assistance from both the World Bank and USAID, the GOP announced a private sector power policy in 1985, followed by a solicitation for proposals. It then began to develop model agreements for the sale of power and the granting of government assistance, a process that continued even as a major project evolved.

Although the groundwork for IP was laid rapidly, progress slowed when the efforts to satisfy Pakistan's power needs became largely wrapped up in one mega-project, the 1,300 MW oil-fired Hab River plant. Negotiations with the development consortium (led by Xenel Industries of Saudi Arabia, with participation by K&M Engineering of the U.S., Mitsui and IHI of Japan, and British Electricity International) bogged down over the price to be paid, the size of the project and the financing arrangements. Just when these hurdles appeared to be cleared in early 1992, the Federal Islamic Court issued a ban on all interest-bearing financial arrangements in the country, effectively halting the project. The commercial banks involved, which had committed $360 million to the project, refused to provide funding under these circumstances; in August 1992 the World Bank stepped in to guarantee the commercial banks' loans through a new technique called "enhanced co-financing." The GOP has appealed the Court's ruling to Pakistan's Supreme Court, and it is expected (though not guaranteed) that ways will be found to sidestep the Court's ruling, as has

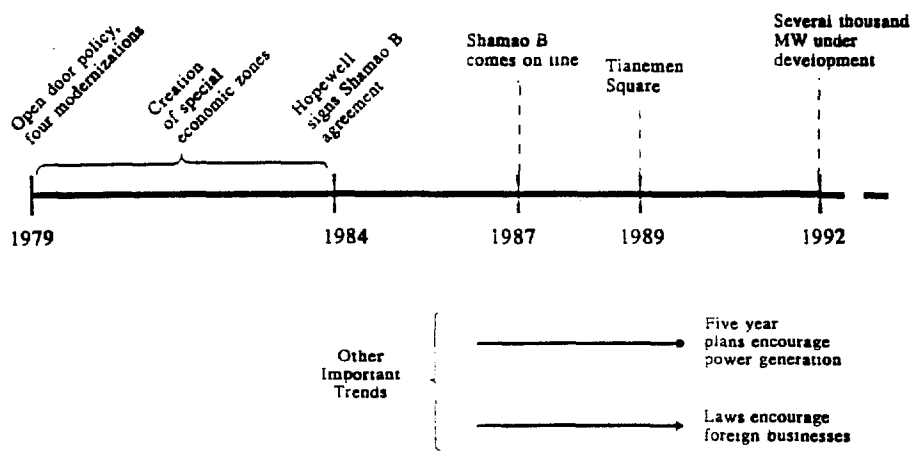

Figure 4: *China's Independent Power Timeline.*

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occurred in other Islamic countries.

The coming to fruition of the Hab River project has helped clear the way for other developments. The GOP is now proceeding with the privatization of the generation, transmission and distribution systems of the country's primary electric utility (WAPDA), has initiated the sale of the 840 MW Jamshoro plant, and has announced its plans to sell other power company assets through competitive solicitations in the near future. **Figure 5** shows the timeline for IP development in Pakistan.

In both China and Pakistan plants were developed concurrent with development of contracts and policies. The GOP was more focused on power policies than China, which was more intent on overall economic policy that permitted investment in the power sector.

The moral of these stories is that each country has unique circumstances that knowledgeable developers can use to their advantage, not unlike the situation in the U.S. However, the U.S. has a common national law, while developers overseas must not only become familiar with the laws and regulations for each country they consider, but must also know when the presence or absence of these statutes can be *bypassed* or *ignored*.

Thus, a strategy of waiting could easily lead a developer to miss the boat. Because most countries' IP markets are much smaller than that in the U.S., while their projects are larger, there are simply fewer opportunities for developers unless they participate in the market from the start.

When the U.K.'s electric power market was deregulated in 1989, authorities quickly received and awarded contracts to a spate of proposals to develop projects, including the 1,750 MW project under development by Enron Power at Teeside. In a short time, the market for new greenfield projects in the U.K. became saturated, and it will be several years before new baseload projects are likely to be available for developers again. Those who miss the first wave may be left standing on the dock, or end up having to pay a premium to buy a portion of a project on which other developers have already taken the first, riskiest steps.

Therefore, developers should: (1) not wait until the market "settles down," or until the legislative context is clarified, (2) gather market intelligence on a range of countries that is large enough not to miss opportunities that could come and go rather quickly, and (3) target attractive markets as early as possible, and begin to explore and negotiate contracts as soon as it appears capacity may be needed.

Conclusion

U.S.-based IP project developers should not pursue projects abroad in hopes of finding a more welcome, less competitive market for that reason alone. The international market bears little resemblance to the U.S. market in a host of critical ways. As developers venture into international waters, they must treat each country market as unique, build an organization that can recognize those differences, meet the competition on its own terms, be prepared to commit substantial financial resources, and be aggressive in pursuing markets before the opportunity fades. ■

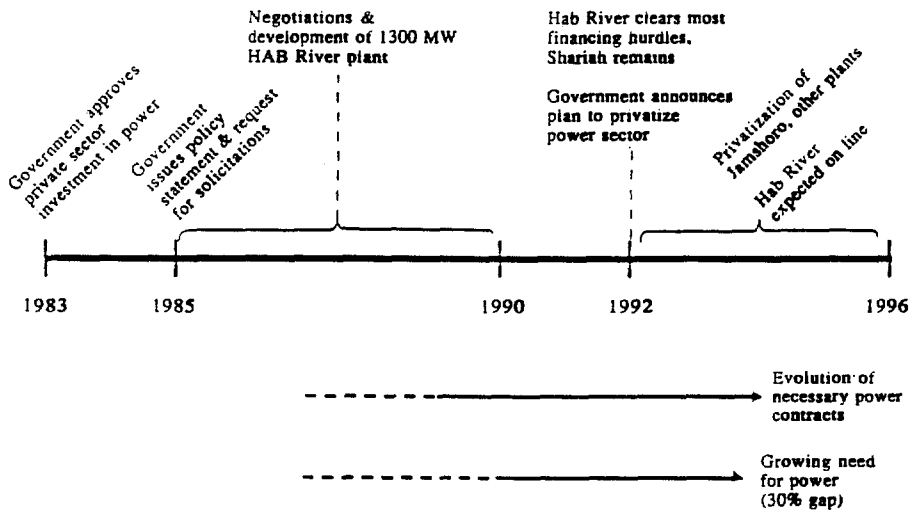

Figure 5: *Pakistan's Independent Power Timeline.*

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tional generation capacity that can be ex-
...ed to be in operation by the beginning
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International power projects and services: getting a share of the market

By Elliot J. Roseman *and* Jean-Louis Poirier. *RCG/Hagler, Bailly Inc.*

In our estimation, nearly 700 GW of new power generation capacity will be ordered by 2000 outside of North America, creating a demand for more than (US)$1 trillion in associated investments. In addition, there are substantial opportunities for plant retrofits and third-party (non-host utility) operation and maintenance contracts.

This considerable demand for new investments is taking place at a time when the world power sector is going through a major transition toward more transparent regulations and more competition. The result is the emergence of private power worldwide. At this juncture, our firm is tracking more than 350,000 MW of private power projects that have been proposed in nearly 70 countries.

With growing emphasis on competition, this demand for new power generation plants and services offers significant business opportunities to developers, utilities and other third parties offering technical know-how and effective project development and management skills. We estimate ...h demand at over (US)$100 billion for ... balance of the 1990s.

First, let's analyze the key trends that are revolutionizing the nature of world power markets in both developed and developing countries, which are providing the impetus for a growing private power market. Second, we'll review the specific needs for power and the level of private power project activity currently underway. Third, we'll evaluate the market for power-related services. Finally, we'll assess the ways in which companies will have to adapt to be competitive on an international scale.

The fundamental trends

Four fundamental trends are shaping the world power market in both developed and developing countries:

- more transparent electric regulations are being put in place;
- existing monopolies are being dissolved and power markets are becoming more open to outside competition;
- existing utilities are being restructured or privatized to become more competitive; and
- there is a tremendous requirement for private financing to meet the power sector needs of numerous countries.

More transparent regulations result in fewer subsidies and lead to commercially-based tariffs that entail unbiased cost allocations and take into account true long-run marginal costs and value of service. Increased transparency also means increased accountability of utility budgets and investment plans. Finally, more transparency helps free utilities from government political pressures, economic intervention, and bureaucratic micro-management.

In turn, more transparent regulations set the stage for increased market competition as monopolies are challenged to offer access to third parties, i.e., private (non-utility) entities allowed to build power plants and sell and/or transmit their power through utility grids to utilities' customers, directly or indirectly.

Third, utility restructurings increase decentralization and separation of functions to improve accountability and performance by establishing local cost/profit centers that can be monitored objectively. The next step may then be the split of power generation, transmission and distribution functions into separate entities which, in some cases, may be privatized. The ownership, plants or operations of some of these utilities may then be sold (in all or in part) to private parties.

Fourth, most developing countries do not have the resources required to finance the growth of their power sector. Although estimates vary, there is a tremendous need for new power generation capacity in developing countries, many of which need to expand their grids and improve their level of service to help spur economic growth. In our own estimation, up to 376 GW of new generation capacity could be ordered by 2000 in nearly 90 developing countries. This translates into (US)$350 billion of power generation investments plus another (US)$300 billion of associated transmission and distribution assets.

Unfortunately, it is most unlikely that the needed funds will be available to developing countries, which would need to mobilize at least (US)$35-40 billion per year. International donor agencies are providing only (US)$7-10 billion per year, and that amount is not likely to increase because of claims on their limited funds to assist other sectors. In addition, developing countries already owe more than (US)$60 billion in outstanding publicly guaranteed power loans. The availability of third-party capital is critical to help solve this major constraint over the course of the decade.

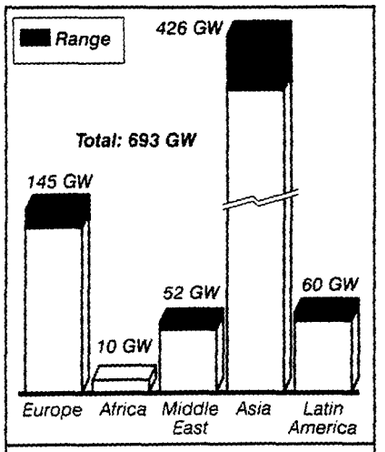

Figure 1. Projected generation capacity orders overseas, 1993-2000. Source: RCG/Hagler, Bailly, Inc.

Changes in developed countries

Separation of power generation and transmission/distribution functions has already taken place in the United Kingdom, New Zealand and Australia. Changes are also taking place in Scandinavia. In Sweden, the government has committed itself to introducing a free electricity market with full third-party access (TPA) by 1994. In Norway, a new reform was put in place earlier this year whereby Statkraft, the publicly owned utility, has to compete with local private or public entities which all have access to the grid. Statkraft was then split into a generation company and a grid management company.

Elsewhere in Europe, Portugal has invited private sector bids to build 1500 MW of new private power plants. In Italy, about 1500 MW of new private power capacity was recently approved for long-term sales to ENEL, the country's public utility. Furthermore, private power projects and third-party access are under intense discussions as part of the European Community's efforts to develop a Common Energy Market.

Changes in developing countries

Important changes are taking place in some 45 developing countries. For example:

- More transparent regulations are being developed in Argentina, Colombia, Indonesia, Korea, Malaysia, and Venezuela.
- Utility sector restructurings are emerging in many countries, including Argentina, Colombia, Ecuador, Iran, India, and Thailand. Similar moves are taking place in eastern European countries. In Poland, Hungary and Czechoslovakia, utility companies are being encouraged to restructure as joint stock companies which may be eventually sold to the private sector. In addition, distribution areas are likely to be franchised or conceded through competitive bids. Other countries such as Bangladesh, Jordan, Turkey and Venezuela are considering massive internal organizational changes.
- Private power plants are being developed in Chile, China, Costa Rica, the Dominican Republic, Germany, India, Indonesia, Jamaica, Malaysia, Mexico, Russia, South Korea, Turkey, and Thailand. And privatization initiatives have been launched in Argentina, eastern Europe, Greece, Pakistan, and Venezuela.
- The need for outside financing is considerable in countries such as China, India, Pakistan, Peru, and the Philippines.

Clearly, the fundamental trend...

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

Energy Pricing, Energy Efficiency, and
Energy Sector Restructuring Component

Bulgaria
Assistance with Energy Legislation
and Regulation
Task Completion Memorandum

Prepared for:

U.S. Agency for International Development
Bureau for Europe and NIS
Office of Environment, Energy,
and Urban Development
Energy and Infrastructure Division

Prepared by:

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August 1996

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CENTRAL AND EASTERN EUROPE
REGIONAL ENERGY EFFICIENCY PROJECT

Task Completion Memorandum

Bulgaria - Assistance with Energy Legislation and Regulation

Summary Task Description

Bulgaria has installed capacity of 12,000 MW. The annual electricity generation is from the following sources: about one-third from the Kozloduy nuclear power station, one-third is from thermal plants firing indigenous coal and lignite, one-quarter from thermal power stations firing imported coal, and the remainder hydroelectric. Imports make up 10% of the electricity balance.

The electricity sector was reorganized in 1991. The Committee of Energy (COE) is a government organization that controls the National Electric Company (NEK), which is a joint-stock company wholly owned by the government. NEK is a vertically integrated electric company which now has a monopoly on electricity supply. NEK is the sole distributor of electricity in Bulgaria, operates the national transmission grid, and all dedicated power stations. NEK purchases some 10% of its of energy from cogeneration facilities in industrial factories and district heating plants.

The electric energy intensity of Bulgaria's economy is high relative to other countries. This has resulted from national development policies, choices in industrial investment, availability of technologies, and electricity pricing policies.

The environmental impact of the electricity sector appears to be severe, with substantial sulfur and particulate emissions from the thermal power stations. The risk of a serious radiation leak from the older VVER-440 units at Kozloduy, which have no containment structures, is much higher than the newer Soviet-designed pressurized water reactors.

Bulgaria's electricity sector is coming under increasing pressure to improve efficiency. These pressures are building from within the country, resulting from democratic reforms, the transition to a market economy, and higher electricity tariffs. Similar pressures are mounting for gas,

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district heating and petroleum use.

Technical assistance will be provided to Bulgaria to develop legislation which promotes energy efficiency and power sector reform, as part of the transition to a market economy.

Specific Goals and Objectives

The objectives of this activity are:

- to provide advice and information to Bulgarian officials on relevant U.S. experience in developing and implementing energy legislation in the areas of electricity and energy efficiency;
- to facilitate the process of developing of workable energy legislation designed to increase energy efficiency and power sector reform;

Expected Outputs

This activity will include several tasks:

1. Definitional mission to establish contact with project participants
2. Four missions to Bulgaria will be undertaken to provide assistance and review of current drafts of energy legislation and for proposed energy efficiency legislation.
3. Provide limited drafting of language as requested.
4. Provide on-going advice by telephone, fax and courier between visits.
5. Provide selected reports and documents on relevant legal and regulatory issues for Bulgarians.
6. Prepare a final Task Completion Memorandum.

Deliverables

Hagler Bailly staff made field trips to Bulgaria in support of energy sector legislation. During these field trips our staff met with key lawmakers and decision makers in various Ministries, the Committee for Energy, and NEK, Draft legislation was reviewed and representative legislation from other countries was provided.

Results and Next Steps

A new comprehensive energy law has been drafted and is currently being considered by a number of Ministries and agencies. The law is not expected to pass in the near future and will probably undergo many more revisions before being sent to the legislature. There does not appear to be a consensus on exactly what is the purpose of the law, and what is expected to be achieved.

The next step in enacting energy sector legislation would be for the law to have a strong advocate who is able to establish a consensus among the affected Ministries and agencies and promote passage by the legislature.

To date, no agency or organization has stepped forward to assume such a role.

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

Energy Pricing, Energy Efficiency, and
Energy Sector Restructuring Component

Slovakia
ESCO Development & EPC Financing

Task Completion Memorandum

Prepared for:

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CENTRAL AND EASTERN EUROPE
REGIONAL ENERGY EFFICIENCY PROJECT

Task Completion Memorandum

Slovakia - ESCO Development & EPC Financing

Summary Task Description

Energy efficiency is a priority in Slovakia. There is interest among the electric utilities, industries, and government in new concepts such as performance-based investments by ESCos (including shared savings and guaranteed lease financing) and demand-side management programs by electric utilities. The initial energy efficiency work under the Emergency Energy Project indicated significant low-cost energy savings opportunities as well as larger investment opportunities. The 1992 Energy Efficiency Business Week held by SEVEn established that there is international interest, including U.S. companies, in investment in energy efficiency under the right conditions. Despite this interest, there are still legal and financial uncertainties as well as technical issues that create significant uncertainty about the likelihood of success carrying out a significant energy efficiency investment involving foreign ESCos.

Financing arrangements for performance-based efficiency projects have evolved in the United States over approximately the last fifteen years. These have never been tested for comparable transactions involving wholly domestic parties, or involving Slovakian together with non-Slovak parties in an international financing. As a result, there are numerous legal and financial issues to settle before private sources of funding, especially foreign sources, will be prepared to invest in Slovakian efficiency projects.

The National Association of Energy Service Companies (NAESCO), under subcontract from Hagler Bailly, will undertake work on the legal/policy, financial and technical issues related to energy service company (ESCo) investment in energy performance contracting (EPC) for energy efficiency projects. NAESCO is a non-governmental organization representing U.S. energy service companies, and has an export trading company, consisting of several member companies, which is developing performance-based energy efficiency projects in Slovakia. Through this organization the results will be made available to interested U.S. energy service companies, lenders and investors. The reports prepared will be presented at a seminar in Bratislava.

Specific Goals and Objectives

The goals and objectives of this task are:

a) improve the legal, policy and financing environment by identifying issues critical to third-party funders of energy efficiency investments by energy services companies (ESCos) and develop recommendations to improve the legal, policy and financial environment.

b) use existing local data to identify the market for energy efficiency investment opportunities; and

c) promote funding of energy performance contracting (EPC) projects to U.S. and international financing institutions.

Expected Outputs

The work is expected to produce the following outputs:

- Develop an agenda for policy, legal, and financial reform for energy efficiency, and initiate action according to this agenda.
- Heightened awareness and receptivity to the ESCo approach to financing energy efficiency in Slovakia.
- Facilitation of the initiation of ESCo-initiated energy efficiency investments by U.S., international, and local financing institutions in Slovakia.
- Increased U.S. ESCo and investor interest in Slovakian opportunities, as evidenced by increased investment proposals.

Deliverables

A detailed draft of the table of contents, or report outline will be prepared for the main report, and submitted to AID/EUR/DR/EI for review, early in the task execution.

The following reports will be prepared. Draft report and final reports will be subject to review and comment by AID/EUR/DR/EI and host country.

a) A 30-40 page report, with an executive summary, summarizing analysis of the legal framework, policy environment and opportunity for financing for ESCo-initiated

energy efficiency projects in Slovakia including an examination of the issues, impediments and options and recommendations.

b) A brief summary report of the findings, issues, conclusions and recommendations emerging from the information dissemination effort.

Twenty-five copies of each report will be provided; ten of each provided to Slovakian entities, 10 to AID/EUR/DR/EI, and 5 to the USAID representative in the country.

Results and Next Steps

Hagler Bailly consultants attended the ENEF94 conference to represent USAID and explore opportunities for EPC contracting in Slovakia. A number of activities were completed:

1. The ENEF conference director was selected to conduct the performance contracting feasibility study.

2. Other conference participants, government officials, and bank representatives were presented with the fundamentals of EPC contracting.

3. The feasibility study was subsequently initiated in conjunction with ICF.

From this trip, the conference, and the feasibility study a number of positive initiatives have taken place in Slovakia:

1. EPS (US) now has an office in Slovakia (EPS-SR) and is actively pursuing performance contracting opportunities. EPS-SR and the Slovak Power Works are in the final stages of forming a joint venture to provide EPC.

2. Landis & Gyr (Europe) in conjunction with EBRD is spearheading a ECU 70 Million program to develop a network of energy service companies.

KIONA INTERNATIONAL, INC.

Trip Report

To: Hagler Bailly and US AID
From: Shirley J. Hansen, Kiona International, Inc.

ENEF'94
BANSKÁ BYSTRICA, SLOVAKIA
NOVEMBER, 1994

(Program and participant list attached. Proceedings available on request.)

Part of my responsibility at this conference was to visibly represent US AID and to gain a preliminary impression of performance contracting potential in the Slovak Republic.

The organizing committee for this conference represented technical personnel, facility managers, the power sector and industry. It was spearheaded by Marián Rutšek and organized without a single entity, such as SEVEn, in charge. Some government funds were involved.

While the conference did not have the polish of the EEBW'94 in Prague, I sensed a far greater need and response from participants in Banská Bystrica. Even though the registration costs were relatively low, it represented considerable investment to those attending the conference. 230 3-day registrants and 80 1-day registrants participated. At least 80 percent of the registrants were from Slovakia. A list of participants is attached.

The exhibition was much larger than EEBW'94 with 40 exhibitors. Many of the displays were very basic technology and services. The exhibition booths were very well attended.

The first session was largely ceremonial with various representative ministries providing the expected greetings. The audience was large, but very passive and very few took any notes. There was considerable emphasis put on the importance of energy efficiency to the economy by the Ministry of Finance. The Ministry of Environment presented a stronger linkage between energy efficiency and the environment.

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ENERGY SUPPLIES

Following the statements by the public figures, there was a series of presentations from those supplying energy in Slovakia. Since data on Slovakian energy supplies after the velvet divorce has been scarce and sometimes conflicting, these presentations offered some valuable information.

Mr. Kvetán of the Slovak Power Enterprise, which represents the ≤ 110 kV, distribution network, reported that 70 percent of the electricity in Slovakia was consumed by industry. He also indicated the Enterprises two greatest spheres of influence was in Least Cost Planning and development of District Heating Systems. The greatest barrier was the "unfavorable finance condition today." He then acknowledged the value of the Utility Partnership Program, "which is sponsored by USAID via USAE."

Mr. Mošat of the Central Slovak Power Works (SSE), which has 10 distribution plants serving 1.6 million in central Slovakia described the company's new 5-year "Business Intention" (developed with the assistance of Anderson Consulting) to focus on customer requirements. The focus will be on electrical quality and reliability as well helping end-users with the "effective utilization of energy." Power Smart (Canada) has been helping set up DSM policies, and he listed four expected advantages of DSM as:

- "lower accounts on electricity for consumers;
- reduced dependence of Slovakia upon import of electricity and fuel;
- significant environment - impact; and
- creating new jobs."

He cited the potential for energy conservation through sectors in Slovakia as:

- inhabitants (residential) 272 GWh;
- service sector 98 GWh; and
- industry.

Mr. Demko of the Slovak Gas Industry (SPP) described the current state of the gas industry (25% of primary energy source) and its development. In 1993, 96%, or 5.9 bn m^3, of the natural gas was imported from Russia. Current consumption by fuel types and predicted growth in natural gas reliance were reported. He expects most of the growth in electrical production and spent considerable time discussing the merits of cogeneration.

Mr. Slavomir Hatina of Slovnaft (key products: motor fuels, lubricating oils and greases, petrochemicals and plastics) discussed the import and use of crude oil. 4.22 million tons (mil. mt.) of crude oil were imported in 1993 all from Russia. This is expected to grow to 4.7 mil. mt. from Russia by an unspecified date. The completion of IKL Pipeline offers the potential for crude oil access from the West.

The attractiveness of getting non-Russian "sweet" crude will help Slovakia respond to the environmental law designed to compel refiners all over Europe to implement desulphurisation capacities or switch to low-sulphur crude by January 1999.

Mr. Ján Prachar discussed hydro-carbon output and underground gas shortage.

Mr. Ludovit Zatko presented the current situation and perspectives of coal production. He concluded that "Slovak natural resources are considerably limited; coal mining has now reached an emergency situation" [underscore supplied.] He stated that the negative impact of price, transport tariff liberalization and competition from Czech Republic are all contributors.

Descriptions of programs from the EU; i.e., SAVE and the EC Energy Center in Bratislava, concluded the day along with a company presentation by Mr. Milan Bartoš of Landis & Gyr, Bratislava.

TECHNOLOGIES, FINANCING, ETC.

Days two and three of the conference were separated into two tracks. One tract focused on basic technical matters, "Effectiveness of Heating Plants," while the other tract encompassed some policy considerations and energy efficiency financing under "Systematic Approach to Energy Efficiency." Both tracts were well attended. Topics, such as boiler optimization and financing were particularly well attended. My presentation on the general concept of performance contracting followed by Mr. Ivo Slavotínek's case studies from the CR were received with great interest evidenced by a lot of note-taking as well as individual approaches after the session. This panel was chaired by Mr. Ján Dohnanský of the state utility. After Mr. Slavotínek's comments, the chair observed that performance ocntracting seemed lika a dream but Mr. Slovotínek's comments proved it could happen and Mr. Dohnanský wanted to talk further with me to indentify ways to make it happen in Slovakia.

The session, which I chaired Thursday morning, included a report by Mr. Dashevsky of CENEF, Moscow, where he discussed the high level of energy intensity in Russia and the opportunities for energy efficiency joint projects and joint ventures in Russia. I used my chair of this session to extend US AID greeetings, commendations and to observe that my presence on behalf of AID indicted its interest in the concept behind ENEF'94

Mr. Dušan Berka, Power Smart, discussed DSM opportunities in Slovakia and the organization's results in developing energy awareness and market transformation toward more energy efficient products. Following the session, Mr. Berka offered to work with our firm and AID in any research or other activities in Slovakia.

Ms. Waltraud Schmid of the Austrian Energy Agency (EVA), an NGO with government support, discussed procedures used in Austria to overcome barriers to energy efficiency.

She particularly noted the absence of "cost-effectiveness" thinking and the problems associated with fuel switching.

Mr. Ján Dohnanský of Slovak Powerplants gave an excellent presentation on the information needed and considerations involved by policy makers from the powerplant perspectives in making DSM decisions. He also noted that these issues had to be dealt with amid changes from a command-and-control economy. Power Smart has served as a consultant to Slovak Powerplants in this effort.

Mr. Bruno Vallance of EVA discussed the agency's investigation of Slovakian energy needs and savings opportunities by industrial sectors. Mr. Vallance stated that industry has the "economic potential to reduce energy consumption by 2005 by 33 percent."

At the end of the conference, the organizing committee of the conference asked me to join them for a celebration luncheon. The committee expressed its intention to hold the second ENEF in 1996 and to narrow the focus to "two or three ideas." I was asked to help plan this conference, to make a presentation at the conference and to chair a session again. I agreed. I also offered to help promote ENEF'96 in America.

SUMMARY EVALUATION OF THE CONFERENCE

The ENEF'94

- was well executed;
- very well received; and
- served a valuable purpose for Slovakians concerned about energy efficiency.

I would recommend that USAID have a visible presence at ENEF'96 and support this endeavor as appropriate.

While further study is necessary to fully ascertain the potential for and institutional barriers to performance ocntracting, the opportunity would seem to be positive. Follow-up discussins regarding performance ocntracting with Marián Rutsek, Ján Dohnanský, and Milan Bartos were particulary valuable and show the greatest potential for fostering performance contracting in the Slovak Republic.
Out of the work performed for USAID in conjunction with the Enef '94 conference, a number of activities have emerged.

1. We acquainted Marion Rutsek, the ENEF conference director, with the opportunities associated with energy performance contracting. From these preliminary discussions Marion Rutsek was later selected as the in-country contact to conduct the AID funded performance contracting feasibility study.

Today Marion Rutsek is the head of EPS SR, a branch of the US ESCO, EPS. He also directed the ENEF '96 conference that devoted one-half day to energy performance contracting.

2. Ján Dohnanský, responsible for DSM in the state utility, the Slovak Power Enterprise, chaired the energy efficiency financing panel at the ENEF '94 conference and became very interested in EPC and its relationship to the utility's DSM efforts. Further discussions were held with Ján Dohnanský at the conference and subsequently which expanded his interest in EPC potential. EPS SR and SE are in the final stages of forming a joint effort to provide EPC. Offices are presently being set up in Bratislava for this purpose.

3. At ENEF '94 discussions were held with Milan Bartos, the head of Landis & Gyr Slovakia, about apparent EPC institutional barriers the company was experiencing in Slovakia. Further discussions and follow-up were conducted. In late 1996, the former Landis & Gyr (now Landis & Staefa) announced the formation of an ESCO in Slovakia with the financial involvement of EBRD. (Copy of press release attached.)

13. STOP PRESS

European Bank for Reconstruction and Development Press Release

FOR IMMEDIATE RELEASE Contact: Rebecca Hill

Date: 18 December 1996 Tel: +44 171 338 6255

East European energy wastage to be tackled by EBRD and Landis & Gyr partnership

To tackle the enormous wastage of energy in central and eastern Europe and the Commonwealth of Independent States, the European Bank for Reconstruction and Development (EBRD) is financing an ECU 70 million multi-project facility with the Swiss company Landis & Gyr (Europe) Corp to develop a network of energy service companies (ESCOs) for the region. Landis & Gyr is one of the world's largest energy management and control companies and the market leader in Europe.

"With no means of controlling energy consumption on the demand side in central and eastern Europe, the energy sector is put under considerable pressure and up to 30 per cent of energy generated is lost. This puts needless strain on national budgets and causes immeasurable damage to the environment," explained Jacques de Larosière, President of the EBRD. "The EBRD, in partnership with an experienced company like Landis & Gyr, can help build a greater awareness of the need for energy savings with the advantage of establishing a private sector industry to support it".

According to Bernard Jamet, Director of the EBRD's Energy Efficiency Team responsible for ESCO development, "Energy service companies are the most effective way to promote energy-saving opportunities in the region, both in the public and private sectors."

The multi-project facility is the second of its kind signed by the EBRD in this sector. Osama Rifai, head of financial services for Landis & Gyr (Europe) Corp, explained that "the facility will support Landis & Gyr's programme of providing energy-saving services to clients, such as hospitals, educational establishments and district heating companies, which have limited access to funds for this purpose".

The ESCOs will install, at their own expense, appropriate technology in their clients' premises to reduce energy consumption, while at the same time providing a guaranteed level of comfort or service in terms of heating, lighting or other energy-related needs. The ESCO recovers its costs from the realised energy savings which it is able to guarantee to the client. Because few of the clients have access to capital, this form of contracted services, known as Energy Performance Contracting, is particularly suitable.

Initially ESCOs will be established in Poland, the Slovak Republic, the Czech Republic and Hungary, with the EBRD providing 35 per cent of finance requirements for each ESCO in the form of debt and equity. Landis & Gyr will provide the balance and will be the majority shareholder in each ESCO. Total financing under the investment programme will be approximately ECU 200 million over a four-year period.

Landis & Gyr (Europe) Corp is wholly owned by Electrowatt, a major Swiss building control and power company. The building control division operates under the brand names of Landis & Staefa and Cerberus, and the energy management business of the power division is carried out under the name of Landis & Gyr.

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THE FEASIBILITY OF PERFORMANCE CONTRACTING IN HUNGARY, POLAND, AND SLOVAKIA

Prepared by
Kiona International, Inc.

Under Subcontract to
ICF Resources Incorporated

U.S. Agency for International Development
Contract No. EUR-0028-C-00-2031-00

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THE FEASIBILITY OF PERFORMANCE CONTRACTING IN SLOVAKIA

PREPARED BY:
KIONA INTERNATIONAL, INC.
for
ICF RESOURCES

May, 1995

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

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EXECUTIVE SUMMARY

Due to its historical association with the Czech Republic (CR) as well as its geographical proximity to CR, there has been a tendency to continuously compare the Czech and Slovak Republics. This comparison has tended to overlook the positive economic aspects of Slovakia. When the Slovak Republic is compared with the broader spectrum of transition economies, Slovakia is clearly one of the better performing economies in Central and Eastern Europe. The country's gross foreign per capital debt is the lowest in Eastern Europe. The GDP per capital is exceeded only by the CR and Hungary in the transition economies.

Many leaders in Slovakia recognize energy efficiency could offer these benefits; but like financially starved nation's around the world, they simply don't have the money to support a broad energy efficiency effort. Furthermore, there are pressing demands on the money that is available.

An exciting opportunity exists to squeeze energy waste out of the Slovak Republic's economy and use those resources to benefit the country and its citizens. It is called energy performance contracting (EPC). Without any upfront costs to the owners, EPC can make potential energy cost savings from future years available to upgrade facilities and cut energy costs today.

EPC is not new or untried. It is being used successfully in thousands of projects in many western countries and a growing number of Slovakia's neighbors, including the Czech Republic and Poland. Experiments in a limited EPC approach are going forward in Banská Bystrica and Malacky.

The firms that offer EPC are called energy service companies (ESCOs). An ESCO identifies energy saving opportunities in a facility or an industrial process; then implements the approved measures at no front-end cost to the owner. All the equipment and services provided by the ESCO are paid from future energy and operational savings. Guaranteed! The ESCO has so much confidence in its services and products that the firm guarantees that all project costs will be covered by money that is now being paid to the utility for wasted energy.

The purpose of this report, and the research leading to it, is to examine the feasibility of implementing an EPC industry in the Slovak Republic, assess what obstacles or deterrents exist to broadly implementing this energy efficiency financing approach, and determine how these difficulties might be resolved. This report offers a "snap shot" of conditions as they appeared to the author during a March 1995 fact finding mission.

To fully analyze the energy situation in Slovakia and to assess the potential for energy performance contracting, it is necessary to first recognize that the independent Slovak

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Republic was established only two years ago. An assessment of the energy situation and its economic implications must also consider the previous development within Czechoslovakia. The heavy industrialization of Slovakia began after World War II under a command-and-control economy. Efficient operations, particularly energy efficient operations, were not a consideration. Much of the industrial development was heavy industry, and energy for these plants was imported and prices were subsidized by the state.

This inherited energy situation is at the heart of many of Slovakia's economic difficulties. The heavy dependence on energy imports and the level of energy required for its industrial sector are burdens on this growing economy. The absence of economic/financial analyses in the energy area and the artificially low energy prices for citizens diminishes an awareness of the importance of what energy efficiency can do for the economy.

As Slovakia strives to reduce its dependence on foreign fuel and bring its artificially low cost of energy to the public in line with its real cost, energy efficiency can offset some of the economic and social dislocation these adjustments can cause. The benefits energy efficiency could bring to Slovakia's transitional economy and its environment are striking. The absence of funds to implement energy efficient measures makes performance contracting an attractive option.

Barriers to performance contracting exist, but they are not insurmountable. Financial issues represent the greatest deterrents. Interest rates and inflation rates are high enough to deter some ESCOs from entering the Slovakian market place and to force the implementation of only the shortest payback measures. In March 1995, the inflation rate was reported to be 12 percent, and interest rates to consumers were in the 16-20 percent range. The Slovakia's economy is relatively stable and the opportunities for performance contracting and the development of an ESCO industry in the Slovak Republic are increasingly attractive.

Indications of an emerging ESCO industry and growing interest in energy performance contracting are evident in Slovakia. Several government entities were very interested in what an ESCO industry could do for the economy and for the government itself. Broad support exists for the experimental guaranteed energy saving projects being conducted in Banská Bystrica and Malacky.

Among these very positive signs, obstacles to effective performance contracting are in evidence. These barriers include: (a) the utility distributors and their potential resistance to energy efficiency in the private sector; (b) the way energy prices to the public have been set and controlled, which has created serious economic constraints as well as institutional resistance to energy efficiency and performance contracting; (c) uncertainties regarding financing; (d) economic conditions, which force the use of only short paybacks and reduce opportunities to implement measures with greater savings persistence and environmental benefits; and (e) the technical, financial and legal understandings required for effective performance contracting, which are emerging, but are not sufficient to support an industry.

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Conditions needed for a broad-based ESCO industry are not quite in place, but favorable changes are in evidence. Procedures and protocols have not yet been established. Some of the problems that plagued ESCO growth in North America are evident. Potential mistakes, such as reliance on separate attention to electric vs. heating measures; using engineers, who do not understand the time value of money and who have no experience in being accountable for energy saving predictions; etc., are already evident.

Performance contracting guidance is critically needed. The timing is excellent to offer seminars and/or conferences, which could help ESCOs establish effective business practices and move beyond avoidable difficulties. In addition, conferences would also heighten awareness of the benefits energy efficiency (and more particularly performance contracting) can bring to Slovakia's economy and environment, encourage U.S. ESCO participation in Slovakia, and help foster the growth of Slovakia's ESCO industry.

Financial issues are a partial deterrent to performance contracting. Interest rates and inflation rates are relatively high but continue to decline. Commercial rates to consumers were in the 16-20 percent range in March of 1995. In early 1995, the inflation rate was reported to be 12 percent and the Slovak National Bank had dropped the discount rate to 11 percent. Of equal concern is the status of the banking industry, which has limited money available and typically offers relatively short term loans.

A broad-based Slovakian ESCO industry may take time to establish and, depending on changing economic conditions, is probably at least two to three years away. The groundwork, however, is being laid now. Appropriate guidance and support at this juncture could be crucial to the ultimate success of an ESCO industry and to the ability of Slovakia to meet its goal of sustainable development. The timing is excellent to foster the development of an ESCO industry.

The following recommendations are based on apparent conditions in March 1995 and are designed to encourage energy efficiency and to foster the development of an ESCO industry in the Slovak Republic.

RECOMMENDATIONS

1. Provide technical assistance and performance contracting guidance to the emerging the Slovak Republic's ESCO market through:

   Liaisons, guidance, consultation, which will:
   - o encourage U.S. ESCO involvement;
   - o foster partnerships of successful foreign ESCOs with in-country partners in prime/sub or joint venture relationships

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- o provide business guidance through in-country consultation or documents, particularly in costing projects and the time value of money;
- o support any government or private sector plans to develop additional pilot, or demonstration, projects in several sectors; and
- o provide consultation to government officials in establishing an energy data base, which includes monetary consideration.

On-site training and/or seminars, which will:

- o offer special training for engineers, prospective ESCOs, financiers, and the legal profession in risk assessment and factors unique to performance contracting. Train engineers, who can now perform energy audits, to do the analysis and calculations required by ESCOs; and
- o provide training in energy efficiency practices for operations and maintenance (O&M) personnel; probably through training O&M supervisors to train their people; and
- o offer seminars for financiers so they can determine when specific performance contracting projects are "bankable."

2. Encourage the use of environmental funds to support energy efficiency in the Slovak Republic.

3. Elicit the support of multi-national development banks (MDBs) and other funding sources to augment or ameliorate the present financial constraints. Consider grants to Slovak banks to buy down interest rates, which could leverage relatively small sums into larger economically attractive financing sources.

   To fit typical MDB size loans to smaller energy efficiency financing needs, MDBs should be encouraged to consider pool financing for groups of projects which would help spread the risk and bring available monies down to projects of a size typical of energy efficiency projects.

4. The high liability the government carries to supplement energy pricing must be brought down. It is a heavy burden for the government, works against energy efficiency, ESCO potential services, and economic well-being.

5. Tax laws and procedures should be examined to be sure no disincentives or inequities exist that negatively impact moves toward energy efficiency, performance contracting and sound economic policies. Secondarily, the normalization of income tax holidays or other inducements for ESCOs should be considered as an incentive for them to do business in Slovakia.

6. Help the national leadership realize that energy efficiency is a sector free problem and the responsibilities extend far beyond the energy sector.

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Closely allied to this need, is support for the government's plan to increase energy prices to the public. Guidance should be offered, as appropriate, so government officials can more readily recognize the value of energy efficiency and performance contracting in significantly reducing the social and economic dislocation caused by these price increase.

7. Encourage the use of metered consumption of heating energy, rather than the current procedure of paying by floor space (m^2), so end-users have an economic incentive to use energy more efficiently.

8. Assess the utility's current tariff structure, and restructure as appropriate so that no entity in the power sector suffers unduly from energy efficiency and demand-side management procedures. Given appropriate conditions, the utility could play a strong role in supporting the development of an ESCO industry.

9. Accelerate the privatization process; so transitional organization can more readily access ESCO assistance.

10. Prepare clearly defined procedures and guidance documents, which will enable ESCOs operating in the Slovak Republic to secure their money within a project; provide for unimpeded opportunities to get money from recalcitrant customers; prepare bankable project to get funding from commercial banks; and allow clear recovery of invested funds and profits as warranted. The perception by many that there is no contract law needs to be overcome.

11. Examine the range of AID and MDB efforts in Hungry and determine where energy efficiency issues, concerns and benefits might be incorporated in these on-going programs.

12. Support any government efforts to make the Slovak crown fully convertible.

13. The money side of energy often seems lost in weighing the benefits of energy efficiency or in making savings calculations. A data base enabling economic analysis of energy use should be developed. Education and training of the money side of energy should be offered energy planners, energy service and energy efficiency financing providers.

14. A good place to start applying financial analyses is the energy efficiency projects in progress. The results of the two experiments at Banská Bystrica and Malacky should be reported in crowns invested, crowns saved and the cost-effectiveness of the project. Economic analyses should accompany any further analysis and implementation of the Handlova project.

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Encourage economic/monetary analysis of energy resources, needs, use and energy efficiency opportunities. Apply market economy return on investment analyses to the projects in Handlova, Banská Bystrica and Malacky.

15. Extend the government sponsored guaranteed savings experiments in heating in the housing sector to electricity usage and add other markets. Use financial analysis in these projects, too.

16. Continue technical support to the banks and government in developing procedures that will most effectively support energy efficiency and performance contracting in Slovakia. Encourage longer term loans and the use of predicted energy savings as collateral.

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INTRODUCTION

In 1995, research was conducted to assess the feasibility of energy efficiency performance contracting in the Slovak Republic and to examine any barriers that might exist to fostering an energy service company (ESCO) industry in the country. More specifically, the key institutional and economic elements needed for the growth of a successful performance contracting industry in Slovakia were examined. Also investigated were the types of energy efficiency investments that would be attractive to energy service companies (ESCOs) and the specific market segments that might interest ESCOs.

To assess these conditions, the investigation involved a literature search and interviews with 42 individuals representing; (1) ministries in the Slovak Republic, (2) segments of the power sector, (3) foundations and companies dedicated to energy conservation in Slovakia, (4) environmental concerns, (5) private companies, (6) financing sources, and (7) Slovakian ESCOs. A Slovak attorney was also interviewed. A list of those interviewed in Slovakia in March 1995 and their respective positions/affiliations is presented in Appendix A.

While conducting the interviews, the opportunity was also used to explain performance contracting and to acquaint the interviewees with its potential benefits to the country, the economy and the environment. A handout was prepared and presented to each interviewee. A copy of this handout also appears in Appendix A.

The reader is cautioned that economic and political conditions in Slovakia are constantly evolving and the findings presented herein offer only a "snap shot" of the situation as it appeared in March 1995. Furthermore, the research was limited to those areas believed to have an impact on the advent of an ESCO industry in Slovakia. The perceptions presented here are based in large measure on the perspectives of those interviewed. Even though a broad range of persons were interviewed, they did agree on many salient points. There were, however, discrepancies in data provided as well as disagreements as to implications of that data.

Section 1 of this report offers a brief overview of performance contracting and a history of the ESCO industry. Mention is made of emerging interests in other areas of the world, including activities in other Eastern European countries, as well as the growing interest of multi-national banks in this concept. It is followed by a brief description of the lessons learned by ESCOs in the West, especially problems incurred during the evolution of ESCOs that could have implications (and repercussions) for performance contracting as it develops in Slovakia. Section 2 highlights the elements key to successful performance contracting and addresses findings relevant to those points.

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Section 3 offers a summary of the economic, political and financial conditions in Slovakia, which are germane to energy efficiency and performance contracting. An overview of the energy situation in Slovakia and the present energy supply structure is presented in Section 4. Section 5 offers some recommendations as to ways an ESCO industry in the Slovak Republic might be fostered.

The research leading to this report was conducted by Kiona International under a contract to ICF Resources, a primary contractor to the U.S. Agency for International Development. The document was prepared by Dr. Shirley Hansen, Kiona International, Inc.

The content of this report rests on the perceptions of the researcher and should not be attributed to those interviewed, the Slovakian Government or other identified sources unless cited through direct quotation. Any mention of products, companies or procedures should not be construed as a favoring, or as an endorsement, explicit or implied, by the author, her firm, ICF Resources, or US AID. The observation, conclusions and recommendations are solely those of the author and do not necessarily reflect those of ICF Resources or US AID.

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SECTION 1. PERFORMANCE CONTRACTING

Performance contracting could enable Slovakia to enhance its economy and its environment and to do so out of funds now being spent on wasted energy. As Slovakia seeks to bring its energy prices for its citizens closer to supply costs, performance contracting could reduce some of the potential social and economic dislocation caused by higher utility bills. In the process of providing energy efficiency services and financing to industry, commercial, public housing sectors, performance contracting can offer exciting business opportunities for the in-country energy service industry, increase employment as well as offer clear advantages for a customer that chooses to cut operating costs through private sector energy financing and services.

Performance contracting allows the customer; e.g., a school, hospital, state agency, commercial business or an industry, to use *future* energy savings to upgrade facilities and cut operating costs *now*. Many organizations in Slovakia are using more energy than they need to, but they lack the financing and/or the expertise to keep the money now being spent for wasted energy. The money, through performance contracting, is made available to the owner/operator of the facility. Energy savings are guaranteed to equal or exceed the cost of the changes needed to achieve those savings. The energy service company (ESCO), which identifies energy saving opportunities in the customer's building, equipment and/or industrial processes. The ESCO then implements those measures approved by the owner at no initial cost to the owner, maintains the measures for the life of the contract and guarantees the energy savings. An ESCO provides the engineering services and acts as a construction manager. Through the life of the contract, the ESCO monitors the savings, maintains the installed equipment and serves as an energy efficiency partner to the owner/operator.

A key service the ESCO performs for financial starved organizations is project financing. The ESCO may use its own funds; or it arranges the financing from a broad range of sources, including utilities, commercial banks, or special funds such as pension funds or environmental funds. Since the ESCO guarantees the money for repayment of the loan, risks to banks are reduced and money from funds are leveraged to serve additional purposes.

The purpose of the performance contracting feasibility study in Slovakia was to assess the potential opportunities and barriers to this energy efficiency financing approach. With the help of many political and energy leaders in Slovakia, the potential for energy performance contracting in the country was explored, specific opportunities identified, problems associated with this approach were determined and possible resolutions examined. This report offers a "snap-shot" of such conditions as they existed in March, 1995.

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PERFORMANCE CONTRACTING IN RETROSPECT

In the late 1970s, Scallop Thermal, a division of Royal Dutch Shell, introduced the concept in North America of using third party financing to improve energy efficiency and cut operating costs. Scallop offered Hanneman Hospital conditioned space for 90 percent of its current utility bill. By upgrading the mechanical system and implementing energy efficient practices, Scallop was able to bring consumption well below the 90 percent level. Scallop paid for its services and made a profit from this difference.

As energy prices continued to climb, the idea of using future energy savings to upgrade facilities and cut operating costs became even more attractive.

In its early stages, the energy financing agreements generally turned on each party receiving a percentage of the energy cost savings. The ESCO received a share to cover its costs and make a profit. The owner also received a share (as well as capital improvements) as an incentive to participate. Since each party received a share of the energy cost savings, this procedure became known as "shared savings."

During the life of the contract, the ESCO expected its percentage of the cost savings to cover all the costs it had incurred, plus a profit. This concept worked quite well as long as energy prices stayed the same or increased.

In the mid-1980s, energy prices began to drop. With lower prices, it took longer than predicted for the firm to recover its costs. Some firms could not meet their payments to their suppliers or financial backers. Companies closed their doors; and in the process, defaulted on their commitments to their shared savings customers. Some suppliers tried to recover costs from the building owners. Lawsuits were filed and "shared savings" was in trouble.

Other troubles also plagued the industry. The concept was sound, but the trust, so essential to a contract based on uncertain future savings, was seriously weakened. Fortunately, some agreements continued to show savings benefits to both parties. Of even greater importance, some companies had guaranteed the savings and they made good on those guarantees.

From this tenuous thread, the "shared savings" industry survived, but its character changed dramatically. Those supplying the financial backing and/or equipment recognized the risks of basing contracts on future energy prices. Higher risks meant higher interest rates, if the money was even available. Insurance that had been available to ESCOs for "shared savings" almost disappeared. By 1983, shared <u>cost</u> savings agreements had shrunk to approximately 5 percent of the market.

Different financing mechanisms also emerged, but nearly all of them offered energy savings guarantees. Shared savings as a financing mechanism still existed, but its appeal was limited. Instead, the guarantee centered on the reduction in the <u>amount</u> of energy consumed and the

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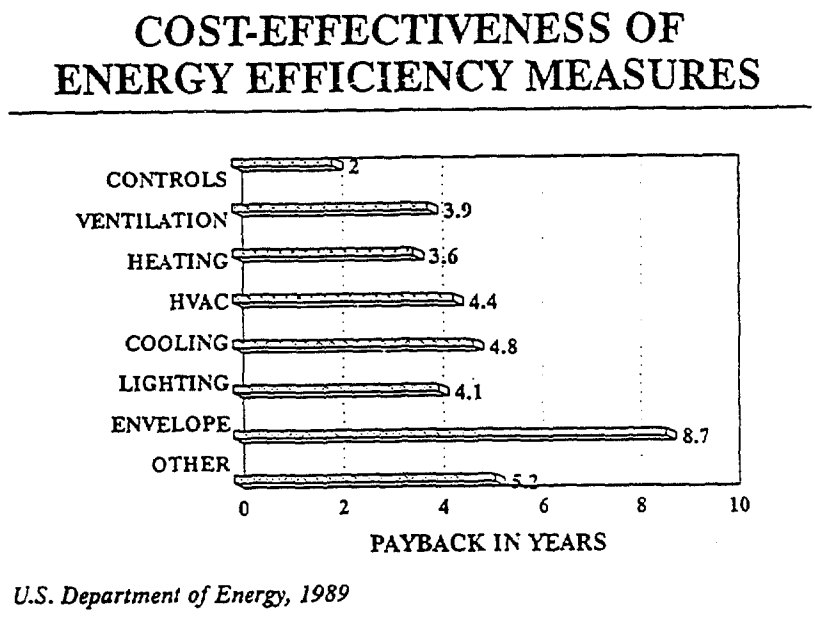
dollar savings calculated at current billing rates. Typically, the projected dollar savings were guaranteed to cover any of the associated debt service obligations of the owner. To avoid the risks associated with falling energy prices, ESCOs began setting an energy floor price below which money guarantees would not apply.

The initial attraction to performance contracting was the financing help. Through the years, the ESCO expertise has become equally attractive. For example, a survey of school administrators in the United States as recently as 1988 found that the majority still thought work on the building envelope; e.g., added insulation, double glazing of windows, etc. was the most cost-effective energy saving measures to take. As shown in Figure 1-1, a U.S. Department of Energy analysis showed that building envelope measures average the longest payback (over eight years) of those measures studied. In contrast, control measures paid back in roughly two years. In attempts to cut energy costs, school administrators were not investing money in the most effective place ... instead, they were waiting eight years to get the return on investment that they should have achieved in two years.



U.S. Department of Energy, 1989

FIGURE 1-1. COST-EFFECTIVENESS ANALYSIS FOR BUILDINGS

ESCOs have learned, sometimes at great expense, what works. And what doesn't!! The earlier temptation to invest in elaborate control systems, for example, no longer exists. Today, ESCOs know exactly how sophisticated a system should be in a given facility -- right down to the number of sensing points and control points that are really needed. That expertise can keep owners from investing valuable money in the wrong measures.

Today, performance contracting has matured into a viable and reliable way of doing business in North America and many countries throughout the world. In the United States and

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Canada, federal law allows, even encourages, federal agencies to use performance contracting to cut operating costs. Nearly 4,000 U.S. school systems have some type of performance contract, and these school systems have a many as 800 buildings. Major manufacturers of energy-related equipment have ESCO services and divisions, utilities have developed or acquired ESCOs, and many regional ESCOs have grown from engineering firms, distributorships and mechanical contractors. It is conservative to say that in the United States there are at least ten major national ESCOs and another 30-35 operating on broad regional bases. A list of the larger U.S. firms, the types of services and financing they offer as well as their preferred markets appear in Appendix D.

In 1994, the International Energy Agency went on record at the Conference on Energy Efficiency in Latin America to support and encourage the ESCO industry. Some version of guaranteed energy savings is now being practiced in France, Germany, Sweden, Spain, Italy, etc. Some ESCO activity is reported in Poland and the Czech Republic has two projects underway. The multi-national banks are increasingly supportive of the energy service company industry. The World Bank conducted a roundtable in September, 1994 to explore the energy efficiency opportunities and assess the viability of creating criteria to foster an ESCO industry in a country as a condition of receiving a World Bank loan. PHARE has begun funding performance contracting in countries, which formerly had command-and-control economies.

TYPICAL ESCO SERVICES

Through the years, ESCO services have become more varied. It has become a customer-driven industry and the customer typically has a selection of ESCO services from which to choose. Services offered by an ESCO usually include:

- a facility audit to identify energy and operational savings opportunities;
- financing from its own resources or through arrangements with banks or other financing sources;
- the purchase, installation and maintenance of the installed energy efficient equipment; possibly maintenance on all energy consuming equipment;
- new equipment training of operations and maintenance (O&M) personnel;
- training of O&M personnel in energy efficient practices;
- monitoring of the operations and energy savings, so reduced energy consumption and operating costs persist; and

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- a guarantee of the energy savings to be achieved.

The popularity of performance contracting rests on the many benefits it delivers. The highlights of the benefits it offers a country, a business offering such a service and the customer are addressed below.

COUNTRY BENEFITS

When private sector energy efficiency financing is used in a country, the benefits include:

- reduced reliance on external energy resources, and a reduction in the associated negative impact on balance of trade;

- reduced demand for financing power supply investments;

- opportunities to upgrade facilities using current and future monies now spent on wasted energy;

- an improved economy, which cuts operating/production costs and increases the country's economic competitiveness;

- increased industrialization without concomitant increases in utility generating capacity;

- increased employment while reducing the needed capitalization for the same quantity of energy; i.e., An unpublished U.S. Department of Energy study of Russian conditions showed that providing the same megawatts through energy efficiency creates five (5) times as many jobs as producing this energy with only one-eighth the capital investment;

- environmental improvement without incurring the costs usually associated with such efforts. In fact, energy efficiency through performance contracting can significantly reduce pollution emissions, such as CO_2, SO_x and NO_x, while it "makes" money; and

- a local energy service industry can be created. Using successful ESCOs in prime/sub or joint venture with in-country partners has already proved to be an excellent means of technology transfer while creating additional businesses and employment opportunities in the developing country.

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BENEFITS TO IN-COUNTRY BUSINESSES

An in-country partner, as a joint venture partner or as a subcontractor, is critical to an effective project for foreign ESCOs. The in-country partner brings to the effort the essential knowledge of the culture and how to do business in that culture. A successful ESCO brings risk management experience as well as technical, financial and contractual knowledge. It is proving to be a successful partnership for all parties.

The ideal in-country partner is a design/build "mechanical contractor," who has heating, ventilation, air conditioning (HVAC), electrical and other related turnkey capabilities, along with experienced project managers to manage the implementation of the projects. In some instances, thermal energy saving expertise and/or a knowledge of industrial process are also important capabilities. An understanding of the financial benefits of energy efficiency is important. Good political connections to enhance marketing efforts, secure the necessary support and/or speed up contract negotiations with large industrial, institutional, and/or commercial customers are also important. The in-country partner should also have experience in the procurement of equipment on an import basis in order to access the current technologies available for energy conservation outside of the country.

The benefits to an in-country partner are substantial from a short-term financial perspective and long-term growth. Offering performance contracting services to its existing customers would allow the in-country partner to provide improved customer relations and expanded services, which includes installing major capital improvements in the customer's facilities at no initial cost to the customer. Performance contracting allows the in-country partner to posture itself into a long-term leadership role by providing its customers with new innovative services, which neither the company nor its competition have previously provided.

From a financial perspective, performance contracting provides a significant positive cash flow benefit to the partner's existing company by creating a substantial amount of business through services without the need for it to acquire any of the significant additional overhead usually associated with increased inventory or greater processing needs. This business growth not only comes from "old" customers, but comes from a "new" customer base.

A third major benefit to the partner, which is a financial benefit, is the fact that no additional fixed resources will have to be obtained in order to implement the performance contracting program. An existing foreign ESCO can provide all support and resources necessary including technical personnel, legal contracts, marketing and performance contracting procedures and methodology to ensure that the program is properly implemented and that project performance risks are reduced.

To summarize, whether an organization chooses to develop its own business, serve as a subcontractor or become a JV partner, performance contracting offers an in-country firm the opportunity to:

- sell to customers who have limited financial resources;
- serve existing customers better;
- increase business -- with limited investment;
- make more money selling savings and service (than just products);
- keep personnel employed;
- demonstrate confidence in products and service;
- hold down energy costs; and
- increase the company's competitiveness.

It also offers businesses an opportunity to serve the country's environmental needs. Energy efficiency is essentially environmentally benign. It is a very cost-effective way to reduce air pollution. Fortunately for all concerned, the avoided utility costs will typically pay for all these benefits.

CUSTOMER ADVANTAGES

The in-country recipient of ESCO services can achieve many business/organizational benefits, including:

- an immediate upgrade of facilities and reduced operating costs -- without any initial owner investment;
- access to the ESCO's energy efficiency expertise. Through savings guarantees, ESCOs have learned from experience just how effective specific energy efficiency measures are under certain conditions and how soon they can pay for themselves;
- positive cash flow -- most projects generate savings that exceed the guarantee;
- the opportunity to use the money that would have been used for required upgrades to meet other needs;
- improved and more energy efficient operations and maintenance;

- normal customer risks are taken by the ESCO, including the guaranteed performance of the new equipment for the life of the contract (not just through a warranty period);

- a more comfortable, productive environment; and

- services paid for with the money the customer would have paid the utilities for wasted energy.

Performance contracting is probably the best and quickest way to be sure an organization is operating as efficiently as possible. It offers the customer a risk shedding opportunity. The only true risk the customer incurs is finding the right ESCO partner and obtaining a contract that best meets the customer's needs.

LESSONS LEARNED IN THE WEST

The performance contracting concept is simple and the advantages to all parties easily documented. The process, however, is relatively complex. As the industry developed in the west, costly mistakes were made. The potential exists to make many of these mistakes in Slovakia. Some serious mistakes that ESCOs have made that might happen to a developing ESCO industry in Slovakia are discussed below.

FREE AUDITS

In their enthusiasm to demonstrate potential savings and the value of what they were offering to customers, ESCOs initially offered potential customers an audit and report at no cost. After expending their time, services -- and *money* -- too many ESCOs found their audits sitting on a shelf or being given to the owner's friend down the street to implement. Sometimes the owner would look over the report and then comment, "This looks good, but I don't see why we can't make these changes ourself."

Increasingly, ESCOs are stressing that they are in the business of doing projects; not audits. Some agreement expressing owner intent is now typically entered into before the comprehensive audit is performed. A growing number of ESCOs charge for an audit -- and some even add a premium -- if the project doesn't go forward.

TOO MUCH; TOO SOON

Convinced of a good thing, many ESCOs historically spread themselves too thin. They attempted to service too large a geographical area, and/or tried to be all things to all people.

Gradually, painfully, they recognized that they needed to specialize in certain market segments, such as hospitals, and to specialize in implementing certain types of measures. They also learned to confine themselves to a doable service area or developed qualified local partners, such as an equipment distributor, to provide maintenance and/or emergency response procedures. Once an ESCO became focused on what it could do best, many sought to build strategic alliances; e.g., a controls company ESCO might establish a relationship with a lighting company.

Others tried to move ahead too fast and became over-extended. As the wise, increasingly grey-haired leaders of the U.S. ESCO industry can attest, performance contracting is front-loaded with risk. These performance contracting leaders will also describe how they eventually learned that performance contracting is essentially risk management; and they conclude, "If you want to stay in the business, you don't take on more risk than you can manage."

GETTING AN *ACCOUNTABLE* ENERGY ENGINEER

In the 1970s and early 1980s, a stark lesson was learned: all engineers are not *energy* engineers. Textile engineers, for example, were not apt to understand ways to increase energy efficiency in an office building. Similarly, as the 1980s moved into the 1990s, ESCOs learned that energy engineers, who were not typically held accountable for predicting potential savings of specific measures in specific applications, could cost them a lot of money.

Performance contracting requires a new level of technical competence. ESCO engineers must be able to calculate all the implementation costs <u>and</u> the potential savings; thus, providing an accurate guide to the cost-effectiveness of each measure and a project -- a prediction the ESCO can, and must, bet money on. This presents a new level of risk assessment and a careful appraisal of administrative commitment and operations and maintenance capabilities. The "people" assessments must be factored into cost-effectiveness calculations of measures; i.e., over the typical performance contract extended time frame, consideration must be given to how much affect people will have on controls, windows, etc. Other factors, such a the predicted life of light bulbs, also become critical concerns. ESCO engineers must be held accountable for their predicted cost/benefit analysis. This requires the ability to assess organizational commitment, as well as O&M manpower capabilities, training needs and potential project support.

COST-EFFECTIVENESS

Performance contracting is primarily a long term financial transaction and requires the ability to calculate the cost of money over time. Engineers calculating cost-effectiveness must understand the impact of inflation on current money rates, the function of discount rates (to

offset the opportunity value of the money), and interest rates if they are to calculate potential savings benefits.

Current economic and political conditions in Slovakia make it difficult to predict future energy prices with any certainty. The government has stated its intention to raise prices in the public sector by 10% in 1995 and another 15% in 1996.

UTILITY ROLE

Once the utility industry in the United States became aware of the performance contracting industry, it became apparent that they could have a major impact on the growth of the ESCO industry. Utilities can impede, enhance or remain neutral regarding such growth. If the utility looses revenue when its customer makes energy efficiency improvements, there is a disincentive for utilities to support such efforts. If there is no clear benefit or loss, utilities may remain neutral. When the utility actively pursues demand-side management (DSM) and/or is offered a means of off-setting lost revenues, utilities can enhance the growth and have a profound impact on the shape of the industry. After an uneasy beginning, the utilities and ESCOs in the west have established an effective working relationship and a major portion of the utility DSM efforts are now performed by ESCOs.

UNDERESTIMATING THE KEY ROLE MANAGEMENT AND OCCUPANTS HAVE, ESPECIALLY O&M STAFF

In the early days, ESCOs so thoroughly convinced management of the value of their services that many owners took a rather passive role. It soon became apparent that the level of savings was frequently determined by the commitment of management, occupants, operators and maintenance (O&M) personnel. While the absence of management commitment is critical, the greatest deal breakers can be O&M personnel who feel threatened, do not understand how the project can help them do their job more effectively, or who do not feel appreciated. O&M staff can easily ruin the best designed project in the world.

A related mistake was not providing sufficient training for the O&M staff, both on the newly installed equipment and on other energy consuming equipment. A U.S. Department of Energy study of effective energy programs in schools and hospitals found that up to 80 percent of the savings could be attributed to energy efficient O&M practices. But these savings require training.

THE VITAL COMMUNICATIONS LINK

In its early days, projects were treated more like direct sales; not long term partnerships. The contract was signed, the equipment installed and the bills were sent once a month. No

further personal contact was planned and projects without this interaction usually suffered.

Effective partnership always requires effective communication. When money is involved it becomes critical. ESCOs with high customer satisfaction have a planned communication strategy throughout the contract.

SECTION 2. KEY INSTITUTIONAL AND ECONOMIC ELEMENTS

Through the years it has become increasingly obvious that specific elements are valuable to effective performance contracting. Some issues are absolutely crucial from the very first consideration of a potential customer. Elements may pertain to the country or localities' economic, political and social conditions. Others pertain to technical considerations and the customer's credentials.

COUNTRY CONDITIONS

Performance contracting extends over several years, and the ESCO expenses are heavily front loaded; therefore, political and economic stability of the country can determine whether or not further consideration is even given to performance contracting. If conditions are relatively stable and moving toward greater stability, then other issues are examined.

POLITICAL & ECONOMIC ELEMENTS

Political stability. The general stability of the government in place is a critical screening factor. A country with a high turn over in parties in power and associated dramatic changes in economic, financial, or banking procedures as well as energy prices, can discourage any long term contracts, especially performance contracts that carry private sector guarantees.

> There is evidence of movement toward a market economy with the current Mečiar administration, but careful observation and some caution are warranted.

Economic Stability. Closely associated with political stability are national economic conditions. Matters that impact on longer term contracts, such as inflation and interest rates, are particularly key.

> In March 1995 the Slovakian banks' interest rates were 16-20 percent with an inflation rate of 12 percent, which yielded a real interest rate in the 4-8 percent range.
>
> The inflation rate and interest rate are relatively attractive in Slovakia compared to most of Eastern Europe, however, the rates are still high for EPC and off-setting economic conditions are needed.

SFR

Financial factors. The condition of the banking industry, its ability to make longer term loans and its flexibility to adapt to new contract provisions are all critical factors in financing a broad ESCO industry.

> The banking industry in Slovakia is not strong, but some indications of slow growth are evident. Loan terms exceeding five years are available.

Monetary factors. The level of foreign investment by ESCOs and their financiers will also be dictated by currency convertibility, who carries the conversion risk, and conditions of repatriation.

> The Slovak koruna (or crown) is not fully convertible. Inside-country convertibility when accompanied by the appropriate documentation; e.g., an invoice, reportedly does not pose a problem.

Energy efficiency as an investment. To sell the economic benefits of performance contracting, political decision makers, energy leaders and those who own and/or manage facilities and industries must view energy efficiency as an economic benefit.

> The heritage of a command-and-control economy tends to overlook economic assessments in the energy field. Common practice in Slovakia is to discuss the investment costs in Slovak korunas and the savings in joules. Major energy studies in Slovakia, such as the Handlova project, have not considered the time value of money in assessing the relative benefits of certain energy savings measures.

The power sector. The structure of the power sector; i.e., generation, transmission and distribution; how tariffs and energy prices are set; and how they are controlled influence the utility's position toward energy efficiency and associated revenues. If a utility stands to lose revenues, it is apt to resist energy efficiency. This, in turn, can impact the profitability of any ESCO activity.

> Slovenské Elektrárne (SE), the national electric utility, adopted the concept of demand-side management in 1992 and has worked closely with Power Smart. With the restructuring of the power sector in 1994, SE became a joint stock company. SE is considering becoming an ESCO.
>
> SE sells electricity to 3 distributors and 4 industries. Due to rate structures, the distributors have an incentive to support energy efficiency in public housing, but not in industry.

An ESCO industry that can be supported by the utilities will grow more readily. The status of demand-side management (as the term is used in the United States) and the opportunity for integrated resource planning are important indicators as to the degree to which the utilities are apt to facilitate performance contracting.

A tariff strategy that rewards each organization in the power sector for supporting energy efficiency, is key to achieving the maximum Slovakian energy and environmental benefits.

ENERGY & ENVIRONMENTAL ELEMENTS

Marketing potential for an ESCO industry are frequently revealed by a country's consumption patterns and its energy intensity (energy consumed per gross domestic product). How these factors compare to other countries as well as within a sector in the country are key concerns.

The level of understanding of the benefits energy efficiency can deliver to the environment will affect the support, acceptance and, often, the funding ESCOs can receive.

Slovakian energy consumption is relatively high in all sectors. Energy intensity is more than twice most areas of the world.

The representative of the Ministry of Environment interviewed has an excellent understanding of the relevance energy efficiency has to the environment.

CUSTOMER ELEMENTS

The energy and cost savings opportunities by market sector and by individual enterprise is of great interest to potential ESCOs, but careful customer evaluation by effective ESCOs doesn't stop there.

Customer benefit. The performance contracting process must benefit the customer. The customer must be allowed to keep some of the energy cost savings or materially benefit in some other fashion from ESCO efforts. If, for example, the major benefits, such as positive cash flow, go to a central fund, history has shown that the critical customer support for the project is lacking.

At the present time, public housing customers cannot keep their savings. If the "experiments" in heating savings-based projects in Banská Bystrica and Malacky show the value of energy cost savings incentive to customers, it is expected that the law will change.

Industry can keep its savings; and, therefore, benefit from performance contracting.

Accessible revenue stream. There also must be a revenue stream that can be accessed; or a way to establish some financial structure so the ESCO can be paid.

> The industry revenue stream can be easily accessed. In the public housing sector this is not possible.

Creditworthiness. The potential customer must be able to exhibit a degree of creditworthiness as well as financial or organizational stability.

> Foreign ownership in Slovakian companies is surprisingly high and often adds to organization stability. Creditworthiness must be checked carefully on a case by case basis. In some instances, where customers have the present ability to honor financial obligations but have a weak credit history, shared savings, which allows the ESCO to carry most or all of the credit burden, may be a viable alternative.

Management commitment. In addition, experience has shown that successful projects require that top management demonstrate a commitment to the project and that there be some commitment in middle management as well as facility and process supervisors.

> The limited application of economic analysis of energy efficiency in Slovakia will require special education/selling for top management. Extra effort will be required if they are to fully appreciate the financial benefits of performance contracting as well as the permanent financial loss when energy work is delayed.

O&M staff. O&M personnel are especially critical to project implementation and long term success. Their attitudes, level of manpower and technical capabilities must be carefully assessed.

> The skills and abilities of Slovakian operations and maintenance personnel is reportedly high, but some training will be necessary. As in any nation, ESCOs will need to do case by case assessments.

Building and equipment conditions. The condition and longevity of the building and its equipment must be weighed. Current function patterns and the likelihood that they will persist in the same fashion must be taken into account.

> Slovakian infrastructure and buildings are frequently in need of major upgrades. Even relatively new equipment may be technologically "outdated" and inefficient. Performance contracting can help meet this critical need, but care must be taken to be sure existing energy-related equipment will function as needed, and to ascertain that the facilities warrant the required investment.

Customer accessibility. The ESCO must judge the geographical and logistical accessibility of a given enterprise, and the extent to which this causes an administrative burden. This burden must then be weighed against the economic opportunity.

Major needs and opportunities exist in urban centers, but many smaller towns may not offer economically feasible opportunities.

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SECTION 3. ECONOMIC, POLITICAL AND FINANCIAL CONDITIONS GERMANE TO ENERGY PERFORMANCE CONTRACTING

Performance contracting by its nature extends over several years and carries with it many uncertainties. Energy service companies (ESCOs) and their financiers invest heavily at the beginning of energy performance contracts. To have a viable project, they must have some assurance that they will get that money back out -- and show a profit for their efforts. When performance contracting is contemplated in transitional economies, the very nature of performance contracting (its dependence on recovering energy cost savings over time) requires that factors, such as political and financial stability of the country, must be carefully weighed. To the extent that the ESCOs, or the financing source, are foreign, then the convertability of the currency and the ability to repatriate the funds are also key.

The first part of this section presents factors related to the broad political, economic and financial stability of Slovakia. It is designed to help both domestic and foreign ESCOs as well as policy-makers, who would like to foster a Slovakian ESCO industry, consider these conditions. This section concludes with a discussion of business issues, which can directly affect the growth of an ESCO industry in Slovakia.

The economic/political status is presented as of March 1995. Some trends key to performance contracting are also offered.

MACROECONOMIC AND POLITICAL INDICATORS

Due to its historical association with the Czech Republic (CR) as well as its geographical proximity to CR, there has been a tendency to continuously compare the Czech and Slovak Republics. This comparison has tended to overlook the positive economic aspects of Slovakia. When the Slovak Republic is compared with the broader spectrum of transition economies, Slovakia is clearly one of the better performing economies in Central and Eastern Europe.

Macroeconomic indicators such as GDP per capita show Slovakia outperforming Poland. Only Hungary and the Czech Republic have higher GDP per capita in the reforming countries. There is, however, major differences within the Slovak Republic regarding the share of the GDP. In 1993, Bratislava carried a disproportionate 33 percent, while Košice had the next highest GDP share with only 6 percent.

Slovakia also has a very low rate of foreign indebtedness. The country's gross foreign per capita debt was USD 597 in 1994, which was the lowest in Eastern Europe.

A study of Slovakian economy by the Austrian banks notes that "...turbulence on the foreign exchange front after separation also seems to have calmed down a bit and the Slovak Republic slowly seems to be making progress toward real growth."[1]

Of concern is the high unemployment rate and the budget deficit of over 6% GDP in 1993, which surpassed the 5 percent level agreed upon with the IMF. Real interest rates were actually negative during the 1990-93 transition process, and capital flight continues to be a problem as savings from internal investors frequently flow out of the country.

As Slovakia exercised its democratic status to vote governments in and out of power, there have been frequent changes in regimes. These changes work to reflect public preferences. However, they also tend to slow economic growth, as changes in administration and administrative policies can temporarily paralyze economic development.

Fall elections in 1994 returned the coalition headed by Vladimír Mečiar to power. While the Mečiar government has been characterized as "left leaning," desires to trade with the west as well as aspirations for the country to be a member of the EU has prompted a focus on a market economy. A March 1995 issue of The Slovak Spectator carried a heading "Slovak Diplomacy Shines in EU Negotiations" and showed Prime Minister Mečiar's willingness (pictured below) to hear out diplomats, such as EU delegate Ján Lišuch (TSAR photo).

Since April, 1993, SR has been a full-fledged member of GATT, which makes it possible for Slovakia to be actively involved in the creation and application of agreed upon preferences. It also assumes an obligation to observe GATT rules in international trade.

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[1] The Slovak Republic, After One year of Independence, Bank Austria, Vienna 1994, pp.11-12.

PRIVATIZATION AND PRIVATE SECTOR GROWTH

Privatization is being carried out based on two acts:

- the so-called Small-scale Privatization Act (the Act no. 427/1990 Coll. on the Transfer of Certain State-owned Property to Other Legal and Natural Persons as amended by subsequent legislation);
- the so-called Large-scale Privatization Act (the Act no. 92/1991 Coll. on the Conditions of Transfer of State-owned Property to Other Persons, as amended by subsequent legislation)

The most significant changes in the Slovak economy concerns ownership structures. By the end of 1992, over 64 percent of Slovak enterprises were privately held. Another 9 percent were in cooperatives and 13 percent were owned by foreign an international organization. Only 12 percent remained as state-owned facilities. The 64 percent represented a jump of nearly 17 percent in private ownership over the preceding year. While some of the growth can be attributed to new enterprises, this increase primarily reflects the move from state and public ownership and the success of the first wave of large scale privatization.

The methods of privatization have been condensed and reported by the Slovak Chamber of Commerce and Industry:

a) Standard methods

1. Direct sale to a predetermined owner -- used mainly in selling very small enterprises when a buyer offers a good price to purchase a business;
2. Public auction -- employed in those cases when the price is the most important consideration in privatization;
3. Public tender -- since rules for carrying out a tender are set, this is the most expedient method to ensure accountability in privatization.

b) Non-standard methods

Voucher privatization -- This is a supplementary method of privatization. The first wave of privatization has already taken place. During this wave, an emphasis was placed on voucher privatization. In the second wave of privatization, stress will be put on standard methods of privatization in order to speed up the process.

Standard methods will be employed in privatizing the following:

- the property of an entity subject to privatization;
- the shares of joint-stock companies, and ownership titles of limited liability companies founded by the National Property Fund of SR through investments made in the property of state-owned companies;
- participation by the state in business activities of other legal persons.

The privatization of state farms and farm mechanization plants is envisaged. In the event that they are transformed into joint-stock companies and the Slovak Land Fund becomes their shareholder, the property to be privatized may be transferred to the Land Fund.

A foreign person may take part in some of the standard forms of privatization (direct sale to a predetermined interested party, public auction, and public tender), by submitting a privatization project, either directly or in cooperation with a resident entity.[2]

For foreign ESCOs considering work in Slovakia, it is important to note the needed involvement of a resident entity.

Those industries with the greatest 1993 exports were in descending order metal processing, machines and tools, chemicals, cars, mineral materials, rubber, paper and pulp, and electronics. Of these, machines and tools (-0.09), cars (0.04), and paper and pulp (-0.04) industries had a negative profit/cost ratio. The fact that these industries were not operating at a profit raises some doubt as to their future potential. The highest profit to cost among the exporters was in water, gas and electric supply industry at +0.23.

KEY FINANCIAL ISSUES AFFECTING THE GROWTH OF AN ESCO INDUSTRY IN SLOVAKIA

The Bank Austria report, "The Slovak Republic After One Year of Independence," further analyzed the situation, noting, "The deficit on the current account was covered by an active capital account of USD 404.0 millon in 1993. Long-term capital transfers of USD 0.9 billion were the most important item on the capital account. Credits taken accounted for USD 0.6 billion in 1993. Back payments of credits amounted to 0.4 billion. Direct investment and portfolio investment were only USD 0.4 billion."[3]

In addition to the general economic indicators discussed above, certain financial issues can affect the ability of a broad-based ESCO industry to grow. Some financial factors are relatively favorable for the creation of an ESCO industry; however, other conditions suggest it will probably take several years to foster any wide-spread industry.

Monetary policy. The Slovak monetary policy has some restrictive aspects, which have been motivated by the goal of price-level stability. To some extent this somewhat restrictive policy

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[2] JUDr. Ing. Pavol Kopál. Slovak Republic -- Your Business Partner, Slovak Chamber of Commerce and Industry, Bratislava 1993, pp. 59.

[3] Op. Cit. Bank Austria, p. 23.

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has been counter-balanced by the liberalization of foreign trade and the financial sector, as well as the advent of new small-scale enterprises and a sharp increase in the velocity of money due to privatization.

Inflation. The Slovak Republic has shown a strong stabilization of its inflation from 61 percent in 1991 to 12-13 percent in 1994. A jump to 23 percent in 1993 was clearly influenced by the imposition of the VAT, which was 6 percent on most foods and services, and 25 percent on all other goods.

Discount rates. The Slovak National Bank's discount rate was decreased to 11 percent in March, 1995. Interest rates on savings accounts varied between 6 percent and 9 percent all through 1992 and reached 12 percent in 1993. A comparison of discount rate and interest rates reveals the real interest rate was negative through the reform process and remained low into 1994.

Banking industry. The banking system is comprised of the National Bank of Slovakia, commercial banks, and banking/financial institutions. NBS is the issuing bank and is charged with maintaining a stable currency and coordinating interbank payments and clearing. There were 28 banks in Slovakia as of January 1, 1994, which included three state banks, four banks with state majority participation, three banks with price majority participation, eight with foreign capital participation and ten branches of foreign banks. The main foreign investor is Austria.

The General Credit bank (VUB) the Investment and Development Bank (IRB) and the Slovak State Savings Bank are considered the most important banks in Slovakia. The author of the report met with IRB officials during the fact finding mission and found the bank to be very interested in performance contracting, especially for some of its own creditworthy customers. The bank indicated such loans could exceed five years and could be offered as low as 16 percent.

The health of the banking sector is shown in the Table 3-1 balance sheet.

RELATED FINANCIAL ISSUES

Slovakian energy savings are typically measured in reduced gigajoules; not Slovak crowns (SK). This is based on a misconception rooted in the idea that physical units of output are the standard by which energy savings benefits should be measured, and from which all other analyses of benefits should flow.

This misconception has very real consequences; particularly for performance contracting, which is primarily a financial transaction.

TABLE 3-1. SLOVAK FINANCIAL SECTOR BALANCE SHEET
SKK billion

Assets	1992	1993	Liabilities	1992	1993
I. Net foreign assets	-3.6	-.05	I. Liquid money (M2)	214.2	253.2
1. Foreign assets in convertible currencies	24.4	45.3	1. Money (M1)	108.2	116.3
2. Foreign liabilities in foreign currencies	28.0	45.8	Currency	30.9	25.1
II. Net domestic assets	217.9	253.7	Sight deposits	77.2	91.2
1. Domestic credits	278.0	337.4	from households	26.5	31.3
Net credit to government	40.5	65.9	from enterprises	50.0	58.8
Net credit to National Property Fund	0.4	6.9	from insurance co.	0.8	1.0
Total credit	237.2	264.6	2. Quasi money	106.2	136.8
to enterprises	215.3	237.5	Time and saving deposits	92.8	108.3
to households	19.8	18.6	households	72.9	82.1
in foreign currency	2.1	8.5	enterprises	5.0	11.8
2. Other items net	60.1	83.7	insurance cos.	14.9	14.4
			foreign currency deposits	13.4	28.5
			households	11.1	29.1
			enterprises	2.4	4.4

Source: National Bank of Slovakia

A failure to take into account the financial savings and the time value of money when making analyses of competing investments creates inaccurate comparisons. Two examples revealed during the fact finding mission illustrate the point. (1) At the Energy Research Institute (EGU) considerable time was spent with the Director, Mr. Jozef Sellej, and Mr. Peter Šesták, who did much of the work and report preparation for the Handlova project. In comparing the relative savings benefits of various options, the time value of money was not considered. Payback parameters were apparently not a factor. (2) A report prepared in 1994 by the EC Energy Centre, "Energy Sector of Slovakia," provides valuable data on consumption in PJ, GWh, etc., but no mention is made of the cost or the potential SK savings. The title page does note, "Description based on information from official Slovak bodies;" so it is possible the monetary data were not available.

Finally, the most indicative, surprising and even disturbing example of the failure to grasp the potential of energy savings in monetary terms rather than joules, was the lack of information on the country's energy bill. We could not find out from the officials with whom we met the country's total energy bill for 1994. If the energy burden is not quantified in crowns, there is little appreciation for the economic impact regarding the importation of 75

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percent of Slovakia's primary energy. Nor, is there the needed focus on the benefits of energy efficiency.

Energy efficiency needs to be regarded as an investment; a cost-effective investment. In transitional economies where the demands are great and the economy is tight, energy efficiency must compete with other investments, even jobs. The absence of energy saving cost/benefit analyses works against a true realization of the value of energy efficiency. When performance contracting project benefits are calculated, the time required to recover the investment makes this a critical issue.

SOURCES OF FUNDS

SLOVAKIAN COMMERCIAL BANKS

There appears to be limited money available from commercial banks for energy performance contracting (EPC). The representatives of the IRB indicated the bank would look favorably on funding EPC projects as an additional service to its credit worthy customers. Loans are available for five years or more. An interest rate of 16 percent will require ESCOs to consider only short payback items.

SLOVAK-AMERICAN ENTERPRISE FUND

The Fund expressed a strong interest in helping to foster an ESCO industry in the Slovak Republic. Support is available for the creation of the business itself and might also be available for project financing. The Fund typically takes an equity position in the new business entity, which it supports, and hopes for a relatively early buyout.

MINISTRY OF ENVIRONMENT

The Director of the Branch for the Ministry of Environment displayed an excellent understanding of the relationship of energy efficiency and environmental protection. He described a new fund, which would include energy efficiency.[4] He indicated the fund has been under development for some time and that it is ready to go forward if the support and approval from other sections of the Ministry can be secured.

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[4] Mr. Belovič, Director of the Branch, Ministry of Environment, In interview, march 1995.

MULTINATIONAL DEVELOPMENT BANKS (MDBs)

MDBs are active in Slovakia. The World Bank and the European Bank of Reconstruction and Development (EBRD) are offering support for energy efficiency. While the EBRD is in discussions with the utility to aid in its DSM efforts, it is not clear whether funds being made available will extend to performance contracting.

Pool Financing. The multi-national development banks (MDBs) have historically loaned sums of money in larger amounts than the amounts needed for energy efficiency projects. This is gradually changing and many MDBs are actively searching for ways to assist countries with energy efficiency efforts. The idea of creating a pool of funds to support a large number of smaller energy efficiency projects is growing.

Such accommodation could leverage MDB money since a third party guarantees the funds will be paid back; thus, making a revolving fund possible. This procedure could offer rates and terms favorable to the ESCO industry, which would stimulate the development of an ESCO business within Slovakia, benefit the Slovak Republic's competitiveness and improve its environment.

SLOVAKIAN GOVERNMENT SUPPORT

The government of the Slovak Republic through its State Energy Inspection (SEI) office is supporting the experimental projects in Banská Bystrica and Malacky, which are designed to demonstrate the value of guaranteed energy savings in heating. Case studies of these two projects are presented in Appendix B. If the project results have the anticipated positive results, it is hoped that the experiments will foster legislation that would allow organizations to keep their savings; thus, paving the way for performance contracting for heating in the public sector. There seemed to be general agreement among government officials interviewed that these projects have value and similar projects in other market sectors and projects involving electricity should be done. Several of the interviewees voiced the desire to have the planned legislation cover electrical savings as well.

DOING BUSINESS IN SLOVAKIA

Transitional economies by definition mean changes of ownership, unstable economic conditions, and short-term planning. Fitting long-term performance contracting in such a context requires special consideration and caution for ESCOs. Some modifications are obvious, such as adjusting the concept of "long term" into a shorter time frame.

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The Slovak Chamber of Commerce and Industry has available a booklet, Slovak Republic - - Your Business Partner, prepared by JUDr. Ing. Pavol Kopál in 1993 that provides clear descriptions and legal citings for most business issues an ESCO might need. Topics include the legislative framework for business activity, the tax system and concessions, depreciation policy, exchange control, foreign trade, labor relations, privatization and bankruptcy provision. It is available from the Chamber.

Several interviewees expressed concern about the absence of contract law. Further exploration revealed that contract law exists, but this perception, by itself, can act as a deterrent.

ESCO ACTIVITY IN SLOVAKIA

Other than the two experimental projects at Banská Bystrica and Malacky, very little ESCO activity is taking place. Landis & Gyr has an active interest in pursuing the performance contracting and the other control manufacturers, Honeywell and Johnson Controls, are giving it careful consideration. Energy Performance Services, which has the performance contracting projects in the Czech Republic, is carefully evaluating the opportunities in Slovakia and may open an office in the Slovak Republic.

The Austrian company, ÖkoPlan, has expressed an interest in developing some performance contracting projects in Slovakia. One of the electrical distributors, ZSE, is in the process of setting up a guaranteed savings project. The nation-wide utility, SE, declared its interest in becoming an ESCO.

Interest is growing. The conditions that would facilitate the growth of an ESCO industry are improving.

ENERGY EFFICIENCY MEASURES

Measures being recommended and implemented have been constrained by the relatively low price of energy. The measures being considered by the emerging Slovak ESCOs are usually short term measures; e.g., heat flow meters, simple controls and heat exchangers. Some maintenance/quick fix measures, are also attractive.

Among the larger measures mentioned by interviewees were:

- boiler upgrades
- new boilers
- energy efficient motor replacement
- steam trimming
- meters

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- heat exchangers
- controls
- weatherstripping

The cost-effectiveness of these measures and others must, of course, be determined on a site by site basis.

Foreign ESCOs must guard against making assumptions based on experiences in other countries. Lighting, for example, may not be nearly as cost-effective as an energy saving measure because the lights are turned off with constant dedication and lamps are comparatively expensive.

Projects that incorporate cogeneration with energy efficiency may be attractive in certain industrial markets and geographical areas.

POTENTIAL MARKETS

Identifying specific market sectors can cause ESCOs to overlook individual opportunities in other sectors. Conversely, there is a tendency to view the whole market as a strong opportunity when an organization within that market could be weak. Every market requires careful due diligence on a site by site basis. With these caveats in mind, there are several markets worthy of further investigation.

Caution, however, is warranted. With the exception of the chemical industry, Slovakian industry is heavily dependent on imports from and deliveries to the Czech Republic. Most Slovak industries have a high dependence on imports. In examining industrial markets, which in Slovakia are very heterogeneous, it is important to recognize that some segments of the market have different profitability profiles. For example, the fertilizers segment of the chemical industry is profitable and quite competitive.

Many Slovakian products are also sensitive to import restrictions in industrial nations.

Industries warranting consideration include:

chemicals
metal production
clothiers
furniture
wood
leather processing, especially shoes
rubber

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Industries in Slovakia face considerable structural change within the next few years. While this makes performance contracting even more attractive to owners, ESCOs must carefully weigh the longevity of the building and its processing equipment as well as the energy consuming equipment that will remain.

Until public facilities (which is housing in Slovakia not schools or hospitals, unless physically connected to the housing) are charged a higher rate for electricity, they will not good candidates.

ECONOMIC, POLITICAL, FINANCIAL DETERRENTS TO BROAD ESCO INDUSTRY AND PROPOSED RESOLUTION

3-1. Interest rates - While more favorable than some of its neighbors' interest rates, the rates in the Slovak Republic are still too high to encourage the implementation of any measures with longer term paybacks. Longer payback items are critically needed for major upgrades, better savings persistence and greater environmental benefits.

Resolution: Encourage the use of multinational development bank (MDB) financing or environmental funds to buy down the rates where appropriate. Through performance contracting, this will then have the effect of leveraging the financing available and better serve Slovakia's industrial needs. Pool financing, which spreads the risks and makes smaller loans possible should also be considered.

Tax laws and potential concessions should be examined to be sure they are equitable. Second, Slovakia should determine if some offsetting incentives, such as corporate income tax holidays, can be offered to energy service companies as an inducement to bring their expertise to Slovakia.

3-2. Convertibility. ESCOs and investors from other countries must be assured that they will be able to get payments and/or money out of the country. (Internal convertibility does not appear to be a problem.)

Resolution: Steps need to be taken to achieve external convertibility as soon as possible. Greater international recognition of the country's increasing economic stability would help.

3-3. The money side of energy. In evaluating the benefits of energy efficiency or in making savings calculations the financial gains are typically overlooked. Slovakia's financial planners do not seem to be fully aware of the economic implications of the nation's energy bill or the burden the government carries through its indirect energy support.

Resolution: A data base enabling economic analysis of energy use should be developed. Government financial planners and decision-makers need to: (1) be more conscious of the economic impacts of artificially low, subsidized energy prices; (2) the government's share of the cost of energy; (3) and its burden to the Slovakian economy; and (4) how current procedures impact the nation's ability to meet other needs.

Education and training of the money side of energy should be offered energy planners, energy service and energy efficiency financing providers.

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3-4. Legal issues - The relative common conception that there is an absence of contract law could prove to be a deterrent to energy performance contracting.

Resolution: Some effort by the government and the legal community to overcome this perception is needed for all contracting procedures. ESCOs, which might serve Slovakia, must be made aware that the "no contract law" perception is false.

3-5. Economic restructuring efforts - AID and others have many projects going forward to address economic concerns. Some of these could effectively embrace energy efficiency concerns and benefits.

Resolution: Review AID and MDB efforts in Slovakia. Consider where energy efficiency issues, concerns and benefits might be incorporated. Examine the reports of the "International Conference on Financing Energy Efficiency Projects in Central & Eastern Europe and in the Commonwealth of Independent States" held in Budapest on 13-14 October, 1994. Items on the agenda particularly germane to this report and this specific issue were:

> Financing Energy Efficiency Projects within the Framework of the UN ECE Energy Efficiency 2000 (ENERGY/WP.4/AC.3/R.1 and R.2);
>
> Multilateral Financing Mechanisms for Energy Efficiency Projects in Central and Eastern Europe and the Confederation of Independent States (CIS);
>
> Bilateral Financing Programmes for Energy Efficiency Projects in Central and Eastern Europe and in the CIS; and
>
> The Role of International Financial Institutions, International Banks, Banking Consortia and National Commercial Banks in Financing Energy Efficiency Projects in Central and Eastern Europe and the CIS.[4]

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[4] Two reports were produced as a result of this meeting, Manual on Financial Engineering: Sources of Financing for Energy Efficiency Projects, and Manual on Business Planning: How to Construct a Business Plan for Energy Efficiency Projects. Both are available from the Economic Commission for Europe, United Nations, Geneva.

SECTION 4. SLOVAKIA'S ENERGY SITUATION

To fully analyze the energy situation in Slovakia, it is necessary to first recognize that the independent Slovak Republic was established only two years ago. An assessment of the energy situation and its economic implications must also consider the previous development within the Czech and Slovak Federal Republic (CSFR), or Czechoslovakia.

The industrialization of Slovakia began after World War II when the CSFR was established in 1918. Under a command-and-control economy, efficient operations, particularly energy efficiency operations, were not a consideration. Much of the industrial development was heavy industry; e.g., building materials, iron and nonferrous metals, chemical plants, etc. as well as crude oil processing and paper/pulp production. Most of the energy for these plants was imported and prices were subsidized by the state.

Slovakia, therefore, inherited high energy consumption in much of its industry. In 1990, immediately following the velvet revolution, 54 percent of the final energy consumption went to industry. By the end of 1991, country-wide consumption had dropped by 2 percent but industry had dropped by 17 percent and had reduced its share of total Slovakian energy consumption to 49 percent. Nevertheless, in 1994 Slovakian industry was still characterized as energy inefficient and industry's share was back over 50 percent. The industrial sector continues to offer a logical target for performance contracting, particularly as the country seeks to become more internationally competitive. 61 percent of the coal consumption (brown and imported cooky coal) is used by industry, with power and metallurgy plants consuming over 80 percent of this.

Slovakia is largely dependent on fuel imports; so increased energy efficiency will also favorably impact its balance of trade. Only 25 percent of the primary sources is provided by domestic production. Figure 4-1 depicts the proportion of imports by fuel.

The brown coal is imported from the CR and cooky coal from Ukraine. Crude oil and gas are imported from Russia.

Approximately 600 PJ is used just for conversion. The level of conversion efficiency is low (66%) compared to the west.

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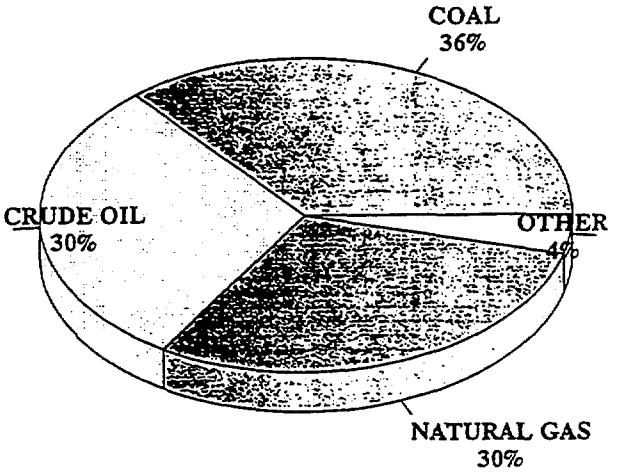
Domestic production relies heavily on nuclear power and to a lesser extent on hydro generation. The hydro capacity is about 29 percent of installed power. Even though the Ministry of Finance notes this is Slovakia's cheapest fuel, the produced electricity from hydro is well below its capacity; as it is presently used mostly as peak power.



Source: Energy Sector of Slovakia, EC Energy Centre, 1994

FIGURE 4-1. PERCENTAGES OF FUEL IMPORTED 1992

ELECTRICITY

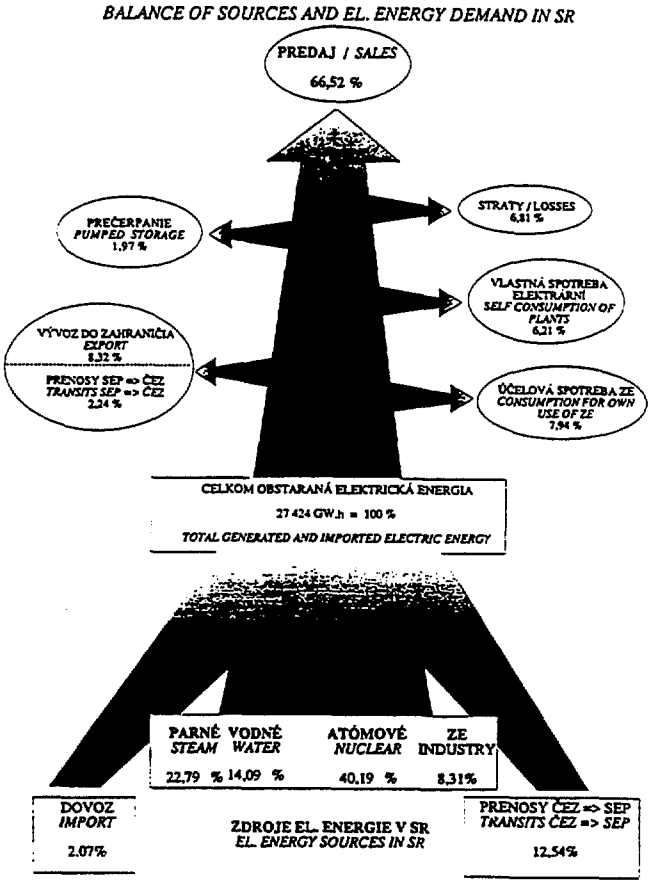


Figure 4-2 depicts the electrical sources and demand as presented in the Slovenské Elektrárne (SE) 1993 annual report.

FIGURE 4-2.

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DSM. SE has had a policy of supporting demand-side management (DSM) since 1992 and is working actively with British Columbia Hydro's Power Smart people to implement it. SE and Power Smart are seeking funding from EBRD for some of the DSM measures.

Figures 4-3 and 4-4, provided by the SE Advisory Center for DSM show the high intensity and low intensity options for electricity use and capacity savings being considered by SE.

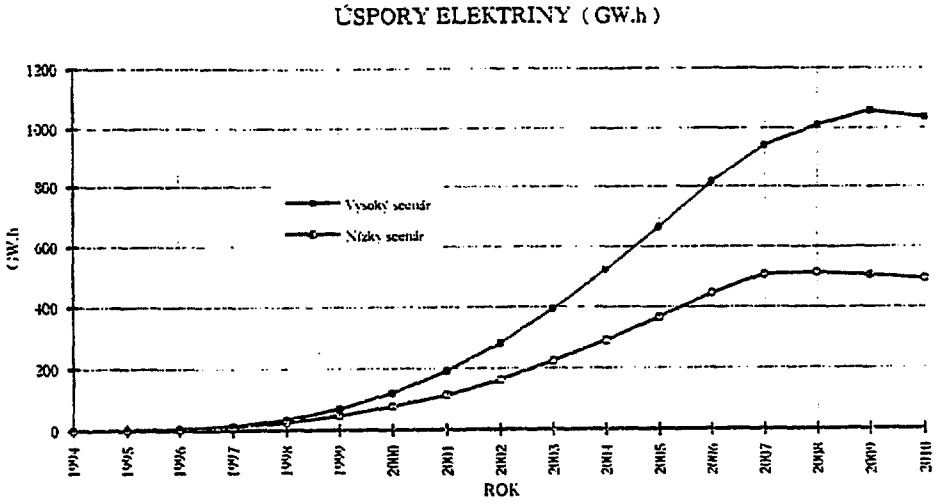

FIGURE 4-3.

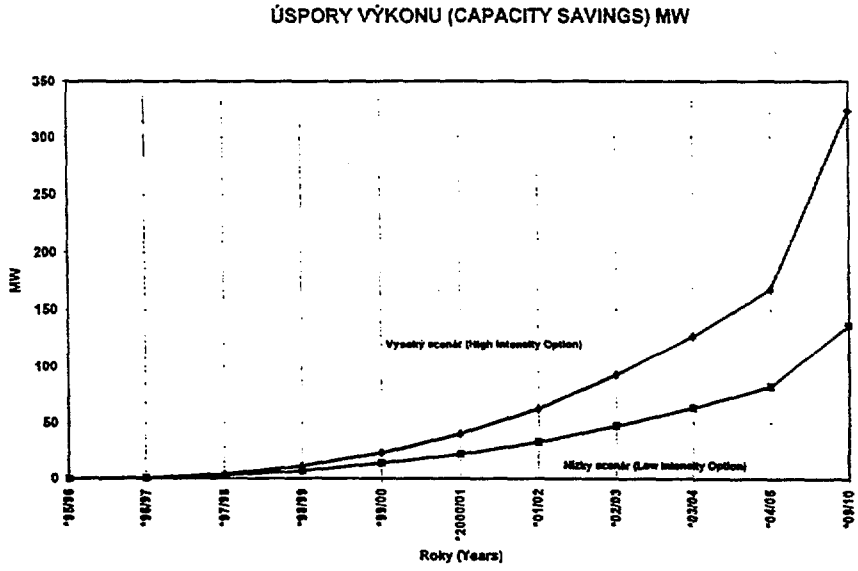

FIGURE 4-4.

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Of particular interest to ESCOs, who are considering cogeneration, is the SE balance chart for 1993 electricity. As shown in Figure 4-5, of the 27,406 GWh total resources only 18,242 GWh reach the customers; i.e., losses of the three distributors are not included in these figures.

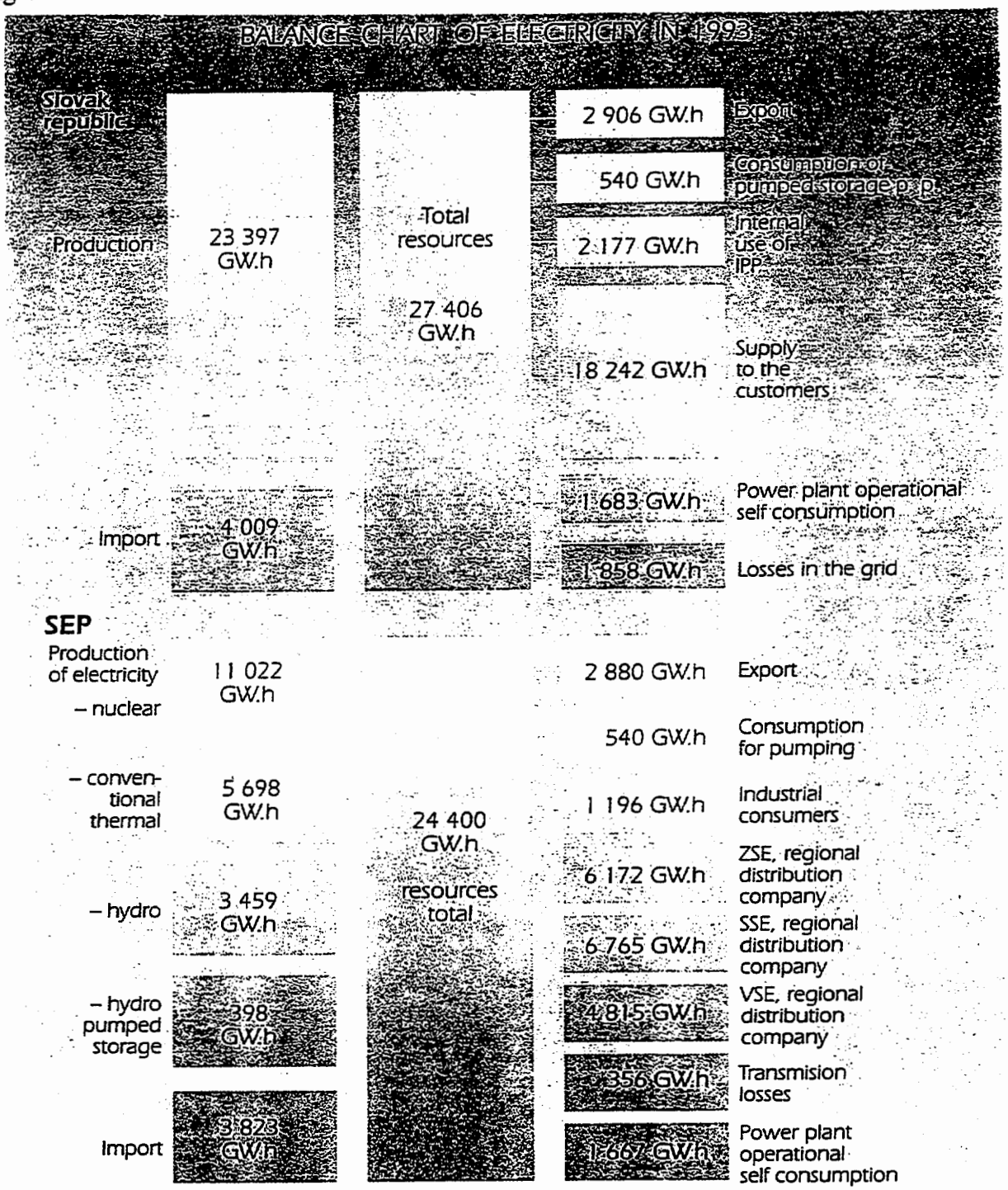

FIGURE 4-5.

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Transmission. SE also operates the transmission network. The transmission networks of 440kV and 220kV. Figure 4-6 offers a schematic of the transmission network as well as the import/export volume in GWh to the CR, Hungary and Ukraine.

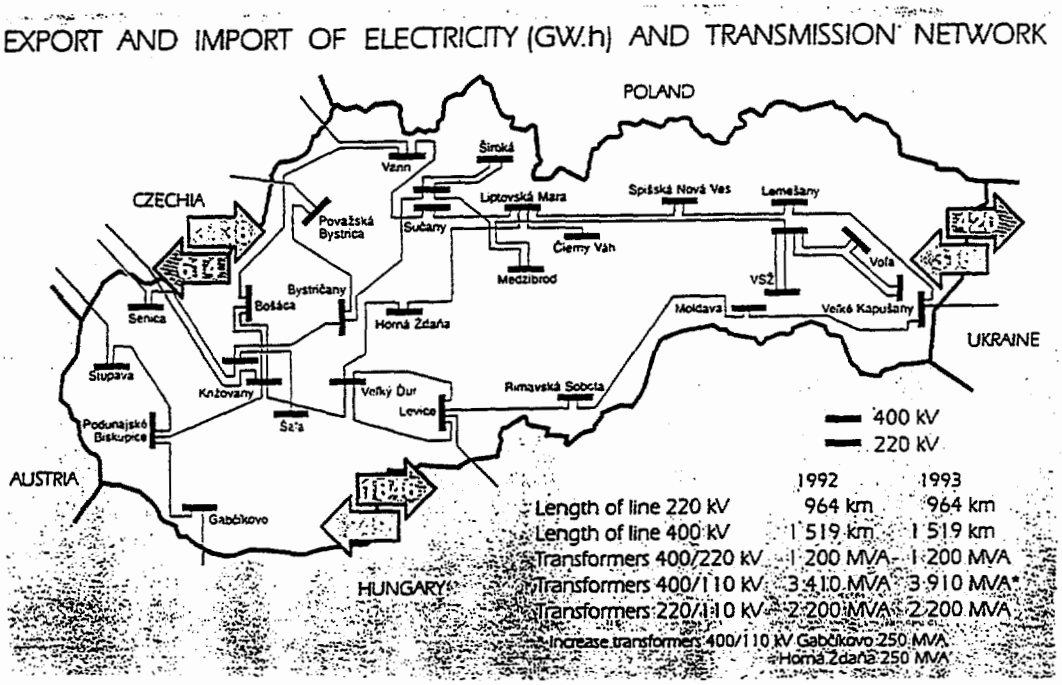

FIGURE 4-6.

Distributors. SE sells directly to four industries and three distributing companies; Západoslovenské energetické závody (ZSE [west] Bratislava); Stredoslovenské energetické závody (SSE [central], Zilina); and Východoslovenské energetické závody (VSE [east], Košice).

While the distributors secure 86 to 95 percent of their power from SE, they also purchase power from industrial companies, generate some of their own power (ZSE and SSE) and ZSE imports 166,310 MWh high voltage power. Total sources for each distributor in 1993 were:

ZSE - 6,758,809 MWh;
SSE - 7,757,276 MWh; and
VSE - 5,087,432 MWh.

Peak load profile for each distribution company by month and combined for the years 1990-93 are shown in Figure 4-7. While demand has dropped, the peak capacity needs are in the winter. The distributors describe their capacity as "limited."

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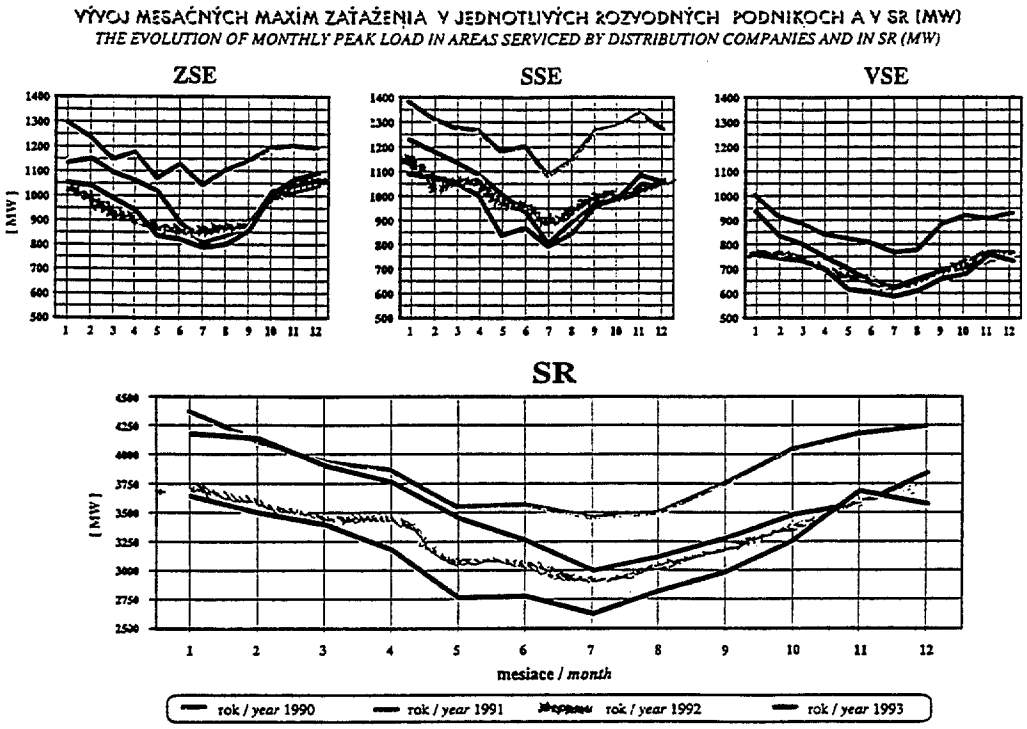
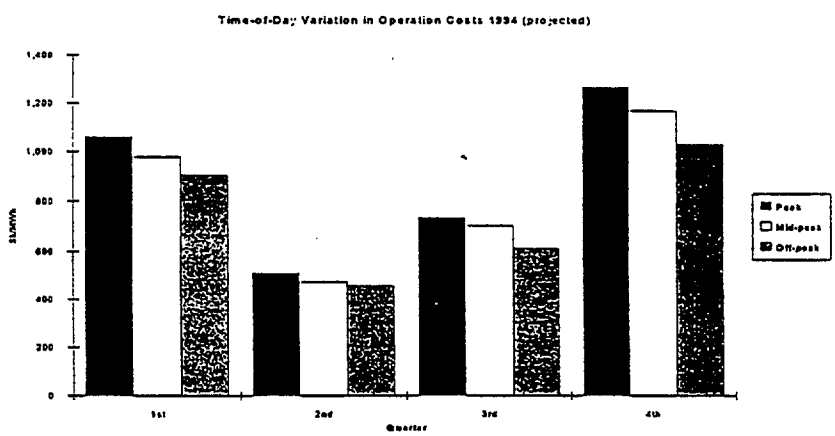


FIGURE 4-7.

ESCO opportunities for industrial energy efficiency and cogeneration costs are influenced by time-of-day figures. Figure 4-8 presents the projected generation costs for each quarter by time-of-day as presented in the USAID electric pricing and tariff study.



Electricity Pricing and Tariff Study

FIGURE 4-8.

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The distributors pay more for the power plus distribution than they receive in revenues for the power sold to the "public." ("Public" does not include most schools, hospitals and government buildings and typically refers to residential housing). They are, therefore, very supportive of performance contracting in this residential market. In fact, ZSE is initiating some guaranteed energy saving projects in its area.

Energy efficiency in the commercial and industrial sector could cause distributors to lose money; so the support of performance contracting in these sectors is tempered. Representatives of the distributors did point out that with capacity being limited, energy efficiency measures could make it possible to serve additional customers with the same quantity. They would, therefore, gain revenue from more flat (hook up) charges from the additional customers for the same quantity sold.

Pricing. The price of energy is set by the Ministry of Finance. The last energy price increase was in 1993, when a 6 percent VAT was applied.

SE sells to distributors at approximately SK 0.98/kWh. The Ministry of Finance reported that SE currently makes a 65 percent profit on the electrical power it sells.

Currently, the selling price "wholesale" (industrial) is SK 1.534/kWh (US$ 0.05/kWh). The average price to the public is SK 0.906/kWh (US$ 0.03/kWh).

The Ministry has proposed to raise prices to the public by 10 percent in 1995 and 15 percent in 1996. No price increases are scheduled for industry.

At present, there is no plan to adjust the tariff system to compensate distributors for lost revenues due to energy efficiency, or to move toward integrated resource planning. These issues have been overshadowed by needed resources in the near future, concerns that the new nuclear plant may not be finished and that imports may have to be increased

HEATING

The 44 PJ consumed in 1993 came from state power, heat plants and from industrial plants. By fuel source, 50 percent is brown or hard coal, 35 percent is gas and 15 percent crude oil.

Figure 4-9 depicts the sources of heat, end use consumption and process losses.

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BALANCE CHART OF HEAT – SEP

Production				Consumption
nuclear p. p.	EBO 503 TJ			
	Mochovce 92 TJ		4 812 TJ	industrial and comercial consumers
	Novaky 3 325 TJ	Total resources 11 238 TJ		
conventional thermal p. p.	Vojany 240 TJ		4 385 TJ	residential consumers
	Košice 6 929 TJ			
			1 007 TJ	operational self consumption
Purchase from other firms	149 TJ		1 034 TJ	Losses

Source: SE

FIGURE 4-9.

The district heating is supplied primarily to Slovakian cities. District heating carries the burden of old plants that urgently need reconstruction. The economic viability of this reconstruction is compromised by pricing problems, production and supply concerns as well as technical problems related to measurement of consumption, losses in production and transport, and the need for insulation. District heating plants are mostly urban and usually owned by the city or town. A few are owned by cooperatives or by a distributor with cogeneration.

End use patterns and the trend to reduce heat consumption is shown in Figure 4-10.

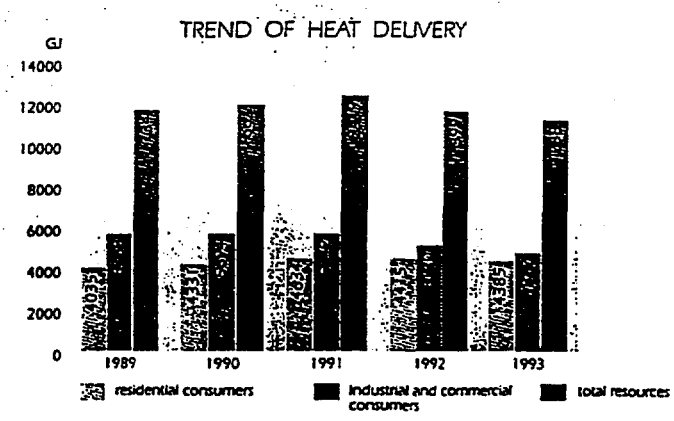

FIGURE 4-10.

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The Director of Price Policy for the Ministry of Finance, expressed concern that space heating for the public sector is over-sized by 50 percent. She indicated that just "exchanging technology" would not be enough, and that upgrading must be done.[6]

Prices

Heating prices vary from SK 160/GJ to SK 570/GJ depending on the producer's ability and cost to generate the heat. It is the Ministry of Finance's responsibility to correct pricing so it equals the production costs, but a spokesperson for the Ministry declared, "It's not easy." Problems include the irregularities in boiler houses.

The Director of Price Policy appears to be very sensitive to end-users problems in non-insulated buildings. To insulate these buildings would cost about SK 60,000/apartment (USD 2,000). For the users, this is very expensive and for the state "impossible."

Since 1993, end-users have had two options of payment: 1) by the square meter of floor space; or 2) by metered consumption. About 60 percent of the district heating is measured by family units in multi-family housing. The intent was to have housing fully metered by the end of 1995, but the costs have presented problems. In many instances, the process also requires a hydraulic balance of the heating system at each apartment, which adds to the cost.

The state provides SK 2.4 billion/year (USD 80 million/year) in subsidies for heating.

DETERRENTS TO AN ESCO INDUSTRY RELATED TO SLOVAKIA'S ENERGY SITUATION; POSSIBLE RESOLUTIONS

4-1. Electric energy prices. Prices have been held low in the public sector; so there has been little inducement to use energy more efficiently. At the distributor level, loses in the public sector are covered by fees from industry. This works against the competitive position of Slovak industry.

Increased prices in the residential area would permit larger investments by ESCO, enabling them to offer more facility upgrades and more environmental benefits.

Resolution: The Slovakian government has expressed the intention of raising prices to the public by 10 percent in 1995 and 15 percent in 1996. These increases should

[6] Mrs. Bónová, Director of Price Policy, Ministry of Finance, In interview, March 1995.

be encouraged, but it should be noted that the price to the public after these increases will still not equal the current costs to distributors.

Industry, the Slovak economy, and unemployment would all benefit if industry did not have to cover distributor losses. An additional increase to the public in 1997, which would at least reach distributor costs should be seriously considered, with industry exeriencing a corresponding relief in its tariff.

4-2. Metering heating consumption. Only if there is a direct relationship between the amount of heating energy consumed and the amount paid will there be the needed incentive to the end-users to conserve. Performance contracting requires metered consumption to calculate savings.

Resolution: Slovakia's desire to get facilities on independent meters should be encouraged. The possibility that ESCOs could provide such metering as part of an energy saving package should be explored. (Small ESCOs in Poland are experiencing a 15 percent savings by changing consumers from "floor space" payments to metered payments.)

4-3. Distributor's revenue losses from energy efficiency. At present, any industrial energy savings will cut revenue and reduce distributors' ability to cover losses in public sales.

Resolution: Efforts to implement DSM at the utility level should consider the distributor's needs and adjust tariffs accordingly. If the utility's current profit margin is as high as reported (65 percent), it should be is sufficient to make some accommodation.

4-4. Lack of awareness of the economic value of energy efficiency. The focus at present is on increased production and/or more energy imports to meet future energy needs. There is little awareness of the economic value of energy efficiency, or its value to offset increased production/imports. The inability of many energy decision-makers we interviewed to cite the country's energy bill, or even the annual cost of energy imports reveals a major factor underlying this problem.

Resolution: Energy planners should be provided an economic analysis of energy production, importation and use in Slovakia -- in crowns. The return on investment (ROI) of certain energy efficiency measures should be included in this analysis.

A good place to start applying financial analyses is the energy efficiency projects in progress. The results of the two experiments at Banská Bystrica and Malacky should be reported in crowns invested, crowns saved and the cost-effectiveness of the project. Economic analyses should accompany any further analysis and implementation of the Handlova project.

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SECTION 5. OVERVIEW OF PERFORMANCE CONTRACTING POTENTIAL

CONCLUSIONS & RECOMMENDATIONS

The potential to save energy in Slovakia is great. Energy intensity is double that of most areas of the world. The country's industrial sector carries a heavy energy burden. 75 percent of Slovakia's energy is imported; so any moves to greater energy efficiency will help the economy, the trade balance, create jobs and make companies more competitive. As with any transitional economy, money to support energy efficiency is difficult to find. Opportunities for and potential benefits from energy performance contracting are great.

Interest rates ranging from 16 to 20 percent, inflation rates at 12 percent and limitations on available commercial financing, however, are deterrents. The incorporation of environmental funds in project financing can help these financing problems. Environmental funds for energy efficiency purposes, however, are limited and the new fund from the Ministry of Environment is not yet approved. Without the environment funds domestic ESCOs, foreign ESCOs or joint venture combinations are, with few exceptions, confined to relying on short payback measures. Relying solely on short payback measures negatively affects project profitability, savings persistence and environmental benefits. The incorporation of environmental funds or funds from multinational development banks into project financing could have a mitigating effect on these financing problems.

The current procedures for setting tariffs/prices do not encourage ESCO activity in the public sector. In the meantime, ESCO actions in Slovakia may focus on the industrial sector.

The government sponsored demonstration projects in Banská Bystrica & Malacky, growing activity among domestic and foreign ESCOs all offer positive signs of an industry ready to grow very rapidly. The industry is not yet established. A broad-based industry is probably two to three years away. Those who want to influence industry development and be in on the "ground floor" should give serious consideration to establishing a presence in the Slovak market now. The future should be attractive to ESCOs; however, only ESCOs with the financial resources to fund the costs of developing the market can afford to invest in the market place at this early stage. Any reprieve from this long-term planning agenda would appear to be in the use of multi-national development bank funds.

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RECOMMENDATIONS

1. Encourage economic/monetary analysis of energy resources, needs, use and energy efficiency opportunities. Apply market economy return on investment analyses to the projects in Handlova, Banská Bystrica and Malacky.

2. Extend the government sponsored guaranteed savings experiments in heating in the housing sector to electricity usage and add other markets. Use financial analysis in these projects, too.

3. Provide technical assistance and performance contracting guidance to the emerging Slovakian ESCO market through

   - offering special training sessions for engineers, prospective ESCOs, financiers, and the legal profession
   - encouraging U.S. ESCO involvement
   - fostering the partnership of experienced ESCOs with in-country partners in prime/sub or joint venture relationships
   - presenting seminars, conferences for decision - makers
   - providing business guidance through in-country consultation or documents, particularly in costing projects and the time value of money
   - Train engineers, who can now perform energy audits, to do the analysis and calculations required by ESCOs
   - providing special training in energy efficiency practices for operations and maintenance (O&M) personnel; probably through training O&M supervisors to train their people.

3. Encourage the implementation of an environmental funding program, which will support energy efficiency in Slovakia.

4. Elicit the support of multi-national development banks and other funding sources to augment or ameliorate the present financial constraints. Provide a grant to Slovakian bank(s) to buy down interest rates, which could leverage relatively small sums into larger economically attractive financing sources.

   To fit typical MDB size loans to energy efficiency needs, MDBs should be encouraged to consider pool financing for groups of buildings or, commercial bank management of a pool to fund a series of loans for smaller projects.

5. Continue technical support to the banks and government in developing procedures that will most effectively support energy efficiency and performance contracting in Slovakia. Encourage longer term loans and the use of predicted energy savings as collateral.

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6. Encourage the government to undertake the comprehensive collection of energy data, which includes energy cost information and develop a nation-wide data base.

8. Help the leadership realize that energy efficiency is a sector free problem and the responsibilities extend far beyond the energy sector itself.

9. Assess the utility's current procedures and its tariff structure, and restructure as appropriate so that no entity in the power sector suffers unduly from energy efficiency and demand-side management procedures.

10. Accelerate the privatization process; so transitional organizations can more readily access ESCO assistance.

11. Give strong support to the government's plan to increase energy prices. Offer guidance so that government officials can more easily recognize the value of energy efficiency and performance contracting in significantly reducing the social and economic dislocation caused by these price increase.

12. Prepare clearly defined procedures and guidance documents, which will enable ESCOs to secure their money within a project; provide for unimpeded opportunities to get money from recalcitrant customers; prepare bankable projects to get funding from commercial banks; and allow clear recovery of invested funds and profits as warranted.

13. Examine the range of AID and MDB efforts in Slovakia and determine where energy efficiency issues, concerns and benefits might be incorporated in these on-going programs.

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APPENDICES

APPENDIX A

Slovakia Interviewees and Handout

APPENDIX A

Slovakia Interviewees

SLOVAKIA INTERVIEWEES
MARCH 1995

Energy Measurement and Services, Ltd.
Marian Rutšek - General Manager

USAID
Loren Schulze
Martin Brunovský

State Energy Inspection - Energy Agency
Juraj Šecko - General Director
Miroslav Kučera - Director

Ministry of Economy
Szitás - Head of Energy Section
Štefan Herich, Head of Department

Vupex, J.S. Co.
Štefan Raninec - Director

European Bank (EBRD)
Egbert Johrens - Senior Banker, Power/Energy Utilities

Landis & Gyr Slovakia
Milan Bartoš - Director

European Communities Energy Center (ECEC) Bratislava
Michael Wild - Director

Slovak Power Plants, Inc. + Power Smart Inc.
Ján Dohňanský - Head of Department, Consulting and Advisory Centre
Pavel Šimko, SE Energy Advisor
Eugénia Maderová, SE Energy Advisor
Dušan Berka, Power Smart
Don McPherson, Power Smart

Association of Energy Mangers (ASENEM)
Ivan Bobák - President
Miroslav Kucera, SEI
Jozef Sabaj, President of Orgrez

Central Slovak Power plants (SSE) and West Slovak Power plants (ZSE)
Pavel Simko and Eugénia Maderová of SE
Ján Jurík, Jozef Križan and Mr. Ciemarie of ZSE
Jozef Podola of SSE

Slovak Gas Industry (SPP)
Peter Kovac, Head of Technical Policy Department
Daniela Bolgacova, Technical Rationalization

Slovak Chamber of Commerce and Industry (SOPK)
L'ubomír Hanus - Director, Department of International Relations

Ministry of Economy
Ivana Rapantová - Director of PHARE program
Jean-Pierre Escribe, PHARE

Ministry of Finance
Mrs. Bónová - Director of Price Policy

Antimonopoly Office
Dušan Valo - Director

Applied Precision
Mikulás Bobik
Ladislav Grno

Schubert & Partners, Law Offices
Stanislav Schubert
Ivan Piterka

Slovak - American Enterprise Fund
Iveta Griačová - Assistant to the President

Energy Research Institute (EGÚ)
Jozef Šellej - Director
Peter Šesták, Program Manager

UEOS Komercia, Inc. (potential ESCO)
Miroslav Vallo - Director
Slavomir Surkoš - Technical Director

Investment and Development Bank (IRB)
Norman Polednak - Manager, Correspondent Banking & International Business Dept.
Ján Hirner - Risk Analysis

Ministry of Environment
Vladimír Belovič - Director of Branch

PERFORMANCE CONTRACTING: POTENTIAL MULTI-LEVEL BENEFITS IN SLOVAKIA

Performance contracting enables a country to enhance its economy and its environment and to do so out of funds now spent on wasted energy. In the process, performance contracting offers exciting business opportunities for the in-country energy service industry and clear advantages for the ultimate recipient, the customer.

WHAT PERFORMANCE CONTRACTING IS

Performance contracting allows the customer, e.g., a school, hospital, state agency, commercial business or industry to use *future* energy savings to upgrade facilities and cut operating costs *now*. The energy service company (ESCO) identifies energy saving opportunities in the customer's building, equipment and/or industrial processes. The ESCO implements those measures approved by the owner at no initial cost to the owner, maintains the measures for the life of the contract and guarantees the energy savings.

PERFORMANCE CONTRACTING: COUNTRY BENEFITS

When performance contracting is implemented in a country in cooperation with an energy service company (ESCO), a number of benefits are available to the country. Included in these opportunities, performance contracting can:

- reduce the country's reliance on external energy resources, and reduce the associated negative impact on balance of trade;
- offer all market sectors an opportunity to upgrade facilities using current and future monies now spent on wasted energy;
- improve the economy by cutting operating/production costs and increasing the country's economic competitiveness;
- allow increased industrialization without concomitant increases in utility generating capacity;

- increase employment while reducing the needed capitalization for the same quantity of energy; i.e., a recent study of Russian conditions showed that making available the same amount of energy through energy efficiency creates five (5) times as many jobs as producing this energy with only one-eighth the capital investment;

- improve the environment without incurring the costs usually associated with such efforts. In fact, energy efficiency through performance contracting can significantly reduce pollution emissions, such as SO_x and NO_x, while it "makes" money;

- help create a local energy service industry. Using successful ESCOs in prime/sub or joint venture in-country partners has already proved to be an excellent means of technology transfer while creating additional businesses and employment opportunities in the developing country.

PERFORMANCE CONTRACTING: BUSINESS PERSPECTIVE

Performance contracting started in Europe, has become refined in the United States and Canada and is now widely accepted in both countries by the federal governments, states, institutions, businesses and industry. From a business perspective, its popularity is largely due to the opportunities it offers a firm to:

- sell to customers who have no money;

- serve existing customers better;

- increase business -- at low incremental cost;

- make more money selling savings and service [reduce production costs; increase profit];

- create jobs [energy efficiency vs. production];

- demonstrate confidence in products and service;

- hold down energy costs;

- reduce environmental damage; and

- increase the company's competitiveness.

Energy efficiency is essentially environmentally benign. It is a very cost-effective way to reduce air pollution.

In-Country Partners

An in-country partner as a joint venture or subcontractor is critical to an effective project for an external energy service company (ESCO).

The ideal in-country partner is a design/build "mechanical contractor," who has heating, ventilation, air conditioning (HVAC), electrical and other related turnkey capabilities, along with experienced project managers to manage the implementation of the projects on a national basis. It is also important that such a partner have good political connections to enhance marketing efforts and to expedite contract negotiations with large institutional and commercial customers. Such a partner would also need to have experience in the procurement of equipment on an import basis in order to access the current technologies available for energy conservation outside of the country.

The benefits to such a partner are substantial from a short-term financial perspective and long-term growth. Offering performance contracting services to its existing customers would allow the partner to provide improved customer relations and expanded services which include installing major capital improvements in the customer's facilities at no initial cost. Pursuing performance contracting would allow the partner to posture itself into a long-term leadership role by providing its customers with new innovative services, which neither the company nor its competition have previously provided.

From a financial perspective, performance contracting provides a significant positive cash flow benefit to the partner's existing company by creating a substantial amount of incremental business to such a company without requiring any additional overhead. This incremental business not only comes from "old" customers, but comes from a "new" customer base, which has a primary need for performance-based contract services.

A third major benefit to the partner, which translates to a financial benefit, is the fact that no additional fixed resources will have to be obtained in order to implement the performance contracting program. An existing external ESCO will provide all support and resources necessary including technical personnel, legal contracts, marketing and performance contracting procedures and methodology to ensure that the program is properly implemented and that project performance risks are mitigated. The savings guarantee requires that the ESCO meet a certain performance standard; hence the name, performance contracting.

SERVICES BY THE ESCO INCLUDE:

- energy audit to identify energy and operational savings opportunities;
- financing arrangements;
- the purchase, installation and maintenance of the installed energy efficient equipment; possibly maintenance on all energy consuming equipment;
- new equipment training of operations and maintenance (O&M) personnel;
- training of O&M personnel in energy efficient practices;
- monitoring of the operations and energy savings, so reduced energy consumption and operating costs persist; and
- a guarantee of the energy savings to be achieved.

PERFORMANCE CONTRACTING: CUSTOMER ADVANTAGES

The in-country recipient of these services can achieve many business/organizational benefits, including:

- an immediate upgrade of facilities and reduced operating costs -- without any initial investment by the owner;
- access to the ESCO's energy efficiency expertise. Through savings guarantees, ESCOs have learned from experience just how effective specific energy conservation measures are under certain conditions and how soon they can pay for themselves.
- positive cash flow. (The measures usually generate savings that exceed the guarantee.);
- the opportunity to use the money that would have been used for upgrades to meet other needs;
- improved and more energy efficient operations and maintenance;
- risks normally incurred by customer are absorbed by the ESCO, including the guaranteed performance of the new equipment for the life of the contract (not just through a warranty period);
- a more comfortable, productive environment; and
- all the services are paid for with the money the customer would have paid the utilities for wasted energy.

Performance contracting is probably the best and quickest way to be sure an organization is operating as efficiently as possible. It offers the customer a risk shedding opportunity. The only true risks to the customer are finding the right ESCO partner and obtaining a contract that best meets the customer's needs. The performance contracting industry has matured in several industrialized nations and the customer can now satisfy these concerns with very little difficulty.

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APPENDIX B

Case Studies

CASE STUDIES

The government of the Slovak Republic has supported two "experiments" in the use of energy savings. Below is a brief description of each.

MALACKY EXPERIMENT

In an agreement with Compagnie General de Chavfte (CGC) - Termotech Ltd., the Malacky project was started on June 1, 1994. This project, scheduled for 15 years, is designed to renovate, operate, maintain and lease equipment for the heating system in Malacky. According to the agreement, the experiment should demonstrate various possibilities for improving energy efficiency in space heating, domestic hot water, heat metering, and global efficiency of energy sources. The result should be a reduction of costs for the delivered heat.

CGC-Termotech Ltd. and the State Energy Inspection (SEI) have signed another agreement to verify the savings up to May 30, 1997.

In order to implement the experiment, the Ministry of Finance and the Ministry of Economy agreed to exempt Malacky from some existing laws.

BANSKÁ BYSTRICA EXPERIMENT

In November, 1994 an agreement was signed between Infratec Ltd. (Austria) and BPM Ltd. (Banská Bystrica). This agreement provided for the running of the heat energy sources in Banská Bystrica from May 1, 1995. The project is scheduled to run for five years and the loan is expected to be repaid from the savings. The project covers 106 heat energy sources with distribution systems. The total investment of SK 150 million will finance the heat metering in buildings, provide for control systems, and renovate the boiler houses. The project guarantees savings of 10.5 million cubic feet of natural gas per year.

The Ministry of Finance and the Ministry of Economy also exempted this project from some existing laws.

APPENDIX C

A Brief Summary of Conditions Relevant to Prospective Slovakian ESCOs

PERFORMANCE CONTRACTING CONCERNS AND OPPORTUNITIES IN SLOVAKIA

OVERVIEW OF PERFORMANCE CONTRACTING POTENTIAL

The potential for an energy service company (ESCO) industry in the Slovak Republic is unfolding. Slovakia imports approximately 75 percent of its energy. Having inherited a heavy historical energy intensity burden, particularly in industry, opportunities to help Slovakia economically are great.

Relatively modest interest rates (16-20 percent) and inflation rates (12 percent) as well as existing banking conditions, however, create limited barriers. The incorporation of environmental funds in project financing can have a mitigating effect on these financing problems. Environmental funds for energy efficiency purposes, however, are limited and will not support a broad based move of the ESCO industry into Slovakia at this time. Without the environment funds, domestic ESCOs and foreign ESCOs, or joint venture combinations are, with few exceptions, confined to using short payback measures. This necessary reliance on short paybacks negatively affects project profitability, savings persistence and environmental benefits.

The current procedures for setting tariffs/prices in the industrial sector do not encourage ESCO activity. Conversely, the distributors can profit from energy efficiency in the housing sector where prices are below cost, but electricity prices are too low to attract ESCO activity and housing is unable to keep heating savings.

The growing activity by domestic and foreign ESCOs gives all the signs of an industry ready to grow. Procedures and practices are not yet established. A broad-based industry is probably two to three years away. The future should be attractive, however, only ESCOs with the financial resources to fund the costs of developing the market and surviving some lean years can afford to invest very much in the market place at this early stage. Any help in the near term would appear to be in the use of multi-national development bank funds or environmental funds.

In an industry used to long sales cycles and slow market development, the trends are encouraging. For U.S. ESCOs seeking an international presence the search for in-country partners and potential markets should soon begin.

SUPPORTING THE ESCO MARKET

Those who seek to foster a market economy, energy efficiency and environmental improvements in the Slovak republic, can gain much by supporting the creation of an ESCO industry. Industry guidance, however, is critically needed. Conditions are good

for a fledgling ESCO industry in Slovakia to go through some of the painful mistake-ridden growth processes experienced in the United States unless technical assistance is offered to help ESCOs move beyond avoidable difficulties. Technological transfer can be accomplished most effectively through encouraging experienced ESCOs to develop joint ventures or sub-contract with in-country partners. Further training, particularly in performance contracting risk assessment and developing project financial/legal structures to manage those risks, would benefit energy service and financing provider relationships.

The reader is cautioned that the observations offer only a "March 1995 snapshot" of a rapidly evolving situation. The treatment of these key elements is followed by a discussion of issues ESCOs should consider if they wish to do business in Slovakia. This discussion includes the types of measures that are most apt to be implemented in immediate projects, the current status of the Slovak Republic's ESCO industry and specific market potential. This section concludes with recommendations based on the research findings that have been presented in the research report.

KEY INSTITUTIONAL AND ECONOMIC ELEMENTS

For ease of analysis and reference, the elements are grouped by economic and political elements at the national level, energy and environmental elements and customer elements.

NATIONAL POLITICAL AND ECONOMIC ELEMENTS

Political stability - With the change in administration in 1994, questions regarding economic changes also emerge. As of March 1995, the new socialist-led government had not shown any significant changes in privatization plans. The political situation was relatively stable and some major economic indicators were fairly positive.

Financial stability - In many respects, Slovakia appears to be close to plan with its financial strategy. The 1994 Austrian bank report characterizes the country as relatively stable. The interest and inflation rate trends are good. Banking has not reached the sophistication of the West, but terms and conditions are gradually improving. The growth and stability of domestic banking is crucial to long-term growth of a broad-based ESCO industry in Slovakia.

Monetary factors - Duties, taxes and other monetary factors need careful assessment by ESCOs. The Slovak koruna (or crown) is not fully convertible. Inside-country convertibility when accompanied by the appropriate documentation; e.g., an invoice, reportedly does not pose a problem.

Monetary policy. The Slovak monetary policy has some restrictive aspects, which have been motivated by the goal of price-level stability. To some extent this somewhat restrictive policy has been counter-balanced by the liberalization of foreign trade and the financial sector, as well as the advent of new small-scale enterprises and a sharp increase in the velocity of money due to privatization.

Inflation. The Slovak Republic has shown a strong stabilization of its inflation from 61 percent in 1991 to 12-13 percent in 1994. A jump to 23 percent in 1993 was clearly influenced by the imposition of the VAT, which was 6 percent on most foods and services, and 25 percent on all other goods.

Discount rates. The Slovak National Bank's discount rate was decreased to 11 percent in March, 1995. Interest rates on savings accounts varied between 6 percent and 9 percent all through 1992 and reached 12 percent in 1993. An assessment of discount rates reveals the real interest rate was negative through the reform process and remained low into 1994.

Banking industry. The banking system is comprised of the National Bank of Slovakia, commercial banks, and banking/financial institutions. NBS is the issuing bank and is charged with maintaining a stable currency and coordinating interbank payments and clearing. There were 28 banks in Slovakia as of January 1, 1994, which included three state banks, four banks with state majority participation, three banks with price majority participation, eight with foreign capital participation and ten branches of foreign banks. The main foreign investor is Austria.

The General Credit Bank (VUB) the Investment and Development Bank (IRB) and the Slovak State Savings Bank are considered the most important banks in Slovakia. The author of the report met with IRB officials during the fact finding mission and found the bank to be very interested in performance contracting, especially for some of its own creditworthy customers. The bank indicated such loans could exceed five years and could be offered as low as 16 percent.

Legal issues - All the essential elements of performance contracting appear to be legally permissible. Attorneys inside the government and in private practice indicated that prime/subcontracting, joint ventures and the principles of performance contracting all meet Slovakian law.

Several interviewees expressed concern about the absence of Slovak contract law, but further exploration revealed legal provisions comparable to those in the Czech Republic, where EPC is in place.

Certain privatization and foreign company procedures require the involvement of a "resident entity."

ENERGY AND ENVIRONMENTAL ELEMENTS

Energy - Slovakia's industries consume a major amount of energy/GDP. Approximately 75% of the Slovak Republic's energy is imported.

The power sector - The structure of the power sector; i.e., generation, transmission and distribution as separate entities; how tariffs and energy prices are set; and how they are controlled influence the utility's position toward energy efficiency and associated revenues. If a utility stands to lose revenues, it is apt to resist energy efficiency. This, in turn, can impact the profitability of any ESCO activity.

> Slovenské Elektrárne (SE), the national electric utility, adopted the concept of demand-side management in 1992 and has worked closely with Power Smart. With the restructuring of the power sector in 1994, SE became a joint stock company. SE is considering becoming an ESCO.
>
> SE sells electricity to 3 distributors and 4 industries. Due to rate structures, the distributors have an incentive to support energy efficiency in public housing, but not in industry.

An ESCO industry that can be supported by the utilities will grow more readily. The status of demand-side management (as the term is used in the United States) and the opportunity for integrated resource planning are important indicators as to the degree to which the utilities are apt to facilitate performance contracting.

> A change in tariff strategy that would reward each organization in the power sector for supporting energy efficiency is key to achieving the maximum Slovakian energy and environmental benefits.

CUSTOMER ELEMENTS

Savings potential - Every sector of the economy has strong energy savings potential; energy cost saving potential is, and will continue to be, affected by government price controls.

Incentive - The public sector has very little in-house economic incentives to save energy; e.g., housing, because they cannot keep the savings and prices are very low. The need for facility upgrades/comfort concerns are considered by many to be sufficient incentives to garner in-house cooperation and support for facilities, such as hospitals.

Credit worthiness, financial and organizational stability - While there is a growing number of privatized firms and state organizations with strong organizational stability, this area must be researched on a case-by-case basis.

Management commitment - As always, ESCOs must assess each organization, but the general eagerness to move to a market economy and to upgrade facilities without any upfront cost will help. Energy costs are a key factor for industrial management in considering operating costs and in improving competitive position.

Facility conditions - While some new construction has taken place in recent years, most of the buildings are old and many are in desperate need of upgrades. Even relatively recent upgrades; i.e., within the last five years, may have old technology and are not necessarily energy efficient. This constitutes and inducement for performance contracting for the owners and a sales opportunity for ESCOs; however, performance contractors must carefully access the buildings' longevity and mechanical conditions to see if the situation warrants the measures being considered. HVAC controls, for example, may appear to be a viable measure, but old boilers may not be in a condition to duty cycle -- or much else. Paybacks for boiler work may go beyond the limits of current financial parameters, which could then rule out the potential control work.

O&M personnel - Skilled O&M manpower may be in short supply. In many instances, ESCOs will need to supplement existing manpower. Energy efficiency capabilities are limited; training will be essential in almost every case.

General attitude is good. O&M people know they have problems and will frequently share their frustrations about existing mechanicals in their buildings. The defensive attitude that frequently needs to be over-come in the United States is not prevalent.

Service needs - As with O&M needs, opportunities are extensive. Alarms, safety, etc. services can often be incorporated in projects that benefit the owner and could benefit the ESCO. Limits are usually set by what the savings package can carry under current economic conditions.

TECHNICAL ELEMENTS

In Slovakia, there is no need to separately address the individual areas of engineering/technical, financial and legal needs as they pertain to performance contracting. With a couple of minor exception, this is virgin territory in all areas. The needs are great. On the plus side, preconceived notions and wrong procedures do not have to be unlearned.

The legal, engineering and financial talent is there and willing to learn. Training seminars would offer valuable support to the growth of the ESCO industry.

ENVIRONMENTAL CONSIDERATIONS

In addition to advantages within Slovakia, ESCOs affiliated with utilities should be looking carefully at opportunities within the Clinton Administration's Climate Change Action Plan. Under The Climate Challenge provision, the Joint Implementation, or JI, program provides for partner companies overseas. Language under the Challenge also speaks to utilities making voluntary reductions. At this point, utilities may simply obtain a "good citizen of the world" standing or a public relations "green" spin-off from an otherwise viable project. Since we are gradually becoming aware of the global implications for anything that happens in a specific country, it could be a precursor to getting environmental credits, similar to the Clear Air Act provisions. If ESCOs can create a better, healthier environment for the people of the Slovak Republic -- and for all of us -- while making money, we all win.

DOING BUSINESS IN SLOVAKIA

Transitional economies by definition mean changes of ownership, unstable economic conditions, and short-term planning. Fitting long-term performance contracting in such a context requires special consideration and caution for ESCOs. Some modifications are obvious, such as changing the concept of "long term" into a shorter time frame.

The Slovak Chamber of Commerce and Industry has available a booklet, Slovak Republic -- Your Business Partner, prepared by JUDr. Ing. Pavol Kopál in 1993 that provides clear descriptions and legal citings for most business issues an ESCO might face. Topics include the legislative framework for business activity, the tax system and concessions, depreciation policy, exchange control, foreign trade, labor relations, privatization and bankruptcy provision. It is available from the Chamber in Bratislava.

CURRENT ESCO ACTIVITY IN SLOVAKIA

Other than the two experimental projects at Banská Bystrica and Malacky, very little ESCO activity is taking place. Landis & Gyr has an active interest in pursuing the performance contracting and the other control manufacturers, Honeywell and Johnson Controls, are giving it careful consideration. Energy Performance Services, which has the performance contracting projects in the Czech Republic, is carefully evaluating the opportunities in Slovakia and may open an office in the Slovak Republic.

The Austrian company, ÖkoPlan, has expressed an interest in developing some performance contracting projects in Slovakia. One of the electrical distributors, ZSE, is in the process of setting up a guaranteed savings project. The nation-wide utility, SE, has declared its interest in becoming an ESCO.

Interest is growing. The conditions that would facilitate the growth of an ESCO industry are improving.

ENERGY EFFICIENCY MEASURES

Measures being recommended and implemented have been constrained by the relatively low price of energy. The measures being considered by the emerging Slovak ESCOs are usually short term measures; e.g., heat flow meters, simple controls and heat exchangers. Some maintenance/quick fix measures, are also attractive.

Among the larger measures mentioned by interviewees were:

- boiler upgrades
- new boilers
- energy efficient motor replacement
- steam trimming
- meters
- heat exchangers
- controls
- weatherstripping

The cost-effectiveness of these measures and others must, of course, be determined on a site by site basis.

Foreign ESCOs must guard against making assumptions based on experiences in other countries. Lighting, for example, may not be nearly as cost-effective as an energy saving measure because the lights are turned off with constant dedication and lamps are comparatively expensive.

Projects that incorporate cogeneration with energy efficiency may be attractive in certain industrial markets and geographical areas.

POTENTIAL MARKETS

Identifying specific market sectors can cause ESCOs to overlook individual opportunities in other sectors. Conversely, there is a tendency to view the whole market as a strong opportunity when an organization within that market could be weak. Every market requires careful due diligence on a site by site basis. With these caveats in mind, there are several markets worthy of further investigation.

Caution, however, is warranted. Most Slovak industries have a high dependence on imports. With the exception of the chemical industry, Slovakian industry is heavily

dependent on imports from and deliveries to the Czech Republic. In examining industrial markets, which in Slovakia are very heterogeneous, it is important to recognize that some segments of the market have different profitability profiles. For example, the fertilizers segment of the chemical industry is profitable and quite competitive.

Many Slovakian products are also sensitive to import restrictions in industrial nations.

Industries warranting consideration include:

chemicals
metal production
clothiers
furniture
wood
leather processing, especially shoes
rubber

Industries in Slovakia face considerable structural change within the next few years. While this makes performance contracting even more attractive to owners, ESCOs must carefully weigh the longevity of the building and its processing equipment as well as the energy consuming equipment that will remain.

Until public facilities (which is housing in Slovakia not schools or hospitals, unless physically connected to the housing) are charged a higher rate for electricity, they will not good candidates.

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RECOMMENDATIONS OF SPECIAL INTEREST TO ESCOs

1. Provide technical assistance and performance contracting guidance to the emerging Slovakian ESCO market through

   - encouraging U.S. ESCO involvement
   - fostering the partnership of experienced ESCOs with in-country partners in prime/sub or joint venture relationships
   - presenting seminars, conferences for decision - makers
   - offering special training sessions for engineers, prospective ESCOs, financiers, and the legal profession
   - providing business guidance through in-country consultation or documents

2. Encourage the use of environmental funds to support energy efficiency in the Slovak Republic.

3. Elicit the support of multi-national development banks and other funding sources to augment or ameliorate the present financial constraints. Providing a grant to Slovakian banks to buy down interest rates, which could leverage relatively small sums into larger economically attractive financing sources.

4. Continue technical support to the banks and the government in developing procedures that will most effectively support energy efficiency and performance contracting in the Slovak Republic. Encourage the use of longer term loans; also predicted energy savings as collateral.

5. Develop a model to facilitate access to revenue streams for institutions, such as schools and hospitals, that currently have no way to retain energy savings.

APPENDIX D

A Representative List of U.S. ESCOs

NAME:	A&C Enercom Consultants	**YEAR INCORPORATED:**	
ADDRESS:	1797 Northeast Expressway Atlanta, GA 30329	**OTHER OFFICE LOCATIONS:**	AZ, CA, CT, FL, GA, IN, ME, MD, MA, MI, MN, NJ, NY, OH, OR, PA, TX, VT, WI
CONTACT:	Dean Alford, President		
PHONE: **FAX:**	(404) 633-9099 (404) 633-0994		
SERVICES OFFERED:	energy audits/planning agreement acquisition/installation project/construction management		training monitoring
GEOGRAPHICAL REGIONS:	National		
MARKETS PREFERRED:	public schools hospitals universities state government		utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $25,000 MAX: None		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan		shared savings bonds

NAME:	Central Hudson Enterprises	**YEAR INCORPORATED:**	1981
ADDRESS:	110 Main Street Poughkeepsie, NY 12601	**OTHER OFFICE LOCATIONS:**	
CONTACT:	Mark Hanhurst		
PHONE: **FAX:**	(914) 485-5770 (914) 485-5947		
SERVICES OFFERED:	energy audits/planning agreement engineering design acquisition/installation project/construction management commissioning		maintenance training monitoring savings verification savings guarantees
GEOGRAPHICAL REGIONS:	Northeast		
MARKETS PREFERRED:	public schools hospitals universities state government federal government		utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $800,000 MAX: None		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan		shared savings guaranteed lease guaranteed savings through 3rd party financing

NAME:	Citizens Conservation Corp.	**YEAR INCORPORATED:**	1981
ADDRESS:	530 Atlantic Ave. Boston, MA 02210	**OTHER OFFICE LOCATIONS:**	Springfield, MA San Francisco, CA
CONTACT:	Steve Morgan, Executive Dir.		
PHONE: **FAX:**	(617) 951-0470 (617) 338-8412		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management		maintenance training savings guarantees
GEOGRAPHICAL REGIONS:	National Ontario, Canada		
MARKETS PREFERRED:	utility/DSM multifamily, esp. public housing		
PROJECT SIZE LIMITS:	MIN: $100,000 MAX: $50,000,000		
FINANCING OFFERED/ARRANGED:	loan guaranteed savings through 3rd party financing		

NAME:	Energy Investment, Inc.	**YEAR INCORPORATED:**	1973
ADDRESS:	One Winthrop Square Boston, MA 02110-1276	**OTHER OFFICE LOCATIONS:**	Lodi, NJ Glastonbury, CT Indianapolis, IN Sunnyvale, CA Burbank, CA Burlington, VT Troy, NY Shorewood, WI
CONTACT:	Amy Gerber, Marketing Mgr.		
PHONE: **FAX:**	(617) 482-8228 (617) 482-3784		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning		maintenance training monitoring savings verification savings guarantees
GEOGRAPHICAL REGIONS:	National		
MARKETS PREFERRED:	public schools hospitals universities state government federal government		utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: case-by-case		
FINANCING OFFERED/ARRANGED:	lease loan guaranteed savings through 3rd party financing		shared savings

NAME:	Energy Masters Corp.	**YEAR INCORPORATED:**	1975
ADDRESS:	9101 West 110th Street Suite 200 Overland Park, KS 66210	**OTHER OFFICE LOCATIONS:**	Chicago, Dallas, Denver, Detroit, Los Angeles, Sacramento, San Francisco
CONTACT:	Donald O. Smith, Chairman and CEO		
PHONE: **FAX:**	(913) 469-5454 (913) 469-5343		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning		maintenance training monitoring savings verification savings guarantees
GEOGRAPHICAL REGIONS:	National Northeast Southeast North Central		South Central Southeast Pacific Northwest Canada
MARKETS PREFERRED:	public schools hospitals universities state government federal government		utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	**MIN:** $50,000 **MAX:** 10 Million		
FINANCING OFFERED/ARRANGED:	lease, municipal lease loan guaranteed savings through 3rd party financing		shared savings guaranteed lease

NAME:	Energy Performance Svcs.	**YEAR INCORPORATED:**	1992
ADDRESS:	300 Stevens Drive Suite 135 Philadelphia, PA 19113	**OTHER OFFICE LOCATIONS:**	Houston, Miami, Montreal, Omaha, Washington, DC
CONTACT:	Thomas K. Dreessen, CEO		
PHONE: **FAX:**	(215) 595-1095 (215) 595-1190		
SERVICES OFFERED:	energy audits/planning agreement engineering/design project/construction management performance guarantees		maintenance training
GEOGRAPHICAL REGIONS:	International		
MARKETS PREFERRED:	public schools hospitals universities state government		federal government non-profit commercial industrial
PROJECT SIZE LIMITS:	**MIN:** $1,000,000 **MAX:** $25,000,000		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan shared savings chauffage guaranteed lease		

NAME:	Enersave, Inc.	**YEAR INCORPORATED:**	1989
ADDRESS:	355 Lexington Ave. New York, NY 10017	**OTHER OFFICE LOCATIONS:**	NY, NJ
CONTACT:	William D. Machold, VP		
PHONE: **FAX:**	(212) 661-9494 (212) 661-9189		
SERVICES OFFERED:	energy audits/planning agreement engineering/design project/construction management maintenance financing		DSM program design & evaluation
GEOGRAPHICAL REGIONS:	NY, MI, PA, MA, VA, NC, SC, GA, FL, AL, TX, IL, OH		
MARKETS PREFERRED:	public schools hospitals universities commercial		
PROJECT SIZE LIMITS:	MIN: $50,000 MAX: $10,000,000		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan shared savings chauffage guaranteed lease		

NAME:	EUA Cogenex Corp.	**YEAR INCORPORATED:**	1983
ADDRESS:	Boott Mills South 100 Foot of John St. Lowell, MA 01852	**OTHER OFFICE LOCATIONS:**	Valley Cottage, NY Victor, NY Smithfield, RI Grand Rapids, MI El Dorado Hills, CA
CONTACT:	Sara Bogosian, Mgr. Marketing & Communications		
PHONE: **FAX:**	(508) 441-0090 (508) 441-9299		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning		maintenance training monitoring savings verification savings guarantees
GEOGRAPHICAL REGIONS:	National Canada		
MARKETS PREFERRED:	public schools hospitals universities state government federal government		utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $100,000 MAX: 5-8 Million		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan		shared savings paid-from-savings

NAME:	Financial Energy Mgmt.	**YEAR INCORPORATED:**	1984
ADDRESS:	1625 Downing St. Denver, CO 80218	**OTHER OFFICE LOCATIONS:**	N/A
CONTACT:	James C. Crossman		
PHONE: **FAX:**	(303) 832-1920 (303) 831-8221		
SERVICES OFFERED:	energy audits/planning agreement acquisition/installation project/construction management monitoring savings verification savings guarantees		
GEOGRAPHICAL REGIONS:	Rocky Mountain & California		
MARKETS PREFERRED:	hospitals universities state government federal government		utility/DSM commercial industrial
PROJECT SIZE LIMITS:	MIN: $25,000 MAX: $1,000,000		
FINANCING OFFERED/ARRANGED:	shared savings guaranteed lease		

NAME:	HEC, Inc.	**YEAR INCORPORATED:**	1990
ADDRESS:	24 Prime Parkway Natick, MA 01760	**OTHER OFFICE LOCATIONS:**	Simsbury, CT Williamsville, NY Chicago, IL Charleston, WV Millidgeville, GA Toronto, Canada
CONTACT:	H. Donald Burbank		
PHONE: **FAX:**	(508) 653-0456 (508) 653-0266		
SERVICES OFFERED:	energy audits/planning agreement engineering/design project/construction management commissioning		training monitoring savings verification savings guarantees
GEOGRAPHICAL REGIONS:	National Northeast Southeast North Central		South Central Southeast Pacific Northwest Canada
MARKETS PREFERRED:	public schools hospitals universities state government		utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $100,000 MAX: $10,000,000		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan		shared savings guaranteed lease guaranteed savings through 3rd party financing

NAME:	Honeywell, Inc.	**YEAR INCORPORATED:**	1886
ADDRESS:	MN12-5180 P.O. Box 524 Minneapolis, MN 55440	**OTHER OFFICE LOCATIONS:**	Nationwide
CONTACT:	Susan Engeleiter, V.P. Government Markets, Home & Building Control		
PHONE: **FAX:**	(612) 951-0182 (612) 951-0137		
SERVICES OFFERED:	energy audits/planning agreement engineering/design project/construction management		maintenance training financing
GEOGRAPHICAL REGIONS:	Nationwide		
MARKETS PREFERRED:	public schools hospitals universities state government		federal government utilities non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $		
FINANCING OFFERED/ARRANGED:	lease municipal lease shared savings guaranteed lease guaranteed savings through 3rd party financing		

NAME:	Johnson Controls, Inc.	**YEAR INCORPORATED:**	1885
ADDRESS:	507 E. Michigan Street P.O. Box 423 Milwaukee, WI 53201	**OTHER OFFICE LOCATIONS:**	Major Cities in US
CONTACT:	Paul von Paumgartten		
PHONE: **FAX:**	(414) 274-4732		
SERVICES OFFERED:	energy audits/planning agreement engineering/design construction maintenance		
GEOGRAPHICAL REGIONS:			
MARKETS PREFERRED:	public schools hospitals universities state government		federal government non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $25,000 MAX: None		
FINANCING OFFERED/ARRANGED:	lease municipal lease shared savings guaranteed lease guaranteed savings through 3rd party financing		

NAME:	KENETECH Energy Management, Inc.	**YEAR INCORPORATED:**	1985
ADDRESS:	15 New England Exec. Park Burlington, MA 01803	**OTHER OFFICE LOCATIONS:**	San Francisco, CA Trenton, MI Pearl River, NY Edison, NJ San Juan, PR Austin, TX Montreal, Quebec
CONTACT:	Patrick Scalli		
PHONE:	(617) 273-5894		
FAX:	(617) 273-1732		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning		maintenance training monitoring savings verification savings guarantees
GEOGRAPHICAL REGIONS:	National Canada		
MARKETS PREFERRED:	public schools hospitals universities		utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $ None MAX: $ None		
FINANCING OFFERED/ARRANGED:	lease municipal lease shared savings		guaranteed lease guaranteed savings through 3rd party financing

NAME:	Landis & Gyr Powers, Inc.	**YEAR INCORPORATED:**	1891
ADDRESS:	1000 Deerfield Parkway Buffalo Grove, IL 60089	**OTHER OFFICE LOCATIONS:**	U.S. and Canada
CONTACT:	Dan Greco		
PHONE:	(708) 215-1000		
FAX:	(708) 215-1093		
SERVICES OFFERED:	Energy Audits Engineering design project government construction		ongoing maintenance on-site energy plant & plant management training
GEOGRAPHICAL REGIONS:	Open		
MARKETS PREFERRED:	public schools hospitals universities state government		federal government non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $10,000 MAX: None		
FINANCING OFFERED/ARRANGED:	lease municipal lease shared savings guaranteed lease guaranteed savings through 3rd party financing		

NAME:	Onsite Energy	**YEAR INCORPORATED:**	1982
ADDRESS:	701 Palomar Airport Road Suite 200 Carlsbad, CA 92009	**OTHER OFFICE LOCATIONS:**	Sacramento, CA Tacoma, WA Reno, NV
CONTACT:	Frank J. Mazanec, VP Business Development		
PHONE: **FAX:**	(619) 931-2400 (619) 931-2405		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning		maintenance training monitoring savings verification savings guarantees financing
GEOGRAPHICAL REGIONS:	National		
MARKETS PREFERRED:	public schools hospitals universities state government		federal government utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $100,000 MAX: $10,000,000		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan shared savings		guaranteed lease guaranteed savings through 3rd party financing

NAME:	Proven Alternatives, Inc.	**YEAR INCORPORATED:**	1991
ADDRESS:	1740 Army Street San Francisco, CA 94124	**OTHER OFFICE LOCATIONS:**	San Francisco, CA Hawaii Milwaukee, WI Portland, OR Bellevue, WA Boston, MA Philadelphia, PA Washington, D.C.
CONTACT:	Richard Miller		
PHONE:	(415) 285-0800		
SERVICES OFFERED:	energy audits/planning agreement engineering/design verifications		maintenance construction
GEOGRAPHICAL REGIONS:	Northeast Mid-Atlantic Midwest East & West Coast		
MARKETS PREFERRED:	public schools hospitals universities state government		federal government utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $50,000 MAX: None		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan		shared savings guaranteed lease installment sale

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NAME:	Sycom Enterprises	**YEAR INCORPORATED:**	1986
ADDRESS:	109L Corp. Blvd. South Plainfield, NJ 07080	**OTHER OFFICE LOCATIONS:**	MD, DC, CA, WA
CONTACT:	Mr. S. Lynn Sutcliffe		
PHONE:	(908) 755-7733		
SERVICES OFFERED:	energy audits/planning agreement engineering/design project/construction management maintenance		
GEOGRAPHICAL REGIONS:			
MARKETS PREFERRED:	public schools hospitals universities state government		federal government non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $ N/A MAX: $ N/A		
FINANCING OFFERED/ARRANGED:	lease municipal lease shared savings guaranteed lease		

NAME:	Ventana Corporation	**YEAR INCORPORATED:**	1981
ADDRESS:	57 Commerce Drive Brookfield, CT 06804	**OTHER OFFICE LOCATIONS:**	Kensington, MD
CONTACT:	William E. Cratty		
PHONE: **FAX:**	(800) 995-1681 (203) 740-3066		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning maintenance		training monitoring savings verification savings guarantees tax exempt lease financing
GEOGRAPHICAL REGIONS:	Northeast Southeast		
MARKETS PREFERRED:	public schools hospitals universities state government non-profit commercial		
PROJECT SIZE LIMITS:	MIN: $100,000 MAX: None		
FINANCING OFFERED/ARRANGED:	lease municipal lease guaranteed savings through 3rd party financing		

NAME:	Viron Energy Services	**YEAR INCORPORATED:**	1974
ADDRESS:	216 NW Platte Valley Drive Kansas City, MO 64150	**OTHER OFFICE LOCATIONS:**	Michigan Ohio Illinois California
CONTACT:	George Diehl		
PHONE: **FAX:**	(800)-475-3500 (816) 746-0260		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning		maintenance training monitoring savings guarantees financing
GEOGRAPHICAL REGIONS:	National		
MARKETS PREFERRED:	public schools hospitals universities state government utility/DSM		
PROJECT SIZE LIMITS:	MIN: $100,000 MAX: None		
FINANCING OFFERED/ARRANGED:	shared savings guaranteed savings through 3rd party financing		

NAME:	Vision Impact Corp.	**YEAR INCORPORATED:**	1990
ADDRESS:	2970 Hartley Road Suite 204 Jacksonville, FL 32257	**OTHER OFFICE LOCATIONS:**	OH, NJ, PA, TX
CONTACT:	Russell W. Spitz		
PHONE: **FAX:**	(904) 262-6101 (904) 260-4515		
SERVICES OFFERED:	energy audits/planning agreement engineering/design acquisition/installation project/construction management commissioning		maintenance training monitoring savings verification savings guarantees
GEOGRAPHICAL REGIONS:	Northeast Southeast North Central		South Central Southeast
MARKETS PREFERRED:	public schools hospitals universities state government		federal government utility/DSM non-profit commercial industrial
PROJECT SIZE LIMITS:	MIN: $100,000 MAX: None		
FINANCING OFFERED/ARRANGED:	lease municipal lease loan shared savings		chauffage guaranteed lease guaranteed savings through 3rd party financing