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EVALUATION OF THE SHAKHTINSKAYA PRIVATE POWER PROJECT FOR INVESTMENT

VOLUME B
SHAKHTINSKAYA PROJECT

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Prepared for:

The Private Sector Energy Development Program and
The Russian Electric Sector Privatization and Restructuring Working Group
of the U.S. Agency for International Development

In Coordination with
RCG/Hagler, Bailly, Inc.

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TABLE OF CONTENTS

TABLES

FIGURES

1.0 Introduction

The Shakhtinskaya power project is the first of a series of plants within the service territory of the regional utility Rostovenergo that has been entrusted to Gasenergo for repowering. The site is located near the city of Rostov in the Northern Caucasus region in Southern Russia. Construction of the new 70 MW plant, located in the small coal mining town of Shakhti approximately 100 kilometers northeast of the city of Rostov, began in 1992.

Financial participants include the following organizations:

- Gasenergo, the majority shareholder with 51.2% of shares.
- Rostovenergo, the regional purchasing utility with 18.55% of shares.
- RAO EES Rossii, the national transmission utility, with 11.9% of shares.
- Mostransgas, the fuel supplier for the project and the region, with 15.8% of shares, and
- Energomach-export, a manufacturer and exporter of Russian gas turbines, with 1.52% of shares.

Gasenergo itself as majority (51%) shareholder, Rostovenergo, the regional purchasing utility, the regional fuel supply company, the firm contracted for the construction of the plant, and RAO EES Rossii (RAO).

At the end of 1993, following a period of sustained hyperinflation and tight credit in the Russian economy, major construction work on the plant was discontinued while the partners sought financing to complete the project. As of April 1994, the power project was 50% complete with an additional $4-5 million of investment needed for completion.

While the Shakhtinskaya investment group has, in principle, agreed to provide the remainder of the financing needed to complete the project, Gasenergo has also been pursuing opportunities to attract potential foreign investors in project equity as an alternative and perhaps more speedy source of funds.

As part of this effort, Gasenergo approached the United States Agency for International Development (USAID) requesting technical assistance in the preparation and presentation of its project in a form consistent with western investment analysis practices. Through the Private Sector Energy Development (PSED) program, USAID's Bureau for Europe and the New Independent States has funded the preparation of the necessary technical and commercial analyses of the project as an objective due diligence study for prospective investors by K & M Engineering and Consulting Corporation (K&M). This study was performed in coordination with RCG/Hagler, Bailly, Inc.

In evaluating the attractiveness of the Shakhtinskaya power plant currently under construction, a thorough and independent analysis of the technical designs, project agreements and risks, and cost estimates was conducted by K&M. This report presents the key findings and conclusions of the K&M team of technical, institutional and financial specialists based on extensive cooperation with specialists from Gasenergo and Energoperspectiva, the developer/designer of the major plant equipment.

2.0 Project Background and Participants

2.1 Background

In 1929 a cogeneration plant was first erected at the Shakhtinskaya site. This plant was refurbished in the 1970s and is currently used exclusively as a heat producing plant. The baseload demand for heat products is from a cotton mill located nearby, with district heating contributing to peak demand during the winter months. The repowered Shakhtinskaya plant will continue to supply baseload steam to the mill and the district heating system and will sell back all power to Rostovenergo. This textile mill, named Dontex Textile Works, is currently undergoing modernization and is expected to export the majority of its production for hard currency.

The plant currently under construction will have four M1 modules consisting of gas turbines with heat recovery boilers designed and developed by Energoperspectiva Company Inc. Each M1 module has an installed capacity of 17.4 MW and 32.5 Gcal/h. The first two M1 units of the plant can be commissioned within 9-12 months of the commitment of the remainder of the financial requirements of the project, with the final two units becoming operational within 5-6 months thereafter.

2.2 Project Participants

The Shakhtinskaya project is the first independent project initiated by Gasenergo and is expected to be the first private power project in Russia. This plant is one of eight generation plants of Rostovenergo, which has contributed land, plant equipment and financing for shares in the new private project. Gasenergo will be the majority shareholder in the Shakhtinskaya project, with 52.1% of shares. Rostovenergo holds 18.55% of the shares in the project.

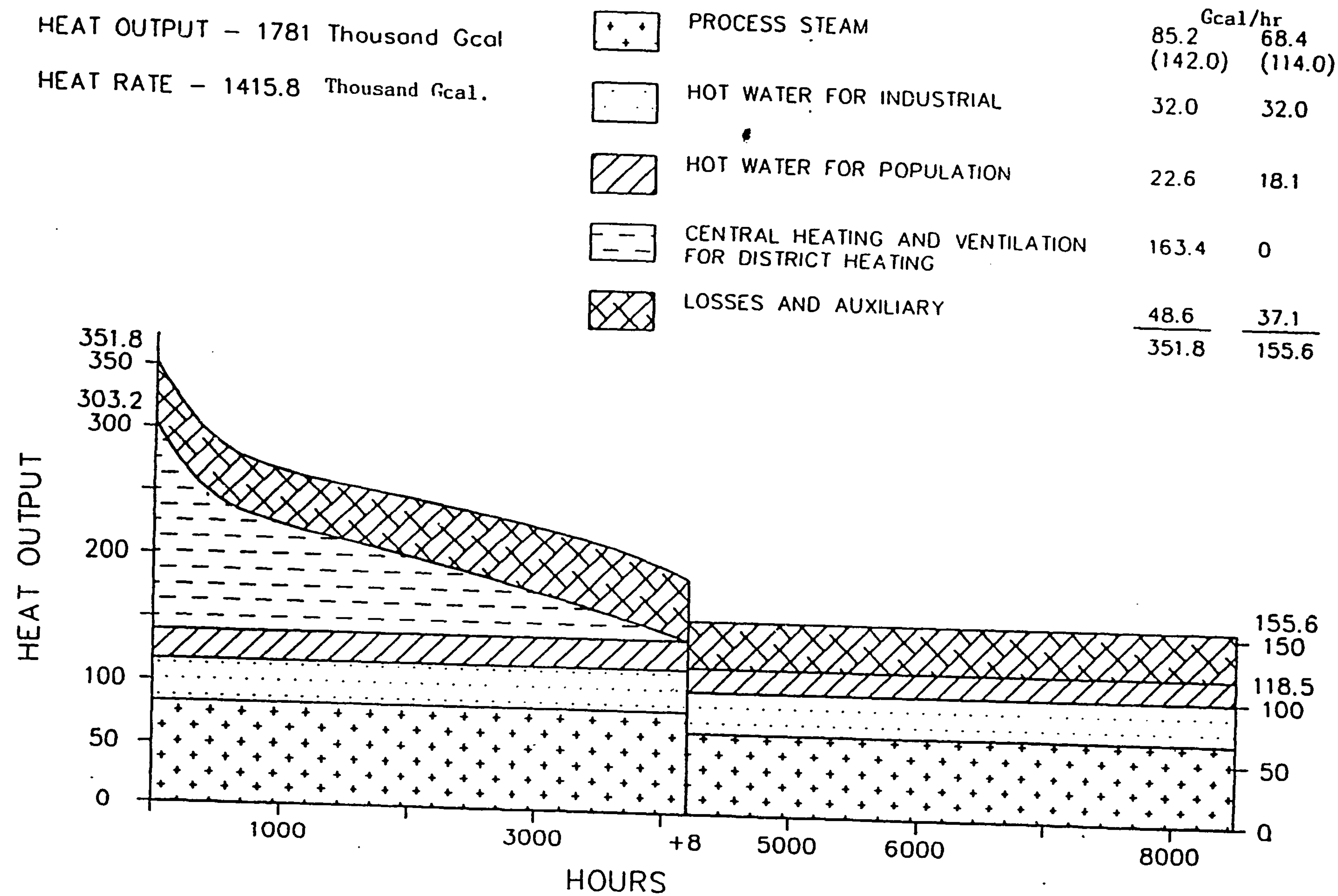
Equity participants and contributors to the project also include RAO EES Rossii, with 11.9% of shares, Mostransgas, the fuel supplier, with 15.89% of shares, and Energomach-export, a manufacturer of power equipment and exporter of Russian gas turbines, with 1.52% of shares in the project.

3.0 Project Description and Capabilities

The original Shakhtinskaya Power Plant was built in 1929 as a coal-fired plant with eight boilers and steam turbines. After the discovery and exploitation of the local natural gas reserves, the plant was backfitted for gas and oil firing and the steam turbines were retired from service. The boilers continue to supply hot water for district heating and steam for the nearby industries.

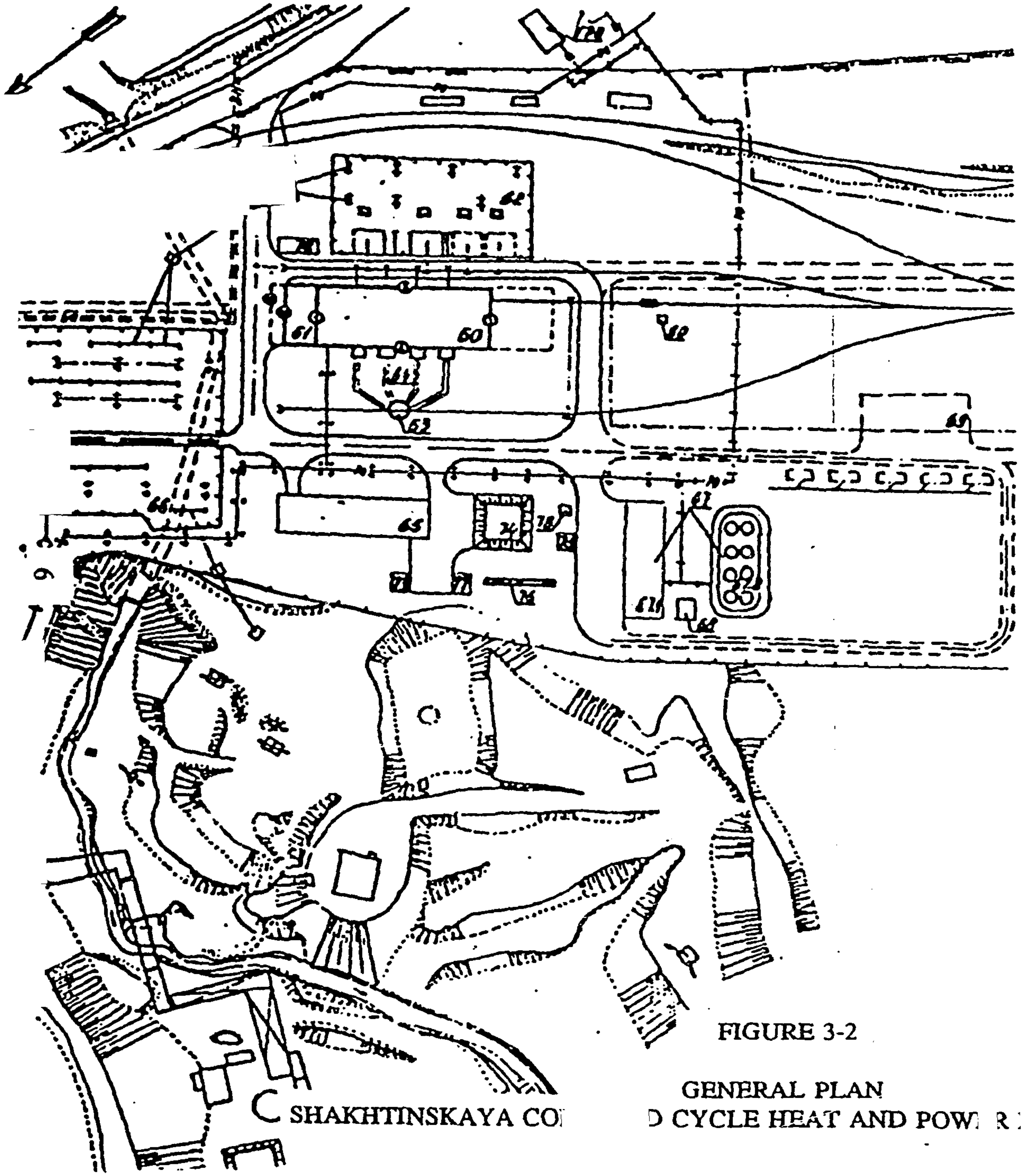
The new cogeneration plant is being built in the area where the coal yard for the original plant was located. The existing boilers of the original plant have been refurbished and five of these boilers will be used to meet peak demands for heating and hot water for the local population during the winter months. The remaining three boilers will operate on standby in case of emergencies. The new cogeneration plant will operate base-loaded throughout the year. Figure 3-1 illustrates the heat demand profile for plant operations and thermal production at different load conditions.

The new cogeneration facility consists of four 17.4 MW combustion turbines, two exhausting to heat exchangers producing district heating and hot water for public housing and two discharging through two heat recovery steam generators (HRSG) producing steam and hot water for the regional industries. The average total electrical output of the power plant, with steam injection to reduce NO_x releases, will be 70 MW of electricity and 134 Gcal/h of thermal output. The new gas turbine facility will produce 524 million kW/h of electricity and 975,000 Gcal of thermal output per year. Figure 3-2 illustrates the general arrangement of the new gas turbine facility.



ANNUAL DIAGRAM FOR THERMAL PRODUCTION

E 3–1



The Shahtinskaya Combined Heat and Power Produc
Technical Upgrade of the Combined Heat and Power Producer With Heat Recovery
General Plan

Plan No.	Name
60	Main gas turbine facility
61	Auxiliary facility with group control panel
62	Gas turbine module transformer installation sit
63	Gas turbine set stack
64	Gas ducts from gas turbine modules to stack
65	Gas compressor room
66	110 kV outdoor switchgear (OSG)
67	Oil facilities
67.1	Oil shop
67.2	Oil storage
68	Emergency oil drain vessel
69	Deisel fuel pump station
70	
71	500m^3 reservoir
72	Plant transformer unit emergency oil pumping
73	Pumping station for residential drainage
74	Accumulation vessel for rain water
75	Rain water treatment pumping station
76	Rain water treatment plants
77	Rain water recycling pumping station
78	Distribution chamber
79	Filter-absorber
80	Transfer pumping house

FIGURE 3-2

GENERAL PLAN

SHAKHTINSKAYA CO D CYCLE HEAT AND POW R RODUCTION PLA

4.0 Supply and Demand of Rostovenergo System

4.1 Introduction

The Shakhtinskaya power project is located in the service territory of Rostovenergo, the northernmost electric utility of the North Caucasus region of Russia. This utility is composed of thirty subsidiary enterprises, including eight power plants, and employs 19,500 people. The majority shareholder in Rostovenergo is RAO EES Rossii (51%). The remaining shares have either been distributed to the employees of the utility or will be sold to the Russian public by auction.

This chapter provides a general background of the power demand situation in the Rostov region and an indication of the potential revenue of the Shakhtinskaya project based upon the financial reliability of the purchasing utility and the economic health of the region.

4.2 Supply and Demand for Electricity

The eight power plants of Rostovenergo represent a combined total capacity of 3,280 MW. The largest plants include one 240 MW hydro plant, eight units of the Novocherkasskaya coal-fired plant, and the Volgodonsk and Rostov heating plants. The Rostovenergo system also includes 1000 km of transmission and distribution lines with a rating of up to 500 KV.

The first power plant built in the region is the Shakhtinskaya power plant which was built in 1929 and is largely representative of the rapidly aging generation asset base of the company. Most of these plants were refurbished or commissioned in the 1960's. The Rostov heating plant which is currently operational, for example, was erected before the turn of this century.

As a result of the age of these plants Rostovenergo has long planned to add new capacity. A 4,000 MW nuclear plant was first planned in the region, but construction on the plant ceased in 1990 due to popular opposition. Rostovenergo conducted a feasibility study for a 8x300 MW coal plant which passed environmental review, but was not implemented because financing was not available. As a result, Rostovenergo is intent on encouraging the least cost option for capacity additions through the repowering of existing generation plants with the assistance of the private sector.

For many years the peak load for Rostovenergo was 3,600 MW. At the present time peak load is only 3,200 MW, largely due to a decline in industrial activity in the region. In the past Rostovenergo was an importer of power, but in January 1994 a decline in production reduced the need for imported capacity, making the region largely self-sufficient. However, during the winter months, additional capacity must still be imported to meet local energy demand. Based on the economic profile of the region, demand for power is not expected to decline further in the near future, and is expected to increase in the longer term.

Rostovenergo's major source of imports are two transmission interconnection systems of the former USSR Integrated Power System, one passing through the territory of Ukraine (80% of the transmission capacity), and another line connecting Rostovenergo directly to the rest of Russia. Since the disintegration of the Soviet Union, however, power transmission flows through Ukraine have all but stopped due to the energy shortage situation in that independent republic. The existing transmission line through Russian territory, and a new transmission line currently under construction, are expected to meet only a fraction of the power needs of this seasonally deficit-ridden area of the North Caucasus.

4.2.1 The Regional Economy

The Rostov region (population of 4.5 million) is geographically at the crossroads of major Russia and CIS trade routes, and serves as the gateway to the North Caucasus region. The main industry throughout the region is agriculture, but the Rostov also boasts several major industrial centers. Rostov is a production center for agricultural machinery (producing 80% of the harvesters made in Russia), and hosts the Atommash factory (currently producing 2-3 1,000 MW nuclear reactors per year), a highly developed chemical industry, a large factory for boiler production, aviation industry production (manufacturing the largest helicopters made in Russia), and a variety of other production facilities.

Coal mining and production is another major industry of the region. Coal production is estimated at 28 million metric tonnes per year. There are also significant natural gas deposits in this region which act as central crossroads for large oil and gas pipelines.

4.2.2 Financial Reliability of Rostovenergo

One of the major problems facing Rostovenergo during the recent transitional period is non-payments for electricity by major industrial customers. In the past, Rostovenergo accumulated receivables of up to 50% of revenues, and was therefore unable to meet its own debts to the wholesale power provider RAO EES Rossii and adjacent utility systems. However, since the passage of a governmental decree allowing power cut-offs to non-paying customers, Rostovenergo is maintaining a pay-back rate of 110% (due to payments of accumulated receivables). The company's debts to RAO EES are now receivables. Rostovenergo's balance sheet for 1993 is presented in Table 4-1.

4.3 Comments

One of the most critical aspects of Rostovenergo as a purchasing utility of the repowered Shakhtinskaya plant is its close relationship with Gasenergo. Rostovenergo is one of the founders and most active sponsors of Gasenergo (many Rostovenergo senior managers themselves own stock in Gasenergo), and has entrusted this private power developer with the repowering of its aging generation units. While it is planned that Gasenergo will maintain a majority stake in only a few of the repowered facilities, it has been chartered with the design and development of a significant number of Rostovenergo's plants.

The attractiveness of the Rostov area for domestic and foreign private power developers stems largely from the utility's aggressive approach to implement restructuring and privatization programs, and its encouragement of private independent power producers (IPP's) in its service territory.

BALANCE SHEET OF "ROSTOVENERGO"		TABLE 4-1	
for 1993 year			
	Code	On 01.01.93	On 31.12.93
ASSETS		*mln. rbl*	*mln. rbl*
I. FIXED ASSETS AND OTHER OFF-CURRENT ASSETS			
Intangibles:			
initial cost	010	0.693	6.783
accumulated depreciation	011	0.083	0.0653
residual cost	012	0.610	6.130
Main Fixed assets:			
initial cost	020	41608.950	55318.576
accumulated depreciation	021	22126.806	22702.959
residual cost	022	19482.144	32615.617
quipment to be installed	030	315.853	583.014
Uncompleted constructions	040	2409.916	9268.611
Long-term committed finances	050	11.764	29.594
Shareholders' contributions	060	0	0
Others	070	0	0
TOTAL	080	22220.287	42502.966
II. CURRENT ASSETS (INVENTORIES)			
Production inventories	100	3308.621	12901.269
Domestic animals for food		69.694	675.047
Low-value assets:			
initial cost	120	109.517	613.887
accumulated depreciation	121	28.019	197.917
residual cost	122	81.498	415.97
Uncompleted buildings	130	108.665	223.426
Prepayments and deferred charges	140	0.095	0.719
Production to be realized	150	33.312	162.169
Products:			
sale price	160	114.190	922.134
trade increase	161	20.299	152.051
consumer price	162	93.891	770.083
Charge for residual products	170	0	0
Value-added tax	175	876.221	2892.112
Others	176	5.920	105.553
TOTAL	180	4577.917	18146.348
III. CURRENT ASSETS (CASH, PAYMENTS, OTHERS)			
Accounts receiveable:			
for production and services	200	2118.121	28890.305
for bills receivable	210	0	0
from subsidiaries	220	0	0
from budget	230	1466.632	97.529
from staff by other operations	240	14.207	27.501
lue-added tax			
other debtors	250	1301.443	2341.374
es to suppliers and contractors	260	3071.822	1406.590
rm financing	270	151.097	5.711
Cash:			
petty cash fund	280	0.795	4.594
settlement account	290	1449.388	6200.593
foreign currency account	300	0	0
other cash	310	1074.984	4279.297
Other current assets	320	0	0
TOTAL	330	10648.489	43253.494
osses:			
in past years	340	1865.460	0
in year of account	350	0	0

BALANCE SHEET OF "ROSTOVENERGO" for 1993 year		TABLE 4-1	
LIABILITIES AND STOCKHOLDER'S EQUITY	Code	On 01.01.93 mln. rbl	On 31.12.93 mln. rbl
I. STOCKHOLDERS' EQUITY			
Capital stock (authorized capital)	400	1633.260	1633.260
Reserve fund	410	0	0
Special funds	420	19725.506	38120.252
Purposeful financing	430	6257.072	14032.662
Rent oblitgations	440	0	0
Settlements with shareholders	450	0	0
Retained profit of past years	460	0	0
Profit:			
in a year of account	470		31460.063
used	471		31430.063
retained in year of account	472		0
TOTAL	480	27615.838	53786.174
II. LONG-TERM LIABILITIES			
Bank long-term credits	500	0	0
Other long-term loans	510	0	0
TOTAL	520	0	0
III. CURRENT (SHORT-TERM) LIABILITIES			
Bank short-term credits	600	2830.000	3612.000
Bank credits for employees	610	0.184	0.009
Other short-term loans	620	0	0
Payments:			
for products and services	630	5446.758	30991.205
by bills	640	0	0
for wages	650	852.092	4468.141
for social insurance and security	660	369.011	2354.719
for property and private insurance	670	0	0
with subsidiaries	680	0	0
for the off-budget purposes	690	0.009	0.032
for the budget	700	184.495	1485.284
) other creditors	710	1879.144	6798.959
ınces from customers and suppliers	720	95.407	406.285
ings of future periods	730	0	0
ırves for future expenses and earnings	740	19.215	0
Reserves for bad debts	750	0	0
Others short-term passives	760	0	0
TOTAL	770	11696.315	50116.634
TOTAL LIABILITIES AND STOCKHOLDER'S EQUITY	780	39312.153	103902.808

Income Statement of "Rostovenergo" for 1993 year	TABLE 4-1		
I. Financial Results			
Characteristics	**Code**	**Profit**	**Losses (Expenses)**
Net Sales	010	183311.605	
Value-added tax	015		30894.768
Excises	020		0
Operating Costs	040		123047.509
Profit from main products sales	050	29364.328	0
Profit from other sales	060	36.003	5.796
Income and expenses from off-sale operations, including	070	3681.620	1646.092
securities and shares in other joint ventures	071		0
Total profit and losses	080	33081.951	1651.888
Total gross profit or losses	090	31430.063	0
Total excess of staff wages	100	5804.036	
II. Profit Use			
Characteristics	**Code**	**On 31.12.93**	
Budget payments, inlcuding	200	15813.414	
profit tax			
wages excess tax			
Reserve fund	210	0	
Deductions for			
accumulation funds	220	3352.102	
consumption funds	230	9419.914	
charity	250	0	
others	260	2844.633	
III. Payments to the budget			
Characteristics	**Code**	**By Calculation**	**Actual Input**
Property tax	300	400.177	263.016
Profit tax	310	15813.414	14842.486
Environment pollution tax	340	193.571	185.955
Land tax	350	235.321	242.959
Value-added tax	355	32596.023	31048.925
Excises	356	0	0
Export tax	360	0	0
Import tax	365	0	0
Income tax	380	2171.274	1793.431
Other taxes	386	3314.176	3677.292
Economical sanctions	390	52.460	52.460
IV. Expenses for calculating profit tax			
Characteristics	**Code**	**Actual**	
For operating and nonoperating activity	500		
For environmental activity	520		
For public health services, public education, culture & others	530	3607.795	
For charity, environmental and health improvement funds and others	540		

5.0 Technical Feasibility

5.1 Technology Selection and Performance Data

The availability of natural gas at Shakhtinskaya makes the selection of efficient combustion turbines the ideal technical solution for electricity production and thermal generation, and it is the best option to modernize the existing facility. The use of prepackaged combustion turbines and other components allows for a much shorter construction period and a lower installation cost.

The existing natural gas pipeline has sufficient capacity to permit full operation of the new turbines, duct firing of the heat recovery steam generators, and operation of the existing boilers. Sharing some of the existing facilities with the new plant reduces the cost of the new facility. The total capacity of the new plant will be 70 MW of electrical generation and 134 Gcal/h of thermal generation.

5.2 Experience of Similar Equipment

Combustion turbines of the capacity similar to the ones installed in Shakhtinskaya have operated successfully in Russia for many years. At the present time there are more than one hundred turbines manufactured by the Zarya Production Association in operation supplying power to factories and small communities. During the period 1977 to 1988, Zarya Production Association (located in Nikolayev, Ukraine) manufactured 547 marine turbines of various types. In addition, numerous turbines have been installed at gas compressor stations, and stationary and mobile power stations. The total operating time of fifty-six 10 MW turbines installed at different power stations without replacement of major components is about 45,000 fired hours. The Zarya turbines have proven their efficiency and reliability under many different operating conditions.

Table 5-1 shows some of the existing installations, capacity, number of units, and year of commissioning.

5.3 Use of Existing Installations

Some of the existing facilities of the original power plant will be utilized to support the new installation. The existing natural gas pipeline will furnish gas to the new plant. New centrifugal compressors will be utilized to increase the natural gas pressure to meet the combustion turbine requirements.

The existing water treatment plant will furnish water to the new plant and additional capacity will not be required. The existing district heating and steam lines will be utilized for distribution of the new plant output.

The existing potable water supply and sewer systems, as well as the industrial waste systems, will be utilized by the new plant. An additional 500 m^3 potable water tank to complement the existing 250 m^3 tank will be provided.

5.4 Availability of Fuel

The new plant is intended to operate on natural gas throughout the year. The calculated yearly usage of natural gas for the total plant is 265,500 metric tonnes. The incoming natural gas line operates at a pressure of 4 atmospheres. This pressure will be increased, by using centrifugal compressors located within the new plant boundary, to the 20 atmospheres required for the operation of the combustion turbines. Gas will also be utilized for the additional duct firing of the two HRSGs and for the operation of the existing boilers.

The natural gas will be furnished by Mostransgas under long-term agreements with Gasenergo. Table 5-2 shows the characteristics of the natural gas to be used at Shakhtinskaya.

5.5 Transmission of Heat Products

The steam and hot water output of the new facility will be connected to the existing steam and hot water distribution system. Condensate return, which is only about 40 percent of the plant thermal output, will also be connected. The difference will be made up by the existing water treatment plant.

The steam user is the Dontex textile works. This plant is being upgraded to meet western industry standards, and it is anticipated that 85 percent of the production will be sold to western European countries. The hot water output will be utilized for city district heating and hot water.

5.6 Environmental Summary

The environmental impact study for the Shakhtinskaya Power Plant was approved by the State Environmental Agency in 1993. Emissions from the plant meet the requirements of the following standards:

1. OND-86 Goskomgidromet, Procedure for Calculation of Airborne Pollutant Concentrations for Enterprise Emissions. Gidrometizdat. 1987.

2. OND-1-84. Instruction on the Procedure for Review of the Coordination and Expert Analysis of Air Conservation Measures and Atmospheric Pollutant Emission Permits for Project Designs. Gidrometizdat. 1984.

3. GOST 17.2.3.02.78: Natural Conservation. Air.

4. GOST 17.2.4.02.81: Natural Conservation. Air.

5. GOST 17.2.6.02.85: Natural Conservation. Air.

6. SaN PiN No. 4946-89: Public Health Regulations Governing Air Conservation for Population Centers. Ministry of Public Health, 1989.

7. Regulations Governing Surface Wate· Protection from Wastewater Contamination. Ministry of Public Health, Ministry of the Fisheries Industry, 1988.

8. Comprehensive List of Maximum Permissible Concentrations and Estimated Safe Pollutant Levels for Fishery Water Reservoirs, 1990.

9. SaN PinN No. 4631-88, No. 4630-88. Ministry of Public Health of the USSR, 1988.

10. SNiP 11-12-73: Noise Protection.

11. SN 245-71: Public Health Standards on Industrial Facility Design.

In reference to Nitrogen Oxide (NO_x) emissions, which are considered the most detrimental release from combustion turbine installations, the emissions will comply with Article 2.8.15 of "Gas Turbine Installations for Driven Turbogenerators GOST 29328-92 of the Russian Federation". This standard limits the releases of NO_x from turbine installations commissioned after January 1995 to 50 mg/m^3 for natural gas and 100mg/m^3 for diesel fuel. The above mentioned standard also states that the values of NO_x shall be determined in a dry portion at 0°C, 0.001013MPa, 15% O_2 (by volume) and recalculated for NO_2. To ensure compliance with GOST 29328-92, steam injection to the combustion turbines will be provided. This feature will maintain the NO_x releases within the allowable limits.

TABLE 5-1

OPERATING GAS TURBINE UNITS MANUFACTURED BY ZARYA PRODUCTION ASSOCIATION - NIKOLAYEV, UKRAINE

Power Plants with Nikolayev 16.19 MW Gas Turbine Units

Barged Power Plants "Severnoye Siyaniye" (SS)

Plant, Region	Number of Units	Year of Commissioning
SS-1, Zeleny Mys, Yakutiya	2	1970
SS-2, Pechora, Republic of Komi	2	1971
SS-3, Sangar, Yakutiya	2	1974
SS-4, Shmidta, Chukhotka	2	1978
SS-5, Nadym, Tyumen Region	2	1980
SS-6, Nadym, Tyumen Region	2	1986

Mobile Power Plants
(excluding 11 rail way power plants temporarily stopped)

Plant, Region	Number of Units	Year of Commissioning
Labytnangi, Tyumen Region	4	1978
Tommot, Yakutiya	4	1977
Severobaykalsk, Buryatiya	2	1978
Tenkely, Yakutiya	1	1979
Tonnelny, Buryatitya	2	1979
Lensk, Yakutiya	2	1980
Lazo, Yakutiya	4	1985
Deputatsky, Yakutiya	6	1986
Yushnaya, Kazakhstan	6	1987
Tengiz, Kazakhstan	12	1990

Stationary Power Plants

Plant,Region	Number of Units	Year of Commissioning
Kuluarskaya, Yakutiya	6	1976
Myskaya, Sovetskaya Gavan	7	1976
Nebid-Dagskaya, Turkmeniya	4	1980
Urengoyskaya, Tyumen Region	6	1982
Neftyaniye Kamny, Azerbyjan	4	1986
Beloyarskaya, Tyumen Region	6	1986
Mirninskaya, Yakutiya	10	1986
Yamburgskaya, Tyumen Region	6	1982

All above power plants deliver electric power (and heat) to mines, oil and gas processing works, industrial and chemical enterprises, settlements and cities. The plants operate as autonomous units as well as in conjunction with the power utilities.

TABLE 5-2

NATURAL GAS CHARACTERISTICS

Component	Percentage, by Volume
Methane, CH_4	54.9
Ethane, C_2H_6	1.65
Propane, C_3H_8	0.59
Butane, C_4H_{10}	0.05
Pentane, C_5H_{12}	0.03
Isobutane, C_4H_{10}	0.06
Hydrogen Sulfide, H_2S	0.05
Carbon Dioxide, CO_2	2.65
Low Heating Value Kcal/m^3	8259
Density Kg/m^3	0.77

6.0 Technical Description of the Plant

6.1 Plant Configuration

The combustion turbines, district heating heat exchangers, heat recovery steam generators (HRSGs) and related equipment are housed in an enclosed building. The northeast end of this building houses the plant common control room for all modules. The exhausts from the HRSGs and heat exchangers discharge through a common stack. The main transformers are located southeast of the main building, adjacent to the switchyard. The centrifugal gas compressors are located in a separate building northwest of the main building. Figure 3-2 shows the general plant arrangement and identifies the major plant components.

6.2 Major Plant Components

The major plant components consist of four 17.4 MW combustion turbines, the district heating heat exchangers and the two heat recovery boilers. The four combustion turbines have been delivered to the job-site and are ready for installation. Although the turbines can operate with oil or gas at Shakhtinskaya, the availability of gas will permit continuous operation with natural gas. Diesel oil will be available as back-up fuel. However, it is anticipated that this fuel will be utilized for a maximum of eight days a year.

The two HRSGs receive the exhaust gases from the two combustion turbines. Each HRSG produces 84.5 tonnes of steam at 40 bar and 255°C. This condition is achieved by additional duct firing of the HRSG. Steam is delivered through existing lines to the nearby industry. In addition, the HRSG produces 7.9 Gcal/h of hot water for industries and district heating.

The other two combustion turbines discharge to two hot water heat exchangers, providing district heating and hot water. The district water heat exchangers have a thermal capacity of 24.4 Gcal/h with a hot water circulation rate of 300 tonne/h.

6.3 System Descriptions and Design Parameters

6.3.1 Combustion Turbine

The combustion turbines are designed to operate with natural gas or oil. Oil will be utilized only in case of interruption of the natural gas supply which is estimated to be no more than eight days a year. The power output and fuel consumption (heat rate) is based on the manufacturer's performance specifications. The manufacturer will provide data for the full range of ambient temperatures at base loads. Each turbine is designed to operate with or without steam injection. Steam injection will be utilized to reduce the NO_x emissions to the atmosphere to allowable limits. Table 6-1 shows the main characteristics of the combustion turbine.

The combustion turbine gas exhaust composition without steam injection is shown in Table 6-2. The NO_x releases with steam injection will not exceed 50 mg/m^3 at 100 percent load when firing natural gas.

Air for combustion is drawn through an inlet filter designed for a maximum pressure loss of 100 mm of water column.

The complete Combustion Turbine Package includes:

- Inlet Filter with inlet vanes,
- Inlet Duct,
- Air Compressor,
- Combustor,
- Turbine,
- Lube and Seal Oil System with Cooler,
- Generator,
- Generator Cooling System, and
- Generator Excitation and Control System.

6.3.2 Heat Recovery Steam Generators (HRSG)

The HRSG is a duct fired single pressure forced circulation boiler generating 84.5 Tonne/h of steam at 40 Bar, 255°C. The feedwater will be preheated by a low temperature economizer and forced by circulation pumps to a high temperature economizer and to a high pressure superheater prior to leaving the HRSG. The Combustion Turbine exhaust gasses discharge to the HRSG at 360°C. However, duct firing of the HRSG using natural gas increases the exhaust gasses temperature to 600°C.

A district heating coil is installed at the exhaust of the HRSG to recover low level heat and maximize the overall thermal efficiency. The exhaust gasses will discharge to the stack at 100°C. Table 6-3 shows the HRSG design parameters.

6.3.3 District Heating, Hot Water Heat Exchangers

Two of the combustion turbines discharge to horizontal finned tubes, vertical heat exchangers furnishing hot water for district heating and hot water for the local population. The characteristics of the heat exchangers are given in Table 6-4.

6.3.4 Electrical

Repowering of the existing plant will be achieved by utilizing the existing 110/35/10 KV substation at the Shakhtinskaya plant. Repowering of the plant will be achieved by installing four generating units, each rated at 20 MVA. The project will be completed in two stages. In the first stage, two of the proposed four generating units will be installed. The two remaining units are to be installed in the second stage. Provisions are made to install two more units, each rated at 12 MVA, in the future.

Power generation from generating unit 1 and unit 2 will be transmitted to substation SH-30 by stepping-up the generator voltage of 10 KV to 220 KV through a 63 MVA transformer. Power generation from generating unit 3 and unit 4 will be transmitted to substation SH-6 by stepping-up the generator voltage of 10 KV to 110 KV through an additional 63 MVA transformer. A 110 KV tie breaker will be utilized between 110 KV transmission lines to substation SH-30 and substation SH-6.

Provision should be made to transmit power to the 35 KV switchgear bus by stepping-up the 10 KV generator voltage of unit 5 and unit 6, planned in the future, and each rated at 12 MVA, through 40 MVA transformers.

Figure 6-1 shows the power plant electrical single line diagram.

6.3.5 Instrumentation and Controls

The combustion turbines are furnished with the necessary instrumentation to monitor the operating conditions and insure a safe operation. Each combustion turbine, HRSG and hot water heat exchanger is provided with an independent control system including:

- Data acquisition system to monitor plant status,
- Annunciation systems and control board mimic convenient to the operator to identity combustion turbine and balance of plant operating conditions,
- Remote manual controls of plant components such as pumps, motors, remote operated valves, etc.,
- Instrumentation for automatic controls, and
- Turbine control system based on computerized and microprocessor controls.

An operator console is provided in the control room with color displays, functional key boards, computer, and printers recording the plant operating conditions. Local instrumentation is provided, where necessary, to insure local controls and monitoring, as required by the plant operating conditions.

6.4 Project Organization and Staffing

Upon completion of the new turbine plant, operation of the existing boiler plant will be integrated into the new plant. The combined units will operate as a single plant to meet the system demand. The plant will be operated under the supervision of the Managing

Director who will be directly responsible for operations and maintenance. The existing boiler plant will continue operating with its current staff, with the exception of a few experienced operations and maintenance personnel who may be transferred to the new plant. Table 6-5 shows the proposed organization and staffing of the new turbine facility. It is anticipated that 78 persons will be required for operations and maintenance.

TABLE 6-1

CHARACTERISTICS OF ZARYA GAS TURBINE ENGINE
(without steam injection)

Characteristic	Measure	Value
Mechanical capacity at the power turbine shaft	MW	18
Efficiency	%	30.7
Generator efficiency	%	97.6
Nominal efficiency	%	30
Installed power capacity	MW	17.4
Working efficiency	%	28.64
LHV of natural gas	$Kcal/Nm^3$	8259
Gas flow rate	Nm^3/h	5374
Gases inlet temperature	°C	877
Gases outlet temperature	°C	369
Air excess coefficient		5.28
Air flow rate	Kg/sec	96.85
Outlet gases flow rate	Kg/sec	98.0
Heat at the outlet	Gcal/h	33.9

TABLE 6-2

CALCULATION OF EXHAUST GASES COMPOSITION FOR 17.4 MW ZARYA GAS TURBINE WITH SUPPLEMENTARY DUCT FIRING (without steam injection)

Air flow rate	kg/s	96.85
Operating efficiency	%	28.64
Operating capacity	MW	14.78
Operating heat rate	MW	51.61
LHV of natural gas	MJ/kg	50.06
Fuel flow rate	kg/s	1.031
Lo (kg AIR/kg FUEL)	kg/kg	16.87
Pure fluent gases - 1	kg/s	18.42
Air excess factor		5.26
Excess air flow rate	kg/s	79.46
Excess air flow rate	-"-	79.46
GT outlet gases flow rate	-"-	97.88
Pure fluent gases composition:	kg/kg	1.000
N_2	-"-	0.721
CO_2	-"-	0.156
H_2O	-"-	0.123
Air composition:	kg/kg	1.000
O_2	-"-	0.233
N_2	-"-	0.767
GT outlet gases mass composition:	%	100.00
O_2	%	18.91
N_2	%	75.83
CO_2	%	2.94
H_2O	%	2.32

SUPPLEMENTARY DUCT FIRING

Additional fuel heat rate	MW	33.61
Additional fuel flow rate	kg/s	0.67
Pure fluent gases - II	-"-	12.00
Pure fluent gases - total flow rate	-"-	30.42
Outlet gases flow rate		98.55
Excess air flow	-"-	68.13
Outlet gases mass composition	%	100.00
O_2	%	16.11
N_2	%	75.28
CO_2	%	4.82
H_2O	%	3.80

TABLE 6-3

HEAT RECOVERY STEAM GENERATOR AT 2.5 MPa/250°C

Characteristic	Measure	Value
Steam flow rate	t/h	84.5
Gases temperature at the inlet of HRSG	°C	659
Gases heat at the inlet of HRSG	Gcal/h	62.8
Pinch-point	°C	30
Feed water temperature	°C	105
Gases temperature at the inlet of district water heat exchanger	°C	148.5
Gases heat at the inlet of district water heat exchanger	Gcal/h	12.5
Waste gases temperature	°C	100
Heat capacity of district water heat exchanger	Gcal/h	3.5
Additional fuel heat flow	Gcal/h	28.9
Additional fuel flow rate	Nm^3/h	3571

TABLE 6-4

DISTRICT HEATING HEAT EXCHANGER

Characteristic	Measure	Value
Heat capacity	Gcal/h	24.4
Water flow rate	t/h	300
Water temperature rise	°C	81.3

TABLE 6-5

Gasenergo Staffing of the Shakhtinskaya Central Heating and Power							
Plant Personnel	Worker Classification	Total		Including			
				Operations		Maintenance	
		No. of Positions	No. of Personnel	No. of Positions	No. of Personnel	No. of Positions	No. of Personnel
1	2	3	4	5	6	7	8
I. Power Plant Personnel							
1.1 Administration							
Director	1a	1	1	1	1	-	-
Safety Engineer	1a	1	1	1	1	-	-
SUBTOTAL		2	2	2	2	-	-
Production Technical Dept.							
Engineer	1a	1	1	1	1	-	-
Design Engineer	1a	1	1	1	1	-	-
SUBTOTAL		2	2	2	2		
Material and Equipment Purchasing Dept.							
Chief of Department	1a	1	1	1	1	-	-
SUBTOTAL		1	1	1	1	-	-
Housekeeping Services							
Chief of Housekeeping	1b	1	1	1	1	-	-
Exterior Plant Housekeeper	1b	1	1	1	1	-	-
Interior Plant Housekeeper	1b	1	1	1	1	-	-

Gasenergo Staffing of the Shakhtinskaya Central Heating and Power							
Plant Personnel	Worker Classification	Total		Including			
				Operations		Maintenance	
		No. of Positions	No. of Personnel	No. of Positions	No. of Personnel	No. of Positions	No. of Personnel
1	2	3	4	5	6	7	8
SUBTOTAL		3	3	3	3	-	-
Shift Supervisor	1b	1	5	1	5	-	-
SUBTOTAL		1	5	1	5	-	-
ADMIN. TOTAL		9	13	9	13	-	-
1.2 Mechanical Plant Personnel							
Chief Mechanical	1a	1	1	1	1	-	-
Engineer	1b	1	1	1	1	-	-
Warehouse	1a	1	1	1	1	-	-
Labor	11d	2	2	2	2	-	-
SUBTOTAL		5	5	5	5	-	-
Mechanical Operations (Shift) Personnel	·						
Gas Turbine Operator	1c	1	5	1	5	-	-
Steam Turbine and HRSG Operator	1c	1	5	1	5	-	-
Natural Gas Booster Compressors Operator	1c	1	5	1	5	-	-
Natural Gas Booster Compressor Roving Operator	1c	1	5	1	5	-	-

Gasenergo Staffing of the Shakhtinskaya Central Heating and Power							
		Total		Including			
				Operations		Maintenance	
Plant Personnel	Worker Classification	No. of Positions	No. of Personnel	No. of Positions	No. of Personnel	No. of Positions	No. of Personnel
1	2	3	4	5	6	7	8
Shift Fitter	1c	1	5	1	5	-	-
SUBTOTAL		5	25	5	25	-	-
MECH. PLANT TOTAL		10	30	10	30	-	-
1.3 Electrical Plant Operations							
Chief Electrical	1a	1	1	1	1	-	-
Engineer	1a	1	1	1	1	-	-
SUBTOTAL		2	2	2	2	-	-
Electrical Shift Personnel							
Electrician	1b	1	5	1	5	-	-
SUBTOTAL		1	5	1	5	-	-
Instruments and Controls							
Instrument Engineer	1b	1	1	-	-	1	1
I&C Technician	1b	2	2	-	-	2	2
SUBTOTAL		3	3	-	-	3	3
Electrical Maintenance							
Electricians	1c	2	2	-	-	2	2
SUBTOTAL		2	2			2	2
ELECT. PLANT TOTAL		8	12	3	7	5	5

Gasenergo Staffing of the Shakhtinskaya Central Heating and Power							
Plant Personnel	Worker Classification	Total		Including			
				Operations		Maintenance	
		No. of Positions	No. of Personnel	No. of Positions	No. of Personnel	No. of Positions	No. of Personnel
1	2	3	4	5	6	7	8
1.4 Data Acquisition System Chief							
Chief	1a	1	1	1	1	-	-
SUBTOTAL		1	1	1	1	-	-
Operating Personnel							
Electrician	1b	1	5	1	5	-	-
Repair Personnel							
Electrician	1b	2	2	-	-	2	2
Electrical Inst. and Controls							
Foreman	1b	1	1	1	1	-	-
Engineer	1b	1	1	1	1	-	-
Electricians	1b	2	2	1	1	1	1
SUBTOTAL		4	4	3	3	1	1
DATA ACQUISITION TOTAL		8	12	5	9	3	3
1.5 Centralized Repairs							
OHAI	1a	1	1	-	-	1	1
SUBTOTAL		1	1	-	-	1	1
Repair Shop Personnel							
Foreman	11d	2	2	-	-	2	2
Mechanics, Welders, Lathe Operators	1c/11d	8	8	-	-	8	8

Gasenergo Staffing of the Shakhtinskaya Central Heating and Power							
Plant Personnel	Worker Classification	Total		Including			
				Operations		Maintenance	
		No. of Positions	No. of Personnel	No. of Positions	No. of Personnel	No. of Positions	No. of Personnel
1	2	3	4	5	6	7	8
SUBTOTAL		10	10	-	-	10	10
CENTRALIZED REPAIRS TOTAL		11	11	-	-	11	11
CENTRAL HEATING AND POWER PLANT PERSONNEL TOTAL		46	78	27	59	19	19

THE SHAKHTINSKAYA POWER PLANT
SINGLE LINE DIAGRAM

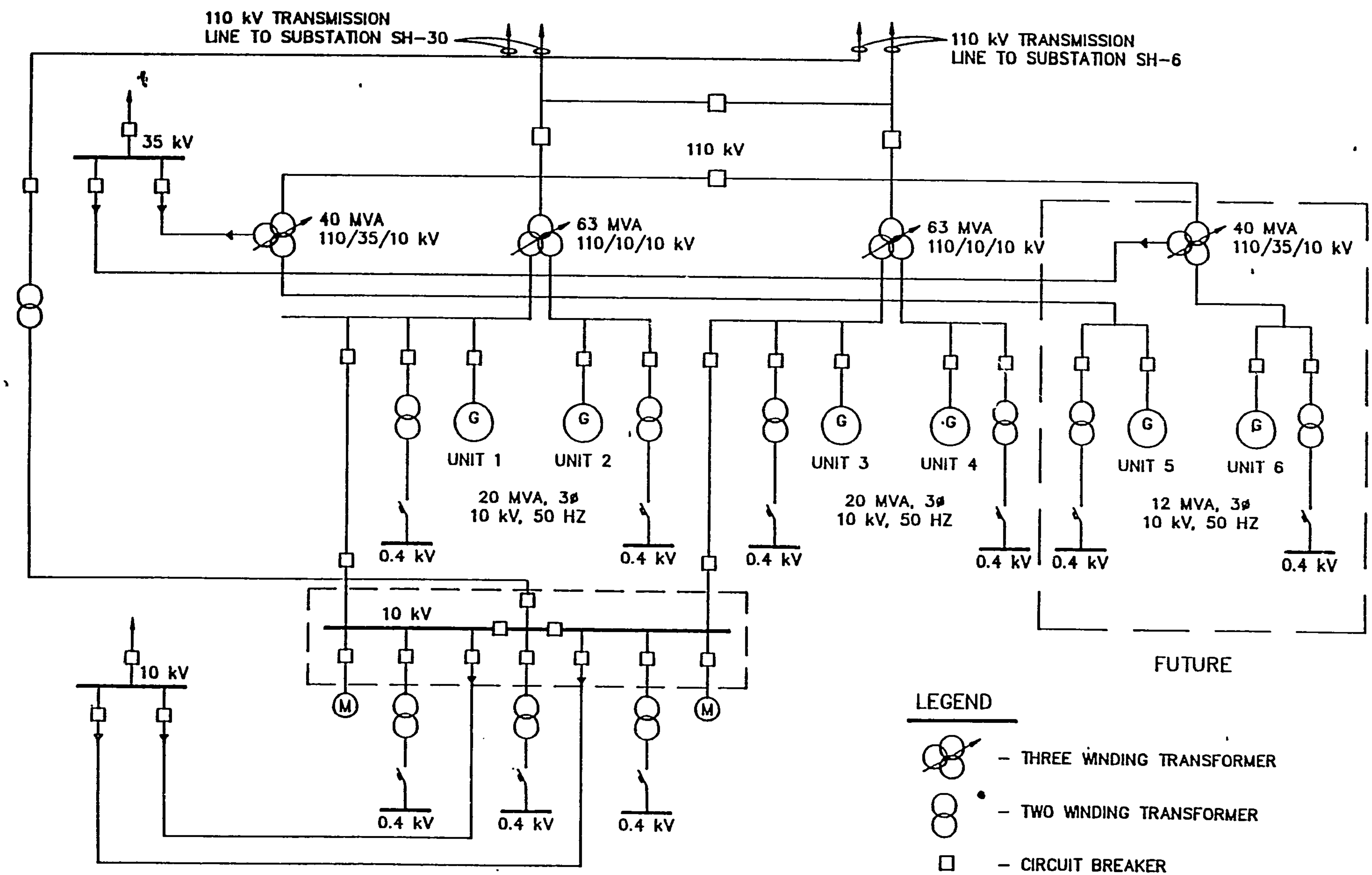


FIGURE 6-1

7.0 Current Status of the Project

Design engineering of Shakhtinskaya was performed by Energoperspectiva Co. Ltd. of Moscow. The design is complete, and only minor engineering problems are expected to surface during the remaining construction phase.

Most of the major equipment has been purchased and is available as required for installation at the construction site. This includes the four combustion turbines, HRSGs, district heating heat exchangers and natural gas compressors.

The plant is currently, as of mid-June 1994, about 50% complete. The structural steel frame of the main building, including the bridge crane, is in place. However, none of the combustion turbine, HRSGs, or auxiliary equipment are installed. The natural gas compressors building structural steel is being erected. The compressor is available at the job-site, awaiting building completion. The stack support is being erected, and the materials for completion of the stack are available at the construction site.

Still to be completed are the erection of the main building and compressor building including the installation of building siding, and the installation of major and auxiliary equipment. Power and control cables must be pulled and terminated after installation of the switchgear, control centers, and control room.

Construction of the foundations of the switchgear are underway, as well as other miscellaneous foundations. At this time, approximately 160 construction workers are employed at the site. An evaluation of the construction status and activities projects approximately twelve additional months of time to complete the facility. However, to meet this schedule a substantial increase in the number of construction workers will be required.

8.0 Existing Project Agreements and Contracts

8.1 Introduction

This chapter provides an overview of the ownership structure of the Shakhtinskaya project, and a brief analysis of the key contracts and agreements governing this project. Power and heat sales agreements are analyzed separately in another chapter of this report. The agreements presented here have all been formalized and in effect since their signing. All existing contracts related to the Shakhtinskaya project have been executed by Gasenergo, on behalf of the plant, and liabilities will be transferred over to the project company once the Shakhtinskaya Joint Stock Company is created.

The aim of this section is to review the adequacy and reliability of key contracts of the Shakhtinskaya project. More detailed analysis regarding the role and sufficiency of these agreements with regards to risk mitigation is presented separately in a subsequent section.

8.2 Project Structure

The Shakhtinskaya Joint Stock Company has five major shareholders. Gasenergo, the largest shareholder, currently holds 52.1% of the project company; Rostovenergo, the purchasing utility, holds 18.55%; Mostransgas, the regional natural gas supplier, holds 15.89%, RAO EES Rossii, the national transmission utility, holds 11.9%; and Energomach-export, a manufacturer and exporter of power equipment, holds 1.52% of shares. Contributions to the authorized capital of the project company by each shareholder is in the form of fixed asset transfers, equipment, services, or cash.

The Shakhtinskaya project utilizes the land, civil structures, and some of the equipment that were part of the plant that belonged to Rostovenergo. Upon repowering, these assets were transferred to the company in return for shares in the project commensurate with the value of those assets. The core agreement for the structure of Shakhtinskaya does not elaborate the methodologies used in valuing asset contributions of the various shareholders, and does not provide details regarding the type of contribution made by each party. From the point of view of a foreign investor, though, the most important consideration is that the relative value of the contributions of each of the participants has been agreed upon among the Russian investors.

8.3 Construction Contracts

The construction contract for the Shakhtinskaya power project was concluded between Gasenergo and the joint stock company Energetic in March of 1992. This contract envisions that all construction work for the rehabilitation of the power plant will be initiated in the final quarter of 1992, and completed in the first quarter of 1994. The lump sum cost for the completion of this work was 230 million rubles in March of 1992(?). All materials used by the contractor are to be paid for by the customer, Gasenergo.

The expenditures remaining to commission the Shakhtinskaya power plant are mostly related to the provision of payments to the construction company. Payments to Energetic were not made in accordance to the turnkey contract due to cost increases resulting from the hyperinflationary period of 1993 and a drastic decrease of lines of credit expected to be available. Upon recalculation of the balance of costs due to Energetic and the additional materials that need to be procured for the completion of the plant, Gasenergo estimates that an additional $4-5 million will ensure the completion and commissioning of Shakhtinskaya. Below is an overview of these remaining costs. All figures are based on the revaluation in June 1994 of existing contracts terms by agreement among the concerned parties.

By way of background information, the engineering and construction company Energetic was set up in January of 1991 in the Stavropol area to work on a turnkey basis in the construction and rehabilitation of power plants. In addition to its work in Shakhtinskaya, Energetic is also overhauling the equipment and pipelines at the Stavropolskaya power plant, Kamenskaya cogeneration plant, Rostovskaya cogeneration plant, Nesvety power plant, and Novochezhasskaya power plant. There are 778 employees in the company, with 57 engineers and a large number of technicians and other specialists. Energetic has facilities for equipment repairs and testing, materials assembly/welding and storage, and significant capacity for transportation and logistics handling.

8.4 O&M Contract

Gasenergo does not have a contractor for the operation of the Shakhtinskaya power plant. Rather, it is intended that the staff currently working at the plant will be transferred to the new project company. Any operational liabilities, therefore, will be borne by the project company which cannot be indemnified from the plant operators.

8.5 Fuel Purchase Agreement

The agreement between Gasenergo and Mostransgas, the natural gas company supplying the region, is essentially a clause incorporated within a general agreement on cooperation between Gasenergo, Rostovenergo and Mostransgas. This fuel supply agreement refers to long standing USSR State Planning Committee orders (1989) to Mostransgas to supply 56,140 Nm^3/h of natural gas to the Shakhtinskaya power plant. Since Gasenergo's Shakhtinskaya power plant is a repowering of the existing plant, all previous agreements for fuel supply to the plant will remain effective for this power project.

8.6 Comments

The project structure agreements are relatively well-defined regarding the equity shares of participants and their respective roles in the project. Gasenergo's approach to incorporating key stakeholders of the project, such as the purchasing utility, the gas company, and the national transmission utility (RAO EES) as project shareholders increases the likelihood of the project's success. Such profit-sharing and equity relationships with business partners complement contractual ties and increase cooperation among the key parties. These agreements also demonstrate Gasenergo's access and ability to build consensus among the key energy players in the region.

Gasenergo's construction contract is also relatively sound in that it identifies a specific scope of work and a lump sum payment based on a turnkey basis. Since the signing of this agreement, however, Gasenergo has periodically agreed to an escalation of the contract price to adjust costs for the hyperinflationary period in Russia. In fact, the uncertain inflationary situation in Russia has been the greatest deterrent to the commissioning of the Shakhtinskaya power plant since construction began in 1992.

Given this inflationary situation, it will be important to the foreign investor to receive assurances that the cost for completing construction of the power plant will not increase (in real terms) upon commitment of the necessary funds. The most effective form of assurance would be for Gasenergo to provide guarantees that it will be responsible for covering all expenses incurred beyond the estimated amount, without decreasing the share of the foreign investor in the project. Gasenergo is prepared to provide such an arrangement.

Table 8-1

INFORMATION ON RESOURCE COMMITMENT
AS OF 01 JUNE 1994
IN MILLIONS OF ROUBLES

Costs	Estimated Costs	Committed Capital	Necessary Financing
Equipment	33,883	31,894	1,989
Construction, Mounting, and Design	33,940	28,954	4,986
Other	11,484	10,528	955
Total	79,306	71,376	7,930

9.0 Key Aspects of Power and Heat Product Sales Agreements

9.1 Introduction

This section provides a brief overview of the key features that have been incorporated into the electric and heat sales agreements between the Shakhtinskaya Project and its purchasing utility, Rostovenergo. These documents have generally been agreed upon among the various parties, but have not yet been formalized. This provides an opportunity for further refinement and revisions that may be necessary to meet the specific needs of potential investors.

9.2 Power Purchase Agreement

The power sales agreement between Shakhtinskaya and Rostovenergo provides for the purchase of all power produced at the plant by Rostovenergo during the plant's useful lifetime. The tariff for this power is set at a 3% discount from the wholesale rate of power transmitted by RAO EES Rossii, the unified transmission grid for Russia. This rate, therefore will be adjusted automatically to correspond to 97% of the wholesale power rate as bulk power tariff changes take place.

Monthly payments for power from the Shakhtinskaya Plant will be made by Rostovenergo at the beginning of each month on the basis of a forecast of production for that month. By the beginning of the following month, the balance of payments would be made to Shakhtinskaya in case of an underpayment, and payments refunded to Rostovenergo in case of an overpayment.

In case of untimely payments, Rostovenergo would be charged a daily penalty amounting to 0.5% of the overdue payment. In the event of a breach of contract or disagreement, the parties agree to resolve all disputes through arbitration court procedures.

9.3 Heat Purchase Agreement

The heat/steam purchase agreement between the Shakhtinskaya Power Project and Rostovenergo is structured in a similar manner as the power purchase agreement. Rostovenergo agrees to purchase all steam produced by the plant throughout the year at a cost that is 3% lower than the wholesale rate.

The monthly payment terms for steam from Shakhtinskaya are similar to power sales, with prepayments at the beginning of the month and account reconciliation at the end. Here also, a 0.5% penalty per day is charged for late payments.

9.4 Comments

The power and heat sales agreements of the Shakhtinskaya power plant provide a certain level of flexibility to the plant in determining optimal output while avoiding any penalties for unavailability resulting from unexpected shutdowns and start-up delays. The payment terms which allow for a prepayment at the beginning of the month are also an advantage to the project in covering O&M costs. Nevertheless, the proposed agreements, as they are currently structured, offer uncertainties that may be otherwise mitigated.

The project currently relies on a tariff based on the wholesale electricity rate, and is not necessarily designed to generate a specified rate of return for the investors. It is also not designed to be inherently adjusted to fuel and other cost increases. This exposes investors to the uncertainty of the future evolution of wholesale tariffs and ratemaking practices at the federal level in maintaining wholesale price increases commensurate with inflation and fuel cost increases.

Gasenergo's heat and power sales agreements have also not incorporated a capacity charge component into the tariff structure to allow for revenue generation at times of low demand for the plant's output. While Shakhtinskaya is expected to operate as a baseload plant, future demand conditions could potentially reduce the purchasing utility's need for year-round steam and power. In such a case, the plant may insist on supplying either electricity or heat that Rostovenergo does not need but is obligated to pay for. This type of situation would lead to inefficiencies for both Gasenergo and Rostovenergo.

In the final analysis, however, the heat and power supply contracts outlined above have not yet been formalized, and there is the possibility to restructure these agreements in a way that is acceptable to both Gasenergo and other investors in the project, including Rostovenergo. This provides the opportunity to revise these agreements to meet the requirements of a specific foreign investor as further negotiations take place.

10.0 Risk Analysis

10.1 Introduction

This chapter examines, in general terms, the types of risk exposure that Gasenergo's projects, and particularly the Shakhtinskaya Project, face given their existing structure. The purpose of this analysis is not only to assess the nature of these projects from a risk perspective but also to identify potential opportunities for further risk mitigation. The primary focus of this analysis is from the point of view of a significant foreign investment in a Gasenergo project, while most of the findings apply also to the project as a whole.

Based on our experience, many Russian private power developers, while cognizant of the potential impact of risks on the profitability of projects, have not developed methodologies to mitigate risks and allocate them among diverse parties. This is a common practice for international private power developers and a critical step in the structuring of private power projects in such countries as Russia. At the same time, though, Gasenergo has shown an interest and eagerness in applying risk analysis and mitigation to their projects, and to a large extent have agreed to modify the structure of the Shakhtinskaya and future projects on the basis of our recommendations. K&M's recommendations for risk mitigation improvements for the Shakhtinskaya Project are summarized in Table 10-1.

10.2 Political Risks

Political risks are perhaps the most difficult to analyze, predict and mitigate in an environment such as Russia. These risks range from general difficulties in enforcing contracts with entities and the adverse effect of continuously evolving taxation legislation, to the more unlikely events of changes in ownership laws or even the outbreak of armed conflict. From the foreign investor's point of view, these risks clearly need to be identified and mitigated prior to the occurrence of any investment transaction.

A most common risk, stated in very general terms, is the potential for difficulties in enforcing agreements in case of a breach of contract or a dispute between the project and Russian private or government counterparts. While this issue may also be classified as a commercial risk, the uncertainty arises primarily from the political issue relating to the effectiveness of Russia's judicial and arbitration process. Arbitration codes do exist in Russia, but there has been little practical experience in arbitration court procedures and third party arbitration and implementation under the country's current situation. While Gasenergo may rely on arbitration procedures offered by law to enforce agreements, it may be possible to structure project contracts in such a manner as to enable more efficient resolution of conflicts. Arbitration procedures may be explicitly identified in contracts, and additional mechanisms, such as performance bonds and escrow accounts, may also be specified to assure fast compensation in cases of damage claims. Gasenergo has expressed its readiness to review its existing agreements and incorporate such mechanisms upon agreement with its counterparts.

Another issue, common not only to Russia but also to the most stable of economies, is the uncertainty arising from the possibility of domestic tax law changes. Russia's taxation system has evolved very rapidly into a complex and sometimes burdensome set of duties and the future promises even further changes. Under the existing project structure of Shakhtinskaya, for example, there are no safeguards against future changes in the taxation structure. It is possible in certain cases, however, to transfer the risk of the adverse impact of tax changes to the purchasing utility if the utility is a government entity, in essence receiving a guarantee from the government against such unpredictable changes. For the Shakhtinskaya Project, though, this option is not likely to be incorporated into Gasenergo's power purchase agreement with the purchasing utility. In this case, the project company as well as its individual investors will need to accept this uncertainty.

Other political risks, ranging from restrictions on currency convertibility and asset ownership to political force majeure issues such as war, can be most effectively addressed through the type of insurance offered by OPIC and MIGA of the World Bank Group. Russia's Gosincor State Investment Corporation and its off-shore insurance program for political risk may also be utilized. Gasenergo, however, has little role in such issues which will primarily need to be addressed by the group of foreign investors themselves.

10.3 Commercial Risks

The greatest opportunity for improving Shakhtinskaya's and Gasenergo's risk profile is in the area of commercial risk mitigation. In general, most commercial risks identified here can be mitigated either by allocating uncertainties among organizations or through insurance. In those instances where either suppliers or the purchaser are not willing to assume additional risks or provide guarantees, Gasenergo is currently in the process of exploring opportunities for insurance. It has, to date, identified and held preliminary discussions with the insurance company of Energogarant, which specializes in providing energy-sector insurance.

Gasenergo is also pursuing discussions with Rostovenergo, the purchasing utility, to revise certain agreements in order to mitigate two key risks for the project. The first risk is that of non-payment by the utility, a real and critical issue not only affecting the Russian electric sector but the economy as a whole. With this regard, Gasenergo's aim is to incorporate additional procedures within its agreements with the utility to ensure a more efficient process in resolving disputes and ensuring payments. Gasenergo also held preliminary discussions with Rostovenergo regarding the availability of fuel supply and the possibility for the utility to procure and supply fuel for Shakhtinskaya. This would mitigate both the risk of fuel shortages and unavailability, and potentially the adverse impact of changes in gas prices on the profitability of the project.

10.4 Financial Risks

Financial risks are defined as those commercial uncertainties that are beyond the influence of organizations that are party to the project. These generally include the impact of unpredictable changes in macro-economic factors such as inflation, interest rates, currency exchange, and general market conditions on the profitability of the project. Financial risks are generally assumed by the project consortium, although in some cases it may be possible to allocate these risks to a third party such as the purchasing utility.

In the case of Gasenergo, and the Shakhtinskaya project specifically, the only allocation of financial risks beyond the project that may be possible at this point is with the shifting of the responsibility for fuel procurement and payment from the project to Rostovenergo. Currency exchange risks, as with other financial risks, will need to be hedged by the potential investors themselves.

10.5 Technological Risks

Technological risks are a key consideration for Gasenergo, and specifically for the Shakhtinskaya project. Here, much of the equipment has already been procured and delivered to the job site since 1992. For such critical components as the gas turbines from the manufacturer in Ukraine, the one-year repair and replacement warranty has already expired. Furthermore, such contractual terms as liquidated damages for equipment non-performance were not incorporated into the original agreement.

A clear opportunity to mitigate the equipment non-performance risk for Shakhtinskaya is to purchase an extension of the original warranty from the turbine manufacturer to guarantee equipment repairs and replacement in case of failure or non-attainability of performance standards. Gasenergo is currently pursuing this option with Zarya, the equipment manufacturer in Ukraine.

10.6 Force Majeure Risk

The unlikely event of damages and losses resulting from a non-political force majeure event, such as an earthquake, is generally a risk that can be covered through insurance. While Gasenergo had not addressed this issue at the time of K&M's evaluation of the Shakhtinskaya project, it is currently conducting discussions with Energogarant, the insurance company, on obtaining insurance against this type of force majeure event.

10.7 Conclusions

The current approach of Gasenergo is structuring the Shakhtinskaya project exposed the project to significant and unnecessary risks. To a large extent, however, these risks can be effectively mitigated through the introduction of modifications in the project's current structure and agreements. If adopted, K&M's recommendations in mitigating commercial, financial and technological risks would reduce the project's risks to an acceptable level from the point of view of a foreign investor. It is the responsibility of the foreign investor, however, to seek mitigation of the political risks affecting investments in power projects in Russia.

TABLE 10-1

GASENERGO/SHAKHTINSKAYA RISK PROFILE

Typical Risk Category	Current Structure for Shakhtinskaya Project	Preliminary K&M Recommendations for Improvement	Gasenergo Response to K&M Suggestions
Political Risks			
Enforcement of Contracts	Arbitration Court if No Decision is Reached	Arbitration Procedures Incorporated into Agreements, Performance Bonds	Possibility for Gasenergo to Revise Agreements
Changes in Tax Laws, Customs, Licensing Procedures	Tariff Set is High to Absorb Impact	Tariff Provisions to Absorb Cost Increases	Project Responsibility
Constraints on Currency Convertibility and Profit Repatriation, Expropriation	None for Project	MIGA/OPIC Insurance for Expropriations, Pledge from Rostovenergo to Compensate for Expropriation	Foreign Investor Responsibility
Political Force Majeure: War, Terrorism	None for Project	MIGA/OPIC Insurance, Gosincor	Foreign Investor Responsibility
Commercial Risks			
Failure by Utility to Make Payments	0.5% Penalty Built-Into Power Purchase Agreement, Purchasing Utility Part Owner in Project	Arbitration Procedures Incorporated into Agreements	Possibility for Gasenergo to Revise Agreements
Construction Delays Due to Owner	Project Responsibility	Project Company Liable for Losses	Project Responsibility
Construction Delays Due to Construction Contractor	Project Responsibility	Contractor Responsible for Construction Delays and Payment of Penalty	Risk Insurance Being Pursued by Gasenergo

Typical Risk Category	Current Structure for Shakhtinskaya Project	Preliminary K&M Recommendations for Improvement	Gasenergo Response to K&M Suggestions
Operating Losses Due to Faulty Design	Project Responsibility	Minimized Through Selection of Experienced Equipment, Contractors and Proven Design	Risk Insurance Being Pursued by Gasenergo
Outage or Losses Due to Operator Error	Project Responsibility	Responsibility of Operator, May be Insured	Risk Insurance Being Pursued by Gasenergo
O&M Expense Overrun, Operator Breach of O&M Agreement or Operator Insolvency	Project Responsibility	Operator Responsible for O&M Plan Overruns, Indemnity from Operator	Risk Insurance Being Pursued by Gasenergo
Personal Injury During Construction and Operation	Social Benefits	Third Party Liability Insurance	Risk Insurance Being Pursued by Gasenergo
Fuel Unavailability	Fuel Supply Agreement	Long Term Fuel Supply Contract with Liquidated Damages	Possibility of Rostovenergo Guaranteeing Fuel
Financial Risks			
Exposure to Hyperinflation	Expected Tariff Adjustments to Inflation by Federal Commission	Tariff Indexation	Project Responsibility
Exposure to Exchange Rate Changes	Expected Tariff Adjustments to Inflation by Federal Commission	Tariff Indexation	Project Responsibility

Typical Risk Category	Current Structure for Shakhtinskaya Project	Preliminary K&M Recommendations for Improvement	Gasenergo Response to K&M Suggestions
Fuel Price Increases	Expected Tariff Adjustments	Tariff Indexation, Purchasing Utility Procures Fuel	Project Responsibility, Possibility for Utility Procurement of Fuel
Competition from Lower Cost Producers/ Imports	Little Competition Expected from RAO and Power Imports	Long Term Power Purchase Agreements	Project Responsibility
Technological Risks			
Equipment Failure	Manufacturer Warranty Expired, Experienced Equipment Selected	Liquidated Damages Agreement with Manufacturer, Extension of Warranty Agreement	Possibility of Warranty Extension for 1 Year
Equipment Sub-Performance (Output & Environmental)	Manufacturer Replaces Equipment, Experienced Equipment Selected	Liquidated Damages Agreement with Manufacturer	Possibility of Warranty Extension for 1 Year
Non-Political Force Majeure			
Natural Disasters	No Insurance	May be Insured, Capacity Payments Could Continue According to Contract	Risk Insurance Being Pursued by Gasenergo

Note: This risk analysis is based on typical risks that may be present in small projects that are developed by Gasenergo as a controlling private developer.

11.0 Economic and Financial Analysis

11.1 Introduction

The financial viability of the Shakhtinskaya project is analyzed in this section based on project capital and operation and maintenance (O&M) costs, as well as heat and power tariffs and fuel costs provided by Gasenergo for the Rostov region. As shown in the analysis presented here, this project is capable of generating significantly high levels of returns of 20-30% internal rate of return (IRR). Based on the tariff structure currently adopted, however, the viability of the project remains highly vulnerable to such economic factors as inflation, currency exchange rates, fuel prices, and adjustments in wholesale heat and electricity tariffs.

This section analyzes the sensitivity of the project's returns to the economic factors mentioned above from the perspective of a foreign investor. A series of scenarios are developed and presented to determine a likely range of outcome for project IRR based on a variety of forecasts and assumptions for these factors. Finally, an alternative tariff structuring approach to minimize the sensitivity of project returns is also suggested here.

11.2 General Assumptions

The fundamental measure of the viability of the Shakhtinskaya project adopted in this analysis is after-tax IRR. This IRR is based on an after-tax stream of rouble revenues for the project converted to US dollars under a variety of monthly exchange rate assumptions given for 30 years of the project's useful life.

11.2.1 Operating Data

The operating data utilized in the analyses here reflect the plant operating data developed by Gasenergo and Energoperspectiva, the designers of the plant. These include the operation of the plant for 7,500 hours per year (at 85.62% capacity factor), generating a combined total of 493.5 GWh of net power and 975,000 Gcals per year. Total operating plant capacity is 65.8 MW for electricity production and 122.2 Gcal/h for heat. Auxiliaries represent 6% of capacity.

Financial close for the plant is assumed for June 1994 for the purposes of analysis. The first two units of the plant are expected to be commissioned in July 1995, and the last two units in January 1996. The expected useful life of the plant is assumed for 30 years.

11.2.2 Currency and Inflation

All capital and O&M expenditures are represented in roubles, and have been escalated by inflation rates assumed for each month of the period prior to the expenditure. Likewise, the cost of fuel as well as heat and power tariffs in roubles have been each escalated by different monthly factors that are varied for each of the forecasting scenarios utilized in the analysis here.

Monthly exchange rates for each of the 30 years of operation have been forecasted for each of the scenarios developed for this analysis. Net after-tax profits are converted into US dollars based on the currency exchange rate of the period, to arrive at IRR estimates.

While relatively high monthly rates of rouble devaluation have been assumed for the period until the year 1999, in most scenarios analyzed here the monthly inflation rate and the fuel and tariff indices have been forecasted to be higher than the exchange rate every month. This is based on the assumption that the Russian economy will continue its trend of high inflation or even hyper-inflation and prices will continue to rise even in dollar-terms, as they have since the liberalization of the rouble in 1991, as shown in Figure 11-1.

Similarly, since fuel costs as well as heat and electricity tariffs to date are significantly undervalued in western standards, the prices of these energy products will be moving closer to world prices, as they have since 1991. To achieve this, therefore, prices in Russia would need to rise at least as rapidly as the devaluation rate of the rouble in the near future. This is a realistic assumption here, and would hold true barring a complete reversal of economic policy in Russia and the reintroduction of subsidies of energy products and constraints on currency exchange rates. Figure 11-1 representing the relative performance of these key indicators in the past 12 months provides a clearer understanding of the historic price and currency trends in Russia. Figure 11-2 provides a representative overview of forecasting assumptions made in most of the scenarios developed for this analysis.

11.2.3 Capital Costs and Depreciation

Capital costs used in these analyses are based on estimates provided by Gasenergo. The cost of expenditures already incurred by the project have been escalated to current prices on the basis of inflation, based upon agreements among all project investors. Estimates of costs for the completion of the plant are given in June 1994 prices. Gasenergo has agreed to provide guarantees that the shares of additional investors would not be affected in case of cost overruns incurred to complete and commission the plant.

Depreciation was assumed at a rate of 5% per year for 20 years, accruing from the first year of the plant's operation. Depreciation has not been incorporated as an actual O&M expense but is treated only as a tax benefit to the project equity owners.

11.2.4 O&M Costs

O&M costs have been assumed to be 3.5% of fixed assets, escalated on a monthly basis by various inflation forecasts under different scenarios. Insurance costs are assumed at 2% of capital costs and are also escalated by inflation.

11.2.5 Fuel Usage and Costs

It is expected that approximately 190 Metric Tonnes (MT) of natural gas will be required to generate each GWh of electricity and 0.17 MT for each Gcal of heat produced. Based on these inputs, natural gas consumption in the plant is expected to reach 265,500 MT/year upon the commissioning of all four units.

The cost of natural given for the Rostov region as of June 1994 was 41.28 roubles/kg of natural gas. At an exchange rate of 1990 prevailing during this period, this cost represents 22.5% of natural gas prices quotes on the NY Mercantile Exchange market (NYMEX). To reach world prices, therefore, fuel prices in Russia would need to increase by 2.3 times in real terms.

While a variety of domestic fuel price forecasts exist, it is extremely difficult to predict the time frame within which gas prices in Russia will reach world prices. While some reports indicate that gas prices will be increased in Russia at a rate consistent with that of inflation until world prices are reached, other analyses indicate that domestic prices for energy products may be capped at 50% of world prices in order to avoid an adverse impact on economic performance. For the purposes of this analysis, however, it is assumed in most scenarios that gas prices will reach world prices at some point before the year 2000. Various scenarios have been developed to analyze the effect on the project of various assumptions of the time frame in which this rise would take place.

11.2.6 Taxes

Four types of taxes have been considered in this analysis, based on the taxation structure presented in the legislative and regulatory overview section of this study (Chapter 8 of Volume A). These include profits taxes, dividend taxes, property taxes, and taxes based on salaries. Annual property taxes are calculated based on net book value of the plant and are incorporated as quarterly expenditures.

Corporate profit taxes in Russia are set between 35% - 38%. In addition, a number of other taxes, including local profits taxes are also applied to corporate income. For the purposes of this analysis, these taxes, including the corporate tax, were set conservatively at 41%.

Dividend taxes of 15% have also been applied for dividends paid to the shareholders of the Shakhtinskaya project joint stock company. These taxes have been applied to earnings remaining after the payment of the 41% profits tax. In this analysis, all cost and revenue figures are calculated excluding VAT taxes.

11.2.7 Financing

The additional capital required to complete the Shakhtinskaya plant is expected to be in the form of an equity investment by a private party. Thus, 100% of the plant will be financed through equity.

11.3 Tariff Structure

11.3.1 Characteristics of the Current Tariff

In accordance with the current agreement between Gasenergo and Rostovenergo the heat and power tariff of the Shakhtinskaya plant will be equivalent to 97% of the value of the wholesale heat and electricity tariffs of the Rostovenergo system. The wholesale tariff for electricity is defined as the cost of purchasing power from RAO EES Rossii in the Rostov region. The wholesale rate for power for Rostovenergo on June 1994 was assumed at 55.4 roubles/KWh and 29,700 rouble/Gcal for heat based on information provided by Gasenergo and Rostovenergo.

The wholesale power tariff for Rostovenergo is estimated in this analysis to be 47.3% of world prices for electricity, assumed to be approximately 5.5 cents/KWh. Here, the heat tariff is assumed to be similarly undervalued compared to international benchmarks.

Assuming no escalation in tariffs and costs, the tariff breakdown for the plant upon operation of all units would be as follows: 20.0% for fuel costs, 9.1% for fixed and variable O&M expense, and 70.1% for gross profits. This is primarily due to a 75% undervaluation of fuel costs vis a vis world prices. Only 29.1% of total revenues, therefore, are affected by cost escalation. Here, the project can generate a constant revenue stream for investors as long as the 70% gross profits component is escalated to compensate for the currency devaluation.

The above breakdown explains the wide range of returns that are demonstrated in the next section based on different scenarios and inflation forecasts. This range varies from as much as 45% IRR is some cases, to a financial loss in others. For example, given a case in which wholesale electricity tariffs in Russia escalate by inflation, the 70% gross profits component, which is generally unaffected by inflation and more dependent on exchange rates, would be increased at a higher rate than currency devaluation. This would therefore lead to a tremendous increase in project returns.

If, on the other hand, wholesale tariffs are maintained relatively constant, and at the same time gas prices are raised gradually to world levels, the fuel cost component may reach as much as 80-90% of the project's tariff. This, compounded with the cumulative effect of income and dividend taxes would essentially eliminate any project returns unless tariffs are also raised to compensate for these costs.

In the current economic environment of Russia it is as difficult to predict with accuracy the future of electric and heat tariffs as it is to predict inflation and fuel prices. The interrelationship between these factors, however, is of tremendous significance to the viability of the Shakhtinskaya project under its current tariff structure. As with fuel prices, it is reasonable to predict that the cost of power will probably approximate world prices by the year 2000. The critical issue for the viability of this project is the time frame in which this rise will occur.

As can be seen in Figure 11-1, electricity tariffs in Russia have historically maintained a direct relationship with inflation, and the Federal Power Commission, which regulates RAO EES Rossii intends to maintain wholesale tariffs at a level that allows RAO's plants to compensate for operating cost increases. No detailed analysis has been performed, however, measuring tariff increases that will be needed in the future to compensate for inflation. It is not clear, therefore, whether only specific components of RAO's tariffs would be increased to compensate for operating cost increases thereby raising the full amount of the tariff by a rate lower than inflation.

The effect of gas price increases is also not clear on RAO's wholesale tariff. As this tariff is an average of the cost of producing power from natural gas, nuclear, hydro, coal, and oil-fired plants, RAO can sustain a rise in the cost of any one of these fuels with a relatively lower increase in the tariff as long as the remaining sources of fuel do not increase as rapidly. Therefore, it may not be accurate to assume that wholesale electricity tariffs will automatically be adjusted to gas cost increases.

Given the difficulties involved in predicting inflation, gas prices and power tariffs in Russia as well as the project's high level of sensitivity to these factors, the numerical relationship between the project's IRR and a wide range of forecasting scenarios is presented in Section 11.4.

11.4 Project Viability and Sensitivity Analysis

In order to analyze the sensitivity of the Shakhtinskaya project's IRR to the key indicators mentioned above a range of likely forecasting assumptions were developed and input into a financial model for the project. These analyses can be placed in three major categories presented as sections 11.4.1 through 11.4.3. The first category incorporates Russian government forecasts which tend to enhance the financial profile of the project. The second series of scenarios tests the sensitivity of the project's IRR to changes in inflation, assuming that the electricity tariff would be increased by inflation, given a certain time lag. Finally, the effect of gas prices on the project's returns were analyzed within a context of power tariffs also rising to world prices in various time frames.

11.4.1 Project Sensitivity: Optimistic Forecast Scenarios

The Shakhtinskaya project's returns are most promising when the government forecast for inflation and currency devaluation are adopted for sensitivity analysis. According to this forecast monthly inflation rates will decrease from around 10% in 1994 to 1.5% in mid-1997. The devaluation of the rouble will also decline from around 5% per month in 1994 to 1.4% in 1997. Here, the electricity tariff is expected to rise in parallel to inflation. Based on these forecasts, the tariff for electricity is expected to rise to world market prices by mid-1996, while gas prices rise to 60% of the level of world prices in the same time frame. These prices are expected to stabilize by 1996-1997. This government forecast is presented in Figure 11-2.

The second scenario analyzed based on government forecast data is one in which the electricity tariff rises lag the inflation rate by half of a year. The results of both of these scenarios are presented in Table 11-1

Table 11-1

Scenario	Heat/Power Tariffs	Cost of Fuel	IRR
Government Forecast Scenario #1	Rise to world prices in 2 years	Rises to 50% of world prices in 2 years	**40.7%**
Government Forecast Scenario #2	Rise to world prices in 2 years	Rises to 50% of world prices in 2 years	**38.1%**

11.4.2 Project Sensitivity to Inflation

One of the key uncertainties in the economy of Russia, and a major determinant of fuel and tariff prices for the Shakhtinskaya Project, is the level of inflation rates that will prevail in the country in the near future. Three series of scenarios were developed here to show the impact of various inflation trends on the viability of the Shakhtinskaya project.

The first group of inflation-based scenarios assumed a high inflation rate of 3 to 6% monthly for 1994 through 1996, with 1.5% per month from 1996 to 1999, and a 3% real annual rate thereafter. In these scenarios it was assumed that tariff rises would lag inflation by a period of 3 months, and the cost of gas would increase to world prices by mid-1998. As shown in Figure 11-3, the resulting IRR varies significantly within a range of 17 to 30%, declining further as a low rate of inflation is assumed.

The second group of scenarios assumes a more pessimistic trend in inflation by setting the monthly inflation rate for the period of 1996 to 1999 at 2.5% monthly. The inflation rate for 1994 to 1996 is again varied from 4 to 6% monthly, as the currency devaluation rate is assumed to be 3% per month until 1996, 1.5% per month until 1999, and 0.5% per month until the end of the plant's life. Here also, the cost of gas is set to increase to world prices by 1998. Figure 11-4 plots the IRR results for each of the scenarios, showing a rate of return in a range of approximately 20-30%, rapidly declining as a lower inflation rate is assumed.

The third set of inflation-based scenarios assumed an even greater level of hyperinflation, while lagging tariff increases behind inflation by a period of 6 months. Here, inflation rates were varied from 3 to 6% per month for the period of 1994 through 1999, stabilizing at an annual real inflation rate of 3%. The currency decline was set at 3% for the period of 1994 through 1999, declining to 2% thereafter. Gas prices were set to increase to world prices by mid-1998, escalated by a real rate of 3% per year thereafter. The results of this analysis is shown in Figure 11-5, with IRR varying significantly within a range of 20% to 22% and declining to zero under higher inflation rate assumptions.

11.4.3 Project Sensitivity to Fuel Costs

Two additional sets of scenarios were developed to analyze the sensitivity of the project to various forecasts of rises in fuel costs. In the first set of scenarios the monthly rouble devaluation rate was assumed to be 3% until 1999 and 1% until the end of the plant's useful life. Inflation was assumed at 5% monthly until 1997, 4% until 1999, and 3% real annual inflation thereafter. Here the heat and electricity tariffs were set to increase to world prices by mid-1999. Various scenarios for gas cost trends were assumed, with the cost of fuel increasing to world prices within 2.5, 3, 3.5, and 4 years from mid-1994. The results of these scenarios are summarized in Table 11-2, showing a general range of 21-24% of IRR for most scenarios, with a significant decline in IRR as fuel costs are increased to world prices rapidly.

Table 11-2

Scenario	Heat/Power Tariffs	Cost of Fuel	IRR
Scenario #1	Rise to world prices in 5 years	Rises to world prices in 4 years	**24.2%**
Scenario #2	Rise to world prices in 5 years	Rises to world prices in 3.5 years	**23.6%**
Scenario #3	Rise to world prices in 5 years	Rises to world prices in 3 years	**22.8%**
Scenario #4	Rise to world prices in 5 years	Rises to world prices in 2.5 years	**22.1%**
Scenario #5	Rise to world prices in 5 years	Rises to world prices in 2 years	**21.5%**

The second set of analyses tied the rate of increase of the heat and power tariffs to increases in gas costs with a lag of 1 year. Gas prices were accelerated to world prices within a range of 2 to 5 years and increased thereafter by a real annual inflation rate of 3%. Tariffs were also capped at world prices and increased thereafter by the same real inflation rate. Currency devaluation was assumed at 3% monthly until mid-1996, 1% until mid-1999, and 0.5% per month until the end of the plant's life. Local currency inflation was set at 5% monthly until 1996, 1.5% until 1999, and at a real annual rate of 3% thereafter. Figure 11-6 provides a summary of IRR results based on the various scenarios analyzed. In general, the resulting rate of return for the scenarios was within a range of 23-26%, with IRR declining significantly when both gas costs and tariffs were escalated at a lower rate.

11.5 Analysis and Conclusions

The analysis presented above demonstrates that the Shakhtinskaya project does provide an opportunity for potential investors to earn a significantly high rate of return on the investment, in some case in the range of 20% to 30%, and even 40%. These returns, however are shown to be extremely sensitive to even relatively minor variations in all key economic indicators, including inflation, currency exchange rates, and fuel costs. As a result, these tariffs should be structured in a manner that maintains the potential benefits of high returns to investors, while also providing for a hedging mechanism that prevents investors' exposure to low returns and financial losses.

One option that would potentially be attractive to the project's investors would be for the Shakhtinskaya project company to enter into an agreement with Rostovenergo to give the plant flexibility in mitigating economic risks. To this end, Gasenergo should explore with Rostovenergo the possibility of maintaining the current tariff structure under normal economic conditions, while obtaining from the utility a certain guaranteed rate of return in the event of unpredictable changes in fuel prices, inflation and exchange rates. This risk mitigation mechanism could be structured as a two-part tariff that allows for the pass-through of fuel costs and increases in O&M components of the tariff by inflation, while adjusting fixed and capacity charge components in a manner that would enable project investors to earn a minimum allowed rate of return. Under such an agreement the project would continue to supply power to Rostovenergo at a 3% discount of the utility's avoided cost of importing power, while reallocating financial risks from the project to the utility company.

Figure 11-1
Economic Indicators: May 1993 to May 1994

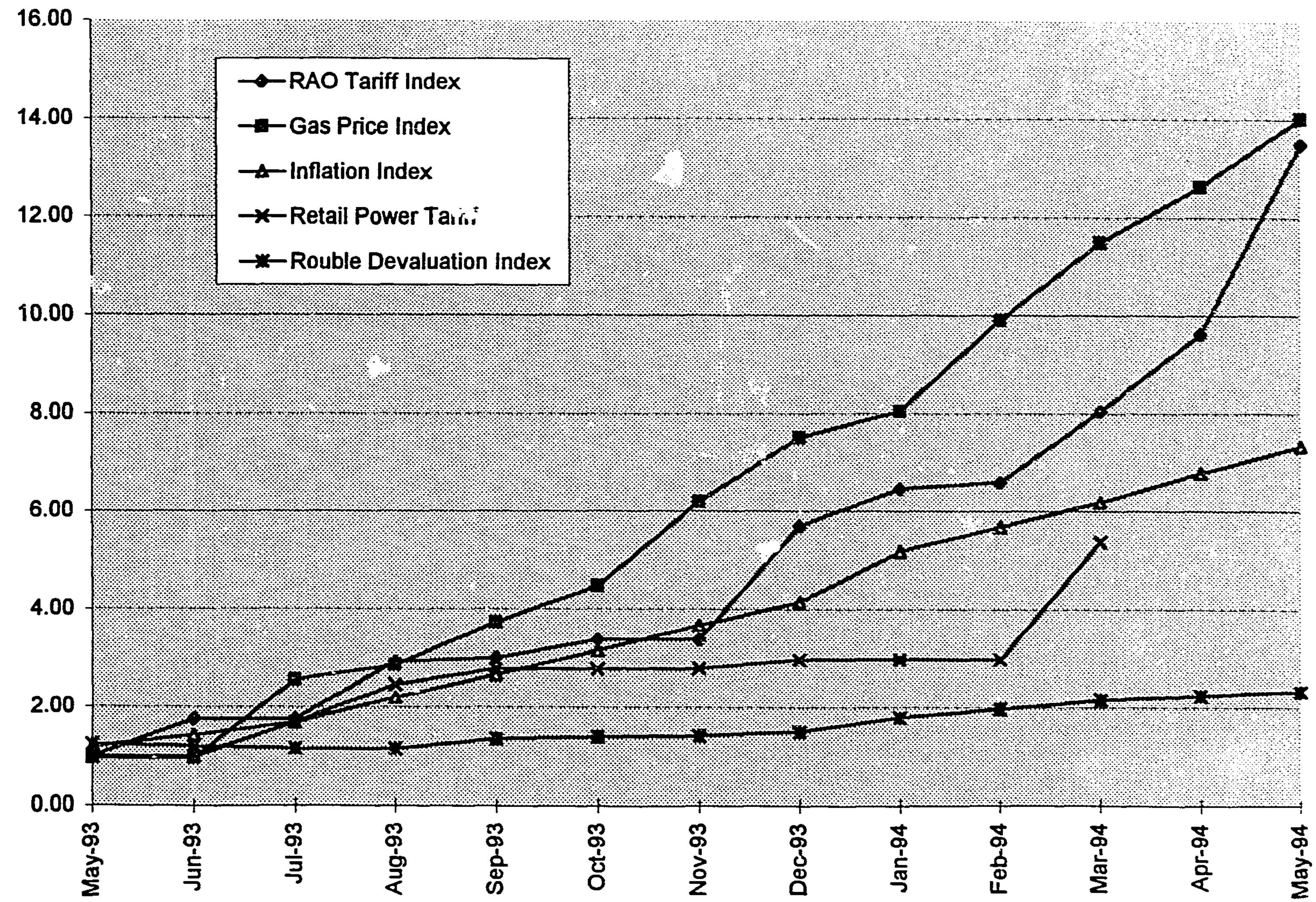


Figure 11-2
Example of Optimistic Forecast Scenario:
From: State Statistics Committee

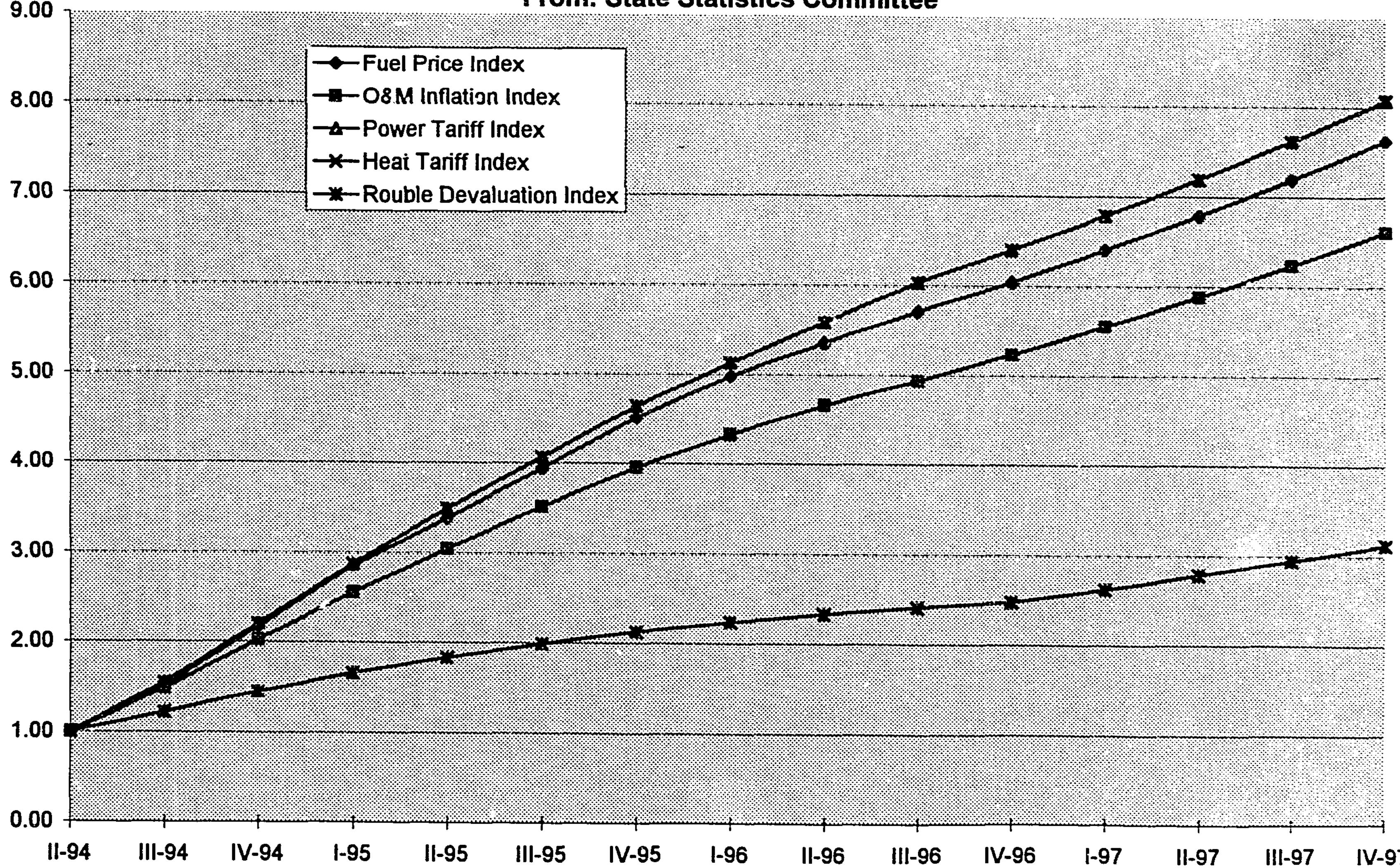
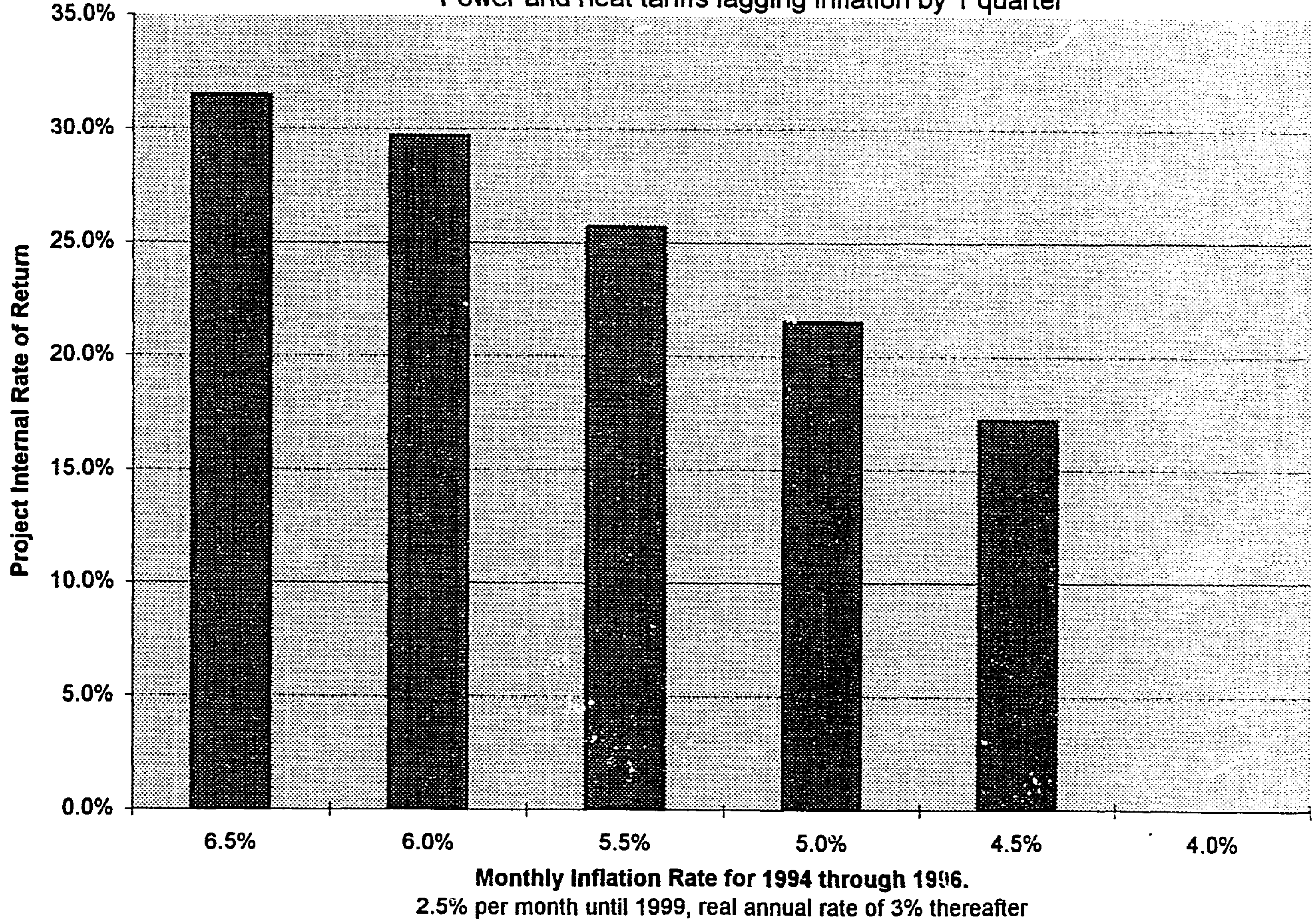


Figure 11-3
Assumptions: Cost of fuel increasing to world prices in 4 years
Power and heat tariffs lagging inflation by 1 quarter



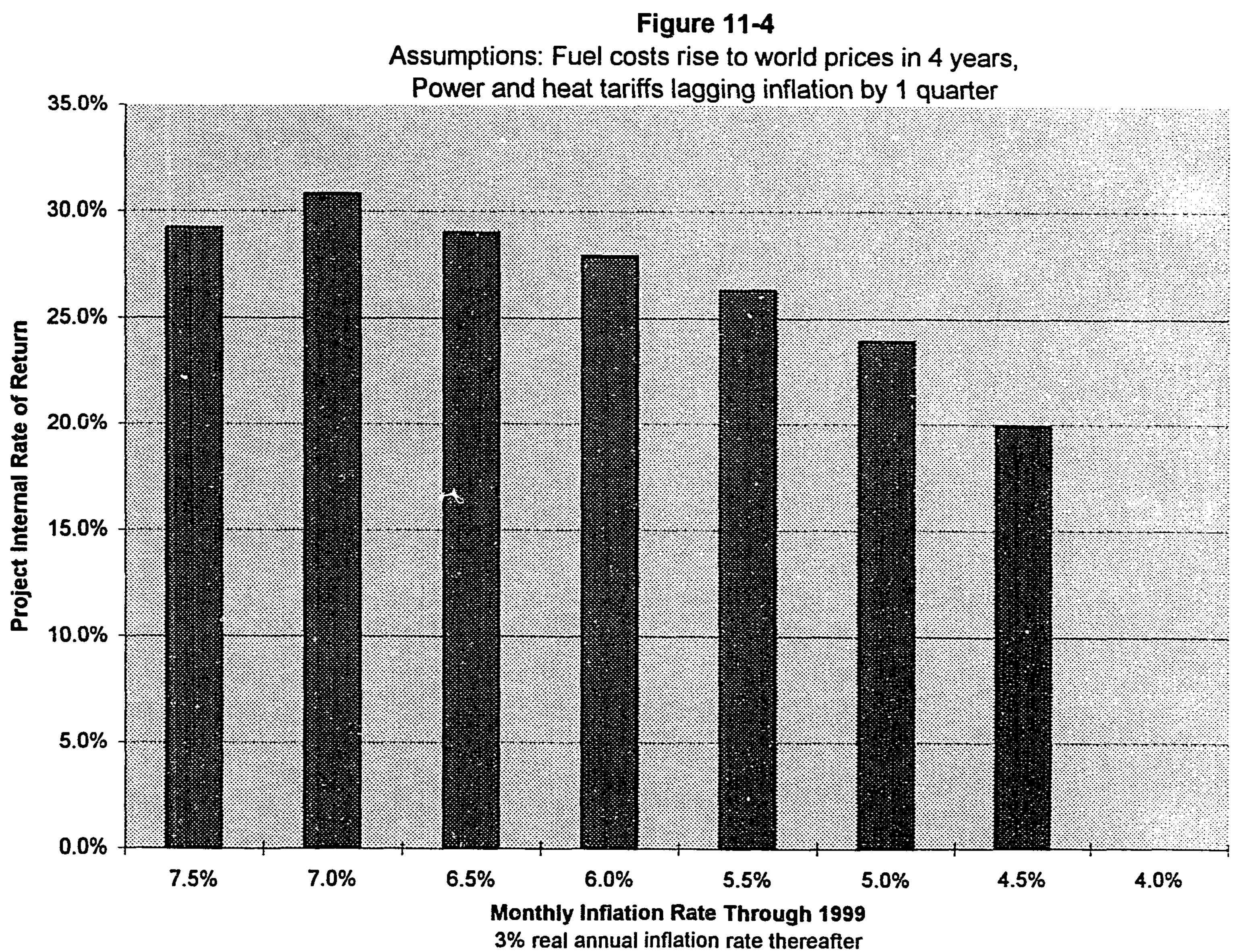


Figure 11-4
Assumptions: Fuel costs rise to world prices in 4 years,
Power and heat tariffs lagging inflation by 1 quarter
Project Internal Rate of Return
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
7.5%
7.0%
6.5%
6.0%
5.5%
5.0%
4.5%
4.0%
Monthly Inflation Rate Through 1999
3% real annual inflation rate thereafter

Figure 11-5
Assumptions: Fuel costs rise to world prices in 4 years,
Power and heat tariffs lag inflation by 2 quarters

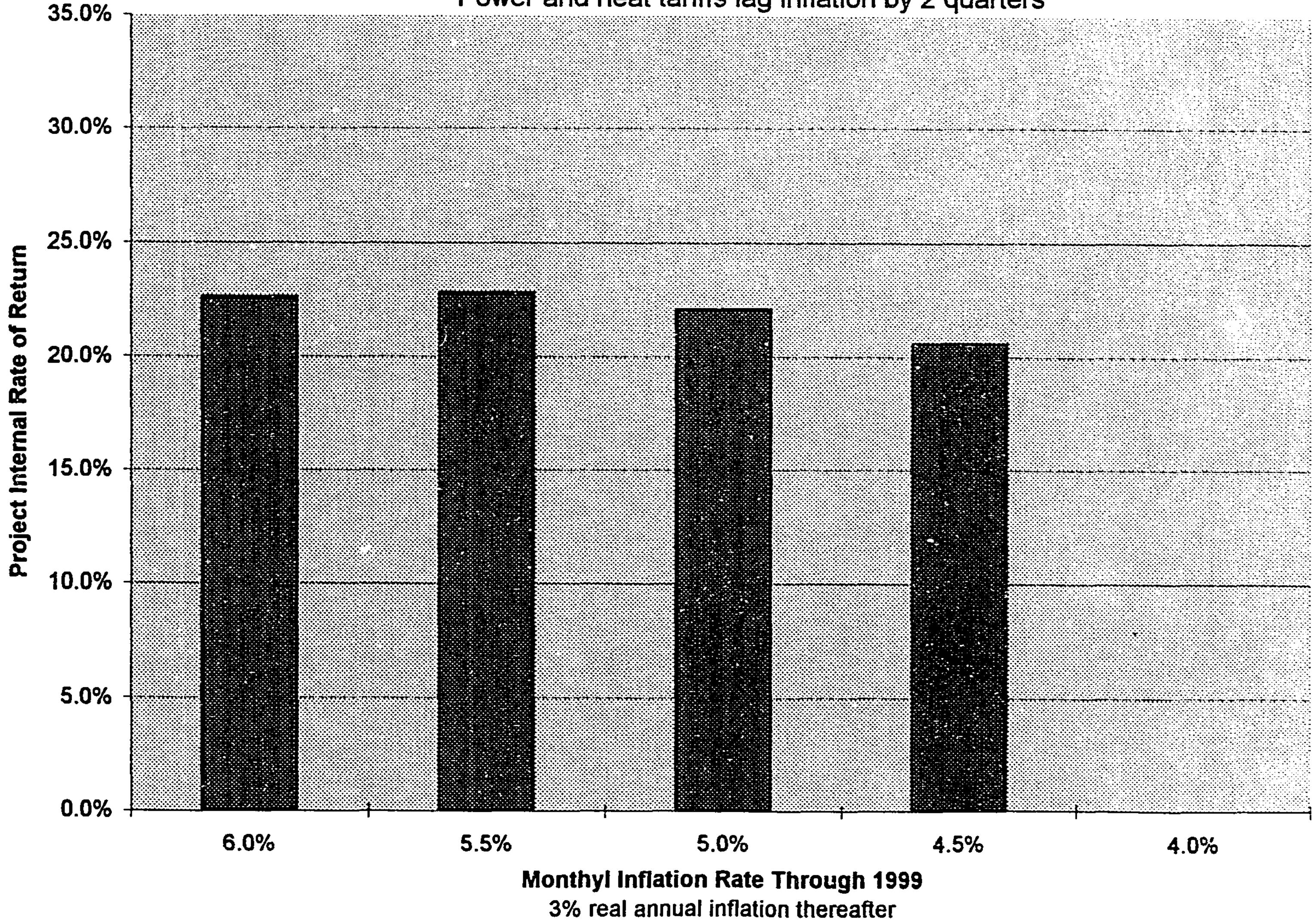


Figure 11-6
Assumptions: Power and heat tariffs lagging fuel rises by 1 year
5% monthly inflation until 1996, 1.5% until 1999, and 3% real annual thereafter