MASTER

Energy Conservation Status & Needs

Medium-Sized Commercial/Industrial Firms

A Study for

Seattle City Light
and the
U.S. Department of Energy

Prepared by

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Preface

Seattle City Light is mandated to achieve conservation of 230 megawatts of electricity by the year 1990. The Office of Conservation is charged with designing and initiating programs to accomplish that goal.

Seattle City Light is looking to its commercial/industrial customers to effect a sizeable share of the savings. In order to assist these customers with the most cost-effective conservation measures, and to persuade businesses to voluntarily develop and implement energy management plans, Seattle City Light's approach must be appropriate and realistic.

Prior to launching a commercial/industrial program, the Seattle City Light Conservation Office contracted with Hall & Associates to conduct a Needs Assessment to determine what approach and what kinds of assistance will be most effective. This report is the documentation of that study.

The study team consisted of Susan H. Hall and Penelope Fredlund of Hall & Associates, with survey design and analysis by H. Stuart Elway of Communication Design. The study was carried out under the direction of Robin C. Calhoun, Director of the Office of Conservation, with assistance from staff members Jim Hermanson and Will Miller.

The U.S. Department of Energy, Region X, contributed funds for the analysis phase of the study.

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ENERGY CONSERVATION STATUS and NEEDS:

MEDIUM-SIZED BUSINESSES

EXECUTIVE SUMMARY

Hall & Associates conducted a needs assessment for Seattle City Light's Office of Conservation, with partial funding from the U.S. Department of Energy. It was a study of medium-sized commercial/industrial firms to determine: 1) what kinds of energy conservation measures these firms are practicing now, and 2) what kind of assistance they could use from utilities and governmental agencies. The focus of the study was limited to voluntary conservation measures.

Two research methods were used: fifty in-person interviews of firms within the Seattle City Light customer service area, and a mailed questionnaire to businesses in Washington and Oregon outside of the City Light area. 102 mail questionnaires were returned and analyzed. There was very little difference between the results of the two survey methods, except that the interviews provided much richer data because of the chance to probe questions and get all questions answered.

The research found that many businesses have taken some steps to conserve energy. For the most part, however, the steps taken have been relatively low-cost, behavior-oriented steps, such as de-lamping, turning off machinery when not in use, and encouraging carpools. Deterrents to instituting further "hard" conservation measures such as new machinery, retrofitting, or changes in machine operations are:

- lack of capital or too long a pay-back period

- lack of information about the possibilities open to them
- lack of expertise or staff to carry out an energy management program
- other management problems take priority, especially if energy costs are a small percentage of a firm's total operating expenses
- uncertainty and confusion about the country's energy future

When asked if they felt our country is now in an energy crisis, the respondents replied, "yes," and many of them blame the government for the confusion and the crisis. Interestingly, however, the respondents are looking to the government to solve the problem. Businessmen would like direct technical assistance from local utilities and local government. They see the state and federal role as one of facilitating both information exchanges and financial incentives.

The interviews and questionnaires revealed that many businesses are proud of their conservation efforts to date, but would be receptive to doing more if it can be shown to be cost-effective and relatively easy to institute. It will be important for utilities and agencies promoting conservation with this group to acknowledge and build on this attitude. Recommendations for specific steps toward the goal of offering conservation assistance fall into three categories: 1) education and information, 2) financial and technical assistance, and 3) conservation coordination.

Informational and educational programs recommend building on existing activities and attitudes, with news releases and articles,

a special logo, an award or "Seal of Good Conservation," and procedures for quick response to all queries or requests for assistance. Secondly, seminars, workshops and technical training programs should be offered. These must be carefully designed, however, to meet the customers specific informational needs. In particular, the Building Owners and Managers Association (BOMA) is identified as an important target group. Through BOMA City Light can influence a major portion of the commercial sector which is directly concerned with building operating costs. The report suggests some workshop formats and activities. Thirdly, Seattle City Light can produce one or more informational publications aimed at the commercial/industrial audiences, such as newsletters, case histories, and handbooks.

Recommendations for financial and technical assistance focus on encouraging technology and retrofitting to produce long-term conservation benefits. Areas to be explored include: tax incentives, faster write-offs, interest-free loans which would involve a minimum of redtape. Also, customers are receptive to lighting and energy surveys, assistance with installation and maintenance of new machinery, and research and development grants.

The final series of recommendations addresses the problem of conflicting and confusing energy policies and information coming from all levels of government. Seattle City Light can serve as Energy Coordinators, the focus of an Energy Network which would integrate the region's information resources pertinent to the commercial/industrial sector. Several possibilities for networking are available to the utility.

Utilities developing commercial/industrial conservation programs should look carefully at their resources and capabilities for offering assistance, and focus their efforts on the areas most likely to give them maximum return. In any program, however, it will be important to focus on voluntary measures, and a positive approach. This sector of the business community operates on a narrow financial margin, but is willing to do its part for energy conservation.

Utilities can play a major role in educating and assisting medium-sized firms toward wiser energy management practices. This study indicates, however, that the approach used toward these customers will be critical to the success of the program. A positive no nonsense approach which takes care not to waste managements' time will be essential.

I. INTRODUCTION

Background

Seattle City Light has gained a national reputation for its aggressive and creative electrical energy conservation program. To date, the major focus has been on residential conservation and stimulating individual awareness and action. While these efforts have been successful, and are being imitated nationwide, the Office of Conservation recognized that Seattle City Light's commercial/industrial customers have a great potential for conserving energy. In order to design the most effective commercial/industrial program, the Conservation staff needed to know: What are these customers doing now to conserve? What kind of assistance do they need in order to do more?

Consequently, the Conservation Office contracted with Hall & Associates to explore the above questions via personal interview with selected City Light customers. This report describes the results of the study.

Objectives

The aims of the study were:

- to determine the present status of energy conservation in medium-sized commercial and industrial firms in the Pacific Northwest

- to determine the realistic potential for energy conservation activities among these firms, especially in the immediate future
- to enable business owners and managers to express their opinions and contribute to the development of government conservation programs and policies
- to determine the ways in which utilities and government agencies, including Seattle City Light, could and should assist energy conservation

Scope

The study will help Seattle City Light (SCL), and others to provide energy- and money-saving help to their medium-sized business customers. City Light's rationale for choosing medium-sized customers was that these users are generally too large to receive conservation aid from the Small Business Administration, yet they often do not have the resources to set up their own conservation staffs and programs.

Organization of the Report

The following pages provide:

- Description of the survey method
- Summary of survey data
- Conclusions drawn from the survey
- Recommendations for conservation assistance
- Recommendations, based on this experience, for similar needs assessments in other areas

II. METHODOLOGY

The basic survey method chosen by Seattle City Light was to conduct structured personal interviews with managers of fifty medium-sized firms in the City Light service area. In addition, City Light called for 150 responses to a questionnaire, similar to that used in the interviews, to be mailed to firms in Washington, Oregon and Idaho. The techniques used in designing and carrying out the mail survey are described in Appendix A.

Because the major effort was devoted to the in-person survey, those techniques are described below. The steps involved were:

- selecting the 50 firms to be interviewed
- designing the survey instrument, i.e., the interview and the questionnaire
- pre-testing the questionnaire on a trial sample
- refining the questionnaire
- conducting the interviews
- analyzing the data
- drawing conclusions
- developing recommendations

A. Sample Selection

Because of budget and time limitations, only a small portion of the medium-sized businesses in the area could be interviewed. Several criteria were used in selecting the fifty firms to be surveyed. The most important criteria included the size of the firm, its consumption history, and its Standard Industrial Code. Table 1 shows this process.

The sample, then, contained diverse types of commercial and industrial firms. This ensured that the needs of a spectrum of

Table 1 Selection of Sample

*These criteria exclude the few very large power consumers, and the many very small consumers (e.g., Boeing, independent gas stations).

**As per SCL's specifications. In practice, 55 were selected and contacted in order to obtain the required 50 interviews.

users would be recognized. However, to avoid too much variability, the several members selected from each group (i.e., the 4 groceries) were similar in size and organizational structure.

This sample was sufficient to allow us to draw some useful generalizations. The inherent constraints on sample size and selection, however, limit the statistical significance of more detailed conclusions or extrapolations.

B. Survey Instrument Design

The personal interview was chosen because it is systematic enough to obtain information from which generalizations can be made, yet it is flexible enough to allow for differences among the firms interviewed.

Accordingly, the 5-page questionnaire, filled in by the interviewer, gave latitude for additional discussion on any point, but provided a consistent structure for each interview.

The 35 questions addressed the areas of:

- information about the companies
- energy conservation experience
- their opinions about government assistance and utility programs for energy conservation
- their need for further information about energy conservation

The study team developed the interview questions, based on basic research themes identified by SCL's Conservation Office with some coordination with the Seattle Energy Office.

C. Testing and Refining

Hall & Associates field tested the draft questionnaire through interviews with a sample of ten firms in the Bellevue, Washington area. This test was conducted outside of the SCL service area in order not to prejudice the actual survey. For the purpose of this test, the Bellevue area is sufficiently similar to Seattle, even though it is served by a private utility.

In the test, no ambiguities or other difficulties were found in the questionnaire, and only minor revisions were needed before the final questionnaire was approved by Seattle City Light.

D. The Interviews

Hall & Associates prepared an introductory letter which was sent out by City Light to managers of the 50 selected firms. We then made appointments for personal interviews at each firm's location.

The process of telephoning the firms, identifying the appropriate people to interview, and setting up appointments convenient for them was time-consuming. However, the procedure was very effective: only 55 firms were contacted to obtain the necessary 50 interviews.

The interviews lasted approximately 25 minutes each. The interviewer not only filled in the responses, but also noted additional discussions or further information provided.

E. Data Analysis

The raw data from the questionnaires was coded into machine-readable form and analyzed with the aid of a CDC 6400 computer.

In order to convert the open-ended responses to numeric codes, a content analysis was performed on all open-ended answers. Coding categories were developed on the basis of that analysis, and the responses were then coded according to the content-analytic schemes.

Frequency distributions and crosstabulations were then produced, and the data were depicted in simple graphic form.

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III. SUMMARY OF SURVEY DATA

A. Basic Characteristics of the Firms Sampled

Table 2 shows the 10 types of business surveyed, and the number of each type in the sample. Tables 3 and 4 give data on the firms' hours and seasonal peaks. Table 5 shows proportions of owners and lessors.

Of all categories of businesses, steel fabricators were least likely to have structures owned by the business. Office buildings, dairies and warehouse structures are more likely to be owned by the business owner.

Businesses ranged in size from 4,000 square feet to above 1 million square feet in size. Twenty-six percent (13) of the buildings were under 30,000 square feet, 20% (10) were between 31-90,000 square feet, 30% (15) were between 91-210,000 square feet, and 24% (12) were 211,000 square feet or over. Smaller businesses were banks, retail, and grocery operations. The largest were warehouses and retail operations.

Respondents reported anywhere between 1% and 100% of heated and cooled square footage. Interestingly, there is no significant correlation between the size of a building and the percent of space either heated or cooled. There was, however, a significant positive correlation between the percent of the building heated and percent cooled. That is, those buildings with a greater proportion of their building heated were also more likely to have a greater proportion of their buildings cooled.

TABLE: 2

Q1: What is the primary business activity carried on here?

N = 50

TABLE: 3

Q3: What are your hours of operation?

Days per week

N = 50

Hours per day

N = 50

NA = No answer

TABLE: 4

Q4: Times during the year when this company is busier than other times.

NA = No answer

TABLE: 5

Q8: Do you own or lease your (building)?

N = 48

B. Present Energy Sources and Uses

Tables 6, 7, 8 and 9 show the primary energy sources for space heating and cooling, for water heating and for process heat. Table 10 shows the prime uses of energy in the different firms.

C. Changing Energy Sources

Two of the fifty firms have switched since 1976 to electricity as their primary energy source. Three other firms plan to do so. One plans to switch from oil to gas.

No firms surveyed have recently switched away from electricity nor did any report they are planning to do so.

TABLE: 6

Q9: What is the primary source for space heat in this company?

N = 50

NA = No answer

TABLE: 7

Q10: What is the primary source for space cooling in this company?

N = 45

NA = No answer

TABLE: 8

Q11: What is the primary source of energy for domestic water heating in this company?

N = 50

TABLE: 9

Q12: What is the primary fuel used to generate production process energy?

N = 50

NA = No answer

TABLE: 10

Q15: What activity would you say consumes the most energy in this company?

D. Existing Energy Conservation

Forty-five of the fifty respondents, including most of every business category, reported that they have preventive maintenance programs. Table 11 shows the proportion of these programs conducted by staff and by outside contractors. Foundries, office buildings, retail operations and groceries contracted their maintenance. Table 12 shows the proportion of programs that included regular checks.

Table 13 shows the respondents' ratings of their own use of electricity. Warehouses were most likely to rate themselves "very efficient," citing their equipment as the major reason. Overall, 19 firms cited equipment as a main reason for efficiency, while 12 cited company policies and 7 cited building features.

Table 14 shows the respondents' estimates of their comparative efficiency.

TABLE: 11

Q16: Does this company have a preventative maintenance program?

N = 50

NA = No answer

X = Don't know

TABLE: 12

16A: Regular check?

N = 50

TABLE: 13

Q17: Overall, how would you rate this company's use of electricity?

N = 50

TABLE: 14

Q19: How does this company compare with similar companies? Is it more efficient or less efficient than most similar companies?

N = 50

DK = Don't know

Table 15 shows that 42 of the firms have taken recent steps to conserve energy. Steel fabrication was the category with the largest proportion of companies which have not taken such steps.

Twenty-seven of the firms cited reducing costs or energy consumption as their conservation goal. None of the foundries mentioned conservation goals. Retail operations had the most diverse goals.

The steps actually being taken included de-lamping (removing unneeded bulbs), turning off lights and machinery when not in use, and promoting employee awareness. Nineteen of the companies felt that they have been very successful in the conservation steps they have taken. Only one felt they had not been successful. In general, the firms measured their success in the visible results of decreased consumption and monetary savings.

There were numerous ideas offered by companies as further ways of conserving energy, but there were a number of reasons given by companies for not taking these steps. The most frequent reason given was cost (21 of the firms). Opinion was widely divided on what the "single most effective step" a company could take to conserve energy. Responses ranged from replacing or modifying equipment (9), replacing or modifying the heating system (5), modifying or replacing the lighting system (8). Insulation, management policies, and energy audits were mentioned by very few of the respondents.

Twenty-five of the respondents said that they were taking the step which they thought to be most effective to conserve energy, while

TABLE: 15

Q20: Has this company taken steps in the past two years to reduce energy consumption?

N = 50

DK = Don't know

13 said they were not. People who were not going to take this step named cost most frequently as the reason for not taking this energy conservation step. Those companies which were taking the "most effective step" either had already done it (14) or are doing it now (14). Thirteen firms taking conservation steps are financing that activity internally. Very few are using capital improvement budgets, loans, or customer fees.

E. Firms' Information Needs

Table 16 and 17 show that many firms do not have adequate conservation information. Warehouses were most satisfied with the information they already receive; foundries were least satisfied. Table 18 shows the companies' opinions as to the best means of obtaining better information. The greatest number of firms (15) felt that information of direct, practical applicability, was the most needed.

Banks and retail operations showed the most interest in management level conservation seminars; for this idea, warehouses showed the least interest. Thirty-four of the respondents said they would be interested in an Energy Use Analysis; again, warehouses were least interested in this program (as with most other programs).

Twenty-nine firms would be interested in a Lighting Service Program to survey and develop recommendations for efficient use of lighting. Twenty-five firms were interested in an Energy Newsletter. The least appealing idea was a Conservation Hotline. Thirty-three firms said they would be unlikely to participate.

Table 19 and Table 20 summarizes these results.

TABLE: 16

Q28: Do you feel that this company has adequate information about energy programs and technology?

N = 50

DK = Don't know

TABLE: 17

Q28A: Do you feel that this company has adequate information about energy programs and technology?

NO...Why not?

N = 50

DK = Don't know

NA = No answer

TABLE: 18

Q32: What would be the best way for energy conservation information to get to this company?

(Totals may add to over 100% as respondents could give more than one response)

N = 50

• = Don't know

TABLE: 19

Q27: Next I would like to read you a list of things that the local power company might do to help businesses conserve energy. For each of these, I would like you to tell me how likely you think this company would be to take part.

Table 20

Likelihood of Participation in Various Utility Programs
For Business Types

	<u>Warehouse</u>	<u>Bank</u>	<u>Plating</u>	<u>Foundry</u>	<u>Office Building</u>	<u>Dairy</u>	<u>Food Processor</u>	<u>Retail</u>	<u>Grocery</u>	<u>Steel Fabricator</u>
<u>Energy Management Seminar</u>										
Very Likely	0	4	1	1	9	0	1	2	3	1
Somewhat Likely	1	0	1	1	2	1	1	1	1	5
Somewhat Unlikely	2	1	0	0	0	0	1	1	0	0
Very Unlikely	3	0	0	0	1	1	0	0	0	3
<u>Workshops</u>										
Very Likely	1	1	0	1	6	1	0	1	2	3
Somewhat Likely	0	0	1	1	3	0	0	1	2	0
Somewhat Unlikely	2	1	1	0	1	0	1	1	0	1
Very Unlikely	3	0	0	0	2	1	2	1	0	5
<u>Energy Use Analysis</u>										
Very Likely	1	4	2	2	8	1	2	4	4	6
Somewhat Likely	0	0	0	0	1	1	1	0	0	1
Somewhat Unlikely	2	1	0	0	0	0	0	0	0	0
Very Unlikely	3	0	0	0	3	0	0	0	0	3
<u>Lighting Service Program</u>										
Very Likely	1	4	2	1	8	1	2	3	3	4
Somewhat Likely	0	0	0	1	1	1	1	1	0	1
Somewhat Unlikely	2	1	0	0	1	0	0	0	1	2
Very Unlikely	3	0	0	0	2	0	0	0	0	3
<u>Conservation Hotline</u>										
Very Likely	0	0	0	0	1	0	0	1	1	2
Somewhat Likely	1	1	0	0	2	0	2	0	0	2
Somewhat Unlikely	0	2	0	0	1	0	0	0	0	1
Very Unlikely	5	2	2	2	8	2	1	3	3	5
<u>Consultant List</u>										
Very Likely	1	3	1	1	5	1	0	1	1	3
Somewhat Likely	0	1	0	0	1	0	2	1	2	0
Somewhat Unlikely	0	0	0	1	1	0	0	0	0	3
Very Unlikely	5	1	1	0	5	1	1	2	1	4
<u>Energy Newsletter</u>										
Very Likely	1	2	0	1	7	1	2	3	3	5
Somewhat Likely	0	3	0	0	3	0	1	0	1	1
Somewhat Unlikely	2	0	1	1	1	0	0	0	0	1
Very Unlikely	3	0	1	0	1	1	0	1	0	3
<u>Low - Interest Conservation Loans</u>										
Very Likely	0	2	1	1	4	1	0	1	2	4
Somewhat Likely	0	0	0	1	1	0	0	1	0	2
Somewhat Unlikely	0	0	0	0	0	0	1	1	0	1
Very Unlikely	6	3	1	0	4	1	2	0	2	3

F. Government Role

The Federal government was most frequently cited as having the most responsibility for the energy situation (21). Consumers followed closely, where 17 of the respondents said that "consumers, or all of us" have the major responsibility. Only 1 said that business had the major responsibility. Table 21 shows these results.

A number of suggestions were made by respondents regarding measures which should be taken to face current energy conditions. Most frequently mentioned was action by government (17), and developing new energy sources (11). Conservation was mentioned by only 3 of the respondents. These results are shown in Table 22.

The most frequently suggested incentive for the Federal government falls under the category of tax incentives, where 28% mentioned that option. Other ideas such as low-cost loans, easing environmental standards, adjusting codes, cutting red tape, alternative energy sources, and technical assistance were suggested. Fewer suggestions were made for state government actions. Thirty-seven could not name an action that state government could take to encourage energy conservation in companies. The most frequently mentioned activity was in the area of tax incentives (3). More roles were perceived for local government, with 13 suggesting that local government disseminate information, and another 8 suggesting technical assistance to companies.

The differences between types of businesses in this survey are summarized in Table 23.

Table 21

Q33: Finally...In your opinion, who or what is most responsible for the current energy situation in this country? (Totals may equal more than 100% as respondents could give more than one response.)

N = 50

DK = Don't know

Table 22

Q35: What do you think should be done in the face of current energy conditions?

(Totals may equal more than 100% as respondents could give more than one response.)

N = 50

NA = No answer

Table 23

Differences between Types of Businesses

	<u>Warehouse</u>	<u>Bank</u>	<u>Plating</u>	<u>Foundry</u>	<u>Office Building</u>	<u>Dairy</u>	<u>Food Processor</u>	<u>Retail</u>	<u>Grocery</u>	<u>Steel Fabricator</u>
<u>Ownership</u>										
Own	3	3	1	1	9	2	3	1	1	4
Lease	0	0	1	1	1	0	0	3	3	4
Rent	0	1	0	0	0	0	0	0	0	0
Combo	1	1	0	0	0	0	0	0	0	0
<u>Energy Source For Space Heating</u>										
Electricity	2	3	1	1	2	0	1	1	2	3
Gas	1	0	1	1	0	1	2	0	2	6
Steam	2	0	0	0	0	0	0	0	0	1
Oil	1	2	0	0	10	1	0	2	0	0
<u>Energy Source For Cooling</u>										
Electricity	5	5	1	1	12	1	0	2	3	7
Gas	0	0	0	1	0	0	1	0	0	1
Oil	1	2	0	0	10	1	0	2	0	0
Other	0	0	0	0	0	1	1	0	0	0
<u>Energy Source For Water Heating</u>										
Electricity	6	5	2	1	3	0	1	2	4	9
Gas	0	0	0	1	0	1	1	0	0	1
Steam	0	0	0	0	9	1	1	1	0	0
<u>Primary Energy Consuming Activities</u>										
Heating	0	2	0	0	9	0	0	0	0	1
Cooling	3	1	0	0	2	0	0	0	1	0
Lighting	1	1	0	0	1	0	0	4	0	1
Production	2	0	2	2	0	1	3	0	0	8
Refrigeration	0	0	0	0	0	1	0	0	3	0
Business Machines	0	1	0	0	0	0	0	0	0	0
<u>Big Size (sq. ft.)</u>										
Less than 30,000	1	3	1	0	0	0	1	1	3	3
31 - 90,000	0	1	1	1	1	0	1	1	0	4
91 - 210,000	2	1	0	1	5	2	1	2	0	1
Over 210,000	3	0	0	0	6	0	0	0	1	2

(CONT'D, Differences Between Types of Businesses)

	<u>Warehouse</u>	<u>Bank</u>	<u>Plating</u>	<u>Foundry</u>	<u>Office Building</u>	<u>Dairy</u>	<u>Food Processor</u>	<u>Retail</u>	<u>Grocery</u>	<u>Steel Fabricator</u>
<u>Preventative Maintenance Program?</u>										
Yes	0	4	1	2	12	2	2	3	4	9
No	0	1	1	0	0	0	1	1	0	1
<u>Type of Maintenance Program?</u>										
Contracted	0	3	0	1	3	0	0	2	1	0
Staff	3	0	1	1	6	2	2	2	3	5
Other	0	0	0	0	1	0	0	0	0	0
<u>Regular Check</u>										
No	0	0	0	0	0	0	0	1	0	0
Yes	2	0	1	1	3	1	2	0	1	5
<u>Efficiency Rating</u>										
Very Efficient	5	1	0	0	3	1	1	0	0	2
Somewhat Efficient	1	2	2	2	7	1	1	4	2	7
Somewhat Inefficient	0	1	0	0	1	0	1	0	2	1
<u>Why Efficiency Rating</u>										
Building	0	2	0	0	4	0	0	0	1	0
Equipment	5	1	1	0	0	1	0	3	1	7
Policies	1	1	0	2	6	0	1	1	0	0
Other	0	0	0	0	1	0	2	0	2	1
<u>Efficiency Comparison with Others</u>										
More Efficient	3	0	1	1	8	1	0	2	1	2
Less Efficient	0	0	0	0	1	0	0	0	0	0
Same	2	3	1	1	1	1	1	1	3	7
Don't Know	1	2	0	0	2	0	2	1	0	1
<u>Steps Taken to Reduce Energy Consumption</u>										
Yes	0	4	1	1	11	2	2	4	4	7
No	0	1	1	1	0	0	1	0	0	3
<u>Conservation Goals</u>										
Reduce Cost	4	0	1	0	3	0	1	1	0	1
Reduce Consumption	0	1	0	0	5	1	1	1	2	0
Increase Awareness	0	1	0	0	0	0	0	0	0	0
Reduce Cost and Consumption	0	0	0	0	2	0	0	2	1	0
Other	0	2	0	0	1	1	0	0	0	1
DK	1	1	1	2	1	0	1	0	1	6

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IV. FINDINGS AND CONCLUSIONS

As described in Section II, the personal interview method was purposely selected in order to elicit opinions, information gaps, requests for further information, and anything else the business owners and managers wished to discuss concerning energy conservation. Our conclusions, therefore, go beyond strict data analysis to include subjective evaluations of attitudes, general energy awareness and concern, and possible receptivity to certain kinds of government assistance.

A. Characteristics of the Sample

The nature of the firms' operations give them inherently different conservation perspectives and approaches. Where energy is a major part of the production process, as in foundries and refrigeration warehouses, the main conservation potential is in the technological area of increasing production efficiency with changes in or replacement of machinery and equipment. Customers may not perceive such major capital investments to be economically attractive at present. For commercial interests such as banks and department stores, energy is a secondary element of doing business.

Office buildings, however, are in a unique category: owners and operators recognize that energy costs have an effect on their business, while their tenants probably give little if any thought to the building's energy consumption.

B. Energy Sources and Uses

The firms differed not only in their energy-intensiveness, but also in their dependence on electricity in particular. Managers of some firms pointed out that they must consider their total energy picture--for some, conserving electricity could produce important savings; for others, an increased use of electricity, through changing from another energy source to electricity, could be economically advantageous.

C. Existing Energy Conservation

It is important to recognize that many businesses already are well aware of the need to conserve energy. Since the oil embargo of 1973, and the droughts of 1974 and 1977, many medium-sized businesses have adopted conservation measures. For the most part, however, these have been "soft, behavior-oriented steps, rather than "hard," technological changes.

Many firms, both industrial and commercial, have already done such things as adjusting thermostats and turning off unnecessary lighting. Some have hired energy consultants to recommend other measures, although the suggestions were not always adopted. In fact, few firms in the surveyed group have gone beyond the most obvious behavioral measures for conserving. They have eliminated obvious waste; many feel that they presently have no incentive to try to conserve more.

Thus, most businesses are aware of the need to conserve; they have taken some steps, but are not proceeding further. This present situation is due to the interplay of several forces:

1. Economics. Of course, this is a prime motivation. It strongly encourages some conservation efforts. However, it is often a lack of economic feasibility that is holding businesses back from adopting further conservation measures.

Much of the remaining potential for conservation lies in technological changes, such as capital investment in new equipment or retrofitting. In many cases, the projected return on such investments is not sufficiently attractive under present energy costs and depreciation allowances. Moreover, these firms do not have the time and staff resources to devote to major in-house conservation research and education programs. Nor do these firms feel that the resulting energy savings would economically justify such efforts.

In a few cases, further conservation would be uneconomical for another reason. For retail customers, more energy efficient (fluorescent) lighting results in an unappealing "blue" light, which has been documented to be counterproductive to sales.

2. Another important motivator has been a sense of social and civic responsibility. This group of business people is very concerned about the nation's economy. They are willing to take inconvenient steps and even to make sacrifices, as a matter of duty, when they are convinced that such efforts are in their and the country's best interest.

This social factor can be used to stimulate some further conservation. For example, in-house competition, as between a chain's branch stores, has effectively stimulated energy savings.

3. An important factor which is restraining further conservation is a lack of information. Many firms are unaware that they could save even more electricity; others are aware of the possibility, but do not have the details needed to adopt new measures.

Clearly, the present electricity conservation efforts of medium-sized businesses must be recognized, and their importance acknowledged. Yet there is room for improvement.

D. Firms' Information Needs

These businesses want practical information, tailored to their situations, and provided by a trustworthy source.

It is important to approach this user group at the appropriate level of awareness: what they need now is nuts-and-bolts information which they can really use. Many of the business people suggested that conservation case histories and "success stories" from similar firms would be useful to them. Likewise, they indicated interest in workshops and seminars, but strongly emphasized that they would want to deal with the specific needs of the businesses in the audience. For example, managers of older office buildings said they had no use for discussions about sophisticated Heating, Ventilation and Air Conditioning systems. They would, however, be interested in information on retrofitting, or adjusting existing equipment.

Presently, the business owners and managers believe that the best sources of this type of technical information should be the various professional and trade associations, such as those listed

in Appendix B. These associations have the most credibility with the persons we interviewed, and often the best access to the firms' policymakers.

E. Government Role. _ _ _ _ _

Most of the business people surveyed felt that government, especially at the Federal level, has been a major cause of present energy problems. They claim that confusions and contradictions both within and among Federal regulatory and implementing agencies have made the nation's energy problems worse rather than better. Respondents generally reflected a lack of confidence in current programs. Interestingly, however, these same people continue to look to the Federal government to solve our energy problems. They want definitive answers to the questions of energy vs. economic trade-offs, the need for nuclear power plants, the nation's capacity for energy independence. They are concerned about potential mandatory conservation measures which would be designed with large business in mind, but would catch the small and medium-sized businesses also, possibly unfairly.

They feel that in the future, therefore, the government should continue to play a major role, but as a facilitator rather than a regulator. They feel that through information programs and financial and technical assistance, government could help businesses to carry out their own, voluntary conservation efforts.

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V. RECOMMENDATIONS

Recommendations are grouped into three categories: Information and Education, which suggests various information media and needs to be addressed; Financial and Technical Assistance which was either suggested by respondents or is a logical result of identified needs; and Coordination between public and private entities to encourage conservation as part of the total energy picture.

Information and Education

It became evident during the study process that most people, whether they were fully informed or not, believed that they knew about and had done all they could to conserve energy. It would be a serious mistake, therefore, to act as if assuming that business people are either uninterested or energy-ignorant.

Recommendation I: Outreach programs should be designed which acknowledge and publicize actions already underway, while at the same time promoting awareness of other conservation possibilities.

Specific strategies might be:

- a) A regular series of news releases and background articles to be provided to local media, but also to trade newsletters, Chamber of Commerce and other appropriate publications which reach the target audiences. As part of this informational program, systematic follow-up would narrow down the list of publications to those most receptive, and most effective, in reaching the target audiences.

The releases could be planned to coincide with newsworthy activities occurring either at City Light, within the business community, or even a national energy occurrence. The theme of the releases could be one of "Seattle business community continues leadership in energy conservation." Availability of information and assistance from SCL should be emphasized.

- b) Develop and disseminate an easily recognizable logo which reinforces the conservation message, such as
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The logo should be used consistently on all Conservation Office materials directed at the commercial/industrial sector, to promote recognition and interest.

- c) Institute an award or a "Seal of Good Conservation Practice" to be awarded to companies who make certain savings. Develop a strategy which will make the award prestigious, so that it will add to recipients' image as good citizens and wise consumers. Take advantage of the award to publicize conservation possibilities and also to publicize the utility's role in assisting interested companies. Try to enlist award-

winners to assist others in their industry with conservation advice.

- d) Adopt a policy of using "plain" language in all news articles, letters, publications, and personal contacts. Minimize verbiage, especially jargon or acronyms. One way to keep on top of this is to recruit a revolving editorial panel of lay persons.
- e) All Seattle City Light employees who have contact with the public, and especially those who deal with commercial and industrial customers should be briefed regularly on the Department's Conservation policies, and on how they affect each staffperson's own job. Telephone stickers or other visible notices with the Conservation Office's consumer hotline phone number should be provided to department staff who get queries they cannot answer. These should carry the Conservation logo.
- f) Appoint one or two staffmembers to answer public queries. Although very few respondents indicated interest in a Conservation Hotline, per se, we believe that arrangements must be made for quick response to requests for assistance or questions which will come in response to increased publicity. Persons charged with this responsibility should not simply refer the caller to someone else in the

Department. He/she should take note of the particular problem, question, or request; should notify the appropriate staffmember that the referral has been made, and verify that the caller will receive proper assistance. A record should be kept of the calls received, the nature and disposition of the call. Occasional follow-up, to see if the caller received satisfaction, and if any further conservation action resulted, should be built into the system. This record and the follow-up will serve as an evaluation mechanism for future planning.

Recommendation 2: Sponsor seminars, workshops and technical training programs. Respondents expressed interest in seminars and workshops, but stressed that they are interested only in information specific to their own situations.

In order to design the workshops, the Conservation Office should consult the potential participants themselves as to their particular technical questions and problems. Also, it would be useful to consult with the Department's own maintenance personnel and any other staffmembers who are familiar with commercial and industrial customers' equipment and needs. Expert resource people for the seminars can be recruited from various places, including SCL's own staff, universities and community colleges, manufacturers' sales representatives, energy consultants, local, state, and Federal agencies, and members of the business community.

Examples of possible programs are:

- a) a "hands-on" workshop designed for maintenance personnel.
- b) a training program to assist representatives of firms to become in-house energy conservation resource persons.
- c) workshops in which representatives from businesses with similar machinery or process requirements can share their problems with each other and get advice from technical experts.
- d) Because office building management presents the greatest opportunity in the commercial sector for substantial energy savings, SCL should put special emphasis on working with this group. The Building Owners and Managers Association (BOMA) has very good credibility with its members, and the Seattle BOMA chapter is one of the most aggressive in the nation. We believe, therefore, that SCL can work successfully with BOMA to develop a model outreach program. SCL and BOMA should involve Association members in workshops and seminar design. One suggested format for an SCL-BOMA Heating Ventilation and Air Conditioning (HVAC) workshop is provided below:

Preliminary: 1. Quick telephone needs assessment to determine particular needs and level of interest.

2. Recruit technical resource persons.

3. Recruit participants--both policy-level and day-to-day managers and maintenance staff if appropriate.

I. Overview of State-of-the-Art

II. Divide into groups according to age and type of building's HVAC system. Each group should have an "expert" resource person. Problem solve, share success stories, develop a list of further information needs or activities the group would like to pursue.

III. Discuss the lists of identified needs, and attempt to get commitments for action from appropriate parties (SCL, building owners, DOE, etc.)

Post-workshops: Follow-up on commitments made, within specified time-frame. Offer further assistance if necessary.

Recommendation 3: Produce one or more publications such as:

a) A newsletter, containing

- case histories of local firms which have succeeded in reducing electrical use

- case histories of firms outside the Seattle area which would be of interest to local firms
 - abstracts of important news items and of reports from trade journals
 - stories on recipients of the "Seal of Good Conservation Practices"
 - updates and definitions of new technology and new terms
- b) Handbooks or manuals for various mechanical operations. Many manufacturers' handbooks do not instruct operators on how to run machinery most energy efficiently. Add to the handbooks some practical conservation steps. Produce a step-by-step manual on how to comply with the new city building codes. Produce a special newsletter for architects, or submit stories to architectural magazines and journals.

Financial and Technical Assistance

During the interviews we noted a contradiction in the responses given to questions about what government could do to assist businesses, and interest in low-interest loans. Many persons who said they cannot afford new equipment indicated they would not want a low-interest government loan, because they suspect that the paperwork and redtape involved in getting the loan would outweigh the advantages. Any financial assistance program, therefore requires a companion internal program to streamline the process, simplify the criteria,

and gauge its success on the number of grants or loans given out and how quickly the monies were obligated.

Recommendation 4: Provide financial incentives for conservation investments. At this time, emphasis should be on "hard" technological programs which will result in continuing, long-term conservation.

Some mechanisms for providing monies are:

- a) larger tax breaks
- b) faster write-off for new machinery
- c) interest-free loans such as Puget Power's program
- d) simplified loan procedures, with an "energy ombudsman" on staff to facilitate applications and awards
- e) variable rate structures which reward businesses for conserving energy

Recommendation 5: Provide technical assistance such as:

- a) lighting surveys and advice
- b) energy use analysis
- c) assistance with installation and maintenance of any newly-installed energy-saving equipment
- d) research and development grants

Coordination

Many of the businesspersons we interviewed mentioned trade-offs between various energy sources. They also believe that SCL and the Northwest Region still has ample untapped renewable resources. Those who are not so sure about renewable reserves mentioned the need to get on with building nuclear power plants.

SCL cannot go to its customers with a narrow "electric-only" approach; the department must be prepared to discuss their customer's energy needs, within the total regional energy framework.

Recommendation 6: SCL can serve as Energy Coordinators, the focus of an Energy Network which would integrate and coordinate the region's information resources pertinent to commercial/industrial sector. Steps to take are:

- a) identify and coordinate with other agencies and organizations which have information and/or influence on the local energy picture
- b) share libraries, newsletters, mailing lists, and other resources among these agencies
- c) include both public and private groups in the network. Enlist their aid in informing the business community (and others) about the total energy picture.
- d. develop understandable fact sheets and graphics which describe the situation and the potential trade-offs
- e) organize energy forums open to all interested persons, where people can meet to discuss energy issues of concern to them. Publicize and report on the forums in newsletters, and continue the forums in the newsletters, encouraging contributions of letters and articles.

Commercial and industrial people in Seattle are concerned about energy availability and costs. They are receptive to new ideas, especially if it can save them some money. Seattle City Light has a high level of credibility with this group of customers, and can provide assistance which will result in substantial energy savings through voluntary conservation measures.

VI. LESSONS LEARNED: RECOMMENDATIONS FOR FUTURE NEEDS ASSESSMENTS

The purpose of this study--to assess the energy conservation needs of medium-sized industrial and commercial firms--was timely and valuable for the Seattle community. The objectives and the underlying design of the study can be applied to other communities and regions as well. However, in reviewing this study as a potential model for industrial needs assessment, other communities should recognize certain limitations. Any utility or organization wishing to conduct the same type of study will have to examine their own community's demographic considerations, business characteristics, and industrial makeup in determining the criteria for their sample selection. The methodology employed in this study was dictated to a large extent by certain specific characteristics of the study area. For example, the airplane and airplane parts S.I.C. code was eliminated from consideration because it is dominated by one large firm in this area. Other studies will be expected to vary as the project is tailored to their community.

An evaluation of the actual design of the study as implemented resulted in the following observations and recommendations:

1. Our experience during the in-person interviews indicated that there was often a substantial variance in electrical energy consumption levels between the selected industrial firms. Although this was possibly to be expected between different S.I.C. codes, it was not anticipated within a single S.I.C. code. Standardizing or controlling

the factor of electrical energy consumption levels in the selection of firms would provide a more even backdrop for findings, comparisons, and analyses.

2. We recommend a greater utilization of computer capabilities in the firm selection methodology. A computer program could be developed which would select firms for S.I.C. codes, utility customers, consumption histories and size. This would have significantly reduced the time and labor investments involved in selecting and setting up in-person interviews.
3. Viewed in a national perspective, the electrical energy situation in the Northwest is unique. Electrical power is inexpensive and available in this region. As a result, intense interest in energy conservation is not yet developing. In other areas of the country, commercial/ industrial firms may be more receptive to new machinery or to other technological investments. For this reason, we recommend that questions and findings be regionalized.
4. The questionnaire used in the personal interviews in this study could be further refined. The series of questions aimed at inquiring about energy conservation steps and goals could be made more

concise. Future questionnaires should make even more provision for soliciting opinions and recommendations from the sampled firms.

5. The purpose of including a mail survey in this study was to enlarge the data base and to provide a more regional perspective to the study. However, because the Conservation Office was unable to obtain adequate S.I.C. code information from the State Energy Offices as have been planned, it became necessary to invest more time and labor into this directive than had been planned. Our mail survey required two mailings and over 250 follow-up telephone calls, for a return rate of 102 responses out of 350 requests. The extra effort to solicit responses was due in part to the fact that targeted respondents have no relationship with Seattle City Light. If the questionnaires had gone out under the sponsorship of the State Energy Office, as originally planned, the initial response rate might have been higher. By contrast, the response rate to requests for personal interviews was extremely high--only 55 firms were contacted for 50 interviews. The major variables here are assumed to be that all 50 firms are customers of Seattle City Light, and all telephone requests for interviews were preceded by a letter from City Light's Director. The mail survey resulted in useful data, which essentially confirms the findings of the interview survey. The quantity and quality

of data gathered in interviews as somewhat higher, however, because we were able to probe until we received satisfactory answers to all questions. The prime concern of Seattle City Light was that the survey would have a positive customer relations spin-off effect. We carefully structured the interviews to be non-threatening, awareness-raising, and positive in tone. From the success rate of our requests for interviews, (50 out of 55 requests), and from comments received during the process, we believe this objective was fulfilled very well. Utilities or others considering this type of assessment should evaluate whether they have a similar need.

Some suggested criteria for selecting survey mode, then, are:

- probable incentive of targeted respondents to participate (strength of the link between surveyor and targeted respondent)
- quality and skills of persons available to conduct the survey
- need for customer relations spin-off
- results to be used to guide policy decisions or as basis for technical decisions
- resources available

Utilities or others considering a similar assessment should consider how useful the mail survey would be. No assumptions should be made about availability of S.I.C. code data or names and addresses of businesses from state energy offices.

6. Institutions such as churches, schools and hospitals were excluded from this study, because their energy needs and incentives to conserve are often different from profit-oriented businesses. These institutions, however, have a conservation potential which extends beyond their own consumption. Institutions involve people from all sectors of society, and are often very influential. It would be very valuable, therefore, to educate and enlist the community's various institutions in the conservation outreach program. A needs assessment similar to the commercial/industrial study can be designed to identify how best to work with and through these institutions.

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APPENDICES

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APPENDIX A

COMMERCIAL/INDUSTRIAL ENERGY CONSERVATION NEEDS ASSESSMENT FOR MEDIUM-SIZED BUSINESSES.

Seattle City Light is mandated to achieve conservation of 230 megawatts of electricity by the year 1990. The Office of Conservation is charged with designing and carrying out programs to accomplish that goal.

The Conservation Office is looking to their commercial/industrial customers to effect a sizeable share of the savings. In order to assist these customers with the most cost-effective conservation measures, and to persuade business to adopt conservation programs voluntarily, Seattle City Light's approach must be appropriate and realistic.

Prior to launching a commercial/industrial program, the Conservation Office contracted with Hall & Associates to conduct a Needs Assessment to determine what approach and what kinds of assistance will be most effective. The assessment was divided into two efforts: a personal interview survey within the Seattle City Light customer service area and a mail survey sent to medium-sized Commercial/Industrial firms in Washington and Oregon. This report is the documentation of the mail survey portion of the assessment.

This report was carried out under the direction of Robin C. Calhoun, Director of the Office of Conservation. The U.S. Department of Energy contributed funds for the analysis and reporting phases of the study.

The questionnaire used in the mail survey was similar to that used in the interviews. The original plan called for mailings to firms in Washington, Idaho and Oregon. However, a similar survey had recently been taken for the Idaho Energy Office, and that office requested that we not conduct another survey in their state. Our efforts, therefore, were focused on firms in Washington and Oregon.

Three hundred fifty firms, representing the same S.I.C. codes used in the interviews, were selected by Seattle City Light. From this mailing of 350 questionnaires, 102 responses were received.

The data were analysed in a manner similar to that of the interview results.

I. SUMMARY OF SURVEY DATA

Characteristics of the Sample (Description of Company)

TYPES OF FIRMS: 102 respondents in the sample represent 10 business categories. Grocery firms is the largest category, comprising over one-quarter (27%) of the respondents. The next largest single category is food-processors (18%); the third and fourth, banks (15%) and offices (10%). The other firms represented in the sample all contain less than 10% of the total firms. They are dairies (7%); plating firms, foundries, and fabricators (each 6%); retail firms (5%) and warehouses (2%). (See Table 1.)

ENERGY SOURCE: A substantial majority (70%) of the respondents named electricity as their primary source of energy. Smaller numbers of the firms listed gas (5%), oil (4%), purchased steam (2%), and self-generated steam (1%) as primary energy sources. 18% of the firms gave more than one primary source of energy. (See Table 2.)

Table 3 indicates the secondary sources used by the businesses named in the sample.

ENERGY CONSUMPTION: Respondents were then asked how they would compare their own energy consumption with that of other, similar firms. 72% of the respondents stated that their own energy consumption was the same as other similar companies, except employees of foundries, who were more likely than others to say their firm is "more efficient than most." (Table 4)

1

Q1: What is your primary business activity?

N= 102

2

Q3: What is the primary source of energy for this company?

N=102

3

Q4: What is the secondary source of energy for this company (if any)?

N=102

NA=No answer

4

Q5: In your opinion, how does this company compare with other, similar companies in terms of electricity consumption?

N=102

NA=No answer

Of the respondents who replied that their firm was more efficient than most, 38% gave equipment or policy reasons. Of those who replied that their firm was less efficient than most, responses were nearly evenly divided between building and equipment reasons. (See Table 5.)

A majority (77%) of the respondents replied that their firms have a preventative maintenance program. (See Table 6.) Table 7 shows the percentage of overhead costs directed to preventative maintenance in those firms.

Of all the respondents, 23% replied that their companies do not have a preventative maintenance program. When asked why they did not, 4 respondents named costs as the reason; 1 named expertise; and 1, other priorities. (See Table 8.)

The respondents were asked to name things a company like their own could do to conserve energy. The answers fell into seven broad categories -- measures concerning production equipment, lights, heating, insulation, employee education, monitoring, or other (often firm-specific reasons). (See Table 9.)

The conservation measures most often cited concerned lights (19% of the total responses). Possible heating conservation was the second most often named category (17% of the total), and included modifying, replacing, or turning down their heating systems.

Production equipment followed as the next most prevalent category (12% of the responses). These responses were divided equally between replacing and modifying equipment.

The largest number of responses (29%) fell in a category which included various firm-specific conservation measures.

5

REASONS FOR GIVING CONSUMPTION COMPARISON

	<u>MORE</u>	<u>SAME</u>	<u>LESS</u>
BUILDING	1	0	2
EQUIPMENT	8	3	2
POLICIES	8	0	1
OTHER	4	1	0
NO REASON GIVEN	0	69	0
n=	21	73	5

6

Q7: Does this company have a preventative maintenance program?

N=102

NA=No answer

7

Q7A: What percentage of your total overhead costs go to preventative maintenance?

N=102

NA=No answer

8

Q7b: Why does this company not have a preventative maintenance program?

COST	21%
EXPERTISE	5%
PRIORITIES	5%
DON'T KNOW	68%

9

Q8: What are some things a company like this one could do to conserve energy?

REPLACE EQUIPMENT	6%
MODIFY EQUIPMENT	6%
CHANGE LIGHTING SYSTEM	5%
TURN OFF SOME LIGHTS PERMANENTLY	6%
TURN OFF LIGHTS WHEN NOT USED	8%
REPLACE HEATING SYSTEM	1%
MODIFY HEATING SYSTEM	10%
TURN DOWN HEAT	6%
ADD INSULATION, WEATHER STRIPPING	10%
MANAGEMENT POLICIES	1%
URGE EMPLOYEES TO CONSERVE	5%
MONITOR ENERGY USE	6%
CONDUCT STUDY OF ENERGY USE	2%
AVOID PEAK DEMAND TIME	1%
OTHER	29%

Table 11 shows these potential conservation actions broken down by business type.

When asked what are the chief reasons companies do not take these measures, the most often cited reason was that they were too costly (45% of the reasons named). Other reasons given were "no expertise" (9%), "not a priority" (4%), "no economic advantage" (2%), and the building design (1%). 39% of the reasons named were other, firm-specific answers. (See Table 10.)

Respondents were then asked what they thought is the single most effective step their company could take to reduce its energy consumption. Responses ranged from replacing or modifying equipment (24%), replacing or modifying the lighting system (20%), replacing or modifying the heating system (16%). Added or modified insulation was the response of 13% of the firms' respondents. 29% gave production-specific steps to reduce energy consumption. (See Table 12.)

Following the question discussed above concerning the single most effective energy conservation step, respondents were asked if their company plans to take that step. 42% replied "yes," while 20% replied "no." (Table 13)

Table 14 lists the most effective conservation steps identified by business type.

For the next question, respondents were asked what, if any, measures had been taken in their companies in the last two years to reduce energy consumption. 63% of the respondents named at least one step taken; 47% named at least two steps; and 27% named at least three different measures taken to reduce energy consumption.

POTENTIAL CONSERVATION ACTIONS BY BUSINESS TYPE

	<u>WAREHOUSE</u>	<u>BANK</u>	<u>PLATING</u>	<u>FOUNDRY</u>	<u>OFFICE</u>	<u>DAIRY</u>	<u>FOOD PROCESSOR</u>	<u>RETAIL</u>	<u>GROCERY</u>	<u>STEEL FABRICATOR</u>
REPLACE EQUIPMENT	0	0	1	1	1	2	2	0	3	1
MODIFY EQUIPMENT	1	0	1	2	0	0	2	0	4	0
CHANGE LIGHTING SYSTEM	0	1	0	1	0	0	0	3	1	2
TURN OFF SOME LIGHTS PERM.	0	5	0	0	0	0	0	2	3	0
TURN OFF LIGHTS WHEN NOT USED	0	2	0	0	2	0	2	3	6	0
REPLACE HEATING SYSTEM	0	0	1	0	0	0	0	0	0	0
MODIFY HEATING SYSTEM	0	0	2	2	4	1	2	1	6	0
TURN DOWN HEAT	0	4	0	0	1	0	1	0	4	0
ADDED INSULATION, WEATHER STRIPPING	0	4	0	0	5	0	2	1	6	0
MANAGEMENT POLICIES	0	0	2	0	0	0	0	0	0	0
URGE EMPLOYEES TO CONSERVE	0	0	0	2	0	1	2	1	2	0
MONITOR ENERGY USE	0	1	0	1	4	1	0	1	3	0

(NOTE: All entries are numbers of respondents, not percentage figures)

10

Q9: What are the chief reasons why companies do not take these measures?

TOO COSTLY	45%
NO ECON. ADVANTAGE/ RETURN ON INVESTMENT	2%
BUILDING DESIGN	1%
NO EXPERTISE	9%
NOT A PRIORITY	4%
OTHER	39%

12

Q10: What do you think is the single most effective step this company could take to reduce its energy consumption?

<u>RESPONSES RELATED TO:</u>	<u>%</u>
PRODUCTION EQUIPMENT	24
LIGHTS	20
HEATING	16
INSULATION	12
OTHER	29
(n=100)	

13

Q11: Is the company planning to take that step?

YES	42%
NO	20
DON'T KNOW	38
(n=100)	

MOST EFFECTIVE CONSERVATION STEPS NAMED BY BUSINESS TYPE

	<u>WAREHOUSE</u>	<u>BANK</u>	<u>PLATING</u>	<u>FOUNDRY</u>	<u>OFFICE</u>	<u>DAIRY</u>	<u>FOOD PROCESSOR</u>	<u>RETAIL</u>	<u>GROCERY</u>	<u>STEEL FABRICATOR</u>
REPLACED EQUIPMENT	0	3	1	2	2	0	1	0	3	0
MODIFIED EQUIPMENT	1	0	0	0	0	1	2	0	3	1
OTHER EQUIPMENT	0	0	0	0	2	1	1	0	0	0
CHANGED LIGHTING SYSTEM	0	2	1	0	0	0	2	0	6	2
TURNUED OFF SOME LIGHTS PERMANENTLY	0	1	0	0	2	0	1	0	0	0
TURN OFF LIGHTS WHEN NOT USED	0	0	1	0	0	1	0	0	1	0
REPLACED HEATING SYSTEM	1	3	0	2	1	0	0	1	2	1
MODIFIED HEATING SYSTEM	0	1	1	0	0	0	0	0	1	0
TURNUED DOWN HEAT	0	0	0	0	0	0	0	2	2	0
INSULATION	0	3	0	0	1	1	0	1	3	0
COMPANY SPECIFIC	0	2	2	2	1	3	11	1	6	2
n=	2	15	6	6	10	7	18	5	26	6

The same major seven categories were used as for previous questions. Lighting was the area most often cited for measures taken (27%); production equipment accounted for 17%; heating, for 15%; insulation, 6%; employee education, 5%; monitoring, 7%; and firm-specific steps, 24%. (See Table 15.)

Each of these categories was further broken down into more specific steps or conservation measures. Table 17 shows these broken down by business type.

Respondents generally rated the measures taken to reduce energy consumption as successful. 40% of the measures were rated very successful while only 3% were rated very unsuccessful. (See Table 16.)

Almost half of the respondents (48%) said that the measures taken to reduce energy consumption were part of an overall program to reduce energy consumption, and 36% said that the measures were taken in order to meet specific management goals. (Tables 18 and 19)

CONSERVATION ASSISTANCE: In the questionnaire, respondents were asked whether the company was satisfied or dissatisfied with the conservation assistance it receives from the Federal Department of Energy, the State Department of Energy, and the Local Utility. As regards the Federal Department of Energy and the State Department of Energy, 62% of the respondents claimed they had received no Federal assistance, 63%, no state assistance. No notable difference between satisfaction and dissatisfaction was noted with either agency. 41% of the respondents stated no assistance from Local Utilities. Of the 37 respondents whose firms had received assistance from Local Utilities, 31 (84%) were satisfied, while only 6 (16%) were dissatisfied with the aid received. (See Tables 20 and 21.)

15

Q13: Has this company taken any measures in the last two years to conserve energy?

<u>RESPONSES RELATING TO:</u>	<u>%</u>
LIGHTS	27
PRODUCTION EQUIPMENT	17
HEATING	15
MONITORING	7
INSULATION	6
EMPLOYEE EDUCATION	5
OTHER	24
(n=139)	

16

Q14: Ratings for measures companies have used in reducing energy consumption. (The 102 companies named 131 different measures taken to reduce energy consumption.)

<u>VERY SUCCESSFUL</u>			<u>VERY UNSUCCESSFUL</u>	
1	2	3	4	5
40%	22%	29%	5%	3%
(n=53)	(n=29)	(n=38)	(n=7)	(n=4)
(n=131)				

17 CONSERVATION STEPS TAKEN BY BUSINESS TYPES

	<u>WAREHOUSE</u>	<u>BANK</u>	<u>PLATING</u>	<u>FOUNDRY</u>	<u>OFFICE</u>	<u>DAIRY</u>	<u>FOOD PROCESSOR</u>	<u>RETAIL</u>	<u>GROCERY</u>	<u>STEEL FABRICATOR</u>
REPLACE EQUIPMENT	0	0	0	2	1	3	3	0	2	0
MODIFIED EQUIPMENT	0	1	0	2	2	2	3	1	1	0
CHANGED LIGHTING SYSTEM	1	1	0	2	0	0	1	3	3	2
TURNUED OFF SOME LIGHTS PERMANENTLY	0	2	0	0	2	0	2	1	4	1
TURN OFF LIGHTS WHEN NOT USED	0	5	0	0	3	0	0	1	3	0
REPLACED HEATING SYSTEM	1	0	0	0	1	0	0	0	0	1
MODIFIED HEATING SYSTEM	0	0	0	1	1	0	1	0	0	1
TURNUED DOWN HEAT	0	5	1	0	1	0	1	2	4	0
ADDED INSULATION- WEATHER STRIPPING	0	2	2	1	0	0	0	0	1	1
ATTENDED SEMINAR	0	0	0	1	0	0	0	0	0	0
MANAGEMENT POLICIES	0	0	1	1	0	1	0	1	0	0
URGE EMPLOYEES TO CONSERVE	0	0	0	0	0	1	1	0	0	0
MONITORING ENERGY USE	1	0	1	2	2	0	0	1	1	0
CONDUCTED STUDY OF ENERGY USE	0	0	0	0	0	0	0	0	1	0
OTHER	0	9	2	3	5	2	4	2	6	1
NOT ASKED	1	3	3	0	2	4	8	0	4	3
n=	4	28	10	15	20	13	24	12	31	10

(NOTE: All entries are numbers of respondents, not percentage figures)

18

Q15: Were the measures taken to reduce energy consumption part of an overall program?

YES 48%

NO 20

DON'T KNOW 32

(n=102)

19

Q16: Were the measures taken in order to meet specific management goals?

YES 36%

NO 31

DON'T KNOW 32

(n=102)

20

Q15: Generally speaking, are you satisfied or dissatisfied with the conservation assistance your company receives from the following agencies?

	FEDERAL DEPARTMENT OF ENERGY	STATE DEPARTMENT OF ENERGY	LOCAL UTILITIES
SATISFIED	5%	7%	30%
DISSATISFIED	5	3	6
NO ASSISTANCE GIVEN	62	63	42
NO OPINION	29	28	23

(n=102)

SATISFACTION WITH AGENCY CONSERVATION ASSISTANCE BY BUSINESS TYPE

	SATISFIED			DISSATISFIED			NO ASSISTANCE		
	<u>DOE</u>	<u>STATE</u>	<u>LOCAL</u>	<u>DOE</u>	<u>STATE</u>	<u>LOCAL</u>	<u>DOE</u>	<u>STATE</u>	<u>LOCAL</u>
WAREHOUSE	0	0	0	0	0	0	1	1	2
BANK	1	1	5	1	1	0	9	9	6
PLATING	1	1	2	0	0	0	4	4	3
FOUNDRY	0	0	4	1	1	0	3	3	4
OFFICE	1	0	5	1	0	2	6	8	3
DAIRY	1	1	2	0	0	1	4	4	2
FOOD PROCESSOR	0	1	5	1	1	1	11	10	6
RETAIL	0	2	0	1	0	1	2	2	3
GROCERY	0	0	4	0	0	1	19	19	14
STEEL FABRICATOR	0	1	4	0	0	0	4	4	1
n=	4	7	31	5	3	6	63	64	44

Almost one-third (33%) of the respondents named at least one thing that the Federal Government should do to help companies like their own conserve energy. There were three major categories of assistance represented in the responses - taxes and/or economic assistance, (33%); policy shifts, (25%); and technical information assistance (42%). The largest specific way mentioned was tax incentives (25%); followed by dissemination of information / education of customers (22%). (See Table 22.)

Similar results were obtained when respondents were asked the same question concerning State Government assistance. Differing from the above results, however, respondents cited dissemination of information and/or education of consumers most frequently (32%). See Table 23.)

When asked the same question with reference to Local Utilities, a definite majority (89%) of the responses cited technical information assistance. Dissemination of information and/or education of consumers accounted for nearly one-half (45%) of all responses. Respondents gave more suggestions for local utilities than for federal or state governments - 44% offering at least one and 9% at least two suggestions. (See Table 24.)

INFORMATION NEEDS: The final section of the questionnaire concerned the needs of companies for information about energy conservation. Over one-half (55%) of the respondents stated that their companies did not have enough information about energy conservation while 31% had about the right amount, and only 5% stated their companies had too much. Only 5% rated the quality of the information as good, 36% gave the information a fair rating and 17% gave it a poor rating. Tables 25 and 26)

22

Q16A: What should the Federal Government be doing to help companies like this one conserve energy? (Respondents were able to give more than one answer so percentages will add up to more than 100%.)

TECHNICAL INFORMATION ASSISTANCE	42%
TAXES, ECONOMIC ASSISTANCE	33
POLICY SHIFTS	25
COMPANY SPECIFIC	36
NO ANSWER/DON'T KNOW	44
(n=102)	

23

Q17: What should State Government be doing to help companies like this one to conserve energy? (Respondents were able to give more than one answer so percentages will add up to more than 100%.)

TECHNICAL INFORMATION ASSISTANCE	53
TAXES, ECONOMIC ASSISTANCE	32
POLICY SHIFTS	15
COMPANY SPECIFIC	34
NO ANSWER/DON'T KNOW	51
(n=102)	

24

Q18: What should the local Utilities be doing to help companies like this one to conserve energy? (Respondents were able to give more than one answer so percentages will add up to more than 100%.)

TECHNICAL INFORMATION ASSISTANCE	89%
POLICY SHIFTS	6
TAXES, ECONOMIC ASSISTANCE	5
COMPANY SPECIFIC	54
NO ANSWER/DON'T KNOW	53
(n=102)	

25 Q19: In general, how would you assess the quantity of the information your company has with regard to energy programs and technology?
Would you say you have:

TOO MUCH	5%
ABOUT RIGHT	31
NOT ENOUGH	55
(n=86)	

26 Q20: How would you rate the quality of the information you do have with regard to energy programs and technology?

EXCELLENT	5%
GOOD	27
ONLY FAIR	36
POOR	17

27 Q21. Why do you give that rating?

ANSWERS FOCUSING ON...

AVAILABILITY OF INFORMATION	43%
QUALITY OF THE MESSAGE	25
FOCUSING ON THE CREDIBILITY OF THE SOURCE	9
FOCUSING ON OUTCOME	3
OTHER	3
NO ANSWER/DON'T KNOW	18
(n=68)	

Tables 28 and 29 depict these responses on the quantity and quality of energy information by business type.

Respondents were then asked why they rated the quality of the information as they did. Four major categories were represented in the responses given - answers focusing on the quality of the message, on the availability of the information, on the outcome, on the credibility of the source. Table 27 shows these results.

The largest percentage (43%) of respondents gave answers focusing on the availability of information. The next most frequently cited of the overall categories (25%) focused on the quality of the message.

Respondents were then asked how their company gets information about energy conservation. The most often cited information sources were utilities (10%), trade publications (10%), media (9%), and trade associations (8%). (See Table 30.)

The large majority of respondents felt that information that was direct, applicable, practical, and economical was the most needed. (See Tables 31 and 32.)

More of the respondents (28%) named the mail as a better means of getting conservation information for their companies than any other way. (See Table 33.)

80% of the respondents gave at least one recommendation with regard to the current energy situation in this country while 40% named at least two or more. Respondents mentioned government action (25% of the responses), development of new energy sources (25%), conservation in general (16%), and action by business (15%) most frequently. (See Table 34.)

28 QUANTITY OF ENERGY INFORMATION BY BUSINESS TYPE

	<u>WAREHOUSE</u>	<u>BANK</u>	<u>PLATING</u>	<u>FOUNDRY</u>	<u>OFFICE</u>	<u>DAIRY</u>	<u>FOOD PROCESSOR</u>	<u>RETAIL</u>	<u>GROCERY</u>	<u>STEEL FABRICATOR</u>	
TOO MUCH	0	1	0	0	1	1	1	0	1	0	.
ABOUT RIGHT	1	4	3	2	3	4	5	3	5	2	
NOT ENOUGH	1	9	3	4	5	2	8	2	18	4	
NO ANSWER	1	1	0	0	1	0	4	0	3	0	
n=	2	15	6	6	10	7	18	5	27	6	{N= 102}

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29 QUALITY OF ENERGY INFORMATION BY BUSINESS TYPE

	<u>WAREHOUSE</u>	<u>BANK</u>	<u>PLATING</u>	<u>FOUNDRY</u>	<u>OFFICE</u>	<u>DAIRY</u>	<u>FOOD PROCESSOR</u>	<u>RETAIL</u>	<u>GROCERY</u>	<u>STEEL FABRICATOR</u>	
EXCELLENT	0	0	0	0	0	0	1	1	1	2	
GOOD	2	6	2	3	2	2	5	1	3	1	
FAIR	0	6	3	2	5	3	3	1	12	1	
POOR	0	1	1	1	2	1	3	2	5	1	
	0	2	0	0	1	1	6	0	6	0	
n=	2	15	6	6	10	7	18	5	37	6	{N= 102}

30

Q22: How does your company currently get information about energy conservation?

TRADE PUBLICATIONS	10%
LOCAL UTILITY	10
"MEDIA" GENERAL	9
TRADE ASSOCIATIONS	8
PERIODICALS	6
CONTRACTORS, SALESMEN	5
GOVERNMENT AGENCIES (DOE)	2
CONSULTANTS	1
OTHER	19
DK/NA	31
(n=102)	

31

Q23: What kinds of energy-related information is more useful to your company?

"HOW TO" INFORMATION	50%
COST INFORMATION	13
"STATE OF THE ART" GENERAL	6
PRACTICAL APPLICATION	4
"ANY KIND"	4
RETROFIT TECHNOLOGY	3
HVAC SPECIFICALLY	1
OTHER	19
(n=72)	

32

Q24: What kinds of conservation information would you like to have which your company does not presently have?

"HOW TO" INFORMATION	45%
COST INFORMATION	9
PRACTICAL APPLICATION	7
"ANY KIND"	7
"STATE OF THE ART" GENERAL	5
RETROFIT TECHNOLOGY	2
OTHER	25

(n=44)

33

Q25: What would be the best method for getting conservation information to your company?

MAIL, NEWSLETTER	28%
PERSONAL CALLS	10
MANUALS, PAMPHLETS	5
SEMINARS, SPEECHES	4
OTHER	15
NA/DK	39

(n=102)

34

Q26: Generally speaking, what do you personally think should be done with regard to the current situation in this country?

GOVERNMENT ACTION	25%
DEVELOP NEW ENERGY	24
CONSERVATION	16
ACTION BY BUSINESS	15
DIRECT ACTION BY PEOPLE	7
EDUCATE PUBLIC	6
RATIONING	1
OTHER	6

(n=122)

II. FINDINGS AND CONCLUSIONS

The mail survey questionnaire asked fewer questions than the interview questionnaire, because we felt there would be a direct correlation between ease in answering and rate of return. Also, with a written questionnaire, the respondent has the opportunity to omit answers or provide ambiguous answers which will not be usable for tabulating results. Despite these inherent restrictions, the mail questionnaire's design successfully provided us with useful data for comparison with the interview data.

As can be seen in Section I, the mail survey data produced no surprises. It confirms the findings and conclusions cited in Section IV of the Needs Assessment report.

A. Characteristics of the Sample

As in the interviews, for respondents which use energy for a production process, the primary conservation potential is in adjustments to or replacements of machinery and equipment. We had a smaller percentage of respondents from the commercial sector, but their answers reflected the same awareness level and energy needs as Seattle City Light's customers: energy is a secondary element of doing business, but they are making adjustments which seem economically practical and simple to do.

B. Energy Sources and Uses

As in the Seattle customer service area, electricity is a major energy source for Northwest commercial and industrial firms.

C. Existing Energy Conservation

93% of the respondents believe that their energy consumption is the same or better than similar companies. They feel that they are doing their part to conserve energy. As in the interview survey, the conservation measures most often cited as either having been accomplished or that could be done were 1) replace or modify the lighting system; 2) replace or modify the heating system; and 3) replace or modify mechanical equipment. Once again, however, we found that few firms have actually gone beyond the "soft" behavioral changes and invested in permanent physical changes. Cost was the most of ten cited reasons for not taking more conservation steps. Once again, economics is the bottom line consideration.

D. Firms' Information Needs

Over one-half of the mail survey respondents felt they did not have enough energy management information. This confirms the interview results.

E. Government Role

When asked what kinds of assistance from what level of government, would be useful to them, respondents reported the following:

	Federal	State	Local
1. technical information	42%	53%	89%
2. tax breaks or economic assistance	33%	32%	6%
3. policy shifts	25%	15%	6%
4. company specific steps	36%	34%	54%

As can be seen from the above chart, these businesses place higher trust and reliance on local utilities and agencies, for information and technical assistance. They want tax incentives and other economic assistance from federal and state agencies, as well as policy changes.

III. RECOMMENDATIONS

Utilities and agencies who wish to assist these customers should review the recommendations in the interview needs assessment report, and evaluate their transferability to other customer service areas. All three areas of assistance cited in the report are indicated: 1) Education and Information, 2) Financial and Technical Assistance, and 3) Coordination. The level of effort and the means of providing the assistance will vary, however, according to the characteristics of the customer service area.

Variables such as geography, number and categories of customers, publicly and privately owned utilities, state and local laws and regulations, and available expertise and resources will affect the possibilities for energy management assistance to Northwest medium-size commercial and industrial firms.

As with Seattle City Light's customers, it will be important to approach this business group with three things in mind: 1. Many firms believe they have already done everything they can do, or at least feel they know what the possibilities are. (This may not be totally correct, but this perception affects a firm's receptivity to utility or governmental offers of assistance.); 2. Economics is the bottom line, but they will also respond to civic responsibility

arguments if "everyone else is doing it."; and, 3. These firms want and need practical technical information which is specific to their processes and operating procedures. Trying to interest them in the cosmic energy picture will turn them off and close off responses to specific requests for action.

Approached properly, however, the mid-size commercial/ industrial sector can and will make changes in their energy management and help conserve our energy resources.

APPENDIX 3

Sample Listing of Pertinent Trade Associations

Dairies (S.I.C. Code 2020):

Milk Industry Association
International Association of Ice Cream Manufacturers

Plating (S.I.C. Code 3470):

American Electroplaters Society
National Metal Finishers Association

Metal Fabrication (S.I.C. Code 3440):

Sheet Metal Association
Oil Heat Institute of Washington (Seattle)
Washington Metal Trades, Inc. (Seattle)
National Association of Manufacturers (Tacoma)

Foundries (S.I.C. Code 3320):

Steel Founders Society
American Foundryman's Society

Warehouses (S.I.C. Code 4220):

International Association of Refrigerated Warehouses
National Furniture Warehouse Association

Grocery Stores (S.I.C. Code 5410):

Food Management Institute

Banks (S.I.C. Code 6090):

Washington State Savings & Loan League
Washington Savings League

Office Buildings (S.I.C. Code 6510):

BOMA
Association of Energy Engineers

APPENDIX C

Personal Interview Form

Seattle City Light
Medium-Sized Firms

Date: _____

FIRM NAME: _____

RESPONDENT NAME: _____

RESPONDENT POSITION: _____

The first few questions have to do with the nature of this company.

1. What is the primary business activity carried on here? _____

2. What other business activities are carried on here?

3. What are your hours of operation? WEEKDAYS: _____ TO _____

SATURDAY: _____ TO _____

SUNDAY: _____ TO _____

4. Are there times during the year when this company is busier than other times?

☐ IF YES When are the busiest periods? _____5. The next questions are about the building this company occupies. How many square feet does this company occupy in total?

6. How many square feet are heated? _____

7. How many square feet are cooled? _____

8. Do you own or lease your (building)? 1..OWN 2..BUYING 3..LEASE 4..RENT
5..COMBINATION

9. What is the primary source of energy for space heat in this company?

1..ELECTRICITY 4..PURCHASED STEAM

2..NATURAL GAS 5..SOLAR

3..FUEL OIL 6..WASTE HEAT

7..OTHER: _____

10. What is the primary source of energy for space cooling in this company?

1..ELECTRICITY 5..PURCHASED CHILLED WATER

2..NATURAL GAS 6..OTHER: _____

3..FUEL OIL 7..NOT APPLICABLE

4..PURCHASED STEAM

11. What is the primary source of energy for domestic water heating in this company?

1..ELECTRICITY 4..FUEL OIL

2..NATURAL GAS 5..SOLAR

3..STEAM 6..OTHER: _____

12. **IF THIS IS A MANUFACTURING FIRM** What is the primary fuel used to generate production process energy?
- 1..ELECTRICITY 4..FUEL OIL
2..NATURAL GAS 5..OTHER: _____
3..COAL
13. a) Has the primary energy source changed since 1976 for: A. HEATING _____
B. COOLING _____
C. PROCESS _____
- b) **IF YES** From what source to what new source?
FROM: _____
TO: _____
14. a) Do you have plans for changing your primary energy source for:
A. HEATING _____
B. COOLING _____
C. PROCESS _____
- b) **IF YES** From what source to what new source?
FROM: _____
TO: _____
15. a) What activity would you say consumes the most energy in this company?

- b) Do you know how much total energy this company consumed in 1978 for:
ELECTRICITY _____
GAS _____
16. Does this company have a preventative maintenance program? 1..YES 2..NO
- a) **IF YES:** What type of program is it? _____

- b) **IF NO:** Why don't you have such a program? _____

17. Overall, how would you rate this company's use of electricity?
1..Very Efficient 2..Somewhat Efficient 3..Somewhat Inefficient 4..Very Inefficient
18. Why do you say ()? _____

19. How does this company compare with similar companies? Is it more efficient or less efficient than most similar companies?
1..MORE 2..LESS 3..SAME 4..DK
20. Has this company taken steps in the past 2 years to reduce energy consumption?
1..YES 2..NO 3..DK

IF "NO" - SKIP TO Q21

20. a) IF YES: What steps are being taken? _____

NUMBER
EACH STEP

b) Where these steps taken to meet particular goals? 1..YES 2..NO
3..DK

c) IF YES: List the conservation goals _____

d) How successful would you say each of these steps has been in meeting the company's goals?

HAND RESPONDENT CARD (A)
NAME EACH STEP FROM Q20a

STEP #1

STEP #2

STEP #3

e) (FOR EACH MEASURE) Why do you say ()?

STEP #1 _____

STEP #2 _____

Step #3 _____

21. IF "NO" ON Q18 What sorts of steps could a company like this one take to conserve energy?

b) What are some things which prevent companies like this one from taking these steps?

22. What do you think is the single most effective step this company could take to conserve energy?

23. Are you planning to take this step? 1..YES 2..NO 3..DK

b) IF "NO": Why not? _____

c) IF YES: When do you plan to take this step? _____

d) How are you financing (this step)? _____

24. The next couple of questions have to do with things government could do to help companies like this one conserve energy. Let's take the Federal Government first. What are some things the Federal Government could do to help companies like this conserve energy?

PROBE: What else could the Federal Government be doing?

25. How about State Government? What else could it be doing to help companies conserve?

PROBE: What else could State Government be doing?

26. Finally, what could local government be doing to help companies like this one conserve energy?

PROBE: What else could Local Government be doing?

27. Next I would like to read you a list of things that the local power company might do to help businesses conserve energy. For each of these, I would like you to tell me how likely you think this company would be to take part.

	<u>VERY LIKELY</u>	<u>SMWHT LKLY</u>	<u>SMWHT UNLKLY</u>	<u>VERY UNLKLY</u>
a) An energy management seminar	1	2	3	4
b) Workshops describing the state of the art for various energy systems	1	2	3	4
c) Energy use analysis (consumption analysis with recommendations for cost-effective conservation measures)	1	2	3	4
d) Lighting Service Program (survey & recommendations for efficient use of lighting)	1	2	3	4
e) Conservation information Telephone HOTLINE	1	2	3	4
f) Lists of certified energy consultants	1	2	3	4
g) Energy Newsletter	1	2	3	4

28. I have just a few last questions. Do you feel that this company has adequate information about energy programs and technology? 1..YES 2..NO 3..DK

IF NO: a). Why not?

* h) Low-interest conservation loans 1 2 3 4

29. How does this company get information about energy conservation? .

PROBE: Any other Ways? _____

30. What kind of information about energy conservation is most useful to this company?

31. What information would be useful that you do not currently have?

32. What would be the best way for that information to get to this company?

33. Finally...In your opinion, who or what is most responsible for the current energy situation in this country?

34. Why do you say ()? _____

35. What do you think should be done in the face of current energy conditions?

Thank you very much. You have been very helpful.

Description of Company

1. What is your primary business activity? _____

2. How many people are employed by this company? FULL TIME: _____

PART TIME: _____

3. What is the primary source of energy for this company?

(CIRCLE NUMBER)

1..ELECTRICITY	5..PURCHASED STEAM
2..NATURAL GAS	6..SELF-GENERATED STEAM
3..FUEL OIL	7..WASTE HEAT
4..COAL	8..OTHER _____

4. What is the secondary source of energy for this company (if any)?

(CIRCLE NUMBER)

1..ELECTRICITY	5..PURCHASED STEAM
2..NATURAL GAS	6..SELF-GENERATED STEAM
3..FUEL OIL	7..WASTE HEAT
9..NONE	4..COAL
	8..OTHER _____

5. In your opinion, how does this company compare with other, similar companies in terms of electricity consumption? Is it:

- 1..MORE EFFICIENT THAN MOST
2..ABOUT THE SAME AS MOST
3..LESS EFFICIENT THAN MOST

6. **IF MORE/LESS EFFICIENT:** Why is this company (More/Less) efficient than most?

7. Does this company have a preventative maintenance program?

1..YES 2..NO

a) **IF YES:** What percentage of your total overhead costs go to preventive maintenance?

- 1..(0 - 0.1%) 3..(1% - 2%)
2..(0.1% - 1%) 4..(Over 2%)

b) **IF NO:** Why don't you have such a program?

Energy Conservation

8. What are some things a company like this one could do to conserve energy?

- 1) _____
- 2) _____
- 3) _____

9. What are the chief reasons why companies do not take these measures?

10. What do you think is the single most effective step this company could take to reduce its energy consumption?

11. Is the company planning to take that step? 1..YES 2..NO 3..DON'T KNOW

12. **IF NO:** Under what conditions would this company take that measure?

13. Has this company taken any measures in the last 2 years to conserve energy?

MEASURE #1) _____

MEASURE #2) _____

MEASURE #3) _____

14. Taking the measures listed above (Question 13), how successful would you say each one has been in reducing this company's energy consumption?

	VERY SUCCESSFUL	VERY UNSUCCESSFUL	don't know
Measure #1	1.....2.....3.....4.....5		9
Measure #2	1.....2.....3.....4.....5		9
Measure #3	1.....2.....3.....4.....5		9

15. Were these measures taken as part of an overall program to reduce energy consumption?

1..YES 2..NO

16. Were these measures taken in order to meet specific management goals?

1..YES 2..NO

Conservation Assistance

These next questions have to do with the relationship of governmental agencies and utility companies to your business with regard to energy conservation.

15. Generally speaking, are you satisfied or dissatisfied with the conservation assistance your company receives from the following agencies:

	<u>SATISFIED</u>	<u>DISSATISFIED</u>	<u>NO ASSISTANCE GIVEN</u>	<u>NO OPINION</u>
a) Federal Dept. of Energy	1	2	3	9
b) State Dept. of Energy	1	2	3	9
c) Your Local Utility	1	2	3	9

16. What should the Federal Government be doing to help companies like this one conserve energy?

17. What should State Government be doing to help companies like this one to conserve energy?

18. What should the Local Utilities be doing to help companies like this one to conserve energy?

Information Needs

19. In general, how would you assess the quantity of the information your company has with regard to energy programs and technology? Would you say you have:
- 1..TOO MUCH 2..ABOUT RIGHT 3..NOT ENOUGH
20. How would you rate the quality of the information you do have with regard to energy programs and technology?
- 1..EXCELLENT 2..GOOD 3..ONLY FAIR 4..POOR
21. Why do you give that rating? _____

22. How does your company currently get information about energy conservation?

23. What kinds of energy-related information is most useful to your company?

24. What kinds of conservation information would you like to have which your company does not presently have?

25. What would be the best method for getting conservation information to your company?

26. Generally speaking, what do you personally think should be done with regard to the current energy situation in this country?

Thank you very much for completing this questionnaire.

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FUNCTION SHIFT ENTRY POINT 000263

STORAGE USED CODE(1) 000274; DATA(0) 000031; PLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR14

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000244	1000L	0001	000022	120L	0001	000214	150L	0001	000124	500L	0001	000126	520L	
0000	I	000006	I	0000	000012	INJP4	0000	I	000007	J	0000	I	000005	M	
0000	F	000010	S	0000	D	000010	SDP	0000	D	000000	SHIFT	0000	R	000002	T

00101	1*		DOUBLE PRECISION FUNCTION SHIFT(SI,NI)	LD0000
00101	2*	C	SHIFT THE 1ST 60 BITS IN DOUBLE PRECISION WORD S, N POSITIONS	000000
00101	3*	C	IGNORF THE RIGHT-MOST 12 BITS OF 72 BITS.	000000
00101	4*	C	IF	000000
00101	5*	C	N > 0 LEFT CIRCULAR	000000
00101	6*	C	N < 0 RIGHT SIGN EXTENSION	000000
00103	7*		DOUBLE PRECISION SDP	000000
00104	8*		DIMENSION S(2),T(2),SI(2)	000000
00105	9*		EQUIVALENCE(SDP,S)	000000
00106	10*		SI(1) = SI(1)	000000
00107	11*		SI(2) = SI(2)	000000
00109	12*		T(1) = 0.	000000
00111	13*		T(2) = 0.	000000
00112	14*		IF (IARS(1),GE,60160 TO 1000	000000
00114	15*		IF (N.CO,6160 TO 1000	000012
00116	16*		IF (N.LI,0160 TO 500	000014
00120	17*		NS = 0	000017
00121	18*	120	M = NINGINS,23)	000022
00122	19*		I = 24 - M	000027
00123	20*		J = 36 - M	000031
00124	21*		FLO(I,M,T(2)) = FLO(I,M,SI(1))	000034
00125	22*		FLO(I,J,T(1)) = FLO(I,J,SI(1))	000047
00126	23*		FLO(I,M,T(1)) = FLO(I,M,SI(2))	000062
00127	24*		FLO(I,J,T(2)) = FLO(I,J,SI(2))	000075
00130	25*		NS = NS - M	000110
00131	26*		SI(1) = T(1)	000113
00132	27*		SI(2) = T(2)	000115
00133	28*		IF (NS,GT,0160 TO 120	000117
00135	29*		GO TO 1000	000122
00136	30*	500	CONTINUE	000124
00137	31*		NS = -M	000124
00140	32*	520	CONTINUE	000126
00141	33*		M = NINGINS,23)	000126

```

00142 34*      J = 36 - M
00143 35*      I = 24 - M
00144 36*      FLD(1H,J,T(1)) = FLD(1D,J,S(1))
00145 37*      FLD(1D,M,T(2)) = FLD(1J,M,S(1))
00146 38*      FLD(1H,1,T(2)) = FLD(1D,I,S(2))
00147 39*      DO 540 I=1,M
00152 40*      J = I - 1
00153 41*      FLD(1J,1,T(1)) = FLD(1D,1,S(1))
00154 42*      540 CONTINUE
00156 43*      NS = NS - M
00157 44*      S(1) = T(1)
00160 45*      S(2) = T(2)
00161 46*      IF (NS.GT.0)GO TO 520
00163 47*      1000 CONTINUE
00164 48*      SHIFT = 50P
00165 49*      RETURN
00166 50*      END a SHIFT

```

```

000135
000137
000142
000160
000171
000214
000214
000217
000231
000231
000234
000236
000240
000244
000244
000245
000273

```

SUBROUTINE STRMOV ENTRY POINT 000043

STORAGE USED CODE(1) 000057; DATA(0) 000016; BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 GET
0004 PUT
0005 NEXT

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000005 1066 0000 1 000003 1 0000 000004 INJP% 0000 1 000002 M 0000 0 000000 Y

00101	1*		SUBROUTINE STRMOV(S1, K1, M, S2, K2)	000005
00101	2*	C		000005
00101	3*	C	STRMOV MOVES M-CHARACTER SUBSTRING OF STRING S1,	000005
00101	4*	C	BEGINNING WITH K1*TH CHARACTER OF STRING S1,	000005
00101	5*	C	TO A NEW LOCATION BEGINNING WITH THE K2*TH	000005
00101	6*	C	CHARACTER POSITION OF STRING S2	000005
00101	7*	C		000005
00103	8*		DOUBLE PRECISION S1(1), S2(1)	000005
00104	9*		DOUBLE PRECISION T	000005
00105	10*		DO 130 M = 1, M	000005
00105	11*	C		000005
00105	12*	C	PUT 1*TH CHARACTER OF S1-STRING INTO TEMPORARY LOCATION T	000005
00110	13*		I = K1 + M - 1	000005
00111	14*		CALL GET1(S1, I, T)	000011
00111	15*	C		000011
00111	16*	C	MOVE CHARACTER ALONG TO S2-STRING	000011
00112	17*		I = K2 + M - 1	000016
00113	18*		CALL PUT1(S2, I, T)	000022
00114	19*	100	CONTINUE	000031
00116	20*		RETURN	000031
00117	21*		END @ SUBROUTINE STRMOV	000056

Address	Code	Label	Text	Hex
00100	1*	CWRITHS		E00002
00101	2*		SUBROUTINE WRITHS(NUNIT,ARRAY,NWORDS,ICODE)	E0C002
00101	3*	C	CALL SEQUENCE NUNIT = TAPE NO.	D0E002
00101	4*	C	ARRAY = ARRAY TO BE LOADED	000002
00101	5*	C	NWORDS = NO. OF WORDS IN ARRAY	E00002
00101	6*	C	CODE = CODE (SEARCH KEY)	D0E002
00103	7*		DOUBLE PRECISION ARRAY(1),CODE,PAGE(151),DCODE	C0C002
00104	8*		EQUIVALENCE (DCODE,ICODE)	E0C002
00104	9*	C	SINCE FORMAL ARGUMENT MAY NOT BE USED IN EQUIVALENCE	E0C002
00104	10*	C	STATEMENT, ASSIGN THE VALUE TO A LOCAL VARIABLE.	C0C002
00105	11*		DCODE = CODE	00C002
00106	12*		LPAGE = 64	D00004
00107	13*		IF(NUNIT.EQ.7) GO TO 90	G0C006
00111	14*		LPAGE = 151	D0C011
00112	15*		ICODE = NCODE(ICODE)	C0C013
00112	16*	C	TRANSFER DATA TO BUFFER ARRAY	D00013
00112	17*	C		E0C013
00113	18*	90	DO 100 I=1,NWORDS	C0C020
00116	19*	100	PAGE(1) = ARRAY(I)	C0C027
00120	20*		WRITE(NUNIT,ICODE,ERR=999) (PAGE(I),I=1,LPAGE)	00C031
00126	21*		RETURN	C0C044
00127	22*	999	CONTINUE	00C050
00130	23*		WRITE(6,1001)NUNIT	00C050
00133	24*	1001	FORMAT(' ERROR DURING WRITHS ON UNIT ',I3)	C0C055
00134	25*		RETURN	C0C055
00135	26*		END 2 SUBROUTINE WRITHS *****	C0C055

5.0 PRINTER PLOT PROGRAM

Lineprinter plots of simulation results are produced by a postprocessor program NSMPPT. This program is executed after the completion of the simulation program. NSMPPT reads simulation and scaling data from file SCRTCH26 and produces the requested line printer plots. Figure 5.1 shows the macroflow diagram of NSMPPT.

Each unique channel of plot data is stored on file SCRTCH26. Channels, such as TIME, which may be used by several plots are stored only once. The format data describes how the channels are to be combined to form the plots. The individual channel data are loaded into an array DSPLY. The data for each plot is then scaled and transformed to hollerith form and placed in the array GRAPHR. Title and scale information are also placed in this array to form the final plot configuration.

The contents of GRAPHR are printed on the lineprinter to produce each plot.

5.1 PRINTER PLOT PROGRAM SOURCE LISTINGS

Compilation listings for the NSMPPT program follows. The names of the routines, listed in alphabetical order, are:

CENTER	NSMPPT
GNFPLT	PLOTG
GRIDLI	QPPLT
LEFTT	QXMXMN
LINPLT	RTLPLT
MNMX	SIMPLT
NCHAR	TNFPLT

FIGURE 5.1 NSMPPT PROGRAM - MACRO FLOW DIAGRAM

SUBROUTINE CENTER ENTRY POINT 000067

STORAGE USED CODE(1) 000105; DATA(1) 000022; BLANK COMMON(1) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NCHAR
0004 GETT
0005 PUTT
0006 NLRRTS

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	060003	1076	0001	000056	200L	0001	000032	25L	0000	0	000002	AR	0000	0	000000	PLK		
0000	I	000004	I	0000	I	000010	11	0000	000013	INJPS	0000	I	000005	JSTART	0000	I	000036	NCH
0000	I	000011	NEND	0000	I	000007	NK											

00100	10		CCENTER		000003
00101	20		SUBROUTINE CENTER(ARRAY,NA,TITLE)		000003
00101	30	C			000003
00101	40	C	CENTERING TITLES		000003
00101	50	C			000003
00101	60	C			000003
00101	70	C	ARRAY CONTAINS CHARACTERS FOR TITLES OF PLOT		000003
00101	80	C	NA = NUMBER OF CHARACTERS IN ARRAY		000003
00101	90	C	TITLE = ARRAY CONTAINING CENTERED TITLE		000003
00101	100	C			000003
00103	110		DOUBLE PRECISION ARRAY(1),TITLE(1),BLK,AR		000003
00104	120		DATA PLK/12H		000003
00106	130		DO 10 I=1,12		000003
00111	140		TITLE(1)=BLK		000003
00112	150	10	CONTINUE		000005
00114	160		CALL NCHAR(ARRAY,NA,JSTART,NCH)		000005
00116	170		IF (NCH.CO.0) GO TO 200		000013
00117	180		NK=(120-NCH)/2+1		000015
00120	190		11=JSTART-1		000022
00121	200		1=NN-1		000025
00122	210		NEND=1+NCH		000027
00123	220	25	11=11+1		000032
00124	230		1=1+1		000034
00125	240		CALL GETT(ARRAY,11,AR)		000037
00126	250		CALL PUTT(TITLE,1,AP)		000044
00127	260		IF 11.LT.NEND1 GO TO 25		000051
00131	270	200	RETURN		000056
00132	280		END		000102

SUBROUTINE CNFPLT ENTRY POINT 000017

STORAGE USED CODE(1) 000023; DATA(0) 000006; BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NRPUS
0004 NI021
0005 NI0R31

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000006 10L 0000 R 000000 DUMMY 0000 030002 INJPS

00100 1* CNFPLT
00101 2* SUBROUTINE CNFPLT (M,I,J,K)
00103 3* READ (26,(END=10) DUMMY
00106 4* 10 N = 1
00107 5* 20 RETURN
00110 6* END

00000C
0000C0
000C00
C00006
C0C007
000G22

SUBROUTINE GRIDLI ENTRY POINT 000370

STORAGE USED CODE(1) 000441; DATA(4) 000033; BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 ALG010
0004 XPR1
0005 NLP03%

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000104	ICL	0001	000117	2CL	0001	000130	3CL	0001	000262	4CL	0001	000270	5CL	
0003	R	000005	MS1P	0000	I	000000	IN	0000	000025	INJPS	0000	I	000003	N	
0000	I	000010	NSTEP	0000	R	000001	SPAN	0000	R	000002	STEP	0000	R	000004	X

```

00100      1+      CGRIDLI                                000000
00101      2+      SUBROUTINE GRIDLI INQVMAX,AMIN,AMAX,SMIN,SMAX,NDIV,MSIG) 000000
00102      3+      C                                000000
00103      4+      C      PURPOSE - TO SELECT AXIS SCALES FOR A LINEAR AXIS. 000000
00104      5+      C                                000000
00105      6+      C      AMIN,AMAX - MIN AND MAX VALUES OF THE DATA. 000000
00106      7+      C      SMIN,SMAX - MIN AND MAX OF AXIS SCALES. 000000
00107      8+      C      NDIV - NUMBER OF GRID DIVISIONS. 000000
00108      9+      C      MSIG - NUMBER OF SIGNIFICANT FIGURES FOR ANNOTATION. 000000
00109      10+     C                                000000
00110      11+     C      IN = 1 000000
00111      12+     C      IF ( SMIN .NE. 0.0 .OR. SMAX .NE. 0.0 ) GO TO 40 000001
00112      13+     C                                000001
00113      14+     C      SET AXIS INCREMENT TO 1,2 OR 5 * 10**N. 000001
00114      15+     C                                000001
00115      16+     C      IF ( ABS(AMIN-AMAX) .LE. 1.E-6*AMAX ) AMAX = 1.000001*AMIN 000010
00116      17+     C      IF ( AMAX .EQ. 0.0 .AND. AMIN .EQ. 0.0 ) AMAX = 1.E-6 000023
00117      18+     C      SPAN = ABS(AMAX-AMIN) 000035
00118      19+     C      STEP = SPAN / FLOAT(NDIVMAX) 000041
00119      20+     C      N = ALG010(STEP) 000045
00120      21+     C      IF ( STEP .LT. 1.0 ) N = N + 1 000057
00121      22+     C      X = STEP / 10.0**N 000066
00122      23+     C      IF ( X .GT. 2.0 ) GO TO 10 000075
00123      24+     C      STEP = 2.0 * 10.0**N 000100
00124      25+     C      GO TO 30 000102
00125      26+     C      10 IF ( X .GT. 5.0 ) GO TO 20 000104
00126      27+     C      STEP = 5.0 * 10.0**N 000107
00127      28+     C      GO TO 30 000115
00128      29+     C      20 STEP = 10.0**N*11 000117
00129      30+     C      IN = 0 000126
00130      31+     C      30 CONTINUE 000130

```

00132	32*	C		000130
00132	33*	C	SET SCALE MAX AND MIN.	000130
00132	34*	C		000130
00133	35*		HSTEP = STEP * 0.5	000130
00134	36*		SMIN = AINT(AMIN/HSTEP) * HSTEP	000132
00135	37*		IF (AMIN .LT. 0.0) SMIN = SMIN - HSTEP	000137
00137	38*		SMAX = AINT(AMAX/HSTEP) * HSTEP	000145
00140	39*		IF (AMAX .GT. 0.0) SMAX = SMAX + HSTEP	000152
00142	40*		X = AMOD(ABS(SMIN),STEP)	000160
00143	41*		IF (X .GT. 0.001*STEP .AND. X .LT. 0.999*STEP)	000167
00143	42*		SMIN = SMIN - HSTEP	000167
00145	43*		X = AMOD(SMAX-SMIN, STEP)	000212
00146	44*		IF (X .GT. 0.001*STEP .AND. X .LT. 0.999*STEP)	000222
00146	45*		SMAX = SMAX + HSTEP	000222
00146	46*	C		000222
00146	47*	C	FIND NUMBER OF SUB-DIVISIONS.	000222
00146	48*	C		000222
00150	49*		NDIV = (SMAX-SMIN) / STEP * 0.5	000745
00151	50*		GO TO 50	000260
00151	51*	C		000260
00151	52*	C	FIND NUMBER OF SIGNIFICANT FIGURES.	000260
00151	53*	C		000260
00152	54*		40 CONTINUE	000262
00153	55*		STEP = (SMAX - SMIN) / FLOAT(NDIV)	000262
00154	56*		50 CONTINUE	000270
00155	57*		XMAX = AMAX(ABS(SMIN),ABS(SMAX))	000270
00156	58*		NMAX = ALOG10(XMAX*.0001)	000276
00157	59*		NSTEP = ALOG10(STEP) + 1.00001	000312
00160	60*		IF (STEP .LE. 1.0 .AND. XMAX .GE. 1.0) NSTEP = NSTEP - 1	000325
00162	61*		IF (STEP .GE. 10.0) IN = 1	000346
00164	62*		NSIG = NMAX - NSTEP + IN	000354
00165	63*		RETURN	000360
00166	64*		END	000440

SUBROUTINE LEFTT ENTRY POINT 000074

STORAGE USED CODE(1) 000107; DATA(0) 000022; BLANK COMMON(2) 000000

COMMON BLOCKS

0003 LEFTT 000146
0004 UNIT 000003

EXTERNAL REFERENCES (BLOCK, NAME)

0005 NCHAR
0006 GETT
0007 NCPR34

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000005	1126	0001	000044	1316	0001	000031	25L	0000	I	000003	I	0000	D	000000	IFLK	
0000	I	000007	JEND	0000	000011	1416	0004	000000	10UTP	0000	I	000004	1START	0003	D	000000	LEFT
0000	I	000006	MUV	0000	I	000005	NCH	0000	I	000002	NN						

00100	1*	LEFTT		000005
00101	2*	SUBROUTINE LEFTTARRAY,LA1		001005
00101	3*	C		000005
00101	4*	C	LEFT TITLE	001035
00101	5*	C		000005
00101	6*	C		001035
00101	7*	C	ARRAY CONTAINS CHARACTERS FOR LEFT TITLE	000005
00101	8*	C	LA = NUMBER OF CHARACTERS IN ARRAY	000035
00101	9*	C		000005
00103	10*		DOUBLE PRECISION ARRAY(1),LEFT,TBLK	001035
00104	11*		COMMON/LEFTT/LEFTT(1)	001005
00105	12*		COMMON/UNIT/10UTP	001005
00106	13*		DATA 10LK/12H /,NN/51/	000005
00106	14*	C		000005
00106	15*	C	BLANK OUT LEFT ARRAY	000005
00106	16*	C		001005
00111	17*		DO 2 I=1,NN	000005
00114	18*		LEFT(I)=10LK	001035
00115	19*	2	CONTINUE	001007
00117	20*		IF (LA.EQ.0) RETURN	000007
00117	21*	C		001007
00117	22*	C	CENTER TITLE IN LEFT ARRAY	001007
00117	23*	C		001007
00121	24*		CALL NCHARARRAY,LA,1START,NCH	000014
00122	25*		IF (NCH.LE.NN) GO TO 25	000022
00124	26*		NCH=NN	000026

```

00125 27* 25 CONTINUE
00126 28*      MUV=(IMN-NCH)/2
00127 29*      IFAD=ISTART+NCH-1
00130 30*      DO 30 I=ISTART,TEND
00133 31*      MUV=MUV+1
00134 32*      CALL GETT(ARRAY,I,LEFT(MUV))
00135 33* 30 CONTINUE
00137 34*      RETURN
00140 35*      END

```

```

000031
000031
000034
000040
000044
000047
000061
000061
000066

```


SUBROUTINE LINPLT ENTRY POINT 000167

STORAGE USED CODE(1) 000233; DATA(1) 000050; ALANK COMMON(2) 000000

COMMON BLOCKS

0003 UNIT 000001

EXTERNAL REFERENCES (BLOCK, NAME)

0004 PLOT
0005 CENTER
0006 LFPIT
0007 PWDUS
0010 N1024
0011 N1024
0012 NERR13

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000022	10L	0000	000034	10DF	0000	000037	101F	0001	000042	15L	0001	000102	20L
0001	000120	30L	0001	000157	40L	0000	000033	50F	0000	1	000030	IND1	0000	000042
0003	1	000000	10UTP	0000	1	000031	NDUM	0000	1	000032	N2	0000	0	000000
														TITLES

00100	1*	CLINPLT	000000
00101	2*	SUBROUTINE LINPLT(X,Y,N,NT,TT,NFL,TL,NTB1,TB1,NTB2,TB2,TAUTO)	000000
00101	3*	C	000000
00101	4*	SUBROUTINE TO DRAW PLOT VIA PLOT	000000
00101	5*	C	000000
00101	6*	C	000000
00101	7*	C	000000
00101	8*	C	000000
00101	9*	C	000000
00101	10*	C	000000
00101	11*	C	000000
00101	12*	C	000000
00101	13*	C	000000
00101	14*	C	000000
00101	15*	C	000000
00101	16*	C	000000
00101	17*	C	000000
00101	18*	C	000000
00101	19*	C	000000
00101	20*	C	000000
00101	21*	C	000000
00101	22*	C	000000
00101	23*	C	000000

DIMENSION K(1),Y(1),TT(1),TL(1),TB1(1),TB2(1)

[illegible]

SUBROUTINE MNMX ENTRY POINT 000074

STORAGE USED CODE(1) 000115; DATA(0) 000013; BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000022 10L 0001 000044 1226 0001 000036 20L 0000 1 000001 1 0000 1 000000 1M
0000 000002 INJPS

00100	1*	CMNMX	000001
00101	2*	SUBROUTINE MNMX (A,N,AMIN,AMAX)	000003
00101	3*	C	000003
00101	4*	C PURPOSE - TO FIND THE MINIMUM AND MAXIMUM VALUES OF AN ARRAY.	000003
00101	5*	C	000003
00101	6*	C A - ARRAY OF VALUES.	000003
00101	7*	C N - NUMBER OF ELEMENTS IN A.	000003
00101	8*	C AMIN,AMAX - MIN AND MAX VALUES FOUND. IF AMIN = AMAX, THEN	000003
00101	9*	C START WITH THE VALUES PASSED IN.	000003
00101	10*	C	000003
00103	11*	C DIMENSION A(1)	000003
00103	12*	C	000003
00103	13*	C CHECK FOR ORIGINAL VALUES OF MIN AND MAX.	000003
00103	14*	C	000003
00104	15*	C IF (AMIN .GT. AMAX) GO TO 10	000003
00106	16*	C IN = 1	000007
00107	17*	C IF (N .LT. 1) RETURN	000011
00111	18*	C GO TO 21	000020
00111	19*	C	000020
00111	20*	C INITIALIZE MIN AND MAX.	000020
00111	21*	C	000020
00112	22*	10 CONTINUE	000022
00113	23*	C AMIN = A(1)	000022
00114	24*	C AMAX = A(1)	000023
00115	25*	C IN = 2	000024
00116	26*	C IF (N .LT. 2) RETURN	000026
00116	27*	C	000026
00116	28*	C SEARCH.	000026
00116	29*	C	000026
00120	30*	20 CONTINUE	000036
00121	31*	C DO 30 I=IN,N	000036
00124	32*	C IF (AMIN .GT. A(I)) AMIN = A(I)	000044
00126	33*	C IF (AMAX .LT. A(I)) AMAX = A(I)	000051
00130	34*	30 CONTINUE	000061

SUBROUTINE NCHAR ENTRY POINT 000073

STORAGE USED CORE(1) 000113; DATA(0) 000012; BLANK COMMON(2) 000000

COMMON BLOCKS

0003 UNIT 000001

EXTERNAL REFERENCES (BLOCK, NAME)

0004 CLT?
0005 NEPR3

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000022	ICL	0001	000069	100L	0001	000027	15L	0001	000046	20L	0001	000056	25L		
0001	000002	5L	0000	0	000002	AR	0000	0	000000	BLK	0000	000005	INJPS	0003	000000	100TP
0000	1	000004	J													

00100	1*	CNCHAR		000000
00101	2*		SUBROUTINE NCHAR(ARRAY,MAX,ISTART,NCH)	000000
00101	3*	C		000000
00101	4*	C	SUBROUTINE TO CALCULATE THE NUMBER OF CHARACTERS IN A CHARACTER	000000
00101	5*	C	STRING	000000
00101	6*	C		000000
00101	7*	C		000000
00101	8*	C	ARRAY CONTAINS CHARACTER STRING	000000
00101	9*	C	NA = NUMBER OF INPUT CHARACTERS	000000
00101	10*	C	ISTART = NUMBER OF FIRST NONBLANK CHARACTER IN STRING	000000
00101	11*	C	NCH = NUMBER OF CHARACTERS IN ARRAY SUPPRESSING BEGINNING	000000
00101	12*	C	AND ENDING BLANKS	000000
00101	13*	C		000000
00103	14*		DOUBLE PRECISION ARRAY(1),BLK,AR	000000
00104	15*		COMMON/UNIT/100TP	000000
00106	16*		DATA PLK/12H	000000
00107	17*		NCH=0	000000
00110	18*		J=0	000000
00111	19*	S	J=J+1	000000
00112	20*		CALL GETT(ARRAY,J,AR)	000004
00113	21*		IF (AR.NC.BLK) GO TO 10	000011
00115	22*		IF (J.GE.MAX) GO TO 100	000014
00117	23*		GO TO 5	000020
00120	24*	10	ISTART=J	000022
00121	25*		J=MAX+1	000023
00122	26*	15	J=J-1	000027
00123	27*		CALL GETT(ARRAY,J,AR)	000031
00124	28*		IF (AR.NC.BLK) GO TO 20	000036

```

00126 29*      IF (J.LC.D) GO TO 100
00130 30*      GO TO 15
00131 31*      NCH=J-1START+1
00132 32*      IF (NCH.GE.0) GO TO 25
00134 33*      NCH=0
00135 34*      GO TO 100
00136 35*      25  CONTINUE
00137 36*      IF (NCH.GT.120) NCH=120
00141 37*      100 CONTINUE
00142 38*      RETURN
00143 39*      END

```

```

0060*1
0000*4
0000*6
0000*1
0000*3
0000*4
0000*6
0000*6
0000*6
0000*6
0000*6
0000*6
0000*6

```

MAIN PROGRAM NSMPPT

STORAGE USED CODE(1) 000133; DATA(0) 000034; BLANK COMMON(2) 000000

COMMON BLOCKS

0003 CPLOTS 000070
 0004 CWORK 000073
 0005 UNIT 000001

EXTERNAL REFERENCES (BLOCK, NAME)

0006 GNFPLOT
 0007 SIMPLT
 0010 ATLPLOT
 0011 INFPLOT
 0012 MINTRA
 0013 ARDUS
 0014 N1031
 0015 N1021
 0016 NRDUS
 0017 NSTOP1

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0003	000006	30L	0001	000043	30L	0001	000052	40L	0001	000112	400L	0000	000032	410F
0001	000064	50L	0001	000127	500L	0001	000100	60L	0000	I	000001	IEND	0000	I
0003	I	000000	10PT	0005	I	000000	10UTP	0003	D	000036	PLOTID	0003	D	000050
														0004
														R
														000000
														WORK

```

00100 1* CHSMPTT                                000000
00100 2* C PROGRAM NSMPPT (OUTPUT,TAPE6=OUTPUT,TAPE26) 000000
00100 3* C                                000000
00103 4* C NONSIM OFFLINE PLOT PACKAGE. 000000
00103 5* C                                000000
00101 6* COMMON /CPLOTS/ IOPT(30),PLOTID(5),PTITLE(8) 000000
00103 7* COMMON /CWORK/ WORK(131) 000001
00104 8* DOUBLE PRECISION PLOTID,PTITLE 000001
00105 9* COMMON /UNIT/ IOUTP 000001
00106 10* IOUTP = 6 000001
00107 11* IRCNT = 0 000003
00110 12* IEND = 0 000004
00112 13* C 000004
00110 14* C READ THE OPTION AND TITLE ARRAYS. 000004
00113 15* C 000004
00111 16* 10 CONTINUE 000006
00112 17* READ (26,END=500) IOPT,PLOTID,PTITLE 000006
00117 18* 12 CONTINUE 000023
00117 19* C 000023
00117 20* C GENERAL PLOTS 000023

```

[illegible]

SUBROUTINE PLOTC ENTRY POINT 000055

STORAGE USED CODE(1) 000067; DATA(1) 000010; BLANK COMMON(2) 000000

COMMON BLOCKS

0003 ZSCALE 000004

EXTERNAL REFERENCES (BLOCK, NAME)

0004 QXMXMN
0005 CPLOT
0006 NEPR36

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000022	10L	0000	000003	INJP4	0000	1	000002	L	0000	1	000001	N	0000	1	000000	NUM
0003	R	000000	XMAX	0003	R	000001	XMIN	0003	R	000002	YMAX	0003	R	000003	YMIN		

00100	1*	C	PLOTC	000000
00101	2*		SUBROUTINE PLOT(X,Y,TAUTO)	000000
00101	3*	C		000000
00101	4*	C	SUBROUTINE WHICH CALLS PLOTTING SUBROUTINE CPLOT	000000
00101	5*	C		000000
00101	6*	C		000000
00101	7*	C	N = NUMBER OF POINTS TO BE PLOTTED	000000
00101	8*	C	X = ARRAY OF POINTS FOR ABSCISSA	000000
00101	9*	C	Y = ARRAY OF POINTS FOR ORDINATE	000000
00101	10*	C	TAUTO=0 AUTOMATIC SCALING	000000
00101	11*	C	TAUTO=1 AXIS VALUES PROVIDED IN ZSCALE	000000
00101	12*	C		000000
00103	13*		COMMON/ZSCALE/XMAX,XMIN,YMAX,YMIN	000000
00104	14*		DIMENSION X(1),Y(1)	000000
00105	15*		DATA NUM /C/	000000
00107	16*		NUM	000000
00110	17*		NUM=NUM+1	000001
00111	18*		L=1/ABS(M)	000004
00112	19*		IF(L.GT.01) NUM=0	000006
00114	20*		IF(NUM.LT.0) GO TO 10	000012
00116	21*		NUM=0	000016
00117	22*		N=L	000017
00120	23*	10	CONTINUE	000022
00121	24*		IF (TAUTO.EQ.0) CALL QXMXMN(X,Y,L,XMAX,XMIN,YMAX,YMIN)	000022
00123	25*		CALL CPLOT(X,XMAX,XMIN,Y,YMAX,YMIN,N)	000034
00124	26*		RETURN	000045
00125	27*		END	000046

SUBROUTINE COPLOT ENTRY POINT D01471

STORAGE USFO CODE(1) G01514; DATA(1) D03173; BLANK COMMON(2) G00000

COMMON BLOCKS

D003 INIT D00001
 D004 CLEFT 000146

EXTERNAL REFERENCES (BLOCK, NAME)

D005 PUTT
 D006 SIRM0V
 D007 GLTR
 D010 FCTR
 D011 GETT
 D017 ALLOCIO
 D013 XPR1
 D014 N2D015
 D015 N1015
 D016 N1025
 D017 N1035
 D020 AL0135

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

D001 D01151 100CL	D001 D01335 120CL	D001 D00122 15CL	D001 D01341 150CL	D001 D00034 154G
D000 D03173 155CF	D001 D01414 160CL	D001 D00110 170G	D001 D01434 170CL	D001 D01447 200CL
D001 D00227 233C	D001 D00230 236G	D001 D00323 261G	D001 D00262 272G	D001 D00156 300L
D001 D00401 301G	D001 D00524 324G	D001 D00565 341G	D001 D00575 351G	D001 D00623 361G
D001 D00736 401G	D001 D01063 425G	D001 D01116 453G	D001 D00171 500L	D001 D01365 506G
D001 D01407 515G	D001 D01430 526G	D001 D00222 600L	D001 D00372 670L	D001 D01312 750L
D000 D02263 BLANK	D000 D02265 CLEFT	D000 D02267 BRIGHT	D000 R D03011 DFLT	D000 R D03007 DIV
D000 D02263 EXPN	D000 R D02761 FCTR	D000 R D02741 FCTR	D000 R D02734 FCTR	D000 R D02753 FCTR
D000 D02263 GRAPH	D000 R D02671 HAXIS	D000 R D02661 HORIZ	D000 I D03026 I	D000 I D03030 TCENTR
D000 D02265 IJ	D000 I D03137 INJPN	D000 I D03040 IOFF	D000 I D03008 IOUTP	D000 I D03017 IP
D000 I D03016 IWT	D000 I D03032 IZERO	D000 I D03031 IO	D000 I D03027 J	D000 I D03034 JO
D000 I D03013 K	D000 I D03021 L	D000 D D00000 LEFT	D000 T D00000 LOC	D000 I D03024 M
D000 I D03022 N	D000 I D03037 NR	D000 I D03036 NS	D000 T D03015 NUM	D000 I D03014 NUMBER
D000 L D02667 PGRAPH	D000 D D02625 POINT	D000 R D03005 RANGE	D000 R D03026 ROUND	D000 R D02722 SCALE
D000 R D03035 TS	D000 R D02777 TX	D000 R D03025 TXMAX	D000 R D03003 TXD	D000 R D02775 VAL
D000 R D03033 XS				

D0100 1* COPLOT
 D0101 2* SUBROUTINE COPLOT(1D,1MAX,1MIN,X0,XMAX,XMIN,NUM01
 D0101 3* C
 D0101 4* PLOTTING SUBROUTINE

D00000
 D00000
 D00000
 D00000

```

00101 5* C TD = ARRAY OF POINTS FOR ABSCISSA (Y-AXIS)
00101 6* C TMAX = MAXIMUM VALUE FOR TD-ARRAY
00101 7* C TMIN = MINIMUM VALUE FOR TD-ARRAY
00101 8* C XD = ARRAY OF POINTS FOR ORIGINATE (Y-AXIS)
00101 10* C XMAX = MAXIMUM VALUE FOR XD-ARRAY
00101 11* C XMIN = MINIMUM VALUE FOR XD-ARRAY
00101 12* C NUMD = NUMBER OF POINTS TO BE PLOTTED
00101 13* C
00101 14* C
00101 15* C
00101 16* C GRAPHR IS A REAL*4 ARRAY CONTAINING PLOT - DIMENSION = 32X52
00101 17* C GRAPHI IS A LOGICAL*1 ARRAY OF DIMENSION 126X52 WHICH IS
00101 18* C EQUIVALENCED TO GRAPHR
00101 19* C GRAPHR(I,J),I=1,51 CONTAINS VERTICAL AXIS
00101 20* C GRAPHR(I,52),I=9,32 CONTAINS HORIZONTAL AXIS
00101 21* C REST OF GRAPHR CONTAINS BORDERS AND ACTUAL PLOT
00101 22* C
00103 23* COMMON/UNIT/OUTP
00104 24* COMMON/CLEFT/LCFT(5)
00105 25* DOUBLE PRECISION LCF1,GRAPHR,POINT,PLEFT,PRIGHT,MOR12
00106 26* DOUBLE PRECISION PLANK,IJ,PGRAPH
00107 27* DIMENSION GRAPHR(74,51),IAXIS(25),SCALE(12),POINT(12)
00110 28* DIMENSION FMTB(5),FMTD(12),FMTS(6),FMTB(12),VAL(2)
00111 29* DIMENSION TD(1),XD(1),TX(2,2),TXQ(2),RANGE(2),DIV(2),DEL(12)
00112 30* DATA SCALE /1.,1.5,2.,3.,4.,5.,6.,8.,10.,15. /
00114 31* DATA K /0/
00116 32* DATA POINT/12H* ,12H3 ,12H3 ,12H2
00116 33* + 12H3 ,12H4 ,12H5
00116 34* + 12H6 ,12H7 ,12H8
00116 35* + 12H9 ,12H ,12HX
00120 36* DATA PLEFT,PRIGHT,MOR12 /12H*--- ,12H ---,
00120 37* + 12H-----/
00124 38* DATA NUMBER /6H543210/
00126 39* DATA PLANK /12H
00126 40* C
00126 41* C OUTPUT FORMATS
00126 42* C
00130 43* DATA FMTD /60H(1X,A1,1X,1PE8.2,12A10,A1) 11X,A1,1K,F8.1,12A10,A
00130 44* +1) /
00132 45* DATA FMTS /72H(1X,1P12E10.2,1PE9.2/8X,1P12E10.2) 43X,OP17F10.1,OP
00132 46* +F9.1/FX,CP17F10.1) /
00134 47* NUM=1FBS(NUMD)
00134 48* C
00134 49* C K IS NONZERO IMPLIES MULTIPLE CURVE PLOTS
00134 50* C
00135 51* IF(K.NE.0)GO TO 1900
00137 52* 50 CONTINUE
00140 53* IAE=0
00141 54* IF=0
00142 55* IF(NUML.LT.0)IP=1
00144 56* IX(1,1)=TMIN
00145 57* IX(1,2)=TMAX
00146 58* IX(2,1)=XMIN
00147 59* IX(2,2)=XMAX
00150 60* VAL(1)=1.0
00150 61* VAL(2)=1.2

```

00152	62*		ROUND=.9999	000026
00152	63*	C		000026
00152	64*	C	DETERMINE EVEN SCALES	000026
00153	65*		DO 600 L=1,2	000034
00153	66*	C		000034
00156	67*		RANGE(L)=ABS(TX(L,2))-TX(L,1)	000034
00156	68*	C		000034
00156	69*	C	CHECK FOR CONSTANT VALUE	000034
00156	70*	C		000034
00157	71*		IF(RANGE(L).EQ.0.)RANGE(L)=2.*ABS(TX(L,1))	000040
00161	72*		IF(RANGE(L).EQ.0.)RANGE(L)=10.	000045
00163	73*		N=ALOG10(RANGE(L))	000051
00164	74*		IF(RANGE(L).LT.1.)N=N-1	000065
00166	75*		EXPVAL(L)=10.**N	000074
00167	76*		DO 100 M=1,9	000102
00172	77*		MTM	000110
00173	78*		IF(SCALE(M).EXPN.GE.(RANGE(L)+ROUND)GO TO 150	000112
00175	79*	100	CONTINUE	000122
00177	80*	150	CONTINUE	000122
00200	81*		RANGE(L)=SCALE(M)*EXPN	000122
00201	82*		DIV(L)=RANGE(L)/10./ZVAL(L)	000125
00202	83*		TXMAX=OMAX1(ABS(TX(L,1)),ABS(TX(L,2)))	000130
00203	84*		IF(TX(L,2)+TX(L,1).GE.0.)GO TO 300	000140
00203	85*	C		000140
00203	86*	C	TRY TO CENTER SCALE ABOUT ORIGIN	000140
00203	87*	C		000140
00205	88*		IF(RANGE(L)/2.-LT.TXMAX)GO TO 500	000144
00207	89*		TX(L)=-(RANGE(L)/2.)	000151
00210	90*		GO TO 600	000154
00211	91*	300	CONTINUE	000156
00211	92*	C		000156
00211	93*	C	TRY TO START OR END SCALE AT ORIGIN	000156
00211	94*	C		000156
00212	95*		IF(RANGE(L).LT.TXMAX)GO TO 500	000156
00214	96*		TX(L)=0.	000161
00215	97*		IF(TX(L,1).LT.0.)TX(L)=-RANGE(L)	000162
00217	98*		GO TO 600	000167
00220	99*	500	CONTINUE	000171
00220	100*	C		000171
00220	101*	C	FIND ORIGIN OF SCALE	000171
00220	102*	C		000171
00221	103*		TX(L)=TX(L,1)-AMOD(TX(L,1),DIV(L))	000171
00222	104*		IF(TX(L,1).GT.TX(L,1)+TX(L,1)-DIV(L))	000177
00222	105*	C		000177
00222	106*	C	INSURE THAT ALL POINTS FALL WITHIN SCALE RANGE	000177
00222	107*	C		000177
00224	108*		IF(TX(L)+RANGE(L).GE.TX(L,2)+ROUND)GO TO 600	000206
00226	109*		M=M+1	000215
00227	110*		GO TO 150	000220
00230	111*	600	CONTINUE	000230
00230	112*	C		000230
00230	113*	C	BLANK OUT PAGE	000230
00230	114*	C		000230
00232	115*		DO 620 J=2,13	000230
00235	116*		DO 620 J=1,5	000230
00240	117*		GRAPH(I,1)=BLANK	000230
00241	118*	620	CONTINUE	000236

00244	1150	DELTA1:=DIV(1)/10.	000236
00245	1200	DELTA2:=DIV(2)/5.	000241
00246	1210		000241
00247	1220	C	000241
00248	1230	C	000241
00249	1240	C	000241
00250	1250	ICENTR=0	000245
00251	1260	IC=IF(IX(1.5-IX(1)/DELTA1))	000257
00252	1270	IF(10.LT.1.OR.10.GT.12)ICENTR=1	000277
00253	1280	IF(10.LT.10)IC=1	000304
00254	1290	IF(10.LT.10)IC=1	000305
00255	1300	IF(10.LT.10)IC=1	000314
00256	1310	IF(10.LT.10)IC=1	000323
00257	1320	IF(10.LT.10)IC=1	000323
00258	1330	IF(10.LT.10)IC=1	000331
00259	1340	IF(10.LT.10)IC=1	000341
00260	1350	IF(10.LT.10)IC=1	000341
00261	1360	IF(10.LT.10)IC=1	000362
00262	1370	IF(10.LT.10)IC=1	000362
00263	1380	IF(10.LT.10)IC=1	000372
00264	1390	IF(10.LT.10)IC=1	000372
00265	1400	IF(10.LT.10)IC=1	000372
00266	1410	IF(10.LT.10)IC=1	000401
00267	1420	IF(10.LT.10)IC=1	000411
00268	1430	IF(10.LT.10)IC=1	000422
00269	1440	IF(10.LT.10)IC=1	000431
00270	1450	IF(10.LT.10)IC=1	000433
00271	1460	IF(10.LT.10)IC=1	000444
00272	1470	IF(10.LT.10)IC=1	000444
00273	1480	IF(10.LT.10)IC=1	000444
00274	1490	IF(10.LT.10)IC=1	000444
00275	1500	IF(10.LT.10)IC=1	000456
00276	1510	IF(10.LT.10)IC=1	000476
00277	1520	IF(10.LT.10)IC=1	000476
00278	1530	IF(10.LT.10)IC=1	000476
00279	1540	IF(10.LT.10)IC=1	000476
00280	1550	IF(10.LT.10)IC=1	000476
00281	1560	IF(10.LT.10)IC=1	000476
00282	1570	IF(10.LT.10)IC=1	000476
00283	1580	IF(10.LT.10)IC=1	000476
00284	1590	IF(10.LT.10)IC=1	000476
00285	1600	IF(10.LT.10)IC=1	000476
00286	1610	IF(10.LT.10)IC=1	000476
00287	1620	IF(10.LT.10)IC=1	000476
00288	1630	IF(10.LT.10)IC=1	000476
00289	1640	IF(10.LT.10)IC=1	000476
00290	1650	IF(10.LT.10)IC=1	000476
00291	1660	IF(10.LT.10)IC=1	000476
00292	1670	IF(10.LT.10)IC=1	000476
00293	1680	IF(10.LT.10)IC=1	000476
00294	1690	IF(10.LT.10)IC=1	000476
00295	1700	IF(10.LT.10)IC=1	000476
00296	1710	IF(10.LT.10)IC=1	000476
00297	1720	IF(10.LT.10)IC=1	000476
00298	1730	IF(10.LT.10)IC=1	000476
00299	1740	IF(10.LT.10)IC=1	000476
00300	1750	IF(10.LT.10)IC=1	000476

00451	233*	M=0	001164
00452	234*	DO 1500 L=1,NUM	001167
00455	235*	LOC=IP	001176
00456	236*	I=FIX(1.5+(TD(L)-TXQ(1))/DELTA(1))	001177
00457	237*	IF (I.LT.1.OR.I.GT.12)GO TO 1200	001212
00461	238*	J=FIX(51.5-(XD(L)-TXQ(2))/DELTA(2))	001227
00462	239*	IF (J.LT.1.OR.J.GT.51)GO TO 1200	001242
00462	240*	C	001242
00462	241*	C CHECK FOR MULTIPLE POINTS	001242
00462	242*	C	001242
00464	243*	CALL GETT (GRAPH(2,J),1,PGRAPH)	001257
00465	244*	IF (PGRAPH .EQ. POINT(IP)) GO TO 1500	001271
00467	245*	IF (PGRAPH .EQ. POINT(I)) GO TO 1500	001274
00467	246*	C	001274
00467	247*	C THIS CHECK IS MACHINE DEPENDENT - CDC 6600	001274
00467	248*	C	001274
00471	249*	IF (PGRAPH .GT. POINT(2) .AND. PGRAPH .LT. POINT(10)) LOC = 12	001277
00473	250*	CALL PUTT (GRAPH(2,J),1,POINT(LOC))	001317
00474	251*	GO TO 1500	001323
00475	252*	1200 CONTINUE	001336
00476	253*	UNT=1	001336
00477	254*	NCH=1	001336
00500	255*	1500 CONTINUE	001343
00502	256*	IF (NUMJ.LT.0 .AND. IP.LT.10)GO TO 2000	001343
00504	257*	K=0	001360
00504	258*	C	001360
00504	259*	C WRITE OUT PLOT	001360
00504	260*	C	001360
00525	261*	DO 1700 I=1,51	001365
00510	262*	IF (POINT(I,5).EQ.1) GO TO 1600	001371
00512	263*	WRITE(10)TP,1550) LEFT(I),(GRAPH(2,J),I),J=2,14)	001376
00521	264*	1550 FORMAT (1X,A1,9X,12A10,A1)	001412
00522	265*	GO TO 1700	001412
00523	266*	1600 WRITE(10)TP,FMTN) LEFT(I),(GRAPH(2,J),I),J=1,14)	001414
00532	267*	1700 CONTINUE	001436
00534	268*	WRITE(10)TP,FMTS) MAXTSC(J),J=1,25)	001436
00537	269*	2000 CONTINUE	001447
00540	270*	RETURN	001447
00541	271*	END	001513

SUBROUTINE QXMYMN ENTRY POINT 000067

STORAGE USED CODE(1) 000121; DATA(0) 000021; BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000015 1110 0000 1 000000 1 0000 000003 IN,PS

00100	1*	QXMYMN	000002
00101	2*	SUBROUTINE QXMYMN(X,Y,N,AMAX,AMIN,OMAX,ONIN)	000002
00101	3*	C	000002
00101	4*	C SUBROUTINE TO DETERMINE MINIMUM AND MAXIMUM VALUES OF ARRAYS	000002
00101	5*	C	000002
00101	6*	C	000002
00101	7*	C N = NUMBER OF PLOT POINTS	000002
00101	8*	C X = ARRAY OF POINTS FOR ANSCISSA	000002
00101	9*	C Y = ARRAY OF POINTS FOR ORDINATE	000002
00101	10*	C AMAX = MAXIMUM VALUE IN X-ARRAY	000002
00101	11*	C AMIN = MINIMUM VALUE IN X-ARRAY	000002
00101	12*	C OMAX = MAXIMUM VALUE IN Y-ARRAY	000002
00101	13*	C ONIN = MINIMUM VALUE IN Y-ARRAY	000002
00101	14*	C	000002
00103	15*	DIMENSION X(1),Y(1)	000002
00104	16*	AMAX=-1.E36	000002
00105	17*	AMIN=1.E36	000004
00106	18*	OMAX=-1.E36	000005
00107	19*	ONIN=1.E36	000006
00110	20*	DO 1 I=1,N	000015
00113	21*	AMAX=AMAX1(X(I),AMAX)	000015
00114	22*	AMIN=AMIN1(X(I),AMIN)	000022
00115	23*	OMAX=OMAX1(Y(I),OMAX)	000030
00116	24*	ONIN=ONIN1(Y(I),ONIN)	000036
00117	25*	CONTINUE	000045
00121	26*	RETURN	000045
00122	27*	END	000120

SUBROUTINE RTPLT ENTRY POINT 000525

STORAGE USED CODE(1) 000544; DATA(1) 004412; BLANK COMMON(2) 000000

COMMON BLOCKS

0003 CLOTS 000011
0004 ZSCALE 000004

EXTERNAL REFERENCES (BLOCK, NAME)

0005 MUMX
0006 GRIDL
0007 MNC004
0010 LTRPLT
0011 KAPUS
0012 K1014
0013 K1024
0014 K1034
0015 MERR44

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000027 10L	0001 000176 102L	0001 000014 116G	0001 000316 120L	0001 000377 130L
0001 000414 140L	0001 000431 150L	0001 000440 167L	0001 000301 220G	0001 000316 234G
0001 000362 245G	0003 004010 250F	0000 004017 263F	0001 000503 270L	0001 000124 30L
0001 000132 30L	0001 000152 70L	0001 000156 90L	0003 R 000002 0A7E	0003 000J15 DUMMY
0003 R 003760 EP2	0000 R 003775 EP2T	0000 R 003774 EP2R	0000 R 004035 GA14	0000 I 003761 1
0003 I 003767 JAU70	0003 I 000001 ICASE	0000 I 004035 IGA14	0003 I 000014 INDEX	0000 I 003777 INDPT
0000 004363 INJPS	0003 000003 IOPT	0000 I 004001 11	0000 I 004032 12	0000 I 004003 J
0000 I 004007 K	0000 I 003766 N	0000 I 003772 NOIVT	0000 I 003770 NOIVR	0000 I 004004 K
0000 I 004000 NM	0000 I 003776 NR	0000 I 003773 NS101	0000 I 003771 NS10R	0003 D 000037 PLOT10
0003 D 000001 PTITLE	0000 R 004006 R1	0003 D 000004 RLPAR	0000 R 003763 RMAX	0000 R 003762 RMIN
0000 R 004005 RR	0003 R 000011 SCALE	0003 R 000006 SCALR	0004 R 000002 SMAXI	0004 R 000000 SMAXR
0004 R 000003 SMINI	0004 R 000001 SMINR	0000 R 000004 X	0000 R 002010 Y	0000 R 003765 YMAX
0000 R 003764 YMIN	0000 D 000000 ZPR			

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00100 1* CRTPLT
00101 2* SUBROUTINE RTPLT (ROOT,IEND)
00102 3* C
00103 4* C PURPOSE - TO BUILD A ROOT LOCUS PLOT FOR NONSIM.
00104 5* C
00105 6* C ROOT - A WORK SPACE INTO WHICH DATA IS READ.
00106 7* C
00107 8* COMMON /CLOTS/ IOPT,ICASE,DATE(2),RLPAR,SCALE(13),SCALE(13),
00108 9* INDEX,DUMMY(18),PLOTID( 51,PTITLE( 8)
00109 10* DOUBLE PRECISION RLPAR,PLOTID,PTITLE

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00104	11*	C		000002
00105	12*		COMMON /ZSCALE/ SMAXR,SMINR,SMAXI,SMINI	000002
00105	13*	C		000002
00106	14*		DIMENSION ROOT(11)	000002
00107	15*		DOUBLE PRECISION ZBFR(16)	000002
00110	16*		DIMENSION X(1000),Y(1000),GAIN(4,50),IGAIN(4,50)	000002
00111	17*		EQUIVALENC (GAIN(1,1),IGAIN(1,1))	000002
00112	18*		DATA EP2 /1.0E-4/	000002
00112	19*	C		000002
00112	20*	C	READ ROOT ARRAY.	000002
00112	21*	C		000002
00114	22*		READ (26,END=270) (ROOT(I),I=1,INDEX)	000002
00122	23*		5 CONTINUE	000017
00122	24*	C		000017
00122	25*	C	FIND MAX AND MIN VALUES.	000017
00122	26*	C		000017
00123	27*		RMIN = 1.0	000017
00124	28*		RMAX = 0.0	000021
00125	29*		YMIN = 1.0	000022
00126	30*		YMAX = 0.0	000023
00127	31*		I = 1	000024
00130	32*	10	CONTINUE	000027
00131	33*		N = ROOT(I) * 0.1	000041
00132	34*		CALL MNMX (ROOT(I+3),N,RMIN,RMAX)	000053
00133	35*		CALL MNMX (ROOT(I+3+N),N,YMIN,YMAX)	000066
00134	36*		I = I + 2*N + 3	000073
00135	37*		IF (I) .LT. INDEX) GO TO 10	000076
00137	38*		IF (YMIN .LT. 0.0) YMIN = 0.0	000076
00137	39*	C		000076
00137	40*	C	FIND SCALE VALUES, IF THEY ARE NOT PROVIDED - REAL.	000076
00137	41*	C		000076
00141	42*		IF (SCALR(1) .LT. SCALR(2)) GO TO 30	000102
00143	43*	20	CONTINUE	000106
00144	44*		SMINR = 0.0	000107
00145	45*		SMAXR = 0.0	000110
00146	46*		IAUTO = 0	000113
00147	47*		CALL CRIDL (12,RMIN,RMAX,SMINR,SMAXR,NOIVR,NSIGR)	000122
00150	48*		GO TO 50	000124
00151	49*	30	CONTINUE	000124
00152	50*		SMINR = SCALR(1)	000125
00153	51*		SMAXR = SCALR(2)	000127
00154	52*		IAUTO = 1	000132
00155	53*	50	CONTINUE	000132
00155	54*	C		000132
00155	55*	C	FIND SCALE VALUES, IF THEY ARE NOT PROVIDED - IMAGINARY.	000132
00155	56*	C		000132
00156	57*		IF (SCALI(1) .LT. SCALI(2)) GO TO 70	000135
00160	58*	60	CONTINUE	000135
00161	59*		SMINI = 0.0	000136
00162	60*		SMAXI = 0.0	000137
00163	61*		CALL CRIDL (12,YMIN,YMAX,SMINI,SMAXI,NOIVI,NSIGI)	000150
00164	62*		GO TO 90	000152
00165	63*	70	CONTINUE	000153
00166	64*		SMINI = SCALI(1)	000156
00166	65*		SMAXI = SCALI(2)	000156
00166	66*	90	CONTINUE	
00166	67*		EP2R = (SMAXR-SMINR) * 0.002	

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00172 65*      (PZ1 = 45MAX1-5MIN1) * D.002
00172 66*
00172 70*      C
00172 71*      C
00173 72*      X(1) = 1.E36
00174 73*      Y(1) = 1.E36
00175 74*      I = 1
00176 75*      N = 0
00177 76*      NR = 0
00200 77*      INDRY = 0
00201 78*      100 CONTINUE
00202 79*      IF ( I .GT. INDEX ) GO TO 160
00204 80*      NN = 001111 + 0.1
00205 81*      NR = NR + 1
00206 82*      GAIN(1, NR) = ROOT(1)+1
00207 83*      GAIN(2, NR) = ROOT(1)+2
00210 84*      ICATN(3, NR) = N + 1
00211 85*      I1 = I + 2
00212 86*      I2 = I1 + NN
00213 87*      IF ( GAIN(2, NR) .EQ. 5.0 .AND. INDRY .EQ. 1 ) GO TO 120
00215 88*      IF ( GAIN(2, NR) .EQ. 5.0 ) INDRY = 1
00217 89*      DO 110 J=1, NN
00222 90*      N = N + 1
00223 91*      X(N) = ROOT(I1+J)
00224 92*      Y(N) = ROOT(I2+J)
00225 93*      110 CONTINUE
00227 94*      ICATN(4, NR) = NN
00230 95*      GO TO 150
00231 96*      120 CONTINUE
00232 97*      NK = 0
00233 98*      DO 140 J=1, NN
00236 99*      RR = ROOT(I1+J)
00237 100*      RI = 001112+J
00240 101*      IF ( ABS(RR) .LE. EPZ ) RR = 0.0
00242 102*      IF ( ABS(RI) .LE. EPZ ) RI = 0.0
00244 103*      DO 130 K=1, N
00247 104*      IF ( ABS(NR-X(K)) .GT. EPZR ) GO TO 130
00251 105*      IF ( ABS(RI-Y(K)) .LE. EPZI ) GO TO 140
00253 106*      130 CONTINUE
00255 107*      NK = NK + 1
00256 108*      N = N + 1
00257 109*      X(N) = RR
00260 110*      Y(N) = RI
00261 111*      140 CONTINUE
00263 112*      ICATN(4, NR) = NK
00264 113*      IF ( NK .LE. 0 ) NR = NR - 1
00266 114*      150 CONTINUE
00267 115*      I = I + 3 + 2 * NN
00270 116*      GO TO 100
00270 117*      C
00270 118*      C
00270 119*      C
00271 120*      160 CONTINUE
00272 121*      ETCOD( 104, 250, 20FR) PLPAR
00275 122*      250 FORMAT (27HROOT LOCUS  PARAMETER  = ,48,78X)
00276 123*      ETCOD( 103, 260, 20FR(19)) DATE, ICASE
00276 124*      260 FORMAT (24I2,16X,17HROOT LOCUS PLOT ,13X,9H CASE NO,14I

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00303	125*		CALL LINPLY 4X,Y,N,EO,PTITLE,10,10IMAGINARY ,Q,QMREAL.	000461
00303	126*		160,28FR,IAUTO}	000461
00303	127*	C		000461
00303	128*	C	ADVANCE FILM AND RETURN	000461
00303	129*	C		000461
00304	130*		RETURN	000477
00305	131*	270	CONTINUE	000478
00306	132*		IFNO = 1	000503
00307	133*		RETURN	000504
00310	134*		END	000543

00100	1*	CSIMPLY	000002
00101	2*	SUBROUTINE SIMPLY (DSPLY,ICND)	000002
00102	3*	C	000002
00103	4*	C PURPOSE - TO BUILD A SERIES OF SIMULATION FOR STEADY-STATE)	000002
00104	5*	C PLOTS, UP TO FIVE GRIDS PER PLOT.	000002
00105	6*	C	000002
00106	7*	C DIMENSION DSPLY(3,3),VAR(3)	000002
00107	8*	C	000002
00108	9*	C COMMON /CPLOTS/ IOPT,ICASE,DATE(2),NPLY,NGRD(6),INDEX,NCODES,	000002
00109	10*	C + ITHANU,MWORK,BUNNY(15),PLOT(10),SI,PI(16)	000002
00110	11*	C	000002
00111	12*	C COMMON /ZSCALE/ XMAX,XMIN,YMAX,YMIN	000002
00112	13*	C DOUBLE PRECISION ZBFR,PLOTID,PFILE,PNAME,PLAK	000002
00113	14*	C	000002
00114	15*	C DIMENSION SCALE(5,4,6),PNAME(5,2,6),NPOS(5,2,6)	000002

00211	73*	52 CONTINUE	000222
00212	74*	ENCODE (96,54,ZRFR) DATE,IP,ICASE,BLKK	000722
00220	75*	54 FORMAT (2A12,12X,24HSTEADY STA 1E DISPLAY .12,13X,	000237
00220	76*	+10ICASE NO. ,E4,47)	000237
00221	77*	50 CONTINUE	000237
00221	78*	C	000237
00221	79*	C CALL PRINTER PLOTTER	000237
00221	80*	C	000237
00222	81*	INX = INOMAX * (NPOS(IG,2,IP)-1) + 1	000237
00223	82*	INY = INOMAX * (NPOS(IG,1,IP)-1) + 1	000245
00224	83*	CALL LINCT (DSPLY(INX),DSPLY(INY),INOX,80,PTITLE,	130252
00224	84*	8,PNAME(IG,1,IP),8,PNAME(IG,2,IP),80,ZRFR,IAUTO)	000262
00225	85*	40 CONTINUE	000306
00227	86*	60 CONTINUE	000306
00231	87*	IF (IL+1).LT. INDEX) GO TO 100	000313
00233	88*	RETURN	000317
00234	89*	500 CONTINUE	000320
00235	90*	IFND = 1	000361
00236	91*	RETURN	
00237	92*	END	

SUBROUTINE TNFPLT ENTRY POINT 000017

STORAGE USED CODE(1) 000023; DATA(0) 000006; BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NARUS
0004 HIO24
0005 NEPR34

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000004 10L 0000 R 000000 DUMMY 0000 000002 INJPS

00100	1*	CTNFPLT	000000
00101	2*	SUBROUTINE TNFPLT (F,G,P,K)	000000
00103	3*	READ (26,END=10) DUMMY	000000
00106	4*	10 K = 1	000006
00107	5*	20 RETURN	000007
00110	6*	END	000022