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

Final Report. Volume 4. Tasks 7-9

By
James R. Watt
George A. Sommerfield

August 1979

Work Performed Under Contract No. EM-78-C-02-4979

Toledo Edison Company
Toledo, Ohio

U. S. DEPARTMENT OF ENERGY

Division of Buildings and Community Systems

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

Task 7

Proposal for Further Work

James R. Watt
George A. Sommerfield

Toledo Edison Company
Toledo, Ohio

May, 1979
Revised August 1979

Prepared for:
The U. S. Department of Energy
Under Contract No. EM-78-C-02-4979

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May 25, 1979

Mr. Charles G. Frazier
DOE, Chicago Operations Office
Building 2, Room I-109
9800 South Cass Avenue
Argonne, Illinois 60439

Dear Mr. Frazier:

Subject: Contract No. EM-78-C-02-4979 "District Heating and Cooling
Systems for Communities Through Power Plant Retrofit and
Distribution Network

We are pleased to continue our participation in the District Heating Demonstration Program and have included our proposal for Phases 2 and 3 for your review. The results of the Phase 1 effort have been encouraging, and I think you will find our proposal for further work details an approach that will lead to the creation of a successful district heating system. The study will be conducted and coordinated through our Research & Development Division which is responsible for bringing projects like this through the economic evaluation phases.

The Demonstration Team utilized in Phase 1 has been expanded by two members for the Phase 2 effort. Rightmyer, Johnson & Associates will bring their expertise in heating system design to the project. The City of Toledo will help us evaluate municipal ownership/financing options and provide the necessary coordination between this project and other downtown development programs. The entire team is as follows:

Toledo Edison Company
Battelle Columbus Laboratories
Stone & Webster Engineering Corporation
Rightmyer, Johnson & Associates
City of Toledo
Ohio Department of Energy
Public Utilities Commission of Ohio
Toledo Metropolitan Area Council of Governments

The team will continue to be directed by James R. Watt as Project Manager. He will be assisted by George Sommerfield as the Assistant Project Manager. Additional details on other team participants can be found in the proposal.

Mr. Charles G. Frazier

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May 25, 1979

Our proposal is essentially two parts; a Technical Proposal consisting of Tasks 7, 8 & 9 as designated in the Phase 1 program and the Cost Proposal. The content of the Technical Proposal follows immediately and the Cost Proposal is bound separately.

We believe that Toledo is a good setting for this Demonstration Project because of the proximity of Acme Station to the proposed service area. Our experience with district heating will be great assistance during all phases of this project. Finally, the potential savings in scarce fuels makes this project an attractive alternative to reduce our dependence on oil.

Please call Mr. James R. Watt or me if you have questions about the proposal.

Sincerely,

A handwritten signature in dark ink, reading "David A. Nelson". The signature is written in a cursive, flowing style with a large initial "D".

David A. Nelson

Vice President, Corporate Development

GAS/dm

TASK 7 - PROPOSAL FOR FURTHER WORK

Executive Summary

Phase 1 was essentially a sifting process in which promising combinations of plants and service areas were separated from all possible configurations. As contractor and Project Manager for the Toledo Study, Toledo Edison has tried to remain alert to a variety of possible ownership alternatives. At the conclusion of Phase 1 the electric utility is still the most logical owner and operator of the district heating system. The combination of Acme Station and the downtown Toledo area has been identified as a potential successful Demonstration Project. The existing steam system can serve as an excellent base from which various expansion plans can be derived. Replacing the steam system with a coal fired cogeneration source provides an excellent opportunity for scarce fuel savings. Additional savings accrue to those customers who convert from using scarce fuels directly to the new district heating system. The combined savings is the driving force which makes this project economically feasible.

To choose the best alternative for further detailed study in Phase 2, two criteria were used to compare the alternative retrofit scheme. Life cycle savings computed for the 25-year life of the investment was the primary measure. Second, the sensitivity of life cycle savings to changes in critical input variables was the second indicator. The sensitivity analysis indicates the relative risks associated with each scheme under varying economic conditions.

To determine the scope of the district heating systems under consideration an energy market analysis was conducted. Potential customers were identified which would double and nearly triple the existing steam

heating load. Concurrently, the engineering consultant scrutinized the plant to determine sources of steam to serve a range of loads. The Demonstration Team then met to determine which service areas were worthy of consideration. Once four retrofit schemes were selected the detailed comparisons could begin. Since the downtown steam system was the basis of the service area, steam was selected as the best distribution medium.

After reviewing twenty different retrofit schemes for Acme Station, the engineering consultant recommended the installation of a back pressure turbine as the best method of obtaining cogeneration steam. The new back pressure turbine will operate in parallel with an existing condensing turbine. This concept provides the benefits of cogeneration and still permits maximum electrical production when there is minimal steam load. Using 235 psig as the extraction pressure permits considerable redundancy within Acme Station since there is a 235 psig header served by several boilers.

The most challenging part of the distribution system will be the underground crossing of the Maumee River which separates Acme Station from the proposed service area. Considerable effort will be spent during Phase 2 to determine the installation details and cost of the river crossing. Engineering costs of other distribution line extensions will be calculated as well to complete the cost estimate for all components of the distribution network.

As a result of the economic analysis, Retrofits #1 and #2 were selected for continued study in Phase 2. Implementing Retrofit #2 would double the steam output and displace over 6 million gallons of oil. The life cycle savings and the risk associated with changing economic conditions is less than that determined for Retrofits #3 and #4.

To proceed into Phase 2 the Demonstration Team is being expanded to include two important contributors. An engineering firm specializing in the design of in-building systems is being added. Their expertise will help determine retrofit costs and resolve specific technical concerns of the potential customers. A representative of the City of Toledo will be included since financial options including municipal ownership are still under consideration. In any case, the city government is strongly committed to guiding the redevelopment of downtown Toledo which is currently underway. They share our belief that a coal fired district heating system will enhance redevelopment efforts. Community support for the Demonstration Program can be better focused with appropriate involvement by local government.

The Task 7 report concludes with the site-specific Scope of Work Toledo Edison developed with the subcontractors to address the requirements of Phases 2 and 3. Because of the nature and size of the Demonstration Project in Toledo, we intend to complete all the technical and economic tasks during Phase 2. Only the final rate making, legal and financing tasks will have to be carried into Phase 3 which we propose to start immediately after the completion of Phase 2. Because of the different costs sharing formulas for Phases 2 and 3, we have created separate technical and cost proposals for the two subsequent phases. Toledo Edison seeks approval, however, for both phases now to accelerate the pace of the Demonstration Program.

TASK 7 - PROPOSAL FOR FURTHER WORK

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3.7.1 Task Deliverables

Explain criteria developed to rank various alternatives including the rationale used to construct the criteria.

3.7.1 Explain Ranking Criteria

Life cycle savings was chosen as the best method to determine economic feasibility of various alternatives. Battelle Columbus Laboratories constructed a computer model which would calculate life cycle savings with any given set of conditions. Cost of service pricing was used to reflect the regulatory environment in which the system is assumed to operate.

A base case was developed to determine the net present value of savings possible over a 25-year life of the investment. Four retrofit and distribution schemes were analyzed using this method.

Risk of each alternative was treated by varying fuel escalation rates, financing options, start up dates, size of investment, customer consumption, and user discount rates from the base case.

A life cycle savings value of zero indicates that district heating costs no more or less than the customers' existing thermal energy source. The sensitivity of life cycle savings to changes in various input variables was evaluated for each retrofit scheme. Comparison of the variation of life cycle savings, or sensitivity, between the different alternatives allowed some comparisons of risk.

Of course, the greater life cycle savings, the more attractive the project. Similarly, the lower the sensitivity to varying conditions, the lower the risk. These are the primary criteria used to rank alternatives.

3.7.2 Task Deliverables

Explain in detail the reasons for preferring some retrofit and thermal distribution configurations to others. List the alternatives chosen for further work.

3.7.2 Preferred Configurations

Energy Market Analysis

Three counties were selected for study based on thermal density and proximity to the candidate power plants. Based on energy density parameters developed in Sweden, thirteen planning districts within Lucas County emerged as potential areas for detailed study. Of these, only Planning District No. 1, which includes the downtown Toledo area, was identified as "very favorable."

An area market survey was then conducted to collect energy data from potential end users. The survey encompassed certain apparent energy intensive firms contiguous to or within a reasonable distance from the downtown area, in which the existing oil fired district heating system is located. The objective of this approach was to identify large valid potential district heating customers on which to establish base district heating loads.

Of the twenty-four customers surveyed, all but two utilized hot water or low pressure steam for the heat transfer medium, making conversion to a central system practical.

Fifteen respondents indicated they would switch to district heating if the delivered cost were equal to the cost of their present energy source.

Eight of those indicated they would pay 15% more. Eight also stated that they would only switch if district heating were 15% less.

Based on these findings, it appears that the existing steam district heating system can serve as a base load for an expanded distribution system. As a result of the energy market survey, preliminary investment estimates, and practicality of retrofit schemes, four district heating distribution system alternatives emerged:

Potential Service Areas

Expansion Plan	1	2	3	4
Thermal Demand 10^6 Btu/Hr.	278.6	325.8	723.0	786.9
Energy Use 10^9 Btu/Yr.	900.2	1,026.2	2,133.5	2,300.5

Retrofits for the Candidate Plants

Toledo Edison's three steam power plants, Davis-Besse Nuclear Power Station, Bay Shore Station and Acme Station, are potential candidates for retrofit to provide thermal energy for district heating in downtown Toledo and surrounding communities.

Although classified as a candidate plant, Davis-Besse Station is too distant from potential thermal loads to be considered a feasible source of energy. Fixed costs for transmission pipelines alone varied from \$12 to \$26 per million Btu depending on the market size, making the cost of energy prohibitive.

Bay Shore Station, the second closest plant to the potential market area, still established fixed costs for transmission of thermal energy

of \$4 to \$5 per million Btu greater than Acme Station. Because of the efficient design of Bay Shore Station heat cycle, heat extraction is difficult and expensive.

Of the three candidate plants, Acme Station is the closest to the potential load and lends itself well to retrofit. Twenty different schemes were studied for the retrofit based on either steam extracted from the turbine flow path or on heat utilized from a non-condensing back-pressure turbine.

Based on the four expansion plans identified in the Energy Market Analysis, non-condensing steam turbines for operation with inlet steam of 1450 psig and 235 psig exhaust pressure were selected. The four alternate schemes are the same except for capacity and distribution system. The turbine is connected to a generator with the following gross electric output and has the following net steam exporting capabilities:

Steam and Electric Output of Back-Pressure Turbines

Expansion Plan	1	2	3	4
Gross Electric Output	15.9 Mwe	18.6 Mwe	31.4 Mwe	31.4 Mwe
Steam Output - 235 psig	212,000	248,000	551,000	600,000

A schematic arrangement of Acme Station which includes the new back pressure turbine is shown on the next page.

Distribution Network

In district heating, thermal energy can be delivered to the end user by either a steam or hot water distribution system.

A steam system is the recommended transfer medium for this demonstration project. Although water is generally preferred if long distances are involved, distance is not a factor here. In addition, the existing downtown system and most of the potential load is steam. Those in-building systems that utilize hot water can be easily retrofitted to accept steam, where the opposite is more difficult.

Present steam users waste condensate to the drain, making the return of condensate to the plant impractical. Since the condensate will not be returned, treatment of make-up water becomes an economic factor. In one retrofit scheme a reboiler was added so that the condensate could be returned directly to the boiler. It was found that the differential capital costs for the reboiler and other related equipment could not be justified by the savings resulting from lesser waste treatment requirements. The additional fixed charges of \$116,000 were three times greater than the estimated \$39,000 in annual savings for reduced water treatment.

Scarce Fuel Savings

The displacement of scarce fuels is accomplished with the proposed district heating system by utilizing coal to provide the energy in place of the fuel oil presently being used in Water Street Station as well as the oil and natural gas presently being used by potential customers.

The following table illustrates the annual displacement of scarce fuels through the implementation of the district heating system.

Potential Annual Displacement of Scarce Fuels

Expansion Plan	1	2	3	4
Equivalent Gallons #6 Oil	5,236,000	6,007,000	7,327,000	8,442,000
(Totals are Cumulative)				

Efficiency of Heat Capture

In the proposed retrofit scheme, fuel chargeable to steam approximates 60% of the fuel required for a steam-only boiler. Stated differently, steam obtained through cogeneration results in a fuel savings of 40% when compared to a steam-only boiler. This figure is valid for full rates steam flow and may vary at other loadings.

Acme Station boilers are more efficient than the Water Street Station boilers. There is more line loss from Acme Station, however, Taking all factors into account, it is possible to predict the total energy saved by the proposed district heating systems as shown in the following table.

Total Annual Energy Saved with Cogeneration

Expansion Plan	1	2	3	4
Total Energy Saved 10^9 Btu/Yr.	411.6	448.7	661.3	666.1
(Cumulative Totals)				

Alternatives Chosen for Further Work

Four expansion plans were analyzed to determine the net present value of the savings over the 25-year life of the investment.

The base case employed the following values in the study:

Utility Cost of Capital: 12%

50% debt at 10.4%

15% preferred stock at 10.4%

35% common stock at 15%

Inflation Rate: 7%

Start Up Date: 1985

User Discount Rate: 15%

Annual Fuel Escalation Rate in Real Terms:

Natural Gas & Oil 6.5%

Coal 3.5%

Electricity 5.5%

(Fuel escalation rates represent midpoints of ranges specified in DOE contract.)

The results of the base case evaluation is as follows:

Life Cycle Savings
(Millions of 1979 Dollars)

Expansion Plan	1	2	3	4
Life Cycle Savings	\$21.7	\$24.9	\$23.4	\$26.4

In addition, results indicate that the projected district heating price is lower than existing steam and electric prices in 1985, but is not lower than natural gas or oil until 1990. District heating is not lower than coal used by the customer until the year 2000. Existing steam heating customers accrue the greatest proportion of the total system savings. As might be expected, coal users realize the negative savings (extra cost) on a per million Btu basis. Finally, there is no economy of scale as the retrofit schemes increase in size.

In the sensitivity analysis, fuel price escalation rates, financing assumptions, start up dates, cost of service, customer consumption, user discount rates and retrofit alternatives are treated as variables. The

most important result of the sensitivity analysis is that of the parameters varied, none have sufficient impact to alter the basic conclusion that the proposed district heating system is an economically sound venture.

Results indicate that there was considerably more risk associated with

Expansion Plans 3 and 4:

- Assuming a zero escalation rate (above inflation) for scarce fuels results in a positive life cycle savings for Plans 1 and 2, but not 3 and 4.
- Changes in the cost of financing impacts Expansion Plans 3 and 4 twice as great as Plans 1 and 2.
- Increasing revenue requirements by 25% decreases life cycle savings 15% for Plan 1, and 40% for Plan 4.
- Decreasing customer consumption by 10% impacts Plan 1 by 15% and Plan 4 by 25%.
- Expansion Plans 1 and 2 have a higher life-cycle-savings to capital-cost ratio than Plans 3 and 4.

Based on the results of Phase 1, Expansion Plans 1 and 2 have been chosen for further work.

	<u>Expansion Plan #1</u>	<u>Expansion Plan #2</u>
Thermal Demand	278.6×10^6 BTU/hr.	325.8×10^6 BTU/hr.
Steam Sendout	212,00 lb/hr.	248,000 lb/hr.
Energy Consumption	900.2×10^9 BTU/yr.	$1,026.2 \times 10^9$ BTU/yr.
Scarce Fuel Displaced	784.3×10^9 BTU/yr.	910.3×10^9 BTU/yr.

The Demonstration Team

To accomplish the Phase 2 effort Toledo Edison determined a scope of work for each of several tasks. By working with consultants these scope of work documents were refined so that the best match possible could be made between the subcontractors' capabilities and the task requirements. Toledo Edison selected a Demonstration Team which had the specific skills required to address the issues identified for detailed study during Phase 2.

The members of the team are as follows:

- Toledo Edison Company
- Battelle Columbus Laboratories
- Stone & Webster Engineering Corporation
- Rightmyer, Johnson and Associates
- City of Toledo
- Ohio Department of Energy
- Public Utilities Commission of Ohio
- Toledo Metropolitan Area Council of Governments

Toledo Edison will maintain its role as project manager for the district heating Demonstration Project. The Corporate Development Mission will be responsible for the completion of this project. The organizational chart in Task 9 shows the structure of the Corporate Development Mission. James R. Watt will be Project Manager and will be assisted by George Sommerfield who is designated as Assistant Project Manager.

Battelle Columbus Laboratories is charged with two specific tasks in the Phase 2 effort. First, they will perform a detailed economic analysis using the refined estimates for capital costs and the more precise estimates for the district heating steam market. Another task for Battelle will be the need to carefully monitor the institutional relationships which may affect the future of the Demonstration Program.

While no specific barriers were identified during Phase 2, more details will be available during Phase 2 which will help some of the regulatory agencies make their final judgements. Formal letters of approval will be sought from agencies which would be in position to make a decision during Phase 2.

Stone & Webster Engineering Corporation will continue as the consultant responsible for the plant retrofit engineering at Acme Station and the engineering design for the steam distribution system. During Phase 1 the cost of the pipeline installation was identified as the largest single capital expense. S&WEC will be utilizing a local contractor to determine the best estimate possible for the actual installed cost of the steam pipeline required. Northwest Mechanical Contractors, Inc. of Toledo will serve in this capacity.

Rightmyer, Johnson and Associates and the City of Toledo have been added to the Demonstration Team as a result of the findings made during Phase 1. To market district heating steam considerable attention must given to the details of end user retrofit. Rightmyer, Johnson and Associates is an engineering firm specializing in heating systems. Their expertise will be used to estimate costs of end user retrofits required so that the total cost of using district heating energy can be determined. Detailed building surveys will be conducted to identify additional potential customers along proposed extensions of the steam distribution system.

Another area of concern is the possibility of municipal ownership or municipal financing of the proposed Demonstration Project. Since the proposed service area falls within the City of Toledo, the administration of the City of Toledo will be represented on the Demonstration

Team. The City is very active in the downtown re-development initiatives presently underway and will be in a position to coordinate the planning of the proposed district heating system. The support of local government will be important to the success of this project even if municipal ownership/financing options are not selected.

The last three organizations will continue their roles as advisory team members. The Ohio Department of Energy will be looking for opportunities to transfer some of the findings of this study to other Ohio utilities. Also, they will help coordinate the effort to keep all state agencies informed as to the impact of the proposed district heating on all aspects of community life. The Public Utilities Commission of Ohio will be very much involved during Phase 2 in developing the regulatory framework for the proposed district heating system. Finally, the Toledo Metropolitan Area Council of Governments (TMACOG) will be represented so that the staff involved with energy planning activities can be kept informed of the district heating project. TMACOG is currently undertaking a Comprehensive Community Energy Management Plan (CCEMP) for Toledo sponsored by U. S. Department of Energy. The Energy Guidance Group (EGG) established to advise the team developing the CCEMP has been involved as an interested party during Phase 1 of this project. Their involvement is expected to continue into Phase 2.

EXHIBIT 1

CONTRACT NO. EM-78-C-02-4979

The Contractor shall conduct Phases 2 and 3 of the U. S. Department of Energy's Program to demonstrate a district heating and cooling system for communities through power plant retrofit and distribution network.

1.0 Objective

The objective of these two phases of the project is to: (a) establish the Preliminary Feasibility and Conceptual Institutional Arrangements; (b) establish the technical feasibility of the most promising Demonstration Project uncovered in Phase 1; (c) establish the institutional arrangements and framework required to bring this alternative to demonstration; (d) conduct a detailed technical feasibility analysis of the most technologically attractive Demonstration Project identified.

The aforementioned Phase 2 and 3 tasks are set forth below and the Contractor shall perform said tasks in accordance with it's proposal to DOE to continue to Phases 2 and 3 as defined in his project Phase 1 Final Report, except as hereinafter modified.

2.0 Scope of Work for Phases 2 and 3

2.1 Task 1 - Technical Assessment of the Power Plant Retrofit

2.1.1 Estimate Construction Cost for Power Plant Retrofit.

- 2.1.1.1 Observe and make record of field conditions.
- 2.1.1.2 Review engineering drawings of existing plant.
- 2.1.1.3 Determine size and kind of equipment required.
- 2.1.1.4 Study any planned changes in the power plant which might affect the proposed retrofit for district heating.
- 2.1.1.5 Determine major interferences between the proposed retrofit and existing plant systems.
- 2.1.1.6 Prepare detailed cost estimates for the proposed retrofit.
- 2.1.1.7 Use engineering sketches to illustrate the conceptual layout of the proposed installations. (Construction drawings will be prepared in the subsequent phase.)

- 2.1.1.8 Determine a schedule for the proposed construction and determine how this project could be completed in coordination with the operating schedule for the plant.
- 2.1.1.9 Assess the scarce fuel savings of the retrofit and service area selected for demonstration.
- 2.1.2 Determine the Energy Balance for the Proposed Retrofit.
 - 2.1.2.1 Calculate the electrical and thermal energy production for a typical annual operating cycle; determine average values for each month.
 - 2.1.2.2 Determine the fuel cost on a monthly basis.
 - 2.1.2.3 Analyze the energy balance between the proposed retrofit and the candidate service areas.
- 2.1.3 Determine the Control Scheme for the District Heating System.
 - 2.1.3.1 Coordinate the development of the control scheme with existing plant control system. Include consideration of the monitoring and acquisition system to be furnished by DOE.
 - 2.1.3.2 Estimate the cost of alternative instrumentation and control systems. Exclude costs of instrumentation furnished by DOE for data acquisition.
- 2.1.4 Determine Operating and Maintenance Expenses.
 - 2.1.4.1 Estimate maintenance costs associated with district heating retrofit for the plant.
 - 2.1.4.2 Determine the operating cost in cooperation with Toledo Edison operating personnel.
- 2.1.5 Provide Engineering Support to Determine the Cost Allocation Between Steam and Electricity.
 - 2.1.5.1 Define methods used to determine the steam production chargeable to district heating on a monthly and annual basis.
 - 2.1.5.2 Define methods used to determine the amount of plant equipment chargeable to district heating.
 - 2.1.5.3 Develop alternative penalty cost calculations for electric energy displacement.

- 2.1.6 Assess the Reliability of Supplying Steam to the District Heating System.
 - 2.1.6.1 Determine failure modes for proposed power plant retrofits.
 - 2.1.6.2 Evaluate use of boiler capacity at the hospital as stand-by capacity.
 - 2.1.6.3 Determine cost of heat-only boiler capacity to avoid electric capacity penalty.
 - 2.1.6.5 Make a detailed analysis of thermal back-up capacity for the system.

2.2 Task 2 - Engineering Design and Construction Estimate for the Steam Distribution System

- 2.2.1 Determine System Design Criteria.
 - 2.2.1.1 Analyze the advantages and disadvantages of dual crossings of the Maumee River compared to a single crossing.
 - 2.2.1.2 Prepare estimates to extend the distribution system to potential customers.
- 2.2.2 Determine Pipeline Installation Criteria
 - 2.2.2.1 Document pipe sizing calculations.
 - 2.2.2.2 Document heat loss calculations.
- 2.2.3 Determine Construction Practices.
 - 2.2.3.1 Describe how the pipeline will be installed. Illustrate with engineering sketches in plan and section.
 - 2.2.3.2 Demonstrate that safety practices now applicable have been considered in estimating the construction cost.
 - 2.2.3.3 Determine the type of pavement restoration required.
 - 2.2.3.4 Demonstrate that the pavement restoration meets applicable regulations.

- 2.2.3.5 Sketch representative plan and profile drawings to illustrate construction techniques and conflicts with other utilities.
- 2.2.3.6 Include basic considerations for traffic routings and maintaining of utilities operation continuity.
- 2.2.4 Review the Process to Obtain Necessary Permits.
 - 2.2.4.1 Estimate cost of obtaining permits and provide a time schedule for this effort.
 - 2.2.4.2 Determine the cost of satisfying the requirements of the permits, e.g., pressure tests.
- 2.2.5 Estimate Costs.
 - 2.2.5.1 Develop a detailed construction budget.
 - 2.2.5.2 Document the assumptions upon which the estimates are based.
 - 2.2.5.3 Indicate the accuracy of the estimates for each cost component.
 - 2.2.5.3 Document cost estimate for the river crossing portion of the project. Make this a separate estimate in all particulars.
- 2.2.6 Determine Materials Necessary for Construction of the Proposed District Heating System.
 - 2.2.6.1 Prepare pipe and insulation specifications for material to be used for the river crossing and the underground portions of the project.
 - 2.2.6.2 Prepare specifications for joints, bends, valves, traps, manholes, and other auxiliary material as required.
 - 2.2.6.3 Determine principal suppliers for all equipment and document price and delivery quotations.

2.2.7 Determine Building Space Needs.

- 2.2.7.1 Determine the space requirements for a pressure reduction station on the downtown side of the Maumee River. Estimate the cost of this facility.
- 2.2.7.2 Consider the space requirements necessary for office, shop and storeroom facilities necessary to operate the district heating system. Consider the cost of this facility at two locations.
- 2.2.7.3 Estimate the cost of providing this space on the Acme Station property.
- 2.2.7.4 Estimate the cost of providing this space as part of the construction of the pressure reduction station.

2.2.8 General Requirements.

- 2.2.8.1 All tasks listed above are to be based on field observations and discussions with Toledo Edison employees involved in operating the existing steam heating system.
- 2.2.8.2 Maps, sketches, tables and other graphic displays are to be prepared so they can be used for both slide presentations and illustrating the engineering reports. (Construction drawings are not a part of this task.)

2.3 Task 3 - User Retrofit and Market Penetration Assessment

2.3.1 Determine the Load Characteristics of Potential New Customers.

- 2.3.1.1 Calculate the peak demand for potential district heating customers. Calculate the total energy required annually.
- 2.3.1.2 Estimate the daily, weekly, and monthly use patterns and energy consumption.
- 2.3.1.3 Construct annual load duration curves for each major customer, or class of customer.
- 2.3.1.4 Combine the customers' loads in accordance with the expansion plans under consideration in Phase 2.

2.3.2 Estimate Cost of End User Retrofit.

- 2.3.2.1 Observe and record field conditions at each location identified as a potential customer in Phase 1.
- 2.3.2.2 Prepare schematics of the in-building system before and after retrofit.

2.3.2.3 Provide a detailed description of method of conversion.

2.3.2.4 Estimate the time required to complete the retrofit installation.

2.3.2.5 Prepare a detailed estimate of the conversion costs. Indicate the relative accuracy of component costs. Determine the range of accuracy for the total cost.

2.3.2.6 Investigate whether a generic methodology may be used to estimate the retrofit costs for typical in-building systems. This methodology would be based on the customer surveys conducted in Section No. 2.3, Para. 2.3.3, below.

2.3.3 Extent of the Service Area and Building Survey

2.3.3.1 The service area will be bounded by the river on the east, Monroe Street on the south, 10th Street and Spielbush on the west, and Cherry Street on the north. A service corridor will be added along Jefferson Avenue from 10th Street to Parkwood. Steam services will be extended on either side of Jefferson to Monroe Street and Madison Avenue.

2.3.3.2 Building surveys are to be conducted at the "Potential Customers Identified in Phase 1" as indicated on Table 1. Additional surveys are required for "Other Potential Customers" as indicated on Table 2.

2.3.3.3 Prepare a map of the proposed service area showing the existing steam distribution system, the potential customers, and the steam line required to serve the additional steam load.

2.4 Task 4 - Economic Analysis

2.4.1 Refine the economic analysis as performed in Phase 1 to include updated and more accurate input data. Fine tune the project economics.

2.4.2 Prepare a comprehensive summary of fuel and electricity price projections applicable to the district heating area based on the best information available from reliable sources. Place particular emphasis on the price of scarce fuel (natural gas and oil where applicable). Select probable price projection ranges acceptable to the decision makers who will be responsible for the decision to proceed with construction.

2.4.3 Based on the selected price projection ranges, analyze the economics of the district heating system using a methodology familiar to the decision makers. Also, provide two Pro-Forma income statements and balance sheets in normal accounting format for each alternative considered. These should reflect the most

TABLE 1POTENTIAL CUSTOMERS IDENTIFIED IN PHASE 1

<u>Customer</u>	<u>1,000 sq.ft.</u>	<u>Fuel</u>	<u>System Type</u>
U. S. Court & Customs House	86.8	Natural Gas	Steam - 2-3 psi
Questor Corp.	71.2	Natural Gas Fuel Oil	HW 8 psi 170°F
Retail Store Employees Union	18.6	Natural Gas	HA roof furnaces
Realvest (Toledo Building)	61.5	Natural Gas	Steam 1 psi
Toledo Trust (New Office)	100		
Owens-Illinois	880	Electric	HW 200°F
Toledo Edison	294	Electric	HW
First Federal	198	Electric	HW 12 psi 200°F
Manhattan Building	30	Natural Gas	Steam
Bennett Building	30	Natural Gas	HW
1810-14 Madison	30	Natural Gas	HW
Mercy Hospital	568	Natural Gas Fuel Oil	Steam 15 psi

TABLE 2OTHER POTENTIAL CUSTOMERS

Executive Towers
Parkview Hospital
Addressograph Multigraph
Park Lane Hotel
Health Care Clinic
Teneyck Towers
McGranahan Distributors
Hillcrest Hotel
Catholic Club
Sheller Globe
Trailways
Gumpp Cadillac
Jefferson Center (School)
Associates Financial Services
Toledo Optical
Lorraine Hotel
Eriksen's
SSOE
Toledo Club
Zenobia Shrine
Bud & Luke's

attractive and least attractive economics within the probable price projection ranges for fuel and electricity. Support all assumptions with appropriate data and include sufficient information to duplicate calculations. Provide sufficient documentation of computer programs employed to permit a numerical check of results.

- 2.4.4 Evaluate the propensity for existing steam customers to remain on the steam system. This analysis will include projections of natural gas prices and availability and an assessment of possible contractual obligations. Discussions of such issues will be held with appropriate company officials of Columbia Gas, Toledo Edison, and large existing steam users.
- 2.4.5 Structure a typical long term contract between thermal energy producer and distributor, where applicable. Structure a typical long term contract between thermal energy distributor and end-users. Demonstrate that the cost allocation between thermal and electric energy has been reviewed by the appropriate regulatory body.
- 2.4.6 Analyze the decision to switch to the new system from the perspective of the user. This will include a determination of the effects of and remedies for customers using investment criteria which are too strict and an evaluation of the possibility of adding other new customers.
- 2.4.7 Incorporate the findings of the market analysis to be conducted by a local firm. To facilitate the use of this analysis, Battelle will participate in the development of questions related to the economic analysis and in the review of the results of the survey related to the economic analysis.

2.5 Task 5 - Institutional Assessment

- 2.5.1 Identify and review new or pending Federal, State, and/or local legislation, regulations, or guidelines that could affect the viability of the project.
- 2.5.2 Initiate discussions with the PUCO on developing approvable ownership-organizational arrangements, accounting rules and rates for the proposed system.
- 2.5.3 Clarify whether the Ohio Power Siting Commission has any jurisdiction over the proposed project, given detailed engineering data (obtain, if possible, such a determination formally in writing from OPSC).
- 2.5.4 Determine on the basis of engineering design specifications whether a "permit to install" from the Ohio Environmental Protection Agency is likely to be required (again in writing from OEPA, if possible, including likely conditions if such a permit is required).

- 2.5.5 Discuss the detailed design specifications with the U. S. Environmental Protection Agency, and secure an opinion from them (formal, if possible) on concurrence or disagreement with OEPA's position.
- 2.5.6 Review the detailed river crossing plans with the Corps of Engineers, the Toledo-Lucas Co. Port Authority, the U. S. Coast Guard, and the Toledo Division of Streets, Bridges and Harbors to identify and characterize potential problems (The Corp's permit cannot be secured during Phase II).
- 2.5.7 Discuss the distribution system configuration with the Toledo Real Estate Department and other relevant local authorities to document potential problems with franchises/easements.
- 2.5.8 Review the detailed engineering plans with the Toledo Division of Engineering and Construction to identify whether those plans are approvable (and, if not, what changes should be made).
- 2.5.9 Update the schedule for approvals developed in Phase I based upon Phase II discussions.

2.6 Task 6 - Legal Review

- 2.6.1 Determine if present Toledo Edison bond covenants restrict the financial options available for the proposed district heating system.
- 2.6.2 Determine if the proposed district heating system could qualify for industrial revenue bonds if Toledo Edison were the system owner.
- 2.6.3 Explore the legal aspects of structuring a joint venture between the City of Toledo and Toledo Edison for the purpose of providing district heating.
- 2.6.4 Determine if municipal ownership with lease back to Toledo Edison is a legal arrangement in Ohio.
- 2.6.5 Investigate the affect the ownership option described in 2.6.4 will have on state regulatory jurisdiction.
- 2.6.6 Evaluate the possibility of establishing a non-profit corporation or a cooperative to own and operate the district heating system.
- 2.6.7 Determine the nature of the contracts between the system owner and the end-users which would establish long term commitments for thermal energy.

2.7 Task 7 - Financing Comparison

- 2.7.1 Explore use of industrial revenue bonds to finance the district heating system.
- 2.7.2 Explore financing options available if municipal or joint venture ownership options were utilized.
- 2.7.3 Determine impact on Toledo Edison's financing plans if the district heating system were financed as a routine construction project.
- 2.7.4 Assess the cost of financing under the various alternative proposals.

2.8 Task 8 - Contractual Arrangements

- 2.8.1 Prepare basis for negotiations with existing and potential district heating customers to establish long term contracts.
- 2.8.2 Prepare contracts for execution.

2.9 Task 9 - Rate Design

- 2.9.1 Determine district heating rates to be implemented as part of long term contracts as well as a regular rate schedule.
- 2.9.2 Determine a fuel escalation formula appropriate for all district heating customers.

2.10 Task 10 - Financing

- 2.10.1 Determine final financing arrangements depending on ownership option selected.
- 2.10.2 If municipal involvement in financing is required, the necessary framework for an offering of municipal bonds will be coordinated with the City of Toledo.

2.11 Task 11 - Proposal for Implementation

2.11.1 Based upon the work accomplished in Tasks 2 and 3, prepare a detailed implementation plan for the remainder of the demonstration program. The steps to be included in this plan are outlined below. As a minimum, the multiphase program should include:

- Description of the Demonstration Project including the preferred retrofit scheme and thermal distribution network.
- Demonstration Master Schedule.
- Detailed Task Schedule for subsequent phases with PERT Charts for each subsequent phase.
- Management Plan, including: (1) Demonstration Team organizational structure, (2) description of tasks necessary for managing the Demonstration Program, (3) functional relationships of members of the Demonstration Team, (4) identification of key personnel including qualifications and level of effort, (5) manpower schedule and (6) cost schedule.
- Items (2) through (6) should be related to tasks detailed in the PERT Charts wherever possible.

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

Task 8

Letters of Cooperation and Commitment

James R. Watt
George A. Sommerfield

Toledo Edison Company
Toledo, Ohio

May, 1979
Revised August 1979

Prepared for:
The U. S. Department of Energy
Under Contract No. EM-78-C-02-4979

TASK 8 - LETTERS OF COOPERATION AND COMMITMENT

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Letters of Cooperation - End-Users

During the market survey conducted as part of Task 3 - Energy Market Analysis in Phase 1, the persons interviewed were asked to sign a statement indicating continuing interest in the district heating project. All of the potential end-users thought the district heating concept was worthy of their continued interest. Since there was not enough data available on which a potential end-user could make a decision, the signed statements do not make any specific commitment. We feel the general consensus on the part of the end users that district heating is worthy of further investigation is gratifying.

During Phase 2, sufficient economic data will be assembled to approach end-users with enough facts so they can begin evaluating the switch to district heating. These preliminary decisions will be required fairly early during the Phase 2 effort so the extent of the expansion of the distribution system can be determined. Contracts will be developed between the supplier and the end-user for execution during Phase 3 of the Demonstration Program.

The signed statements provided by the potential end-users are duplicated on the following pages:

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date _____

Mr. Thomas Barriger
Plant Engineer
DeVilbiss Corporation
300 Phillips Avenue
Toledo, Ohio 43612

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed Robert V. Bullis Date 1/31/77

Mr. Robert Bullis
Board of Education
Toledo School District
E. Manhattan & Elm Street
Toledo, Ohio 43608

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____ Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed

John Carnicom

Date

1-15-78

U. S. Court House

Mr. John Carnicom
General Services Administration
234 Summit Street
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____ Date _____

Mr. Ray L. Carter, Jr.
Toledo Ticket
2963 Catawaba
Toledo, Ohio 43612

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____ Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed

John Cheney

Date

1/15/79

Mr. John Cheney
Eprad, Inc.
123 W. Woodruff Avenue
Toledo, Ohio 43624

My company would not be interested in discussing the use of district heating and cooling service.

Signed

Date

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date _____

Mr. John Eberly, Jr.
Manhattan Building Company
P. O. Box 333
Toledo, Ohio 43691

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed *Frank Fonville*

Date 16 Dec 79

Mr. Frank Fonville
Ransom & Randolph Company
324 Chestnut
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date _____

Mr. George Hartman
Toledo Museum of Art
2445 Monroe Street
Toledo, Ohio 43620

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed Paul Hemsoth

Date 1-15-79

Mr. Paul Hemsoth
Vice President - Administrative Services
Toledo Trust Company
245 N. Summit Street
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed

Richard Howe

Date

Jan 16, 1979

At a future time, five years from this date, we would be interested in discussing the feasibility. Not at this time.

Mr. Richard Howe
Owens-Illinois
Madison & St. Clair Streets
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed

Date

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date _____

Mr. Norm Muhme
Plant Engineer
NL Industries
1945 Smead
Toledo, Ohio 43607

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed

Date

1-16-79

Mr. Dick Murphy
Plant Engineer
ITT Continental Baking
1102 N. Summit Street
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed

Date

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed

James O'Leary

Date

Jan 17, 1978

First Federal Building

Mr. James O'Leary
Michael Realty Company
First Federal Plaza - Third Floor
701 Adams Street
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed

Date

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed [Signature]

Date Jan 17 1974

Edison Plaza

Mr. James O'Leary
Michael Realty Company
300 Madison Avenue
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date _____

Mr. James B. Plummer
 Mercy Hospital
 2200 Jefferson Avenue
 Toledo, Ohio 43624

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed Al Recknagel Jr.

Date 1-11-79

Mr. Al Recknagel, Jr.
Good Displays, Inc.
1301 N. Summit Street
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed Michael W. Roth Date January 22, 1979

Mr. Michael W. Roth
Jeep Corporation
940 N. Cove
Toledo, Ohio 43657

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____ Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed

William Schweitzer

Date

1/1/72

Mr. William Schweitzer
 Questor Corporation
 John Goerlich Center
 One John Goerlich Square
 Toledo, Ohio 43691

My company would not be interested in discussing the use of district heating and cooling service.

Signed

Date

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date 1/15/84

Mr. Tom Strall
St. Vincent's Hospital
2213 Cherry Street
Toledo, Ohio 43608

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed

Terry Suhaich

Date

1/11/79

Mr. Terry Suhaich
Realvest, Inc.
316 N. Michigan Street
Toledo, Ohio 43624

My company would not be interested in discussing the use of district heating and cooling service.

Signed

Date

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date _____

Mr. John Sylvester
Retail Store Employees
Union Local 954
730 N. Summit Street
Toledo, Ohio 43604

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed CA Thomas Date 1-16-79

Mr. Carl Thomas
University of Toledo
2801 W. Bancroft Street
Toledo, Ohio 43606

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____ Date _____

Preliminary Customer Response

My company would be interested in discussing the use of district heating and cooling service if it is shown to be economically feasible.

Signed _____

Date _____

Mr. R. A. White
Mellocraft Company
1302 Locust
Toledo, Ohio 43608

My company would not be interested in discussing the use of district heating and cooling service.

Signed _____

Date _____

Letter of Cooperation - City of Toledo

The City of Toledo is very interested in the success of the district heating Demonstration Project for a number of reasons. First, since steam presently heats a major portion of the central business district, steam heating is already recognized as a vital utility service in the community. Second, the availability of space heating energy tied to a coal fired base may be a positive factor in spurring further downtown development. Third, several of the city buildings are heated with steam so the future cost of this energy source has an impact on the city's operating budget. Fourth, since the city is presently involved with steam rate negotiations, the creation of revitalized district heating system would result in a more structured approach in the rate setting process. Finally, if the Demonstration Project results in the elimination of the need for Water Street Station, then the City's plans for comprehensive riverfront redevelopment would be possible.

The following letter from Edward York, Acting Director-Department of Public Utilities, offers the full cooperation of the City of Toledo in working out the details to create a successful Demonstration project.

CITY OF TOLEDO OHIO

DEPARTMENT OF PUBLIC UTILITIES

404 Adams Street

May 16, 1979

J. Michael Porter
CITY MANAGER

LEO A. GRANT
DIRECTOR

Mr. James R. Watt
Director of Research
and Development
The Toledo Edison Company
300 Madison Avenue
Toledo, OH 43652

Re: Phase 2 - District Heating
Demonstration Project

Dear Mr. Watt:

The City of Toledo welcomes your proposal to proceed with the exploration of the economics of the District Heating System in the future.

Our Utilities Department is vitally concerned with all energy services for Toledo. We hope that a revitalized District Heating System will have a positive impact on downtown development. As a user of heat steam, the City sees the possible switch from oil to coal as a possible substitute in controlling the escalating price of heat steam.

Please address requests directly to me, and City of Toledo participation will be assured.

Yours very truly,

Edward D. L. York
Edward D. L. York
Acting Director
Department of Public Utilities

EDLY:bjf

cc: The Hon. Doug DeGood, Mayor, City of Toledo
J. Michael Porter, City Manager

Letters of Commitment

Toledo Edison Company and the three principal subcontractors have written letters which commit these important participants to the Phase 2 effort. Toledo Edison Company, Battelle Columbus Laboratories, and Stone & Webster Engineering Corporation were all involved in the completion of the tasks required during Phase 1. Their continued contributions to the district heating project will contribute greatly to making the Demonstration Program successful. Rightmyer, Johnson and Associates are also anxious to join the team and help determine the market potential and retrofit costs necessary so that new customers can use the thermal energy services. Together these organizations can undertake and successfully complete the required tasks in Phase 2.

JOHN P. WILLIAMSON
~~President~~ Chairman & CEO
 (419) 259-5225

May 15, 1979

Mr. Charles G. Frazier
 District Heating & Cooling Chairman
 DOE, Chicago Operations Office
 Building 2, Room I-109
 9800 South Cass Avenue
 Argonne, Illinois 60439

Subject: District Heating and Cooling Systems for Communities
 Through Power Plant Retrofit and Distribution Network -
 Phases 2 and 3

Dear Mr. Frazier:

As prime proposer with over-site responsibility, it is the intent of The Toledo Edison Company to continue participation through Phases 2 and 3.

The limitations on the proposed financial support for the Demonstration Program are understood and are acceptable to the Demonstration Team.

The Department of Energy shall have reasonable access to the Demonstration Project for monitoring and evaluating performance during later phases and may conduct a 3-year demonstration evaluation after the first year of operation if the Demonstration Project is constructed.

Cordially yours,

/aq

Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
Telephone (614) 424-6424
Telex 24-5454

May 15, 1979

Mr. James R. Watt
Director, Research and Development Department
Toledo Edison Company
300 Madison Avenue
Toledo, Ohio 43652

Dear Mr. Watt:

Battelle's Columbus Laboratories is interested in and committed to continued participation in the "District Heating and Cooling Systems for Communities Through Power Plant Retrofit Distribution Network" project proposed by Toledo Edison Company in response to the U.S. Department of Energy request for Phase II proposals. The preliminary feasibility study conducted during Phase I of the project demonstrated potential market areas exist, technical retrofits are feasible, scarce fuel savings can be realized, no serious institutional barriers exist and positive life cycle savings are expected. Battelle, as a subcontractor to Toledo Edison, will expand upon its Phase I research during Phase II with respect to the institutional and economic analyses. In addition, our research staff is committed to assist in appropriate aspects of subsequent Phases as these are funded and as our skills are required.

We are prepared to continue the close working relationship with Toledo Edison and Stone & Webster Engineering Corporation and establish such a relationship with Rightmyer, Johnson and Associates. This team, plus the four advisory and review members of the Demonstration Team will assure a thorough analysis of the Demonstration Project.

You are assured of our full support in this important assessment of the viability and acceptability of conserving energy and scarce fuels through retrofitting for district heating.

Very truly yours,

A handwritten signature in cursive script, appearing to read "Albert H. Adelman".

Albert H. Adelman
Associate Director for Research

STONE & WEBSTER ENGINEERING CORPORATION

CHERRY HILL OPERATIONS CENTER
3 EXECUTIVE CAMPUS, P.O. BOX 5200
CHERRY HILL, NEW JERSEY 08034

TWX: 710-892-0147
710-892-0148

BOSTON
NEW YORK
CHERRY HILL, N.J.
DENVER
CHICAGO
HOUSTON
PORTLAND, OREGON
SAN DIEGO
WASHINGTON, D.C.

DESIGN
CONSTRUCTION
REPORTS
EXAMINATIONS
CONSULTING
ENGINEERING

Toledo Edison Company
Attention Mr. J. R. Watt
Project Manager
300 Madison Avenue
Toledo, OH 43652

May 23, 1979

Dear Mr. Watt:

DISTRICT HEATING AND COOLING STUDY
DOE CONTRACT EM-78-R-02-4979 - PHASE 2 PROPOSAL

We appreciate the opportunity to propose our services in support of your Phase 2 proposal to the Department of Energy for the continuation of the District Heating and Cooling Study, Contract No. EM-78-R-02-4979. We have completed our Phase 1 efforts and now believe that one or more of the proposed retrofit schemes are practical for the Toledo area and for Toledo Edison Company from a technical point of view.

We understand that, as in the Phase 1 work, Battelle Columbus Laboratories will also support your Phase II proposal and we look forward to working with them. We also understand that the Ohio Department of Energy and the Toledo Area Metropolitan Council of Governments will be asked to participate in the Demonstration Team.

As in Phase 1, we propose to have Mr. A. A. Anastasio continue to direct our services as the Stone & Webster Project Engineer. He will be the single individual responsible to you and to our management for our work. Mr. Anastasio will continue to be assisted by Mr. G. F. Melick as a Study Advisor, and Mr. J. Traub as an Engineer, in the area of engineering economics.

If the Phase 2 study results warrant further work, we will offer our services to continue to support your efforts.

Please call Dr. N. H. Schilmoeller or me at (609) 482-3000 if we can be of further assistance to you.

Very truly yours,

R. A. Zanetti
Assistant Manager
Cherry Hill Operations Center

RIGHTMYER, JOHNSON & ASSOCIATES / Consulting Mechanical Engineers

2436 SYLVANIA AVENUE, TOLEDO, OHIO 43613 PHONE: (419) 473-9767

May 17, 1979

Mr. James R. Watt
The Toledo Edison Company
Edison Plaza
300 Madison Avenue
Toledo, Ohio 43652

RE: District Heating Project - Phase II

Dear Mr. Watt:

Our recent discussions with you concerning our participation in the subject project have certainly been interesting and stimulating.

We understand that we will be working with you toward the completion of this phase. Our participation will be to assist you in accumulating, reviewing and analyzing data as referred to in your letter of April 27, 1979, as "Item 4 - User Retrofit and Market Penetration Assessment".

We look forward to working with you.

Very truly yours,

RIGHTMYER, JOHNSON & ASSOCIATES

John H. Rightmyer, P.E.

JHR:elb

Advisory Members of the Demonstration Team

In addition to the three principal subcontractors, Toledo Edison Company has the support of three advisory members of the Demonstration Team. These participants represent both local government, the state public utilities commission, and the state energy agency. Each organization will have their representative on the Demonstration Team. At each of the review meetings, Toledo Edison and its subcontractors will be alert to the input from the advisory members. As part of the intensive review process, the constructive criticism offered by these team members will be a valuable contribution to the overall success of the project.

Each of the advisory members lend their enthusiastic support to the Phase 2 effort. The thoughts expressed in their letters of commitment on the following pages demonstrate their sincere interest in the success of the district heating project.

STATE OF OHIO
PUBLIC UTILITIES COMMISSION
180 EAST BROAD STREET
COLUMBUS, OHIO 43215

JAMES A. RHODES
GOVERNOR

COMMISSIONERS
C. LUTHER HECKMAN, CHAIRMAN
WILLIAM S. NEWCOMB, JR.
MICHAEL DEL BANE

May 17, 1979

Mr. James R. Watt
Director of Research and Development
The Toledo Edison Company
Edison Plaza
300 Madison Avenue
Toledo, OH 43652

SUBJECT: Phase 2 - District Heating Demonstration Project.

Dear Mr. Watt:

The Public Utilities Commission has profited by its participation in the Phase 1 activity of your contract effort with the United States Department of Energy on the District Heating Demonstration Project. If you should be selected for the Phase 2 effort, we would look forward to continuation of the relationship developed in Phase 1.

We believe that the advantages of continued participation will accrue to the Commission and the State of Ohio in a measure at least as great as those provided to you and the contracting agency. We both recognize the benefits to be obtained by increasing the overall efficiency of the provision of utility services. An equally important benefit of our participation is the demonstrated objective of removing real or imagined regulatory roadblocks and institutional barriers to entry of business and industry into co-generation operations and projects in Ohio.

We expect to continue to provide representation at technical and review meetings and accomplish such assignments as are appropriate during the contract period.

Sincerely,

John D. Borrows
John D. Borrows, P.E.
Director of Utilities

JDB/AGP:ss 17-8

James A. Rhodes
GOVERNOR

OHIO DEPARTMENT OF ENERGY

30 East Broad Street 34th Floor
Columbus, Ohio 43215
(614) 466-6797

Robert S. Ryan
DIRECTOR

May 18, 1979

Mr. James R. Watt
Director, Research & Development
The Toledo Edison Company
Edison Plaza
Toledo, Ohio 43652

Dear Mr. Watt:

Thank you for sending the Final Report on Phase 1 of the Toledo District Heating and Cooling project. We are certainly interested in the progress of this study and wish to be kept informed as it continues.

This Department has accepted a role as a member of the project Demonstration Team. Our concern involves the functions of technical review and of economic and energy analysis in an advisory capacity. Our responsibility will continue to involve coordinating the interests of ODOE and other state agencies in the project.

We view our participation as an opportunity to obtain first-hand information on this significant demonstration project as an example of potential district heating and cooling programs for other Ohio cities. We also see it as an opportunity to relay to the Demonstration Team pertinent information we are obtaining from a similar project in Piqua.

This is to indicate our intention to continue the advisory involvement of ODOE through Phase 2 of the Toledo project.

Sincerely,

TOLEDO METROPOLITAN AREA COUNCIL OF GOVERNMENTS

420 Madison Ave. / Suite 725

Toledo, Ohio 43604 / Phone (419) 241-9155

May 15, 1979

James R. Watt
Director of Research & Development
Toledo Edison Company
Edison Plaza
300 Madison Avenue
Toledo, Ohio 43652

SUBJECT: Phase 2 - District Heating Demonstration Project

Dear Mr. Watt:

The Toledo Metropolitan Area Council of Governments will lend full cooperation and support to the demonstration team to study the District Heating Demonstration Project to bring it to successful conclusion.

We are pleased to serve on the demonstration team in the capacity of an advisor and reviewer to the project. The Energy Guidance Group to the TMACOG Comprehensive Community Energy Management Project funded by DOE has formally endorsed your project and its sessions will continue to be used as a forum to air your problems and to report progress to the public and other interested parties.

The continued cooperation and coordination between these two projects is necessary for the satisfactory conclusion of both. TMACOG will be pleased to furnish such data as we have available which would enhance ongoing progress.

Sincerely,

A handwritten signature in black ink, appearing to read 'Calvin M. Lakin', is written over a horizontal line.

Calvin M. Lakin
Executive Director

mt

cc: June M. Brown
Project Director-Energy

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

Task 9

Detailed Work Management Plan

James R. Watt
George A. Sommerfield

Toledo Edison Company
Toledo, Ohio

May, 1979
Revised August 1979

Prepared for:
The U. S. Department of Energy
Under Contract No. EM-78-C-02-4979

TASK 9 - DETAILED WORK MANAGEMENT PLAN

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Task 9 - Detailed Work Management Plan

From the previous tasks performed in this phase, certain directions have become evident. It is clear that Phase 2 should be pursued, but that the scope of work should be limited to two possible retrofit and distribution schemes. To accomplish Phase 2, a scope of work by tasks has been prepared. The reader is referred to Task 7 - Proposal for Further Work, which describes the tasks necessary to successfully complete Phase 2.

The Work Management Plan includes Phase 3. It is felt that Phase 2 will provide adequate information on the technical, economic and institutional feasibility to allow a direct entry into institutional and contractual arrangements. By compressing Phases 2 and 3 into one twelve-month effort, the project time should be shortened. Additional study into the technical, institutional and economic aspects should not be necessary after Phase 2. The Work Management Plan is illustrated in the network diagram following this introduction.

A Demonstration Team has been assembled capable of undertaking the detailed studies as outlined in the Phase 2 scope of work. All of the Demonstration Team members for the Phase 1 effort have expressed a desire to continue into the subsequent phases. Stone & Webster Engineering Corporation of Cherry Hill, New Jersey, will continue as the subcontractor to assess retrofit and distribution schemes. Battelle Columbus Laboratories will address institutional and economic assessments. In addition, a local mechanical engineering firm, Rightmyer, Johnson and Associates, will assess customer retrofit of in-building

systems and survey the thermal markets of the options selected for Phase 2. The legal firm of Fuller, Henry, Hodge and Snyder will be engaged as necessary to obtain legal opinions on pertinent matters.

The review and advisory members, the Ohio Department of Energy, the Public Utilities Commission of Ohio, and the Toledo Metropolitan Area Council of Governments (TMACOG) will continue in their capacity. Toledo Edison will continue to use the TMACOG organization as a public forum for community participation. In addition, the City of Toledo has been added to the Demonstration Team. Leo Grant, Director of Utilities, will act in the city's interest.

The Demonstration Team, its members and responsibilities, are detailed in subsequent sections of this task report.

Toledo Edison is committing other company disciplines to both Phase 2 and Phase 3. Financial, legal and rate personnel will cooperate fully to provide the expertise essential in these phases.

Toledo Edison will continue to act as Prime Proposer, to organize, manage and monitor the Demonstration Team effort. As in Phase 1, James R. Watt, Research & Development Director, will manage the project. George Sommerfield, Research Projects Manager, will continue to provide management assistance. With the experience of both Mr. Watt and Mr. Sommerfield, direct control over project tasks and manpower utilization is assured which will aid in the timely completion of the Demonstration Project.

DISTRICT HEATING DEMONSTRATION PROGRAM PHASES 2 & 3 SUMMARY WORK PLAN

PHASE 2 AND 3
MANHOOR AND MONEY UTILIZATION

Task Description	Toledo Edison		Stone and Webster		Battelle Columbus		Rightmyer and Johnson		Fuller, Henry, Hodge & Snyder		Total Effort	
	Hours	\$	Hours	\$	Hours	\$	Hours	\$	Hours	\$	Hours	\$
Detailed Work Plan	200	3,680	100	3,286	30	1,378	30	609			360	8,953
Plant Retrofit Assessment	430	7,520	2,000	65,721							2,430	73,241
Distribution System Assessment	150	3,040	3,160	103,840			30	609			3,340	107,489
User Retrofit and Market Assessment	520	8,560	50	1,643	37	1,700	1,400	29,564			2,007	41,467
Economic Assessment	500	8,640	50	1,643	726	33,351	30	609			1,306	44,243
Institutional Assessment	310	5,200	50	1,643	598	27,471					958	34,314
Legal Assessment	350	5,840			37	1,700			50	3,000	437	10,540
Financial Assessment	330	5,920			37	1,700					367	7,620
Final Report - Phase 2	330	6,400	50	1,643	37	1,700	30	609			397	10,352
Institutional and Contractural Arrangements - Phase 3	1,060	19,100							35	2,000	1,095	21,100

PHASE 2 - DISTRICT HEATING PROJECT

DEMONSTRATION TEAM ORGANIZATION

PHASE 2 - DISTRICT HEATING PROJECT
DEMONSTRATION TEAM PERSONNEL RESPONSIBILITY

PHASE 3 - DISTRICT HEATING PROJECT

DEMONSTRATION TEAM ORGANIZATION

PHASE 3 - DISTRICT HEATING PROJECT

DEMONSTRATION TEAM ORGANIZATION

CORPORATE DEVELOPMENT STAFF
April 1, 1979

Members of the Demonstration TeamToledo Edison Company

Toledo Edison Company serves an area of 2500 square miles in Northwestern Ohio with electric energy. The number of retail customers has increased to over 261,000 in all customer classes. Sales of nearly 7.7 billion kilowatt-hours resulted in 1978 revenue of over \$340 million. Approximately 36% of this energy is used in the industrial sector. Because of the strong base of industrial loads the annual load factor in 1978 was 67%. Summer peak loads are still experienced although the recent dependence on electric heating in all sectors of our customer mix may change that fact. The 1978 summer peak was 1386 MW.

Over the last 75 years the prime activity of the Toledo Edison Company has been the electric power business. However, in two communities Toledo Edison Company distributes natural gas, which results in slightly over \$3 million in annual revenue. In addition, for the past 50 years, the sale of district heating steam has provided a source of thermal energy to the central business district in Toledo. Approximately \$2.9 million in revenue resulted from this district heating operation in 1978.

The experience and expertise of Toledo Edison Company as an electric utility operating large power plants and distributing energy in its service area is an important asset to this project. The ability to forecast system loads, develop expansion plans, complete complex construction programs on a timely basis, and market the services provided are all activities within the corporate experience.

The Corporate Development Mission includes the planning and research functions of Toledo Edison Company. The specific experience of the Research and Development Division is relevant to the subject proposal and will be utilized. Load surveys, load management studies, and the development of complex computer models for evaluating changing load patterns have been primary outputs of this group.

Toledo Edison Company is the project manager of the Demonstration Program. In this role they will direct and coordinate the activities of the Demonstration Team. The leadership exercised by Toledo Edison Company through its Corporate Development Staff will result in the timely completion of this study including the reports and other deliverables requested by the Department of Energy.

The personal resumes of the key personnel are provided in the following pages.

JAMES R. WATT

PROJECT MANAGER

EDUCATION

Toledo University - B.S. Electrical Engineering, Cum Laude, 1956.

LICENSES AND REGISTRATIONS

Professional Engineer - Ohio

PROFESSIONAL AFFILIATIONS

Eta Kappa Nu - Electrical Engineering Honor Society - Member

Tau Beta Pi - Engineering Honor Society - Member

American Society of Heating, Refrigeration & Air Conditioning
Engineers - Member

PUBLICATIONS

"Heat Reclaim, Variable Volume Air Serve New Office", Heating Piping
and Air Conditioning, April, 1972.

EXPERIENCE SUMMARY

Mr. Watt is presently Director of Research and Development Division at Toledo Edison and has directed and participated in a number of studies of alternate energy sources. Included are two studies on alternatives for the downtown Toledo heating system and one cogeneration study.

Mr. Watt was primarily responsible for the direction of these efforts in addition to determining heat balances and optimization of thermal cycles.

Mr. Watt is also responsible for customer load surveys utilizing magnetic tape recording meters. Load management by various schemes such as radio and ripple control are also his responsibility. His department recently completed Phase 1 of a contract with the US Department of Energy to perform a study to investigate the use of by-product heat from electric power plants to serve a district heating network.

As Manager of Technical and Support Services prior to his present assignment, Mr. Watt provided technical assistance to the Customer Services Section. He served as the special consultant to the Toledo school system on heating and energy conservation during the construction of nine new schools. He was the Company's liaison with the designers of the mechanical system of the 17-story Edison Plaza. He served on the University of Toledo advisory board for curriculum at the two-year community college. He has many years of experience in all aspects of space conditioning. His prior work experience in the pneumatic temperature control industry and the additional marketing experience as Power Engineer at Toledo Edison round out a sound background in the energy field.

RECENT EXPERIENCE RECORD

Toledo Edison Company, Toledo, Ohio

1976 to Date - Appointed Director of Research & Development Division. Duties include direction of a U.S. Department of Energy project investigating the use of by-product heat from electric power plants to serve a district heating network, participation in cogeneration studies and evaluations of alternative energy systems, and involvement in other special projects as required. Load management and load survey activities are also part of the Research & Development Division.

1966 to 1976 - Appointed Manager of Technical and Support Services

(Prior to 1976, known as Technical Services)

Responsibilities included lending technical assistance to Marketing group; maintaining liaison between Company, architectural and engineering firms, and public authorities such as the University of Toledo. Conceived and implemented load survey metering, translation and associated computer programs.

1962 to 1966 - Appointed to Senior Power Engineer

Joined Toledo Edison in 1972 as Power Engineer and appointed to Senior Power Engineer soon after. Duties included advisory capacity on utility matters to industrial customers.

JOHNSON SERVICE COMPANY - MILWAUKEE, WISCONSIN

1960 to 1962 - Sales Engineer, Louisville Office

Bid, designed, supervised installation of pneumatic control systems on industrial processes, commercial space conditioning equipment and systems.

1956 to 1959 - Sales Engineer, Akron Office

Bid, designed, supervised installation of pneumatic control systems on industrial processes, commercial space conditioning equipment and systems.

GENERAL ELECTRIC COMPANY - ERIE, PENNSYLVANIA

1959 to 1960 - Design Engineer, Variable Speed Drives

Designed and tested rotary and static AC to DC conversion and associated controls for metal working industry. Designed wire drawing drive for final professional engineer's requirement.

GEORGE A. SOMMERFIELD

ASSISTANT PROJECT MANAGER

EDUCATION

University of Toledo - M.S. in Industrial Engineering - 1974

University of Toledo - B.S. in Electrical Engineering - 1969

HONORS

Tau Beta Pi - Engineering Honorary

Eta Kappa Nu - Electrical Engineering Honorary

REGISTRATIONS

Engineering-in Training - Ohio

PROFESSIONAL AFFILIATIONS

Institute of Electrical and Electronic Engineers - Member

Power Engineering Society - Member

Professional Communication Society - Member

National Management Association - Member

PUBLICATIONS"Forecasting Load Growth", Transmission and Distribution, October, 1974.

"Computer Aided Data Collection for Distribution Planning", T. A. Smart,

M. McGranagh, G. Sommerfield, Presented at IEEE PICA Conference;

May, 1979.

EXPERIENCE SUMMARY

George Sommerfield is currently the Research Projects Manager responsible for coordinating Toledo Edison's research program. Projects under his management have included solar water heating demonstration installations, evaluation of remote control load management systems, and computer modeling of an electrical distribution system. His duties also include maintaining liaison with research projects sponsored by the Electric Power Research Institute.

During the last year, Mr. Sommerfield has been primarily involved as Assistant Project Manager for a U.S. Department of Energy project investigating the use of by-product heat from electric power plants to serve a district heating network. His responsibilities included coordinating the activities of the subcontractors, providing data from Toledo Edison's records to the consultants, preparing task summaries and coordinating the publication of task reports, preparing monthly reports and assisting the project manager as required.

Before joining the Research & Development Division, George Sommerfield was responsible for planning the expansion of the distribution system and preparing the appropriate construction budget items. He joined Toledo Edison Company in January, 1970, as an Assistant Engineer in Distribution Engineering. Since that time, he has been promoted to engineering positions of increasing responsibility including a promotion to Senior Assistant Engineer in July, 1972, to Associate Engineer in March, 1975, to Research & Development Engineer in October, 1975 and to his present position as Research Projects Manager in September, 1978.

Other Toledo Edison Company Support

Various engineers and technical people from the utility's staff will be utilized from time to time to review the alternative thermal energy system concepts. Plant operating personnel will have an input to the technical and economic assessment of the various proposed engineering alternatives. Similarly, Finance and Legal personnel will lend their assistance to the project. Finally, the Rate Department will be involved in creating the rates and contracts necessary for the district heating system.

Battelle Columbus Laboratories

Battelle Columbus Laboratories is one of two principal subcontractors selected by Toledo Edison Company for the Demonstration Team. Their activities will primarily involve the economic and institutional assessments required in the Phase 2. Their role was especially significant in Phase 1 and they intend to continue to support Toledo Edison Company through Phase 2 as the detailed analysis continues to determine the best candidate demonstration system configuration. They will report to Toledo Edison and will exchange information with the engineering consultant, Stone & Webster, in developing the detailed reports for each task.

Battelle Columbus Laboratories is the original research center of Battelle Memorial Institute, a nonprofit, public-purpose organization which performs research under contract for both government and industry. The Columbus staff totals about 2,600, of whom about half hold academic degrees and about one-quarter hold advanced degrees. The research staff includes scientists, engineers, and economists representing practically every technical discipline. They average about 13 years of research experience per person.

Battelle Columbus has a technical organization which does not confine a research program within a single group or department. Any person on the staff can work on any research program that requires his specific expertise. The flexibility is of particular importance to this Demonstration Program because the problems are broad and often complex and they fall in many technical areas. Thus, a multidisciplinary approach helps in problem solving. Whatever the nature of the research problem, Battelle's technical breadth makes it practical to assemble the required research team.

Toledo Edison Company believes that Battelle has the relevant experience and expertise to accomplish the institutional and economic analysis based on their efforts during Phase 1 of this project. The resumes for key personnel of Battelle Columbus Laboratories follow.

F. JERE BATES

PROJECT MANAGER

EDUCATION

Franklin and Marshall College - B.A. in Economics, 1965

Lehigh University - M.S. in Economics, 1972

PROFESSIONAL AFFILIATIONS

National Association of Business Economists

Omicron Delta Epsilon - Honor Society

Beta Gamma Sigma - Honor Society

EXPERIENCE SUMMARY

At Battelle, Mr. Bates has been engaged in projects which include energy economic analysis electric utility load forecasting, regional energy studies, and energy marketing analysis. Mr. Bates as Battelle's project manager during Phase 1 of this District Heating Project thereby acquiring extensive experience that will facilitate the successful completion of this phase. His economic analysis and accounting background enable him to bring specific expertise to these studies.

Mr. Bates has worked in both the industrial and utility sectors of the business community. His experience with an electric utility includes expansion planning and electric demand and energy forecasting. His responsibilities as Supervisor of Load Analysis included forecasting of kilowatthour sales, customers, and revenues by rate class and forecasting of peak loads.

In conjunction with the above duties, Mr. Bates represented his company on a planning committee of an integrated power pool. During this period he chaired the committee which conducted several regional research studies to identify the weather component which contributes to the peak electric demand.

RECENT EXPERIENCE RECORD

Battelle Columbus Laboratories, Columbus, Ohio

1977 to Date - Utility Economist, Economics, Planning and Policy
Analysis Section

Mr. Bates is engaged in electric utility and other energy fields research. Examples of his experience are:

District Heating and Cooling Studies. Mr. Bates was Battelle's project manager during Phase 1 of this currently proposed research program. During Phase 1 he managed all Battelle tasks including the determination of potential service areas for district heating, preparation of an energy market analysis of the potential service areas, determination of the institutional viability of the alternative systems and preparation of an economic analysis of the alternative district heating systems developed during that phase.

Energy Economics. The financial attractiveness of two photovoltaic systems was analyzed from both a utility ownership and a private business ownership viewpoint under the direction of Mr. Bates. Both ownership evaluations employed life-cycle costing methodology.

Regional Energy Studies. The development of alternative regional long-range energy consumption patterns was directed by Mr. Bates. The consumption patterns and forecasts were developed by energy type within all consuming sectors.

Market Potential Analyses. Mr. Bates is a task leader for the preparation of economic comparisons of alternative energy sources. He has developed energy source selection criteria that impact on energy station design and market potential.

General Public Utilities Service Corporation, Reading, Pennsylvania
1971 to 1977 - Planning and Economics Division

Wide-ranging experience including short-and long-term analysis of fuel availability and price, analysis of fixed charges, and economic evaluation of alternative capital investment proposals. Direction of load forecasting and analysis as Supervisor - Load Analysis. GPU representative on, and served as chairman of, the Load Analysis Subcommittee of the PJM Interconnection (electric power pool).

Metropolitan Edison Company, Reading, Pennsylvania

1969 to 1971 - Assistant to the Director of Pensions

All aspects of pensions activities were undertaken as well as other personnel-related activities.

1967 to 1969 - Internal Auditor

Responsibility of conducting audits in all phases of electric utility operations.

JOHN C. SKELTON

ECONOMIC ANALYST

EDUCATION

B.S., Engineering (1976) Cornell University

M. Engr., Operations Research/Industrial Engineering (1977) Cornell University

M.B.A., Managerial Economics and Finance (1978) Cornell University

EXPERIENCE SUMMARY

Mr. Skelton is presently a system and economic analyst primarily responsible for the development and application of economic and quantitative techniques to areas in energy planning and business operations. His recent focus has been evaluating the market feasibility and overall economic viability of proposed systems. The analysis has incorporated the use of capital budgeting techniques to determine financial impacts of the system and the use of modeling to measure cost and performance trade-offs and to identify economies of scale.

EXPERIENCE RECORD

Battelle Columbus Laboratories, Columbus, Ohio

1978 to Date - System and Economic Analyst

Examples of Mr. Skelton's recent experience are:

Economics of District Heating. Mr. Skelton was Battelle's task leader for the preliminary economic analysis conducted during Phase 1 of this currently proposed research program. In this task the delivered cost of thermal energy, and the total revenue generating potential of the system were determined employing a life cycle costing methodology.

Electric Load Forecasting. Deriving estimates of hourly and seasonal energy demands for different customer classes is currently being directed by Mr. Skelton. The energy and demand forecasts are based upon a build up of detailed end-use components in the residential, commercial and residential sectors and are operationalized in a computer model.

BENJAMIN G. MAIDEN

INSTITUTIONAL PLANNER
POLICY ANALYSTEDUCATION

B.S., Natural Resource Development (1972) The Ohio State University

M.S., Water Resource Development (1973) The Ohio State University

Further graduate study at the University of Arizona in water resources
administration and urban and regional planning

Ph.D., Resource Analysis, The Ohio State University (in progress)

EXPERIENCE SUMMARY

Mr. Maiden has focused his efforts on programs dealing with energy/
environmental policy analysis and implementation program development.
He has had a leadership role on programs dealing with policy analysis
relative to energy development, water resource management, land use
planning, and solid waste/resource recovery planning. Many of these
programs involved the formulation of policy options and implementation
alternatives to deal with emergent energy and environmental problems.
During this proposed research Mr. Maiden will continue his Phase 1
roll, institutional analysis task leader.

EXPERIENCE RECORDBattelle Columbus Laboratories, Columbus, Ohio1974 to Date - Various positions associated with Institutional

Environmental and Energy Planning and Analysis

Examples of his experience are:

Institutional Analysis. Mr. Maiden was the institutional assessment task leader during Phase 1 and will continue this roll in Phase 2 on district heating. A comprehensive analysis of the potential institutional constraints was conducted by him. Other institutional research he has conducted include the formulation of public involvement strategies and citizen participation techniques and a review of the institutional barriers to the development of solar energy for industrial use. This latter study analyzed incentives and disincentives that are currently being employed by the Federal government, and suggested new approaches to faster solar energy development in industry.

Energy Development. Currently, Mr. Maiden is managing a multi-disciplinary study for a private utility company which involves the development of a methodology for power plant siting and the conduct of environmental assessments of the candidate sites.

Waste Management/Resource Recovery. Mr. Maiden has served as the project manager and principal investigator for two recent waste management/resource recovery studies for the development of a handbook for planning and evaluating resource recovery options for major military installations (including waste stream evaluation, appropriate technology identification, market analysis, cost-benefit evaluation and environmental impact analysis) and to analyze scrap-related industries located in Minneapolis, Minnesota for opportunities to relocate such industries to less obtrusive sites.

Environmental Planning. Mr. Maiden's recent environmental planning research efforts were directed towards the development of a methodology to guide Bureau of Reclamation staff in the preparation of environmental and feasibility studies, and towards the development of a land/water use suitability model for the New Orleans District of the Corps of Engineers which functionally organizes and historically deals with the complexities of land and water resource planning.

Land Use. Mr. Maiden recently completed a program for EPA's Urban Planning Task Force in which he prepared a report on land use data collection and analysis techniques. This document was included as part of an Areawide Assessment Procedures Manual distributed nationally by EPA to guide 208 agencies in areawide water quality management planning. He has also served as a task leader for the land use impact analysis of a proposed freeway project in Columbus, Ohio.

Ohio Department of Natural Resources, State of Ohio

1973 to 1974 - Planner in the Division of Planning

Water Resource Planner. He participated as a member of a multi-disciplinary team charged with the responsibility of reviewing two Ohio regional water development plans for substantive quality and for consistence with state programs and policy. These plans were comprehensive in scope covering water quality, water supply, fish and wildlife propagation, recreation and flood control.

Stone & Webster Engineering Corporation

Stone & Webster is the other principal subcontractor selected by Toledo Edison to perform specific tasks required in this Demonstration Program. Their role will be primarily involved with engineering aspects of the program. Stone & Webster has the experience and expertise to handle this project throughout all the phases. They will report to Toledo Edison Company and exchange information with the Battelle Columbus Laboratories, the other principal subcontractor, in completing each task.

Stone & Webster will detail the retrofit plans for Acme Station and determine distribution system alternatives. Additionally, they will conduct the economic analysis of the installation and operation of all necessary subsystems. The engineering analysis in this second phase will be conceptual but in greater detail than required in the initial phase. As the Demonstration Program moves to subsequent phases, the engineering effort will become more detailed so that construction drawings and equipment specifications can be created.

Stone & Webster Engineering Corporation has been organized to supply engineering services since 1889. To date it has been associated with the installation of over 77 million KW of hydro, nuclear, and fossil-fired electric generating facilities. It has also designed and/or constructed over 11,000 miles of transmission lines and associated substations.

The main office for Stone & Webster Engineering Corporation is located in Boston, Massachusetts. Operations centers are located in New York, New York; Denver, Colorado; and Cherry Hill, New Jersey. The Cherry Hill Operations Center, which will support this Demonstration Study, is a full service engineering corporation employing about 1,200 people. Of these, about 450 are engineers and 400 are designers. Current projects at this office include three nuclear plants, a coal-fired plant, and numerous special services in support of operating fossil-fired plants and cogeneration facilities.

Based on their contribution to the Phase 1 effort, Toledo Edison believes that Stone & Webster has the required skills to perform the Phase 2 tasks. Personnel having background and experience relevant to particular project areas will be drawn upon from within the Cherry Hill Operations Center organization as their expertise is required. Resumes of key personnel follow.

ANDREW A. ANASTASIO

STUDY MANAGER

EDUCATION

Brooklyn Polytechnic Institute - Graduate courses in Mechanical

Engineering, 15 credits

Pratt Institute - B.S. in Mechanical Engineering

Training

U.S. Navy - Supervisor Development Institute Course, Basics of Instruction

LICENSES AND REGISTRATIONS

Professional Engineer - New Jersey

EXPERIENCE SUMMARY

Mr. Anastasio joined Stone & Webster in April 1978 as a Project Engineer in the Power Division. He has had 16 years of experience on various fossil and industrial projects as a Mechanical Engineer. His most recent experience was with Paul L. Geiringer and Associates. He was a Project Manager/Engineer involved in the direction and coordination of engineering activities including design, specifications, bid analysis, costing, and scheduling. He was also totally responsible for the liaison and coordination with the client's engineering and operating staffs. These projects included coal, oil, and gas fired units. Andy Anastasio was project manager for the Stone & Webster efforts during Phase 1 of the district heating project.

RECENT EXPERIENCE RECORDStone & Webster Engineering Corporation - Cherry Hill, New Jersey1978 to Date - Appointed Project Engineer for Lignite Reference

Fossil Power Plant

Mr. Anastasio is directing the overall project effort to develop site plans and general arrangement drawings for a 700-800 MW lignite coal fired power plant.

Paul L. Geiringer and Associates - Marlton, New Jersey

1973 to 1978 - During this period in his work career, Mr. Anastasio was intimately involved in the design of a coal fired boiler plant for Kraft, Inc., a total energy plant for Harvard Medical School, and many other sizeable projects associated with district heating and cooling systems and electric power generation. Most appropriate for this project is his experience in the design and replacement of the entire hot water district heating system for McGuire Air Force Base and the enlarging of the central heating and cooling distribution system to serve the new educational complex at the Marine Base, Quantico, Virginia.

Davy Powergas - Lakeland, Florida - Paul L. Geiringer and Associates

1957 to 1973 - Mr. Anastasio was responsible for the design, equipment purchase and cost control of various fossil fueled electric generating plants. Also pertinent to this project is his experience with boiler replacement at Sunmount State School, the expansion of boiler plants and district heating and cooling system for Rutgers University, the design of a central heating and cooling plant and distribution system for at C.W. Post College and the design of a total energy plant for Sears Roebuck and Company Merchandise Center.

GEORGE F. MELICK

STUDY ADVISOR

EDUCATION

New York University - M.A. Degree, Historical and Philosophic

Foundations of Education

Columbia University - Master of Engineering, Design Project:

Steam Condenser Design

Stevens Institute of Technology - M.S. in Mechanical Engineering

with Heat Power Option

Princeton University - ³B.S.E. in Mechanical Engineering

LICENSES AND REGISTRATIONS

Professional Engineer - New Jersey

PROFESSIONAL AFFILIATIONS

American Society of Mechanical Engineers - Member

American Society of Engineering Education - Member

National Society of Professional Engineers - Member

Sigma IX, Pi Tau Sigma, Tau Beta Pi - Member

New Jersey Society of Professional Engineers - Member

SELECTED PUBLICATIONS

"An Assessment of Energy Storage Systems Suitable for Use by Electric Utilities", EPRI EM-264 Project 225 ERDA E(11-1)-2501 Final Report
July 1976 (contributed to section on Thermal Energy Storage).

EXPERIENCE SUMMARY

Mr. Melick is a studies specialist and consultant in the Power Division with 31 years of experience in Mechanical Engineering. While employed at Stone & Webster, he has directed and participated in several studies involving energy utilization, conservation, and cogeneration including the Phase 1 effort of the district heating project.

In the cogeneration studies Mr. Melick was responsible for development of the thermal cycles, preparation of heat balances, optimization of equipment and piping, and providing assistance to cost estimates.

Before these assignments, Mr. Melick was Study Manager for a study that evaluated various methods of waste heat utilization for generation of electricity at a western phosphorus producing plant.

Prior to joining Stone & Webster Engineering Corporation, Mr. Melick was an engineering educator for 21 years at Rutgers University, Columbia University, and Stevens Institute of Technology. He taught the undergraduate and graduate levels, and directed sponsored research in the application of operations research techniques to the design of steam power plants. At Rutgers, he served as Assistant Dean, Associate Dean, and Acting Dean of the College of Engineering.

RECENT EXPERIENCE RECORDStone & Webster Engineering Corporation - Cherry Hill, New Jersey

1977 to Date - Appointed Consultant in the Power Division

Cogeneration Feasibility Study - Department of Energy - Refer to Corporate Experience for Details. Mr. Melick is responsible for the heat balances, thermal cycle, and optimization of equipment and piping.

Cogeneration Study - Industrial - Refer to Corporate Experience for details. His responsibilities on this study are similar to those described for the Department of Energy study.

Rutgers University - New Brunswick, New Jersey

1961 to 1977 - Mr. Melick taught various courses in mechanical engineering and was responsible for coordinating undergraduate educational programs of the college. He was involved in program development during a period of rapidly increasing enrollment as the college grew from 1,000 students to over 1,500 in the years from 1975 to 1977. In 1976, Mr. Melick was appointed Acting Dean, College of Engineering and was responsible for managing the efforts of 86 faculty members organized in six departments plus the Bureau of Engineering Research.

Public Service Electric and Gas Company - Newark, New Jersey

1966 to 1975 - Here he performed engineering and economic studies of nuclear, fossil fired, and combined cycle power systems. (Employed full time during the summers of 1966, 1967, and 1969-1975, and part time during the school years from 1969 to 1975.)

JOHN W. TRAUB, JR.

ENGINEER

EDUCATION

Drexel Institute of Technology - B.S. in Mechanical Engineering

LICENSES AND REGISTRATION

Professional Engineer - Pennsylvania

PROFESSIONAL AFFILIATIONS

Association of Iron and Steel Engineers - Member

PUBLICATIONS

"Alan Wood's Iron Powder Plant", (co-author), paper published in the
Iron and Steel Engineer, 1960

"Alan Wood's BOF Shop", (co-author), paper published in the Iron and
Steel Engineer, 1969; received AISE Kelly Award (1970)

EXPERIENCE SUMMARY

Mr. Traub is a Mechanical Engineer with over 32 years of experience in the steel and power industries. He has recently participated in two cogeneration feasibility studies and is currently directing a cogeneration study for the Jacksonville Naval Air Repair Rework Facility at Jacksonville, Florida. Each of these studies involved development of system configuration, equipment selection, and established capital and operating costs for plants using various types of fuel, including coal.

Prior to joining Stone & Webster Engineering Corporation, he worked for Pedco - Environmental as a Consulting Engineer. His work involved development of cost estimates for pollution control devices and systems for the steel industry.

Prior to this Mr. Traub spent 31 years with Alan Wood Steel Company. During his career at Alan Wood Steel, Mr. Traub held many engineering and management positions including the position of Chief Mechanical Engineer of the Engineering and Construction Department. This department provided engineering and design services for major expansion projects as well as the operating and maintenance departments. Mr. Traub's varied responsibilities included preparation and/or supervision of design concepts, cost estimates, capital expenditure forecasts, schedules, drafting work, detail and design engineering, specifications, and construction work. The scopes of work ranged from projects requiring minor drawing revisions to major expansion programs. Project costs ranged from several thousands to multi-millions of dollars. During this time his supervisory responsibilities encompassed activities in the steel company's entire Engineering and Construction Department.

Stone & Webster Engineering Corporation - Cherry Hill, New Jersey

1977 to Date - Appointed Assistant Project Engineer - 1977

U.S. Department of Defense, Jacksonville Naval Air Station - 1978

Cogeneration Feasibility Study

Mr. Traub is presently developing the parameters required to evaluate the feasibility of cogeneration for the Jacksonville Naval Air Rework Facility. This work involves developing projected steam demands, the heat balances and operating costs for each of five basic cogeneration configurations. These include: Coal and oil-fired boilers with back pressure turbine generators, coal-fired boilers with both back pressure and condensing turbine generators, diesel generators with waste heat boilers, combustion turbines with waste heat boilers, and combustion turbines with waste heat boilers and a steam turbine generator in a combined cycle configuration.

U.S. Department of Energy (DOE; formerly ERDA) - 1977 to 1978

Cogeneration Feasibility Study

As the Mechanical Engineer assigned to this study, Mr. Traub developed the required heat balances for the various concepts studied. He also developed operating costs and performed economic and technical comparisons. Reliability and sensitivity to economic factors were important considerations. In addition, he prepared several sections of the resulting report.

Monochem Incorporated - 1977 to 1978 Coal Fired Cogeneration Study

His involvement in this project included developing operating costs and reviewing the basic design parameters and calculations.

PEDCO - Environmental - Cincinnati, Ohio1977 - Appointed Consulting Engineer - 1977

Here Mr. Traub worked as a consulting engineer and developed the concepts, preliminary designs, and cost estimates for pollution control devices and systems used in the steel industry. This work involved control of emissions from bulk material handling systems (ore yards, storage piles, conveyors), coke ovens, sintering machines, steelmaking furnaces, blast furnace operations, and waste gas bleeder stacks. Cost input was utilized in a computer program which provided a total investment scheme for any phase of steelmaking on a unit-capacity basis.

Alan Wood Steel Company - Conshohocken, Pennsylvania1946 to 1977 - Appointed Chief Mechanical Engineer - 1976

In his capacity as Chief Mechanical Engineer, Mr. Traub was responsible for the Mechanical Section of the Engineering Department. Active projects during this time included the installation of a coke gas ammonia removal system and a coal charging car for the coke ovens.

Appointed Chief Primary Engineer - 1973

Throughout this period he was responsible for directing the mechanical engineering functions required by the primary operating departments - the coke plant, blast furnaces, basic oxygen furnaces, and utilities. He supervised a staff of seven engineers. Major projects in progress or completed consisted of an ammonia removal system for coke oven gas, the coal charging car for the coke oven batteries, a waste ammonia liquor disposal system, a clarification system for blast furnace gas scrubber water, two sinter plant pollution control systems (bag house and wet scrubber), erection of blast furnace stoves, and the relining of blast furnaces.

Appointed Acting Manager, Engineering and Construction Department - 1969

In this capacity, Mr. Traub actually assumed responsibility for direction of the Engineering and Construction Department consisting of a 24-man staff. A 17,500 kva turbo-generator, an industrial boiler, replacement of a multi-fuel fired boiler, sinter plant pollution control systems, and a blast furnace scrubber water system were all installed during the time Mr. Traub served as Acting Manager of the Engineering and Construction Department.

Rightmyer, Johnson and Associates

Rightmyer, Johnson and Associates is one of the subcontractors chosen by Toledo Edison Company for the Demonstration Team. This firm will be responsible for assessing the market penetration of the selected distribution schemes, and addressing the problems and costs associated with in-building retrofit. They will pursue these assignments on a customer-by-customer basis to ensure reliable information. They will report to Toledo Edison who will interface their findings with related tasks assigned to other team members.

Rightmyer, Johnson and Associates have been mechanical design and consulting engineers for 16 years. They have designed the mechanical systems for Mercy Hospital, Medical College of Ohio at Toledo, Michael J. Owens Technical Center, and numerous other schools, industries and commercial establishments. Their strong space conditioning and piping experience make them a logical choice for the proposed task.

Resumes of key personnel follow.

JOHN HOLDEN RIGHTMYER

STUDY MANAGER

EDUCATION

University of Toledo - B.S. in Mechanical Engineering

LICENSES AND REGISTRATION

Professional Engineer - Ohio, Indiana, Illinois, Michigan, Pennsylvania

PROFESSIONAL AFFILIATIONS

American Society of Heating, Refrigerating, and Air Conditioning

Engineer - Member

National Society of Professional Engineers - Member

EXPERIENCE SUMMARY

Mr. Rightmyer and Mr. Johnson joined to form the consulting firm that bears their names in 1962. Mr. Rightmyer brought solid experience in heating, ventilating and air conditioning to the firm. Since that time, he has directed and coordinated the mechanical design for buildings of all sizes and use. He is considered an expert in thermodynamic principles, and practical application of these principles, by others in his field. The firm, under the mutual direction of Mr. Rightmyer and Mr. Johnson, provides design, specifications, bid analysis, costing and project supervision for diverse clientel.

KENNETH SCHMIDT

PROJECT ENGINEER

EDUCATION

University of Toledo - B.S. in Mechanical Engineering

EXPERIENCE SUMMARY

Mr. Schmidt is a specialist in piping and design and has been with Rightmyer, Johnson and Associates for 15 years. He has recently participated in the design of Medical College of Ohio at Toledo.

His current responsibilities include piping and design and alterations at Sohio Refinery and a \$40 million addition to the Chevrolet Transmission Plant.

His previous work experience included several years as mechanical engineer with Kaighin and Hughes, Engineers and Contractors.