trenton ICES

Demonstration of a Grid-Connected
Integrated Community Energy System
PHASE II
Volume 1

MASTER

Prepared for:
The U.S. Department of Energy
Contract N9 EC-77-C-02-4212

Prepared by:
City of Trenton
Department of Planning and Development
10 Capitol Street, Trenton, New Jersey 08608

New Jersey Energy Research Institute
Public Service Electric & Gas Company
Richard G. Stein & Partners
Turner Construction Company
R.G. Vanderweil, Inc.

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22 March 1978

Trenton ICES

PHASE II
DRAFT FINAL REPORT

PREFACE

The following draft report consists of two sections.

At the conclusion of Phase II, Demonstration of a Grid-Connected Integrated Community Energy System, an economic analysis was performed. This analysis was based upon the assumption of Public Service Electric and Gas Company (PSE&G)'s ownership and operation of the ICES plant and distribution system. Therefore the parameters of the analysis were PSE&G's standard engineering practices, standard instrumentation and controls design, standard operating procedures and standard estimating methods. The capital costs were developed as a joint effort of the entire Demonstration Team. The value of electric energy was assumed to be the Pennsylvania-Jersey-Maryland Power Interconnection off-peak and on-peak incremental energy costs. Escalation rates for various cost components were determined by the PSE&G "Escalation Task Force." The resulting analysis showed the ICES operating at a levelized annual penalty in 1982 dollars of \$2.5 to \$3.0 million.

Subsequent to this economic analysis based on PSE&G ownership, the Team began to look at an analysis of the economic implications of an alternative ownership and also alternative escalation scenarios. This analysis, based on the U.S. Army Corp of Engineers procedures for feasibility studies of selective energy plants, was performed very quickly by Richard G. Stein and Partners, and has not yet been reviewed by the Team.

Public Service Electric and Gas Company has not had an opportunity to examine this analysis and does not wish in any way to appear to endorse or concur with its conclusions, prior to PSE&G review.

Richard G. Stein and Partners and R.C. Vanderweil Inc. do not take issue with the economic analysis based on PSE&G ownership, but wish to express the opinion that the analysis reflects only that specific ownership option with its particular internal and external constraints, assumptions and procurement procedures.

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Consequently the draft material submitted herein has been split into two sections. The first section contains material prepared directly by PSE&G. The second section contains the remainder of the workscope items. This organization in no way implies that any particular material submitted is solely the work of one party. Many workscope items were joint efforts of several Team members.

The final version of this report will either reconcile the differences apparent in this organization or will present clearly divided opinions within a single organizational structure.

PSEG

The Energy People

DRAFT

TRENTON ICES
PHASE II FINAL REPORT

INTRODUCTION

Public Service Electric and Gas Company (PSE&G) has provided this separate draft report to satisfy the contractual requirements of its agreement with the Department of Planning and Development of the City of Trenton, the prime contractor with the U. S. Department of Energy.

The report has been submitted in this manner because a unanimous agreement has not been reached by the Trenton ICES Study Team members on cost estimates and the economic analysis. This report does not contain a detailed description of the Trenton ICES plant and associated facilities and related items which is being prepared by other Study Team members. Such information, which is included in a separate City of Trenton report, will also be provided in the final report as required.

DRAFT

Trenton ICES
Phase II Report

U. S. D.O.E. Contract EC-77-C-02-4212

Prepared By: Public Service Electric & Gas Company
Under Contract with the City of Trenton

Other Trenton ICES Study Team Members

The City of Trenton

Richard G. Stein and Partners

Turner Construction Company

R. G. Vanderweil, Inc.

The New Jersey Energy Research Institute

March 22, 1978

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SECTION I

CONCLUSIONS

Conclusions

The Phase II Report covering the Design and Evaluation for a Grid Connected Thermally Controlled Integrated Community Energy System (ICES) for the City of Trenton, New Jersey has resulted in the following findings:

1. The ICES concept for the Trenton site-specific study is not economic by a wide margin. In contrast to the results of the Phase I and the Phase II 90-day reports, the current economic analysis indicates that, based on normal PSE&G financing, the site-specific Trenton ICES plant results in substantial cost penalty amounting to \$2,800,000 per year (1982 dollars) on a levelized basis, in comparison with the conventional alternative of providing thermal energy to the Community.
2. Although operation of the ICES, as compared to the conventional alternative of providing thermal and electric energy to the Trenton ICES Community, would be more energy efficient, it would result in an additional oil consumption of about 11,000 bbls per year.
3. If the cost of money could be reduced from about 10% to 5% through other means of financing, the Trenton ICES cost penalty indicated above would be reduced by less than half.

4. The estimated cost of steam production to customers based on the conventional alternative ranges from about \$5.00 for certain existing buildings to about \$8.00 for new buildings, or an average of about \$5.50 per 1000 pounds (1978 dollars). Conversely, the estimated cost to PSE&G for steam production and distribution from the ICES is expected to exceed \$9 per 1000 pounds (1978 dollars).
5. Taxes, in various forms, add a substantial burden to the ICES plan costs based on PSE&G ownership. Such taxes make the ICES economics even less attractive. Because of the already huge cost penalty developed, the New Jersey gross receipts and franchise tax was not included in the economic evaluation.
6. The drastic increases in cost penalty resulted from the following major changes:
 - a. Substantial changes in the Community's thermal energy demand profiles, particularly for the summer season. This results in adverse impact on ICES economics due to lower plant utilization factor and less electric capacity and energy credit.
 - b. Substantial increases in ICES plant capital cost estimates occurred between Phase I and Phase II. The increases over the Phase I estimates were primarily due to the use in Phase I of non-current vendor-catalog prices and the selection of equipment based on

simplified schematics as compared to a more detailed Phase II evaluation based on current equipment prices and detailed engineering assessment.

- c. Higher ICES operating and maintenance cost estimates because of cyclic operating modes and the provision of two plant operators per shift to meet state regulations and safety requirements. Conversely, the differential operating and maintenance cost estimates compared with the conventional alternative have been based on the customers' current projection that most of their existing maintenance personnel will be retained even if the ICES plan is implemented.
 - d. Lower capital cost needs for the conventional alternative because of reduced equipment replacements based on the latest information provided by the ICES customers.
7. Additional customers for the Trenton ICES Community could make the economic picture better, particularly with an increased summer usage of steam. This impact has not been explored at the present time.
8. To make the Trenton ICES plan marginally economic, the total capital cost, of about \$15,000,000 (1978 dollars) for the ICES plant and steam distribution system, would have to be reduced by at least one-half, through some forms of subsidy, in addition to low-cost financing.

9. The above-stated cost penalties were based on no provision of thermal storage. The application of thermal storage would further aggravate the ICES economic penalty because the resulting operating-cost savings could not offset the additional capital cost required for such storage facilities.
10. Further investigation confirms the previous conclusion that there are no apparent insurmountable institutional hurdles in implementing the Trenton ICES plan. The most critical open-end would be the negotiation of mutually-acceptable service contracts based on thermal rates that would be attractive to the customers of the Community.
11. From its inception, both U. S. Department of Energy and PSE&G agreed that, in their experience, a commercial/office building community thermal load profile has rather low full load hours use of maximum demand. The expected ICES turbine-generator loadings are equivalent to approximately 3,200 hours per year of full-load operation. This poor loading is a result of the customers' thermal profile.

12. Inherently, ICES, or any Cogeneration scheme, has a greater economic advantage when compared to another capital alternative such as in a "new" community. The ICES Demonstration Community consists largely of existing buildings. Half of the few new buildings began construction or reached final planning during Phase II. Therefore, when this latest economic analysis was performed of thermal energy supply comparing the conventional alternative with ICES, no credit was taken for capital savings in most buildings. As potential customers contemplate the cost of ICES steam, they are logically unwilling to include amortization of existing facilities.
13. The following observations, therefore, can be made as a result of the Trenton ICES study:
 - a. Cogeneration installations may be economically more attractive for communities with higher utilization factors of thermal energy.
 - b. Economic status of cogeneration installations may also improve for commercial/residential communities consisting primarily of new developments where the potential capital savings could be maximized.

SECTION II

SUMMARY OF DELIVERABLES

SUMMARY OF DELIVERABLES

The deliverables covered by the contract with the City of Trenton have been divided into four major areas to facilitate the review of study. These areas, which are briefly outlined below, include an enumeration of the appropriate Appendices.

Institutional Assessment

The Institutional Assessment includes a variety of items such as, minutes of meetings and public hearings, legal interpretations and the initiation of requests for rulings by regulatory agencies. These items are reported in Appendices A through P (excluding Appendix E).

Preliminary Design

The Preliminary Design covers the Trenton ICES design and operation including site plan, schematics, piping diagrams, instrument diagrams and lists of equipment with associated costs. These items are included in Appendices R, S and T.

Energy Use and Cost Analysis

The Energy Use and Cost Analysis evaluates the cost benefit of system design, thermal energy supply costs and electric energy service costs. These items are included in Appendices E, T, U and V.

Work Management Plan

The Work Management Plan shows the proposed plan for Phases III through VI. It is included in Appendix W.

APPENDIX A

(3.5.1 a2)

SELECTIVE ACCEPTANCE OF
ICES CUSTOMERS

DRAFT

3.5.1 a2 Selective Acceptance of ICES Customers

- a) 2) Legal assessment of PSE&G's authority to selectively accept thermal service customers. The Law Department has investigated the right to refuse unwanted customers. A memorandum dated March 6, 1978 from Mr. Frank Sickinger, Assistant General Attorney, (copy attached) states that PSE&G has the right to refuse connection if the customers installation does not accord with our standard terms and conditions or because same would adversely affect the adequacy of service to other customers. However, it would appear, that PSE&G could not refuse steam service to any member of the public fronting the street in which the steam mains are laid unless there would be a detrimental effect on all the other customers, such as inability to deliver the steam in quantities and at pressure necessary as limited by the boilers in the plant.

As presently proposed, separate contracts for steam service would be entered into between PSE&G and individual Trenton ICES customers. This service contract would include a statement that the customers also agrees to the Standard Terms and Conditions for Thermal Service, which are included by reference and as an integral part of the agreement. The Standard Terms and Conditions for Thermal Service would also be submitted to the Board of Public Utility Commissioners for their review. The contract which is for site-specific thermal service, would then eliminate the issue of right of refusal.

Public Service Electric and Gas Company 80 Park Place Newark, N.J. 07101 201/430-6461

Frank A. Sickinger Assistant General Attorney

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March 6, 1978

RECEIVED
REFER TO

Mr. Ku
3/19/78

To the Vice President - Law

Re: Trenton ICES Advisory Committee

At the last meeting of the Committee, the Chairman (Mr. W. S. Ku) asked me to express an opinion on the following two questions:

1. Is there a statute allowing the placement of steam lines in the public streets?
2. Could ICES refuse service to any applicant for steam?

The answer to question one is not entirely clear because of the status of the State's statutes. In 1896, the Legislature provided, under an act entitled "Steam Heat and Power Companies", which is set forth in N.J.S.A. 48:14-1, as follows:

"Any corporation organized or to be organized by virtue of Title 14, Corporations, General, for the purpose of producing and distributing steam heat and power, may lay the necessary pipes and conduits beneath the public roads, highways, streets, avenues and alleys, provided that the consent of the governing body of any city, town or township wherein or through which it is contemplated to lay such pipes and conduits shall first be obtained, such consent to be by ordinance of such governing body duly adopted.

Such use of public streets and highways in any city, town or township shall be subject to such terms, regulations and restrictions as may be imposed by the governing body thereof."

This statute was repealed by the Laws of 1962, Chapter 198, which changed many sections of Title 48 "Public Utilities". At the end thereof, various sections of Title 48, including this one, were repealed without explanation, effective 90 days after passage.

March 6, 1978

In reviewing the changes made in the statutes, it was noted that N.J.S.A. 48:2-13, the general jurisdiction statute for the Public Utility Commission, was changed to delete the word "steam" preceding the word "railroad" from the prior act.

I have also considered Chapter 7 of Title 48, which is entitled "Electric Light, Heat and Power Companies", but said chapter does not speak of steam and it is presumed that the word "heat" means electric heat and has no relation to steam generation.

It would appear, therefore, that there is no State franchise or statutory permission to install steam pipes in streets as in the case of electric and gas lines. It will, therefore, be necessary to obtain a consent by ordinance from the City of Trenton to lay such steam pipes, which would act the same as a franchise.

I have also considered the gross receipts tax act in determining whether there is a State franchise. It does provide for including in the franchise tax act the "using or occupying public streets, highways, roads or other public places by virtue of a franchise or authority or permission from the State or any municipality thereof ***." (N.J.S.A. 54:30A-18). Further, under N.J.S.A. 54:30A-58, wherein the schedule of property and unit values to be used to apportion the gross receipts taxes is set forth, it does include under "Electric Light, Heat and Power Systems" a classification entitled "Heating System Mains" and "Heating System Services".

This statute indicates, therefore, that there can be a municipal franchise without a State franchise.

In summary, therefore, it is my opinion that there is no statutory right to lay steam mains in public streets, but such franchise or permission must be granted by ordinance of the City of Trenton.

As to the second question, I refer you to the memorandum of January 6, 1978, copy attached, forwarded to the Committee in answer to the same question, which concluded that we can only refuse connection if the customers installation does not accord with our standard terms and conditions or because same would adversely affect the adequacy of service to other customers.

It would appear, therefore, that we could not refuse steam service to any member of the public fronting the street in which the steam mains are laid unless there would be a detrimental effect on all the other customers, such as inability to deliver the steam in quantities and at pressure necessary as limited by the boilers in the plant.

March 6, 1978

Although it was not requested, I did mention the gross receipts tax act and remember that a comment was made at the last meeting that the City of Trenton was hoping to receive additional monies from the same. As set forth under the first question, it would appear that the income from the steam lines would be subject to the gross receipts tax.

Frank A. Sickinger
Assistant General Attorney

Approved:

Roger M. Nelson
General Attorney

FAS:em
attach.

PSEG

Public Service Electric and Gas Company 80 Park Place Newark, N.J. 07101 Phone 201/430-7000

RECEIVED

January 6, 1978

JAN 6 1978

To the Assistant General Attorney:

FRANK A. SICKINGER
ASSISTANT GENERAL ATTORNEY

Re: Trenton ICES - Right to Refuse Customers.

The Trenton ICES Steam Generating Project is subject to the jurisdiction of the Board of Public Utilities (see memorandum dated April 15, 1977), and therefore the issue of whether or not the ICES can refuse certain thermal service applications must be resolved according to the applicable public utility statutes and regulations which govern all utilities in the State of New Jersey. N.J.S.A. 48:3-3 and N.J.A.C. 14:3-3.5 would seem to be on point.

"No public utility shall provide or maintain any service that is unsafe, improper or inadequate, or withhold or refuse any service which reasonably can be demanded or furnished when ordered by the board." N.J.S.A. 48:3-3

A municipality engaging in the operation of any light, heat or power plant must comply with all board rules, regulations and recommendations to the same extent as any other public utility. See N.J.S.A. 40:62-2. Therefore, the above-mentioned statute would apply to the ICES project and would seem to deny any right to refuse any reasonable service.

However, the regulations applicable to public utilities would seem to recognize that in some limited instances, a utility may refuse to connect. This may occur only when the utility is asked to connect its facilities to a customer installation.

"(a) A utility may refuse to connect with any customer's installation when it is not in accordance with the standard terms and conditions of the utility furnishing the service, which have been filed with the Board, and with the provisions of applicable governmental requirements.

(b) When, because of its size or character, the customer installation desired to be connected to the facilities of the utility is so unusual as to adversely affect the adequacy of the service furnished to other customers, present or prospective, the utility may require special provisions for the service in question or may refuse the same." N.J.A.C. 14:3-3.5

Therefore, it appears that, except in a narrowly defined situation, a utility has no right to refuse service applications. To overcome this duty of accepting service applications for the ICES project, it might be wise to draft the standard terms and conditions to be filed with the Board in such a way as to limit the type of potential customer seeking this service. If this tactic is not practical, any undesirable application might be rebutted by arguing that the safety and adequacy of other customers' service would be adversely affected if the service in question is not refused.

D. Sandra Burns,
Attorney

APPENDIX B

(3.5.1 b)

**OWNERSHIP OF THERMAL
SUBSTATIONS**

3.5.1-b Ownership and Operation of Thermal Substations and Distribution Systems

Early investigations in Phase I of Trenton ICES study included the concept of six central equipment centers which would utilize the steam from the ICES plant for both heating and cooling purposes. These equipment centers, also known as thermal substations, would contain steam - hot water converters, two-stage absorption chillers, condensate receivers/pumps, cooling towers, pumps and auxiliary equipment and storage capacity.

During the early portion of the Phase II study, the concept of thermal substations appeared to retain it's validity. However, as the study proceeded in depth, customer load profiles changed resulting in changes in the design and operation of the plant, thermal substations and distribution system.

The relative advantages of the thermal substation concept were drastically reduced, not only from a design and operation viewpoint, but more significantly, from a customer preference viewpoint. As individual meetings were held with each customer in the latter portion of the Phase II study, it soon became evident that most customers preferred only steam service.

As a result of these factors the thermal substation concept was revised. The present plan calls for the installation or modification of thirteen equipment centers located on the customers property. These equipment

centers may contain such items as steam - hot water converters, two-stage absorption chillers, condensate receivers/pumps, cooling towers, pumps and auxiliary equipment and storage capacity. In existing buildings, only storage equipment would be added. This plan includes ownership and operation of these facilities by the customer. Thus, PSE&G would not own and operate these equipment centers. For the economic analysis, the cost for the absorption chillers and appurtenances has been assumed to be born by the customer. The storage system cost was, however, included as a PSE&G cost and included in the capital cost for the ICES "terminal." It should be noted that the concept of locating storage on the customer's premises was not discussed with the customer and may present an additional institutional problem.

The distribution system, from the ICES plant to the customer-owned and operated equipment centers or thermal substations, would be owned and operated by PSE&G. This confirms information contained in the Phase I report and the Phase II Draft 90-Day Report.

APPENDIX C

(3.5.1 c1)

FINANCING PLAN

Item 3.5.1.C.1 Financing Plan

Alternative methods of financing the capital required for the Trenton ICES project were reviewed with the PSE&G Treasurers Department. This review of the necessary capital to construct utility plant facilities included the following three factors:

1. Such facilities are required to meet the energy supply demand of PSE&G customers.
2. The additional capital to be raised will not adversely affect PSE&G's ability to maintain a fair rate of return.
3. The additional capital commitment is within the overall financing capability of PSE&G.

If PSE&G were the owner and operator of the Trenton ICES plant, the capital would be provided as shown in the attached table titled PSE&G Annual Capital Requirements and Sources of Capital. Since the financing of the Trenton ICES would come from PSE&G's total capital pool and the incremental capital for this project represents only a fraction of one percent of the overall PSE&G capital needs, the cash-flow impact of the Trenton ICES would be relatively small. Because of this fact, it is the opinion of representatives of the PSE&G Treasurers Department, that there would not be any constraints that may be imposed on this project relative to other PSE&G indebtedness by regulatory authority.

PSE&G has also investigated the use of Economic Development Authority (EDA) financing for a portion of the ICES plant costs.

While it appears that this method of financing may not be feasible for the site-specific Trenton ICES project, we are awaiting additional information from EDA. It is possible that a portion of the cost of the project, \$1 million, could be financed with Industrial Revenue Bonds under the provision of the small issue exemption. However, this type of financing would require a new set of corporate documents and could not be secured by PSE&G bonds. In lieu of mortgage bond security, the bond holders could be given a security interest in the facilities.

It is less likely that the \$5 million small issue exemption provision could be exercised. The capital expenditure test must be satisfied to qualify for financing under the \$5 million provision. This test requires that capital expenditures not exceed \$5 million. The capital expenditure test requires that the amount of the bond issue, plus capital expenditures in the same geographic area for three years before and after the financing shall be \$5 million or less. PSE&G probably would be unable to meet this test because of projected expenditures on nearby electric and gas facilities.

The attached December 29, 1977 internal PSE&G letter from Mr. Riepl, Assistant Treasurer to Mr. Mallard, Vice President-System Planning provides additional detail on the EDA approach to financing.

In addition to the alternatives outlined above, PSE&G has also explored the advantages of setting up a wholly-owned subsidiary to finance the necessary capital for the Trenton ICES project. Aside from the potential of receiving the Fox-Lance temporary property tax abatement, there appears to be no overwhelming advantages to subsidiary ownership of the Trenton ICES project. It is possible that provision of the Fox-Lance law would allow PSE&G to pay two percent of construction costs per year for a period of 15 to 20 years in lieu of municipal taxes on the property and improvements (excluding equipment). However, after that time period the normal tax rate would apply.

Another financing alternative which was explored is the possibility of using funds provided by the New Trenton Corporation, which raises funds through tax-exempt bonds. Funding of projects for private entities is limited to 25% of the total available funds. The other 75% must be used for public projects. This approach would have the advantage of providing lower cost financing because of the ability to issue tax-exempt bonds. Representatives of the City of Trenton have agreed to provide additional information to PSE&G as to the term and conditions of such financing.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

ANNUAL CAPITAL REQUIREMENTS AND SOURCES OF CAPITAL
(MILLIONS OF DOLLARS)

	Actual 1976	1977	1978	Estimated 1979	1980	1981
<u>CONSTRUCTION EXPENDITURES AND CAPITAL REQUIREMENTS</u>						
Construction Program:						
Additions to Utility Plant	280.1	369.9	541.9	577.2	710.3	785.5
Nuclear Fuel	21.5	52.4	95.9	98.9	67.5	107.4
Advances to Subsidiaries	31.0	24.9	34.6	40.7	34.7	27.2
Total Construction Expenditures	\$332.6	\$447.2	\$672.4	\$716.8	\$812.5	\$920.1
Maturing Debt	150.0	31.0	-	53.3	18.6	31.0
Bond Sinking Funds and Other Cash Obligations	(11.6)	153.2	(103.3)	31.0	63.6	29.5
Sub Total Capital Requirements	\$471.0	\$631.4	\$569.1	\$801.1	\$894.6	\$980.6
Trenton ICES Project (if implemented)	-	-	\$ 4.7	\$ 4.7	\$ 4.7	\$ 4.7
Total Capital Requirements	\$471.0	\$631.4	\$573.8	\$805.8	\$899.3	\$985.3
<u>SOURCES OF CAPITAL</u>						
Internally Generated Funds	\$254.4	\$271.0	\$243.0	\$326.3	\$288.9	\$269.4
Financing:						
Long Term Debt	118.6	123.4				
Pollution Control Bonds - Drawdown	10.9	3.1				
Preferred Stock	48.2	29.7	(See Note 2)			
Common Stock	44.2	15.0				
Short Term Debt - Net	(5.3)	129.2				
Total Financing	\$216.6	\$360.4	\$330.8	\$479.5	\$610.4	\$715.9
Total Sources of Capital	\$471.0	\$631.4	\$573.8	\$805.8	\$899.3	\$985.3

NOTES:

(1) Source of Data: July 1977 Financial Forecast,
August 1977 Construction Budget.

(2) Financing program for 1978 through 1981 designed to maintain
capitalization ratios of approximately 50% long term debt,
13% preferred stock, and 37% common equity.

December 29, 1977

T-1.9.1.8.9

To Stephen A. Mallard
Vice President - System Planning

TRENTON ICES PROJECT

Attached is a report on the feasibility of issuing tax-exempt bonds to finance the Trenton ICES project and/or creating a subsidiary company to own and operate ICES for tax-saving purposes.

The results of our investigation indicate that it is neither feasible to issue Industrial Revenue Bonds nor to form a new subsidiary in connection with the ICES project. It appears that the ICES project should be owned and operated by PSE&G and should be financed from the Company's overall pool of capital.

Frank J. Riopl
Assistant Treasurer

FJR:jem

Attachment

Memorandum to Frank J. Riepl
Assistant Treasurer

December 23, 1977

TRENTON INTEGRATED COMMUNITY ENERGY SYSTEM (ICES) FINANCING

The possibility of financing the ICES project with Industrial Development Bonds was explored with Roger Camp of Merrill Lynch. A brief description of the operation of the ICES project was given to Roger Camp by telephone for review by the Merrill Lynch staff and the Brown Wood attorneys to determine whether or not the project would qualify for financing with Industrial Development Bonds. The result of the review was that the project did not qualify for that type of financing.

Roger Camp indicated that \$1 million of the cost of the project could be financed with Industrial Revenue Bonds under the provisions of the small issue exemption. He suggested that the small issue financing, if it was to be considered, could be done at the time of the EDA pollution control financing. It would have to be a separate and distinct financing, it would require a new set of documents and could not be secured by PSE&G mortgage bonds. In lieu of mortgage bond security, the bond holders could be given a security interest in the facilities.

The \$5 million small issue exemption provision was also discussed with Roger Camp. The capital expenditure test must be satisfied to qualify for financing under the \$5 million provision. The capital expenditure test requires that the amount of the bond issue, plus capital expenditures for the three years prior to the financing in the geographical area under the jurisdiction of the financing authority, plus capital expenditures for the three years following the financing in the same geographical area, shall be \$5 million or less. The Company obviously cannot meet this test on a state wide basis for financing through the EDA, and it is doubtful that the test could be met, or provide any substantial benefits, on a county wide basis for financing through a county authority, even if Mercer County had such an authority.

Roger Camp indicated that it might be possible to finance the gas turbines with Industrial Development Bonds under the "local furnishing of electric energy" provision if it could be substantiated that the electricity generated was used in Mercer and a contiguous county. The potential use of the electricity was reviewed in the Transmission Planning Department. It was indicated that electricity loses its identity once it is fed into the system, and that the Company would not want to be placed in the position of substantiating that the output from any of our stations is used in a specific area. Even if it could be established that the electric output of the station was used in two contiguous counties in the vicinity of the ICES plant, it might not be practical to attempt to finance the gas turbines under the "local furnishing of electricity" provision since the primary production of the ICES plant is supposed to be thermal output and electric generation secondary output.

Memorandum to Frank C. Riepl
Assistant Treasurer

December 23, 1977

The possible tax benefits of forming a subsidiary company to operate the ICES project were explored with representatives of our Federal Income Tax Department. It was the consensus that there would be no tax advantage to forming a subsidiary company for this operation since E&G files a consolidated Federal income tax return for the parent and all subsidiary companies.

Clayton A. Brown
Senior Financial Assistant

APPENDIX D

(3.5.1 c2)

COST ALLOCATION

3.5.1-c.2 ICES Cost Allocation Between Thermal and Electrical Generation

In order to develop appropriate rates for the energy produced by the ICES plant a suitable cost allocation must be developed. The original was titled the ICES Electric Energy Value Approach. The steps involved included determining:

1. Annual Fixed Charges for Capital Cost
2. Annual Fuel Cost, Operation and Maintenance and Administrative
3. Replacement Capacity and Energy Costs

Then determining the average steam cost per MBtu by subtracting the Replacement Capacity and Energy Costs (3) from the sum of the Annual Fixed Charges for Capital Cost (1) and the Annual Fuel Cost, Operation and Maintenance and Administrative Costs (2) and dividing by the projected annual steam output of the ICES plant and ultimately the possible thermal energy charges to customers would be determined by adding PSE&G profit margin and overheads to the Average Steam Cost.

However, careful review by PSE&G's Rates and Load Management Department indicated that this alternative is in conflict with current costing techniques. As a result, the revised cost allocation procedure is based on the separate cost of thermal and electric facilities.

Specifically, the procedure is as follows.

1. Determine the capital cost for each major component or subsection of the ICES plant, carefully separating electrical, thermal and electrical/thermal components.
2. Determine the capital cost for the distribution system and appurtenances.
3. Determine the capital cost for any terminal equipment to be included as an ICES cost. Presently, these costs are limited to the storage systems and their appurtenances.
4. Determine the operating costs.
5. Determine the cost of service connections, meter reading, billing, uncollectibles, etc.
6. Identify each item as thermal, electrical, or electrical/thermal in nature.
7. Apportion the electrical/thermal items.
8. Using the thermal items calculate the production cost for steam. The remaining electrical costs will become part of PSE&G electrical rate base and treated separately.

APPENDIX E

(3.5.1 c3)

VALUE OF ELECTRIC ENERGY

SEE APPENDIX V, TABLE 3,
page 2.

APPENDIX F

(3.6.1 c5)

CUSTOMER ENERGY USE
ANALYSIS

3.5.1-c.5

TRENTON ICES

CUSTOMER ENERGY-USE ANALYSIS

Subsequent to the most recent series of meetings, a careful evaluation was made of the potential steam sales to the Demonstration Community. As can be seen from the accompanying exhibit, this total is $194,936 \times 10^3$ pounds per hour. This differs from the ICES plant output by two factors. The first is distribution losses and secondly two different computational techniques were used to evaluate these steam flows.

In the case of ICES a computer modeling technique was used for each building, as explained earlier. Customer steam sales are based on actual energy use figures for existing buildings and computer simulation for new buildings.

TRENTON ICES
POTENTIAL STEAM SALES (10³ POUNDS) *

<u>Customer</u>	<u>Total</u>	<u>Max. Winter Month</u>	<u>Max. Summer Month</u>	<u>Avg. Month</u>
Mercer County	17,681	3,602	1,263	1,473
State of N. J.				
Health & Agri.		844	0	-
Dept. of Education		1,568	0	-
Labor & Industry		3,271	552	-
Cultural Center		2,888	0	-
State House		7,104	0	-
Total	77,490	-	-	6,458
DEP	6,657	768	1,018	555
Justice Dept.	27,941	2,829	4,861	2,328
Kingsbury Corp. I	27,405	4,008	2,732	2,284
II	12,066	2,599	0	1,006
Capital Place Assoc.				
I & II	8,837	1,443	855	736
City of Trenton				
Civic Center	14,236	1,900	1,904	1,186
Luther Arms	<u>2,623</u>	<u>466</u>	<u>0</u>	<u>219</u>
Total	194,936	33,290	13,185	16,245

*Enthalpy of 1,000 Btu/pound assumed.

CUSTOMER SALES

Preference theory prevails in a businessman's choice of energy systems as well as in an individual's choices regarding purchase of consumer goods. It may appear clear to the layman that an energy system which is guaranteed of supply and represents the lowest life-cycle cost alternative would represent the first choice. Many elements impact on the decision process, however. The ICES team, represented by PSE&G further qualified the prospective "customers" (Demonstration Community).

Ultimately qualification consists of approaching a prospective customer with a preliminary price for thermal energy and convincing him that the price and the associated investment in appurtenances and maintenance costs represent a worthwhile investment. In the case of a new structure, that task is simplified based on the fact that the customer must choose an energy system. However, an existing structure, with an existing energy system is not faced with the dilemma of energy choice. In the case of the existing system, the customer must be convinced that it is worthwhile for him to initiate an action.

This is further complicated by the financial systems utilized by the operator or owner of the facilities. Ability to finance capital vs. sustaining additional operating cost is another important element of preference.

PSE&G has developed a computer program (copy included in this section) which will act as the basis for a model used to assist customers in evaluating the adoption of ICES as a preferable energy source. The program addresses three elements of cost.

1. Yearly operating costs, maintenance costs and taxes which are extended into a series and then returned to present worth using a string solution (present worth of all future costs).
2. Long-Term Capital costs relating to the structure are evaluated in terms of a specific debt service.
3. Short-Term Capital costs relating to the energy system are evaluated in a different debt service including considerations for multiple replacement and salvage.

A careful analysis of customer costs of producing on-site thermal energy has been conducted using both this computer model and more classical conventional techniques. The results which include consideration for use of absorption air conditioning rather than electric by certain customers demonstrate a predicted difference in average steam costs for existing (including buildings under

final design or construction) as opposed to new buildings. This is based on the new buildings having an option of alternate systems and being able to benefit from certain capital cost savings. These cost savings result from the following formula.

$$\text{SAVE} = (\text{BOILER COST} + \text{ELECTRIC A/C COST} + \text{DIFF. ELEC. LOAD CNTR. COST}) - \text{ABS. A/C COST}$$

The results show, that based on 1978 dollars, customer production costs range between \$5.02 as a low for existing buildings to \$7.87 for new buildings. Competitive ICES steam rates, to insure sales to all members of the Demonstration Community, should accommodate the low range of \$5.02 to \$5.62. One existing (Pre. 1982) customer who will replace an electric immersion boiler with ICES steam shows a production cost of \$6.98.

Competitive Range

Based on these discussions with customers and careful analysis, PSE&G has determined the "acceptable range" of thermal energy cost. The actual ranges were not quoted by the customers but were calculated from information gathered in meetings, as detailed above. The term acceptable range is not entirely applicable since the customer will always be willing to pay a lower price, but not higher than quoted. The maximum most customers would pay for steam based on a weighted average cost is approximately \$5.51 per 1,000 pounds. Rates as low as \$5.02 will be necessary to entice all customers and one customer would pay as much as \$7.87.

TRENTON ICES
ASSUMPTIONS USED IN CUSTOMER
LIFE CYCLE COST ANALYSIS

Cost of Money	- 10.4%
Levelized Cost of Fuel	- #6 \$6.57/MMBtu (1982) Electric (1.5023 multiplier)
Actual Cost of Fuel	- #2 \$ 2.80/MMBtu #6 3.15/MMBtu (1978 low \$16.80/Barrel (1978) high 18.90/Barrel
Rates of Inflation	- 5.8% #6 Oil 4.5% Electric (Future worth in 1981 for 1978 costs is 1.14) (1.7469 Multiplier)
Carrying Charges	- 12.7% 6.0% on-maintenance 5% on equipment

LIST

CG-LIFECYCLE 10:56:04 9 MAR 78

```
10 PRINT 'THE PURPOSE OF THIS PROGRAM IS TO EVALUATE'
20 PRINT 'ENERGY USE SYSTEMS BY A LIFE CYCLE COST APPROACH'
21 PRINT
22 PRINT
30 PRINT 'ENERGY SYSTEMS FREQUENTLY INVOLVE ONE OR MORE OF THE'
31 PRINT 'FOLLOWING CAPITAL COSTS'
32 PRINT '    INSULATION'
33 PRINT '    BOILERS AND HEAT EXCHANGERS'
34 PRINT '    ELECTRICAL DISTRIBUTION'
35 PRINT '    SPACE'
36 PRINT '    STACKS'
37 PRINT '    FUEL STORAGE'
38 PRINT '    CONTROLS'
40 PRINT 'CAPITAL COST COMPONENTS ARE DIVIDED INTO BOTH LONG AND'
41 PRINT 'SHORT TERM'
42 PRINT 'LONG TERM CAPITAL COST REFERS TO THOSE ASSOCIATED WITH'
43 PRINT 'THE BUILDING STRUCTURE'
50 PRINT 'WHAT IS THE INTEREST RATE IN DECIMAL FORM'
51 PRINT 'OF THE LONG TERM CAPITAL COSTS'
60 INPUT I1
70 PRINT 'WHAT IS THE LONG TERM CAPITAL COST'
75 INPUT C1
80 PRINT 'SHORT TERM CAPITAL COST REFERS TO THOSE ASSOCIATED'
81 PRINT 'WITH THE ENERGY SYSTEM'
82 PRINT 'WHAT IS THE EXPECTED LIFE OF THE SYSTEM'
85 INPUT L2
90 PRINT 'WHAT IS THE INTEREST RATE OF THE SHORT TERM COSTS'
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100 PRINT 'WHAT IS THE COST'
110 INPUT C2

180 PRINT 'PROPERTY TAXES ARE BASED ON THE TOTAL CAPITAL COST'
185 PRINT 'WHAT IS THE EFFECTIVE TAX RATE IN %/100'
190 INPUT T1
191 T1=T1*(C1+C2)

200 PRINT 'ENERGY SYSTEMS FREQUENTLY INVOLVE ONE OR MORE OF THE'
210 PRINT 'FOLLOWING MAINTENANCE COSTS'
220 PRINT '    OPERATION OF PUMPS AND BURNERS'
221 PRINT '    ATOMIZATION'
222 PRINT '    FUEL HEATING AND TRACING'
223 PRINT '    WATER TREATMENT'
224 PRINT '    OPERATING ENGINEERS'
225 PRINT '    SYSTEM MAINTENANCE'
230 PRINT 'WHAT ARE THE ANNUAL MIANTENANCE COSTS'
240 INPUT M

250 PRINT 'WHAT IS THE CONVERSION OR INSTALLATION COST'
260 INPUT V1
261 C2=C2+V1
262 C9=C1+C2

270 PRINT 'WHAT IS THE INSURANCE COST'
280 INPUT V2

290 PRINT 'WHAT IS THE TOTAL ANNUAL ENERGY COST'
291 PRINT 'FOR ALL ENERGIES'
295 INPUT E1

300 PRINT 'WHAT IS THE INFLATION RATE IN DECIMAL FORM FOR ENERGY'
301 INPUT I5
302 PRINT 'WHAT IS THE INFLATION RATE FOR THE REMAINING OPERATING COSTS'
303 INPUT I4
380 O1=T1+M+V2
393 PRINT

```

395 PRINT 'RESULTS OF THE ANALYSIS ARE'

396 PRINT 'YEARS LONG TERM SHORT TERM OPERATING TOTAL'

397 PRINT '-----

398 P8=0

399 P4=0

400@LONG TERM CAPITAL COSTS ARE CAPITALIZED

401 FOR N=0 TO L2 STEP 1

408 P1=0

409 P9=0

410 $P1 = C1 + (C1 * I1) * ((1 + I1)^N - 1) / (I1 * (1 + I1)^N)$

430 $P2 = C2 + (C2 * I2) * ((1 + I2)^N - 1) / (I2 * (1 + I2)^N)$

431 IF P2 >= 0 GO TO 440

432 P2=0

440 P9=P2+P1

700@ TOTAL ALL COSTS AND FIND PRESENT WORTH OF OPERATING COSTS

710 $P8 = P8 + E1 * (1 + I5)^N / (1 + I2)^N$

720 $P4 = P4 + O1 * (1 + I4)^N / (1 + I2)^N$

724 P7=P4+P8

725 O9=P9+P7

729 PRINT N; 'P1'; 'P2'; 'P7'; 'O9'

730 NEXT N

770 PRINT

1990 STOP

1991 END

TRENTON ICES
ANNUAL COMPETITIVE
EQUIVALENT STEAM COST
(CONVENTIONAL SYSTEM)

<u>Customer</u>	<u>10³ Pounds Steam</u>	<u>Barrels Oil</u>	<u>kWh</u>	<u>Cost</u>	<u>Capital Cost*</u>	<u>Maintenance</u>	<u>Reduction in Operating Engineers</u>
Mercer County	17,681	4,802	-	\$ -	\$ -	\$ 2,912	\$ -
N. J. State House and LI/HA	77,490	20,500	-	-	-	12,760	56,400
DEP	6,657	848	256,500	15,377	105,040	1,096	18,800
Justice Department	27,941	7,318	-	-	-	4,601	-
Kingsbury I	27,405	7,500	-	-	-	4,513	-
Kingsbury II	12,066	3,160	-	-	-	1,987	-
Capital Place	8,837	1,583	45,670	17,318	220,415	1,455	-
Civic Center	14,236	2,203	436,545	32,625	223,275	2,344	18,800
Luther Arms	<u>2,623</u>	<u>-</u>	<u>430,792</u>	<u>17,879</u>	<u>-</u>	<u>432</u>	<u>-</u>
Total	<u>194,936</u>	<u>47,914</u>	<u>1,169,507</u>	<u>\$83,199</u>	<u>\$548,730</u>	<u>\$32,100</u>	<u>\$94,000</u>

*Includes Amortization of Related Excess
Capital for new buildings and overheads.

TRENTON ICES
ANNUAL COMPETITIVE
EQUIVALENT STEAM COST
(CONVENTIONAL SYSTEM)

Customer	1978 Average Competitive Energy Cost \$/10 ³ Pounds	1982 Levelized Cost \$/10 ³ Pounds	1978 Steam Operating Cost \$/10 ³ Pounds	Raw Energy Cost 1978		1982 Levelized	Equivalent 10 ³ Pounds Steam**
				Low	High		
Mercer County	5.02	11.05	4.73-5.30	\$ 80,674	\$ 90,758	\$189,295	17,681
N. J. State House and LI/HA	5.62	12.28	5.34-5.89	344,400	387,450	808,110	77,490
DEP	6.05	11.06	4.41-4.87	29,623	31,404	59,763	10,542
Justice Department	4.85	10.67	4.57-5.12	122,942	138,310	288,476	27,941
Kingsbury I	5.05	11.13	4.76-5.34	126,000	141,750	295,650	27,405
Kingsbury II	4.84	10.67	4.56-5.11	53,088	59,724	124,567	12,066
Capital Place	7.87	13.38	3.17-3.55	43,912	47,237	92,061	9,528
Civic Center	5.83	10.53	4.09-4.41	69,635	74,262	142,716	20,849
Luther Arms	<u>6.98</u>	<u>12.02</u>	<u>-</u>	<u>17,879</u>	<u>17,879</u>	<u>30,620</u>	<u>2,623</u>
Total	<u>-</u>	<u>-</u>	<u>-</u>	<u>\$ -</u>	<u>\$ -</u>	<u>\$ -</u>	<u>206,125</u>

Weighted Average Cost Per 10³ Pounds (1978) = \$5.51

**Assumed Electric A/C 4.44 times more efficient than absorption.

COMMUNITY LOAD PROFILES

The following load profiles represent computer simulations of the thermal use and, where possible, empirical data for electrical use/demand. Each Demonstration Community building is included. In some cases where absorption cooling would be used for ICES and electric vapor compression without, two sheets are included depicting those alternates.

*Existing

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Convetional System (No ICES)

☒ For ICES System

Building Name State House Complex (State House, Annex & War Memorial)

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Office

Floor Area (Gross) 513,300 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting		
Base Power		
Air Conditioning		
Space Heating		
itchen/Laundry		
Computer		
Total	3,263	2,239

AIR CONDITIONING DEMAND DATA

Design Heat Gain - MBtu

Tons-Electric 2x225 plus window units* Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 17,000 MBtu

Net Occupied Heat Loss 17,000 MBtu

KW - Connected Electric Heating -

BUILDING OCCUPANCY

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.
m-5pm Wkdays	100		68
All Others	0		68

ELECTRICAL ENERGY DATA

Month	Max. DkW Day	Max. DkW Night	Day	Night
	8:00 a.m. - 8:00 p.m.	8:00 a.m. - 8:00 p.m.	kWh	kWh
January	2,016	less than day	676,800	204,393
February	1,909		753,600	231,420
March	1,879		633,600	203,957
April	1,877		657,600	215,897
May	2,566		624,000	173,855
June	2,851		787,200	189,436
July	3,079		878,400	214,361
August	3,263		998,400	269,648
September	3,028		739,200	199,584
October 15	2,586		600,000	150,811
October 15-31	-		-	-
November	2,239		580,800	162,586
December	1,898		619,200	193,766

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

Month	MBtu/Month *
January	7,104
February	5,903
March	4,832
April	1,923
May	
June	
July	
August	
September	
October 15	
October 15-31	1,635
November	4,217
December	6,473

*Dom. H. W. not included.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Convventional System (No ICES)

☒ For ICES System

Building Name Cultural Center (LIB, AUD, MUS, & PLAN)

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Library, Auditorium, Museum, Planatorium

Floor Area (Gross) 192,425 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting		
Base Power		
Air Conditioning		
Space Heating		
itchen/Laundry		
Computer		
Total	Included in State House	

AIR CONDITIONING DEMAND DATA

Design Heat Gain	-	MBtu
Tons-Electric	2x250	Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss	7,000	MBtu
Net Occupied Heat Loss	7,000	MBtu
KW - Connected Electric Heating	-	

BUILDING OCCUPANCY (See attached sheet)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	<u>Included in State House</u>		<u> </u>	<u> </u>
February	<u> </u>	<u> </u>	<u> </u>	<u> </u>
March	<u> </u>	<u> </u>	<u> </u>	<u> </u>
April	<u> </u>	<u> </u>	<u> </u>	<u> </u>
May	<u> </u>	<u> </u>	<u> </u>	<u> </u>
June	<u> </u>	<u> </u>	<u> </u>	<u> </u>
July	<u> </u>	<u> </u>	<u> </u>	<u> </u>
August	<u> </u>	<u> </u>	<u> </u>	<u> </u>
September	<u> </u>	<u> </u>	<u> </u>	<u> </u>
October 15	<u> </u>	<u> </u>	<u> </u>	<u> </u>
October 15-31	<u> </u>	<u> </u>	<u> </u>	<u> </u>
November	<u> </u>	<u> </u>	<u> </u>	<u> </u>
December	<u> </u>	<u> </u>	<u> </u>	<u> </u>

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month*</u>
January	<u>2,888</u>
February	<u>2,430</u>
March	<u>2,033</u>
April	<u>900</u>
May	<u>-</u>
June	<u>-</u>
July	<u>-</u>
August	<u>-</u>
September	<u>-</u>
October 15	<u>-</u>
October 15-31	<u>736</u>
November	<u>1,794</u>
December	<u>2,647</u>

*Dom. H. W. not included.

OCCUPANCY PROFILE FOR CULTURAL CENTER

	<u>Seculday</u>	<u>Saturday</u>	<u>Sunday</u>
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	38	38	0
9	79	38	0
10	79	58	20
11	79	58	20
12	79	58	20
13	100	80	42
14	79	80	42
15	79	80	42
16	79	58	20
17	60	0	
18	38	0	
19	0	0	
20	0	0	
21	0	0	
22	0	0	
23	0	0	
24	0	0	

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Conventional System (No ICES)☐ For ICES SystemBuilding Name Department of EducationNew ☐ Existing (Pre. 1980) ☒Type of Use/Occupancy OfficesFloor Area (Gross) 89,800 Square Feet

ELECTRICAL DEMAND DATA

Summer Demand
(kW)Winter Demand
(kW)

Lighting

Base Power

Air Conditioning

Space Heating

Kitchen/Laundry

Computer

Total

Included in State House

AIR CONDITIONING DEMAND DATA

Design Heat Gain - MBtuTons-Electric 1x500* Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 3,000 MBtuNet Occupied Heat Loss 3,000 MBtuKW - Connected Electric Heating -

BUILDING OCCUPANCY

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.
am-5pm Wkdays	100	75	72
All Other	0		72

ELECTRICAL ENERGY DATA

Month	Max. DkW Day	Max. DkW Night	Day kWh	Night kWh
	8:00 a.m. - 8:00 p.m.	8:00 a.m. - 8:00 p.m.		
January	Included in State House			
February				
March				
April				
May				
June				
July				
August				
September				
October 15				
October 15-31				
November				
December				

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

Month	MBtu/Month**
January	1,568
February	1,346
March	1,145
April	579
May	-
June	-
July	-
August	-
September	-
October 15	-
October 15-31 1-14	433
November	1,023
December	1,461

**Dom. H. W. not included.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Conventional System (No ICES)☒ For ICES SystemBuilding Name Health and AgricultureNew ☐ Existing (Pre. 1980) ☒Type of Use/Occupancy Office and LaboratoriesFloor Area (Gross) 144,000 Square Feet

ELECTRICAL DEMAND DATA

Summer Demand
(kW)Winter Demand
(kW)

Lighting

Base Power

Air Conditioning

Space Heating

Kitchen/Laundry

Computer

Total

1,953

1,903

AIR CONDITIONING DEMAND DATA

Design Heat Gain - MBtuTons-Electric 2x750*Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 9,000 MBtuNet Occupied Heat Loss 9,000 MBtuKW - Connected Electric Heating -

BUILDING OCCUPANCY

(See page D/1-10 of Phase I report)

<u>Time Period</u>	<u>% Occupancy</u>	<u>Indoor Summer Temp.</u>	<u>Indoor Winter Temp.</u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u>	<u>Max. DkW Night</u>	<u>Total</u>	
	<u>8:00 a.m. - 8:00 p.m.</u>	<u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u>	<u>Night</u>
			<u>kWh</u>	<u>kWh</u>
January	<u>1,899</u>	<u>less than day</u>	<u>535,050</u>	
February	<u>1,913</u>		<u>529,650</u>	
March	<u>1,903</u>		<u>555,300</u>	
April	<u>1,760</u>		<u>504,000</u>	
May	<u>1,760</u>		<u>626,400</u>	
June	<u>1,917</u>		<u>823,050</u>	
July	<u>1,953</u>		<u>900,900</u>	
August	<u>1,877</u>		<u>864,900</u>	
September	<u>1,769</u>		<u>612,450</u>	
October 15	<u>1,723</u>		<u>641,250</u>	
October 15-31	<u>-</u>		<u>-</u>	
November	<u>1,723</u>		<u>571,725</u>	
December	<u>1,723</u>		<u>571,725</u>	

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month*</u>
January	<u>3,271</u>
February	<u>2,792</u>
March	<u>2,554</u>
April	<u>1,644</u>
May	<u>528</u>
June	<u>504</u>
July	<u>552</u>
August	<u>504</u>
September	<u>528</u>
October 15	<u>240</u>
October 15-31	<u>1,090</u>
November	<u>2,245</u>
December	<u>3,087</u>

*Dom. H. W. not included.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Conventional System (No ICES)☒ For ICES SystemBuilding Name Labor and IndustryNew ☐ Existing (Pre. 1980) ☒Type of Use/Occupancy OfficeFloor Area (Gross) 300,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting		
Base Power		
Air Conditioning		
Space Heating		
Kitchen/Laundry		
Computer		
Total	3,372	2,628

AIR CONDITIONING DEMAND DATA

Design Heat Gain - MBtuTons-Electric 2x965* = 1x200*Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 3,000 MBtuNet Occupied Heat Loss 3,000 MBtuKW - Connected Electric Heating -

BUILDING OCCUPANCY

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

Month	Max. DkW Day	Max. DkW Night	Total	
	8:00 a.m. - 8:00 p.m.	8:00 a.m. - 8:00 p.m.	Day kWh	Night kWh
January	2,208	less than day	873,600	
February	2,052		760,800	
March	2,172		792,000	
April	2,016		712,800	
May	3,108		822,000	
June	3,192		928,800	
July	3,372		1,088,400	
August	3,276		1,086,000	
September	2,928		807,600	
October 15	2,748		758,400	
October 15-31	-		-	
November	2,628		740,400	
December	2,088		817,200	

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

Month	MBtu/Month*
January	844
February	671
March	471
April	187
May	-
June	-
July	-
August	-
September	-
October 15	-
October 15-31	142
November	410
December	742

*Dom. H. W. not included.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Conventional System (No ICES)

☒ For ICES System

Building Name Justice Department

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Courtrooms and offices

Floor Area (Gross) 800,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting		
Base Power		
Air Conditioning		
Space Heating		
itchen/Laundry		
Computer		
Total	1,680	1,680

AIR CONDITIONING DEMAND DATA

Design Heat Gain 19,000 MBtuh

Tons-Electric - Tons-Absorption 1,585

HEATING DEMAND DATA

Design Heat Loss 12,000 MBtu

Net Occupied Heat Loss 12,000 MBtu

KW - Connected Electric Heating 0

BUILDING OCCUPANCY (See D/1-6 and D/1-7 of Phase I Report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	1,680	1,160	513,390	168,110
February				
March				
April				
May				
June				
July				
August				
September				
October 15				
October 15-31				
November				
December				

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>M MBtu/Month*</u>
January	2,829
February	2,264
March	1,735
April	564
May	1,194
June	3,402
July	4,602
August	4,861
September	1,960
October 15	324
October 15-31	478
November	1,283
December	2,445

*Dom. H. W. not included.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☐ For Conventional System (No ICES)

☒ For ICES System

Building Name DEP

New ☒ Existing (Pre. 1980) ☐

Type of Use/Occupancy Office

Floor Area (Gross) 250,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	565	565
Base Power	220	220
Air Conditioning	-	-
Space Heating	-	-
itchen/Laundry	-	-
Computer	50	50
Total	835	835

AIR CONDITIONING DEMAND DATA

Design Heat Gain 4,000 MBtu

Tons-Electric - Tons-Absorption 335

HEATING DEMAND DATA

Design Heat Loss 3,000 MBtu

Net Occupied Heat Loss 3,000 MBtu

KW - Connected Electric Heating -

BUILDING OCCUPANCY (See page D/1-6 of Phase I report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	835	784	242,250	135,120
February				
March				
April				
May				
June				
July				
August				
September				
October 15				
October 15-31				
November				
December				

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month*</u>
January	768
February	625
March	440
April	187
May	255
June	714
July	989
August	1,018
September	396
October 15	48
October 15-31	137
November	397
December	683

*Dom, H. W. not included.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Convventional System (No ICES)

☐ For ICES System

Building Name DEP

New ☒ Existing (Pre. 1980) ☐

Type of Use/Occupancy Office

Floor Area (Gross) 250,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	565	565
Base Power	220	220
Air Conditioning	300	-
Space Heating	-	-
itchen/Laundry	-	-
Computer	50	50
Total	1,135	835

AIR CONDITIONING DEMAND DATA

Design Heat Gain 4,000 MBtu

Tons-Electric 335 Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 3,000 MBtu

Net Occupied Heat Loss 3,000 MBtu

KW - Connected Electric Heating -

BUILDING OCCUPANCY (See page D/1-6 of Phase I Report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	835	784	242,250	135,120
February	835	784	242,250	135,120
March	835	784	242,250	135,120
April	835	784	242,250	135,120
May	1,135	1,084	255,000	141,495
June	1,135	1,084	279,300	151,620
July	1,135	1,084	294,225	157,320
August	1,135	1,009	296,175	157,545
September	1,135	1,009	263,250	143,820
October 08 1-14	1,060	934	244,950	136,020
October 15-31	835	784	242,250	135,120
November	835	784	242,250	135,120
December	835	784	242,250	135,120

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month</u>
January	768
February	625
March	440
April	187
May	-
June	-
July	-
August	-
September	-
October 15	-
October 15-31	137
November	397
December	683

ICES DEMONSTRATION COMMUNITY

no sheets required for each building.

☒ For Convventional System (No ICES)

☒ For ICES System

Building Name Kingsburg I

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Residential

Floor Area (Gross) 254,500 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting		
Base Power		
Air Conditioning		
Space Heating		
itchen/Laundry		
Computer		
Total	588	630

AIR CONDITIONING DEMAND DATA

Design Heat Gain - MBtu

Tons-Electric - Tons-Absorption 700*

HEATING DEMAND DATA

Design Heat Loss 6,000 MBtu

Net Occupied Heat Loss 6,000 MBtu

KW - Connected Electric Heating 165

BUILDING OCCUPANCY (See page D/1-4 of Phase I report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Total</u> <u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	324	less than day	227,200	112,000
February	606		221,200	107,600
March	630		190,200	93,000
April	558		195,600	96,600
May	306		163,000	81,000
June	588		235,200	114,600
July	588		287,400	139,200
August	570		273,000	135,600
September	510		212,400	107,400
October 15	366		173,400	84,000
October 15-31	-		-	-
November	312		184,200	89,400
December	336		183,000	88,800.

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month*</u>
January	2,541
February	2,122
March	1,770
April	746
May	385
June	1,223
July	1,633
August	1,732
September	676
October 15	119
October 15-31	607
November	1,476
December	2,345

*Dom. H. W. not included

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Conventional System (No ICES)

☒ For ICES System

Building Name Kingsbury II

New ☒ Existing (Pre. 1980) ☐

Type of Use/Occupancy Low Rise Residential

Floor Area (Gross) 200,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	280	280
Base Power	250	250
Air Conditioning	-	-
Space Heating	-	-
itchen/Laundry	-	-
Computer	-	-
Total	530	530

AIR CONDITIONING DEMAND DATA

Design Heat Gain no air conditioning MBtu

Tons-Electric 0 Tons-Absorption 0

HEATING DEMAND DATA

Design Heat Loss 6,000 MBtu

Net Occupied Heat Loss 6,000 MBtu

KW - Connected Electric Heating 0

BUILDING OCCUPANCY

(See page D/1-3 of Phase I report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

Individually metered apartments
ten house meters.

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	220	430	53,000	36,350
February				
March				
April				
May				
June				
July				
August				
September				
October 15				
October 15-31				
November				
December				

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month</u>
January	2,599
February	2,192
March	1,892
April	778
May	
June	
July	
August	
September	
October 15	
October 15-31	633
November	1,583
December	2,389

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Convventional System (No ICES)☒ For ICES SystemBuilding Name Mercer County Court House/Detention CenterNew ☐ Existing (Pre. 1980) ☒Type of Use/Occupancy Prison, officesFloor Area (Gross) 290,000 Square Feet-----
ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	_____	_____
Base Power	_____	_____
Air Conditioning	_____	_____
Space Heating	_____	_____
itchen/Laundry	_____	_____
Computer	_____	_____
Total	<u>472</u>	<u>206</u>

AIR CONDITIONING DEMAND DATADesign Heat Gain - MBtuTons-Electric 225* Tons-Absorption ------
HEATING DEMAND DATADesign Heat Loss 6,000 MBtuNet Occupied Heat Loss 6,000 MBtuKW - Connected Electric Heating _____

BUILDING OCCUPANCY

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	255	less than day	68,670	42,330
February	255		68,670	42,330
March	255		68,670	42,330
April	255		68,670	42,330
May	420		82,045	46,270
June	472		101,190	54,790
July	472		108,930	59,910
August	432		112,080	59,515
September	420		88,470	49,415
October 15	367		73,650	43,645
October 15-31	-		-	-
November	255		68,670	42,330
December	255		68,670	42,330

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month</u>
January	3,602
February	3,239
March	3,168
April	2,219
May	1,125
June	1,168
July	1,256
August	1,263
September	1,114
October 15	446
October 15-31	1,436
November	2,978
December	3,562

Includes A/C, kit., and laundry.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Convventional System (No ICES)

☐ For ICES System

Building Name Capital I/II

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Office

Floor Area (Gross) 153,000/160,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	394	394
Base Power	156	156
Air Conditioning	600	-
Space Heating	-	-
itchen/Laundry	-	-
Computer	50	50
Total	1,200	600

AIR CONDITIONING DEMAND DATA

Design Heat Gain 8,000 MBtu

Tons-Electric 667 Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 5,000* MBtu

Net Occupied Heat Loss 5,000* MBtu

KW - Connected Electric Heating -

BUILDING OCCUPANCY (See page D/1-5 of Phase I Report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA *

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	600	570	178,290	102,830
February	600	570	178,290	102,830
March	600	570	178,290	102,830
April	600	570	178,290	102,830
May	1,125	720	202,665	106,805
June	1,200	720	253,740	113,555
July	1,200	795	282,690	119,255
August	1,125	795	290,490	119,330
September	1,125	720	221,340	109,055
October 1-5 1-14	975	720	183,540	103,505
October 15-31	600	570	178,290	102,830
November	600	570	178,290	102,830
December	600	570	178,290	102,830

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month*</u>
January	1,443
February	1,153
March	891
April	292
May	-
June	-
July	-
August	-
September	-
October 15	-
October 15-31	276
November	746
December	1,244

*Includes Capital Place Comm. A/C and heat.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☐ For Conventional System (No ICES)

☒ For ICES System

Building Name Capital Place I/II

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Office

Floor Area (Gross) 153,000/160,000 Square Feet

ELECTRICAL DEMAND DATA

Summer Demand
(kW)

Winter Demand
(kW)

Lighting

Base Power

Air Conditioning

Space Heating

Kitchen/Laundry

Computer

Total

900

600

AIR CONDITIONING DEMAND DATA

Design Heat Gain 8,000 MBtu

Tons-Electric 335

Tons-Absorption 335

HEATING DEMAND DATA

Design Heat Loss 5,000 MBtu

Net Occupied Heat Loss 5,000 MBtu

KW - Connected Electric Heating

BUILDING OCCUPANCY

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	600	less than day	178,290	102,830
February	600		178,290	102,830
March	600		178,290	102,830
April	600		178,290	102,830
May	825		198,000	104,000
June	900		249,000	111,000
July	900		278,000	117,000
August	825		276,000	117,000
September	825		216,300	107,000
October 15	675		183,500	103,500
October 15-31	-		-	-
November	600		178,290	102,830
December	600		178,290	102,830

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month</u>
January	1,443
February	1,153
March	891
April	292
May	190
June	575
July	805
August	855
September	327
October 15	40
October 15-31	276
November	746
December	1,244

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☐ For Convnetional System (No ICES)

☒ For ICES System

Building Name Civic Center

New ☒ Existing (Pre. 1980) ☐

Type of Use/Occupancy Exhibits/Functions

Floor Area (Gross) 100,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	200	200
Base Power	25	25
Air Conditioning	-	-
Space Heating	-	-
itchen/Laundry	-	-
Computer	-	-
Total	225	225

AIR CONDITIONING DEMAND DATA

Design Heat Gain 12,000 MBtu

Tons-Electric - Tons-Absorption 1,000

HEATING DEMAND DATA

Design Heat Loss 5,000 MBtu

Net Occupied Heat Loss 5,000 MBtu

KW - Connected Electric Heating

BUILDING OCCUPANCY (See page C/1-8 of Phase I report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	225	225	65,615	22,160
February				
March				
April				
May				
June				
July				
August				
September				
October 15				
October 15-31				
November				
December				

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month *</u>
January	1,900
February	1,532
March	1,276
April	520
May	240
June	1,237
July	1,728
August	1,904
September	659
October 15	55
October 15-31	446
November	1,070
December	1,669

*Dom. H. W. not included.

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Convventional System (No ICES)

☐ For ICES System

Building Name Civic Center

New ☒ Existing (Pre. 1980) ☐

Type of Use/Occupancy Exhibits/Functions

Floor Area (Gross) 100,000 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	200	200
Base Power	25	25
Air Conditioning	900	-
Space Heating	-	-
itchen/Laundry	-	-
Computer	-	-
Total	1,125	225

AIR CONDITIONING DEMAND DATA

Design Heat Gain 12,000 MBtu (Includes War Mem. Aud.)

Tons-Electric 1,000 Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 5,000 MBtu

Net Occupied Heat Loss 5,000 MBtu

KW - Connected Electric Heating -

BUILDING OCCUPANCY (See page D/1-8 of Phase I Report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>

ELECTRICAL ENERGY DATA

(Includes War Memorial A/C)

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	225	225	65,615	22,130
February	225	225	65,615	22,130
March	225	225	65,615	22,130
April	225	225	65,615	22,130
May	825	675	82,565	23,210
June	1,125	1,050	142,940	37,610
July	1,050	900	172,715	44,660
August	975	750	184,640	45,935
September	825	675	107,315	29,885
October 15 1-14	600	225	69,740	22,160
October 15-31	225	225	65,615	22,160
November	225	225	65,615	22,160
December	225	225	65,615	22,160

THERMAL ENERGY DATA

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month</u>
January	1,900
February	1,532
March	1,276
April	520
May	-
June	-
July	-
August	-
September	-
October 15 1-14	-
October 15-31	446
November	1,070
December	1,669

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

Customer will use internal source heat pumps and replace electric boilers with steam.

☐ For Convventional System (No ICES)

☒ For ICES System

Building Name Luther Arms (150 units)

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Residential

Floor Area (Gross) 91,500 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting , Appl. & basepower	150	150
Base Power	-	-
Air Conditioning	-	-
Space Heating	-	97
itchen/Laundry	-	-
Computer	-	-
Total	150	247

AIR CONDITIONING DEMAND DATA Will use heat pumps.

Design Heat Gain 1,000 MBtu

Tons-Electric 85 Tons-Absorption -

HEATING DEMAND DATA (Including domestic hot water.)

Design Heat Loss 1,562 MBtu

Net Occupied Heat Loss 1,562 MBtu

KW - Connected Electric Heating 161

BUILDING OCCUPANCY (See page D/1-4 of Phase I report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.
24 hours	100		

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	245	less than day	51,803	37,835
February	243		50,120	36,610
March	221		47,720	34,210
April	210		43,620	30,110
May	275		41,670	27,635
June	225		45,195	26,135
July	225		47,745	26,435
August	225		50,745	26,360
September	241		42,720	26,460
October 15	195		42,870	29,360
October 15-31				
November	221		46,570	33,060
December	239		50,270	36,760

THERMAL ENERGY DATA

(Excludes Demand Credit)

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month</u>
January	466
February	404
March	425
April	279
May	
June	
July	
August	
September	
October 15	
October 15-31	191
November	411
December	447

ICES DEMONSTRATION COMMUNITY

Two sheets required for each building.

☒ For Conventional System (No ICES)

☐ For ICES System

Building Name Luther Arms

New ☐ Existing (Pre. 1980) ☒

Type of Use/Occupancy Residential

Floor Area (Gross) 91,500 Square Feet

ELECTRICAL DEMAND DATA

	Summer Demand (kW)	Winter Demand (kW)
Lighting	150	150
Base Power	-	-
Air Conditioning	75	-
Space Heating	-	275
Kitchen/Laundry	-	-
Computer	-	-
Total	225	425

AIR CONDITIONING DEMAND DATA

Design Heat Gain 1,000 MBtu

Tons-Electric 85 Tons-Absorption -

HEATING DEMAND DATA

Design Heat Loss 1,562 MBtu

Net Occupied Heat Loss 1,562 MBtu

KW - Connected Electric Heating 458

BUILDING OCCUPANCY See page D/1-4 of Phase I Report)

Time Period	% Occupancy	Indoor Summer Temp.	Indoor Winter Temp.
24 hours	100		

ELECTRICAL ENERGY DATA

<u>Month</u>	<u>Max. DkW Day</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Max. DkW Night</u> <u>8:00 a.m. - 8:00 p.m.</u>	<u>Day</u> <u>kWh</u>	<u>Night</u> <u>kWh</u>
January	420	less than day	80,620	67,110
February	415		77,170	63,660
March	355		70,320	56,810
April	320		80,020	66,585
May	290		52,020	38,285
June	264		52,195	33,435
July	264		54,745	33,360
August	264		57,745	32,760
September	264		50,820	34,460
October 15	278		56,570	43,060
October 15-31	-		-	-
November	350		66,870	53,360
December	400		77,170	63,660

THERMAL ENERGY DATA (Includes Demand Credit)

Includes domestic water but excludes electric heating and electric air conditioning.

<u>Month</u>	<u>MBtu/Month</u>
January	-
February	-
March	-
April	-
May	-
June	-
July	-
August	-
September	-
October 15	-
October 15-31	-
November	-
December	-

Domestic water = 39 kW, 14,000 kWh/mo.

APPENDIX G

(3.5.1 c6)

THERMAL SERVICE POLICY

C 6
3.5.1-c.4 Thermal Service Policy

The proposed Standard Terms and Conditions for Thermal Service, revised to include minor changes are included in this report. These Standard Terms define PSE&G's thermal service policy for ICES.

THIRD DRAFT

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

STANDARD TERMS AND CONDITIONS

FOR

THERMAL SERVICE

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

GENERAL OFFICES

80 PARK PLACE

NEWARK, NEW JERSEY 07101

Date of Issue:

Effective:

Issued by Everett L. Morris,
Senior Vice President - Customer Operations
80 Park Place, Newark, New Jersey 07101

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

STANDARD TERMS AND CONDITIONS

1. GENERAL

These Standard Terms and Conditions, filed as a part of the thermal service tariff of Public Service Electric and Gas Company, hereinafter referred to as "PSE&G," set forth 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 promise 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 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 appropriate Commercial Office of PSE&G in person or by mail. 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 failure 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. Change of Use: Subsequent to initial application, customer shall notify PSE&G in writing of any change in his use of service which might affect the cost, size or availability of service.

2.3. 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.

OBTAINING SERVICE (Continued)

All deposits shall bear simple interest at the rate of six percent per annum, payable at the time that the deposit is refunded to the 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 not 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.

- 2.4. Main Extensions: The customer may be required to make a deposit for the extension of thermal mains as set forth in Section 3 of these Standard Terms and Conditions.
- 2.5. Service Conditions: The customer may be required to make a contribution toward the cost of installing a service connection as set forth in Section 5 of these Standard Terms and Conditions.
- 2.6. Permits: PSE&G, where necessary, will make application for any street opening permits for installing its service connections and shall not be required to furnish service until

OBTAINING SERVICE (Continued)

after such permits are granted. The customer may be required to pay the municipal charge, 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.

- 2.7. Temporary Service: Where service is to be used at 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.

3. EXTENSION OF DISTRIBUTION MAINS

- 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 Statutes 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 an extension to serve an individual permanent residential customer does not exceed five times 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 years 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,

EXTENSION OF DISTRIBUTION MAINS (Continued)

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 the 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 to PSE&G for an 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 pursuant 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 or sale of land, but not as ultimate residents, PSE&G may require a deposit from the applicant covering

EXTENSION OF DISTRIBUTION MAINS (Continued)

the entire cost of the extension necessary 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 five times the estimated annual revenue from each such completion on said extension. If during a ten-year period following 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

EXTENSION OF DISTRIBUTION MAINS (Continued)

the total amount of the monthly bills rendered to and paid by the customer for 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 steam at a minimum pressure of 125 PSIG at the service valve on the customers premises. PSE&G does not guarantee the amount of superheat or the moisture content of the steam supplied.

At the request of the customer, service at less than 125 PSIG will be supplied via a pressure reducing station to be installed and maintained by PSE&G in the customer's premises. Metering of steam supply will still be used to establish an excess facilities charge. Such charge will be computed at a rate of 1.5% of the total additional cost of said appurtenances. The charge will be added to the customer's bill each month service is supplied.

5. SERVICE CONNECTIONS

5.1. General: The customer shall consult PSE&G as to the exact point at which the service pipe 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 pipe except where, in the judgment of PSE&G, its economic considerations; conditions on its distribution system; improvement of service conditions; or volume of the customer's requirements, make it desirable to install more than one service pipe.

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 50 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 50 feet, the service pipe 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 50 feet of service connection which

SERVICE CONNECTIONS (Continued)

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 50 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 \$50.00 or less.

The charge for the service connection shall be based on actual construction costs.

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

6. METERS AND ASSOCIATED EQUIPMENT

6.1. General: 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 judgment 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 ventilated, 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 or negligence of the customer or his agents or servants, or of failure to return equipment

METERS AND ASSOCIATED EQUIPMENT (Continued)

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 of piping or into any old system of 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.

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. The customers piping system shall be installed so as to provide for the return of all condensate to the Company's meter (and, at the Company's option, to its mains), and shall terminate at a point and in a manner satisfactory to the Company, for connection with its pipes or other apparatus.

The following equipment must be installed and maintained by the Customer in all cases:

- (a) A shut off valve.
- (b) A reducing and regulating valve adequate to reduce the steam pressure as it exists at the point of delivery, to the requisite pressure to serve the Customer.
- (c) An adequate steam trap to drain the condensate from the heating system.
- (d) Proper sewer connection, always available for use by the Company, of sufficient capacity to drain the entire condensate from the heating system into the sewer after it has passed through the Company's meter, including the necessary apparatus to reduce the temperature of all water sufficiently to comply with any law or ordinance, before it is allowed to flow into the sewer.

CUSTOMER'S INSTALLATION (Continued)

- 7.3. Utilization Apparatus: 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 customers 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.
- 7.4. 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.
- 7.5. Appliance Adjustments: PSE&G will not make any adjustments nor conduct any maintenance on customers' thermal appliances.
- 7.6. Adequacy and Safety of Installation: 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

CUSTOMER'S INSTALLATION (Continued)

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.

7.7. Quality of Condensate:

Condensate returned should be at least 90°F in temperature with a Ph of between 7.0 and 8.5. Conductivity should not exceed 500 micromhos and the solids may not exceed 50 microns in size.

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 1000 pounds use occurring in a 60 minute period, which average, if used continuously for 60 minutes, would produce the number of pounds of steam 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. Correction for Pressure: In any case where, pursuant to Section 4.3, PSE&G measures the energy delivered to a customer under pressure greater than that compensated for in the metering equipment, the energy registered by the meter or meters of PSE&G shall be subject to correction for billing purposes by the application of a proper correction factor.

METER READING AND BILLING (Continued)

- 8.3. 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.
- 8.4. 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.
- 8.5. Testing of Meters: At such times as PSE&G may deem proper, PSE&G will test its meters.
- 8.6. Billing Adjustments: Whenever a meter is found to be registering fast or slow by 5% or more, an adjustment of charges shall be made.
- 8.7. 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 provides 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.

METER READING AND BILLING (Continued)

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

- 8.8. 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 prorating is based. For temporary service accounts the minimum period for billing purposes shall be one month.
- 8.9. 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.
- 8.10. Billing of Changes 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.

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

8.12. Rate: Customer will be required to sign a contract for steam service. The terms and conditions of said contract shall reflect the specific operating characteristics and economic circumstances of the customer and the facilities required to supply thermal service.

9. LEAKAGE

Customer shall immediately give notice to PSE&G at its office of any escape of energy 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) non-payment of a valid bill due for service furnished at a present or previous location. However, non-payment 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 Public Service 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

DISCONTINUANCE OF SERVICE (Continued)

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.

- 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 \$100 will be made for restoration of service when service has been suspended or discontinued for nonpayment 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 discontinued 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 judgment, 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 Jersey.

Public Service 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.

3.5.1-c.6 Steam Rate Methodology

Steam rates would be determined using methodology similar to our present rate making practices for electric and gas service. That is, the pricing of steam service to customers would be cost based.

All of the capital equipment costs would be allocated to either the steam or electric utility by the planning engineers and the rate personnel working together. The allocation would be based on examining the functions and usage of each piece of equipment. Similarly, operating and maintenance expenses would be examined, functionalized and allocated.

Having the plant and expenses now functionalized to the steam utility, these costs would further be broken into customer, demand (lbs./hr.) and commodity (lbs.) components. These cost components would be directly translated into rates after adjusting for state and federal taxes and rate of return on the investment allocated to steam utility plant. Provision would be made to recover increases or decreases in steam cost production due to increases or decreases of raw materials needed for production.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
NEWARK, NEW JERSEY

CONTRACT FOR STEAM SERVICE

THIS AGREEMENT, made by and between Public Service Electric and Gas Company (hereinafter called the "Company"), and _____

(hereinafter called the "Customer"), whose premises are located at _____
in the City of Trenton.

WITNESSETH: That in consideration of the mutual covenants and agreements herein contained, the parties hereto contract and agree with each other as follows:

FIRST: That for and during the 25 year period commencing on and from the date on which the delivery of steam hereunder is actually begun, which, it is estimated, will be approximately the _____ day of _____, 19____, and ending on the _____ day of _____, 19____, the Company agrees to furnish to the Customer, and the Customer agrees to receive from the Company and to use and pay for, all steam that shall be required by the Customer for the operation of equipment located on the premises described above. Steam service so rendered shall be delivered to the Customer at a delivery point, more particularly described as the service valve located as follows:

The "contract capacity" shall be defined as the maximum demand

requested by customer which shall be _____.

SECOND: Steam service so rendered shall be billed by the Company and paid for by the Customer as follows:

1. Energy Charge:

(a) During the billing months of _____ through _____

First _____ lbs. per month @ _____ ¢ per 1,000 lbs.

Next _____ lbs. per month @ _____ ¢ per 1,000 lbs.

Over _____ lbs. per month @ _____ ¢ per 1,000 lbs.

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

First _____ lbs. per month @ _____ ¢ per 1,000 lbs.

Next _____ lbs. per month @ _____ ¢ per 1,000 lbs.

Over _____ lbs. per month @ _____ ¢ per 1,000 lbs.

(c) The bill calculated from the above shall be increased or decreased in the amount of _____ ¢ per 1,000 lbs. billed for every full _____ ¢ variation above or below _____ ¢ fuel related cost per 1,000 lbs. sold as determined by the fuel related cost for the month immediately preceeding the current billing period.

2. Demand Charge:

For the first _____ lbs. (or less) of billing demand _____ ¢ per lb.

For the next _____ lbs. of billing demand _____ ¢ per lb.

For the excess over _____ lbs. of billing demand _____ ¢ per lb.

An additional demand charge of \$ _____ per pound (or less) will be made for each pound of steam in excess of the contract capacity for the month in which that contract capacity is exceeded.

3. 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.

4. Service Charge:

There shall be a monthly service charge or credit per 1,000 lbs. of contract capacity for each month. Said service charge shall be computed as a function of fixed and variable operating, maintenance and labor charges (excluding fuel) incurred in operating the PSE&G thermal service system supplying steam to this location. The charge will be billed per 1,000 lbs. of steam as _____ for every _____ variation in those costs.

5. Condensate Credit:

For each full gallon of return condensate metered monthly at the service location there shall be a credit of \$_____ per gallon. Maximum condensate, in gallons, for which a credit will be made shall be equal to the total monthly steam use divided by 8.33. All condensate shall be clean and of acceptable Ph as detailed in the Standard Terms and Conditions for Thermal Service.

6. Terms of Payment:

Bills are due on presentation. The customer agrees to pay a 10% premium for any bills payed beyond 15 days after presentation.

7. Deposit:

As detailed in the standard terms and conditions the customer agrees to furnish a deposit of \$_____ upon completion of this contract.

These charges are subject to approval and revision by the New Jersey Board of Public Utilities.

THIRD: The Company shall be under no obligation to supply steam to any equipment other than that which is installed on the Customer's premises on the effective commencement date of this agreement, but may, at its option, decline to serve any such additional equipment when, in the opinion of the Company, capacity is not available either in the Company's steam generating equipment or its distribution mains. The Customer agrees that no additions to or alterations in existing equipment will be made unless and until the written consent of the Company has been first obtained.

FOURTH: This contract shall be binding upon the parties hereto, their successors and assigns (but the customers shall not assign any interest in this contract without the Company's prior written consent), and shall remain in full force and effect for the term stated herein, and is to be considered renewed for periods of one year and from year to year thereafter unless written notice to the contrary is given by either party to the other at least thirty (30) days prior to the date of beginning or any renewal thereof.

FIFTH: *The Customer hereby agrees to all of the terms and conditions set forth in detail in the standard terms and conditions which are hereby made an integral part of this agreement.*

IN WITNESS WHEREOF, the parties hereto have caused this contract to be executed in duplicate by their duly authorized officers in this the _____ day of _____, 19____.

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

By _____

Customer

By _____

Title _____

APPENDIX H

(3.5.1 c7)

CUSTOMER NEGOTIATIONS

3.5.1-c 7 Agreements

During each of the most recent customer meetings PSE&G requested prospective members of the Demonstration Community to again submit letters of intent. In contrast to previous negotiations, PSE&G is now conducting the negotiations itself, instead of allowing the City of Trenton to act on its behalf, as had been the case in Phase I.

Unfortunately, due to the sequence of design, analysis, final evaluation and cost determination, a final rate or cost could not be determined prior to the conclusion of Phase II. Letters received are therefore of necessity, as strong as our offer of supply. Firm commitments are impossible without proposed rates.

The letters which follow represent all those received to date.

ARCHITECTURE ENGINEERING PLANNING
A PROFESSIONAL CORPORATION

8116 OLD YORK ROAD, ELKINS PARK, PA. 19117 215 ME 5-7000

25 January 1978

P S E & G
80 Park Place
Room 2168A
Newark, New Jersey 07101

Attn: Clark W. Gellings

Re: Luther Arms
Steam heating

Dear Clark:

During our meeting of 23 January 1978, you requested the total hourly use of energy for heating where we could, at a future date use steam instead of electricity.

The following are heating requirements based on a maximum hourly usage:

Heat recovery unit (heating, ventilation, air)	550,000 BTU/hr
Domestic water heater	187,000 BTU/hr
Building heating (boiler portion)	<u>825,000 BTU/hr</u>
	1,562,000 BTU/hr

If I can be of further assistance, please do not hesitate to call.

Very truly yours,

HASSINGER SCHWAM ASSOCIATES

Gary Cohen, P.E.

GC:jc

TRENTON LUTHERAN HOUSING CORPORATION

489 West State Street • Trenton, New Jersey 08618 • Telephone: (609) 695-7755

January 25, 1978
RECEIVED
Land Management
Department
JAN 26 1978

Clark W. Gellings, P.E.
Public Service Electric and Gas
80 Park Place, Room 2168A
Newark, New Jersey 07101

Dear Mr. Gellings:

In accordance with our conversation of January 23, this is to confirm the interest of Lutheran Housing, Inc., Luther Arms, in the ICES project. We have designed the building with the capacity of converting to your system. As a non-profit corporation, we may have difficulty generating the capital costs for conversion. This would be our only problem in using the system.

Sincerely,

F. Kenneth Shirk, Sec.
Lutheran Housing, Inc.

ARTHUR R. SYPEK, SR.
COUNTY EXECUTIVE

COUNTY OF MERCER
OFFICE OF THE COUNTY EXECUTIVE
ADMINISTRATION BUILDING
P.O. Box 8068
TRENTON, NEW JERSEY 08650

February 22, 1978

Mr. Robert I. Smith
Public Service Electric and Gas Company
80 Park Place
Newark, New Jersey 07101

Dear Mr. Smith:

I would like to thank you for the informative presentation made by your company to the County of Mercer. The Integrated Community Energy System represents a positive step toward energy conservation and the County would like to encourage such measures.

We understand from Mr. Clark Gellings of Public Service, that the Mercer County Courthouse and Detention Center Complex could become a part of this co-generation system, and not only encourage energy conservations, but become an active participant, as well as gain an economic benefit from becoming an ICES steam customer.

At the proper time, I will submit such a proposal to the Board of Freeholders.

We would appreciate being informed when a final decision has been made to construct this facility.

Sincerely,

Arthur R. Sypek
County Executive
County of Mercer

ARS:mac:d

3.5.1-c.7
TRENTON ICES
FILED TARIFF VS. CONTRACT

The PSE&G Rates and Load Management Department has carefully investigated the use of a filed thermal service tariff, including rates as opposed to an individual customer contract.

Background

PSE&G, as a utility operating in the State of New Jersey and serving both gas and electric energies to the City of Trenton, is subject to continuous review by the Board of Public Utility Commissioners. Therefore any action involving supply of thermal energy, consistent with PSE&G's charter, is subject to some scrutiny. There is a fine line between the concept of a filed tariff vs. contracts. Contracts may also be filed or put on record and even if a filed tariff is used; a contract, indicating terms of service might also be required.

Contract

If ICES is to become a reality and if PSE&G is the owner/operator, a contract would be most appropriate and desirable for use in this case. Among the most prominent reasons are the following:

1. Regardless of how carefully the standard terms and conditions are written and despite the legal precedents regarding our right to refuse other customers thermal service, a contract would eliminate entirely the issue of refusal. With a tariff, a customer located elsewhere in our service area may insist on service at the same rate as the Trenton ICES customers are receiving. While PSE&G may be willing to expand our investment in Cogeneration, a site-specific analysis is necessary to determine the relative economic benefits of each potential location.
2. Allocation of costs for ICES may become an intricate issue with regard to our overall operations. With a filed rate, PSE&G must exercise care not to improperly charge overheads to ICES, or to subsidize ICES. The overheads in question are related to General and Administrative expenses of running the Company. A contract allows PSE&G to account for direct costs and negotiate contracts on that basis.

3. PSE&G's existing Cogeneration customer, Exxon receives up to 2,500,000 pounds of steam per hour from PSE&G's Linden Generating Station. The arrangement with Exxon is by contract - a precedent for using a similar legal device in future cogeneration arrangements.
4. In the case of ICES, the State of New Jersey is proposed as the largest thermal service customer. Since another division of the State would have direct control or approval of a tariff, if one were used, the situation could become tenuous.
5. Use of a contract would allow PSE&G to obtain a long term commitment for the customer.
6. Use of a contract would facilitate the inclusion of adjustment clauses tying the price of steam to a base rate plus escalation in fuel, operating and maintenance expenses, thus eliminating the need for continued renegotiation.

PSE&G is currently in conference with the New Jersey Board of Public Utilities on this matter. Currently PSE&G proposes to file the Standard Terms and Conditions for Thermal Service which outline the details of service and then use a contract to simply define the costs and commitment.

TRENTON ICES
CUSTOMER NEGOTIATIONS

Background

As reported in earlier phases of the ICES study, prospective customers had been interviewed by officials of the City of Trenton and preliminary commitments received. Subsequent to the conclusion of the Phase I study, it was decided to implement the recommendation which specified PSE&G as the owner-operator, if the concept is to proceed. Prior to March 22 therefore, PSE&G officials conducted meetings, for the first time, with the prospective customers.

Purpose

The purpose of these meetings were as follows:

1. To discuss with customers the basic structure of a rate or service contract which would be used for supplying thermal service to the Trenton ICES Community.
2. To indicate that PSE&G expects to supply thermal energy to them at rates which should be competitive with their costs if they provide their own supplies. By March PSE&G should have detailed figures showing the projected long-term costs based on ICES supply as well as their own conventional supply.
3. To indicate that the thermal energy supplied by PSE&G will most likely be in the form of steam, unless PSE&G is to provide necessary heat conversion and storage facilities. To obtain feedback from customers regarding their preference if they had a choice and the conditions of their existing supply terminal facilities and projected operating and maintenance costs.
4. To obtain a letter from each customer following this initial meeting stating that if the final PSE&G tariff provides a cost competitive service to the customer, it will be ready to enter into a service contract with PSE&G.
5. To further indicate that PSE&G has not yet decided to proceed with the project. A decision is due in the spring.

PSE&G felt that it was not in the best interest of the project to quote a rate range even on a preliminary basis. The use of "ball-park" figures can be devastating in future negotiations. While all parties involved are indeed professional and cooperating well on the highest levels of understanding, costs once quoted are cast in stone and not easily changed. Only after the conclusion of the Phase II study will PSE&G consider discussing specific tentative rates.

Agenda

The following basic agenda was used with each customer group.

1. Review ICES Concept
2. Status
3. Customer Buildings Included
4. Review Service Contract
5. Form of Energy
6. Letter of Intent
7. Customer Costs to Produce Steam
 - a. Operation of Oil Pumps
 - b. Burners
 - c. Steam Atomization
 - d. Maintenance
 - e. Heating and Tracing
 - f. Operating Engineers
 - g. Salary Rate - With Fringes
 - h. Water Treatment
 - i. Space Saving

Conclusions

Realistically, the concept of Cogeneration implemented by one of the nations largest utilities is easily accepted by the members of the ICES Demonstration Community. No one can easily reject the prospect of an energy supply which proposes to be cheaper than other alternatives. Specific minutes of each meeting have been prepared, and are included in this report. A summary, highlighting each agenda item as discussed above follows.

Summary

1. Review ICES Concept - Most customers were generally familiar with the concept and offered little comment. Some discussions related to ICES being a "good neighbor" and a few were curious about steam distribution, its location and easements. No difficulties surfaced as a result of those discussions.

2. Status - A few customers felt that the U. S. Department of Energy should contribute some capital cost toward the construction of ICES to insure PSE&G's involvement. This follows discussions by PSE&G officials that "unless ICES is competitive with alternate fuels our Company will not sponsor it."
3. Customer Buildings Included - Following a description of the buildings which might be included, several of the customers inquired about the potential expansion of ICES to other of the facilities.
4. Review of Service Contract - None of the potential customers interviewed had any particular objection to a long term contract. Some concern was voiced as to the form of adjustment clauses regarding the burden which would remain for efficient operation if PSE&G could merely bill the customer for any costs.
5. Form of Energy - The majority of the customers interviewed indicated that steam was the preferred supply form. Most end-users were in steam appliances. High temperature hot water would pose too many conversion problems. Several did request service at low pressure (15 PSI). There seemed to be relatively little interest in chilled water supply.

Additional comments were made relative to condensate pressure and return.
6. Customer Costs to Produce Steam - The potential customers who operate existing buildings cooperated generously in providing detailed information on the operation and maintenance of their plants.

Schedule of Future Negotiations

If PSE&G should decide to proceed with ICES, it is essential that before any large financial commitments are made regarding purchase of equipment, property, etc., a firm commitment must be received from each prospective member of the Demonstration Community.

It would be ideal if PSE&G knew the precise in-service date for the ICES plant as well as the actual construction, operating, maintenance and fuel costs for 1982. This is obviously not the case. The problem then is to persuade a group of businessmen to sign an iron clad contract for a commodity which has a undetermined price. The future of at least one prospective building, The Department of

Environmental Protection, is as yet uncertain. Other projects such as the Civic Center, which appear reasonably certain do have a few road blocks ahead. In summary all these factors spell risk and forces any prospective developer of a cogeneration project to require a greater return on investment than he normally receives.

Chronologically, the following milestones relate to future negotiations with the prospective ICES customers.

1. Review and update the final Demonstration Community load profile. Perform a sensitivity analysis with "uncertain" buildings such as the Department of Environmental Protection removed. (2 months)
2. Review and update the economic analysis. (2 weeks)
3. Determine steam rates in current dollars and identify escalations in 1982. (2 weeks)
4. Prepare a contract for execution which details rates in 1978 and identifies escalations. (2 weeks)
5. Schedule customer meetings and request execution of contracts. (1 month)
6. Continue ICES project.

Memorandum of Meeting with Prospective Trenton ICES Customer

Date and Time: March 6, 1978 - 3:00 p.m.

Customer or

Agency Involved: Eugene M. Grant and Company

Location: 200 Park Avenue
New York, New York

In Attendance

Richard E. Kobrin - Vice President - Eugene M. Grant and Company

C. W. Gellings - Rates and Load Management Department, PSE&G

A. M. Ornstein - Commercial and Consumer Affairs, PSE&G

Summary

After a general description of the ICES concept by PSE&G personnel, Mr. Gellings explored certain areas of mutual concern as outlined in the Agenda. Specific reactions were as follows:

1. Grant Corporation officials are willing to consider purchasing thermal energy for Capital Place I and II. Capital Place I is designed and under construction. Electric air conditioning will be used.
2. The customer prefers steam supply for these buildings.
3. Regarding the proposed contract, costs and termination rights the customer indicated willingness to explore any reasonable economic alternative.
4. The customer felt that, in addition to potential savings in energy, they could benefit from other intangible savings as well as maintenance. No reduction in operating engineers is anticipated.
5. A letter of intent, indicating interest in this concept will be prepared and transmitted.

Conclusion

Economics warranting, this prospective customer is interested in receiving an ICES steam supply.

Memorandum Meeting with Prospective Trenton ICES Customer
Date and Time: January 23, 1978 - 2:00 p.m.
Customer or
Agency Involved: Trenton Lutheran Housing Corp.
Location: Trenton City Planning Department Offices
 10 Capitol Street
 Trenton, New Jersey

In Attendance

F. Kenneth Shirk - Sec. Lutheran Housing, Inc.
Gary Cohen, P.E. - Hassinger, Schwarn Association
James Greenburg - Department of Planning, City of Trenton
C. W. Gellings - Rates and Load Management Department, PSE&G
D. F. Rieco - Commercial and Consumer Affairs, PSE&G

Summary

After a general description of the ICES concept by PSE&G personnel, Mr. Gellings explored certain areas of mutual concern as outlined in the Agenda. Specific reactions were as follows:

1. The Luther Arms project is currently designed for internal, water source heat pumps with supplemental electric immersion boilers. The three boilers are specified so as to enable retroconnection (conversion cost \$1,000 each) to steam exchangers. ICES would supply 60% of all heating needs below the operating balance point plus all domestic hot water requirements.
2. Despite the anticipated reliability of the proposed ICES design, HUD requires complete redundancy in the heating system. A loop distribution system may alleviate this.
3. The customer has no specific problems with a service contract as long as the escalation clauses are not too loose.
4. The customer could accept a high temperature hot water supply and would consider chilled water if available by 1980. Current designs are based on steam. The customer prefers a low pressure service (15 pounds).
5. Questions were raised regarding condensate return in so far as what our temperature and pressure requirements will be. The customer's consultant points out that the maximum temperature for effluent to be discharged into city sewers is 100°F.
6. No savings are anticipated in operating, maintenance or space aside of the raw energy.

7. The prospective customer points out that this facility will operate under Section 8 of HUD's code which requires that tenants pay only 25% of their income the balance of operating expenses is provided directly by HUD. The customer has no incentive, therefore, except his own interest in energy conservation, to convert to an alternate energy form. Additionally, no capitol is available to finance a conversion except from HUD.
8. The customer is interested in receiving ICES steam to heat his nearby church.
9. A letter of intent is forthcoming.

Conclusion

If the amortization of conversion costs can be reconciled, this customer is willing to accept an ICES steam supply as long as the costs are competitive.

Memorandum of Meeting with Prospective Trenton ICES Customer
Date and Time: January 27, 1978 - 1:30 p.m.
Customer or
Agency Involved: State of New Jersey
Location: Taxation Building
Corner State and Willow Streets
Trenton, New Jersey

In Attendance

Charles Richman	- Department of Energy, State of New Jersey
Don Blauth	- Capitol Services, State of New Jersey
Don Leibowitz	- N. J. Div. of Purchase & Property, State of N. J.
Ronald Spressart	- Dept. of Building & Construction, State of N. J.
C. W. Lawrence	- New Jersey Energy Research Institute
George Elmo	- Dept. of Building & Construction, State of N. J.
Marino Rossi	- Dept. of Building & Construction, State of N. J.
John Clarke	- Director of Planning, City of Trenton
C. W. Gellings	- Rates and Load Management Department, PSE&G
D. F. Rieco	- Commercial and Consumer Affairs, PSE&G

Summary

After a general description of the ICES concept by PSE&G personnel, Mr. Gellings explored certain areas of mutual concern as outlined in the Agenda. Specific reactions were as follows:

1. The prospective customer agreed to the inclusion of the Labor and Industry, Health and Agriculture, Statehouse, Justice and Department of Environmental Protection (DEP) buildings in the ICES Demonstration Community as a realistic assumption depending on economics and service policies.
2. State officials pointed out that the Justice Complex will probably use electric centrifugal chillers and not absorption as originally planned. PSE&G agreed to discuss this in further detail at another time.
3. The customer has no specific problems with a contract as opposed to a filed tariff, but expressed a desire to review a draft copy once one is prepared.
4. Unquestionably, because of the Statehouse and L&I complexes, the State recommends steam as the preferred energy form.
5. A condensate return system was discussed and State personnel urged PSE&G not use a vacuum return system.
6. State officials expressed concern over the reliability of a radial steam distribution system and urged PSE&G to continue its studies of a loop system.

7. This customer was the most emphatic regarding the need for ICES steam to be competitive. They related their expected analysis would rely almost solely on the cost of fuel and some direct operating expenses. No large operating and maintenance savings, aside from fuel, are anticipated. A few of the ten existing operating engineers might be eliminated through attrition. Mr. Richman recommended that their elimination causes political problems and should not be included in the analysis. Additional information on operating expenses will be forwarded.
8. The prospective customer discussed the possibility of ICES ownership by a third party. PSE&G representatives explained the grid-connected concept and outlined the institutional difficulties associated with a nonutility ICES.
9. State officials inquired as to the minimum number of buildings necessary to make this project a reality and indicated that they will not be able to commit the DEP buildings for some time.
10. State officials will again prepare a letter of interest to PSE&G.

Conclusion

State officials demonstrated a refreshingly realistic view of alternate energy supply forms. They will evaluate our final proposal carefully and, if economics warrant, adopt ICES.

Memorandum of Meeting with Prospective Trenton ICES Customer

Date and Time: January 27, 1978 - 10:00 a.m.

Customer or

Agency Involved: Mercer County Improvement
Authority and Mercer County

Location: Mercer County Offices
640 South Broad Street
Trenton, New Jersey

In Attendance

R. F. Maiorino	- Director - Mercer County Improvement Authority
L. DiDonato	- Director - Building and Construction, State of New Jersey
D. Menella	- County Executive Director
F. V. Walsh, Jr.	- Attorney for Mercer County
J. Clarke	- Director of Planning, City of Trenton
C. W. Gellings	- Rates and Load Management Department, PSE&G
D. R. Rieco	- Commercial and Consumer Affairs, PSE&G

Summary

After a general description of the ICES concept by PSE&G personnel, Mr. Gellings explored certain areas of mutual concern as outlined in the Agenda. Specific reactions were as follows:

1. The Mercer County Improvement Authority, as a developer for the State of New Jersey is prepared to connect the Labor and Industry/Health and Agriculture (L&I) Complex to an ICES steam supply. Since the Justice Complex will be supplied from the L&I complex, it will also be retroconnected. Absorption chillers will be used in the Justice Complex if sufficient boiler capacity exists in the L&I buildings. (A discrepancy exists between the information supplied here and future meetings detailed by other minutes.) It was suggested that PSE&G contact the consulting engineers involved in the design to clarify this point.
2. The Justice Complex will use solar energy for domestic water heating.
3. The preferred form of energy supply is steam. High temperature hot water would cause additional conversion problems. Chilled water would necessitate abandoning additional equipment and would not allow the customer the control he feels is necessary.
4. Retroconnection of the War Memorial was discussed and it was suggested that the consultant charged with a study of the air conditioning for the project be contacted.
5. Retroconnection of the Mercer County Court House/Detention Complex is anticipated as part of the overall conversion.

6. Mercer County officials anticipate that the cost of ICES steam will be substantially below their existing system costs. PSE&G officials carefully reviewed the Company's neutral position and indicated that a final economic analysis would be concluded in March.
7. County Officials will prepare a letter of intent to again state their interest in this project.
8. The customer has no objection to a contract with adjustment clauses.

Conclusion

Mercer County officials are surprisingly enthusiastic about the ICES concept. Apparently they are under the impression that there is no doubt about the economics.

Memorandum of Meeting with Prospective Trenton ICES Customer
Date and Time: January 23, 1978 - 10:00 a.m.
Customer or
Agency Involved: Kingsburg Corp.
Location: Trenton City Planning Department Offices
10 Capitol Street
Trenton, New Jersey

In Attendance

Robert W. Kennedy	- Kingsburg Corporation
James A. Waldron	- Attorney for Kingsburg Corporation
Robert L. Bloch, P.E.	- Consulting Engineer
George J. Kimmerle	- Mahong & Kvosec, Architect
James Greenburg	- Department of Planning, City of Trenton
C. W. Gellings	- Rates and Load Management Department, PSE&G
D. F. Rieco	- Commercial and Consumer Affairs, PSE&G

Summary

After a general description of the ICES concept by PSE&G personnel, Mr. Gellings explored certain areas of mutual concern as outlined in the Agenda. Specific reactions were as follows:

1. Kingsburg Corporation officials are willing to consider purchasing thermal energy for Kingsburg I and II. Kingsburg II will have provision for future individual electric air conditioning. No central chilling will be installed since HUD will not finance same.
2. The customer prefers steam supply for these buildings and is interested in having PSE&G install a portion of our steam system early in the construction for their use for conversion later. Service will be desired at the Kingsburg I high rise and to each of approximately ten of the Kingsburg II buildings. The customer recommends we coordinate our design now to guarantee a smooth conversion.
3. Regarding the proposed contract, concern was expressed over fluctuations in escalating costs and in termination rights. PSE&G officials indicated that these points could be worked out in the contract. The customer felt that a contract held advantages over a filed tariff.
4. The customer felt that, in addition to potential savings in energy, they could benefit from savings in maintenance. Operating Engineers are limited to one shift in the high rise and would still be required.
5. As in all new housing projects, Kingsburg II tenants will pay their own electric bills.

6. Anticipation of space savings could yield an additional 100 square feet in each of the 12 new buildings. Additionally, no chimneys will be required.
7. A letter of intent, indicating interest in this concept will be prepared and transmitted.

Conclusion

Economics warranting, this prospective customer is interested in receiving an ICES steam supply.

APPENDIX I

(3.5.1 d)

FUEL ALLOCATION

TRENTON ICES STUDY

1- FUEL ALLOCATION

The following fossil fuels were examined as to their use in the combustion turbines of the Trenton ICES; No. 2 oil, No. 6 oil, natural gas and coal.

No. 2 oil was selected because PSE&G has the most experience burning this oil in our combustion turbines and this oil will be available in sufficient quantity for the life of the plant. We don't feel oil allocation for the ICES plant will be a problem, in fact, FEA, Title 10, Part 211.1 excludes No. 2 oil from mandatory allocation. As mentioned in both our Phase 1 and 90 day report, no one can guarantee this oil will be allocated to the ICES plant, however, we have received a letter of support for the ICES plant from Mr. D. J. Bardin, then Administrator of the Federal Energy Administration, and present Head of the Economic Regulatory Administration.

In order to burn No. 6 oil in the combustion turbines of the ICES plant, a costly modification to the fuel handling system would be necessary. Based on several prototype installations, the maintenance requirements to insure a clean fuel supply would increase and unit reliability would become poorer. Burning No. 6 oil in combustion turbines is relatively new and in our judgement has proven neither technically nor economically feasible at this time.

The present natural gas supply situation would not allow PSE&G to use gaseous fuel for our combustion turbines other than possibly during indeterminate periods in the summer, and for short emergency periods if other alternatives are not available. However, if additional gas supplies could be made available from new sources such as Atlantic off-shore drilling, coal gasification, LNG, etc., then gas may be considered as a viable future fuel supply for the ICES plant.

A promising technology that has the potential of burning coal in a combustion turbine system is the fluidized bed combustion system. In this fuel system, coal is burned at high pressure in a bed of inert material such as limestone. However, we feel it highly unlikely that this technology will be commercially available in the near future.

APPENDIX N

(3.5.1 f)

EASEMENTS AND RIGHTS OF WAY

3.5.1-f Draft Easement and Right-of-Way Agreements

Agreements

PSE&G, with the assistance of the Department of Planning and Development of the City of Trenton, has investigated the legal requirements for permission to install thermal energy distribution facilities in or on property owned by the City of Trenton, potential ICES customers or private parties. As part of this review, the PSE&G Law Department has prepared a letter dated March 6, 1978 on the subject of PSE&G rights as covered by their franchise or other enabling legislation (copy attached). In brief, it states that the answer to the question about PSE&G rights is not entirely clear. In the opinion of the PSE&G Law Department there is no statutory right to lay steam mains in public streets, but such franchise or permission must be granted by ordinance of the City of Trenton.

The Standard Terms and Conditions For Thermal Service includes Section 2.6 titled Permits, which covers street opening permits and also states that "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." This section of the Standard Terms and Conditions For Thermal Service clearly covers aspects of the thermal distribution system required to provide service to individual customers.

In other areas, where permission to use private property for the installation and operation of the thermal distribution system is required easements would be prepared for each affected property owner. Sample easements are attached to show the form of the agreement.

A list of property owners affected by the total distribution system has been prepared by the Department of Planning and Development of the City of Trenton and is attached. The type of right-of-way agreement that may be required for each aspect of the thermal distribution system has been shown on this list.

PSEG

Public Service Electric and Gas Company 80 Park Place Newark, N J 07101 201/430-6461

Frank A. Sickinger Assistant General Attorney

March 6, 1978

RECEIVED
DEPT. OF
ENERGY

Mr. Ku
3/19/78

To the Vice President - Law

Re: Trenton ICES Advisory Committee

At the last meeting of the Committee, the Chairman (Mr. W. S. Ku) asked me to express an opinion on the following two questions:

1. Is there a statute allowing the placement of steam lines in the public streets?
2. Could ICES refuse service to any applicant for steam?

The answer to question one is not entirely clear because of the status of the State's statutes. In 1896, the Legislature provided, under an act entitled "Steam Heat and Power Companies", which is set forth in N.J.S.A. 48:14-1, as follows:

"Any corporation organized or to be organized by virtue of Title 14, Corporations, General, for the purpose of producing and distributing steam heat and power, may lay the necessary pipes and conduits beneath the public roads, highways, streets, avenues and alleys, provided that the consent of the governing body of any city, town or township wherein or through which it is contemplated to lay such pipes and conduits shall first be obtained, such consent to be by ordinance of such governing body duly adopted.

Such use of public streets and highways in any city, town or township shall be subject to such terms, regulations and restrictions as may be imposed by the governing body thereof."

This statute was repealed by the Laws of 1962, Chapter 198, which changed many sections of Title 48 "Public Utilities". At the end thereof, various sections of Title 48, including this one, were repealed without explanation, effective 90 days after passage.

March 6, 1978

In reviewing the changes made in the statutes, it was noted that N.J.S.A. 48:2-13, the general jurisdiction statute for the Public Utility Commission, was changed to delete the word "steam" preceding the word "railroad" from the prior act.

I have also considered Chapter 7 of Title 48, which is entitled "Electric Light, Heat and Power Companies", but said chapter does not speak of steam and it is presumed that the word "heat" means electric heat and has no relation to steam generation.

It would appear, therefore, that there is no State franchise or statutory permission to install steam pipes in streets as in the case of electric and gas lines. It will, therefore, be necessary to obtain a consent by ordinance from the City of Trenton to lay such steam pipes, which would act the same as a franchise.

I have also considered the gross receipts tax act in determining whether there is a State franchise. It does provide for including in the franchise tax act the "using or occupying public streets, highways, roads or other public places by virtue of a franchise or authority or permission from the State or any municipality thereof ***." (N.J.S.A. 54:30A-18). Further, under N.J.S.A. 54:30A-58, wherein the schedule of property and unit values to be used to apportion the gross receipts taxes is set forth it does include under "Electric Light, Heat and Power Systems" a classification entitled "Heating System Mains" and "Heating System Services".

This statute indicates, therefore, that there can be a municipal franchise without a State franchise.

In summary, therefore, it is my opinion that there is no statutory right to lay steam mains in public streets, but such franchise or permission must be granted by ordinance of the City of Trenton.

As to the second question, I refer you to the memorandum of January 6, 1978, copy attached, forwarded to the Committee in answer to the same question, which concluded that we can only refuse connection if the customers installation does not accord with our standard terms and conditions or because same would adversely affect the adequacy of service to other customers.

It would appear, therefore, that we could not refuse steam service to any member of the public fronting the street in which the steam mains are laid unless there would be a detrimental effect on all the other customers, such as inability to deliver the steam in quantities and at pressure necessary as limited by the boilers in the plant.

March 6, 1978

Although it was not requested, I did mention the gross receipts tax act and remember that a comment was made at the last meeting that the City of Trenton was hoping to receive additional monies from the same. As set forth under the first question, it would appear that the income from the steam lines would be subject to the gross receipts tax.

Frank A. Sickinger
Assistant General Attorney

Approved:

Roger M. Nelson
General Attorney

FAS:em
attach.

PSEG

Public Service Electric and Gas Company 80 Park Place Newark, N.J. 07101 Phone 201/430-7000

January 6, 1978

RECEIVED

JAN 6 1978

To the Assistant General Attorney:

FRANK A. SICKINGER
ASSISTANT GENERAL ATTORNEY

Re: Trenton ICES - Right to Refuse Customers.

The Trenton ICES Steam Generating Project is subject to the jurisdiction of the Board of Public Utilities (see memorandum dated April 15, 1977), and therefore the issue of whether or not the ICES can refuse certain thermal service applications must be resolved according to the applicable public utility statutes and regulations which govern all utilities in the State of New Jersey. N.J.S.A. 48:3-3 and N.J.A.C. 14:3-3.5 would seem to be on point.

"No public utility shall provide or maintain any service that is unsafe, improper or inadequate, or withhold or refuse any service which reasonably can be demanded or furnished when ordered by the board." N.J.S.A. 48:3-3

A municipality engaging in the operation of any light, heat or power plant must comply with all board rules, regulations and recommendations to the same extent as any other public utility. See N.J.S.A. 40:62-2. Therefore, the above-mentioned statute would apply to the ICES project and would seem to deny any right to refuse any reasonable service.

However, the regulations applicable to public utilities would seem to recognize that in some limited instances, a utility may refuse to connect. This may occur only when the utility is asked to connect its facilities to a customer installation.

"(a) A utility may refuse to connect with any customer's installation when it is not in accordance with the standard terms and conditions of the utility furnishing the service, which have been filed with the Board, and with the provisions of applicable governmental requirements.

(b) When, because of its size or character, the customer installation desired to be connected to the facilities of the utility is so unusual as to adversely affect the adequacy of the service furnished to other customers, present or prospective, the utility may require special provisions for the service in question or may refuse the same." N.J.A.C. 14:3-3.5

Therefore, it appears that, except in a narrowly defined situation, a utility has no right to refuse service applications. To overcome this duty of accepting service applications for the ICES project, it might be wise to draft the standard terms and conditions to be filed with the Board in such a way as to limit the type of potential customer seeking this service. If this tack is not practical, any undesirable application might be rebutted by arguing that the safety and adequacy of other customers' service would be adversely affected if the service in question is not refused.

D. Sandra Burns,
Attorney

THIS INDENTURE, made this day of ,
in the year one thousand nine hundred and seventy-
between

hereinafter designated " ", and PUBLIC SERVICE
ELECTRIC AND GAS COMPANY, a corporation of the State of
New Jersey, having its principal office at 80 Park Place,
in the City of Newark, in the County of Essex, and State
of New Jersey, hereinafter designated "Public Service",

W I T N E S S E T H :

That the said for and in consideration
of the sum of One Dollar (\$1.00), lawful money of the
United States of America, to it in hand paid by Public
Service, the receipt whereof is hereby acknowledged, has
given, granted and conveyed, and by these presents does
give, grant and convey unto Public Service, its successors
and assigns, forever, the permanent right, privilege,
authority and easement to install, lay, construct,
reconstruct, operate, maintain, inspect, repair, remove,
replace and relay underground and/or overhead steam mains
together with all necessary fittings and appurtenances, in,
on, over, under, across and along lands of
situate, lying and being in the of
in the County of , and State of New Jersey,
shown in red line on the map of Public Service Electric
and Gas Company, attached hereto and hereby made a part
hereof, said map being designated as "

Public Service, for itself, its successors and assigns, covenants and agrees with its successors and assigns, that after the installation of the said underground and/or overhead steam mains, together with all necessary fittings and appurtenances, and after each subsequent disturbance of the above described land for any of the purposes aforesaid, Public Service at its own cost and expense shall restore the lands as nearly as possible to the condition in which it was immediately prior to the commencement of the work.

The construction, reconstruction, operation, maintenance, and repair of said underground and/or overhead steam mains and appurtenances shall be at the sole cost and expense of Public Service.

Public Service hereby agrees to indemnify, protect and save harmless from and against any and all expense or damages it may incur or suffer or be in anywise subjected to by reason of Public Service's use of the easement herein granted as aforesaid.

IN WITNESS WHEREOF, has caused its corporate seal to be hereunto affixed and these presents to be signed and attested by its proper officers thereunto duly authorized all as of the day and year first above written.

BY _____

Attest:

STATE OF NEW JERSEY)
 ; SS.
COUNTY OF)

BE IT REMEMBERED, that on this day
of , in the year of our Lord one thousand
nine hundred and seventy- , before me, a

 of the State of New Jersey, personally
appeared who being duly
sworn on his oath saith that he is the Clerk of the
 , the within named, and that
 is the Mayor of the

 that deponent knows the common or corporate
seal of said and that the seal annexed to
the within instrument is such common or corporate seal;
that the said instrument was signed by the said Mayor and
the seal of said affixed thereto in the presence
of deponent; that said instrument was signed, sealed and
delivered as and for the voluntary act and deed of said
 for the uses and purposes therein expressed,
pursuant to a resolution of the Mayor and
and at the execution thereof this deponent subscribed his
name thereto as witness. The full and actual consideration
paid or to be paid for the transfer of title to realty
evidenced by the within instrument, as such consideration
is defined in P.L. 1968, c.49, Sec. 1(c), is \$1.00.

Sworn and subscribed to
before me this day
of 197 .

The within instrument was prepared by

APPENDIX O

(3.5.1 g)

LABOR RELATIONS PLAN

DRAFT

3.5.1-g Labor Relations Plan

The overall question of labor relations has been investigated by members of the PSE&G Industrial Relations Department. Their investigation was divided into the following three distinct sections; ICES plant, distribution system and facilities on customers property. They concluded that the operation of the ICES plant and the thermal distribution system would require negotiations but would present no major labor relations problems. However, where PSE&G personnel would be required to maintain and/or operate facilities located on customer property labor difficulties of some consequence may arise. Since this latter case involving the use of PSE&G personnel to operate and maintain facilities on customer property is not being considered, the major potential obstacle has been removed. Therefore, PSE&G should not have any difficulty in operating and maintaining the ICES plant and thermal distribution system from a labor relations standpoint.

A copy of the memorandum covering the above, dated February 10, 1978, from Mr. Malcom Sawhill, Manager-Industrial Relations, is attached.

Public Service Electric and Gas Company 80 Park Place Newark N.J. 07101 Phone 201/430-7000

February 10, 1978

Memorandum to Wei Shing Ku

TRENTON ICES

This office has been asked to review the labor relation implications of the envisioned Trenton ICES. We have examined the proposal based upon Public Service owning and operating the facility. Should some different arrangement be the final outcome then the following observations would require modification.

We see no problem of operating and maintaining this facility as a satellite of Mercer Generating Station. The personnel manning the facility would unquestionably be from IBEW locations and would retain such affiliation. Such a satellite would necessitate negotiating a limited number of changes in the present Agreement but it is not anticipated that this would present any major difficulty.

It is envisioned that whatever switching would be required would be handled by a Traveling Operator from Trenton Electric Distribution Division and such assignments would not require any modification of the Agreement.

Maintenance of the steamlines leading from the plant to customer facilities could be handled by the Gas Transmission and Distribution Department and although this would require some negotiations with the appropriate Union, no major stumbling block is anticipated. It is felt that the Plumbers Union would more than welcome this additional work.

We do feel that if our responsibility for the maintenance of these lines were to be extended beyond the metering point wherein we would be responsible for maintaining the customer's equipment we would encounter labor difficulties of some consequence. I have reviewed this memorandum with the Manager - Industrial Relations Gas Operations and he is in agreement with the above stated conclusions.

We have reached this stated position based upon our discussion with your committee on February 9, 1978. When and if it appears that this project may become a reality we would be pleased to sit with you to determine the specific changes that would be required in the various labor Agreements to meet your needs.

Malcolm C. Sawhill
Manager - Industrial Relations
Electric Operations

APPENDIX F

(3.5-1 h2)

**PRELIMINARY ENVIRONMENTAL
ASSESSMENT REPORT**

**DRAFT ENVIRONMENTAL ASSESSMENT
TRENTON INTEGRATED COMMUNITY ENERGY SYSTEM (ICES)
CITY OF TRENTON, MERCER COUNTY, NEW JERSEY**

**Public Service Electric and Gas Company
80 Park Place
Newark, New Jersey 07101**

DOE (ERDA) Contract EC-77-C-02-4212,

MARCH 1978

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TRENTON ICES ENVIRONMENTAL IMPACT ASSESSMENT

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CHAPTER 1 - THE PROPOSED ACTION

1.1 Summary

Public Service Electric and Gas Company proposes to design, construct, and operate a grid connected, thermally controlled, Integrated Community Energy System (ICES) on an urban renewal site in downtown Trenton, New Jersey after the economic and financial viability of the project has been confirmed. This cogeneration system would utilize gas turbines generating electricity and waste heat boilers producing 125 psig steam. The steam would be distributed to a Demonstration Community of existing and future buildings in 13 groups. Figures 1.1-1 and 1.1-2 show the site area and Demonstration Community, respectively.

The proposed activity constitutes Phase III of a continuing project under U.S. Department of Energy (formerly Energy Research and Development Administration) Contract EC-77-C-02-4212. Since this project includes DOE sponsorship an Environmental Assessment is required under 10 CFR Part 711 as amended January 26, 1977. Concurrent environmental review will also be performed by the Delaware Valley Regional Planning Commission, the U.S. Department of Housing and Urban Development (and the A-95 review agencies), and the New Jersey Department of Environmental Protection and Community Affairs.

CITY OF TRENTON
DEPARTMENT OF PLANNING AND DEVELOPMENT
DIVISION OF PLANNING

0 400 800 1200
MAY 1971

ICES

SITE AREA

Figure 1.1-1

CHAPTER 1 - THE PROPOSED ACTION

1.1 Summary (Cont'd)

Study team participants include:

The City of Trenton (Department of Planning and Development)

Public Service Electric and Gas Company

R. G. Vanderweil - Engineers

R. G. Stein and Partners - Architects

Turner Construction Company

The New Jersey Energy Research Institute

1.2 Conclusions

Construction and operation of ICES will not create a significant adverse environmental impact within the Demonstration Community area or within the City of Trenton. ICES represents an optimal combustion energy system for demonstration in this urban setting. It will comply with all applicable air quality and noise control regulations through careful design, implementation of control measures, and the combustion of a clean light fuel oil.

Participation in this project by DOE does not constitute a major Federal action significantly affecting the quality of the human environment, as defined in the National Environmental Policy Act of 1969.

1.3 Historic Background

ICES emerges from the national concern to extract the greatest possible useful energy from each unit of scarce fuel consumed. Large Modern fossil fuel generating plants have achieved overall fuel to electricity efficiencies approaching 40%. The remaining 60% of the combustion heat is released as thermal energy into the environment.

ICES will generate electricity at lower efficiencies than a large central plant. However, a large portion of the heat discharged by the generating equipment will not be released but captured and used for producing steam for distribution to outlying buildings for heating, cooling, and domestic hot water. Almost sixty-three percent of the fuel energy input is utilized, representing a near doubling of overall fuel utilization by producing electric energy and satisfying the thermal energy needs of buildings.

Trenton ICES will be thermally controlled. The demand for thermal energy at the various buildings will control the plant output. In turn, the electricity produced will be fed into the Pennsylvania-New Jersey-Maryland electrical grid via the PSE&G system. The total useful output of the plant will always serve a demand. This promotes annual fuel utilization which closely approximates the peak operating efficiency.

1.3 Historic Background (Cont'd)

Steam distribution systems have been used in Europe and the United States, particularly New York City, where district heating from central stations is widely employed. Economies of scale are realized and individual building managements are relieved of operating and maintaining their own heating and cooling plants.

1.4 Project Description

Trenton ICES will consist of a central station distributing 125 psig steam to outlying steam customers who will use this steam directly for heating and cooling or indirectly for hot water and domestic hot water. Thermal substations will in turn deliver steam, hot water, and chilled water to the nine groups of individual buildings in the Demonstration Community. The customers' facilities will contain such equipment as: steam to hot water converters, two-stage absorption chillers, condensate receivers and pumps, cooling towers, and other auxiliary equipment.

The steam will be produced in boilers using waste heat in the combustion gasses exhausted from four 2.5 megawatt gas turbine modules. In addition, there will be two conventional water tube boilers for standby and peak thermal demands. A schematic of ICES steam operation is shown in Figure 1.4-1.

W = WINTER LOAD IN POUNDS
 PER HOUR STEAM AT 125
 PSIG, SATURATED.
 S = SUMMER LOAD IN POUNDS
 PER HOUR STEAM AT 125
 PSIG, SATURATED.

ICES PLANT & DISTRI-
 BUTION SCHEMATIC

Figure 1.4-1

ICES

1.4 Project Description (Cont'd)

Daily average fuel consumption of approximately 11,000 gallons of No. 2 fuel oil can be delivered during weekdays by a maximum of three 6,000 gallon trucks per day. Rail delivery from a main line 1500 feet away is also feasible, if economical.

The ICES central station will be contained in a separate building adjacent to the planned municipally owned parking garage sharing the same site. The ICES building will be owned by PSE&G but will be architecturally blended with the 1200 space garage.

Elevated walkways connecting the garage with some outlying building groups are planned which will carry steam lines over streets minimizing pavement openings in those areas. A public Energy Information Center is planned in which details of ICES operation and energy production in general can be learned.

1.5 Demonstration Community

Trenton ICES will supply the anticipated thermal energy demands of a Demonstration Community with a total floor space of 3,700,525 square feet (See Table 1.5-1), to be completed in 1982.

ICES could be expanded to serve the potential future ICES customers listed on the same table. This has been allowed for in the ICES design but is not proposed at this time.

Table 1.5-1

ICES DEMONSTRATION COMMUNITY

I. Planned

<u>BUILDING</u>	<u>SQUARE FEET</u>	<u>CONSTRUCTION</u>	
		<u>START</u>	<u>COMPLETION</u>
Kingsbury I Towers	280,000	Existing	
Kingsbury I Lowrise	74,500	Existing	
Mercer County Detention Center	160,000	Existing	
Mercer County Courthouse	130,000	Existing	
Labor and Industry	300,000	Existing	
Health and Agriculture	144,000	Existing	
Statehouse Complex (incl War Mem)	795,525	Existing	
Luther Arms*	91,500	Existing	
Capital Place 1*	175,000	Existing	
Existing Building Subtotal		2,150,525 ft ²	
Justice Department	800,000	1978	1980
Capital Place Commercial	200,000	1979	1980
Kingsbury II	200,000	1980	1981
Civic Center	100,000	1981	1982
Dept. Environmental Protection-	250,000	1981 ²	1982
Future Building Subtotal		1,550,000 ft ²	
TOTAL		3,700,525 ft ²	

*Not yet complete but with anticipated completion ahead of ICES availability

II. Potential Future

<u>BUILDING</u>	<u>SQUARE FEET</u>	<u>CONSTRUCTION</u>	
		<u>START</u>	<u>COMPLETION</u>
N. J. State Dept. of Treasury	180,000	Existing	
Mercer County Community College	18,000	Existing	
Mercer County Courthouse Extension	36,000	Not established	
Mercer County Admin. Bldg	100,000	Not established	
Capital Place 3	100,000	Not established	
Capital Place 4	150,000	Not established	
Commercial Bldgs (2)	80,000	Not established	
A State Office Bldg.	250,000	Not established	
Potential Future	914,000		
GRAND TOTAL	4,614,525		

1.6 Gas Turbine and Waste Heat Boiler Description

ICES will consist of four Solar Centaur (or equivalent) 2500 kilowatt gas turbines with inlet and exhaust silencers. Each unit will incorporate a 17,500 #/hr waste heat boiler producing saturated steam. The ICES plant will also contain one two 30,000 #/hr oil-fired water tube auxiliary boilers. There will be three fuel oil storage tanks of 50,000 gallons each. Condensate polishing and makeup demineralizers will serve the waste heat and auxiliary boilers.

There will be an installed automatic CO2 or Halogen fire detection and protection system for each gas turbine-generator unit. Also a gas hazard detection system will continuously monitor for combustible gases inside the turbine enclosure. A typical gas turbine and waste heat module is shown in Figure 1.6-1.

1.7 ICES Operation

1.7.1 Thermal Control

The ICES plant will be operated in response to thermal demand, generating electricity as a by-product. Whenever thermal demand is such that one or more waste heat boilers could operate between 75 and 100% capacity, the appropriate number of gas turbine modules will be operated. Demand levels in between will be met by the auxiliary boilers.

From time to time Pennsylvania - New Jersey - Maryland electrical grid emergencies may necessitate ICES gas turbine use beyond the duration needed to satisfy of Demonstration Community thermal demand. In this case, exhaust gases will bypass the waste heat boiler.

1.7 ICES Operation (Cont'd)

1.7.2 Thermal Load Characteristics

The estimated steam demand for the existing and planned future Demonstration Community buildings is 214 million pounds of steam per year. This determination included separate assessments of existing buildings versus the more energy efficient designs which will be implemented between now and 1982. Both categories were assumed to be energy conscious in their use of steam. Using ASHRAE accepted procedures, weather conditions were simulated from Philadelphia Test Reference Year 1969, selected from among twenty-eight years of record.

Except under the emergency conditions mentioned above electric demand was not a consideration in planning ICES plant operation. Normally, the plant will be thermally controlled and the electric grid will absorb or provide electricity, as required.

Table 1.7-1 summarizes ICES Annual Operation.

1.8 Financial Considerations

1.8.1 Cost

The total capital investment in 1978 dollars of the ICES project central station is approximately \$18 million and will represent less than 1% of PSE&G's total capital outlay in the years of 1978 through 1981. But because Public Service Electric and Gas Company will obtain capital

Table 1.7 - 1
SUMMARY OF ICES ANNUAL OPERATION

Steam Output:	Total	214 X 10 ⁶ lbs
Electric Output	On-Peak	17,600 megawatthours
	Off-Peak	13,800 megawatthours
	Total	31,400 megawatthours
Fuel Oil Input:	Turbine	83,600 barrels
	Boiler	7,300 barrels
	Total	90,900 barrels

DEC/kd
3/15/78

1.8 Financial Considerations (Cont'd)

1.8.1 Cost (Cont'd)

for ICES through its normal financing processes, a satisfactory rate of return on investment must be obtained. Otherwise ICES would place an unusual economic burden on PSE&G, since our electrical capacity needs are being met through construction of generating plants elsewhere in the PSE&G System.

ICES will not alter PSE&G's electric generating expansion program. Furthermore, ICES' economic benefits cannot be extrapolated to larger systems or additional systems at this time.

1.8.2 Customer Commitments

The planned Demonstration Community is composed of individual buildings and groups of buildings which are managed both privately and publicly. Buildings cannot be required to connect with ICES. Instead they must be attracted by demonstrated cost savings. PSE&G has made initial contact with the managements of the Demonstration Community buildings and with related groups and has received letters of intent on which this project is based.

1.8 Financial Considerations (Cont'd)

1.8.2 Customer Commitments (Cont'd)

Parties indicating interest in ICES include:

Governor Byrne

The New Jersey State Treasurer

Former Federal Energy Administration

Mercer County Improvement Authority

Mercer County Executive

New Trenton Corporation

Capital Place Associates

Trenton and Mercer County War Memorial Building
Commission

New Jersey Housing Finance Administration

Kingsbury Corporation

Trenton Lutheran Housing Corporation

PSE&G also contacted twenty-five domestic utilities which provide thermal energy service to take advantage of their experience in formulating the ICES rate structure. PSE&G believes that an attractive thermal service package can be offered to the building groups comprising the Demonstration Community and that the overall system can be managed satisfactorily.

1.8 Financial Considerations (Cont'd)

1.8.3 Ownership of Facilities

PSE&G will own the land, the building and the ICES plant equipment. PSE&G's charter permits selling steam, and the utility has expertise in operating and maintaining energy facilities. Fee ownership of the land is necessary in order to make the project bondable. Construction management is greatly simplified by PSE&G ownership, as compared with potential municipal or joint ownership. A parking garage entrance proposed for South Warren Street will require an entrance easement through PSE&G land.

The pedestrian walkway and underlying land will be owned by others, and PSE&G may need to lease occupancy rights for steam lines suspended on the walkways. PSE&G is expected to own and operate the steam distribution system. Customers are expected to own and operate the thermal terminal facilities installed on their premises. Appropriate control will be coordinated by PSE&G. Final leasing and insurance details have not yet been resolved.

1.9 Schedule

If approved, ICES site area construction would begin in December 1979 with work commencing on the steam distribution system. In April 1980, structural construction would begin. Startup is scheduled for October 1981 through January 1982,

1.9 Schedule (Cont'd)

with commercial operation thereafter. Figure 1.9-1 depicts the ICES schedule.

1.10 Expansion Potential

After 1982 a 914,000 square foot increase is foreseeable to the size of the original Demonstration Community. To accommodate this expansion, the ICES building has a fifth bay which can accommodate one more 2.5 megawatt turbine and boiler module. If the fifth bay is used for such a module, ICES' total electric capacity will be 12.5 megawatts. The steam distribution system can accept 25% growth without modification.

1.10 Expansion Potential (Cont'd)

Any such expansion would require a reassessment of environmental impact, based on the conditions existing in Trenton at that time. Such expansion is not proposed as part of this environmental assessment.

CHAPTER 2 - THE EXISTING ENVIRONMENT

2.1 Physiography and Geology

Trenton ICES will be located within an established urban renewal site approximately 1/4 mile inland from the Delaware River. It will be situated near the south bank of Assunpink Creek, a fast moving stream which drains a substantial area in Mercer County (91.4 sq. miles). The ground slopes gently westward to the river with a more substantial rise toward the northeast, where the commercial center of Trenton lies.

At present, the ICES site has been cleared and is used as a parking lot. The site is bounded to the east by South Broad Street, to the north by the Assunpink Creek stream bank (Factory Street), to the west by South Warren Street (formerly Lamberton Street) and to the south by Livingston Street. The entire parking garage site which includes the ICES plant site occupies approximately three acres.

The site lies in the Atlantic Coastal Plain to the immediate south of the "fall line" which separates this geophysical province from the Piedmont Plateau. The Atlantic Coastal Plain is typified by unconsolidated sands and clays over bedrock at considerable depths. However, the ICES site is near the "fall line" and the bedrock is closer to the surface. The overlying sand, gravel and silt or clay soil is the Cape May formation (Wisconsin period), a recent alluvial deposit of glacial outwashings.

2.1 Physiography and Geology (Cont'd)

The underlying bedrock is the Wissahickon formation, a Paleozoic micaceous schist or gneiss. The Wissahickon formation frequently contains numerous joints and fractures.

Field borings were performed near the site during 1963 and 1966 for a proposed shopping center which was never developed. Site Engineers, Inc. of Morristown, New Jersey, advanced approximately 33 test borings and referred their elevations to City Datum.

Analysis of recovered soil samples and rock cores reveals the following (References 1 and 2):

There is a randomly located upper stratum of miscellaneous fill consisting mainly of sand, gravel, cinders and construction debris which varies in thickness between 2 ft. and 13 ft. deep. This layer is followed by strata containing brown fine to medium sand, gravel, silt and clay and decomposed bedrock. Found at all boring locations, this layer varies between 12 and 35 ft. (approximately). This layer is underlain by the bedrock. The bedrock was cored in several locations and found to consist of hornblende and orthoclase gneiss with granite or quartz intrusions. The rock has frequent cracks or joints which were inferred from the loss of drill water and the recovery of broken rock cores. Ground water was noted

2.1 Physiography and Geology (Cont'd)

at elevations varying between + 55.24 and + 66.64, referred to City Datum. From the two studies, Site Engineers concluded that the natural soils on the site are basically granular and noncompressible. The area presents generally favorable subsurface conditions for the construction of light to heavy structures. Site Engineers noted that the subsurface conditions varied markedly from one location to another. They recommended that a specific evaluation be conducted for each structure planned for the urban renewal area. Such an effort is planned for Trenton ICES. However, Boring Area 3 (See Figure 2.1-1) is reasonably close to ICES and its data have been used to preliminarily plan the foundations for the generating equipment and the ICES building.

This area has a bedrock surface which is generally deep (in excess of 30 ft.) and overlain by strata of decomposed rock. Isolated pockets of fill may be encountered but the surface stratum is generally either fine sand or sand and gravel. The fine sand in its present condition can sustain light footing loads while medium to heavy footing loads may be supported by the sand and gravel. Very heavy building loads may be carried on piles. A discontinuity in rock type was encountered among borings in this area. It is probably the fault line which runs through the Trenton

Boring Area No. 3
Site Engineers
Program, 1966

Figure 2.1-1

2.1 Physiography and Geology (Cont'd)

area. Therefore, any plans for building in this area should include a careful investigation before piles are driven.

Flood levels were recorded in 1955 and referred to city datum as follows:

<u>Location</u>	<u>Elevation</u>
Filtration Plant	+73.3
War Memorial	+72.6
Freeway Bridge	+67.2

Records indicate that the ICES site is well above the 100 year flood level of both the Delaware River and Assunpink Creek (Reference (3)).

2.2 Land Use

Trenton ICES will be situated on the northwest corner of a parcel of land known as Disposition Parcel 14, Project Area No. 1 in the John Fitch Way General Neighborhood Renewal Project, an effort which began in the mid 1960's and which receives funding from the U.S. Department of Housing and Urban Development.

The latest revision of the urban renewal plan (not yet approved by the City or HUD) has the following objectives:

1. Establishment of new uses as part of the State of New Jersey Office Building Program and the Mercer County Office Building Program.
2. Provision of land to aid the First Lutheran Church of Trenton in realizing modernization plans.
3. Establishment of a new downtown focus, that is, a large shopping mall incorporating retail and other facilities which could include stores, theaters, a hotel or motel, and offices, and which shall include integrated parking facilities to be provided by the Trenton Parking Authority or Parking Utility.
4. Provision of new traffic ways for state and local purposes based on the city's master plan for downtown traffic ways and regional highway proposals.
5. Enhancement of historical Trent House by the expansion of its grounds.

2.2 Land Use (Cont'd)

6. Provision of an open public plaza adjacent to projected office tower construction.
7. Construction of a thermal/electrical generating station (Integrated Community Energy System - ICES) by Public Service Electric and Gas Company, which will provide energy for eighteen buildings existing/proposed (private housing, governmental offices and other public uses). The buildings serviced by the proposed generating station are either located in the Urban Renewal Project Area or are in close proximity of said area. As a support element of the generating station, Public Service Electric and Gas Company will also construct and bury fuel storage tanks underground at the site of the proposed parking garage (to be constructed by Trenton Parking Utility or Trenton Parking Authority) which will be located adjacent to the generating station.

Originally a run-down commercial and light industrial area, the John Fitch General Neighborhood Renewal Project Areas 1 and 2 will eventually contain a unified development business area with such permitted uses as: retail and service facilities, parking, offices (including those of government), hotels and motels, theaters, pedestrian malls and bridges, parks, and any structural elements necessary to cover Assunpink Creek.

2.2 Land Use (Cont'd)

Project improvements will consist of street widenings, the construction of new streets and utilities, the relocation and capping of utilities, and the provision of an open public plaza.

Residential, industrial or manufacturing uses, with the specific exception of a "'limited' capacity utility generating station" are prohibited.

All utility lines are required to be underground.

To the northeast lies the City Center South Urban Renewal Area whose objectives are:

1. Clearance of substandard buildings and the removal of mixed land uses and other blighting influences in the Central Business District.
2. Provision of commercial and mall facilities commensurate with Trenton's role as the State capital and the center of an urban region.
3. Provision of adequate public facilities in the central business district including improved water and sewer facilities, circulation improvements, parking facilities, parks and public open space and underground utilities.

ICES AREA LAND USE

Figure 2.2-1

2.2 Land Use (Cont'd)

Southeast of ICES the Mill Hill Historic District extends over portions of six city blocks. Nineteenth century town houses of architectural value are being restored privately. Due north of ICES the West State Street Historic District includes the major original State Office and other buildings.

Bordering John Fitch Way 1 and 2 to the south is John Fitch Way General Neighborhood Renewal Area No. 3 whose objectives include promoting high density residential development such as the Kingsbury and Luther Arms Projects.

The urban renewal and other general areas are shown in Figure 2.2-1.

Traffic flow patterns are to be improved in the entire area by eliminating narrow streets and alleys, improving intersections, and by requiring each building to provide one or more truck loading and unloading bays.

Typically present traffic loadings on ICES area streets are as follows (Reference 4):

<u>Street</u>	<u>Vehicles per Day (1976)</u>
South Warren	6,000 - 8,000
Livingston	6,600
Broad	8,000 - 16,000
East Lafayette	3,600

2.3 Social and Economic Setting

2.3.1 History

The first white settler in Trenton was Mahlon Stacy, an English Quaker, who obtained a land grant in 1679. The little hamlet which developed was called The Falls. Stacy built a wooden grist mill at the junction of Assunpink Creek and the Delaware River. This grist mill occupied a site on the south bank of the creek where it passes beneath South Broad Street. The brass marker denoting the grist mill site lies to the northeast of ICES on the other side of South Broad Street, but will be separated from ICES by the garage.

Stacy's son sold 800 acres of land to William Trent, a Philadelphia merchant, in 1714. Trent replaced the log mill with one of stone and later (1719) built a brick house which still stands on Market Street.

Trent laid out a town north of Assunpink Creek, and later Trent's Town became the county seat of Hunterdon County. Trent became a speaker in the Assembly and was Colonel of the Hunterdon County Militia. It is said that George Washington, the Marquis deLafayette and General Rochambeau were entertained at the Trenton House.

2.3 Social and Economic Setting (Cont'd)

2.3.1 History (Cont'd)

Trenton grew to a small village of 500 inhabitants during colonial times, primarily due to its strategic situation on travel routes between New York and Philadelphia. The availability of water power encouraged the establishment of mills and workshops. In 1745, the town received a royal charter of incorporation. By 1776, Trenton was a village of about 100 houses clustered along King and Queen Streets (now Warren and Broad Streets) which lie immediately to the north of the ICES site.

On the morning of December 26, 1776, Trenton was the scene of an important Revolutionary War battle. General Washington's troops crossed the Delaware and attacked the Hessian barracks at 8:00 that morning. Nearly 1000 prisoners were taken and the Colonial troops suffered only four wounded. The site where General Washington began his attack is marked by a 155 foot monument at the intersection of North Warren Street, North Broad Street, Brunswick, Pennington and Princeton Avenues. This is about six blocks north of the proposed ICES location. The Hessian barracks, of which one unit still stands, is located about 3-1/2 blocks northwest of ICES on North Willow Street.

2.3 Social and Economic Setting (Cont'd)

2.3.1 History (Cont'd)

Responding to Washington's attack, the English General Cornwallis arrived in Trenton shortly before sunset on January 2, 1777 and found the Continental troops drawn up on high ground near Assunpink Creek. The battle which followed is known locally as the Second Battle of Trenton, or Battle of the Assunpink. That night, Washington and his officers conferred in the Douglass House to determine their strategy. This house was originally located immediately opposite the ICES and garage site at 193 South Broad Street, but has since been relocated to its present site at the corner of East Front Street and South Montgomery Street.

Trenton became the State capital in 1790, having been rejected as the seat of the United States government. At the turn of the 19th century, industrial development in Trenton began in earnest.

The Trenton City landmarks list includes those landmarks appearing on the State and National Registers of Historic Places (Reference 5) as well as those of local interest designated by the City Council. Sixteen of the landmarks or areas nearest ICES are shown on Figure 2.3-1.

2.3 Social and Economic Setting (Cont'd)

2.3.1 History (Cont'd)

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2.3 Social and Economic Setting (Cont'd)

2.3.1 History (Cont'd)

In 1806, a 1,100 foot long bridge was built spanning the Delaware. In 1838, Trenton became the seat of the newly created Mercer County. This began Trenton's century of greatest growth.

The Delaware and Raritan Canal was built through Trenton followed by the Camden and Amboy Railroad. Water power development was furthered by the Delaware Falls Company, and the famous John A. Roebling began manufacturing steel cable. Pottery making thrived based on colonial activity. English and Irish craftsmen began producing wares which competed with those of European factories. Walter Lenox started the manufacture of fine china in 1888. Other industries established in the 19th century included rubber manufacture, shoes, furniture, jewelry, and paint. Soon Trenton became the national center for the manufacture of barbed wire and anvils, two products which helped to win the American West.

The DeLaval Steam Turbine Company established its major operation in Trenton in 1901. By 1920, the slogan "Trenton makes, the World takes" was displayed on a 330 foot long sign on a bridge across the Delaware. Trenton's population reached its

2.3 Social and Economic Setting (Cont'd)

2.3.1 History (Cont'd)

peak of approximately 125,000 between 1930 and 1950. Since that time, the population has declined, and in 1970 it was 104,638.

Trenton's position in New Jersey today is based on manufacturing: ceramics, rubber, and steel products, and by housing principal offices of the State and county governments. To strengthen Trenton's position, in March, 1976, Governor Brendon T. Byrne issued an executive order requiring agencies to return to their core cities (i.e., Trenton, Newark, or New Brunswick) as state leases expire on suburban office space.

2.3.2 Social Character and Economic Activity

At full development, the John Fitch Way General Neighborhood Renewal Projects 1, 2, and 3 will provide new offices and employment opportunities.

In this managed community, residential activity will be centered to the south in the following developments:

- a. Luther Arms - elderly housing
- b. Kingsbury I Highrise - low and moderate income
- c. Kingsbury I Lowrise - " " " "
- d. Kingsbury II Lowrise - " " " "

2.4 Biology

The ICES plant and parking garage site is used completely as a paved urban parking lot and, as such, ecologically significant plant and animal life is virtually absent. To the north, the bank of Assunpink Creek slopes to meet a concrete conduit completely enclosing the stream's flow. At full development, the John Fitch urban renewal project calls for an additional unit of Capital Place to lie directly astride this conduit. (See Fig. 3.2-1) Presently the stream banks support scrub brush and weed growth.

To the east Assunpink Creek Park contains a variety of managed landscape and natural plant species. The stream is channelized through old stone retaining walls and flows rapidly over rubble. To the west, below South Warren Street, Assunpink Creek emerges from the conduit and its banks support the growth of some deciduous trees.

2.5 Meteorology and Air Quality

2.5.1 Meteorology

The climate of Trenton is typical of urban central New Jersey. Winters with average temperatures near freezing are bracketed by relatively long periods of moderate temperatures in spring and fall. Summers are hot and humid (average temperature near 75° F with frequent daily maximums in the 80's and 90's).

2.5 Meteorology and Air Quality (Cont'd)

2.5.1 Meteorology (Cont'd)

There are approximately 5,000 heating degree days during the winter (approximately 1,000 per month in December, January, and February) with a base of 65° F. Cooling degree days are observed in summer with 300 to 400 per month being typical in July, August, and September (1100 full load equivalent cooling hours).

2.5.2 Air Quality

The air quality assessment for ICES Project is based on data collected by the New Jersey Department of Environmental Protection from its Trenton air quality monitoring system (Reference 6). These data were compared with State Ambient Air Quality Standards (NJAC7:27-13) for carbon monoxide, sulfur dioxide, and suspended particulates. Air quality data was collected at 16 East State Street in downtown Trenton. This location was affected by traffic on nearby through streets where the configuration of structures may have caused higher concentrations than in open areas.

Analysis of data NJDEP data indicates that the amount of sulfur dioxide in the ambient air in downtown Trenton exceeded the secondary National and State Ambient Air Quality Standards of 0.10 (ppm) for

2.5 Meteorology and Air Quality (Cont'd)

2.5.2 Air Quality (Cont'd)

a maximum 24 hour coverage only once during the 1973 monitoring period, and not at all during 1972. The primary standards for sulfur dioxide was not exceeded during these periods. While the carbon monoxide exceeded the primary standard for the maximum one hour average of 35 (ppm) fifteen times in 1972, these standards were only exceeded four times during 1973. The standards were not exceeded during the first 6 months of 1974. Primary standards of 9 (ppm) for the maximum 8 hour average were exceeded 3010 times in 1972, 1463 times in 1973, but were only exceeded 7 times during the first six months of 1974. More recently, however, the Trenton area in general has been declared a "non-attainment area" with respect to carbon monoxide and hydrocarbon air quality standards.

During the 1972 monitoring period, the 24 hour maximum concentration of suspended particulates recorded was 171 u g/m^3 and the Annual Geometric Mean was 68.0. Both of these readings are well below the primary standard of 260 u g/m^3 for the 24-Hour Maximum and the Annual Geometric Mean of 60 u g/m^3 . During the 1973 monitoring period, the system recorded

2.5 Meteorology and Air Quality (Cont'd)

2.5.2 Air Quality (Cont'd)

165 $\mu\text{g}/\text{m}^3$ as the 24-Hour Maximum with an Annual Geometric Mean of 73.3. This indicates that the 1973 concentration of suspended particulates exceeded the secondary air quality standards but were not in excess of primary standards.

The Trenton area is considered an attainment area with respect to air quality standards for oxides of nitrogen, particulates, and SO_2 .

Table 2.5-1

Trenton Air Quality Monitoring Data

	1974	<u>Ambient Air Quality</u>		<u>National and State Standards</u>	
	<u>(1st 6 Mo.)</u>	<u>1973</u>	<u>1972</u>	<u>Primary</u>	<u>Secondary</u>
Sulfur dioxide (ppm)					
Max. 3 hr. avg.		0.175	0.140	-	0.5
Max. 24 hr. avg.		0.115 (1) *	0.073	0.14	0.10
Annual Average		0.011	0.012	0.03	0.02
Carbon Monoxide (ppm)					
Max. 1 hr. avg.	21.0 (0) *	41.6 (4) *	41.5 (15) *	35	-
Max. 8 hr. avg.	10.0 (7) *	32.3 (1463) *	34.5 (3010) *	9	-
Particulates (u g/m ³)					
Max. 24 hr. avg.		165	171	260	150
Annual geom. mean		73.3	68.0	75	60

* No. of times standard was exceeded.

2.6 Ambient Sound Levels

ICES is located in an evolving area where traffic and construction are the principal sources of noise. Routine industrial activity is not prevalent, and the nearest concentrated residential area is centered around Jackson and Market Streets, approximately 1200 feet to the southeast. The John Fitch Way (Highway 29) lies approximately 1200 west, paralleling the Delaware River. Major exits and on ramps to this highway including Market Street itself serve ICES area traffic.

A complete description of a location's ambient sound level includes its magnitude at various frequencies as a function of time. It is common practice to consolidate frequency effects by measuring the A-weighted sound level. Noise regulations usually include A-weighted (dBA) standards. The A-weighted measurement approximates the response of the lower human ear and correlates well with the perceived "noisiness" and "annoyance" of a sound level.

The A-weighted sound level is neither constant nor uniform for any location. Temporary disturbances, moving noise sources, wind, etc. create noticeable variations. Noise measuring instruments are available which record the percentage of time certain incremental noise levels are exceeded, producing a characteristic profile of the location.

2.6 Ambient Sound Levels (Cont'd)

Such a twenty-four hour profile was recorded in late 1974 (Reference 7) at Market and Lamberton Streets near the John Fitch Way, approximately 1500 ft. from ICES (Table 2.6-1).

It is seen that sound levels exceeding 60 dBA were recorded nearly 20% of the time while 56 dBA (approximately) represents the sound level exceeded 50% of the time. Such levels are in the higher ranges of urban and commercial area data.

Table 2.6-1
Distribution of Noise Level
Market and Lamberton Streets, Trenton, J.J.

<u>Channel Number</u>	<u>dBA range</u>	<u>Percent of total</u>
1	> 40	7.8
2	> 40 to $\leq$ 45	2.0
3	> 45 to $\leq$ 50	8.2
4	> 50 to $\leq$ 55	20.9
5	> 55 to $\leq$ 60	41.7
6	> 60 to $\leq$ 65	16.4
7	> 65 to $\leq$ 70	2.5
8	> 70 to $\leq$ 75	.4
9	> 75 to $\leq$ 80	< .1
10	> 80 to $\leq$ 85	< .1
11	> 85 to $\leq$ 90	0
12	> 90	0

2.7 Water Quality

Trenton ICES is located immediately beside Assunpink Creek approximately 1/4 mile upstream from its confluence with the Delaware River. These two streams are the principal water bodies near the project.

The water quality and/or flow of Assunpink Creek is measured at five stations: Carson's Mills, Clarksville, Bakersville, at the Chambers Street Bridge in Trenton and at the Peace Street Bridge in Trenton near the Creek mouth (Reference 8). The Peace Street monitoring station is the closest to Trenton ICES.

In the 1976 Water Year (October 1975 to September 1976), Assunpink Creek's dissolved oxygen dropped steadily as the stream flowed between monitoring stations toward the Delaware River. At the same time, biochemical oxygen demand (BOD) rose. Nitrogen levels increased as did bacteriological counts. This is consistent with the creek's watershed activity which includes rapidly expanding housing developments as well as agricultural areas. An Environmental Protection Agency sponsored sewage treatment plant is under construction in nearby Hamilton Township.

During the same Water Year, the flow in Assunpink Creek at Chambers Street (where the drainage area is 89.4 sq. miles) ranged from 26 to 960 cubic ft. per second with a mean flow of 146 cubic ft. per second.

2.7 Water Quality (Cont'd)

The Delaware River is gaged at the raw water intake of the Trenton Water Department (drainage area: 6,780 sq. miles). During the Water Year October 1975 to September 1976, the daily average flow ranged from approximately 3,280 cubic ft. per second to 99,600 cubic ft. per second, with an average of 13,530. The annual average flow in the Delaware at Trenton over the period since 1913 has been 11,660 cubic ft. per second.

Water quality data indicate that the Delaware River at Trenton is suitable for a public drinking water supply following conventional treatment. All physical, chemical and bacteriological parameters were within (or could be reduced to) limits set by the national Interim Primary Drinking Water Regulations (Reference 9). The data included certain heavy metals and a variety of pesticides, the latter all being below detectable limits.

Ground water use in the Trenton ICES area is minimal. A public water supply system serves the area. Likewise, sanitary sewers serve the entire district and subsurface discharge of pollutants is not prevalent.

Assunpink Creek was observed on January 19, 1978 in the vicinity of the ICES project. It was channelized and rapidly flowing over stones and rubble, free of visible

2.7 Water Quality (Cont'd)

floating matter or oil sheen, and in an apparently healthy condition. Immediately to the north of the ICES site, previous construction has created a conduit which extends from South Warren Street a full block to South Broad Street. The entire flow of the creek passes through this conduit. It will act as a buffer between Assunpink Creek and the ICES construction activities.

CHAPTER 3 - POTENTIAL ENVIRONMENTAL IMPACT

3.1 Physiographic and Geologic Impact

3.1.1 Construction

Trenton ICES will be constructed on friction (possibly end bearing) piles as indicated by a site specific boring program not yet undertaken. Concrete pile caps will in turn support a reinforced concrete foundation slab. Equipment will be supported separately from the enclosure building on approximately 28 to 30 piles. The building will require a similar number of additional piles. Under normal circumstances such piles can be driven at the rate of approximately two per hour.

Existing site grade is nearly suitable for ICES necessitating only approximately 500 cu. yards of net excavation. Approximately 700 cu. yards of reinforced concrete will be used in the ICES foundations. Continuous (round-the-clock) pours are not anticipated; concrete delivery may be assumed to take place in the normal work day. Reinforced concrete bents for the ICES building framework are expected to be prefabricated and delivered to the site.

3.1 Physiographic and Geologic Impact (Cont'd)

3.1.1 Construction - (Cont'd)

The ICES foundations will be separated by a joint from those of the adjacent municipal parking garage.

The occurrence of ground water at moderate depths below grade should not affect ICES due to the slab foundation's near grade location. ICES' physical presence will bar ground water recharge, but, since this area has been historically urbanized, this is considered insignificant.

3.1.2 Operation

The principal potential geologic impact of gas turbine operations is the transmission of groundborne vibration to adjacent areas. This will be minimized by ICES' placement on piles in unconsolidated soils, which act to damp out vibrations. Furthermore, the supports for the gas turbines and the adjacent structures will be designed to promote isolation of the turbines and to prevent sympathetic vibrations elsewhere in the ICES building.

3.1 Physiographic and Geologic Impact (Cont'd)

3.1.3 Site Restoration

No significant earth moving or other structurally related activities are planned for site restoration.

3.2 Land Use Impacts

3.2.1 Construction

The ICES area has undergone constant change since the early 1960's when area demolition began. Since then a modern office and residential area has emerged with one or more buildings always under construction. Current activity is centered on Capital Place I immediately to the north of Assunpink Creek, opposite ICES.

The original land use (prior to 1960) of the ICES site was commercial and residential. Any disruptions caused by demolition and relocation are historical today. Construction noise, dust, traffic alterations, etc., are typical in the urban renewal area and will not cease until project completion in the 1980's. The present parking lot will be removed but replaced by the municipally owned parking garage within 2-3 years. Utilization of pedestrian walkways to support

3.2 Land Use Impacts (Cont'd)

3.2.1 Construction (Cont'd)

pedestrian walkways to support steam lines will minimize the number of street openings required.

3.2.2 Operation

ICES will not influence or preclude completion of the John Fitch urban renewal area as presently planned. The parking garage and pedestrian walkways are intended whether or not ICES exists, and ICES itself occupies only 10% of the 3 acre garage site. Existing and planned commercial and residential areas can accommodate the anticipated sound level increases attributable to ICES.

From a safety standpoint, both the gas turbines and the low pressure (125 psig) boilers present well proven technology and represent no hazard to the community.

Architecturally, the urban renewal area incorporates a variety of building styles, shapes and exterior treatments arranged on somewhat randomly oriented individual sites. ICES, although

3.2 Land Use Impacts (Cont'd)

3.2.2 Operation (Continued)

separate, will be keyed to the parking garage design (see Figure 3.2-1). The only new visual element not present in the immediate urban renewal area will be the four vertical exhaust stacks, extending approximately 100 feet above grade. These are unavoidable and necessary to disperse stack gases and to elevate the release point for exhaust sound emissions.

3.2.3 Site Restoration

No additional impacts over those described above are envisioned. Final ICES completion calls for an Energy Information Center accessible to parking garage patrons and any others interested in learning about ICES.

3.3 Social and Economic Impacts

3.3.1 Construction

ICES has little impact on the social and economic character of the immediate area distinguishable from that of the John Fitch urban renewal project in general. The total ICES project represents a capital investment of \$18 million, has provided engineering and architectural work already, and will produce

Capital Place
showing ICES
at Lower Right

ICES

Figure 3.2-1

3.3 Social and Economic Impacts (Cont'd)

3.3.1 Construction (Cont'd)

construction and manufacturing employment when implemented.

As mentioned in Section 3.2.2, the parking garage and walkways will be constructed in any event, and individual building energy systems (or a central heating plant only) will be required.

Under Section 106 of the National Historic Preservation Act, a site-specific archeological investigation is required prior to construction, if Federal funds are involved. Such a program will be conducted, if applicable.

3.3.2 Operation

ICES' overriding principal benefit will be the conservation of fossil fuels, by producing electric and thermal energy simultaneously with an overall efficiency of 63%.

In terms of employment, ICES will require a staff estimated at 12 persons. Initially, at least, they will be provided by transfer from other

3.3 Social and Economic Impacts (Cont'd)

3.3.2 Operation (Cont'd)

PSE&G facilities. No loss of jobs at existing Demonstration Community buildings is anticipated, since each will retain heat and air conditioning distribution equipment to which personnel could be reassigned.

During operation, fuel delivery (three trucks per working day) over existing streets would produce an indistinguishable increase over present traffic levels.

3.3.2.1 Safety

With respect to safety, both the gas turbines and the low pressure (125 psig) boilers represent well-proven technology and present a minimum hazard to the community at large.

In response to a request by the New Jersey Department of Environmental Protection, the safety aspects of ICES have been investigated and are discussed below.

Fire

Each gas turbine/generator unit will have an independent installed CO₂ or Halogen fire detection and protection system. Portable foam fire extinguishers will also be provided. The building and control room will have chemical

3.3 Social and Economic Impacts (Cont'd)

Fire (Cont'd)

or water base fire extinguishers appropriate to each area.

A fire at a PSE&G gas turbine unit occurred in 1972. The automatic fire extinguishing system responded immediately and the operating personnel used portable units. The fire was extinguished within a few minutes and all damage was confined to PSE&G property.

Boiler Explosion:

Pressure vessel explosions are extremely rare and are controlled by careful inspection and adherence to safety codes both in the design and maintenance of each boiler. ICES will use water tube boilers operated at a relatively low pressure, making it likely that any possible boiler drum explosion would be confined to the ICES building.

Furnace explosions have occurred at PSE&G units (1960 and 1966) but in both instances, damage was confined to the PSE&G property. The package boilers to be used for Trenton ICES will have automatic controls to minimize accidental accumulation of explosive gases and to purge the gases before furnace ignition.

3.3 Social and Economic Impacts (Cont'd)

Steam Line Rupture:

A major steam line rupture has never occurred in the PSE&G system. Leakages have taken place but no large pipes have been severed. In the ICES distribution system, the steam pressure will be relatively low and the steam lines will be either located on overhead pedestrian walkways or be buried. This will minimize the opportunity for damage to occur and will confine the effects of any leakage to a limited area.

Turbine Blade Failure:

Turbine blades or compressor disks have failed on two occasions within the PSE&G system, but in both cases, the effects were confined to the PSE&G plant.

The turbines to be used at Trenton ICES will not be prototype but will be of a proven design. Approximately 145 gas turbine units operate safely today in the PSE&G system.

Fuel Explosion:

The fuel for Trenton ICES will be No. 2 fuel oil, the same fuel used in many homes and commercial establishments. Fuel tanks will be underground and fuel deliveries will be made by qualified contractors. There is

3.3 Social and Economic Impacts (Cont'd)

Fuel Explosion: (Cont'd)

little likelihood that the fuel itself or its vapors could explode.

Fuel Leaks and Spills:

A fuel leak occurred at a PSE&G gas turbine plant during one of the turbine blade failure events described above. Leakage was prevented by emergency shutoff valves and confined to a limited area within the PSE&G property. The probability of a large offsite fuel leak or spill at Trenton ICES is very small.

In conclusion, each ICES gas turbine unit will be enclosed as well as located inside a building. All foreseeable accidents and their effects would be confined to the ICES building or premises.

ICES operating personnel will be trained to respond to all foreseeable accidents. In addition, automatic systems will respond and protect the machinery from damage and the public from harm.

3.3 Social and Economic Impacts (Cont'd)

3.3.9 Site Restoration

No increase over environmental impact levels described above will take place during site restoration.

3.4 Biological Impact

Due to the extremely limited existing biological content of the ICES site, no biological impact of any significance is anticipated in construction, operation, or site restoration.

3.5 Air Quality Impact

Trenton ICES will burn No. 2 Fuel Oil and will emit combustion products typical of a well designed, properly operated group of gas turbines using such a fuel. It should be noted that subsequent to October 1, 1971 No. 2 and lighter fuels have been limited to a sulfur content of 0.2% by weight or less (NJAC 7:27-9.2).

ICES' emissions of sulfur dioxide (SO₂), particulates, oxides of nitrogen (NO_x), hydrocarbons (HC's) and carbon monoxide (CO) are estimated in Table 3.5-1.

Table 3.5-1
ICES Atmospheric Emissions

	NO _x	HC's	CO	Particulates	SO ₂
Emission Factor (lbs/10 ³ gal)*	67.8	5.57	15.4	5.0	140 (S%)
Emission Rate					
Maximum Hourly (lbs)					
Maximum Daily (lbs)					
Average Daily (lbs)					
Annual (lbs)					
(tons)	135.6	11.14	30.8	10.0	56.0

Fuel Usage	Maximum Hourly	_____	gals
	Maximum Daily	_____	gals
	Average Daily	_____	gals
	Annual Average	<u>4,000,000</u>	gals

*DS Kircher and CC Masser, "Off Highway Stationary Sources," in Compilation of Air Pollutant Emission Factors. Part A, USEPA, February 1976.

3.5 Air Quality Impact (Continued)

New Jersey sets emission standards for particulates, smoke, and sulfur dioxide, based on heat release rate, opacity and fuel sulfur content respectively (NJAC 7:27-3, 4, and 9). ICES will comply with all such applicable standards.

No final Federal New Source Performance Standard for gas turbines exists. However, one has been proposed (40 CFR Part 60, October 3, 1977). Any such applicable standard in effect at the time of ICES construction will be observed. PSE&G has reviewed and considered the implications of the 1977 amendments to the Clean Air Act (PL95-95). Preoperational monitoring and modeling requirements are potentially applicable to ICES after August 7, 1978. They do not apply at present, and in any case are subject to modification by the State, to suit the particular area or application.

PSE&G is continuing to review ICES' atmospheric emissions, particularly NO_x and is seeking ways to reduce them. The turbine manufacturer has developed dry control systems for NO_x which show promise. Finally, credit was not taken for the exhaust gases' passage through waste heat boilers, a factor which significantly lowers the exhaust temperature and which could reduce overall emissions of NO_x.

3.5 Air Quality Impact (Continued)

The New Jersey Department of Environmental Protection which administers air pollution regulations in New Jersey, will be kept fully informed as ICES design and these analyses progress.

3.6 Sound Level Impact

3.6.1 Construction

The ICES foundations and enclosure building will require driving approximately 60 piles. This is anticipated to create the greatest amount of construction-related noise. Pile driving will require approximately one week to complete.

Other construction activity will be typical of that which has taken place in the urban renewal area over the last several years.

3.6.2 Operation

As planned, ICES will utilize four gas turbine and waste heat boiler modules. Such an installation, enclosed in a building as ICES will be, and with a vertical exhaust 100 feet above grade has not been field tested for sound level emissions. However, manufacturer's data (References 10, 11) is available for an encased Solar Centaur unit with near-ground level inlet and exhaust silencers. These data were used to estimate conservatively ICES' ability to comply with applicable State regulations.

3.6 Sound Level Impact (Cont'd)

3.6.2 Operation (Cont'd)

Table 3.6-1 summarizes sound emission levels and the predicted sound levels at the nearest commercial operation and group of private residences.

From Table 3.6-1 it is seen that the daytime continuous airborne sound standards set by New Jersey can be met for nearly every frequency during four-unit operation. Night compliance is indicated for one unit operation, using manufacturer's data. Thus it is seen that night operation of more than one unit will require an overall acoustic design which produces overall sound levels at 50 feet from the ICES building of 74 dBA. It is believed that this can be achieved through proper acoustic design.

It should also be noted that in the above analysis, credit was not taken for the sound attenuation which will occur when the turbine exhaust gases pass through the waste heat recovery boiler. It did not include the fact that ICES will be shielded from the most concentrated residential areas by the parking garage nor did it include the elevated, vertical exhaust.

Table 3.6-1
Trenton ICES Sound Level Impact

Octave Band (Hz)	Single Unit (dB at 50 feet)	Single Unit at Nearest Commercial Establishment (dB at 300 ft)	Applicable Standard (1)	Single Unit at Nearest Residence (dB at 800 ft)	Applicable Standard (1) Day Night	
63	81	67	82	57	82	71
125	76	62	74	52	74	61
250	74	60	67	50	67	53
500	72	58	63	48	63	48
1000	68	54	60	44	60	45
2000	64	50	57	38	57	42
4000	59	45	55	31	55	40
8000	56	36	53	20	53	38
dBA	74	60	65	50	65	50
	(Four Units)	(Four Units)		(Four Units)		
dBA	80	66	65	56	65	50

(1) NJAC 7:29-1, July 1, 1977

3.7 Water Quality Impact

3.7.1 Construction

The nearby waters of Assunpink Creek are effectively protected from any influence during ICES construction by the protective conduit through which the creek flows. Nevertheless an acceptable erosion and sediment control plan will be prepared and submitted to the Mercer Soil Conservation District. Concrete wash water should not be a problem since concrete will be delivered from an off site source. Portable toilets will be maintained for the construction workers.

3.7.2 Operation

Toilet and lavatory facilities for 12 persons will be provided and connected to the Trenton municipal sewage system. Boiler makeup and condensate polishing demineralizer regenerants and rinses will produce approximately 6 gallons per minute of waste. This waste stream will be discharged to the municipal sewer. The only connection with surface waters will be roof and storm drains associated with ICES which will either connect with the Trenton municipal storm drain system or proceed directly to Assunpink Creek. Any such discharge will be free of oil, grease and significant quantities of suspended solids.

3.8 Unavoidable Adverse Environmental Impact

3.8.1 Construction

The unavoidable environmental impacts of construction which have been described in detail elsewhere are summarized below.

1. Pile driving
2. Construction related trucks and other traffic
3. Limited street openings
4. Temporary removal of the existing parking spaces on the ICES portion of the site.

3.8.2 Operation

The unavoidable environmental impacts of operations, which have been described in detail elsewhere are summarized below.

1. Sound Level Impact
2. Air Quality Impact
3. Visual Appearance of Exhaust Stacks
4. Transportation of Fuel to ICES

3.8.3 Site Restoration

No other adverse environmental impacts other than those described above are anticipated.

3.9 Irreversible or Irretrievable Commitments or Resources

3.9.1 Construction

ICES will require approximately 1/3 acre of valuable urban land. This land however, would either be absorbed into the adjacent parking garage or used for another urban renewal related activity. ICES does not detract from planned open spaces for the urban renewal project. As an individual entity it does not visually intrude on any park or historic location.

3.9.2 Operation

The materials of construction needed for ICES are generally available. None have been identified as in short supply.

PSE&G has investigated the availability of fuel oil for ICES and has determined that there are no apparent general constraints (Bardin, 1977). The total annual oil consumption is 90,900 barrels.

3.9.2 Operation (Continued)

Natural gas is a resource which is in short supply, and it is unavailable at present for ICES. Gas turbines such as those planned could switch to natural gas, for example if offshore drilling makes it available. Then oil could be conserved. Figure 3.9-1 shows the savings in oil consumption due to the operation of ICES vs. conventional oil burning heating and electric generating systems.

3.9.3 Site Restoration

No other adverse environmental impacts beyond those described above are anticipated.

CHAPTER 4 - COORDINATION WITH FEDERAL, STATE, REGIONAL OR LOCAL PLANS AND POLICIES

Agencies contacted during initial review of ICES feasibility were the New Jersey Departments of Environmental Protection, Labor and Industry, and Commerce, the Delaware Valley Regional Planning Commission, the Delaware River Basin Commission, the New Jersey Public Utilities Commission, the New Jersey State Energy Office, and the Trenton City Planning Board. Input from these agencies was encouraged and has been received in many instances. It has been determined that the Board of Public Utilities will regulate ICES in the area of its franchise, the issuance of financial instruments, and the setting of rates, and will act on PSE&G's application to sell steam. Federal Power Commission (now Federal Energy Regulatory Commission) jurisdiction will also apply since ICES will be connected to the Pennsylvania-New Jersey-Maryland electrical grid.

The ICES demonstration team has actively promoted public participation through meetings, news releases, and the dissemination of printed information.

4.1 Demonstration Community/Urban Renewal Plan

The ICES project has been coordinated with the City of Trenton and it is believed to be entirely compatible with the objectives of the John Fitch General Neighborhood Urban Renewal Plan, although the plan must be amended.

4.1 Demonstration Community/Urban Renewal Plan (Cont'd)

Under a proposed agreement, PSE&G will be a "redeveloper" of the ICES parcel. PSE&G will own the ICES land in fee and have a use covenant with the City of Trenton valid for 40 years. PSE&G will supply the City with detailed construction, landscape, lighting, vehicular, pedestrian and construction staging plans, and a narrative statement, all for City approval. Monthly progress reports will be supplied and any changes will require City approval.

Before the project is initiated a formal application to the Trenton Municipal Planning Board must be submitted. If approved, the Planning Board would authorize an otherwise nonconforming electrical generating plant within the so called "Business-A" district. Then an amended urban renewal plan must be submitted to the U.S. Department of Housing and Urban Development, following action by the Planning Board (including public hearings), and City Council vote. Concurrent review is required (including this Environmental Assessment) by the Delaware Valley Regional Planning Commission and the New Jersey Department of Community Affairs (NJDCA).

4.2 Building Permit

On September 25, 1977 a meeting was held with representatives from the NJDCA, the New Jersey Department of Labor and Industry - Division of Mechanical Inspection, and the City of Trenton Building Inspector to discuss ICES' special requirements. Fire separation requirements between plant, garage, and walkways were discussed. The arrangement plans were revised accordingly.

It was also determined that PSE&G is responsible for any street opening permits which may be required.

ICES will be built in accordance with all applicable portions of the BOCA Code.

4.3 Air Quality Management

Trenton ICES will be constructed and operated in accordance with all applicable State and local regulations and ordinances related to air pollution control.

It will be necessary to secure a permit to construct and a certificate to operate air pollution control apparatus or equipment from the New Jersey Department of Environmental Protection (NJAC 7:27-8). This will control the ICES final design with regard to atmospheric emissions.

4.3 Air Quality Management (Cont'd)

The sulfur content in ICES' fuel will not exceed 0.2% (a requirement of NJAC 7:27-9). Smoke emissions will meet State requirements (NJAC 7:27-3).

During air pollution control alerts, warnings and emergencies, ICES can comply with the standby plans of NJAC 7:27-12 as follows:

1. ICES will use fuel with the lowest available ash and sulfur content.
2. ICES can curtail boiler lancing or soot blowing.
3. ICES' electricity will not ordinarily be essential to the P-J-M grid; electric generation could cease, leaving the auxiliary boilers to satisfy Demonstration Community thermal demand.

4.4 Solid and Liquid Wastes

With respect to normal refuse, municipal collection services will be used. No large quantities of toxic or hazardous material will be stored or used at ICES. Liquid wastes will be handled as described in Section 3.7 with sewage, demineralizer wastes and boiler blowdown being collected for municipal treatment.

4.5 Sound Levels

Noise abatement from ICES must enable compliance with New Jersey Standards. This is fully described in Section 3.6 above, and it has been determined that ICES will be designed to comply with applicable sound level standards.

A letter from Mr. E. J. DiPolvere, NJDEP Office of Noise Control, has been received indicating optimism concerning ICES' basic ability to comply with State noise standards, based on a preliminary assessment in June, 1977.

4.6 Drainage

The State requires that an erosion and sediment control plan be approved by the Mercer Soil Conservation District since ICES will disturb more than 5,000 square feet of land. Such a plan will be filed for approval and will control any adverse impact from ICES area storm water flows. No liquid waste will be discharged directly to any surface water, including Assunpink Creek. Settled storm drainage may be permitted to drain to the creek depending on final design.

4.7 Industry Standards & Codes

Nearly every project involving fuel combustion, boilers, electric transformers and other equipment is regulated or guided by industry codes and standards. PSE&G makes it a practice to observe these codes wherever applicable and will ensure that all applicable portions of ASME, ASTM, IEEE, etc., standards are followed and that the entire project is built in accordance with applicable portions of the BOCA code.

4.8 Flood Plain, Wetlands, Coastal Area Management, Etc.

ICES is not located in a designated flood plain area (See Section 2.1). Neither is it located in a wetlands area or an area covered by the Coastal Area Facilities Review Act. Therefore, no agency coordination on these matters is required.

CHAPTER 5 - SHORT TERM USES VS. LONG TERM MAINTENANCE AND ENHANCEMENT OF ENVIRONMENTAL PRODUCTIVITY

5.1 Cumulative and Long Term Effects

ICES sound level impact, although within acceptable limits, uses a substantial portion of the available margin of sound level increase within the immediate urban renewal area. This would influence the siting of other projects producing significant sound levels. However, within the urban renewal area no such projects are planned.

Anticipated atmospheric emissions will influence air quality in the Trenton area airshed to the extent they will disperse in the area. However, their relative contribution is very small (See Section 3.5) and no cumulative or chronic condition is anticipated.

5.2 Short Term Gains Vs. Long Term Losses

ICES is compatible with the overall urban renewal and Demonstration Community plans. As a prototype project, its fuel use represents a substantial gain over existing oil fired electric generating capacity and building energy systems. PSE&G is committed to major system electric power expansion by a series of nuclear power plant projects and considers such an approach the most viable on a large scale under present economic and environmental conditions.

5.2 Short Term Gains Vs. Long Term Losses (Continued)

For a particular urban or industrial situation, cogeneration may provide a worthwhile option. For this reason, PSE&G proposes to build, operate and evaluate ICES.

5.3 Project Influence on Future Options

The construction and operation of ICES utilizes only a small land parcel within a large urban renewal community. Its presence imposes little influence on future options. In the distant future ICES is readily removable or convertible to other uses.

The chief influence on future options applies to those buildings which connect to ICES and become dependent on a central steam source. New buildings will not possess their own individual heating plants and existing buildings will abandon (and probably remove) theirs. An investment in a steam transmission network will have been made. Therefore, if the ICES concept is unsuccessful, a central steam plant will need to be maintained for the life of the Demonstration Community buildings. This can be accomplished by removing the gas turbine and waste heating boiler modules, but maintaining the auxiliary boiler component of ICES.

5.3 Project Influence on Future Options (Continued)

A successful ICES demonstration will prove the concept, and generate operating experience, and may open the way to future cogeneration projects in appropriate settings.

CHAPTER 6 - ALTERNATIVES

In preparation. To be supplied with final report.

CHAPTER 7 - REFERENCES

- (1) Site Engineers, Inc., Morristown, N.J., letter to Hyman Korman, Inc., August 21, 1963.
- (2) Site Engineers, Inc. Morristown, N.J., Report on Preliminary Soil Survey, John Fitch Way, Urban Renewal Project Area No. 3, Trenton, N.J., Project No. 892, July 5, 1966.
- (3) City of Trenton, U.S. Department of Housing and Urban Development, Federal Insurance Administration, Federal Flood Hazard Boundary Map, January 2, 1976.
- (4) Delaware Valley Regional Planning Commission, Trenton C.B.D. Highway Network, map, 1977.
- (5) Trenton Municipal Historic Landmarks List, 1977.
- (6) Trenton Department of Planning and Development, Air Quality Assessment, Fitch Way III Urban Renewal Project NJR-74, 1974.
- (7) NJDEP, Office of Noise Control, letter to Trenton Department of Planning and Development, January 23, 1975.
- (8) U.S. Geological Survey, Water Resources Data for New Jersey, Water Year 1976, Water Data Report NJ-76-1.
- (9) U.S. Environmental Protection Agency, National Interim Primary Drinking Water Regulations, 1976.
- (10) Solar, a division of International Harvester, Report on Sound Attenuated Enclosures for Solar Gas Turbines, September 1, 1976.
- (11) Solar, a division of International Harvester, Sound Attenuation Data for Solar Industrial Gas Turbines, March 1975.

APPENDIX R

(3.5.2 c)

PRELIMINARY DESIGN

117233 A 110

MEZZANINE

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1	2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6	7	8	9	10	11	12

CITY OF TRENTON ENGINEERING DEPARTMENT 117233 A 110		TRENTON ICES	
RICHARD S. STEIN AND PARTNERS 117233 A 110		MEZZANINE PLAN - EL. 87' 6"	
R. S. HANDELMAN ENGINEERING INC. 117233 A 110		PUBLIC SERVICE ELECTRIC AND GAS COMPANY ENGINEERING DEPARTMENT NEWARK, N. J.	
117233 A 110		117233 A 110	

117234 A 110

ROOF PLAN

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CITY OF TRENTON DEPARTMENT OF PLANNING AND DEVELOPMENT RICHARD A. STEIN AND PARTNERS ARCHITECTS AND ENGINEERS 100 N. 3RD STREET, 10TH FLOOR PHILADELPHIA, PA. 19106 TURNER CONSTRUCTION COMPANY 100 N. 3RD STREET, 10TH FLOOR PHILADELPHIA, PA. 19106		TRENTON ICES <small>TRAIL II</small> MECHANICAL ROOF PLAN PUBLIC SERVICE ELECTRIC AND GAS COMPANY ENGINEERING DEPARTMENT NEWARK, N.J. DATE: 5-18-78 DRAWN: J.E.B. CHECKED: J.E.B. 117234 A 110B	
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TRENTON ICES CHASE II
 100% COTTON 100% COTTON

SECTION "A-A"

JOURNAL OF MANAGEMENT INQUIRY

SERVICE ELECTRIC AND GAS COMPANY

SEEKING DEPARTMENT

NEWARK, N. J.

DATE 8-12-78

DATE RECEIVED _____

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117235 **A** 1109

SECTION H-H

CITY OF TRENTON MUNICIPALITY OF TRENTON AND BUREAU OF RECORD & TITLE AND PLANNING TRENTON, NEW JERSEY	TRENTON ICES	PLASE 11 PLANT 11
R. H. TANNERSON ENGINEERS INC. ENGINEERING CONSULTANTS, 1000 N. 1ST STREET, PHILADELPHIA, PENNSYLVANIA 19107	SECTION "B-B"	
TURNER CONSTRUCTION COMPANY 1000 N. 1ST STREET, PHILADELPHIA, PENNSYLVANIA 19107	AFFIDAVIT	NOT RECORDED
PUBLIC SERVICE ELECTRIC AND GAS COMPANY ENGINEERING DEPARTMENT TRENTON, N. J.	SECTION "B-B"	
GENERAL NOTES: ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE SPECIFICATIONS AND CONDITIONS OF THE CONTRACT AND THE STANDARD SPECIFICATIONS FOR PUBLIC UTILITIES CONSTRUCTION AND MAINTENANCE.	DATE: 3-15-78 BY: [Signature] FOR: [Signature]	
THE RECORDING OFFICE HAS RECEIVED THIS INSTRUMENT FOR RECORDING.	* 117236 A 1109	

117237 A 1109

SECTION "C-C"

NO.	REVISION
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CITY OF TRENTON DEPARTMENT OF PLANNING AND DEVELOPMENT RICHARD S. STEIN AND PARTNERS ENGINEERS AND ARCHITECTS 100 N. 2ND STREET, SUITE 200 TRENTON, NEW JERSEY 08602 ROBERT G. HAN ASSOCIATES, P.C. ENGINEERS AND ARCHITECTS 100 N. 2ND STREET, SUITE 200 TRENTON, NEW JERSEY 08602 TURNER CONSTRUCTION COMPANY 100 N. 2ND STREET, SUITE 200 TRENTON, NEW JERSEY 08602		TRENTON ICES PHASE II SECTION "C-C" MECHANICAL PUBLIC SERVICE ELECTRIC AND GAS COMPANY ENGINEERING DEPARTMENT NEWARK, N. J. 117237 A 1109	
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117721 A 1057

CITY OF TRENTON
 ENGINEERED BY PLANNING AND DEVELOPMENT
 WILLIAM B. STEIN AND PARTNERS
 100 N. 11TH ST. PHILADELPHIA, PA. 19107
 R. A. SANDERSON ENGINEERS INC.
 100 N. 11TH ST. PHILADELPHIA, PA. 19107
 ROBERT D. HANSEN ASSOCIATES, INC.
 100 N. 11TH ST. PHILADELPHIA, PA. 19107
 THOMAS CONSTRUCTION COMPANY
 100 N. 11TH ST. PHILADELPHIA, PA. 19107

TRENTON ICES		CHART 11
MAIN STEAM SYSTEM		
PUMPING DIAGRAM	MECHANICAL	
PUBLIC SERVICE ELECTRIC AND GAS COMPANY		
ENGINEERING DEPARTMENT		
NEWARK, N. J.		
DATE: 1-15-78	BY: J. J. J.	REVISION: 1
117721	A 1057	

501 V 222 211

CITY OF TRENTON
 ENGINEER IN CHARGE AND SUPERVISOR
 RICHARD A. STEIN AND PARTNERS
 100 N. 10TH ST. 10TH FL.
 PHILADELPHIA, PA. 19107
 ROBERT J. ALLEN, ASSOCIATE, P.E.
 TOWN OF TRENTON, N.J. 08611
 TURNER CONSTRUCTION COMPANY
 PHILADELPHIA, PA. 19107

TRENTON ICES PAGE 11
 BOILER FEED & CONDENSATE SYSTEM
 JAMES J. JACOBSON RECOMMENDED
 PUBLIC SERVICE ELECTRIC AND GAS COMPANY
 ENGINEERING DEPARTMENT
 NEWARK, N.J.
 Date: 1-18-78
 No: 117722
 117722 A 1057

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CITY OF THENTON
DEPARTMENT OF PLANNING AND DEVELOPMENT
RICHARD G. STEIN AND PARTNERS
ARCHITECTS, NEW YORK, N.Y.
R. E. YANDEPVELL ENGINEERS INC.
THENTON, THENTON, THENTON, N.J.
ROBERT SILMAN ASSOCIATES, P.C.
THENTON, THENTON, THENTON, N.J.
TURNER CONSTRUCTION COMPANY
THENTON, THENTON, THENTON, N.J.

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TRENTON ICES PHASE II DRAWINGS

MAIN STEAM SYSTEM

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
ENGINEERING DEPARTMENT
NEWARK, N. J.

NEWARK, N. J.
FROM: W. J. S. N. E. M. TO: J. G. H. E.
DATE: 2-5-78
SUBJECT: S. G. A. P. 3

117750 **A** IIII

CITY OF TRENTON
 DIVISION OF PLANNING AND DEVELOPMENT
 RICHARD S. STEIN AND PARTNERS
 ENGINEERS, P.C.
 100 N. 2ND ST., 10TH FL.
 TRENTON, NJ 08602
 RICHARD S. STEIN AND PARTNERS
 ENGINEERS, P.C.
 100 N. 2ND ST., 10TH FL.
 TRENTON, NJ 08602
 ROBERT S. SILVERMAN ASSOCIATES, P.C.
 100 N. 2ND ST., 10TH FL.
 TRENTON, NJ 08602
 TURNER CONSTRUCTION COMPANY
 100 N. 2ND ST., 10TH FL.
 TRENTON, NJ 08602

NO.	DATE	BY	CHKD.	REVISION
1	10-1-58	J. J. J.	J. J. J.	1
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3	10-1-58	J. J. J.	J. J. J.	3
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11	10-1-58	J. J. J.	J. J. J.	11
12	10-1-58	J. J. J.	J. J. J.	12

NOTES:
 1. SEE SPECIFICATIONS FOR GAS TURBINE AND FUEL OIL SYSTEM.
 2. SEE SPECIFICATIONS FOR GAS TURBINE AND FUEL OIL SYSTEM.
 3. SEE SPECIFICATIONS FOR GAS TURBINE AND FUEL OIL SYSTEM.
 4. SEE SPECIFICATIONS FOR GAS TURBINE AND FUEL OIL SYSTEM.

CITY OF TRENTON ENGINEERING DEPARTMENT RICHARD STEIN AND PARTNERS ENGINEERS ARCHITECTS 100 N. 3RD ST. TRENTON, N.J. 08602		TRENTON ICES FUEL OIL SYSTEM PUBLIC SERVICE ELECTRIC AND GAS COMPANY ENGINEERING DEPARTMENT NEWARK, N.J.	
PROJECT NO. 117752 DRAWING NO. A 1111		DATE: 10-1-58 BY: J. J. J. CHECKED: J. J. J.

RELAY LIST	FUNCTION	TYPE
1	VOLTAGE REGULATOR	120V
2	LOSS OF EXCITATION	120V
3	HEAT RESEQUENCE	120V
4	GENERATOR OVERCURRENT	120V
5	GENERATOR OVERCURRENT	120V
6	GENERATOR OVERCURRENT	120V
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97	GENERATOR OVERCURRENT	120V
98	GENERATOR OVERCURRENT	120V
99	GENERATOR OVERCURRENT	120V
100	GENERATOR OVERCURRENT	120V

INSTRUMENT	DESCRIPTION
1	AC AMMETER
2	AC VOLTMETER
3	AC WATTMETER
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CITY OF TRENTON
ENGINEERING DEPARTMENT
TRENTON, N.J.

REVISION

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TRENTON ICES (PAGE 11)
DRAWING

ONE LINE DIAGRAM

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
ENGINEERING DEPARTMENT
TRENTON, N.J.

117753 A IIII

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MOORE CUT-OFF RELAYS

GC-64

MODEL 64 AIR-TO-OPEN RELAY

MODEL 64D AIR-TO-CLOSE RELAY

ALL CONNECTIONS ARE 1/4" NPT

Series 64 cut-off relays are actually two-port, air-actuated valves—designed for pneumatic service.

The model 64 is a normally closed (air-to-open) relay. As the above drawing illustrates, the application of an actuating pressure will open the valve-plunger assembly; permitting the input pressure to pass directly to the output connection. This relay has a metal-to-metal valve seat.

The model 64D is a normally open (air-to-close) relay. In this case, the application of a loading pressure will force the diaphragm rod downward; effectively sealing off the input pressure from the output. This relay uses a neoprene seat to insure a bubble-tight seal.

With either of these relays, the output pressure will be cut off—or turned on—by a much lower actuating pressure.

Remote Cut-Off for Model 50 Controller

Series 64 cut-off relays were designed originally for use with certain Nullmatic controllers. Other Moore

controllers incorporate an integral cut-off relay for automatic-manual switching. In either case, whether the cut-off relay is built into the controller or if it is not, the relay is used to cut off the controller output and to seal in the valve pressure.

The illustration at the bottom of the page shows how a 64D cut-off relay can be used with a remotely mounted model 50 controller and a "T4R" control station.

The preceding example shows the principal use of series 64 cut-off relays. However, these instruments are also often used in simple pneumatic circuits, where a positive cut-off action—with a low actuating pressure—is required.

OPERATING CHARACTERISTICS

	Model 64	Model 64D
Nominal actuating pressures for input of 20 psi	1-4 psi	1-2 psi
Maximum operating pressure:	60 psi	
Ambient temperature limits:	-25° to +180°F	
Capacity: with 25 psig supply and 0 psig outlet	2 scfm	

Materials of Construction

Aluminum, brass, stainless steel, and neoprene.

Flow Controllers

For liquid-flow applications, each of these instruments will provide a constant mass flow— independent of pressure changes.

ALL CONNECTIONS ARE 1/4 NPT
MOUNTING HOLES ARE 9/32 DIA.

For gas-flow applications, compressibility must be considered if a constant mass flow is desired. Therefore, two types are available, for either constant upstream or constant downstream reference pressure.

The needle valve helps to determine rangeability and capacity. Four valves available from stock.

MODEL 63BU

FOR GASES WITH CONSTANT UPSTREAM REFERENCE PRESSURE

MODEL 63BD

FOR GASES WITH CONSTANT DOWNSTREAM REFERENCE PRESSURE

These instruments are used in conjunction with an external needle valve to provide constant volume flow rates for either liquids or gases over a continuously adjustable flow range. With liquids—which are, of course, not compressible—the constant volume flow will also be a constant mass flow.

The ability to control at very low rates (in the order of one scc/min) and their wide rangeability (as high as 500:1 for the low-flow units) make these controllers useful in a wide variety of applications. One widespread use is in gas chromatography, in which the controller regulates the small (20-200 sccm) helium stream that carries the process sample. Other applications include: liquid purge and blending operations in process plants, a wide variety of precision flow controls in pilot plants, and many uses in laboratories.

MODEL SELECTION: The selection of a controller for gas-flow applications depends upon whether the upstream or the downstream pressure will remain con-

stant. There are types for both conditions. Either type may be used for liquid flow (since compressibility is not a factor).

GENERAL SPECIFICATIONS

► MATERIALS

	Brass Units	316 SS
Body	Brass	316 SS
Diaphragm	Neoprene	KYNAR
Differential Spring	18-8 SS	316 SS
Valve Plunger & Seat	303 SS	316 SS
Plunger Spring		
(used in "D" models only)	63BD 316 SS	316 SS
	63BD-L Phos. Br.	316 SS

► RATINGS

Temperature	180°F	250°F
Pressure*	250 psi	500 psi

* If the needle valve is to be closed maximum pressure must be limited to 50 psig for the Model 63BU-L and 63SU-L and 100 psig for all the others. This is to prevent damage to the diaphragm and seats.

PRINCIPLE OF OPERATION

Moore Low-Flow Controllers maintain a constant differential in the pressures across an external needle valve or other restriction, making the flow a function of the needle valve opening only.

On gas applications (where compressibility is a factor), the type of controller used is determined by the pressure conditions. For applications with constant pressure upstream, the type and circuit shown in the upper schematic is used. The constant pressure serves as a reference on the top of the controller diaphragm, and the loading spring exerts a constant force which results in an output which is always 3 psi less than the reference pressure. On the second type, used with constant pressure downstream, the directions of loading spring force and pilot-valve operation are reversed.

MODEL NO.	Brass Units	316 SS Units
For liquid-flow control independent of pressure or—		
for gas-flow control	63BD	63SD
with constant downstream pressure	63BD-L*	63SD-L*
	63BD3A†	—
	63BD4A‡	—
for gas-flow control		
with constant upstream pressure	63BU	63SU
	63BU-L*	63SU-L*
* with special valve plungers and ports to handle very low flow rates.		
† piped assembly, including rotameter (scale 0.25–2.5 scfh, gas)		
‡ piped assembly, including rotameter (scale 18–180 cc/min., H ₂ O)		

	Higher Range Models 63BD and 63SD; 63BU and 63SU	Low Flow Models 63BD-L and 63SD-L; 63BU-L and 63SU-L
GAS FLOW-CAPACITY		
Maximum at less than critical flow *	$SCCM = 4000 \sqrt{\frac{\Delta P}{SG}} \times P_d \times \frac{530}{T}$	$SCCM = 400 \sqrt{\frac{\Delta P}{SG}} \times P_d \times \frac{530}{T}$
Maximum at critical flow *	$SCCM = 2000 P_u \sqrt{\frac{1}{SG} \times \frac{530}{T}}$	$SCCM = 200 P_u \sqrt{\frac{1}{SG} \times \frac{530}{T}}$
Minimum controllable flow	Approximately 1/200 of maximum	$SCCM = 8 \frac{\Delta P (P_u + P_d)}{R_v T}$
LIQUID FLOW-CAPACITY		
Maximum	$CCM = 470 \sqrt{\frac{\Delta P}{SG}}$	$CCM = 47 \sqrt{\frac{\Delta P}{SG}}$
Minimum	Approximately 1/200 of maximum	$CCM = .06 \frac{\Delta P}{R_v}$
NEEDLE VALVE SIZING (With 3 psi drop across valve)		
For any liquid	$Kn = \frac{CCM}{6550 \sqrt{\frac{1}{SG}}}$	
For any gas	$Kn = \frac{SCCM}{49000 \sqrt{\frac{1}{SG} \times P_n \times \frac{530}{T}}}$	

*Critical flow exists when the ratio of upstream pressure (Pu) to downstream pressure (Pd) is equal to or less than approximately 0.53:

$$\frac{P_d}{P_u} \leq 0.53$$

The actual ratio value for air is 0.528; it should be noted that it varies slightly for other gases.

SCCM = Cubic centimeters per minute of gas at standard conditions (70°F, 14.7 psia). Note: 1 SCF = 28,317 SCC.

ΔP = psi pressure drop across the controller valve = total drop minus 3 psi.

P_u = psia pressure at inlet of controller (allow 3 psi for drop across the needle valve, if it is installed upstream).

P_d = psia pressure at outlet of controller (allow 3 psi for drop across the needle valve, if it is installed downstream).

P_n = psia pressure at outlet of needle valve.

SG = Specific gravity of the gas referred to air, or specific gravity of the liquid referred to water at 4°C.

T = Absolute temperature of the gas = degrees F + 460.

R_v = Ratio of viscosities of gas referred to air; or Ratio of viscosities of liquid at operating temperature to water at 4°C.

Kn = Flow constant of needle valve.

Rangeability and minimum controllable flow of each size depend upon the needle valve used, the specific gravity of the fluid, the operating pressures, and other factors.

The formulas permit calculation of maximum flows for both the low-flow and higher-range models. Because minimum flows occur in a laminar pattern with the low-flow models, a separate formula is furnished. Rangeability is considerably higher on gases than on liquids.

FLOW-RANGE EXAMPLES

Conditions:

15 psig (29.7 psia) at inlet of controller

10 psi drop across controller (not including 3 psi needle-valve drop)

70° F. process temperature

	Max. Flow	Min. Flow
Higher-range units (Series 63)		
On air	56,000 scc/min	280 scc/min
On water	1,500 cc/min	7.5 cc/min

Low-range units (Series 63-L)

On air	5,600 scc/min	7 scc/min
On water	149 cc/min	0.6 cc/min

NEEDLE VALVES: Rangeability and capacities (especially minimum flows) are also determined by the needle-valve design and characteristics. Four valves are offered, covering many conventional application requirements. (The last two listed are often used with the low-flow models.)

Part No.	Body	Needle	Kn*	Rangeability
3036	SS	SS	0.37	100:1
3034	SS	SS	0.15	350:1
10846	Brass	SS	0.09	500:1
10847	SS	SS	0.09	500:1

* Flow factor in Moore formulas.

PURGE-FLOW CONTROL

SPECIFIC-GRAVITY-CONTROL APPLICATION

The diagram above shows a typical specific-gravity-control application, in which:

Two purge-flow controllers maintain a constant purging condition for the particular settings of their integral needle valves.

A Nullmatic differential-pressure transmitter measures the difference in pressures within the two dip tubes and transmits an air-pressure signal to a model 55 Nullmatic controller.

The controller, illustrated, contains its own control-point-setting regulator. In the diagram, a model 73 built-in valve positioner is being controlled by the output pressure of the Nullmatic controller.

The diagram below illustrates a typical liquid-level air-purge control application. Such applications are generally considered noncritical.

LIMITATIONS: These vented instruments were not designed for liquid-purge applications. For information on series 63 low-flow controllers (used for liquid purging), request GC-63.

MODELS
62V
62VNA

MOORE PRODUCTS CO.
Spring House, Pa. 19477

Foreign Manufacturing Subsidiaries:
Canada, United Kingdom & Mexico

Constant-Differential Relays

MODEL 62VNA

ALL CONNECTIONS 1/4 NPT

*OPTIONAL

These constant-differential relays serve as air-flow controllers, maintaining an essentially constant air purge for each setting of an integral needle valve.

By maintaining a constant differential-pressure drop across a built-in needle valve (for any flow setting up to about 1 cu. ft. of air per minute), each instrument insures an essentially constant volumetric rate of flow—regardless of variations in process or supply pressure.

The differential applied to the integral needle valve is determined by a spring-loaded diaphragm. This diaphragm controls the action of the supply-port plunger, automatically admitting supply air to the needle valve at the required rate. Excess purge air bleeds to the atmosphere, when necessary.

Series 62 constant differential relays are made entirely of brass, stainless steel and neoprene. These components are not affected by ordinary air-line impurities.

Note: Models 62VN and 62VNA permit flows of less than 0.9 scfh. It is therefore recommended that a flow indicator be used in the downstream line.

Model No.		Purge Rate cfh
62V		0.9 to 2.1
62VA	pipcd assembly†	0.9 to 2.1
62VN		0.06 to 1.8
62VNA	pipcd assembly†	0.06 to 1.8

† Includes indicating rotameter with 0.25 to 2.5 scfh scale range. To order rotameter for use with existing 62V or 62VN, specify part number 12431-5.

GENERAL SPECIFICATIONS

Materials of Construction

Top & bottom forgings	Brass
Retaining nut	Brass
Diaphragm	Neoprene
Differential Spring	Stainless Steel
Valve Plunger	Stainless Steel
Plunger Spring	Stainless Steel

Ambient Temperature Limits —40° to +180°F

Supply Pressure

100 psi max. (minimum supply pressure is 5 psi above highest output pressure required.)

Moore constant-differential relays eliminate most of the problems encountered in conventional bubbling systems, because:

- Each relay holds the bubbling rate constant, maintaining high accuracy of measurement.
- The differential pressure which is maintained across the needle valve is approximately 1½ psi; allowing wider needle valve openings which are less subject to clogging.
- Full supply pressure (up to 100 psi) is connected to the purge system—resulting in a greater margin of safety.

In addition to the preceding advantages, the use of a constant-differential relay eliminates the need for a supply regulator. Models 62V and 62VA assure reasonable purge rates at all times. Another safety feature is the automatic exhaust, which bleeds off any excess air caused by the presence of foreign particles on the pilot seat of the supply-port plunger.

Multiple Input Low-Pressure Selectors

Model 614 Shown

- input signals are dead-ended (non-flowing)
- 'stackable' modules – for up to six inputs
- no accrued-error buildup, as with a series of two-input-type selectors
- piloted output for high capacity in override circuits

Series 612 multiple input low-pressure selectors accept up to six input signals and transmit an output signal which is equal to the lowest input. These instruments are frequently used in override control systems.

OPERATION

A multiple input low-pressure selector consists of a number of force-balance input-reproducer sections and an output booster. Each reproducer incorporates a diaphragm which acts on a pilot nozzle. Pilot air is fed to the underside of all reproducers from a common supply restriction.

The input signal is reproduced by the automatic throttling action of the reproducer diaphragm as it regulates the bleed through the pilot nozzle to atmosphere.

Model 613 Shown

When the various inputs to the reproducers are at different levels, the reproducer with the lowest input value will have

SPECIFICATIONS

Input Range: 3–15 psig, standard
3–27 psig, maximum

Supply Pressure: 20-psig, standard
50-psig, maximum

Response Level: < 0.1" H₂O

Accuracy of 1:1 Ratio: better than 1/2%

Calibration Accuracy: better than 1%

Effect of Flow on Output Pressure
(at 9-psig output):

Flow	Pressure Drop
0.12 scfm	0.1 psig
1.9 scfm	1.0 psig

Selection Differential: less than 0.2" H₂O

Air Consumption: less than 0.1 scfm

Connections: 1/8" NPT

control; and the diaphragms on all other reproducers will have sealed their respective pilot nozzles.

The booster section, in turn, provides a high-capacity re-transmission of the lowest reproduced pressure.

TYPICAL APPLICATION

The circuit shown is for a motor-driven centrifugal compressor. Primary control is compressor-discharge pressure. As downstream demand fluctuates, the inlet valve must be opened or closed to adjust compressor capacity to match demand. In order to maintain the required discharge pressure when an increased demand occurs, the inlet-valve opening must be increased. To maintain discharge pressure for a reduced demand, the valve opening must be reduced. This is the normal function of the Discharge-Pressure Controller.

Opening and closing the inlet valve also affects other system parameters. Opening the valve will cause the suction

pressure to drop and the motor-current load to increase. Suction pressure below design value and excessive motor current are unsafe operating conditions.

When either unsafe condition occurs, it is necessary to override the Discharge-Pressure Controller by closing the inlet valve to bring the parameters back to safe limits. The two Override Controllers (Suction-Pressure & Motor-Current) implement the necessary corrective action. Both Override Controllers are "tied" into the basic circuit by means of the Multiple Input Low-Pressure Selector, Model 613.

Under normal conditions, motor current and suction pressure are within safe limits, and their controller-output signals are high. The Discharge-Pressure Controller, therefore, manipulates the inlet valve through the Model 613.

If an unsafe condition occurs (high motor load or low suction pressure), the respective Override Controller output will fall below the output of the Discharge-Pressure Controller. The resultant low-pressure signal will be selected by the Model 613 as the "corrective" control signal to the inlet valve.

When the unsafe condition is alleviated, normal Discharge-Pressure Control will be resumed automatically.

MOORE PRODUCTS CO., Spring House, Pa. 19477

Manufacturing Subsidiaries:
 MOORE PRODUCTS CO. (U.K.) LIMITED
 East Molesey, Surrey, England
 MOORE INSTRUMENT CO. LTD.,
 Buda, Ont., Canada

BOOSTER RELAYS

MODEL 61H

MODEL 61L

Series 61 booster relays are normally used to reproduce pneumatic signals in a 1:1 ratio—whenever input isolation or increased flow capacity is required. Various models are available to meet a wide range of application requirements.

HIGH-CAPACITY

Model 61H: This is a high-capacity booster relay, designed to improve the stroking speed of large diaphragm valves. The model 61H relay incorporates a stabilizing bypass needle valve between input and output, eliminating the need for an externally piped bypass. For additional information, request AD61H. (This relay is not normally used in measuring circuits.)

MODERATE ACCURACY

Model 61L: This relay combines moderate accuracy with a moderate capacity (approximately 3.5 scfm output at 9 psi). Like the 61H relay, this instrument is used primarily in straightforward valve-booster applications, rather than in measurement circuits.

HIGH ACCURACY

Model 61F: The sensitive pre-formed diaphragms in this relay insure greater accuracy in 1:1 transmission. The output capacity of the model 61F relay is about one-fourth that of the 61L. The 61F relay is used in measuring circuits.

Model 61FE: This relay is similar to the model 61F, in that it incorporates preformed diaphragms. The main difference is that the 61FE includes a $\frac{1}{8}$ " NPT connection for those applications where a tapped exhaust is required.

HIGH ACCURACY (with zero adjustment)

Model 610F: This relay is similar to the model 61F, in that it incorporates preformed diaphragms. The main difference is that the 610F relay includes a zero-adjustment screw—for maximum accuracy.

OPERATING CHARACTERISTICS

	Model 61H	Model 61L	Model 61F & 61FE	Model 610F
Normal input and output pressure:	3-15 psi for all models			
Maximum input pressure:	100 psi	100 psi	50 psi	50 psi
Maximum supply pressure:	100 psi	100 psi	50 psi	50 psi
Overload protection to any connection:	150 psi	150 psi	100 psi	100 psi
Accuracy of 1:1 ratio*:	5%	2%	0.5%	0.5%
Zero error*:	—	3%	1%	None†
Reproducibility*:	0.1%	0.1%	0.02%	0.02%
Linearity*:	0.4%	0.4%	0.1%	0.1%
Ambient temperature limits:	-40° to +180°F			
Flow capacity††	10.5 scfm	4.5 scfm	2.4 scfm	2.4 scfm

* These performance figures are based on a 3-15 psi input.

† The model 610F relay incorporates a zero adjustment (+1 -1/2 psi) for maximum accuracy.

†† Flow which causes output pressure to droop 1 psi at 9 psi setting.

BOOSTER RELAYS

MODEL 61H

MODELS 61L, 61F, 61FE and 610F

SUPPLY AND OUTPUT CONNECTIONS 1/4 NPT

MODEL NO.	A	B	INPUT
61L	$2 \frac{5}{8}$	4	1/8 NPT
61F	$2 \frac{13}{16}$	$4 \frac{3}{16}$	1/8 NPT
61FE*	$2 \frac{13}{16}$	$4 \frac{3}{16}$	1/4 NPT
610F	$3 \frac{5}{32}$	$4 \frac{17}{32}$	1/4 NPT

* With 1/8 NPT conn. for tapped exhaust

OPERATION

Input pressure, acting upon the effective area of the upper diaphragm, produces a force which is opposed by the output pressure exerted upon the effective area of the lower diaphragm. The opposing forces are in a direct 1:1 ratio. Hence, any increase in the input pressure will depress the diaphragm assembly; opening the pilot valve to admit a sufficient supply of air to the output to re-balance the input pressure.

A decrease in input pressure will cause the diaphragm assembly to lift off the exhaust port—reducing the output and again re-balancing the input.

Fig. above shows typical circuit where 1:1 booster valve is used to improve stroking speed of large diaphragm valve.

NULLMATIC DERIVATIVE UNITS

GC-59

OPERATION

All series 59 derivative instruments incorporate a built-in Nullmatic booster pilot, which provides an output signal to re-balance the input forces developed within the derivative-response section of the instrument.

Direct-Derivative Response: Models 59D and 59DH operate in the same manner. With the 59D instrument, which has a 6:1 derivative gain . . . input pressure from the process transmitter acts upon the upper (input) diaphragm. Due to the difference between input- and output-diaphragm areas, a step change in input produces a 6:1 step change in output to maintain force balance.

In a steady-state condition (with no change in input), the output pressure acts on both sides of the output diaphragm—and output pressure re-balances input pressure directly.

The output pressure is connected to the intermediate chamber, through the needle valve. Therefore, there is a lag between a change in output and a change in intermediate pressure.

With a continuous ramp change in input pressure, the intermediate pressure will lag the output pressure by a constant amount, proportional to the rate of change in output. Thus, the intermediate pressure will partially re-balance the input; reducing the effective gain. The result is that the output will continuously lead the input by a definite amount, proportional to the rate of change in input.

The time by which the output leads the input is the "derivative time" as set on the graduated needle valve.

Inverse-Derivative Response: The operation of the model 59R instrument is similar to the preceding description. With the inverse-derivative instrument, how-

—and the needle valve connects the input pressure to the intermediate chamber.

Nullmatic Booster Pilot: Any unbalance in the derivative section's diaphragm stack changes the position of the nozzle seat; increasing or decreasing pressure in the chamber above the pilot diaphragm. Whenever the pressure above the pilot diaphragm increases, the diaphragm will be forced down—closing the exhaust ports and opening the supply port, until the output pressure increases enough to re-balance the system.

OPERATING CHARACTERISTICS for models 59D, 59R, and 59DH

Normal pressures	3 to 15 psi for input and output 20 psi for supply
Maximum operating pressures	50 psi for input and output 60 psi for supply
Maximum overload protection	100 psi to any connection
Minimum output pressure	0.3 psi with 25 psi supply
Steady-state (input-to-output) ratio	1:1 for all models (within 0.5%)
Response level	0.1% of full scale
Ambient-temperature limits	—40° to +180°F

MOORE PRODUCTS CO., Spring House, Pa. 19477

Manufacturing Subsidiaries:
MOORE PRODUCTS CO. (U.K.) LIMITED
East Molesey, Surrey, England

MOORE NULLMATIC DERIVATIVE UNITS

DERIVATIVE ACTION GC-59

59DH
HIGH-GAIN
DIRECT ACTION

Derivative action is used to compensate for process and measurement lags in systems with slow response; typically for temperature measurement and control. Derivative action may be used to advantage:

- to insure the fastest control recovery, following a load change—with the derivative action used in conjunction with proportional and reset control modes.
- to prevent control overshoot on startup, or following large load changes—a common problem whenever reset action is used.

All Moore series 509 controllers include an integral derivative section. In these three-mode Nullmatic controllers, the derivative action on the input precedes proportional and reset responses. This is the only arrangement that can prevent overshooting on startup. It also provides the most effective control, following any large load change.

Models 59D and 59DH derivative units are used to add derivative action to existing single- or two-mode controllers, or to provide separate derivative action for other applications. Either of these instruments permits the addition of derivative action on the input—rather than the output—of any controller. (This is the required arrangement to eliminate overpeaking on startup.)

DERIVATIVE GAIN: The output of a derivative unit is equal to the input *plus* an amount which is proportional to the rate of input change. For a theoretical (ideal) derivative unit, the response to an input step change would be an infinite output step change. In actual practice, however, an ideal derivative response is not usable; primarily because of noise in the measuring signal. Therefore, the derivative response to an input step change, or the *derivative gain*, is purposely limited.

A model 59D, with a gain of 6:1, is suitable for most applications. For systems with very long time constants, the model 59DH, which has a nominal 30:1 gain, should be used.

The response curves on the opposite side of this page show that derivative gain also affects the time that it takes for the derivative output to respond to an input change. For a given derivative-time setting, the high-gain unit responds more rapidly than the model 59D. This is why the high-gain model 59DH instrument provides better control whenever long derivative-time settings are required.

DERIVATIVE TIME: Since the magnitude of derivative response is proportional to the rate of input change, a steady input change will make the output lead the input by a definite *derivative time*. This "lead time" is indicative of how the derivative-control action anticipates the effect of a load change—and how the derivative action can be used to compensate for measurement lags.

Inverse-Derivative Action: The inverse-derivative control mode was introduced by Moore Products Co. in 1948. . . . This special control action is used to stabilize the control of fast processes, or to filter noisy measurement signals. Inverse-derivative response, used in conjunction with proportional and reset control modes, insures stable, responsive control of flow—or similar fast processes.

The response of the model 59R inverse-derivative unit to an input step change is in a relationship of 1:6; with respect to an input step change. Inverse-derivative output *lags* a steadily changing input by the time setting. An inverse-derivative unit is therefore responsive to sustained input changes; however, it will *attenuate* high-frequency variations, which are characteristic of signal noise.

MODEL NO.	Derivative Action	Derivative Gain	Derivative Time Setting (Minutes)*	
			Standard	Fast
59D	Direct	6:1	0.05—20	0.005
59DH	Direct	30:1 (nominal)	0.05—20*	to
59R	Inverse	1:6	0.05—20	2

* With a volume chamber (part #10587-5), the model 59DH will provide derivative time settings from 0.5 to 200 minutes. For volume-chamber installation dimensions, request drawing 3537-64.

MOORE

LIMIT RELAYS

HIGH- and LOW-LIMIT RELAYS

GC-58

58L, LOW-LIMIT RELAY

58H, HIGH-LIMIT RELAY

ALL CONNECTIONS ARE 1/4 NPT

These relays provide dependable limit stops for pneumatic control circuits. Each of these high- and low-limit relays incorporates an integral pressure regulator to maintain the limit setting; and to provide a continuous indication of the setting on a pressure gauge.

Low-Limit Setting

The model 58L low-limit relay consists of an integral pressure regulator, plus a built-in high-pressure-selecting relay. The operation of the high-pressure-selecting section is explained on the opposite side of this sheet.

A low-limit relay maintains an output pressure which is equal to the input pressure—until the input falls below the setting of the limit adjusting screw. Whenever the input is above the regulator setting, it is admitted directly to the output. When the input falls below the regulator setting, the regulated pressure is admitted directly to the output.

High-Limit Setting

The model 58H high-limit relay consists of an integral pressure regulator, plus a built-in low-pressure-selecting relay.

A high-limit relay maintains an output pressure which is equal to the input pressure—until the input exceeds the setting of the integral pressure regulator. Whenever the input is below this setting, it is admitted directly to the output. When the input is above this setting, the regulated pressure is reproduced as the output.

Limiting a Controller's Set Point

The problem: To maintain a pneumatic set point within high and low limits—thus preventing the process from reaching undesirable limits, even though the remote set point might call for "unsafe" limits.

The solution: A low-limit relay, model 58L, in series with a high-limit relay, model 58H. A gauge on each instrument indicates the control-limit setting.

Materials of Construction

Aluminum, brass, stainless steel, zinc alloy, and neoprene or Teflon.

OPERATING CHARACTERISTICS

Normal input and output range:		3 to 15 psi
Supply pressure:		20 psi
Maximum input pressure:		30 psi for low-limit relay*
		50 psi for high-limit relay
Limit adjustment:		0-16 psi
Ambient-temperature limits:		-40° to +180°F

* By substituting a Teflon disk for the neoprene flapper, the model 58L can maintain a set point as low as 2 psi or as high as 50 psi.

MOORE PRESSURE-SELECTING RELAYS

GC-585

Model 585 High-Pressure Selector

OPERATING CHARACTERISTICS	MODEL 585
Normal input and output range:	3 to 15 psi
Maximum input pressure:	30 psi*
Ambient temperature limits:	-40° to +180°F
* 100 psi for model 58SH	

Moore high pressure-selector relays automatically select the higher pneumatic signal; then transmit the selected pressure signal. These relays are normally used for safety or for override-control applications.

High-Pressure Selection

The model 585 high-pressure selector relay selects the higher of two pneumatic signals, and admits the selected signal directly to the next element in the system.

The operation of the 585 relay is quite simple. The higher input pressure forces the flapper disk up or down, closing off the lower input-air-pressure connection. This allows the higher input pressure to be admitted directly to the output connection.

For applications requiring selection among more than two signals, a single unit is available for up to 5 inputs.

A typical application for this relay is override control. For example—

The problem: To provide override temperature control on a flow-control circuit.

The solution: One variable (flow) is controlled normally. The second variable (temperature) is tied into the control loop through the high-pressure selector relay. Normally, the flow controller operates the valve.

If the temperature reaches an abnormally high value, the output of this controller will increase above that of the other controller. At this point, through the high-pressure selector relay, the temperature controller will override the flow controller to close the control valve.

The model 58SH, which incorporates a Teflon disk in lieu of the neoprene flapper used with the model 585, may be used at operating pressures up to 100 psi.

Low-Pressure Selection (Refer to GC-612.)

Materials of Construction

Aluminum, brass, stainless steel, neoprene or Teflon.

MOORE PRODUCTS CO.,
Spring House, Pa. 19477

Foreign Manufacturing Subsidiaries:
Canada, United Kingdom & Mexico

3 × 6 STRIP-CHART RECORDERS

Series 53_9 strip-chart recorders may be mounted as individual units or in multiples, in a single cutout, along with any series 527 or 528 stations. They can be used to indicate and record up to three pneumatic input signals.

FEATURES

- Servo-positioned pen assemblies
- Fiber-tip pens with integral ink reservoirs
- Snap-in magazine assembly for convenient chart changes
- Separate torque motor for high-speed chart rewind
- Unobstructed access to pens and reservoir

MODEL 5319

one-pen
(red)

MODEL 5329

two-pen
(red, blue)

MODEL 5339

three-pen
(red, blue, green)

PERFORMANCE DATA

Calibrated Accuracy $\pm 0.5\%$ FS
Repeatability 0.2% FS
Response Level 0.1% FS

DESIGN SPECIFICATIONS — (see reverse side)

MODEL DESIGNATION

Type	Model Number	
	Universal* Rear Block	Fixed Rear Plate with Bulkhead Type Connections
One-Pen	5319M	5319X
Two-Pen	5329M	5329X
Three-Pen	5339M	5339X

Note: See Bulletin 9003 for standard charts

* Universal Rear Block

1. Permits up to 5 instruments to be piped to a common supply point
2. Permits removal of recording chassis and substitution of indicating chassis in same case without disturbing adjacent stations.

OPTIONS & ACCESSORIES

1. Dual Speed Chart Drive motor 110VAC, 60Hz (7/8" per min. and 7/8" per hr.) with 3 position, "center-off" selector switch on chassis
2. Chart drive on-off switch
3. Alarm Lights and Alarm Switches
4. Pneumatic Impulse Chart Drive
5. Non-Standard Input Ranges (other than std. 3–15 psig) — Any input range from 3–13.5 psig to 3–16.5 psig. (Specify range desired)
6. 110 VAC, 50Hz (7/8" per hour) Chart Drive
7. Angle Mounting Calibration — Recorder suitable for for mounting on panel face tilted back from vertical up to 60 degrees (Specify angle desired)
8. Identification Tag — Rear-mounted stainless steel tag, permanently affixed
9. Coded legend card, advise required text (available space for 4 lines of text and 28 characters per line)
10. Mounting Trim — Two pieces of decorative metal trim with adhesive backing to improve appearance of right and left edges of each panel cutout (Part No. 14480-161)

DESIGN SPECIFICATIONS

1. Dimensions Bezel size: 3" wide x 6 5/8" high
Station depth: 27 9/16" behind panel face
Panel cutout: single station 3 1/16" wide x 6 1/32" high (1/16 - 0)
Multiple stations add 3.010" to width for each additional station.
2. Chart Type: 4" strip, rectilinear vertical scale
3. Pens Number of pens per unit:
Model 5319 1 red
Model 5329 1 red, 1 blue
Model 5339 1 red, 1 blue, 1 green
Type: replaceable fibertip
Inking system: Disposable cartridge, 1000 ft. trace length capacity.
4. Scales
(1 per pen) White vinyl with black inscription, 4" scale length graduated in process units.
5. Chart Drive Type: removable snap-in magazine
Speed: 7/8" hr. normal.
(optional speeds available)
Rewind mechanism: (electric units) - Torque motor type.
(pneumatic impulse drive units) - slip clutch.
Chart Capacity: 31 days @ 7/8" hr.
6. Mounting Flush vertical panel
(1/8" to 1" thick)
suitable for panels with up to 60° tilt back from vertical with recalibration.
7. Pen Actuator: Type: Pneumatic servo driven
Damping: integral non-adjustable
Input: 3-15 psig normal
Span adjust range:
10.5 to 13.5 psig
Zero adjust range:
0 to 7 psig
Overrange protection: Application of 30 psig to input will not damage unit.
8. Connections Pneumatic: 1/8" NPT pipe taps (female)
Electrical: conduit 3 access holes 1/2", 3/4" & 1" size
Wiring: push on terminals suitable for #16 - #20 AWG wire -- removal of push on connectors provides #5 screw terminals.
9. Ambient Limits .. 10 F to 100 F, 20% to 90% RH with Standard ink
25 F to 130 F, 20% to 90% RH with optional ink
10. Supply Requirements ... Pneumatic: 20 psig - .035 SCFM per pen normal consumption
18 psig minimum
25 psig maximum
Electric: 110V ±10% 60Hz - 8 watts normal (other voltages & frequencies available)
11. Materials of Construction Aluminum, brass, cadmium plated steel, stainless steel, zinc, Delrin[®], neoprene, polyurethane, Lexan[®].
12. Station Weight .. 18 lb., 12 oz.

MOORE PRODUCTS CO., Spring House, Pa. 19477

Foreign Manufacturing Subsidiaries:

SHORT CASE RECORDERS for individual cutouts

LONG CASE RECORDERS for single-row gang mounting

6x6 STRIP-CHART RECORDERS

FEATURES

- servo-positioned pen assemblies
- fiber-tip pens with integral ink reservoirs
- snap-in magazine assembly for convenient chart changes
- separate torque motor for high-speed chart rewind
- impact-resistant, snap-on door (not shown)

The Series 53, 6 x 6 Recorders are panel-mounted, strip chart recorders. The Long Case style can be used in a common cutout with the 3 x 6 SYNCRO line of instrumentation. The Short Case style is used for single hole mounting in any control panel. Both styles can be used to record and indicate up to 3 pneumatic input signals.

PERFORMANCE DATA

Calibration Accuracy	±0.5% of span
Repeatability	0.2% of span
Response Level	0.1% of span

SPECIFICATIONS

Inking System:.....Fiber-tip pens with disposable,
slip-in cartridges.

Chart Drive:.....115V, 60Hz with 7/8" per hour
standard speed. Other voltages, fre-
quencies and chart speeds available.

Chart Rewind:.....Separate torque motor.

Chart Replacement:.....Chart inserted in snap-in maga-
zine assembly

Supply Pressure:.....20 psig required

Connections:.....Pneumatic - 1/8" NPT
Electric - Enclosed rear mounted
terminal strip with 1/2" conduit
access hole.

Description	Model Number	
	Long Case	Short Case
Single-Pen Recording	5318	5310
Two-Pen Recording	5328	5320
Three-Pen Recording	5338	5330

NOTE: Moore servo-driven recorders are also available in two complete lines of recording control stations.

OPTIONS AND ACCESSORIES

1. Alarm Switches – up to two switches per pen
2. Optional Chart Speeds – 13 1/8 inches/min. thru 7/8" inches/hour in select steps.
3. Pneumatic Impulse Chart Drive – accepts standard 4 pulses per minute to give 7/8"/hour chart speed.
4. Angle Mounting Calibration – up to 60 degrees back from vertical (specify angle).
5. Non-Standard Input Ranges – any input range from 3-13.5 to 3-16.5 psig
6. Common Supply Header Fittings – for use with Long Case style to permit common supply system in gang mounting.

Nullmatic® M/P Recording Control Stations

illustration
one-third
actual size

MODEL NUMBERS ¹		CONTROL MODES	CONTROLLER LOCATION ¹	
APPLICATION	One-Pen	Two-Pen ²				
	for a 4-pipe system, substitute T4R for T2					
SINGLE-LOOP CONTROL	5311MT2	5321MT2	Automatic Manual	On-Station		
with option of independent primary control						
SINGLE-STATION CASCADE	• P4	5311P4T2 not available with manifold or as 4-pipe system	5321P4T2	Cascade Auto Primary Auto Manual	Three Remote Controllers	
	with option of independent secondary control					
	• P5	N/A	5321MP5T2	Cascade Auto Secondary Auto Manual	Primary Controller On-Station	
REMOTE-SET with option of remote or local setpoint	• P53	5311MP53T2	5321MP53T2	Ext. Set Auto Local Set Auto Manual	On-Station	
	with provision for + bias on external setpoint					
	• A6	5311MA6T2	5321MA6T2	Ext. Set (Cas) Auto Local Set Auto Manual	On-Station	
with provision for + or — bias on external setpoint						
one master signal sets several secondary circuits; + or — bias allows load apportionment	• A68	5311MA68T2	5321MA68T2	Ext. Set (Cas) Auto Local Set Auto Manual	On-Station	

¹MANIFOLD CONNECTIONS: Models listed above include Moore manifold which accepts plug-in Nullmatic controller. Delete M for field- or pipe-connected controller.

²SECOND PEN is available for independent input—except for cascade model P5.

► STATION TYPE: Any of the above stations (except P4T2) are field-convertible from T2 to T4R by repositioning a gasket.

- T2: for auto/man switching, internal switch isolates controller output from valve. Controller usually on or near station.
- T4R: For auto/man switching, station provides relay operating pressure for external cut-off relay to isolate controller

output. Controller usually located at process; but can be station-mounted.

► CONTROLLER SELECTION: T2 stations require series 50 or 509 Nullmatic controllers. T4R stations require 561 or 569.

- Single-Loop, P53, A6 & A68: One controller req'd per station.
- P4: Three controllers req'd per station. Must be series 50 or 509. Third controller, used in primary automatic mode, allows optimum tuning. (Frequently used for 3-element drum level control.)
- P5: Two controllers req'd per station. Primary must be series 50 or 509—regardless of type of station selected T2 or T4R.

PANEL CUTOUT
width: 5-7/16
height: 5-11/16

Nullmatic® K/P Indicating Control Stations

APPLICATION	MODEL NUMBERS ¹		CONTROL MODES	CONTROLLER LOCATION ¹	
	Conventional Indicating	Scanning-Type			
	for a 4-pipe system, substitute T4R for T2				
SINGLE-LOOP CONTROL	524MT2	526MT2	Automatic Manual	On-Station	
SINGLE-STATION CASCADE	with option of independent primary control				
	• P4	524P4T2 not available with manifold or as 4-pipe system	526P4T2	Cascade Auto Primary Auto Manual	Three Remote Controllers
	with option of independent secondary control				
	• P5	524MP5T2	526MP5T2	Cascade Auto Secondary Auto Manual	Primary Controller On-Station
	REMOTE-SET	with option of remote or local setpoint			
• P53		524MP53T2	526MP53T2	Ext. Set Auto Local Set Auto Manual	On-Station
with provision for + bias on external setpoint					
• A6		524MA6T2	526MA6T2	Ext. Set (Cas) Auto Local Set Auto Manual	On-Station
with provision for + or — bias on external setpoint					
one master signal sets several secondary circuits; + or — bias allows load apportionment	• A68	524MA68T2	526MA68T2	Ext. Set (Cas) Auto Local Set Auto Manual	On-Station

¹ **MANIFOLD CONNECTIONS:** Models listed above include Moore manifold which accepts plug-in Nullmatic controller. Delete M for field- or pipe-connected controller.

² **TWO SIZES:** Models listed above are 6 x 6 bezel size. For bezel size of 5 x 5½, substitute model series 523 (for 524) or 525 (for 526).

³ **DUPLEX GAUGE:** Each station has a duplex receiver gauge. Center pointer: controlled variable. Peripheral pointer: selective indication of regulator output (setpoint) or valve-loading pressure.

⁴ **NIAFRAM ELEMENTS:** Niafram elements are standard with all scanning-type stations. Bourdon gauges are standard for conventional indicating. For a high-torque Niafram element in conventional indicating station, substitute model series 52N4 (6 x 6 bezel) or 52N3 (5 x 5½ bezel).

► **STATION TYPE:** Field-convertible from T2 to T4R, refer to notes on page 4.

► **CONTROLLER SELECTION:** refer to notes on page 4.

PANEL CUTOUTS:

6 x 6 Bezel Size
width: 5-7/16
height: 5-11/16

5 x 5½ Bezel Size
width: 4-9/16
height: 4-9/16

APPLICATION AND ORDERING INFORMATION

plug-in models listed⁽¹⁾

Application	Proportional (Throttling) Band			Reset Action minutes per repeat	With Manual Reset Action
	2 to 200%	5 to 500%	200% fixed		2 to 200% Throttling
Station- or Remote-Set					Station- or Remote-Set
proportional plus reset	50M	50MW		0.1 to 50	50MX-2
	50MF	50MFW	50MFY	0.01 to 5	
Station- or Remote-Set—with built-in cut-off relay ⁽³⁾					With Derivative Action applied ahead of proportional and reset actions
proportional plus reset	561M	561MW		0.1 to 50	
	561MF	561MFW	561MFY	0.01 to 5	
Station- or Remote-Set					
proportional plus reset plus derivative	509M	509MW		0.1 to 50	0.05 to 20 minutes with 6:1 derivative gain
	509MF	509MFW		0.01 to 5	
	509MH ⁽²⁾			0.1 to 50	0.05 to 20 minutes ⁽⁴⁾ nominal 30:1 der. gain
	509MFH ⁽²⁾			0.01 to 5	
Station- or Remote-Set—with built-in cut-off relay ⁽³⁾					
proportional plus reset plus derivative	569M	569MW		0.1 to 50	0.05 to 20 minutes with 6:1 derivative gain
	569MF	569MFW		0.01 to 5	
	569MH ⁽²⁾			0.1 to 50	0.05 to 20 minutes ⁽⁴⁾ nominal 30:1 der. gain
	569MFH ⁽²⁾			0.01 to 5	

All controllers listed in the above tables have pre-formed diaphragms for high response. With all Nullmatic controllers, the restrictions are externally accessible for easy servicing.

(1) To order a pipe-mounted, remote-set controller, delete letter M from model number.

(2) Pipe-mounted versions of these controllers are not available.

(3) Each of these RESET BYPASS CONTROLLERS in-

corporates a built-in, relay-operated valve which opens a bypass around the reset needle valve when the control station is on manual. This permits manual valve-loading pressure to be impressed *instantly, fully, and continuously* on the reset reference chamber—facilitating bumpless transfer between manual, automatic, and various cascade modes of operation.

(4) Optional volume chamber is available to increase derivative time to 0.5-200 minutes.

T2 Circuit—Controller Located Near Control Station

In T2 circuits, the controller output is disconnected from the valve by the station switches during manual control. A model 50 or 509 controller (or the corresponding manifold type) is used.

This circuit is generally used on processes with normal or long time-constants, such as the temperature-control application shown at the right.

SERIES 50

PROPORTIONAL
PLUS
RESET

REMOTE-SET

Series 50 controllers are all-purpose instruments that have found wide application on a variety of processes, including flow, temperature, pressure, liquid-level, specific gravity, etc. They are most commonly used in the control room (where their high response level and ample output capacity enable them to handle the majority of applications), but they may also be located at the process, with a separate cut-off relay. Models are available for both plug-in mounting and pipe connection.

The photo shows the sturdy, weatherproof construction of these controllers—a stack of interchangeable parts and diaphragms.

Note the convenient switching plates for setting the controller action and reset-feedback, the external tracking adjustment (protected by a flush rubber plug), one of the externally-accessible restrictions (the slotted screw to the right of controller-action plate), and the weatherproof plastic covers for reset and throttling knobs.

pipe-mounted model shown

Temperature Transmitters

OPERATING CHARACTERISTICS

	Bulb size ⁽¹⁾	Minimum	Maximum
Temperature spans	3/4 x 4"	50°F (30°C)	1000°F (540°C)
	3/8 x 4"	70°F (40°C)	1000°F (540°C)
	Bulb size	Copper	Stainless Steel
Maximum bulb operating temperature	3/4 x 4"	800°F	1400°F
	3/8 x 4"	800°F	1000°F ⁽²⁾
Minimum bulb operating temperature		-450°F (-270°C)	
Supply pressure		normal is 20 psi maximum is 50 psi	
Output pressure		3-15 psi (within 1%*)	
Response level		within 0.01% of full scale	
Air consumption (with 20 psi supply)		less than 0.08 scfm in balanced condition on dead-end service	
Speed of response (with transmitter coupled through 100 ft. of 1/4" OD tubing to receiver) ⁽³⁾		Bare copper bulb0.02 minutes ⁽⁴⁾ Bare SS bulb0.03 minutes Copper bulb in copper well0.3 minutes Copper bulb in SS well0.6 minutes	
Ambient temperature effect (max. change in output for +50°F change in ambient temperature)		less than 1% of full-scale shift on most ranges	

⁽¹⁾ materials contacting process fluid—copper or stainless steel standard bulbs and wells; special materials available at extra cost.

⁽²⁾ certain spans can be used to 1400°F with factory approval.

⁽³⁾ with 500 ft. transmission line, lag times will increase approximately 0.07 minutes.

⁽⁴⁾ these time constants are the lag times required for a 63.2% response.

* Instruments which have been calibrated to within 1/4% are available, at extra cost.

HOW TO ORDER

Please furnish the following data:

1. Measured Range
2. Transmitted Output Pressure—standard is 3-15 psi. Other ranges are available.
3. Thermal Element
 - (a) plain, rigid, or averaging bulb
 - (b) bulb size and material—copper or 316 S.S.
 - (c) extension neck and capillary length—if non-standard
4. Fitting
 - (a) type—see pages 2 & 3
5. Thermal Well (optional)
 - (a) length below thread—5 1/2, 8 1/4 or 12 1/4"
 - (b) material—304 or 316 S.S.; Monel, nickel, or copper also available
 - (c) provision for lagging, if required
 - (d) contact strip which provides for improved heat transfer between thermal well and bulb

Note: Bulbs in special lengths and diameters can be furnished.

Printed in U.S.A., 7765M

STOCK TRANSMITTER ASSEMBLIES*

Temperature Range	Order Model Number
3/4 x 4 Plain Bulbs, 316 S.S.	
0-100°F	33D5072 (D7F)
0-100°C	33C5072 (C7C)
0-150°C	33A5072 (A8C)
0-150°F	33C5072 (C8F)
50-150°F	33E5072 (E19F)
0-200°F	33C5072 (C9F)
50-250°F	33C5072 (C2F)
0-300°F	33A5072 (A11F)
0-400°F	33A5072 (A3F)
3/8 x 4 Plain Bulbs, 316 S.S.	
0-50°C	33E5475 (E6C)
0-100°C	33C5475 (C7C)
0-200°C	33A5475 (C9C)
0-100°F	33D5475 (D7F)
0-200°F	33C5475 (C9F)
0-300°F	33A5475 (A11F)
3/4 x 6 Rigid Bulbs, 316 S.S.	
0-300°F	33A5079 (A11F)
50-300°F	33A5079 (C71F)

MOORE PRODUCTS CO., Spring House, Pa. 19477

Foreign Manufacturing Subsidiaries:
Canada, United Kingdom & Mexico

Standard Thermal Elements

Illustration above shows standard 3/4 x 4 bulbs: (1) Union-connected rigid; (2) plain bulb - 20" neck. Averaging bulb (3) is 316 S.S. with 14-ft. active portion in 6" coil - union or compression fitting, 20" neck. The union screw connection (A) is for bare-bulb installations. Compression fitting (B) includes locknut and washers. Thermal well (C) can be furnished in 5-1/2" to 24" or more below thread, with or without lagging.

750°F. It has a 1" NPT male thread for connection to the vessel.

3/8 x 4 Bulbs

Available in copper or 316 S.S., plain or rigid design, with a standard 24" extension neck. Rigid bulbs are always used with a metal-ferrule-type of compression fitting to provide pressure ratings up to 1500 psi for stainless steel, or 1000 psi for copper.

The following accessories are available for plain bulbs—

Compression Fitting: This basic 3/16" tube fitting employs split asbestos washers as a seal. It is adjustable over the entire length of the standard 24" long extension neck. With this compression fitting, the 1/2" NPT male thread for connection to the vessel may be used for pressure installations to 1000 psi at 750°F.

Thermal Well: The thermal well may be used to enclose a 3/8 x 4 bulb for pressure installations to 2500 psi at 750°F. It has a 3/4" NPT male thread for connection to the vessel.

Averaging Bulbs

Averaging bulbs are used to obtain high-speed response in the measurement of temperatures in ducts, ovens, dryers, pipelines, etc. The loose coils can be stretched out to measure average temperature over a large area, thus minimizing the effects of local hot spots.

The averaging bulb which is illustrated above incorporates a 14-ft. active portion in a 6" loose-coil OD, with 20" extension neck. This bulb is composed of a 3/16" diam, type 316 S.S. element coil. The anchor ring will pass through a 3/4" hole.

Another averaging coil (not illustrated) is available with the active portion arranged in a 1-1/16" diam fixed-coil OD.

Armored Tubing

For all of the preceding thermal systems, 36" of stainless-steel flexible tubing is standard. Special lengths can be provided; and a special corrosion-resistant coating can also be provided.

Standard Thermal Elements for Nullmatic Temperature Transmitters

Plain bulbs are generally used on open kettles, shallow pots, and tanks—where no threaded support is required. By adding a compression fitting and a union screw connection, a plain bulb may be used to provide a fixed position. However, such bare-bulb installations cannot be used when pressure-tight seals are required or if fluid forces are significant.

For vessels under pressure or whenever strong lateral forces are present, rigid bulbs or plain bulbs in thermal wells should be used. (Note: Rigid bulbs in the 3/4 x 4 size cannot be used in thermal wells.)

Other Bulb Selection Criteria

The speed of response depends primarily upon the degree of contact between the bulb and the measured process medium. Bare bulbs provide the fastest response. Response speed will also depend upon the circulation present in the processing vessel.

The maximum permissible length of the capillary between the bulb and the thermal-system (sensing) bellows in the transmitter is limited to 25 ft.

3/4 x 4 Bulbs

Available in copper or 316 S.S., plain or rigid design, with a standard 20" long extension neck. Rigid bulbs are always used with union screw connections to provide pressure ratings up to 1500 psi for stainless steel, or 1000 psi for copper.

The following accessories are available for plain bulbs—

Compression Fitting: This basic fitting employs split asbestos washers as a seal. It is adjustable over the entire length of the standard 20" long extension neck.

(Note: A compression fitting is used with either a union-screw connection or a thermal well; it is not used alone.)

Union Screw Connection: The union screw connection, used for bare-bulb installations in processing vessels, has a 3/4" NPT male thread for connection to the vessel.

Thermal Well: The thermal well may be used to enclose a 3/4 x 4 bulb for pressure installations to 2500 psi at

NULLMATIC Temperature Transmitters

Series 33 temperature transmitters are used to measure temperatures to 1400°F (760°C). Measured spans may be as small as 50°F or as large as 1000°F.

Each of these instruments is a Class III thermometer with two basic components: A sealed thermal system, filled with helium; and a Nullmatic force-balance transmitter which converts pressure changes in the thermal system—caused by changes in temperature—into conventional 3-15 psi* pneumatic output signals.

These instruments are used to measure temperatures in various types of process vessels, including reactors, fractionating columns, textile dyeing equipment, and heat exchangers. Nullmatic temperature transmitters are also used to measure temperatures in pipelines, air ducts, flues, etc.

Force-Balance Operation

The schematic drawing illustrates the simplicity of the Moore Nullmatic temperature transmitter. This instru-

* Other ranges are available (i.e. 3-27 psi)

Standard Assemblies

A list of standard transmitter and thermal system assemblies appears on page 4.

For more detailed information about transmitter selection, non-stock thermal systems and optional variations, request AD33-6.

ment contains no links, levers, pivots or other friction-producing members to affect response or accuracy. In addition, simple in-line construction allows this rugged instrument to withstand severe shock and vibration environments.

As the process temperature rises, the pressure of the gas in the thermal system increases; increasing the force exerted by the thermal-system bellows. This increased force tends to move the thrust-rod assembly downward, closing the detecting nozzle to restrict pilot-air flow, and thus increase the pressure in the chamber above the diaphragm.

As pressure in the chamber above the diaphragm increases, the diaphragm will be forced down—closing the exhaust ports and opening the supply port—until the output pressure increases enough to re-balance the system. When the force exerted by the equalizing (re-balance) bellows again equals the force exerted by the thermal-system (sensing) bellows, the thrust-rod assembly will move upward and the diaphragm will be returned to its equilibrium position.

The accuracy of this transmitter, as with all Nullmatic force-balance instruments, results from the fact that under all conditions the total bellows movement is in the order of 0.001". This small motion minimizes hysteresis and non-linearity errors. This is facilitated by a circuit which maintains a constant differential-pressure-drop across the nozzle—with the differential determined by the force of the spring under the diaphragm.

Note: Except for the effective area of the equalizing bellows, all Series 33 transmitters are essentially the same.

Pneumatic Pressure Transmitters

SERIES 173 HELIX-TYPE

PILOT ROD—ACTIVATED BY PRESSURE-SENSING ELEMENT (HELIX OR STACKED CAPSULE)

SUPPLY PRESSURE
PILOT PRESSURE
TRANSMITTED (OUTPUT) PRESSURE

SERIES 174 CAPSULAR-TYPE

These instruments combine a pressure-sensing element with a standard Moore motion transmitter—which detects the position of the pressure-sensing element and provides a linear 3-15 psi output signal. Maximum accuracy is assured by the fact that the pressure-sensing element develops many times the two-gram force required for full-scale operation of the transmitter pilot.

Series 173 instruments combine a helix-type, pressure-sensing element with the Moore motion transmitter.

Series 174 instruments combine a stacked capsule pressure-sensing element with the Moore motion transmitter.

OPERATION

The schematic drawing above shows the Moore motion transmitter—with a built-in booster-pilot valve, which assures dependable transmission of the 3-15 psi output signal.

Supply air flows through a restriction into the motion transmitter's bellows assembly, past the wire pilot, to atmosphere. The pressure within the bellows (pilot pressure) depends upon the position of the pilot with respect to its annular nozzle, as it is displaced by the pressure-sensing element.

There is a tapered step on the diameter of the wire pilot. If the wire pilot should move down so that only a small diameter restricts the nozzle, the back-pressure will decrease. Conversely, when the pilot moves up so that the large diameter restricts the nozzle, the back-pressure will increase. For this reason, the system will always come to equilibrium with the annular nozzle aligned to the tapered portion of the pilot.

The pilot pressure is also present in the chamber above the booster-pilot diaphragm. As the pilot pressure increases, the booster-pilot diaphragm will be forced down—closing the exhaust port and opening the supply port—to increase transmitted output pressure.

Re-balance occurs when the output increases enough to force the bellows assembly upward; bringing the annular nozzle back to its original position with respect to the pilot. The amount of change in output required to accomplish re-balance depends upon the range spring in the motion transmitter.

OPERATING CHARACTERISTICS

	SERIES 173	SERIES 174
Supply pressure—		
Normal	20 psi for all instruments	
Maximum	35 psi for all instruments	
Minimum	16 psi for all instruments	
Output pressure	3-15 psi for all instruments	
Process pressure spans	see tables on page 2	
Response level*	0.08 %	0.1 %
Reproducibility*	0.15 %	0.15 %
Ambient temperature limits	—40° to +180°F	for all instruments

* expressed as a percentage of full scale.

Reverse action (optional): increase input; decrease output

Helix-Type Transmitters

Capsular-Type Transmitters

2

SERIES 173

SERIES 174

Series 173 instruments combine a helix-type pressure-sensing element with the standard Moore motion transmitter. The pressure-sensing element is connected to the pilot rod of the motion transmitter. The position of the pressure-sensing element is thus converted into a linear 3-15 psi output.

On the first page, there is a schematic illustration of the Moore motion transmitter, along with a description of operation.

Basic Model No.	Process Spans (psi) †		Helix Element
	Min.	Max.	
173B	0-15	0-300	Brass
173C	0-15	0-8000	Be Cu
173N	0-15	0-525	Ni-Span C
173S	0-15	0-10,000	316 S.S.

† request AD173-1 for detailed data on overrange protection and for a list of the standard spans available—using various range springs.

Note: Suppression adjustments permit process spans to be adjusted over any range up to the maximum operating pressure.

Series 174 instruments combine a stacked capsule pressure-sensing element with the standard Moore motion transmitter. The pressure-sensing element is connected to the pilot rod of the motion transmitter — thus providing a linear 3-15 psi output, which is proportional to the position of the pressure-sensing element.

Reversible Outputs: The transmitter linkage is reversible with all series 174 pressure transmitters. This allows the instrument to transmit an output which is direct-acting with pressure or vacuum; or reverse-acting with pressure or vacuum.

Basic Model No.	Process Spans † (Vacuum or Pressure)		Capsular Element
	Min.	Max.	
174P	2"H ₂ O	0-30 psi	Phos. Bronze
174N	3"H ₂ O	0-30 psi	Ni-Span C
174S	6"H ₂ O	0-40 psi	316 S.S.

† request AD174-1 for detailed data on overrange protection and for a list of the standard spans available—using various range springs.

Note: Suppression adjustments permit process spans to be adjusted over any range from full vacuum to the maximum operating pressure.

Receiver Gauge (optional): For local indication of process variable (may be threaded directly into tapped connection in series 173 or 174 transmitter).

BARTON FLOW METER

OPERATION

Differential pressure is applied against opposing bellows in the meter body. These stainless steel bellows, enclosed in separate pressure-tight chambers, are connected by a common center shaft. The differential pressure causes the bellows assembly to move a proportional amount, determined by the elasticity of the bellows, range spring and torque tube.

The bellows are filled with a liquid (ethylene-glycol is standard), and the two bellows are connected via a pulsation-damping needle valve. As the differential increases, liquid is displaced from one bellows to the other. If the differential should exceed the operating range of the meter, the bellows will continue to move until the O-ring seal on the center shaft seats against the center plate. This traps the liquid in the bellows; allowing the differential to continue to increase up to the full static pressure rating of the meter body, without causing damage—because the liquid fill, being incompressible, prevents additional movement.

Noise and pulsation which may be present in the flow line can be damped by adjusting the pulsation-damper screw to change the displacement rate of the liquid fill.

The schematic drawing on the right shows the Moore motion transmitter—with a built-in booster-pilot valve, which assures dependable transmission of the 3-15 psi output signal. Rotation of the instrument's output shaft operates the pilot of the motion transmitter.

Supply air flows through a restriction into the motion transmitter's bellows assembly, past the wire pilot, to atmosphere. The pressure within the bellows (pilot pressure) depends upon the position of the pilot with respect to its annular nozzle, as it is displaced by the output shaft of the Barton meter.

MOORE MOTION TRANSMITTER

There is a tapered step on the diameter of the wire pilot. If the wire pilot should move down so that only the small diameter restricts the nozzle, the back-pressure will decrease. Conversely, when the pilot moves up so that the large diameter restricts the nozzle, the back-pressure will increase. For this reason, the system will always come to equilibrium with the annular nozzle aligned to the tapered portion of the pilot.

The pilot pressure is also present in the chamber above the booster-pilot diaphragm. As the pilot pressure increases, the booster-pilot diaphragm will be forced down—closing the exhaust port and opening the supply port—to increase transmitted output pressure, which is also effective under the lower diaphragm.

Re-balance occurs when the output increases enough to force the bellows assembly upward; bringing the annular nozzle back to its original position with respect to the pilot. The amount of change in output required to accomplish re-balance depends upon the range spring in the motion transmitter.

MOORE PRODUCTS CO., Spring House, Pa. 19477

Manufacturing Subsidiaries:
MOORE PRODUCTS CO. (U.K.) LIMITED
East Molesey, Surrey, England
MOORE INSTRUMENT CO. LTD.
Rexdale, Ont., Canada

Differential-Pressure Transmitters

Series 11 H/P differential pressure transmitters can be used for any application where it is necessary to monitor differential pressure. For example, a series 11 instrument can be used in conjunction with an orifice plate, a venturi, or other primary flow element, to measure liquid flow—and to transmit a pneumatic signal. These instruments are also used to measure density or specific gravity, interface levels between immiscible or other un-mixed liquids, and liquid level in closed vessels.

One of the outstanding features of this instrument is its ability to withstand repeated full-differential over-range, up to the maximum pressure rating of the meter, without sustaining damage or affecting accuracy.

Each of these instruments consists of a Barton meter body and a Moore motion transmitter.

OPERATING CHARACTERISTICS

Supply pressure	20 psi standard (maximum is 35 psi)
Output pressure	3-15 psi standard (other output ranges are available; including 3-27 and 6-30 psi)
Supply pressure effect	less than 0.3% of full scale with a 5 psi increase in supply
Maximum air consumption	0.1 scfm in balanced condition on dead-end service, with 20 psi supply
Response level	0.02% of full scale
Reproducibility	0.1% of full scale
Drift*	output will not change more than 0.3% of full scale during one year
Ambient temperature limits	—40° to +180°F for transmitter —60° to +200°F for meter body†

* change in output with respect to time—all other variables held constant.

† special liquid fills are available for temperatures as low as —170°F.

Ordering Information

To order a model 11 H/P transmitter, select the basic model number which designates the required safe working pressure and the desired meter-body material. The meter-body range number (suffix no.) is added to the basic model number. For example: If the differential-pressure range is to be 0-200 inches of water, and the maximum static pressure on a stainless-steel meter body will not exceed 3000 psi; then the model 11SH200 should be specified.

Meter-Body Selection

Basic Model No.	Safe Working Pressure, psi	Meter-Body Material
11AL	1000	aluminum
11C	1000	forged steel
11S	1000	316 stainless steel
11CH	2500	forged steel
11SH	3000	316 stainless steel
11AS	4500	forged alloy steel
11SHX	6000	329 stainless steel

Note: All meter bodies are furnished with 316 stainless-steel process bellows and an externally-adjustable pulsation damper.

Meter-Body Range *

Model Suffix No.	Differential Pressure (inches H ₂ O)	Model Suffix No.	Differential Pressure (inches H ₂ O)
10	0-10	200	0-200
25	0-25	250	0-250
50	0-50	300	0-300
100	0-100	350	0-350
150	0-150	400	0-400

* By employing the range adjustment, and by selecting various range springs (listed in AD1102A), spans as low as 20% of the ranges listed above may be obtained. For Example: a 0-2" H₂O differential-pressure range can be specified. Zero-centered ranges are also available.

TRENTON ICES PROJECT
OUTLINE SPECIFICATIONS FOR MECHANICAL EQUIPMENT

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EQUIP. NO. 1

EQUIP. DESIGNATION

Gas Turbine Generator Sets

1. Four (4) Industrial Gas Turbine Generator Sets
2. Continuous duty rating 2400 kW (min) to ³⁰⁰⁰300 kW (max) at 60°F ambient air.
3. Guarantee 25,000 hours without major overhaul with one start a day.
4. Generator rating to equal or exceed maximum turbine capability for standby duty with generator at 0.8 power factor, output at 60 Hz and 13,800 volts.
5. All generator wiring and electrical insulation and gas turbine control and electrical instrument wiring to be in accordance with NEMA standards and NEC requirements.
6. Heat rate guarantee (ISO standard 14,500 Btu/Kw-hr.)
7. The latest applicable standards of IEEE, NEMA, ASA, OSHA, ANSI and ASME shall apply.
8. Provide controls package to bring up to speed, synchronize, put on line and deenergize and stop machine. (The standby start to a Hot Bus, continuous duty system). In addition to floor standing control cubicles, provide a remote panel for each unit. The turbine generator set shall be capable of manual or automatic operation.
9. Package to include all necessary auxiliaries such as fuel system for #2 oil, lube oil system, governor and safety systems, insulation and lagging on turbine and hot end connection. Equipment to be similar to Solar Centaur gas turbine generator set GS 4000 except silencers, air filter and lube oil coolers which will be specified separately.
12. Necessary devices to protect the turbine generator from malfunctions and damage shall be provided.

EQUIP. NO. 2

EQUIP. DESIGNATION Combustion Air Filter Units

1. Four (4) Combustion air filter units.
2. Allowable pressure drop 2.0 in. of H₂O
3. Effective filtering down to 5 u particle size.
4. Filter differential pressure indicator and alarm.
5. Suitable for out-of-doors installation. Equipment to be similar to Solar Model AW4002.

EQUIP. NO. 3

EQUIP. DESIGNATION Combustion Air Inlet Silencer

1. Four (4) Combustion air inlet silencers.
2. Allowable pressure drop 0.5 in. of H₂O
3. Noise attenuating to average 50 db at frequencies above 1000 Hz.
4. Equipment to be similar to Solar Model AX 3282.

EQUIP. NO. 4

EQUIP. DESIGNATION Waste Heater Boiler Exhaust Silencer

1. Four waste heat boiler silencers.
2. Allowable pressure drop 0.5 in. of H²O.
3. Noise attenuation to be effective across octave band and to be 35 dbA
4. Equipment to be similar to Solar Model AX 3527.

EQUIP. NO. 5

EQUIP. DESIGNATION Gas Turbine Lube Oil Coolers

1. Four (4) lubricating oil coolers for outdoor service.
Each cooler designed to reject 450,000 Btu/hr.
Cooling temperature rise across face of cooler not
to exceed 30°F at any time.
2. Cooling air to be circulated through each heat exchanger
by a fan driven by a 3 phase, 480 volt, 60 Hertz, totally
enclosed motor.
3. Heat exchanger material to be non-corrosive and suitable
for a service pressure of 25 psig.
4. Equipment to be similar to Solar standard ambient oil
cooler for Solar Centaur Gas Turbine Generator Set.

EQUIP. NO. 6

EQUIP. DESIGNATION Waste Heat Boilers

1. Four (4) un-fired heat recovery boilers. Each rated at 150 psig saturated steam from gas turbine exhaust flow from 135,000 pounds per hour at 850°F to 155,000 pounds per hour at 800°F and to be capable of accommodating the same range of flows with gas temperatures at inlet as low as 500°F without causing dew point corrosion in the boiler, breeching or stacks.
2. Waste Heat Boilers will be built in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
3. Each boiler will produce 17,000 pounds per hour (PPH) saturated steam at 150 psig with a gas flow of 146,000 PPH and a gas inlet temperature of 830°F with a feed water temperature of 220°F to an economizer.
4. Internal by-pass furnished with boiler will be fitted. Stacks, breeching, ducting, dampers, damper drives, expansion joints and isolating blanks will be furnished by other than boiler manufacturer.
5. Boiler will be complete with insulated casing, water drum, mud drum, downcomers, tubes, steam separator, structural steel base, safety valves, feedwater regulator, gage glasses, connections mounting and accessories.
6. Equipment to be similar to Deltak Model 3-167 with economizer.

EQUIP. NO. 7

EQUIP. DESIGNATION Waste Heat Boiler Exhaust System Dampers

1. Four sets of six (6) dampers with drives for use in Waste Heat Boilers exhaust system.
2. Damper bearings to be grease lubricated and to be located external to damper frame. Each shaft to be fitted with stuffing box packed with heat-resistant low friction packing (900°F service).
3. Dampers in closed position to be tight within one half (1/2) percent at entire range of gas temperature (500°F to 900°F).
4. Dampers to have air ram drive and to be interlocked so that boiler dampers (inlet and outlet) will open as by-pass damper closes and vice versa. Means to be provided so that dampers can be manually operated (with vented or disconnected ram) with application of no more than 50 pound force when damper is hot or cold.
5. All metal parts exposed to gases to be of non-corrosive material.

EQUIP. NO. 8

EQUIP. DESIGNATION

Waste Heat Boiler Exhaust System
Expansion Joints

1. Eight (8) fabric type exhaust system expansion joints for 900°F service.
2. Materials of joint to be brass wire inserted asbestos with 1/4" x 3" zinc coated steel retaining rings backing molded flanges.
3. Expansion joint to be free of stress points at flange.

EQUIP. NO. 9

EQUIP. DESIGNATION Auxiliary Boiler (Fired)

Two (2) package-type water tube steam generator, rated at 30,000 #/hr at 150 psig and saturated (366°F) steam, skid mounted, complete with the following features:

1. Boilers will be built in accordance with ASME Boiler and Pressure Vessel Code, Section I, for Power Boilers and the requirements of the State of New Jersey (and City of Trenton - if any) for high pressure fired steam boilers.
2. Boilers to be complete with economizer burner assembly and automatic cam operated metering valve, responding to steam pressure signal suitable for firing #2 oil but not including forced draft fan and fuel oil pump.
3. Burner Turndown Range 8 to 1.
4. Provide complete automatic controls and safety monitoring system with audible alarms and visual display (annunciator type) indicating low and high water level trip, high steam pressure trip and flame out trip (Manual start-stop) and with fuel air ratio controller.
5. Guarantee against defective workmanship and materials for one year from the date of operation and provide performance guarantee to operate at an efficiency greater than 80% over the operating range.
6. Noise level not to exceed 80 dbA at three feet from the casing.
7. Two self supporting stacks 100 ft. high, duly insulated inside the building. The material of stacks will be Corten "A" steel or equal with a painters trolley.

EQUIP. NO. 10

EQUIP. DESIGNATION

Forced Draft Fans

Two (2) Forced Draft Fans rated at 9,900 SCFM. Fans will be furnished complete with 30, 440V, motors and coupling, common skid with boiler, and with the following characteristics.

1. Fan rotor will have sleeve-type oil ring lubricated bearings and supported independently of motor bearings. Rotor to be statically and dynamically balanced. Rotor and housing to be primed and painted with a corrosion-resisting coating on all ferrous non-wear surfaces.
2. Coupling to be flexible type. Final alignment to be done after skid is bolted down in place.
3. Noise level not to exceed 80 dbA at a distance of 3 feet from the fan or motor.
4. Motors to be in accordance with NEMA standards of the National Electrical Code (latest edition).
5. The fans and motors will be for service with two 30,000 pounds per hour water tube boilers.

EQUIP. NO. 11

EQUIP. DESIGNATION Condensate Pumps

1. Four (4) single stage condensate pumps. Pumps to be rated at 80 gpm with a discharge pressure of 40 psig and with a NPSH available of 12 psia. Temperature of water to be pumped = 180°F.
2. Pumps to be furnished with standard flanges for inlet and outlet connections and 1/2" vent connection.
3. All pumps will be supplied with 480 volts three phase, 60 hertz motors. Motors to be drip proof and in accordance with NEMA standards and the requirements of the National Electric Code. Rating of motors to be approximately 5 hp. Motor, coupling and pump to be delivered mounted on a common bed-plate and tested as an assembly prior to shipping.

EQUIP. NO. 12

EQUIP. DESIGNATION Boiler Feed Pumps

1. Four (4) multi-stage boiler feed pumps. Pumps will be rated at 80 gpm with a discharge pressure of 210 psig and a net positive suction head of 12 psia. Temperature of water pumped will be approximately 220^oF.
2. Pumps to be furnished with standard flanges at inlet and outlet connections and 1/2" vent connection.
3. Pumps to be supplied with 480 volts, three phase, 60 hertz motors. Motors to be drip-proof and in accordance with NEMA standards and the requirements of the National Electric Code. Rating of motor to be approximately 25 horsepower. Motors, couplings, and pumps will be delivered mounted on common bed-plates and tested as an assembly prior to shipping.

EQUIP. NO. 13

EQUIP. DESIGNATION

Fuel Oil Transfer Pumps

1. Three (3) positive displacement rotary fuel oil transfer pumps each rated at 20 gpm with a net positive suction head of 5 psia and with a discharge pressure of 50 psig. Temperature of fuel oil #2 is ambient.
2. Pumps will be supplied with 480 volts, three phase, 60 hertz motors. Motors to be drip-proof and in accordance with NEMA standards and the requirements of the National Electric Code. Motor, coupling and pump to be delivered mounted on a common bed plate and tested as an assembly prior to shipping.

EQUIP. NO. 14

EQUIP. DESIGNATION Fuel Oil Booster Pumps

1. Three (3) positive displacement rotary fuel oil booster pumps each rated at 15 gpm with a discharge pressure of 60 psig and with a net positive suction head of 10 psia. Temperature of fuel oil #2 is ambient.
2. Pumps will be supplied with 480 volts, three phase, 60 hertz motors. Motors will be drip-proof and in accordance with NEMA standards and the requirements of the National Electric Code. Motor, coupling and pump to be delivered mounted on a common bed plate and tested as an assembly prior to shipping.

EQUIP. NO. 15

EQUIP. DESIGNATION Auxiliary Fuel Oil Booster Pumps

1. Two (2) positive displacement rotary auxiliary fuel oil pumps each rated at 8 gpm with a discharge pressure of 60 psig and with a net positive suction head of 10 psia. Temperature of fuel oil #2 is ambient.
2. Pumps will be supplied with 480 volts, three phase, 60 hertz motors. Motors will be drip-proof and in accordance with NEMA standards and the requirements of the National Electric Code. Motor, coupling and pump to be delivered mounted on a common bed plate and tested as an assembly prior to shipping.

EQUIP. NO. 16

EQUIP. DESIGNATION Deaerator

1. Two (2) jet type deaerators complete with vent condenser and integral storage tank capable of holding at least 500 gallons. Deaerator rated at 60,000 pounds of water per hour.
2. External shell is to be fabricated of welded rolled low-carbon steel plate for a design pressure of 50 psig and 10 psig operating. Fabrication to meet requirement of ASME Boiler and Pressure Vessel Code.
3. Preheating Spray distributor and trays will be fabricated of monel or stainless steel.
4. Feedwater will have oxygen less than 0.005 cc per liter after deaeration.
5. Deaerator and feedwater pumps will be mounted on one skid and supplied as a package unit.

EQUIP. NO. 17

EQUIP. DESIGNATION Fuel Oil Strainer (Coarse)

1. One (1) duplex type oil strainer for service with #2 oil at ambient temperature (Trenton, NJ). Steel strainer material to be capable of retaining particles of 500 micron size or larger. Basket structure to be designed so that total stoppage of strainer will not cause failure of basket. Also fit each basket with permanent magnet array to pick up corrosion products or stray ferrous chips.
2. Strainer will be rated for 125 gpm oil at 0°F. Fit strainer body with 2-1/2 inch standard flanges at inlet and outlet connections. Also provide 1/2" vent and drain connections for each half of duplex.

EQUIP. NO. 18

EQUIP. DESIGNATION Fuel Oil Strainer (Coarse)

1. One (1) duplex type oil strainer for service with #2 oil at ambient temperature (Trenton, NJ). Steel strainer material to be capable of retaining particles of 500 micron size or larger. Basket structure to be designed so that total stoppage of strainer will not cause failure of basket. Also fit each basket with permanent magnet array to pick up corrosion products or stray ferrous chips.
2. Strainer will be rated for 125 gpm oil at 0°F. Fit strainer body with 2-1/2 inch standard flanges at inlet and outlet connections. Also provide 1/2" vent and drain connections for each half of duplex.

EQUIP. NO. 19

EQUIP. DESIGNATION

Chemical Addition Pumps,
Boiler Feed

1. Three (3) chemical feed systems, each consisting of 55 gallon tank of corrosion resistant material, complete with stand, tank lid, pump, agitator, agitator bracket, gauge glass, strainer, suction valve and piping. Units to be shipped completely assembled and ready for installation.
2. Pump to be positive displacement proportioning simplex type driven by a constant speed drip-proof motor. Pump capacity to be variable thru entire range (i.e., 0% to 100%). Maximum capacity to be 10 gpm. All metal parts of pump wet by chemicals are to be corrosion resistant material suitable for service with acidic and basic chemicals used in boiler water treatment.

EQUIP. NO. 20

EQUIP. DESIGNATION

Water Softening
Demineralizer

1. One (1) water softening demineralizer for pre-treatment of boiler make-up water. Trenton City water, with a total hardness in the order of 100 milligram/liter is to be softened to 1 milligram/liter total hardness in passing through the demineralizer. Demineralizer equipment to include capability for automatic bypass during regeneration or in event of stoppage and with fast backwash, resin regeneration treatment (slow flow) and fast rinse.
2. Tank to be steel vessel rated at 125 psig, hot dipped double galvanized. Hydrotest tank to 180 psig. Design flow rate to be 40 gpm.
3. Water inlet and effluent connections to be standard (ANSI) pipe thread, size 1-1/2".
4. Unit is to be shipped completely assembled, pretested and ready to install.
5. Supplier should obtain his own analysis prior to establishing performance guarantee. However, for preliminary guidance, the following information may be helpful regarding characteristics of Trenton water:

pH = 7.61

Total Alkalinity (as CaCO_3) = 52 mg/l

Calcium = 72 mg/l

Iron = 0.35 mg/l

Magnesium = 0.03 mg/l

EQUIP. NO. 21

EQUIP. DESIGNATION Condensate Demineralizer

1. One (1) condensate polisher for use in parallel flow with condensate returning to boiler feed system.
2. Tank of polisher to be steel vessel rated at 125 psig and hydrotested to 180 psi. All ferrous parts to be hot double dipped galvanized. Design flow rate to be 40 gpm. Condensate inlet and outlet connections to be standard 4" flanged pipe connections.
3. Equipment to include capability for automatic by-pass during regeneration or if out of service. Valving to accommodate fast-back-wash, resin regeneration treatment, slow flow and fast rinse. (Total condensate flow can be diverted through demineralizer for fast flow conditions). Unit is to be shipped completely assembled, pre-tested and ready to install.

EQUIP. NO. 22

EQUIP. DESIGNATION Tanks - Atmospheric Pressure Service

1. Six (6) low carbon (mild) steel atmospherically vented tanks for fuel oil or water service. All tank plate material to be 3/8" thick Class A Open Hearth ASTM Specification A-283 Grade C. Shapes to be in accordance with ASTM Specification A-36, A-212, or A-285.
2. Three (3) tanks will be for fuel oil (#2API) service. Fuel oil tanks will be installed underground and are to be shop assembled and delivered to the site ready for installation. Fuel oil tanks to be constructed to Underwriter's (NBFO) specifications and furnished with certification. Inside of oil tanks to be coated with oil prior to shipment. Each oil tank to be fitted with two 18 inch manhole. The fuel oil storage tanks are to be horizontal cylindrical tanks with flat heads.
3. The three (3) water service tanks will consist of two (2) cylindrical blow-off tanks and one drain tank. The blow-off tanks are to be approximately 36" diam. by 60" shell. Tanks to be fitted with dished heads and piped and supported for above ground horizontal installation. The drain tank is to be cylindrical in shape with flat top and bottom. This tank will be furnished skid mounted on I-beams for installation at grade. Interior surfaces of waer tanks will be shipped free of any coating.
4. All tank surfaces including interior surfaces to be thoroughly grit blasted, cleaned of all mill scale, grease, paint, dirt, and rust after fabrication and prior to coating. Outside of all tanks to be given two coats of primer. Primer for oil tanks to be red lead. Primer for water tanks to be high temperature aluminum paint suitable for 300°F service.
5. Approximate size particulars of these eight tanks are as follows:

<u>Name</u>	<u>Quantity</u>	<u>Dimensions</u>	<u>Size (each) Gals.</u>
Fuel Oil Storage	3	12' dia. x 59'L.	50,000
Blow Off Tanks	2	3' dia. x 5' at T.LN.	280
Drain Tank	1	5' dia. x 6'H.	3,500

Details of piping connections showing orientation and size and location of gauging and other instrument connections will be as shown on sketches (to be furnished at time of request for proposals for contract purposes).

INSTRUMENT & VALVE LIST

INSTRUMENT OR VALVE NO.	TITLE	RANGE	VALVE ACTIVATED BY	ELEC ON PANEL	TYPE MODEL MANUFACTURER	REQ. OR ORDER NO.	CONN. SIZE	P. S. DWG. NO. M-MECH. C-CONT.	P. S. B/P NO.	REMARKS
LIT-1	No. 1 FUEL OIL TANK LEVEL TRANSMITTER									
LI-2	No. 1 FUEL OIL TANK LEVEL INDICATOR									
LIT-4	No. 2 FUEL OIL TANK LEVEL TRANSMITTER									
LI-5	No. 2 FUEL OIL TANK LEVEL INDICATOR									
POS-7	TRANSFER PUMP STRAINER DIFFERENTIAL PRESSURE SWITCH									
PI-8	No. 1 TRANSFER PUMP DISCHARGE PRESSURE INDICATOR									
PI-9	No. 2 TRANSFER PUMP DISCHARGE PRESSURE INDICATOR									
PI-10	No. 3 TRANSFER PUMP DISCHARGE PRESSURE INDICATOR									
LIT-11	No. 2 F.O. TANK									
LI-12	No. 2 F.O. TANK									
LS-13	"									
LS-14	"									
LSH-3	No. 1 FUEL OIL TANK HIGH LEVEL SWITCH									
LSH-6	No. 2 FUEL OIL TANK HIGH LEVEL SWITCH									
POS-15	JET BOOSTER PUMP STRAINER DIFFERENTIAL PRESSURE SWITCH									
PI-16	JET BOOSTER PUMP STRAINER INLET PRESSURE INDICATOR									
PI-17	JET BOOSTER PUMP STRAINER OUTLET PRESSURE INDICATOR									
PI-18	TRANSFER PUMP STRAINER INLET PRESSURE INDICATOR									
PI-19	TRANSFER PUMP STRAINER OUTLET PRESSURE INDICATOR									
POS-20	BOILER BOOSTER PUMP STRAINER DIFFERENTIAL PRESSURE SWITCH									
PI-21	BOILER BOOSTER PUMP STRAINER INLET PRESSURE INDICATOR									
PI-22	BOILER BOOSTER PUMP STRAINER OUTLET PRESSURE INDICATOR									
PI-23	No. 1 JET BOOSTER PUMP DISCHARGE PRESSURE INDICATOR									
PI-24	No. 2 JET BOOSTER PUMP DISCHARGE PRESSURE INDICATOR									

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GENERATING STATION-UNIT NO. 1

INSTRUMENT OR VALVE NO	TITLE	RANGE	VALVE ACTIVATED BY	ELEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO	CONN SIZE	P.S. DWG NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
PI-25	No 3 Jet Booster Pump Discharge Pressure Indicator									
PI-26	No 1 Boiler Booster Pump Discharge Pressure Indicator									
PI-27	No 2 Boiler Booster Pump Discharge Pressure Indicator									
HIK-28	MANUAL/AUTO PRESS. STA.									
PSH-29	HIGH HEADER PR. --									
HIK-30	DISCHARGE PR. INDICATOR									
PSH-31	No 2 Fuel Oil Filter Discharge Pressure Indicator									
PSL-32	JET FUEL OIL HEADER LOW PRESSURE SWITCH									
PI-33	JET FUEL OIL HEADER PRESSURE INDICATOR									
PT-34	JET FUEL OIL HEADER PRESSURE TRANSMITTER									
PC-35	JET FUEL OIL HEADER PRESSURE CONTROLLER									
PSL-36	BOILER FUEL OIL HEADER LOW PRESSURE SWITCH									
PI-37	BOILER FUEL OIL HEADER PRESSURE INDICATOR									
PT-38	BOILER FUEL OIL HEADER PRESSURE TRANSMITTER									
PC-39	BOILER FUEL OIL HEADER PRESSURE CONTROLLER									
PC-40	BAID BOILER MINIMUM F.O. PRESSURE CONTROLLER									
PC-41	BAID BOILER MINIMUM F.O. PRESSURE CONTROLLER									
CT-42	CONDENSATE RETURN CONDUCTIVITY TRANSMITTER									
CR-43	CONDENSATE RETURN CONDUCTIVITY REORDER									
LG-44	CONDENSATE RECEIVER LEVEL GAGE									
LSL-45	CONDENSATE RECEIVER LOW LEVEL SWITCH									
LSH-46	CONDENSATE RECEIVER HIGH LEVEL SWITCH									
LT-47	CONDENSATE RECEIVER LEVEL TRANSMITTER									

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GENERATING STATION-UNIT NO

INSTRUMENT OR VALVE NO.	TITLE	RANGE	VALVE ACTIVATED BY	ELEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN SIZE	P. S. DWG. NO. M-MECH. C-CONT.	P. S. B/P NO.	REMARKS
LC-48	CONDENSATE RECEIVER LEVEL CONTROLLER									
PI-49	NO. 1 CONDENSATE PUMP INLET PRESSURE INDICATOR									
PI-50	NO. 1 CONDENSATE PUMP OUTLET PRESSURE INDICATOR									
PI-51	NO. 2 CONDENSATE PUMP INLET PRESSURE INDICATOR									
PI-52	NO. 2 CONDENSATE PUMP OUTLET PRESSURE INDICATOR									
PI-53	NO. 3 CONDENSATE PUMP INLET PRESSURE INDICATOR									
PI-54	NO. 3 CONDENSATE PUMP OUTLET PRESSURE INDICATOR									
PS-55	CONDENSATE PUMP DISCHARGE HEADER PRESSURE SWITCH									
PI-56	CONDENSATE PUMP DISCHARGE HEADER PRESSURE INDICATOR									
PI-57	DEAERATOR PRESSURE INDICATOR									
LG-58	DEAERATOR LEVEL GAUGE									
LSC-59	DEAERATOR LOW LEVEL SWITCH									
LSH-60	DEAERATOR HIGH LEVEL SWITCH									
LT-61	DEAERATOR LEVEL TRANSMITTER									
LC-62	DEAERATOR LEVEL CONTROLLER									
PI-63	NO. 1 BOILER FEED PUMP INLET PRESSURE									
PI-64	NO. 1 BOILER FEED PUMP OUTLET PRESSURE INDICATOR									
PI-65	NO. 2 BOILER FEED PUMP INLET PRESSURE INDICATOR									
PI-66	NO. 2 BOILER FEED PUMP OUTLET PRESSURE INDICATOR									
PI-67	NO. 3 BOILER FEED PUMP INLET PRESSURE INDICATOR									
PI-68	NO. 3 BOILER FEED PUMP OUTLET PRESSURE INDICATOR									
PS-69	BOILER FEED PUMP DISCHARGE PRESSURE SWITCH									
PI-70	BOILER FEED PUMP DISCHARGE PRESSURE INDICATOR									
FT-71	TOTAL FEEDWATER FLOW TRANSMITTER									

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ICES

GENERATING STATION-UNIT NO.

INSTRUMENT OR VALVE NO.	TITLE	RANGE	VALVE ACTIVATED BY	ELEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN SIZE	P.S. DWG. NO. M-MECH. C-CONT.	P.S.D/P NO.	REMARKS
FI-72	TOTAL FEEDWATER FLOW INDICATOR									
PT-73	FEEDWATER SUPPLY HEADER PRESSURE TRANSMITTER									
PC-74	FEEDWATER SUPPLY HEADER PRESSURE CONTROLLER									
FIT-75	No. 1 WASTE HEAT BOILER FEEDWATER FLOW TRANSMITTER									
FI-76	No. 1 WASTE HEAT BOILER FEEDWATER FLOW INDICATOR									
FIT-77	No. 2 WASTE HEAT BOILER FEEDWATER FLOW TRANSMITTER									
FI-78	No. 2 WASTE HEAT BOILER FEEDWATER FLOW INDICATOR									
FIT-79	No. 3 WASTE HEAT BOILER FEEDWATER FLOW TRANSMITTER									
FI-80	No. 3 WASTE HEAT BOILER FEEDWATER FLOW INDICATOR									
FIT-81	No. 4 WASTE HEAT BOILER FEEDWATER FLOW TRANSMITTER									
FI-82	No. 4 WASTE HEAT BOILER FEEDWATER FLOW INDICATOR									
FIT-83	A BOILER FEEDWATER FLOW TRANSMITTER									
FI-84	A BOILER FEEDWATER FLOW INDICATOR									
FIT-85	B BOILER FEEDWATER FLOW TRANSMITTER									
FI-86	B BOILER FEEDWATER FLOW INDICATOR									
LG-87	No. 1 W.H. BOILER DRUM LEVEL GAUGE									
LSH-88	No. 1 W.H. BOILER HIGH DRUM LEVEL SWITCH									
LSL-89	No. 1 W.H. BOILER LOW DRUM LEVEL SWITCH									
LT-90	No. 1 W.H. BOILER DRUM LEVEL TRANSMITTER									
LG-91	No. 2 W.H. BOILER DRUM LEVEL GAUGE									
LSH-92	No. 2 W.H. BOILER HIGH DRUM LEVEL SWITCH									
LSL-93	No. 2 W.H. BOILER LOW DRUM LEVEL SWITCH									
LT-94	No. 2 W.H. BOILER DRUM LEVEL TRANSMITTER									
LT-95	No. 1 W.H. BOILER DRUM LEVEL TRANSMITTER									

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GENERATING STATION-UNIT NO.

INSTRUMENT OR VALVE NO	TITLE	RANGE	VALVE ACTIVATED BY	FLEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO	CONN SIZE	P.S. DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
LG-96	NO. 2 W.H. BOILER DRUM LEVEL CONTROLLER									
LG-97	NO. 3 W.H. BOILER DRUM LEVEL GAUGE									
* LSH-98	NO. 3 W.H. IS-GR HIGH DRUM LEVEL SWITCH									
* LSL-99	NO. 3 W.H. BOILER LOW DRUM LEVEL SWITCH									
LT-100	NO. 3 W.H. BOILER DRUM LEVEL TRANSMITTER									
LG-101	NO. 3 W.H. BOILER DRUM LEVEL CONTROLLER									
LG-102	NO. 4 W.H. BOILER DRUM GAUGE									
* LSH-103										
* SL-104										
LT-105										
LG-106										
LG-107	A									
LSH-108										
LSL-109										
LT-110										
LG-111										
LG-112	B									
LSH-113										
LSL-114										
LT-115										
LR-116										

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GENERATING STATION-UNIT NO.

INSTRUMENT OR VALVE NO	TITLE	RANGE	VALVE ACTIVATED BY	FLC OR FUEL	TYPE MODEL MANUFACTURER	REQ OR ORDER NO	CONN SIZE	P. S DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
FT-117	No 1 W.H. BOILER STEAM FLOW TRANS.									
FI-118	No 1 W.H. BOILER STEAM FLOW IND.									
FT-119	No 2 W.H. BOILER STEAM FLOW TRANS									
FI-120	No 2 W.H. BOILER STEAM FLOW IND.									
FT-121	No 3 W.H. BOILER STEAM FLOW TRANS									
FI-122	No 3 W.H. BOILER STEAM FLOW IND									
FT-123	No 4 W.H. BOILER STEAM FLOW TRANSMITTER									
FI-124	No 4 W.H. BOILER STEAM FLOW IND									
FT-125	A AUX BOILER STEAM FLOW TRANS									
FI-126	A AUX BOILER STEAM FLOW IND									
FT-127	B AUX BOILER STEAM FLOW TRANS									
FI-128	B AUX BOILER STEAM FLOW IND									
PI-129	MAIN STEAM HEADER PRESSURE INDICATOR									
PT-130	MAIN STEAM HEADER PRESSURE TRANSMITTER									
PI-131	MAIN STEAM HEADER PRESSURE									
FT-132	LOAD A STEAM FLOW TRANSMITTER									
FI-133	LOAD A STEAM FLOW INDICATOR									
FT-134	LOAD B STEAM FLOW TRANSMITTER									
FI-135	LOAD B STEAM FLOW INDICATOR									
PI-136	DEAERATOR STEAM SUPPLY PRESSURE									
PC-137	DEAERATOR STEAM SUPPLY PRESSURE CONTROLLER									
PI-138	PLANT HEATING STEAM PRESSURE									
PC-139	PLANT HEATING STEAM PRESSURE CONTROLLER									

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GENERATING STATION-UNIT NO.

INSTRUMENT OR VALVE NO.	TITLE	RANGE	VALVE ACTIVATED BY	ELEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN SIZE	P.S. DWG. NO. M-MECH. C-CONT.	P.S.D/P NO.	REMARKS
HIK-140	COND. REC. LEVEL									
PI-141	COND. Pump Disc. HEADER									
PI-142	"									
HIK-143	DISCHARGE LEVEL									
PI-144	F.W. Supply HEADER									
HIK-145	F.W. Supply HEADER									
LY-146	NO A									
HIK-147	NO A									
LY-148	2									
HIK-149	2									
LY-150	2									
HIK-151	2									
LY-152	3									
HIK-153	3									
LY-154	4									
HIK-155	4									
LY-156	B									
HIK-157	B									
PI-158	1									
HIK-159	1									
PI-160	2									
HIK-161	2									
PI-162	3									
HIK-163	3									

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1 GENERATING STATION-UNIT NO

INSTRUMENT OR VALVE NO	TITLE	RANGE	VALVE ACTIVATED BY	ELEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN SIZE	P. S. DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
PY-164	4									
NIK-165	4									
PY-166	A									
NIK-167	A									
PY-168	B									
NIK-169	B									
PI-170	1									
PT-171	1									
PI-172	1									
PI-173	2									
PT-174	2									
PI-175	2									
PI-176	3									
PT-177	3									
PI-178	3									
PI-179	4									
PT-180	4									
PI-181	4									
PI-182	A									
PT-183	A									
PI-184	A									
PI-185	B									
PT-186	B									
PI-187	A									

GENERATING STATION-UNIT NO.

INSTRUMENT & VALVE LIST

INSTRUMENT OR VALVE NO	TITLE	HAND LOCATION	VALVE ACTIVATED BY	ELEC ON PANEL	TYPE MODEL MANUFACTURER	REQ OR ORDER NO	CONN SIZE	P. S. DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
PT-188	GENERATOR									
PI-189	" Z-MOTOR									
PI-190	" INLET									
PI-191	HEATING STEAM INLET									
TE-192	1	L								
TE-193	2	L								
TE-194	3	L								
TE-195	4	L								
TE-196	A	L								
TE-197	B	L								
LI-198	COND. RECEIVER									
CIT-199	COND. DEMIN. INLET CONDUCTIVITY									
CIT-200	COND. DEMIN. OUTLET CONDUCTIVITY									
TI-201	COND. RECEIVER OUTLET TEMP.									
TI-202	DEAERATOR OUTLET TEMP.									
PI-203	FEEDWATER HDR. PRESS.									
TI-204	FEEDWATER HDR. TEMP.	L								
TI-205	"	L								
TI-206	" (CONTROL ROOM)	C								
TW-207	COND. RECEIVER OUT. TEMP.	L								
TW-208	DEAERATOR OUT. TEMP.	L								
TW-209	FEEDWATER HDR. TEMP.	L								
TW-210	"	L								
TW-211	COND. PUMP. DISCH. TEMP.	L								

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GENERATING STATION - UNIT NO

INSTRUMENT & VALVE LIST

INSTRUMENT OR VALVE NO.	TITLE	PROCESS LOCATION	VALVE ACTIVATED BY	ELEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN SIZE	P. S. DWG. NO. M-MECH. C-CONT.	P. S. B/P NO.	REMARKS
TW-212	COND. DENIM. DISCH. TEMP.	L								
TW-213	COND. RETURN TEMP.	L								
TI-214	"	L								
LR-215	NO. 4 WHB DRUM LEVEL	CR								
LR-216	NO. 3 WHB DRUM LEVEL	CR								
LR-217	NO. 2 WHB DRUM LEVEL	CR								
LR-218	NO. 1 WHB DRUM LEVEL	CR								
LR-219	'A' AUX. BLR. DRUM LEVEL	CR								
LR-220	'B' AUX. BLR. DRUM LEVEL	CR								
TE-221	NO. 4 WHB INLET GAS TEMP. TC	L								
TE-222	"	L								
TR-223	NO. 4 WHB INLET TEMPS.	CR								
TE-224	NO. 4 WHB EXIT GAS TEMP. TC	L								
TE-225	NO. 3 WHB									
TR-226	DITTO NO. 1 WHB TEMPS									
TE-227										
TE-228										
TE-229	NO. 2 WHB									
TR-230	DITTO NO. 1 WHB TEMPS.									
TE-231										
TE-232										
TE-233	NO. 1 WHB. DITTO NO. 1									
TR-234	WHB TEMPS.									
TE-235										
TE-236										

GENERATING STATION-UNIT NO.

INSTRUMENT & VALVE LIST

INSTRUMENT OR VALVE NO.	TITLE	RANGE LOCATION	VALVE ACTIVATED BY	REC ON PANEL	TY - MODEL MANUFACTURER	REQ. ON ORDER NO.	CONN SIZE	P.S. DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
TE-237	A' AUX. BLR EXIT GAS TEMP.	L								
TR-238	A' AUX. BLR TEMP.	CR								
TE-239	B' AUX. BLR EXIT GAS TEMP.	L								
TE-240	B' AUX. BLR TEMP. EXIT GAS TEMP.	L								
TW-241	NO. 4 WHB STEAM TEMP.	L								
TW-242	NO. 3 WHB STEAM TEMP.	L								
TW-243	NO. 2 WHB STEAM TEMP.	L								
TW-244	NO. 1 WHB STEAM TEMP.	L								
TW-245	A' AUX. BLR STEAM TEMP.	L								
TW-246	B' AUX. BLR STEAM TEMP.	L								
FE-247	LOAD 'B' STM. FLOW ORIFICE	L								
FE-248	NO. 4 WHB STM. FLOW ORIFICE	L								
FE-249	NO. 3 WHB	L								
FE-250	NO. 2 WHB	L								
FE-251	NO. 1 WHB	L								
FE-252	A' AUX. BLR STM. FLOW ORIFICE	L								
FE-253	B' AUX. BLR	L								
FE-254	PLANT FW FLOW ORIFICE	L								
CY-255	COND. CONDUCTIVITY DUMP CONTROL	LP								
XV-256	COND. CONDUCTIVITY DUMP SOLENOID VALV.	LP								
FE-257	TOTAL COND. RETURN FLOW	L								
FIT-258	"	L								
FE-259	CITY WATER MAKE-UP FLOW	L								
FIT-260	"	L								

GENERATING STATION - UNIT NO. _____

INSTRUMENT OR VALVE NO.	TITLE	RANGE	VALVE ACTIVATED BY	ELEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN SIZE	P. S. DWG. NO. M-MECH. C-CONT.	P. S. B/P NO.	REMARKS
FI-261	TOTAL COND. RETURN FLOW	CR								
FI-262	CITY WATER MAKE-UP FLOW	CR								
FE-263	NO. 4 WHB FW FLOW	L								
FE-264	NO. 3 WHB	L								
FE-265	NO. 2 WHB	L								
FE-266	NO. 1 WHB	L								
FE-267	'A' AUX. BLR. FW FLOW	L								
FE-268	'B' AUX. BLR.	L								
PI-269	PLANT STEAM HDR. PRESS.	CR								
FQ-270	LOAD 'B' TOTAL STEAM FLOW INTEGRATOR	LP								
WI-271	LOAD 'B' TOTAL STEAM FLOW INDICATOR	CR								
FY-272	LOAD 'B' TOTAL STEAM FLOW COMPENSATOR	LP								
TE-273	LOAD 'B' STEAM TEMP.	L								
TT-274	LOAD 'B' STEAM TEMP.	LP								
TW-275	LOAD 'B' STEAM TEMP.	L								
PI-276	PLANT STEAM PRESS. E/P	LP								
FE-277	LOAD 'A' STEAM FLOW ORIFICE	L								
FY-278	LOAD 'A' STEAM FLOW COMPENSATOR	LP								
FQ-279	LOAD 'A' TOTAL STEAM FLOW INTEGRATOR	LP								
WI-280	LOAD 'A' TOTAL STEAM FLOW INDICATOR	CR								
TW-281	LOAD 'A' STEAM TEMP.	L								
TE-282	LOAD 'A' STEAM TEMP.	L								
TT-283	LOAD 'A' STEAM TEMP.	LP								
FE-284	HOUSE HTG. STEAM FLOW	L								

GENERATING STATION-UNIT NO. _____

INSTRUMENT OR VALVE NO.	TITLE	RANGE	VALVE ACTIVATED BY	ELEC CIR PHEN	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN SIZE	P.S. DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
FE-285	GENERATOR SYM. FLOW	L								
FQ-286	4A JET F.O. METER	L								
FQ-287	#3 "	L								
FQ-288	#2 "	L								
FQ-289	#1 "	L								
FQ-290	A' AUX. BLR. F.O. METER	L								
TW-292	JET F.O. HDR. TEMP.	L								
TW-293	AUX. BLR. F.O. HDR. TEMP.	L								
PT-293	A' AUX. BLR. BWR. F.O. HDR. PRESS.	L								
PI-295	"	L								
PI-296	"	CR								
PT-297	B' AUX. BLR. "	L								
PI-298	"	L								
PI-299	"	CR								
PT-300	AUX. BLR. F.O. HDR. PRESS.	L								
PI-301	"	CR								
FT-302	A' AUX. BLR. F.O. FLOW	L								
FT-303	B' AUX. BLR. "	L								
FR-304	A' AUX. BLR. FLOW RECORDER	CR								
FR-305	B' " "	CR								
LG-306										
TR-307	B' AUX. BLR. TEMP.	CR								
FIT-308	NO. COND. REC. MAKE-UP									

13 GENERATING STATION-UNIT NO. _____

INSTRUMENT & VALVE LIST

INSTRUMENT OR VALVE NO	TITLE	RANGE	VALVE ACTIVATED BY	REC OIL PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO	CONN SIZE	P.S. DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
FE-309	NO. 2 COND. RECEIVER MAKE-UP									
LG-310	NO. 2 COND. RECEIVER									
LSL-311	"									
LSH-312	"									
LT-313	"									
LC-314	"									
LI-315	"									
HIK-316	"									
LG-317	NO. 2 DEAERATOR									
LSL-318	"									
LSH-319	"									
LT-320	"									
LE-321	"									
HIK-322	"									
PI-323	"									
PT-324	"									
PI-325	"									
PI-326	2A BFP									
PI-327	2B BFP									
PI-328	2A BFP									
PI-329	2B BFP									
PI-330	2A COND. PUMP									
PI-331	2B " "									
PI-332	2A " "									

GENERATING STATION - UNIT NO

CONTROL VALVES

INSTRUMENT OR VALVE NO.	TITLE	RANGE	VALVE ACTIVATED BY	FLEC OR PNEU	TYPE MODEL MANUFACTURER	REQ OR ORDER NO.	CONN. SIZE	P.S. DWG. NO. M-MECH. C-CONT.	P.S.B/P NO.	REMARKS
LCV-801	CONDENSATE RECEIVER LEVEL									
LCV-802	DEAERATOR LEVEL									
PCV-803	FEEDWATER HEADER PRESSURE									
LCV-804	NO. 4 WHB DRUM LEVEL									
LCV-805	NO. 3 WHB DRUM LEVEL									
LCV-806	NO. 2 WHB DRUM LEVEL									
LCV-807	NO. 1 WHB DRUM LEVEL									
LCV-808	'A' AUX. BLR. DRUM LEVEL									
LCV-809	'B' AUX. BLR. DRUM LEVEL									
CCV-810	COND. DUMP VALVE									
CCV-811	COND. BLOW VALVE									
PCV-812	DEAERATOR PRESS.									
PCV-813	HOUSE HTG. STEAM PRESS.									
PCV-814	JET F.O. BOOST. PUMPS DISCH. PRESS.									
PCV-815	AUX. BLR. F.O. BOOST. PUMPS DISCH. PRESS.									
PCV-816	#1 JET F.O. BOOST. PUMP CUSHION									
PCV-817	#2									
PCV-818	#3									
PCV-819	#1 AUX. BLR. F.O. BOOST. PUMP CUSHION									
PCV-820	#2									
PCV-821	'A' AUX. BLR. F.O. FLOW									
PCV-822	'B' " "									
PCV-823	'A' AUX. BLR. MINI. F.O. PRESS.									
PCV-824	'B' " "									

PCV-825 No. 2 COND. REC.
LEVEL

LCV-827 No. 1 deaerator

GENERATING STATION - UNIT NO.

APPENDIX S

(3.5.3 a2)

FINAL PRELIMINARY COST
ESTIMATE

TRENTON ICES
SUMMARY OF ESTIMATESCentral Plant

Capital:

Labor	\$ 1,682,200
Material	\$ 6,487,300
Engineering and Drafting plus Overheads	\$ 2,740,000

Contingency:

Labor	\$ 441,500
Material	\$ 649,000

SUBTOTAL	\$12,000,000
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Energy Information Center	\$ 40,000
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TOTAL	\$12,040,000
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Escalation to First Quarter 1982	\$ 2,060,000
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GRAND TOTAL FOR CENTRAL PLANT	\$14,100,000
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Steam Distribution System

Capital:

Labor	\$ 790,000
Material	\$ 881,000
Engineering, Drafting and Overheads	\$ 407,000

Contingency:

Labor	\$ 120,000
Material	\$ 88,000

SUBTOTAL	\$ 2,286,000
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Escalation to First Quarter 1982	\$ 414,000
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GRAND TOTAL FOR STEAM DISTRIBUTION SYSTEM	\$ 2,700,000
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Grid Connection

Capital:

Labor	\$ 85,000
Material	\$ 300,000
Engineering, Drafting and Overheads	\$ 91,000

Contingency:

Labor	\$ 18,000
Material	\$ 30,000

SUBTOTAL	\$ 524,000
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Escalation to First Quarter 1982	\$ 96,000
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GRAND TOTAL FOR GRID CONNECTION	\$ 620,000
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Thermal Storage

Capital:

Labor	\$ 825,000
Material	\$1,190,000
Engineering, Drafting and Overheads	\$ 509,000

Contingency:

Labor	\$ 130,000
Material	\$ 120,000

SUBTOTAL	\$2,774,000
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Escalation to First Quarter 1982	\$ 526,000
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GRAND TOTAL FOR THERMAL STORAGE	\$3,300,000
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TSS:peg

3/20/78

1A2 12/13

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATES SUMMARY

March 22, 1978

ITEM NO.	TITLE	LABOR (1978)	MATERIAL (1978)	TOTAL COST (1978)
<u>CENTRAL PLANT</u>				
A-1.	Land and Site Preparation incl. survey and boring sampling	60,000	99,000	159,000
A-2.	Central Plant Building incl. mat, foundations and building facilities	385,000	572,000	957,000
A-3.	Central Plant Mechanical Equipments	195,000	3,530,000	3,725,000
A-4.	Freight Elevator incl. enclosure	8,000	29,000	37,000
A-5.	Water Treatment Equipment, Tanks, Pumps, etc.	30,000	93,000	123,000
A-6.	Fuel Oil System Tanks, Pumps, Strainers, Filters	123,000	137,500	260,500
A-7.	Air Compressors	1,000	15,000	16,000
A-8.	Valves for Central Plant	8,000	85,000	93,000
A-9.	Piping for Central Plant	85,200	90,300	175,500
A-10.	Instruments and Controls for Central Plant, Control Room Equipment, Electric Metering, Protective Relays, Gas Turbine Sequencer, etc.	329,000	968,000	1,297,000
A-11.	Water Supply Main, Potable Water Lines, Water Fountains	9,000	13,500	22,500
A-12.	Fire Protection System	5,000	15,000	20,000
A-13.	Electrical Transformers, Switchgear, Bus, Cables, Conduits, etc.	66,000	680,000	746,000
A-14.	Ventilation and other Ducts	64,000	96,000	160,000
A-15.	Repair Shop	10,000	58,000	68,000
A-16.	Security incl. fence	4,000	6,000	10,000
A-17.	Field Overheads and Fees	300,000	-	300,000
TOTAL		1,682,200	6,487,300	8,169,500

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATES SUMMARY

March 22, 1978

ITEM NO.	TITLE	LABOR (1978)	MATERIAL (1978)	TOTAL COST (1978)
<u>STEAM DISTRIBUTION SYSTEM</u>				
B-1.	Walkways for Distr. Piping	85,000	85,000	170,000
B-2.	Piping	465,000	450,000	915,000
B-3.	Piping Cathodic Protection	10,000	16,000	26,000
B-4.	Valves	2,000	10,000	12,000
B-5.	Instruments and Controls	50,000	200,000	250,000
B-6.	Steam Meters at Customer's Premises	32,000	80,000	112,000
B-7.	Condensate Meters	26,000	40,000	66,000
B-8.	Field Overheads and Fees	120,000	-	120,000
	TOTAL	<u>790,000</u>	<u>881,000</u>	<u>1,671,000</u>
<u>THERMAL STORAGE SYSTEM</u>				
C-1.	Tanks, Piping and Valves, etc.	577,000	620,000	1,197,000
C-2.	Cathodic Protection	13,000	40,000	53,000
C-3.	Instruments and Controls	120,000	530,000	650,000
C-5.	Field Overheads and Fees	115,000	-	115,000
	TOTAL	<u>825,000</u>	<u>1,190,000</u>	<u>2,015,000</u>
<u>ICES CONNECTION TO PSE&G GRID</u>				
D-1.	One (1) 13/26 kV Step-up Trans.	50,000	275,000	325,000
D-2.	26 kV Line to PSE&G Grid	25,000	25,000	50,000
D-3.	Field Overheads and Fees	<u>10,000</u>	<u>-</u>	<u>10,000</u>
	TOTAL	<u>85,000</u>	<u>300,000</u>	<u>385,000</u>
E-1.	<u>ENERGY INFORMATION CENTER</u>	25,000	15,000	40,000
F-1	<u>CONVERTORS, PUMPS ETC.</u>	50,000	175,000	225,000
		50,000	175,000	225,000

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

<u>ITEM NO.</u>	<u>TITLE</u>	<u>LABOR (1978)</u>	<u>MATERIAL (1978)</u>	<u>TOTAL COST (1978)</u>
	<u>CENTRAL PLANT</u>			
A-1.0	<u>SITE</u>			
1.1	Land, Site Preparation, and Purchasing Expense	10,000	99,000	109,000
1.2	Survey incl. Boring, Sample	50,000	-	50,000
	SUB-TOTAL	<u>60,000</u>	<u>99,000</u>	<u>159,000</u>
A-2.0	<u>STRUCTURAL</u>			
2.1	Building Envelope incl. facilities	245,000	382,000	627,000
2.2	Concrete Foundations, Floor Slabs	55,000	53,000	108,000
2.3	Piling/Foundations	18,000	13,000	31,000
2.4	Trench Covers and Frames	13,000	21,000	34,000
2.5	Steel Mezzanine, Platforms Boiler Supports	22,000	56,000	78,000
2.6	Stairs and Handrails	16,000	31,000	47,000
2.7	Duct Bank	1,000	1,000	2,000
2.8	Sidewalks and Grading, etc.	15,000	15,000	30,000
	SUB-TOTAL	<u>385,000</u>	<u>572,000</u>	<u>957,000</u>

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

<u>ITEM NO.</u>	<u>TITLE</u>	<u>LABOR (1978)</u>	<u>MATERIAL (1978)</u>	<u>TOTAL CO (1978)</u>
A-3.0	<u>CENTRAL STATION EQUIPMENT</u>			
3.1	Four (4) Basic Gas Turbines on skids, combustion air filters, inlet silencers, generators	* See Item No. 3.22	2,085,000	2,085,0
3.2	Three (3) electro hydraulic startup		27,200	27,2
3.2.1	One (1) black start-up		33,800	33,8
3.3	Fuel Booster and Filter Pump, etc.		22,200	22,2
3.4	Lubricating Oil Systems		14,400	14,4
3.5	Generator Winding Temp. Detectors		8,300	8,3
3.6	Temperature Monitors		8,300	8,3
3.7	Water Wash Systems		4,100	4,1
3.8	KVAR Controls		13,600	13,6
3.9	Standard Controls		16,500	16,5
3.10	Battery Control systems		12,400	12,4
3.11	Standard Enclosures with Fire Protection		148,000	148,0
3.12	Enclosures to meet OSHA		20,600	20,6
3.13	Circuit Breakers		165,000	165,0
3.14	Exhaust Silencers		14,400	14,4
3.15	Exhaust Expansion Joints		8,200	8,2
3.16	Freight		49,000	49,0
3.17	Motor Control Centers		8,000	8,0

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

ITEM NO.	TITLE	LABOR (1978)	MATERIAL (1978)	TOTAL COST (1978)
3.18	Waste Heat Boilers with Steam Separators, trim, soot blowers, feedwater regulator, economizers		340,000	340,000
3.19	Freight		6,000	6,000
3.20	Waste Heat Boiler Chimney		80,000	80,000
3.21	Motor Control Centers for Waste Heat Boilers		40,000	40,000
* 3.22	Construction Labor for Item No. 3.1 to 3.21	115,000	-	115,000
3.23	Auxiliary Boilers with Burners, Economizers, trim, etc.	40,000	255,000	295,000
3.24	Auxiliary Boilers Stacks	40,000	150,000	190,000
	SUB-TOTAL	195,000	3,530,000	3,725,000
A-4.0	<u>FREIGHT ELEVATOR</u>			
4.1	Hydraulic Elevator	3,000	21,000	24,000
4.2	Steel Tube, Hole, Pit	4,000	1,000	5,000
4.3	Enclosures, Doors	1,000	7,000	8,000
	SUB-TOTAL	8,000	29,000	37,000
A-5.0	<u>WATER TREATMENT</u>			
5.1	Water Treatment, Pollution Abatement and Sewer Treatment Equipment	8,000	20,000	28,000
5.2	Two (2) Drain Tanks	* See Item No. 5.9	2,000	2,000
5.3	Two (2) Condensate Receivers		5,000	5,000
5.4	Four (4) Condensate Pumps		4,000	4,000
5.5	Two (2) Deaerators		35,000	35,000
5.6	Four (4) Feedwater Pumps		14,000	14,000

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

ITEM NO.	TITLE	LABOR (1978)	MATERIAL (1978)	TOTAL COST (1978)
5.7	Two (2) Blowdown Tanks, Two (2) Blowoff Tanks and Heat Exchangers		10,000	10,000
5.8	Oil Separator		3,000	3,000
* 5.9	Construction Labor for Item No. 5.2 to 5.8	22,000	-	22,000
	SUB-TOTAL	30,000	93,000	123,000
A-6.0	<u>FUEL OIL SYSTEM</u>			
6.1	Storage Tanks	9,000	94,500	103,500
6.2	Excavation and Backfill	40,000	2,800	42,800
6.3	Local Piping	8,000	8,000	16,000
6.4	Sheating	53,000	10,000	63,000
6.5	Three (3) F.O. Transfer Pumps	* See Item No. 6.11	3,000	3,000
6.6	Two (2) Auxliary F.O. Booster Pumps		1,000	1,000
6.7	Three (3) F.O. Booster Pumps		2,000	2,000
6.8	Eight (8) Filters		4,800	4,800
6.9	Three (3) Duplex Strainers		2,400	2,400
6.10	Cathodic Protection	3,000	9,000	12,000
* 6.11	Construction Labor for Item No. 6.5 to 6.10	10,000	-	10,000
	SUB-TOTAL	123,000	137,500	260,500

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

<u>ITEM NO.</u>	<u>TITLE</u>	<u>LABOR (1978)</u>	<u>MATERIAL (1978)</u>	<u>TOTAL COST (1978)</u>
A-7.0	<u>AIR COMPRESSORS</u>			
7.1	Instrument Air Compressor and Dual Dryer	1,000	10,000	11,000
7.2	Station Air Compressor	-	5,000	5,000
	SUB-TOTAL	<u>1,000</u>	<u>15,000</u>	<u>16,000</u>
A-8.0	<u>VALVES</u>			
8.1	Valves excluding labor for valves 4" and smaller (see Item A-9)	8,000	85,000	93,000
	SUB-TOTAL	<u>8,000</u>	<u>85,000</u>	<u>93,000</u>
A-9.0	<u>PIPING</u>			
9.1	Main Steam	25,000	50,000	75,000
9.2	Condensate	11,000	14,000	25,000
9.3	Blowoff	5,200	4,600	9,800
9.4	Blowdown	5,200	4,600	9,800
9.5	Chemical Feed	1,600	1,500	3,100
9.6	Boiler Feed	5,400	7,100	12,500
9.7	Fuel Oil (from pumping station to turbines)	9,800	6,500	16,300
9.8	Drains	2,000	2,000	4,000
9.9	Hydrotesting	20,000	-	20,000
	SUB-TOTAL	<u>85,200</u>	<u>90,300</u>	<u>175,500</u>

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

<u>ITEM NO.</u>	<u>TITLE</u>	<u>LABOR (1978)</u>	<u>MATERIAL (1978)</u>	<u>TOTAL COST (1978)</u>
A-10.0	<u>INSTRUMENTS AND CONTROLS</u>			
10.1	Feedwater, fuel oil, steam	157,000	340,000	497,000
10.2	Control Room Equipment	10,000	50,000	60,000
10.3	Chemical Feed	10,000	10,000	20,000
10.4	Turbine, Generator and other Systems	98,000	285,000	383,000
10.5	Electric Metering Protective Relays, Gas Turbine Sequencer and Load Control, Gas Turbine Special Requirements	29,000	273,000	302,000
10.6	Testing Lab. Expense	20,000	-	20,000
10.7	Relay Dept. Expense	5,000	10,000	15,000
	SUB-TOTAL	329,000	968,000	1,297,000
A-11.0	<u>WATER SUPPLY</u>			
11.1	Main Water Supply and Central Plant Potable Water	8,000	12,000	20,000
11.2	Make-up Water Lines	1,000	1,500	2,500
	SUB-TOTAL	9,000	13,500	22,500
A-12.0	<u>FIRE PROTECTION</u>			
12.1	Control Room, Switchgear Room	3,000	10,000	13,000
12.2	Back-Up System	2,000	5,000	7,000
	SUB-TOTAL	5,000	15,000	20,000

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

ITEM NO.	TITLE	LABOR (1978)	MATERIAL (1978)	TOTAL COST (1978)
A-13.0	<u>ELECTRICAL</u>			
13.1	13 kV Metal Clad Switchgear	15,000	450,000	465,000
13.2	Two (2) 13 kV/460 Volt Transformers	10,000	60,000	70,000
13.3	Two (2) 460 V Switchgear	5,000	25,000	30,000
13.4	One (1) 460/208-120 Transformer	3,000	10,000	13,000
13.5	Three (3) 460 V Motor Control Centers	10,000	60,000	70,000
13.6	Lighting Bus and Fixtures	3,000	10,000	13,000
13.7	Cable, Connectors and Conduits	20,000	65,000	85,000
	SUB-TOTAL	66,000	680,000	746,000
A-14.0	<u>VENTILATION AND DUCTS</u>			
14.1	Ventilation Fans, Inlet Air Ducts, Gen. Exh. Ducts, Turbine Enclosure Ducts, Breaching and Insulation	64,000	96,000	160,000
	SUB-TOTAL	64,000	96,000	160,000
A-15.0	<u>REPAIR SHOP</u>			
15.1	Engine Lathe with Attachments	* See Item No. 15.9	7,500	7,500
15.2	Drill Press		2,000	2,000
15.3	Milling Machine		10,000	10,000
15.4	Bench Grinders		500	500
15.5	Work Benches		2,000	2,000
15.6	Vices, Small Tools and Instruments		6,000	6,000
15.7	Welding Equipment, Gas and Electric		15,000	15,000
15.8	Lockers, Racks, etc.		15,000	15,000

TRENTON ICES
 PHASE II
 CAPITAL COST ESTIMATE DETAILS

March 22, 1978

<u>ITEM NO.</u>	<u>TITLE</u>	<u>LABOR (1978)</u>	<u>MATERIAL (1978)</u>	<u>TOTAL COST (1978)</u>
15.9	Construction Labor for Item No. 15.1 to 15.8	10,000	-	10,000
	SUB-TOTAL	<u>10,000</u>	<u>58,000</u>	<u>68,000</u>
A-16.0	<u>SECURITY</u>			
16.1	Fence, Intercom, Electric Locks	4,000	6,000	10,000
	SUB-TOTAL	<u>4,000</u>	<u>6,000</u>	<u>10,000</u>
A-17.0	<u>FIELD OVERHEADS AND FEES</u>			
17.1	Temporary Roads, Parking, Lighting, Piping, Final Clean up, liability insurance, tags, painting and contractor's fee	300,000	-	300,000
		<u>300,000</u>	<u>-</u>	<u>300,000</u>

APPENDIX T

(3.5.3 b)

CAPITAL COST ALLOCATION

3.5.3-b
ELEMENTS INCLUDED IN
CAPITOL COST SUMMARY

ICES

1. ICES plant including tie-into PSE&G.
2. Steam distribution to major connection points on existing buildings and to new buildings. Each building would have its own chillers, storage and pressure reduction stations.
3. Absorption chillers for all proposed (Post 1982) buildings, thermal storage pumps, and pressure reducing stations for all buildings as well as associated piping.
4. Conversion of electric chillers in the existing buildings were not included. It should be noted that Kingsbury I and a portion of the Mercer County Court House presently use absorption chillers.
5. Electrical Load Centers for all proposed buildings for which electric heat was considered, reflecting the requirements for base electrical use in those buildings without electric HVAC.
6. Thermal space requirements, where applicable.

CONVENTIONAL OIL HEATED

1. Oil-fired boilers, fuel storage and stacks for certain proposed buildings.
2. Electrical chillers and associated equipment for certain proposed buildings.
3. Electrical Load Centers for all proposed buildings for which electric heat was considered, reflecting the additional requirements for electric air conditioning.
4. Terminal space requirements, where applicable.

CONVENTIONAL ELECTRICALLY HEATED

1. Heat pump system for certain proposed buildings except the Civic Center - War Memorial Complex. Due to the unusual latent/sensible ratio in these structures, a resistance system with electric centrifugal chillers was used.
2. Electrical Load Centers for certain proposed buildings, as appropriate, reflecting the increased requirement for total electric HVAC systems.
3. Terminal space requirements.

BUILDINGS CONSIDERED

Only four buildings are in a planning status which would permit consideration of alternate systems, as follows:

1. Department of Environmental Protection
2. Kingsburg II
3. Capital II
4. Civic Center

ICES TERMINAL
CAPITAL CONSIDERATIONS
ENDUSE EQUIPMENT*

<u>Building</u>	<u>Boilers</u>	<u>Absorption Chillers</u>	<u>Electric Chillers</u>	<u>Electric Heating</u>
Mercer County	Existing	Existing	-	-
N. J. State House	Existing	-	Existing	-
LI/HA	Existing	-	Existing	-
DEP	x	x	x	x
Justice Department	Existing	Existing	-	-
Kingsburg I	Existing	Existing	-	-
Kingsburg II	x	-	-	x
Capital I	Existing	-	Existing	-
Capital II	x	x	x	x
Civic Center	x	x	x	x
Luther Arms	-	-	Existing	Existing

*Excluding Storage

TRENTON ICES
SPACE SAVING IN
PROPOSED CONSTRUCTION
1978 COST

<u>Building</u>	<u>Conventional Boiler Room Square Feet</u>	<u>ICES "Boiler" Room</u>	<u>Credit of Remainder @ \$30/ft²</u>
Capital I	\$ 2,600	\$2,100	\$15,000
DEP	1,500	1,500	-
Civic Center	3,000	2,400	18,000
Kingsbury II	1,000	-	30,000
Justice	<u>3,600</u>	<u>3,600</u>	<u>-</u>
Total	<u>\$11,700</u>	<u>\$9,600</u>	<u>\$63,000</u>

Note: The above does not include consideration for fees in construction or general contingencies.

TRENTON ICES
END-USE EQUIPMENT

<u>Building</u>	<u>Boilers Size MMBH</u>	<u>Boilers Cost</u>	<u>Absorp. Size Tons</u>	<u>Absorp. Cost</u>	<u>Electric Chillers Tons</u>	<u>Electric A/C Cost</u>	<u>Electric Load Center Cost*</u>	<u>Electric Heating</u>	<u>Electric Load Center Cost**</u>
DEP	5.2	\$ 52,000	455	\$150,000	470	\$141,000	\$ 37,800	\$154,000	\$ 63,000
Kingsbury II	10.4	104,000	0	-	0	-	-	25,000	50,000
Capital II	8.6	86,000	770	240,000	935	280,500	43,050	300,000	71,750
Civic Center	<u>10.4</u>	<u>104,000</u>	<u>1,120</u>	<u>410,000</u>	<u>1,400</u>	<u>420,000</u>	<u>57,750</u>	<u>400,000</u>	<u>96,250</u>
Total	34.6	\$346,000	2,345	\$800,000	2,805	\$841,500	\$138,600	\$879,000	\$281,000

*Excess for electric air conditioning.

**Excess for electric heating.

TRENTON ICES
END-USE EQUIPMENT

Cost
(1977)

ICES TERMINAL

Absorption Chillers	\$ 800,000
Building Space (Credit)	(63,000)
	<u>\$ 737,000</u>
Overhead 20%	147,400
Contingency 10%	<u>73,700</u>
Total	\$ 958,100

CONVENTIONAL OIL HEATED

Boilers)	
Fuel Storage)	\$ 346,000
Stack and Breeching)	
Elec. Load Centers	138,600
Elec. Chillers	<u>841,500</u>
	\$ 1,326,100
Overhead 20%	265,220
Contingency 10%	<u>132,610</u>
Total	\$ 1,723,930

CONVENTIONAL ELECTRICALLY HEATED

Heat Pumps and Resistance	\$ 879,000
Electrical Load Centers	<u>281,000</u>
	\$ 1,160,000
Overhead 20%	232,000
Contingency 10%	<u>116,000</u>
Total	\$ 1,508,000

APPENDIX U

(3.5.3 c2)

THERMAL ENERGY SUPPLY OPERATING AND MAINTENANCE COSTS

ELECTRIC ENERGY SERVICE COSTS

3.5.3-c
TRENTON ICES
ELECTRIC ENERGY COSTS

Concentrating on the PSE&G ownership option or with PSE&G continuing to supply all electrical needs (ICES selling all electrical output to PSE&G), the electrical energy costs were computed based on individual metering to each proposed building and present metering arrangements with existing buildings. Electrical supply would consist of secondary service at 120/208Y or 265/460Y fed from a network of spot-network. PSE&G Rate Schedules GLP and LPL would therefore be applied.

All existing buildings were calculated on present energy use and Rate Schedules. It should be noted that Executive Order Number 13, issued by Brendan T. Byrne, Governor of New Jersey on December 12, 1974, calls for mandatory energy conservation measures in "all State-owned and State-leased buildings." Included were guidelines on temperature settings, HVAC operation and illumination. The energy figures used for electric and oil consumption in existing State buildings reflect the reduction in consumption effected by Executive Order Number 13.

Since conversion of electric air conditioning in the existing buildings is not contemplated at this time, the electric energy use was considered identical within existing buildings, for both conventional and ICES options. Electrical energy use within new buildings was considered with electrical air conditioning for the conventional system and with absorption air conditioning for the ICES system. Energy use data for air conditioning is low, reflecting conservation measures.

TRENTON ICES
PSE&G ENERGY ADJUSTMENT

Since PSE&G's most recent rate change on February 1, 1978, the Energy Adjustment as applied to each kilowatthour billed on Rate Schedules GLP and LPL has been filed with the New Jersey Board of Public Utilities as \$.000061 per kilowatthour.

TRENTON ICES
BUILDING ELECTRICAL ENERGY COST
PSE&G RATE SCHEDULES (February 1, 1978)

I. Proposed Buildings Using Oil Heat

Existing Buildings	\$1,333,425
Proposed Buildings Without ICES	929,024
Total Community Without ICES	\$2,262,449

II. Proposed Buildings Using Electric Heat

Proposed Buildings Without ICES	1,049,922
Total Community Without ICES	2,383,347

III. ICES

Proposed Buildings With ICES	845,825
Total Community With ICES	\$2,179,250

TRENTON ICES
BUILDING ELECTRICAL ENERGY USE

	<u>kWh/Year</u>
I. <u>Proposed Buildings Using Oil Heat</u>	
Existing Buildings	30,773,910
Proposed Buildings Without ICES	20,880,285
Total Community Without ICES	51,654,195
II. <u>Proposed Buildings Using Electric Heat</u>	
Proposed Buildings Without ICES	24,682,747
Total Community Without ICES	55,456,657
III. <u>ICES</u>	
Proposed Buildings With ICES	19,710,778
Total Community With ICES	50,484,688

EXISTING BUILDINGS
PSE&G ELECTRICAL SERVICE

<u>Service Location</u>	<u>Rate Schedule</u>	<u>Yearly kWh</u>	<u>Maximum kW Demand</u>	<u>Cost (1978)</u>
Mercer County Court House/Detention	LPL	1,545,910	472	\$ 69,745
State House Complex	HTS	8,548,800	3,263	357,582
Kingsbury I	LPL	2,545,800	630	113,605
Health & Agriculture	LPL	7,736,400	1,953	331,946
Labor & Industry	LPL	10,188,000	3,372	439,915
War Memorial*	GLP-ED	<u>209,000</u>	<u>250</u>	<u>20,632</u>
Total		<u>30,773,910</u>	<u>9,940</u>	<u>\$1,333,425</u>

*Air conditioning for the War Memorial is included in the Civic Center
(See Proposed Buildings).

PROPOSED BUILDINGS
PSE&G ELECTRICAL SERVICE
WITH ICES PLANT

<u>Service Location</u>	<u>Rate Schedule</u>	<u>Yearly kWh</u>	<u>Maximum kW Demand</u>	<u>Cost (1977)</u>
Kingsburg II	RS/GLP	1,272,000	220	\$ 79,818
Dept. Environmental Protection	LPL	4,528,440	835	185,751
Civic Center	LPL	1,053,300	225	49,610
Justice Department	LPL	8,178,000	1,680	337,002
Luther Arms	LPL	932,018	275	44,706
Capital Place I/II	LPL	<u>3,747,020</u>	<u>900</u>	<u>148,938</u>
Total		<u>19,710,778</u>	<u>4,135</u>	<u>\$845,825</u>

PROPOSED BUILDINGS
PSE&G ELECTRICAL SERVICE
WITHOUT ICES PLANT - OIL HEATING

<u>Service Location</u>	<u>Rate Schedule</u>	<u>Yearly kWh</u>	<u>Maximum kW Demand</u>	<u>Cost (1977)</u>
Kingsburg II	RS/GLP	1,272,000	220	\$ 79,818
Dept. Environmental Protection	LPL	4,784,940	1,135	201,128
Civic Center*	LPL	1,489,845	1,125	82,235
Justice Department	LPL	8,178,000	1,680	337,002
Luther Arms	LPL	1,362,810	420	62,585
Capital Place I/II	LPL	<u>3,792,690</u>	<u>1,200</u>	<u>166,256</u>
Total		<u>20,880,285</u>	<u>5,780</u>	<u>\$929,024</u>

*Includes air conditioning for War Memorial.

TRENTON ICES
ELECTRIC HEATING

As an alternative to energy and cost studies with oil heating, we have estimated the cost and additional electric energy use, which would result, if some of the proposed buildings, not yet designed, utilized electric heating.

The electric heating system considered in most cases was an internal source heat pump. A seasonal performance of 1.5 : 1.0 was utilized as a conservative estimate of reduced heating energy use. The Civic Center was assumed to use straight resistance systems.

PROPOSED BUILDINGS
PSE&G ELECTRIC SERVICE
WITHOUT ICES PLANT -
ELECTRIC HEATING AND ENERGY

<u>Service Location</u>	<u>Rate Schedule</u>	<u>Additional Yearly kWh*</u>	<u>Winter Maximum kW Demand</u>	<u>Additional Cost (1977)</u>
Dept. Environmental Protection	LPL	706,262	1,714	\$ 35,170
Civic Center**	LPL	2,739,700	1,104	73,250
Luther Arms (in- cluded in conven- tional data)	LPL	-	-	-
Capital Place II	LPL	<u>356,500</u>	<u>750</u>	<u>12,478</u>
Total		<u>3,802,462</u>	<u>3,568</u>	<u>\$120,898</u>

Includes only those still able to redesign before construction.

*kWh = (Heating Required/.9) X (.67 for Heat Pump or 1.0 for Resistance)
**Resistance

TRENTON ICES
BUILDING OIL CONSUMPTION

In order to evaluate the energy use of an oil heated, conventional community as compared to an ICES community - the use of oil, if all heating were done by on-site boilers, was considered. Actual consumption based on an average of several years was used. As mentioned under Electric Energy Costs, above, the impact of Executive Order 13 is included in the oil consumption figures.

TRENTON ICES
BUILDING OIL CONSUMPTION
WITH HEATING SUPPLIED FROM
ON-SITE BOILERS

	<u>Barrels/Year</u>
Existing Buildings	32,802
Proposed Buildings	15,112
Total Community Without ICES	47,914
Total #2 and #4 Oil	11,243
Total #6 Oil	36,671

EXISTING BUILDINGS
YEARLY OIL HEATING ENERGY
PRESENT AVERAGE USE

<u>Boiler Plant</u>	<u>Fuel</u>	<u>Heating 10⁶ Btu</u>	<u>Oil* 10⁶ Btu</u>	<u>Oil** Barrels</u>
Mercer Court House	#4	13,048	20,711	3,571
Detention	#6	4,003	6,354	1,059
Detention Kitchen	#2	630	1,000	172
Health & Agriculture, Labor & Industry and State House Complex	#6	77,490	123,000	20,500
Kingsbury I	#2***	<u>27,405</u>	<u>43,500</u>	<u>7,500</u>
Total		<u>122,576</u>	<u>194,565</u>	<u>32,802</u>

*Seasonal combustion efficiency of 70% and 10% distribution losses included.

**#6 Oil 6 x 10⁶ Btu/barrel, #2 and #4 at 5.8 x 10⁶.

***Assumed.

PROPOSED BUILDINGS
YEARLY OIL ENERGY
WITHOUT ICES PLANT

<u>Boiler Plant</u>	<u>Fuel</u>	<u>Energy 10⁶ Btu</u>	<u>Oil* 10⁶ Btu</u>	<u>Oil** Barrels</u>
Kingsbury II	#6	12,066	18,960	3,160
Dept. Environmental Protection	#6	3,237	5,087	848
Civic Center	#6	8,413	13,220	2,203
Justice Department	#6	27,941	43,907	7,318
Luther Arms	None	-	-	-
Capital I/II	#6	<u>6,045</u>	<u>9,499</u>	<u>1,583</u>
Total		<u>57,702</u>	<u>90,673</u>	<u>15,112</u>

*Seasonal combustion efficiency of 70% and 10% distribution losses included.

**#6 Oil at 6×10^6 Btu/Barrel.

TRENTON ICES
 OPERATING AND MAINTENANCE
 YEARLY COST OF ENDUSE SYSTEMS

	<u>All Applicable Buildings Oil Heat</u>	<u>Existing Buildings Using Oil Heat - Certain Proposed Using Electric Heat</u>	<u>ICES</u>
Operation of Oil Pumps	Included in Electrical	Included in Electrical	\$ -
Burner Operation	Included in Electrical	Included in Electrical	
Steam Atomization	\$ 8,900	\$ 7,120	-
Steam Heating and Tracing of #6 Oil	4,000	3,200	-
Maintenance	16,200	12,960*	-
Operating Engineers	394,800	357,200	300,800
Insurance	1,000	750	
Water Treatment Activities	<u>2,000</u>	<u>1,600</u>	<u> </u>
Total	<u>\$426,900</u>	<u>\$382,830</u>	<u>\$300,800</u>

*Includes \$3,000 additional maintenance for heat pumps.

TRENTON ICES
 LICENSED BOILER OPERATORS
 AND/OR MAINTENANCE PERSONNEL
 REQUIRED AT BUILDING LOCATIONS

	<u>Conventional Oil Heat</u>	<u>Conventional Electric Heat</u>	<u>ICES</u>
State House Complex*	4	4	3
Health and Agriculture and Labor and Industry	5	5	3
Kingsburg I	1	1	1
Luther Arms	-	-	-
Mercer Court and Detention	4	4	4
Kingsburg II	-	-	-
Capital I/II	2	2	2
Civic Center	2	1	1
DEP	<u>3</u>	<u>2</u>	<u>2</u>
Total Personnel	21	19	16
Total Cost at \$18,000**	\$394,800	\$357,200	\$300,800

*During summer months the boilers are shutdown and the five operators used for other maintenance.

**Based on State of New Jersey salary rates of \$14,800 per year plus fringe benefits.

MAJOR CHANGES IN
CONVENTIONAL SYSTEM COSTS
(ICES vs. OIL-FIRED) PHASE I TO II

1. Operating and Maintenance

ICES:	from \$	374,000	(1977)	to \$	300,800	(1978)
CONV:	from	661,100	(1977)	to	426,900	(1978)
		<u>\$ 314,100</u>			<u>\$ 126,100</u>	

Reason: Less operating engineers used than estimated and fewer (%) would be eliminated.

2. Capital

ICES:	from \$1,460,100	(1977)	to \$	958,100	(1978)	
CONV:	from	3,260,800	(1977)	to	1,723,930	(1978)
		<u>\$1,800,700</u>			<u>\$ 765,830</u>	

Reason:

- One building (Kingsburg II) will not use air conditioning.
- One building (Luther Arms) has already decided to use heat pumps.
- The Justice Complex has decided to use absorption cooling regardless of the outcome of ICES. Additionally, boilers from the adjacent Health and Agriculture/Labor and Industry Complex are large enough to supply steam to the Justice Complex.
- Capital Place I, now under construction, is designed for electric air conditioning and will not change.

Capital cost benefits which represent a savings of an absorption only steam as compared to electric chiller, appurtenances and boilers are artificial advantages to existing buildings in which the owner had decided, on his own to choose some form of space conditioning. During the progress of the ICES study, several proposed buildings reached planning or construction stages which precluded the use of "artificial paper advantages" in the form of these capital cost savings.

3. Electric Energy Cost

ICES:	from \$2,195,073	(1977)	to \$2,179,250	(1978)		
CONV:	from	2,366,121	(1977)	to	2,262,449	(1978)
		<u>\$ 171,048</u>			<u>\$ 83,199</u>	

- Reasons:
- a. Kingsbury II residential units will be individually metered.
 - b. Increase in estimated electrical use for Kingsbury II, Dept. Environmental Protection and Justice Complex.
 - c. Decision of Luther Arms and Capital Place I to use electric air conditioning and Kingsbury II not to use any air conditioning.

4. Oil Energy Consumption (Conventional)

From 40,975 barrels per year to 47,914 barrels per year

- Reasons:
- a. Increase in estimated thermal profiles for Justice Complex, Kingsbury II, Dept. Environmental Protection, Civic Center and Capital Place I/II.
 - b. Justice Complex decision to use absorption cooling.

TRENTON ICES
PHASE II
OPERATING AND MAINTENANCE COST ESTIMATES

MARCH 22, 1978

G-1	Gas-Turbines Generators, Waste Heat Boilers, etc.	718,000
G-2	Water Treatment Chemicals	10,000
G-3	Steam Distribution System Piping, Instruments, etc.	42,000
G-4	Meter Reading	8,000
G-5	Meter Recalibration	35,000
G-6	Walkways for Steam Distribution Maintenance	5,000
G-7	Easements for Walkways, Buildings, Streets, etc.	<u>10,000</u>
	SUB TOTAL	<u>828,000</u>
G-8	Thermal Storage System-Tanks, Heaters, Circulating Pumps & Motors etc.	\$ 65,000
G-9	Chillers and Cooling Towers	60,000
G-10	Grid Connection	<u>5,000</u>
	SUB TOTAL	\$130,000
	TOTAL O&M	\$958,000

ENERGY ADJUSTMENT

Average cost per kilowatthour of energy produced, purchased and interchanged in

the twelve month period ended June 30, 1978 17.049 mills

Base cost per kilowatthour 17.000 mills

Differential cost per kilowatthour above base cost 0.049 mills

RATE SCHEDULES

RS, GLP, LPL,
WH, RHS, HS,
RST

HTS

Amount per kilowatthour of Energy Adjustment Charge after application of:

(1) losses to the secondary customer of 8.6726% and; (2) taxes
related to revenue from sales of electricity of 12.7378% (for Rate

Schedule HTS also apply factor of 0.8846) 0.0061¢ 0.0054¢

Date of Issue: January 30, 1978

Effective: February 1, 1978

Issued by E. L. MORRIS, Senior Vice President—Customer Operations
80 Park Place, Newark, New Jersey 07101Filed pursuant to Order of Board of Public Utilities, dated January 26, 1978
in Docket No. 7711-1107

RATE SCHEDULE RS RESIDENTIAL SERVICE

APPLICABLE TO USE OF SERVICE FOR:

Residential purposes.

CHARACTER OF SERVICE:

Continuous.

RATE:**Service Charge:**

\$3.64 in each month.

Kilowatthour Charge:

0.8793¢ per kilowatthour for the first 20 kilowatthours used in each month

6.0323¢ " " " " next 280 " " " " "

6.0323¢ " " in excess of 300 " " " " of the months of June through Oct.

4.6883¢ " " " " 300 " " " " " " " " Nov. through May

Energy Adjustment:

A charge or credit will be made when the estimated July through June twelve-month average cost per kilowatthour to Public Service of energy produced, purchased and interchanged is 0.001 mills per kilowatthour above or below 17.000 mills per kilowatthour. Immediately prior to July of each year, the estimated average cost will be determined for the succeeding twelve-month period. This estimated average cost will be adjusted for any under- or over-recovery which may have occurred during the operation of the Company's previously approved clause. The net charge or net credit will be the adjusted differential cost above or below 17.000 mills per kilowatthour multiplied by factors to reflect applicable losses, and taxes related to revenue from the sales of electricity. Any net charge or net credit will apply to all kilowatthours billed each month of the succeeding twelve-month period. In the event that a major change in the average cost occurs during the twelve-month period, a revised estimated average cost will be calculated and applied for the remainder of the period in accordance with the above.

MINIMUM CHARGE:

The monthly minimum charge shall be \$3.64.

TERMS OF PAYMENT:

Bills are due on presentation.

TERM:

Customer may discontinue service upon notice.

SPECIAL PROVISIONS:

This Rate Schedule is available when all continuous service is measured by one meter:

- (a) In individual residences and appurtenant outbuildings;
- (b) In residential premises where customer's use of electric service for purposes other than residential is incidental to his residential use;
- (c) On residential farms;
- (d) For rooming or boarding houses where the number of rented rooms does not exceed twice the number of bedrooms occupied by the customer;

Date of Issue: January 30, 1978

Effective: February 1, 1978

Issued by E. L. MORRIS, Senior Vice President—Customer Operations

80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utilities, dated January 26, 1978

in Docket No. 7711-1107

**RATE SCHEDULE RS
RESIDENTIAL SERVICE**

(Continued)

- (e) To a customer in a two- or three-family building who has the service for incidental common-use equipment registered on his meter;
- (f) In individual flats or apartments in multiple-family buildings;
- (g) In multiple-family buildings of two or more individual flats or apartments where electric service is furnished to the tenants or occupants of the flats or apartments by the owner without a specific charge for such service, provided that the Service Charge and the number of kilowatthours in each block of the Kilowatthour Charge and the Minimum Charge are multiplied by the number of individual flats or apartments, whether occupied or not.

STANDARD TERMS AND CONDITIONS:

This Rate Schedule is subject to the Standard Terms and Conditions on Sheets Nos. 6 to 19, inclusive, of this Tariff.

Date of Issue: January 30, 1978

Effective: February 1, 1978

**Issued by E. L. MORRIS, Senior Vice President--Customer Operations
80 Park Place, Newark, New Jersey 07101**

**Filed pursuant to Order of Board of Public Utilities, dated January 26, 1978
in Docket No. 7711-1107**

RATE SCHEDULE GLP
GENERAL LIGHTING AND POWER SERVICE

APPLICABLE TO USE OF SERVICE FOR:

General purposes.

CHARACTER OF SERVICE:

Continuous.

RATE:

Service Charge:

\$3.64 in each month.

Kilowatt Charge—in the months of June through October:

First kilowatt of monthly maximum demand included in the Kilowatthour Charge

\$6.07 per kilowatt for the next.....9 kilowatts of monthly maximum demand

5.54 65 66 67 68 69 90 65 66 67 68 69

4.97 " " in excess of 100 " " " " "

Kilowatt Charge—in the months of November through May:

First kilowatt of monthly maximum demand included in the Kilowatthour Charge

\$5.66 per kilowatt for the next.....9 kilowatts of monthly maximum demand

5.13 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90

4.56	"	"	in excess of	100	"	"	"	"	"
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Kilowatt-hour Charge:

0.8793¢ per kilowatthour for the first.....20 kilowatthours used in each month

```
6.92344 per knowabout for die first.....20 knowabouts used in each mor
        "      "      "      " next.....80          "      "      "      "
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5.2884	44	45	46	47	48	49	50	51	52	53	54
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[illegible]

3.3444	44	44	in excess of	8.000	44	44	44	44	44
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Energy Adjustment:

A charge or credit will be made when the estimated July through June twelve-month average cost per kilowatthour to Public Service of energy produced, purchased and interchanged is 0.001 mills per kilowatthour above or below 17.000 mills per kilowatthour. Immediately prior to July of each year, the estimated average cost will be determined for the succeeding twelve-month period. This estimated average cost will be adjusted for any under- or over-recovery which may have occurred during the operation of the Company's previously approved clause. The net charge or net credit will be the adjusted differential cost above or below 17.000 mills per kilowatthour multiplied by factors to reflect applicable losses, and taxes related to revenue from the sales of electricity. Any net charge or net credit will apply to all kilowatthours billed each month of the succeeding twelve-month period. In the event that a major change in the average cost occurs during the twelve-month period, a revised estimated average cost will be calculated and applied for the remainder of the period in accordance with the above.

Other Charges:

See SPECIAL PROVISIONS (b) Primary Distribution Service, (c) Auxiliary or Breakdown Service, (d) Building Heating Service and (e) Police Recall or Fire Alarm System Service.

MINIMUM CHARGE:

The monthly minimum charge shall be \$3.64 where customer's monthly maximum demand is determined by estimate, and \$11.20 where customer's monthly maximum demand is determined by measurement.

Date of Issue: January 30, 1978

Effective: February 1, 1978

Issued by E. L. MORRIS, Senior Vice President—Customer Operations
80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utilities, dated January 26, 1978
in Docket No. 7711-1107

**RATE SCHEDULE GLP
GENERAL LIGHTING AND POWER SERVICE**

(Continued)

DETERMINATION OF DEMANDS:

The customer's monthly maximum demand shall be determined either by measurement or by estimate.

By Measurement: The customer's monthly maximum demand shall be the greatest kilowatt demand occurring during the month as recorded by a demand meter, furnished by Public Service, which measures the maximum kilowatt demand of a steady load in any thirty-minute interval.

By Estimate: Where no demand meter is installed, the customer's monthly maximum demand in any month shall be determined by dividing the kilowatthour use in such month by 100.

TERMS OF PAYMENT:

Bills are due on presentation.

TERM:

One year and thereafter until terminated by five days' notice.

SPECIAL PROVISIONS:

- (a) **Limitations on Service:** Service under this Rate Schedule will not be supplied where the capacity required exceeds 400 kilowatts for any new installation, except that when Special Provision (d) is applied the capacity required may exceed 400 kilowatts in any of the months of November through May.
- (b) **Primary Distribution Service:** Where special conditions such as location, size, or type of load require that customer take service at a primary distribution voltage, customer shall furnish, install, and maintain a service entrance interrupting device acceptable to Public Service and, where necessary, transformers and appurtenances. (See also Section 6.4. of the Standard Terms and Conditions) Customer's monthly bill, except Minimum Charge and any facilities charge, will be subject to a discount of 5%. Public Service will supply the metering equipment to measure service at the service entrance voltage either directly or by means of compensated metering on the secondary side of the transforming devices.
- (c) **Auxiliary or Breakdown Service:** When Auxiliary or Breakdown Service, as defined in Section 10 of the Standard Terms and Conditions, is supplied, the following charges and provisions shall apply:
 - (c-1) **Contract Capacity Charge:**
 - \$2.86 per kilowatt per month for the first 10 kilowatts of Contract Capacity
 - \$1.72 per kilowatt per month in excess of 10 kilowatts of Contract Capacity
 - (c-2) **Determination of Contract Capacity:** The contract kilowatt capacity shall be equivalent to 85% of the customer's kilovolt-ampere requirement, as rated by Public Service; in no event shall the contract kilowatt capacity be less than the monthly maximum demand. The customer may be required to furnish and install, at his own expense, a load-limiting device, approved by Public Service, which shall be maintained by Public Service at customer's expense. The maximum kilovolt-ampere demand setting of the load-limiting device shall be under the sole control of and be

Date of Issue: October 18, 1976

Effective: October 21, 1976

Issued by W. E. SCOTT, Executive Vice President
80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utility Commissioners, dated October 14, 1976
in Docket No. 761-8

**RATE SCHEDULE GLP
GENERAL LIGHTING AND POWER SERVICE**

(Continued)

adjusted only by Public Service, and shall not be tampered or interfered with in any way by the customer. At any time that there is an increase in the contract kilowatt capacity, a new Term shall commence; the contract kilowatt capacity may not be revised downward during any Term.

(c-3) **Determination of Demands:** The customer's monthly maximum demand shall be determined by measurement only and, for billing purposes, be not less than one kilowatt.

(c-4) **Minimum Charge:** In lieu of the Minimum Charge hereinbefore set forth, the Minimum Charge in any month shall be \$2.86 per kilowatt of Contract Capacity, but not less than \$11.20.

(c-5) **Parallel Operation:** Customer shall not, at any time, operate private plant service in parallel with the service furnished by Public Service except with the written consent of Public Service.

- (d) **Building Heating Service:** Where a customer requires and has permanently installed comfort building heating equipment with a total rated capacity of not less than 25 kilowatts, the customer's monthly maximum measured demand shall be reduced for billing purposes during the months of November through May by an amount equal to one-half of the rated capacity in kilowatts of such building heating equipment, provided:

(d-1) The rated capacity used for determining such decrease in billing demand shall not exceed the kilowatt equivalent of the Btu heat loss, as determined by Public Service, of the area to be heated, which area shall not be heated in whole or in part by systems or equipment utilizing the process of combustion. Comfort building heating equipment shall also include lighting where the Btu equivalent of the connected lighting equipment is 60% or more of the heat loss as determined by Public Service of the area in which it is installed.

(d-2) The billing demand in the months of November through May shall be not less than the higher of (1) 25 kilowatts, or, (2) 50% of the monthly maximum demand.

- (e) **Police Recall or Fire Alarm System Service:** Unmetered police recall or fire alarm system service will be furnished for signaling lamps, bells, or horns with an individual rating not greater than 100 watts or 1/8-horsepower, as rated by Public Service, at a charge of 14¢ per month for each signaling lamp, bell, or horn connected, but the total charge shall in no case be less than \$1.40 per month. No other energy-using devices shall be connected to the police recall or fire alarm system. The customer shall provide, at his own expense, all necessary equipment and wiring, including the service connection.

STANDARD TERMS AND CONDITIONS:

This Rate Schedule is subject to the Standard Terms and Conditions on Sheets Nos. 6 to 19, inclusive, of this Tariff.

Date of Issue: March 17, 1977

Effective: March 10, 1977

Issued by W. E. SCOTT, Executive Vice President
80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utility Commissioners, dated March 10, 1977
in Docket No. 7611-1141

**RATE SCHEDULE LPL
LARGE POWER AND LIGHTING SERVICE**

APPLICABLE TO USE OF SERVICE FOR:

General purposes at secondary and primary distribution voltages.

CHARACTER OF SERVICE:

Continuous.

RATE:

Kilowatt Charge—in the months of June through October:

\$315.00 for the first 50 kilowatts or less of monthly maximum demand

\$5.23		per kilowatt for the next.....	50	kilowatts of monthly maximum demand					
4.85	"	" " " "	500	"	"	"	"	"	"
4.59	"	" " " "	500	"	"	"	"	"	"
4.32	"	" " " "	900	"	"	"	"	"	"
4.15	"	in excess of.....	2,000	"	"	"	"	"	"

Kilowatt Charge—in the months of November through May:

\$294.00 for the first 50 kilowatts or less of monthly maximum demand

\$4.82						per kilowatt for the next.....	50	kilowatts of monthly maximum demand
4.44	"	"	"	"	"	""	500	" " " "
4.18	"	"	"	"	"	""	500	" " " "
3.91	"	"	"	"	"	""	900	" " " "
3.74	"	"				in excess of.....	2,000	" " " "

Kilowatthour Charge:

6.2964¢	per kilowatthour for the first.....	5,000	kilowatthours used in each month
3.3464¢	" " " " next.....	45,000	" " " " "
3.1244¢	" " " " ".....	200,000	" " " " "
3.0164¢	" " " " ".....	250,000	" " " " "
2.7724¢	" " " " in excess of.....	500,000	" " " " "

Energy Adjustment:

A charge or credit will be made when the estimated July through June twelve-month average cost per kilowatthour to Public Service of energy produced, purchased and interchanged is 0.001 mills per kilowatthour above or below 17.000 mills per kilowatthour. Immediately prior to July of each year, the estimated average cost will be determined for the succeeding twelve-month period. This estimated average cost will be adjusted for any under- or over-recovery which may have occurred during the operation of the Company's previously approved clause. The net charge or net credit will be the adjusted differential cost above or below 17.000 mills per kilowatthour multiplied by factors to reflect applicable losses, and taxes related to revenue from the sales of electricity. Any net charge or net credit will apply to all kilowatthours billed each month of the succeeding twelve-month period. In the event that a major change in the average cost occurs during the twelve-month period, a revised estimated average cost will be calculated and applied for the remainder of the period in accordance with the above.

Other Charges:

See SPECIAL PROVISIONS (a) Night Use, (b) Primary Distribution Service, (c) Substation Service-Individual Customer, (d) Auxiliary or Breakdown Service, (e) Interruptible Service, (f) Seasonal Use and (g) Building Heating Service.

Date of Issue: January 30, 1978

Effective: February 1, 1978

Issued by E. L. MORRIS, Senior Vice President—Customer Operations
80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utilities, dated January 26, 1978
in Docket No. 7711-1107

**RATE SCHEDULE LPL
LARGE POWER AND LIGHTING SERVICE**

(Continued)

MINIMUM CHARGE:

In any month the Minimum Charge shall be the Kilowatt Charge in such month plus \$1.10 per kilowatt of capacity required by customer, which capacity shall be not less than the higher of the monthly maximum demand in the current month or that in any of the months of June, July, August and September during the immediately preceding eleven months.

Waiver of Minimum Charge: When customer is temporarily prevented from receiving service during any month by reason of any act of God, accident, strike or work stoppage, legal process, governmental interference, or compliance with any governmental order, Public Service at its discretion may waive the Minimum Charge applicable in such month upon due receipt from customer of written request for such waiver.

DETERMINATION OF DEMANDS:

The customer's daily maximum 24-hour demand shall be the greatest average number of kilowatts supplied by Public Service during any fifteen-minute interval in each calendar day.

The customer's monthly maximum demand shall be the greatest average of the daily maximum 24-hour demands selected from four different days in the current month, or 75% of the highest daily maximum 24-hour demand, whichever is the higher.

The customer's daily maximum "day period" demand shall be the greatest average number of kilowatts supplied by Public Service during any fifteen-minute interval in each "day period."

The customer's monthly maximum "day period" demand shall be the greatest average of the daily maximum "day period" demands selected from four different days in the current month, or 75% of the highest daily maximum "day period" demand, whichever is the higher.

The daily maximum demands shall be determined by the registration of a recording demand meter furnished by Public Service. Where the use of electric service is intermittent or subject to violent fluctuations, Public Service may base the customer's maximum demands upon five-minute in lieu of fifteen-minute intervals. Where the customer's monthly maximum demand is less than 1000 kilowatts, or where the use of electric service is predominantly for lighting service, or where requested in writing by customer, in lieu of the determination of the customer's monthly maximum demand as hereinbefore provided, Public Service may base the customer's monthly maximum demand upon the greatest kilowatt demand occurring during the month as recorded by a demand meter, furnished by Public Service, which measures the maximum kilowatt demand of a steady load in any thirty-minute interval.

TERMS OF PAYMENT:

Bills are due on presentation.

TERM:

One year and thereafter until terminated by five days' notice.

Date of Issue: October 18, 1976

Effective: October 21, 1976

Issued by W. E. SCOTT, Executive Vice President
80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utility Commissioners, dated October 14, 1976
in Docket No. 761-8

**RATE SCHEDULE LPL
LARGE POWER AND LIGHTING SERVICE**

(Continued)

SPECIAL PROVISIONS:

- (a) **Night Use:** When the kilowatthours used by a customer during the "night periods" in any month, as determined by the registration of a meter furnished by Public Service, are not less than 30% of the total kilowatthours used in such month, or when the kilowatthours used during the "night periods" in the twelve months ended with such month are not less than 30% of the total kilowatthours used in such twelve months, customer shall have the option in such month of being billed for the kilowatthours used during the "night periods" at 2.7724¢ per kilowatthour and for the kilowatthours used during the "day periods" at the Kilowatthour Charge hereinbefore set forth, in lieu of being billed for the total kilowatthours used at the Kilowatthour Charge hereinbefore set forth. If in any such month customer's monthly maximum "day period" demand is less than customer's monthly maximum demand, a deduction shall be made in the Kilowatt Charge equivalent to the amount of such difference in kilowatts of demand at one-half the charges per kilowatt as specified in the above Kilowatt Charge. The "day period" and the "night period" shall be designated by Public Service from time to time, but until further notice are hereby defined as being the periods from 8:00 A.M. to 8:00 P.M. and from 8:00 P.M. to 8:00 A.M., respectively.
- (b) **Primary Distribution Service:** Where special conditions such as location, size, or type of load require that customer take service at a primary distribution voltage, customer shall furnish, install, and maintain a service entrance interrupting device acceptable to Public Service and, where necessary, transformers and appurtenances. (See also Section 6.4. of the Standard Terms and Conditions) Customer's monthly bill, except Minimum Charge and any facilities charge, will be subject to a discount of 5%. Public Service will supply the metering equipment to measure service at the service entrance voltage either directly or by means of compensated metering on the secondary side of the transforming devices.
- (c) **Substation Service—Individual Customer:** Where special conditions such as location, size, or type of load require that customer be supplied at a subtransmission or transmission voltage, and customer and Public Service agree that Public Service will furnish, install, and maintain a substation solely to serve customer from the secondary side of the transformers at nominal voltages of 4,150 volts, 13,200 volts, or 26,400 volts, such service shall be considered as secondary distribution service and the charges in this Rate Schedule will not be subject to discount. Customer may be required to sell or lease a site for the location of the substation. Public Service may require a guaranteed annual payment and a termination agreement.
- (d) **Auxiliary or Breakdown Service:** When Auxiliary or Breakdown Service, as defined in Section 10 of the Standard Terms and Conditions, is supplied, the following charges and provisions shall apply:
- (d-1) **Contract Capacity Charge:**
\$247.00 for the first 100 kilowatts or less of Contract Capacity
\$ 1.97 per kilowatt per month in excess of 100 kilowatts of Contract Capacity
- (d-2) **Determination of Contract Capacity:** The contract kilowatt capacity shall be equivalent to 85% of the customer's kilovolt-ampere requirement, as rated by Public Service; in no event shall the contract kilowatt capacity be less than the monthly maximum demand. The customer may be required to furnish and install, at his own expense, a load-limiting device, approved by Public Service, which shall be maintained by Public Service at customer's expense. The maximum kilovolt-ampere demand setting of the load-limiting device shall be under the sole control of and be adjusted only by Public Service, and shall not be tampered or interfered with in any way by the customer. At any time that there is an increase in the contract kilowatt capacity, a new Term shall commence; the contract kilowatt capacity may not be revised downward during any Term.

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80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utilities, dated January 26, 1978
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**RATE SCHEDULE LPL
LARGE POWER AND LIGHTING SERVICE**

(Continued)

- (d-3) **Demand Credit:** The Kilowatt Charge shall be subject to a credit of \$1.87 per kilowatt of metered monthly maximum demand.
- (d-4) **Determination of Demands:** In the Determination of Demands as hereinbefore set forth, the customer's monthly maximum "day period" demand shall be equivalent to customer's monthly maximum demand for billing purposes.
- (d-5) **Night Use:** The Kilowatthours subject to the Night Use provision hereinbefore set forth shall be limited to 60% of the total kilowatthours used during such month, at \$415.86 for the first 15,000 kilowatthours or less and at 2.7724¢ per kilowatthour for the excess.
- (d-6) **Minimum Charge:** In lieu of the Minimum Charge hereinbefore set forth, the Minimum Charge in any month shall be the Contract Capacity Charge. The Waiver of Minimum Charge is not applicable.
- (d-7) **Parallel Operation:** Customer shall not, at any time, operate private plant service in parallel with the service furnished by Public Service, except with the written consent of Public Service.
- (e) **Interruptible Service:** Interruptible Service will be furnished when and where available under the following conditions:
- (e-1) Where a customer agrees to take service under this Rate Schedule at a single service connection and agrees to reduce his maximum peak demand during times of interruption, a monthly deduction shall be made of \$1.50 per kilowatt of interruptible capacity.
- (e-2) Customer will be required to sign an Application for Interruptible Electric Service under this Rate Schedule, specifying the amount of firm capacity required during interruptions and the amount of interruptible capacity, which capacity shall not be less than 500 kilowatts.
- (e-3) Upon advance notice of two hours, from any hour of any day given to customer by Public Service by telephone or otherwise, customer shall reduce his load to the amount of firm capacity specified in the Application for Interruptible Electric Service until further notice. Customer shall designate personnel who will accept notification of interruption at any hour of any day. Where necessary, Public Service will install and maintain suitable metering at its meter location for customer verification of compliance with the interruption notice.
- (e-4) Firm capacity shall be reflected in the measurement by a magnetic tape meter of customer's maximum measured demand during the period of interruption called for. If it is determined by Public Service that customer did not reduce his load to the amount contracted for in (e-2) above, the excess over that amount shall be billed at a Kilowatt Charge of \$36.00 per kilowatt.
- (e-5) Public Service agrees to limit the total hours of interruption as described in this Rate Schedule to the customer during an annual period to a maximum of 150 hours, which hours of interruption can occur consecutively or at any time--the total occurrences not to exceed 15 times during the calendar year.
- (e-6) Where customer signs an Application for Interruptible Electric Service and elects to be billed under this Special Provision, the Term of Service shall be three years in lieu of Term stated in this Rate Schedule. Public Service reserves the right to determine whether successive Terms may be negotiated and under what conditions interruptible capacity may be transferred to firm service.
- (f) **Seasonal Use:** This provision is in the process of elimination and is limited to those customers receiving service hereunder in the month of March 1964.

When a customer has a seasonal load and guarantees a minimum payment of at least \$1,690 in each annual period, if the monthly maximum demand in each of the four months, November to February, inclusive, is less than 50% of the highest monthly maximum demand in any of the immediately

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80 Park Place, Newark, New Jersey 07101

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in Docket No. 7711-1107

**RATE SCHEDULE LPL
LARGE POWER AND LIGHTING SERVICE**

(Continued)

preceding eight months, March to October, inclusive, such customer shall be billed for any electric service used at the regular charges hereinbefore set forth, except that in lieu of the Kilowatt and Minimum Charges hereinbefore set forth, the minimum charge shall be \$25.95 per month and customer shall have the option, in any month, of being billed at \$5.20 per kilowatt of demand based on the greatest average number of kilowatts used during any fifteen-minute interval in the month, as determined by the registration of a recording demand meter furnished by Public Service.

- (g) **Building Heating Service:** Where a customer requires and has permanently installed comfort building heating equipment with a total rated capacity of not less than 50 kilowatts, the customer's monthly maximum measured demands shall be reduced for billing purposes during the months of November through May by an amount equal to one-half of the rated capacity in kilowatts of such building heating equipment, provided:

(g-1) The rated capacity used for determining such decrease in billing demand shall not exceed the kilowatt equivalent of the Btu heat loss, as determined by Public Service, of the area to be heated, which area shall not be heated in whole or in part by systems or equipment utilizing the process of combustion. Comfort building heating equipment shall also include lighting where the Btu equivalent of the connected lighting equipment is 60% or more of the heat loss as determined by Public Service of the area in which it is installed.

(g-2) The billing demand in the months of November through May shall be not less than the higher of (1) 50 kilowatts, or, (2) 50% of the monthly maximum demand.

- (h) **Resale:** Service under this Rate Schedule is not available for resale.

STANDARD TERMS AND CONDITIONS:

This Rate Schedule is subject to the Standard Terms and Conditions on Sheets Nos. 6 to 19, inclusive, of this Tariff.

Date of Issue: March 17, 1977

Effective: March 10, 1977

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80 Park Place, Newark, New Jersey 07101

Filed pursuant to Order of Board of Public Utility Commissioners, dated March 10, 1977
in Docket No. 7611-1141

**RATE SCHEDULE HTS
HIGH TENSION SERVICE****APPLICABLE TO USE OF SERVICE FOR:**

General purposes at subtransmission and transmission voltages.

CHARACTER OF SERVICE:

Continuous.

RATE:**Kilowatt Charge:**

\$1250.00 for the first 250 kilowatts or less of monthly maximum demand

\$4.33 per kilowatt for the next 1,750 kilowatts of monthly maximum demand

3.98 " " " " " 3,000 " " " " "

3.83 " " " " " 10,000 " " " " "

3.73 " " in excess of 15,000 " " " " "

Kilowatthour Charge:

5.5023¢ per kilowatthour for the first5,000 kilowatthours used in each month

2.8993¢ " " " " next45,000 " " " " "

2.7893¢ " " " " "200,000 " " " " "

2.6313¢ " " " " "250,000 " " " " "

2.4163¢ " " " " "300,000 " " " " "

2.2973¢ " " in excess of800,000 " " " " "

Energy Adjustment:

A charge or credit will be made when the estimated July through June twelve-month average cost per kilowatthour to Public Service of energy produced, purchased and interchanged is 0.001 mills per kilowatthour above or below 17.000 mills per kilowatthour. Immediately prior to July of each year, the estimated average cost will be determined for the succeeding twelve-month period. This estimated average cost will be adjusted for any under- or over-recovery which may have occurred during the operation of the Company's previously approved clause. The net charge or net credit will be the adjusted differential cost above or below 17.000 mills per kilowatthour multiplied by factors to reflect applicable losses, and taxes related to revenue from the sales of electricity. Any net charge or net credit will apply to all kilowatthours billed each month of the succeeding twelve-month period. In the event that a major change in the average cost occurs during the twelve-month period, a revised estimated average cost will be calculated and applied for the remainder of the period in accordance with the above.

Other Charges:

See SPECIAL PROVISIONS (b) Night Use, (c) Service at Transmission Voltages, (d) Auxiliary or Break-down Service and (e) Interruptible Service.

MINIMUM CHARGE:

In any month the Minimum Charge shall be the Kilowatt Charge in such month plus \$1.00 per kilowatt of capacity required by customer, which capacity shall be not less than the monthly maximum demand in the current month or in any month during the immediately preceding eleven months, whichever is the higher.

Waiver of Minimum Charge: When customer is temporarily prevented from receiving service during any month by reason of any act of God, accident, strike or work stoppage, legal process, governmental interference, or compliance with any governmental order, Public Service at its discretion may waive the Minimum Charge applicable in such month upon due receipt from customer of written request for such waiver.

Date of Issue: January 30, 1978

Effective: February 1, 1978

Issued by E. L. MORRIS, Senior Vice President—Customer Operations

80 Park Place, Newark, New Jersey 07101

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in Docket No. 7711-1107

**RATE SCHEDULE HTS
HIGH TENSION SERVICE**

(Continued)

DETERMINATION OF DEMANDS:

The customer's daily maximum 24-hour demand shall be the greatest average number of kilowatts supplied by Public Service during any fifteen-minute interval in each calendar day.

The customer's monthly maximum demand shall be the highest of (1) the greatest average of the daily maximum 24-hour demands selected from four different days in the current month, (2) 75% of the highest daily maximum 24-hour demand, or (3) 250 kilowatts, but not less than 15,000 kilowatts when service is furnished at 138,000 volts or higher for capacity requirements exceeding 30,000 kilovolt-amperes.

The customer's daily maximum "day period" demand shall be the greatest average number of kilowatts supplied by Public Service during any fifteen-minute interval in each "day period."

The customer's monthly maximum "day period" demand shall be the highest of (1) the greatest average of the daily maximum "day period" demands selected from four different days in the current month, (2) 75% of the highest daily maximum "day period" demand, or (3) 250 kilowatts, but not less than 15,000 kilowatts when service is furnished at 138,000 volts or higher for capacity requirements exceeding 30,000 kilovolt-amperes.

The daily maximum demands shall be determined by the registration of a recording demand meter furnished by Public Service. Where electric service is supplied for traction power to a rail rapid-transit system, Public Service shall base the customer's monthly maximum demand upon the greatest average number of kilowatts supplied by Public Service during any single coincident hour-ended sixty-minute interval, together with appropriate use, in lieu of fifteen-minute intervals. Where the use of electric service is intermittent or subject to violent fluctuations, Public Service may base the customer's maximum demands upon five-minute in lieu of fifteen-minute intervals. Where the use of electric service is predominantly for lighting service, or where requested in writing by customer, in lieu of the determination of the customer's monthly maximum demand as hereinbefore provided, Public Service may base the customer's monthly maximum demand upon the greatest kilowatt demand occurring during the month as recorded by a demand meter, furnished by Public Service, which measures the maximum kilowatt demand of a steady load in any thirty-minute interval.

TERMS OF PAYMENT:

Bills are due on presentation.

TERM:

One year and thereafter until terminated by five days' notice.

SPECIAL PROVISIONS:

- (a) **Service Entrance Installations:** Customer shall furnish, install, and maintain a service entrance interrupting device acceptable to Public Service and, where necessary, transformers and appurtenances. Public Service will supply the metering equipment to measure service at the service entrance voltage either directly or by means of compensated metering on the secondary side of the transforming devices. (See also Section 6.4. of the Standard Terms and Conditions)
- (b) **Night Use:** When the kilowatthours used by a customer during the "night periods" in any month, as determined by the registration of a meter furnished by Public Service, are not less than 30% of the total kilowatthours used in such month, or when the kilowatthours used during the "night periods" in the twelve months ended with such month are not less than 30% of the total kilowatthours used in such twelve months, customer shall have the option in such month of being billed for the kilowatthours

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80 Park Place, Newark, New Jersey 07101

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**RATE SCHEDULE HTS
HIGH TENSION SERVICE**

(Continued)

used during the "night periods" at 2.4163¢ per kilowatthour and for the kilowatthours used during the "day periods" at the Kilowatthour Charge hereinbefore set forth, in lieu of being billed for the total kilowatthours used at the Kilowatthour Charge hereinbefore set forth. If in any such month customer's monthly maximum "day period" demand is less than 90% of customer's monthly maximum demand, a deduction shall be made in the Kilowatt Charge equivalent to the amount of such difference in kilowatts of demand at one-half the charges per kilowatt as specified in the above Kilowatt Charge. The "day period" and the "night period" shall be designated by Public Service from time to time, but until further notice are hereby defined as being the periods from 8:00 A.M. to 8:00 P.M. and from 8:00 P.M. to 8:00 A.M., respectively.

- (d) **Service at Transmission Voltages:** Where customer takes service at transmission voltage, Customer's monthly bill, exclusive of facilities charge, will be subject to a discount of 2%.
- (d) **Auxiliary or Breakdown Service:** When Auxiliary or Breakdown Service, as defined in Section 10 of the Standard Terms and Conditions, is supplied, the following charges and provisions shall apply:

(d-1) **Contract Capacity Charge:**

\$2808.00 for the first 1,400 kilowatts or less of Contract Capacity

\$2.29 per kilowatt per month for the next 18,600 kilowatts of Contract Capacity

\$2.16 per kilowatt per month in excess of 20,000 kilowatts of Contract Capacity

(d-2) **Determination of Contract Capacity:** The contract kilowatt capacity shall be equivalent to 85% of the customer's kilovolt-ampere requirement, as rated by Public Service; in no event shall the contract kilowatt capacity be less than the monthly maximum demand. The customer may be required to furnish and install, at his own expense, a load-limiting device, approved by Public Service, which shall be maintained by Public Service at customer's expense. The maximum kilovolt-ampere demand setting of the load-limiting device shall be under the sole control of and be adjusted only by Public Service, and shall not be tampered or interfered with in any way by the customer. At any time that there is an increase in the contract kilowatt capacity, a new Term shall commence; the contract kilowatt capacity may not be revised downward during any Term.

(d-3) **Demand Credit:** The Kilowatt Charge shall be subject to a credit of \$1.86 per kilowatt for the first 5,000 kilowatts of metered monthly maximum demand and \$2.02 per kilowatt in excess of 5,000 kilowatts of metered monthly maximum demand.

(d-4) **Determination of Demands:** In the Determination of Demands, as hereinbefore set forth, the customer's monthly maximum "day period" demand shall be equivalent to customer's monthly maximum demand for billing purposes.

(d-5) **Night Use:** The kilowatthours subject to the Night Use provision hereinbefore set forth shall be limited to 60% of the total kilowatthours used during such month, at \$362.45 for the first 15,000 kilowatthours or less and at 2.4163¢ per kilowatthour for the excess.

(d-6) **Minimum Charge:** In lieu of the Minimum Charge hereinbefore set forth, the Minimum Charge in any month shall be the Kilowatt Charge plus the Contract Capacity Charge less the Demand Credit. The Waiver of Minimum Charge is not applicable.

(d-7) **Parallel Operation:** Customer shall not, at any time, operate private plant service in parallel with the service furnished by Public Service except with the written consent of Public Service.

Date of Issue: January 30, 1978

Effective: February 1, 1978

Issued by E. L. MORRIS, Senior Vice President—Customer Operations

80 Park Place, Newark, New Jersey 07101

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in Docket No. 7711-1107

**RATE SCHEDULE HTS
HIGH TENSION SERVICE**

(Continued)

- (e) **Interruptible Service:** Interruptible Service will be furnished when and where available under the following conditions:

(e-1) Where a customer agrees to take service under this Rate Schedule at a single service connection and agrees to reduce his maximum peak demand during times of interruption, a monthly deduction shall be made of \$1.50 per kilowatt of interruptible capacity.

(e-2) Customer will be required to sign an Application for Interruptible Electric Service under this Rate Schedule, specifying the amount of firm capacity required during interruptions and the amount of interruptible capacity, which capacity shall not be less than 500 kilowatts.

(e-3) Upon advance notice of two hours, from any hour of any day given to customer by Public Service by telephone or otherwise, customer shall reduce his load to the amount of firm capacity specified in the Application for Interruptible Electric Service until further notice. Customer shall designate personnel who will accept notification of interruption at any hour of any day. Where necessary, Public Service will install and maintain suitable metering at its meter location for customer verification of compliance with the interruption notice.

(e-4) Firm capacity shall be reflected in the measurement by a magnetic tape meter of customer's maximum measured demand during the period of interruption called for. If it is determined by Public Service that customer did not reduce his load to the amount contracted for in (e-2) above, the excess over that amount shall be billed at a Kilowatt Charge of \$36.00 per kilowatt.

(e-5) Public Service agrees to limit the total hours of interruption as described in this Rate Schedule to the customer during an annual period to a maximum of 150 hours, which hours of interruption can occur consecutively or at any time—the total occurrences not to exceed 15 times during the calendar year.

(e-6) Where customer signs an Application for Interruptible Electric Service and elects to be billed under this Special Provision, the Term of Service shall be three years in lieu of Term stated in this Rate Schedule. Public Service reserves the right to determine whether successive Terms may be negotiated and under what conditions interruptible capacity may be transferred to firm service.

- (f) **Termination of Service by Customer:** Where a customer, served at 138,000 volts or higher, terminates service prior to fifteen years from the initial date of service, customer shall be obligated to pay Public Service that part of the total actual cost of any of the 138,000 volt or higher facilities, land, easements, interests, or rights of way used in rendering such service, under the following schedule:

(f-1) Actual cost of facilities through the first year; thence such actual cost reduced by 5% quarterly during the next succeeding year; thence reduced by 1¼% quarterly during the next succeeding six years; thence reduced by 1¾% quarterly during the next succeeding six years; and thence reduced by 2% quarterly during the remaining year.

(f-2) Actual cost of land, easements, interest, or rights of way through the first year; thence at 80% of actual cost during any of the next succeeding nine years; thence reduced by 4% quarterly during the remaining five years.

(f-3) In the event that Public Service determines to serve other loads from or otherwise use the aforesaid facilities, lands, easements, interests, or rights of way, then their cost shall be allocated on an equitable basis for the determination of the termination payment reflecting the difference between the actual cost and the allocated cost.

- (g) **Limitations on Loads Served at 138,000 Volts or Higher:** Customer may be required to supply advance information as to conditions affecting his load as an aid to Public Service in load scheduling.

Date of Issue: March 17, 1977

Effective: March 10, 1977

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80 Park Place, Newark, New Jersey 07101

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**RATE SCHEDULE HTS
HIGH TENSION SERVICE**

(Continued)

Public Service shall not, without prior written acceptance, be obligated to deliver at a single service location an amount of power in excess of a maximum demand of 50,000 kilowatts at 85% power factor.

(h) Resale: Service under this Rate Schedule is not available for resale.

STANDARD TERMS AND CONDITIONS:

This Rate Schedule is subject to the Standard Terms and Conditions on Sheets Nos. 6 to 19, inclusive, of this Tariff.

Date of Issue: January 13, 1977

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80 Park Place, Newark, New Jersey 07101**

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APPENDIX V

(3.5.3 d2)

ECONOMIC FEASIBILITY EVALUATION AND FINANCIAL ANALYSIS

ECONOMIC FEASIBILITY EVALUATION AND FINANCIAL ANALYSIS

PHASE II SUMMARY

- (1) The economic screening of the ICES shows a penalty of about \$2.8 million per year when compared to the conventional oil heated system (See Table 1).
- (2) From the standpoint of overall fuel consumption of PSE&G and ICES, the ICES plan would burn about 10,700 barrels of oil more per year than the conventional system plan. However, ICES would reduce the PSE&G coal requirement by about 5800 tons which is the heat equivalent of 25,200 barrels of oil. On this basis, ICES compared to the conventional plan results in an equivalent oil saving of about 14,500 bbls. of oil.
- (3) The installation of the ICES plant would not alter the PSE&G nuclear capacity expansion program. If the installation of such a plant is to be considered as an alternate to nuclear capacity, then an entire different economic evaluation would have to be made.

COST COMPARISON OF ALTERNATIVE ENERGY SUPPLIES
TO TRENTON DOWNTOWN COMMUNITY

		<u>Levelized Annual Costs ICES Installation 1982</u>	
		<u>Normal Operation</u>	<u>No Storage</u>
A. ICES (PSE&G OWNERSHIP)			
1.	ICES Energy Production		
(a)	Capital		
	Plant & Steam Distribution	\$2,240,000	
	Grid Connection	80,000	
	Terminal Equipment	190,000	
(b)	Fuel	3,410,000	
(c)	Operating & Maintenance		
	Plant & Steam Distribution	1,670,000	
	Terminal Equipment	630,000	
2.	Replacement Energy & Capacity Credit	(2,020,000)	
3.	Transmission & Distribution Credit		
(a)	Energy Losses	(90,000)	
(b)	Long Range Investment Savings	<u>(110,000)</u>	
	SUBTOTAL	\$6,000,000	
B. CONVENTIONAL SYSTEM (NEW BUILDINGS OIL HEATED)			
1.	Steam Production		
(a)	Capital	\$ 280,000	
(b)	Fuel	1,910,000	
(c)	Operating & Maintenance	890,000	
2.	Increased Electrical Energy (Cooling Production)	140,000	
	SUBTOTAL	\$3,220,000	
C. ICES PENALTY OR (SAVINGS)			
		\$2,780,000	

COST COMPARISON OF ALTERNATE ENERGY SUPPLIES
TO TRENTON DOWNTOWN COMMUNITY

LEVELIZED ANNUAL COSTS, THOUSAND OF 1982 DOLLARS					
Normal Operation			On-Peak Operation		
		Limited		Only	
	Storage	No Storage	Storage	No Storage	
A. ICES (PSE&G Ownership)					
1. ICES Energy Production					
(a) Capital	\$3,000	\$2,510	\$2,600	\$3,000	
(b) Fuel	3,560	3,410	3,410	2,960	
(c) Operating & Maintenance	2,310	2,300	2,290	2,100	
2. Replacement Energy & Capacity Credit	(2,100)	(2,020)	(2,030)	(1,550)	
3. Transmission & Distribution Credit					
(a) Energy Losses	(100)	(90)	(90)	(70)	
(b) Long Range Investment Savings	(110)	(110)	(110)	(110)	
SUBTOTAL	\$6,560	\$6,000	\$6,070	\$6,330	
B. CONVENTIONAL SYSTEM (New Buildings Oil Heated)					
1. Steam Production					
(a) Capital	\$ 280	\$ 280	\$ 280	\$ 280	
(b) Fuel	1,910	1,910	1,910	1,910	
(c) Operating & Maintenance	890	890	890	890	
2. Increased Electrical Energy (Cooling Production)	140	140	140	140	
SUBTOTAL	\$3,220	\$3,220	\$3,220	\$3,220	
C. ICES PENALTY OR (SAVINGS)	\$3,340	\$2,780	\$2,850	\$3,110	

Revenue Flow

Based on the conclusion of the economic analysis, regardless of the scenario selected, revenue requirements would be such as to force a price for steam which is considerably higher than that which the customer presently incurs (or would incur in a conventional system). Revenue flow for this project becomes an academic exercise.

Based on the theory that ICES were profitable the following is the revenue flow methodology.

1. Since rates are cost based, they would be priced to sufficiently recover capital costs.
2. Escalation clauses in the contracts would assure adequate revenue requirements for fuel, operating and maintenance expenses.

TABLE 3
BASIC DATA

1. ICES AND CONVENTIONAL SYSTEM DATA

A. Capital Costs (1982 Dollars)

(1) ICES plant including land, building, 4-2.5 MW combustion turbines - waste heat boilers, fuel storage, fuel handling, standby boilers, water treatment.	\$14,100,000
Steam distribution.	2,700,000
Grid Connection.	620,000
Terminal equipment, pumps, heat exchangers, absorption chillers.	1,440,000
ICES SYSTEM TOTAL	\$18,860,000
(2) Conventional system, new buildings oil heated. Includes boilers, fuel storage, load centers, electric chillers.	2,100,000
(3) Conventional system, new buildings electrically heated. Includes heat pumps, load centers.	1,840,000

B. Carrying Charges (Return, Depreciation, Taxes)

ICES equipment (25 year recovery)	12.7%
Conventional system (25 year recovery)	12.7%

C. Fuel Costs (includes transportation, \$/MBtu)

<u>Representative Years</u>	<u>Conventional Plant</u>		
	<u>ICES Plant</u> <u>#2 Oil</u>	<u>#2 Oil</u>	<u>#6 Oil</u>
1982	4.31	4.74	4.03
1985	5.16	5.66	5.00
1990	6.43	7.06	6.50
1995	8.10	8.90	7.41
2000	10.29	11.30	11.29
2005	13.08	14.36	15.02
Levelized Annual Cost			
1982-2006 *	6.47	7.08	6.57

D. Operating & Maintenance Costs (O&M)

(1) ICES Plant variable costs

<u>Representative Years</u>	<u>Variable O&M Mills/kWhr</u>
1982	10.3
1985	12.2
1990	16.4
1995	21.9
2000	29.3
2005	39.3
Levelized Annual Cost 1982-2006 *	16.9

(2) ICES Annual Fixed Costs (1982 \$)

Plant	\$ 527,000
Steam Distribution	126,000
Terminal maintenance	<u>359,000</u>
TOTAL	\$ 1,012,000

(3) Conventional plant annual fixed costs
(1982 \$)

Oil heated	\$ 540,000
Electrically heated	480,000

2. UTILITY DATA

A. Energy and Capacity

<u>Representative Years</u>	<u>Capacity Payment Rate Schedule (\$/kW/yr)</u>	<u>Avg. Incremental Energy Cost (Mills/kWhr)</u>	
		<u>On-Peak</u>	<u>Off-Peak</u>
1982	32	46.3	30.6
1985	40	56.3	35.4
1990	54	73.1	43.2
1995	72	85.4	50.0
2000	96	113.1	68.4
2005	129	144.4	87.3
Levelized Annual Cost 1982-2006 *	57	72.1	43.8
Levelized Study Cost **	15		

Notes:

- * The annual levelized cost is the yearly average, weighted on a present worth basis, of a fluctuating series of expenses in 1982 dollars at a 10.4% cost of money.

- ** The probability that PSE&G will receive capacity payments for the study period is estimated to be 25%. The study figure was weighted accordingly and present worthed at 10.4%.

GENERAL NOTE: The following escalation rates have been used in this analysis.

#2 OIL	4.87%
#6 OIL	5.85%
ELECTRICITY	4.50%
O&M	6.00%

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APPENDIX W

(3.5.3 e)

WORK MANAGEMENT PLAN

ORGANIZATION OF FUTURE WORK: BY PHASE AND BY TASK

The following work management plan is provided as a requirement of the Phase II contract. The inclusion of this section in the report in no way represents a commitment on the part of PSE&G to initiate and complete Phase III. A separate statement covering the PSE&G position on Phase III is included in an appropriate section of this report.

The work management plan is based on PSE&G being the prime contractor for Phases III - VI. The mandays shown for Phase III include the total estimated mandays for the prime contractor and all subcontractors.

TRENTON ICES

WORK MANAGEMENT PHASE III TO VI

Phase III

Task I: Institutional Resolution:

- A. Finalize rate structure.
- B. Reach agreements with customers on terms of service.
- C. Obtain signed contracts covering the purchase of land from the city of Trenton, and Planning and Zoning Board of adjustment approvals for the proposed project.
- D. Obtain all necessary easements - permits and other right-of-way agreements.
- E. Obtain a firm commitment covering oil allocation from the U.S. DOE to guarantee the initial and continued operation using oil for the ICES plant under the cogeneration concept.
- F. Negotiate any required changes in existing agreements between PSE&G and the respective unions involved in operating and maintaining the thermal plant and distribution system.
- G. Obtain approval of the Bureau of Public Utilities or other regulating agencies as required.

Task I Mandays = 200

Task II: Engineering and Design

- A. Review of thermal demand, based on customers response.
- B. Reassess the plant size and turbine-generator and auxiliary boiler sizes.
- C. Finalize the plant size and mode of operation.
- D. Evaluate the effect of potential future customers.
- E. Finalize the space requirement for the plant, oil storage and other services.
- F. Obtain U.S. DOE data collection requirements and assess their effect on the plant design, operation, and operating costs.

G. Write specifications for:

1. Turbine and generators.
2. Waste heat boilers
3. Auxiliary boilers
4. Electrical grid connection and station equipment.
5. Steam distribution system
6. Instruments and controls for plant, steam distribution, and thermal storage.
7. Water Treatment
8. Piping
9. Ducting
10. ICES connection to PSE&G grid

Task II Mandays = 1,200

Task III: Environmental Assessment

- A. Final environmental report.
- B. Assess the effect of No_x emissions.

Task III Mandays = 100

Task IV: Equipment Ordering

- A. Receive and evaluate bids and place orders for turbine and generators, waste heat boilers, auxiliary boilers, electrical equipment, steam distribution and instruments and controls.
- B. Follow-up the orders and coordinate.

Task IV Mandays = 750

Task V: Detail Engineering and Design and Coordination:

- A. Engineering and detail design of all systems - mechanical and electrical.
- B. Interface the various systems and with various departments.

Task V Mandays = 7,400

Task VI: Structural Engineering and Design

- A. Finalize the building design, prepare detailed drawings and place order for structural construction.
- B. Architectural design

Task VI Mandays = 1,650

Task VII: Final Costs

- A. Finalize capital and O&M cost estimates

Task VII Mandays = 60

Task VIII: Operation Preparation

- A. Obtain the required permits/licenses for construction, operation of plant.
- B. Obtain fuel allotments if required.

Task VIII Mandays = 60

Task IX: Final Cost Analysis

- A. Re-evaluate thermal supply costs and customer's life-cycle cost analysis of alternate supply plan.

Task IX Mandays = 10

Phase III Mandays Summary

<u>Task</u>	<u>Mandays</u>
I	200
II	1,200
III	100
IV	750
V	7,400
VI	1,650
VII	60
VIII	60
IX	<u>10</u>
	11,430

Phase IV

Task I: Construction Management

- A. Pre-construction planning and management of construction.

Task II: Construction

- A. Coonstruction of plant building and other plant related buildings and facilities.
- B. Installation of plant equipment.
- C. Construction of steam distribution system

Task III: Customer Relation

- A. Continuation of customer liaison to coordinate service connections.
- B. Public relations and advertisements.

Task IV: Metering and Billing

- A. Finalize metering and billing procedures
- B. Train appropriate personnel

Task V: Startup Procedures

- A. Write startup, testing and operation procedures
- B. Write ICES evaluation procedures.

Task VI: Operation and Maintenance Procedures

- A. Prepare a detailed operation and maintenance procedure manual.
- B. Prepare spare parts list.

Phase V

Task I: System Installation Tests

- A. Testing to verify that the equipment installation have been made in accordance with the construction documents.

Task II: Startup Tests

- A. Preparation of startup tests schedule.
- B. Conduct startup tests and trial operation.

Task III: Installation of Monitoring Equipment

- A. Design and installation of monitoring instrumentation systems (MIS) for detailed data collection.
- B. Design and installation of data collection system for U.S. DOE.

Task IV: Performance Tests

- A. Provide for and perform a one-year performance test of the ICES demonstration system.

Task V: Customer Liaison

- A. Continue customer liaison to assure proper communications and billings.

Phase VI

Task I: Operation and Maintenance Management

- A. Operation and maintenance of the ICES demonstration system.

Task II: Long-Term Demonstration Evaluation

Evaluate the Demonstration System and prepare periodic reports.

Task III: Post-Contract Operation

- A. Preparation of a post contract program plan for the continued operation of the Demonstration System.

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