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DISTRICT HEATING AND COOLING SYSTEMS FOR COMMUNITIES THROUGH POWER PLANT RETROFIT DISTRIBUTION NETWORK

Phase 2, Final Report for the Period March 1, 1980—January 31, 1984

January 31, 1984

Work Performed Under Contract No. AC02-78CS20071

Public Service Electric & Gas Company
Newark, New Jersey

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DISTRICT HEATING AND COOLING SYSTEMS FOR COMMUNITIES THROUGH POWER PLANT RETROFIT DISTRIBUTION NETWORK PHASE 2

FINAL REPORT

FOR THE PERIOD

1 MARCH 1980 - 31 JANUARY 1984

VOLUME II

REPORT DATE: 31 JANUARY 1984

WORK PERFORMED UNDER CONTRACT

DE-AC022-78CS20071

PUBLIC SERVICE ELECTRIC & GAS COMPANY
80 PARK PLAZA
NEWARK, NEW JERSEY 07101

FOREWORD

This is the Final Report of Phase 2 of "District Heating and Cooling Systems for communities through Power Plant Retrofit Distribution Network." It is composed of an Executive Summary and seven volumes:

Executive Summary

Volume I: Detailed Summary

Volume II: Introduction, Load & Service Area Assessment, Institutional Questions, Rates, Financial Considerations

Volume III: Technical Considerations

Volume IV: Cost Estimates, Staged Development Scenarios, Economic Evaluation, Impact on Fuel and the Environment, Alternates to Conventional Heating Systems, Conclusions, Recommendations

Volumes V-VII: Appendices A - C

ACKNOWLEDGEMENTS

The following key personnel contributed to the completion of this report:

PSE&G R&D Department: C. R. Guerra, M. L. Zwillenberg

PSE&G, System Planning Department: M. P. Bhavaraju, T. M. Piascik, F. Cassidy, J. P. Everett, K. Krauszer

Stone & Webster Engineering Corp.: D. Samela, R. Ulfstam, G. Kan

Transflux International, Ltd.: M. G. Kurz

Stone & Webster Management Consultants, Inc.: G. S. Levitt, E. Schiaffino

Numerous contributions by other subcontractor and PSE&G personnel are gratefully acknowledged.

PREFACE

This volume begins with an Introduction summarizing the history, methodology and scope of the study, the project team members and the private and public groups consulted in the course of the study. The Load and Service Area Assessment follows, including:

- A compilation and analysis by Transflux International, Ltd. of existing statistical thermal load data from census data, industrial directories, PSE&G records and other sources.
- An analysis by Stone & Webster Management Consultants Inc. of responses to a detailed, 4-page thermal load questionnaire.
- Data on public buildings and fuel and energy use provided by the New Jersey Dept. of Energy.
- Results of other customer surveys conducted by PSE&G.

A discussion of institutional questions follows. The general topic of rates is then discussed, including a Draft Hypothetical Tariff for Thermal Services prepared by the PSE&G Rates and Loads Management Department.

The final section of this volume discusses financial considerations. This includes a report by Coopers & Lybrand identifying alternative ownership/financing options for district heating systems and the tax implications of these options. Four

of these options were then selected by PSE&G and a financial (cash-flow) analysis done (by the PSE&G System Planning Dept.) in comparison with a conventional heating alternative. Year-by-year cost of heat ($/10^6 Btu) was calculated and tabulated, and the various options compared.

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Detailed Summary

VOLUME III

6. Technical Considerations

VOLUME IV

7. Cost Estimates
8. Staged Development Scenarios
9. Economic Evaluation
10. Impact on Fuel and on the Environment
11. Alternates to Conventional Heating Systems
12. Conclusions
13. Recommendations

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SECTION 1

INTRODUCTION

1. INTRODUCTION

District Heating is actually an American invention! It originated in the late 19th century and its early growth was "fueled" by the availability of cheap "waste" atmospheric pressure steam which became available from small non-condensing electric power plants which were being built in U.S. cities, in close proximity to thermal as well as electric load. With the later introduction of condensing steam turbines, and the replacement of small generating units by much larger ones farther from inner cities, the cost of steam district heating rose, and customers were lost to (then) cheaper sources of heat such as oil and natural gas.

In Europe (particularly Scandinavia, the U.S.S.R. and Eastern Europe, Germany and France), district heating started to grow at about the end of World War II. It grew as a hot water (rather than steam) transmission system. Such factors as lower heat loss, less electric generation loss (due to steam extraction at lower pressure) and lower piping cost (due to lower temperature), as well as generally higher energy prices than in the U.S., made the economic picture of European District Heating more favorable than that of U.S. steam district heating.

With the increase in U.S. energy prices since 1973, a second look is being taken at district heating as a means of reducing energy costs and substituting domestic energy sources (coal, wastes) for imported oil.

PSE&G's involvement in cogeneration and district heating began in the late 1950's with large scale combined steam and power production and steam transmission through a pipeline to a nearby oil refinery. In 1975 the Company conducted an internal study of the potential for district heating using waste heat from its electric generating stations. This was followed by a survey of potential industrial cogeneration sites in New Jersey.

In late 1978 the USDOE-funded Phase 1 (Preliminary Feasibility) Study of District Heating was initiated. All of PSE&G fossil-fueled electric generating stations were screened (Figure 1.1), and three northern New Jersey stations (Hudson,

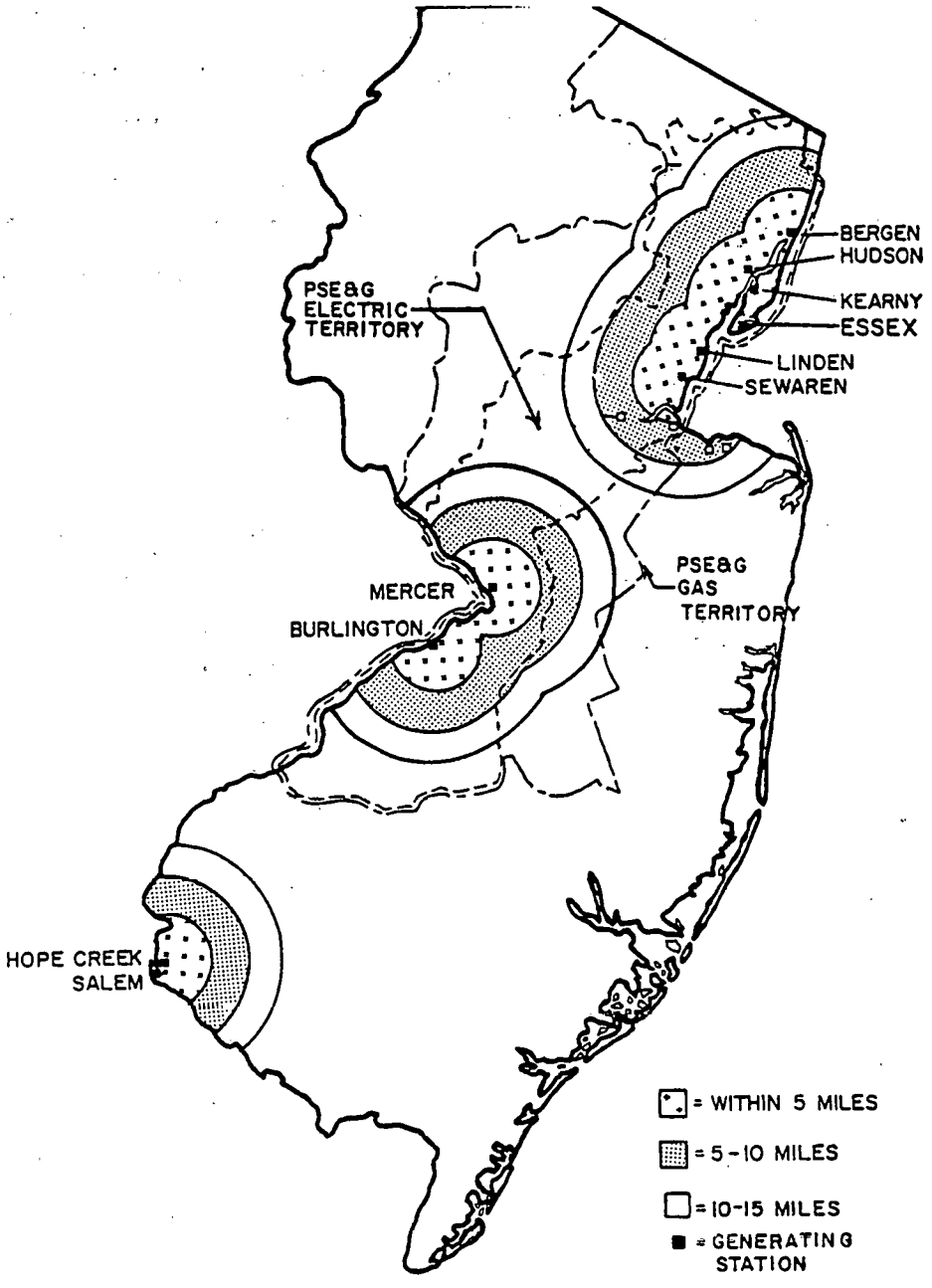

BERGEN
HUDSON
KEARNY
ESSEX
LINDEN
SEWAREN
PSE&G
ELECTRIC
TERRITORY
PSE&G
GAS
TERRITORY
MERCER
BURLINGTON
HOPE CREEK
SALEM
= WITHIN 5 MILES
= 5-10 MILES
= 10-15 MILES
= GENERATING
STATION

FIG. 1.1

Essex and Bergen) in the areas of highest thermal load density, recommended for further study. It was found that there was more than enough potential thermal load within five miles of each of these stations to utilize the available waste heat.

The Phase 2 (Detailed Feasibility) District Heating Study began in 1980 and concentrated on the Hudson Generating Station because of its proximity to the concentrated Jersey City and Newark load areas and the new developments planned for the Hackensack Meadowlands. Initially, the oil-fired Essex Unit No. 1 (Newark) and Hudson Unit No. 1 (Jersey City) were also considered. However it was soon apparent that district heating based on coal would be more viable, and the coal-fired Hudson Unit No. 2 was used as the study basis of a large, regional district heating system for northeastern New Jersey (Figures 1.2 and 1.3).

To keep capital investment in step with revenues, the staged development of district heating on the European model was adopted. Hot water transmission was also adopted from Europe, because of its reduced losses, inherent heat storage and reduced electric generation loss. Local heating/cogeneration plants in dispersed areas showing high thermal-load concentrations would be built initially. They would be interconnected first with each other, and later with a heating/cogeneration plant of larger magnitude, the 196 MWe Kearny No. 12 combustion turbine complex and with the 600 MWe Hudson Unit No. 2. The retrofitting of the Hudson Unit No. 2 would itself be done in three stages, to keep heat supply and capital investment in step with thermal load growth and revenues. Thus, the initial Hudson retrofit would provide 200 million BTU/hr, the next stage 800 million BTU/hr and the final output would be 1,600 million BTU/hr. The specific order of connection of heat sources is based on load and reliability considerations, which force the initial retrofit stages of the "central plant" Hudson Unit No. 2 ahead of the "intermediate plant" Kearny No. 12.

Initially, both district heating and cooling were considered. However it was soon found that, in the context of base thermal loading of the (Hudson) central generating plant and a summer-peaking electric utility (PSE&G), cooling was not feasible. Because of the lower COP (coefficient of performance) of absorption vs.

Staged Development and Dispatch Concept

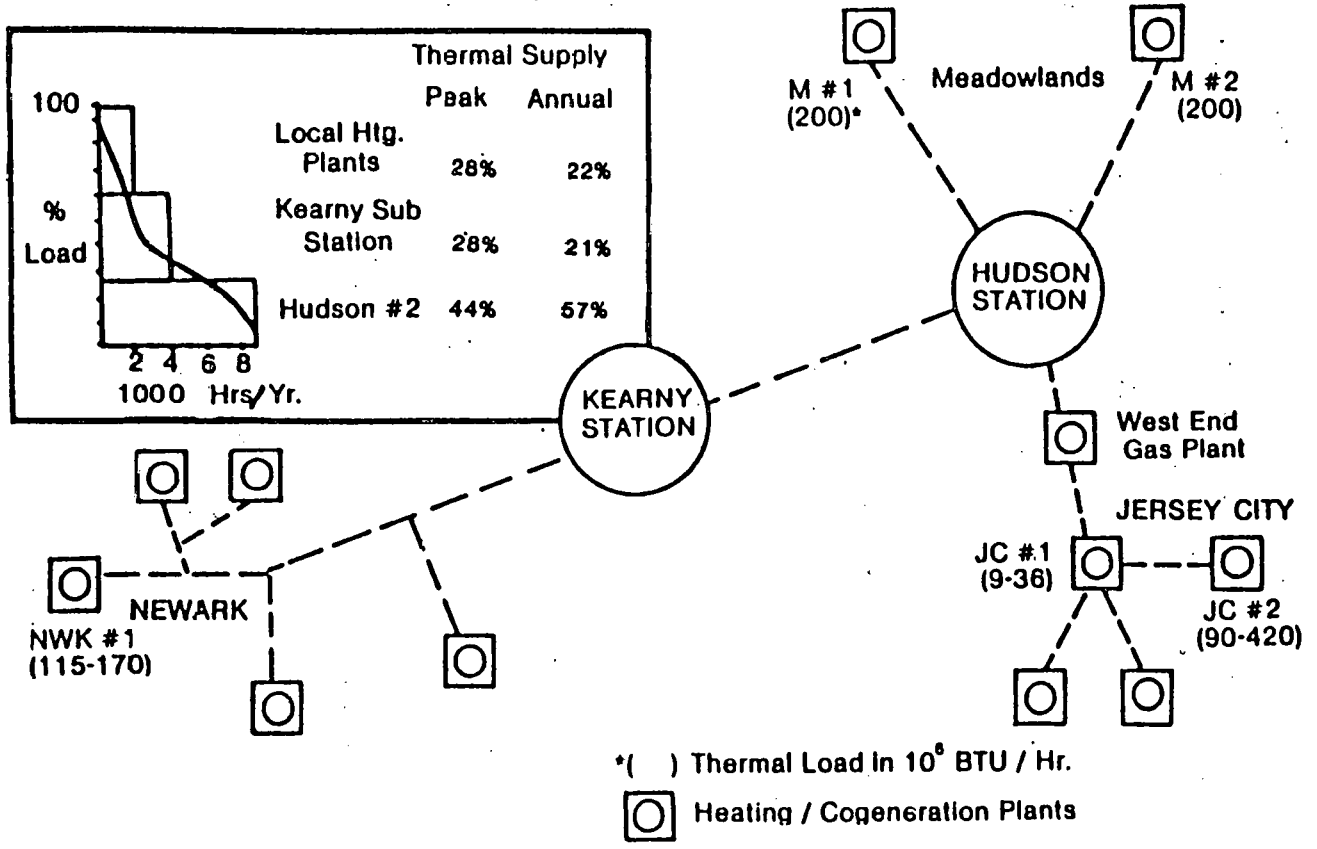


FIG. 1.2

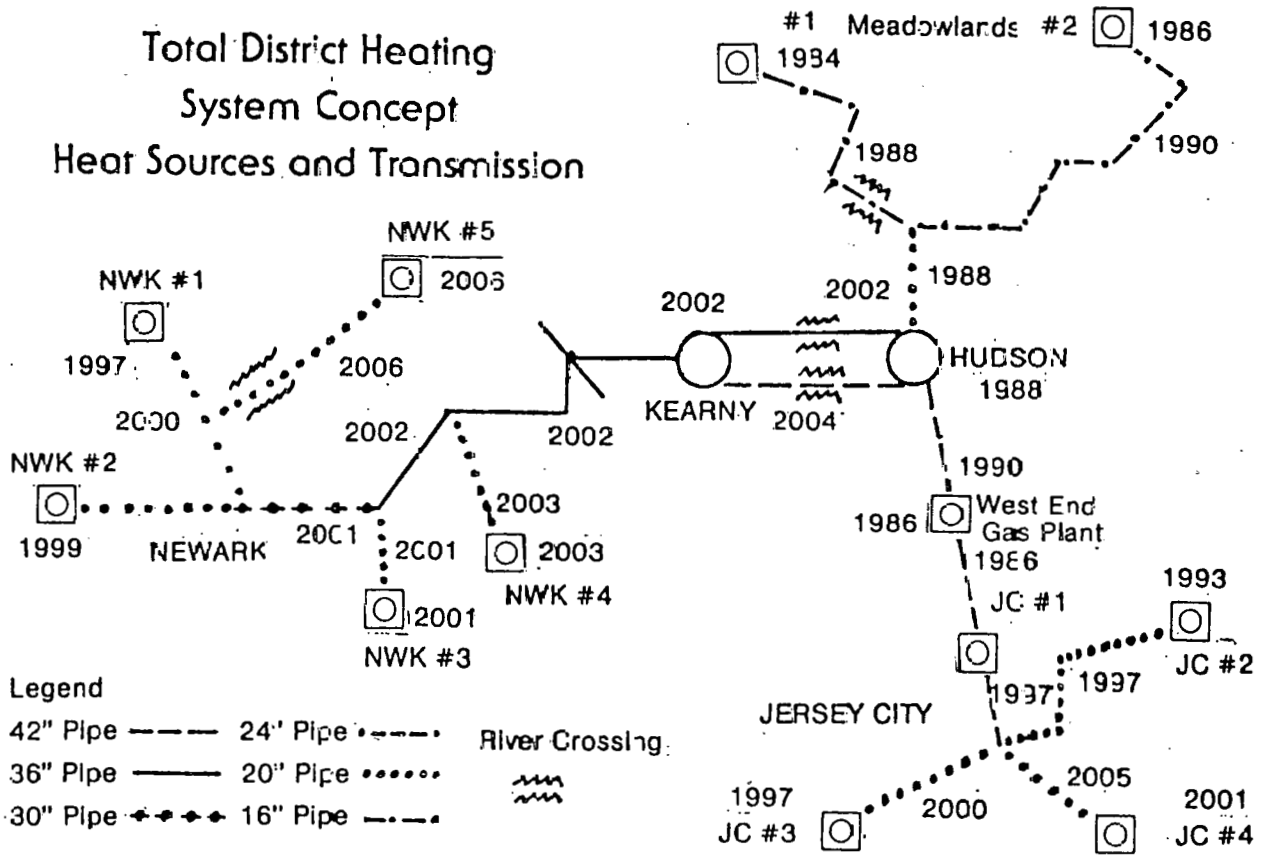

Total District Heating
System Concept
Heat Sources and Transmission
#1 Meadowlands #2
1986
1984
1988
1990
NWK #5
2006
NWK #1
1997
2006
2000
2002
2002
2002
2002
1988
HUDSON
1988
KEARNY
2004
1990
NWK #2
1999
NEWARK
2001
2001
2003
2003
NWK #4
NWK #3
1986
West End
Gas Plant
1986
JC #1
1993
JC #2
1997
1997
JERSEY CITY
2005
1997
JC #3
2000
2001
JC #4
Legend
42" Pipe
24" Pipe
36" Pipe
20" Pipe
30" Pipe
16" Pipe
River Crossing

FIG. 1.3

compression chillers (0.4–0.6 vs. 3.0 or more), the loss in electric generation caused by steam extraction (to provide hot water sendout to run absorption chillers) would exceed the electric consumption of equivalent compression chillers. The central production and sendout of chilled water had already been eliminated by the greater cost of a 4–pipe vs. a 2–pipe transmission and distribution system. The hot water 2–pipe system could not be used to distribute chilled water in the summer because the lower available temperature difference ($20^{o}F$ for cooling vs. $120^{o}F$ for heating) makes the heating pipe undersized for cooling. Thus cooling was removed from further consideration in the context of a large, central, thermal distribution system, and only district heating was considered further. Cooling might, however, be a possibility in certain local, site–specific situations such as, a cogeneration unit run for summer electric demand and providing heat which would otherwise be wasted, and a landfill gas–fueled facility where the gas is produced at a constant rate and would be lost if not utilized during the summer.

The potential for district heating was examined in terms of the total system and two subsystems of overlapping scales:

A. The total system (3.7×10^{9}BTU/hr peak) based on Hudson Unit No. 2, Kearny Unit No. 12 and local gas–fired heating and cogeneration plants built up in staged development on the European model.

B. A major district heating site (200×10^{6}BTU/hr peak) based on a new development or an existing urban housing complex, using landfill gas, natural gas or limited steam extraction from Hudson Unit No. 2.

C. A mini district heating site (on the order of 10×10^{6}BTU/hr peak) based on "stand–alone" cogeneration facilities serving a small number of apartment buildings, and fueled by waste gas, natural gas, or wastes. These could serve as the initial nuclei for district heating system development while being economically viable even if a larger district heating grid (based on a coal–fired central generating station) were not eventually built. The need for this type of facility emerged late in Phase 2 as capital needs and constraints

became apparent. They were thus not studied in detail, but are the subject of on-going PSE&G investigations of district heating options/opportunities for future consideration.

From the perspective of energy efficiency and use of low cost fuel, the staged development of district heating offers the greatest advantages after all the inter-connections with the main thermal source (e.g. power plant) are completed. To facilitate this objective, the development of dispersed district heating/cogeneration sites should be coordinated to ensure that the specifications of the thermal sendout from each site allow it to be eventually interconnected properly into a district heating grid.

The basis of the economic analysis of district heating was that the utility's electric and gas customers would not be economically burndened by the implementation of district heating, and that any incremental costs due to district heating (e.g. district heating capital and operating costs, replacement electric power, abandonment of unamortized gas mains) would be charged to district heating customers.

The project team assembled for Phase 2 included:

PSE&G:

R&D – Project Management and Coordination
System Planning – Economic and Financial Analysis, Rates
Gas Transmission and Distribution – Piping system design and costs
Engineering and Construction – Review of cost estimates and designs
Customer and Marketing – Load survey
Rates and Load Management – Tariffs
Law, Finance, Environmental
Affairs and others listed
in Table 1-I – Consultation in areas of expertise and review of results

TABLE 1-I

PRIME CONTRACTOR DEMONSTRATION TEAM

PSE&G Research Corporation - Advanced Systems, R&D

C. Guerra - Project Manager
M. Zwillenberg - Assistant Project Manager
M. Bhavaraju - Assistant Project Manager

PSE&G Company - Project Coordination Team

Principal	Alternate (s)	Department
G. Bowdren		Elec. Prod. Methods
	C. Cordeiro	Mech. Eng. Pwr. Systems
G. Clarkson/W. Rogers	R. Lark - R. Valiga,	Rates & Load Mgmt.
M. Plawner	L. Oches, E. Moran	Finance - Planning/Resch.
P. Cullen	R. Girol	Marketing - Ind.& Comm.
R. Postlethwaite	W. Harding - K. DePew	Gas T&D
-	-	Marketing - Residential
M. Bhavaraju	J. Everett - 6696	System Planning
M. Vaskis	B. Brown	Governmental Affairs
J. Shissias	S. Siebert	Environmental Affairs
J. Lacey	R. Fryling, W. Hoctson	Law - General Solicit.
C. Sulzberger	-	Law - General Attorney
R. Williamson	R. Houghton	Comptroller - Income Tax
L. Codey	H. Umland	Corp. Rate Counsel
-	-	Finance - Economiv Resch.
C. Wood	-	Fuel Supply
J. Ryan	-	Treasurer's
F. Cassidy	W. Anderson	System Planning - Engg. Econ.
J. Maddocks	K. Marchi	Area Development
J. Latham	-	Contract Admin.
R. Zgorzynski	-	Computer Services
-	-	Res. & Plan.
J. Wright	V. Kolu	Gas Planning
K. Tanis	-	Elec. T&D - Utilities Relocation
R. Boernlein	-	Marketing Residential

Subcontractors:

Stone & Webster Engineering Corp.	– Powerplant retrofit, detailed engineering design and cost estimates
Transflux International Ltd.	– Load determination, conceptual design of district heating systems and heating plants
Stone & Webster Management Consultants, Inc.	– Load assessment questionnaire design analysis of responses
Westinghouse Electric Co.) General Electric Co.)	– Steam turbine retrofit
Coopers & Lybrand Inc.	– Assessment of Financing and ownership options
Trenton State College	– Air quality modeling calculations
N.J. Department of Energy	– Fuel and energy use data
Desert Reclamation Industries Inc.	– Aquifer thermal storage consultant

In the course of Phase 2 of this district heating study, meetings, briefings and consultations have been held with the following groups, to inform them about the potential benefits of district heating, and to solicit their input.

PSE&G Senior Management
New Jersey Board of Public Utilities
New Jersey Department of Energy
New Jersey Department of Environmental Protection
New Jersey Department of Labor & Industry Office of Boiler and Pressure Vessel Compliance
Bergen County Utilities Authority (Sewage and MSW authority)
Hackensack Meadowlands Development Commission
Newark Redevelopment and Housing Authority
Summit Plaza (Former "Operation Breakthrough" Total Energy housing Complex)
Hartz Mountain Industries, Inc.) Land developers in the
Bergen County Associates) Hackensack Meadowlands
Various potential sources of venture capital for "third-party" energy projects

Various aspects of the project results have been reviewed with/by the following firms/individuals with district heating experience under both U.S. and European conditions:

Studsvick (Mr. Peter Margen)
Danpower Inc. (Mr. Peter Jensen and others)
St. Paul District Heating Co. (Mr. Hans Nyman, President)
Swedish Trade Office (Mr. Lennart Henriz)
Ecopipe USA INC.* (Mr. Tommy Anderberg, President)

*Supplier of pipe for the St. Paul district heating system.

SECTION 2

LOAD & SERVICE AREA ASSESSMENT

2. LOAD & SERVICE AREA ASSESSMENT

2.1 Summary

The district heating system under investigation is a system based on either the Hudson G.S. or the Essex G.S. as baseload heat supply sources. The first is capable of providing base load for a total system peak of 4000 million BTU/hr., while the other can supply a 1000 million BTU/hr. system.

The service area assessment was based on industrial/commercial directories and on statistical data. For the Hudson G.S., the Jersey City/Hoboken area and the developing Hackensack Meadowlands area (including Secaucus and parts of Lyndhurst) were evaluated, all within 3-4 miles of the plant. For Essex, the Newark/Harrison area was investigated, also within 3 miles. The results:

	million BTU/hr.	
Jersey City/Hoboken		
- industrial/commercial	135	
- highrise residential	375	
- low-rise residential	2000	2510
Meadowlands		
- new developments	370	
- existing industrial/commercial	40	410
sub-total		2920
- Kearny area new development	270	
Newark/Harrison		
- industrial/commercial	900	
- highrise residential	100	
- low-rise residential	2400	3670
TOTAL		6490

The areas are shown on the enclosed Regional Plan (Fig. 2.1).

These figures do not account for additional potential users as

- heating of public buildings
- heat for process use

Even so, the Essex station maximum output is fully utilized by the capture of 22% of the potential Newark/Harrison market within a three mile radius.

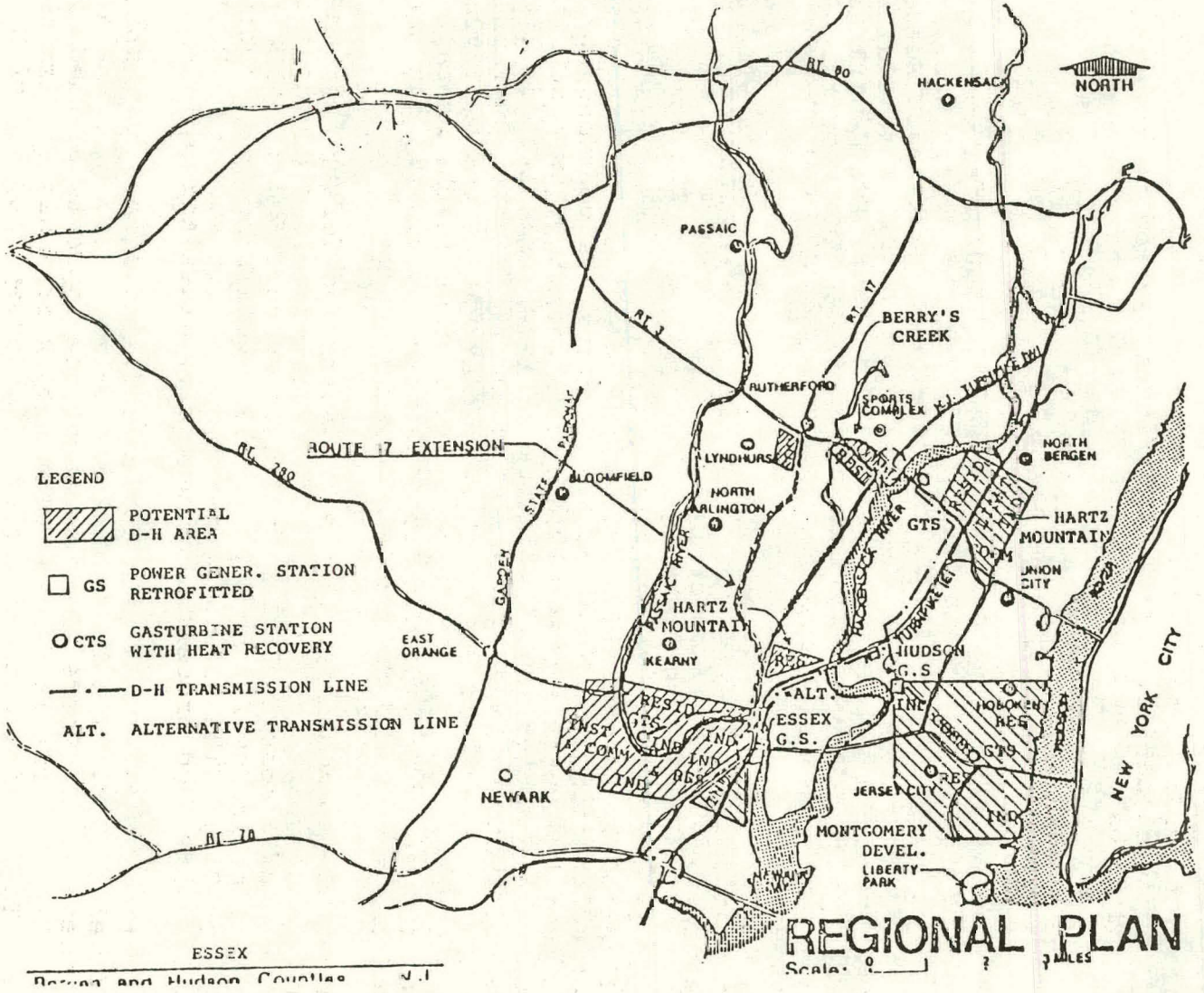

LEGEND
POTENTIAL D-H AREA
GS POWER GENER. STATION RETROFITTED
CTS GASTURBINE STATION WITH HEAT RECOVERY
D-H TRANSMISSION LINE
ALT. ALTERNATIVE TRANSMISSION LINE
ROUTE 17 EXTENSION
HACKENSACK
NORTH
PASSAIC
BERRY'S CREEK
RUTHERFORD
SPORTS COMPLEX
LYNDHURST
BLOOMFIELD
NORTH ARLINGTON
NORTH BERGEN
HARTZ MOUNTAIN
GTS
UNION CITY
EAST ORANGE
KEARNY
HUDSON G.S
ESSEX G.S.
ALT.
NEWARK
JERSEY CITY
HOBOKEN
MONTGOMERY DEVEL.
LIBERTY PARK
NEW YORK CITY
ESSEX
REGIONAL PLAN

Fig. 2.1

The capability of the Hudson No. 2 unit is more than sufficient to provide heat for the total potential market in the Jersey City-Hoboken-Hackensack Meadowlands area within its 10 year development. It is also capable of providing 62% of the potential heat use in both areas combined, including heat derived from intermediate gas-turbine plants and from peaking heater plants.

The regional plan shows not only the supply area found promising, but also the transmission mains and the approximate locations of logical intermediate stage gasturbine stations with heat recovery. The fully developed size of these stations at this point can be estimated to be

Newark - if supplied by Essex	40 MW
- if supplied by Hudson	100 MW
Jersey City	60 MW
Meadowlands	20 MW

A number of small boiler plants will be connected to these gas-turbine facilities. Their total installed capacity will be roughly four times the gasturbine plant capacity in megawatt heat equivalent.

A detailed survey of major potential users is necessary to firm up these figures.

Additional data have been collected also by a number of non statistical methods. Questionnaires had been sent to 280 selected potential customers to find what kind and how much fuel is consumed and in what final form the heat is transmitted. The results show a split of approximately 45% gas and 55% oil of different quality is fired by these enterprises. Nearly 45% of the non-residential customers have steam systems and 70% of these operate at or below 15 psig send-out pressure. The share of steam systems in the overall customer pool is an important consideration because it can materially affect the sizing and operation of an HTW system.

A survey of 41 industrial plants in Newark and Jersey City established heating and cooling loads and fuel usage. The plants surveyed have an hourly peak fuel consumption of approx. 600×10^6 BTU/hr at 17 locations in Newark and approx. 130×10^6 BTU/hr at 24 locations in Jersey City. The plants so surveyed include such high fuel use activities as food processing, chemicals, glass and textiles.

An additional effort was made to identify and assess the impact of new developments. The Hackensack Meadowlands is one of the areas being developed. There are four major developments planned in Jersey City and one in Kearny. The Newark area has no firm major plans. The Housing Authorities of both Jersey City and of Newark have urgent needs in renewing plant and heating systems of their existing housing stock.

2.2 Characterization of the service area

The compilation of data for the determination of the potential district heating areas relied on published information as the first approach. Then special surveys were instituted to refine and confirm the findings.

2.2.1 Data sources

In order to compile a list of potential users, the following data sources were used:

A. Newark (Essex County) Directory of Business, 1972, Greater Newark Chamber of Commerce, Newark, N. J. The relevant pages (pp. G-27 to -76 inclusive) are enclosed.

Hudson County Industrial Directory, 1977, Hoboken and Jersey City Chambers of Commerce. The relevant pages are enclosed.

The businesses listed in these directories are either left as printed, marked with a reference symbol or crossed out. The ones which are unmarked are relatively small (approximately less than 30000 sq. ft.) establishments. Those which do not show the physical size of the enterprise were generally treated the same way unless they employ a large number of people (more than 150-200) or unless they were considered a large potential heat user due to their trade. The enterprises marked by a symbol are considered large users of heat and they were included in a separate list also enclosed.

B. New Jersey State Industrial Directory, 1976.

The relevant pages (pp. G-137 to -161 inclusive) for Newark and Harrison, and pp. G-180 to -192 for Jersey City and Hoboken, have been used to add to and update the data found in the previous sources. The treatment of the entries is identical to that described above, with one addition. Those businesses not shown in the other source and not large enough to be included in the list of major users are marked by a bracket on the right-hand side of the relevant entries.

C. The New Jersey Department of Energy Office of Technical Assistance prepared an inventory of public buildings as part of Stage 1 of Phase 2 of this project. The relevant pages of the Essex and Hudson County summaries are enclosed. Those buildings which are outside the proposed boundaries of the district heating system are crossed out.

D. Data derived from PSE&G Gas Sales Department files pinpointing locations and number of apartment units in buildings having more than 50 units per building. This data was compiled as part of the Phase 1 effort of this project. The details of this work are in Appendix A.

2.2.2 Representation of data

The data compiled from the above sources is represented on the enclosed maps and lists. The list of "Major Industrial & Commercial Establishments within the Newark/Harrison Potential District Heating Area" gives the map marking, name and address, zip code, sq. ft. floor area, number of employees and the type of business and its SIC code number. The map attached to it shows the location of each establishment by its marking. The second map, taken from the Phase 1 Final Report, shows the location of the major multi-family housing units and the number of apartment units in each. It also gives some data on estimated sq. ft. areas of offices in the Newark downtown area, but that should be considered superseded by the data now compiled.

The zip code areas all these establishments fall within are as follows:

07101 to 104
07107, 07108
07111, 07114
07105 Doremus Avenue and environs

The data compiled for Jersey City and Hoboken provides information in the same way as above, including the attached relevant maps.

The zip code areas all these establishments fall within are as follows:

07302
07304 to 307

The Hackensack Meadowlands data originates in the plans of its two major developers, Bergen County Assn. and Hartz Mountain Industries. The adjoining Secaucus (zip code 07094) and Lyndhurst (zip code 07071) data is taken from the same sources as Jersey City's.

2.2.3 Summary data - Newark/Harrison

The investigations yielded the following:

. Major users included in the list -

- sq. ft. floor area where given	24454329
- number of people employed where floor area was given	27899
- number of people employed where floor area was not given	29218

. Users not included in the major user's list -

- where floor area was given	6543507
- number of people employed where floor area was given	50154
- number of people employed where floor area was not given	46103

When one compares the number of people employed in enterprises where the floor area was given, to those where it was not, one finds that they are nearly identical in both the major user and the other user categories. This allows us to extrapolate and reasonably double the floor area figures given. This results in a total floor area of close to 60 million sq. ft. As a very rough estimate, this represents 900 million BTU/hr peak heating requirement for space heating. The over-6000 residential units in highrise apartments represents over 100 million BTU/hr peak heating load. As far as the institutional buildings are concerned, there is not enough data available at this time to derive even an approximate heating load. That should be achieved by the survey.

The statistical review conducted in Phase I of the same area showed that there are over 300,000 people per square mile residing within that potential district heating area. Discounting for the people in the high-rises individually accounted for, the rest of the housing for that population represents a potential of 2.4 billion BTU/hr. peak heating load. There is hardly any single-family housing in this area, with the exception of Harrison. Most of the typical buildings are multi-family row houses.

2.2.4 Summary Data - Jersey City/Hoboken

The investigations yielded the following:

. Major users included in the list -

- sq. ft. floor area where given	3525340
- number of people employed where floor area was given	4937
- number of people employed where floor area was not given	1971

. Users not included in the major user's list -

- where floor area was given	1093400
- number of people employed where floor area was given	2962
- number of people employed where floor area was not given	4920

The statistical review conducted in Phase I of the same area showed that there are 590,000 people per square mile residing within that potential district heating area. Discounting for the people in the high-rises individually acfounted for, the rest of the housing for that population represents a potential of 2 billion BTU/hr. peak heating load. There is hardly any single-family housing in this area. Most of the typical buildings are multi-family row houses.

When one compares the number of people employed in enterprises where the floor area was given, to those where it is not, one finds that in the major user category there are less than half, while in the other user category there are about twice as many people employed. The extrapolation has to be done by category:

Major users:

$$3.5 \times 10^6 \times \frac{2}{5} = 1.4 \times 10^6 \text{ sq. ft.}$$

Other users:

$$1.1 \times 10^6 \times \frac{5}{3} = \frac{1.8 \times 10^6 \text{ sq. ft.}}{3.2 \times 10^6 \text{ sq. ft.}}$$

So the total estimated industrial/commercial floor area is 8.8 million sq. ft., and as a very rough estimate represents 150 million BTU/hr. peak heating requirement. There have been over 8800 residential units identified

in the Phase I study, all part of highrise or large block of apartment buildings. These represent an approximate peak heating load of 175 million BTU/hr. Institutional building sizes and loads are not identified yet to estimate the load they represent. This also should be achieved by the survey.

2.2.5 Summary Data - Meadowlands

This supply area is characterized by its large new developments. These are planned and expected to be constructed by Bergen County Associates/Rose Assn. (Berry's Creek) and by Hartz Mountain Industries (Secaucus, Kearny). Start of construction is expected in 1982 and cover a 10-15 year span. Some construction by Hartz Mountain is already completed and most of it is unsuitable to be connected to a D-H system without complete reconstruction of in-house heating/cooling systems.

The enclosed tables show chronologically the Berry's Creek development plans for the next 11 years. We have also attached heating/cooling load estimates which these buildings represent. There is no time schedule in force at this moment for the Hartz Mountain developments. One, at Rte. 3 and the N.J. Turnpike has plans drawn up and the list of buildings with load estimates is also attached. On the Kearny development site we have no data. It is an approximately 600 acre site between the East and West spurs of the N.J. Turnpike close to the point where they unite. The development is thought to be mainly residential. The enclosed excerpt from the Hackensack Meadowlands Master Development Plan shows maximum allowable land coverage rates. Multiple housing maximums are 20 units to an acre, and duplexes eight units to one. Assuming half and half of one kind and the other, 14 units per acre is the average. For this kind of buildings the heating load average is 40000 BTU/unit. So the site at full development will need 270 million BTU/hr. This was calculated by reducing the actual building site area to 80% of total acreage, allowing for roads, common areas, etc. When the new developments materialize, the existing communities will also benefit from the service. Secaucus and parts of Lyndhurst are within easy reach of the D-H network necessary to supply the new developments. Major industrial/commercial/institutional users are listed as before on the attached lists. These yield the following:

. Major users included in the list -

- sq. ft. floor area where given	1059900
- number of people employed where floor area was given	1410
- number of people employed where floor area was not given	1510

. Users not included in the major user's list -

- where floor area was given	372150
- number of people employed where floor area was given	905
- number of people employed where floor area was not given	422

The major user category yields an equal number of people employed in enterprises with known building areas and in those without. So the square ft. figure can be doubled. In the non-major user category, the multiplier is 1.5 on the same basis. So the total floor area is estimated at 2.5 million sq. ft. and the heating load at 40 million BTU/hr. peak. Some institutional buildings are shown on the N.J. DOE's attached list, but load figures are not available.

The individual housing in the Secaucus/Lyndhurst area is overwhelmingly single-family structures, not likely to be connected economically to the D-H system.

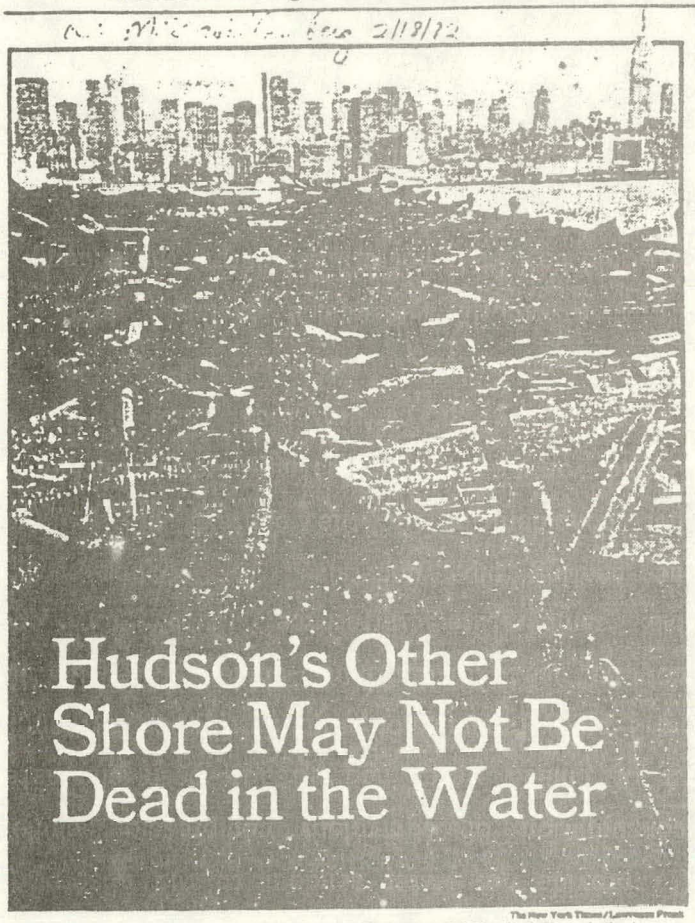
The total estimated load in the area by 1992, if construction proceeds as planned, is 410 million BTU/hr. winter peak. Additional load could be picked up along the transmission main in Union and North Bergen, which were not investigated at this time.

2.3 Special Developments

2.3.1 Port Authority Plans

Enclosed is a newspaper clipping showing the N.Y.-N.J. Port Authority's plans for an industrial development. Two of the prospective sites are within the potential D-H area--the Greenville Yards (No. 3) in Jersey City and Doremus Ave. (No. 4), Newark. There is no decision or detailed plans yet.

Millions Being Invested to Counter Decay in New Jersey Cities



Hudson's Other Shore May Not Be Dead in the Water

The New York Times/Lawrence Frank

Charred piers in Weehawken, N.J. New York City's skyline is at top.

By ROBERT HANLEY

Though its views of the Manhattan skyline are unsurpassed, the New Jersey side of the Hudson River may itself be unsurpassed as an eyesore. The docks and railroad yards of the once-vital waterfront lie rotting and rusting, the victims of vandalism, abandonment and neglect.

Lately, there are signs the scene may soon be considerably less depressing. In Jersey City, a waterfront commission was recently organized by Mayor Gerald McCann and two huge residential and commercial projects are planned. Hoboken, too, has ambitious ideas for piers that have been moribund for a decade.

And in the last few weeks the Port Authority of New York and New Jersey has invested $10.8 million for acreage along the Hudson where it hopes to build a $150 million coal terminal. Officials who anticipate a burgeoning coal market in Europe in coming years, say a facility where trains from Pennsylvania and West Virginia could transfer their cargo to freighters would create a bounty for the agency and, perhaps, as much as $200 million a year for financially strapped Conrail. A Port Authority spokesman said last week that environmental and engineering studies for the project would begin in early spring.

These waterfront plans, though impressive, are not universally praised. Former Governor Byrne, in his final State of the State message last month, bemoaned the "scar tissue of uncoordinated development" along the river. Such sentiments are hardly surprising considering Mr. Byrne's own failed effort to impose state controls over the 17-mile stretch from the George Washington Bridge to Bayonne. In 1970, he appointed a 35-member study commission to assess what regional organization would be required to coordinate develop-

ment, only to have it suggest one dominated by local homerulers. When he countered with a proposal for a board top-heavy with state officials, the communities objected and the measure died.

Mr. Byrne suffered another rebuff last month over Liberty State Park, 700 riverfront acres in Jersey City on which Trenton and Washington have poured about $84 million during the past 20 years in an effort to create North Jersey's answer to Central Park. Mr. Byrne tried to toss out a master plan which emphasized pastoral parkland and instead allow construction of housing, commercial development and even a small amusement center. When open land advocates objected, he pulled back, leaving the park's fate to his Republican successor, Thomas H. Kean.

Aides to Mr. Kean said recently that he has little enthusiasm for the large scale development that Mr. Byrne favored, but did not rule out growth altogether. Neither do Jersey City officials. "We have an open mind to development in and around the park," said Mark Munley, the Director of Housing and Economic Development. "It depends on what the development is."

Since taking office last summer, Mayor McCann has made no secret of his wish to lure professionals and executives to town, regardless of whether they displace the poor. One Jersey City proposal by private developers that has won his blessing is a $300 million plan to build two 75-story glass towers of offices and condominium apartments, the latter with prices starting at around $100,000, directly across the river from the twin towers of Manhattan's World Trade Center.

The architectural echo is no accident. "The whole design is in response to the World Trade Center," said Mr. Munley. The matching towers on each side of the river are envisioned as a "grand entryway to the upper harbor."

North of where these twin towers would rise, a $2 billion housing complex called Gilmcher Harbourside is further along. Construction of the first stage, with 1,400 condominiums and 750,000 square feet of office space, is to begin next year.

Banking on Coal

A few miles south of these developments, the Port Authority spent $6 million for 236 acres in the dormant Greenville railroad yard, where it originally thought about building its coal port. But Mr. McCann, it turned out, had his eye on the yard as a possible site for housing and the agency backed down. Meanwhile, the Port Authority has purchased another waterfront site near the Jersey City-Bayonne border for the coal port.

Wherever it is built, the port would be likely spread dividends up and down the river. It might be especially valuable to Weehawken, where the bankruptcy last year of Seatrain Lines has stripped the town of about 20 percent of its yearly tax revenues and left a big dock idle. It could also speed development of the Erie Lackawanna Ferry Terminal and three huge piers near it in Hoboken.

Those piers were used to ship American troops overseas during World War I — they are still called the "Doughboy Piers" — and to ship battlefield supplies to the front during World War II. (They are also the setting for "On the Waterfront," which starred Marlon Brando.) The piers are too small for containerization, which has revolutionized the shipping business in the last decade or so, and Hoboken wants to lease them from the United States Maritime Administration, the current owner, for residential, commercial and recreational development.

As for the old ferry terminal, a plan to change it into a shopping mall has been scrapped. City officials now hope that with a $1.4-million Federal Urban Development Action grant, they can turn it, appropriately enough, into a motion picture and television studio.

FIG. 2.2

2.3.2 Montgomery St. Redevelopment - Jersey City

The redevelopment area is shown on enclosed map 'A'2 as amended. It encompasses 15 city blocks. It is aimed to create modern, mostly multi-family housing for owners or for private investment rentals. It is being actively pursued by the City. It is located close by the city hall and existing high-rise rental housing. As such, it represents a good potential initial D-H core area.

2.3.3 Summit Plaza - Jersey City

It is an apartment house-office complex of 485 apartments, 46000 sq. ft. of offices, and a school. It was provided with a total-energy plant as part of "Operation-breakthrough." This 3000kW diesel plant and its 27 million BTU/hr hot water boilers provide the power, heating and cooling for the complex. The distribution is by a 280°F hot water loop and by a separate chilled water loop. Chilled water is produced by absorption chillers of 1092T total capacity. They experience an overall thermal efficiency of 61.4% for combined power and heat generation and a chiller COP of 0.4. The plant is half loaded at the peak of each one of the services.

If this plant was integrated in a Hudson G.S.-based D-H system, it will be capable of acting as the second and third stages of a system with a total capability of 28 million BTU/hr peak. This is twice the peak requirements of this complex. The plant is less than a mile away from Hudson and a few hundred feet away from Journal Square, the high density commercial hub of the City.

2.3.4 Lefrak/Glimcher - Jersey City

In the vicinity of the Holland Tunnel entrance a large scale development is at its conceptual stage. 1400 apartments and 750000 sq. ft. of office space is visualized as the extent of the project. It is slated to break ground shortly. The plans indicate an expected heating load of 30 million BTU/hr. The enclosed copy of an article discusses this and other potential areas of development in Jersey City (Fig. 2.2).

2.3.5 Newark Redevelopment and Housing Authority

Table 2-I shows the buildings under the management of the Authority. Figure 2.3 shows their location. For the D-H project the ones circled are of significance. They are in or close to the downtown area and within the projected high density supply area. This complex is presently supplied by a central boiler plant and a steam distribution system, both aged and in need of replacement or upgrading, as discussions with their management brought it out.

2.3.6 Jersey City Housing Authority

There are six building complexes under their management within the projected supply area. They are at six different sites and range in age between 25 to 40 years. One of the building groups--Marion Gardens--which is also the closest to the Hudson G.S. was recently converted to hot water heating including new boilers at an approximate cost of $4000 per housing unit. The other complexes are steam heated and all but one of the boiler plants were renewed within the last five years.

2.3.7 Schools and Hospitals

A list of schools and hospitals within the cities investigated was compiled by the NJDOE including, where available, data on their fuel use, size and/or boiler installations. The details are shown in Appendix A and the estimated loads had been included in the load calculation of the selected supply areas.

TABLE 2-I

NUMBER OF DWELLING UNITS, SITE AREAS, DENSITIES
AND DATES OF INITIAL OCCUPANCY; BY HOUSING PROJECT
NRHA - MAY 28, 1981

PROJECT	NO. OF DWELLING UNITS	NO. OF BEDROOMS	SITE IN ACRES	NO. OF DU/AC [a]	NO. OF BR/AC [b]	AVERAGE NO. BR PER DU	DATE OF INITIAL OCCUPANCY
LOW RISE							
Z-1 S. Boyden	529	975	15.62	34	62	1.8	Oct. 1940
Z-2 Pennington	234	411	4.55	51	90	1.8	Feb. 1940
Z-5 Baxter	568	1,076	12.07	47	89	1.9	May 1941
Z-6 Stephen Crane	354	643	14.26	25	45	1.8	Oct. 1940
Z-7 Hyatt	401	810	9.75	41	83	2.0	Mar. 1942
Z-8 Felix Fuld	297	594	6.73	44	88	1.8	Dec. 1941
Z-9 Roosevelt hms.	273	510	11.55	24	44	1.9	Nov. 1946
Z-14 Bradley Ct.	301	632	9.71	31	65	1.9	Dec. 1941
SUBTOTAL	2,957	5,653	84.24	35	67	1.9	-
MIXED LOW/HIGH RISE							
Z-10 Kretchmer	730	1,756	14.83	49	118	2.4	May 1953
Z-11 Walsh	629	1,604	14.82	42	108	2.6	May 1953
SUBTOTAL	1,359	3,306	29.65	46	113	2.5	-
HIGH RISE ELDERLY							
Z-16 Stephen Crane Eld.	199	221	1.99	99	111	1.1	Nov. 1962
Z-17 Kretchmer Eld.	196	220	1.56	125	139	1.1	Jan. 1962
Z-18 Hayes Elderly	98	109	.81	121	135	1.1	Feb. 1962
Z-21E Seth Boyden Eld.	360	396	3.00	120	132	1.1	July 1969
Z-21F Seth Boyden Eld.	200	220	1.70	118	129	1.1	Oct. 1969
Z-22B Baxter Elderly	251	274	3.40	74	81	1.1	Dec. 1967
Z-22C Stephen Crane Eld.	375	405	2.90	129	140	1.1	Apr. 1968
Z-22D Stephen Crane Eld.	375	405	3.10	121	131	1.1	June 1968
Z-21A Kretchmer Eld.	440	464	3.70	119	131	1.1	Dec. 1966
Z-25 J.C. White Manor	206	232	2.42	85	96	1.1	Apr. 1976
B-1 Branch Brk. Manor	200	220	2.52	79	87	1.1	July 1978
SUBTOTAL	2,696	2,954	24.70	109	120	1.1	-
OTHER HIGH RISE							
Z-12 Hayes	1,457	3,144	19.15	76	164	2.2	Jan. 1954
Z-13 Columbus	1,439	3,649	14.60	100	250	2.5	Oct. 1955
Z-15 Stella Wright	1,208	2,902	14.13	85	205	2.4	Dec. 1959
Z-19 Scudder hms.	1,674	3,823	c 17.60	95	217	2.3	Dec. 1962
SUBTOTAL	5,776	13,518	65.48	88	206	2.3	-
SCATTERED SITE							
Z-27	103	366	d 5.89	17	62	3.6	Oct. 1978
TOTALS	12,891	25,851	209.96	61	123	2.0	-

NOTES:
a. DU/AC = Dwelling Units per Acre.
b. BR/AC = Bedrooms Per Acre. Efficiency dwelling units counted as one-bedroom.
c. Excluding Play Field Site of 1.87 Acres.
d. Total of two separate Sites of 3.69 Ac. and 2.20 Ac.

PROGRAM.3

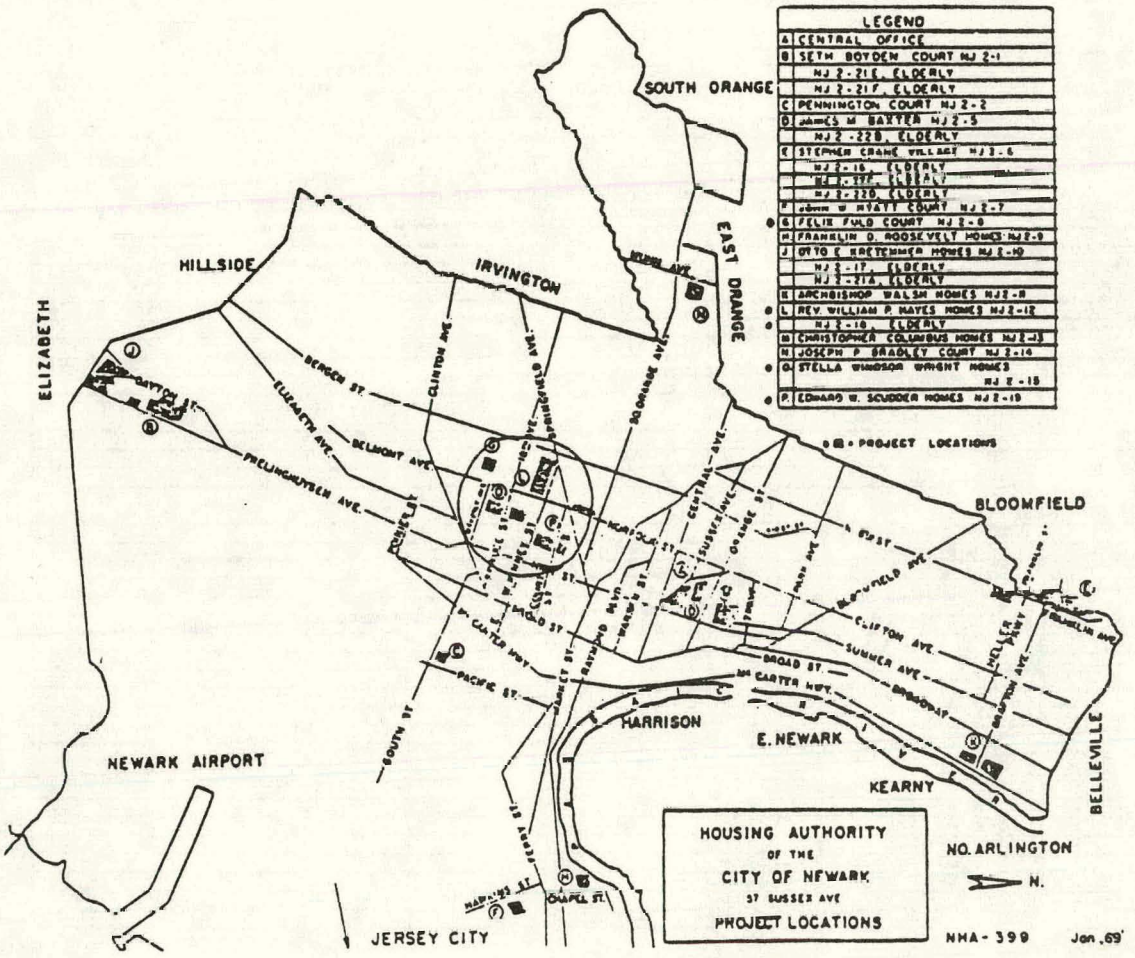

LEGEND
A CENTRAL OFFICE
B SETH BOYDEN COURT NJ 2-1
NJ 2-21E, ELDERLY
NJ 2-21F, ELDERLY
C PENNINGTON COURT NJ 2-2
D JAMES M BAXTER NJ 2-5
NJ 2-22B, ELDERLY
E STEPHEN CRANE VILLAGE NJ 2-6
NJ 2-16, ELDERLY
NJ 2-17E, ELDERLY
NJ 2-22D, ELDERLY
F JOHN W HYATT COURT NJ 2-7
G FELIX FULD COURT NJ 2-8
H FRANKLIN D. ROOSEVELT HOMES NJ 2-9
J OTTO E KRETCHMER HOMES NJ 2-10
NJ 2-17, ELDERLY
NJ 2-21A, ELDERLY
K ARCHBISHOP WALSH HOMES NJ 2-11
L REV. WILLIAM P HAYES HOMES NJ 2-12
NJ 2-18, ELDERLY
M CHRISTOPHER COLUMBUS HOMES NJ 2-13
N JOSEPH P BRADLEY COURT NJ 2-14
O STELLA WINDSOR WRIGHT HOMES NJ 2-15
P EDWARD W. SCUDDER HOMES NJ 2-19
PROJECT LOCATIONS
SOUTH ORANGE
HILLSIDE
IRVINGTON
EAST ORANGE
ELIZABETH
BLOOMFIELD
NEWARK AIRPORT
HARRISON
E. NEWARK
KEARNY
BELLEVILLE
NO. ARLINGTON
JERSEY CITY
HOUSING AUTHORITY
OF THE
CITY OF NEWARK
37 SUSSEX AVE
PROJECT LOCATIONS
N.
NHA-399
Jan. '69

FIG. 2.3

2.4 SURVEY OF POTENTIAL DISTRICT HEATING CUSTOMERS

In order to establish the potential market for district heating, a sample of the customers situated along the distribution route proposed by the Public Service Electric & Gas Company (PSE&G) were surveyed. This project was organized into three tasks:

- Design a questionnaire which would supply the required information.
- Administer the questionnaire to a selected sample of customers.
- Analyze the data culled from the questionnaires.

2.4.1 QUESTIONNAIRE DESIGN

The questionnaire developed for this site-specific phase of PSE&G's district heating study appears as exhibit 1. The questionnaire was designed primarily to determine total heating and process requirements which could be served by a district heating system. The name of the firm and the individual being interviewed, the location of the firm, the interviewer, and the date of the interview are entered first. A questionnaire number is given to each customer. Each customer is classified as being either in the residential, multiuse, commercial, or industrial class and is assigned a code number which consists of a two digit SIC code and nine other digits which correspond to location.

The following information is also requested:

Customer Information

- Type of establishment
- Total building and heated floor area
- Daily and weekly occupancy hours
- Number of boiler and cooling plant operators

Fuel consumption for the Twelve Months Ending December 1980

- Consumption of natural gas, fuel oil, and electricity
- Annual bills for natural gas, fuel oil, and electricity
- Uses of natural gas, fuel oil, and electricity
- Indication of any change in consumption and reason

Existing Equipment

Heating Equipment

- Media by which heat is supplied to rooms
- Boiler type and output
- Age of equipment
- Steam pressure level

Cooling Equipment

- Type of use
- Total cooling tonnage
- Total absorption tonnage
- Average age of absorption equipment

Process Steam or Hot Water

- Annual usage of steam
- Water temperature
- Percent of recycling and temperature of recycled water
- Type of Operations
- Annual average operating hours
- End use

Domestic Water Heating

- Type of distribution
- Boiler type
- Storage capacity

- Water temperature
- Annual use
- Maximum hourly use

Future Plans

Short Term (six months to two years)

- Indication of plans for change of equipment or fuel use
- Nature of change
- Description of any anticipated equipment change

Long Term (two to five years)

- Indication of building floor space change
- Indication of change in heating, cooling, or process equipment
- Description of any anticipated equipment change
- Payback period and ROI required
- Other future plans

Questions for Campus Type Projects Only

- Number of buildings
- Heat distribution media characteristics
- Size of distribution piping
- In house connection type
- Type of domestic hot water system
- Average age of system

The forms were designed for ease of administration and to avoid undue burden to the customer selected for the interview. The results of each questionnaire were entered into a data base for analysis by a computerized statistical package.

2.4.2 ADMINISTRATION OF THE QUESTIONNAIRE

The survey was conducted entirely by PSE&G personnel. The appropriate sample size was determined by PSE&G in consultation with Stone and Webster Management Consultants, Inc. (SWMCI). Determination of the sample size was influenced by the number of PSE&G personnel available for the field surveys.

The actual customers surveyed were selected by PSE&G in concert with another, independent consultant. The questionnaire was administered to 254 customers. In addition the sample consists of 27 customers who had participated in a different survey developed by PSE&G for another purpose and which provided some of the information required. Thus, there were a total of 281 participants.

The interviews were conducted by PSE&G field personnel in late 1981 and early 1982. The interviewees were advised that their answers would remain confidential.

2.4.3 DATA ANALYSIS

Data from the 281 responses were input into a data base for analysis. The data used for the analysis has been checked so that unreasonable or wrong entries were deleted.

A breakdown of the 281 respondents by customer class appears in exhibit 2. The industrial class, with 153 respondents (54% of the total), is the largest class represented, followed by the commercial class with 115 respondents (41% of the total). The residential and multiuse classifications had 8 respondents (3% of the total) and 5 respondents (2% of

the total) respectively. The results for the residential and multiuse class should be interpreted with caution due to the small sample sizes. Therefore, the following discussion will focus on the industrial and commercial class.

The percentage of the customers in each class using gas and No. 2 oil, No. 4 oil, and No. 6 oil appears in Exhibit 3.

Total heating requirements by class and heating by fuel type appear in exhibit 4. The industrial class, at 9,104,282 MMBTU (69% of the total), has the greatest heating requirements of all the classes by a wide margin. The commercial class is next with heating requirements of 2,561,266 MMBTU (19% of the total).

Exhibit 5 provides annual average heating fuel bill per customer. The average bill for industrial customers is $199,000 per customer and the average bill for commercial customers is $170,100 per customer.

Average use per customer by class appears in exhibit 6. The residential class has the largest total average use at 199,961 MMBTU per customer followed by the industrial class at 61,934 MMBTU per customer.

Exhibit 7 provides average costs of fuel by type and by customer class. These data are for the calendar year ended December 1980.

The range in age of boiler plants by customer class is given in Exhibit 8. For the industrial class 68% of the boiler plants are 10 years old or over and 25% are over 20 years old. In the commercial class 54% of the boiler plants are 10 years old or more and 18% are over 20 years old.

Exhibit 9 shows that over 44% of the customers surveyed, excluding the residential customers, use steam heating systems, and 30.2% are equipped with steam heating systems operating at below 15 psig.

Exhibit 10 shows that 137 of those surveyed (48%) have central domestic water heating systems and 89 (32%) have individual systems. There were no responses to this question by 55 (20%) of those survyed. Direct fired boilers are used by 96 of those surveyed (34%) followed by use of electric boilers by 61 respondents (22%). Hot water from other systems is used by 39 customers (14%) and steam from other systems is used by 21 customers (7%). There were no responses to this question from 64 (23%) of those surveyed.

Future equipment installation and floor space expansion plans are summarized in Exhibit 11. In the short term, defined as within the next 2 years, 26 of those survyed (9%) said they had plans for some type of new equipment installation. The remaining 255 (91%) either had no such plans, did not answer, or were unsure. In the long term, defined as in the next 2 to 5 years, 18 customers (6%) responded that they planned to increase floor space, and 263 (94%) indicated they had no definite plans to increase or decrease their floor space. Also in the long term, 19 customers (7%) indicated they had plans for equipment changes and 262 (93%) had no definite plans for changes.

Payback periods for each class appear in exhibit 12. On average the multiuse customers require a payback period of 8.3 years, the residential and commercial customers require a payback period of 5.3 years, and the industrial customers require a payback period of 4.0 years.

HEATING, COOLING, AND DISTRICT HEATING QUESTIONNAIRE

Name of firm _____ Questionnaire # _____

Address _____ Date _____

_____ Person interviewed _____

_____ Interviewer _____

CUSTOMER CLASS

(A) Residential ☐ (C) Commercial ☐

(B) Multiuse ☐ (D) Industrial ☐

Gas customer account #(s) _____ Gas rate schedule(s) _____

Electric customer account # _____ Electric rate schedule _____

1. **Customer Information** Code # ☐☐☐☐☐☐☐☐☐☐ 1 11

Manufacturing (M) Product manufactured _____

Apartments (A) No. of dwelling units _____

Office (F)

Warehouse (W)

Retail establishment (R)

Other (O), including multiuse, specify _____ 12 ☐

Total building floor area (1,000 sq. ft.) _____ 13 ☐☐☐☐ 17

Heated floor area (1,000 sq. ft.) _____ 18 ☐☐☐☐ 22

Daily occupancy (hours) _____ 23 ☐☐ 24

Weekly (hours) _____ 10-40(A) 41-80(B) 81-120(C) 121-168(D) _____ 25 ☐

Number of boiler and cooling plant operators _____ 26 ☐☐ 28

2. **Fuel Consumption for the Twelve Months Ending December 1980**

	Amount		Annual Bill ($1,000)		Used For*	
Natural gas (1,000 therms)	29 ☐☐☐	32	33 ☐☐☐	36	☐	37
Fuel oil (1,000 gal.) #2	38 ☐☐☐	41	42 ☐☐☐	45	☐	46
#4 or #5	47 ☐☐☐	50	51 ☐☐☐	54	☐	55
#6	56 ☐☐☐	59	60 ☐☐☐	63	☐	64
Electricity (1,000 kwh)	65 ☐☐☐	70	71 ☐☐☐	74	☐	75

Other fuel type _____ Consumption _____ Unit _____

* H = Space heating P = Process W = Domestic water heating G = General (specify % of each type of use) 80 ☐ 1

Has this consumption changed over the previous 12 months?

Yes ☐ No ☐ Percent change _____ %

Reason for change _____

_____

Comments: _____

_____

_____

_____

EXISTING EQUIPMENT

3. **Heating Equipment** Code # [1–11]

How is the heat supplied to the rooms?

Steam (S) _____ [12]
Hot water (W) _____ [13]
Other (O), specify _____ [14]

How is the heat produced?

	Type	Output MMBtu/hr
Steam boiler (S) _____	[15]	[16–17]
Hot water boiler (W) _____	[18]	[19–20]
Direct-heated hot air furnace (A) _____	[21]	[22–23]
Electric (E) _____	[24]	[25–26]

Age of equipment - (A) 1-10 years (B) 10-20 years (C) over 20 years _____ [27]
If steam, is system operated at 15 psig or below? Yes (Y) No (N) _____ [28]
If yes, level of operation in psig _____ [29–30]
Comments: _____

4. **Cooling Equipment**

Type of use (check all applicable)

Comfort ☐ Computer ☐ Process ☐ Refrigeration ☐

Total cooling tonnage _____ [31–34]
Total absorption tonnage _____ [35–38]
Average age of absorption equipment in years _____ [39–40]

Comments: (specify refrigeration and process tonnage and temperature)

5. **Process Steam or Hot Water**

If steam pressure is at 15 psig or below, supply annual usage in million lb. _____ [41–43]
If hot water, supply the following:
Temperature (°F) _____ [44–46]
Flow rate during operating hours (gal./hr.) _____ [47–50]
Is water recycled? _____ Yes (Y) _____ No (N) _____ [51]
If yes: Percent of recycling _____ [52–53]
Temperature of recycled water _____ [54–56]
Type of Operation _____ Seasonal (S) _____ Year Round (R) _____ [57]
Annual average operating hours _____ [58–61]
Type of steam end use, describe: _____

6. **Domestic Water Heating**

Type of distribution system _____ Central (C) _____ Individual (I) _____ [62]
Boiler type: Direct fired (F)_____ Steam from other systems (S)
Hot water from other systems (W) _____ Electric (E) _____ [63]
Size of total storage capacity (in 100 gal.) _____ [64–66]
Water temperature _____ [67–69]
Annual use (1,000 gal.) _____ [70–74]
Maximum hourly use (gal.) _____ [75–79]
Comments: _____

[2] [80]

FUTURE PLANS

7a. Short Term

Code # 1 [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] 11

Based on current operation and knowledge, are there any firm plans for change of equipment or amount of fuel use in the next six months to one year? _____ Yes (Y) _____ No (N) _____ [ ] 12

Is all or part of the change operational? Yes (Y) _____ No (N) _____ [ ] 13

If yes, describe and give reasons for the change:

_____

_____

Does this represent an increase (I) or decrease (D) in fuel use? _____ [ ] 14

percent of change _____ 15[ ][ ] 16

If change in equipment is anticipated, please describe below.

Type (Heating, Cooling, Process) (H) (C) (P)	Equipment Description	New Equipment Estimated Cost ($1,000)	Addition (A) Removal (R)	Annual Fuel or Energy Use	Units*	Type*
17[ ]	_____	18[ ][ ][ ][ ] 21	22[ ]	23[ ][ ][ ][ ][ ] 27	28[ ]	29[ ]
30[ ]	_____	31[ ][ ][ ][ ] 34	35[ ]	36[ ][ ][ ][ ][ ] 40	41[ ]	42[ ]
43[ ]	_____	44[ ][ ][ ][ ] 47	48[ ]	49[ ][ ][ ][ ][ ] 53	54[ ]	55[ ]

*Units
T = thousands of therms
G = thousands of gallons
K = thousands of kwh

*Type of Fuel
N = Natural gas
O = Oil
E = Electricity

Comments: _____

_____

_____

7b. Long Term

On a long-term basis, what increase (decrease) do you expect in the next two to five years?

	Amount	Units (P-F)
Building Floor Space % Growth (P) or 1,000's of sq. ft. (F) _____	56[ ][ ][ ][ ] 59	[ ] 60
Increase (I) _____ Decrease (D) _____		[ ] 61

Do you anticipate any changes in the heating, cooling, or process equipment?

Yes (Y) _____ No (N) _____ [ ] 62

If yes, describe below

Type (Heating, Cooling, Process)	Equipment Added (Removed)	Approximate Annual Energy Requirements (Specify Units)	Cost of Equipment ($1,000)	Year of Change
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

8. What is the payback period or return on investment required for fuel and energy related investments

_____ 63 Years [ ][ ] 64 _____ 65 %[ ][ ] 66

9. Are you able and willing to eliminate the boiler operator position?

Yes (Y) _____ No (N) _____ Don't Know (D) _____ 67[ ]

10. Can you provide your daily or annual thermal energy consumption curves for your building?

Yes _____ No _____

Information attached _____ Will follow _____ [3] 80

Other Comments: _____

_____

11. Do you now, or will you in the future, generate electricity?

Yes _____ No _____

If yes, describe equipment used.

	Maximum Hourly Kw	Annual Mwh
Engine	_____	_____
Gas turbine	_____	_____
Steam turbine	_____	_____

12. Estimate your annual usage of energy for the next two years (or annual growth rate (decline) in energy usage)

_____

13. For Campus Type Projects Only

Number of buildings _____

Heat distribution media-steam _____ psig, hot water _____ (supply) | _____ (return) °F/°F

Heat user pressure, temperature in buildings – steam _____ psig, hot water _____ | _____ °F/°F

Distribution piping - Total length _____ ft.
Max. dia. _____ in.

In-house connection - Direct ☐ _____ indirect, with heat extractor ☐

Domestic hot water - Central ☐ individual building ☐

Average age of system - Central plant _____ yr.
Distribution _____ yr.
In-house systems _____ yr.

Exhibit 2

PUBLIC SERVICE ELECTRIC & GAS COMPANY

SURVEY SAMPLE SIZE

	Sample Size	
Customer Class	Number	Percent of Total
Residential	8	3 %
Multiuse	5	2
Commercial	115	41
Industrial	153	54
Total	281	100 %

Exhibit 3

PUBLIC SERVICE ELECTRIC & GAS COMPANY

PERCENTAGE OF CUSTOMERS USING EACH FUEL BY CLASS[1]

Customer Class	Gas	No. 2 Oil	No. 4 Oil	No. 6 Oil
		(Percent)		
Residential	88	25	63	0
Multiuse	20	40	20	0
Commercial	50	24	22	13
Industrial	68	28	20	18

Note:

[1]Percentages within a class are greater than 100 due to use of more than one fuel.

Exhibit 4

PUBLIC SERVICE ELECTRIC & GAS COMPANY

TOTAL HEATING REQUIREMENTS BY CUSTOMER CLASS

Customer Class	Gas	No. 2 Oil	No. 4 Oil	No. 6 Oil	Total
			(MMBTU)		
Residential	91,300	883,238	625,152	-	1,599,690
Multiuse	100	6,552	7,680	-	14,332
Commercial	1,342,300	101,065	211,661	906,240	2,561,266
Industrial	4,245,100	1,710,996	947,405	2,200,781	9,104,282
Total	5,478,800	2,701,851	1,791,898	3,107,021	13,279,570

Exhibit 5

PUBLIC SERVICE ELECTRIC & GAS COMPANY

ANNUAL AVERAGE HEATING FUEL BILL PER CUSTOMER

Customer Class	Gas	No. 2 Oil	No. 4 Oil	No. 6 Oil	Average
			(Thousands of Dollars)		
Residential	53.6	196.0	731.6	-	327.1
Multiuse	-(1)	26.0	40.0	-	33.0
Commercial	228.9	28.4	54.2	369.0	170.1
Industrial	82.5	284.2	141.0	288.4	199.0

Note:

(1)Number of responses was insufficient to obtain a meaningful result.

Exhibit 6

PUBLIC SERVICE ELECTRIC & GAS COMPANY

AVERAGE USE PER CUSTOMER BY CLASS

Customer Class	Gas	No. 2 Oil	No. 4 Oil	No. 6 Oil	Total
			(MMBTU Per Customer)		
Residential	13,043	441,619	125,030	-	199,961
Multiuse	100	3,276	7,680	-	2,866
Commercial	24,405	3,743	8,819	69,416	22,868
Industrial	42,880	40,738	31,580	84,645	61,934

Exhibit 7

PUBLIC SERVICE ELECTRIC & GAS COMPANY

AVERAGE COST OF FUEL BY CUSTOMER CLASS[1]

Customer Class	Gas	No. 2 Oil	No. 4 Oil	No. 6 Oil
	(Dollars per MMBTU)			
Residential	4.45	-[2]	6.19	-
Multiuse	-[2]	8.01	5.21	-
Commercial	6.19	7.70	6.48	5.95
Industrial	5.59	7.27	6.28	6.17

Note:

[1] January - December 1980

[2] Number of responses was insufficient to obtain a meaningful result.

Exhibit 8

PUBLIC SERVICE ELECTRIC & GAS COMPANY

RANGE IN AGE OF BOILER PLANT BY CUSTOMER CLASS

Customer Class	1-10 Years	10-20 Years	Over 20 Years	Total
		(Percent)		
Residential	24	38	38	100
Multiuse	20	60	20	100
Commercial	46	36	18	100
Industrial	32	43	25	100

Exhibit 9

PUBLIC SERVICE ELECTRIC & GAS COMPANY

STEAM CUSTOMERS AS A PERCENT OF TOTAL CUSTOMERS SURVEYED

Total	Below 15 Psig
44.8%(1)	30.2%(1)
46.6%(2)	32.0%(2)

Note:

(1) Excludes residential class.

(2) Includes all classes.

Exhibit 10

PUBLIC SERVICE ELECTRIC & GAS COMPANY

DOMESTIC WATER HEATING SYSTEMS

Type of System	Number	Percent
Central	137	48 %
Individual	89	32
N/A	55	20
Boiler Type		
Direct Fired	96	34
Steam from other Systems	21	7
Hot water from other Systems	39	14
Electric	61	22
N/A	64	23

Exhibit 11

PUBLIC SERVICE ELECTRIC & GAS COMPANY

FUTURE EQUIPMENT INSTALLATION AND FLOOR SPACE EXPANSION PLANS

SHORT-TERM (Next 2 Years)

Equipment Installation	Number	Percent
Yes	26	9 %
No	219	78
Not Definite	36	13

LONG-TERM (2 to 5 years)

Floor Space Change		
Increase	18	6
Decrease	0	0
Not Definite (stay the same)	263	94

Change in Equipment		
Yes	19	7
No	225	80
Not Definite	37	13

Exhibit 12

PUBLIC SERVICE ELECTRIC & GAS COMPANY

AVERAGE PAYBACK PERIOD BY CLASS

Customer Class	Period (Years)
Residential	5.3
Multiuse	8.3
Commercial	5.3
Industrial	4.0

2.5 Fuel Use Survey

Another large scale survey was initiated based on NJDOE boiler registration data. The simple questionnaire shown as Table 2-II had been sent to 8700 potential customers. 871 answered the call. Table 2-III shows the summarized results. Of the 483 buildings identified by its use only 91 were residential. Rougly 40 percent of the buildings have cooling besides heating. 22.1% use gas, while the rest use different qualities of oil. This breakdown does not seem to agree with the larger base statistical surveys which indicate that gas-oil use breaks 45% v. 55% in the area.

A PSE&G survey of the New Jersey industrial energy market covered the whole of its supply territory. The data for the two major cities, Newark and Jersey City, covered 41 plants and it is shown on Table 2-IV. It shows a tilt towards the use of gas at these plants, but that is probably due to the origin of the addresses, which was the major electric and gas users lists of the Company.

TABLE 2-II

DISTRICT HEATING POTENTIAL SURVEY
HEATING/COOLING/FUEL USE DATA

Company Name: _____
Address of Facility: _____
_____
Owner (if different than above) _____
Owner's Mailing Address: _____
Your Name/Position: _____
Phone Number: _____

FUEL USE:	OIL (Gallons) No. 2	No. 4 or 5	No. 6	Gas (Therms)	Other Specify type/units
Annual:	____	_____	____	_____	_____
*Monthly:	____	_____	____	_____	_____

BUILDING/SITE DATA

Land area (acres) _____ (sq. ft.) _____
Total building plan area (sq. ft.) _____
No. of buildings: _____
Total floor space (sq. ft.) _____ Total building volume (cu.ft.) _____

BUILDING TYPE (CIRCLE): residential, commercial, institutional, industrial

USE:				
-hrs/ day	NA	_____	_____	_____
-days/wk	NA	_____	_____	_____

TYPE OF HEATING/COOLING SYSTEMS (Check where appropriate)**

	Heating	Cooling	Other (specify)
Central	_____	_____	NA
Individual	_____	_____	NA
Steam	_____	_____	_____
Hot water	_____	_____	_____
Air	_____	_____	NA
Electric	_____	_____	NA

CONSTRUCTION INFORMATION (Facilities larger than 1 million BTU/hr or 1000 lb/hr steam)
(Check one)

Existing Facility _____; Under construction _____;
Proposed operation in 1-2 years; _____;
Proposed operation in 3-5 years _____;

NOTES:

*Please indicate Monthly Fuel Use by individual months.

**If fuel used is for other than space heating/cooling, please indicate the nature of the alternate use(s) and the fuel used for such purposes by individual months (attach additional sheets if necessary).

PLEASE ATTACH THE MAILING LABEL FROM THE COVER LETTER OR WRITE THE BOILER REGISTRATION NUMBER FROM THAT LABEL BELOW:

TABLE 2-III

DISTRICT HEATING POTENTIAL SURVEY
HEATING/COOLING/FUEL USE SUMMARY

TOTAL USE

NO. 2 OIL	NO. 4 OR 5 OIL	NO. 6 OIL	TOTAL OIL	GAS
829902 GAL	9874894 GAL	7642947 GAL	25816843 GAL	13631032 THERM
1.14x10 BTU	1.38x10 BTU	1.11x10 BTU	3.63x10 BTU	1.36x10 BTU

GAS/OIL USE RATIO = GAS USED/OIL USED

NO. 2	NO. 4 OR 5	NO. 6	TOTAL OIL
1.19	0.98	1.22	0.221

BREAK DOWN OF BUILDING TYPES

RESIDENTIAL	COMMERCIAL	INSTITUTIONAL	INDUSTRIAL	UNDEFINED
91	129	81	157	25

BREAKDOWN OF HEATING + COOLING SYSTEMS

	HEATING	COOLING
CENTRAL	209	109
INDIVIDUAL	51	83
STEAM	274	7
HOT WATER	150	1
AIR	42	34
ELECTRIC	26	85
TOTAL	752	319

TABLE 2-IV

PSE&G ENERGY MARKET SURVEY
1981
ANNUAL FUEL USE

NEWARK SIC	Nat. gas 10^3therm heat	Nat. gas 10^3therm cool	#4-6 Oil 10^3gal. heat	#4-6 Oil 10^3gal. cool	#2 Oil 10^3gal. heat	#2 Oil 10^3gal. cool	Coal 10^3tons heat	Coal 10^3tons cool
20 - Food	712	-	333	-	-	-	-	-
28 - Chemicals	3129	769	1474	110	188	-	-	-
33 - Metals	151	-	163	-	-	-	-	-
36 - El. equipt.	4268	201	802	38	-	-	-	-
38 - Instrum.	-	-	240	240	-	-	-	-
Total	8260	970	3012	388	188	-	-	-
10^6BTU/yr.	826000	97000	430716	55484	26132	-	-	-
∿load								
10^6BTU/hr.	382.4	53.9	199.4	30.8	12.1	-	-	-

JERSEY CITY								
20 - Food	190	-	83	55	36	-	-	-
22 - Textile	272	-	-	-	-	-	-	-
23 - Apparel	71	-	-	-	-	-	-	-
26 - Paper	163	-	-	-	-	-	-	-
28 - Chemicals	478	-	6	-	-	-	-	-
32 - Stone,glass	533	-	-	-	-	-	-	-
33 - Metals	246	-	-	-	163	-	-	-
34 - Fabr.metals	65	-	191	-	-	-	-	-
37 - Transp.equipt.	10	-	-	-	-	-	-	-
76 -	105	-	-	-	3	-	-	-
Total	2133	-	280	-	202	-	-	-
10^6BTU/yr.	213330	-	40040	-	28078	-	-	-
∿load								
10^6BTU/hr.	98.76	-	18.5	-	13.00	-	-	-

SECTION 3

INSTITUTIONAL QUESTIONS

3. INSTITUTIONAL QUESTIONS

3.1 Regulatory Questions

Meetings and discussions were held, at staff level, with State regulatory agencies relevant to district heating, including the New Jersey Board of Public Utilities (NJBPU), the New Jersey Department of Environmental Protection (NJDEP), the New Jersey Department of Labor & Industry (NJDL&I). Personnel of the New Jersey Department of Energy (NJDOE) were assigned to liaison with this study, and also assisted with tasks in the area of energy and fuel use assessment. However, statements and opinions expressed by staff members of these agencies are not binding on the agencies, which have refused to issue "hypothetical rulings" on district heating. Their attitude has been, "We will rule when you come to us with an actual rate case or licensing request to decide." A "Hypothetical Draft Tariff for Thermal Service" (Section 4) was sent to NJBPU for review and comment, but despite repeated inquiries, no response was forthcoming. With this qualification, the results of discussions with regulatory bodies will be summarized below.

There are currently no regulations "on the book" on district heating in New Jersey primarily because there is no district heating other than military bases and college campuses. Since these do not cross property lines, they would not be regulated, in any event. However, there is little doubt that district heating which did cross property lines would be regulated under current N.J. law, whether or not it was owned by PSE&G (a "utility"). The New Jersey Statute specifically gives the N.J. Board of Public Utilities the right to regulate "sales of heat." (This is unlike the situation in some other States where sales of steam are specified in the statute, but sales of hot water might escape regulation.) Excepted from regulation would be situations (like college campuses and military bases) where no property lines are crossed and municipal utilities operating entirely within their own borders. Industrial parks and shopping centers might be exempt as long as the developer retains ownership of all streets and buildings, and if the energy source were within the property. However, once buildings are sold to individual owners

and/or streets become public areas, there would be crossing of property lines and regulation could impinge.

Whether district heating is "regulated," or "a public utility" has important implications to its viability. The Federal tax aspects of "utility" vs. "non-utility" status are discussed in Section 5 "Financial Considerations." The implications of "regulation" will be discussed here. In New Jersey there is a Gross Receipts and Franchise Tax (GR&FT) of about 13% added to all utility bills. This would, in effect, raise the price of district heating by 13% and make an otherwise viable project marginal, while killing already marginal projects. However, it would be within the power of the State Legislature to change this, if they were convinced that a lower GR&FT rate on a viable district heating system would provide higher revenues to the State than 13% on a district heating system that is never built.

Another regulation-related problem is the traditional utility "rate-of-return" rate setting process, whereby a utility's rates are set on the basis of an "allowed rate of return on investment" (rate base), typically 16% at present. As noted below (Sections 4, 5, 9), because district heating is heavily front-end capital loaded, rate of return regulation would result in the first few years' heat prices to the customer being much higher than the conventional alternative heat source (individual gas-fired boilers in each building), which would mean no customers at all! Conversely, in subsequent years, as fuel prices escalate, rate of return regulation would set heat prices far below the customers' alternative heat price, and there would be no way of recovering the initial years' losses at a later time (Figure 3.1). Some way of leveling out earlier and later heat prices, such as by long-term contracts with customers, thus seems essential.

Federal regulations which might impact district heating include PURPA and the Public Utility Holding Company Act (PUHCA). PUHCA restricts the type of activities that existing public utilities can engage in and the manner in which they may be

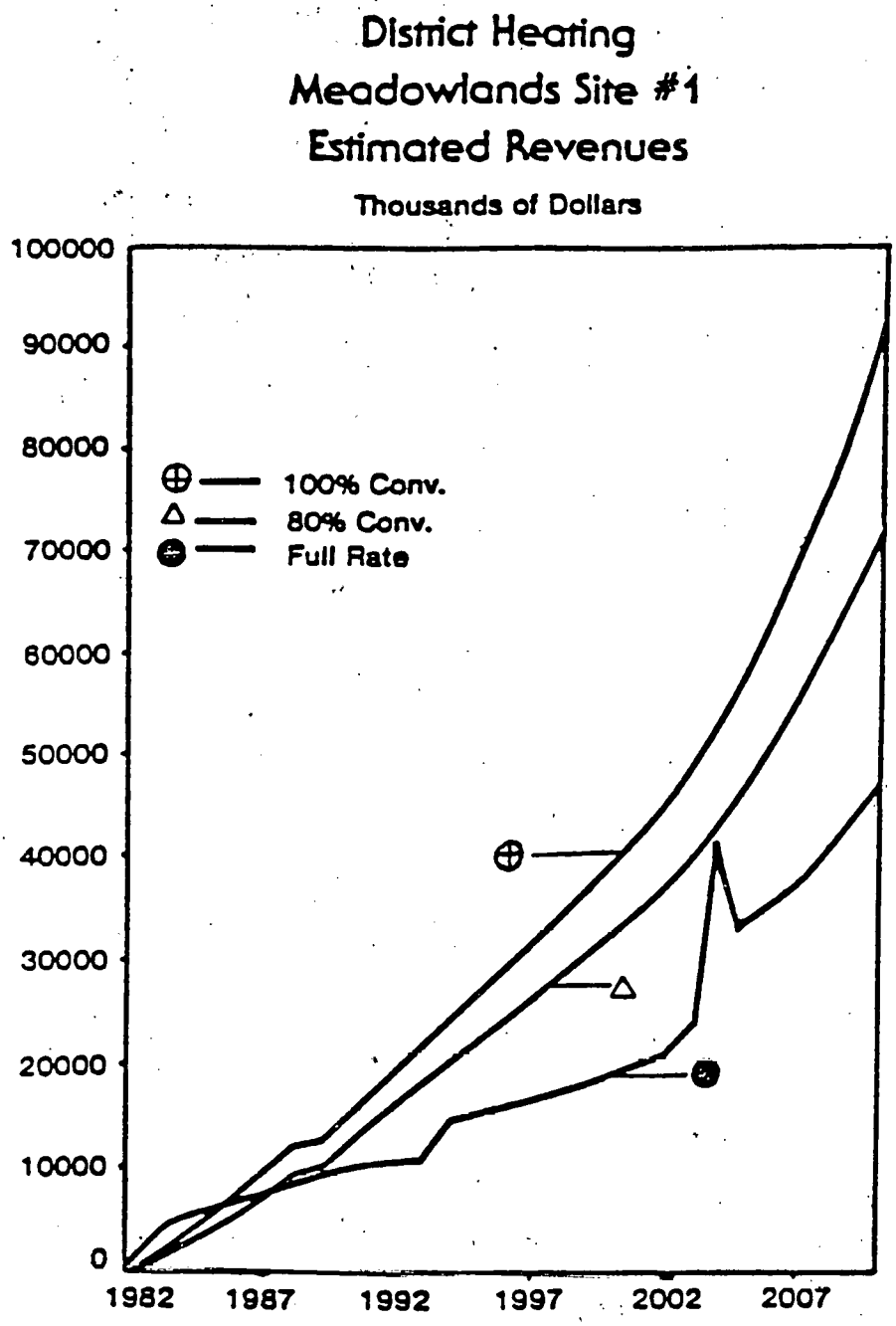

District Heating
Meadowlands Site #1
Estimated Revenues
Thousands of Dollars
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1982
1987
1992
1997
2002
2007
100% Conv.
80% Conv.
Full Rate

FIG. 3.1

organized, including the use of subsidiaries. Proposed revisions to PUHCA are currently before Congress and may affect this situation. PURPA limits certain tax and regulatory benefits to cogenerators to facilities not more than 50% owned by electric utilities. This limits the participation of electric utilities in cogeneration/district heating projects to "third party" arrangements if the benefits of PURPA are desired. Proposals to remove this 50% utility ownership restriction on cogeneration facilities are being advanced.

Federal Fuel Use Act (FUA) restrictions on natural gas use have been eased during this project and are no longer a problem to district heating.

The regulations of the New Jersey Department of Labor and Industry Office of Boiler and Pressure Vessel Compliance (NJDL&I) require a full time operator on-site at all steam boilers. After several meetings with NJDL&I they agreed that fired hot water heating units were different enough from steam boilers to allow remote control and operation, with a central remote control operator monitoring each plant and shutting it down remotely if needed, and a "roving boiler operator" in radio contact with the central remote operator, and visiting each plant once each day (Figure 3.2). This reduces the number of boiler operators needed for 11 local heating plants and considerably improves the economics of the district heating system. It was also agreed by NJDL&I that if hot water from the district heating system were used to generate low pressure steam at a customer's facility, these steam generators, being unfired, would not require a boiler operators.

3.2 Environmental Questions

By utilizing an existing coal-fired central generating unit (Hudson), an existing gas turbine plant (Kearny) and gas-fired local boiler plants, environmental impact of the proposed district heating system has been minimized. In discussions with NJDEP, no insurmountable licensing barriers or environmental impact was found. The time scale for required environmental licenses are short enough (1 - 1-1/2 years) not to be the limiting factor in construction of a district heating system.

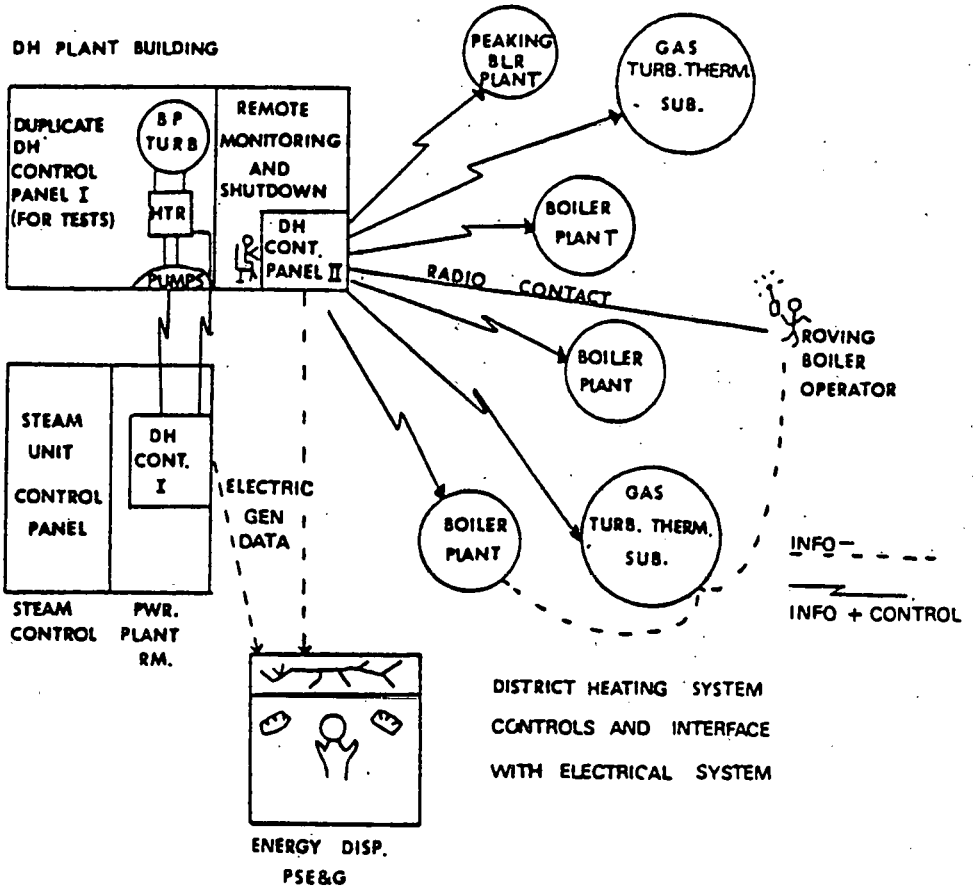

DH PLANT BUILDING
DUPLICATE DH CONTROL PANEL I (FOR TESTS)
BP TURB
HTR
PUMPS
REMOTE MONITORING AND SHUTDOWN
DH CONT. PANEL II
PEAKING BLR PLANT
GAS TURB. THERM. SUB.
BOILER PLANT
RADIO CONTACT
ROVING BOILER OPERATOR
BOILER PLANT
STEAM UNIT CONTROL PANEL
DH CONT. I
ELECTRIC GEN DATA
BOILER PLANT
GAS TURB. THERM. SUB.
INFO
INFO + CONTROL
STEAM CONTROL
PWR. PLANT RM.
ENERGY DISP. PSE&G
DISTRICT HEATING SYSTEM CONTROLS AND INTERFACE WITH ELECTRICAL SYSTEM

FIG. 3.2

Air quality modeling using a USEPA-approved computer model was performed for the largest scale, 3.7 x 10^9BTU/hr peak output district heating system, as a "worst-case." NO_x, particulates and SO_2 were modeled. The effects of increased fuel burning at Hudson, Kearny and the local heater plants were considered, as well as the reduction/elimination of fuel use by district heating customers. Either negligible effects or minor improvements in air quality were found. This modeling effort and its results are described in detail in Section 10.6.

There are expected to be no land-use or noise abatement problems associated with the proposed district heating system. The local heating plants are gas-fired. It was found that sites are available suitably located with respect to gas and electric supply and thermal load. There are no separate pumping stations. All pumps are contained within the central (Hudson), intermediate (Kearny) and local heating plants. The fired water heaters (50-60 million BTU/hr each) are of a type common in commercial/industrial service and pose no noise abatement problem. The Trenton District Energy Company (see below) has obtained all needed approvals despite the higher noise associated with its diesel engines (compared with gas boilers in our proposed system).

3.3 Rights-of-Way

The proposed district heating system has been designed to minimize right-of-way problems. Maximum use is made of existing PSE&G electric and gas rights-of-way. This also reduces construction cost through reduction of interferences with existing underground utilities, paving, etc. One river crossing is made through an existing minimally used gas transmission line tunnel to reduce costs. Other river crossings are made along the river bottom, without using existing bridges or other structures. Costs for this crossing were based on recent PSE&G experience with gas transmission line river crossings. It was decided not to use railroad rights-of-way because of the unfavorable experience the Gas Department has had regarding charges for such usage. Permission to use city streets, where needed, must be obtained on a site-specific basis once street routing is definite, but no problems are expected. (A district heating system is currently under construction by the Trenton District

Energy Corporation (TDEC) in the center of Trenton, and has received all necessary approvals.) The portions of our proposed district heating system in new developments in the Hackensack Meadowlands and elsewhere would be installed at the same time as other underground utilities (water, sewage, electricity, telephone) and thus require no additional street opening.

3.4 Ownership of Customer Conversion Units

The conversion package which interfaces the district heating system hot water, essentially a box of pumps, heat exchangers and controls, could be owned either by the customer or the utility (district heating system). There are certain advantages to having the package owned by the utility, and that was the approach taken in this study. Utility ownership allows full control of the technical specifications, construction and performance of the unit for optimum compatibility with the district heating system. It allows the cost of the conversion package to be recovered in service rates over a longer period of time instead of being paid in a lump-sum "connection charge," or over the short 3-5 year payback period typically expected by potential customers as shown in our load survey (Section 2). Thus, utility ownership of the conversion package would improve district heating economic viability.

3.5 Utility Constraints

Electric/gas utilities contemplating district heating face a number of particular issues not facing other prospective district heating entities. These are discussed briefly below:

3.5.1 Replacement Power/Fuel

The coal-fired Hudson Unit No. 2 was chosen as the basis and base-load thermal source of the district heating system because of its low fuel cost. However, extracting steam for district heating use derates the Hudson unit and reduces its electric generation capacity. When this happens during a period when Hudson No. 2 is operating at full load, the power lost must be made up by dispatching other, more

costly generating units, either on the PSE&G system or on the PJM (Pennsylvania–New Jersey–Maryland) Interconnection, of which PSE&G is a member. Often, the "incremental unit" on the system is oil–fired, and the replacement power for the loss at Hudson is generated by burning oil elsewhere on the system. Thus, the "oil displacement" by district heating is reduced, and an additional cost, charged to district heating, is incurred. At other times (particularly at night) the incremental unit on the electric system may be nuclear. Forcing Hudson to run to meet thermal needs might then force the turn–down of a nuclear unit. This is highly undesirable as nuclear plants are not designed for cycling service. In addition, a loss, charged to district heating, would be incurred on the power Hudson is forced to generate above grid cost.

3.5.2 Impact on the Gas System

Consideration was given to the problem of determining the impact of district heating on the PSE&G gas system. It was found that the thermal load of even the fully developed district heating system is small with respect to overall gas system demand, and even smaller during the early years of district heating system development. The uncertainties in long term gas supply, load forecast, rate relief, etc., would have a much larger impact on the gas system than a district heating system. These factors make it difficult to perform an accurate and meaningful analysis of the impact of district heating on the gas system, and more difficult the farther into the future one tries to project. Any such analysis should be done on a short–term basis, using the most up–to–date data, only when a detailed economic analysis is being made of a specific district heating project, and then should be part of an assessment of overall profitability to PSE&G as a total corporation.

3.5.3 Limited Life of Retrofitted Central Plant

Objection is sometimes made to the proposed retrofit of Hudson No. 2, Kearny No. 12 or any other existing powerplant, on the basis that, by the time the retrofit is fully loaded, the plant will be at the end of its planned economic lifetime. It must be realized, however, that with good maintenance plants can be

kept operating well past their planned economic lifetime. With increasing costs of and constraints upon the construction of new generating units, utilities are working harder at this, and EPRI (the Electric Power Research Institute) has an impressive R&D program in this area. Also, when a second "product"--saleable heat--is available from a plant, the economics upon which its "economic lifetime" is based must be re-examined.

3.5.4 Capital Constraints

District heating systems are heavily capital-intensive. The largest district heating system considered in this study would cost over $600 million in today's dollars. Many utilities, PSE&G among them, are subject to capital constraints due to other current construction. Possible ways to approach this problem are (1) to start with a small initial system, (2) to seek outside funding from venture capital sources, municipality or customer groups and various grants, and (3) to wait several years until more capital funds are available when present construction programs have been completed.

3.6 Local Heater Plant Operating Costs

At the inception of a district heating system, all the heat comes from the local heating plants. If this is all natural gas, the cost can be high, but would decrease once the retrofitted central powerplant is in service and the local plants revert to peaking/backup duty. However, in the event that a larger, central power-plant-based district heating system never materialized, the district heating company would be left with high-operating-cost heating plants and connected customers it was committed to serve. This could be avoided if the initial, isolated heating plants were made self-sufficient, or as nearly so as possible, through use of waste fuels (including landfill gas, where available), coal (using fluidised bed combustion) and cogeneration.

3.7 Economic/Financial/Regulatory Uncertainties

In contacts with developers of industrial parks and shopping centers and other potential large district heating customers, little psychological inertia or bias against district heating was found, if it would be priced below competing fuels. However, prospective customers wanted definite price and delivery date commitments. (Recent fuel price oscillations have also caused many prospective customers to distrust economic analyses based on fuel price projections.) However, definite commitments on district heating cost of heat and delivery date are difficult to make without knowing definitely the number, location and loads of customers, i.e. without signed-up customers. This is also impacted by expected regulatory treatment, and regulatory agencies are reluctant to give any binding opinions in advance of an actual case. This "vicious circle" might be broken by: (1) Starting with small systems which reduce exposure. Smaller risks require less certainty. (2) Get contingent commitments from customers based on their own estimated cost of alternative supply. They agree to connect if district heating is competitive.

Another "uncertainty" from the standpoint of the district heating entity is the default or departure of customers leaving the district heating system with underutilized facilities. This might be alleviated by concentrating on governmental and institutional customers as was done by TDEC in Trenton, or by some sort of insurance/bonding arrangement.

3.8 Summary

Some of these issues and suggested solutions are listed in Table 3-I.

TABLE 3-I

District Heating Barriers to Implementation and Suggestions for Resolution

Barrier	Actions Required
Marginal Economics	(1) Reduce costs, particularly T&D piping installed cost; (2) Negotiate resolution of taxation/regulatory issues with state government; (3) Reduce local heating plant operating costs by use of cogeneration and waste fuels.
Startup losses due to heavy capital loading	(1) Phase DH capital costs more gradually, use transportable heater plants as in Europe; (2) Rate adjustment to offset startup losses and repay later.
High capital costs of T&D piping	(1) Investigate cost reduction via European DH technology and development/ adaptation of advanced technologies including cost optimization via subsurface mapping using computer graphics, street-specific cost/routing optimization.
Uncertainties in Economic/ Financial conditions and fuel prices	(1) Minimize exposure by starting with small systems; (2) Obtain contingent commitments from customers based on estimated costs (customer supplies his cost projections of alternative supply and agrees to connect if DH is competitive.)
Cost of operating small local heating plants in isolation from central DH system	(1) Use of waste fuels (including landfill gas), coal (using AFBC) (2) Utilization of cogeneration to improve economics.
High total capital costs vs. utility capital constraints due to other construction	(1) Start with small initial system; (2) Seek outside (venture capital) financing (3) Municipality/customer group backing (4) Creative financing, leasing, UDAG, Block Grants.

SECTION 4

RATES

4. RATES

Basic approaches to rate formulation were established and a Draft Hypo-thetical Tariff for Thermal Service was formulated by the PSE&G Rates and Load Management Department, which reports to the Senior Vice President-Customer Operations. A copy of the Draft Tariff is at the end of this Section. This Draft Tariff was submitted to NJ BPU for comment, but no comments were received, despite repeated inquiries. Rate schedules for various classes of customers would be determined based on the load characteristics and cost of service of each customer class, in a manner analogous to gas and electric service. Section 5 (Financial Considerations) and Section 9 (Economic Evaluation) detail the determination of costs.

The Draft Tariff considers fully metered service with demand and energy charges. Ownership of connecting equipment (customer interface) is not mentioned, but the Economic Evaluation (Section 9) considered it to be utility owned and rolled into the rates. The customer is offered a choice of billing for service as incurred or spread over the year under a "Budget Plan." (See Section 8.10 of Draft Tariff.) No provision was made for utilization of customer equipment, but this could be considered on a site-specific basis where practicable. A discussion of technical aspects of such utilization is given in Section 6.7.4 of this report.

As noted on page 3 of the Tariff, service will be offered to specifically defined areas. Section 2.1 of the Tariff provides that applications for service, where it is not available or where it might adversely affect the supply to other customers, may be rejected. Sections 13.1 through 13.3 of the Tariff provide for limitations or interruption of service due to emergency conditions, and a disclaimer of liability for direct or consequential damages due to such limitations or interruptions. Section 7.2 of the Tariff provides for up to 200 feet of service connection at no cost to the customer, but for customer payment of the cost of any service connection beyond 200 feet.

Cost of service is defined subject to the criterion that all costs associated with district heating shall be covered by revenues from the district heating customers, and no such costs shall be passed on to existing electric and gas customers. Capital costs of the Hudson and Kearny plant retrofits and all specifically district heating-related capital costs are charged to district heating. Fuel costs for district heating local heating plants, replacement electric power, labor, pumping energy and materials are similarly charged to district heating. Table 4-I gives a list of these expenses.

Tables 4-II and 4-III and Figures 4.1 through 4.3 give some preliminary cost-of-heat values calculated on this basis for various financing options. Revised and updated versions of this data are discussed in detail in Sections 5 and 9 of this report.

TABLE 4-I

ALLOCATION OF DISTRICT HEATING COSTS

Capital Related
- Boilers
- Hudson #2 Retrofit
- Kearny #12 Retrofit
- Natural Gas Service
- Conversion Packages
- Metering
- Transmission
- Distribution

Fuel Related
- Increased Electric System Production Costs
- Natural Gas

O & M Costs
- Manpower
- Pumping energy
- Materials

Gross Receipts and Franchise Taxes

TABLE 4-II

DISTRICT HEATING, 1984-1993

	COST OF HEAT $/10^6 BTU						
YEAR	(1)	(2)	(3)	(4)	(5)	PEAK LOAD 10^6 BTU/HR	ANNUAL THERMAL SALES 10^9 BTU
1984	13.89	106.24	104.76	108.39	92.35	15	35
1985	20.44	42.40	40.94	40.45	36.87	70	166
1986	22.11	33.99	32.15	33.93	29.17	148	350
1987	24.03	31.62	29.43	29.32	26.77	235	556
1988	25.70	32.88	30.39	31.61	27.56	325	769
→ 1989	27.56	31.54	28.77	30.95	26.13	422	998
1990	29.79	32.46	29.44	31.98	26.70	525	1,242
1991	32.19	33.28	30.16	33.01	27.28	600	1,419
1992	34.85	36.98	33.19	36.24	29.77	665	1,573
1993	37.60	41.00	37.77	41.11	33.50	715	1,691

(1) CONVENTIONAL HEATING SYSTEM

(2) DISTRICT HEATING - BASE CASE

(3) DISTRICT HEATING - TAX-EXEMPT

(4) DISTRICT HEATING - LEASE

(5) DISTRICT HEATING - NON-UTILITY STATUS

TABLE 4-III

FINANCIAL ANALYSIS

Description of Cases

Conventional Heating	. Conventional financing Rate of return regulated
District Heating Base	. Conventional financing Rate of return regulated
District Heating Tax-Exempt	. Distribution plant financed with Industrial Development Bonds (IDB) @ 7.5% . Straight line depreciation of distribution plant over the ACRS tax life . Remaining capital conventionally financed . Rate of return regulated
District Heating Lease	. Heater plant leased at an annual payment of 11.3% of capital cost . Total investment reduced by heater plant capital investment . Remaining capital conventionally financed
District Heating Non-Utility Status	. No gross receipts and franchise tax . All plant depreciated over five years for tax purposes

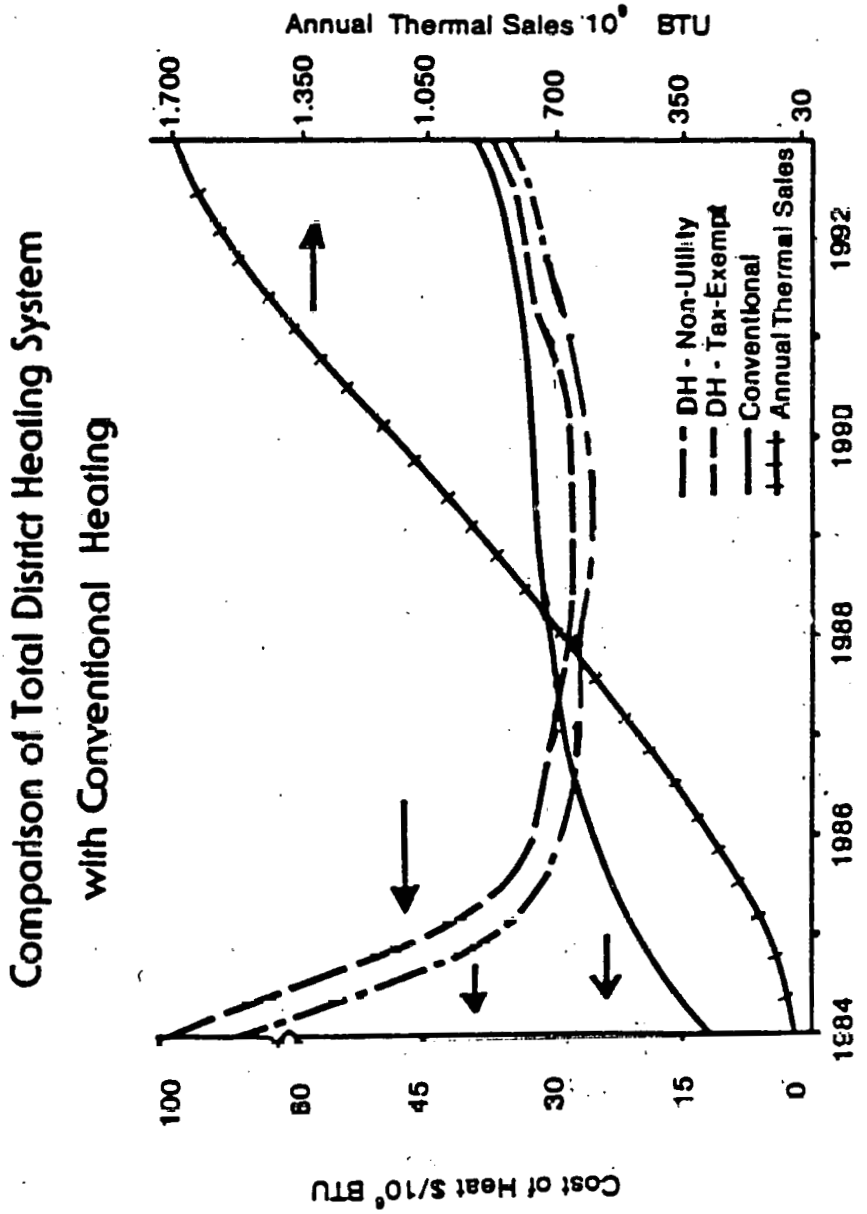

Comparison of Total District Heating System
with Conventional Heating
Annual Thermal Sales 10⁹ BTU
1.700
1.350
1.050
700
350
30
DH - Non-Utility
DH - Tax-Exempt
Conventional
Annual Thermal Sales
1984
1986
1988
1990
1992
100
80
45
30
15
0
Cost of Heat $/10⁶ BTU

FIG. 4.1

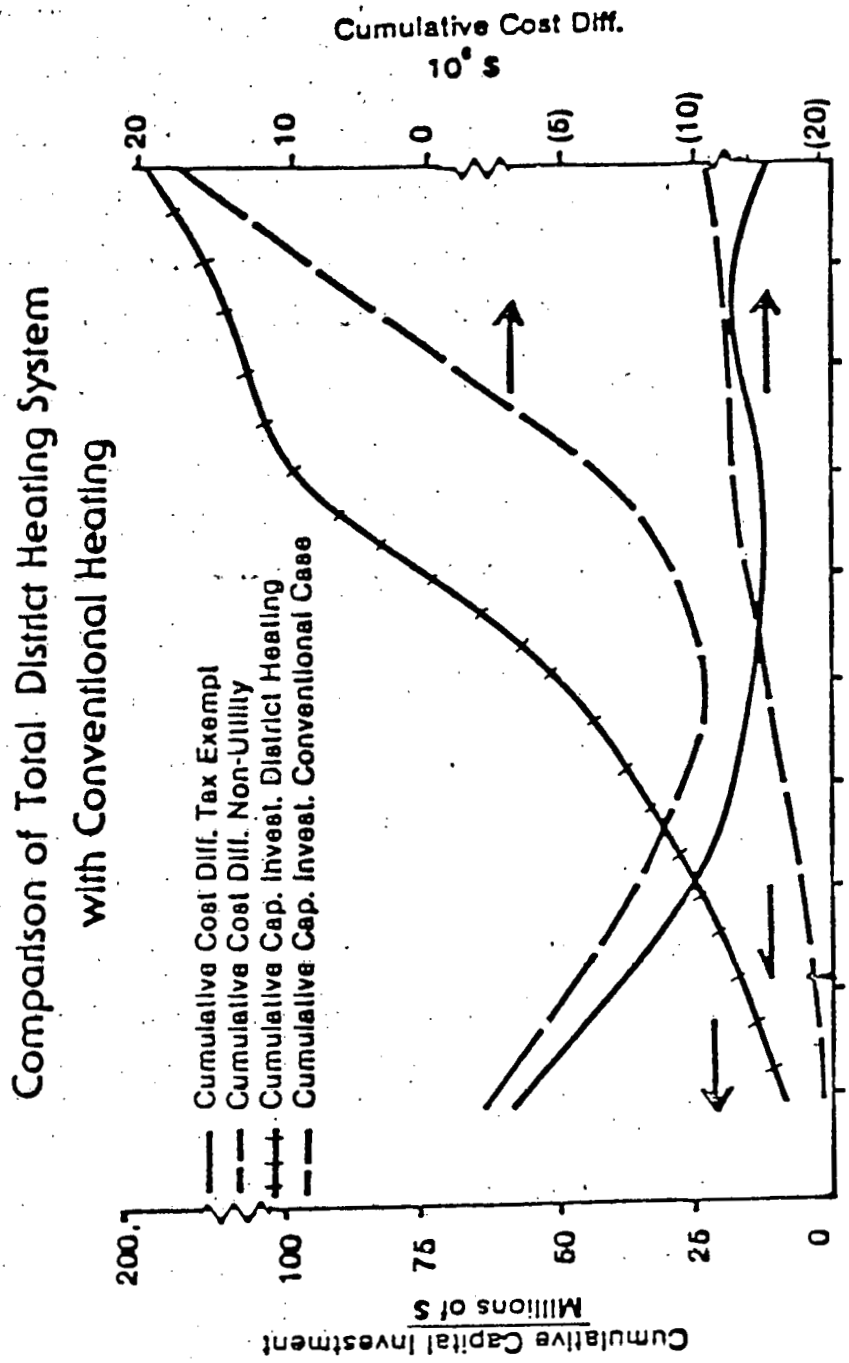

Comparison of Total District Heating System with Conventional Heating
Cumulative Cost Diff. Tax Exempt
Cumulative Cost Diff. Non-Utility
Cumulative Cap. Invest. District Heating
Cumulative Cap. Invest. Conventional Case
Cumulative Capital Investment Millions of $
Cumulative Cost Diff. 10^6 $
200
100
75
50
25
0
20
10
0
(6)
(10)
(20)
1984
1986
1988
1990
1992

FIG. 4.2

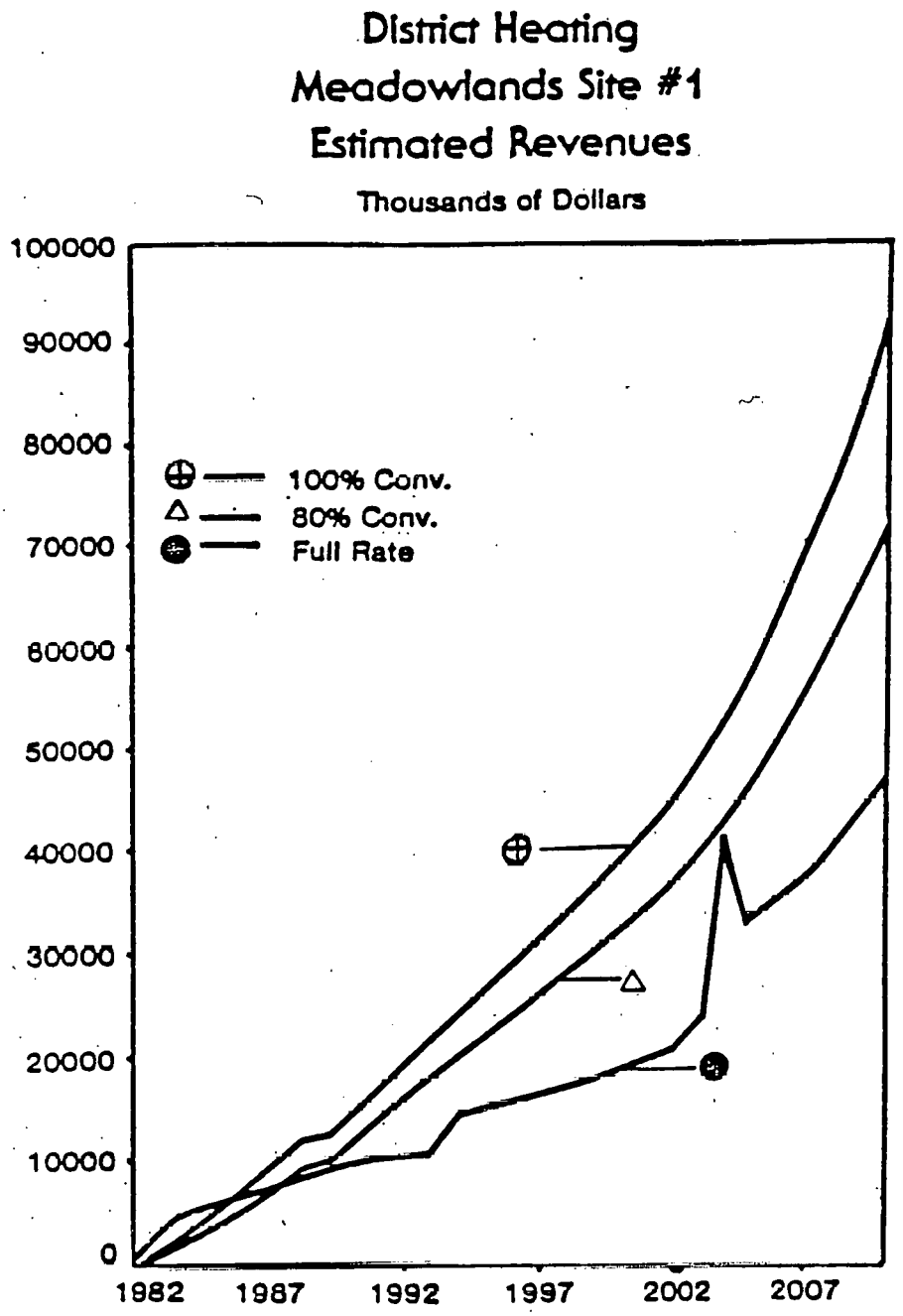

District Heating
Meadowlands Site #1
Estimated Revenues
Thousands of Dollars
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
100% Conv.
80% Conv.
Full Rate
1982
1987
1992
1997
2002
2007

FIG. 4.3

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

B.P.U.N.J.No. Thermal Service Original Sheet No. 1

HYPOTHETICAL TARIFF FOR THERMAL SERVICE

Applicable in

territory served as shown on

Sheet Number 3

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

GENERAL OFFICES

80 PARK PLAZA

NEWARK, NEW JERSEY 07101

Date of Issue: Effective:

Issued by EVERETT L. MORRIS,
Senior Vice President - Customer Operations
80 Park Plaza, Newark, New Jersey 07101
Filed pursuant to Order of Board of Public Utilities, dated
in Docket No.

This hypothetical Thermal Service Tariff was developed to satisfy the requirements of a Department of Energy funded project. In the event that the project shows District Heating as being viable, this Tariff would probably be used. Depending on the number of customers and their service characteristics requesting thermal service, a contract containing many of the requirements stipulated in this tariff, many also we used.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

B.P.U.N.J.No. 7 THERMAL SERVICE Original Sheet No. 2

TABLE OF CONTENTS

Date of Issue: Effective:

Issued by EVERETT L. MORRIS,
Senior Vice President -
Customer Opeations
Filed pursuant to Order of Board of Public Utilities, dated
in Docket No.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

B.P.U.N.J.No. THERMAL SERVICE Original Sheet No. 3

TERRITORY SERVED

Thermal service is currently being offered to the following communities, as transmission facilities expand communities may be added.

Newark

Jersey City

Secaucus

Date of Issue: Effective

Issued by EVERETT L. MORRIS,
Senior Vice President - Customer Operations
80 Park Plaza, Newark, New Jersey 07101
Filed pursuant to Order of Board of Public Utilities, dated
in Docket No.

STANDARD TERMS AND CONDITIONS

FOR

THERMAL SERVICE

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

GENERAL OFFICES

80 PARK PLAZA

NEWARK, NEW JERSEY 07101

Date of Issue: Effective:

STANDARD TERMS AND CONDITIONS

1. GENERAL

These Standard Terms and Conditions, filed as part of the thermal service tariff of Public Service Electric and Gas Company, hereinafter referred to as "PSE&G," setforth the terms and conditions under which thermal service will be supplied and govern all classes of service to the extent applicable, and are made a part of all agreements for the supply of thermal service.

No representative of PSE&G has authority to modify any provision contained in this Tariff or to bind PSE&G by any promises or representation contrary thereto.

The benefits and obligations under an application or agreement for service shall begin when PSE&G makes thermal service available to the customer.

Standard agreements to supply thermal service shall be in accordance with the rate schedule and shall be based upon plant facilities which are sufficient for providing safe, proper and adequate service. PSE&G may require contributions toward the investment, and may establish such minimum charges and facilities charges

as may be equitable under the circumstances involved where: (1) large or special investment is necessary for the supply of service; (2) capacity required to serve customer's equipment is out of proportion to the use of thermal service for occasional, intermittent, or low load factor purposes, or is for short durations.

2. OBTAINING SERVICE

2.1. Application: An application for service may be made at the Customer Service Department of any Commercial Office of PSE&G in person, by mail or by phone. Forms for application for service, together with terms and conditions and contract forms, will be furnished upon request. Customer shall state, at the time of making application for service, the conditions under which service will be required and customer will be required to sign an agreement or other form then in use by PSE&G covering special circumstances for the supply of thermal service.

PSE&G may reject applications for service where such service is not available or where such service might affect the supply to other

customers, or for faiilure of customer to agree to comply with any of these Standard Terms and Conditions.

See also Section 13. Service Limitations, of these Standard Terms and Conditions.

2.2. Initial Selection of Rate Schedule: PSE&G will assist in the selection of the available rate schedule which is most favorable from the standpoint of the customer. Any advice given by PSE&G will necessarily be based on customer's written statements detailing his proposed operating conditions.

2.3. Change of Use: Subsequent to initial application, customer shall notify PSE&G in writing as soon as possible of any change in his use of service which might affect the cost, size or availability of service. Lack of notification of change of use might ultimately require a deposit as outlined below or disconnection of service.

2.4. Deposit and Guarantee: Where PSE&G deems it necessary, a deposit or other guarantee satisfactory to PSE&G may be required as security for the payment of future and final bills before PSE&G will commence or continue to render service.

A deposit may be required from a customer equal to the estimated bills which would accrue for two months' service.

All deposits shall bear simple interest at the rate of nine percent per annum, payable at the time that the deposit is refunded to this depositor, provided said deposit remains with PSE&G for a period of three months or longer. Deposits shall cease to bear interest upon discontinuance of service.

A deposit is <u>not</u> a payment or part payment of any bill for service, except that on discontinuance of service, PSE&G may apply said deposit against unpaid bills for service, and only the remaining balance of the deposit will be refunded. PSE&G shall have a reasonable

time in which to read the meters and to ascertain that the obligations of the customer have been fully performed before being required to return any deposit. To have service resumed, customer will be required to restore deposit to original amount.

2.5. Maintain Extensions: The customer may be required to make a deposit for the extension of thermal mains or an outright payment as setforth in Section 3 of these Standard Terms and Conditions.

2.6. Service Conditions: The customer may be required to make a contribution toward the cost of installing a service connection as setforth in Section 5 of these Standard Terms and conditions.

2.7. Permits: PSE&G, where necessary, will make application for all highway crossing, street opening, railroad crossing and bridge crossing permits for installation of all mains and services and shall not be required to furnish service until after such permits are granted.

The customer may be required to pay the charges, if any, for permission to open the street. The customer shall obtain and present to PSE&G, for recording or for registration, all instruments providing for easements or rights of way, and all permits (except street opening permits), consents, and certificates necessary for the introduction of service.

2.8. Temporary Service: Where service is to be used an installation for a limited period and such installation is not permanent in nature, the use of service shall be classified as temporary. In such cases, the customer may be required to pay to PSE&G the cost of the facilities required to furnish service. The minimum period of temporary service for billing purposes shall be one month.

After two years of service a temporary service installation shall be eligible for refunds. Excluding the first two annual service periods, refunds equal to 10% of the revenue received by PSE&G during an annual service period shall be made at the end of such

period. In no case shall the total amount refunded be in excess of the installation cost paid by the customer, nor shall refunds be made for more than eight consecutive annual service periods.

2.9. Service Area: PSE&G reserves the right to limit the territory in which it offers thermal service. The area in which this service is currently offered is shown on Sheet Number ___ "Territory Served." When and if the territory expands, service will be made available to customers subject to the conditions setforth herein.

3. EXTENSION OF THERMAL FACILITIES

3.1. General: PSE&G will construct, own and maintain distribution mains located on streets, highways and on rights of way acquired by PSE&G, used or usable as part of the distribution system of PSE&G. The making of a deposit under any of the following cases shall not give the customer any interest in the facilities, the ownership being vested exclusively in PSE&G.

The following formulae shall not be binding on the parties but are suggested as a guide to customers and utilities. Parties are still free to exercise their rights under New Jersey Revised Statues 48:2-27. When an applicant for an extension is dissatisfied with these suggested regulations he may petition the Board for a finding that the extension should be made without charge.

3.2. Individual Residential Customer: Where the cost to PSE&G for a facility expansion to serve an individual permanent residential customer does not exceed the estimated annual revenue, PSE&G will make the necessary extension upon receiving from the customer an application for service. Such application shall be made by the owner of the property or by a responsible tenant and shall be for an indefinite period; not less, however, than the number of months necessary to produce, at the normal annual charge, the cost of the extension.

3.2.1. Where the cost of an extension exceeds the amount which PSE&G will install without cost to a customer, in accordance with Section 3.2, the excess cost of the extension shall be deposited and remain with PSE&G without interest. When the actual annual revenue from premises exceeds the amount of revenue which was used as the basis for the initial deposit computation, or th basis for a previous deposit return, there shall be returned to the depositor an additional amount equal to five times such excess. In no event shall more than the original deposit be returned to the depositor nor shall any part of the deposit remaining after ten years from the date of the original deposit be returned. PSE&G will waive the deposit required where the amount is $100.00 or less.

3.2.2. Where the cost of PSE&G for any extension to serve an individual permanent residential customer exceeds the

amount which PSE&G will install without cost to the customer, in accordance with Section 3.2, PSE&G and the customer may agree upon a monthly revenue guarantee not to exceed one-sixtieth of the total cost of the extension, in lieu of a deposit persuant to Section 3.2.1.

3.3. Residential Land Developer: Where applications for extensions into newly developed tracts of land are made by individuals, partnerships, or corporations interested in the development of sale or land, but not as ultimate residents, PSE&G may require a deposit from the applicant covering the entire cost of its facility expansion to serve the tract.

3.3.1. Extension deposits shall not carry interest and are to be returned as hereinafter provided to the depositor when new buildings abutting on such extensions are under construction and have been framed and roofed.

3.3.2. The deposit shall be returned in an amount equal to the estimated annual revenue from each such completion on said extension. If during the ten-year period from the date of the original deposit, the actual annual revenue, during any year of said ten-year period, from premises abutting upon said extension shall exceed the annual revenue which was the basis for the previous deposit return, there shall be returned to the depositor an additional amount equal to five times such excess. In no event shall more than the original deposit be returned to the depositor nor shall any part of the deposit remaining after ten years from the date of the original deposit be returned.

3.4. Commercial and Industrial: PSE&G may require any customer to deposit an amount equal to the entire cost of the new facilities required to supply service, such amount to be subject to refund as follows: At the end of the first

service year, an amount without interest equal to 10% of the total amount of the monthly bills rendered to and paid by the customer for thermal service furnished by PSE&G for that year will be refunded, and thereafter refunds similarly determined will continue each year until such time as the accumulated annual refunds are equal to but not in excess of the sum deposited; provided, however, that any part of the deposit not returned to the customer within ten years after the beginning of the first service year shall remain the property of PSE&G. No refund will be made if service is discontinued prior to the expiration of the first service year.

Where it is necessary to provide additional facilities to serve increased requirements of an existing customer, PSE&G may require the customer to deposit an amount equal to the cost of such additional facilities. This amount shall be subject to refund as outlined in the preceding paragraph, except that the refunds will be calculated at 10% of the excess revenue over a predetermined base.

4. CHARACTERISTICS OF SERVICE

4.1. Standard Service Supply: PSE&G will endeavor, but does not guarantee, to furnish a continuous supply of thermal energy metered on a Btu basis.

5. SERVICE CONNECTIONS

5.1. General: The word service as used herein shall mean a set of two pipes (supply and return) as installed between the distribution supply main, the customer's building, and the distribution return main. The customer shall consult PSE&G as to the exact point at which the service will enter the building before installing interior piping or starting any other work dependent upon the location of the service pipe. PSE&G will determine the location of the service pipe depending upon existing facilities in the street and other practical considerations.

Thermal service will be supplied to each building or premises through a single service except where, in the judgement of PSE&G, its economic considerations; conditions on its

distribution system; improvement of service conditions; or volume of th customer's requirements, make it desirable to install more than one service.

The making of a payment in any of the following cases shall not give the customer any interest in the service connection, the ownership being vested exclusively in PSE&G.

5.2. Service Connection Charges: PSE&G will furnish and place, at no cost to the customer, up to 200 feet of service connection, measured at right angles from the nearest curb line to the customer's building, at the point of service entrance designated by PSE&G. Where the distance is in excess of 200 feet, the service will be installed subject to a charge equal to the amount by which the cost of the service connection exceeds the greater of either twice the customer's annual revenue as estimated by PSE&G or the cost of the first 200 feet of service connection which otherwise would be furnished without charge as provided above. Should the customer request a service entrance

at a location other than that designated by PSE&G, the customer shall pay the additional cost associated with said change in point of service entrance provided that the customer shall not be required to pay for the first 200 feet of service connection in any case, and provided further, that the customer shall not be required to pay for any portion of the cost of the service connection if the cost thereof does not exceed twice the estimated annual revenue. PSE&G will waive the charge to the customer when the amount is $100 or less.

5.3. Change in Location of Existing Service Piping: Any change requested by the customer in the location of the existing service piping, if approved by PSE&G, will be made at the expense of the customer.

6. METERS AND ASSOCIATED EQUIPMENT

6.1. General: PSE&G will select the type and make of metering and its other equipment, and may, from time to time, change or alter such equipment; its sole obligation is to supply meter-

ing that will furnish accurate and adequate records for billing purposes.

A single meter and associated equipment, as necessary, will be furnished and installed by PSE&G for each separately billed rate schedule under which a customer receives service.

Additional meters and associated equipment will be installed only where, in the judgement of PSE&G, its economic considerations; conditions on its distribution system; improvement of service conditions; or the volume of the customer's requirements, make it desirable to install such additional equipment.

6.2. Seals: PSE&G may seal or lock any meters or enclosures containing meters and associated metering equipment. No person except a duly authorized employee of PSE&G shall break or remove a PSE&G seal or lock.

6.3. Protection of Meter and Service Equipment: Customer shall furnish and maintain a suitable space for the meter and associated equipment.

Such space shall be as near as practicable to the point of entrance of the service pipe, adequately ventilating, dry and free from corrosive vapors, not subject to extreme temperatures, readily accessible to duly authorized employees or agents of PSE&G. Customer shall not tamper with or remove meters or other equipment, nor permit access thereto except by duly authorized employees or agents of PSE&G. In case of loss or damage to the property of PSE&G from the act of negligence of the customer or his agents or servants, or of failure to return equipment supplied by PSE&G, customer shall pay to PSE&G the amount of such loss or damage to the property. All equipment furnished at the expense of PSE&G shall remain its property and may be replaced whenever deemed necessary and may be removed by it at any reasonable time after the discontinuance of service. In the case of defective service, the customer shall not interfere or tamper with the apparatus belonging to PSE&G but shall immediately notify PSE&G to have the defects remedied.

6.4. PSE&G to Turn on Service: No person other than a duly authorized employee or agent of PSE&G shall turn thermal energy into any new system or piping or into any old system or piping from which the use of thermal energy has been discontinued.

6.5. Change in Location of Meters and Associated Equipment: Any change requested by the customer in the existing location of the meters and associated equipment, if approved by PSE&G, will be made at the expense of the customer.

6.6. Other devices: No branch circuits or devices are permitted on the supply side of the meter.

7. CUSTOMER'S INSTALLATION

7.1. General: No material change in the size, total capacity, or method of operation of customer's equipment shall be made without previous written notice to PSE&G.

7.2. Piping: Piping installed on the customer's premises must conform to all requirements of the State Uniform Construction Code, municipal or other properly constituted public authorities.

Piping on customer's premises, owned by PSE&G, on the primary side of the heat exchanger is designed to operate as a closed loop system. Customer shall not make any connection which will divert or impede the flow of water in this primary loop.

7.3. Maintenance of Customer's Installation: Customer's entire installation shall be maintained in the condition required by the State Uniform Construction Code, municipal or other public authorities having jurisdiction and by PSE&G.

7.4. Appliance Adjustments: PSE&G will not make any adjustments nor conduct any maintenance on customers' thermal appliances.

7.5. Adequacy and Safety of Installtion: PSE&G shall not be required to supply thermal service until the customer's installation shall have been approved by the authorities having jurisdiction. PSE&G may withhold or discontinue its service whenever such installation or part thereof is deemed by PSE&G to be unsafe, inadequate, or unsuitable for receiving service, or to interfere with or impair the continuity or quality of service to the customer or to others.

PSE&G will assume no responsibility for the condition of customer's thermal installation or for accidents, fires, or failures which may occur as the result of the condition of such installation.

Neither by inspection or nonrejection, nor in any other way, does PSE&G give any warranty, expressed or implied, as to the adequacy, safety or other characteristics of any structure, equipment, wires, pipes, appliances or devices used by the customer.

Where the use of thermal service is to be intermittent or occasional, or for low load factor purposes or for short durations, equipment shall not be connected without previous written notice to PSE&G. The customer's equipment shall not be used in such a manner as to cause objectionable pressure pulsations or disturbances in the PSE&G system; if violated, PSE&G may require customer to correct the character of use, or in the absence of correction, may discontinue the service.

7.6 Utilization Apparatus: All utilization apparatus shall have the approval of PSE&G. The manner of installation of all utilization apparatus shall be in accordance with State Uniform Construction Code.

8. METER READING AND BILLING

8.1. Measurement of Energy Used: PSE&G will select the type and make of metering equipment and may, from time to time, change or alter such equipment; its sole obligation is to supply meters that will accurately and adequately furnish records for billing purposes.

PSE&G reserves the right to meter the demand of any customer. The maximum demand when determined by a demand meter shall be the highest 60 minute integrated demand occurring during the billing period in which such use is made. The integrated demand is the average of the Btu's use occurring in a 60 minute period, which average, if used continuously for 60 minutes, would produce the number of Btu's actually consumed during such period.

Where service through more than one meter is permitted by PSE&G as outlined under Section 6.1 of these Standard Terms and Conditions, the use registered by the individual meters will be combined for billing purposes. In all other instances, each meter shall be billed separately.

Bills will be based upon registration of PSE&G meters except as otherwise provided for in this Tariff.

8.2. Separate Billing for Each Installation: The thermal service used by a customer through

each service connection shall be billed separately at the applicable rate schedule selected by the customer. See Sections 5.1 and 6.1 of these Standard Terms and Conditions.

8.3. Submetering: The service and supply of thermal energy by PSE&G for the use of owners, tenants, or occupants of buildings or premises, will be furnished to them as customers of PSE&G through PSE&G individual meters, and will not be supplied for submetering for resale by or to any owner, tenant or occupant of any such building or premises.

8.4. Testing of Meters: At such times as PSE&G may deem proper, PSE&G will test its meters. Meters will be tested at the request of the customer for a fee of $50. If such metering equipment is found to be registering more than 5% fast, no charge will be made for testing. A refund will be granted persuant to Section 8.5.

8.5. Billing Adjustments: Whenever a meter is found to be registering fast or slow by 5% or more, an adjustment of charges shall be made.

8.6. Meter Reading and Billing Period: Unless otherwise specified in this Tariff, the charges are stated on a monthly basis. The term "month" for billing purposes shall mean the period between any two consecutive regularly scheduled meter readings. Meter reading schedules provide for reading meters, in accordance with their geographic location, as nearly as may be practicable every thirty days. Schedules are prepared in advance by PSE&G and are available for inspection.

PSE&G may read meters and render bills on a "bimonthly" basis, with the monthly charges prorated on a two-month basis.

8.7. Proration of Monthly Charges: For all billings for service, including initial bills, final bills, and bill for periods other than twenty-five to thirty-six days inclusive, except for temporary service accounts, the monthly charges will be prorated on the basis of one-thirtieth for each day of service, each month being considered as thirty days when determining the number of days on which prorat-

ing is based. For temporary service accounts the minimum period for billing purposes shall be one month.

8.8. Averaged Bills: Where PSE&G is unable to read the meter, PSE&G may estimate the amount of energy supplied and submit an averaged bill, so marked, for customer's acceptance. Adjustment of such customer's averaged use to actual use will be made after an actual meter reading is obtained.

8.9. Malfunctioning Meter: In case the seal of the meter is broken other than by employees of PSE&G, or the meter fails to register with commercial accuracy, the amount of thermal service used and to be paid for (for the number of days the meter is not properly in service) shall be the equivalent of the next former or, if no former, subsequent equivalent number of days of proper metered use.

8.10. Budget Plan: Customers billed under Rate Schedule GTS shall have the option of paying for their use of total service in equal esti-

mated monthly installments. The total service for a 12 month period will be averaged over 11 months and may be paid in 11 equally monthly installments. Adjustments will be made in the twelfth month if actual charges are more or less than the estimated amount.

8.11. Late Payment Charge - A late payment charge at the rate of .788% per monthly billing period shall be applied to the accounts of all customers taking service. The charge will be applied to all amounts billed including accounts payable and unpaid finance charge amounts applied to previous bills, which are not received by PSE&G on or before a date specified on the bill. The amount of the finance charge to be added to the unpaid balance shall be calculated by multiplying the unpaid balance by the late payment charge rate. When payment is received by the Company from a customer who has an unpaid balance which includes charges for late payment, the payment shall be applied first to such charges and then to the remainder of the unpaid balance.

8.12. Billing of Charges in Tariff: Unless otherwise ordered by the Board of Public Utilities, the charges and the classification of service set forth in this Tariff or in amendments hereof shall apply to the first month's billing of service in the regular course on and after the effective date set forth in such Tariff covering the use of thermal service subsequent to the scheduled meter reading date for the immediately preceding month.

8.13. Payment of Bills: Payment of bills for service are due on presentation and are payable at any Customer Service Department of any Commercial Office of PSE&G or to any collector or collection agency duly authorized by PSE&G.

9. LEAKAGE

Customer shall immediately give notice to PSE&G at its office of any leakage in the PSE&G system in or about the customer's premises.

10. ACCESS TO CUSTOMER'S PREMISES

PSE&G shall have the right of reasonable access to customer's premises, and to all property furnished by

PSE&G, at all reasonable times for the purpose of inspection of customer's premises incident to the rendering of service, reading meters or inspecting, testing or repairing its facilities used in connection with supplying the service, or for the removal of its property. The customer shall obtain, or cause to be obtained, all permits needed by PSE&G for access to its facilities. Access to facilities of PSE&G shall not be given except to authorized employees of PSE&G or duly authorized governmental officials.

11. DISCONTINUANCE OF SERVICE

11.1 By PSE&G: PSE&G, upon reasonable notice, when it can be reasonably given, may suspend or curtail or discontinue service for the following reasons: (1) For the purpose of making permanent or temporary repairs, changes or improvements in any part of its system; (2) For compliance in good faith with any governmental order or directive notwithstanding such order or directive subsequently may be held to be invalid; (3) For any of the following acts or omissions on the part of the customer: (a) nonpayment of a valid bill due for service furnished at a present or previous location.

However, nonpayment of business service shall not be a reason for discontinuance of residence service; (b) tampering with any facility of PSE&G; (c) fraudulent representation in relation to the use of service; (d) customer moving from the premises, unless the customer requests that service be continued (e) providing service to others without approval of PSE&G; (f) failure to make or increase an advance payment or deposit as provided for in these Standard Terms and Conditions; (g) refusal to contract for service where such contract is required; (h) connecting and operating equipment in such manner as to produce disturbing effects on the service of PSE&G or other customers; (i) failure of the customer to comply with any of these Standard Terms and Conditions; (j) where the condition of the customer's installation presents a hazard to life or property; or (k) failure of customer to repair any faulty facility of the customer; (4) For refusal of reasonable access to customer's premises for necessary purposes in connection with rendering of service, including meter installation, reading or testing, or

the maintenance or removal of the property of PSE&G; (5) PSE&G also reserves the right to terminate service upon five years written notice.

11.2. At Customer's Request: A customer wishing to discontinue service must give notice as provided in the applicable contract. Where such notice is not received by PSE&G, customer shall be liable for service until final reading of the meter is taken. Notice to discontinue service will not relieve a customer from any minimum or guaranteed payment under any contract or rate schedule.

12. RECONNECTION CHARGE

A reconnection charge of $50.00 will be made for restoration of service when service has been suspended or discontinued for non-payment of any bill due.

13. SERVICE LIMITATIONS

13.1. Continuity of Service: PSE&G will use reasonable diligence to provide a regular and uninterrupted supply of service. Should the supply be suspended, curtailed, or discon-

tinued by PSE&G for any of the reasons set-forth in Section 11 of these Standard Terms and Conditions, or should the supply of service be interrupted, curtailed, deficient, defective, or fail, by reason of any act of God, accident, strike, legal process, governmental interference, or by reason of compliance in good faith with any governmental order or directive notwithstanding such order or directive subsequently may be held to be invalid PSE&G shall not be liable for any loss or damage, direct or consequential, resulting from any such suspension, discontinuance, interruption, curtailment, deficiency, defect or failure.

13.2. Emergencies: PSE&G may curtail or interrupt service to any customer or customers in the event of emergency threatening integrity of its system or the systems to which it is directly or indirectly connected if, in its sole judgement, such action will prevent or alleviate the emergency condition.

13.3. Unusual Conditions:. PSE&G may place limitations on the amount and character of service it will supply and may refuse service to new customers or to existing customers for additional load if PSE&G is unable to obtain or does not have assured the necessary production raw materials or equipment and facilities to supply such service.

14. TERMINATION, CHANGE, OR MODIFICATION OF PROVISIONS OF TARIFF

This Tariff is subject to the lawful orders of the Board of Public Utilities of the State of New Jesey.

PSE&G may at any time and in any manner permitted by law, and the applicable rules and regulations of the Board of Public Utilities of the State of New Jersey, terminate, or change or modify by revision, amendment, supplement, or otherwise, this Tariff or any part hereof, or any revision or amendment hereof or supplement hereto.

RAW MATERIALS ADJUSTMENT

The bill calculated from the appropriate tariff shall be increased or decreased in the amount of _____¢ per million Btu's billed for every full _____¢ variation above or below _____¢ fuel related cost per million Btu's sold as determined by the fuel related cost for the month immediately preceding the current billing period.

APPLICABLE TO USE OF SERVICE FOR:

General Thermal Service

CHARACTERISTICS OF SERVICE:

Continuous

RATE:

Energy Charge:

(a) During the billing months of _____ through _____

First _____ MMBtu per month @ _____ per MMBtu

Over _____ MMBtu per month @ _____ per MMBtu

(b) In the remaining billing months of _____ through _____

First _____ MMBtu per month @ _____ per MMBtu

Over _____ MMBtu per month @ _____ per MMBtu

Demand Charge:

For the first _____ MMBtu (or less) of billing demand _____ per MMBtu.

For the next _____ MMBtu of billing demand _____ per MMBtu.

For the excess over _____ MMBtu of billing demand _____ per MMBtu.

An additional demand charge of $_____ per MMBtu (or less) will be made for MMBTU of the thermal energy in excess of the contract capacity for the month in which that contract capacity is exceeded.

Minimum Charge:

There shall be a minimum monthly charge of $_____ for each of the billing months of _____ through _____ and for any other month when connected.

TERMS OF PAYMENT:

Bills are due on presentation.

TERM:

____ years until termination with _____ months notice.

SPECIAL PROVISIONS:

STANDARD TERMS AND CONDITIONS:

This rate schedule is subject to the Standard Terms and Conditions on Sheet Nos. 4 to 35, inclusive, of this tariff.

SECTION 5

FINANCIAL CONSIDERATIONS

5. FINANCIAL CONSIDERATIONS

5.0 Introduction

The economic evaluation of Section 9 compares the various conventional and district heating plans on the basis of levelized annual minimum revenue requirements. In other words, the economic evaluation focuses on the effect of each plan on long term costs to heating customers. This section addresses the analysis of short term financial and rate considerations. This analysis is necessary because even the most economic plan in the long run may have short run effects that render it unattractive.

5.1 Method of Analysis

The analysis summarized below was done using corporate modeling techniques. The input to a corporate model consists of all of the year-by-year construction expenditures, operating and maintenance expenses, and various financial data for each plan. The corporate model produces yearly income statements and balance sheets for each plan. The present analysis was conducted for a 10 year period (1984-1993).

Three important results are presented for each plan stated:

1. Cost of heat to the customer.
2. Total construction expenditures.
3. Percent of construction expenditures financed internally.

These three results provide a picture of the rate and financial attractiveness of each plan.

5.2 Scenarios Studied

The rate and financial analysis was conducted for the fully developed system compared to a conventional system, and for Berry's Creek without Hudson No. 2

retrofit compared to a conventional system. In addition, in order to test the effect of various financing schemes, the financing schemes shown in Table 5–I were analyzed. Table 5–II shows the financial assumptions employed.

In all cases it is assumed that the heating business would be rate of return regulated with an overall cost of capital of 11.9% as shown in Table 5–II.

5.3 Results and Conclusions

Table 5–III shows the results for key financial variables for the period 1984–1993. Pro–forma income statements and balance sheets are shown in Attachments A through E. As can be seen, total construction expenditures and percent internally generated funds are most favorable in the conventional system case. In three of the four district heating cases, the average percent internally generated funds is below the Company's target of 50% of capital requirements.

Several observations can be made about the effect of unconventional financing methods on financial performance:

- The reduction of interest expense in the tax exempt case is more than offset by the increase in cash taxes; thus, internally generated funds and net cash flow are reduced relative to the district heating base case.

- The approximate 10% reduction in capital investment in the lease case is almost entirely offset by a combination of the reduction in depreciation and ITC tax benefits and their respective accruals and the increase in O&M expense due to the lease payment. The net effect is financial performance very similar to the district heating base case with little effect on average cost.

- Exclusion of Gross Receipts and Franchise Tax and shorter tax lives in the non–utility status case serve to improve both cash flow and cost relative to the district heating base case.

TABLE 5-I

FULLY DEVELOPED SYSTEM
DESCRIPTION OF CASES

Conventional Heating	• Conventional financing • Rate of return regulated
District Heating Base	• Conventional financing • Rate of return regulated
District Heating Tax-Exempt	• Distribution plant financed with Industrial Development Bonds (IDB) @ 7.5% • Straight line depreciation of distribution plant over the ACRS tax life • Remaining capital conventionally financed • Rate of return regulated
District Heating Lease	• Heater plant leased at an annual payment of 11.3% of capital cost • Total investment reduced by heater plant capital investment • Remaining capital conventionally financed
District Heating Non-Utility Status	• No gross receipts and franchise tax • All plant depreciated over five years for tax purposes

TABLE 5-II

DISTRICT HEATING ANALYSIS
FINANCIAL ASSUMPTIONS

Long Term Cost of Capital (All Cases)

	Ratio	Cost	Weighted Cost
Debt	43%	10.5%	4.5%
Preferred Stock	12	9.5	1.1
Common Stock	45	14.0	6.3
Total	100%		11.9%

District Heating Tax-Exempt Case - Distribution plant financed with 7.5% industrial development bonds.

District Heating Lease Case - Heater plant leased at an annual payment of 11.3% of capital cost.

TABLE 5-III

FULLY DEVELOPED SYSTEM
1984-1993

Case	Average Price of Heat $/mBtu	Rank	Total Construction Expenditures $Million	Rank	% Internal Generation %	Rank
Conventional System	27	1	27	1	77	1
Dist. Heating Base	42	4	199	3	43	3
Dist. Heating Tax-Exempt	40	3	199	3	37	5
Dist. Heating Lease	42	4	172	2	42	4
Dist. Heating Non-Utility	36	2	199	3	52	2

However, the overwhelming conclusion of the financial analysis is that while the financing plan has an effect on the average cost to PSE&G of providing heat, it has little or no effect on overall financial performance, as shown in Table 5–III.

It should also be noted that the price of heat to the customer associated with district heating, averaged over the first ten years of the study period, ranges from 33–57% higher than the price associated with conventional technology. A comparison of prices for the 1984 to 1993 period is shown in Table 5–IV. This renders the district heating system very unattractive to the customer in the short run.

5.4 Results and Conclusions – Berry's Creek

As was the case in the economic analysis, district heating at Berry's Creek is more attractive than for the fully developed system. As shown in Table 5–V internal generation of funds, while lower for the district heating alternative, is still well above acceptable levels. Although the 10 year total expenditure of less than $26 million is four and one–half times higher than the conventional plan, it is still a relatively modest amount. Table 5–VI shows a comparison of prices of heating for the conventional and district heating cases. While the pattern of these price projections is the same as the fully developed system, the district heating system becomes cheaper in a much shorter period of time, four years, and the average price in the district heating system is cheaper over the 10 year period.

5.5 Summary

The financial analysis described in this section shows that a relatively small scale district heating project at Berry's Creek is worthy of further consideration, while the fully developed system is financially unattractive. These results agree with the economic analysis.

It should be noted that much more detailed financial and rate analyses would be required prior to PSE&G committing funds to a district heating project. The results of the analysis are extremely sensitive to the timing and amounts of construction

TABLE 5-IV

DISTRICT HEATING
1984-1993
PRICE OF HEAT
($/mBtu)

Year	(1)	(2)	(3)	(4)	(5)
1984	13.89	106.24	104.76	108.39	92.35
1985	20.44	42.40	40.94	40.45	36.87
1986	22.11	33.99	32.15	33.93	29.17
1987	24.03	31.62	29.43	29.32	26.77
1988	35.70	32.88	30.39	31.61	27.56
1989	27.56	31.54	28.77	30.95	26.13
1990	29.79	32.46	29.44	31.98	26.70
1991	32.19	33.28	30.16	33.01	27.28
1992	34.85	36.36	33.19	36.24	29.77
1993	37.60	41.00	37.77	41.11	33.50

(1) Conventional Heating System
(2) District Heating - Base Case
(3) District Heating - Tax-Exempt
(4) District Heating - Lease
(5) District Heating - Non-Utility Status

TABLE 5-V

BERRY'S CREEK
WITHOUT HUDSON RETROFIT (WITH LANDFILL GAS)
1984-1993

Case	Average Price of Heat $/mBtu	Rank	Total Construction Expenditures $Million	Rank	% Internal Generation %	Rank
Conventional System	26	2	6	1	83	1
District Heating	22	1	26	2	72	2

TABLE 5-VI

BERRY'S CREEK
WITHOUT HUDSON RETROFIT (WITH LANDFILL GAS)
1984-1993
PRICE OF HEAT
($/mBtu)

	Conventional	District Heating
1984	10	21
1985	14	22
1986	17	23
1987	21	21
1988	25	20
1989	28	21
1990	28	32
1991	34	23
1992	39	25
1993	43	26

expenditures, the exact method of revenue regulation, and some of the institutional considerations discussed elsewhere in this report. Such detailed financial analysis is not possible at this time since these considerations are open to considerable variation.

5.6 Sources of Outside Funding for District Heating

Because of current capital commitment constraints due to other construction in progress, sources of outside funding for district heating development have been investigated.

One possible option would be a limited partnership approach with possible private stock offering. This route is currently under intensive study for another possible new business venture. Discussions have been held with the following venture capital organizations:

- Scallop Thermal Management Corporation (a subsidiary of Royal Dutch Shell)
- Donaldson, Lufkin and Jenrette
- Parsons Brinkerhoff
- D. Silvers Associates

Another possibility might be HUD/UDAG funding through a municipality, as part of the financing package.

Study of financing options and contacts with potential sources of funding are continuing.

INCOME STATEMENT
($1000S)
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*** CONVENTIONAL HEATING SYSTEM ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
TOTAL REVENUES	639	3516	8115	14060	20635	28911	38602	47995
OPERATION & MAINT	509	2782	6393	11102	16407	23298	31341	39224
BOOK DEPRECIATION	8	45	113	200	293	388	496	599
FEDERAL INCOME TAX	-53	-208	-269	-333	-339	-411	-529	-461
DFD FED INCOME TAX	12	73	179	304	429	540	659	755
ITC ACCRUAL	53	210	271	332	314	328	405	287
ITC CREDIT	-1	-5	-13	-21	-31	-41	-52	-62
GROSS RECEIPTS TAX	89	487	1125	1949	2860	4007	5351	6653
TOTAL OPER EXP	617	3384	7799	13533	19934	28109	37671	46994
OPER INCOME	22	132	314	527	702	802	931	1001
INTEREST EXPENSE	8	48	113	185	251	299	347	374
NET INCOME	14	84	203	341	451	503	584	627

INCOME STATEMENT
($1000S)
****

*** CONVENTIONAL HEATING SYSTEM ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL REVENUES	57147	66393	73984	84547	98558	117592	143554	178892
OPERATION & MAINT	47037	55033	61725	70883	82791	98919	120728	150604
BOOK DEPRECIATION	683	756	808	876	991	1159	1379	1659
FEDERAL INCOME TAX	-510	-480	-481	-704	-915	-1173	-1405	-1790
DFD FED INCOME TAX	810	834	817	824	900	1043	1241	1502
ITC ACCRUAL	284	201	152	329	489	682	822	1072
ITC CREDIT	-71	-78	-84	-91	-103	-121	-144	-173
GROSS RECEIPTS TAX	7921	9203	10255	11719	13661	16313	19898	24796
TOTAL OPER EXP	56155	65468	73193	83836	97814	116822	142519	177669
OPER INCOME	992	925	791	711	744	870	1036	1223
INTEREST EXPENSE	371	345	296	265	278	325	387	457
NET INCOME	621	579	496	445	466	545	649	766

INCOME STATEMENT
($1000S)
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*** CONVENTIONAL HEATING SYSTEM ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL REVENUES	227796	287451	352686	436537	536755	641441	738609	844494
OPERATION & MAINT	191871	242360	297759	368992	453963	543108	626052	716723
BOOK DEPRECIATION	2048	2517	3024	3642	4414	5219	6005	6811
FEDERAL INCOME TAX	-2447	-2753	-3243	-4220	-5187	-5531	-6188	-6858
DFD FED INCOME TAX	1894	2358	2824	3416	4189	4931	5553	6131
ITC ACCRUAL	1537	1575	1759	2339	2816	2577	2687	2757
ITC CREDIT	-212	-259	-310	-372	-450	-532	-611	-694
GROSS RECEIPTS TAX	31575	39844	48886	60508	74400	88910	102379	117055
TOTAL OPER EXP	226266	285642	350698	434306	534145	638682	735877	841926
OPER INCOME	1530	1809	1988	2231	2610	2759	2732	2568
INTEREST EXPENSE	572	676	733	823	960	1013	987	934
NET INCOME	958	1133	1254	1408	1650	1745	1745	1634

INCOME STATEMENT
($1000S)
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*** CONVENTIONAL HEATING SYSTEM ***

YEAR	2008	2009	2010	2011
TOTAL REVENUES	961156	1086295	1223551	1373241
OPERATION & MAINT	817744	927950	1049822	1183199
BOOK DEPRECIATION	7523	8037	8401	8685
FEDERAL INCOME TAX	-6797	-7017	-7704	-8580
DFD FED INCOME TAX	6456	5348	5995	5464
ITC ACCRUAL	2010	1341	1034	819
ITC CREDIT	-766	-817	-853	-881
GROSS RECEIPTS TAX	133226	150571	169596	190345
TOTAL OPER EXP	959395	1086433	1226292	1379051
OPER INCOME	1760	-137	-2741	-5810
INTEREST EXPENSE	632	-49	-1001	-2127
NET INCOME	1129	-88	-1740	-3683

BALANCE SHEET
($1000S)
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*** CONVENTIONAL HEATING SYSTEM ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
GROSS PLANT	529	2624	5329	8650	11793	15073	19123	21991
LESS: DEPR RESERV	8	52	165	365	658	1046	1542	2141
NET PLANT	522	2572	5164	8285	11135	14027	17581	19850
LONGTERM DEBT	158	749	1402	2125	2652	3047	3562	3557
PREFERRED STOCK	44	209	391	593	740	850	994	993
COMMON STOCK	142	757	1380	2028	2444	2716	3081	2917
RETAINED EARNINGS	4	28	67	196	331	473	647	806
GR&FT RESERVE	89	487	1125	1949	2860	4007	5351	6653
ITC RESERVE	52	257	515	826	1110	1397	1750	1975
DFD FIT RESERVE	12	85	264	568	997	1536	2196	2951
TOTAL LIABILITIES	522	2572	5164	8285	11135	14027	17581	19850

BALANCE SHEET
($1000S)
****

*** CONVENTIONAL HEATING SYSTEM ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
GROSS PLANT	24833	26845	28368	31658	36543	43367	51588	62305
LESS: DEPR RESERV	2824	3580	4387	5263	6254	7414	8792	10451
NET PLANT	22009	23265	23981	26395	30289	35953	42796	51854
LONGTERM DEBT	3500	3078	2552	2504	2791	3396	3972	4729
PREFERRED STOCK	977	859	712	699	779	948	1108	1320
COMMON STOCK	2698	2109	1432	1268	1449	1944	2381	2978
RETAINED EARNINGS	965	1112	1239	1353	1472	1611	1776	1971
GR&FT RESERVE	7921	9203	10253	11719	13661	16313	19898	24796
ITC RESERVE	2188	2311	2379	2617	3003	3564	4242	5141
DFD FIT RESERVE	3761	4595	5412	6235	7135	8178	9419	10920
TOTAL LIABILITIES	22009	23265	23981	26395	30289	35953	42796	51855

BALANCE SHEET
($1000S)
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*** CONVENTIONAL HEATING SYSTEM ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
GROSS PLANT	77677	93431	111020	134408	162568	188339	215212	242786
LESS: DEPR RESERV	12499	15015	18039	21681	26095	31314	37320	44131
NET PLANT	65179	78416	92981	112727	136473	157025	177892	198655
LONGTERM DEBT	6159	6716	7253	8431	9850	9448	9349	8443
PREFERRED STOCK	1719	1874	2024	2353	2749	2637	2609	2356
COMMON STOCK	4231	4524	4766	5640	6702	5835	5282	3914
RETAINED EARNINGS	2216	2504	2824	3184	3606	4053	4502	4921
GR&FT RESERVE	31575	39844	48886	60508	74400	88910	102379	117055
ITC RESERVE	6466	7783	9232	11199	13565	15610	17686	19749
DFD FIT RESERVE	12814	15172	17996	21412	25601	30532	36086	42216
TOTAL LIABILITIES	65178	78416	92981	112727	136473	157025	177892	198655

BALANCE SHEET
($1000S)
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*** CONVENTIONAL HEATING SYSTEM ***

YEAR	2008	2009	2010	2011
GROSS PLANT	262884	276290	286632	294823
LESS: DEPR RESERV	51654	59690	68091	76776
NET PLANT	211230	216600	218541	218048
LONGTERM DEBT	3586	-4527	-14529	-25986
PREFERRED STOCK	1001	-1264	-4055	-7252
COMMON STOCK	-1459	-9927	-19948	-30993
RETAINED EARNINGS	5212	5189	4743	3798
GR&FT RESERVE	133224	150571	169596	190345
ITC RESERVE	20993	21517	21698	21636
DFD FIT RESERVE	48672	55041	61036	66500
TOTAL LIABILITIES	211230	216600	218541	218048

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--BASE CASE ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
TOTAL REVENUES	4887	7292	12476	18495	26406	33088	42069	49621
OPERATION & MAINT	3766	5240	7581	10453	14335	16814	22418	27458
BOOK DEPRECIATION	69	163	472	819	1321	1947	2388	2769
FEDERAL INCOME TAX	-546	-187	-2032	-239	-2760	-1167	-1348	-535
DFD FED INCOME TAX	131	303	844	1422	2180	3127	3679	4045
ITC ACCRUAL	550	205	2175	535	3187	1583	1854	1095
ITC CREDIT	-8	-20	-56	-97	-153	-226	-278	-322
GROSS RECEIPTS TAX	677	1011	1729	2564	3660	4586	5831	6878
TOTAL OPER EXP	4639	6716	10712	15457	21769	26668	34544	41387
OPER INCOME	248	577	1763	3038	4637	6422	7524	8234
INTEREST EXPENSE	92	208	630	1068	1657	2396	2805	3075
NET INCOME	156	369	1134	1970	2980	4026	4720	5159

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--BASE CASE ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL REVENUES	59632	72414	81057	83191	92150	105304	136337	155098
OPERATION & MAINT	30266	35177	42843	45903	53784	59106	78906	89599
BOOK DEPRECIATION	3755	4849	5125	5246	5497	6703	8111	9270
FEDERAL INCOME TAX	-5954	-826	813	494	-42	-5622	-789	-3774
DFD FED INCOME TAX	5515	7032	6861	6352	6086	7347	8885	10100
ITC ACCRUAL	6781	1938	327	706	1398	7475	3150	6576
ITC CREDIT	-442	-574	-608	-624	-656	-790	-951	-1098
GROSS RECEIPTS TAX	8266	10037	11235	11531	12773	14596	18898	21498
TOTAL OPER EXP	48187	57634	66596	69609	78840	88815	116210	132170
OPER INCOME	11445	14780	14461	13582	13310	16489	20128	22927
INTEREST EXPENSE	4274	5520	5401	5072	4971	6158	7517	8562
NET INCOME	7171	9260	9061	8510	8339	10331	12611	14365

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--BASE CASE ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL REVENUES	201836	247916	256994	349140	447201	487682	526698	573961
OPERATION & MAINT	117792	140300	117706	169996	206157	195017	213568	248883
BOOK DEPRECIATION	11470	14559	19602	24665	32750	40923	44658	47940
FEDERAL INCOME TAX	-7305	-8806	-17280	-5033	-38310	-54	2277	7143
DFD FED INCOME TAX	12988	17202	24086	30467	42388	53376	55079	55466
ITC ACCRUAL	10902	13425	24388	13944	50069	14746	15580	11350
ITC CREDIT	-1363	-1732	-2305	-2886	-3855	-4837	-5297	-5705
GROSS RECEIPTS TAX	27977	34364	35622	48394	61987	67598	73006	79557
TOTAL OPER EXP	172460	209312	201900	279548	351185	366768	398871	444633
OPER INCOME	29376	38604	55094	69592	96016	120915	127827	129328
INTEREST EXPENSE	10975	14427	20325	25683	35305	44412	46173	47037
NET INCOME	18401	24177	34769	43909	60711	76503	81654	82291

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--BASE CASE ***

YEAR	2008	2009	2010	2011
TOTAL REVENUES	637366	702508	759868	809611
OPERATION & MAINT	297386	355381	415481	468762
BOOK DEPRECIATION	50712	53060	54621	55779
FEDERAL INCOME TAX	9014	14197	15870	18224
DFD FED INCOME TAX	54709	52760	48827	43794
ITC ACCRUAL	12188	7739	5573	4300
ITC CREDIT	-6062	-6364	-6565	-6715
GROSS RECEIPTS TAX	88345	97375	105325	112220
TOTAL OPER EXP	506292	574148	639132	696364
OPER INCOME	131074	128360	120735	113247
INTEREST EXPENSE	47024	46183	44072	41459
NET INCOME	84050	82177	76664	71788

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING--BASE CASE ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
GROSS PLANT	5496	7549	29298	34650	66521	82354	100894	111840
LESS: DEPR RESERV	69	232	704	1523	2843	4790	7178	9947
NET PLANT	5427	7317	28594	33127	63678	77564	93716	101893
LONGTERM DEBT	1753	2213	9779	10570	20993	24637	28788	29782
PREFERRED STOCK	489	618	2729	2950	5859	6876	8034	8311
COMMON STOCK	1794	2171	9758	9957	19969	22651	25589	25319
RETAINED EARNINGS	41	145	476	1105	2000	3132	4538	5849
GR&FT RESERVE	677	1011	1729	2564	3660	4586	5831	6878
ITC RESERVE	541	727	2846	3284	6318	7676	9252	10024
DFD FIT RESERVE	131	434	1277	2699	4879	8006	11684	15729
TOTAL LIABILITIES	5427	7317	28594	33128	63678	77564	93716	101893

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING--BASE CASE ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
GROSS PLANT	179646	199023	202292	209356	223333	298079	329574	395333
LESS: DEPR RESERV	13702	18551	23676	28922	34419	41122	49233	58503
NET PLANT	165944	180472	178616	180434	188914	256957	280341	336830
LONGTERM DEBT	51630	53505	49363	47250	47427	69868	73307	89781
PREFERRED STOCK	14409	14932	13776	13186	13235	19498	20458	25055
COMMON STOCK	46352	45955	39308	34925	32981	53831	54219	67804
RETAINED EARNINGS	7680	10039	12350	14523	16651	19286	22499	26154
GR&FT RESERVE	8266	10037	11235	11531	12773	14596	18898	21498
ITC RESERVE	16363	17727	17446	17529	18271	24956	27154	32432
DFD FIT RESERVE	21245	28277	35138	41489	47575	54922	63807	73907
TOTAL LIABILITIES	165944	180472	178616	180434	188914	256957	280341	336830

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING---BASE CASE ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
GROSS PLANT	504355	638604	882487	1021928	1522616	1670079	1825881	1939378
LESS: DEPR RESERV	69973	84532	104134	128799	161549	202472	247130	295070
NET PLANT	434382	554073	778353	893129	1361067	1467607	1578751	1644308
LONGTERM DEBT	119256	155552	231598	257604	414874	431061	448422	447517
PREFERRED STOCK	33201	43410	64632	71889	115779	120296	125141	124889
COMMON STOCK	93966	125782	196487	212485	361533	358887	356042	333994
RETAINED EARNINGS	30838	37005	45883	57101	72637	92224	113237	134338
GR&FT RESERVE	27977	34364	35622	48394	61987	67598	73006	79557
ITC RESERVE	42171	53864	75947	87006	133219	143120	153412	159056
DFD FIT RESERVE	86095	104097	128183	158650	201038	254414	309492	364958
TOTAL LIABILITIES	434382	554072	778354	893129	1361067	1467607	1578751	1644308

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING---BASE CASE ***

YEAR	2008	2009	2010	2011
GROSS PLANT	2061259	2138653	2194380	2237378
LESS: DEPR RESERV	345781	398841	453463	509242
NET PLANT	1715478	1739812	1740918	1728136
LONGTERM DEBT	440182	431484	407972	381718
PREFERRED STOCK	125074	120414	113853	106526
COMMON STOCK	313043	274413	230138	184255
RETAINED EARNINGS	155984	177140	196810	215217
GR&FT RESERVE	88345	97375	105325	112220
ITC RESERVE	165183	166559	165566	163151
DFD FIT RESERVE	419667	472427	521254	565048
TOTAL LIABILITIES	1715478	1739812	1740918	1728136

INCOME STATEMENT
($1000S)

*** DISTRICT HEATING-TAX-EXEMPT OPTION/ RATE RELIEF ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
TOTAL REVENUES	4819	7042	11799	17216	24403	30183	38149	44970
OPERATION & MAINT	3766	5240	7581	10453	14335	16814	22418	27458
BOOK DEPRECIATION	70	163	472	819	1321	1947	2388	2769
FEDERAL INCOME TAX	-547	-231	-2155	-562	-3247	-1886	-2464	-1970
DFD FED INCOME TAX	97	219	619	1089	1625	2298	2691	2956
ITC ACCRUAL	550	205	2175	535	3187	1583	1854	1095
ITC CREDIT	-8	-20	-56	-97	-153	-226	-278	-322
GROSS RECEIPTS TAX	668	976	1635	2386	3383	4184	5288	6233
TOTAL OPER EXP	4593	6552	10271	14623	20450	24715	31897	38218
OPER INCOME	225	490	1528	2593	3952	5468	6252	6752
INTEREST EXPENSE	110	272	801	1393	2195	3259	4002	4557
NET INCOME	115	218	726	1200	1757	2209	2250	2196

INCOME STATEMENT
($1000S)

*** DISTRICT HEATING-TAX-EXEMPT OPTION/ RATE RELIEF ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL REVENUES	54424	66708	75225	77442	86085	98130	127059	142504
OPERATION & MAINT	30266	35177	42843	45903	53784	59106	78906	89599
BOOK DEPRECIATION	3755	4850	5125	5246	5497	6703	8111	9270
FEDERAL INCOME TAX	-7706	-2857	-1551	-1998	-2795	-8758	-4675	-8647
DFD FED INCOME TAX	4410	5903	5955	5580	5383	6428	7599	8042
ITC ACCRUAL	6781	1938	327	706	1398	7475	3150	6576
ITC CREDIT	-442	-574	-608	-624	-654	-790	-951	-1098
GROSS RECEIPTS TAX	7544	9246	10427	10734	11932	13602	17612	19753
TOTAL OPER EXP	44608	53384	62518	65548	74543	83766	109751	123495
OPER INCOME	9816	13325	12707	11895	11543	14365	17307	19010
INTEREST EXPENSE	5999	7473	7485	7217	7261	8793	10768	12780
NET INCOME	3817	5552	5223	4678	4282	5572	6539	6229

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING-TAX-EXEMPT OPTION: RATE RELIEF ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL REVENUES	184033	223519	224607	309013	396282	426954	456891	499237
OPERATION & MAINT	117792	140300	117786	169996	206157	195017	213568	248883
BOOK DEPRECIATION	11470	14559	19602	24665	32750	40923	44659	47940
FEDERAL INCOME TAX	-13670	-17273	-28564	-19006	-55465	-21823	-23745	-22150
DFD FED INCOME TAX	9663	12437	17926	22768	32060	42242	43362	43923
ITC ACCRUAL	10902	13425	24388	13944	50069	14746	15580	11350
ITC CREDIT	-1363	-1732	-2305	-2886	-3855	-4837	-5297	-5705
GROSS RECEIPTS TAX	25509	30982	31133	42832	54929	59180	63330	69199
TOTAL OPER EXP	160295	192698	179947	252314	316644	325447	351457	393439
OPER INCOME	23738	30821	44660	56698	79638	101507	105435	105798
INTEREST EXPENSE	16722	22179	30348	38231	51191	63629	68083	71445
NET INCOME	7017	8642	14292	18468	28448	37877	37351	34353

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING-TAX-EXEMPT OPTION: RATE RELIEF ***

YEAR	2008	2009	2010	2011
TOTAL REVENUES	555629	619032	679951	732782
OPERATION & MAINT	297384	355381	415481	468762
BOOK DEPRECIATION	50712	53060	54621	55779
FEDERAL INCOME TAX	-24634	-22927	-22918	-22525
DFD FED INCOME TAX	43748	43909	42832	41078
ITC ACCRUAL	12186	7739	5573	4300
ITC CREDIT	-5862	-6364	-6565	-6715
GROSS RECEIPTS TAX	77016	85804	94248	101571
TOTAL OPER EXP	450354	516603	583273	642251
OPER INCOME	105276	102429	96679	90531
INTEREST EXPENSE	73593	74222	72586	69766
NET INCOME	31683	28207	24093	20765

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING-TAX-EXEMPT OPTION/ RATE RELIEF ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
GROSS PLANT	5496	7549	29298	54650	66521	82354	100894	111840
LESS/ DEPR RESERV	70	232	704	1523	2843	4790	7178	9947
NET PLANT	5427	7317	28594	53128	63678	77564	93716	101893
LONGTERM DEBT	2407	3904	14393	17799	33259	43609	52932	58606
PREFERRED STOCK	361	294	1850	1610	3586	3401	3708	3251
COMMON STOCK	1323	1009	6632	5348	12230	10913	11394	9122
RETAINED EARNINGS	30	92	304	687	1215	1836	2505	3063
GR&FT RESERVE	668	976	1535	2386	3383	4184	5288	6233
ITC RESERVE	541	727	2846	3284	6318	7676	9252	10024
DFD FIT RESERVE	97	316	934	2023	3648	5946	8637	11592
TOTAL LIABILITIES	5427	7316	28594	53128	63678	77564	93716	101893

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING-TAX-EXEMPT OPTION/ RATE RELIEF ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
GROSS PLANT	179646	199023	202292	209356	223333	298079	329574	395333
LESS/ DEPR RESERV	13702	18551	23677	28923	34420	41123	49234	58504
NET PLANT	165944	180472	178616	180433	188913	256956	280341	336829
LONGTERM DEBT	84022	90055	85818	85396	88779	120402	137053	175471
PREFERRED STOCK	8846	8746	7805	7019	6551	11107	9618	10127
COMMON STOCK	29128	27338	22474	18336	15485	31146	23895	24212
RETAINED EARNINGS	4038	5452	6785	7979	9072	10493	12158	13743
GR&FT RESERVE	7544	9246	10427	10734	11932	13602	17412	19753
ITC RESERVE	16363	17727	17445	17529	18271	24956	27154	32632
DFD FIT RESERVE	16003	21906	27861	33441	38824	45252	52851	60892
TOTAL LIABILITIES	165944	180472	178615	180433	188914	256956	280340	336830

BALANCE SHEET
($1000S)

DISTRICT HEATING-TAX-EXEMPT OPTION: RATE RELIEF

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
GROSS PLANT	504355	638604	882487	1021928	1522616	1670079	1825881	1939378
LESS: DEPR RESERV	69974	84532	104135	128800	161550	202473	247132	295071
NET PLANT	434382	554072	778352	893128	1361066	1467606	1578749	1644307
LONGTERM DEBT	238564	313592	432037	505168	733897	795378	859284	896354
PREFERRED STOCK	12128	15301	29129	28314	59652	57266	55046	49374
COMMON STOCK	29925	39608	87806	80021	190243	171590	153441	123555
RETAINED EARNINGS	15529	17733	21383	26100	33380	43077	52689	61497
DRIFT RESERVE	25509	30982	31133	42832	54929	59180	63330	69199
ITC RESERVE	42171	53864	75947	87006	133219	143128	153412	159056
DFD FIT RESERVE	70556	82992	100918	123486	155746	197987	241349	285272
TOTAL LIABILITIES	434381	554072	778352	893128	1361066	1467606	1578750	1644307

BALANCE SHEET
($1000S)

DISTRICT HEATING-TAX-EXEMPT OPTION: RATE RELIEF

YEAR	2008	2009	2010	2011
GROSS PLANT	2061259	2138653	2194380	2237378
LESS: DEPR RESERV	345783	398843	453464	509244
NET PLANT	1715476	1739810	1740916	1728134
LONGTERM DEBT	931099	927405	902730	865374
PREFERRED STOCK	44898	39415	34256	29538
COMMON STOCK	98605	70782	45257	22240
RETAINED EARNINGS	69654	76917	83098	88422
DRIFT RESERVE	77016	85804	94248	101571
ITC RESERVE	165183	166559	165566	163151
DFD FIT RESERVE	329020	372928	415741	456839
TOTAL LIABILITIES	1715476	1739810	1740916	1728134

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--LEASING OPTION/ RATE RELIEF ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
TOTAL REVENUES	4986	6958	12452	17151	25386	32468	41447	49222
OPER & MAINT	3766	5240	7581	10453	14335	16814	22418	27458
LEASE PAYMENT	468	468	1926	1926	1926	2155	2155	2155
BOOK DEPRECIATION	16	57	200	382	883	1484	1899	2280
FEDERAL INCOME TAX	-149	-232	-866	-457	-2940	-1098	-1497	-690
DFD FED INCOME TAX	34	116	370	687	1511	2475	3049	3488
ITC ACCRUAL	134	205	882	585	3187	1380	1854	1095
ITC CREDIT	-2	-7	-24	-45	-102	-171	-220	-264
GROSS RECEIPTS TAX	691	964	1726	2377	3519	4500	5745	6823
TOTAL OPER EXP	4958	6811	11795	15868	22319	27540	35402	42343
OPER INCOME	28	147	656	1284	3067	4929	6044	6878
INTEREST EXPENSE	11	53	234	465	1096	1839	2253	2569
NET INCOME	18	94	422	819	1971	3090	3791	4310

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--LEASING OPTION/ RATE RELIEF ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL REVENUES	59431	72601	80602	83016	92304	105953	134814	154567
OPER & MAINT	30266	35177	42843	45903	53784	59106	78906	89599
LEASE PAYMENT	2155	3092	3092	3092	3485	6288	6288	8071
BOOK DEPRECIATION	3266	4254	4423	4544	4750	5594	6684	7640
FEDERAL INCOME TAX	-6123	-219	536	196	-38	-3639	-1425	-2929
DFD FED INCOME TAX	5032	6428	6151	5747	5505	6214	7336	8395
ITC ACCRUAL	6781	1107	327	706	1049	4987	3150	4994
ITC CREDIT	-384	-503	-525	-541	-567	-659	-782	-905
GROSS RECEIPTS TAX	8238	10063	11172	11507	12794	14686	18686	21425
TOTAL OPER EXP	49230	59399	68020	71156	80762	92578	118843	136289
OPER INCOME	10201	13202	12582	11860	11542	13374	15971	18279
INTEREST EXPENSE	3010	4930	4699	4429	4310	4995	5964	6826
NET INCOME	4191	8272	7883	7431	7232	8380	10007	11453

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--LEASING OPTION: RATE RELIEF ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL REVENUES	200543	247165	253661	346930	444343	485443	523271	571668
OPER & MAINT	117792	140300	117786	169996	206157	195017	213560	248883
LEASE PAYMENT	9248	13062	13811	16237	17838	20669	21687	21687
BOOK DEPRECIATION	9504	12027	16552	21255	28883	36552	39851	43017
FEDERAL INCOME TAX	-7150	-6535	-18012	-4401	-38634	477	801	4727
DFD FED INCOME TAX	10905	14361	20636	26749	38279	48857	50343	51165
ITC ACCRUAL	9858	10041	23724	11791	48648	12235	14676	11350
ITC CREDIT	-1130	-1432	-1943	-2482	-3397	-4320	-4728	-5122
GROSS RECEIPTS TAX	27797	34260	35160	48088	61590	67287	72531	79239
TOTAL OPER EXP	176824	216084	207714	287234	359364	376776	408729	454945
OPER INCOME	23719	31081	45947	59696	84979	108667	114542	116722
INTEREST EXPENSE	8861	11616	16951	22031	31247	39913	41374	42452
NET INCOME	14858	19465	28996	37665	53732	68754	73168	74270

INCOME STATEMENT
($1000S)
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*** DISTRICT HEATING--LEASING OPTION: RATE RELIEF ***

YEAR	2008	2009	2010	2011
TOTAL REVENUES	636748	702570	761959	813265
OPER & MAINT	297386	355381	415481	468762
LEASE PAYMENT	22876	22876	22876	22876
BOOK DEPRECIATION	45654	47868	49429	50587
FEDERAL INCOME TAX	7333	11298	12946	15105
DFD FED INCOME TAX	50824	49299	46039	41679
ITC ACCRUAL	11134	7739	5573	4300
ITC CREDIT	-5463	-5748	-5950	-6100
GROSS RECEIPTS TAX	88260	97383	105615	112727
TOTAL OPER EXP	518006	586095	652009	709935
OPER INCOME	118742	116474	109950	103330
INTEREST EXPENSE	42600	41906	40135	37828
NET INCOME	76142	74568	69815	65502

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING--LEASING OPTION1 RATE RELIEF ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
GROSS PLANT	1339	3392	12211	17563	49434	63231	81771	92717
LESS: DEPR RESERV	16	73	273	654	1538	3022	4921	7200
NET PLANT	1323	3319	11938	16909	47896	60209	76851	85517
LONGTERM DEBT	201	806	3657	5008	15866	19154	23761	25167
PREFERRED STOCK	56	225	1021	1398	4428	5345	6631	7023
COMMON STOCK	205	813	3673	4819	15589	18162	21854	22230
RETAINED EARNINGS	5	31	154	422	1014	1883	3012	4107
GRIFT RESERVE	691	964	1726	2377	3519	4500	5745	6823
ITC RESERVE	132	330	1188	1678	4764	5973	7607	8438
DFD FIT RESERVE	34	150	520	1207	2717	5192	8241	11729
TOTAL LIABILITIES	1323	3319	11938	16909	47896	60209	76850	85517

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING--LEASING OPTION1 RATE RELIEF ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
GROSS PLANT	160523	171590	174859	181923	192411	242265	273780	323715
LESS: DEPR RESERV	10466	14720	19143	23687	28438	34031	40715	48355
NET PLANT	150057	156870	155716	158236	163974	208254	233065	275360
LONGTERM DEBT	47396	46518	42985	41382	40721	54415	59191	70833
PREFERRED STOCK	13227	12982	11996	11548	11364	15186	16518	19767
COMMON STOCK	43862	40835	35126	31552	29015	41208	43657	52927
RETAINED EARNINGS	5739	7846	9858	11755	13601	15738	18267	21201
GRIFT RESERVE	8238	10063	11172	11507	12794	14686	18686	21425
ITC RESERVE	14834	15438	15240	15406	15887	20216	22584	26672
DFD FIT RESERVE	16761	23189	29340	35087	40592	46806	54142	62536
TOTAL LIABILITIES	150057	156870	155716	158236	163974	208254	233065	275360

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING--LEASING OPTION: RATE RELIEF ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
GROSS PLANT	422293	522704	759942	877854	1364333	1486685	1633447	1746944
LESS: DEPR RESERV	57859	69886	86438	107693	136576	173129	212980	255997
NET PLANT	364434	452818	673504	770161	1227757	1313557	1420467	1490947
LONGTERM DEBT	97952	123301	199570	220068	375111	385143	402934	405677
PREFERRED STOCK	27336	34410	55694	61414	104682	107482	112447	113212
COMMON STOCK	77526	99088	171500	183329	331832	324728	324518	308344
RETAINED EARNINGS	24983	29948	37352	46975	60726	78328	97157	116202
GRANT RESERVE	27797	34260	35160	48088	61590	67287	72531	79239
ITC RESERVE	35399	44009	65789	75099	120349	128265	138214	144442
DFD FIT RESERVE	73441	87802	108438	135188	173467	222324	272664	323832
TOTAL LIABILITIES	364434	452818	673504	770161	1227757	1313557	1420467	1490947

BALANCE SHEET
($1000S)
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*** DISTRICT HEATING--LEASING OPTION: RATE RELIEF ***

YEAR	2008	2009	2010	2011
GROSS PLANT	1858281	1935675	1991402	2034400
LESS: DEPR RESERV	301651	349518	398947	449534
NET PLANT	1556630	1586157	1592455	1584867
LONGTERM DEBT	405748	392467	372001	348532
PREFERRED STOCK	113232	109526	103814	97265
COMMON STOCK	280809	255713	216383	175026
RETAINED EARNINGS	135811	155008	172921	189716
GRANT RESERVE	80260	77383	105615	112727
ITC RESERVE	150113	152104	151726	149926
DFD FIT RESERVE	374657	423956	469995	511674
TOTAL LIABILITIES	1556630	1586157	1592455	1584866

INCOME STATEMENT
($1000S)
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*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
TOTAL REVENUES	4248	6341	10707	15663	22128	27413	34599	40674
OPERATION & MAINT	3766	5240	7581	10453	14335	16814	22418	27458
BOOK DEPRECIATION	69	163	472	819	1321	1947	2388	2769
FEDERAL INCOME TAX	-796	-717	-3563	-2655	-6226	-5721	-5827	-4318
DFD FED INCOME TAX	394	854	2360	3743	5427	7302	7588	7108
ITC ACCRUAL	550	205	2175	535	3187	1583	1854	1095
ITC CREDIT	-8	-20	-56	-97	-153	-226	-278	-322
GROSS RECEIPTS TAX	0	0	0	0	0	0	0	0
TOTAL OPER EXP	3975	5726	8969	12797	17890	21700	28142	33789
OPER INCOME	273	615	1738	2866	4237	5712	6456	6885
INTEREST EXPENSE	101	222	620	1008	1514	2131	2407	2571
NET INCOME	172	393	1117	1858	2723	3581	4050	4314

INCOME STATEMENT
($1000S)
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*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL REVENUES	48817	59161	66034	67631	75510	87145	114068	130064
OPERATION & MAINT	30266	35177	42843	45903	53784	59106	78906	89599
BOOK DEPRECIATION	3755	4849	5125	5246	5497	6703	8111	9270
FEDERAL INCOME TAX	-11389	-7740	-3856	-1652	-427	-7609	-5274	-10362
DFD FED INCOME TAX	10063	12827	10212	7096	5125	8095	12197	15457
ITC ACCRUAL	6781	1938	327	706	1398	7475	3150	6576
ITC CREDIT	-442	-574	-608	-624	-656	-790	-951	-1098
GROSS RECEIPTS TAX	0	0	0	0	0	0	0	0
TOTAL OPER EXP	39034	46478	54042	56676	64721	72979	96139	109442
OPER INCOME	9783	12684	11992	10955	10789	14166	17930	20622
INTEREST EXPENSE	3653	4737	4478	4091	4029	5291	6696	7701
NET INCOME	6129	7947	7513	6864	6760	8876	11234	12921

INCOME STATEMENT
($1000S)
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*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL REVENUES	169730	208193	212753	288129	367763	395038	420309	456658
OPERATION & MAINT	117792	140300	117786	169996	206157	195017	213568	248883
BOOK DEPRECIATION	11470	14559	19602	24665	32750	40923	44658	47940
FEDERAL INCOME TAX	-18891	-26693	-45664	-40646	-90174	-62328	-48130	-27885
DFD FED INCOME TAX	23138	33225	49456	61670	88142	106878	93721	77226
ITC ACCRUAL	10902	13425	24388	13944	50069	14746	15580	11350
ITC CREDIT	-1363	-1732	-2305	-2886	-3855	-4837	-5297	-5705
GROSS RECEIPTS TAX	0	0	0	0	0	0	0	0
TOTAL OPER EXP	143047	173084	163264	226743	283089	290398	314101	351808
OPER INCOME	26683	35109	49489	61386	84673	104639	106207	104849
INTEREST EXPENSE	9969	13121	18257	22655	31134	38434	38364	38134
NET INCOME	16715	21988	31231	38731	53539	66206	67844	66715

INCOME STATEMENT
($1000S)
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*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	2008	2009	2010	2011
TOTAL REVENUES	509511	567979	622738	671800
OPERATION & MAINT	297386	355381	415481	468762
BOOK DEPRECIATION	50712	53060	54621	55779
FEDERAL INCOME TAX	-10230	11450	26794	36577
DFD FED INCOME TAX	59995	42394	26739	16467
ITC ACCRUAL	12168	7739	5573	4300
ITC CREDIT	-6062	-6364	-6565	-6715
GROSS RECEIPTS TAX	0	0	0	0
TOTAL OPER EXP	403989	463661	522643	575171
OPER INCOME	105522	104317	100095	96630
INTEREST EXPENSE	37857	37532	36537	35375
NET INCOME	67665	66785	63558	61254

BALANCE SHEET
($1000S)
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*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	1984	1985	1986	1987	1988	1989	1990	1991
GROSS PLANT	5496	7549	29298	34650	66521	82354	100894	111840
LESS: DEPR RESERV	69	232	704	1523	2843	4790	7178	9947
NET PLANT	5427	7317	28594	33127	63678	77564	93716	101893
LONGTERM DEBT	1931	2297	9520	9671	19170	21417	24422	24550
PREFERRED STOCK	539	641	2657	2699	5350	5977	6816	6851
COMMON STOCK	1976	2348	9481	9046	18168	19513	21452	20489
RETAINED EARNINGS	45	156	482	1075	1893	2900	4106	5202
DRIFT RESERVE	0	0	0	0	0	0	0	0
ITC RESERVE	541	727	2846	3284	6318	7676	9252	10024
DFD FIT RESERVE	394	1248	3609	7352	12778	20080	27668	34776
TOTAL LIABILITIES	5427	7317	28594	33127	63678	77564	93716	101893

BALANCE SHEET
($1000S)
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*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	1992	1993	1994	1995	1996	1997	1998	1999
GROSS PLANT	179646	199023	202292	209356	223333	298079	329574	395333
LESS: DEPR RESERV	13702	18551	23676	28922	34419	41122	49233	58503
NET PLANT	165944	180472	178616	180434	188914	256957	280341	336830
LONGTERM DEBT	45039	45184	40115	37810	38934	61837	65702	80991
PREFERRED STOCK	12569	12609	11195	10552	10865	17257	18336	22602
COMMON STOCK	40366	38494	31273	27108	26558	48263	49447	62159
RETAINED EARNINGS	6788	8792	10709	12461	14186	16450	19312	22599
DRIFT RESERVE	0	0	0	0	0	0	0	0
ITC RESERVE	16363	17727	17446	17529	18271	24956	27154	32632
DFD FIT RESERVE	44839	57644	67878	74974	80099	88194	100391	115848
TOTAL LIABILITIES	165944	180472	178616	180434	188914	256957	280341	336830

BALANCE SHEET
($1000S)
****

*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	2000	2001	2002	2003	2004	2005	2006	2007
GROSS PLANT	504355	638604	882467	1021928	1522616	1670079	1825881	1939378
LESS: DEPR RESERV	69973	84532	104134	120799	161549	202472	247130	295070
NET PLANT	434382	554073	778353	893129	1361067	1467607	1578751	1644308
LONGTERM DEBT	108887	141039	206718	224798	368239	363833	366903	359458
PREFERRED STOCK	30387	39360	57689	62734	102764	101535	102391	100314
COMMON STOCK	87098	115136	175895	184922	321332	299771	285525	260627
RETAINED EARNINGS	26854	32463	40438	50332	64034	80984	98443	115550
DR&FT RESERVE	0	0	0	0	0	0	0	0
ITC RESERVE	42171	53864	75947	87006	133219	143128	153412	159056
DFD FIT RESERVE	138986	172211	221667	283336	371478	478356	572078	649303
TOTAL LIABILITIES	434382	554073	778353	893129	1361067	1467607	1578751	1644308

BALANCE SHEET
($1000S)
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*** NON-UTILITY STATUSIRATE RELIEF ***

YEAR	2008	2009	2010	2011
GROSS PLANT	2061259	2130653	2194380	2237378
LESS: DEPR RESERV	345781	398841	453463	509242
NET PLANT	1715478	1731812	1740918	1728136
LONGTERM DEBT	361629	353271	342676	331137
PREFERRED STOCK	100920	98587	95630	92410
COMMON STOCK	245472	219533	192138	164356
RETAINED EARNINGS	132977	150170	166477	182183
DR&FT RESERVE	0	0	0	0
ITC RESERVE	165183	166559	165566	163151
DFD FIT RESERVE	709298	751692	778431	794898
TOTAL LIABILITIES	1715478	1731812	1740918	1728136

ATTACHMENT F: "ALTERNATIVE OWNERSHIP ARRANGEMENTS FOR PROPOSED DISTRICT HEATING SYSTEM"

This study by Coopers and Lybrand examined a number of ownership/financing arrangements and their tax implications. Four options recommended by Coopers and Lybrand were selected for the preceding financial analysis and compared with conventional heating (gas-fired heating furnaces in each building), as shown in Table 5-I.

Public Service Electric & Gas Company

ALTERNATIVE OWNERSHIP ARRANGEMENTS FOR PROPOSED DISTRICT HEATING SYSTEM

Final Report

December 1981

Prepared By

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December 22, 1981

Dr. Carlos Guerra
Manager, Advanced Systems
Research and Development
Public Service Electric and Gas Company
80 Park Plaza
Newark, New Jersey

Re: Purchase Order #802517

Dear Dr. Guerra:

Coopers & Lybrand is pleased to submit to the Public Service Electric and Gas Company our report entitled, "Alternative Ownership Arrangements for District Heating Systems." This report details our analysis of four major ownership options and associated financing sources.

Our research focuses on the pros and cons of the following ownership options:

- Direct PSE&G ownership
- Sale-leaseback arrangements (including "safe harbor" leases)
- Third party or joint venture ownership
- Customer ownership

Throughout the analysis, special attention is paid to the effects of these ownership forms on the tax burdens and financing costs to be experienced by project sponsors and participants.

Based upon our comparative analysis, we recommend that PSE&G's district heating economic feasibility study include scenarios representing (1) direct PSE&G ownership with conventional financing; (2) direct PSE&G ownership with lower-cost, non-conventional financing; (3) a sale-leaseback or safe-harbor lease arrangement; and (4) third party or joint venture ownership. Several variations of the customer ownership scenario were considered in the report but are not recommended for detailed feasibility analysis because the likely benefits of such ownership are insubstantial relative to likely benefits under the other options considered.

This study is intended to aid PSE&G's internal assessment of the feasibility of a proposed district heating system. Though numerous legal and tax issues have been raised, we must caution that this study is not an official tax or accounting opinion. Thus, issues raised in the report should be evaluated by PSE&G's tax, legal and bond counsel prior to implementation of any of the options discussed.

It has been a pleasure working with you and your study team. Should you have any further questions with which we can be of assistance, please do not hesitate to contact us.

Very truly yours,

Coopers & Lybrand

BKR:gm
DPR

Attach.

ACKNOWLEDGEMENTS

This report was prepared by Daniel P. Reingold, a Supervising Consultant in Coopers & Lybrand's Economic Studies Group and Randall A. Snowling, a Manager in C&L's National Tax Consulting Group, under the supervision of Barry K. Rogstad and Paul A. Schecter, Partners-in-Charge of the Economic Studies and National Tax Consulting Groups, respectively. Special thanks go to Thomas C. Hough of the Synergic Resources Corporation for sharing with C&L his research on related issues. The report was typeset by the C&L Report Department.

Table of Contents

* These Appendices are located in Volume VII of this Final Report, pp. 99-118.

List of Exhibits

OVERVIEW

In conjunction with the Public Service Electric & Gas Company's Phase 2 feasibility study of district heating and cooling systems, Coopers & Lybrand was engaged to investigate ownership and financing alternatives for such systems. This report presents the results of the investigation. Its purpose is to assist the PSE&G study team in selecting an ownership scenario for use in its projections of the proposed project's financial and economic performance.

Optimizing eligibility for investment tax credits, accelerated depreciation methods, and tax-exempt financing can significantly affect a project's financial and economic viability. Throughout the analysis below, particular attention is paid to the effects of alternative forms of ownership on the tax burdens and financing costs to be experienced by project sponsors and participants. The report is divided into four sections:

I. Executive Summary and Recommendation
II. Background
III. Ownership Alternatives
Appendices: Analysis of Relevant Tax Provisions *

Section I summarizes the report and presents our recommendation regarding ownership scenarios to be used by the PSE&G study team. Section II provides a brief overview of the two projects under consideration by PSE&G. Further discussion of the project's economic and technical aspects is available in PSE&G's Phase 1 and 2 feasibility reports. Section III analyzes alternative ownership and financing schemes. Finally, the appendices present an analysis of certain relevant tax laws.

* These Appendices are located in Volume VII of this Final Report, pp. 99-118.

I EXECUTIVE SUMMARY

Background

This report presents the results of Coopers & Lybrand's investigation of ownership and financing options for the Public Service Electric & Gas Company's proposed district heating and cooling system. Its purpose is to assist the PSE&G feasibility study team in selecting ownership and financing scenarios for use in its projections of the proposed project's financial and economic performance.

This report was prepared as a management consulting assignment by Coopers & Lybrand's Economic Studies Group. Though numerous tax and legal issues are raised in this report, and though members of C&L's National Tax Office provided considerable assistance, THIS STUDY WAS NOT COMMISSIONED BY PSE&G, NOR INTENDED BY C&L, TO PROVIDE A TAX OR ACCOUNTING OPINION ON THE PROPOSED PROJECT. RATHER, IT WAS INTENDED TO AID PSE&G'S INTERNAL ASSESSMENT OF THE FEASIBILITY OF THE PROJECT. ISSUES RAISED IN THIS REPORT SHOULD BE EVALUATED BY PSE&G'S TAX, LEGAL, AND BOND COUNSEL PRIOR TO IMPLEMENTATION OF ANY OF THE OPTIONS DISCUSSED HEREIN.

The district heating systems under consideration consist of four distinguishable elements:

1. Peaking Unit: Installation at customer locations of oil- or gas-fired package boilers to produce hot water.

2. Thermal Substations: Construction of oil- or gas-fired thermal substations, to produce electricity and hot water.

3. Base Load Unit: Retrofitting the existing Hudson and Essex steam generating plants, to generate electricity and hot water.

4. Distribution System: Construction of pipelines connecting stations to substations, and substations to customers.

Ownership Alternatives

Four options for structuring the ownership and financing of these properties are evaluated in this report. The evaluation emphasizes various ways of reducing PSE&G's capital investment and cost of capital through maximizing eligibility for tax credits and depreciation allowances. The options should be considered in light of other, particularly regulatory and business, factors.

The four options are:

Option 1 -- Direct PSE&G Ownership

Option 2 -- Sale/Leaseback and Safe Harbor Lease Arrangements

Option 3 -- Third Party or Joint Venture Ownership

Option 4 -- Customer Ownership

Tax treatment of each asset type (i.e., plant, substation boilers, pipelines, peaking unit boilers, and heat exchangers) varies with the form of ownership. Exhibits 1-4 summarize the likely treatment of each asset type, and attendant effects on financing requirements, under each of the four ownership options. In general, tax treatment of the assets is influenced by these rules:

- Oil or gas fired boilers do not qualify for tax credits.
- Property owned or used by regulated public utilities is ineligible for energy tax credits (ETC).
- Most district heating system property would be eligible for 10% ITC, unless owned by the end-users (e.g., customers).
- Property owned by public utilities is depreciated under the new Accelerated Cost Recovery System (ACRS) as 10 or 15 year public utility property; other property is, in general, depreciated as 15 year real or 5 year personal property.

- Properties classifiable as "qualified cogeneration facilities" may be exempt from rate regulation, hence not defined as public utility property, and therefore eligible for ETC if owned 50% or less by a public utility.

A brief summary of the four options and rules pertaining to each is provided immediately below. A more detailed discussion of the transactions involved in each ownership option is provided in Part III. The appendices explain the new tax law and some important technical aspects of relevant tax laws and IRS rulings.

Option 1 - Direct PSE&G Ownership

Option 1 includes ownership of the entire district heating system by PSE&G, a PSE&G subsidiary, or a municipality that leases the assets back to PSE&G. The latter ownership form involves structuring of the sale/leaseback so that it fails the IRS' lease rules and thus the project is considered for Federal tax purposes to be owned by PSE&G, not by the municipality. As such, we have placed the municipal ownership/leaseback method under the direct ownership option.

Conventional as well as non-conventional sources of financing could be used to fund PSE&G's direct ownership of the project. Four financing methods are discussed in the text. They could be used alone, in combination with each other, or to supplement other sources. The four methods, discussed in more depth in Part III and the appendices, are:

- Tax exempt municipal bonds
- Deep discount bonds
- Leveraged preferred stock
- High premium convertible debt

Normally, the use of tax-exempt municipal bonds will reduce the amount of energy tax credits which may be claimed (see Appendix D). However, all direct ownership forms considered here

are ineligible for energy tax credits, regardless of financing mechanism. This is because PSE&G is regulated as a public utility and property owned by public utilities is ineligible for ETC. The same rule would hold for a PSE&G subsidiary or for a municipal leaseback to PSE&G.

Other investment tax credits, however, would not be affected under the direct PSE&G ownership options. In addition, under the newly-enacted Accelerated Cost Recovery System (ACRS), the majority of the proposed system's assets would be depreciated as 15 year public utility property (see Appendix A). Some equipment, however, may qualify for treatment as 5 or 10 year property.

Qualifying the issue as tax-exempt, however, presents a challenge. After reviewing five classes of property which may qualify for tax exempt financing, we have concluded that a promising approach would be to attempt to classify the bond as an issue used to finance "facilities for the furnishing of water services." An IRS ruling on this issue is recommended. In addition, a determination by the New Jersey Board of Public Utilities as to whether the system's rates would be regulated is also advisable.

Option 2 - Sale/Leaseback

This option involves independent ownership of the project, combined with a lease of the property to PSE&G. Under this plan, PSE&G could construct the facilities, sell them to a lessor, and then leaseback the property. At first glance, it appears that ownership by an independent corporation or partnership which is not a public utility would overcome the ETC ineligibility problem encountered under the direct ownership options. However, IRS regulations indicate quite clearly that property leased to a public utility cannot avoid being defined as public utility property for tax purposes. Thus, the same restriction that blocks the use of energy credits for direct utility ownership also blocks their use by non-utility owners if the property is

leased to PSE&G or any other regulated public utility. Nevertheless, the 10% ITC and 15 year depreciation allowable under ACRS would still be available to the lessor owner who, in turn, could offer PSE&G advantageous lease terms.

A new form of lease -- the safe harbor lease -- became a viable option with passage of the Economic Recovery Tax Act of 1981 wherein rules governing lease transactions were substantially liberalized. Under this option, a company which cannot use tax benefits immediately because it has losses or insufficient taxable income can transfer (i.e., sell) those benefits to a third party. For the district heating system proposed by PSE&G, transferable benefits include 10% ITC and 15 year accelerated depreciation. Nevertheless, previously enacted restrictions blocking public utility eligibility for energy credits and placing limits on accelerated depreciation methods remain applicable under the new tax law. Thus, this lease form should only be considered by PSE&G if it concludes that its taxable income is insufficient to absorb all the credits and benefits generated by investment in the district heating project. The basic types of leases under which tax benefits may be transferred are described in Part III.

With either lease form, PSE&G's finance needs for the project would be reduced to the extent the lessor is investing his own capital. The lessor's interests must be at least 20% of the property cost under the old leasing rules but only 10% under the new safe harbor provisions.

Option 3 - Third Party or Joint Venture Ownership

A potential way around the laws prohibiting a public utility from obtaining energy tax credits and 5 year (rather than 15 year) depreciation is to have an independent company own the district heating equipment and sell the output to PSE&G, or to establish a joint venture in which PSE&G owns 50% or less. These options are primarily of relevance to the Hudson plant which might qualify for the ETC as cogeneration equipment if the utility ownership restriction could be overcome. These options

would not, however, provide a way of obtaining energy credits for the peaking units or substations. These are planned to be oil or gas-fired, hence ineligible for ETC. Pipelines also would be ineligible since they are not "energy property."

The key to obtaining ETC under this type of arrangement is to avoid having the independent or joint venture owner considered a regulated public utility for tax purposes. Under Section 210 of the Public Utilities Regulatory Policies Act of 1978 (PURPA), qualified cogeneration facilities (QCFs) are exempt from state or local rate regulation provided the facilities are not more than 50% owned by an electric utility or public utility holding company. Consequently, if the independent or joint venture owner qualifies as a QCF, energy tax credits may be available for certain properties.

Exhibit 3, which summarizes this option, assumes qualification as a QCF and thus indicates availability of the 10% ETC for the retrofitted, coal-fired Hudson plant. A legal opinion and IRS ruling on whether the project would be considered a non-public utility under this ownership option is essential.

Option 4 -- Customer Ownership

Customer ownership -- either individually or in a cooperative -- is an option for the peaking units and heat exchangers to be installed at the customer location. Individual customer ownership would not be relevant to the retrofitted plants or the substations installed away from the customer's location.

Tax incentives for customer ownership are limited. Energy tax credits would not be available for retail stores nor office or apartment buildings. Apparently, only customers actually engaged in manufacturing would obtain the ETC, and only for the heat exchangers, not the full retrofit costs.

Customer owned heat exchangers and peaking units would in most cases not qualify for the 10% ITC. Only heat exchangers

which are integral parts of a manufacturing process -- an unexpected circumstance for the likely retail, office and residential development in the Meadowlands -- would qualify for the ITC.

Customer ownership of heat exchangers and peaking units enables avoidance of the restrictions on accelerated depreciation which would apply to direct PSE&G ownership. However, in most cases, these assets will be part of heating systems and consequently considered real property subject to the 15 year ACRS table for real estate. Five year ACRS depreciation would apply only if the equipment is used as an integral part of a manufacturing process.

A customer-owned cooperative might be established as an alternative to individual customer ownership. Substations might also be part of the cooperative's system. However, the tax benefits remain almost as limited as with individual owners. And, since the cooperative would be a distinct entity, paper losses attributable to accelerated depreciation could not be flowed through to the member-users, though tax credits might. One way around this flow through problem would be to have the peaking units owned initially by a partnership.

Under Option 3 and 4, where a third party (including customers) owns all or part of the district heating system, PSE&G could retain operating control by establishing a PSE&G service corporation which would manage the system under contract to the third party owners. In this way, PSE&G's initial investment and, possibly, some restrictions on benefits for public utility ownership could be reduced.

Recommendation

The purpose of this study has been to assist the PSE&G study team in the selection of ownership scenarios for use in its projections of the proposed project's financial and economic performance. We recommend that the study team consider, at least, the following scenarios:

- Base scenario: direct PSE&G ownership with conventional financing.

- Reduced financing cost scenario: direct PSE&G ownership with non-conventional financing (i.e., some mix of tax-exempt bonds and other non-conventional financing sources).

- Lease scenario: traditional and/or safe harbor sale and leaseback. (This scenario offers a means of reducing PSE&G's investment by the lessor's contribution. It also offers a means of transferring tax benefits if PSE&G expects to lack taxable income.)

- Third party - PSE&G joint venture scenario. (This scenario enables determination of the added value of 5 year accelerated depreciation -- rather than 15 year -- for all assets and 10% energy tax credits on the Hudson plant retrofit. Though PSE&G's required investment would be reduced to the extent of third party involvement, this scenario should be analyzed in light of the whole project, not just PSE&G's portion. This will allow comparability with the other scenarios.)

Analysis of various customer ownership forms is not recommended for three reasons: (a) customer resistance to invest is expected to be quite high; (b) customer ownership appears possible only for properties representing a small portion of the total investment required; and (c) customers owning these properties would be ineligible for investment and energy tax credits and would be restricted to accelerated depreciation under the new ACRS 15 year real property table.

EXHIBIT 1. LIKELY BENEFITS UNDER DIRECT PSE&G OWNERSHIP*

Property \ Benefit	Reduced PSE&G Investment?	Reduced Cost of Capital?	10% Energy Tax Credit	10% Investment Tax Credit	ACRS Depreciation
Essex Plant		X		X	
Hudson Plant		X		X	
Pipelines	NO	X		X	
Substations**		X	None Available	X	
Peaking Units**		X		X	
Heat Exchangers		X		X	5 Year?

Reduced by Value of ITC and Accelerated Depreciation

15 Year Utility Property (possibly 10 year)

*Assumptions:

- Direct ownership includes ownership by PSE&G, a PSE&G subsidiary, or municipal ownership with lease (violating IRS' rules) to PSE&G.
- District heating services used by existing or new office, retail and apartment buildings as part of space heating systems, not an integral part of manufacturing facilities.

**Peaking unit and substation boilers are fired by oil or gas, including methane recovered from landfills. Hence, even if other components qualify for ITC the boilers may not.

EXHIBIT 2. LIKELY BENEFITS UNDER SALE-LEASEBACK ARRANGEMENTS*

Property \ Benefit	Reduced PSE&G Investment?	Reduced Cost of Capital?	10% Energy Tax Credit	10% Investment Tax Credit	ACRS Depreciation
Essex Plant	X (Reduced by Lessor's 10%, 20% Contribution)	X (If PSE&G Lacks Taxable Income)	None Available	X	15 Year Utility Property (possibly 10 year)
Hudson Plant	X	X		X	
Pipelines	X	X		X	
Substations**	X	X		X	
Peaking Units**	X	X		X	
Heat Exchangers	X	X		X	5 year?

*Assumptions:

- The sale-leaseback category includes traditional sale-leasebacks under the IRS rules and new "safe harbor" leases made possible by the Economic Recovery Tax Act of 1981.
- District heating services used by existing or new office, retail and apartment buildings as part of space heating systems, not an integral part of manufacturing facilities.

**Peaking unit and substation boilers are fired by oil or gas, including methane recovered from landfills. Hence, even if other components qualify for ITC, the boilers may not.

EXHIBIT 3. LIKELY BENEFITS UNDER THIRD PARTY OR JOINT VENTURE OWNERSHIP*

Property \ Benefit	Reduced PSE&G Investment?	Reduced Cost of Capital?	10% Energy Tax Credit	10% Investment Tax Credit	ACRS Depreciation
Essex Plant	X (Reduced by Third Party Contribution)	X Reduced By Value of ITC, DTC, and Accelerated Depreciation		X	5 Year Personal Property
Hudson Plant	X	X	X	X	
Pipelines	X	X		X	
Substations**	X	X		X	
Peaking Units**	X	X		X	
Heat Exchangers	X	X		X	

*Assumptions:

- Third party ownership is defined as ownership by a non public utility unrelated to PSE&G; joint venture is defined to involve PSE&G ownership of 50% or less of project. (Note: viability of these options is contingent upon project classification as public utility property.]
- District heating services used by existing or new office, retail and apartment buildings as part of space heating systems, not an integral part of manufacturing facilities.

**Peaking unit and substation boilers are fired by oil or gas, including methane recovered from landfills. Hence, even if other components qualify for ITC, the boilers may not.

EXHIBIT 4. LIKELY BENEFITS UNDER CUSTOMER OWNERSHIP*

Property \ Benefit	Reduced PSE&G Investment?	Reduced Cost of Capital?	10% Energy Tax Credit	10%* Investment Tax Credit	ACRS Depreciation
Substations**	X (Reduced by Amount of Customer Investment)	X (Reduced Only by Value of Accelerated Depreciation)	Not Available	Not Available (see assumptions)	15 Year Real Property
Peaking Units**	X	X			
Heat Exchangers	X	X			

*Assumptions:

- Customer ownership of peaking units and heat exchangers is considered. If ownership is by a customer cooperative. substations are also considered. Other property (e.g., main plant and pipelines) would not be owned by customers.
- District heating services used by existing or new office, retail and apartment buildings as part of space heating systems, not an integral part of manufacturing facilities.
- It is assumed that the assets would constitute a heating system component and that there is no resale. Credits may become available in part if there is a resale.

**Peaking unit and substation boilers are fired by oil or gas, including methane recovered from landfills.

II. BACKGROUND

PSE&G is investigating the technical, institutional, and economic feasibility of establishing district heating systems within its New Jersey service region. PSE&G's Phase 2 feasibility study assesses the potential of retrofitting its Hudson and Essex stations and of constructing the requisite thermal substations, pipeline distribution system, and local (i.e., customer site) conversion equipment.*

The district heating systems under consideration consist of four distinguishable elements:

1. Peaking Unit: Installation at customer locations of oil- or gas-fired package boilers and heat exchangers to produce hot water.
2. Thermal Substations: Construction of oil- or gas-fired thermal substations, to produce electricity and hot water.
3. Base Load Unit: Retrofitting the existing Hudson and Essex steam generating plants, to generate electricity and hot water.
4. Distribution System: Construction of pipelines connecting stations to substations, and substations to customers.

The proposed sequence of construction would begin with the first element, peaking units at customer locations, proceeding next to construction of thermal substations and, finally, retrofitting the power plants. Pipelines would be constructed as needed, with connections between the substations and customers constructed simultaneously with substation construction and substation-powerplant connections established before completion of the retrofit stage. The PSE&G study team's preliminary plans

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* During the course of our investigation, the PSE&G study team excluded the Essex station from consideration. Nevertheless, since some of our work had already been completed, references to the Essex station have been retained in the text.

point to completion of the peaking unit stage by 1985 and of the total system sometime in the early or mid-1990's. The construction period for peaking units is estimated at 1-1/2 years; plant retrofitting is estimated to require approximately four years.

Peaking units entail relatively low capital costs and high operating costs while retrofit of existing power plants requires very high capital investment but relatively low operating costs. PSE&G estimates that implementation of the entire district heating system based at the Hudson plant would cost approximately $420 million. The Hudson plant is coal-fired and has generating capacity of 600 megawatts. Essex is oil-fired and has 100 megawatt capacity. Both plants can burn gas as a backup fuel. The gas may be derived from landfills.

Potential district heating and cooling customers include apartment buildings, office buildings, shopping centers, schools, hospitals, and industrial facilities. Both new and existing structures offer a potential market. However, new structures appear to be a better target for initial commercialization efforts. PSE&G's Phase 1 study concluded that new construction developments offer the most favorable conditions for implementation of district heating and cooling services. The Phase 1 investigation also concluded that high density loads such as industrial, commercial, and high-rise apartment buildings were most economically favorable to the proposed system. In contrast, areas with less concentrated loads, such as single family home neighborhoods, were concluded to offer little market potential since costs of district heating and cooling to the customers would exceed current energy costs.

Although some European district heating systems have spanned a 20-mile radius, PSE&G's anticipated service areas are within five miles of either the Essex or Hudson plants. Primary potential market areas for the Hudson station are Jersey City,

Hoboken, other communities along the Hudson River, and neighboring communities in the Hackensack-Meadowlands area. The latter area is expected to offer significant future thermal load growth in the residential, commercial and industrial sectors. For the Essex station, potential market areas include the cities of Newark, Harrison, and surrounding municipalities. In contrast to the new developments expected in the Hudson plant's area, the retrofitted Essex Station generally would serve existing population centers with high-rise residences and offices.

The PSE&G study team has identified several specific potential custmers for the Hudson and Essex stations. Although discussions between PSE&G and these customers are only at preliminary stages, some of these potential customers are:

Hudson Plant

- A new Hartz Mountain facility located in the Meadowlands;
- A new shopping center/office building/residential complex in the Meadowlands;
- An existing complex in Jersey City (Summit Plaza);
- Redeveloped buildings on the Jersey City waterfront.
- Other existing buildings in Jersey City

Essex Plant

- The new Gateway-3 complex in Newark;
- Rehabilitation of Dorrimus Avenue Industrial Park (toy factory, chemical plants, etc.).

The following section discusses alternative means of organizing these projects in order to maximize tax and financing advantages available to PSE&G and to other potential project sponsors.

III. OWNERSHIP ALTERNATIVES

This section outlines a number of options that PSE&G may wish to consider in structuring the ownership of its proposed district heating systems. The emphasis is on ways to reduce the cost of capital through maximizing available tax benefits. These options are being provided for consideration in light of regulatory and business considerations. Accordingly, the fact that a form of operation may be feasible from a tax standpoint should not be allowed to overshadow business or regulatory concerns. Appendices discussing relevant points of tax law are attached.

The options to be discussed below are:

1. Direct ownership by PSE&G, a PSE&G subsidiary, or a municipality that leases the property back to PSE&G.

2. Independent ownership of facilities, and lease to PSE&G.

3. Third party or joint venture ownership of facilities, with sale of product to PSE&G.

4. Customer or customer cooperative ownership of peaking units, hookup equipment and, for cooperatives only, substations.

OPTION 1

DIRECT OWNERSHIP

Direct ownership of the entire district heating project is one ownership option available to PSE&G. This option includes ownership by PSE&G itself, a PSE&G subsidiary or a municipality that leases the assets back to PSE&G.

If a subsidiary is used, it is assumed that it would be consolidated with the PSE&G parent company on a consolidated tax return in order that any tax benefit (i.e., losses) generated by the initial capital investment could be used to offset the parent's tax liability.

Four possible methods for financing these direct ownership forms are discussed below. They could be used separately, in combination with each other, or in combination with other financing sources. The four methods are:

(a) Tax exempt municipal bonds

(b) Deep discount bonds

(c) Leveraged preferred stock purchase by corporate investors

(d) High premium convertible debt

Tax Benefits Under All Direct Ownership Options

Regardless of financing mechanism, all direct ownership forms offer the same tax benefits and face the same restrictions. Direct ownership by PSE&G is, by definition, ownership by a regulated public utility. Assets owned by utilities are depreciated under the new (1981) Accelerated Cost Recovery System's (ACRS) public utility tables. The majority of the proposed project's assets would fall under the 15 year table though some equipment may qualify for treatment as 5 or 10 year property. (ACRS tables are reprinted in Appendix A.)

The assets would also be eligible for the 10% investment tax credit. Energy tax credits (ETC), however, are not allowable because the law explicitly cites public utility property (including property leased to a public utility for use in a public utility function) as ineligible for ETC.

Normally, the use of tax-exempt municipal bond financing (Option 1(a)) would reduce the amount of ETC available. However, since the public utility restriction eliminates the ETC anyway, direct ownership with municipal bond financing offers the same tax benefits as the other financing mechanisms. (See Appendix D for discussion of effects of exempt or subsidized financing on availability of tax credits.)

Each of the four financing mechanisms are reviewed below.

(a) Municipal Bond Financing

Tax exempt bond financing, if available, may provide an opportunity to reduce borrowing costs. The objective would be to have a local community or development authority issue a tax-exempt revenue bond, the proceeds of which could then be used to finance construction of particular cogeneration projects. PSE&G would retain direct ownership under this plan. This would be done either through the local communities that would benefit from the project, or through the New Jersey Economic Development Authority (NJEDA). A series of bond issues could be used depending on capital needs.

Recent reductions in individual tax rates, in particular the reduction from 70% to 50% of the top marginal tax rate on "unearned income," have indirectly reduced the relative attractiveness of the municipal bond market. Though this change in the tax law plus other market forces has resulted in a narrowing of the interest rate differential between exempt and non-exempt issues, financing costs with exempt bond still often remain below non-exempt corporate bond issues.

Two forms of municipal bonds -- general obligation and revenue bonds -- are relevant. A general obligation bond, which is a bond backed by the full faith and credit of the issuing government, is one type of tax-exempt bond that could be used to finance a cogeneration project in order to take advantage of the lower rates that tax-exempt bonds carry relative to bonds issued by commercial companies. However, general obligation bonds require approval of the public by referendum. Consequently, such obligations are typically not a vehicle used to finance local industrial development.

Instead, the vehicle used for this type of financing is the revenue bond. A revenue bond is one which provides the buyer a security interest in the property financed or in the payments with respect to such property. Unfortunately, revenue bonds are only tax exempt if they fall within certain rigidly defined classes. Five property classes which may qualify for tax exempt financing are reviewed in Appendix C.

The most promising approach would be to attempt to classify the bond as an issue used to finance "facilities for the furnishing of water services." To meet the requirements of this classification, two conditions must hold: (1) the water must be made available to the general public; and (2) rates must be regulated or the facility operated by a governmental unit. While it is apparent that this provision was directed toward drinking water systems, district heating appears to meet the law's literal requirements.

The initial stage of development of PSE&G's district heating system includes the installation of peaking units proximate to individual industrial and commercial customers. This presents an issue as to whether this would be considered offering of water services to the general public. However, since this stage is part of an overall plan, and the law recognizes industrial and commercial users as part of the general public, this requirement

would appear to be met. A ruling from the IRS on this particular issue would be a necessary step should exempt-bond financing prove to be an economic alternative.

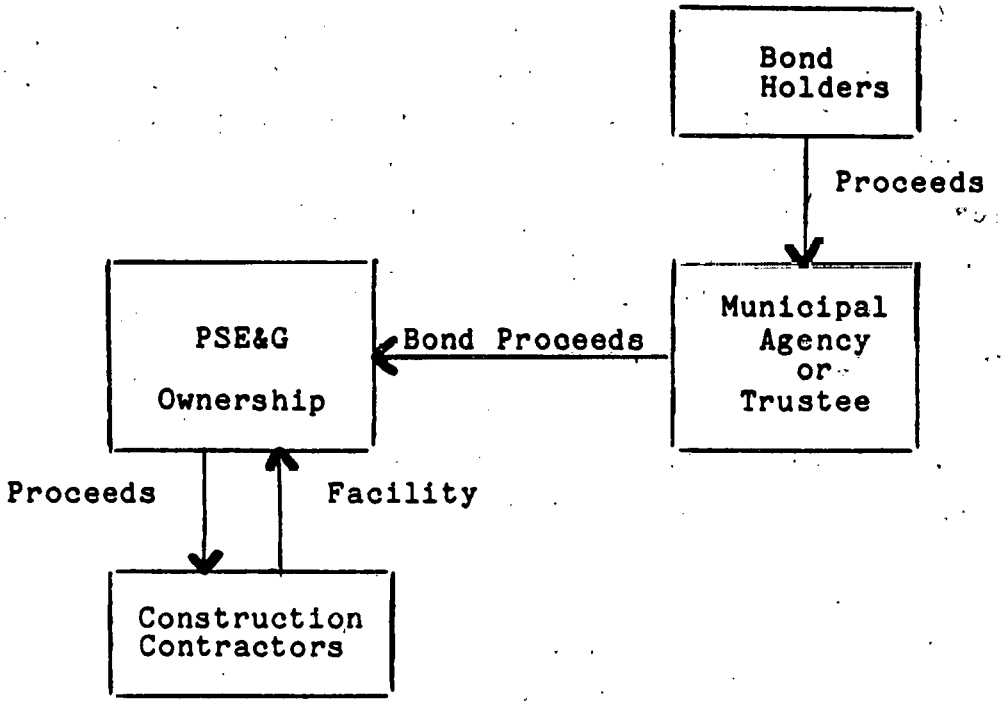
Whether the second requirement -- that rates be regulated -- is met would depend on a determination by the N.J. Board of Public Utilities. Clearly, PSE&G ownership of the facilities would preclude qualification under the "operated by governmental unit" provision.

A schematic diagram of direct ownership with municipal bond financing is shown on the following page.

Exhibit 5

OPTION 1(a) -- (i)

DIRECT OWNERSHIP - MUNICIPAL BOND FINANCING



Sometimes the municipality issuing the tax exempt bonds wishes to retain title to the property involved, primarily as a security interest should the obligator default on the bonds. In order to avoid a loss of tax benefits, the government issuer will lease the property under a lease transaction that violates the IRS's definition of a true lease. Under local law, the government issuer retains title to the property, but for Federal tax purposes the lessee of the property is treated as its owner, and is accordingly entitled to depreciation and tax credits to the extent otherwise available under direct PSE&G ownership.

The key in this type of transaction is the assumption that the IRS leasing standards are violated. Usually this is done by leasing the property under terms that cover its entire useful life; giving the lessee an option to purchase the property for $1 as soon as the bond has been paid off; and having the government avoid putting any of its own funds into the project. Note that the IRS will not rule that a transaction is a lease in cases when the leased property is of unique benefit to the lessee, and the lessor would therefore be unable to find a different lessee at the end of the lease period.

Since a municipality is a tax exempt organization for whom tax credits and depreciation are not available, the treatment of the lease as a sale is beneficial to the commercial lessee, without offering any serious disadvantage to the municipality.

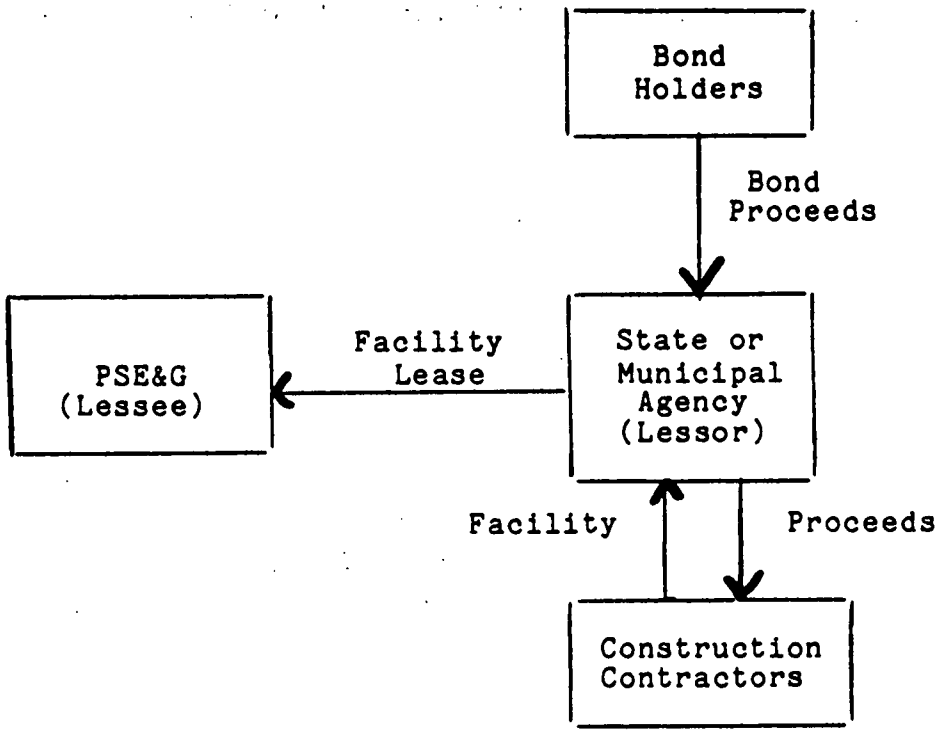
(Note: New liberal provisions which allow the parties involved in financing transaction to call the transaction a lease for tax purposes are not relevant in the immediate context. In order for the new rules to be involved, both parties to the transaction must so elect. These new "safe harbor" lease provisions are discussed under Option 2.)

A schematic diagram of this municipal ownership and lease-to-PSE&G option is presented on the following page. Tax benefits and operating characteristics of the project would be the same as under the other direct ownership forms discussed above.

Exhibit 6

OPTION 1(a) -- (ii)

MUNICIPAL OWNERSHIP AND LEASE TO PSE&G: MUNICIPAL BOND FINANCING



(b) Deep Discount Bonds

As an alternative to municipal bond financing, should such financing be unavailable or additional capital be needed, PSE&G could issue its own corporate bonds at a substantial discount. This is known as the "deep discount bond" technique.

A deep discount bond is one that carries a coupon rate significantly below market. For example, if the market rate is 14%, the bond could be issued at 4%. Of course, customers for such bonds would pay considerably less than the face amount to bring the effective yield on the bond in line with the market.

The purpose behind this technique is to take advantage of tax rules governing the taxation of bonds issued at discount. The amount of the discount is treated as interest by both the seller and the buyer. Each year the seller accrues a proportionate amount of the discount as an interest deduction, and the buyer includes the same proportionate amount as interest income. However, if the buyer is a tax-exempt organization (e.g., a pension fund), the interest that is accruing as a deduction to P3E&G would not be taxable to the buyer. PSE&G's interest deduction would not be affected, regardless of the buyer's status. The purpose of selling to tax-exempt organizations is that they would presumably pay the best price for these bonds, based on the fact that the amount of discount treated as income to them each year is not taxable income. The exempt organizations is, therefore, not disadvantaged by tax rules and would be looking toward the redemption of the bond at full face value to provide its desired yield. The drawback of deep discount bonds is that, at maturity, the issuer must have adequate cash to repay the full face value to the bondholder.

The following example illustrates how a deep discount bond may benefit PSE&G: Assume the issuance of a 4% bond discounted to an actual return on maturity equal to 14% per year. PSE&G

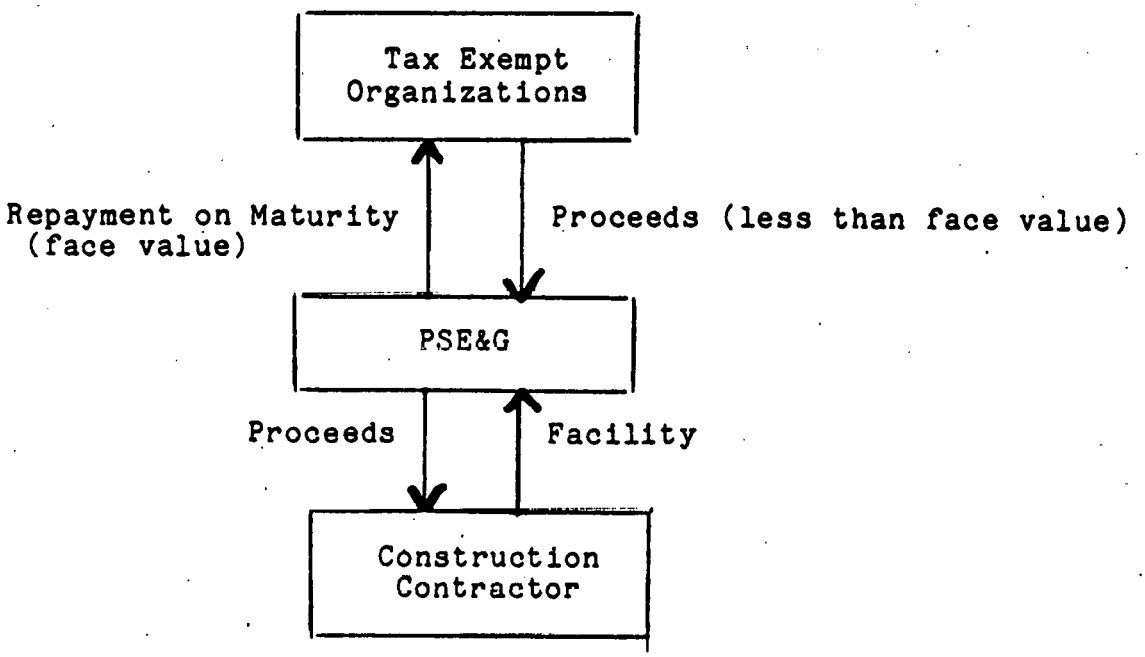
would accrue the discount as an interest deduction along with the actual payment to achieve a 14% deduction. If we assume a 50% tax rate, each $14 of deductions would produce a $7 tax savings or $3 more per year than the actual payment.

The diagram on the following page illustrates a deep discount bond transaction.

Exhibit 7

OPTION 1(b)

DIRECT OWNERSHIP -- DEEP DISCOUNT BONDS



(c) Leveraged Purchase By Corporate Investors of Preferred Stock

A third financing method that might prove advantageous to PSE&G under the direct ownership scenario would be the sale of preferred stock to a corporate buyer who will leverage the purchase. Under this plan, the corporate investor could borrow funds and, in turn, invest those funds in preferred PSE&G stock. The interest rate paid on the borrowed funds could exceed the dividend rate earned on the preferred stock because 85% of intercorporate dividend payments are excludable from corporate taxable income while interest expenses are deductible.

The key aspect of this financing plan is §243 which provides that corporations receiving dividends from other corporation do not pay taxes on 85% of such earnings. To the extent the investing corporation funds its stock purchase with debt, it will be able to earn a tax-free profit equal to the difference between its after-tax cost of debt and the after-tax dividend received from PSE&G. From PSE&G's perspective, its cost of preferred equity will be no more--and perhaps less--than it would have been absent the intercorporate dividend tax exclusion while still retaining direct ownership of the project. However, it should be noted that in this case PSE&G would get no deduction for the dividend payments. An example and schematic diagram of this form of financing is shown on the following pages.

(Note, there are special rules pertaining to preferred stock of public utilities issued prior to October 1, 1942, or which were issued on or after that date to refund or replace preferred stock, bonds or debentures issued before such date. §§244 and 247. Because of their limited scope these provisions were not taken into account).

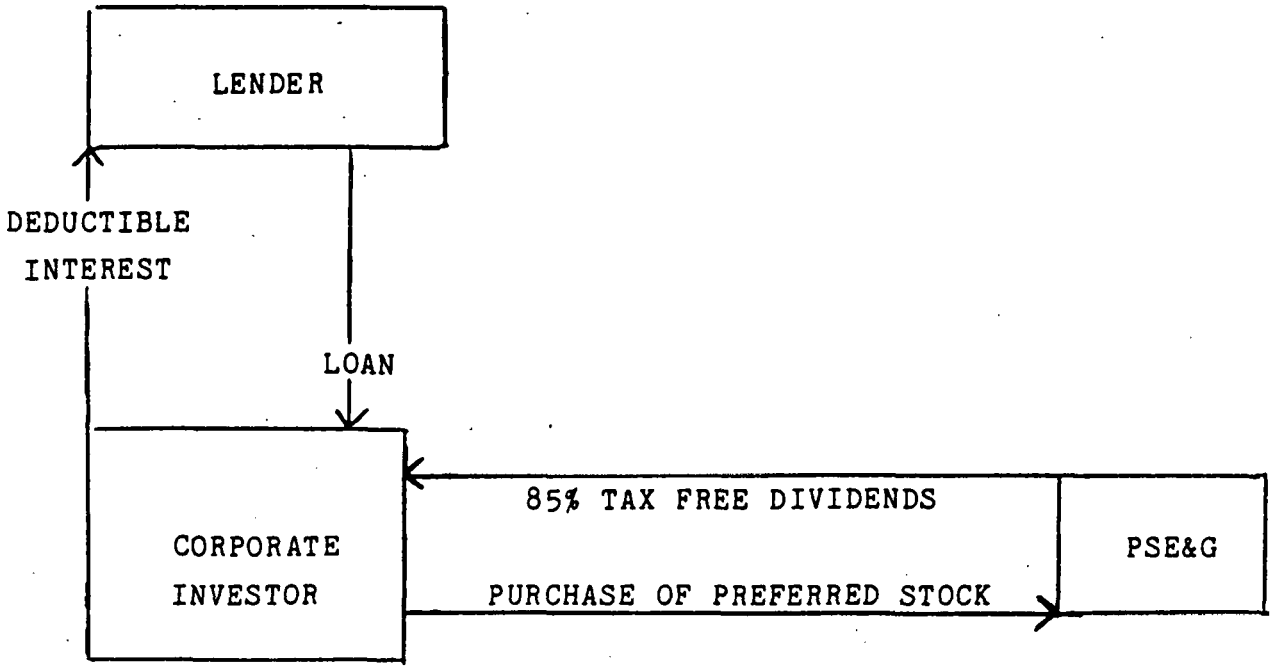
OPTION 1(c)

Example of Leveraged Purchase of Preferred Stock

- A bank leasing company borrows $800,000 at 15% and, using $200,000 of its own cash,
- Purchases $1 million of PSE&G preferred stock paying a 12.5% dividend
- The deductible annual interest expense is $120,000 (or, at 50% tax bracket, $60,000 of actual expense)
- The annual dividend earnings on the stock are $125,000 of which 85% or $106,250 is tax free
- 15% of the dividend would be subject to tax. Assuming a 50% rate, the tax on the dividend would be $9,375 (.15 X $125,000 X .5)
- Final result: 55,625 of after tax earnings (i.e., $125,000 minus $60,000 after tax interest paid minus $9,375 tax on taxable dividends) or a return of about 28% to the investor on the 200,000 cash investment.

OPTION 1(c)

DIRECT OWNERSHIP -- LEVERAGED PURCHASE OF PREFERRED STOCK



(d) High Premium Convertibles

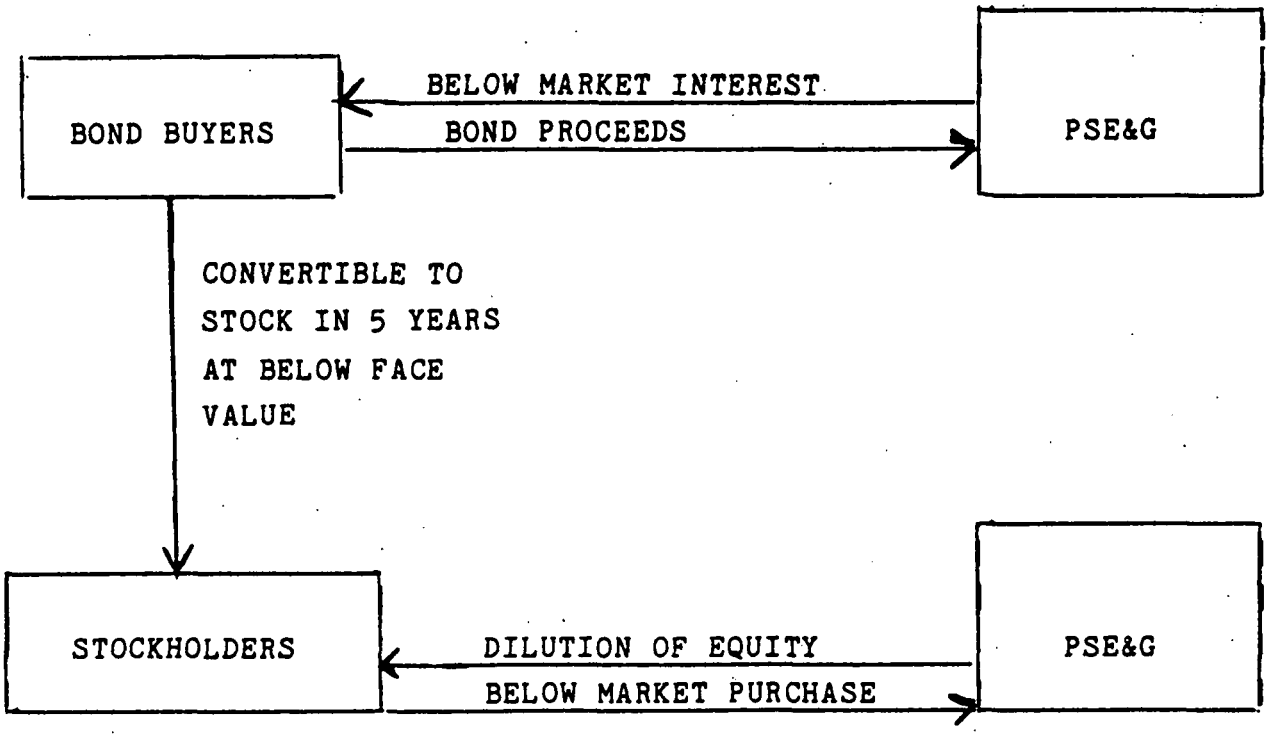
A fourth financing method which might be considered to provide partial financing to a project under direct PSE&G ownership involves the use of high premium convertible debt. Under this plan, PSE&G would attempt to sell corporate bonds at a premium, thereby paying an interest rate below the prevailing market rate. In return, the bond buyer obtains the right to "put" the bond back to PSE&G in, say, 5 years, convertible into stock at a price equivalent to, say, 70 percent of the then-prevailing price of the stock. In effect, the bond buyer agrees to a below market rate, with an option to buy stock in the future at below face value. PSE&G obtains below market financing in the current period but must be prepared for some dilution of stockholders' equity at the time of conversion 5 years hence. A diagram of this option is shown on the following page.

To our knowledge, this option has not been used by any utilities though it is under consideration by several. From the IRS' standpoint, the key issue is whether this form of financing should be classified as debt or equity. As debt, interest payments would be deductible while, as equity, they would not. Further analysis of the Internal Revenue Code's rules for distinguishing debt from equity is advisable.

Exhibit 9

OPTION 1(d)

DIRECT OWNERSHIP -- HIGH PREMIUM CONVERTIBLE DEBT



OPTION 2

SALE-LEASEBACK ARRANGEMENTS

In order to maximize tax benefits and reduce PSE&G's total required investment, a sale-leaseback might present some opportunities worth considering. With passage of liberalized leasing rules under the Economic Recovery Tax Act of 1981, two general forms of sale-leaseback arrangements are now available: (a) those under the tax rules which existed prior to the 1981 Act and which remain in effect for certain types of lease transactions; and (b) those under the new "safe harbor" provisions outlined in the 1981 Act. Each is described separately below.

From a tax standpoint, these techniques should only be considered where the lack of taxable income would prevent PSE&G from using the tax benefits itself or where tax losses or other available credits would inordinately delay PSE&G's own use of credits. In effect, the lease technique represents a sale of tax benefits that would otherwise be lost or deferred. In this context we would point out that the tax rules are very complex and that care must be taken in structuring the transaction so that it is treated as a lease.

Nevertheless, there are circumstances where a sale-leaseback can be advantageous to PSE&G from a non-tax perspective. For example, under either lease form, PSE&G's capital contribution would be reduced to the extent the lessor contributes capital investment. The lessor's minimum at risk investment must be at least 20% of the property's adjusted basis under the old leasing rules, but only 10% under the new safe harbor provisions.

(a) Sale-Leasebacks Under Pre-1981 Tax Laws

Under the old rules -- which remain in effect -- PSE&G can construct the desired facilities using interim financing and then sell the property to a lessor for an amount sufficient to cover

construction costs. The lessor then would lease the property back to PSE&G, retaining the tax benefits for itself, and reflecting this in the lease deal.

This option may not be economically feasible to the extent the same tax benefits could be utilized by PSE&G in-house, though lease arrangements are sometimes structured as a way of removing financing from a company's balance sheet regardless of whether direct ownership would be more economical. Below we consider the use of this technique for the substations and the Essex and Hudson plant retrofit.

The Lease Structure

Typically, utilities enter into lease arrangements in situations where, because of prior large capital investments, additional tax benefits cannot be utilized in-house. A lease arrangement places these benefits in the hands of the lessor who, in turn, adjusts the lease payments accordingly. The lessor could either be a single corporate lessor (e.g., an insurance company) or a syndicate of corporations that would allocate the tax benefits among them (e.g., through a partnership). Where the lessor in turn finances the purchase of the lease property in order to further maximize tax benefits relative to equity, the arrangement is typically referred to as a leveraged lease.

The tax benefits to the lessor in a structured lease deal are tax credits and depreciation. The lessor maximizes the use of these benefits, and is thereby able to offer lease terms that place the user in a better cash flow position than would direct ownership through conventional financing. As in the direct ownership option, 10% ITC and accelerated depreciation benefits would be available to the assets' owner, the lessor. We would caution, however, that the lease technique is not a means of obtaining otherwise unavailable energy credits, as the following discussion illustrates.

Substations and Peaking units - Energy Credits

The use of the lease technique would not generate energy credits for the substations and peaking units. They would be distinct properties and not an integral part of either the Essex or Hudson plants. The substations and peaking units would be new facilities and not installed at an industrial or commercial facility at which electricity or qualified energy was produced as of January 1, 1980. In addition, current plans are for these boilers to be oil or gas-fired. For these reasons, they would not qualify as energy property.

Retrofit Equipment - Energy Credits

Lease of the retrofit equipment at the Hudson and Essex plants was considered. Since both plants were in operation prior to 1981, they would meet the Internal Revenue Code definition of cogeneration equipment. However, a major roadblock to the use of this technique is that a lease of cogeneration property back to PSE&G would appear to nullify the availability of any energy credits. Treas. Reg. §1.46-3(g)(3) clearly indicates that "property leased by a lessor.... to a lessee who uses such property predominantly in a public utility activity is public utility property for purposes of computing the lessor's or lessee's qualified investment with respect to such property."

This regulation is significant because it would mean that the same restriction that blocks the use of energy credits for direct utility ownership (§48(1)(17)) would also block the availability of the energy credits to a lessor.

Classification of the property as public utility property even though a non-utility lessor is the owner can also have a significant effect on allowable depreciation. As public utility property, the majority of the assets involved in a sale-leaseback to PSE&G would be depreciated under the same ACRS 15 year public utility table applied in the case of direct ownership.

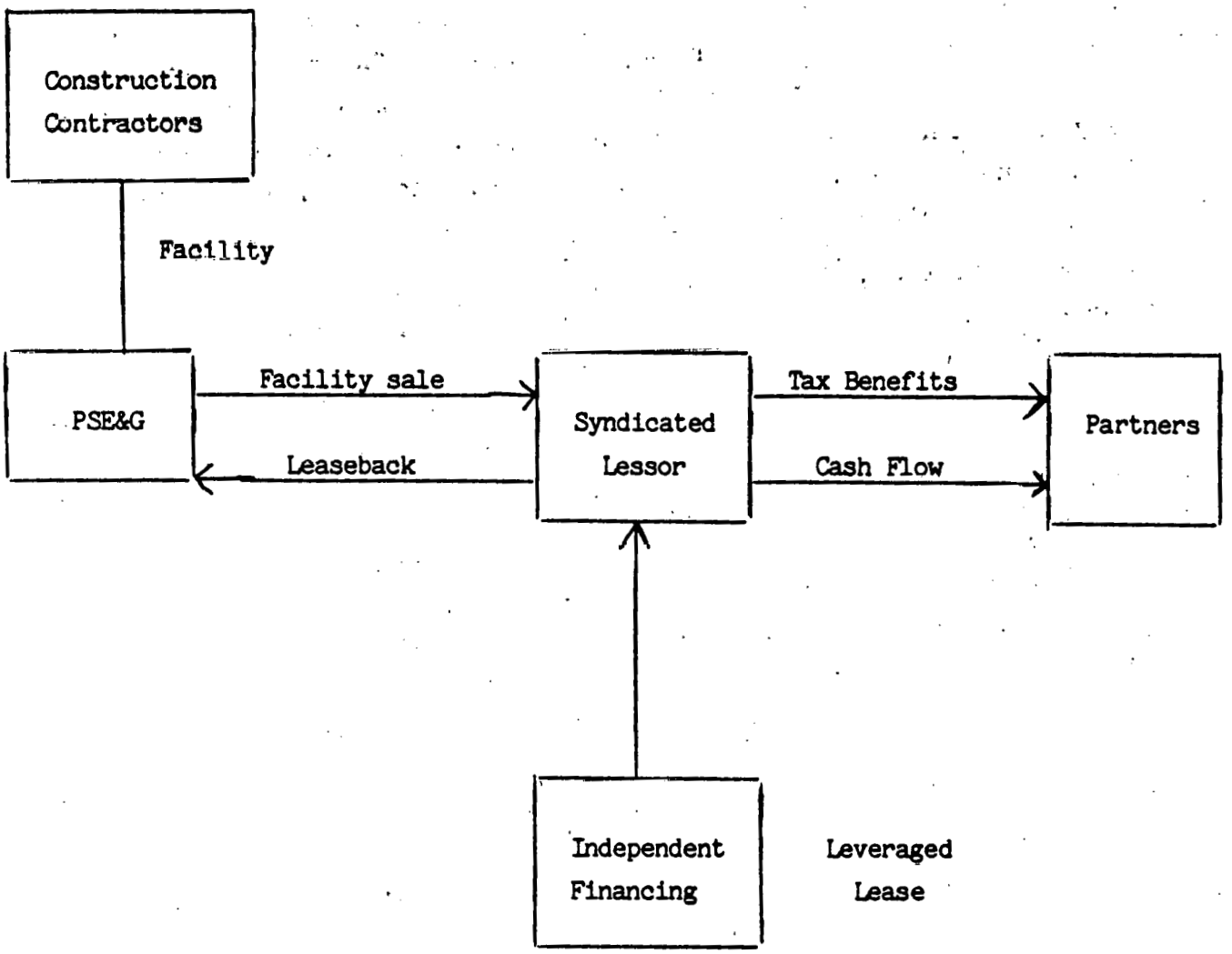
We would also caution that due to the nature of the property involved, and its special use by PSE&G, the IRS may not recognize the transaction at all as a true lease.

A typical leveraged sale-leaseback under the pre-1981 "true lease" rules is illustrated schematically on the following page.

Exhibit 10

OPTION 2

SALE - LEASEBACK UNDER "TRUE" LEASE RULES*



* Prior rules remain in effect except where the new "safe harbor" lease rules are available, and an election is made to use them.

(b) Sale Leaseback -- Safe Harbor Lease Under New Tax Law

The Economic Recovery Tax Act of 1981 liberalized the rules pertaining to lease transactions. As with leveraged lease transactions used in the past, the objective remains the same. A company which cannot use tax benefits in the form of accelerated depreciation and credits will transfer them for consideration to an independent entity which may use them. The new rules are so liberal that a company which cannot use tax benefits may effectively sell them. The form of the sale is a sale leaseback, but in substance the transaction is nothing more than an outright sale of depreciation and credits.

Nevertheless, the same restrictions which block the use of energy credits and which place limits on the method of depreciation are applicable under the new rules as well. Thus, the property would be considered public utility property, hence ineligible for ETC and would be depreciable, for the most part, under the ACRS 15 year public utility tables.

The new law provides greater flexibility in structuring traditional sale-leaseback transactions, because meeting the safe harbor makes the IRS leasing guidelines irrelevant. Thus, a transaction may qualify as a bona fide lease even though it contains these provisions, which would disqualify it under the IRS guidelines:

- The lessor need not project a profit from the transaction apart from its tax benefits.

- The lessor does not need a minimal unconditional investment of at least 20% of the cost of the property. (Only 10 percent is required).

- The fair market value of the asset at the end of the lease term is no longer relevant.

- A lease term of up to the greater of 90% of useful life or 150% of ADR class life is now permitted.

- The lease may provide for a "put" that requires the lessee to purchase the property at the end of the lease term.

- The lessee may have an option to purchase the leased asset at the end of the lease term for an amount that has no relationship to the fair market value of the asset.

- Limited use property, such as assets that are an integral part of the lessee's plant, may be the subject of a safe harbor lease, notwithstanding the fact that the asset would not have any real economic value to the lessor at the end of the lease term.

There are three basic types of lease transactions being used: (i) the wash lease, designed to transfer back credits and depreciation; (ii) leases transferring depreciation only; and (iii) the ITC strip lease, designed to transfer only the tax credits. Each is described below.

(i) Wash Sale

The wash sale is the primary type of transaction contemplated by the safe harbor leasing provision. For example, corporation X might buy a $1,000,000 asset from a manufacturer for a $200,000 down payment with an $800,000 purchase note owed to the manufacturer, the manufacturer's financing company or a third party lender. X would then (within 3 months) enter into a sale-leaseback transaction with corporation Y, whereby Y will make an upfront payment of $170,000 to $200,000 to X, and the payment of the remaining $800,000 to $830,000 will be represented

by a note with a reasonable amount of interest indicated. In turn, X would lease the asset from Y for a rental amount exactly equal to the interest and principal payments due on the note from Y to X. At the end of the lease term, X would have an option to buy the asset from Y for a nominal amount.

X would not report the receipt of the upfront $170,000 - $200,000 payment as income, since X is selling the asset to Y for the exact amount of its purchase cost. X would report income from interest payments made by Y. In addition, X would be entitled to rental deductions for its payments to Y.

Y would treat the upfront $170,000 to $200,000 as a non-deductible asset acquisition cost. Y would be treated as the owner of the asset, and be entitled to the investment credit and the ACRS deductions on the asset. Y would be entitled to a deduction for the interest portion of its payment to X on the note. Y would also report the rental payments from X as income.

During the term of the lease, X would be responsible for making payments to the manufacturer, the manufacturer's finance company or the third party lender for the loan on the initial purchase of the asset by X. Thus, the lessee would have in effect sold the tax benefits (investment credit and ACRS deductions) for an upfront payment of $170,000 to $200,000. To the extent that X is in a taxable position during the term of the lease, it would derive additional benefit from the fact that the rental deductions on the lease exceed interest payments received on Y's note.

Y would negotiate the price it is willing to pay for the tax benefits associated with the asset in accordance with its tax rate, the term of the lease agreement and the degree of risk of disqualification from the safe harbor provision. In the event of disqualification (for any reason) from the safe harbor provision, the transaction will be treated as a resale from Y to X with recapture consequences and loss of future tax benefits. In most cases, Y would obtain an indemnification from X requiring payment for loss of tax benefits through safe harbor disqualification.

(ii) Transfer of Depreciation Only

Where the buyer of an asset is going to have taxable income, but be in less than the maximum tax bracket, it may seek to transfer the ACRS depreciation benefits only.

For example, X, after purchasing a $1,000,000 asset from the manufacturer, would them resell the asset to Y for an upfront payment of $60,000. Y would then lease the property back to X and file a §48(d) election to cede the investment credit back to X as lessee. X would keep the $60,000 upfront payment, while Y's schedule of payments would mirror X's schedule of rental payments. The tax consequences and other aspects of the lease should be substantially similar to the wash sale lease. The lease transferring only ACRS deductions should not have the potential problems in qualifying for the safe harbor that exists with an ITC Strip, described below.

(iii) ITC Strip

Immediately after passage of the 1981 Act, a great deal of publicity was given to the ITC Strip, which entails the use of a safe harbor lease to allow the user of the asset to sell the investment tax credit and retain the ACRS deduction benefits.

It is uncertain that Treasury will sanction the ITC Strip as a qualified safe harbor leasing transaction. At this time, it appears that Treasury is leaning toward a negative position on this issue. (This issue was not addressed in the Temporary Regulations issued on October 20, 1981.)

An ITC Strip transaction might be structured in this way: X buys an asset for $1,000,000 and enters into a lease with Y (Lease #1). The lease agreement provides that Y will make an advance payment on the lease of $140,000. X then agrees to pass the investment credit through to Y with a §48(d) election. Y

then subleases the asset back to X (Lease #2). With the exception of the $140,000 prepayment, which X keeps, the rental schedule under the lease and sublease will be identical.

Y would take a $100,000 investment tax credit and amortize the $140,000 leasehold cost over the term of the lease. X would have to report the $140,000 as rental income and would take the depreciation deductions.

Diagrams of these three forms of safe harbor leases are shown on the following pages.

Exhibit 11

SAFE HARBOR

WASH LEASE

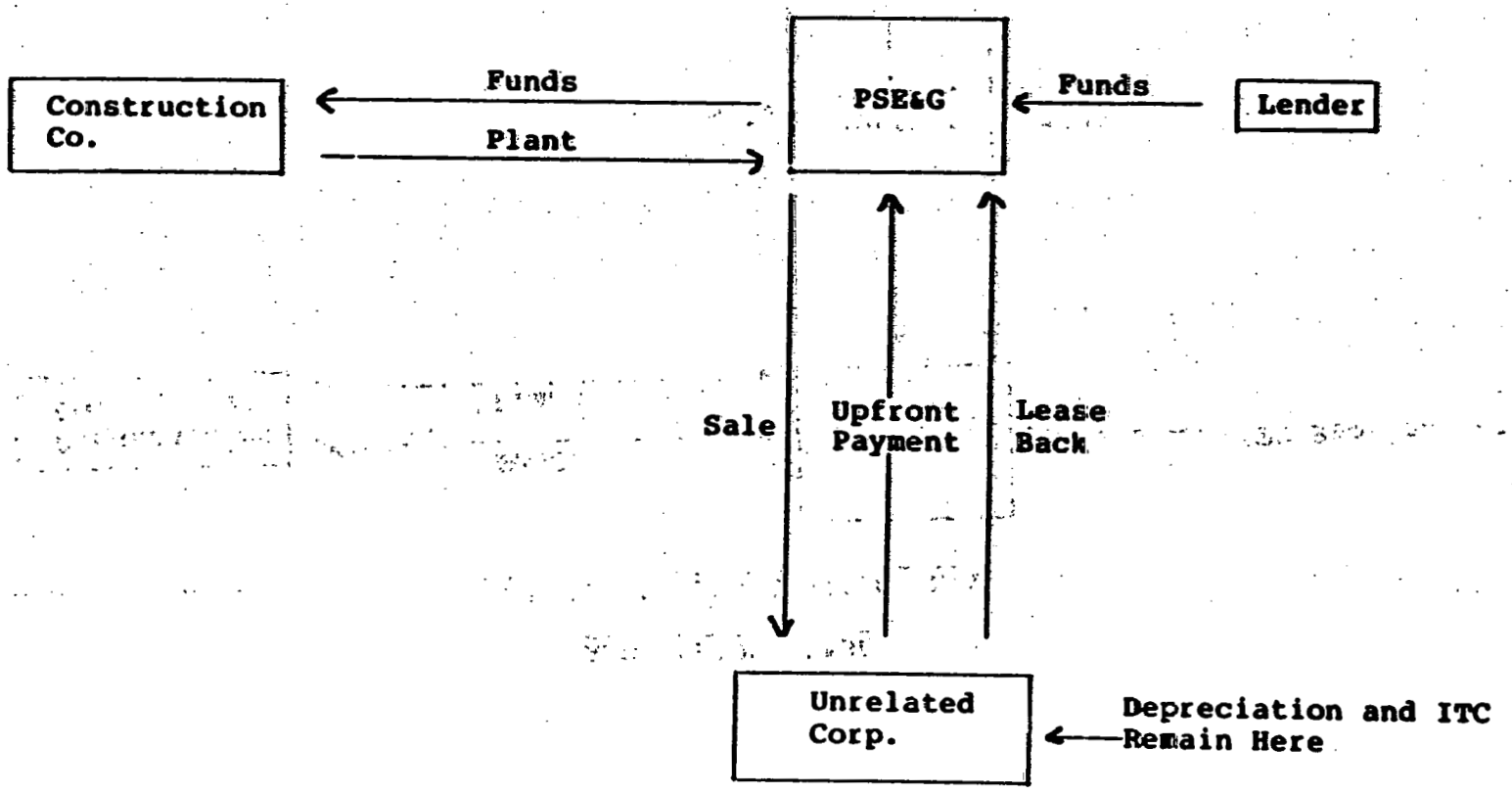


Exhibit 12

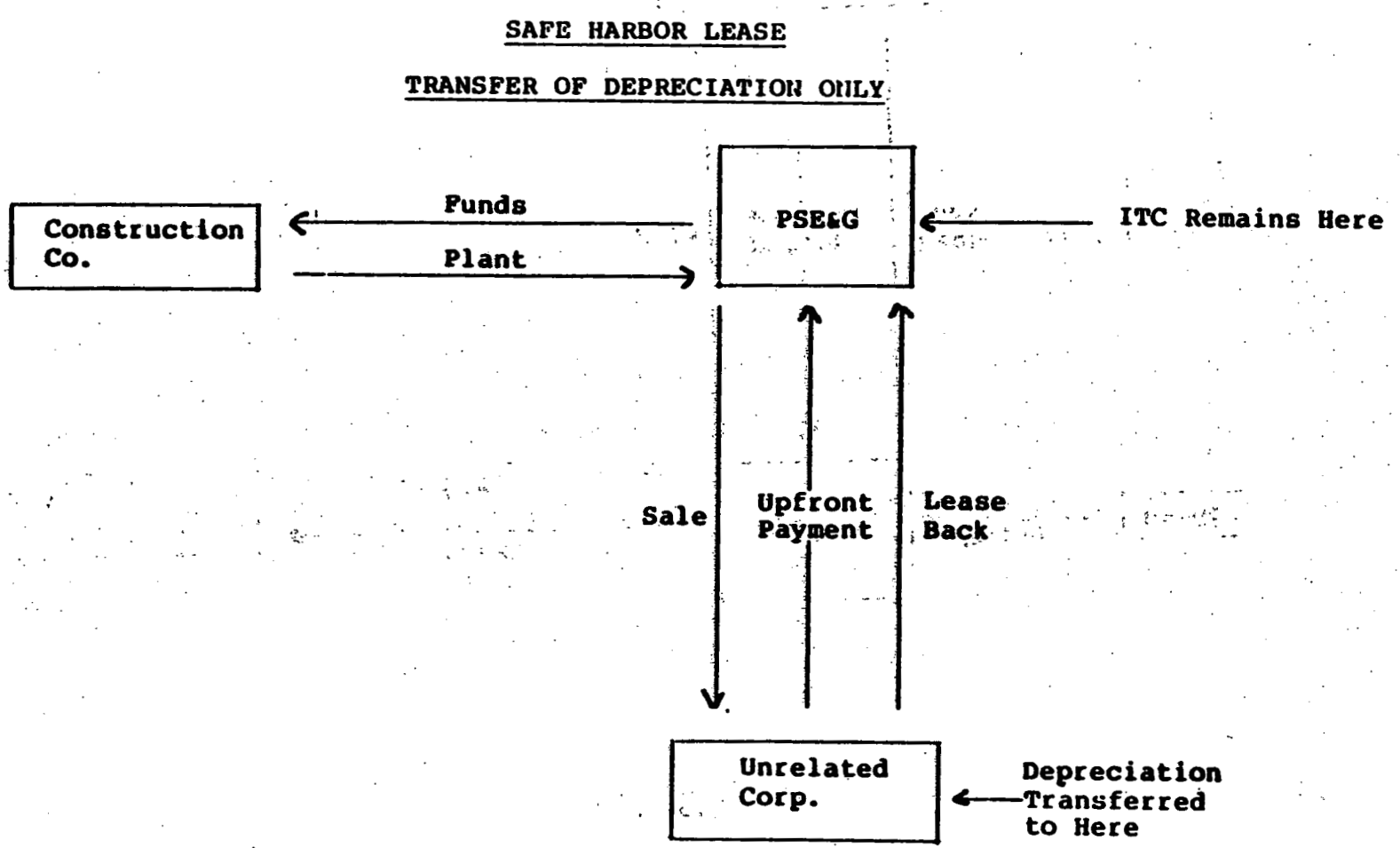
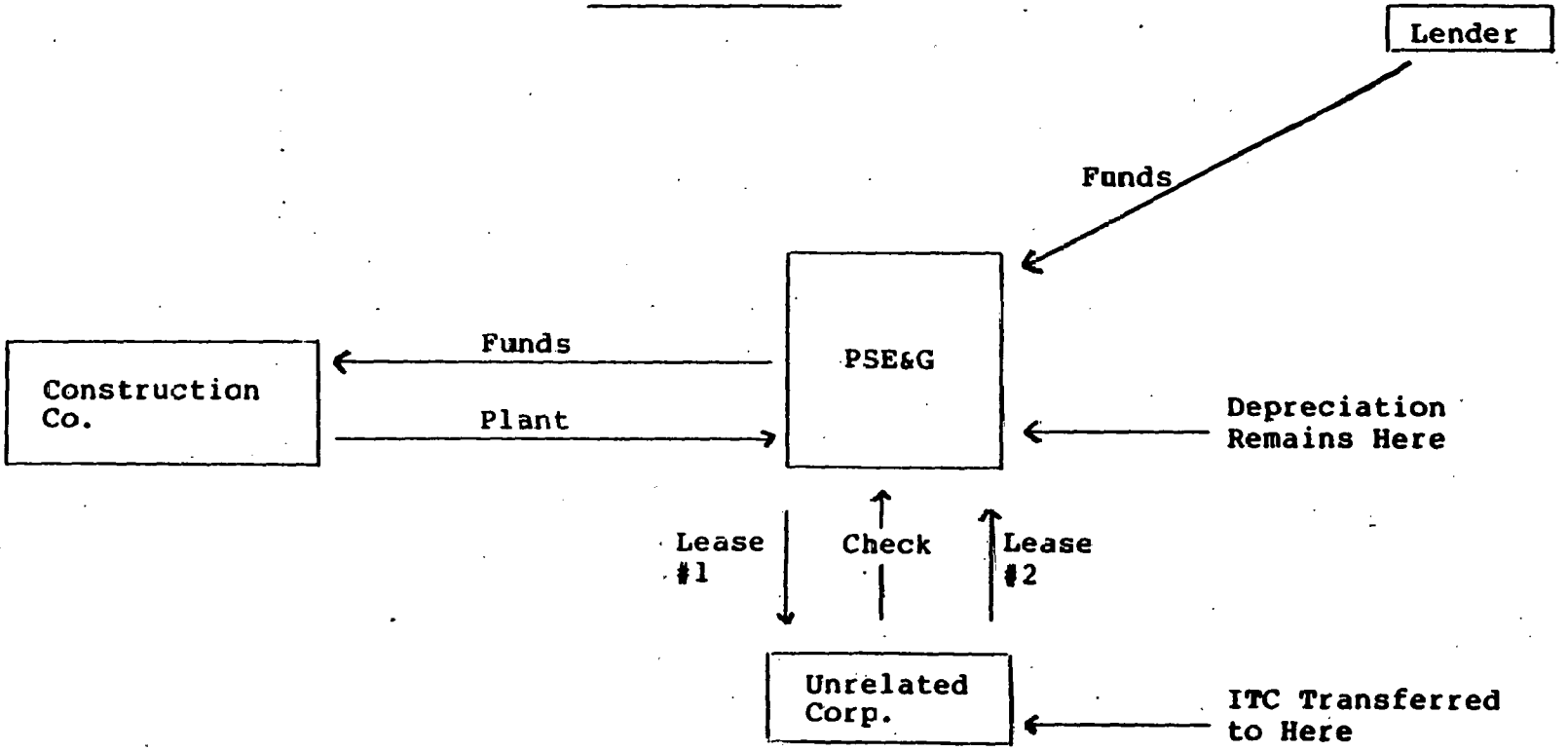

SAFE HARBOR LEASE
TRANSFER OF DEPRECIATION ONLY
Construction Co.
Funds
Plant
PSE&G
ITC Remains Here
Sale
Upfront Payment
Lease Back
Unrelated Corp.
Depreciation Transferred to Here

Exhibit 13

SAFE HARBOR

STRIPPER LEASE*



*Note: IRS sanction is uncertain. See text.

OPTION 3

THIRD PARTY OR JOINT VENTURE OWNERSHIP -- SALE OF OUTPUT TO PSE&G

A potential way around the restrictions imposed by the law on a public utility obtaining energy credits and 5 year depreciation of assets is to have a third party or a joint venture (in which PSE&G owns an interest of 50% or less) own the cogeneration equipment. This option is primarily of relevance with respect to the Hudson plant which would appear to qualify for energy credits but for the utility ownership restriction.

This option is least viable in the context of peaking units and substations which would not appear to qualify under any of the classes of energy property because they are expected to be oil or gas-fired. However, 5 year ACRS depreciation may be available for these items.

Public Utility Status

The objective of this type of an arrangement is to avoid having the independent owner considered a public utility for tax purposes. Again, the question of whether rates are regulated determines status as public utility property. While this is an issue on which advice of legal counsel should be requested, we call attention to §210(e) of the Public Utilities Regulatory Policies Act of 1978 (PURPA) which exempts from regulation at state and local levels certain qualified cogeneration and small power production facilities.

The key is the degree of ownership. If an unrelated party which is not engaged in the sale of electric power owns the cogeneration equipment or is in a joint venture in which PSE&G owns a 50% or less interest then the operation of the facility would appear to be free of the public utility restrictions in the IRS Code pertaining to energy credits and depreciation methods.

Energy Credit/5 Year Depreciation

Under this scenario, the provisions which classify public utility property are inapplicable because the property is not public utility property. Consequently, the property would be classified under the general ACRS rules, and presumably the majority of the assets involved could be considered equipment available for five year writeoff under the 5 year ACRS personal property table.

The restriction which prevents public utilities from claiming credits on qualified energy property would also be extinguished, and energy credits would become available. However, the removal of this public utility restriction would not affect the classification of property as energy property. Hence, this removal of the utility restrictions would only free the cogeneration equipment installed at the Hudson site, which is coal fired. It would not create energy credits for oil or gas-fired properties which do not qualify as energy property. This holds for boilers fired by landfill gas, also.

(The retrofit at the Essex plant would not qualify for ETC because the plant uses oil, and equipment cannot qualify as energy property if more than 20% of the fuel for the system consists of oil or natural gas. However, if, as part of the retrofit, Essex was converted to coal, the cogeneration equipment would qualify.)

Investment Tax Credits

Independent ownership also raises a question as to the availability of investment credits. The IRS has taken the position that cogeneration equipment does not qualify for ITC where the owner is not in the business of selling utility services. However, it is likely that the activity of the venture would be considered a utility service in the form of the sale of steam to customers.

Consequently, third party (non-utility) ownership or a joint venture between PSE&G and an independent, non-utility party would likely have these advantages under the following circumstances:

1) Peaking Units. Obtain 10% ITC, 5 year writeoff, but no energy credits, provided the peaking unit is a cogeneration facility under §210 of PURPA or is not regulated by the New Jersey Board of Public Utilities.

2) Substation. Again, assuming PURPA §210 applies or lack of state regulation - 5 year writeoff, ITC on all equipment, and no ETC.

3) Hudson Plant. Cogeneration retrofit would get ITC, ETC and 5 year writeoff assuming §210 of PURPA applies.

It should be kept in mind that this is a sketch of a possible structuring of ownership that would appear to salvage the energy credit for the retrofit of the Hudson plant. An IRS ruling on this issue would be advisable.

Schematic diagrams of the third party and joint venture ownership options are shown on the following two pages.

Exhibit 14

OPTION 3 (a)

THIRD PARTY OWNERSHIP ---SALE OF OUTPUT TO PSE&G

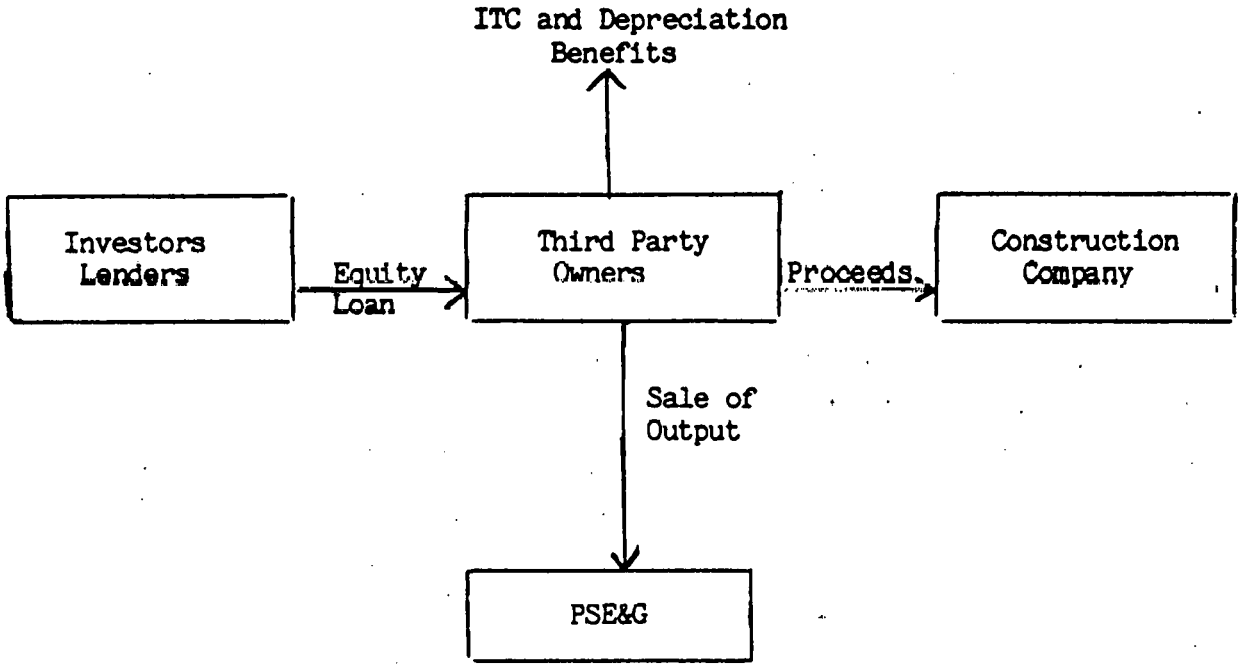
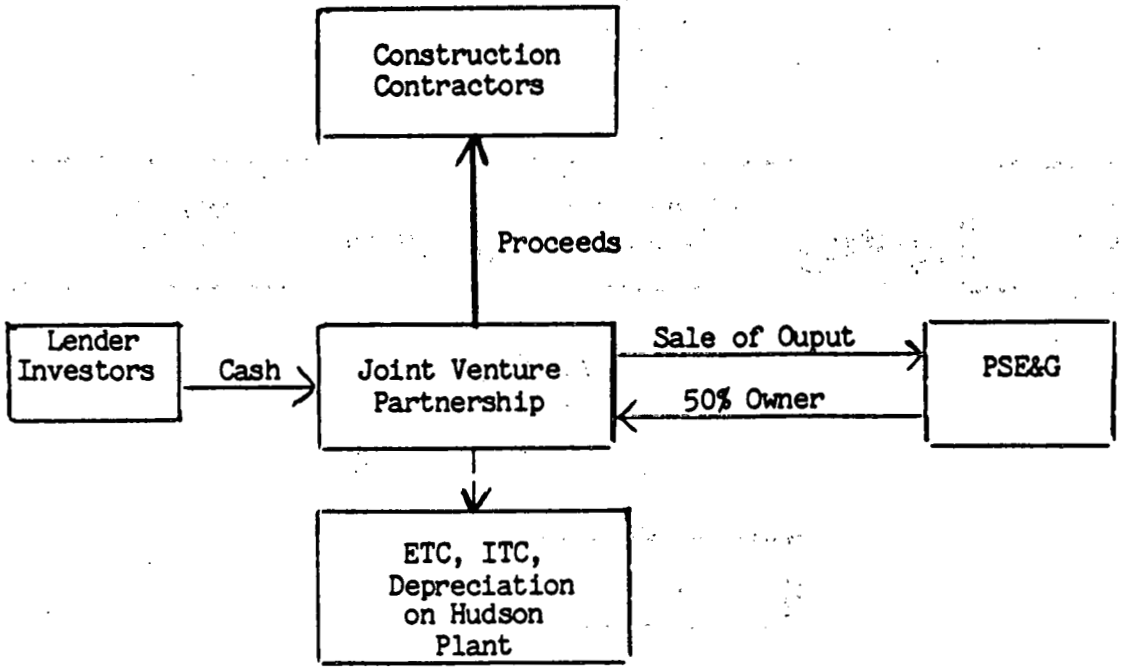


Exhibit 15

OPTION 3 (b)

JOINT VENTURE*



* PSE&G owns 50% or less.

OPTION 4

CUSTOMER OWNERSHIP

It is our understanding that PSE&G intends to carry out the financing and construction of the proposed district heating system in stages with the first stage being the construction of peaking units proximate to its customers. In addition, it will be necessary to finance and construct customer hook-ups and to retrofit existing customer heating systems to be compatible to the district heating system.

Customer ownership of peaking units and heat exchangers raises essentially the same issues that are raised with respect to PSE&G ownership or joint venture ownership: depreciation; ITC; and ETC. The tax incentives to encourage customers to own peaking units or to finance connections and retrofit are limited, as described below.

Energy Credits

Peaking units rely on quick starting fuels such as natural gas. By definition, such units would not qualify for energy credits as cogeneration equipment regardless of who owns them. This would be the case even though the gas was obtained from a landfill. Regulations provide that "methane produced from landfill is not an alternative substance." Hence, boilers which burn synthetic gas are not alternative energy property. (Note, however, the equipment used to produce the methane is alternative energy property used to produce a synthetic fuel.) There are no other provisions under which peaking units would qualify as energy property.

Where a customer installs a heat exchanger as part of the retrofit of a heating system to make it compatible to the PSE&G system, there is a possibility that this cost may qualify for energy credits. Heat exchangers are devices for transferring

heat from one liquid to another. These may qualify as energy property if installed for use in an industrial or commercial process carried on as of October 1, 1978. However, recent IRS regulations have defined a commercial or industrial process to exclude retail stores, office buildings, and apartments. Consequently, there would be no ETC for heat exchangers installed in new construction, or for retrofit of retail, office or residential buildings. Apparently, only those customers actually engaged in manufacturing would obtain this incentive, and only for the heat exchangers, not the full retrofit costs. Consequently, restrictions in the law and IRS regulations mean that the energy credit would not be an effective overall incentive to customer retrofit. A bill to correct the IRS regulations defining industrial or commercial process is currently pending in Congress.

ITC

The investment credit may be only a limited incentive to customer ownership of peaking units and heat exchangers due to numerous restrictions.

The investment credit is available only to limited categories of property including, in relevant part:

- Tangible personal property;
- Other property used as "an integral part of manufacturing, production or extraction or of furnishing... electrical energy, gas, water or sewage disposal services."

Further, even though a property may meet these definitions it may not qualify for ITC due to other restrictions. In addition, there are restrictions disqualifying oil or gas fired boilers in many instances.

The peaking unit equipment used to tie into customer heating systems would most likely not be considered personal property.

Hence, if the peaking units and hookups are to qualify for ITC, they must be classified as "other property" used as an integral part of manufacturing or production, or in providing water services. Consequently, the ITC would appear to be an incentive to an industrial user who will use the hot water from the peaking units in his manufacturing process. However, the specific statutory provision denying ITC to industrial process boilers fueled by oil and gas would eliminate this incentive.

In the case of peaking units and hookups used in retail and office buildings, it is highly unlikely that the customer will obtain the ITC since the heating system would typically be used for space heating purposes (i.e., not an integral part of manufacturing, etc.). In addition, a specific restriction denies ITC for use in apartment buildings.

The one possibility of customers obtaining ITC for peaking units would be in the case of commercial projects such as the Meadowlands Development. If the owner of the complex is considered to use the peaking unit to provide water services to tenants, the ITC may be available as "other property used to provide water services," and the oil and gas fired boiler restriction would not apply since this is a commercial use. However, the IRS position on the other property issue for utility services is generally not favorable. The IRS attempts to restrict the "other property" exception to cover only actual utility operations. In other words, if a landlord sells utility services (e.g., water) to his tenants the IRS may deny the ITC for the equipment used to do this, but if the services are sold by a public utility the credit would be allowed. A ruling on the availability of the ITC to the owner of the Meadowlands (or similiar projects) would be advisable.

Customer owned heat exchangers would not, in most instances, qualify for ITC because such items are generally installed in space heating systems and are considered real property. However, where the heat exchanger is an integral part of a manufacturing process it would qualify for ITC.

Depreciation

ACRS depreciation, without the restrictions which apply to utilities, is one advantage that customer ownership may appear to have over PSE&G ownership. Unfortunately, the benefit is limited in its scope.

Customer ownership of heat exchangers and retrofit equipment installed at their own facilities will benefit from ACRS depreciation. The public utility rules pertaining to five or ten year classification won't apply. However, the exchangers will in most cases be part of heating systems and consequently will be considered real property and subject to a special 15 year ACRS table for real estate. Only where the heat exchangers are used as an integral part of a manufacturing process would they be depreciated over five years.

The same rules as applicable to heat exchangers would apply where the customer owns a peaking unit provided the unit is not classified as public utility property.

Financing Ownership by Customer: Small Issue IRB

In any case where customer ownership is feasible, the customer should consider taking advantage of municipal bond financing under the small issue exemption ($10,000,000 or less).

Qualifying under the small issue exemption requires that the company's total expenditures in the issuing municipality for a six year period (3 years prior and 3 years subsequent to bond issuance) not exceed $10 million. It is possible that many potential end-use customers may meet these requirements.

The objective would be to suggest this to the customer as an incentive which reduces his cost of capital. A service corporation owned by PSE&G could then be formed to offer management services to the customer under a service contract. The service

contract would have to anticipate an integration of this system with a future expanded system. At this point, there would be no direct costs to PSE&G, but PSE&G would have to assume a certain degree of risk to the extent that ownership of facilities would not be in its own hands.

Customer-Owned Cooperative

A customer-owned cooperative is one way of dealing with some of the practical problems relating to inducing customers to finance the construction of peaking units. This approach might also be considered with respect to substations as well.

Under this alternative, customers would establish a cooperative to own and operate units. The cooperative would then sell the water to its stockholder members at actual cost (including overhead).

Since the various units would be owned by the cooperative and hot water sold to its members on an "as needed" basis, there would appear to be a better chance of classifying the units as "other property used to provide water services." The available ITC would then be allocated among the members in proportion to the business they do with the organization.

However, since the cooperative would be a distinct entity, paper losses attributable to ACRS depreciation would remain on the books of the cooperative and could not be flowed through to the owner-users. Consequently, the tax benefits attributable to cooperative ownership would not be the primary inducement to using this form of ownership. The fact that the cooperative could be used to achieve economies of scale, and would be user owned, may provide the needed incentive.

As an alternative, the assets could be initially owned by a partnership in order to flow tax credits and losses in the first year of operations to the owners. Subsequently, the assets of the partnership could be transferred to a cooperative in exchange for membership shares. The members would then operate the cooperative to sell hot water to them at cost.

The cooperative and partnership-to-cooperative options are shown in the diagrams on the following page.

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