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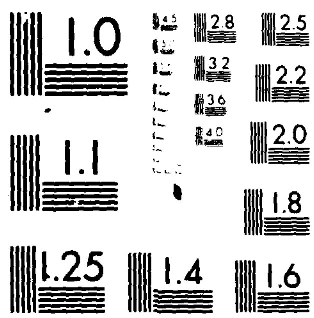

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US Army Corps of Engineers
Facilities Engineering Support Agency

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FESA-T-2091

INVESTIGATION OF SINGLE VERSUS DUAL - HOT AND COLD BUILDING WATER SYSTEMS

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15 October 1981

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Reduction of lavatory hot water temperature to tepid (105°F) and elimination of cold water faucets may, in some instances, offer a cost effective means for energy conservation. A manual calculation method has been derived from a computer simulation of water systems. This will permit the reader to quickly and easily evaluate his own water system. The mathematical model used for the simulation confirmed three highly effective; low/no cost actions for energy conservation in all hot water systems.

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1. Install a flow restrictor in all hot water taps;
2. Apply an insulation blanket to the outside of central water heaters, and
3. Reduce water temperature to the lowest permissible level.

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SUMMARY

Hot water use in Army facilities can be wasteful of energy. The Department of Energy has ruled that tepid water (105F) may be supplied to lavatory and janitorial faucets instead of hot water. There are many alternative possibilities for implementing this ruling and it is important to select the most energy conserving and cost effective action. A mathematical model and computer simulation were developed to study hot water systems. A manual, arithmetic method was also developed to permit Facilities Engineers to select the best alternatives for their individual circumstances. Several actions were identified as always reducing energy use on a cost effective basis. These actions are:

Set the thermostat on central water heaters to 105F whereever these heaters serve only lavatory faucets and/or janitorial sinks.

Install flow restrictors in lavatory faucets.

Install an insulation blanket on the outside shell of central water heaters.

Many other possible actions were studied and these included:

Supply tepid water to cold water faucets and eliminate cold water faucet lines.

Supply tepid water to all fixtures and eliminate all cold water lines.

Eliminate central heaters and install point-of-use heaters.

All of the possibilities have been analyzed for three different geographic areas in both retrofit and new construction circumstances. No action was identified as being universally desirable. The desirability of any action beyond the three identified above will likely be very sensitive to the water heater energy source and the local costs of fuel and electricity. It is, therefore, important that each opportunity be analyzed using local fuel, material and labor costs. Appendix A will guide the reader in making such an analysis.

TABLE OF CONTENTS

INTRODUCTION

Energy savings in residential and commercial heated water systems have been the subject of a number of technical studies.(1)(2)(3)(4)

Three cost-effective, energy conservation actions have been repeatedly identified.

Reduce heated water flow rate at the point-of-use. Faucet and shower flow restrictors are readily available at hardware stores and plumbing shops. Restrictors may cost less than one dollar and can reduce the flow of heated water from 2-4 gallons per minute down to ½-1 gallon per minute which has proved sufficient for personal use.

Add an insulation blanket to the outside of central water heater tanks. Water heater insulation kits are available from plumbing supply and building material outlets. The cost may be in the range of $20-25 per kit. Energy savings are significant and the payback period may be only about two years.

Turn down the heated water temperature. The energy savings achievable by temperature reduction will depend on how low the water temperature may be set. Some published guidelines were summarized in a recent report on water heaters.(5) A few typical heated water temperature requirements are recounted below.

Sanitizing	180°F
Commercial Dishwashing	140°F
Residential Dishwashing	140°F
Shower	110°F
Lavatory and Janitorial Faucets	105°F

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[1] Shepherd, P.B.; Performance Evaluation of Point of Use Water Heaters; FESA-TS-2081 1980.

[2] ERDA; Insulation Refit Kit for Domestic Water Heaters; PO Nos. WA 76-3813 and WA-76-3814, March 1973.

[3] Slaughter, G.G. and D.E. Spann; An Efficiency Evaluation and Consumer Economic Analysis of Domestic Water Heaters; Oak Ridge National Laboratory; ORNL/CON-5; September 1978.

[4] Technical Guidelines for Energy Conservation; AFCEO-TR-77-12; NBSR 77-1238.

[5] Shepherd, op cit.

Task Order 14 addresses an analysis of lavatory and janitorial faucets. Department of Energy regulations state, in part, "Temperature for domestic hot water must be set at 105F ----. ---- domestic hot water ---- is ---- used for personal hygiene or general cleaning." The Scope and Requirements of the Task Order, therefore, deal with how one may achieve the maximum energy conservation on a cost effective basis through temperature reduction at lavatory and janitorial faucets. The principle strategy specified in the Task Order is to investigate the benefits of reducing the number of lavatory faucets. One tepid water faucet would be available instead of the traditional hot and cold water faucets. Some of the implementation methods specified for evaluation included the following.

> Reduce central hot water storage tank temperature from 140F to 105F and shut off cold water supply to the lavatory basin.
>
> Shut off the hot water supply system and use point-of-use water heaters to boost the cold water temperature at the lavatory basins to 105F.
>
> Shut of the cold water supply system and use tepid water for all purposes including the flushing of toilets.

There are, of course, other potential schemes to consider when analyzing the most energy efficient/cost effective ways to take advantage of the reduced (105F) water temperature for domestic use. All conventional possibilities have been included in the analysis.

The Task Order also directed that the following topics be addressed in this study.

> What is the energy saving resulting from reducing heated water temperature from 140F to 105F.
>
> Identify energy "penalties" if tepid water is supplied to cold water use points.
>
> Identify reduced maintenance costs attributable to a reduction in the number of water faucets.
>
> Identify reduced construction costs achieved by deleting one (cold) domestic water loop and furnishing only one faucet at lavatory sinks.

The above topics and many others are easily addressed by the mathematical model developed for the analysis of domestic water systems.

This report describes the mathematical model, its theoretical background, and computer simulations. Background information has been provided on water use in Army facilities and water heating energy use and costs. The results of the computer similation are presented for examples of different water systems using different fuels in different DoE Regions. Appendix A contains a simplified, manual calculation procedure so that Facilities Engineers may quickly and easily analyze energy savings and life cycle costs for all their domestic water systems using local fuel and plumbing costs.

ENERGY AND COST ANALYSIS

Many different types of hot water systems should be studied under various conditions in order to analyze the heated water supply system alternatives referenced in the Task Order. These studies could be a considerably large task for an individual or even for a group of people. With the aid of a computer and a competent mathematical model, the analysis becomes a much simpler and more rapidly completed task. This is why the computer program was written to simulate different heated water supply systems for various types of buildings. The program analyzes system energy use, installation costs (new and/or retrofit) and ten year life cycle costs(1) for comparison.

The main concept of the simulation program is to compare results obtained from a central heater hot water supply system model to results obtained from central heater tepid supply system, or no central heater supply system models. Point-of-use heaters are used as required in the tepid and no central heater supply system simulations. Buildings requiring tepid temperature water, or relatively small amounts of hot water, have a great potential for energy savings if the central heater supply temperature is reduced from hot to tepid. A potential energy saving also occurs if the central heater is removed and point-of-use heaters are installed as needed. However, as concluded in an earlier study(2) point-of-use heaters are only effective,

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[1] Federal Register, Part IV, DoE; April 30, 1979.

[2] Performance Evaluation of Point-of-use Heaters; Task Order 8.

physically and/or economically, in certain conditions. These conditions will be discussed later in the report.

The tepid water temperature requirement produces another potential savings. Basins requiring only a tepid supply do not need a cold water supply, and, tepid water can theoretically be supplied to fixtures which normally are supplied with cold water. Under these conditions some or all of a building's cold water supply system can be eliminated. This can create a savings during construction of a building, or a credit for returned plumbing during an existing building water system retrofit. The overall retrofit credit will probably be negligible or nonexistant, due to the fact that the returned plumbing credit may be less than the removal labor expense. Systems supplying only tepid water to certain fixtures will experience energy use penalties due to the use of tepid water instead of cold water. These energy use penalties could add up to be more, during the life cycle, than the construction savings. In fact, the energy penalties could overshadow the construction savings in the first year of operation.

In order to confront the possibilities stated above, the program is constructed to study six basic building water supply system models. These models and their theoretical water temperature distributions are shown in Table 1.

TABLE 1
WATER SUPPLY SYSTEM MODELS

System	Central Heater Storage Tank Temperatures	Supply to Faucets*	Supply to Toilets**
1. Standard - hot & cold	Hot (140F)	Hot/ Cold	Cold
2. Tepid - No cold supply	Tepid (105F)	Tepid	Tepid
3. Tepid - tepid & cold	Tepid (105F)	Tepid/ Cold	Cold
4. Tepid - no cold to faucets	Tepid (105F)	Tepid	Cold
5. Cold	None	Tepid/ Cold	Cold
6. Cold - No cold to faucets	None	Tepid	Cold

* Point-of-use heaters used as required.
**Indicates supply temperature to all fixtures requiring only cold supply.

Systems requiring the installation of point-of-use heaters are further modelled to include six combinations of point-of-use heater types[1] used on the different fixture types. Table 2 shows the six combinations.

TABLE 2
POINT-OF-USE WATER HEATER COMBINATIONS

Combination	Lavatory Faucet	Janitorial Faucet	All Others
1	Instantaneous	Instantaneous	Instantaneous
2	Instantaneous	1 gal mini tank	Instantaneous
3	1 gal mini tank	1 gal mini tank	Instantaneous
4	½ gal mini tank	1 gal mini tank	1 gal minitank
5	½ gal mini tank	Instantaneous	1 gal minitank
6	1 gal mini tank	Instantaneous	1 gal minitank

Lavatory and janitorial faucets are the principle fixtures requiring heated water in the building types in question. And by conclusions of an early study of point-of-use heaters[2] it was determined that 1/2 gallon minitank point-of-use heaters are not sufficient for slop (janitorial) faucet demands.

With the time allowed, and the knowledge that an easily understood, systematic method for manual analysis must be adapted from the program, the mathematical portion of the program is purposely simple and short. To achieve a short and simple mathematical model, certain assumptions were made. These assumptions will be discussed in Appendix A.

The program contains six major sections of calculations. The first section calculates heat lost from the heated water pipes located in the building. (To avoid analysis of outside heated line heat losses, the central heater is assumed to be located in the building.) The second section

[1] Shepherd, P.B.; Performance Evaluation of Point-of-Use Water Heaters; FESA-TS-2081 1980.

[2] Ibid.

of calculations determines hot and cold water demands for each fixture type (i.e. lavatory faucet, janitorial faucet, toilet, etc.) in the building. Calculations in section 3 reveal the energy use and storage tank standby heat losses of the central heater. Point-of-use heater energy uses and standby heat losses are calculated in section 4. In section 5 the energy uses and heat losses are combined to produce an annual energy use. This annual energy use determines an annual energy cost. An installation cost is also calculated in section 5. The annual energy use, annual energy cost and installation cost pertain only to the heated water supply system. Finally, section 6 contains the life cycle cost calculations.

EVALUATION OF HOT WATER USE IN ARMY FACILITIES

This topic has to a large extent been excerpted from Report FESA-TS-2081, Performance Evaluation of Point-of-Use Water Heaters.(1) The background and design information is essential to the understanding and analysis of hot water use and faucets.

Hot water use at Army facilities was surveyed through literature references (2,3,4) and observations at Fort Rucker, Alabama. The types of buildings and their use sources of hot water which were considered include:

Single Family Residence	- lavatory - shower - dishwasher - clothes washer
Barracks	- lavatory - shower - janitorial
Office	- lavatory - janitorial
Outposts	- lavatory

[1] Shepherd, P.B.; Performance Evaluation of Point-of-Use Water Heaters; FESA-TS-2081 1980.

[2] ASHRAE Handbook, 1976 Systems; Chapter 37.

[3] Ibid.

[4] Technical Guidelines for Energy Conservation; AFCEO-TR-77-12; NBSR 77-1238.

Base Exchanges (without kitchen or cafeteria)	- lavatory - janitorial
Food Service Facilities	- dish rinsing - dishwasher - lavatory - janitorial
Hospitals	- operating rooms - out-patient rooms - showers - lavatories - laboratories - janitorial
Schools	
Elementary	- lavatory - janitorial
Secondary	- lavatory - showers - laboratory - janitorial
Libraries	- lavatory - janitorial
Mechanical Service Stations	- lavatory - shower
Training Facilities	- lavatory - janitorial

The potential consideration of point-of-use water heaters, which are usually of limited capacity, make it necessary to identify the hot water requirements of each point of service. There is much contradiction in the literature on this subject. This is best illustrated by the article, "It Can Be Confusing",(1) which concluded that there are differences in hot water use which may vary, for example, by geographical area. It is mandatory for this study that representative hot water use figures be selected for the calculations and for decisions.

The data used were taken predominantly from ASHRAE Design guidelines and are shown in Tables 3 through 10.

[1] Cook, R.E.: "It Can Be Confusing"; ASHRAE Journal; 59; April 1976.

TABLE 3

FIXTURE HOT WATER FLOW RATES (1)

Fixture	Gallons Per Minute of Hot Water
Lavatory Faucet	2.25
Sink Faucet	3.38
Bathtub Faucet	4.50
Laundry Sink	3.75
Shower	2.75 - 7.50

[1] ASHRAE Handbook, 1972 Fundamentals, 507.

TABLE 4

HOT WATER DEMAND FOR VARIOUS TYPES OF BUILDINGS[1]

Gallons of Water Per Hour Per Fixture, Calculated at a Final Temperature of 140°F

	Club	Gym-nasium	Hospital	Indus-trial Plant	Office Build ing	Private Resi-dence	School
Basins, private lavatory	2	2	2	2	2	2	2
Basins, public lavatory	6	8	6	12	6	-	15
Bathtubs	20	30	20	-	-	20	-
Dishwasher	50-150	-	50-150	20-100	-	15	20-100
Foot Basins	3	12	3	12	-	3	3
Kitchen Sink	20	-	20	20	20	10	20
Laundry, stationary tubs	28	-	28	-	-	20	-
Pantry sink	10	-	10	-	10	5	10
Showers	150	225	75	225	30	30	225
Slop sink	20	-	20	20	20	15	20
Hydrotherapeutic Showers	-	-	400	-	-	-	-
Hubbard baths	-	-	600	-	-	-	-
Leg baths	-	-	100	-	-	-	-
Arm baths	-	-	35	-	-	-	-
Sitz baths	-	-	30	-	-	-	-
Continuous-flow baths	-	-	165	-	-	-	-
Circular wash sinks	-	-	20	30	20	-	30
Semicircular wash sinks	-	-	10	15	10	-	15

---
[1]Op Cit., 1976 Systems, 37.16.

TABLE 5

HOT WATER REQUIREMENT FOR MESS KITCHENS [1]

Equipment	Gal/Hr.
Vegetable sink	45
Single pot sink	30
Double pot sink	60
Triple pot sink	90
Prescrapper (open type)	180
Preflush (hand operated)	45
Preflush (closed type)	240
Recirculating preflush	40
Bar sink	30
Lavatories (each)	5

[1] Op Cit., 1976 Systems, 37.18.

TABLE 6

RESIDENTIAL HOT WATER USAGE (1)

Food Preparation	3 Gal.
Hand Dishwashing	4 Gal.
Automatic Dishwasher	15 Gal.
Clothes Washer	21 Gal.
Shower or Bath	15 Gal.
Face and Hand Washing	2 Gal.

[1] Op Cit., 1976 Systems, 37.9.

TABLE 7

NSF RINSE WATER (180°F) REQUIREMENTS FOR DISHWASHING MACHINES [1]

Type and Size of Dishwasher	Flow Rate, gpm	Hot Water Requirements, Gal/Hr at 180°F: Heaters With No Internal Storage	Hot Water Requirements, Gal/Hr at 180°F: Heaters With Internal Storage to Meet gpm Flow Demand
Door type			
16 x 16 in. rack	6.94	416	69
18 x 18 in. rack	8.67	520	87
20 x 20 in. rack	10.4	624	104
Undercounter type	5	300	70
Conveyor type single tank	6.94	416	416
Multiple tank (dishes flat)	5.78	347	347
Multiple tank (dishes inclined)	4.62	277	277
Silver washers	7	420	45
Utensil washers	8	480	75
Makeup water requirements	2.31	139	139

[1] Op Cit., 1976 Systems, 37.17.

TABLE 8

HOT WATER DEMANDS AND USE FOR VARIOUS TYPES OF BUILDINGS [1]

Type of Building	Maximum Hour	Maximum Day	Average Day
Men's Dormitories	3.8 Gal/Person	22.0 Gal/Person	13.1 Gal/Person
Women's Dormitories	5.0 Gal/Person	26.5 Gal/Person	12.3 Gal/Person
Office Buildings	0.4 Gal/Person	2.0 Gal/Person	1.0 Gal/Person
Food Service Establishments:			
Full Meal Restaurants and Cafeterias	1.5 Gal/Max Meals/Hr	11.0 Gal/Max Meals/Hr	2.4 Gal/Avg Meals/Day*
Elementary Schools	0.6 Gal/Student	1.5 Gal/Student	0.6 Gal/Student*
Junior and Senior High Schools	1.0 Gal/Student	3.6 Gal/Student	1.8 Gal/Student*

* Per day of operation.

[1] Op Cit., 1976 Systems, 37.11.

TABLE 9

HUD-FHA MINIMUM WATER HEATER CAPACITIES

FOR ONE AND TWO FAMILY LIVING UNITS[1]

Number of Baths		1-1.5		2-2.5				3-3.5			
Number of Bedrooms	1	2	3	2	3	4	5	3	4	5	6
GAS[d]											
Storage - Gal	20	30	30	30	40	40	50	40	50	50	50
1,000 Btu Input	27	36	36	36	36	38	47	38	38	47	50
1-Hr Draw - Gal	43	60	60	60	70	72	90	72	82	90	92
Recovery - Gal/Hr	23	30	30	30	30	32	40	32	32	40	42
ELECTRIC[d]											
Storage - Gal	20	30	40	40	50	50	66	50	66	66	80
Kilowatts - Input	2.5	3.5	3.4	4.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5
1-Hr Draw - Gal	30	44	58	58	72	72	88	72	88	88	102
Recovery - Gal/Hr	10	14	18	18	22	22	22	22	22	22	22
OIL[d]											
Storage - Gal	30	30	30	30	30	30	30	30	30	30	40
1,000 Btu Input	70	70	70	70	70	70	70	70	70	70	70
1-Hr Draw - Gal	89	89	89	89	89	89	89	89	89	89	89
Recovery - Gal/Hr	59	59	59	59	59	59	59	59	59	59	59
TANK TYPE INDIRECT[a,e]											
I-W-H Rated Gal in 3 Hr, 100 F deg Rise		40	40		66	66[c]	66	66	66	66	66
Manufacturer Rated Gal 3 Hr 100 F deg Rise		49	49		75	75[c]	75	75	75	75	75
Tank Capacity in Gal		66	66		66	66[c]	82	66	82	82	82
TANKLESS TYPE INDIRECT[b,e]											
I-W-H Rated GPM 100 F deg Rise		2.75	2.75		3.25	3.25[c]	3.75	3.25	3.75	3.75	3.75
Manufacturer Rated Draw 5 Min 100 F Deg Rise		15	15		25	25[c]	35	25	35	35	35

[a]Boiler-connected water heater capacities (180 F boiler water, internal or external connection).
[b]Boiler-connected heater capacities (200 F boiler water, internal or external connection).
[c]Also for 1-1.5 baths & 4 B.R. for indirect water heaters.
[d]Storage capacity, input and recovery requirements indicated in the table are typical and may vary with each individual manufacturer. Any combination of these requirements to produce the stated 1-hr draw will be satisfactory.
[e]Heater capacities and inputs are minimum allowable. Variations in tank size are permitted when recovery is based on 4 gph/kw @ 100 F deg rise for electrical A.G.A. recovery ratings for gas heaters, and IBR ratings for steam and hot water heaters.

[1]Minimum Property Standards for One and Two Family Living Units, HUD-FHA.

TABLE 10

REPRESENTATIVE HOT WATER USE TEMPERATURES [1]

Use	Temp.F
Lavatory	105
Showers and tubs	110
Therapeutic Baths	110
Commercial and Institutional Dishwashing	
Wash	140
Sanitizing Rinse	180
Commercial and Institutional Laundry	180
Residential Dishwashing	140
Surgical Scrubbing	110

[1] ASHRAE Handbook, 1976 Systems, 37.8.

Additional references used in estimating hot water use are shown in Tables 11 through 14.

TABLE 11

HOT WATER USE AT SOME ARMY FACILITIES [1]

Offices (no kitchen or shower)	2 to 3 gal/day/person
Base Exchange (no kitchen)	1 gal/day/customer
Food Service	3 gal/meal plus 3 gal/day/employee
Schools (including cafeteria and showers)	3 gal/day/person
Barracks	20-30 gal/day/person
Hospitals	30-50 gal/day/person

[1] "Technical Guidelines for Energy Conservation", AFCEC-TR-77-12, NBSR 77-1238.

The data contained in Tables 3 through 11 were used to derive Table 12. This shows the fixture flow rates and demands which may be used in some engineering calculations.

TABLE 12

ESTIMATED HOT WATER USE FOR VARIOUS TYPES OF ARMY FACILITIES

Building Type	Fixture	Flow Rate Per Fixture	Use Gal. Per Hour Per Fixture	Temperature °F
Single Family Residence	Lavatory	2-1/4	2	105
	Shower/Tub	3/4-1/2	30/20	110
	Dishwasher	3	15	140
	Clothes Washer	3	20	Tepid(a)
Barracks	Lavatory	2-1/4	8	Tepid
	Shower	3	30	110
	Janitorial	3-3/4	20	Tepid
Office, Library, Training Station	Lavatory	2-1/4	6	Tepid
	Janitorial	3-3/4	20	Tepid
Outpost	Lavatory	2-1/4	2	Tepid
Food Service	Sink (Typical Single)	3-3/4	35	110
	Dishwasher	Varies	Varies	140/180
	Lavatory	2-1/4	5	Tepid
	Janitorial	3-3/4	20	Tepid
Hospital	Sink (Typical)	3-3/4	30	110
	Shower/Tub	6	75/20	110
	Therapeutic Shower (Typical)	?	400	110
	Therapeutic Bath (Typical)	?	100	110
	Lavatory	2-1/4	6	Tepid
	Janitorial	3-3/4	20	Tepid
Elementary School	Lavatory	2-1/4	15	Tepid
	Janitorial	3-3/4	20	Tepid
Secondary School	Lavatory	2-1/4	15	Tepid
	Shower	4	225	110
	Laboratory	3-3/4	30	120
	Janitorial	3-3/4	20	Tepid
Mechanical Service	Lavatory	2-1/4	8	Tepid
	Shower	4	75	110

(a) Use cold water laundry detergent

TABLE 13

RATE OF HOT WATER FLOW PER FIXTURE UNIT

Fixture Unit	ASHRAE Design Data	Chronomite Labs Advertising Data
Lavatory	2.25	1
Bath	4.50	1-1/2
Shower	2.75-7.50	2
Washing Machine	3.75	1
Sink	2.25	1

TABLE 14

HOT WATER USE FOR RESIDENTIAL PURPOSES

Function	Hot Water Consumption per Use: ASHRAE Design Data (1)	Hot Water Consumption per Use: Zanker-Forbach Minitherm Advertising
Wash Hands	2 Gal.	3/4 - 1-1/2 Gal.
Bath	20 Gal.	39-47 Gal.
Shower	15 Gal.	8-12 Gal.

[1] ASHRAE Handbook, 1976 Systems, 37.9.

WATER HEATING ENERGY USE AND OPERATING COSTS

General Considerations

There are a number of factors to be considered when selecting new water heaters and when analyzing potential retrofit opportunities. This report is concerned only with the analysis of hot water faucets where the water temperature may be reduced to 105°F. There will, therefore, be no analysis or discussion of other effective energy conservation measures which include the following:

- apply additional insulation to storage water heater tanks,[1]
- reduce service water flow rate,[2]
- insulate hot water service pipes.

The energy used by any water heater will be affected by the following:

- ground or supply water temperature,
- service water temperature requirement,
- quantity of water used,
- standby heat loss,
- line losses,
- efficiency of water heater.

Identification or calculation of each of the above variables will allow one to make a rational comparison of water heater alternatives.

Ground or Supply Water Temperature

This is frequently an uncontrollable variable. Only when point-of-use heaters are used as boosters for storage heaters does a controlled and constant supply temperature enter the calculations.

Service Hot Water Temperature Requirements

General guidelines for hot water temperature are contained in Table 10. These temperatures may be used when comparing water heater alternatives unless, of course, some special temperature requirements pertain. An example of a special requirement might be a photographic processing laboratory. Office buildings and other public facilities which require hot water <u>only for lavatories</u> are a special case as OSHA mandates hot <u>OR</u> tepid water

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[1] Shepherd, P.B.; Performance Evaluation of Point-of-Use Water Heaters; FESA-TS-2081 1980.

[2] ERDA; Insulation Refit Kit for Domestic Water Heaters; PO Nos. WA 76-3813 and WA-76-3814, March 1973.

for lavatories.[1] Tepid is not defined in the regulation but is assumed to be "warm to the touch" and has been defined in this Task Order as 105°F.

Quantity of Water Used

Quantities of water used by various types of service taps may be estimated from Tables 3, 4, 5, 6, 7, and 8. It is recommended that consideration be given to the installation of flow restrictors on showers and lavatory faucets. Showers may be limited to a flow rate of 1-1/2 gallons per minute and lavatories may be reduced to 1/2 gallon per minute. Aerators are recommended to be used in combination with flow restrictors. Comparisons of water heater alternatives should be based on the final, retrofitted flow rates.

Standby Heat Loss

Storage type water heaters all have standby heat losses. Standby heat loss is the loss of heat from the hot water through the jacket or shell of the heater. A study of these standby losses was included in two studies of the insulation retrofit of water heaters.[2, 3] The following two Tables constructed from data in these two reports may be used when calculating the energy use comparisons of water heaters.

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[1] OSHA Safety and Health Standard (29 CFR 1910); General Industry; 1910. 141(2) (ii); 268; November 1978.

[2] ERDA; Insulation Refit Kit for Domestic Water Heaters; March 1977.

[3] Slaughter, G.C. and D.E. Spann, An Efficiency Evaluation and Consumer Economic Analysis of Domestic Water Heaters, Oak Ridge National Laboratory, ORNL/CON-5, September 1978.

TABLE 15

STANDBY HEAT LOSS FROM ELECTRICALLY

HEATED DOMESTIC WATER HEATERS

BTU per Hour[1]

Temperature Difference[2]	Water Heater Capacity, Gal 30	40	50	60
40	250	250	300	300
50	320	320	370	380
60	390	390	440	460
70	460	460	510	540
80	530	530	580	620
90	600	600	650	700

(1) Data presume 1 in. of factory-installed fiber glass shell insulation.

(2) Temperature of water in tank, ^{o}F less air temperature in room where heater is located.

TABLE 16

STANDBY HEAT LOSS FROM GAS

HEATED DOMESTIC WATER HEATERS

BTU per Hour(1)

Temperature Difference	Water Heater Capacity, Gal 40	50
40	700	700
50	800	800
60	1150	1200
70	1350	1420
80	1550	1650
90	1800	2000

(1) Data presume 1 in. of factory-installed fiber glass shell insulation.

(2) Temperature of water in tank, ^{o}F, less air temperature in room where heater is located.

Thus, a 50 gallon gas storage water heater set for 140°F may cost $45.65 per year in standby losses where gas costs $0.367 per therm. Conversely, an electric heater of 50 gallons would cost $65.06 when electricity costs $0.0497 per KWH.

It is important to note that standby losses are not "lost" if the water heater is located in heated space such as a closet or laundry room. Thus, the location of the existing water heater must be considered when preparing the life cycle costing calculations. The cost of standby losses is a real cost which must be accounted for. However, any standby energy losses saved must be replaced by the heating system if the water heater is in conditioned space.

Line Losses

Line losses are difficult to deal with in energy analyses because they are not a static phenomenon. There are design data which have been successfully used for many years and it is recommended that these data be used for water heater energy analyses. The data to be used in calculation are shown in Tables 17 and 18.(1)

[1] ERDA; Insulation Refit Kit for Domestic Water Heaters; March 1977.

TABLE 17

HEAT LOSS FROM COPPER TUBING

BTU Per Hour Per Foot of Length in Air

Tubing Diameter, in.	Tube to Air Temperature Difference, °F			
	50	60	70	80
3/8	10	12	15	18
1/2	13	15	18	22
5/8	15	18	21	26
3/4	17	21	25	30

TABLE 18

HEAT LOSS FROM STEEL PIPE

BTU Per Hour Per Foot of Length in Air

Pipe Diameter, In.	50° Pipe to Air Temperature Difference
1/2	23
3/4	29
1	35

Heat losses from buried hot water pipes are even more difficult to deal with as one must know the apparent thermal conductivity of the soil involved and at its average moisture content and actual density. Soils may have a "k" factor ranging from 4 to 22. The reader is referred to the ASHRAE Handbook for details dealing with heat loss in buried pipes.[1]

Efficiency of Water Heaters

Analysis and consideration of water heater alternatives should recognize the differences in heat transfer efficiency of various types of heaters. These differences are primarily associated with the energy source although not necessarily attributable to that source. Comparative analytical techniques used in this study may employ general, "handbook" efficiencies when authenticated manufacturers' data are not available for specific units. Efficiencies which may be used are displayed in Table 19.

[1] ASHRAE Handbook, 1977 Fundamentals, 22.9.

TABLE 19

TYPICAL EFFICIENCIES OF

DOMESTIC TYPE WATER HEATERS

Type of Heater	Efficiency
Oil-Fired	0.70
Gas-Fired	0.75
Electric	0.95

Calculation of Water Heater Energy Use

The annual energy required to heat water for specific taps within a building may be calculated according to the following equation:

$$H = \frac{8.3 \times V \times N \; (T_O - T_I)}{E}$$

H = annual energy requirement, BTU
V = gallons per day required from tap
N = number of days per year tap is used
T_O = temperature of hot water required from tap, ^oF
T_I = temperature of water entering water heater, ^oF
E = efficiency of water heater

The selection of power rating of instantaneous, point-of-use, electric water heaters may be indicated by the following equation:

$$R = 0.16 \times F \times (T_O - T_I)$$

R = power rating of heaters, kW
F = flow rate from tap, gallons per minute

No general agreement was found concerning the constant multiplier to be used in this equation. A range of values from 0.146 to 0.184 could be justified based on the various inputs obtained during this study.

Inputs for the two equations in this section may be obtained from actual measurements made at taps being considered for retrofit. Alternatively, the tables contained on pages through may be consulted for typical data. The use of typical data, taken from these tables, is acceptable for use in comparative analyses such as making a "yes" or "no" retrofit decision or in selecting between two or more alternate candidates for new water heaters.

Annual water heater energy use by remote and/or storage water heaters must also include standby and/or line losses as was previously discussed. The calculation of estimated total annual energy use is illustrated in the Appendix A.

RESULTS

The computer simulations of building heated water supply system alternatives produce somewhat mixed results. However, two inexpensive methods of energy conservation prevail for all simulations. These methods are flow restriction at all fixtures and installation of retrofit insulation blankets on central water heaters. Both methods are proven energy savers for all heated water supply systems and their installation will provide cost effective energy conservation in all cases.

The alternative supply system which resulted in the cheapest 10 year life cycle cost (and many times, the cheapest annual energy cost) in the majority of the simulations is the computer program supply system model three. System model three requires only the lowering of the central heater storage tank hot water temperature (140F) to a tepid temperature (approximately 105F). In buildings requiring only a tepid or lower temperature water supply, this system was the best alternative in most cases. This is especially true in existing buildings being studied for retrofit of the hot water supply systems.

The alternative supply system which requires the lowering of the central heater water temperature to a tepid temperature and supplying only tepid water to faucets (system model four) was found to have the lowest life cycle cost only under certain conditions and only in new construction simulations.

These certain conditions involve the estimation of increased use of tepid water at the faucets with no cold supply. From the simulation output it is seen that, depending on the location (varying fuel costs), an estimated increase in overall tepid water use of 0 percent to 30 percent can eliminate this supply system alternative as the system with the cheapest life cycle cost. The installation cost savings for unused plumbing in new constructions must be greater than the energy use penalties incurred (due to increase tepid use) during the life cycle, for this supply system to result in the cheapest alternative. Due to the fact that only small credit amounts, or no credit amounts, can be obtained in retrofit cases, this system alternative is not a good system to apply in existing buildings.

Supplying only tepid water to a building (excluding the cold water supply), as it might be imagined, creates a large increase in water heating requirements. The energy use penalties created by supplying tepid water to toilets and water coolers are too great to be overcome by the new construction cost savings for unneeded plumbing, during the life cycle. In fact, the energy use penalties may overshadow the cost savings in the first year of operation. These penalties create an even worse picture in retrofit cases where only small or no returned plumbing credits occur.

It is suggested that this type of alternative supply system be ignored in all future considerations.

As in the previous point-of-use heater study[(1)], the simulation results reveal that the installation of point-of-use heaters may reduce annual water heating energy costs but they usually increase the total life cycle cost. This is due to the high point-of-use heater costs. Only in regions where the cost of electricity is low compared to natural gas and fuel oil costs, does the point-of-use heater heated water supply system become a feasible alternative (for buildings requiring a tepid temperature maximum water supply). This also occurs only when new construction is being considered, where money can be saved on unused plumbing. (A heated water pipe is not needed in this type of supply system.) Retrofit installation costs of the point-of-use heaters will almost always be too great for consideration of this type of supply system in existing buildings.

There is one exception in the study of the point-of-use heater supply system alternative. This exception occurs when an electric central heater is being used. In this case, the higher the cost of electricity the more attractive the point-of-use heater alternative becomes. This exception applies to both retrofit and new construction analysis. It must be reiterated that if point-of-use heaters are considered, flow restriction <u>must</u> be incorporated for the point-of-use heaters to meet heating and demand requirements.

Supplying only tepid water to faucets in a point-of-use heater water supply system will only create a more expensive system. This is illustrated by system model six in the computer program printed output.

The case where a building requires hot water only at certain faucets is simulated in the exchange building type simulation. Results indicate that if demand is great enough at

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[1] Shepherd, P.B.; Performance Evaluation of Point-of-Use Water Heaters; FESA-TS-2081 1980.

the faucet requiring hot water, then the best alternative is to leave the central heater water storage temperature on hot, and install flow restriction and an insulation blanket on the central heater. However, in areas where the cost of electricity is competitive to the cost of natural gas and/or fuel oil, another of the alternative systems becomes more attractive. This alternative calls for lowering the temperature of the central heater water to tepid and installing a point-of-use heater as needed. In the case of the simulations, this means installing a point-of-use heater on the janitorial sink. Of course, flow restriction is a must under these conditions.

CONCLUSIONS

Energy may be saved on a cost effective basis in lavatory and janitorial hot water systems.

These actions are always effective in reducing energy use and life-cycle costs.

Set central water heater temperature at 105F.

Install flow restrictions in lavatory faucets.

Add supplemental insulation to central water heaters.

Other potentially desirable methods for reducing energy use and cost should be analyzed for local fuel and installation costs using a simple method given in Appendix A.

RECOMMENDATIONS

Reduce central heater temperature to 105F wherever these heaters serve only lavatory and/or janitorial faucets.

Install flow restrictors in all lavatory faucets.

Install insulation blankets on the outside shell of central water heaters.

Implement additional, candidate conservation measures only after analyzing the energy and cost effectiveness of each according to the method given in Appendix A.

APPENDIX A

ENERGY CALCULATIONS AND LIFE CYCLE COST ANALYSIS

Fortunately a computer is not required for occasional, comparative analyses of heated water supply system alternatives. A simple step-by-step manual method has been devised for use by Facilities Engineers. The method which will be discussed is adapted from the computer simulation program mathematical model to allow for a simple analysis. As in the computer program, this method is strictly for comparative analysis of supply system alternatives. The manual calculations are summarized on pages 58-61.

The alternative building heated water supply system manual analysis method is divided into six general areas of calculation. These areas are, as in the computer program:

- Heated Water Line Heat Losses,
- Fixture Demands,
- Central Heater Heat Use and Losses,
- Point-of-Use Heater Heat Use and Losses,
- Energy Uses, Energy and Installation Costs,
- Life Cycle Costs.

Before beginning the calculations it is suggested that some time be taken to gather all information needed to do the analysis (refer to the Input Description Section). A Survey Table has been constructed to aid in the gathering of information. This Table, shown on page 62, states what information is required and how to obtain the information.

The analysis follows the step-by-step method:

A. Heated Water Line Heat Losses.

1. Determination of total heated line length using the equation,

$$\ell_T = \ell + \ell_{TWC} + \ell_{TTU}, \tag{44}$$

where

ℓ_T is the total heated line length (feet),

ℓ is the normal heated line length in a hot and cold supply system (feet),

ℓ_{TWC} is the total additional line length to all water coolers in a no cold supply system (feet),

ℓ_{TTU} is the total additional line length to all toilets and urinals in a no cold supply system (feet), The total heated line length can be determined. In the traditional, hot and cold supply system ℓ_T will equal ℓ. However, if the cold supply lines are removed then heated water is supplied to all the fixtures, creating additional line heat losses. In alternative systems supplying only tepid water, the ℓ_{TWC} and ℓ_{TTU} adjustments must be made to the heated line length.

2. Line heat losses to the "environment".
Line heat losses to the "environment" can be obtained from Table 20. The contents of Table 20 were computed using Equation (2) of the computer mathematical model. Remember, some or all of the heated water lines may be located in unconditioned space. These heat losses in unconditioned space do not contribute to conditioned space heating. Also, heat loss of this type in conditioned space is calculated using the temperature difference between the hot or tepid water temperature and room temperature. In unconditioned space the temperature difference is between the hot or tepid water temperature and ambient temperature.

The total water line heat loss to the "environment" is found using,

$$q_{LE1} = \ell_{TC} \times q_{HEC} \times n_{CC} \tag{45}$$

$$q_{LE2} = \ell_{TU} \times q_{HEU} \times n_{CC} \tag{46}$$

where

q_{LE1} is the line heat loss to the "environment" in conditioned space (BTU/DAY).

q_{LE2} is the line heat loss to the "environment" in unconditioned space (BTU/DAY).

ℓ_{TC} is the total heated water line length in conditioned space (feet),

q_{HEC} is the heat loss in conditioned space from Table 20 (BTU/Cooldown Cycle/Feet),

ℓ_{TU} is the total heated water line length in unconditioned space (feet),

q_{HEU} is the heat loss in unconditioned space from Table 20 (BTU/Cooldown Cycle/Feet),

n_{CC} is the number of cooldown cycles per day.

The total water line heat loss to the "environment" is,

$$q_{TLE} = q_{LE1} + q_{LE2}. \tag{47}$$

However, only q_{LE1} will contribute to conditioned space heating.

TABLE 20

HEATED WATER PIPE HEAT LOSS TO THE "ENVIRONMENT" BTU PER COOLDOWN CYCLE PER FOOT OF LENGTH IN AIR

COPPER

PIPE TO AIR TEMPERATURE DIFFERENCE, °F

Nominal Inside Diameter (In)	Actual (4) Inside Diameter (In)	10	20	30	40	50	60	70	80	90	100	110
1/2	0.545	1.01	2.02	3.03	4.04	5.05	6.06	7.07	8.08	9.09	10.10	11.11
3/4	0.785	2.09	4.19	6.28	8.38	10.47	12.57	14.66	16.76	18.85	20.95	23.04
1	1.025	3.57	7.14	10.71	14.28	17.86	21.43	25.00	28.57	32.14	35.71	39.28
1 1/4	1.265	5.44	10.88	16.32	21.76	27.20	32.63	38.07	43.51	48.95	54.39	59.83
1 1/2	1.505	7.70	15.40	23.10	30.80	38.49	46.19	53.89	61.59	69.29	76.99	84.69
2	1.985	13.39	26.79	40.18	53.57	66.96	80.36	93.75	107.14	120.54	133.93	147.32

STEEL

Nominal Inside Diameter (In)	Actual Inside Diameter (In)											
1/2	0.622	1.32	2.63	3.95	5.26	6.58	7.89	9.21	10.52	11.84	13.15	14.47
3/4	0.824	2.31	4.62	6.92	9.23	11.54	13.85	16.15	18.46	20.77	23.08	25.39
1	1.049	3.74	7.48	11.22	14.96	18.70	22.44	26.18	29.92	33.66	37.40	41.14
1 1/4	1.380	6.47	12.95	19.42	25.89	32.37	38.84	45.31	51.78	58.26	64.73	71.20
1 1/2	1.610	8.81	17.62	26.43	35.24	44.05	52.86	61.67	70.48	79.29	88.11	96.92
2	2.067	14.52	29.04	43.57	58.09	72.61	87.13	101.66	116.18	130.70	145.22	159.74

3. Line heat losses "down the drain".
Table 20 is also to be used to find the "down the drain" heat losses. Heated water lines in conditioned space are calculated using the temperature difference between room temperature and the ground water supply temperature. The temperature difference for lines in unconditioned space is between ambient temperature and the ground water supply temperature. Total heat loss "down the drain" for the water lines is,

$$q_{TLD} = \{(\ell_{TC} \times q_{HDC}) + (\ell_{TU} \times q_{HDU})\} \times n_{CC} \qquad (48)$$

where

q_{TLD} is the total line heat loss "down the drain" (BTU/Day),

ℓ_{TC} is the total heated water line length in conditioned space (feet),

q_{HDC} is the heat loss in conditioned space from Table 20 (BTU/Cooldown Cycle/Feet),

ℓ_{TU} is the total heated water line length in unconditioned space (feet),

q_{HDU} is the heat loss in unconditioned space from Table 20 (BTU/Cooldown Cycle/Feet),

n_{CC} is the number of cooldown cycles.

Line heat losses "down the drain" do <u>not</u> contribute to conditioned space heating as the name implies.

4. "Convective" water line heat losses.
Table 21 contains "convective" heat loss information for the heated water lines. Equation (6) of this computer program mathematical model was used to calculate Table 21 contents. "Convective" heat losses in conditioned space contribute to space heating. And, as with heat losses to the "environment", the conditioned space "convective" heat loss is calculated using the temperature difference between the hot or tepid water temperature and room temperature. The temperature difference for unconditioned space water lines is between hot or tepid water and ambient temperature.

TABLE 21

HEATED WATER PIPE "CONVECTIVE" HEAT LOSS
BTU PER HOUR PER FOOT OF LENGTH IN AIR (*)

COPPER — PIPE TO AIR TEMPERATURE DIFFERENCE, °F

Nominal Inside Diameter (In)	Actual (**) Outside Diameter (In)	10	20	30	40	50	60	70	80	90	100	110
1/2	0.670	0.93	2.21	3.68	5.27	6.96	8.74	10.60	12.53	14.51	16.56	18.65
3/4	0.910	1.17	2.79	4.62	6.63	8.76	11.00	13.34	15.76	18.26	20.83	23.47
1	1.150	1.40	3.32	5.51	7.90	10.44	13.11	15.90	18.78	21.76	24.83	27.97
1 1/4	1.390	1.61	3.83	6.35	9.10	12.03	15.11	18.33	21.65	25.09	28.62	32.24
1 1/2	1.630	1.81	4.31	7.16	10.26	13.56	17.03	20.65	24.40	28.27	32.25	36.33
2	2.110	2.20	5.24	8.69	12.45	16.46	20.67	25.06	29.61	34.31	39.14	44.09

STEEL

Nominal Inside Diameter (In)	Actual Outside Diameter (In)	10	20	30	40	50	60	70	80	90	100	110
1/2	0.747	1.01	2.40	3.99	5.71	7.55	9.49	11.50	13.59	15.75	17.96	20.24
3/4	0.949	1.21	2.88	4.77	6.84	9.04	11.35	13.75	16.26	18.84	21.50	24.22
1	1.174	1.42	3.37	5.60	8.02	10.60	13.32	16.15	19.08	22.10	25.22	28.41
1 1/4	1.505	1.71	4.06	6.74	9.66	12.77	16.04	19.45	22.98	26.63	30.38	34.22
1 1/2	1.735	1.90	4.52	7.50	10.75	14.21	17.85	21.64	25.57	29.63	33.80	38.07
2	2.192	2.26	5.39	8.94	12.81	16.93	21.27	25.79	30.47	35.31	40.28	45.37

* Assuming no insulation.
** Assuming a 1/8 inch pipe wall thickness.

After determining the "convective" heat loss per foot of pipe from Table 21 total "convective" heat loss is easily calculated by,

$$q_{LC1} = q_{HCC} \times \ell_{TC} \tag{49}$$

$$q_{LC2} = q_{HCU} \times \ell_{TU} \tag{50}$$

$$q_{TLC} = q_{LC1} + q_{LC2} \tag{51}$$

where

q_{LC1} is the "convective" heat loss for lines in conditioned space (BTU/HR),

q_{LC2} is the "convective" heat loss for lines in unconditioned space (BTU/HR),

q_{TLC} is the total pipe "convective" heat losses (BTU/HR),

q_{HCC} is the "convective" heat loss for lines in conditioned space from Table 21 (BTU/HR/Feet),

ℓ_{TC} is the length of pipe in conditioned space (feet),

q_{HCU} is the "convective" heat loss for lines in unconditioned space from Table 21 (BTU/HR/Feet),

ℓ_{TU} is the length of pipe in unconditioned space (feet),

Only q_{LC1} contributes to conditioned space heating, even though q_{LC1} and q_{LC2} are combined to find the total "convective" heat loss for the water lines.

All heated water pipe heat losses will be combined with heater energy use and heat losses to calculate total energy uses.

B. Fixture Demands.

1. Fixture use demands.
Hot water demands for faucets are calculated by,

$$g_{Hi} = u_{Hi} \times n_{Fi} \tag{52}$$

where

g_{Hi} is the hot water demand per fixture Type i (GPM),

u_{Hi} is the estimated hot water usage per fixture of Type i (GPH),

n_{Fi} is the number of fixtures of Type i.

Estimated hot water usage per fixture information was obtained from previous studies.(1) This information is repeated on pages 10 to 23. Supplying only tepid water to some fixtures may increase the heated water use of the fixtures (i.e. lavatory and janitorial faucets). This increase may occur from use of tepid water for cold water purposes. Some judgment must be incorporated in determining the increased tepid water use. Lavatory faucets may not realize any significant increase in the use of tepid water, whereas, janitorial faucets will probably have a noticeable increase in tepid use.

To properly estimate heated water usage in a building with no cold supply system (i.e. tepid water supplied to all fixtures), demand must be calculated for toilets, urinals, water cooler, etc. These demands, which are normally cold water demands, can be calculated by,

$$g_{Ci} = u_{Ci} \times n_{Fi} \quad (53)$$

where

g_{Ci} is the cold water demand per fixture Type i (GPH),

u_{Ci} is the estimated cold water usage per fixture of Type i (GPH),

n_{Fi} is the number of fixtures of Type i.

2. Water cooler energy use.
With cold water supply, water cooler energy use is not a significant factor in this study. However, when no cold water supply is available and tepid water is supplied, the energy used by water coolers is greatly increased. The increase in energy use is so great that water cooler energy demand becomes an important factor in the analysis of the alternative water supply systems. Table 22 gives water cooler energy use information. The data in Table 22 is created from equation (10) of the computer program mathematical model, which is a simple approach to estimating the energy use. By no means does the equation depict precise water cooler energy use. The temperature difference will either be between a ground water supply and the cooler outlet temperature or between a tepid supply and the cooler outlet temperature. Due to the fact that water cooler compressors

[1] Shepherd, P.B.; Performance Evaluation of Point-of-Use Water Heaters; FESA-TS-2081, 1980.

may have different efficiencies, the Table gives results based on compressor efficiencies from 50 percent to 95 percent.

TABLE 22

WATER COOLER ENERGY USE ESTIMATION
BTU PER GALLON

COMPRESSOR EFFICIENCY	TEMPERATURE DIFFERENCE (F)									
(%)	5	10	20	30	40	50	60	70	80	90
50	83.31	166.62	333.24	499.86	666.48	833.10	999.72	1166.34	1332.96	1499.58
55	75.74	151.47	302.95	454.42	605.89	757.36	908.84	1060.31	1211.78	1363.25
60	69.43	138.85	277.70	416.55	555.40	694.25	833.10	971.95	1110.80	1249.65
65	64.08	128.17	256.34	384.51	512.68	640.85	769.02	897.18	1025.35	1153.52
70	59.51	119.01	238.03	357.04	476.06	595.07	714.09	833.10	952.11	1071.13
75	55.54	111.08	222.16	333.24	444.32	555.40	666.48	777.56	888.64	999.72
80	52.07	104.14	208.27	312.41	416.55	520.69	624.82	728.96	833.10	937.24
85	49.01	98.01	196.02	294.04	392.05	490.06	588.07	686.08	784.09	882.11
90	46.28	92.57	185.13	277.70	370.27	462.83	555.40	647.97	740.53	833.10
95	43.85	87.69	175.39	263.08	350.78	438.47	526.17	613.86	701.56	789.25

Once an energy use has been selected from Table 22, the total water cooler energy use can be calculated. The equation to do so is,

$$E_{WC} = q_{WC} \times g_{Ci} \qquad (54)$$

where

E_{WC} is the total energy use by all water coolers (BTU/HR),

q_{WC} is the energy use by a water cooler from Table 22 (BTU/HR),

g_{Ci} is the water demand from equation (53) (GPH).

Fixture demands and water cooler energy use values will be used to find central heater and point-of-use energy consumptions and annual energy use.

C. Central Heater Energy Use and Heat Losses.
A simple, straight-forward approach is also used in determining central heater use and standby losses.

1. Central heater energy use due to fixture demands. Equation (11) of the computer program mathematical model is used to construct Table 23. The Table gives an estimation of central heater use due to fixture demands based on the efficiency of different central heaters. The temperature difference will either be between hot water and ground water temperature, or between tepid water and ground water temperature. Notice that Table 23 contains many of the same values as Table 22.

TABLE 23

CENTRAL HEATER ENERGY USE DUE TO FIXTURE DEMANDS
BTU/GAL

CENTRAL (2) HEATER EFFICIENCY (%)	TEMPERATURE DIFFERENCE (F) (1)										
	10	20	30	40	50	60	70	80	90	100	110
60	138.85	277.70	416.55	555.40	694.25	833.10	971.95	1110.80	1249.65	1388.50	1527.35
65	128.17	256.34	384.51	512.68	640.85	769.02	897.18	1025.35	1153.52	1281.69	1409.86
70	119.01	238.03	357.04	476.06	595.07	714.09	833.10	952.11	1071.13	1190.14	1309.16
75	111.08	222.16	333.24	444.32	555.40	666.48	777.56	888.64	999.72	1110.80	1221.88
80	104.14	208.27	312.41	416.55	520.69	624.82	728.96	833.10	937.24	1041.38	1145.51
85	98.01	196.02	294.04	392.05	490.06	588.07	686.08	784.09	882.11	980.12	1078.13
90	92.57	185.13	277.70	370.27	462.83	555.40	647.97	740.53	833.10	925.67	1018.23
95	87.69	175.39	263.08	350.78	438.47	526.17	613.86	701.56	789.25	876.95	964.64

(1) Subtract incoming water temperature from water temperature delivered by heater.

(2) If heater efficiency is not known, use the following:

electric heater - 95%
gas heater - 75%
oil heater - 70%

Central heater energy demand is simply calculated by,

$$q_{CHi} = q_{CH} \times g_{Hi} \tag{55}$$

$$q_{TCH} = \Sigma^{(*)} q_{CHi} \tag{56}$$

where

q_{CHi} is the central heater energy demand per fixture Type i (BTU/HR),

q_{TCH} is the total central heater energy demand (BTU/HR),

q_{CH} is the central heater energy use from Table 23 (BTU/GAL),

g_{Hi} is the fixture demand per fixture Type i (GPH).

2. Central heater standby losses.
Tables 24 and 25 contain standby loss information for electric and natural gas-fired central heaters, based on Equation (14) of the mathematical model. Because standby loss depends on the surface area of the storage tank, the height and diameter of the storage tank must be known. The temperature difference will be calculated from hot or tepid water temperature to room or ambient temperature. Room temperature is used if the central heater is located in conditioned space. The Tables are also based on an insulation R-value of 2.5 (approximately 1 inch of fiberglass insulation). Natural gas-fired heater standby losses values will also be used for fuel oil-fired heaters.

(*) The symbol Σ denotes the summation (addition) of all values.

TABLE 24

ELECTRIC CENTRAL HEATER STORAGE TANK STANDBY LOSSES
BTU/HR

CAPACITY (GAL)	HEIGHT (IN)	DIAMETER (IN)	TEMPERATURE DIFFERENCE (F) 10	20	30	40	50	60	70	80	90	100	110
30	100.00	9.39	85.76	171.51	257.27	343.03	428.79	514.54	600.30	686.06	771.81	857.57	943.33
	80.00	10.50	78.07	156.14	234.21	312.29	390.36	468.43	546.50	624.57	702.64	780.71	858.79
	60.00	12.13	69.86	139.72	209.58	279.44	349.30	419.15	489.01	558.87	628.73	698.59	768.45
	40.00	14.85	61.42	122.84	184.27	245.69	307.11	368.53	429.95	491.38	552.80	614.22	675.64
	20.00	21.00	55.87	111.73	167.60	223.47	279.33	335.20	391.07	446.93	502.80	558.67	614.53
	10.00	29.70	64.37	128.75	193.12	257.49	321.86	386.24	450.61	514.98	579.36	643.73	708.10
40	100.00	10.85	99.71	199.42	299.13	398.84	498.56	598.27	697.98	797.69	897.40	997.11	1096.82
	80.00	12.13	91.01	182.02	273.02	364.03	455.04	546.05	637.06	728.07	819.07	910.08	1001.09
	60.00	14.00	81.81	163.62	245.43	327.25	409.06	490.87	572.68	654.49	736.30	818.12	899.93
	40.00	17.15	72.64	145.28	217.93	290.57	363.21	435.85	508.50	581.14	653.78	726.42	799.06
	20.00	24.25	67.95	135.89	203.84	271.78	339.73	407.67	475.62	543.56	611.51	679.45	747.40
	10.00	34.30	81.20	162.41	243.61	324.81	406.02	487.22	568.42	649.63	730.83	812.03	893.24
50	100.00	12.13	112.16	224.31	336.47	448.63	560.79	672.94	785.10	897.26	1009.42	1121.57	1233.73
	80.00	13.56	102.60	205.19	307.79	410.39	512.98	615.58	718.17	820.77	923.37	1025.96	1128.56
	60.00	15.66	92.60	185.19	277.79	370.39	462.98	555.58	648.17	740.77	833.37	925.96	1018.56
	40.00	19.17	82.91	165.82	248.73	331.63	414.54	497.45	580.36	663.27	746.18	829.09	912.00
	20.00	27.12	79.35	158.70	238.05	317.40	396.75	476.10	555.45	634.80	714.15	793.50	872.85
	10.00	38.35	97.56	195.11	292.67	390.23	487.79	585.34	682.90	780.46	878.02	975.57	1073.13

TABLE 25

NATURAL GAS-FIRED CENTRAL HEATER STORAGE TANK STANDBY LOSSES
BTU/HR

CAPACITY (GAL)	HEIGHT (IN)	DIAMETER (IN)	TEMPERATURE DIFFERENCE (F) 10	20	30	40	50	60	70	80	90	100	110
30	100.00	9.39	248.70	497.39	746.09	994.78	1243.48	1492.17	1740.87	1989.57	2238.26	2486.96	2735.65
	80.00	10.50	226.41	452.81	679.22	905.63	1132.04	1358.44	1584.85	1811.26	2037.66	2264.07	2490.48
	60.00	12.13	202.59	405.18	607.77	810.36	1012.96	1215.55	1418.14	1620.73	1823.32	2025.91	2228.50
	40.00	14.85	178.12	356.25	534.27	712.50	890.62	1068.75	1246.87	1424.99	1603.12	1781.24	1959.37
	20.00	21.00	162.01	324.03	486.04	648.05	810.07	972.08	1134.09	1296.10	1458.12	1620.13	1782.14
	10.00	29.70	186.68	373.36	560.04	746.72	933.41	1120.09	1306.77	1493.45	1680.13	1866.81	2053.49
40	100.00	10.85	289.16	578.32	867.49	1156.65	1445.81	1734.97	2024.13	2313.30	2602.46	2891.62	3180.78
	80.00	12.13	263.92	527.85	791.77	1055.69	1319.62	1583.54	1847.47	2111.39	2375.31	2639.24	2903.16
	60.00	14.00	237.25	474.51	711.76	949.02	1186.27	1423.52	1660.78	1898.03	2135.28	2372.54	2609.79
	40.00	17.15	210.66	421.32	631.99	842.65	1053.31	1263.97	1474.64	1685.30	1895.96	2106.62	2317.29
	20.00	24.25	197.04	394.08	591.12	788.16	985.21	1182.25	1379.29	1576.33	1773.37	1970.41	2167.45
	10.00	34.30	235.49	470.98	706.47	941.96	1177.45	1412.94	1648.43	1883.92	2119.41	2354.90	2590.39
50	100.00	12.13	325.26	650.51	975.77	1301.02	1626.28	1951.54	2276.79	2602.05	2927.30	3252.56	3577.82
	80.00	13.56	297.53	595.06	892.59	1190.12	1487.65	1785.18	2082.71	2380.24	2677.76	2975.29	3272.82
	60.00	15.66	268.53	537.06	805.59	1074.12	1342.65	1611.18	1879.71	2148.24	2416.77	2685.29	2953.82
	40.00	19.17	240.44	480.87	721.31	961.74	1202.18	1442.61	1683.05	1923.48	2163.92	2404.35	2644.79
	20.00	27.12	230.11	460.23	690.34	920.46	1150.57	1380.68	1610.80	1840.91	2071.02	2301.14	2531.25
	10.00	38.35	282.92	565.83	848.75	1131.66	1414.58	1697.50	1980.41	2263.33	2546.25	2829.16	3112.08

No additional calculations are needed to find the central heater standby losses. The value can be obtained directly from the Tables. However, the effects of altering insulation R-value of the central heater can be studied by using Equation (14) to calculate the central heater standby losses with different R-values. From previous studies,[1] it was shown that increased central heater insulation can greatly reduce standby losses and, therefore, reduce energy consumption.

If the central heater is located in conditioned space then the standby losses will contribute to space heating. This contribution is significant and should be considered in the analysis. (This contribution will be non-existent in heated water supply systems containing no central heater.)

D. Point-of-Use Heater Energy Use and Heat Losses.

1. Energy use due to fixture demand.
   Point-of-use heater energy use due to fixture demand can be determined using information obtained from Table 23 (Point-of-use heaters can be considered as having an efficiency of 95% (electric).) Once a value has been selected from Table 23 the total point-of-use heater demand is calculated by,

$$q_{PHi} = q_{PH} \times g_{Hi} \tag{57}$$

$$q_{TPH} = \Sigma^{(*)}\ q_{PHi} \tag{58}$$

   where

   q_{PHi} is the point-of-use energy demand for fixture Type i (BTU/HR),

   q_{TPH} is the total point-of-use energy demand (BTU/HR),

   q_{PH} is the point-of-use energy use from Table 23 (BTU/GAL),

   g_{Hi} is the heated water demand for fixture Type i (GPH).

2. Instantaneous heater power ratings, minimum and maximum output temperatures.

(*) The symbol Σ denotes the summation (addition) of all values.

[1] Shepherd, P.B.; Performance Evaluation of Point-of-Use Water Heaters; FESA-TS-2081 1980.

If instantaneous type of point-of-use heaters are to be studied then power ratings, and minimum and maximum outlet temperatures must be determined. Table 26 is calculated from Equation (17) of the mathematical model, to allow for easy estimation of the power rating required to meet the specifications. Table 26 contains the same data found in a previous study on point-of-use heaters.[1] The temperature difference is calculated from hot or tepid temperature to either tepid or ground water temperature. Flow restriction is utilized to produce lower tap flow rates.

[1] *Ibid.*

TABLE 26

REQUIRED KILOWATT RATING FOR INSTANT WATER HEATERS

TAP FLOW RATE (GPM)	TEMPERATURE DIFFERENCE (F) 20	40	60	80	100
1/2	1.6	3.2	4.3	6.4	8.0
1	3.2	6.4	9.6	12.8	16.0
1 1/2	4.8	9.6	14.4	19.2	--
2	6.4	12.8	19.4	--	--
2 1/2	8.0	16.0	--	--	--
3	9.6	19.2	--	--	--
3 1/2	11.2	--	--	--	--
4	12.8	--	--	--	--

Table 26 entries to the left and above the stepped line are the only power ratings which 110 volt service may be used. Due to the factor that presently the maximum instant water power rating is 20 KW, all entries greater than 20 KW are excluded. After selecting the proper power rating the minimum and maximum instant water heater outlet temperatures must be checked. This fluctuation in outlet temperature is due to the variation in ground water temperature during the year. (Instantaneous heaters receiving a constant tepid supply will have a constant outlet temperature.) Minimum and maximum instantaneous heater outlet temperatures can be calculated by,

$$t_{CPHi} = P_i/(0.16 \times f_{RTi}) + t_{CGT} \tag{59}$$

$$t_{HPHi} = P_i/(0.16 \times f_{RTi}) + t_{HGT} \tag{60}$$

where

t_{CPHi} is the minimum instantaneous heater outlet temperature for fixtures of Type i (F),

t_{HPHi} is the maximum instantaneous heater outlet temperature for fixtures of Type i (F),

P_i is the power rating selected from Table 26 (KW),

f_{RTi} is the flow rate of the faucet (GPM),

t_{CGT} is the minimum ground water temperature (F),

t_{HGT} is the maximum ground water temperature (F).

These minimum and maximum heater outlet temperatures must fall within a certain range for the instantaneous heater to be a feasible alternative.

3. Mini-storage tank standby losses.
When mini-storage tank type point-of-use heaters have been selected for study, the standby heat losses from the tanks must be calculated. Mini-storage tank heat loss information can be found in Table 27. Table 27 data was calculated using the same equation as that used to create Table 24 (electric heater standby losses). The point-of-use mini-tank heaters are assumed to have an insulation R-value of 2.5 (same as the central heater assumption). The same guidelines for central heater standby loss analysis apply for the point-of-use mini-tank standby losses, except for the assumption that mini-tank hot water temperature is kept at 190°F.

TABLE 27

MINI-STORAGE TANK STANDBY LOSSES
BTU/HR

½ GALLON CAPACITY:

HEIGHT (IN)	DIAMETER (IN)	TEMPERATURE DIFFERENCE (F) 60	70	80	90	100	110	120	130	140	150	160
10.00	3.83	23.91	27.90	31.88	35.87	39.85	43.84	47.82	51.81	55.79	59.78	63.76
9.00	4.04	23.31	27.19	31.08	34.96	38.85	42.73	46.62	50.50	54.39	58.27	62.16
8.00	4.29	22.75	26.55	30.34	34.13	37.92	41.72	45.51	49.30	53.09	56.89	60.68
7.00	4.58	22.28	26.00	29.71	33.42	37.14	40.85	44.56	48.28	51.99	55.71	59.42
6.00	4.95	21.95	25.61	29.27	32.93	36.59	40.25	43.91	47.57	51.22	54.88	58.54
5.00	5.42	21.88	25.53	29.18	32.82	36.47	40.12	43.76	47.41	51.06	54.70	58.35
4.00	6.06	22.31	26.02	29.74	33.46	37.18	40.90	44.61	48.33	52.05	55.77	59.49
3.00	7.00	23.81	27.78	31.75	35.72	39.69	43.66	47.63	51.59	55.56	59.53	63.50
2.00	8.57	28.21	32.91	37.61	42.31	47.01	51.71	56.42	61.12	65.82	70.52	75.22
1.00	12.13	44.82	52.28	59.75	67.22	74.69	82.16	89.63	97.10	104.57	112.04	119.51

1 GALLON CAPACITY:

HEIGHT (IN)	DIAMETER (IN)											
20.00	3.83	43.97	51.30	58.63	65.96	73.29	80.62	87.95	95.28	102.61	109.94	117.27
18.00	4.04	42.34	49.40	56.46	63.51	70.57	77.63	84.69	91.74	98.80	105.86	112.91
16.00	4.29	40.70	47.48	54.27	61.05	67.83	74.62	81.40	88.18	94.97	101.75	108.53
14.00	4.58	39.07	45.58	52.09	58.60	65.11	71.63	78.14	84.65	91.16	97.67	104.18
12.00	4.95	37.49	43.74	49.99	56.24	62.49	68.74	74.99	81.24	87.49	93.74	99.99
10.00	5.42	36.07	42.08	48.09	54.10	60.11	66.13	72.14	78.15	84.16	90.17	96.18
8.00	6.06	35.00	40.83	46.66	52.49	58.33	64.16	69.99	75.83	81.66	87.49	93.32
6.00	7.00	34.80	40.60	46.40	52.20	58.00	63.80	69.60	75.41	81.21	87.01	92.81
4.00	8.57	37.18	43.38	49.57	55.77	61.97	68.16	74.36	80.56	86.76	92.95	99.15
2.00	12.13	51.16	59.69	68.21	76.74	85.27	93.79	102.32	110.85	119.37	127.90	136.43

Total point-of-use mini-tank standby losses are calculated by,

$$q_{SPH\frac{1}{2}i} = q_{SPH\frac{1}{2}} \times n_{Fi} \tag{61}$$

$$q_{SPH1i} = q_{SPH1} \times n_{Fi} \tag{62}$$

$$q_{TSPH} = \Sigma \text{ (All } q_{SCH\frac{1}{2}i} \underline{\text{ OR }} q_{SCH1i} \text{ involved in the particular study)} \tag{63}$$

where

$q_{SPH\frac{1}{2}i}$, q_{SPH1i} are the ½ and 1 gallon mini-tank standby losses for fixture Type i (BTU/HR),

$q_{SPH\frac{1}{2}}$, q_{SPH1} are the ½ and 1 gallon mini-tank standby losses from Table 27 (BTU/HR),

n_{Fi} is the number of fixtures of Type i,

q_{TSPH} is the total point-of-use mini-tank standby losses (BTU/HR).

In most cases the point-of-use mini-storage tank heater will be located in conditioned space and the standby losses will contribute to space heating. Standby losses should be small enough to ignore in this case.

E. & F. Annual Energy Uses, Energy and Installation Costs, and Life Cycle Cost Analysis.
At this point the step-by-step method of analysis follows the mathematical model exactly (refer to Equations (27) through (43)). The remainder of the analysis should be accomplished using Equations (27) through (43).

To summarize the step-by-step analysis method for heated water supply system alternatives:

A. Heated Water Line Heat Losses.

1. Total line length.

$$\ell_T = \ell + \ell_{TWC} + \ell_{TTU} \tag{44}$$

2. Line heat losses to the "environment".

$$q_{LE1} = \ell_{TC} \times q_{HEC} \times n_{CC} \tag{45}$$

$$q_{LE2} = \ell_{TU} \times q_{HEU} \times n_{CC} \tag{46}$$

$$q_{TLE} = q_{LE1} + q_{LE2} \qquad (47)$$

(q_{HEC} & q_{HEU} from Table 20)

3. Line heat losses "down the drain".

$$q_{TLD} = \{(\ell_{TC} \times q_{HDC}) + (\ell_{TU} + q_{HDU})\} \times n_{CC} \qquad (48)$$

(q_{HDC} & q_{HDU} from Table 20)

4. Line "convective" heat losses.

$$q_{LC1} = q_{HCC} \times \ell_{TC} \qquad (49)$$

$$q_{LC2} = q_{HCU} \times \ell_{TU} \qquad (50)$$

$$q_{TLC} = q_{LC1} + q_{LC2} \qquad (51)$$

(q_{HCC} & q_{HCU} from Table 21)

B. Fixture Demands.

1. Fixture use.

$$g_{Hi} = u_{Hi} \times n_{Fi} \qquad (52)$$

$$g_{Ci} = u_{Ci} \times n_{Fi} \qquad (53)$$

2. Water cooler energy use.

$$E_{WC} = q_{WC} \times g_{Ci} \qquad (54)$$

(q_{WC} from Table 22)

C. Central Heater Energy Use and Heat Losses.

1. Energy use.

$$q_{CHi} = q_{CH} \times g_{Hi} \qquad (55)$$

$$q_{TCH} = \Sigma\, q_{CHi} \qquad (56)$$

(q_{PH} from Table 23)

2. Standby losses.

q_{SCH} from Table 24 or 25

D. Point-of-Use Heater Energy Use and Heat Losses

1. Energy use.

$$q_{PHi} = X_{gHi} \tag{57}$$

$$q_{TPH} = \Sigma\ q_{PHi} \tag{58}$$

(q_{PH} from Table 23)

2. Instantaneous power rating.

P_i from Table 26.

(P_i is the power rating for fixtures of Type i).

3. Minimum and maximum instantaneous outlet water temperatures.

$$t_{CPHi} = P_i/(0.16 \times f_{RTi}) + t_{CGT} \tag{59}$$

$$t_{HPHi} = P_i/(0.16 \times f_{RTi}) + t_{HGT} \tag{60}$$

4. Mini-storage tank standby losses.

$$q_{SPH\frac{1}{2}i} = q_{SPH\frac{1}{2}} \times n_{Fi} \tag{61}$$

$$q_{SPH1i} = q_{SPH1} \times n_{Fi} \tag{62}$$

$$q_{TSPH} = \Sigma\ (\text{All } q_{SPH\frac{1}{2}i}\ \underline{\text{OR}}\ q_{SPH1i} \text{ involved in the particular study.}) \tag{63}$$

($q_{SPH\frac{1}{2}}$ & q_{SPH1} from Table 27)

E. Annual Energy Uses, Energy and Installation Costs.

1. Annual energy use.

$$E_{AE} = \{(E_{WC} + q_{TPH}) \times T_{HD} \times T_{DY}\} + q_{TSPH} \times 24 \times 365 \tag{27}$$

$$E_{TAE} = E_{AE} + \{(q_{TLC} + q_{TCH}) \times T_{HD} + (q_{TLE} + q_{TLD})\} \times T_{DY} + (q_{SCH} \times 24 \times 365) \tag{28}$$

$$E_{TAG} = \{(q_{TLC} + q_{TCH}) \times T_{HD} + (q_{TLE} + q_{TLD})\} \times T_{DY} + (q_{SCH} \times 24 \times 365) \tag{29}$$

$$E_{TAO} = \text{same as } E_{TAG} \text{ equation} \tag{30}$$

2. Annual conditioned space heating contribution.

$$E_{CON} = \{(q_{LC1} \times T_{HD}) + q_{LE1}\} \times T_{DY} + \{(q_{SCH} + q_{TSPH}) \times 24 \times 365\} \quad (*)$$

3. Annual energy costs.

$$C_{AE} = E_{TAE} \times P_E/3413 \quad (31)$$

$$C_{AG} = E_{TAG} \times P_G/10^6 \quad (32)$$

$$C_{AO} = E_{TAO} \times P_O \times 7.1429/10^6 \quad (33)$$

4. New construction installation cost.

$$C_F = \Sigma\ (n_{Fi} \times P_{Fi}) \quad (34)$$

$$C_{NFRC} = \Sigma\ (n_{Fi} \times P_{NRCFi}) \quad (35)$$

$$C_{PH} = \Sigma\ (n_{Fi} \times P_{PHi}) \quad (36)$$

$$C_{TOT} = C_F - C_{NFRC} + C_{CH} + C_{PH} \quad (37)$$

5. Retrofit installation cost.

$$C_{RFRC} = \Sigma\ (n_{Fi} \times P_{RFRC}) \quad (38)$$

$$C_{TOT} = C_{PH} - C_{RFRC} - C_{RCCH} \quad (39)$$

F. Life Cycle Cost Analysis.

1. Life cycle energy costs.

$$L_{CE} = C_{AE} \times W_E \quad (40)$$

$$L_{CG} = C_{AG} \times W_G \quad (41)$$

$$L_{CO} = C_{AO} \times W_O \quad (42)$$

2. Central heater replacement.

$$C_{RCH} = C_{CH} \times W_{SYR} \quad (43)$$

3. Total life cycle.

$$L_{TOT} = C_{TOT} + L_{CE} + L_{CG} + L_{CO} + C_{RCH} \quad (44)$$

The manual method of analysis can be used for the study of heated water supply system alternative or for simultaneous analysis of various heated water supply system alternatives for comparison. Refer to the manual method example to see how the method is intended to be used.

BUILDING HEATED WATER SUPPLY SYSTEM
INPUT SURVEY TABLE

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE
1. Building Type	--	--	--
2. Fixture Data per Fixture Type (*Repeat for each type) (Types: lavatory basin, janitorial sink, toilets, urinals, water coolers, etc.)			
a. Quantity	n_{Fi}	Building Specifications	
b. Max water temperature requirement	--	Building Specifications	--
c. Hot water flow rate (GPH) adjust for flow restriction. (Only fixtures requiring heated water)	Table 26 f_{RTi}	Fixture Flow Rate Tables	
d. Heated water demand (GPH) adjust for flow restriction, and for increased use of tepid if no cold supply is present. (Only fixtures requiring heated water)	u_{Hi}	Fixture Demand Tables	
e. Cold water demand (GPH) (Fixtures requiring only cold water)	u_{Ci}	Fixture Demand Tables	
f. Installed heated plumbing cost (for each DOE region) ($)	P_{Fi}	National Construction Estimator	
g. Credits (for each DOE region) ($):			
1. New construction - unused plumbing	P_{NFRCi}	National Construction Estimator	

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE
2. Retrofit - return plumbing	P_{RFRCi}	(Salvage-removal labor cost)	
h. Water cooler compressor efficiency (%) (water cooler type only)	Table 22	Manufacturer's Specifications ASHRAE	
3. Central Heater Data			
a. Efficiency (%)	Table 23	Central Heater Efficiency Table	
b. Storage tank height (in)	Tables 24 & 25	Manufacturer's Heater Specifications	
c. Storage tank diameter (in)	Tables 24 & 25	Manufacturer's Heater Specifications	
d. Location (unconditioned or condition space)	--	Building Specifications	--
e. Remaining life of heater (yrs)	Life Cycle Cost	(Expected life--age of heater)	
f. Life extension due to lowering of water temperature (yrs)	Life Cycle Cost	Manufacturer's Information	
g. Installed cost of heater (for each DOE region)	C_{CH}	National Construction Estimator	
h. Return credit on heater (retrofit analysis only)	C_{RCCH}	(Salvage - removal labor cost)	
4. Heated Water Pipe Data			
a. Inside pipe diameter (in)	Tables 20 & 21	Assume Uniform Diameter	
b. Normal total heated water pipe length (ft)	ℓ	Building Specifications	
c. Total additional length to all water cooler (ft)	ℓ_{TWC}	Building Specifications	
d. Total additional length to all toilets and urinals (ft)	ℓ_{TTU}	Building Specifications	

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE
e. Total length in conditioned space (ft)	ℓ_{TC}	Building Specifications	
f. Total length in unconditioned space (ft)	ℓ_{TU}	Building Specifications	
g. Number of cooldown cycles per day	n_{CC}	Include partial cooldown cycles	
5. Temperatures (F)			
a. Hot water supply 1. Minimum allowable 2. Maximum allowable	t_H	140°F or as specified	
b. Tepid water supply 1. Minimum supply 2. Maximum supply	t_T	105°F or as specified	
c. Ground water supply (for each location)	Tables 20,22,23 & 26	Geological Area Information	
d. Minimum ground water supply (for each location)	t_{CGT}	Geological Area Information	
e. Maximum ground water supply (for each location)	t_{HGT}	Geological Area Information	
f. Water cooler outlet	Table 22	Manufacturer's Specifications	
g. Room	t_R	68°F or Building Specifications	
h. Average ambient (outside) (for each location)	t_A	Geological Area Information	
6. Point-Of-Use Heater Data			
a. Types	--	Task Order 8	
b. Mini-storage tank dimensions: 1. Height (in)	Table 27	Manufacturer's Specifications	
2. Diameter (in)	Table 27	Manufacturer's Specifications	
c. Installation cost per type and size ($)	P_{PHi}	Task Order 8	

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE
7. Operational Data			
a. Hours per work day	T_{HD}	Operation Specifications	
b. Work days per year	T_{DY}	Operation Specifications	
8. DOE Region Data			
a. Energy costs			
1. Electricity ($/KWH)	P_E	Federal Register (DOE Part IV)	
2. Natural gas ($/million BTU)	P_G	Federal Register (DOE Part IV)	
3. Fuel oil ($/GAL)	P_O	Federal Register (DOE Part IV)	
b. 10 year present worth factors			
1. Electricity	W_E	Federal Register (DOE Part IV)	
2. Natural gas	W_G	Federal Register (DOE Part IV)	
3. Fuel Oil	W_O	Federal Register (DOE Part IV)	
9. Single Present Worth for the Expected Replacement Year of the Central Heater	W_{SYR}	Federal Register (DOE Part IV)	

The following example illustrates a method of completing the input survey table and the use of the manual analysis method. This example shows only one method of data gathering and analysis. Other ways may be developed by Facilities Engineers to gather some or all of input information.

In the example it is assumed that it is desired to study an existing office building for alternative heated water supply systems. For economic and energy conservation purposes. It is also desired that future construction of office buildings of this type and size be studied in the same way. The building is located on a base close to Chicago, Illinois (DoE Region V). The building contains 8 lavatory basins, 2 janitorial sinks, 8 toilets and 2 water coolers. Occupancy is that of an typical Army facility office building density. Scheduled operations in the building are based on an 8 hour work day, a 5 day normal work week and 250 total days per year.

It is decided that five alternative systems will be analyzed, for comparison to the present hot and cold supply system. These five alternative systems are:

1. Tepid supply with no cold supply.
2. Tepid and cold supply.
3. Tepid and cold supply, no cold supply to faucets.
4. Cold supply only, point-of-use heaters used.
5. Cold supply only, point-of-use heaters used with no cold supply to faucets.

The plan of attack is to complete the input survey table before beginning any analysis. With the building type already given, the task of completing the survey table continues. Fixture information is required for the lavatory basins, janitorial sinks, toilets and water coolers.

Information supplied initially states that there are 8 lavatory basins. Studying tables found on pages 10 to 23 it is found that only tepid temperature water need be supplied to basins in an office building. Normal flow rate for a lavatory faucet is found to be 2.25 gallons per minute (flow restriction will be introduced later). Lavatory faucet hot water demand is 6.00 gallons per hour per basin. A percent flow allowed value of 22 percent will be used to simulate flow restriction on the alternative systems. This restriction is accompanied by a decrease in demand of 66 percent of original demands for the lavatory faucets. The lavatory basins are assumed to experience no increase in tepid use when no cold water is supplied. The cold water flow rate and demand is not needed. Costs and credits are related to the lavatory basins, as for all fixtures, will be calculated later.

Flow rate and hot water demand for the 2 janitorial sinks are obtained also from Tables 4 and 12. Flow rate for the sinks is 3.75 gallons per minute and the hot water demand is 20 gallons per hour per sink. Janitorial sinks also require only a tepid temperature supply. The same percent flow allowed value of 22 percent is used for the janitorial sinks on the alternatives. However, it is determined that the sinks will not have a corresponding decrease in use. Again, cold water demand is not needed. In cases where no cold supply exists it is assumed the janitorial sinks will experience a 30 percent increase in tepid use.

Cold water demand must be determined for the eight toilets. (If urinals exist, their demand should be converted to equivalent toilet demand, knowing that urinals use 3.0 gallons per flush.) From a study on water use and conservation[1] it is found that flushometer type toilets use 3.5 gallons per flush. Knowing the estimated occupancy density of the office building, the average number of toilet flushes per person per work day and the number of hours in the normal work day, the cold demand for the toilets is 17.5 gallons per hour per toilet (based on an average of 2.5 flushes per day per person). Toilet cold water demand information may be available in tables from earlier studies which would cancel the need to calculate the demand. Of course, toilets require only a cold water supply. Toilet flow rates are not needed.

For the 2 water coolers, only cold water demand and compressor efficiency need be estimated. A compressor efficiency of 70 percent is sufficient for this study. Cold water demand for the water coolers may be found in available tables. If no information can be found, then the estimated demand must be calculated. From a reliable source[2] a value of 0.083 gallons per hour per person is obtained for the use of office building, and there are 2 water coolers, the water cooler demand is estimated at 2.66 gallons per hour per water cooler.

Moving on to the central heater data, it is discovered that the office building in question contains a 50 gallon, natural gas-fired central water heater. Natural gas heater efficiency is estimated at 75 percent.[3] The heater's storage tank height is found to be 60 inches and its diameter is approximately 15-3/4 inches. The central heater is located in conditioned space (in a closet on the lowest floor). Remaining

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[1] Water Use and Conservation at Federal Facilities in the Washington, D.C. Metropolitan Area; EPA.

[2] ASHRAE Handbook; 1975 Equipment; Section 38.4.

[3] Shepherd, P.B.; Performance Evaluation of Point-of-Use Water Heaters; FESA-TS-2081 1980.

life of the heater is estimated at 7 years. A brief talk with the heaters manufacturer reveals that if the heater's storage tank temperature is lowered to tepid then the heater should last an additional 2 years. Heater costs and credits will be determined later.

The total hot water line length (as for the total cold water line length) is determined from the building specifications to be approximately 240 feet. The average inside diameter of the pipe (which is made of copper) is 3/4 inches (which is actually 0.785 inch[1]). If no cold supply is to be offered, it is found from building specifications that it would require an average additional 10 feet of pipe to supply tepid water to each toilet and an average of 30 feet of pipe to supply tepid water to a water cooler. The entire water supply system is located in conditioned space within the building. The hot water demands must be studied, to estimate the number of heated line cooldown cycles occur in one day. It is determined that only 1 complete cooldown cycle will occur during each day (overnight). However, partial cooldown cycles must also be included so the number of cooldown cycles per day is increased to 1.2 to adjust for the partial cycles.

Hot water storage temperature is set at 140F. The desired tepid temperature requirement is found to be 105F. The range of allowable temperatures for the tepid supply is determined to be 95F to 115F. (Because all of the water supply system is located in conditioned areas with the building, the average annual ambient temperature is not needed.) From area information the average temperature of the groundwater supplied is 45F. The groundwater will vary from 39F to 51F during the year. Heated room temperature is designed to be constant at 68F. The water coolers are found to be set to a supply outlet water temperature of 40F.

Both instantaneous and mini-storage tank type point-of-use heaters will be studied. Costs for these units will be determined later. At this time only the mini-storage tank dimensions need be found. It is decided that only 1/2 and 1 gallon capacity mini-tanks will be studied for this type of point-of-use heaters. A height of 6 inches and a diameter of 5 inches are used for the 1/2 gallon tank. For the 1 gallon tank, a height of 8 inches and a diameter of 6.06 inches are used. From discussions with the manufacturers it is concluded that the 1/2 gallon capacity heater (750 watts) can deliver a maximum of 6.25 gallons of hot water per hour, and a 1 gallon capacity heater (750 watts) can deliver approximately 12 gallons per hour under normal conditions. The water temperature inside the point-of-use tanks is set at 190F.

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[1] ASHRAE Handbook; 1975 Equipment.

Cost and credit information depends on the geographical location of the building. From the initial information, it is known that the base on which the building is located near Chicago, Illinois. (Illinois is located in DoE Region V.) Costs are to be determined on a total installed basis as they pertain to heated water supply systems only.

The idea used to find fixture installed cost as related to the heated water supply system is to calculate the total installed cost for the heated center lines and divide the cost by the number of fixtures using the heated supply. The <u>National Construction Estimator</u> (1980) is used to calculate the total installed cost of the lines. The wage modification factor for plumbers in Chicago is 96 percent. The subcontract installed prices for 3/4 inch copper tubing per foot are \$1.65 for material and \$2.95 for labor. The total installed cost of the lines is:

$$\{\$1.65/\text{ft} + (\$2.95/\text{ft} \times 0.96)\} \times 240 \text{ ft} = \$1075.68.$$

This value is divided equally between the 8 lavatory basins and the 2 janitorial sinks, which use the heated water supply. This results in an installed cost of \$107.57 per fixture. The toilets and water coolers do not use the heated water and thus, are considered not to have installed costs with respect to the heated water supply. New construction credits will occur for those supply systems, using no cold water supply (computer program system model 2); no central heated water supply (point-of-use supply systems) or limited cold water supply (computer program system model 4). Since it is known that the cold water lines are approximately as long and the same size as the heated lines the credits are easily estimated. New constructions not using a cold water supply will save (credit) \$1075.68. The same value can be used for new constructions not using a central heated water supply. A system not supplying cold water to faucets will probably only realize a credit of under half the installed cost per faucet. This credit is determined to be \$50.00 per faucet (of the \$107.57 calculated earlier). The toilets and water coolers will have no credits.

In most cases retrofit credits for returned plumbing will be negligible or non existant. This is due to the fact that the cost involved in removing the plumbing may be more than the salvage price for the plumbing. For this reason all retrofit credits for fixtures are assumed to be zero.

The National Construction Estimator (1980) is used again to calculate the installed cost of a central heater. The prices are $185.00 for materials and $112.00 for labor. In Chicago, the total installed cost becomes,

$$\$185.00 + (\$112.00 \times 0.96) = \$292.52$$

In retrofit supply systems involving the removal of the central heater, a credit may occur. A credit is created if the salvage price of the central heater is greater than the labor cost in removing the heater. It is found that in this study, the salvage price for the heater is approximately equal to the cost of removing the heater and thus, no credit occurs.

Due to the variation in point-of-use heater prices, some assumptions must be made. From an earlier point-of-use study,[1] the followed installed prices are calculated,

4.6 to 9 kw instantaneous	- $237.00
10 kw instantaneous	- $400.00
20 kw instantaneous	- $420.00
1/2 gallon mini-tank	- $200.00
1 gallon mini-tank	- $260.00

These prices will be used regardless of the geographical location.

The Federal Register (Part IV, DoE) gives the cost of energy. (These 1980 values are probably now understated, and local costs should be used.) The cost of electricity in DoE Region V is $0.049/KWH (for commercial use) and the cost of natural gas is $2.75/million BTU (1980 prices in 1980 dollars). Using the Federal Register again, the 10 year present worth factors for electricity and natural gas are obtained. Also, the single present worth factor for the expected year of central heater replacement is found. The 10 year present worth factors in DoE Region V are 6.609 for electricity and 7.730 for natural gas. The single present worth factor for heater replacement at 7 years is 0.5132 and at 9 years (7 years + 2 year life extension) is 0.4241.

The input survey table is now complete. The completed survey table is shown on the following pages.

[1] Ibid.

BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION
INPUT SURVEY TABLE

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE OR NAME
1. Building Type	---		Office
2. Lavatory Faucets:			
a. Quantity	n_{F1}		8
b. Max water temp requirement (F)	---		Tepid
c. Hot water flow rate (GPM)	f_{RT1}		2.25
Percent flow allowed (%)	Table 26		22.00
d. Heated water demand (GPH)	u_{H1}		6.00
Corresponding usage (%)			66.00
f. Installed heated plumbing cost ($/fixture)	P_{F1}		107.57
g. Credits ($/fixture):			
1. New construction	P_{NFRC1}		50.00
2. Retrofit	P_{RFRC1}		0.00
2. Janitorial Faucets:			
a. Quantity	n_{F2}		2
b. Max water temp requirement (F)	---		Tepid
c. Hot water flow rate (GPM)	f_{RT2}		3.75
Percent flow allowed (%)	Table 26		22.00

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE OR NAME
d. Heater water demand	u_{H2}		20.00
Percent increase in tepid demand (no cold systems) (%)			30.00
f. Installed heated plumb. cost ($/fixture)	P_{F2}		107.57
g. Credits ($/fixture):			
1. New construction	P_{NFRC2}		50.00
2. Retrofit	P_{RFRC2}		0.00
2. Toilets:			
a. Quantity	n_{F3}		8
b. Max water temp requirement (F)	---		Cold
e. Cold water demand (GPH)	u_{C3}		17.5
2. Water Coolers:			
a. Quantity	n_{F4}		2
b. Max temp requirement (F)	---		Cold
e. Cold water demand (GPH)	u_{C4}		2.66
3. Central Heater Data (Natural Gas-Fired)			
a. Efficiency (%)	Table 23		75.00
b. Storage tank height (in.)	Tbl 24&25		60.00
c. Storage tank diameter (in.)	Tbl 24&25		15.70
d. Location	---		Conditioned
e. Remaining life (yrs)	Life Cycle Cost		7

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE OR NAME
f. Life extension (yrs)	Life Cycle Cost		2
g. Installed Cost ($)	C_{CH}		292.52
h. Return credit ($)	C_{RCCH}		0.00
4. Heated Water Pipe Data:			
a. Inside pipe diameter (in.)	Tbl 20&22, 23&26		3/4
b. Normal total line length (ft)	ℓ		240.00
c. Additional length to water coolers (ft)	ℓ_{TWC}		60.00
d. Additional length to toilets (ft)	ℓ_{TTU}		80.00
e. Total length in conditioned space (ft)	ℓ_{TC}		240.00
g. Number of cooldown cycles per day	n_{CC}		1.20
5. Temperatures (F):			
a. Hot water supply	t_H		140.00
b. Tepid water supply	t_T		105.00
Minimum Allowable			95.00
Maximum Allowable			115.00
c. Ground water supply	Tbl 22		45.00
d. Minimum ground water	t_{CGT}		39.00
e. Maximum ground water	t_{HGT}		51.00
f. Water cooler outlet	Table 22		40.00
g. Room	t_R		68.00

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE OR NAME
6. Point-of-Use Heater Data:			
a. Types:			Instantaneous Mini-storage tank
b. Mini-tank dimensions			
½ gallon			
1. Height (in.)	Table 27		6.00
2. Diameter (in.)	Table 27		5.00
1 gallon			
1. Height (in.)	Table 27		8.00
2. Diameter (in.)	Table 27		6.06
c. Installed Cost ($)			
4.6 to 9.0 kw instantaneous	$P_{PH\,i}$		237.00
10.0 kw instantaneous	$P_{PH\,i}$		400.00
20.0 kw instantaneous	$P_{PH\,i}$		420.00
½ gallon mini-tank	$P_{PH\,i}$		200.00
1 gallon mini-tank	$P_{PH\,i}$		260.00
7. Operational Data:			
a. Hours per work day	T_{HD}		8.00
b. Work days per year	T_{DY}		250.00
8. DoE Region Data:			
a. Energy costs			
1. Electricity ($/KWH)	P_E		0.049
2. Natural gas ($/mil BTU)	P_G		2.75

REQUIRED INFORMATION	MATH SYMBOL OR USE	HOW TO OBTAIN	VALUE OR NAME
b. 10 year present worth factors			
1. Electricity	W_E		6.609
2. Natural gas	W_G		7.730
9. Single Present Worth Factor For Expected Replacement Year of Central Heater:			
a. At 7 years	W_{SYR}		0.5132
b. At 9 years	W_{SYR}		0.4241

Upon completion of the input survey table, the analysis may begin. All six supply systems (the present hot and cold water supply plus the five alternatives) will be analyzed at one time. This simultaneous analysis will aid in the comparison of the different systems. As the description of the manual method states, the study is executed step-by-step as follows:

A. Heated Water Line Heat Losses

1. Total Heated Line Length

The present hot and cold supply plus alternatives 2 and 3 will have the normal length, while additional line length is heated in alternative 1. Of course, alternatives 4 and 5 do not contain any heated lines of any significant length. All lines are located in conditioned space so $\ell_{TC} = \ell_T$ for all systems.

Therefore,

Present system $-\ell_T = \ell = 240$ (feet)
Alternative 1 $- \ell_T = \ell + \ell_{TWC} + \ell_{TTU} = 240 + 60 + 80 = 380$ (ft)
Alternative 2 $- \ell_T = \ell = 240$ (feet)
Alternative 3 $- \ell_T = \ell = 240$ (feet)
Alternative 4 $- \ell_T = 0$
Alternative 5 $- \ell_T = 0$

2. Line Losses to the "Environment"

For the present system, the temperature difference used here is 140F - 68F = 72F. The temperature difference for alternatives 1 through 3 is 105F - 68F = 37F. These differences are used to find the correct values from Table 20. (Alternative 4 and 5 contain no heated lines) Because all lines are located in conditioned space. Thus,

Present system $- q_{TLE} = q_{LE1} = 240 \times 15.08 \times 1.2 = 4343.04$ Btu/day
Alternative 1 $- q_{TLE} = q_{LE1} = 380 \times 7.75 \times 1.2 = 3534.00$ Btu/day
Alternative 2 $- q_{TLE} = q_{LE1} = 240 \times 7.75 \times 1.2 = 2232.00$ Btu/day

Alternative 3 - $q_{TLE} = q_{LE1} = 240 \times 7.75 \times 1.2 = 2232.00$ Btu/day

Alternative 4 - $q_{TLE} = 0$

Alternative 5 - $q_{TLE} = 0$

3. Line Heat Losses "Down the Drain"

To find the correct value from Table 20 the temperature difference used for all systems (except alternatives 4 & 5) is 68F - 45F = 23F. The result is

Present system - $q_{TLD} = 240 \times 4.82 \times 1.2 = 1388.16$ Btu/day

Alternative 1 - $q_{TLD} = 380 \times 4.82 \times 1.2 = 2197.92$ Btu/day

Alternative 2 - $q_{TLD} = 240 \times 4.82 \times 1.2 = 1388.16$ Btu/day

Alternative 3 - $q_{TLD} = 240 \times 4.82 \times 1.2 = 1388.16$ Btu/day

Alternative 4 - $q_{TLD} = 0$

Alternative 5 - $q_{TLD} = 0$

4. "Convective" Heat Losses

The same temperature differences used to find heat losses to the "environment" are used here to obtain the correct values from Table 21. Again, for alternatives 4&5, these losses are zero.

Present system - $q_{TLC} = q_{LC1} = 13.82 \times 240 = 3316.80$ Btu/hour

Alternative 1 - $q_{TLC} = q_{LC1} = 6.03 \times 380 = 2291.40$ Btu/hour

Alternative 2 - $q_{TLC} = q_{LC1} = 6.03 \times 240 = 1447.20$ Btu/hour

Alternative 3 - $q_{TLC} = q_{LC1} = 6.03 \times 240 = 1447.20$ Btu/hour

Alternative 4 - $q_{TLC} = 0$

Alternative 5 - $q_{TLC} = 0$

B. Fixture Demands

1. Fixture Use Demands

In the alternative systems, flow is restricted to 22 percent of normal for lavatory basins and janitorial sinks. This restriction will create a decrease to 66 percent of normal usage at the lavatory basins, while the janitorial sinks will experience no significant drop in usage. Also, a 30 percent increase in tepid use in systems with no cold supplied to the faucets must be accounted for. Therefore,

Present system - g_{H1} = 6.00 x 8 = 48.00 GPH
g_{H2} = 20.00 x 2 = 40.00 GPH
g_{C3} = 17.50 x 8 = 140.00 GPH
g_{C4} = 2.66 x 2 = 5.32 GPH

Alternatives 2 & 4 - g_{H1} = (6.00 x .66) x 8 = 31.68 GPH
g_{H2} = 20.00 x 2 = 40.00 GPH
g_{C3} = 17.50 x 8 = 140.00 GPH
g_{C4} = 2.66 x 2 = 5.32 GPH

Alternatives 1, 3 & 5 - g_{H1} - (6.00 x .66) x 8 = 31.68 GPH
g_{H2} - (20.00 x 1.30) x 2 = 52.00 GPH
g_{C3} - 17.50 x 8 = 140.00 GPH
g_{C4} - 2.66 x 2 = 5.32 GPH

2. Water Cooler Energy Use

In all systems, except alternative 1, the temperature difference here is 45F - 40F = 5F. Due to the fact that no cold water is supplied in alternative 1, the difference is 105F - 40F = 65F. Knowing the compressor efficiency is estimated at 70 percent, results in, Present system - E_{WC} = 59.51 x 5.32 = 316.59 BTU/hour

Alternative 1 - E_{WC} = 773.60 x 5.32 = 4115.55 BTU/hour

Alternative 2 - E_{WC} = 316.59 BTU/hour

Alternative 3 - E_{WC} = 316.59 BTU/hour

Alternative 4 - E_{WC} = 316.59 BTU/hour

Alternative 5 - E_{WC} = 316.59 BTU/hour

C. Central Heater Energy Use and Heat Losses

1. Energy Use

In all systems, except alternative 1, only the lavatory and janitorial faucets use the heated water supply. In alternatives 4 & 5, however, the heated water is supplied by point-of-use heaters only. Because no cold water is available in alternative 1, the toilets and the water coolers will use heated water. The temperature difference for the present system is 140F - 45F = 95F, while the difference for alternative 1, 2 & 3 is 105F - 45F = 60F. Natural gas-fired heater efficiency is 75 percent.

Present system - q_{TCH} = 1055.26 x (48.00 + 40.00) = 92862.88 BTU/hour

Alternative 1 - q_{TCH} = 666.48 x (31.68 + 52.00 + 140.00 + 5.32) = 152623.92 BTU/hour

Alternative 2 - q_{TCH} = 666.48 x (31.68 + 40.00) = 47773.29 BTU/hour

Alternative 3 - q_{TCH} = 666.48 x (31.68 + 52.00) = 55771.05 BTU/hour

Alternative 4 - q_{TCH} = 0

Alternative 5 - q_{TCH} = 0

2. Standby Losses

Here, the temperature difference (Table 25) for the present system is 140F - 68F = 72F. For alternative 1 through 3, the difference is 105F - 68F = 37F. Alternatives 4 & 5 do not incorporate a central heater and therefore there are no losses of this type.

Present system - q_{SCH} = 1933.42 BTU/hour

Alternative 1 - q_{SCH} = 993.56 BTU/hour

Alternative 2 - q_{SCH} = 993.56 BTU/hour

Alternative 3 - q_{SCH} = 993.56 BTU/hour

Alternative 4 - q_{SCH} = 0

Alternative 5 - q_{SCH} = 0

D. Point-of-Use Heater Energy Use and Heat Losses

Only alternatives 4 & 5 use point-of-use heaters and, therefore, all other systems need not be considered in this section. Selection of the correct point-of-use heaters to use is critical. The point-of-use heaters have limitations that must be checked before selections can be made. An earlier study on point-of-use heaters(1) discussed the methods of insuring that the specific point-of-use heaters meet the requirements. Fixture flow rates and demands, and heater cost determine which is the right size and type of point-of-use to select. With the 22 percent of normal flow allowed restriction on the faucets, the actual flow rates are:

Lavatory basin - f_{RT1} = 2.25 x .22 = 0.50 GPM

Janitorial sink - f_{RT2} = 3.75 x .22 = 0.82 GPM

The reduced flow rate causes a reduction in usage only at the lavatory basins. The usage reduction is:

6.00 x .66 = 3.96 GPH.

The usage at the janitorial sink stays at 20.00 GPH. However, in alternative 5 the janitorial sinks experience a 30 percent increase in tepid use, so a janitorial sink use increases to:

20.00 x 1.30 = 26 GPH.

In both alternatives 4 & 5, instantaneous and mini-storage tank type point-of-use heaters meet the lavatory basin flow rate and demand requirements. In alternative 5, however, no cold water is allowed to the faucets. In the previous point-of-use heater

[1] Ibid.

study[1] it is explained that there must be cold mixing water available for mini-tank types to reduce the temperature of the storage water to the desired outlet temperature. Therefore, in the alternative 5 system only instantaneous heaters may be applied.

Also, from the previous study an example shows that if a 1/2 gallon minitank can be used, then it is usually cheaper to purchase and install (and cheaper during the life cycle) than an instantaneous heater, under these circumstances. However, neither a 1/2 or 1 gallon minitank heater will meet the janitorial sink demand in alternative 4.

Taking everything into consideration initial selections are made:

Alternative 4 - Lavatory basins - 1/2 gallon mini-storage tank
Janitorial sinks - instantaneous
Alternative 5 - Lavatory basins - instantaneous
Janitorial sinks - instantaneous

Now, the different instantaneous power ratings must be determined from Table 26. The temperature difference here is 105F - 45F = 60F. From Table 26, a power rating of 8.00 kw is estimated for the janitorial sinks in both alternatives 4 and 5. Checking the minimum and maximum heater outlet temperatures gives,

$$t_{CPH2} = \{8.00/(0.16 \times 0.82)\} + 39F = 99.96F$$

$$t_{HPH2} = \{8.00/(0.16 \times 0.82)\} + 51F = 111.96F.$$

These values are within the 95F to 115F range and therefore meet the requirements.

The power rating obtained from Table 26 for the lavatory sinks in alternative 5 is 4.8 kw. Checking the minimum and maximum out test temperatures gives,

$$t_{CPH1} = \{4.8/(0.16 \times 0.50)\} + 39F = 99F$$

$$t_{HPH1} = \{4.8/(0.16 \times 0.50)\} + 51F = 111F$$

These values also meet the requirements.

Now that the correct point-of-use heater selections have been made, the analysis can continue.

[1]Ibid.

1. Energy Use (Point-of-Use Heaters)

Using Table 23 and an efficiency of 95 percent the energy use is determined.

Present system - $q_{TPH} = 0$

Alternative 1 - $q_{TPH} = 0$

Alternative 2 - $q_{TPH} = 0$

Alternative 3 - $q_{TPH} = 0$

Alternative 4 - $q_{TPH} = 526.17 \times (31.68 + 40.00)$
$= 37715.87$ BTU/hour

Alternative 5 - $q_{TPH} = 526.17 \times (31.68 + 52.00)$
$= 44029.91$ BTU/hour

2. Standby Losses (Point-of-Use Heaters)

Using Table 27 (mini-tank selections only). Remember mini-storage tank usually stores water at 190F. The temperature difference is 190F - 68F = 122F.

Present system - $q_{TSPH} = 0$

Alternative 1 - $q_{TSPH} = 0$

Alternative 2 - $q_{TSPH} = 0$

Alternative 3 - $q_{TSPH} = 0$

Alternative 4 - $q_{TSPH} =$ (44.64 BTU/hour)(4 lav. sinks)
$= 178.56$ BTU/hour

Alternative 5 - $q_{TSPH} = 0$

E. Annual Energy Use, Energy and Installation Costs

1. Annual Energy Use

In the present system and alternatives 1, 2, & 3, the annual energy use will be comprised of electrical and natural gas energy uses. Alternatives 4 & 5 annual energy uses are made up of only electricity uses.

Present system - $E_{TAE} = E_{AE} = 316.59 \times 8 \times 250 =$
633,180 BTU/year

$E_{TAG} = \{[\{(3316.80 + 92862.88) \times 8\} + 4343.04 + 1388.16] \times 250\} + (1933.42 \times 24 \times 365) =$
210,728,920 BTU/year

(Total annual energy used = 210,728,920 + 633,180 =
211,362,100 BTU/year

Alternative 1 - $E_{TAE} = E_{AE} = 4115,55 \times 8 \times 250 =$
8,231,100 BTU/year

$E_{TAG} = \{[\{(2291.40 + 152623.92) \times 8\} + 3534.00 + 2197.92] \times 250\} + (993.56 \times 24 \times 365) =$ 319,967,200 BTU/year

(Total annual energy used = 319,967,200 + 8,231,100 = 328,198,300 BTU/year)

Alternative 2 - $E_{TAE} = E_{AE} = 316.59 \times 8 \times 250 =$
633,180 BTU/year

$E_{TAG} = \{[\{(1447.20 + 47773.29) \times 8\} + 2232.00 + 1388.16] \times 250\} + (993.56 \times 24 \times 365) =$ 108,049,610 BTU/year

(Total annual energy used = 108,049,610 + 633,180 = 108,682,790 BTU/year)

Alternative 3 - $E_{TAE} = E_{AE} = 316.59 \times 8 \times 250 =$ 633,180 BTU/year

$E_{TAG} = \{[\{(1447,29 + 55771.05) \times 8\} + 2232.00 + 1388.16] \times 250\} + (993.56 \times 24 \times 365) =$ 124,045,120 BTU/year

(Total annual energy used = 124,045,120 + 633,180 = 124,678,300 BTU/year)

Alternative 4 - $E_{TAE} = E_{AE} = \{(316.59 + 37715.87) \times 8 \times 250\} + (178.56 \times 24 \times 365) =$ 77,629,106 BTU/year

Alternative 5 - $E_{TAE} = E_{AE} = (316.59 + 44029.91) \times 8 \times 250 =$ 88,693,000 BTU/year

2. Annual Conditioned Space Heating Contribution

Present system - $E_{CON} = [\{(3316.80 \times 8) + 4343.04\} \times 250] + (1933.42 \times 24 \times 365) =$ 24,656,119 BTU/year

Alternative 1 - E_{CON} = $\{\{(2291.40 \times 8) + 3534.00\} \times 250\} + (993.56 \times 24 \times 365) =$ 14,169,886 BTU/year

Alternative 2 - E_{CON} = $\{\{(1447.20 \times 8) + 2232.00\} \times 250\} + (993.56 \times 24 \times 365) =$ 12,155,986 BTU/year

Alternative 3 - E_{CON} = $\{\{(1447.20 \times 8) + 2232.00\} \times 250\} + (993.56 \times 24 \times 365) =$ 12,155,986 BTU/year

Alternative 4 - E_{CON} = $178.56 \times 24 \times 365 = 1,564,186$ BTU/year (only the mini-storage tanks contribute)

Alternative 5 - $E_{CON} = 0$

3. Annual Energy Cost

Present system - $C_{AE} = (633,180 \times 0.049)/3413 = \$9.09$
$C_{AG} = (210,728,920 \times 2.75)/10^6 = \$579.50$
(Total annual cost = \$588.59)

Alternative 1 - $C_{AE} = (8,231,100 \times 0.049)/3413 = \$118.17$
$C_{AG} = (319,967,200 \times 2.75)/10^6 = \$879.91$
(Notice the increase in costs due to tepid water being used at all fixtures. Total annual cost = \$998.08)

Alternative 2 - $C_{AE} = (633,180 \times 0.049)/3413 = \$9.09$
$C_{AG} = (108,682,790 \times 2.75)/10^6 = \$298.88$
(Total annual cost = \$307.97)

Alternative 3 - $C_{AE} = (633,180 \times 0.049)/3413 = \$9.09$
$C_{AG} = (124,045,120 \times 2.75)/10^6 = \$341.12$
(Total annual cost = \$350.21)

Alternative 4 - $C_{AE} = (77,629,106 \times 0.049/3413 = \$1114.51$

Alternative 5 - C_{AE} = (88,693,000 x 0.049)/3413 = \$1273.35

(Notice that even though alternative 4 & 5 use much less energy, the cost of electricity makes the alternatives' energy costs prohibitively high as compared to the other systems.)

4. New Construction Installation Cost

Present system - C_F = (107.57 x 4) + (107.57 x 2) = \$645.42

C_{NFRC} = 0

C_{PH} = 0

C_{TOT} = 645.42 - 0 + 292.52 + 0 = \$937.94

Alternative 1 - C_F = \$645.42

C_{NFRC} = \$645.42 (No cold supply needed)

C_{PH} = 0

C_{TOT} = 645.42 - 645.42 + 292.52 + 0 = \$292.52

Alternative 2 - C_F = \$645.42

C_{NFRC} = 0

C_{PH} = 0

C_{TOT} = \$645.42 - 0 + 292.52 + 0 = \$937.94

Alternative 3 - C_F = \$645.42

C_{NFRC} = (50 x 4) + (50 x 2) = \$300.00

C_{PH} = 0

C_{TOT} = 645.42 - 300.00 + 292.52 + 0 = \$637.94

Alternative 4 - C_F = 0

C_{NFRC} = 0

C_{PH} = (200.00 x 4) + (237.00 x 2) = \$1274.00

C_{TOT} = 0 - 0 + 0 + 1274.00 = \$1274.00

Alternative 5 - C_F = 0

C_{NFRC} = 0

C_{PH} = (237.00 x 4) + (237.00 x 2) = \$1422.00

C_{TOT} = 0 - 0 + 0 + 1422.00 = \$1422.00

5. Retrofit Installation Cost

Present system - $C_{TOT} = 0$

Alternative 1 - $C_{PH} = 0$
$C_{RFRC} = (0 \times 4) + (0 \times 2) = 0$
$C_{TOT} = 0 - 0 - 0 = 0$

Alternative 2 - $C_{PH} = 0$
$C_{RFRC} = 0$
$C_{TOT} = 0 - 0 - 0 = 0$

Alternative 3 - $C_{PH} = 0$
$C_{RFRC} = 0$
$C_{TOT} = 0 - 0 - 0 = 0$

Alternative 4 - $C_{PH} = \$1274.00$
$C_{RFRC} = 0$
$C_{TOT} = 1274.00 - 0 - 0 = \$1274.00$

Alternative 5 - $C_{PH} = \$1422.00$
$C_{RFRC} = 0$
$C_{TOT} = 1422.00 - 0 - 0 = \$1422.00$

F. Life Cycle Cost Analysis

1. Life Cycle Energy Costs

Present system - $L_{CE} = 9.09 \times 6.609 = \$60.08$
$L_{CG} = 579.50 \times 7.730 = \$4479.54$

Alternative 1 - $L_{CE} = 118.17 \times 6.609 = \$780.98$
$L_{CG} = 879.91 \times 7.730 = \$6801.70$

Alternative 2 - $L_{CE} = 9.09 \times 6.609 = \$60.08$
$L_{CG} = 298.88 \times 7.730 = \$2310.34$

Alternative 3 - $L_{CE} = 9.09 \times 6.609 = \$60.08$
$L_{CG} = 341.12 \times 7.730 = \$2636.86$

Alternative 4 - $L_{CE} = 1114.51 \times 6.609 = \$7365.80$

Alternative 5 - $L_{CE} = 1273.35 \times 6.609 = \$8415.57$

2. Central Heater Replacement (Retrofit only)

Present system - $C_{RCH} = 292.52 \times 0.5132 = \$150.12$

Alternatives 1,2&3 - $C_{RCH} = 292.52 \times 0.4241 = \$124.06$

Alternatives 4&5 - $C_{RCH} = 0$

3. Total Life Cycle Cost

a. New Construction

Present system - L_{TOT} = 937.94 + 60.08 + 4479.54 = \$5477.56

Alternative 1 - L_{TOT} = 292.52 + 780.98 + 6801.70 = \$7875.20

Alternative 2 - L_{TOT} = 937.94 + 60.08 + 2310.34 = \$3308.36

Alternative 3 - L_{TOT} = 637.94 + 60.08 + 2636.86 = \$3334.88

Alternative 4 - L_{TOT} = 1274.00 + 7365.80 = \$8639.80

Alternative 5 - L_{TOT} = 1422.00 + 8415.57 = \$9837.57

b. Retrofit

Present system - L_{TOT} = 0 + 60.08 + 4479.54 + 150.12 = \$4689.74

Alternative 1 - L_{TOT} = 0 + 780.98 + 6801.70 + 124.06 = \$7706.74

Alternative 2 - L_{TOT} = 0 + 60.08 + 2310.34 + 124.06 = \$2494.48

Alternative 3 - L_{TOT} = 0 + 60.08 + 2636.86 + 124.06 = \$2821.00

Alternative 4 - L_{TOT} = 1274.09 + 7365.80 = \$8639.80

Alternative 5 - L_{TOT} = 1422.00 + 8415.57 = \$9837.57

The calculation portion of the analysis is now complete.

By studying the results it is easily concluded that in this case, the most economical, and best energy conserving heated water supply system is Alternative 2. Alternative 2 supply system calls for the lowering of the central heater temperature to 105F and install flow restrictors on all lavatory and janitorial faucets. This alternative uses less energy and is easily and inexpensively constructed. In both retrofit and new construction this alternative is by far the best supply system to use.

APPENDIX B

MATHEMATICAL MODELLING

Mathematical Model

The program contains six general sections of calculation. These areas are:

- Heated Water Line Heat Losses (inside only)
- Fixture Demands
- Central Heater Heat Use and Losses
- Point-Of-Use Heater Heat Use and Losses
- Energy Uses, Energy and Installation Costs
- Life Cycle Costs

Heated water line losses are calculated using a total heated line length adjustment equation, a heat loss to the "environment" equation, a heat loss "down the drain" equation, and a "convective" heat loss equation. The three heat loss equations each come in two forms to account for losses in conditioned and unconditioned space. The total line length equation is of the form:

$$\ell_T = \ell + (\ell_{WC} \text{ X } n_{WC}) + (\ell_{TU} \text{ X } n_{TU}) \tag{1}$$

where:

ℓ_T is the total heated line length (feet)

ℓ is the normal (hot and cold supply) heated line length (feet)

ℓ_{WC} is the average additional heated line length to a water cooler in a no cold supply system (feet)

n_{WC} is the number of water coolers (drinking fountains)

ℓ_{TU} is the average additional heated line length to a toilet (or urinal) in a no cold supply system (feet)

n_{TU} is the number of toilets and urinals

The heat to the "environment" equation is:

$$q_{LE1} = 0.3399 \text{ X } (d_{IN})^2 \text{ X } \ell_T \text{ X } (t_{HT} - t_R) \text{ X } n_{CC} \text{ X } (P_C/100) \tag{2}$$

$$q_{LE2} = 0.3399 \text{ X } (d_{IN})^2 \text{ X } \ell_T \text{ X } (t_{HT} - t_A) \text{ X } n_{CC} \text{ X } \{1-(P_C/100)\} \tag{3}$$

where:

q_{LE1} is the heat loss to the "environment" in conditioned space (BTU/day)

q_{LE2} is the heat loss to the "environment" in unconditioned space (BTU/day)

d_{IN} is the inside pipe diameter (in)

ℓ_T is the total heated line length (feet)

t_{HT} is the heated water supply temperature (hot or tepid) (^oF)

t_R is the room temperature (^oF)

t_A is the ambient temperature (^oF)

n_{cc} is the number of pipe cool down cycles per day

P_c is the percent of pipe in conditioned space

Notice that when P_c = 100 percent, then $q_{LE2} = 0$, and similarly, when P_c = 0 percent then $q_{LE1} = 0$. The heat loss to the "environment" in conditioned space contributes to the space heating and will lower the space heating requirement. This pipe heat loss is comparatively small and will, in general, make only a small change in space heating requirements.

The equation for "down the drain" heat loss is:

$$q_{LD1} = 0.3399 \times (d_{IN})^2 \times \ell_T \times (t_R - t_C) \times n_{cc} \times (P_c/100) \quad (4)$$

$$q_{LD2} = 0.3399 \times (d_{IN})^2 \times \ell_T \times (t_A - t_C) \times n_{cc} \times \{1-(P_c/100)\} \quad (5)$$

where:

q_{LD1} is the heat loss "down the drain" on conditioned space (BTU/day)

q_{LD2} is the heat loss "down the drain" on conditioned space (BTU/day)

t_C is the ground water temperature (^oF)

d_{IN} is the inside pipe diameter (in)

ℓ_T is the total heated line length (feet)

t_R is the room temperature (^oF)

t_A is the ambient temperature (^oF)

n_{cc} is the number of pipe cool down cycles per day

P_c is the percent of pipe in conditioned space

This heat loss is considered to be "down the drain" because it contributes no heat to the surrounding space. In general, this loss is very small compared to the central heater storage tank losses.

The "convective" heat loss equation is as follows:

$$q_{LC1} = 0.0707 \text{ X } \left(\frac{t_{HT}-t_R}{d_{out}}\right)^{.25} \text{ X } d_{out} \text{ X } \ell_T \text{ X } (t_{HT}-t_R) \text{ X } (P_c/100) \quad (6)$$

$$q_{LC2} = 0.0707 \text{ X } \left(\frac{t_{HT}-t_A}{d_{out}}\right)^{.25} \text{ X } d_{out} \text{ X } \ell_T \text{ X } (t_{HT}-t_A) \text{ X } \{1-(P_c/100)\} \quad (7)$$

where:

q_{LC1} is the "convective" heat loss in the pipe in conditioned space (BTU/hour)

q_{LC2} is the "convective" heat loss in the pipe in unconditioned space (BTU/hour)

d_{out} is the outside pipe diameter (in)

t_{HT} heated water supply temperature (hot or tepid) (^oF)

t_R is the room temperature (^oF)

ℓ_T is the total heated line length (feet)

P_c is the percent of heated pipe in conditioned area

"Convective" pipe heat loss also contributes to a reduction in space heating requirements in conditioned area. However, as in the case of the heat loss to the "environment", the convective heat loss is small in comparison to most space heating requirements.

The fixture demand calculation section includes equations for fixture type demands and water cooler (drinking fountain) energy use. Since one water supply system contains no cold water system, both heated and cold water demands must be calculated. The demand equations are:

$$g_{Hi} = u_{Hi} \times n_{Fi} \times \{1 + (P_I/100)\} \quad (8)$$

$$g_{Ci} = u_{Ci} \times n_{Fi} \quad (9)$$

where:

g_{Hi} is the heated water demand per fixture type i (GPH)

g_{Ci} is the cold water demand per fixture type i (GPH)

u_{Hi} is the estimated heated water usage per fixture of type i (GPH)

$u_{C}i$ is the estimated cold water suage per fixture of type i (GPH)

n_{Fi} is the number of fixtures of type i

P_I is the percent increased use of tepid water at faucets with no cold water supply

There can be an increase in heated water use at faucets supplying only tepid water due to the faucets cold water demand.

The water cooler use equation appears in the form

$$E_{wc} = (100/e_{wc}) \times 8.331 \times (t_{TC}-t_{WC}) \times u_{wc} \times n_{WC} \quad (10)$$

where:

E_{wc} is the water cooler energy use (BTU/hour)

e_{wc} is the efficiency of the compressor (%)

t_{Tc} is the supply temperature (tepid or cold) (^{o}F)

t_{wc} is the outlet temperature (^{o}F)

u_{wc} is the estimated water cooler use (GPH)

n_{wc} is the number of water cooler

This equation only approximates the water cooler energy use and is used because of its simplicity. An efficiency of 70 percent is used for all simulations.

The calculations of central heater heat use and standby losses contain equations for central heater demand per mixture type, total heat demand (use) and total central heater storage tank standby losses. The central meter demand equations are:

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INVESTIGATION OF SINGLE VERSUS DUAL - HOT AND COLD BUILDING WAT--ETC(U)
OCT 81 P B BRUCE, M S RAMSEY, P B SHEPHERD DAAK70-78-C-0002

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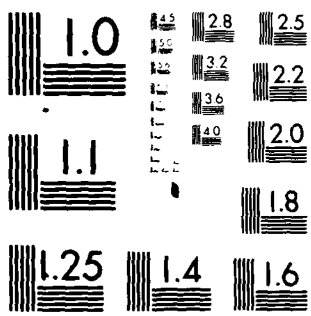

1.0
4.5
5.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

$$q_{CHi} = \{8.331 \times (t_{HT} - t_C) \times g_{Hi}\}/e_{CH} \quad (11)$$

$$q_{TCH} = q_{CHi} \quad (12)$$

where:

q_{CHi} is the central heater demand per fixture type i (BTU/hour)

q_{TCH} is the total central heater demand (BTU/hour)

e_{CH} is the efficiency of the heater (decimal %)

t_{HT} is the heated water supply temperature (hot or tepid) (^{o}F)

t_C is the ground water temperature (^{o}F)

g_{Hi} is the heated water demand per fixture type i (GPH)

Again, this equation gives only a simple approximation. The central heater efficiencies used in the simulations(1) are listed in Table .

TABLE 28

TYPICAL EFFICIENCIES OF DOMESTIC TYPE WATER HEATERS

Type	Efficiency
Electric	0.95
Gas-Fired	0.75
Oil-Fired	0.70

The area equation:

$$A_{CH} = 0.0218 \times d_{CH} \times \left(\frac{d_{CH}}{2} + h_{CH}\right)$$

is used in the central heater standby loss equation

$$q_{SCH} = \{A_{CH} \times (t_{HT} - t_{AR})/R_{CH}\} \times f_{GO}$$

where:

A_{CH} is the storage tank surface area (square feet)

d_{CH} is the storage tank diameter (in)

(1) Shepherd, P. B., Performance Evaluation of Point-of-Use Water Heaters, FESA-TS-2081, 1980.

h_{CN} is the storage tank height (in)

g_{SCH} is the total storage tank standby tank (BTU/hour)

R_{CH} is the insulation R value {(HR) (Sq.Ft.) (^{O}F)/BTU}

f_{GO} is the additional standby loss factor for gas and oil heaters

Because of the previous studies into the effect of increased central heater insulation[(1)], the R value for all simulations is set to 2.5. However, central heater insulation is an effective means in which standby losses can be greatly reduced. Central heater insulation should be a consideration when selecting an energy conservation alternative.

Closer analysis of standby loss information supplied in the earlier study of point-of-use heater[(2)] reveals that standby losses for natural gas-fired heaters can be approximated by equation (14) using the additional loss factor. A good approximation of the loss factor is found to be 2.9, which is used in all simulations. Due to the fact that no additional information on oil-fired heaters has been found, the same factor is employed during fuel oil heater simulations.

Point-of-use heater calculations include equations for heater demand, instantaneous heater power rating, minimum and maximum outlet temperature and mini-tank standby losses. The demand equations for point-of-use heaters calculate fixture type and total demands. These equations are:

$$q_{PHi} = \{8.331 \text{ X } (t_{HT} - t_{TC}) \text{ X } q_{Hi}\}/0.95 \qquad (15)$$

$$q_{TPH} = \Sigma\, q_{PHi} \qquad (16)$$

where:

q_{PHi} is the point-of-use heater demand per fixture type i (BTU/hour)

q_{TPH} is the total point-of-use demand (BTU/hour)

t_{HT} is the heated water supply temperature (hot or tepid (^{O}F)

t_{TC} is the supply temperature (tepid or cold) (^{O}F)

g_{Hi} is the heated water demand per fixture type i (GPH)

(1) ERDA, Insulation Refit Kit for Domestic Water Heaters, PO Nos. WA 76-3813 and WA 76-3814, March 1973.

(2) Shepherd, P. B., Performance Evaluation of Point-of-Use Water Heaters, FESA-TS-2081, 1980.

Efficiency of 95 percent is assumed for all point-of-use heaters. As revealed in an earlier point-of-use heater study(1), equation (15) actually may understate the energy use.

The instantaneous point-of-use heater power rating equation is:

$$P_i = 0.16 \times f_{RTi} \times (f_{RS}/100) \times (t_{HT} - t_{TC}) \qquad (17)$$

where:

P_i is the required power rating of an instantaneous point-of-use heater for fixture type i (KW)

f_{RTi} is the flow rate of fixture of type i (GPM)

f_{RS} is the percent flow allowed (acts as a restriction)

t_{HT} is the heated water supply temperature (hot or tepid) (^{o}F)

t_{TC} is the supply temperature (tepid or cold) (^{o}F)

The constant, 0.16, was used as the multiplier for a range of values from 0.146 to 0.184 in a previous point-of-use heater study(1). The percent flow variable is introduced to allow for flow restriction analysis, which is another important conservation measure.

The calculated power rating is used to find the minimum and maximum outlet temperature of the instantaneous heater using the equations:

$$t_{CPi} = \{P_i/\{0.16 \times f_{RTi} \times (f_{RS}/100)\}\} + t_{CGT} \qquad (18)$$

$$t_{HPHi} = \{P_i/\{0.16 \times f_{RTi} \times (f_{RS}/100\}\} + t_{HGT} \qquad (19)$$

where:

t_{CPHi} is the minimum outlet temperature of the instantaneous heater with power rating, pi, for fixture type i (^{o}F)

t_{HPHi} is the maximum outlet temperature of the instantaneous heater with power rating, pi, for fixture type i (^{o}F)

(1) Shepherd, P. B., Performance Evaluation of Point-of-Use Water Heaters, FESA-TS-2081, 1980.

t_{CGT} is the yearly minimum supply water temperature (^{o}F)

t_{HGT} is the yearly maximum supply water temperature (^{o}F)

f_{RTi} is the flow rate of fixture of type i (GPM)

f_{RS} is the percent flow allowed (restriction)

If the instantaneous heater is supplied with tepid water from a central heater, then there should be no fluctuation in the instantaneous heater outlet temperature. However, if no central heater is involved and the instantaneous point-of-use heater is supplied with ground temperature water, then there will be a seasonal fluctuation in the point-of-use heaters outlet temperature. This fluctuation will correspond to the fluctuation in ground water temperature(1). In this case, the minimum and maximum heater outlet temperature must be determined to avoid scalding and/or insufficient heating.

The point-of-use mini-storage tank standby losses are calculated in the same manner as the central heater standby losses. Equations (20) through (23) show this comparison:

$$A_{PH\frac{1}{2}} = 0.0218 \text{ X } d_{PH\frac{1}{2}} \text{ X} (\frac{d_{PH\frac{1}{2}}}{2} + h_{PH\frac{1}{2}}) \quad (20)$$

$$A_{PH\frac{1}{2}} = 0.0218 \text{ X } d_{PH1} \text{ X} (\frac{d_{PH1}}{2} + h_{PH1}) \quad (21)$$

$$q_{SPH\frac{1}{2}} = A_{PH\frac{1}{2}} \text{ X } (190. - t_{RA})/R_{CH} \quad (22)$$

$$q_{SPH1} = A_{PH1} \text{ X } (190. - t_{RA})/R_{CH} \quad (23)$$

where:

$A_{PH\frac{1}{2}}$, A_{PH1} are the surface areas for ½ and 1 gallon mini-storage tanks (square feet)

$d_{PH\frac{1}{2}}$, d_{PH1} are the diameters for ½ and 1 gallon mini-storage tanks (in)

$h_{PH\frac{1}{2}}$, h_{PH1} are the heights for ½ and 1 gallon mini-storage tanks (in)

t_{RA} is the room or ambient temperature (^{o}F)

R_{CH} is the R value of storage tank insulation

(1) Shepherd, P. B., Performance Evaluation of Point-of-Use Water Heaters, FESA-TS-2081, 1980.

Point-of-use mini-storage tank insulation is assumed to be approximately equal to the central tank insulation and, therefore, a value of 2.5 is used in the insulation R value. The storage temperature is assumed to be 190°F in the mini-tank heater.

Point-of-use standby losses per fixture type are calculated by:

$$q_{SPH\frac{1}{2}i} = q_{SPH\frac{1}{2}} \times n_{Fi} \quad (24)$$

$$q_{SPH1i} = q_{SPH1} \times n_{Fi} \quad (25)$$

where:

$q_{SPH\frac{1}{2}}$, q_{SPH1} are the standby losses for ½ and 1 gallon mini-storage tanks (BTU/hour)

n_{Fi} number of fixtures of type i

A total point-of-use standby loss value for all fixtures is found using:

$q_{TSPH} = \Sigma$ (All $q_{SPH\frac{1}{2}i}$ or q_{SPH1i} involved in a particular point-of-use heater combination) (26)

The section of the program which calculates energy use, energy and installation costs contains equations for electric, natural gas and fuel oil annual energy use(s) and cost(s), annual contribution to conditioned space heating, and new/retrofit installation costs (as related to the heated water supply system). The annual energy use equations are:

$$E_{AE} = \{(E_{WC} + q_{TPH}) \times T_{HD} \times T_{DY}\} + q_{TSPH} \times 24 \times 365 \quad (27)$$

$$E_{TAE} = E_{AE} + \{(q_{LC1} + q_{LC2} + q_{TCH}) \times T_{HD} + (q_{LE1} + q_{LE2} + q_{LD1} + q_{LD2})\} \times T_{DY} + (q_{SCH} \times 24 \times 365) \quad (28)$$

$$E_{TAG} = \{(q_{LC1} + q_{LC2} + q_{TCH}) \times T_{HD} + (q_{LE1} + q_{LE2} + q_{LD1} + q_{LD2})\} \times T_{DY} + (q_{SCH} \times 24 \times 365) \quad (29)$$

$$E_{TAO} = \{(q_{LC1} + q_{LC2} + q_{TCH}) \times T_{HD} + (q_{LE1} + q_{LE2} + q_{LD1} + q_{LD2})\} \times T_{DY} + (q_{SCH} \times 24 \times 365) \quad (30)$$

where:

E_{AE} is the annual electrical energy use by water coolers and point-of-use heaters (BTU)

E_{TAE}, E_{TAG}, E_{TAO} are the total annual electrical, natural gas and fuel oil energy use as related to heated water use (BTU)

T_{HD} is the number of hours of operation/work day

T_{DY} is the number of work days/year

All other variables calculated previously.

Of course, standby losses are considered to occur continuously, therefore, q_{SCH} and q_{TSPH} are multiplied by 24 hours/day and 365 days/year.

The annual contribution to conditioned space heating is:

$$E_{CON} = \{(q_{LC1} \times T_{HD}) + q_{LE1}\} \times T_{DY} + \{(q_{SCH} + q_{TSPH}) \times 24 \times 365\}$$

The annual energy costs are simply calculated by:

$$C_{AE} = E_{TAE} \times P_E/3413 \quad (31)$$

$$C_{AG} = E_{TAG} \times P_G/10^6 \quad (32)$$

$$CAO = E_{TAO} \times P_O \times 7.1429/10^6 \quad (33)$$

Where:

C_{AE}, C_{AG}, C_{AO}, are the annual electrical, natural gas and fuel oil heated water use energy costs ($)

P_E is the cost of electricity ($/KWH)

P_G is the cost of natural gas ($/Million BTU)

P_O is the cost of fuel oil ($/gallon)

3413 is the KW to BTU conversion factor

7.1429 is the gallons of fuel oil to million BTU conversion factor

New construction installation costs result from the equations:

$$C_F = \Sigma\ (n_{Fi} \times P_{Fi}) \tag{34}$$

$$C_{NFRC} = \Sigma\ (n_{Fi} \times P_{NRCFi}) \tag{35}$$

$$C_{PH} = \Sigma\ (n_{Fi} \times P_{PHi}) \tag{36}$$

$$C_{TOT} = C_F - C_{NFRC} + C_{CH} + C_{PH} \tag{37}$$

where:

C_F is the total fixture installed heated plumbing cost ($)

C_{NFRC} is the total fixture plumbing credit for unused plumbing in systems supplying only tepid water to some or all fixtures ($)

C_{PH} is the total point-of-use heater installed cost ($)

C_{TOT} is the overall installed cost

P_{Fi} is the price of heated plumbing per fixture of type i ($)

P_{NRCFi} is the price of heated plumbing credit for unused plumbing per fixture of type i ($)

P_{PHi} is the price of an installed point-of-use heater for fixture type i ($)

C_{CH} is the installed cost of the central heater ($) ($C_{CH}$ does not apply to systems using only point-of-use heaters)

The idea of the heated plumbing price per fixture is to divide up the total heated plumbing line cost into equal parts for each fixture using the heated water. (For simplicity, the heated water lines are considered to be made of only one diameter, homogeneous pipe.) The credit for unused plumbing is assumed to be that portion of the cold water lines which need not be installed at fixtures requiring only a tepid supply. Again, for simplicity, the cold water loop is assumed to be the same size pipe and the same material as the heated water lines. In most simulations' runs, this credit was considered to be less than half of the installed heated plumbing cost per fixture. If no cold supply is needed in the building, then the total credit will be the cost of the entire installed cold water line system.

Retrofit installation cost equation is:

$$C_{TOT} = C_{PH} - C_{RFRC} - C_{RCCH}$$

where:

C_{TOT} is, again, the total overall installed cost ($)

C_{RCCH} is the return credit for the central heater removed from systems using only point-of-use heater ($)

C_{PH} is the total point-of-use heater installed cost ($)

C_{RFRC} is the total fixture plumbing credit for returned plumbing in systems supplying only tepid water to some or all fixtures ($)

Finally, the life cycle cost equations calculate life cycle energy, heater replacement and total life cycle costs. The life cycle energy costs are calculated by:

$$L_{CE} = C_{AE} \times W_E \qquad (39)$$

$$L_{CG} = C_{AG} \times W_G \qquad (40)$$

$$L_{CO} = C_{AO} \times W_O \qquad (41)$$

Where:

L_{CE}, L_{CG}, L_{CO} are the life cycle costs for electricity, natural gas and fuel oil ($)

W_E, W_G, W_O are the ten year present worth factors(1) for electricity, natural gas and fuel oil

The cost of replacing the central heater during the ten year life cycle is:

$$C_{RCH} = C_{CH} \times W_{SYR}$$

where:

C_{RCH} is the replacement cost (\$)

C_{CH} is the central heater installed cost (today's dollars)

W_{SYR} is the single present worth factor of non-recurring costs (1) at the year of replacement.

Total life cycle cost is simply:

$$L_{TOT} = C_{TOT} + (L_{CE} + L_{CG} + L_{CO}) + C_{RCH} \tag{43}$$

where:

L_{TOT} is the total life cycle cost (\$)

All values not pertaining to the model being analyzed are set to zero. The mathematical model is written to allow for analysis of many different building types and sizes, under many varying conditions.

Program Execution

The heated water supply system simulation program is designed for interactive (conversational) input. The user is lead through the input section of the program by a series of input requests. Refer to the simulation result section for a list of input requirements.

When all input requests are fulfilled, the program enters a set of "nested" loops. The loops allow for the analysis of sets of values for given variables and all possible combinations. With each combination of input variables, all six water supply system models are analyzed. A building's heated water supply system and the alternatives can be simulated under several varying conditions during one execution of the program.

Output from the program is in table form, with results for each of the six system models printed for easy comparison. The table is printed for each combination of the input data. Refer to the simulation result section for examples of program output.

The building heated water supply system simulation computer program output is contained in Appendix C. It is made up of three major sections. The first section is a three page description of the input information for the specific set of simulations. This is followed by a summary section which gives printed results obtained for each desired combination of input variables. The third section shows the results graphically for all simulations. The input description section and the printed summary sections are page numbered and show the date in which the simulations were run.

The input description section is for the most part self-explanatory. This section is much like the input survey table used for the manual analysis method in Appendix A. The completion of the input survey table example illustrates how this section of the program output is completed.

The printed summary section contains the summarized results of each simulation analyzed. Each page contains up to three summaries. In each summary pertinent input information is printed on the first lines. The point-of-use model values depict which point-of-use combination was selected for each of the six supply sustem models. Results are then printed for each of the six system models. The abbreviated description of the values are printed to the left. The definitions of the abbreviations are as follows:

TAE BTU (BTU)- Total Annual Energy Use (BTU)
ASH CTR (BTU)- Annual Conditioned Space Heating Contribution (BTU)
TAE COST ($) - Total Annual Energy Cost ($)
INS COST ($) - Installation Cost Before Credits ($)
RET CR ($) - Total Credits ($)
TOT COST ($) - Total Installation Cost After Credits ($)
TLEC COST ($)- Total Life Cycle Energy Cost ($)
RPLC HTR ($) - Control Heater Replacement Cost During the Life Cycle ($)
TLC COST ($) - Total Life Cycle Cost ($)

Value fields which contain a row of asterisks indicates that the restrictions imposed on the point-of-use heaters could not be met by any of the six point-of-use combinations in that particular system model. In this case, the total life cycle cost field also contains a row of stars.

In the third section of the program output the simulation results are shown graphically. There are two different graph formats. The first format illustrates the effect that the inputted flow restriction has on the resultant annual energy cost and life cycle costs. This format is used for each percent increase in tepid use value inputted and these values are held constant as flow restriction (percent flow allowed) is varied. The second format does exactly the opposite, it holds flow restriction constant and varies the percent increase in tepid use values. The second format illustrates the effect that increased tepid use (in those systems with no cold water to the faucets) has on life cycle cost and annual energy use.

Each of the six system models are shown on each graph, unless they have failed to meet the requirements imposed on point-of-use heaters. Corresponding supply system model numbers appear on the right.

Thermal Equations

The equations, both theoretical and experimental, were carefully chosen for their validity as well as applicability for the range of operating conditions this study was concerned with. Some are simply time-honored relationships that may be found in heat transfer textbooks or handbooks. Other equations are experimentally derived correlations that seem to work "best" for a relatively narrow range of problem situations. Most of these equations may also be found in modern heat transfer texts or references.

Beginning at the basics, a British Thermal Unit (BTU) is defined as that amount of energy required to increase the temperature of one pound (mass) of water by one degree fahrenheit at or near its maximum density (approximately at 39.1°F).(1) This simple definition is the basis for calculating many of the energy requirements of any water based system. Expressed in a psuedo-mathematical form yields:

$$1 \text{ BTU} \Rightarrow 1 \text{ lbm}_{H_2O} * 1^{\circ}F$$

Hence, to determine the energy required to heat water in a storage tank, simply determine the <u>mass</u> of water to be heated and multiply by the desired increase in °F temperature to get BTU's. To illustrate:

Let: X_1 = number of gallons of water to be heated.

Q = BTU's required

T_i = initial water temperature, degrees F

T_f = final water temperature, degrees F

It is also known that at 20°C (68°F), one gallon of water contains 8.331 pounds-mass of water. Therefore:

$$Q = (X_1)(T_f - T_i)(8.331)$$

Fore example, if cold water temperature is 40°F, final temperature is 140°F and the tank has 60 gallon capacity. In this case, the energy required per cycle is:

$$Q = (60)(140-40)(8.331) = 49{,}986 \text{ BTU's/cycle.}$$

(1) Handbook of Chemistry & Physics, 5th Edition, p.F.71, 1976.

If one wishes to put this into a time frame basis, simply multiply Q in BTU's/cycle by the number of cycles per unit of time, say 4 cycles/day. In that case:

$$Q/\text{day} = Q(4) = (49{,}986)(4) = 199{,}994 \text{ BTU's/day}$$

Line Losses

There were two main categories of line losses considered in the analysis. One was the energy lost due to water lying in pipes stagnant "cooling off" and hence that energy used in heating it, being wasted. The second category was that of convective losses during times when hot water is actively flowing in the pipes.

The equations pertaining to the stagnant cooling of water in the lines are of the same type as those for the initial heating of the water, with the variables being the mass of the water and temperature change in degrees F. In order to put them into a "workable" form, arithmetic was applied as shown below:

$$Q = (\text{mass})\ (\Delta T)$$

$$\text{mass} = (\text{Volume})(\text{Density})$$

$$\text{Volume} = (\text{cross-sectional area of pipe aperature})(\text{length})$$

$$= \left(\frac{\pi D^2}{4}\right)(L)\underbrace{\left(\frac{1}{144}\right)}_{\text{Conversion factor}}\ \text{ft}^3$$

Assume density, $\rho = 62.32\ \text{lbm/ft}^3$

$$Q = \left(\frac{\pi D^2}{4}\right)(L)\left(\frac{1}{144}\right)(62.32)(\Delta T)$$

Rearranging terms yields:

$$Q = \left(\frac{\pi * 62.32}{4 * 144}\right)(D^2)(L)(\Delta T)$$

$$= (.3399)(D^2)(L)(\Delta T)$$

where:

D = inside diameter, inches

L = length of pipe, feet

ΔT = Change in temperature, degrees F

This general expression has two slightly different applications. The first is the case whereby the "hot" water cools to room "ambient" temperature. If the pipe is located in a "conditioned" space, the energy is not truly wasted as it contributes to space heating during cold weather.

The second case is that of the water which has already cooled to ambient. In this case, the energy required to bring the groundwater to ambient temperature literally goes "down the drain" as the user of hot water waits for the water to become hot.

The equation is identical in both cases and all terms <u>except</u> ΔT remain constant. ΔT is quite different for the two cases. In the first example, ΔT is defined as $T_{HOT\ WATER} - T_{AMBIENT}$. In the second case, it is $T_{AMBIENT} - T_{GROUNDWATER}$, with the condition that both differences be greater than zero, or else assumed zero if negative.

The handling of the data is somewhat different as well. Energy lss in cooling to ambient represents a decreased space heating requirement. That which goes "down the drain" is totally lost. The computerized model utilized takes these factors into account.

The second main classification of line losses are those occurring due to convective losses while hot water is flowing in the pipe. The generalized equation for any convective mode of heat transfer is of the form:

$$Q = hA(T_s - T\infty)$$

where:

$Q \triangleq$ energy flow from

$A \triangleq$ convective surface area, ft^2

$T_s \triangleq$ surface temperature, ^oF

$T_\infty \triangleq$ fluid temperature, $^{\circ}F$

$h \triangleq$ convective heat transfer coefficient, $\frac{BTU}{hr\ ft^2\ {}^{\circ}F}$ (1)

The only difficulty in using this equation is determining the proper value of the convective heat transfer coefficient, h. The coefficient h is a complex function of geometry, fluid flow, and fluid properties. Fortunately, much work has been directed at developing relationships for various configurations and fluids. McAdams (2) suggests for air being naturally convected around horizontal cylinders (i.e., pipes) that:

$$h = 0.27\ \left(\frac{\Delta T}{D}\right)^{.25}$$

be used for the region of interest in this study. Substituting into the general convection equation, rearranging, and making appropriate conversions for dimensions yields:

$$Q = 0.0707\ \left(\frac{\Delta T}{D}\right)^{.25} DL\Delta T$$

where:

Q = convective energy loss, BTU/hr.

ΔT = pipe temperature less ambient temperature, $^{\circ}F$

D = outside diameter of pipe, inches

L = length of pipe, feet

As before, these convective "losses", if pipe is located in a conditioned space, decrease the space heating requirements of the building.

Another item was checked in the course of the study. This item was the determination of the actual "faucet end" temperature of hot water. This was done to determine how long it would take for the pipes to "heat up" after the water was turned on, and the corresponding time it took for the exit water temperature to be "hot". What follows is how this was accomplished. The results show that with the exception of extremely long pipe runs, cold ambients, and low flow rates - all simultaneously - the reader need not repeat the analysis. Except as mentioned above, the water simply does not "cool off" enough to be of any consequence.

(1) Engineering Heat Transfer, 1977, Kerleker & Desmond, p.13.
(2) McAdams, W.H., Heat Transmission, McGraw Hill, 3rd Edition, 1954.

For the inside surface convection coefficient, h, the equation derived by Petukhov and Popov[1], experimentally, was chosen as it is believed to be the most accurate available in the region of parameters involved. It is:

$$Nu = \frac{(f/8)\ Re\ Pr}{1.07 + 12.7 \sqrt{f/8}\ (Pr^{2/3}-1)} ,$$

where:

Nu = Nusselt number, $\frac{hD}{k}$

Re = Reynold's number, $e\ \frac{vD}{\mu}$

Pr = Prandtl number, $\frac{\mu Cp}{k}$

f = Friction factor as defined by:

$$f = \{1.82\ Log_{10}(Re) - 1.64\}^{-2}$$

Remember that the heat transferred in a convective mode is determined by:

$$Q = hA\Delta T$$

A very difficult transient problem occurs here because ΔT is changing as a function of Q. Hence, a "brute force" approach was used. The algorithm was to divide the water and pipe into extremely small parts, calculate the heat flow out of the water (and into the pipe) for the very small parts, change the temperature of the small parts of water and pipe accordingly let the water flow for one small unit of time, and repeat the process. As the size of the "parts" becomes infinitesimal, this method becomes exact. The accuracy is, of course, a function of the size of the parts. Results showed that, except as mentioned before, this need not be considered in calculations relating to hot water faucets.

(1) Petukhov, B.S. and Popov, V.N.,"Theoretical Calculations of Heat Exchange and Fractional Resistance in Turbulent Flow in Tubes of an Incompressible Fluid with Variable Physical Properties", Trans. High Temperature, 1, No. 1, 1963.

Standby Losses

For hot water tank standby loss calculations, an easy equation to use, which will give reasonable results, is from Fourier's conduction equation:

$$q = =kA \frac{dT}{dx}$$

This relationship is approximated by:

$Q = \frac{kA\Delta T}{x}$, where

Q = heat flow from hot to cold

k = thermal conductivity

A = area perpendicular to energy flow

$\Delta T = T_{Hot} - T_{Cold}$

x = distance through surface in axis of heat flow.

Also note that thermal resistance, R, is defined as:

$\frac{x}{k}$, where:

x = thickness, inches, and

k = thermal conductivity, $\frac{Btu \cdot in}{hr \cdot ft^2 \cdot {}^oF}$

Hence, the conduction equation becomes:

$Q = \frac{(A)(\Delta T)}{R}$, where:

Q = Energy flow from hot to cold, Btu/hr

A = Area perpendicular to energy flow, ft^2

ΔT = Hot temperature, (ie-hot water temperature) minus cold temperature, (ie-outer surface temperature of the water storage tank), ^oF

R = Thermal Resistance, $\frac{hr \cdot ft^2 \cdot {}^oF}{Btu}$

Typical values of R would range from 1.0 to 6.0 for a hot water storage tank. A concerned engineer would be ablt to determine an approximate value either by experimentation or, more likely, by consulting with the manufacturer of the tank and/or inspecting the insulation of the tank.

In the case of gas and oil-fired boilers, the equation should also include an adjustment to account for the inefficiencies involved. Hence, the equation would now become:

$$Q = \frac{A\Delta T}{R} * \eta ,$$

where η is the efficiency factor, to be in the range of 1.0 to 2.0. Again, this efficiency could be determined by consulting the manufacturer.

Hot Water Usage Adjustments

One school of thought is that if personnel are accustomed to using a certain temperature of water for say washing hands, then they will continue to do so, regardless of the hot water temperature. For example, if one once used one gallon of 40°F cold water mixed with one gallon of 160°F hot water to obtain two gallons of 100°F water, and the hot water supply temperature is reduced to 100°F, they would now simply draw the entire two gallons from the hot water tap. To calculate this for more complicated examples use:

$$usage_3 = \left(\frac{T_2 - T_1}{T_3 - T_1}\right) * (usage_1 + usage_2), \text{ where}$$

T_1 = cold water line temperature, °F

T_2 = desired outlet temperature, °F

T_3 = new hot water temperature, °F

$Usage_1$ = old hot water usage, gallons

$Usage_2$ = old cold water usage when mixed with hot water, gallons; and

$Usage_3$ = new hot water requirements, gallons

To illustrate, let

cold water temperature = $40^{o}F$

required temperature = $95^{o}F$

new hot water temperature = $110^{o}F$

old hot water usage = 10 gallons/hr.

To further complicate things, suppose the old cold water "mix" ($Usage_2$), is not known. In that case, it may be calculated with:

$$Usage_2 = \frac{Usage_1 (T_4 - T_2)}{T_2 - T_1}$$, where

T_4 = Old hot water temperature, ^{o}F, and all other variables are the same.

Hence, with the old hot water temperature setting at $160^{o}F$, we see:

$$Usage_2 = \frac{10 \times (160 - 95)}{(95 - 40)} = 11.8181$$

and, therefore,

$$Usage_3 = (\frac{95 - 40}{110 - 40}) * (10 + 11.8181) = 17.14 \text{ gallons}$$

Hence, the new hot water usage rate, 17.143 gallons, should be used instead of 10 gallons. Of course, this school of thought has yet to be proven as fact.

The following section shows graphically what happens to the temperature of the water stored in a point-of-use mini-storage tank hot water heater for various inputs. The inputs and curve identification is found on the page preceding the graphs. Also included is a table on the approximate maximum time a point-of-use mini-storage tank hot water heater can satisfactorily operate continuously.

As a "rule of thumb", the point-of-use mini-storage tank hot water heaters take roughly five times as long to heat up as to be depleted.

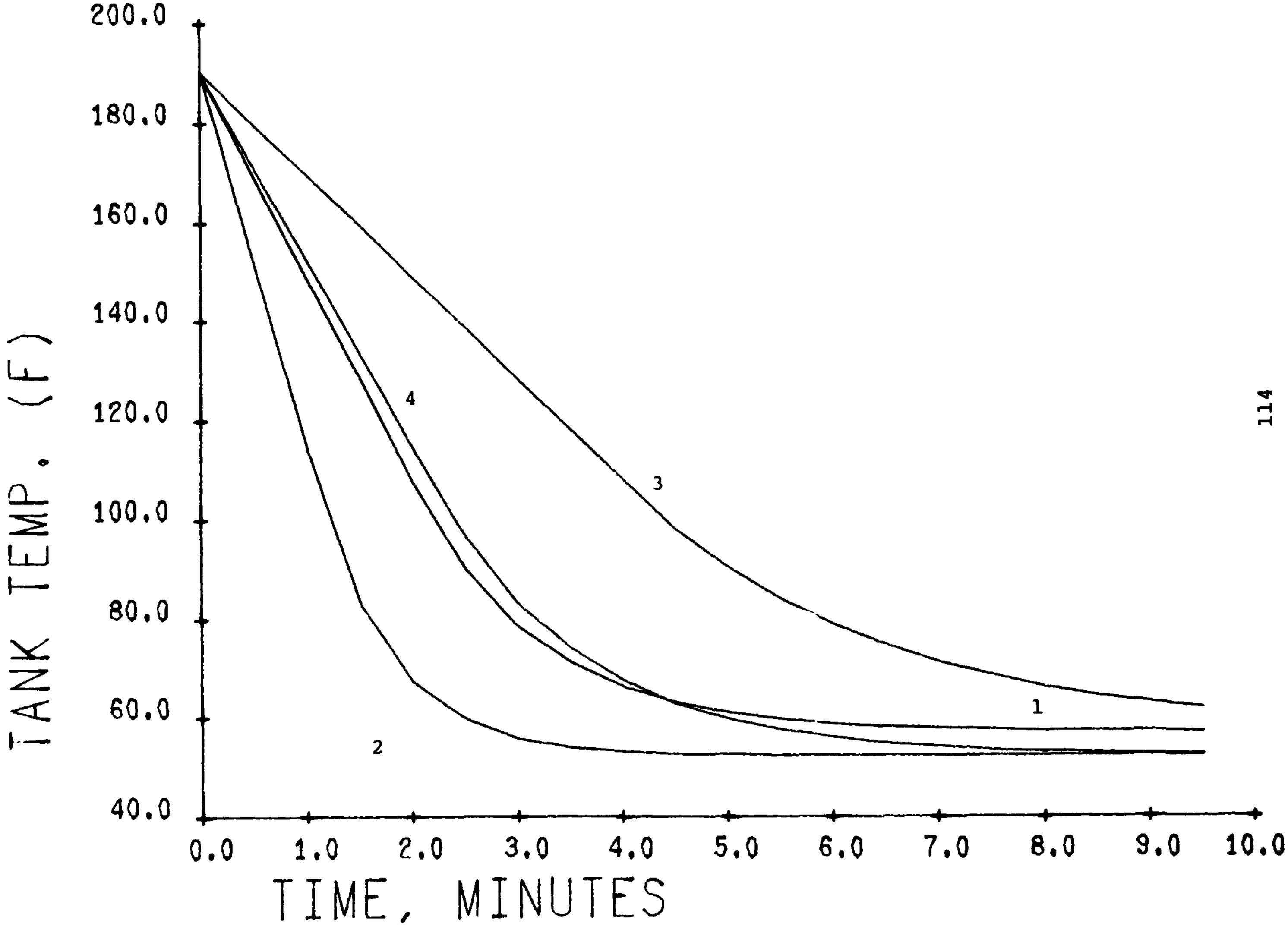
TABLE 29

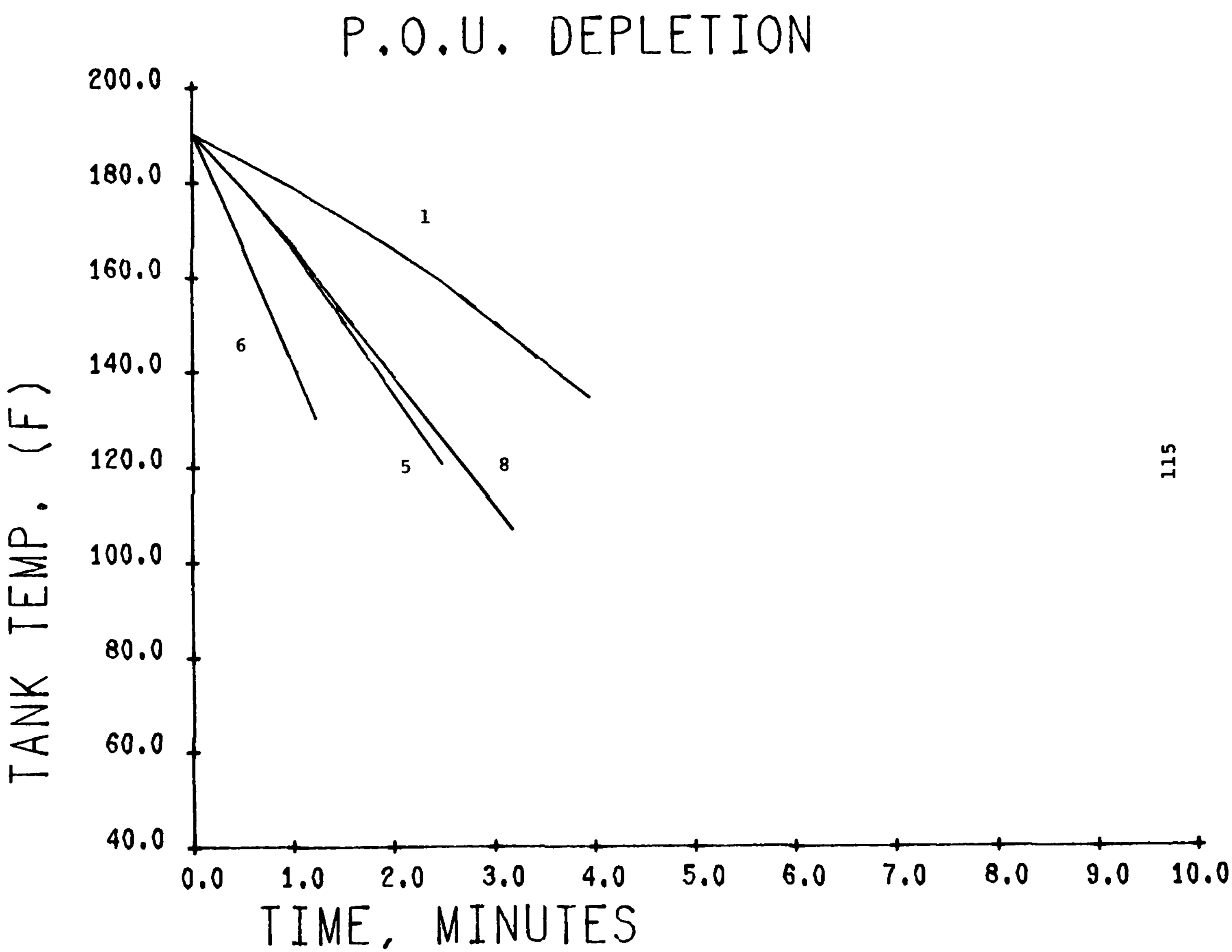
POINT-OF-USE MINI-STORAGE TANK HEATER DEPLETION

CURVE #	TOUT	TMAKE	TCOLD	CAPACITY	DEMAND	DEPLETION TIME
1	105	45	45	0.500	2.250	1.5
2	105	45	45	0.500	3.750	1.0
3	105	45	45	1.000	2.250	2.5
4	105	45	45	1.000	3.750	1.5
5	105	45	105	0.500	2.250	2.0
6	105	45	105	0.500	3.750	1.5
7	105	45	105	1.000	2.250	4.0
8	105	45	105	1.000	3.750	2.0
9	105	105	45	0.500	2.250	3.0
10	105	105	45	0.500	3.750	1.5
11	105	105	45	1.000	2.250	7.0
12	105	105	45	1.000	3.750	3.0
13	105	105	105	0.500	2.250	2.5
14	105	105	105	0.500	3.750	10.5
15	105	105	105	1.000	2.250	6.0
16	105	105	105	1.000	3.750	4.5
17	140	45	45	0.500	2.250	1.5
18	140	45	45	0.500	3.750	1.0
19	140	45	45	1.000	2.250	2.5
20	140	45	45	1.000	3.750	1.5
21	140	45	105	0.500	2.250	2.0
22	140	45	105	0.500	3.750	1.0
23	140	45	105	1.000	2.250	3.5
24	140	45	105	1.000	3.750	2.0
25	140	105	45	0.500	2.250	3.0
26	140	105	45	0.500	3.750	1.5
27	140	105	45	1.000	2.250	7.5
28	140	105	45	1.000	3.750	3.0
29	140	105	105	0.500	2.250	6.0
30	140	105	105	0.500	3.750	2.5
31	140	105	105	1.000	2.250	12.0
32	140	105	105	1.000	3.750	5.0

Where: Curve # is the curve number on the following pages
TOUT is the desired outlet temperature, °F
TMAKE is the P.O.U. heater make-up water temp, °F
TCOLD is the water temp of both mixing valve and faucet cold supply, °F
CAPACITY is the P.O.U. heater tank capacity, gallons
DEMAND is hot water (140°F) demand rate, gpm
TIME is approximate continuous use time, minutes

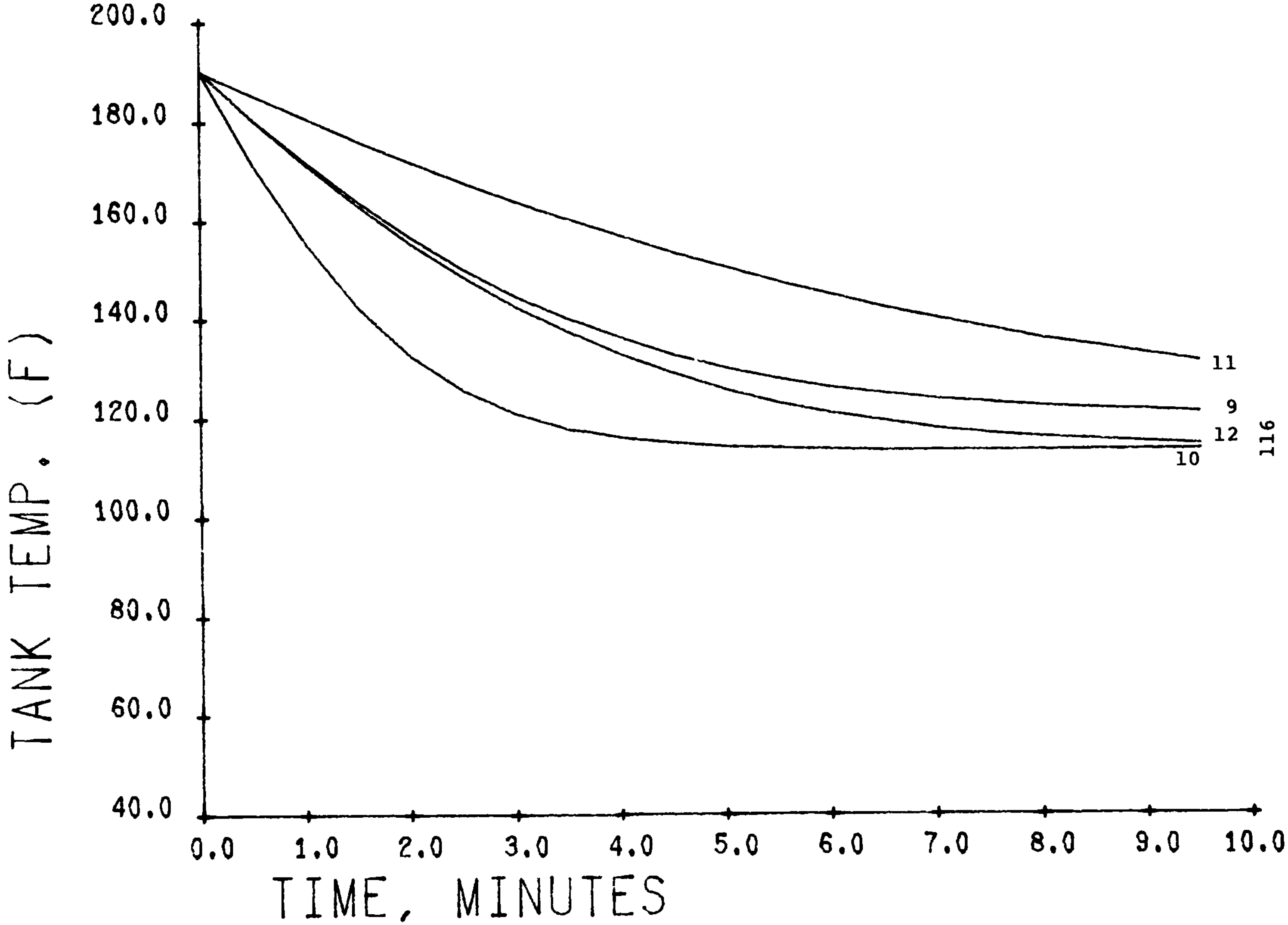
P.O.U. DEPLETION

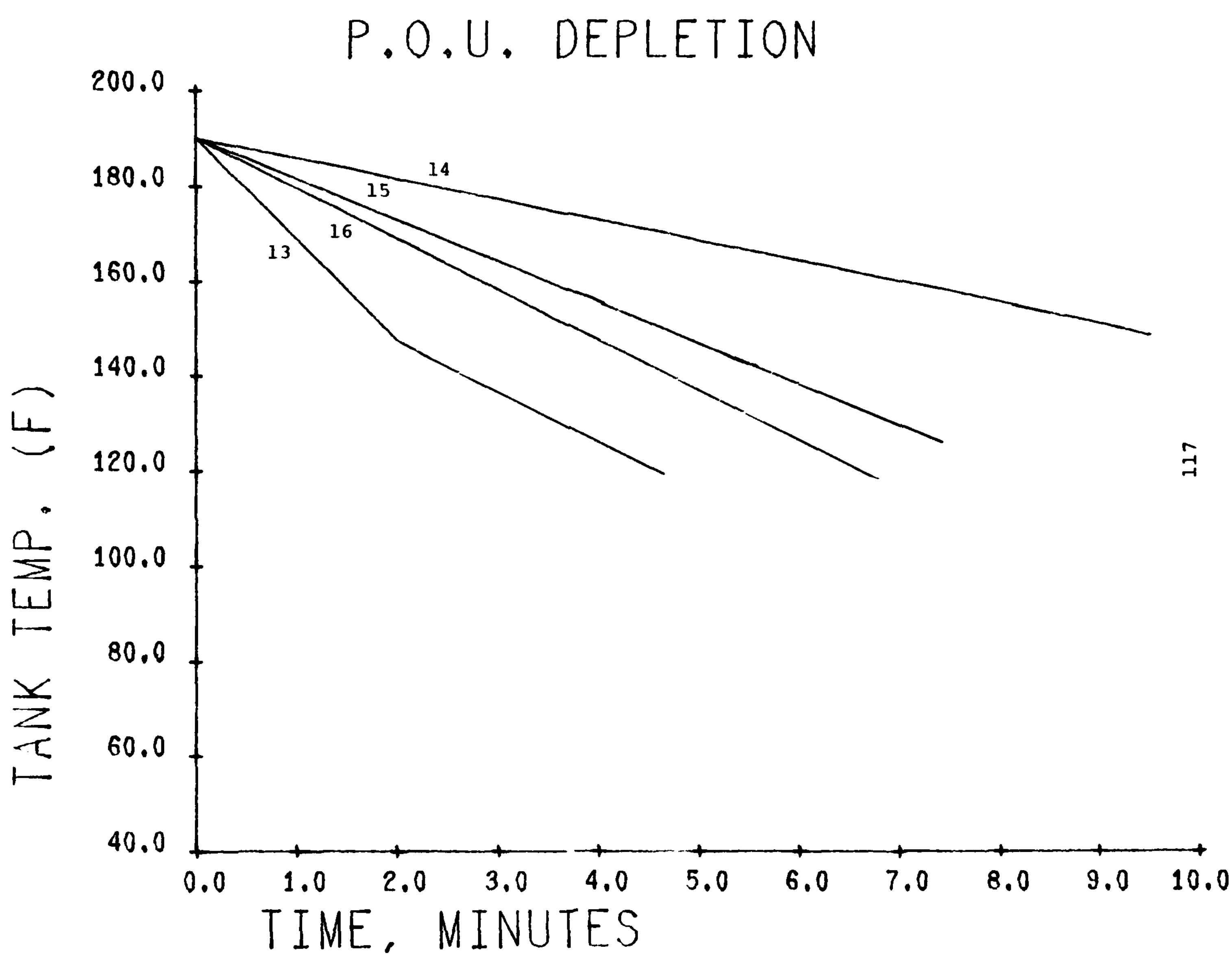




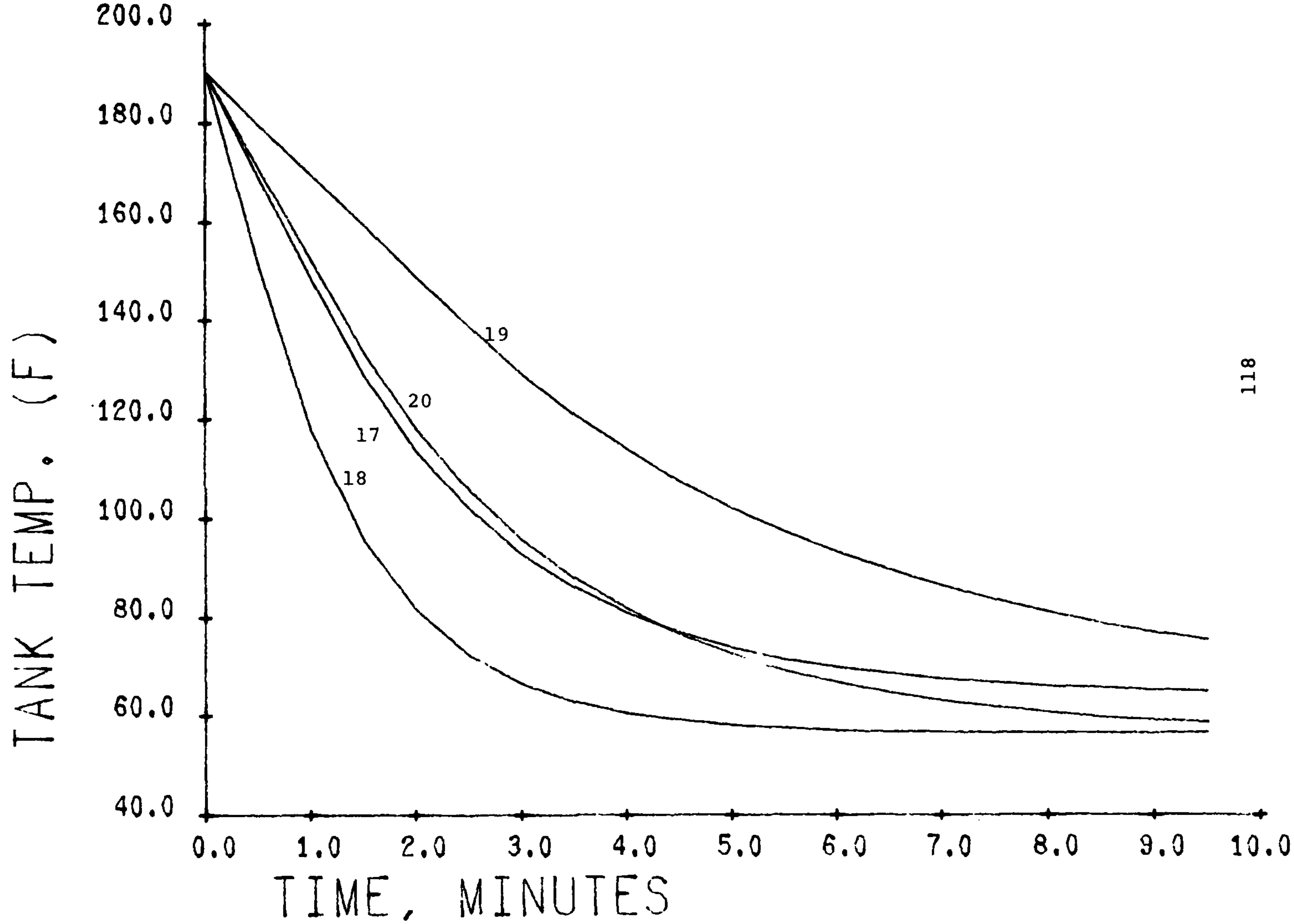
P.O.U. DEPLETION
TANK TEMP. (F)
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME, MINUTES
1
6
5
8

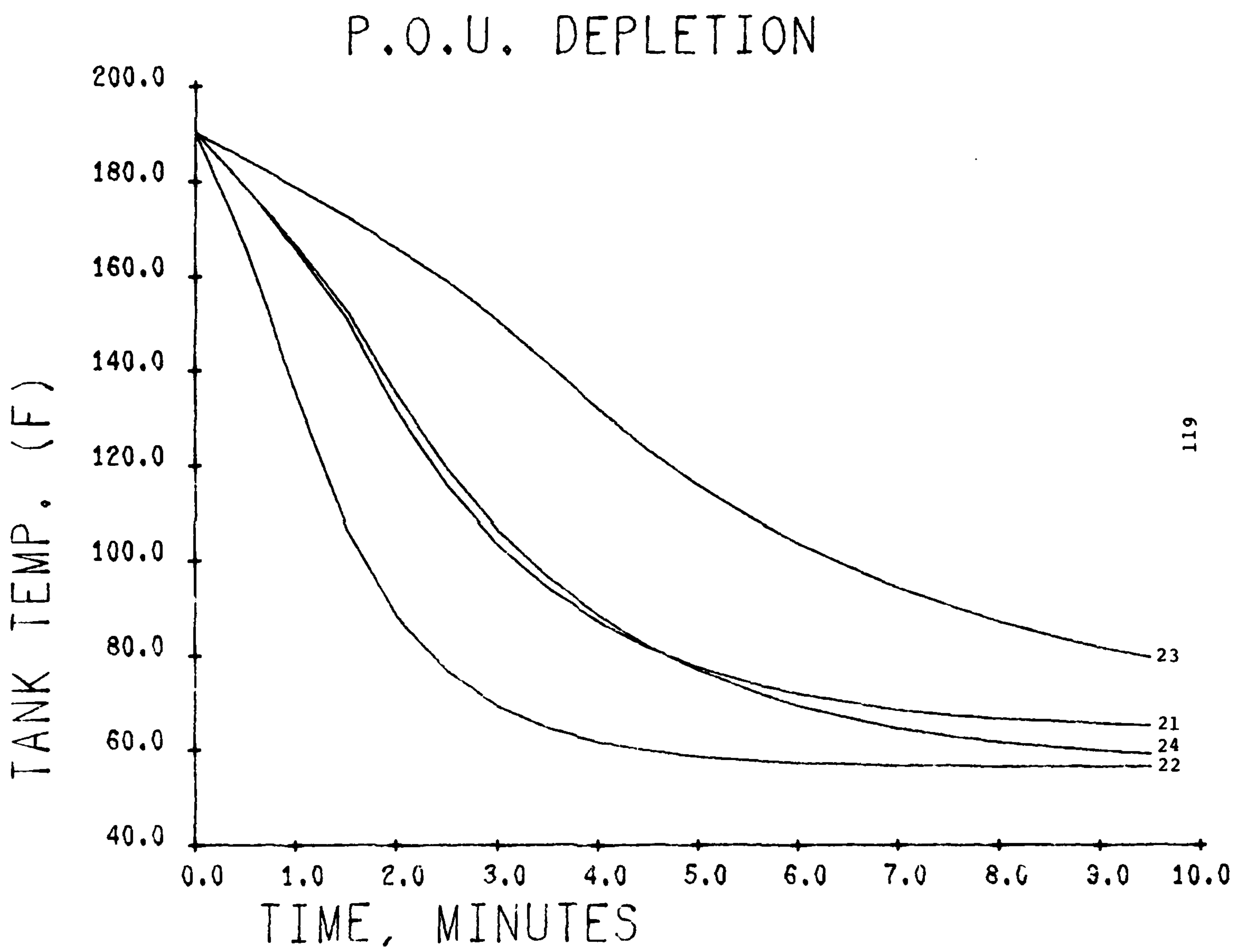
P.O.U. DEPLETION



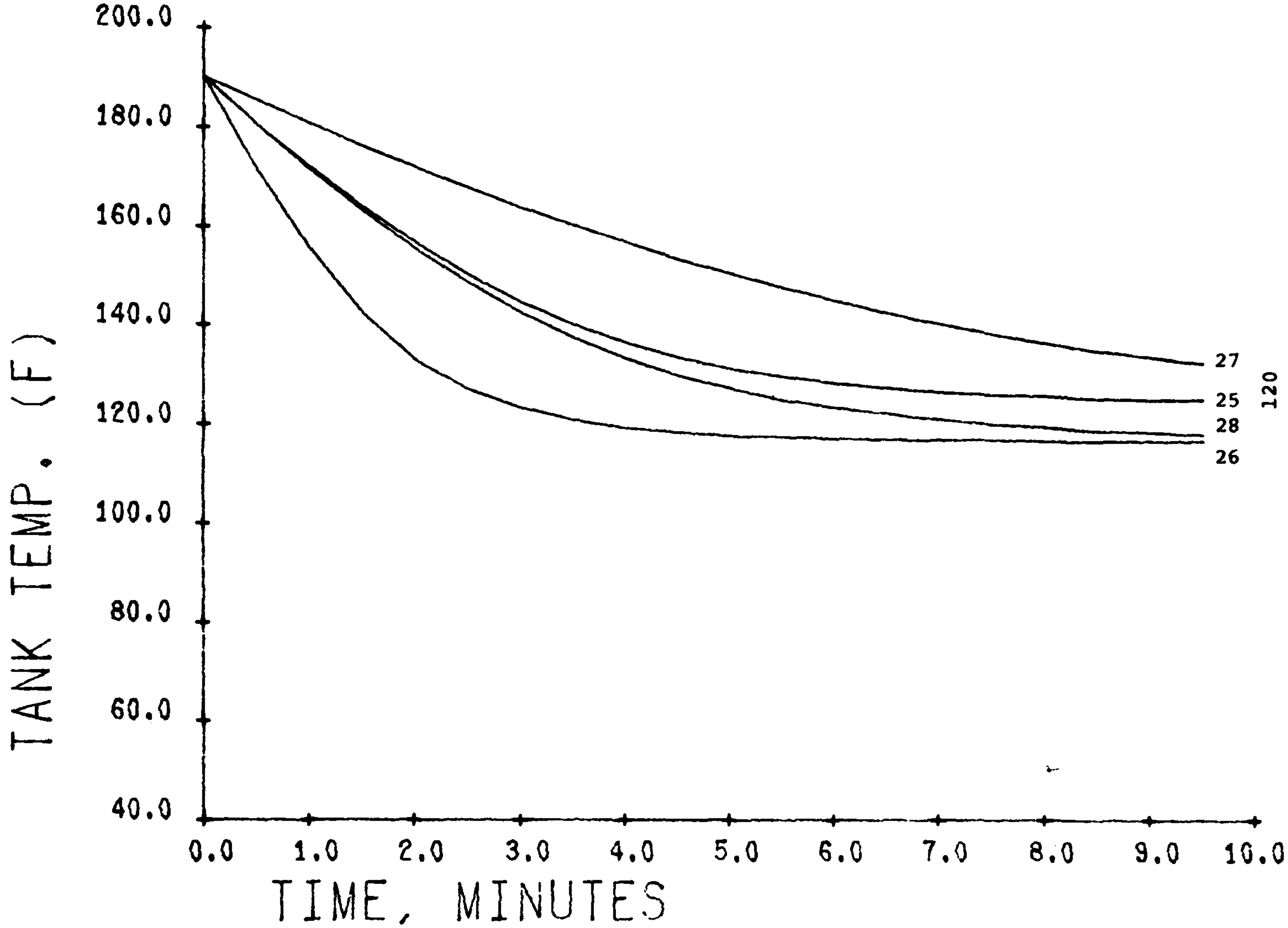

P.O.U. DEPLETION
TANK TEMP. (F)
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME, MINUTES
14
15
16
13

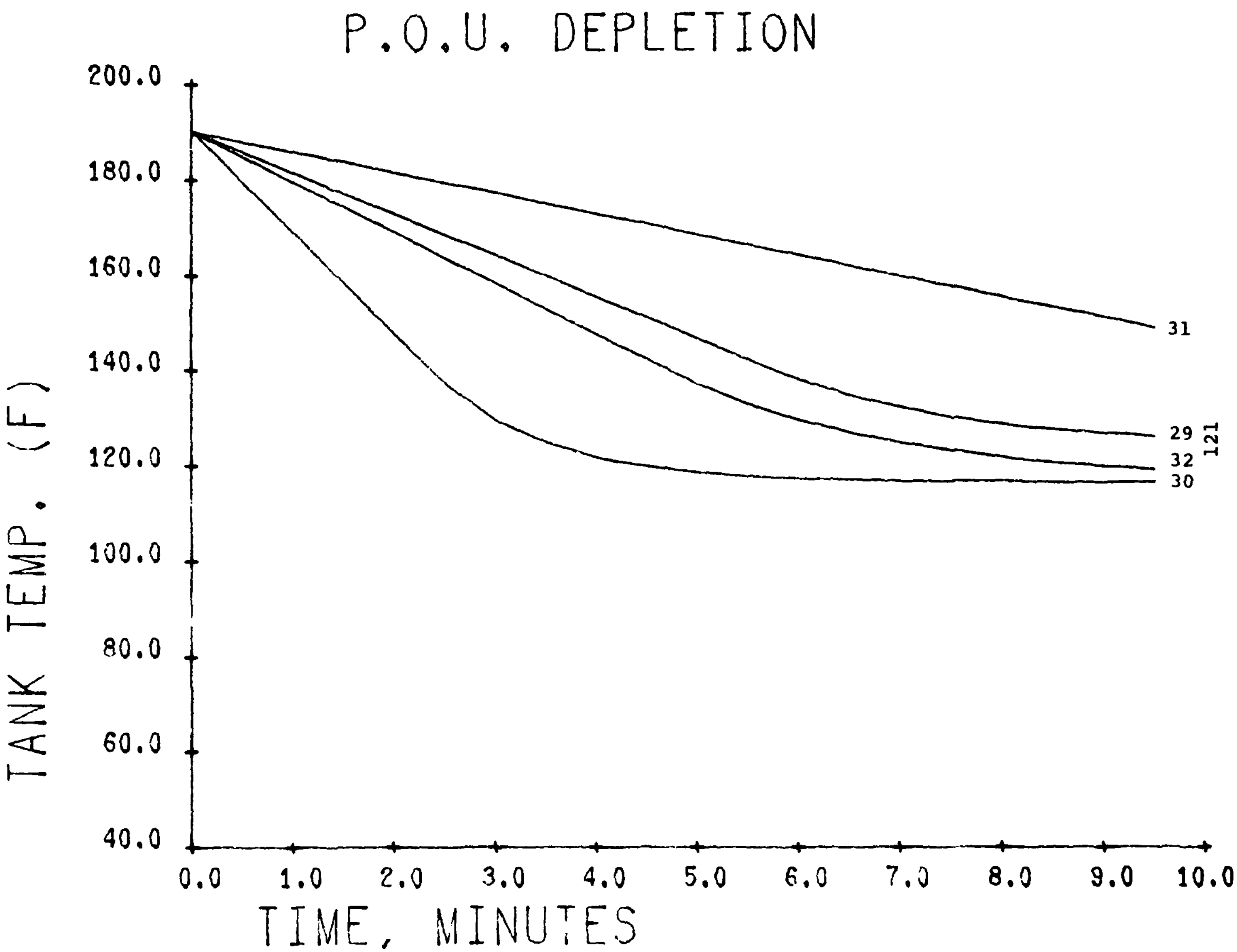
P.O.U. DEPLETION




P.O.U. DEPLETION
TANK TEMP. (F)
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
3.0
10.0
TIME, MINUTES
23
21
24
22

P.O.U. DEPLETION




P.O.U. DEPLETION
TANK TEMP. (F)
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME, MINUTES
31
29
32
30

APPENDIX C

DESCRIPTION OF SIMULATION INPUT

To reach meaningful conclusions for this study, many different combinations of input information need be analyzed. For this reason, a basic structure is adopted for all input information used for the computer simulation. This structure is as follows:

- Building Type and Specifications
  - DoE Region
    - Cost Analysis (New/Retrofit)
      - Central Heater Fuel Type (electric/natural gas/fuel oil)
        - Percent Increase in Tepid Use (no cold systems)
          - Flow Restriction (percent flow allowed)

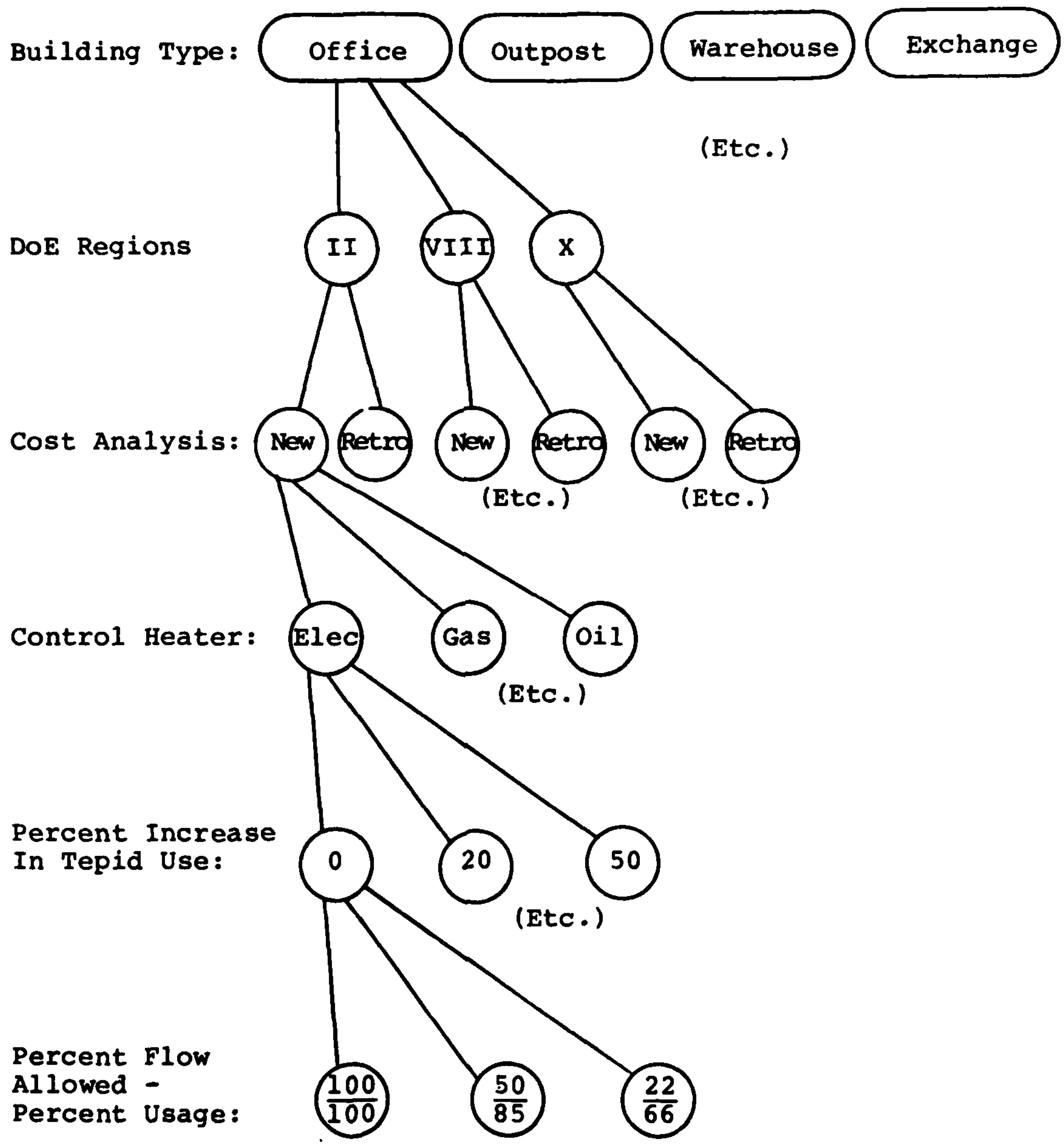
Four building types are analyzed. The four types are office, outpost, warehouse and exchange. The office depicts high demand per fixture and non-continuous use (only eight hours per day, 250 days per year). The outpost illustrates low demand per fixture and continuous use. The warehouse type is simulated for its low demand per fixture and non-continuous use. And finally, the exchange depicts high demand per fixture with more continuous use (12 hours per day; 300 days per year).

Each building is simulated in each of three DoE regions. DoE regions II, VIII and X are selected for diversity in energy costs.(1) Within each DoE region, both new construction and retrofit cost analysis are computed. Electric, natural gas-fired and fuel oil-fired central heaters are analyzed within each cost analysis.

In order to show the effects on increase tepid use when no cold water is supplied to faucets in certain systems, three percent values are studies for each central heater type. These percent values are 0 percent, 20 percent and 50 percent. Within each percent increase tepid use value simulation, three flow restriction values are analyzed. The flow restrictions are accomplished by means of percent of normal flow allowed and corresponding percent of normal usage values for each faucet. Janitorial faucet usage is considered to be unchanged even with flow restriction. The three sets of values used are:

TABLE 29

SIMULATION INPUT STRUCTURE



Percent Flow Allowed	Percent of Normal Usage
100	100
50	85
22	66

Assumptions had to be made on the corresponding percent usage values. However, the values follow closely those values used in an earlier study.(1)

The variation in each level of the input structure creates four "trees". The "tree" structure is shown in Table 29.

The use of the structured input is evident in the printed output. Each value of a lower level in the structure is evaluated before the value of the next higher level is changed. In this way, all combinations are simulated systematically.

The first three pages of printed output describe the input used for the specific building. Consult the input survey completion example for information pertaining to the gathering of the input information for the computer simulations (the same method applies). The only major difference comes in the exchange type building where janitorial sinks are assumed to require hot water, not tepid. This means that if tepid water is supplied from the central heater, then a point-of-use heater must be installed to add the additional heat to the water. The effect of the addition to the point-of-use requirement in System Models 2 through 4 is quite evident in the printed output for the exchange building simulation.

(1) Shepherd, P. B., Performance Evaluation of Point-of-Use Water Heaters, FESA-TS-2081, 1980.

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BUILDING: CODE = 1 NAME = OFFICE

FXTR TYPE	FXTR NAME	QTY	TEMP REQ CODE	HOT/TEPID FLOW RATE (GPM)	EST USAGE (GPH/FXTR) HOT/TEP	COLD
1	LAVATORY FAUCET	4	2	2.25	6.00	6.00
2	JANITORIAL FAUCET	1	2	3.75	20.00	20.00
3	TOILET	4	3	0.00	17.50	17.50
5	DRINKING FOUNTAIN	2	3	0.00	2.66	2.66

----- CENTRAL HEATER -----

CODE	NAME	EFFECIENCY
1	ELEC	0.95
2	GAS	0.75
3	OIL	0.70

CENTRAL HEATER STORAGE TANK

HEIGHT (IN)	DIAMETER (IN)
40.00	19.17

CENTRAL HEATER R VALUE(S) = 2.50

ADDITIONAL STANDBY LOSS FACTOR FOR GAS/OIL HEATERS = 2.90
CENTRAL HEATER LOCATION (C=COND SPACE, U=UNCOND) = C
REMAINING LIFE OF HEATER (YRS) = 6
ALTERNATIVE SYSTEM HEATER LIFE EXTENSION (YRS) = 2

NORMAL HEATED WATER LINE LENGTH(S) (FT) = 120.00

-------- HEATED WATER LINES --------

DIAMETER (IN)	EXTRA LENGTH COOLER (FT)	TOILET (FT)	PERCENT CONDITIONED SPACE
0.785	40.00	10.00	100.00

NUMBER OF PIPE COOLDOWN CYCLES PER DAY= 1.20

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-------------- CONSTANT TEMPERATURES (F) --------------

******** HOT *******			******* TEPID ******			WATER	
WATER SUPPLY	MIN ALLOW	MAX ALLOW	WATER SUPPLY	MIN ALLOW	MAX ALLOW	COOLER OUTLET	ROOM
140.	130.	150.	105.	95.	115.	40.	68.

FOR DOE REGIONS:	2	8	10
AMBIENT TEMP (F)	51.00	51.00	60.00
GROUND WATER TEMP (F)	45.00	50.00	55.00
MIN GRD WATER TEMP (F)	39.00	45.00	49.00
MAX GRD WATER TEMP (F)	51.00	55.00	61.00

PERCENT INCREASED TEPID USE (NO COLD SYSTEMS) = 0.00 20.00 50.00

PERCENT OF FLOW (FLOW RESTRICTION) = 100.00 50.00 22.00
CORRESPONDING PERCENT USAGE = 100.00 80.00 66.00

WATER COOLER EFFECIENCY (%) = 70.00

NUMBER OF HOURS IN WORK DAY = 8.00
NUMBER WORK DAYS IN YEAR = 250.00

-------------------- POINT-OF-USE HEATERS --------------------

CODE	NAME	STORAGE TANK HEIGHT (IN)	STORAGE TANK DIAMETER (IN)	MAX EXTR DEMAND (GPH)	INSTALLED COST
4	INSTANTANEOUS 4.6 KW				237.00
5	INSTANTANEOUS 10 KW				400.00
6	INSTANTANEOUS 20 KW				420.00
7	MINITANK 1/2 GAL	6.00	5.00	6.25	200.00
8	MINITANK 1 GAL	8.00	6.06	12.00	260.00

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FOR DOE REGION:	2	8	10
FOR FXTR TYPE 1 ($/FXTR) -			
INSTALLED COST	113.20	106.86	141.55
RETURN CR NEW	50.00	45.00	60.00
RETURN CR RETROFIT	0.00	0.00	0.00
FOR FXTR TYPE 2 ($/FXTR) -			
INSTALLED COST	113.20	106.86	141.55
RETURN CR NEW	50.00	45.00	60.00
RETURN CR RETROFIT	0.00	0.00	0.00
CREDIT - NO HOT/COLD SUPPLY	565.00	530.00	700.00
CENTRAL HTR TYPE 1 ($) -			
INSTALLED COST	260.88	252.15	299.68
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 2 ($) -			
INSTALLED COST	301.48	291.40	346.28
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 3 ($) -			
INSTALLED COST	301.48	291.40	346.28
RETURN CREDIT	0.00	0.00	0.00
COST OF ENERGY -			
ELECTRICITY ($/KWH)	0.070	0.036	0.022
NATURAL GAS ($/MBTU)	3.710	2.330	3.500
FUEL OIL ($/GAL)	0.581	0.541	0.550
10 YR PRESENT WORTH FACTORS -			
ELECTRICITY	6.183	6.841	6.601
NATURAL GAS	7.067	9.325	7.950
FUEL OIL	7.440	7.547	7.452

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8320E 08	0.1402E 09	0.5151E 08	0.5151E 08	0.4693E 08	0.4693E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1706.53	2876.96	1056.61	1056.61	962.64	962.64
INS COST ($)	826.87	826.87	826.87	826.87	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	*********	*********
TLEC CST ($)	10551.51	17788.25	6533.05	6533.05	5952.05	5952.05
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	11378.39	18050.13	7359.93	7109.93	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7508E 08	0.1335E 09	0.4633E 08	0.4633E 08	0.4334E 08	0.4175E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1539.90	2739.60	950.41	950.41	888.94	856.45
INS COST ($)	826.87	826.87	826.87	826.87	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	1220.00	2100.00
TLEC CST ($)	9521.24	16938.94	5876.44	5876.44	5496.34	5295.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10348.11	17200.82	6703.32	6453.32	6716.34	7395.43

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6939E 08	0.1288E 09	0.4271E 08	0.4271E 08	0.3813E 08	0.3813E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1423.26	2643.44	876.08	876.08	782.11	782.11
INS COST ($)	826.87	826.87	826.87	826.87	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	1185.00	1185.00
TLEC CST ($)	8800.05	16344.42	5416.81	5416.81	4835.80	4835.80
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9626.93	16606.30	6243.69	5993.69	6020.80	6020.80

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.8320E 08	0.1495E 09	0.5151E 08	0.6077E 08	0.4693E 08	0.5619E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1706.53	3066.89	1056.61	1246.54	962.64	1152.58
INS COST ($)	826.87	826.87	826.87	826.87	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	*********	*********
TLEC CST ($)	10551.51	18962.60	6533.05	7707.40	5952.05	7126.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	11378.39	19224.48	7359.93	8284.28	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	20.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.7508E 08	0.1418E 09	0.4633E 08	0.5459E 08	0.4334E 08	0.5000E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1539.90	2908.81	950.41	1119.63	888.94	1025.66
INS COST ($)	826.87	826.87	826.87	826.87	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	1220.00	2100.00
TLEC CST ($)	9521.24	17985.19	5876.44	6922.68	5496.34	6341.67
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10348.11	18247.06	6703.32	7499.56	6716.34	8441.67

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.6939E 08	0.1364E 09	0.4271E 08	0.5025E 08	0.3813E 08	0.4567E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1423.26	2798.15	876.06	1030.79	782.11	936.82
INS COST ($)	826.87	826.87	826.87	826.87	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	1185.00	1185.00
TLEC CST ($)	8800.05	17300.99	5416.81	6373.37	4835.80	5792.37
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9626.93	17562.87	6243.68	6950.25	6020.80	6977.37

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8320E 08	0.1634E 09	0.5151E 08	0.7466E 08	0.4693E 08	0.7008E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1706.53	3351.79	1056.61	1531.44	962.64	1437.47
INS COST ($)	826.87	826.87	826.87	826.87	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	*********	*********
TLEC CST ($)	10551.51	20724.13	6533.05	9468.93	5952.05	8887.92
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	11378.39	20986.01	7359.93	10045.81	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7508E 08	0.1542E 09	0.4633E 08	0.6696E 08	0.4334E 08	0.6238E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1539.90	3162.63	950.41	1373.45	888.94	1279.48
INS COST ($)	826.87	826.87	826.87	826.87	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	1220.00	2100.00
TLEC CST ($)	9521.24	19554.54	5876.44	8492.04	5496.34	7911.03
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10348.11	19816.42	6703.32	9068.92	6716.34	10011.03

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6939E 08	0.1477E 09	0.4271E 08	0.6157E 08	0.3813E 08	0.5699E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1423.26	3030.21	876.08	1262.85	782.11	1168.88
INS COST ($)	826.87	826.87	826.87	826.87	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	261.87	826.87	576.87	1185.00	1185.00
TLEC CST ($)	5800.05	18735.83	5416.81	7808.22	4835.80	7227.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9626.93	18997.71	6243.69	8385.09	6020.80	8412.21

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1126E 09	0.1788E 09	0.6896E 08	0.6896E 08	0.4693E 08	0.4693E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	428.71	801.85	266.51	266.51	962.64	962.64
INS COST ($)	867.47	867.47	867.47	867.47	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	*********	*********
TLEC CST ($)	3018.23	5517.46	1871.97	1871.97	5952.05	5952.05
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3885.71	5819.94	2739.45	2489.45	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1024E 09	0.1708E 09	0.6244E 08	0.6244E 08	0.4334E 08	0.4175E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	388.53	744.35	240.17	240.17	888.94	856.45
INS COST ($)	867.47	867.47	867.47	867.47	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1220.00	2100.00
TLEC CST ($)	2736.56	5140.95	1688.16	1688.16	5496.34	5295.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3604.04	5443.43	2555.64	2305.64	6716.34	7395.43

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9525E 08	0.1651E 09	0.5787E 08	0.5787E 08	0.3813E 08	0.3813E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	360.40	704.10	221.74	221.74	782.11	782.11
INS COST ($)	867.47	867.47	867.47	867.47	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1185.00	1185.00
TLEC CST ($)	2539.40	4877.39	1559.49	1559.49	4835.80	4835.80
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3406.87	5179.87	2426.97	2176.97	6020.80	6020.80

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	20.0	GAS	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1126E 09	0.1905E 09	0.6896E 08	0.8069E 08	0.4693E 08	0.5619E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	428.71	845.37	266.51	310.03	962.64	1152.58
INS COST ($)	867.47	867.47	867.47	867.47	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	*********	*********
TLEC CST ($)	3018.23	5825.00	1871.97	2179.51	5952.05	7126.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3885.71	6127.48	2739.45	2796.99	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	20.0	GAS	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1024E 09	0.1812E 09	0.6244E 08	0.7289E 08	0.4334E 08	0.5000E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	388.53	783.12	240.17	278.94	888.94	1025.66
INS COST ($)	867.47	867.47	867.47	867.47	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1220.00	2100.00
TLEC CST ($)	2736.56	5414.94	1688.16	1962.15	5490.34	6341.67
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3604.04	5717.42	2555.64	2579.63	6715.34	8441.67

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	20.0	GAS	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.9525E 08	0.1747E 09	0.5787E 08	0.6743E 08	0.3813E 08	0.4567E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	360.40	739.55	221.74	257.19	782.11	936.82
INS COST ($)	867.47	867.47	867.47	867.47	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1185.00	1185.00
TLEC CST ($)	2539.40	5127.90	1559.49	1810.00	4835.80	5792.37
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3406.87	5430.38	2426.97	2427.48	6020.80	6977.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1126E 09	0.2081E 09	0.6896E 08	0.9829E 08	0.4693E 08	0.7008E 08
ASH CTR (BTU)	0.1901F 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	428.71	910.64	266.51	375.30	962.64	1437.47
INS COST ($)	867.47	867.47	867.47	867.47	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	*********	*********
TLEC CST ($)	3018.23	6286.32	1871.97	2640.83	5952.05	8887.92
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3885.71	6588.80	2739.45	3258.31	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1024E 09	0.1969E 09	0.6244E 08	0.8857E 08	0.4334E 08	0.6238E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	388.53	841.28	240.17	337.10	888.94	1279.48
INS COST ($)	867.47	867.47	867.47	867.47	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1220.00	2100.00
TLEC CST ($)	2736.56	5825.93	1688.16	2373.14	5496.34	7911.03
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3604.04	6128.41	2555.64	2990.62	6716.34	10011.03

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9525E 08	0.1890E 09	0.5787E 08	0.8176E 08	0.3813E 08	0.5699E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	360.40	792.72	221.74	310.36	782.11	1168.88
INS COST ($)	867.47	867.47	867.47	867.47	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1185.00	1185.00
TLEC CST ($)	2539.40	5503.66	1559.49	2185.76	4835.80	7227.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3406.87	5806.14	2426.97	2803.24	6020.80	8412.21

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1193E 09	0.1902E 09	0.7315E 08	0.7315E 08	0.4693E 08	0.4693E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	505.54	924.08	313.96	313.96	962.64	962.64
INS COST ($)	867.47	867.47	867.47	867.47	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	*********	*********
TLEC CST ($)	3744.94	6662.96	2319.60	2319.60	5952.05	5952.05
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4612.42	6965.44	3187.08	2937.08	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1817E 09	0.6617E 08	0.6617E 08	0.4334E 08	0.4175E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	457.90	861.86	282.92	282.92	888.94	856.45
INS COST ($)	867.47	867.47	867.47	867.47	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1220.00	2100.00
TLEC CST ($)	3393.75	6242.54	2091.88	2091.88	5496.34	5295.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4261.23	6545.02	2959.36	2709.36	6716.34	7395.43

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1006E 09	0.1757E 09	0.6128E 08	0.6128E 08	0.3813E 08	0.3813E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	424.55	818.32	261.18	261.18	782.11	782.11
INS COST ($)	867.47	867.47	867.47	867.47	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1185.00	1185.00
TLEC CST ($)	3147.92	5948.24	1932.47	1932.47	4835.80	4835.80
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4015.40	6250.72	2799.95	2549.95	6020.80	6020.80

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	20.0	OIL	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1193E 09	0.2027E 09	0.7315E 08	0.8572E 08	0.4693E 08	0.5619E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	505.54	976.23	313.96	366.12	962.64	1152.58
INS COST ($)	867.47	867.47	867.47	867.47	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	*********	*********
TLEC CST ($)	3744.94	7051.01	2319.60	2707.65	5952.05	7126.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4612.42	7353.49	3187.08	3325.13	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	20.0	OIL	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1929E 09	0.6617E 08	0.7737E 08	0.4334E 08	0.5000E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	457.90	908.33	282.92	329.38	888.94	1025.66
INS COST ($)	867.47	867.47	867.47	867.47	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1220.00	2100.00
TLEC CST ($)	3393.75	6588.25	2091.88	2437.59	5496.34	6341.67
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4261.23	6890.73	2959.36	3055.07	6716.34	8441.67

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	20.0	OIL	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1006E 09	0.1860E 09	0.6128E 08	0.7152E 08	0.3813E 08	0.4567E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	424.55	860.80	261.18	303.67	782.11	936.82
INS COST ($)	867.47	867.47	867.47	867.47	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1185.00	1185.00
TLEC CST ($)	3147.92	6264.32	1932.47	2248.56	4835.80	5792.37
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4015.40	6566.80	2799.95	2866.04	6020.80	6977.37

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	100.0	100.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1193E 09	0.2216E 09	0.7315E 08	0.1045E 09	0.4693E 08	0.7008E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	505.54	1054.47	313.96	444.36	962.64	1437.47
INS COST ($)	867.47	867.47	867.47	867.47	*********	*********
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	*********	*********
TLEC CST ($)	3744.94	7633.08	2319.60	3289.72	5952.05	8887.92
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4612.42	7935.56	3187.08	3907.20	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	50.0	80.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.2097E 09	0.6617E 08	0.9416E 08	0.4334E 08	0.6238E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	457.90	978.03	282.92	399.09	888.94	1279.48
INS COST ($)	867.47	867.47	867.47	867.47	1220.00	2100.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1220.00	2100.00
TLEC CST ($)	3393.75	7106.83	2091.88	2956.17	5496.34	7911.03
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4261.23	7409.31	2959.36	3573.65	6716.34	10011.03

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	NEW	22.0	66.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1006E 09	0.2013E 09	0.6128E 08	0.8688E 08	0.3813E 08	0.5699E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	424.55	924.53	261.18	367.40	782.11	1168.88
INS COST ($)	867.47	867.47	867.47	867.47	1185.00	1185.00
RET CR ($)	0.00	565.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.47	302.47	867.47	617.47	1185.00	1185.00
TLEC CST ($)	3147.92	6738.45	1932.47	2722.68	4835.80	7227.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4015.40	7040.93	2799.95	3340.16	6020.80	8412.21

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8320E 08	0.1402E 09	0.5151E 08	0.5151E 08	0.4693E 08	0.4693E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1706.53	2876.96	1056.61	1056.61	962.64	962.64
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	10551.51	17788.25	6533.05	6533.05	5952.05	5952.05
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	10698.77	17909.95	6654.75	6654.75	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7508E 08	0.1335E 09	0.4633E 08	0.4633E 08	0.4334E 08	0.4175E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1539.90	2739.60	950.41	950.41	888.94	856.45
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	9521.24	16938.94	5876.44	5876.44	5496.34	5295.43
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	9668.50	17060.64	5998.14	5998.14	6716.34	7395.43

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6939E 08	0.1288E 09	0.4271E 08	0.4271E 08	0.3813E 08	0.3813E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1423.26	2643.44	876.08	876.08	782.11	782.11
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	8800.05	16344.42	5416.81	5416.81	4835.80	4835.80
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	8947.31	16466.12	5538.51	5538.51	6020.80	6020.80

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8320E 08	0.1495E 09	0.5151E 08	0.6077E 08	0.4693E 08	0.5619E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1706.53	3066.89	1056.61	1246.54	962.64	1152.58
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	10551.51	18962.60	6533.05	7707.40	5932.05	7126.40
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	10698.77	19084.30	6654.75	7829.10	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7508E 08	0.1418E 09	0.4633E 08	0.5459E 08	0.4334E 08	0.5000E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1539.90	2908.81	950.41	1119.63	888.94	1025.66
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	9521.24	17985.18	5876.44	6922.68	5496.34	6341.67
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	9668.50	18106.88	5998.14	7044.38	6716.34	8441.67

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6939E 08	0.1364E 09	0.4271E 08	0.5025E 08	0.3813E 08	0.4567E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1423.26	2798.15	876.08	1030.79	782.11	936.82
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	8800.05	17300.99	5416.81	6373.37	4835.80	5792.37
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	8947.31	17422.69	5538.51	6495.07	6020.80	6977.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.8320E 08	0.1634E 09	0.5151E 08	0.7466E 08	0.4693E 08	0.7008E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1706.53	3351.79	1056.61	1531.44	962.64	1437.47
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	10551.51	20724.13	6533.05	9468.93	5952.05	8887.92
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	10698.77	20845.83	6654.75	9590.63	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	50.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.7508E 08	0.1542E 09	0.4633E 08	0.6696E 08	0.4334E 08	0.6238E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1539.90	3162.63	950.41	1373.45	888.94	1279.48
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	9521.24	19554.54	5876.44	8492.04	5496.34	7911.03
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	9668.50	19676.24	5998.14	8613.74	6716.34	10011.03

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.6939E 08	0.1477E 09	0.4271E 08	0.6157E 08	0.3813E 08	0.5699E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1423.26	3030.21	876.08	1262.85	782.11	1168.88
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	8800.05	18735.83	5416.81	7808.22	4835.80	7227.21
RPLC HTR ($)	147.26	121.70	121.70	121.70	0.00	0.00
TLC COST ($)	8947.31	18857.53	5538.51	7929.92	6020.80	8412.21

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1126E 09	0.1788E 09	0.6896E 08	0.6896E 08	0.4693E 08	0.4693E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	428.71	801.85	266.51	266.51	962.64	962.64
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3018.23	5517.46	1871.97	1871.97	5952.05	5952.05
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3188.41	5658.10	2012.61	2012.61	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1024E 09	0.1708E 09	0.6244E 08	0.6244E 08	0.4334E 08	0.4175E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	388.53	744.35	240.17	240.17	888.94	856.45
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	2736.56	5140.95	1688.16	1688.16	5496.34	5295.43
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	2906.75	5281.59	1828.80	1828.80	6716.34	7395.43

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9525E 08	0.1651E 09	0.5787E 08	0.5787E 08	0.3813E 08	0.3813E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	360.40	704.10	221.74	221.74	782.11	782.11
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	2539.40	4877.39	1559.49	1559.49	4835.80	4835.80
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	2709.58	5018.03	1700.13	1700.13	6020.80	6020.80

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1126E 09	0.1905E 09	0.6896E 08	0.8069E 08	0.4693E 08	0.5619E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	428.71	845.37	266.51	310.03	962.64	1152.56
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3018.23	5825.00	1871.97	2179.51	5952.05	7126.40
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3188.41	5965.64	2012.61	2320.15	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1024E 09	0.1812E 09	0.6244E 08	0.7289E 08	0.4334E 08	0.5000E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	388.53	783.12	240.17	278.94	888.94	1025.66
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	2736.56	5414.94	1688.16	1962.15	5496.34	6341.67
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	2906.75	5555.58	1828.80	2102.79	6716.34	8441.67

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9525E 08	0.1747E 09	0.5787E 08	0.6743E 08	0.3813E 08	0.4567E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	360.40	739.55	221.74	257.19	782.11	936.82
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	2539.40	5127.90	1559.49	1810.00	4835.80	5792.37
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	2709.58	5268.54	1700.13	1950.64	6020.80	6977.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1126E 09	0.2081E 09	0.6896E 08	0.9829E 08	0.4693E 08	0.7008E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	428.71	910.64	266.51	375.30	962.64	1437.47
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3018.23	6286.32	1871.97	2640.83	5952.05	8887.92
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3188.41	6426.96	2012.61	2781.47	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1024E 09	0.1969E 09	0.6244E 08	0.8857E 08	0.4334E 08	0.6238E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	388.53	841.28	240.17	337.10	888.94	1279.48
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	2736.56	5825.93	1688.16	2373.14	5496.34	7911.03
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	2906.75	5966.57	1828.80	2513.78	6716.34	10011.03

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	65.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9525E 08	0.1890E 09	0.5787E 08	0.8176E 08	0.3813E 08	0.5699E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	360.40	792.72	221.74	310.36	782.11	1168.88
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	2539.40	5503.66	1559.49	2185.76	4835.80	7227.21
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	2709.58	5644.30	1700.13	2326.40	6020.80	8412.21

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1193E 09	0.1902E 09	0.7315E 08	0.7315E 08	0.4693E 08	0.4693E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	505.54	924.08	313.96	313.96	962.64	962.64
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3744.94	6662.96	2319.60	2319.60	5952.05	5952.05
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3915.13	6803.60	2460.24	2460.24	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1817E 09	0.6617E 08	0.6617E 08	0.4334E 08	0.4175E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	457.90	861.86	282.92	282.92	888.94	856.45
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	3393.75	6242.54	2091.88	2091.88	5496.34	5295.43
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3563.94	6383.18	2232.52	2232.52	6716.34	7395.43

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1006E 09	0.1757E 09	0.6128E 08	0.6128E 08	0.3813E 08	0.3813E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	424.55	818.32	261.18	261.18	782.11	782.11
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	3147.92	5948.24	1932.47	1932.47	4835.80	4835.80
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3318.10	6086.88	2073.11	2073.11	6020.80	6020.80

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1193E 09	0.2027E 09	0.7315E 08	0.8572E 08	0.4693E 08	0.5619E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	505.54	976.23	313.96	366.12	962.64	1152.58
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3744.94	7051.01	2319.60	2707.65	5952.05	7126.40
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3915.13	7191.65	2460.24	2848.29	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1929E 09	0.6617E 08	0.7737E 08	0.4334E 08	0.5000E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	457.90	908.33	282.92	329.38	888.94	1025.66
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	3393.75	6588.25	2091.88	2437.59	5496.34	6341.67
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3563.94	6728.89	2232.52	2578.23	6716.34	8441.67

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1006E 09	0.1860E 09	0.6128E 08	0.7152E 08	0.3813E 08	0.4567E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	424.55	860.80	261.18	303.67	782.11	936.82
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	3147.92	6264.32	1932.47	2248.56	4835.80	5792.37
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3318.10	6404.96	2073.11	2389.20	6020.80	6977.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1193E 09	0.2216E 09	0.7315E 08	0.1045E 09	0.4693E 08	0.7008E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	505.54	1054.47	313.96	444.36	962.64	1437.47
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3744.94	7633.08	2319.60	3289.72	5952.05	8887.92
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3915.13	7773.72	2460.24	3430.36	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	50.0	80.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.2097E 09	0.6617E 08	0.9416E 08	0.4334E 08	0.6238E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	457.90	978.03	282.92	399.09	888.94	1279.48
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2100.00
TLEC CST ($)	3393.75	7106.83	2091.88	2956.17	5496.34	7911.03
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3563.94	7247.47	2232.52	3096.81	6716.34	10011.03

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	2	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1006E 09	0.2013E 09	0.6128E 08	0.8688E 08	0.3813E 08	0.5699E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	424.55	924.53	261.18	367.40	782.11	1168.88
INS COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1185.00	1185.00
TLEC CST ($)	3147.92	6738.45	1932.47	2722.68	4835.80	7227.21
RPLC HTR ($)	170.18	140.64	140.64	140.64	0.00	0.00
TLC COST ($)	3318.10	6879.09	2073.11	2863.32	6020.80	8412.21

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7994E 08	0.1297E 09	0.4825E 08	0.4825E 08	0.4371E 08	0.4371E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	843.22	1368.41	508.98	508.98	461.05	461.05
INS COST ($)	786.44	786.44	786.44	786.44	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	*********	*********
TLEC CST ($)	5768.52	9361.32	3481.95	3481.95	3154.07	3154.07
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	[illegible]
TLC COST ($)	6554.97	9617.77	4268.40	4043.40	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	0.0	ELEC	[illegible]

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7211E 08	0.1234E 09	0.4337E 08	0.4337E 08	0.4041E 08	0.3882E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	760.63	1302.21	457.47	457.47	426.25	409.54
INS COST ($)	786.44	786.44	786.44	786.44	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	1220.00	2020.00
TLEC CST ($)	5203.51	8908.42	3129.56	3129.56	2916.00	2801.68
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5989.96	9164.87	3916.01	3691.01	4136.00	4821.68

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6663E 08	0.1190E 09	0.3995E 08	0.3995E 08	0.3699E 08	0.3540E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	702.82	1255.86	421.41	421.41	390.19	373.48
INS COST ($)	786.44	786.44	786.44	786.44	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	1037.00	1185.00
TLEC CST ($)	4808.01	8591.39	2882.89	2882.89	2669.33	2555.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5594.46	8847.84	3669.34	3444.34	3706.33	3740.01

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.7994E 08	0.1382E 09	0.4825E 08	0.5674E 08	0.4371E 08	0.5219E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	843.22	1457.95	508.98	598.52	461.05	550.59
INS COST ($)	786.44	786.44	786.44	786.44	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	*********	*********
TLEC CST ($)	5768.52	9973.86	3481.95	4094.49	3154.07	3766.61
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6554.97	10230.31	4268.40	4655.94	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	20.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.7211E 08	0.1310E 09	0.4337E 08	0.5093E 08	0.4041E 08	0.4638E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	760.63	1381.98	457.47	537.24	426.25	489.31
INS COST ($)	786.44	786.44	786.44	786.44	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	1220.00	2020.00
TLEC CST ($)	5203.51	9454.14	3129.56	3675.28	2916.00	3347.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5989.96	9710.59	3916.01	4236.73	4136.00	5367.40

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	60.0	20.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.6663E 08	0.1259E 09	0.3995E 08	0.4686E 08	0.3699E 08	0.4232E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	702.82	1328.80	421.41	494.34	390.19	446.41
INS COST ($)	786.44	786.44	786.44	786.44	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	1037.00	1185.00
TLEC CST ($)	4808.01	9090.33	2882.89	3381.83	2669.33	3053.95
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5594.46	9346.77	3669.34	3943.28	3706.33	4238.95

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7994E 08	0.1509E 09	0.4825E 08	0.6947E 08	0.4371E 08	0.6493E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	843.22	1592.26	508.9[illegible]	732.83	461.05	684.90
INS COST ($)	786.44	786.44	786.44	786.44	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	*********	*********
TLEC CST ($)	5768.52	10892.67	3481.95	5013.30	3154.07	4685.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6554.97	11149.12	4268.40	5574.75	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	8[illegible].0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7211E 08	0.1423E 09	0.4337E 08	0.6227E 08	0.4041E 08	0.5773E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	760.63	1501.64	457.47	656.90	426.25	608.97
INS COST ($)	786.44	786.44	786.44	786.44	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	1220.00	2020.00
TLEC CST ($)	5203.51	10272.72	3129.56	4493.86	2916.00	4165.98
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5989.96	10529.16	3916.01	5055.31	4136.00	6185.98

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6663E 08	0.1363E 09	0.3295E 08	0.5723E 08	0.3699E 08	0.5269E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	702.82	1438.20	421.41	603.74	390.19	555.82
INS COST ($)	786.44	786.44	786.44	786.44	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.44	256.44	786.44	561.44	1037.00	1185.00
TLEC CST ($)	4808.[illegible]1	98[illegible].75	2882.89	4[illegible]30.25	2669.33	3802.37
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5594.46	10095.20	3669.34	4691.70	3706.33	4987.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1655E 09	0.6467E 08	0.6467E 08	0.4371E 08	0.4371E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	262.97	453.32	161.10	161.10	461.05	461.05
INS COST ($)	825.69	825.69	825.69	825.69	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	*********	*********
TLEC CST ($)	2419.02	4011.63	1469.12	1469.12	3154.07	3154.07
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3244.72	4307.33	2294.82	2069.82	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9854E 08	0.1580E 09	0.5855E 08	0.5855E 08	0.4041E 08	0.3882E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	237.93	422.30	144.76	144.76	426.25	409.54
INS COST ($)	825.69	825.69	825.69	825.69	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1220.00	2020.00
TLEC CST ($)	2192.22	3765.42	1323.41	1323.41	2916.00	2801.68
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3017.92	4061.12	2149.11	1924.11	4136.00	4821.68

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9165E 08	0.1527E 09	0.5427E 08	0.5427E 08	0.3699E 08	0.3540E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	220.41	400.57	133.33	133.33	390.19	373.48
INS COST ($)	825.69	825.69	825.69	825.69	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1037.00	1185.00
TLEC CST ($)	2033.46	3593.06	1221.42	1221.42	2669.33	2555.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2859.16	3888.76	2047.12	1822.12	3706.33	3740.01

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1762E 09	0.6467E 08	0.7542E 08	0.4371E 08	0.5219E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	262.97	478.38	161.10	186.15	461.05	550.59
INS COST ($)	825.69	825.69	825.69	825.69	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	*********	*********
TLEC CST ($)	2419.02	4245.26	1469.12	1702.74	3154.07	3766.61
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3244.72	4540.96	2294.82	2303.44	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9854E 08	0.1675E 09	0.5855E 08	0.6813E 08	0.4041E 08	0.4638E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	237.93	444.62	144.76	167.08	426.25	489.31
INS COST ($)	825.69	825.69	825.69	825.69	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1220.00	2020.00
TLEC CST ($)	2192.22	3973.55	1323.41	1531.55	2916.00	3347.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3017.92	4269.25	2149.11	2132.25	4136.00	5367.40

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9165E 08	0.1615E 09	0.5427E 08	0.6303E 08	0.3699E 08	0.4232E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	220.41	420.98	133.33	153.73	390.19	446.41
INS COST ($)	825.69	825.69	825.69	825.69	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1037.00	1185.00
TLEC CST ($)	2033.46	3783.36	1221.42	1411.71	2669.33	3053.95
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2859.16	4079.06	2047.12	2012.41	3706.33	4238.95

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1924E 09	0.6467E 08	0.9155E 08	0.4371E 08	0.6493E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	262.97	515.96	161.10	223.73	461.05	684.90
INS COST ($)	825.69	825.69	825.69	825.69	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	*********	*********
TLEC CST ($)	2419.02	4595.69	1469.12	2053.18	3154.07	4685.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3244.72	4891.39	2294.82	2653.87	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9854E 08	0.1819E 09	0.5855E 08	0.8250E 08	0.4041E 08	0.5773E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	237.93	478.10	144.76	200.56	426.25	608.97
INS COST ($)	825.69	825.69	825.69	825.69	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1220.00	2020.00
TLEC CST ($)	2192.22	4285.76	1323.41	1843.75	2916.00	4165.98
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3017.92	4581.46	2149.11	2444.45	4136.00	6185.98

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9165E 08	0.1746E 09	0.5427E 08	0.7617E 08	0.3699E 08	0.5269E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	220.41	451.59	133.33	184.34	390.19	555.82
INS COST ($)	825.69	825.69	825.69	825.69	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1037.00	1185.00
TLEC CST ($)	2033.46	4068.81	1221.42	1697.16	2669.33	3802.37
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2859.16	4364.50	2047.12	2297.86	3706.33	4987.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1146E 09	0.1759E 09	0.6851E 08	0.6851E 08	0.4371E 08	0.4371E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.62	734.91	273.23	273.23	461.05	461.05
INS COST ($)	825.69	825.69	825.69	825.69	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	*********	*********
TLEC CST ($)	3398.98	5485.14	2052.68	2052.68	3154.07	3154.07
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4224.68	5780.84	2878.38	2653.38	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1680E 09	0.6198E 08	0.6198E 08	0.4041E 08	0.3882E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	409.21	693.27	246.28	246.28	426.25	409.54
INS COST ($)	825.69	825.69	825.69	825.69	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1220.00	2020.00
TLEC CST ($)	3080.82	5183.09	1851.14	1851.14	2916.00	2801.68
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3906.52	5478.79	2676.84	2451.84	4136.00	4821.68

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9676E 08	0.1624E 09	0.5740E 08	0.5740E 08	0.3699E 08	0.3540E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	379.53	664.11	227.41	227.41	390.19	373.48
INS COST ($)	825.69	825.69	825.69	825.69	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1037.00	1185.00
TLEC CST ($)	2858.10	4971.65	1710.06	1710.06	2669.33	2555.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3683.80	5267.35	2535.76	2310.76	3706.33	3740.01

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	20.0	OIL	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1146E 09	0.1874E 09	0.6851E 08	0.8003E 08	0.4371E 08	0.5219E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.62	779.43	273.23	317.75	461.05	550.59
INS COST ($)	825.69	825.69	825.69	825.69	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	*********	*********
TLEC CST ($)	3398.98	5821.12	2052.68	2388.67	3154.07	3766.61
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4224.68	6116.82	2878.38	2989.37	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	20.0	OIL	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1782E 09	0.6198E 08	0.7224E 08	0.4041E 08	0.4638E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	409.21	732.93	246.28	285.94	426.25	489.31
INS COST ($)	825.69	825.69	825.69	825.69	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1220.00	2020.00
TLEC CST ($)	3080.82	5482.42	1851.14	2150.47	2916.00	3347.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3906.52	5778.12	2676.84	2751.17	4136.00	5367.40

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	20.0	OIL	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.9676E 08	0.1718E 09	0.5740E 08	0.6678E 08	0.3699E 08	0.4232E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	379.53	700.38	227.41	263.67	390.19	446.41
INS COST ($)	825.69	825.69	825.69	825.69	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1037.00	1185.00
TLEC CST ($)	2858.10	5245.32	1710.06	1983.74	2669.33	3053.95
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3683.80	5541.02	2535.76	2584.44	3706.33	4238.95

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	100.0	100.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1146E 09	0.2047E 09	0.6851E 08	0.9731E 08	0.4371E 08	0.6493E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.62	846.21	273.23	384.53	461.05	684.90
INS COST ($)	825.69	825.69	825.69	825.69	*********	*********
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	*********	*********
TLEC CST ($)	3398.98	6325.10	2052.68	2892.64	3154.07	4685.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4224.68	6620.90	2878.38	3493.34	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	50.0	80.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1936E 09	0.6198E 08	0.8763E 08	0.4041E 08	0.5773E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	409.21	792.42	246.28	345.43	426.25	608.97
INS COST ($)	825.69	825.69	825.69	825.69	1220.00	2020.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1220.00	2020.00
TLEC CST ($)	3080.82	5931.42	1851.14	2599.47	2916.00	4165.98
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3906.52	6227.12	2676.84	3200.17	4136.00	6185.98

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	NEW	22.0	66.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9674E 08	0.1859E 09	0.5740E 08	0.8086E 08	0.3699E 08	0.5269E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	379.53	754.77	227.41	318.07	390.19	555.82
INS COST ($)	825.69	825.69	825.69	825.69	1037.00	1185.00
RET CR ($)	0.00	530.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	295.69	825.69	600.69	1037.00	1185.00
TLEC CST ($)	2858.10	5655.84	1710.06	2394.25	2669.33	3802.37
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3683.80	5951.54	2535.76	2994.95	3706.33	4987.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7994E 08	0.1297E 09	0.4825E 08	0.4825E 08	0.4371E 08	0.4371E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	843.22	1368.41	508.98	508.98	461.05	461.05
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	5768.52	9361.32	3481.95	3481.95	3154.07	3154.07
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	5910.86	9478.95	3599.58	3599.58	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7211E 08	0.1234E 09	0.4337E 08	0.4337E 08	0.4041E 08	0.3882E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	760.63	1302.21	457.47	457.47	426.25	409.54
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	5203.51	8908.42	3129.56	3129.56	2916.00	2801.68
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	5345.85	9026.05	3247.19	3247.19	4136.00	4821.68

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6663E 08	0.1190E 09	0.3995E 08	0.3995E 08	0.3699E 08	0.3540E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	702.82	1255.86	421.41	421.41	390.19	373.48
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	4808.01	8591.39	2882.89	2882.89	2669.33	2555.01
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	4950.35	8709.02	3000.52	3000.52	3706.33	3740.01

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7994E 08	0.1382E 09	0.4825E 08	0.5674E 08	0.4371E 08	0.5219E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	843.22	1457.95	508.98	598.52	461.05	550.59
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	5768.52	9973.86	3481.95	4094.49	3154.07	3766.61
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	5910.86	10091.49	3599.58	4212.12	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7211E 08	0.1310E 09	0.4337E 08	0.5093E 08	0.4041E 08	0.4638E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	760.63	1381.98	457.47	537.24	426.25	489.31
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	5203.51	9454.14	3129.56	3675.28	2916.00	3347.40
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	5345.85	9571.77	3247.19	3792.91	4136.00	5367.40

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6663E 08	0.1259E 09	0.3995E 08	0.4686E 08	0.3699E 08	0.4232E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	702.82	1328.80	421.41	494.34	390.19	446.41
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	4808.01	9090.33	2882.89	3381.83	2669.33	3053.95
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	4950.35	9207.96	3000.52	3499.46	3706.33	4238.95

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.7994E 08	0.1509E 09	0.4825E 08	0.6947E 08	0.4371E 08	0.6493E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	843.22	1592.26	508.98	732.83	461.05	684.90
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	5768.52	10892.67	3481.95	5013.30	3154.07	4685.42
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	5910.86	11010.30	3599.58	5130.93	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	50.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.7211E 08	0.1423E 09	0.4337E 08	0.6227E 08	0.4041E 08	0.5773E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	760.63	1501.64	457.47	656.90	426.25	608.97
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	5203.51	10272.72	3129.56	4493.86	2916.00	4165.98
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	5345.85	10390.34	3247.19	4611.49	4136.00	6185.98

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.6663E 08	0.1363E 09	0.3995E 08	0.5723E 08	0.3699E 08	0.5269E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	702.82	1438.20	421.41	603.74	390.19	555.82
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	4808.01	9838.75	2882.89	4130.25	2669.33	3802.37
RPLC HTR ($)	142.33	117.62	117.62	117.62	0.00	0.00
TLC COST ($)	4950.35	9956.38	3000.52	4247.87	3706.33	4987.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1655E 09	0.6467E 08	0.6467E 08	0.4371E 08	0.4371E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	262.97	453.32	161.10	161.10	461.05	461.05
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	2419.02	4011.63	1469.12	1469.12	3154.07	3154.07
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2583.52	4147.57	1605.06	1605.06	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9854E 08	0.1580E 09	0.5855E 08	0.5855E 08	0.4041E 08	0.3882E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	237.93	422.30	144.76	144.76	426.25	409.54
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	2192.22	3765.42	1323.41	1323.41	2916.00	2801.68
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2356.72	3901.35	1459.35	1459.35	4136.00	4821.68

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9165E 08	0.1527E 09	0.5427E 08	0.5427E 08	0.3699E 08	0.3540E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	220.41	400.57	133.33	133.33	390.19	373.48
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2033.46	3593.06	1221.42	1221.42	2669.33	2555.01
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2197.96	3729.00	1357.36	1357.36	3706.33	3740.01

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1762E 09	0.6467E 08	0.7542E 08	0.4371E 08	0.5219E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	262.97	478.38	161.10	186.15	461.05	550.59
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	2419.02	4245.26	1469.12	1702.74	3154.07	3766.61
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2583.52	4381.20	1605.06	1838.68	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9854E 08	0.1675E 09	0.5855E 08	0.6813E 08	0.4041E 08	0.4638E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	237.93	444.62	144.76	167.08	426.25	489.31
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	2192.22	3973.55	1323.41	1531.55	2916.00	3347.40
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2356.72	4109.49	1459.35	1667.49	4136.00	5367.40

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9165E 08	0.1615E 09	0.5427E 08	0.6303E 08	0.3699E 08	0.4232E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	220.41	420.98	133.33	153.73	390.19	446.41
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2033.46	3783.36	1221.42	1411.71	2669.33	3053.95
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2197.96	3919.30	1357.36	1547.65	3706.33	4238.95

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1083E 09	0.1924E 09	0.6467E 08	0.9155E 08	0.4371E 08	0.6493E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	262.97	515.96	161.10	223.73	461.05	684.90
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	2419.02	4595.69	1469.12	2053.18	3154.07	4685.42
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2583.52	4731.63	1605.06	2189.11	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9854E 08	0.1819E 09	0.5855E 08	0.8250E 08	0.4041E 08	0.5773E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	237.93	478.10	144.76	200.56	426.25	608.97
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	2192.22	4285.76	1323.41	1843.75	2916.00	4165.98
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2356.72	4421.70	1459.35	1979.69	4136.00	6185.98

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9165E 08	0.1746E 09	0.5427E 08	0.7617E 08	0.3699E 08	0.5269E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	220.41	451.59	133.33	184.34	390.19	555.82
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2033.46	4068.81	1221.42	1697.16	2669.33	3802.37
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	2197.96	4204.74	1357.36	1833.10	3706.33	4987.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1146E 09	0.1759E 09	0.6851E 08	0.6851E 08	0.4371E 08	0.4371E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.62	734.91	273.23	273.23	461.05	461.05
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3398.98	5485.14	2052.68	2052.68	3154.07	3154.07
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3563.48	5621.08	2188.62	2188.62	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1680E 09	0.6198E 08	0.6198E 08	0.4041E 08	0.3882E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	409.21	693.27	246.28	246.28	426.25	409.54
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	3080.82	5183.09	1851.14	1851.14	2916.00	2801.68
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3245.31	5319.02	1987.08	1987.08	4136.00	4821.68

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9676E 08	0.1624E 09	0.5740E 08	0.5740E 08	0.3699E 08	0.3540E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	379.53	664.11	227.41	227.41	390.19	373.48
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2858.10	4971.65	1710.06	1710.06	2669.33	2555.01
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3022.60	5107.59	1846.00	1846.00	3706.33	3740.01

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1146E 09	0.1874E 09	0.6851E 08	0.8003E 08	0.4371E 08	0.5219E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.62	779.43	273.23	317.75	461.05	550.59
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3398.98	5821.12	2052.68	2388.67	3154.07	3766.61
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3563.48	5957.06	2188.62	2524.60	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1782E 09	0.6198E 08	0.7224E 08	0.4041E 08	0.4638E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	409.21	732.93	246.28	285.94	426.25	489.31
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	3080.82	5482.42	1851.14	2150.47	2916.00	3347.40
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3245.31	5618.36	1987.08	2286.41	4136.00	5367.40

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9676E 08	0.1718E 09	0.5740E 08	0.6678E 08	0.3699E 08	0.4232E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	379.53	700.38	227.41	263.67	390.19	446.41
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2858.10	5245.32	1710.06	1983.74	2669.33	3053.95
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3022.60	5381.26	1846.00	2119.68	3706.33	4238.95

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1146E 09	0.2047E 09	0.6851E 08	0.9731E 08	0.4371E 08	0.6493E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.62	846.21	273.23	384.53	461.05	684.90
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3398.98	6325.10	2052.68	2892.64	3154.07	4685.42
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3563.48	6461.04	2188.62	3028.58	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	50.0	80.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1936E 09	0.6198E 08	0.8763E 08	0.4041E 08	0.5773E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	409.21	792.42	246.28	345.43	426.25	608.97
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	2020.00
TLEC CST ($)	3080.82	5931.42	1851.14	2599.47	2916.00	4165.98
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3245.31	6067.36	1987.08	2735.41	4136.00	6185.98

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	8	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.9676E 08	0.1859E 09	0.5740E 08	0.8086E 08	0.3699E 08	0.5269E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	379.53	754.77	227.41	318.07	390.19	555.82
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2858.10	5655.84	1710.06	2394.25	2669.33	3802.37
RPLC HTR ($)	164.49	135.93	135.93	135.93	0.00	0.00
TLC COST ($)	3022.60	5791.78	1846.00	2530.19	3706.33	4987.37

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7667E 08	0.1191E 09	0.4499E 08	0.4499E 08	0.4048E 08	0.4048E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	494.27	768.31	290.01	290.01	260.96	260.96
INS COST ($)	1007.42	1007.42	1007.42	1007.42	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	*********	*********
TLEC CST ($)	3262.69	5071.67	1914.36	1914.36	1722.62	1722.62
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4270.12	5379.10	2921.79	2621.79	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6914E 08	0.1133E 09	0.4040E 08	0.4040E 08	0.3748E 08	0.3589E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	445.69	730.57	260.42	260.42	241.59	231.38
INS COST ($)	1007.42	1007.42	1007.42	1007.42	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	1220.00	1368.00
TLEC CST ($)	2942.04	4822.52	1719.09	1719.09	1594.76	1527.35
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3949.47	5129.95	2726.52	2426.52	2814.76	2895.35

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6386E 08	0.1092E 09	0.3718E 08	0.3718E 08	0.3426E 08	0.3268E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	411.69	704.15	239.72	239.72	220.88	210.67
INS COST ($)	1007.42	1007.42	1007.42	1007.42	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	1037.00	1185.00
TLEC CST ($)	2717.59	4648.11	1582.40	1582.40	1458.07	1390.66
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3725.02	4955.54	2589.83	2289.83	2495.07	2575.66

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7667E 08	0.1269E 09	0.4499E 08	0.5270E 08	0.4048E 08	0.4820E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	494.27	818.06	290.01	339.75	260.96	310.70
INS COST ($)	1007.42	1007.42	1007.42	1007.42	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	*********	*********
TLEC CST ($)	3262.69	5400.03	1914.36	2242.72	1722.62	2050.99
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4270.12	5707.46	2921.79	2950.15	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6914E 08	0.1202E 09	0.4040E 08	0.4727E 08	0.3748E 08	0.4277E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	445.69	774.89	260.42	304.74	241.59	275.70
INS COST ($)	1007.42	1007.42	1007.42	1007.42	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	1220.00	1368.00
TLEC CST ($)	2942.04	5115.06	1719.09	2011.63	1594.76	1819.89
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3949.47	5422.49	2726.52	2719.06	2814.76	3187.89

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6386E 08	0.1155E 09	0.3718E 08	0.4347E 08	0.3426E 08	0.3896E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	411.69	744.67	239.72	280.24	220.88	251.19
INS COST ($)	1007.42	1007.42	1007.42	1007.42	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	1037.00	1185.00
TLEC CST ($)	2717.59	4915.58	1582.45	1849.87	1458.07	1658.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3725.07	5223.01	2589.83	2557.30	2495.07	2843.13

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7667E 08	0.1384E 09	0.4499E 08	0.6428E 08	0.4048E 08	0.5977E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	494.27	892.67	290.01	414.37	260.96	385.32
INS COST ($)	1007.42	1007.42	1007.42	1007.42	**********	**********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	**********	**********
TLEC CST ($)	3262.69	5892.57	1914.36	2735.27	1722.62	2543.53
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4270.12	6200.00	2921.79	3442.70	**********	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6914E 08	0.1305E 09	0.4040E 08	0.5759E 08	0.3748E 08	0.5308E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	445.69	841.36	260.42	371.22	241.59	342.17
INS COST ($)	1007.42	1007.42	1007.42	1007.42	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	1220.00	1368.00
TLEC CST ($)	2942.04	5553.87	1719.09	2450.44	1594.76	2258.70
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3949.47	5861.30	2726.52	3157.87	2814.76	3626.70

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6386E 08	0.1249E 09	0.3718E 08	0.5290E 08	0.3426E 08	0.4839E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	411.69	805.45	239.72	341.01	220.88	311.97
INS COST ($)	1007.42	1007.42	1007.42	1007.42	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	307.42	1007.42	707.42	1037.00	1185.00
TLEC CST ($)	2717.59	5316.77	1582.40	2251.07	1458.07	2059.33
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3725.02	5624.20	2589.83	2958.50	2495.07	3244.33

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	0.0	GAS	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1522E 09	0.6038E 08	0.6038E 08	0.4048E 08	0.4048E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	369.96	556.95	216.94	216.94	260.96	260.96
INS COST ($)	1054.03	1054.03	1054.03	1054.03	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	*********	*********
TLEC CST ($)	2924.68	4356.21	1708.19	1708.19	1722.62	1722.62
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3978.71	4710.24	2762.22	2462.22	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	0.0	GAS	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.9466E 08	0.1452E 09	0.5467E 08	0.5467E 08	0.3748E 08	0.3589E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	335.78	527.68	195.83	195.83	241.59	231.38
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1220.00	1368.00
TLEC CST ($)	2656.30	4137.81	1543.66	1543.66	1594.76	1527.35
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3710.33	4491.84	2597.69	2297.69	2814.76	2895.35

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	0.0	GAS	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.8804E 08	0.1403E 09	0.5067E 08	0.5067E 08	0.3426E 08	0.3268E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	311.86	507.19	181.05	181.05	220.88	210.67
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1037.00	1185.00
TLEC CST ($)	2468.44	3984.93	1428.50	1428.50	1458.07	1390.66
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3522.47	4338.96	2482.53	2182.53	2495.07	2575.66

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1619E 09	0.6038E 08	0.7016E 08	0.4048E 08	0.4820E 08
ˆH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	369.96	591.16	216.94	251.15	260.96	310.70
INS COST ($)	1054.03	1054.03	1054.03	1054.03	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	*********	*********
TLEC CST ($)	2924.68	4628.20	1708.19	1980.18	1722.62	2050.99
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3978.71	4982.23	2762.22	2734.21	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9466E 08	0.1539E 09	0.5467E 08	0.6338E 08	0.3748E 08	0.4277E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	335.78	558.16	195.83	226.31	241.59	275.70
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1220.00	1368.00
TLEC CST ($)	2656.30	4380.13	1543.66	1785.98	1594.76	1819.89
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3710.33	4734.16	2597.69	2540.01	2814.76	3187.89

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8804E 08	0.1483E 09	0.5067E 08	0.5863E 08	0.3426E 08	0.3896E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	311.86	535.05	181.05	208.92	220.88	251.19
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1037.00	1185.00
TLEC CST ($)	2468.44	4206.47	1428.50	1650.05	1458.07	1658.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3522.47	4560.50	2482.53	2404.08	2495.07	2843.13

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1766E 09	0.6038E 08	0.8482E 08	0.4048E 08	0.5977E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	369.96	642.48	216.94	302.47	260.96	385.32
INS COST ($)	1054.03	1054.03	1054.03	1054.03	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	*********	*********
TLEC CST ($)	2924.68	5036.19	1708.19	2388.16	1722.62	2543.53
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3978.71	5390.22	2762.22	3142.19	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9466E 08	0.1669E 09	0.5467E 08	0.7644E 08	0.3748E 08	0.5308E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	335.78	603.88	195.83	272.03	241.59	342.17
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1220.00	1368.00
TLEC CST ($)	2656.30	4743.61	1543.66	2149.46	1594.76	2258.70
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3710.33	5097.64	2597.69	2903.49	2814.76	3626.70

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8804E 08	0.1602E 09	0.5067E 08	0.7058E 08	0.3426E 08	0.4839E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	311.86	576.86	181.05	250.72	220.88	311.97
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1037.00	1185.00
TLEC CST ($)	2468.44	4538.80	1428.50	1982.37	1458.07	2059.33
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3522.47	4892.83	2482.53	2736.40	2495.07	3244.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1100E 09	0.1616E 09	0.6387E 08	0.6387E 08	0.4048E 08	0.4048E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	437.08	655.85	255.72	255.72	260.96	260.96
INS COST ($)	1054.03	1054.03	1054.03	1054.03	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	*********	*********
TLEC CST ($)	3246.71	4842.26	1895.25	1895.25	1722.62	1722.62
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4300.74	5196.29	2949.28	2649.28	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9994E 08	0.1543E 09	0.5778E 08	0.5778E 08	0.3748E 08	0.3589E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	396.48	622.79	230.83	230.83	241.59	231.38
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1220.00	1368.00
TLEC CST ($)	2946.24	4604.97	1711.84	1711.84	1594.76	1527.35
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4000.27	4959.00	2765.87	2465.87	2814.76	2895.35

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9288E 08	0.1491E 09	0.5351E 08	0.5351E 08	0.3426E 08	0.3268E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	368.05	599.66	213.41	213.41	220.88	210.67
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1037.00	1185.00
TLEC CST ($)	2735.90	4438.87	1583.45	1583.45	1458.07	1390.66
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3789.93	4792.90	2637.48	2337.48	2495.07	2575.66

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	20.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1100E 09	0.1721E 09	0.6387E 08	0.7434E 08	0.4048E 08	0.4820E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	437.08	696.99	255.72	296.87	260.96	310.70
INS COST ($)	1054.03	1054.03	1054.03	1054.03	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	*********	*********
TLEC CST ($)	3246.71	5148.87	1895.25	2201.86	1722.62	2050.99
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4300.74	5502.90	2949.28	2955.89	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9994E 08	0.1636E 09	0.5778E 08	0.6711E 08	0.3748E 08	0.4277E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	396.48	659.45	230.83	267.49	241.59	275.70
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1220.00	1368.00
TLEC CST ($)	2946.24	4878.13	1711.84	1985.00	1594.76	1819.89
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4000.27	5232.16	2765.87	2739.03	2814.76	3187.89

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9286E 08	0.1576E 09	0.5351E 08	0.6204E 08	0.3426E 08	0.3896E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	368.05	633.17	213.41	246.92	220.88	251.19
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1037.00	1185.00
TLEC CST ($)	2735.90	4686.62	1583.45	1833.20	1458.07	1658.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3789.93	5042.65	2637.48	2587.23	2495.07	2843.13

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	100.0	100.0	50.0	OIL	0 0 0 0 1 1

- - - - SUPPLY SYSTEM MODEL - - - -	1	2	3	4	5	6
TAE USE (BTU)	0.1100E 09	0.1878E 09	0.6387E 08	0.9005E 08	0.4048E 08	0.5977E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	437.08	758.71	255.72	358.58	260.96	385.32
INS COST ($)	1054.03	1054.03	1054.03	1054.03	*********	*********
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	*********	*********
TLEC CST ($)	3246.71	5608.79	1895.25	2661.78	1722.62	2543.53
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4300.74	5962.82	2949.28	3415.81	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	50.0	80.0	50.0	OIL	0 0 0 0 5 1

- - - - SUPPLY SYSTEM MODEL - - - -	1	2	3	4	5	6
TAE USE (BTU)	0.9994E 08	0.1776E 09	0.5778E 08	0.8111E 08	0.3746E 08	0.5308E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	396.48	714.44	230.83	322.47	241.59	342.17
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1220.00	1368.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1220.00	1368.00
TLEC CST ($)	2946.24	5287.88	1711.84	2394.75	1594.76	2258.70
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4000.27	5641.91	2765.87	3148.78	2814.76	3626.70

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	NEW	22.0	66.0	50.0	OIL	0 0 0 0 5 1

- - - - SUPPLY SYSTEM MODEL - - - -	1	2	3	4	5	6
TAE USE (BTU)	0.9288E 08	0.1704E 09	0.5351E 08	0.7484E 08	0.3426E 08	0.4839E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	368.05	683.44	213.41	297.19	220.88	311.97
INS COST ($)	1054.03	1054.03	1054.03	1054.03	1037.00	1185.00
RET CR ($)	0.00	700.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.03	354.02	1054.03	754.02	1037.00	1185.00
TLEC CST ($)	2735.90	5063.24	1583.45	2207.83	1458.07	2059.33
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3789.93	5417.27	2637.48	2961.86	2495.07	3244.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7667E 08	0.1191E 09	0.4499E 08	0.4499E 08	0.4048E 08	0.4048E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	494.27	768.31	290.01	290.01	260.96	260.96
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3262.69	5071.67	1914.36	1914.36	1722.62	1722.62
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	3431.85	5211.47	2054.16	2054.16	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6914E 08	0.1133E 09	0.4040E 08	0.4040E 08	0.3748E 08	0.3589E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	445.69	730.57	260.42	260.42	241.59	231.38
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2942.04	4822.52	1719.09	1719.09	1594.76	1527.35
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	3111.21	4962.32	1858.89	1858.89	2814.76	2895.35

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6386E 08	0.1092E 09	0.3718E 08	0.3718E 08	0.3426E 08	0.3268E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	411.69	704.15	239.72	239.72	220.88	210.67
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2717.59	4648.11	1582.40	1582.40	1458.07	1390.66
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	2886.76	4787.91	1722.20	1722.20	2495.07	2575.66

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.7667E 08	0.1269E 09	0.4499E 08	0.5270E 08	0.4048E 08	0.4820E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	494.27	818.06	290.01	339.75	260.96	310.70
INS COST ($)	0.00	0.00	0.00	0.00	**********	**********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	**********	**********
TLEC CST ($)	3262.69	5400.03	1914.36	2242.72	1722.62	2050.99
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	3431.85	5539.83	2054.16	2382.52	**********	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6914E 08	0.1202E 09	0.4040E 08	0.4727E 08	0.3748E 08	0.4277E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	445.69	774.89	260.42	304.74	241.59	275.70
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2942.04	5115.06	1719.09	2011.63	1594.76	1819.89
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	3111.21	5254.86	1858.89	2151.43	2814.76	3187.89

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.6386E 08	0.1155E 09	0.3718E 08	0.4347E 08	0.3426E 08	0.3896E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	411.69	744.67	2[illegible]9.72	280.24	220.88	251.19
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2717.59	4915.58	1582.40	1849.87	1458.07	1658.13
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	2886.76	5055.38	1722.20	1989.67	2495.07	2843.13

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.7667E 08	0.1384E 09	0.4499E 08	0.6428E 08	0.4048E 08	0.5977E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.0000E 00	0.0000E 00
TAE COST ($)	494.27	892.67	290.01	414.37	260.96	385.32
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3262.69	5892.57	1914.36	2735.27	1722.62	2543.53
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	3431.85	6032.37	2054.16	2875.07	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	50.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.6914E 08	0.1305E 09	0.4040E 08	0.5759E 08	0.3748E 08	0.5308E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	445.69	841.36	260.42	371.22	241.59	342.17
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2942.04	5553.87	1719.09	2450.44	1594.76	2258.70
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	3111.21	5693.67	1858.89	2590.24	2814.76	3626.70

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.6386E 08	0.1249E 09	0.3718E 08	0.5290E 08	0.3426E 08	0.4839E 08
ASH CTR (BTU)	0.9086E 07	0.6129E 07	0.4408E 07	0.4408E 07	0.1584E 07	0.0000E 00
TAE COST ($)	411.69	805.45	239.72	341.01	220.88	311.97
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2717.59	5316.77	1582.40	2251.07	1458.07	2059.33
RPLC HTR ($)	169.16	139.80	139.80	139.80	0.00	0.00
TLC COST ($)	2886.76	5456.57	1722.20	2390.87	2495.07	3244.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1522E 09	0.6038E 08	0.6038E 08	0.4048E 08	0.4048E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	369.96	556.95	216.94	216.94	260.96	260.96
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	2924.68	4356.21	1708.19	1708.19	1722.62	1722.62
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3120.15	4517.75	1869.72	1869.72	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9466E 08	0.1452E 09	0.5467E 08	0.5467E 08	0.3748E 08	0.3589E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	335.78	527.68	195.83	195.83	241.59	231.38
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2656.30	4137.81	1543.66	1543.66	1594.76	1527.35
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2851.78	4299.35	1705.20	1705.20	2814.76	2895.35

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8804E 08	0.1403E 09	0.5067E 08	0.5067E 08	0.3426E 08	0.3268E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	311.86	507.19	181.05	181.05	220.88	210.67
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2468.44	3984.93	1428.50	1428.50	1458.07	1390.66
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2663.92	4146.47	1590.04	1590.04	2495.07	2575.66

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1619E 09	0.6038E 08	0.7016E 08	0.4048E 08	0.4820E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	369.96	591.16	216.94	251.15	260.96	310.70
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	2924.68	4628.20	1708.19	1980.18	1722.62	2050.99
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3120.15	4789.74	1869.72	2141.72	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9466E 08	0.1539E 09	0.5467E 08	0.6338E 08	0.3748E 08	0.4277E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	335.78	558.16	195.83	226.31	241.59	275.70
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2656.30	4380.13	1543.66	1785.98	1594.76	1819.89
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2851.78	4541.67	1705.20	1947.52	2814.76	3187.89

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8804E 08	0.1483E 09	0.5067E 08	0.5863E 08	0.3426E 08	0.3896E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	311.86	535.05	181.05	208.92	220.88	251.19
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2468.44	4206.47	1428.50	1650.05	1458.07	1658.13
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2663.92	4368.01	1590.04	1811.58	2495.07	2643.13

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1041E 09	0.1766E 09	0.6038E 08	0.8482E 08	0.4048E 08	0.5977E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	369.96	642.48	216.94	302.47	260.96	385.32
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	2924.68	5036.19	1708.19	2388.16	1722.62	2543.53
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3120.15	5197.73	1869.72	2549.70	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9466E 08	0.1669E 09	0.5467E 08	0.7644E 08	0.3748E 08	0.5308E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	335.78	603.88	195.83	272.03	241.59	342.17
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2656.30	4743.61	1543.66	2149.46	1594.76	2258.70
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2851.78	4905.15	1705.20	2311.00	2814.76	3626.70

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.8804E 08	0.1602E 09	0.5067E 08	0.7058E 08	0.3426E 08	0.4839E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	311.86	576.86	181.05	250.72	220.88	311.97
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2468.44	4538.80	1428.50	1982.37	1458.07	2059.33
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2663.92	4700.34	1590.04	2143.91	2495.07	3244.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1100E 09	0.1616E 09	0.6387E 08	0.6387E 08	0.4048E 08	0.4048E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	437.08	655.85	255.72	255.72	260.96	260.96
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3246.71	4842.26	1895.25	1895.25	1722.62	1722.62
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3442.19	5003.80	2056.79	2056.79	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9994E 08	0.1543E 09	0.5778E 08	0.5778E 08	0.3748E 08	0.3589E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	396.48	622.79	230.83	230.83	241.59	231.38
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2946.24	4604.97	1711.84	1711.84	1594.76	1527.35
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3141.71	4766.51	1873.38	1873.38	2814.76	2895.35

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9288E 08	0.1491E 09	0.5351E 08	0.5351E 08	0.3426E 08	0.3268E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	368.05	599.66	213.41	213.41	220.88	210.67
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2735.90	4438.87	1583.45	1583.45	1458.07	1390.66
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2931.37	4600.41	1744.99	1744.99	2495.07	2575.66

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1100E 09	0.1721E 09	0.6387E 08	0.7434E 08	0.4048E 08	0.4820E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	437.08	696.99	255.72	296.87	260.96	310.70
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3246.71	5148.87	1895.25	2201.86	1722.62	2050.99
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3442.19	5310.41	2056.79	2363.40	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9994E 08	0.1636E 09	0.5778E 08	0.6711E 08	0.3748E 08	0.4277E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	396.48	659.45	230.83	267.49	241.59	275.70
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2946.24	4878.13	1711.84	1985.00	1594.76	1819.89
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3141.71	5039.67	1873.38	2146.54	2814.76	3187.89

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9288E 08	0.1576E 09	0.5351E 08	0.6204E 08	0.3426E 08	0.3896E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	368.05	633.17	213.41	246.92	220.88	251.19
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2735.90	4688.62	1583.45	1833.20	1458.07	1658.13
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2931.37	4850.16	1744.99	1994.74	2495.07	2843.13

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1100E 09	0.1878E 09	0.6387E 08	0.9005E 08	0.4048E 08	0.5977E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.0000E 00	0.0000E 00
TAE COST ($)	437.08	758.71	255.72	358.58	260.96	385.32
INS COST ($)	0.00	0.00	0.00	0.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	*********	*********
TLEC CST ($)	3246.71	5608.79	1895.25	2661.78	1722.62	2543.53
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3442.19	5770.33	2056.79	2823.32	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	50.0	80.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9994E 08	0.1776E 09	0.5778E 08	0.8111E 08	0.3748E 08	0.5308E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	396.48	714.44	230.83	322.47	241.59	342.17
INS COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1220.00	1368.00
TLEC CST ($)	2946.24	5287.88	1711.84	2394.75	1594.76	2258.70
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	3141.71	5449.42	1873.38	2556.29	2814.76	3626.70

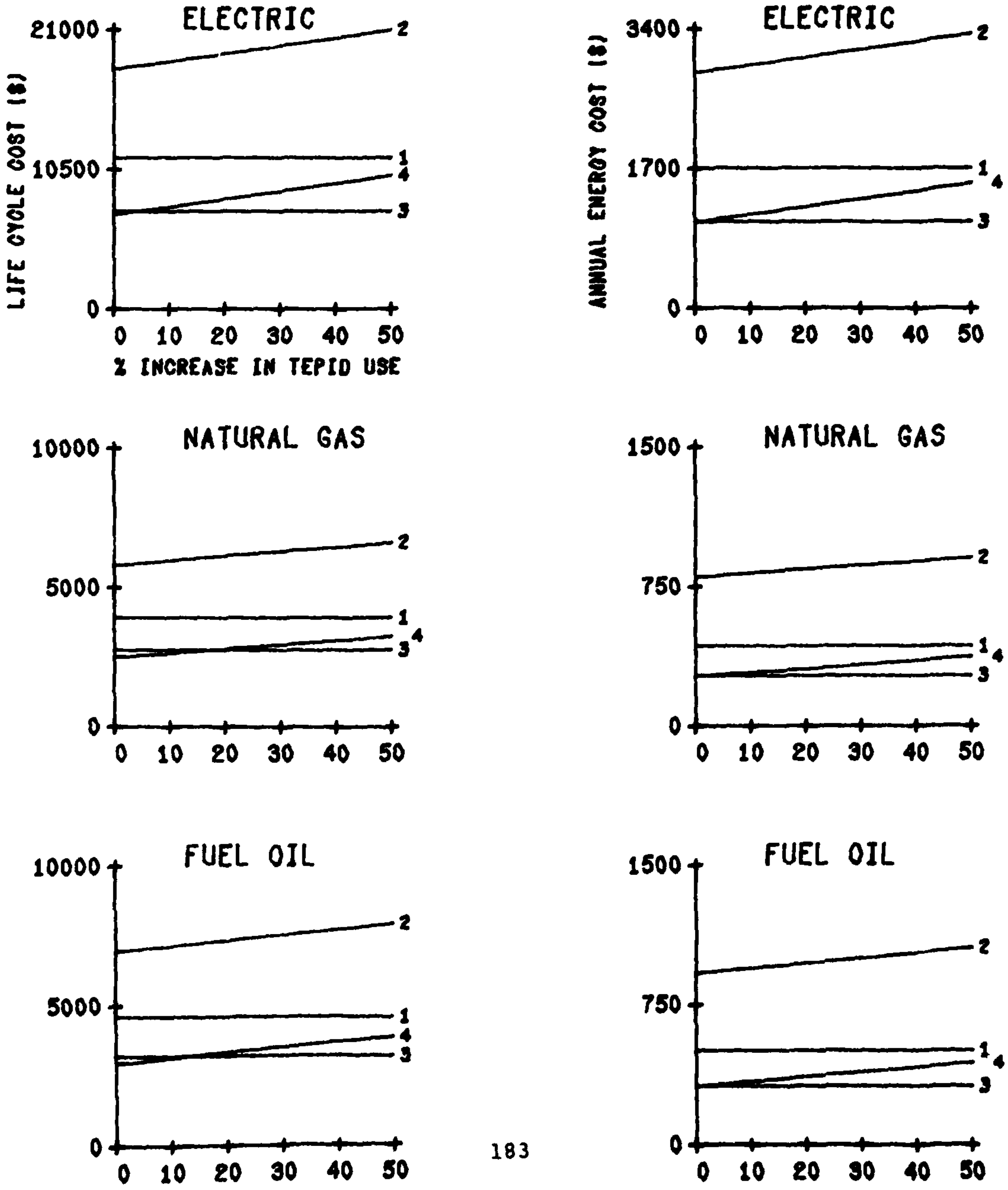
BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
1	10	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.9288E 08	0.1704E 09	0.5351E 08	0.7484E 08	0.3426E 08	0.4839E 08
ASH CTR (BTU)	0.1901E 08	0.1123E 08	0.9512E 07	0.9512E 07	0.1584E 07	0.0000E 00
TAE COST ($)	368.05	683.44	213.41	297.19	220.88	311.97
INS COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	1037.00	1185.00
TLEC CST ($)	2735.9[illegible]	5063.24	1583.45	2207.83	1458.07	2059.33
RPLC HTR ($)	195.47	161.53	161.53	161.53	0.00	0.00
TLC COST ($)	2931.37	5224.78	1744.90	2369.37	2495.07	3244.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	2	100.00	100.00

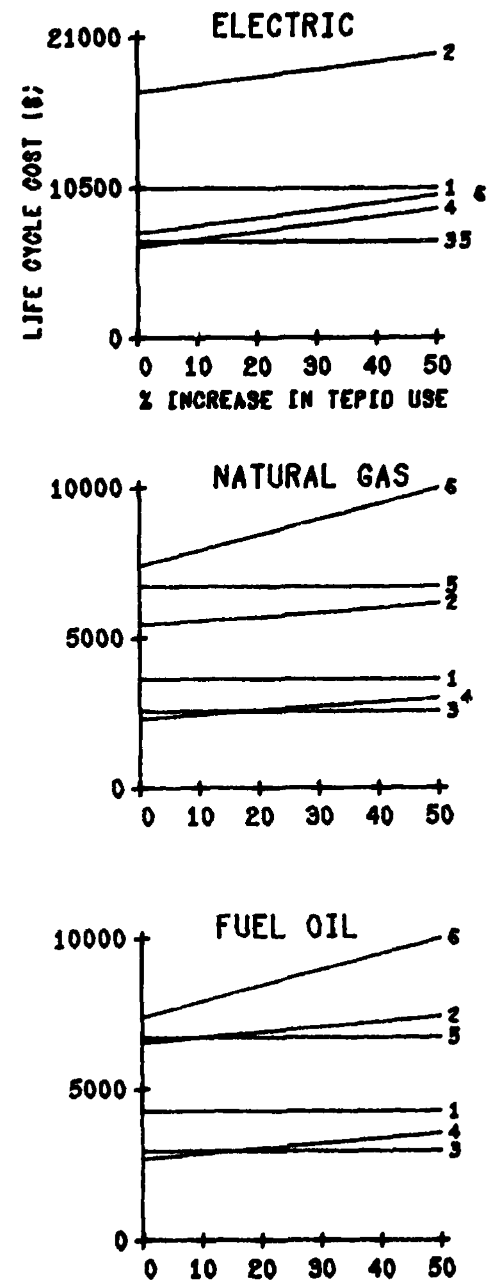
*** NEW CONSTRUCTION ***

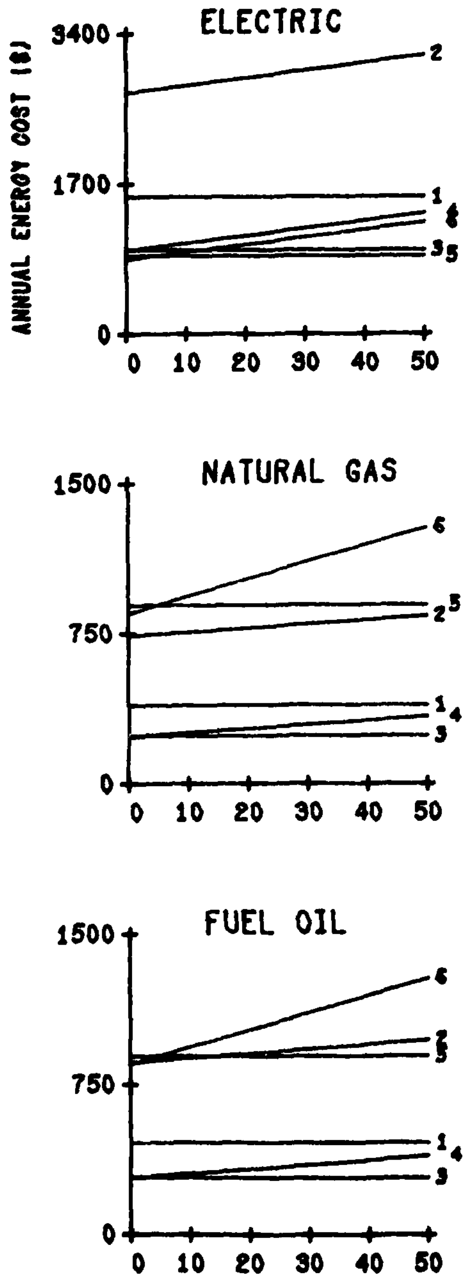


JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	2	50.00	80.00

*** NEW CONSTRUCTION ***

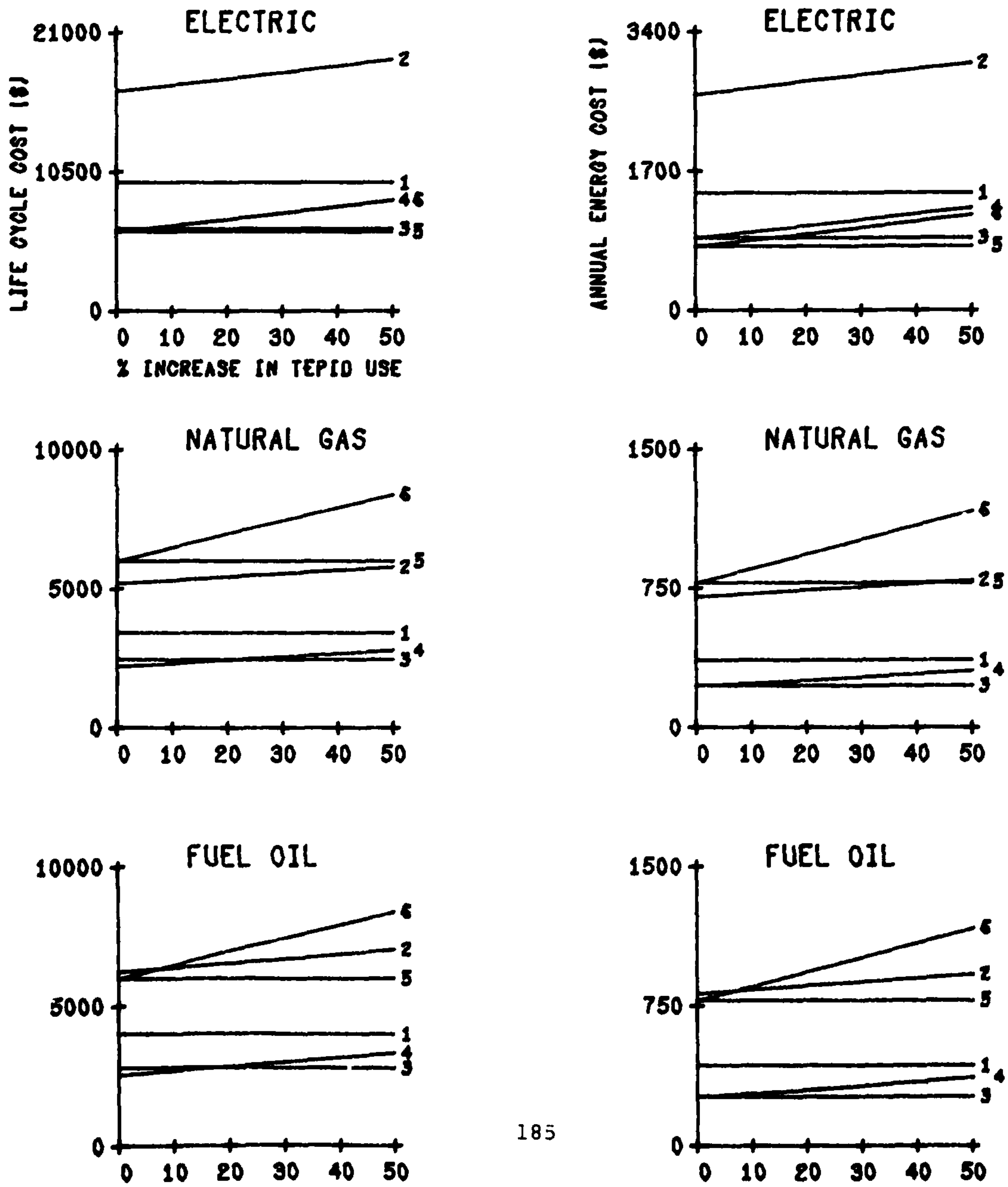




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	2	22.00	66.00

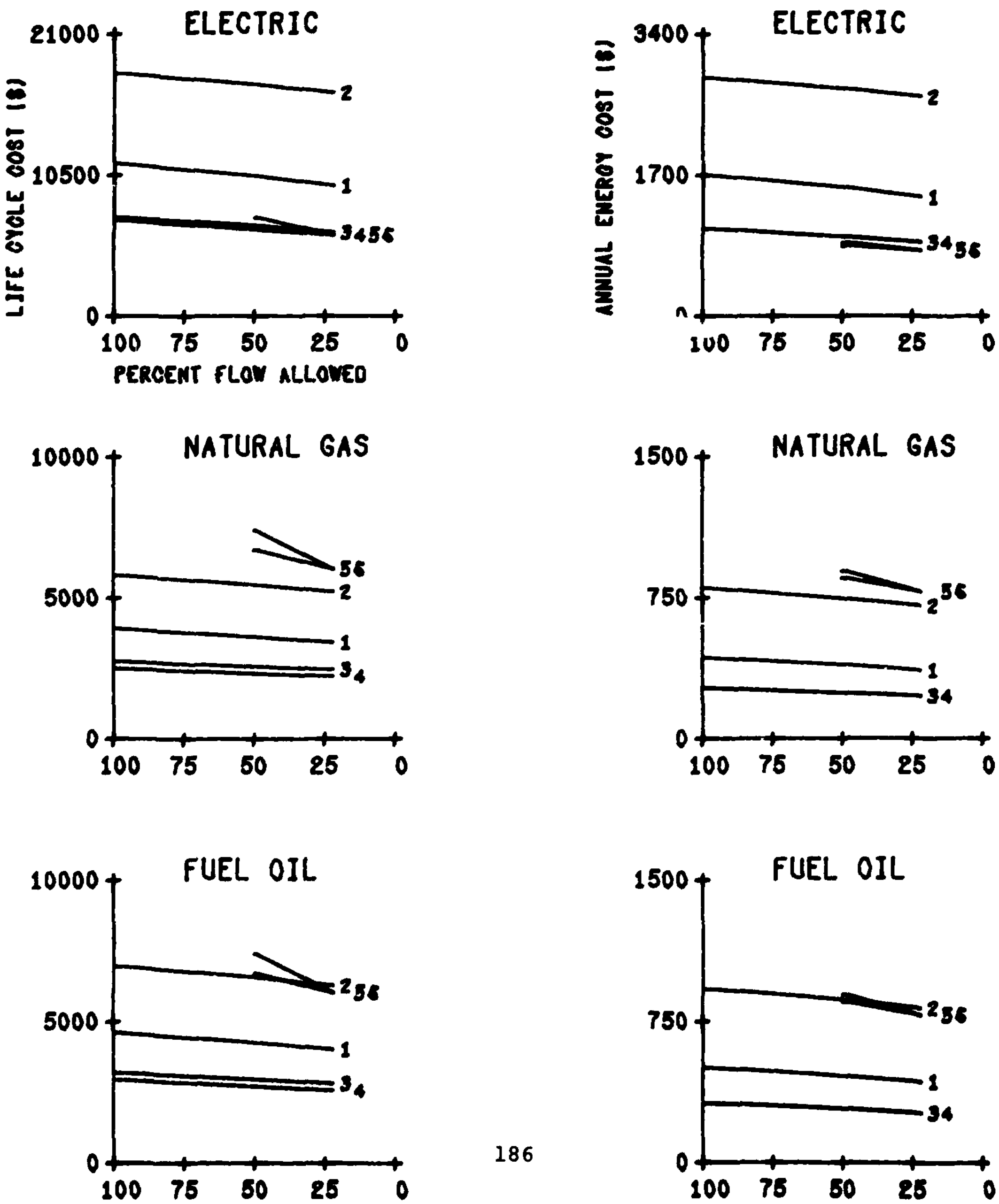
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	2	0.00

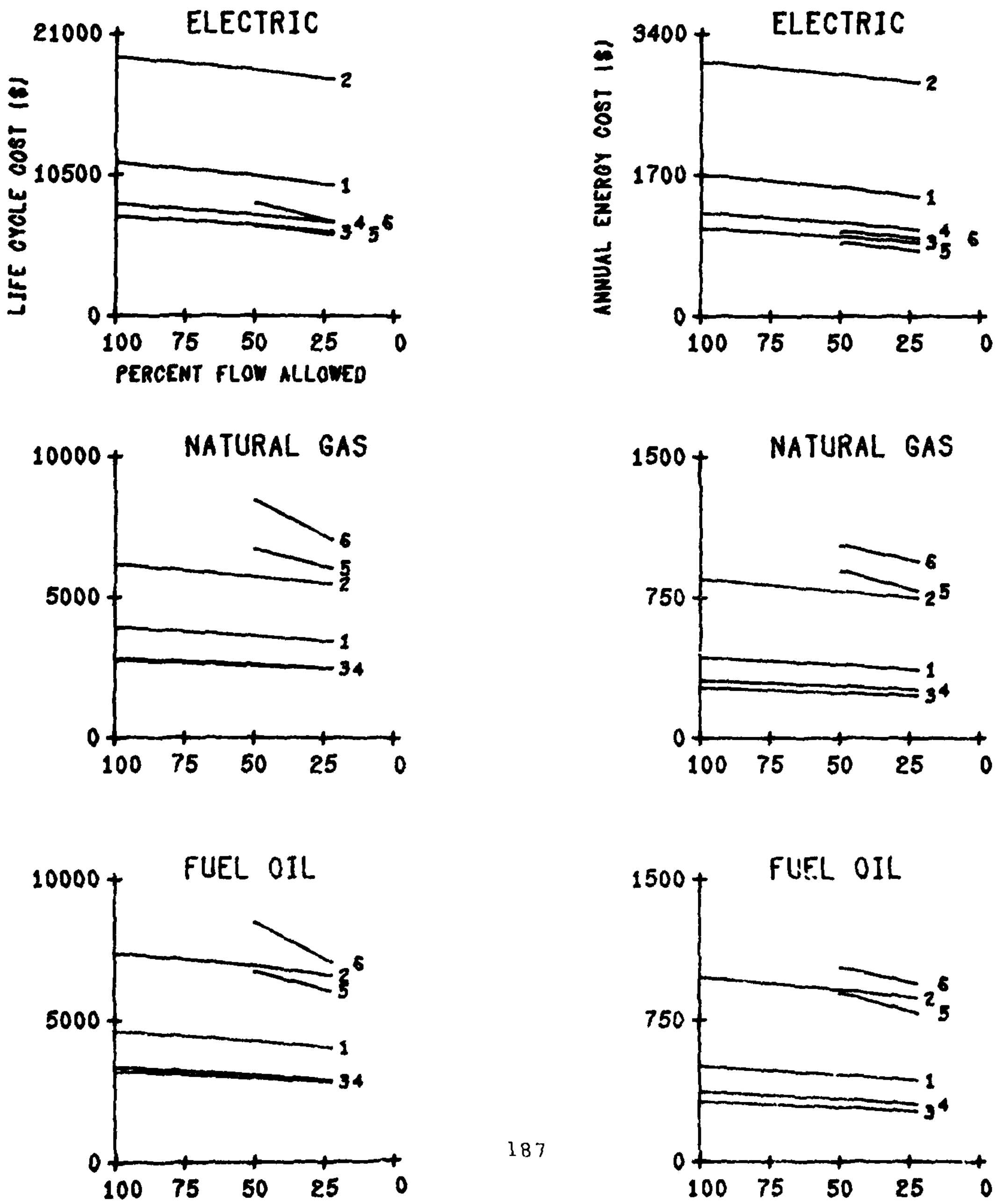
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	2	20.00

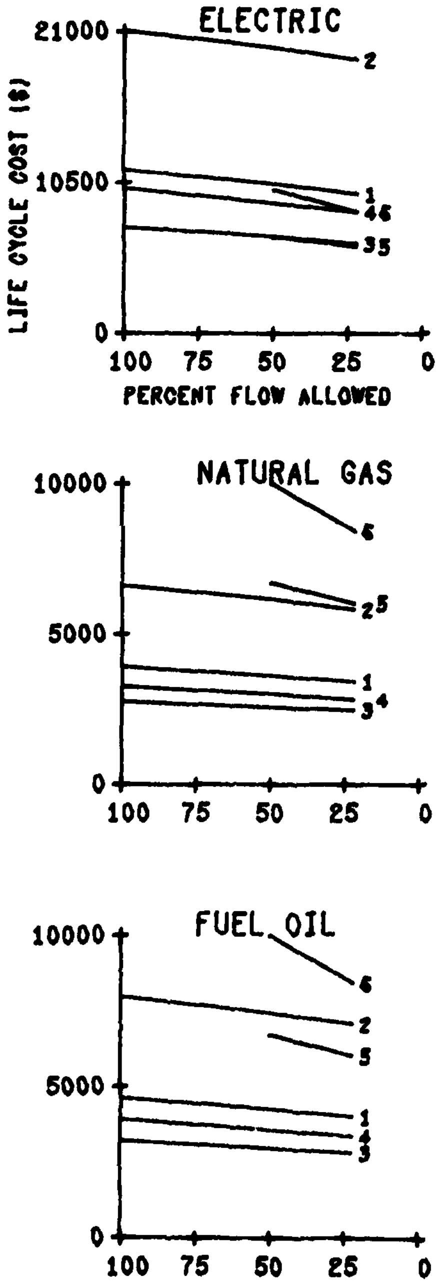
*** NEW CONSTRUCTION ***

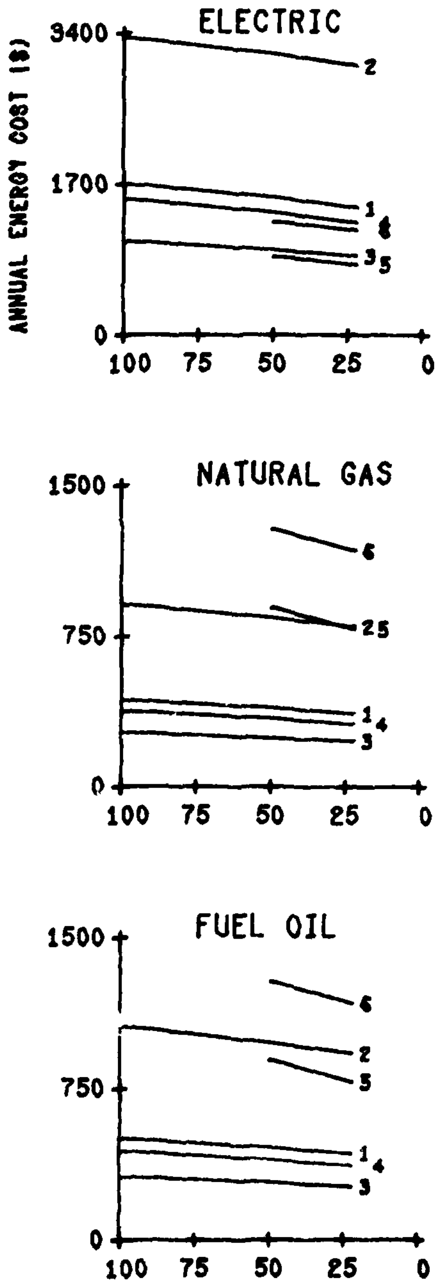


JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	2	50.00

*** NEW CONSTRUCTION ***

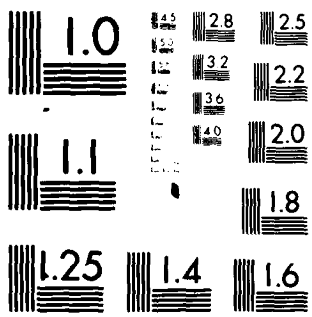




AD-A112 649 JOHNS-MANVILLE SALES CORP DENVER CO RESEARCH AND DEV--ETC F/G 13/1
INVESTIGATION OF SINGLE VERSUS DUAL - HOT AND COLD BUILDING WAT--ETC(U)
OCT 81 P B BRUCE, M S RAMSEY, P B SHEPHERD DAAK70-78-D-0002

UNCLASSIFIED USAFESA-T-2091 NL

3 OF 6
AD A112649



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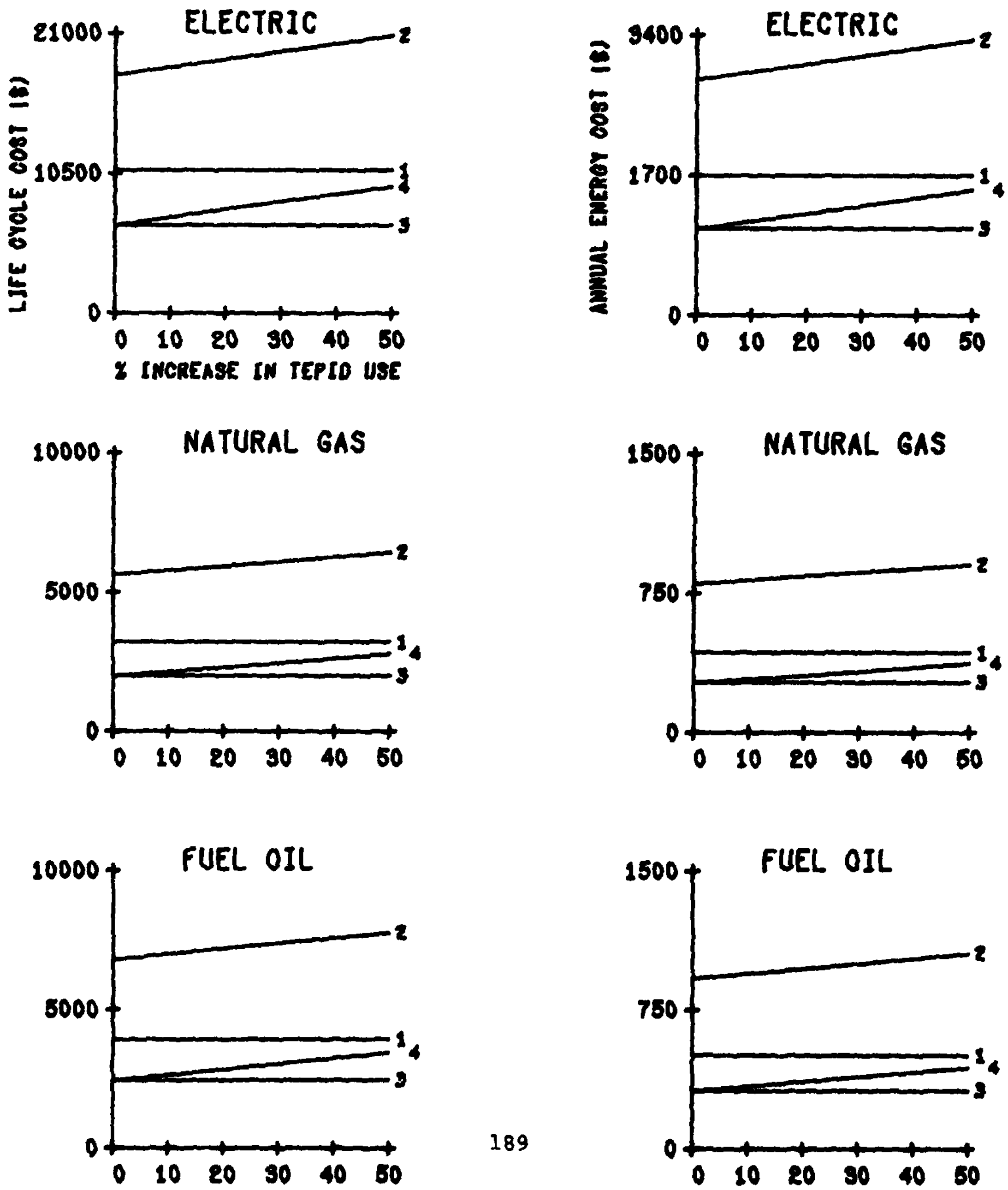
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	2	100.00	100.00

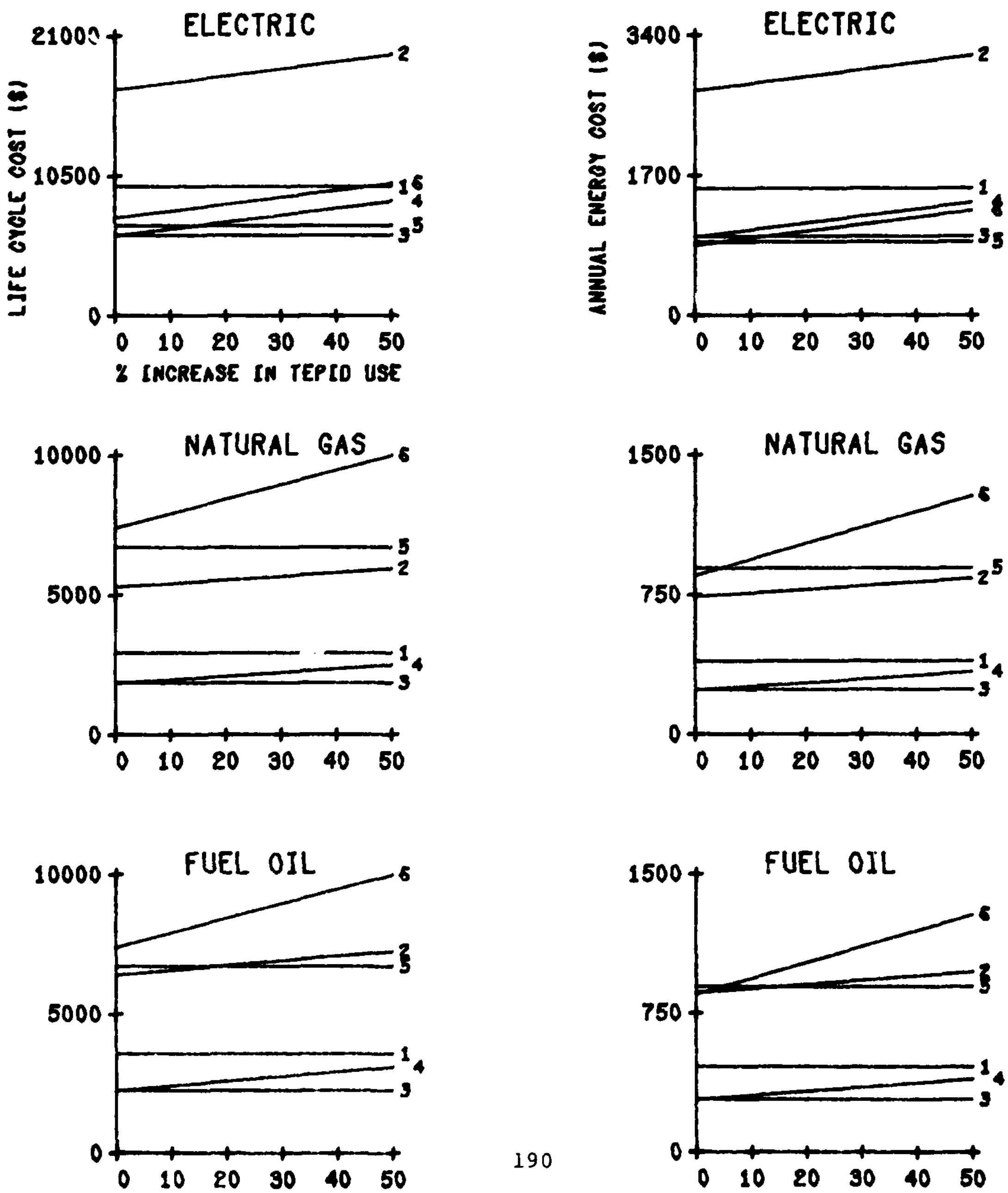
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	2	50.00	80.00

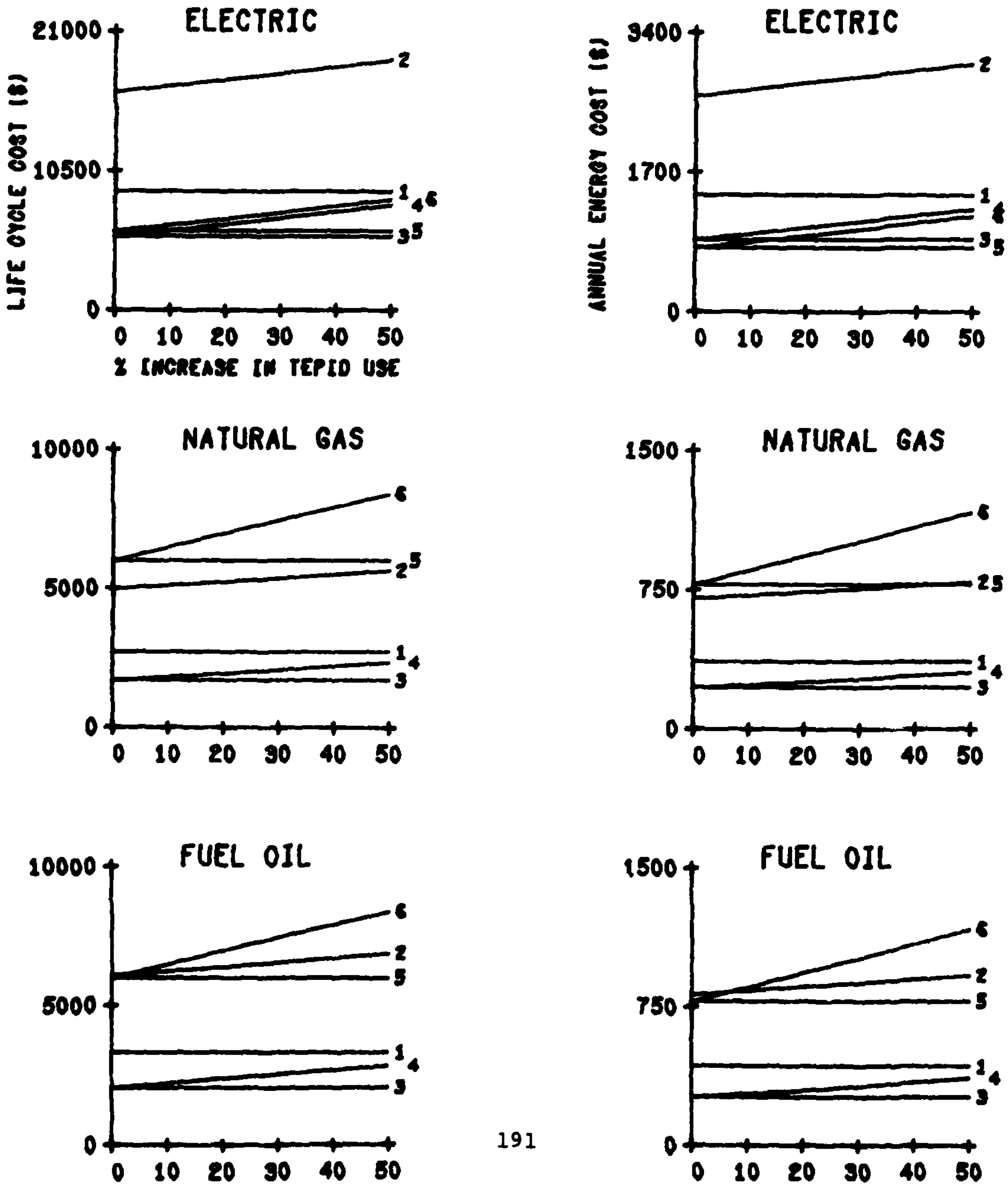
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	2	22.00	66.00

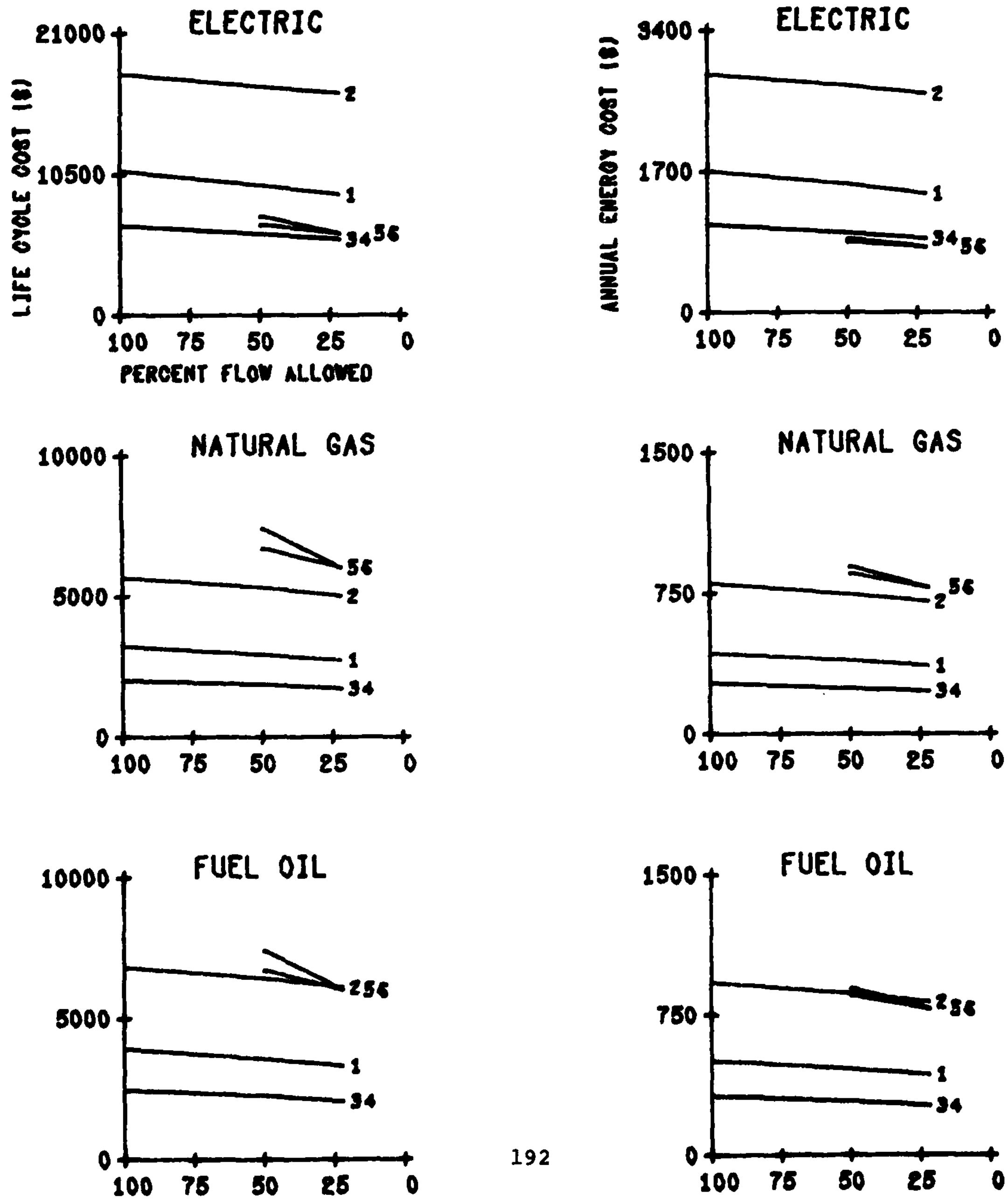
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	2	0.00

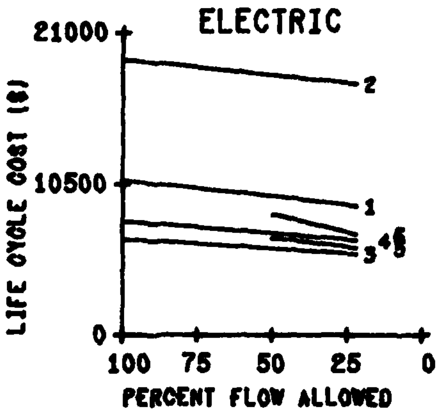
****** RETROFIT ******

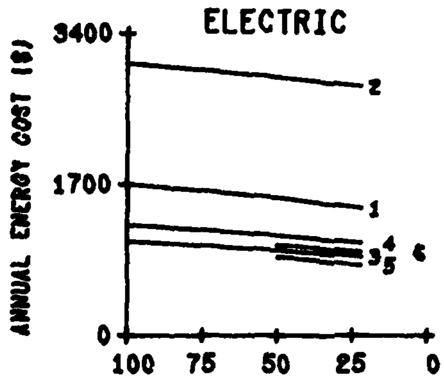


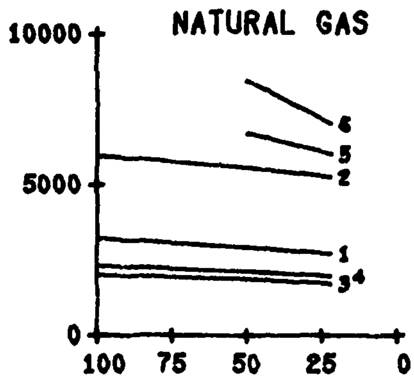
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

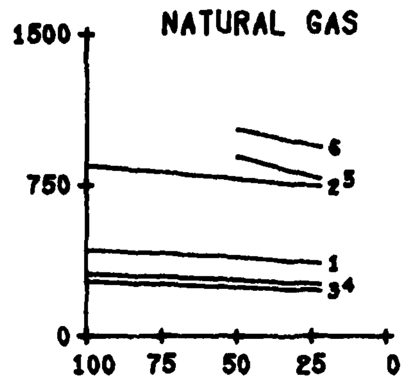
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	2	20.00

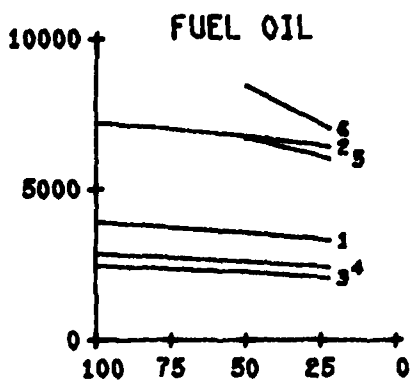
****** RETROFIT ******

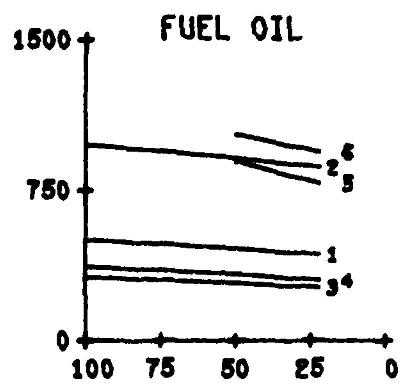








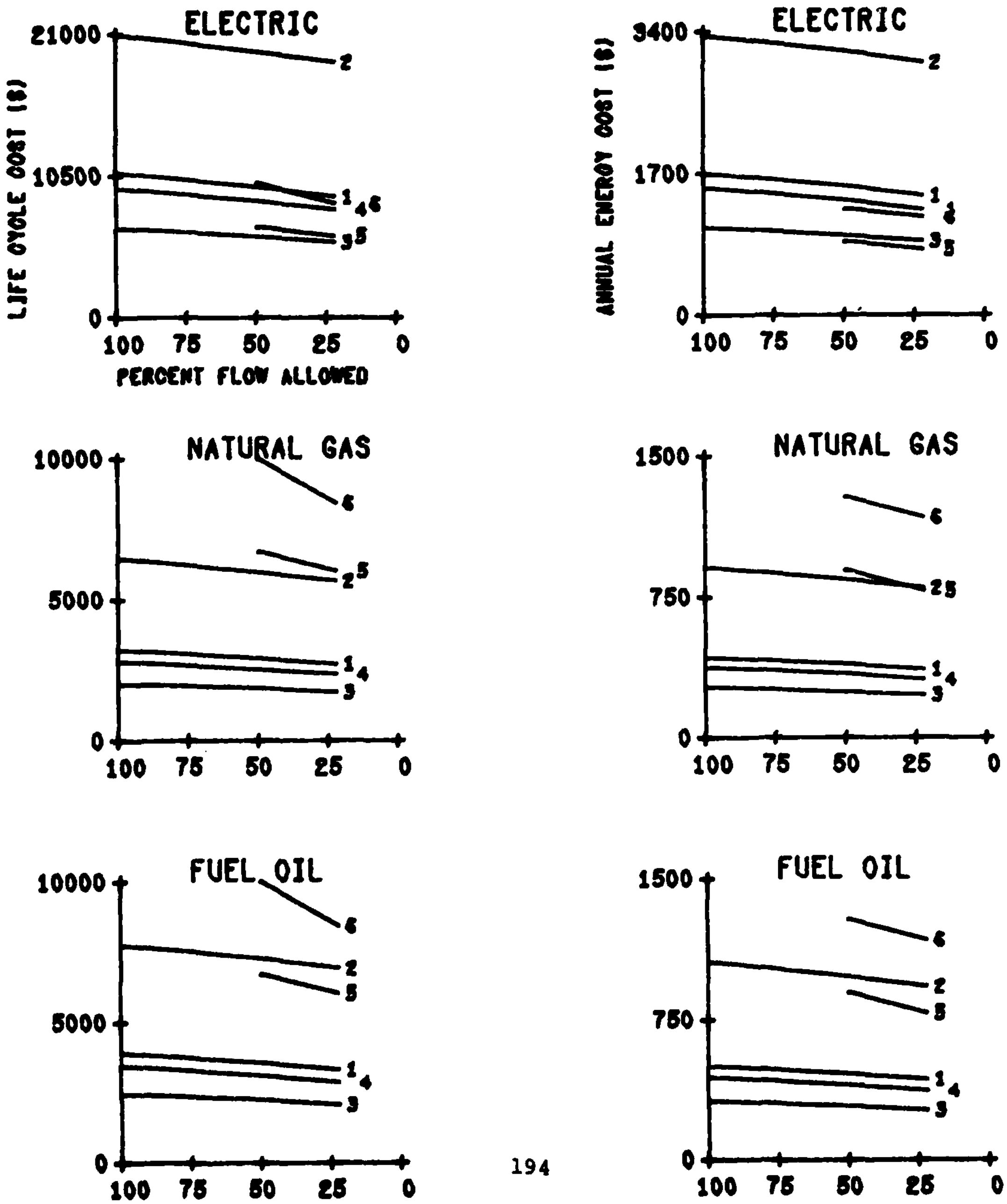




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	2	50.00

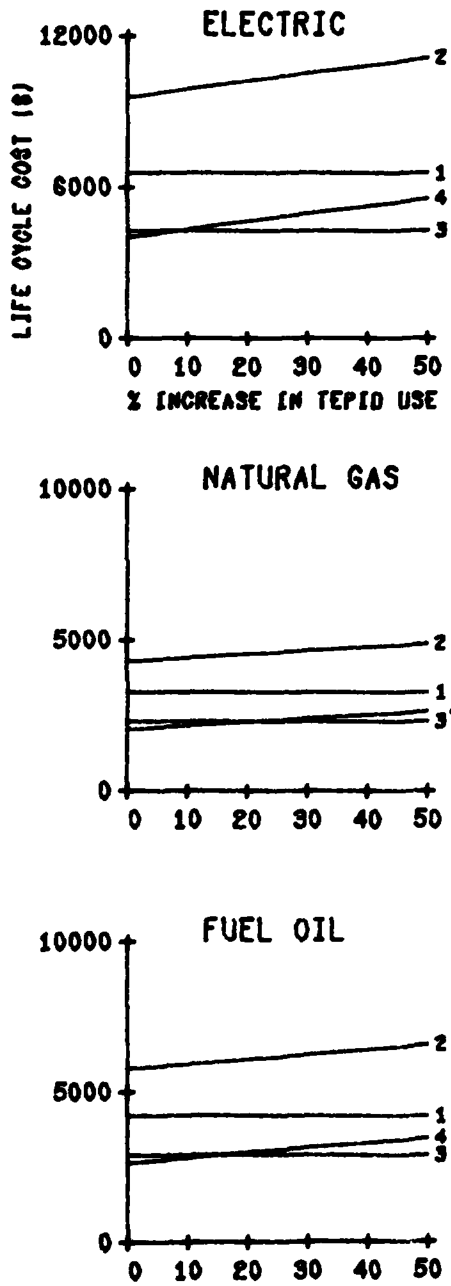
****** RETROFIT ******

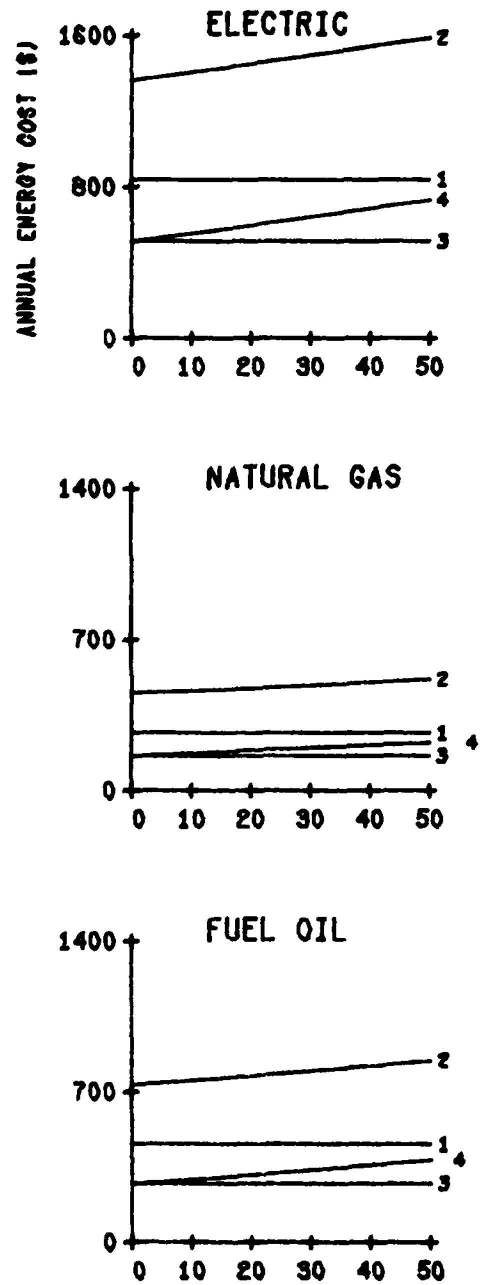


JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	8	100.00	100.00

*** NEW CONSTRUCTION ***

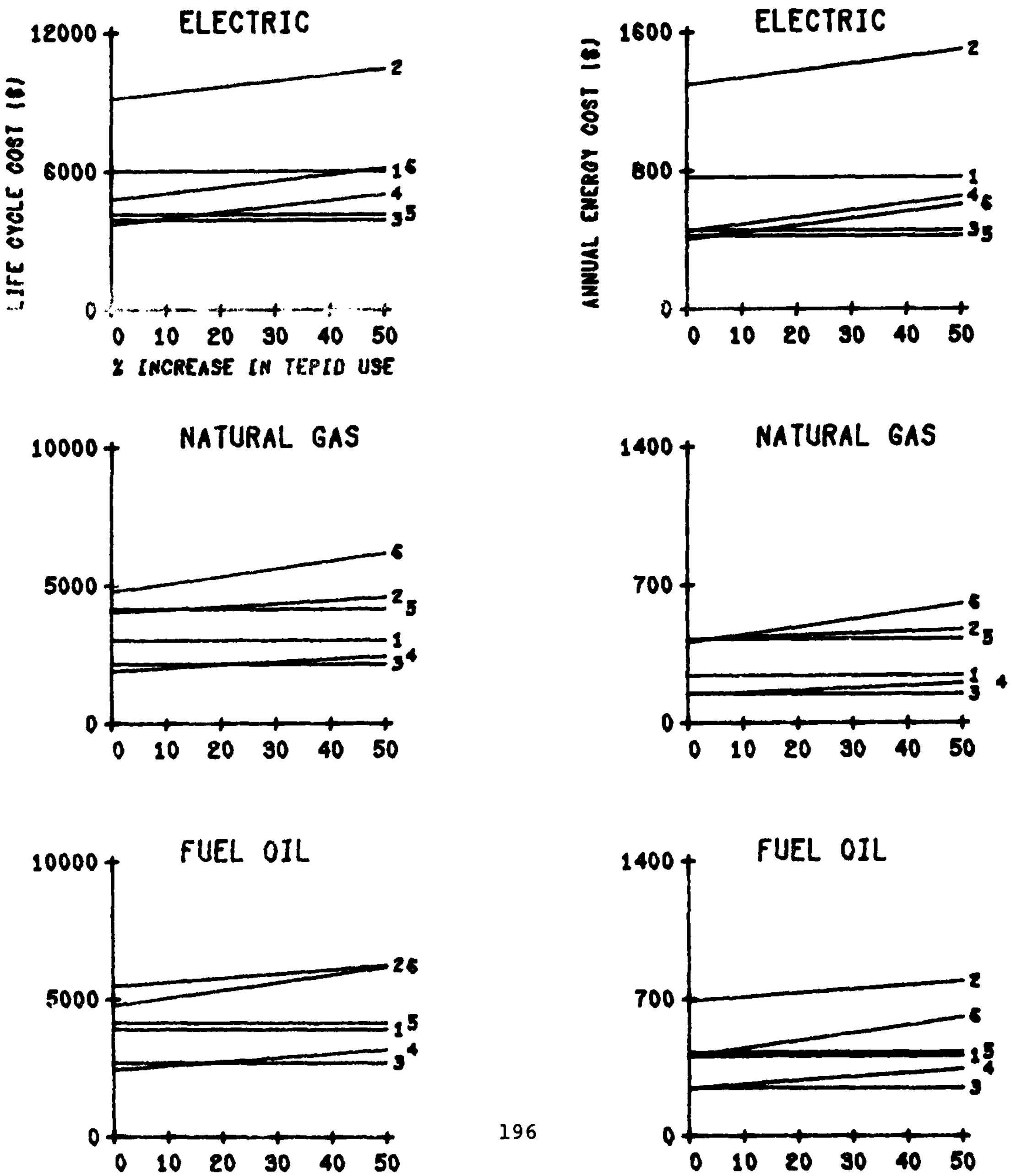




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	8	50.00	80.00

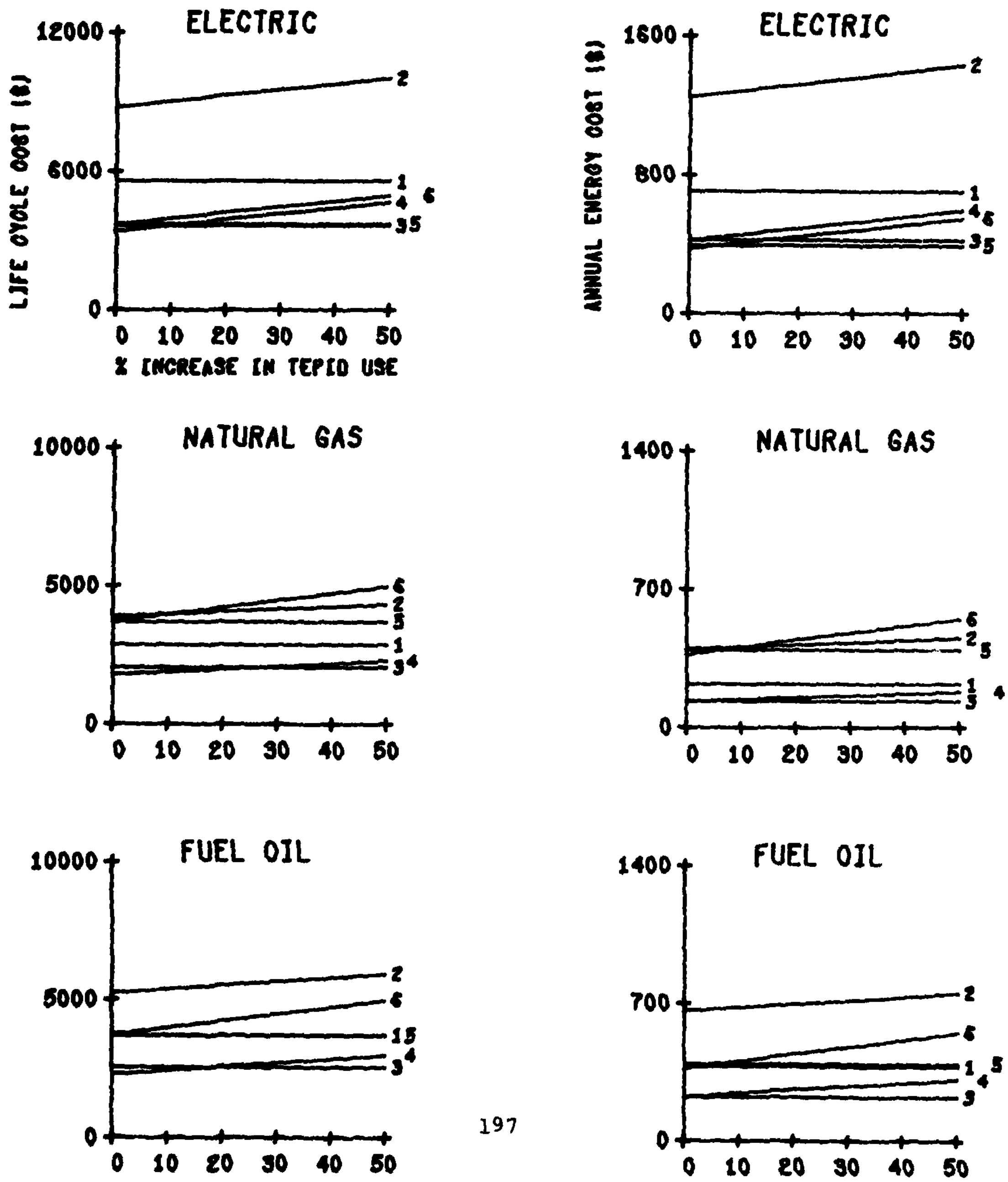
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	8	22.00	66.00

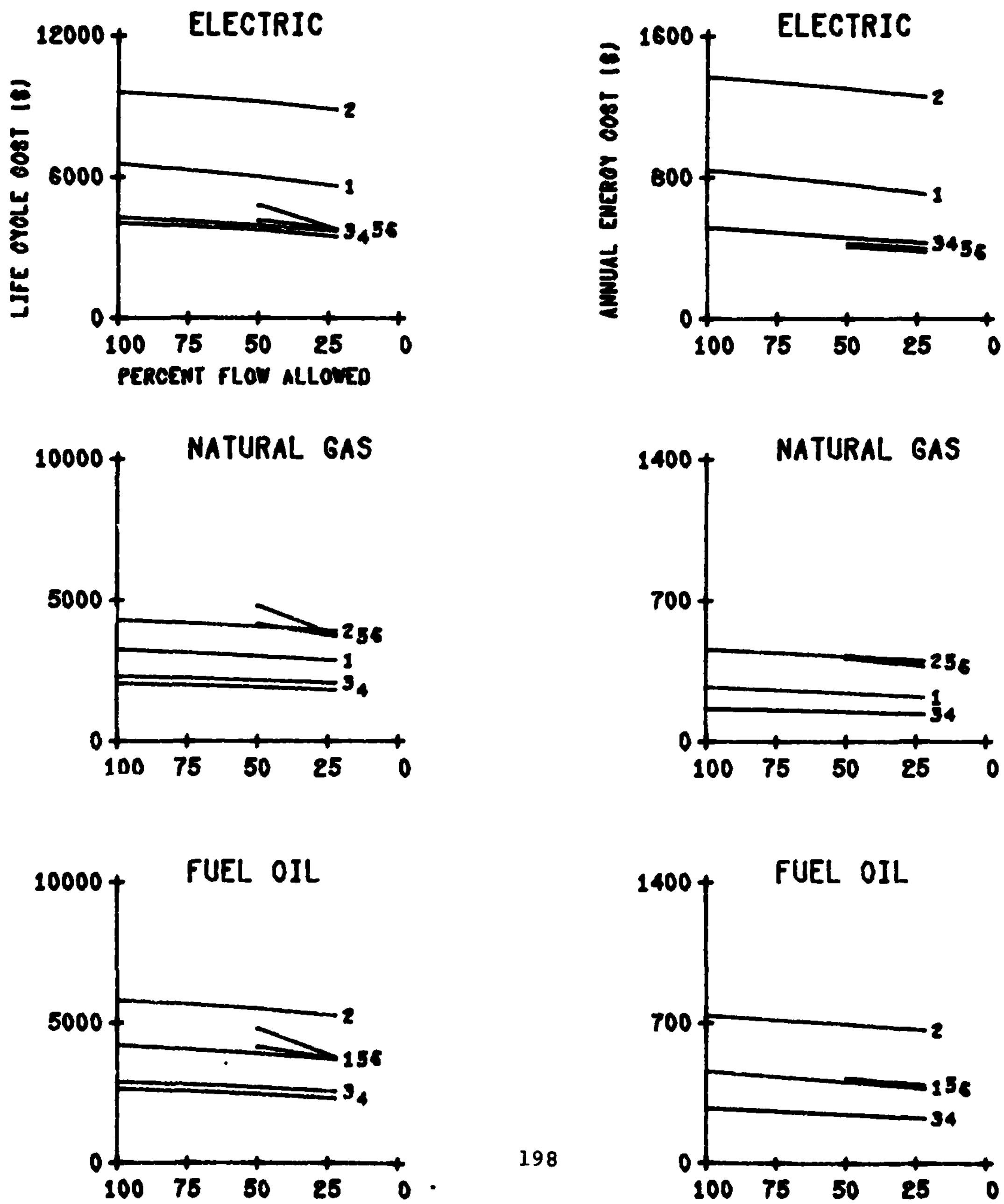
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	8	0.00

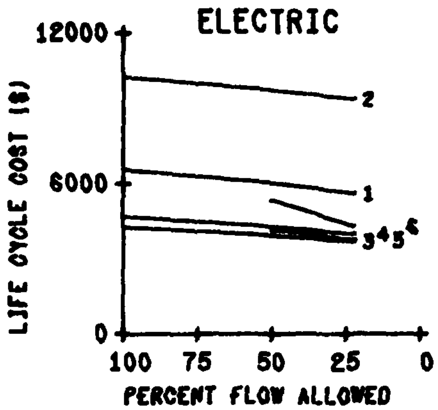
*** NEW CONSTRUCTION ***

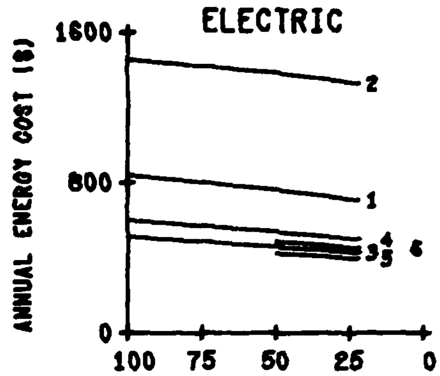


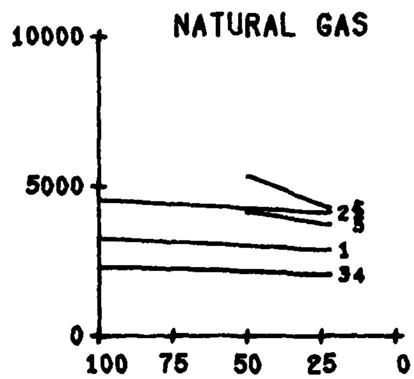
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

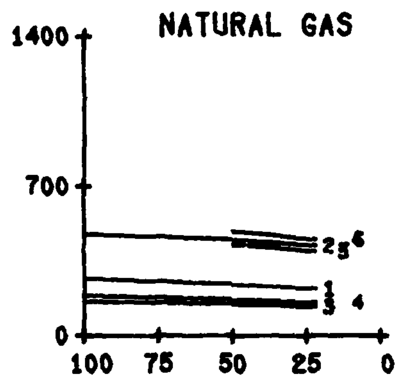
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	8	20.00

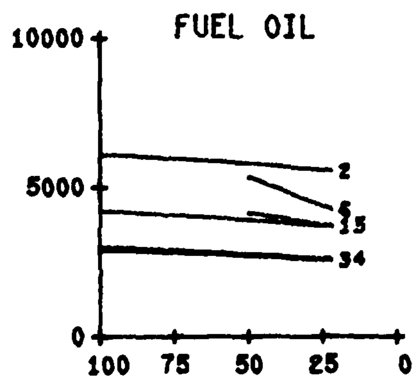
*** NEW CONSTRUCTION ***

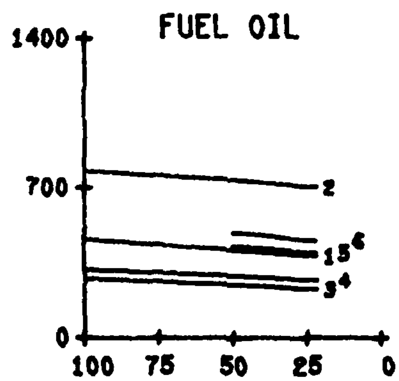








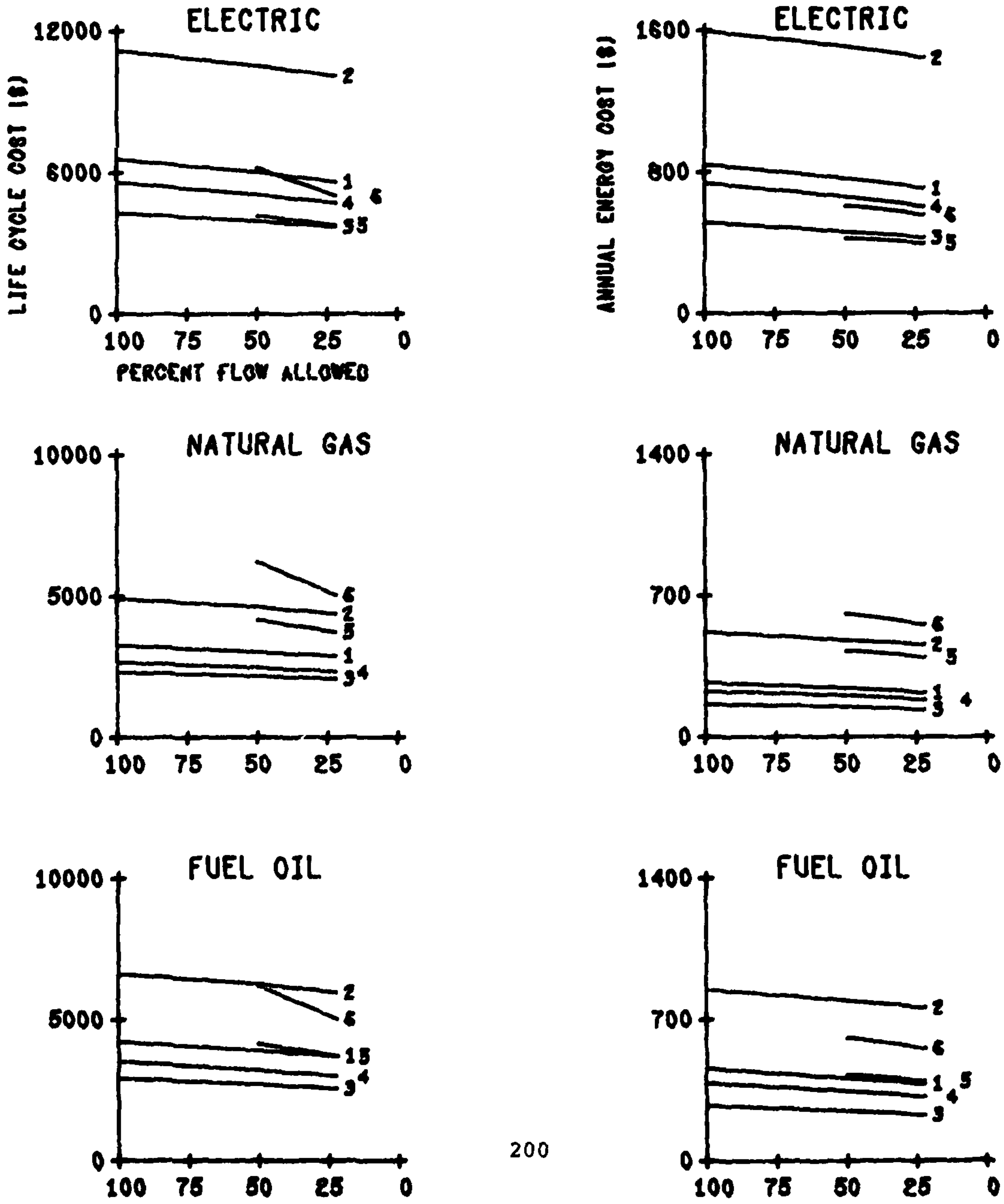




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	8	50.00

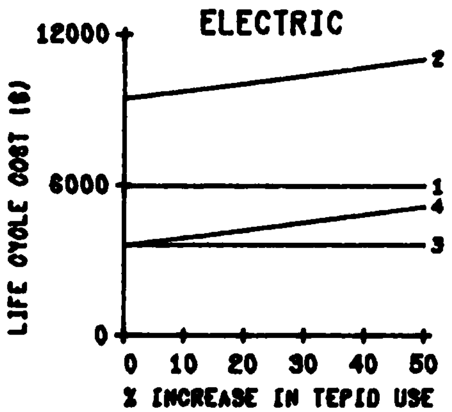
*** NEW CONSTRUCTION ***

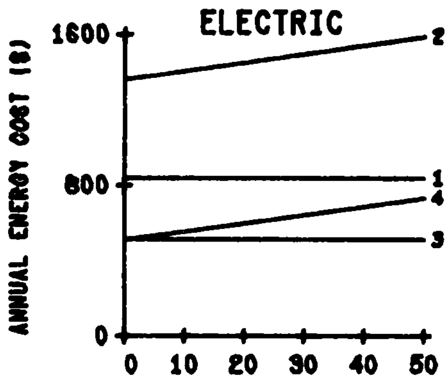


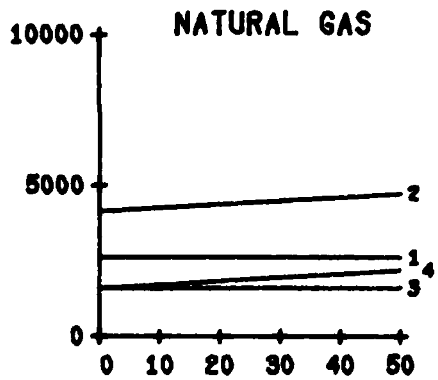
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

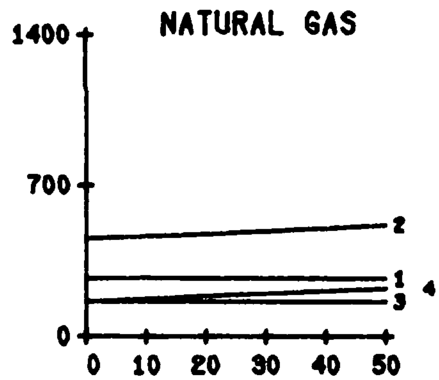
BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	8	100.00	100.00

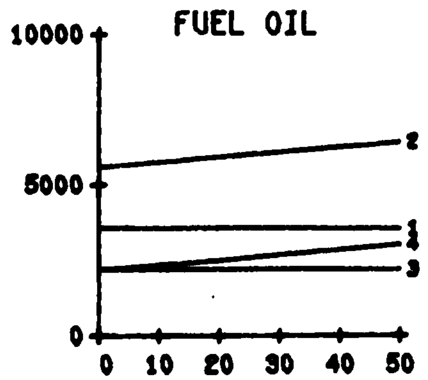
****** RETROFIT ******

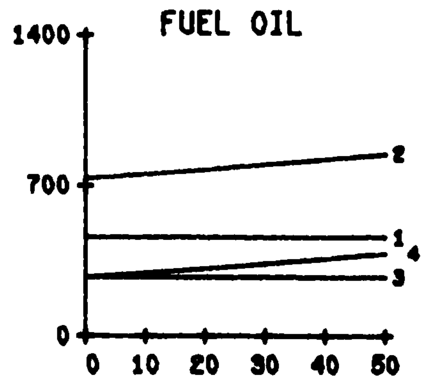








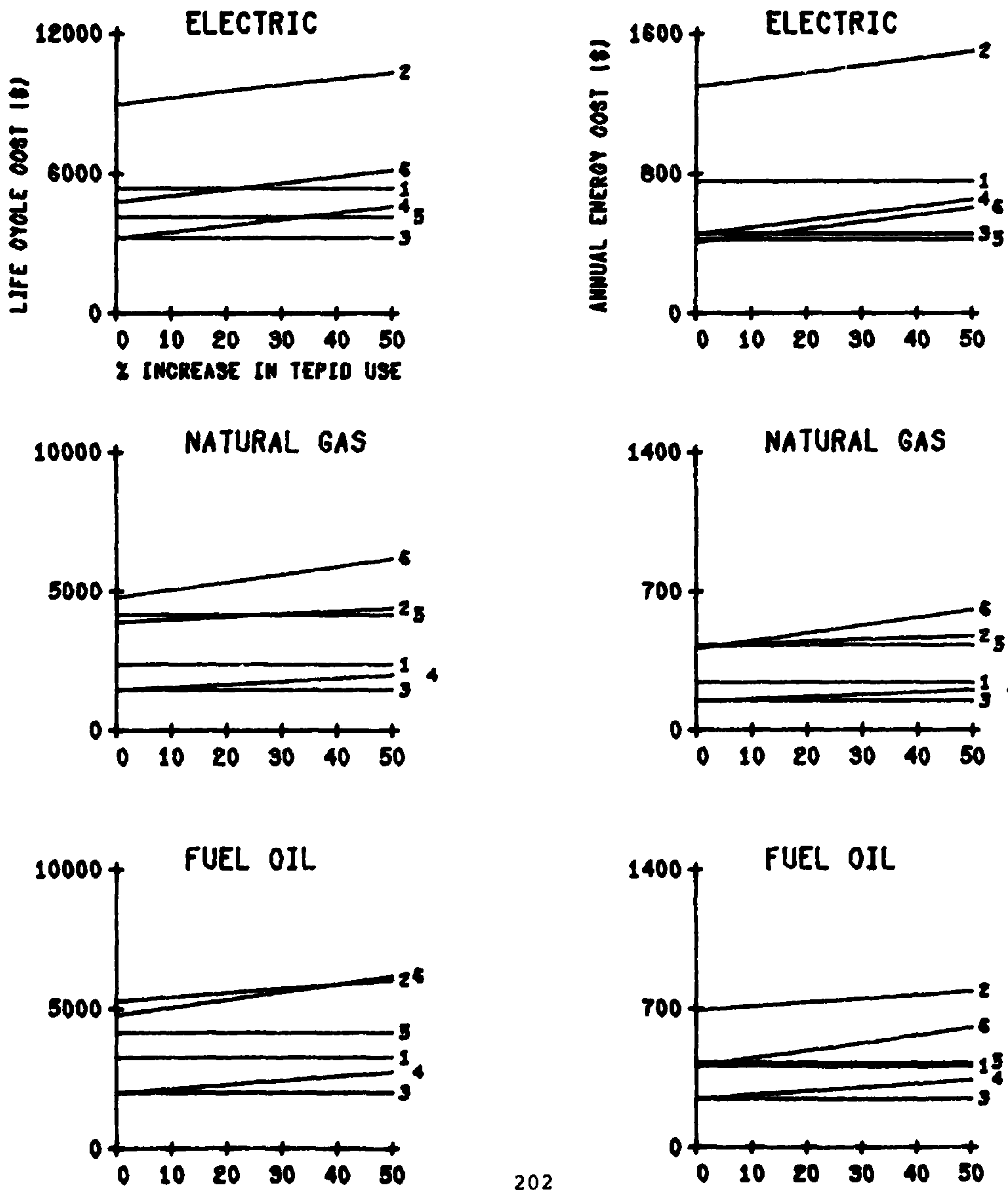




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	8	50.00	80.00

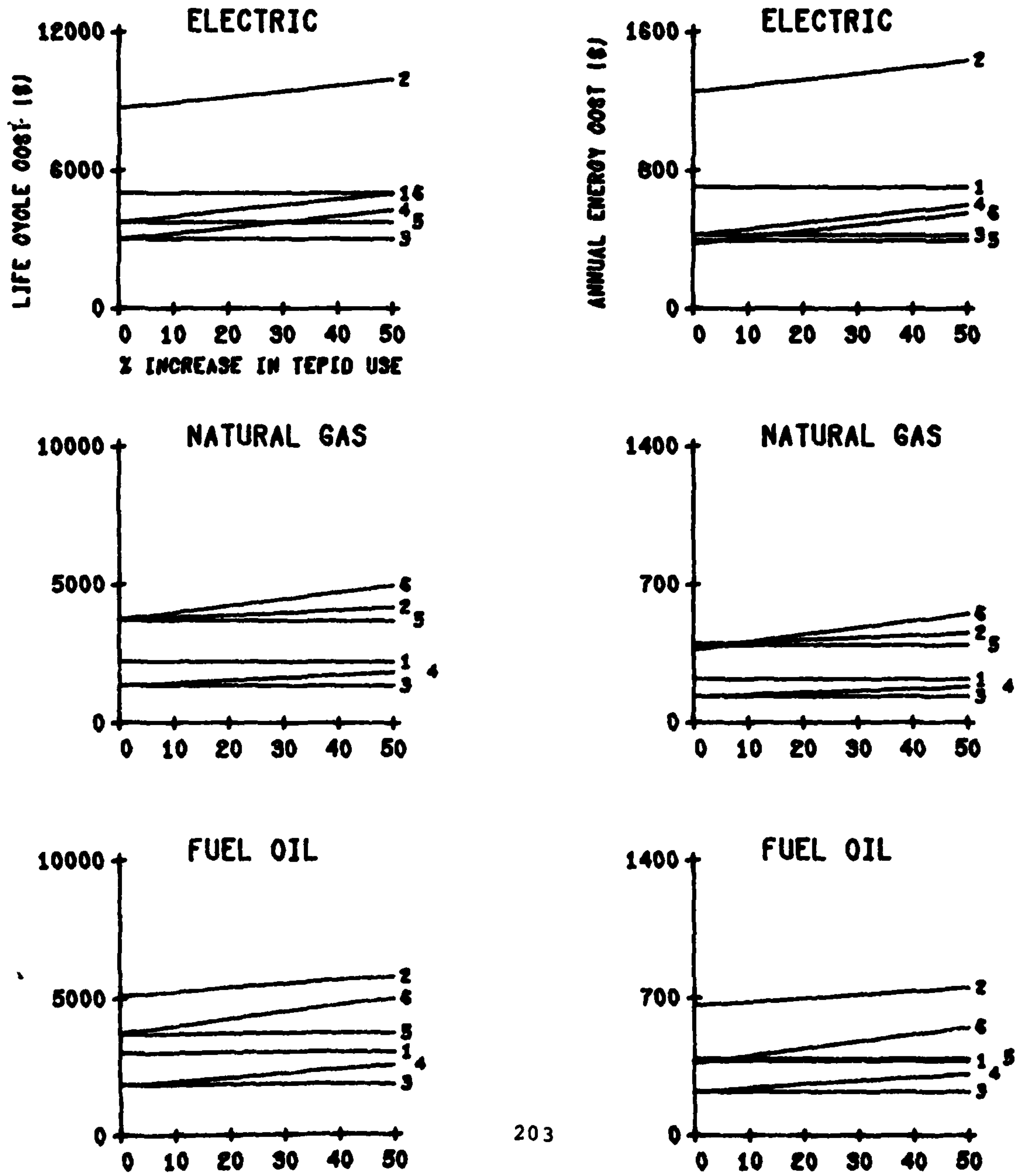
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	8	22.00	66.00

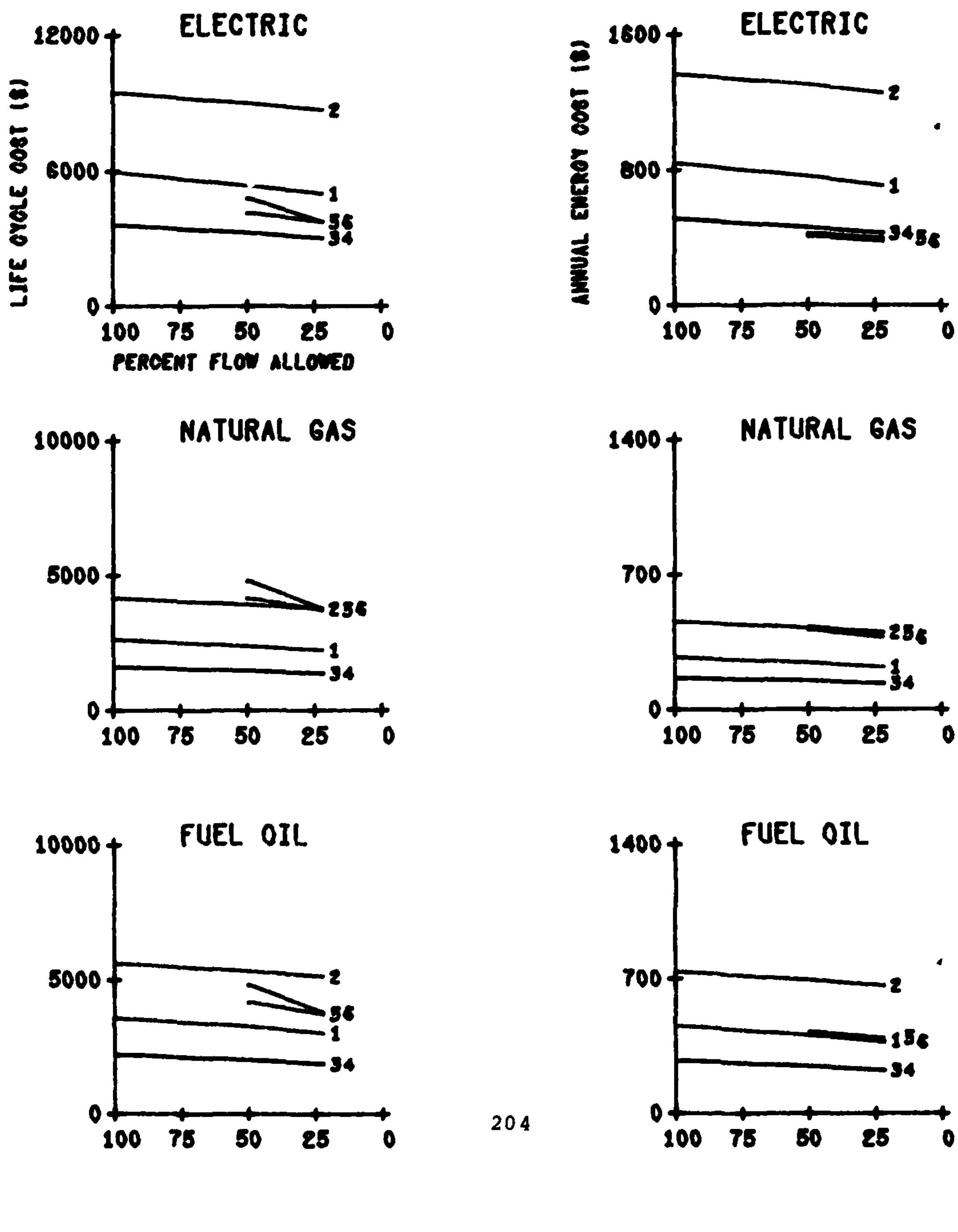
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	8	0.00

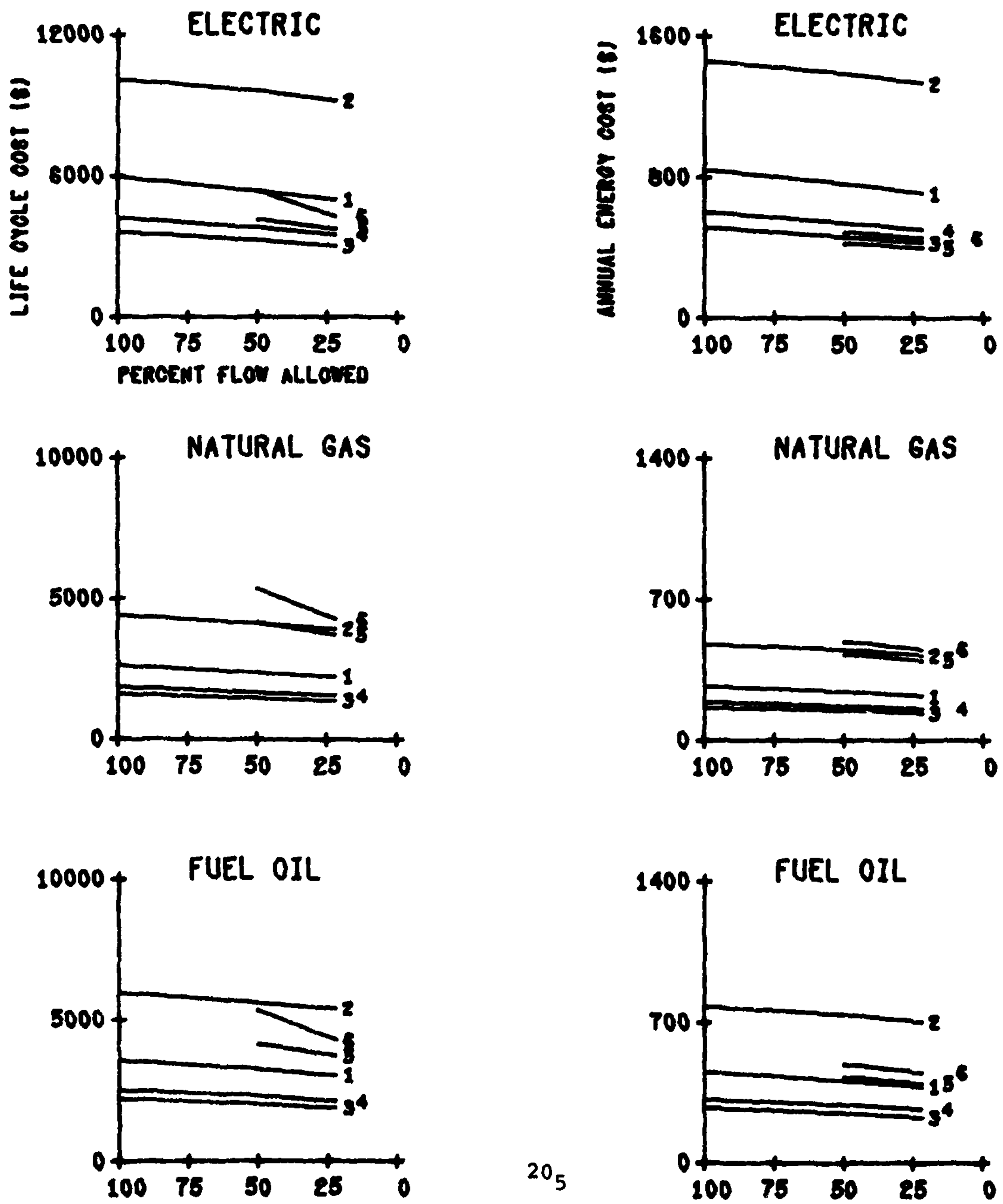
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	8	20.00

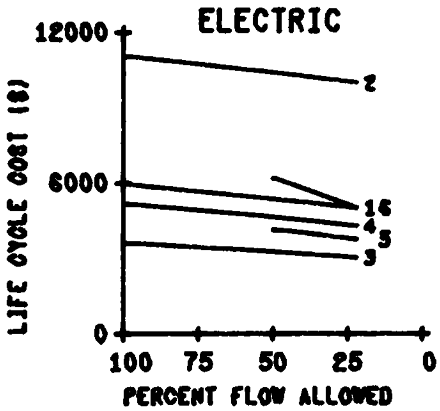
****** RETROFIT ******

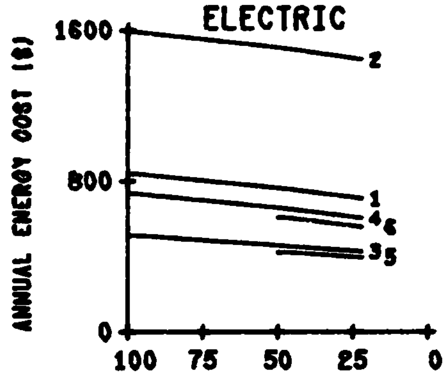


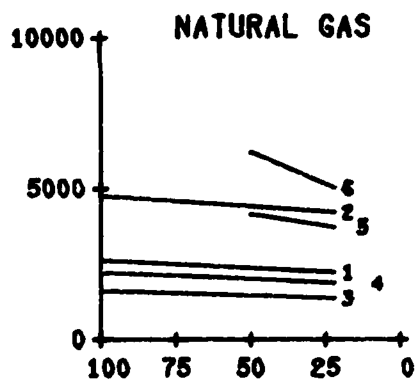
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

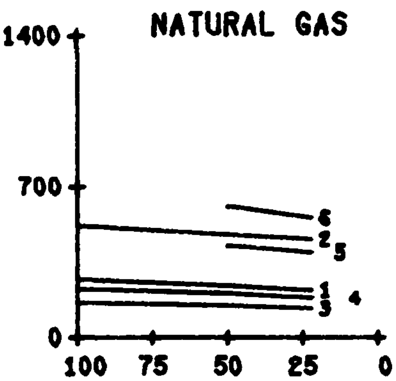
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	8	50.00

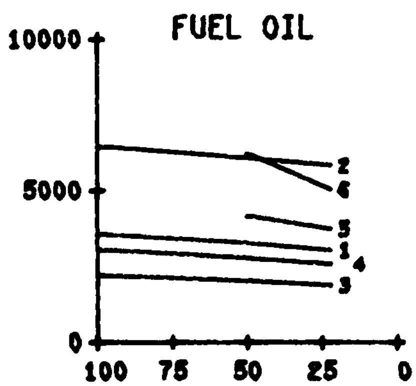
****** RETROFIT ******

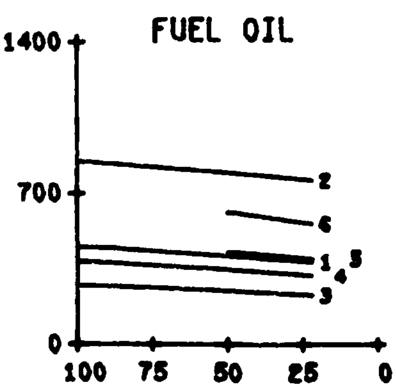








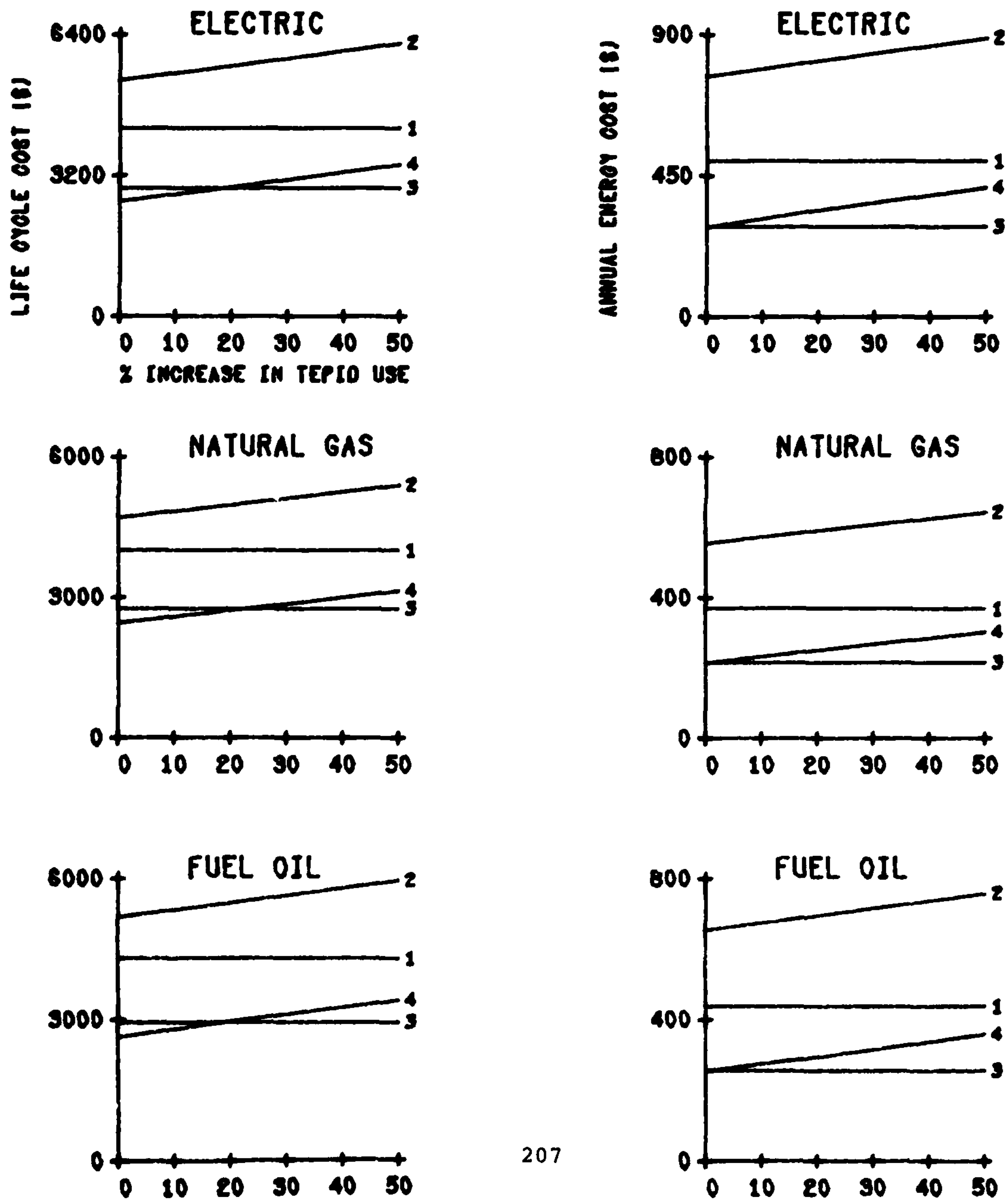




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	10	100.00	100.00

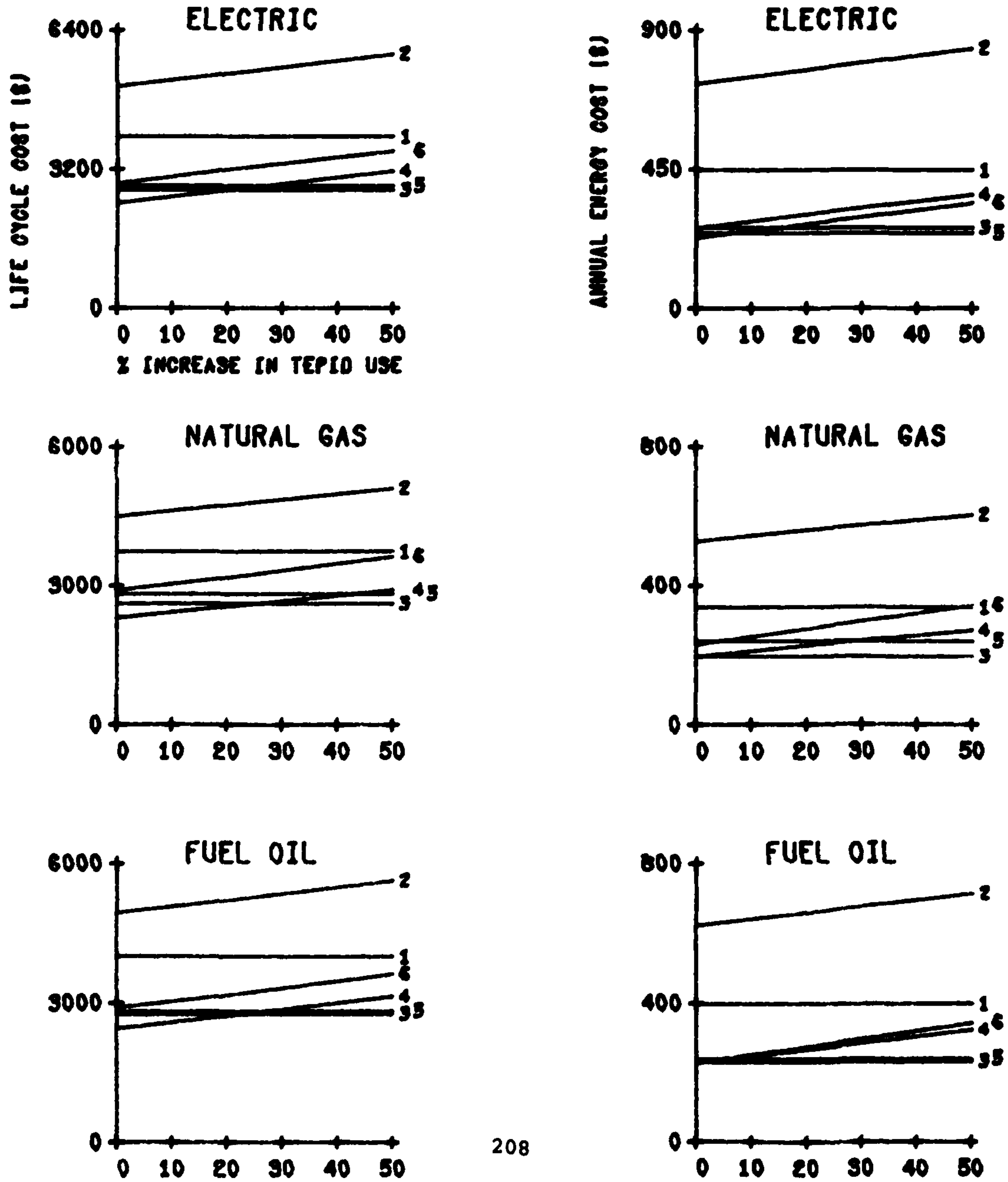
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	10	50.00	80.00

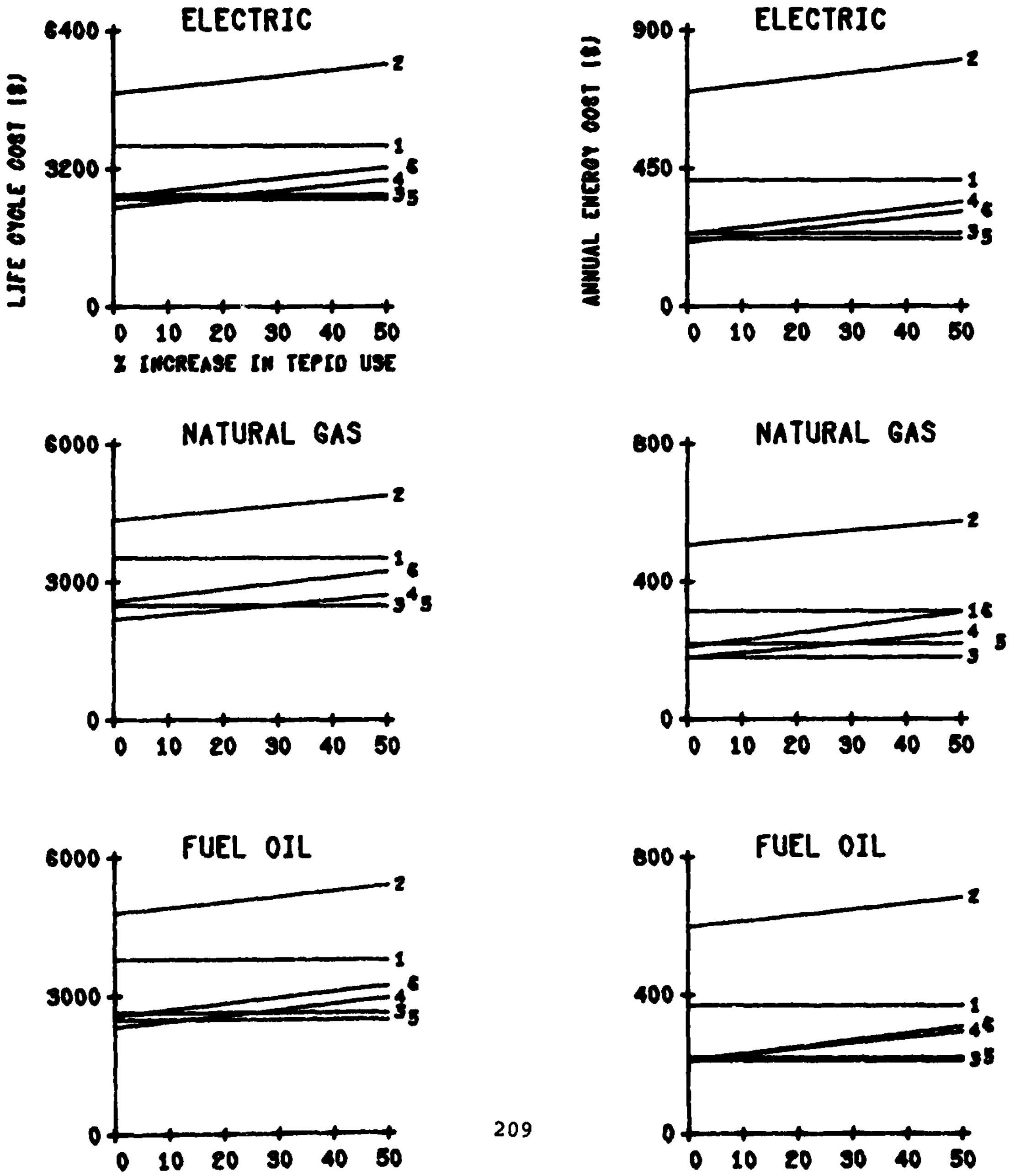
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	10	22.00	66.00

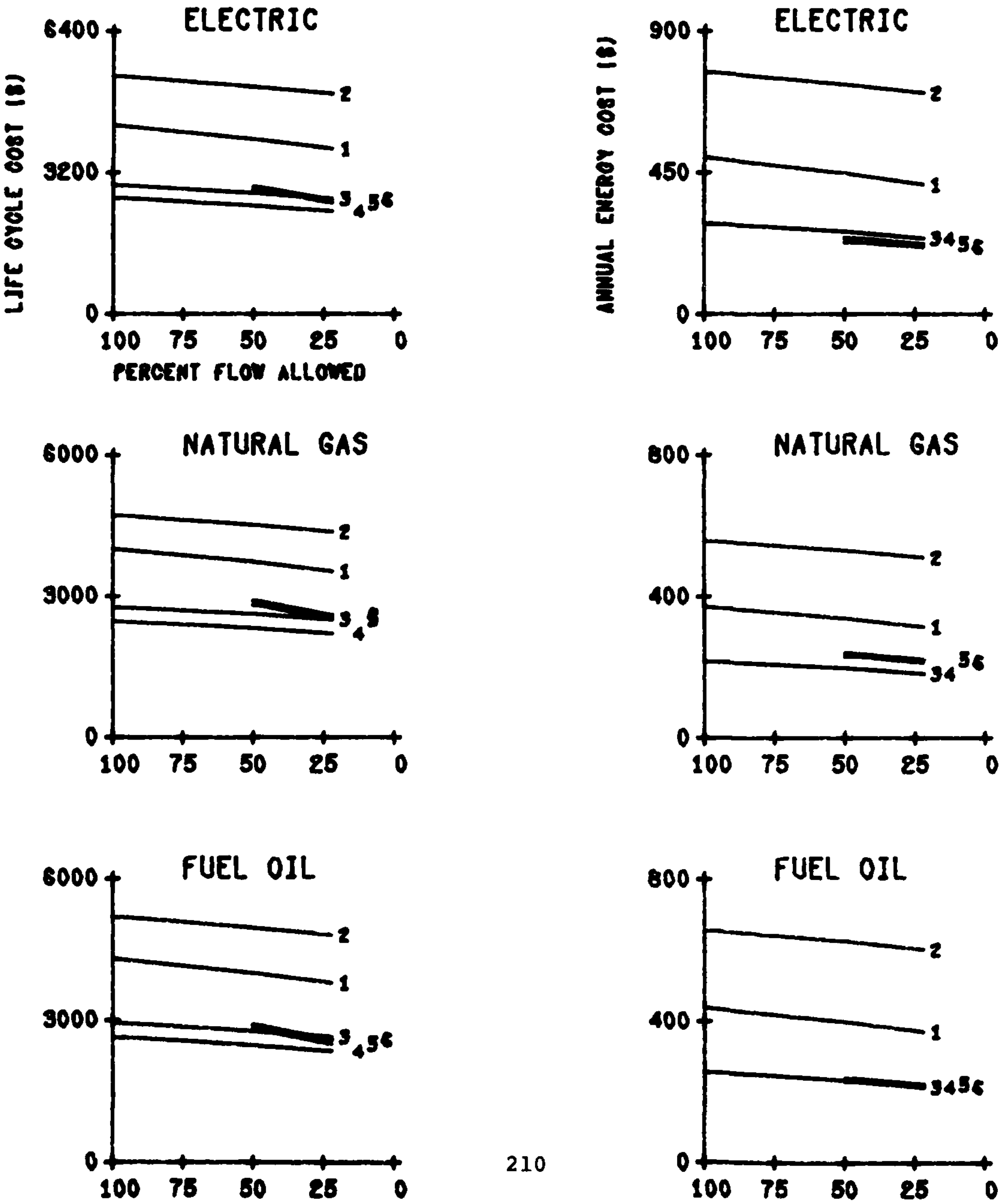
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	10	0.00

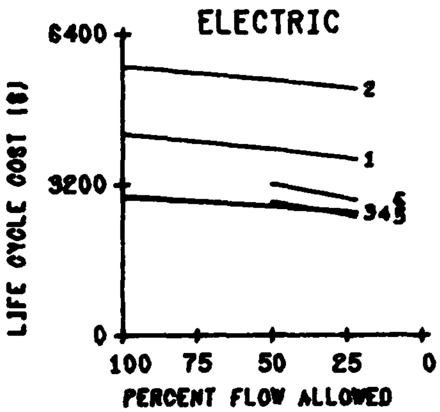
*** NEW CONSTRUCTION ***

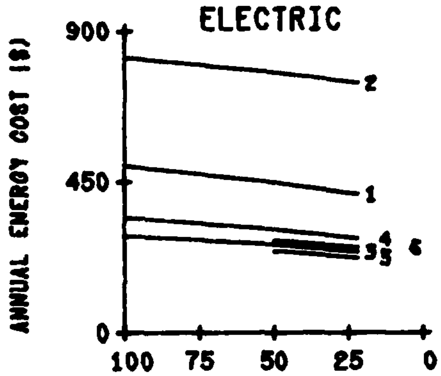


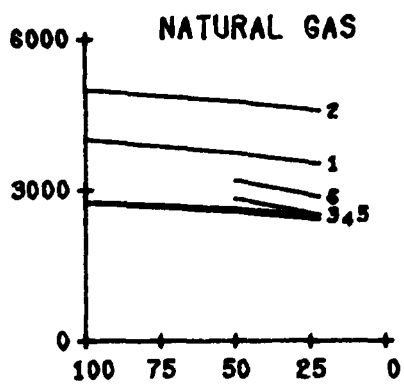
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

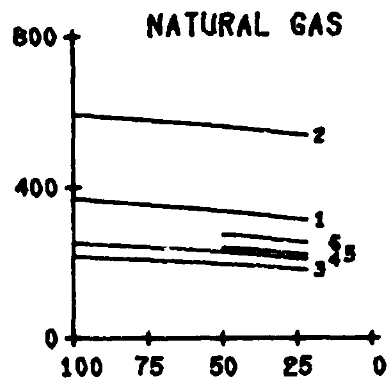
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	10	20.00

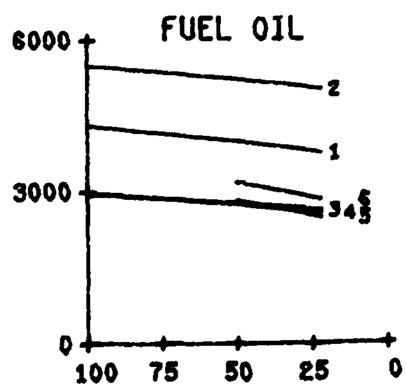
*** NEW CONSTRUCTION ***

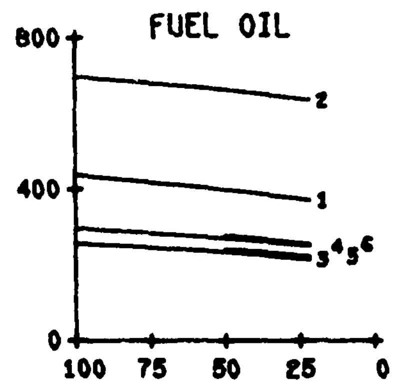








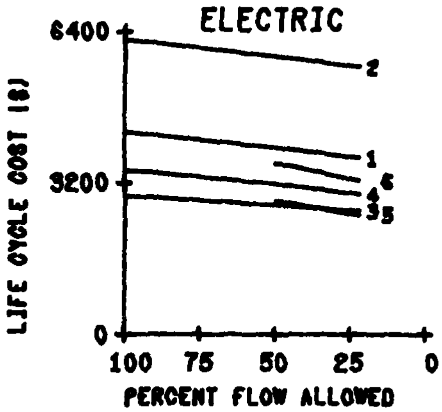


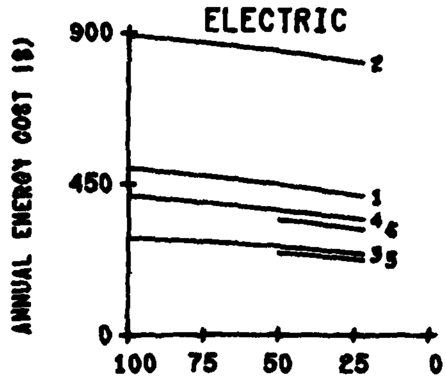


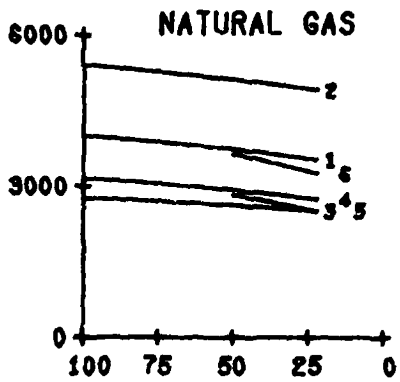
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

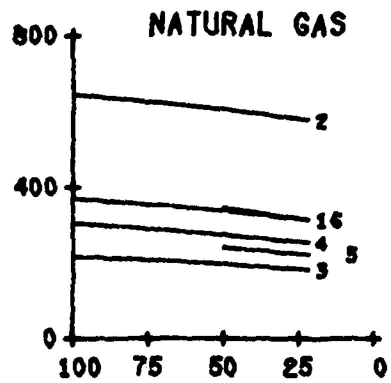
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	10	50.00

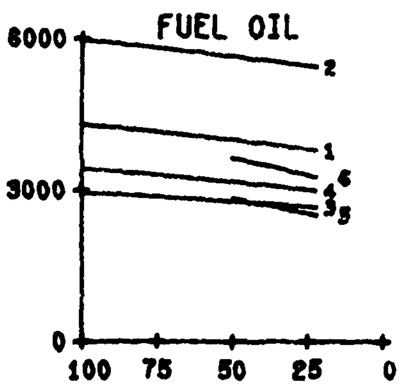
*** NEW CONSTRUCTION ***

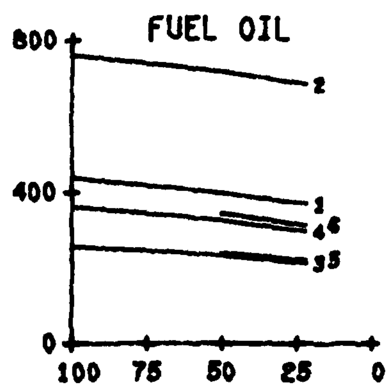








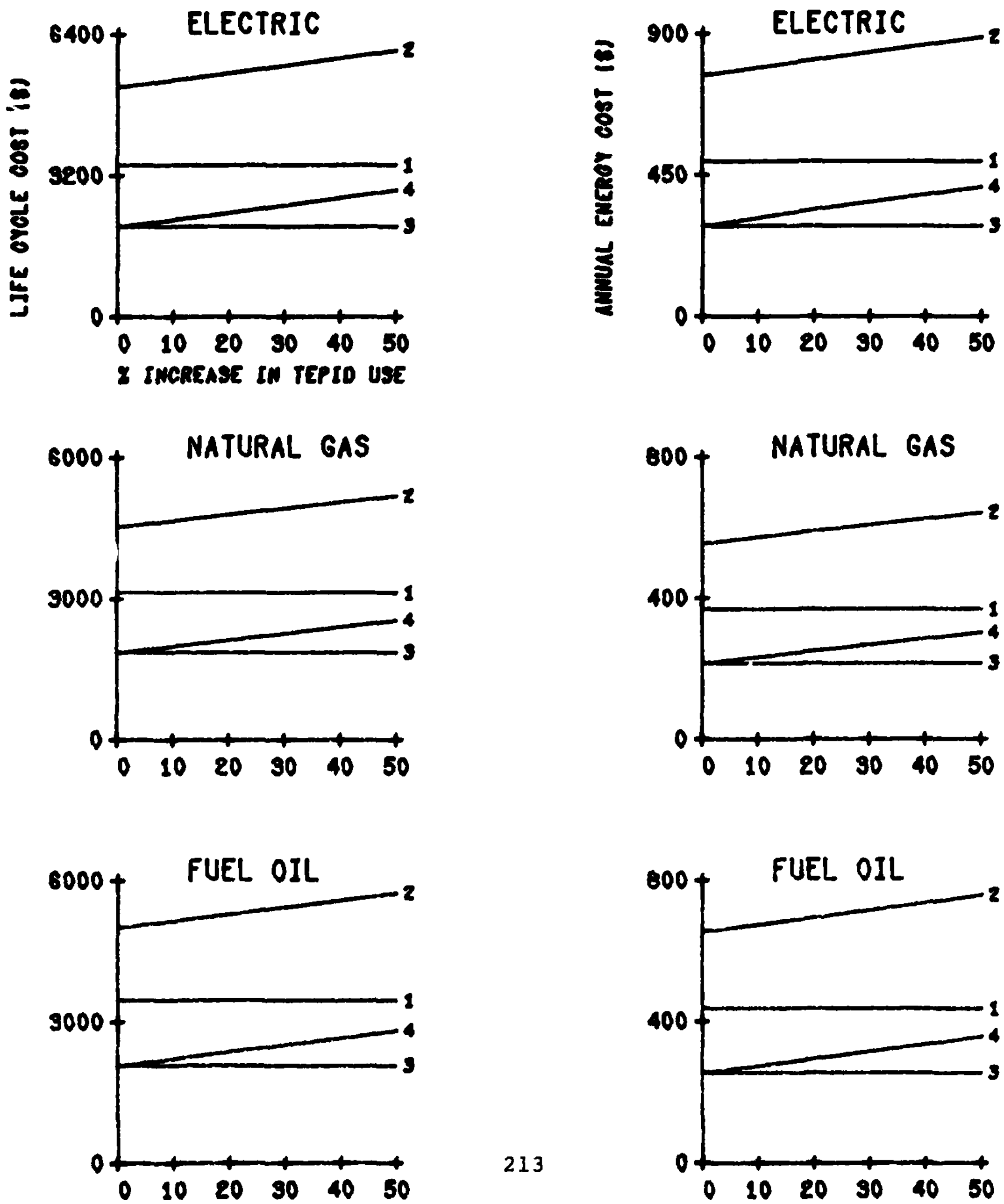




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	10	100.00	100.00

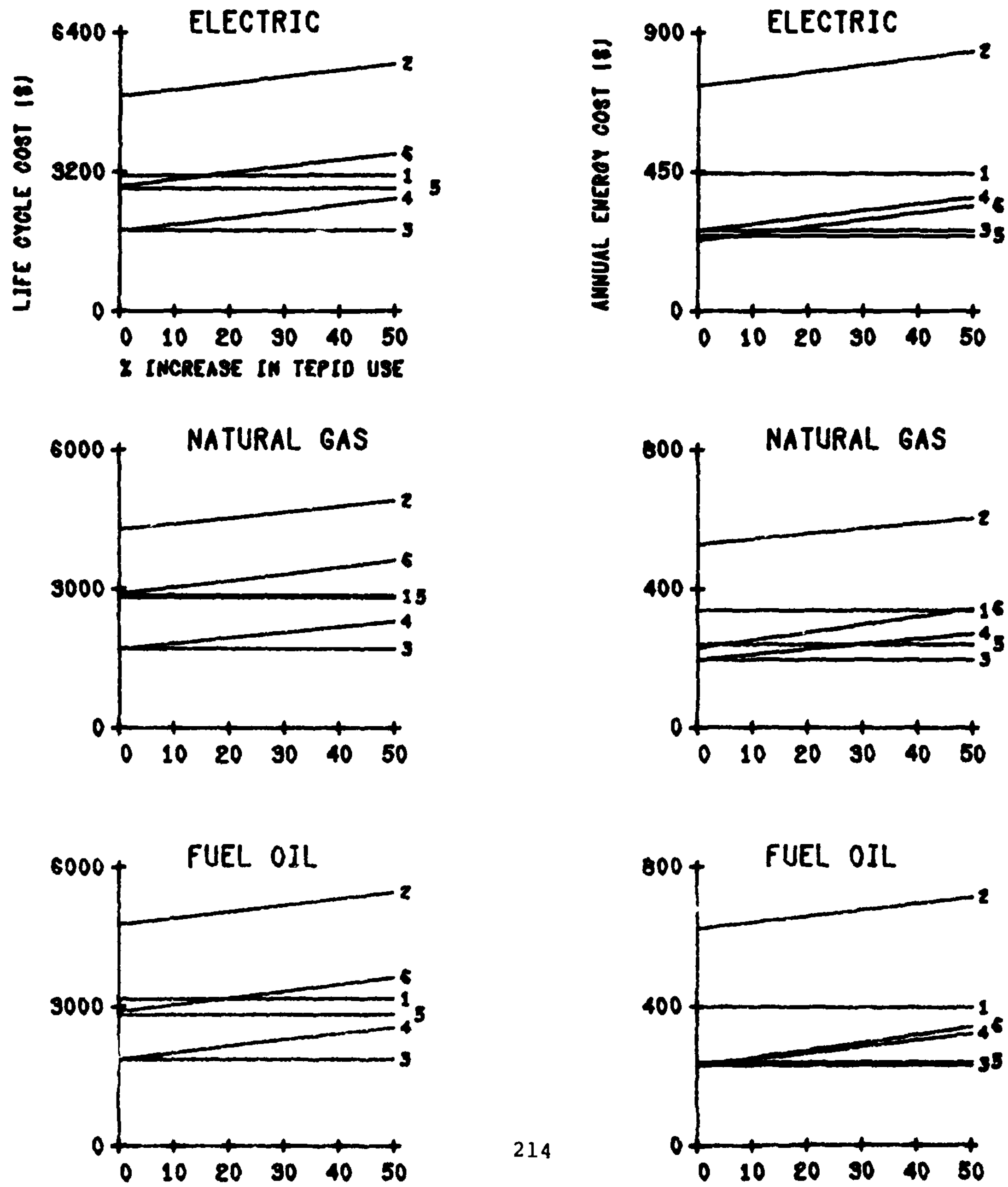
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	10	50.00	80.00

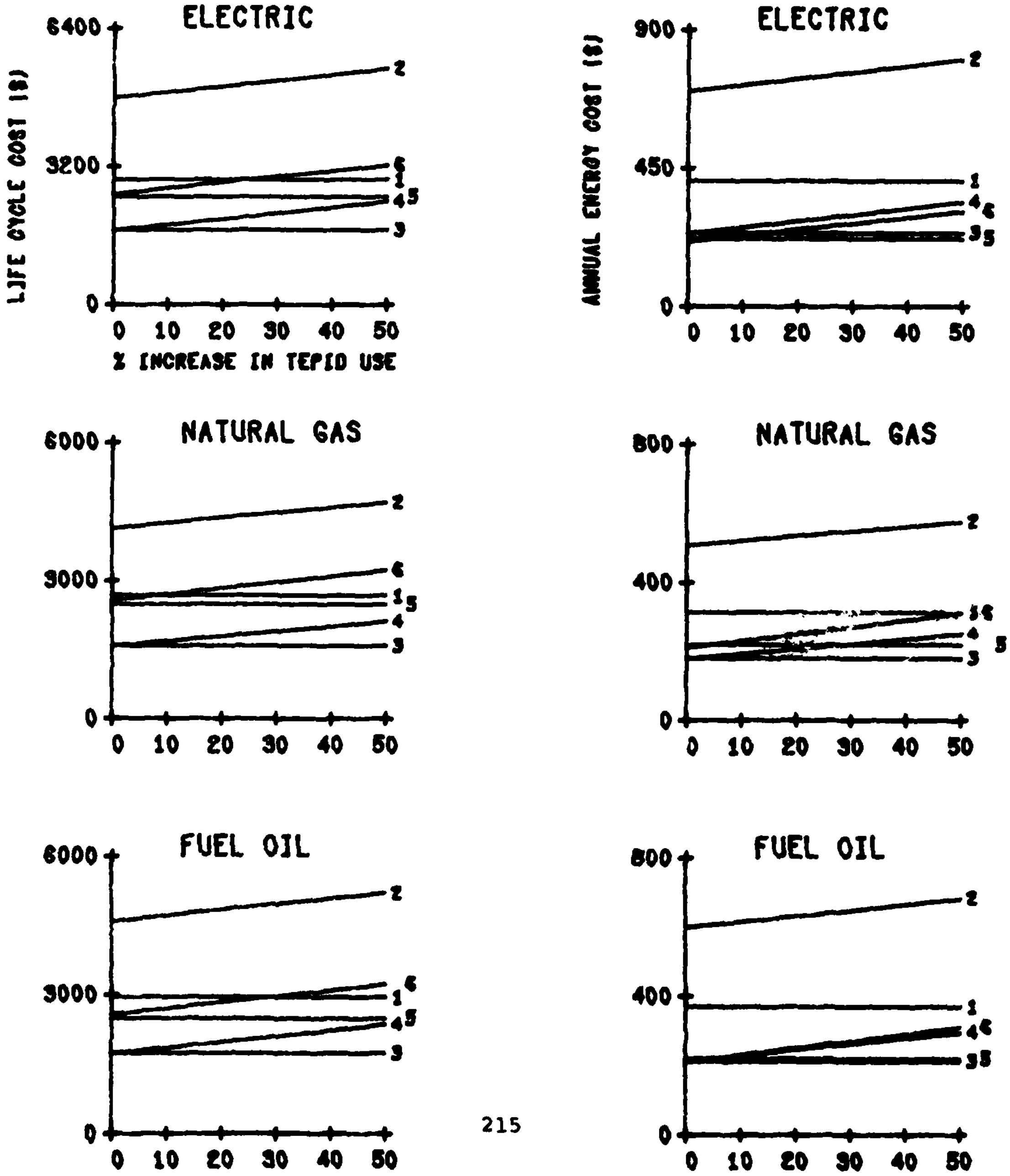
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
1	10	22.00	66.00

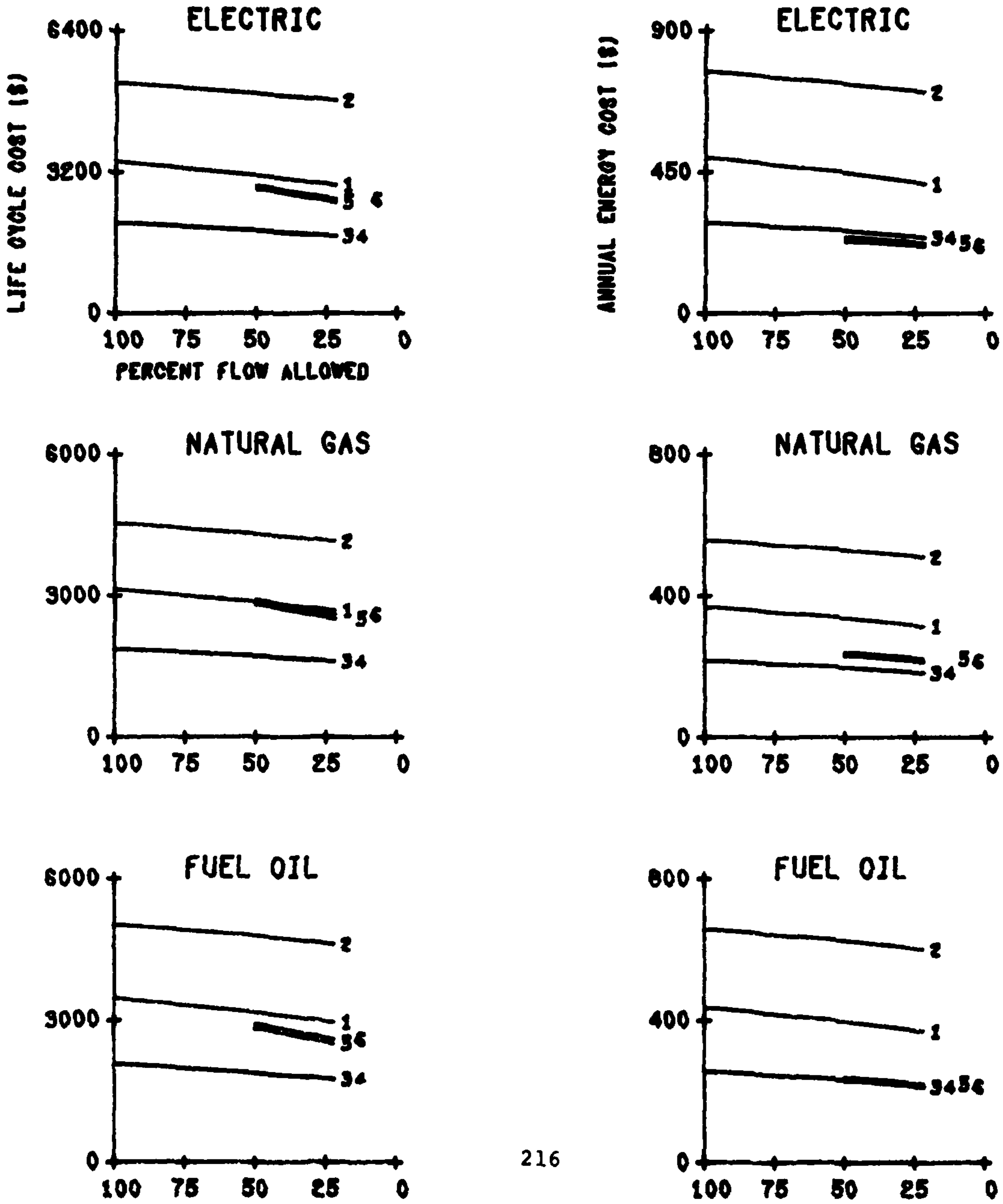
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	10	0.00

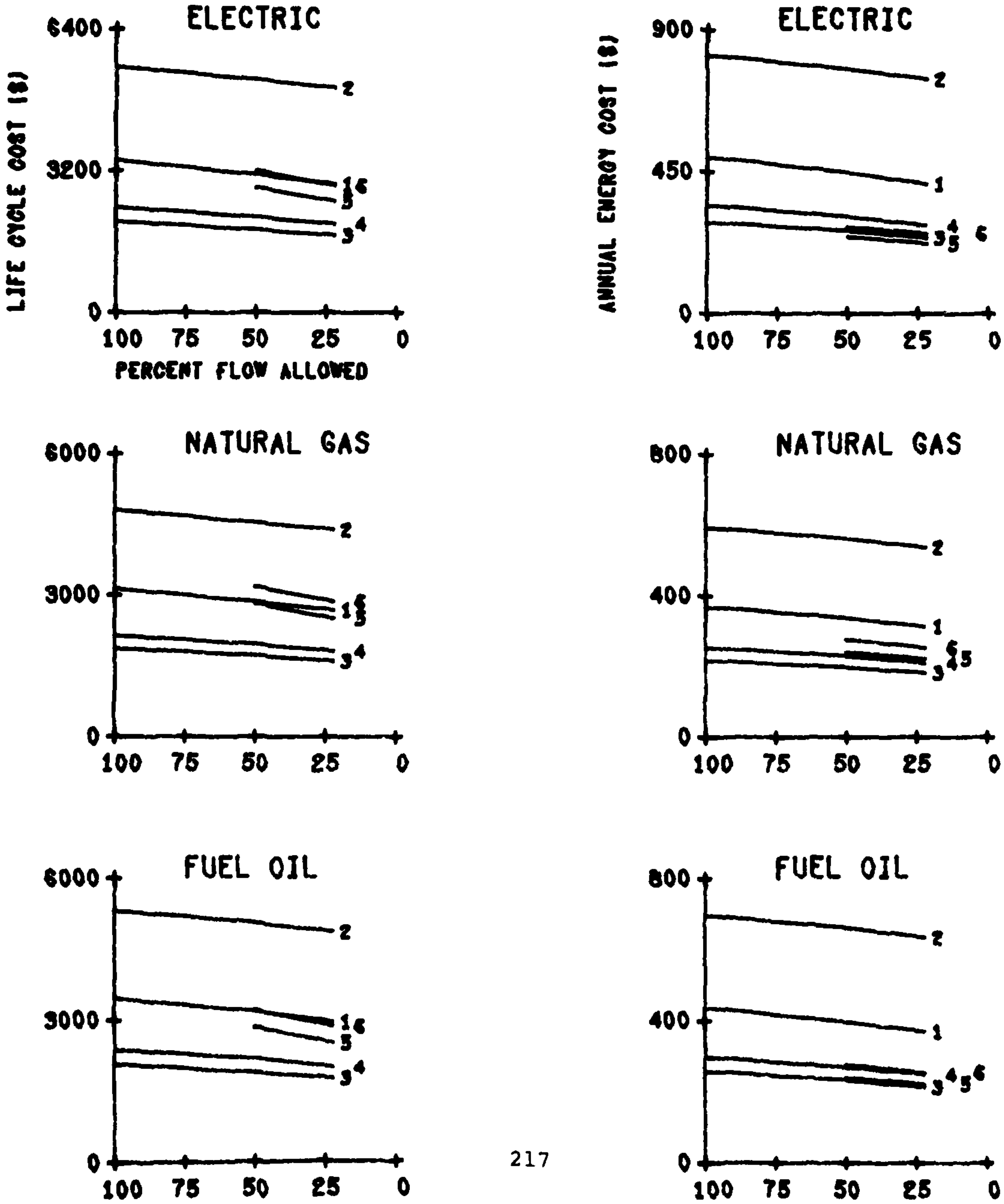
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	10	20.00

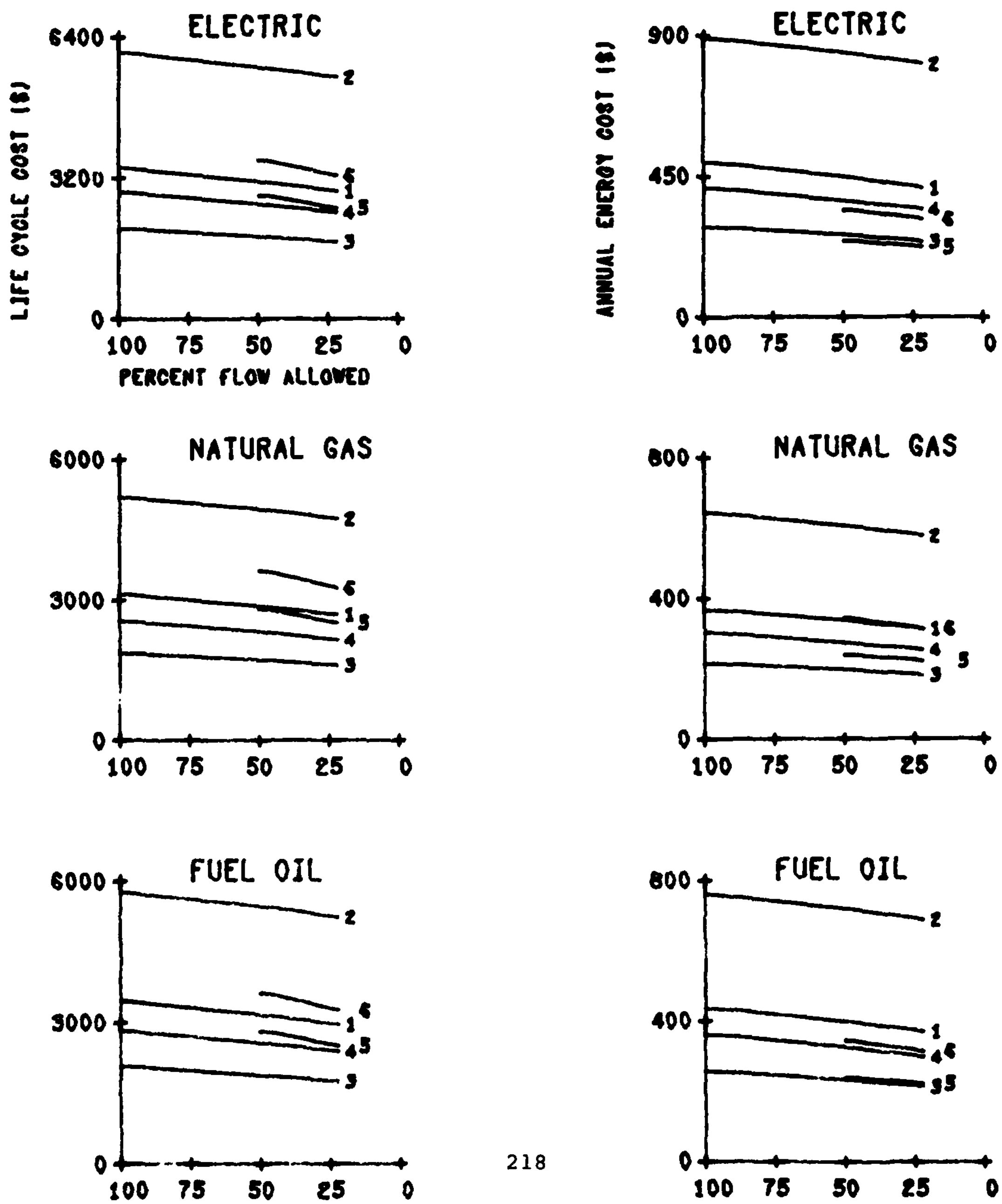
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
1	10	50.00

****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

BUILDING: CODE = 4 NAME = OUTPOST

FXTR TYPE	FXTR NAME	QTY	TEMP REQ CODE	HOT/TEPID FLOW RATE (GPM)	EST USAGE (GPH/FXTR) HOT/TEP	COLD
1	LAVATORY FAUCET	1	2	2.25	2.00	2.00
3	TOILET	1	3	0.00	6.56	6.56

----- CENTRAL HEATER -----

CODE	NAME	EFFECIENCY
1	ELEC	0.95
2	GAS	0.75
3	OIL	0.70

CENTRAL HEATER STORAGE TANK

HEIGHT (IN)	DIAMETER (IN)
32.00	16.60

CENTRAL HEATER R VALUE(S) = 2.50

ADDITIONAL STANDBY LOSS FACTOR FOR GAS/OIL HEATERS = 2.90
CENTRAL HEATER LOCATION (C=COND SPACE, U=UNCOND) = C
REMAINING LIFE OF HEATER (YRS) = 6
ALTERNATIVE SYSTEM HEATER LIFE EXTENSION (YRS) = 4

NORMAL HEATED WATER LINE LENGTH(S) (FT) = 15.00

-------- HEATED WATER LINES --------

DIAMETER (IN)	EXTRA LENGTH COOLER (FT)	TOILET (FT)	PERCENT CONDITIONED SPACE
0.545	10.00	10.00	100.00

NUMBER OF PIPE COOLDOWN CYCLES PER DAY= 1.20

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

-------------- CONSTANT TEMPERATURES (F) --------------

******** HOT *******			******* TEPID ******			WATER	
WATER SUPPLY	MIN ALLOW	MAX ALLOW	WATER SUPPLY	MIN ALLOW	MAX ALLOW	COOLER OUTLET	ROOM
140.	130.	150.	105.	95.	115.	40.	68.

FOR DOE REGIONS:	2	8	10
AMBIENT TEMP (F)	51.00	51.00	60.00
GROUND WATER TEMP (F)	45.00	50.00	55.00
MIN GRD WATER TEMP (F)	39.00	45.00	49.00
MAX GRD WATER TEMP (F)	51.00	55.00	61.00

PERCENT INCREASED TEPID USE (NO COLD SYSTEMS) = 0.00 20.00 50.00

PERCENT OF FLOW (FLOW RESTRICTION) = 100.00 50.00 22.00
CORRESPONDING PERCENT USAGE = 100.00 85.00 66.00

WATER COOLER EFFECIENCY (%) = 70.00

NUMBER OF HOURS IN WORK DAY = 24.00
NUMBER WORK DAYS IN YEAR = 365.00

-------------------- POINT-OF-USE HEATERS --------------------

CODE	NAME	STORAGE TANK HEIGHT (IN)	STORAGE TANK DIAMETER (IN)	MAX FXTR DEMAND (GPH)	INSTALLED COST
4	INSTANTANEOUS 4.6 KW				237.00
5	INSTANTANEOUS 10 KW				400.00
6	INSTANTANEOUS 20 KW				420.00
7	MINITANK 1/2 GAL	6.00	5.00	6.25	200.00
8	MINITANK 1 GAL	8.00	6.06	12.00	260.00

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

FOR DOE REGION:	2	8	10
FOR FXTR TYPE 1 ($/FXTR) -			
INSTALLED COST	53.50	50.24	67.97
RETURN CR NEW	40.00	37.00	45.00
RETURN CR RETROFIT	0.00	0.00	0.00
CREDIT - NO HOT/COLD SUPPLY	53.50	50.24	67.97
CENTRAL HTR TYPE 1 ($) -			
INSTALLED COST	195.28	187.90	228.08
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 2 ($) -			
INSTALLED COST	226.72	218.35	263.92
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 3 ($) -			
INSTALLED COST	226.72	218.35	263.92
RETURN CREDIT	0.00	0.00	0.00
COST OF ENERGY -			
ELECTRICITY ($/KWH)	0.070	0.036	0.022
NATURAL GAS ($/MBTU)	3.710	2.330	3.500
FUEL OIL ($/GAL)	0.581	0.541	0.550
10 YR PRESENT WORTH FACTORS -			
ELECTRICITY	6.183	6.841	6.601
NATURAL GAS	7.067	9.325	7.950
FUEL OIL	7.440	7.547	7.452

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1978E 08	0.4245E 08	0.1177E 08	0.1177E 08	0.9614E 07	0.9218E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	405.70	870.81	241.54	241.54	197.19	189.06
INS COST ($)	248.78	248.78	248.78	248.78	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	200.00	*********
TLEC CST ($)	2508.48	5384.24	1493.44	1493.44	1219.23	1169.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2757.26	5579.52	1742.22	1702.22	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1759E 08	0.4107E 08	0.1039E 08	0.1039E 08	0.8231E 07	0.7835E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	360.80	842.45	213.18	213.18	168.83	160.70
INS COST ($)	248.78	248.78	248.78	248.78	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	200.00	*********
TLEC CST ($)	2230.84	5208.89	1318.09	1318.09	1043.88	993.66
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2479.62	5404.17	1566.87	1526.87	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1481E 08	0.3932E 08	0.8642E 07	0.8642E 07	0.6084E 07	0.6084E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.0000E 00	0.0000E 00
TAE COST ($)	303.92	806.53	177.25	177.25	124.78	124.78
INS COST ($)	248.78	248.78	248.78	248.78	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	237.00	*********
TLEC CST ($)	1879.16	4986.78	1095.97	1095.97	771.54	771.54
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2127.94	5182.06	1344.75	1304.75	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1978E 08	0.4430E 08	0.1177E 08	0.1362E 08	0.9614E 07	0.1106E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	405.70	908.62	241.54	279.35	197.19	226.88
INS COST ($)	248.78	248.78	248.78	248.78	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	200.00	*********
TLEC CST ($)	2508.48	5618.05	1493.44	1727.24	1219.23	1402.81
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2757.26	5813.33	1742.22	1936.02	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1759E 08	0.4264E 08	0.1039E 08	0.1196E 08	0.8231E 07	0.9402E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	360.80	874.59	213.18	245.32	168.83	192.85
INS COST ($)	248.78	248.78	248.78	248.78	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	200.00	*********
TLEC CST ($)	2230.84	5407.62	1318.09	1516.82	1043.88	1192.39
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2479.62	5602.90	1566.87	1725.60	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1481E 08	0.4054E 08	0.8642E 07	0.9859E 07	0.6084E 07	0.7301E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.0000E 00	0.0000E 00
TAE COST ($)	303.92	831.48	177.25	202.21	124.78	149.74
INS COST ($)	248.78	248.78	248.78	248.78	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	237.00	*********
TLEC CST ($)	1879.16	5141.09	1095.97	1250.28	771.54	925.85
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2127.94	5336.37	1344.75	1459.06	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1978E 08	0.4706E 08	0.1177E 08	0.1638E 08	0.9614E 07	0.1382E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	405.70	965.34	241.54	336.07	197.19	283.60
INS COST ($)	248.78	248.78	248.78	248.78	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	200.00	*********
TLEC CST ($)	2508.48	5968.75	1493.44	2077.95	1219.23	1753.52
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2757.26	6164.03	1742.22	2286.73	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1759E 08	0.4499E 08	0.1039E 08	0.1431E 08	0.8231E 07	0.1175E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	360.80	922.80	213.18	293.53	168.83	241.06
INS COST ($)	248.78	248.78	248.78	248.78	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	200.00	*********
TLEC CST ($)	2230.84	5705.72	1318.09	1814.92	1043.88	1490.49
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2479.62	5901.00	1566.87	2023.70	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1481E 08	0.4236E 08	0.8642E 07	0.1168E 08	0.6084E 07	0.9126E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.0000E 00	0.0000E 00
TAE COST ($)	303.92	868.92	177.25	239.64	124.78	187.17
INS COST ($)	248.78	248.78	248.78	248.78	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	248.78	195.28	248.78	208.78	237.00	*********
TLEC CST ($)	1879.16	5372.55	1095.97	1481.75	771.54	1157.32
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2127.94	5567.83	1344.75	1690.53	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3066E 08	0.5657E 08	0.1782E 08	0.1782E 08	0.9614E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	113.76	209.88	66.14	66.14	197.19	189.06
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	803.96	1483.24	467.41	467.41	1219.23	1169.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1084.18	1709.96	747.63	707.63	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2789E 08	0.5482E 08	0.1607E 08	0.1607E 08	0.8231E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	103.47	203.38	59.64	59.64	168.83	160.70
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	731.25	1437.32	421.48	421.48	1043.88	993.66
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1011.47	1664.04	701.70	661.70	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	0.0	GAS	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2437E 08	0.5260E 08	0.1385E 08	0.1385E 08	0.6084E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	90.44	195.15	51.41	51.41	124.78	124.78
INS COST ($)	280.22	280.22	280.22	280.22	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	237.00	*********
TLEC CST ($)	639.15	1379.15	363.32	363.32	771.54	771.54
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	919.37	1605.87	643.54	603.54	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3066E 08	0.5890E 08	0.1782E 08	0.2016E 08	0.9614E 07	0.1106E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	113.76	218.54	66.14	74.80	197.19	226.88
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	803.96	1544.47	467.41	528.64	1219.23	1402.81
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1084.18	1771.19	747.63	768.86	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2789E 08	0.5680E 08	0.1607E 08	0.1806E 08	0.8231E 07	0.9402E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	103.47	210.74	59.64	67.00	168.83	192.85
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	731.25	1489.36	421.48	473.53	1043.88	1192.39
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1011.47	1716.08	701.70	713.75	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	20.0	GAS	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2437E 08	0.5414E 08	0.1385E 08	0.1539E 08	0.6084E 07	0.7301E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	90.44	200.87	51.41	57.12	124.78	149.74
INS COST ($)	280.22	280.22	280.22	280.22	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	237.00	*********
TLEC CST ($)	639.15	1419.56	363.32	403.73	771.54	925.85
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	919.37	1646.28	643.54	643.95	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3066E 08	0.6241E 08	0.1782E 08	0.2366E 08	0.9614E 07	0.1382E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	113.76	231.54	66.14	87.80	197.19	283.60
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	803.96	1636.31	467.41	620.48	1219.23	1753.52
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1084.18	1863.03	747.63	860.70	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2789E 08	0.5978E 08	0.1607E 08	0.2103E 08	0.8231E 07	0.1175E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	103.47	221.79	59.64	78.05	168.83	241.06
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	731.25	1567.43	421.48	551.60	1043.88	1490.49
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1011.47	1794.15	701.70	791.82	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	50.0	GAS	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2437E 08	0.5645E 08	0.1385E 08	0.1771E 08	0.6084E 07	0.9126E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	90.44	209.44	51.41	65.70	124.78	187.17
INS COST ($)	280.22	280.22	280.22	280.22	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	237.00	*********
TLEC CST ($)	639.15	1480.18	363.32	464.35	771.54	1157.32
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	919.37	1706.90	643.54	704.57	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3198E 08	0.6014E 08	0.1866E 08	0.1866E 08	0.9614E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	132.73	249.59	77.44	77.44	197.19	189.06
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	987.56	1856.95	576.19	576.19	1219.23	1169.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1267.78	2083.67	856.41	816.41	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2901E 08	0.5826E 08	0.1678E 08	0.1678E 08	0.8231E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	120.40	241.80	69.65	69.65	168.83	160.70
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	895.82	1799.01	518.25	518.25	1043.88	993.66
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1176.04	2025.73	798.47	758.47	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	0.0	OIL	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2524E 08	0.5588E 08	0.1440E 08	0.1440E 08	0.6084E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	104.78	231.93	59.79	59.79	124.78	124.78
INS COST ($)	280.22	280.22	280.22	280.22	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	237.00	*********
TLEC CST ($)	779.61	1725.61	444.86	444.86	771.54	771.54
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1059.83	1952.33	725.08	685.08	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3198E 08	0.6264E 08	0.1866E 08	0.2116E 08	0.9614E 07	0.1106E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	132.73	259.97	77.44	87.82	197.19	226.88
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	987.56	1934.21	576.19	653.45	1219.23	1402.81
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1267.78	2160.93	856.41	893.67	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2901E 08	0.6039E 08	0.1678E 08	0.1891E 08	0.8231E 07	0.9402E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	120.40	250.62	69.65	78.48	168.83	192.85
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	895.82	1864.67	518.25	583.92	1043.88	1192.39
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1176.04	2091.39	798.47	824.14	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	20.0	OIL	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2524E 08	0.5753E 08	0.1440E 08	0.1605E 08	0.6084E 07	0.7301E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	104.78	238.79	59.79	66.64	124.78	149.74
INS COST ($)	280.22	280.22	280.22	280.22	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	237.00	*********
TLEC CST ($)	779.61	1776.60	444.86	495.85	771.54	925.85
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1059.83	2003.32	725.08	736.07	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3198E 08	0.6639E 08	0.1866E 08	0.2491E 08	0.9614E 07	0.1382E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	132.73	275.55	77.44	103.40	197.19	283.60
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	987.56	2050.09	576.19	769.34	1219.23	1753.52
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1267.78	2276.81	856.41	1009.56	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2901E 08	0.6358E 08	0.1678E 08	0.2210E 08	0.8231E 07	0.1175E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	120.40	263.86	69.65	91.72	168.83	241.06
INS COST ($)	280.22	280.22	280.22	280.22	200.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	200.00	*********
TLEC CST ($)	895.82	1963.18	518.25	682.42	1043.88	1490.49
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1176.04	2189.90	798.47	922.64	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	NEW	22.0	66.0	50.0	OIL	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2524E 08	0.6001E 08	0.1440E 08	0.1853E 08	0.6084E 07	0.9126E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	104.78	249.07	59.79	76.92	124.78	187.17
INS COST ($)	280.22	280.22	280.22	280.22	237.00	*********
RET CR ($)	0.00	53.50	0.00	40.00	0.00	0.00
TOT COST ($)	280.22	226.72	280.22	240.22	237.00	*********
TLEC CST ($)	779.61	1853.09	444.86	572.33	771.54	1157.32
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1059.83	2079.81	725.08	812.55	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1978E 08	0.4245E 08	0.1177E 08	0.1177E 08	0.9614E 07	0.9218E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	405.70	870.81	241.54	241.54	197.19	189.06
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	2508.48	5384.24	1493.44	1493.44	1219.23	1169.01
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2618.72	5384.24	1493.44	1493.44	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1759E 08	0.4107E 08	0.1039E 08	0.1039E 08	0.8231E 07	0.7835E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	360.80	842.45	213.18	213.18	168.83	160.70
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	2230.84	5208.89	1318.09	1318.09	1043.88	993.66
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2341.08	5208.89	1318.09	1318.09	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1481E 08	0.3932E 08	0.8642E 07	0.8642E 07	0.6084E 07	0.6084E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.0000E 00	0.0000E 00
TAE COST ($)	303.92	806.53	177.25	177.25	124.78	124.78
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	1879.16	4986.78	1095.97	1095.97	771.54	771.54
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1989.40	4986.78	1095.97	1095.97	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1978E 08	0.4430E 08	0.1177E 08	0.1362E 08	0.9614E 07	0.1106E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	405.70	908.62	241.54	279.35	197.19	26.88
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	2508.48	5618.05	1493.44	1727.24	1219.23	1402.81
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2618.72	5618.05	1493.44	1727.24	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1759E 08	0.4264E 08	0.1039E 08	0.1196E 08	0.8231E 07	0.9402E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	360.80	874.59	213.18	245.32	168.83	192.85
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	2230.84	5407.62	1318.09	1516.82	1043.88	1192.39
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2341.08	5407.62	1318.09	1516.82	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1481E 08	0.4054E 08	0.8642E 07	0.9859E 07	0.6084E 07	0.7301E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.0000E 00	0.0000E 00
TAE COST ($)	303.92	831.49	177.25	202.21	124.78	149.74
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	1879.16	5141.09	1095.97	1250.28	771.54	925.85
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1989.40	5141.09	1095.97	1250.28	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1978E 08	0.4706E 08	0.1177E 08	0.1638E 08	0.9614E 07	0.1382E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	405.70	965.34	241.54	336.07	197.19	283.60
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	2508.48	5968.75	1493.44	2077.95	1219.23	1753.52
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2618.72	5968.75	1493.44	2077.95	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1759E 08	0.4499E 08	0.1039E 08	0.1431E 08	0.8231E 07	0.1175E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	360.80	922.80	213.18	293.53	168.83	241.06
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	2230.84	5705.72	1318.09	1814.92	1043.88	1490.49
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2341.08	5705.72	1318.09	1814.92	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 2 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1481E 08	0.4236E 08	0.8642E 07	0.1168E 08	0.6084E 07	0.9126E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.0000E 00	0.0000E 00
TAE COST ($)	303.92	868.92	177.25	239.64	124.78	187.17
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	1879.16	5372.55	1095.97	1481.75	771.54	1157.32
RPLC HTR ($)	110.23	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1989.40	5372.55	1095.97	1481.75	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3066E 08	0.5657E 08	0.1782E 08	0.1782E 08	0.9614E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	113.76	209.88	66.14	66.14	197.19	189.06
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	803.96	1483.24	467.41	467.41	1219.23	1169.01
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	931.95	1483.24	467.41	467.41	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2789E 08	0.5482E 08	0.1607E 08	0.1607E 08	0.8231E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	103.47	203.38	59.64	59.64	168.83	160.70
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	731.25	1437.32	421.48	421.48	1043.88	993.66
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	859.24	1437.32	421.48	421.48	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 2 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2437E 08	0.5260E 08	0.1385E 08	0.1385E 08	0.6084E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	90.44	195.15	51.41	51.41	124.78	124.78
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	639.15	1379.15	363.32	363.32	771.54	771.54
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	767.14	1379.15	363.32	363.32	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3066E 08	0.5890E 08	0.1782E 08	0.2016E 08	0.9614E 07	0.1106E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	113.76	218.54	66.14	74.80	197.19	226.88
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	803.96	1544.47	467.41	528.64	1219.23	1402.81
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	931.95	1544.47	467.41	528.64	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2789E 08	0.5680E 08	0.1607E 08	0.1806E 08	0.8231E 07	0.9402E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	103.47	210.74	59.64	67.00	168.83	192.85
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	731.25	1489.36	421.48	473.53	1043.88	1192.39
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	859.24	1489.36	421.48	473.53	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2437E 08	0.5414E 08	0.1385E 08	0.1539E 08	0.6084E 07	0.7301E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	90.44	200.87	51.41	57.12	124.78	149.74
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	639.15	1419.56	363.32	403.73	771.54	925.85
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	767.14	1419.56	363.32	403.73	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3066E 08	0.6241E 08	0.1782E 08	0.2366E 08	0.9614E 07	0.1382E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	113.76	231.54	66.14	87.80	197.19	283.60
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	803.96	1636.31	467.41	620.48	1219.23	1753.52
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	931.95	1636.31	467.41	620.48	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	50.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2789E 08	0.5978E 08	0.1607E 08	0.2103E 08	0.8231E 07	0.1175E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	103.47	221.79	59.64	78.05	168.83	241.06
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	731.25	1567.43	421.48	551.60	1043.88	1490.49
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	859.24	1567.43	421.48	551.60	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 2 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2437E 08	0.5645E 08	0.1385E 08	0.1771E 08	0.6084E 07	0.9126E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	90.44	209.44	51.41	65.70	124.78	187.17
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	639.15	1480.18	363.32	464.35	771.54	1157.32
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	767.14	1480.18	363.32	464.35	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3198E 08	0.6014E 08	0.1866E 08	0.1866E 08	0.9614E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	132.73	249.59	77.44	77.44	197.19	189.06
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	987.56	1856.95	576.19	576.19	1219.23	1169.01
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1115.54	1856.95	576.19	576.19	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	0.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2901E 08	0.5826E 08	0.1678E 08	0.1678E 08	0.8231E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	120.40	241.80	69.65	69.65	168.83	160.70
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	895.82	1799.01	518.25	518.25	1043.88	993.66
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1023.80	1799.01	518.25	518.25	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 2 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2524E 08	0.5588E 08	0.1440E 08	0.1440E 08	0.6084E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	104.78	231.93	59.79	59.79	124.78	124.78
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	779.61	1725.61	444.86	444.86	771.54	771.54
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	907.59	1725.61	444.86	444.86	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3198E 08	0.6264E 08	0.1866E 08	0.2116E 08	0.9614E 07	0.1106E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	132.73	259.97	77.44	87.82	197.19	226.88
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	987.56	1934.21	576.19	653.45	1219.23	1402.81
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1115.54	1934.21	576.19	653.45	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2901E 08	0.6039E 08	0.1678E 08	0.1891E 08	0.8231E 07	0.9402E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	120.40	250.62	69.65	78.48	168.83	192.85
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	895.82	1864.67	518.25	583.92	1043.88	1192.39
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1023.80	1864.67	518.25	583.92	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2524E 08	0.5753E 08	0.1440E 08	0.1605E 08	0.6084E 07	0.7301E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	104.78	238.79	59.79	66.64	124.78	149.74
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	779.61	1776.60	444.86	495.85	771.54	925.85
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	907.59	1776.60	444.86	495.85	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3198E 08	0.6639E 08	0.1866E 08	0.2491E 08	0.9614E 07	0.1382E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	132.73	275.55	77.44	103.40	197.19	283.60
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	987.56	2050.09	576.19	769.34	1219.23	1753.52
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1115.54	2050.09	576.19	769.34	1419.23	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2901E 08	0.6358E 08	0.1678E 08	0.2210E 08	0.8231E 07	0.1175E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	120.40	263.86	69.65	91.72	168.83	241.06
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	895.82	1963.18	518.25	682.42	1043.88	1490.49
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1023.80	1963.18	518.25	682.42	1243.88	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	2	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 2 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2524E 08	0.6001E 08	0.1440E 08	0.1853E 08	0.6084E 07	0.9126E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.0000E 00	0.0000E 00
TAE COST ($)	104.78	249.07	59.79	76.92	124.78	187.17
INS COST ($)	0.00	0.00	0.00	0.00	237.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	237.00	*********
TLEC CST ($)	779.61	1853.09	444.86	572.33	771.54	1157.32
RPLC HTR ($)	127.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	907.59	1853.09	444.86	572.33	1008.54	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1900E 08	0.3916E 08	0.1100E 08	0.1100E 08	0.8846E 07	0.8450E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	200.51	413.10	116.08	116.08	93.31	89.13
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1371.69	2826.07	794.12	794.12	638.33	609.75
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1609.83	3013.97	1032.26	995.26	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1693E 08	0.3789E 08	0.9737E 07	0.9737E 07	0.7578E 07	0.7182E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	178.63	399.73	102.71	102.71	79.94	75.76
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1222.03	2734.61	702.65	702.65	546.87	518.29
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1460.17	2922.51	940.79	903.79	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1430E 08	0.3629E 08	0.8132E 07	0.8132E 07	0.5973E 07	0.5577E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	150.92	382.80	85.77	85.77	63.00	58.82
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1032.45	2618.75	586.80	586.80	431.01	402.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1270.59	2806.65	824.94	787.94	631.01	*********

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1900E 08	0.4085E 08	0.1100E 08	0.1269E 08	0.8846E 07	0.1014E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	200.51	430.93	116.08	133.90	93.31	106.95
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1371.69	2948.02	794.12	916.07	638.33	731.70
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1609.83	3135.92	1032.26	1117.21	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1693E 08	0.3933E 08	0.9737E 07	0.1117E 08	0.7578E 07	0.8619E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	178.63	414.89	102.71	117.86	79.94	90.91
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1222.03	2838.27	702.65	806.31	546.87	621.95
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1460.17	3026.17	940.79	1007.45	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1430E 08	0.3740E 08	0.8132E 07	0.9247E 07	0.5973E 07	0.6692E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	150.92	394.56	85.77	97.54	63.00	70.59
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1032.45	2699.24	586.80	667.29	431.01	482.92
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1270.59	2887.14	824.94	868.43	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1900E 08	0.4339E 08	0.1100E 08	0.1523E 08	0.8846E 07	0.1267E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	200.51	457.67	116.08	160.64	93.31	133.69
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1371.69	3130.95	794.12	1099.00	638.33	914.63
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1609.83	3318.85	1032.26	1300.14	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1693E 08	0.4148E 08	0.9737E 07	0.1332E 08	0.7578E 07	0.1077E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	178.63	437.62	102.71	140.59	79.94	113.64
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1222.03	2993.76	702.65	961.80	546.87	777.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1460.17	3181.66	940.79	1162.94	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1430E 08	0.3908E 08	0.8132E 07	0.1092E 08	0.5973E 07	0.8365E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	150.92	412.21	85.77	115.19	63.00	88.24
INS COST ($)	238.14	238.14	238.14	238.14	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	238.14	187.90	238.14	201.14	200.00	*********
TLEC CST ($)	1032.45	2819.97	586.80	788.02	431.01	603.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1270.59	3007.87	824.94	989.16	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2968E 08	0.5240E 08	0.1685E 08	0.1685E 08	0.8846E 07	0.8450E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	69.17	122.09	39.26	39.26	93.31	89.13
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	645.03	1138.55	366.12	366.12	638.33	609.75
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	913.62	1356.90	634.71	597.71	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2706E 08	0.5079E 08	0.1524E 08	0.1524E 08	0.7578E 07	0.7182E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	63.05	118.35	35.52	35.52	79.94	75.76
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	587.94	1103.66	331.24	331.24	546.87	518.29
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	856.53	1322.01	599.83	562.83	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2373E 08	0.4876E 08	0.1321E 08	0.1321E 08	0.5973E 07	0.5577E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	55.29	113.61	30.78	30.78	63.00	58.82
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	515.64	1059.48	287.05	287.05	431.01	402.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	784.23	1277.83	555.64	518.64	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2968E 08	0.5454E 08	0.1685E 08	0.1899E 08	0.8846E 07	0.1014E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	69.17	127.08	39.26	44.25	93.31	106.95
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	645.03	1185.06	366.12	412.64	638.33	731.70
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	913.62	1403.41	634.71	644.23	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2706E 08	0.5261E 08	0.1524E 08	0.1706E 08	0.7578E 07	0.8619E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	63.05	122.59	35.52	39.76	79.94	90.91
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	587.94	1143.20	331.24	370.77	546.87	621.95
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	856.53	1361.55	599.83	602.36	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2373E 08	0.5017E 08	0.1321E 08	0.1462E 08	0.5973E 07	0.6692E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	55.29	116.90	30.78	34.07	63.00	70.59
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	515.64	1090.17	287.05	317.75	431.01	482.92
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	784.23	1308.52	555.64	549.34	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2968E 08	0.5775E 08	0.1685E 08	0.2220E 08	0.8846E 07	0.1267E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	69.17	134.56	39.26	51.73	93.31	133.69
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	645.03	1254.83	366.12	482.40	638.33	914.63
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	913.62	1473.18	634.71	713.99	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2706E 08	0.5534E 08	0.1524E 08	0.1979E 08	0.7578E 07	0.1077E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	63.05	128.95	35.52	46.12	79.94	113.64
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	587.94	1202.50	331.24	430.08	546.87	777.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	856.53	1420.85	599.83	661.67	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2373E 08	0.5229E 08	0.1321E 08	0.1674E 08	0.5973E 07	0.8365E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	55.29	121.84	30.78	39.01	63.00	88.24
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	515.64	1136.22	287.05	363.80	431.01	603.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	784.23	1354.57	555.64	595.39	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	0.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3093E 08	0.5567E 08	0.1761E 08	0.1761E 08	0.8846E 07	0.8450E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	119.55	215.14	68.07	68.07	93.31	89.13
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	902.29	1623.68	513.74	513.74	638.33	609.75
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1170.88	1842.03	782.33	745.33	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	0.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2812E 08	0.5395E 08	0.1589E 08	0.1589E 08	0.7578E 07	0.7182E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	108.67	208.49	61.42	61.42	79.94	75.76
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	820.20	1573.51	463.57	463.57	546.87	518.29
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1088.79	1791.86	732.16	695.16	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	0.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2455E 08	0.5177E 08	0.1371E 08	0.1371E 08	0.5973E 07	0.5577E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	94.90	200.07	53.00	53.00	63.00	58.82
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	716.21	1509.96	400.02	400.02	431.01	402.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	984.80	1728.31	668.61	631.61	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3093E 08	0.5796E 08	0.1761E 08	0.1990E 08	0.8846E 07	0.1014E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	119.55	224.00	68.07	76.93	93.31	106.95
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	902.29	1690.57	513.74	580.63	638.37	731.70
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.[illegible]	0.00
TLC COST ($)	1170.88	1908.92	782.33	812.22	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2812E 08	0.5590E 08	0.1589E 08	0.1784E 08	0.7578E 07	0.8619E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	108.67	216.02	61.42	68.95	79.94	90.91
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	820.20	1630.36	463.57	520.43	546.87	621.95
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1088.79	1848.71	732.16	752.02	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2455E 08	0.5328E 08	0.1371E 08	0.1523E 08	0.5973E 07	0.6692E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	94.90	205.92	53.00	58.85	63.00	70.59
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	716.21	1554.11	400.02	444.17	431.01	482.92
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	984.80	1772.46	668.61	675.76	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	100.0	100.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3093E 08	0.6140E 08	0.1761E 08	0.2334E 08	0.8846E 07	0.1267E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	119.55	237.30	68.07	90.23	93.31	133.69
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	902.29	1790.90	513.74	680.97	638.33	914.63
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1170.88	2009.25	782.33	912.56	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	50.0	85.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2812E 08	0.5882E 08	0.1589E 08	0.2076E 08	0.7578E 07	0.1077E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	108.67	227.32	61.42	80.25	79.94	113.64
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	820.20	1715.65	463.57	605.71	546.87	777.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1088.79	1934.00	732.16	837.30	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	NEW	22.0	66.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2455E 08	0.5555E 08	0.1371E 08	0.1750E 08	0.5973E 07	0.8365E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	94.90	214.69	53.00	67.62	63.00	88.24
INS COST ($)	268.59	268.59	268.59	268.59	200.00	*********
RET CR ($)	0.00	50.24	0.00	37.00	0.00	0.00
TOT COST ($)	268.59	218.35	268.59	231.58	200.00	*********
TLEC CST ($)	716.21	1620.33	400.02	510.39	431.01	603.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	984.80	1838.68	668.61	741.98	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1900E 08	0.3916E 08	0.1100E 08	0.1100E 08	0.8846E 07	0.8450E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	200.51	413.10	116.08	116.08	93.31	89.13
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1371.69	2826.07	794.12	794.12	638.33	609.75
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1477.76	2826.07	794.12	794.12	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1693E 08	0.3789E 08	0.9737E 07	0.9737E 07	0.7578E 07	0.7182E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	178.63	399.73	102.71	102.71	79.94	75.76
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1222.03	2734.61	702.65	702.65	546.87	518.29
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1328.10	2734.61	702.65	702.65	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1430E 08	0.3629E 08	0.8132E 07	0.8132E 07	0.5973E 07	0.5577E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	150.92	382.80	85.77	85.77	63.00	58.82
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1032.45	2618.75	586.80	586.80	431.01	402.43
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1138.52	2618.75	586.80	586.80	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1900E 08	0.4085E 08	0.1100E 08	0.1269E 08	0.8846E 07	0.1014E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	200.51	430.93	116.08	133.90	93.31	106.95
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1371.69	2948.02	794.12	916.07	638.33	731.70
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1477.76	2948.02	794.12	916.07	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1693E 08	0.3933E 08	0.9737E 07	0.1117E 08	0.7578E 07	0.8619E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	178.63	414.89	102.71	117.86	79.94	90.91
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1222.03	2838.27	702.65	806.31	546.87	621.95
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1328.10	2838.27	702.65	806.31	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1430E 08	0.3740E 08	0.8132E 07	0.9247E 07	0.5973E 07	0.6692E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	150.92	394.56	85.77	97.54	63.00	70.59
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1032.45	2699.24	586.80	667.29	431.01	482.92
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1138.52	2699.24	586.80	667.29	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1900E 08	0.4339E 08	0.1100E 08	0.1523E 08	0.8846E 07	0.1267E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	200.51	457.67	116.08	160.64	93.31	133.69
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1371.69	3130.95	794.12	1099.00	638.33	914.63
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1477.76	3130.95	794.12	1099.00	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1693E 08	0.4148E 08	0.9737E 07	0.1332E 08	0.7578E 07	0.1077E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	178.63	437.62	102.71	140.59	79.94	113.64
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1222.03	2993.76	702.65	961.80	546.87	777.43
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1328.10	2993.76	702.65	961.80	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1430E 08	0.3908E 08	0.8132E 07	0.1092E 08	0.5973E 07	0.8365E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	150.92	412.21	85.77	115.19	63.00	88.24
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	1032.45	2819.97	586.80	788.02	431.01	603.65
RPLC HTR ($)	106.06	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1138.52	2819.97	586.80	788.02	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2968E 08	0.5240E 08	0.1685E 08	0.1685E 08	0.8846E 07	0.8450E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	69.17	122.09	39.26	39.26	93.31	89.13
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	645.03	1138.55	366.12	366.12	638.33	609.75
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	768.28	1138.55	366.12	366.12	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2706E 08	0.5079E 08	0.1524E 08	0.1524E 08	0.7578E 07	0.7182E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	63.05	118.35	35.52	35.52	79.94	75.76
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	587.94	1103.66	331.24	331.24	546.87	518.29
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	711.20	1103.66	331.24	331.24	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2373E 08	0.4876E 08	0.1321E 08	0.1321E 08	0.5973E 07	0.5577E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	55.29	113.61	30.78	30.78	63.00	58.82
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	515.64	1059.48	287.05	287.05	431.01	402.43
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	638.90	1059.48	287.05	287.05	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2968E 08	0.5454E 08	0.1685E 08	0.1899E 08	0.8846E 07	0.1014E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	69.17	127.08	39.26	44.25	93.31	106.95
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	645.03	1185.06	366.12	412.64	638.33	731.70
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	768.28	1185.06	366.12	412.64	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	20.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2706E 08	0.5261E 08	0.1524E 08	0.1706E 08	0.7578E 07	0.8619E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	63.05	122.59	35.52	39.76	79.94	90.91
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	587.94	1143.20	331.24	370.77	546.87	621.95
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	711.20	1143.20	331.24	370.77	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2373E 08	0.5017E 08	0.1321E 08	0.1462E 08	0.5973E 07	0.6692E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	55.29	116.90	30.78	34.07	63.00	70.59
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	515.64	1090.17	287.05	317.75	431.01	482.92
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	638.90	1090.17	287.05	317.75	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2968E 08	0.5775E 08	0.1685E 08	0.2220E 08	0.8846E 07	0.1267E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	69.17	134.56	39.26	51.73	93.31	133.69
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	645.03	1254.83	366.12	482.40	638.33	914.63
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	768.28	1254.83	366.12	482.40	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2706E 08	0.5534E 08	0.1524E 08	0.1979E 08	0.7578E 07	0.1077E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	63.05	128.95	35.52	46.12	79.94	113.64
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	587.94	1202.50	331.24	430.08	546.87	777.43
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	711.20	1202.50	331.24	430.08	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2373E 08	0.5229E 08	0.1321E 08	0.1674E 08	0.5973E 07	0.8365E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	55.29	121.84	30.78	39.01	63.00	88.24
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	515.64	1136.22	287.05	363.80	431.01	603.65
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	638.90	1136.22	287.05	363.80	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.3093E 08	0.5567E 08	0.1761E 08	0.1761E 08	0.8846E 07	0.8450E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	119.55	215.14	68.07	68.07	93.31	89.13
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	902.29	1623.68	513.74	513.74	638.33	609.75
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1025.55	1623.68	513.74	513.74	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.2812E 08	0.5395E 08	0.1589E 08	0.1589E 08	0.7578E 07	0.7182E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	108.67	208.49	61.42	61.42	79.94	75.76
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	820.20	1573.51	463.57	463.57	546.87	518.29
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	943.45	1573.51	463.57	463.57	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.2455E 08	0.5177E 08	0.1371E 08	0.1371E 08	0.5973E 07	0.5577E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	94.90	200.07	53.00	53.00	63.00	58.82
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	716.21	1509.96	400.02	400.02	431.01	402.43
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	839.47	1509.96	400.02	400.02	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3093E 08	0.5796E 08	0.1761E 08	0.1990E 08	0.8846E 07	0.1014E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	119.55	224.00	68.07	76.93	93.31	106.95
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	902.29	1690.57	513.74	580.63	638.33	731.70
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1025.55	1690.57	513.74	580.63	838.33	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2812E 08	0.5590E 08	0.1589E 08	0.1784E 08	0.7578E 07	0.8619E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	108.67	216.02	61.42	68.95	79.94	90.91
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	820.20	1630.36	463.57	520.43	546.87	621.95
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	943.45	1630.36	463.57	520.43	746.87	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2455E 08	0.5328E 08	0.1371E 08	0.1523E 08	0.5973E 07	0.6692E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	94.90	205.92	53.00	58.85	63.00	70.59
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	716.21	1554.11	400.02	444.17	431.01	482.92
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	839.47	1554.11	400.02	444.17	631.01	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3093E 08	0.6140E 08	0.1761E 08	0.2334E 08	0.8846E 07	0.1267E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	119.55	237.30	68.07	90.23	93.31	133.69
INS COST ($)	0.00	0.00	0.00	0.00	200.00	**********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	**********
TLEC CST ($)	902.29	1790.90	513.74	680.97	638.33	914.63
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1025.55	1790.90	513.74	680.97	838.33	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2812E 08	0.5882E 08	0.1589E 08	0.2076E 08	0.7578E 07	0.1077E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	108.67	227.32	61.42	80.25	79.94	113.64
INS COST ($)	0.00	0.00	0.00	0.00	200.00	**********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	**********
TLEC CST ($)	820.20	1715.65	463.57	605.71	546.87	777.43
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	943.45	1715.65	463.57	605.71	746.87	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	8	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2455E 08	0.5555E 08	0.1371E 08	0.1750E 08	0.5973E 07	0.8365E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	94.90	214.69	53.00	67.62	63.00	88.24
INS COST ($)	0.00	0.00	0.00	0.00	200.00	**********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	**********
TLEC CST ($)	716.21	1620.33	400.02	510.39	431.01	603.65
RPLC HTR ($)	123.25	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	839.47	1620.33	400.02	510.39	631.01	**********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1823E 08	0.3587E 08	0.1023E 08	0.1023E 08	0.8078E 07	0.7682E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.56	231.22	65.96	65.96	52.07	49.51
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	776.02	1526.32	435.44	435.44	343.72	326.86
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1072.07	1754.40	731.49	686.49	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1627E 08	0.3471E 08	0.9081E 07	0.9081E 07	0.6925E 07	0.6529E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	104.93	223.79	58.53	58.53	44.64	42.09
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	692.67	1477.29	386.41	386.41	294.69	277.83
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	988.72	1705.37	682.46	637.46	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1379E 08	0.3325E 08	0.7621E 07	0.7621E 07	0.5466E 07	0.5070E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	88.94	214.38	49.13	49.13	35.23	32.68
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	587.09	1415.18	324.30	324.30	232.58	215.73
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	883.14	1643.26	620.35	575.35	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1823E 08	0.3740E 08	0.1023E 08	0.1177E 08	0.8078E 07	0.9218E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.56	241.12	65.96	75.86	52.07	59.42
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	776.02	1591.69	435.44	500.81	343.72	392.24
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1072.07	1819.77	731.49	751.86	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1627E 08	0.3602E 08	0.9081E 07	0.1038E 08	0.6925E 07	0.7835E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	104.93	232.21	58.53	66.95	44.64	50.50
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	692.67	1532.86	386.41	441.98	294.69	333.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	988.72	1760.93	682.46	693.03	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1379E 08	0.3427E 08	0.7621E 07	0.8635E 07	0.5466E 07	0.6084E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	88.94	220.92	49.13	55.66	35.23	39.21
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	587.09	1458.33	324.30	367.45	232.58	258.88
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	883.14	1686.41	620.35	618.50	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1823E 08	0.3971E 08	0.1023E 08	0.1407E 08	0.8078E 07	0.1152E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.56	255.98	65.96	90.72	52.07	74.27
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	776.02	1689.75	435.44	598.87	343.72	490.30
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1072.07	1917.83	731.49	849.92	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1627E 08	0.3798E 08	0.9081E 07	0.1234E 08	0.6925E 07	0.9794E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	104.93	244.84	58.53	79.58	44.64	63.13
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	692.67	1616.21	386.41	525.33	294.69	416.75
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	988.72	1844.29	682.46	776.38	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1379E 08	0.3579E 08	0.7621E 07	0.1015E 08	0.5466E 07	0.7605E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	88.94	230.73	49.13	65.47	35.23	49.02
INS COST ($)	296.04	296.04	296.04	296.04	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	296.04	228.08	296.04	251.04	200.00	*********
TLEC CST ($)	587.09	1523.05	324.30	432.17	232.58	323.60
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	883.14	1751.13	620.35	683.22	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2871E 08	0.4823E 08	0.1587E 08	0.1587E 08	0.8078E 07	0.7682E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	100.48	168.81	55.56	55.56	52.07	49.51
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	798.89	1342.04	441.71	441.71	343.72	326.86
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1130.78	1605.96	773.60	728.60	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2622E 08	0.4677E 08	0.1441E 08	0.1441E 08	0.6925E 07	0.6529E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	91.80	163.70	50.45	50.45	44.64	42.09
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	729.84	1301.43	401.10	401.10	294.69	277.83
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1061.73	1565.35	732.99	687.99	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2308E 08	0.4492E 08	0.1256E 08	0.1256E 08	0.5466E 07	0.5070E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	80.80	157.23	43.98	43.98	35.23	32.68
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	642.39	1249.99	349.65	349.65	232.58	215.73
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	974.28	1513.91	681.54	636.54	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2871E 08	0.5017E 08	0.1587E 08	0.1782E 08	0.8078E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	100.48	175.62	55.56	62.37	52.07	59.42
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	798.89	1396.19	441.71	495.86	343.72	392.24
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1130.78	1660.11	773.60	782.75	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2622E 08	0.4842E 08	0.1441E 08	0.1606E 08	0.6925E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	91.80	169.49	50.45	56.24	44.64	50.50
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	729.84	1347.46	401.10	447.13	294.69	333.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1061.73	1611.38	732.99	734.02	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2308E 08	0.4620E 08	0.1256E 08	0.1385E 08	0.5466E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	80.80	161.72	43.98	48.47	35.23	39.21
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	642.39	1285.73	349.65	385.39	232.58	258.88
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	974.28	1549.65	681.54	672.28	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2871E 08	0.5309E 08	0.1587E 08	0.2074E 08	0.8078E 07	0.1152E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	100.48	185.83	55.56	72.59	52.07	74.27
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	798.89	1477.42	441.71	577.09	343.72	490.30
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1130.78	1741.34	773.60	863.98	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2622E 08	0.5090E 08	0.1441E 08	0.1855E 08	0.6925E 07	0.9794E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	91.80	178.17	50.45	64.92	44.64	63.13
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	729.84	1416.50	401.10	516.17	294.69	416.75
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1061.73	1680.42	732.99	803.06	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2308E 08	0.4813E 08	0.1256E 08	0.1577E 08	0.5466E 07	0.7605E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	80.80	168.47	43.98	55.22	35.23	49.02
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	642.39	1339.34	349.65	439.00	232.58	323.60
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	974.28	1603.26	681.54	725.89	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMUL[illegible]N RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2989E 08	0.5120E 08	0.1656E 08	0.1656E 08	0.8078E 07	0.7682E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.43	201.16	65.09	65.09	52.07	49.51
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	875.14	1499.11	485.09	485.09	343.72	326.86
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1207.03	1763.03	816.98	771.98	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2723E 08	0.4964E 08	0.1500E 08	0.1500E 08	0.6925E 07	0.6529E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	106.99	195.02	58.95	58.95	44.64	42.09
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	797.30	1453.33	439.31	439.31	294.69	277.83
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1129.19	1717.25	771.20	726.20	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2386E 08	0.4766E 08	0.1302E 08	0.1302E 08	0.5466E 07	0.5070E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	93.76	187.24	51.17	51.17	35.23	32.68
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	698.72	1395.34	381.32	381.32	232.58	215.73
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1030.61	1659.26	713.21	668.21	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2989E 08	0.5329E 08	0.1656E 08	0.1865E 08	0.8078E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.43	209.36	65.09	73.28	52.07	59.42
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	875.14	1560.16	485.09	546.13	343.72	392.24
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1207.03	1824.08	816.98	833.02	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2723E 08	0.5141E 08	0.1500E 08	0.1677E 08	0.6925E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	106.99	201.98	58.95	65.91	44.64	50.50
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	797.30	1505.22	439.31	491.19	294.69	333.40
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1129.19	1769.14	771.20	778.08	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2386E 08	0.4903E 08	0.1302E 08	0.1440E 08	0.5466E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	93.76	192.65	51.17	56.57	35.23	39.21
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	698.72	1435.63	381.32	421.60	232.58	258.88
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1030.61	1699.55	713.21	708.49	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2989E 08	0.5641E 08	0.1656E 08	0.2178E 08	0.8078E 07	0.1152E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.43	221.64	65.09	85.57	52.07	74.27
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	875.14	1651.72	485.09	637.70	343.72	490.30
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1207.03	1915.64	816.98	924.59	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2723E 08	0.5407E 08	0.1500E 08	0.1943E 08	0.6925E 07	0.9794E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	106.99	212.43	58.95	76.35	44.64	63.13
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	797.30	1583.05	439.31	569.03	294.69	416.75
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1129.19	1846.97	771.20	855.92	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	NEW	22.0	66.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2386E 08	0.5110E 08	0.1302E 08	0.1646E 08	0.5466E 07	0.7605E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	93.76	200.76	51.17	64.68	35.23	49.02
INS COST ($)	331.89	331.89	331.89	331.89	200.00	*********
RET CR ($)	0.00	67.97	0.00	45.00	0.00	0.00
TOT COST ($)	331.89	263.92	331.89	286.89	200.00	*********
TLEC CST ($)	698.72	1496.06	381.32	482.04	232.58	323.60
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1030.61	1759.98	713.21	768.93	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1823E 08	0.3587E 08	0.1023E 08	0.1023E 08	0.8078E 07	0.7682E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.56	231.22	65.96	65.96	52.07	49.51
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	776.02	1526.32	435.44	435.44	343.72	326.86
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	904.77	1526.32	435.44	435.44	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1627E 08	0.3471E 08	0.9081E 07	0.9081E 07	0.6925E 07	0.6529E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	104.93	223.79	58.53	58.53	44.64	42.09
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	692.67	1477.29	386.41	386.41	294.69	277.83
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	821.42	1477.29	386.41	386.41	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1379E 08	0.3325E 08	0.7621E 07	0.7621E 07	0.5466E 07	0.5070E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	88.94	214.38	49.13	49.13	35.23	32.68
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	587.09	1415.18	324.30	324.30	232.58	215.73
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	715.84	1415.18	324.30	324.30	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1823E 08	0.3740E 08	0.1023E 08	0.1177E 08	0.8078E 07	0.9218E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.56	241.12	65.96	75.86	52.07	59.42
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	776.02	1591.69	435.44	500.81	343.72	392.24
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	904.77	1591.69	435.44	500.81	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1627E 08	0.3602E 08	0.9081E 07	0.1038E 08	0.6925E 07	0.7835E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	104.93	232.21	58.53	66.95	44.64	50.50
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	692.67	1532.86	386.41	441.98	294.69	333.40
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	821.42	1532.86	386.41	441.98	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1379E 08	0.3427E 08	0.7621E 07	0.8635E 07	0.5466E 07	0.6084E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	88.94	220.92	49.13	55.66	35.23	39.21
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	587.09	1458.33	324.30	367.45	232.58	258.88
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	715.84	1458.33	324.30	367.45	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1823E 08	0.3971E 08	0.1023E 08	0.1407E 08	0.8078E 07	0.1152E 08
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.56	255.98	65.96	90.72	52.07	74.27
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	776.02	1689.75	435.44	598.87	343.72	490.30
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	904.77	1689.75	435.44	598.87	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1627E 08	0.3798E 08	0.9081E 07	0.1234E 08	0.6925E 07	0.9794E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	104.93	244.84	58.53	79.58	44.64	63.13
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	692.67	1616.21	386.41	525.33	294.69	416.75
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	821.42	1616.21	386.41	525.33	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1379E 08	0.3579E 08	0.7621E 07	0.1015E 08	0.5466E 07	0.7605E 07
ASH CTR (BTU)	0.5169E 07	0.2977E 07	0.2543E 07	0.2543E 07	0.3960E 06	0.0000E 00
TAE COST ($)	88.94	230.73	49.13	65.47	35.23	49.02
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	587.09	1523.05	324.30	432.17	232.58	323.60
RPLC HTR ($)	128.75	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	715.84	1523.05	324.30	432.17	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2871E 08	0.4823E 08	0.1587E 08	0.1587E 08	0.8078E 07	0.7682E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	100.48	168.81	55.56	55.56	52.07	49.51
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	798.89	1342.04	441.71	441.71	343.72	326.86
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	947.87	1342.04	441.71	441.71	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2622E 08	0.4677E 08	0.1441E 08	0.1441E 08	0.6925E 07	0.6529E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	91.80	163.70	50.45	50.45	44.64	42.09
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	729.84	1301.43	401.10	401.10	294.69	277.83
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	878.83	1301.43	401.10	401.10	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2308E 08	0.4492E 08	0.1256E 08	0.1256E 08	0.5466E 07	0.5070E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	80.80	157.23	43.98	43.98	35.23	32.68
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	642.39	1249.99	349.65	349.65	232.58	215.73
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	791.37	1249.99	349.65	349.65	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 4 1

- - - - - - - - - - - SUPPLY SYSTEM MODEL- - - - - - - - -

	1	2	3	4	5	6
TAE USE (BTU)	0.2871E 08	0.5017E 08	0.1587E 08	0.1782E 08	0.8078E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	100.48	175.62	55.56	62.37	52.07	59.42
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	798.89	1396.19	441.71	495.86	343.72	392.24
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	947.87	1396.19	441.71	495.86	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	20.0	GAS	0 0 0 0 4 1

- - - - - - - - - - - SUPPLY SYSTEM MODEL- - - - - - - - -

	1	2	3	4	5	6
TAE USE (BTU)	0.2622E 08	0.4842E 08	0.1441E 08	0.1606E 08	0.6925E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	91.80	169.49	50.45	56.24	44.64	50.50
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	729.84	1347.46	401.10	447.13	294.69	333.40
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	878.83	1347.46	401.10	447.13	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 4 1

- - - - - - - - - - - SUPPLY SYSTEM MODEL- - - - - - - - -

	1	2	3	4	5	6
TAE USE (BTU)	0.2308E 08	0.4620E 08	0.1256E 08	0.1385E 08	0.5466E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	80.80	161.72	43.98	48.47	35.23	39.21
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	642.39	1285.73	349.65	385.39	232.58	258.88
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	791.37	1285.73	349.65	385.39	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2871E 08	0.5309E 08	0.1587E 08	0.2074E 08	0.8078E 07	0.1152E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	100.48	185.83	55.56	72.59	52.07	74.27
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	798.89	1477.42	441.71	577.09	343.72	490.30
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	947.87	1477.42	441.71	577.09	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2622E 08	0.5090E 08	0.1441E 08	0.1855E 08	0.6925E 07	0.9794E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	91.80	178.17	50.45	64.92	44.64	63.13
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	729.84	1416.50	401.10	516.17	294.69	416.75
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	878.83	1416.50	401.10	516.17	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2308E 08	0.4813E 08	0.1256E 08	0.1577E 08	0.5466E 07	0.7605E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	80.80	168.47	43.98	55.22	35.23	49.02
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	642.39	1339.34	349.65	439.00	232.58	323.60
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	791.37	1339.34	349.65	439.00	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2989E 08	0.5120E 08	0.1656E 08	0.1656E 08	0.8078E 07	0.7682E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.43	201.16	65.09	65.09	52.07	49.51
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	875.14	1499.11	485.09	485.09	343.72	326.86
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1024.12	1499.11	485.09	485.09	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2723E 08	0.4964E 08	0.1500E 08	0.1500E 08	0.6925E 07	0.6529E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	106.99	195.02	58.95	58.95	44.64	42.09
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	797.30	1453.33	439.31	439.31	294.69	277.83
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	946.29	1453.33	439.31	439.31	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2386E 08	0.4766E 08	0.1302E 08	0.1302E 08	0.5466E 07	0.5070E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	93.76	187.24	51.17	51.17	35.23	32.68
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	698.72	1395.34	381.32	381.32	232.58	215.73
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	847.70	1395.34	381.32	381.32	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.2989E 08	0.5329E 08	0.1656E 08	0.1865E 08	0.8078E 07	0.9218E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.43	209.36	65.09	73.28	52.07	59.42
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	875.14	1560.16	485.09	546.13	343.72	392.24
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1024.12	1560.16	485.09	546.13	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.2723E 08	0.5141E 08	0.1500E 08	0.1677E 08	0.6925E 07	0.7835E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	106.99	201.98	58.95	65.91	44.64	50.50
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	797.30	1505.22	439.31	491.19	294.69	333.40
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	946.29	1505.22	439.31	491.19	494.69	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.2386E 08	0.4903E 08	0.1302E 08	0.1440E 08	0.5466E 07	0.6084E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	93.76	192.65	51.17	56.57	35.23	39.21
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	698.72	1435.63	381.32	421.60	232.58	258.88
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	847.70	1435.63	381.32	421.60	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2989E 08	0.5641E 08	0.1656E 08	0.2178E 08	0.8078E 07	0.1152E 08
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	117.43	221.64	65.09	85.57	52.07	74.27
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	875.14	1651.72	485.09	637.70	343.72	490.30
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1024.12	1651.72	485.09	637.70	543.72	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	50.0	85.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2723E 08	0.5407E 08	0.1500E 08	0.1943E 08	0.6925E 07	0.9794E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	106.99	212.43	58.95	76.35	44.64	63.13
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	797.30	1583.05	439.31	569.03	294.69	416.75
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	946.29	1583.05	439.31	569.03	494.69	*********

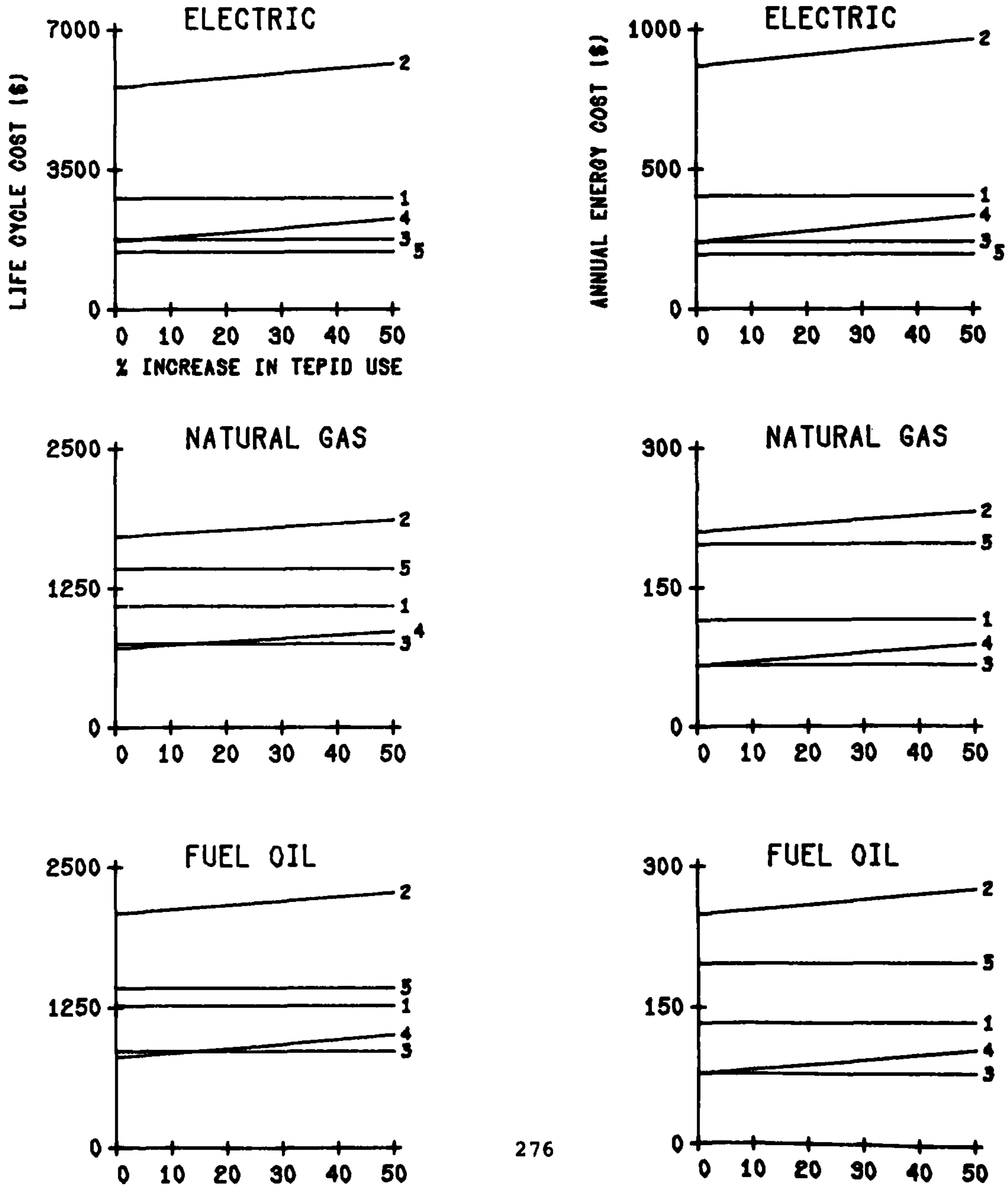
BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
4	10	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2386E 08	0.5110E 08	0.1302E 08	0.1646E 08	0.5466E 07	0.7605E 07
ASH CTR (BTU)	0.1216E 08	0.6570E 07	0.6135E 07	0.6135E 07	0.3960E 06	0.0000E 00
TAE COST ($)	93.76	200.76	51.17	64.68	35.23	49.02
INS COST ($)	0.00	0.00	0.00	0.00	200.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	200.00	*********
TLEC CST ($)	698.72	1496.06	381.32	482.04	232.58	323.60
RPLC HTR ($)	148.98	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	847.70	1496.06	381.32	482.04	432.58	*********

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	2	100.00	100.00

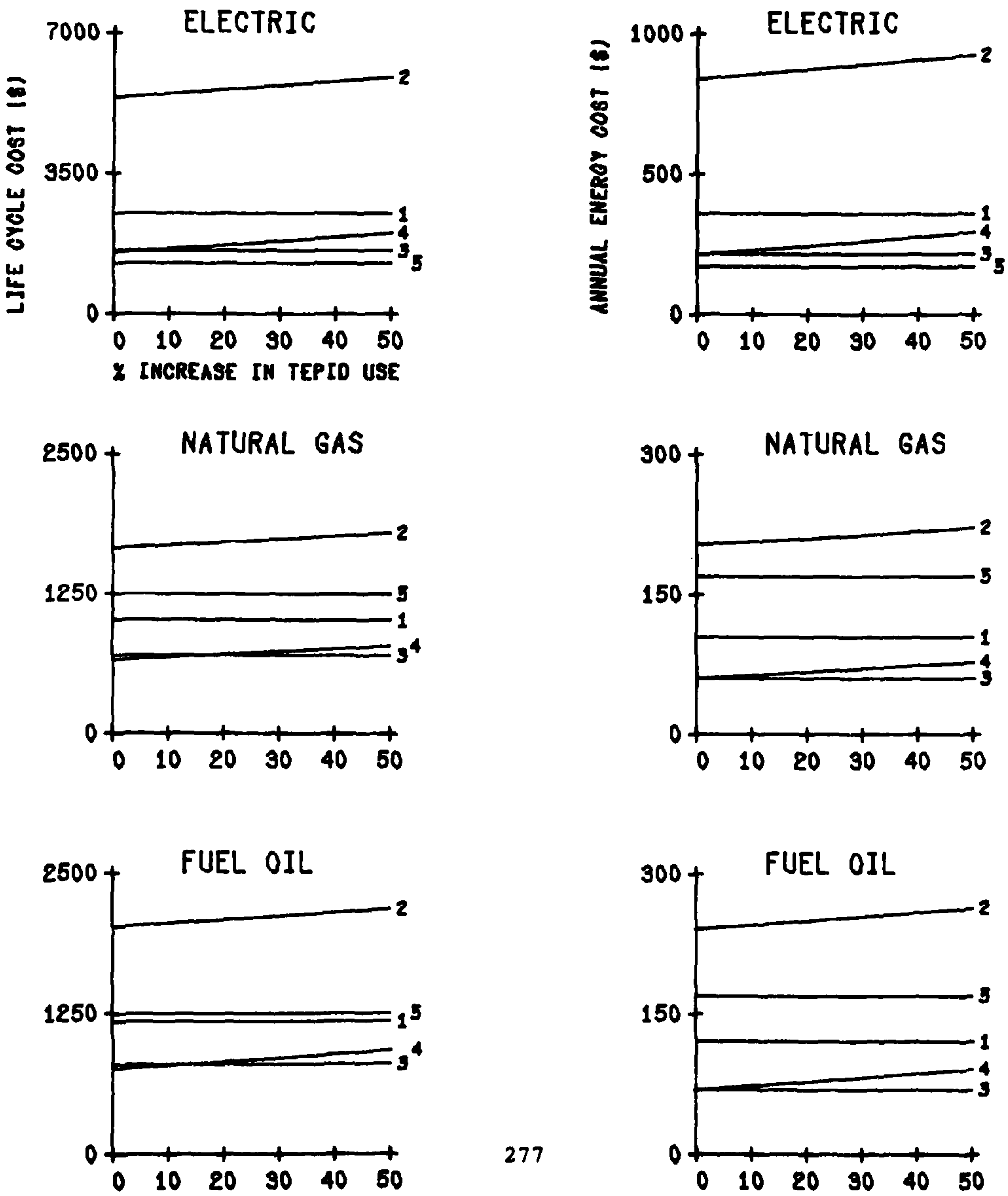
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	2	50.00	85.00

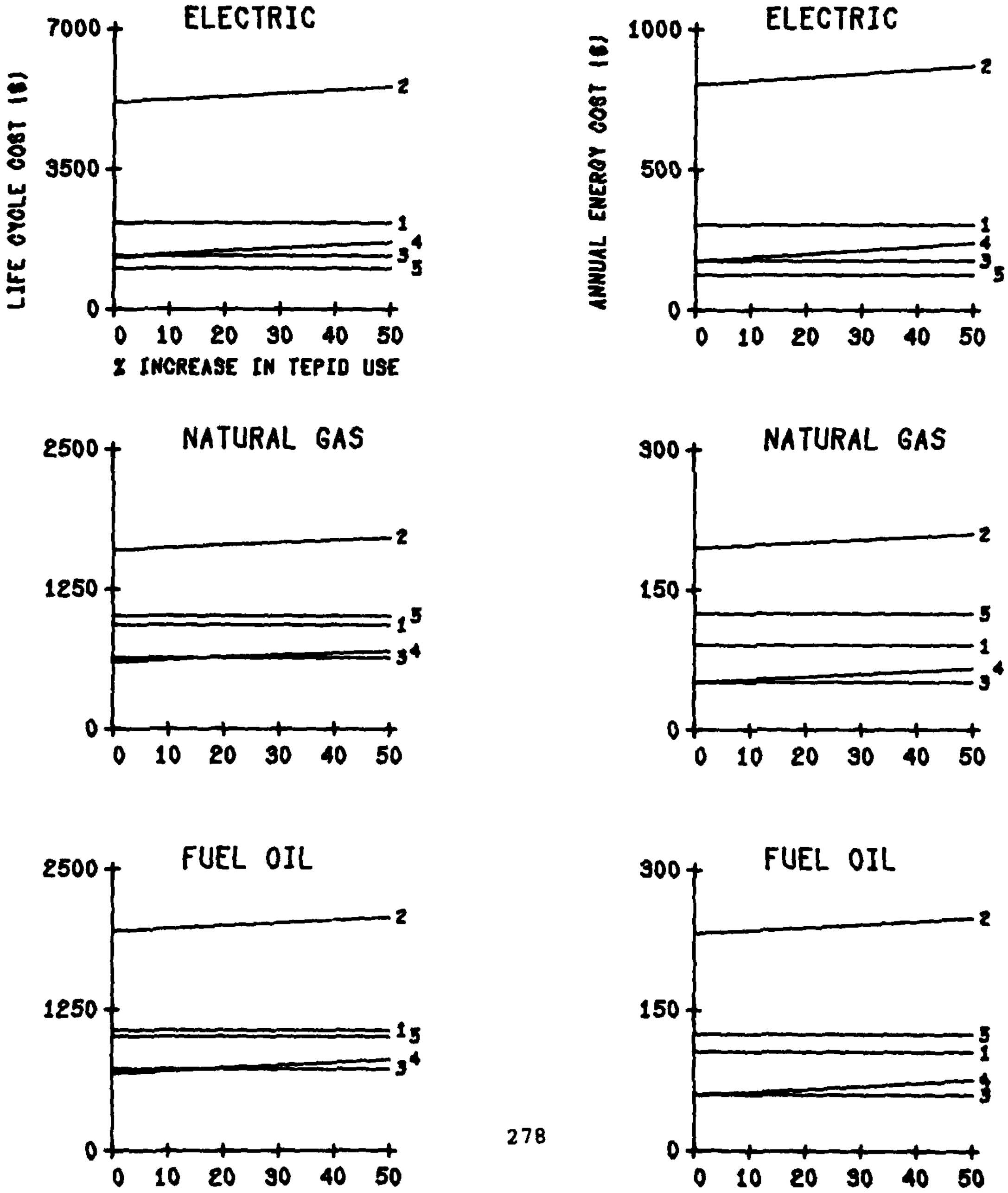
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	2	22.00	66.00

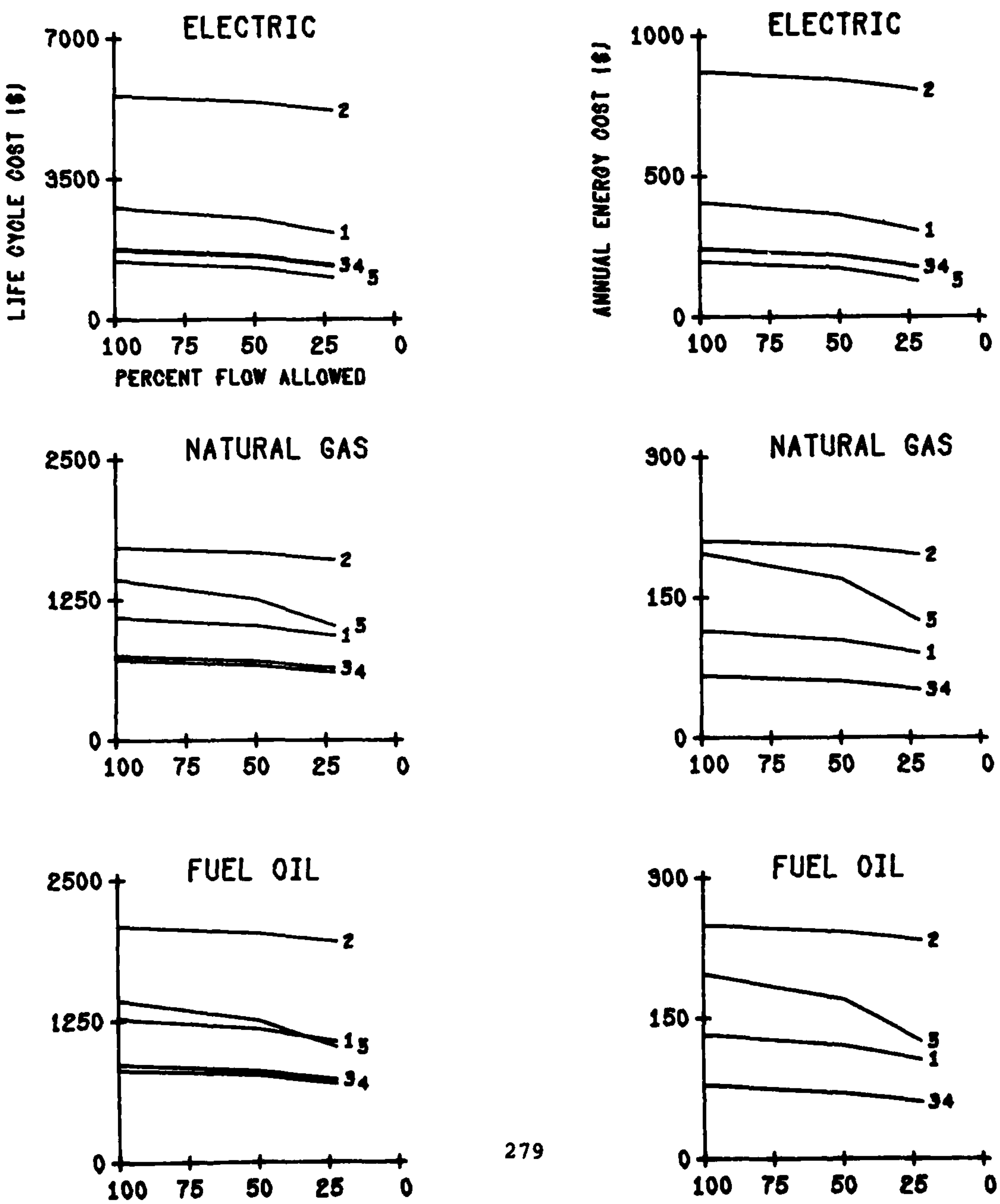
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	2	0.00

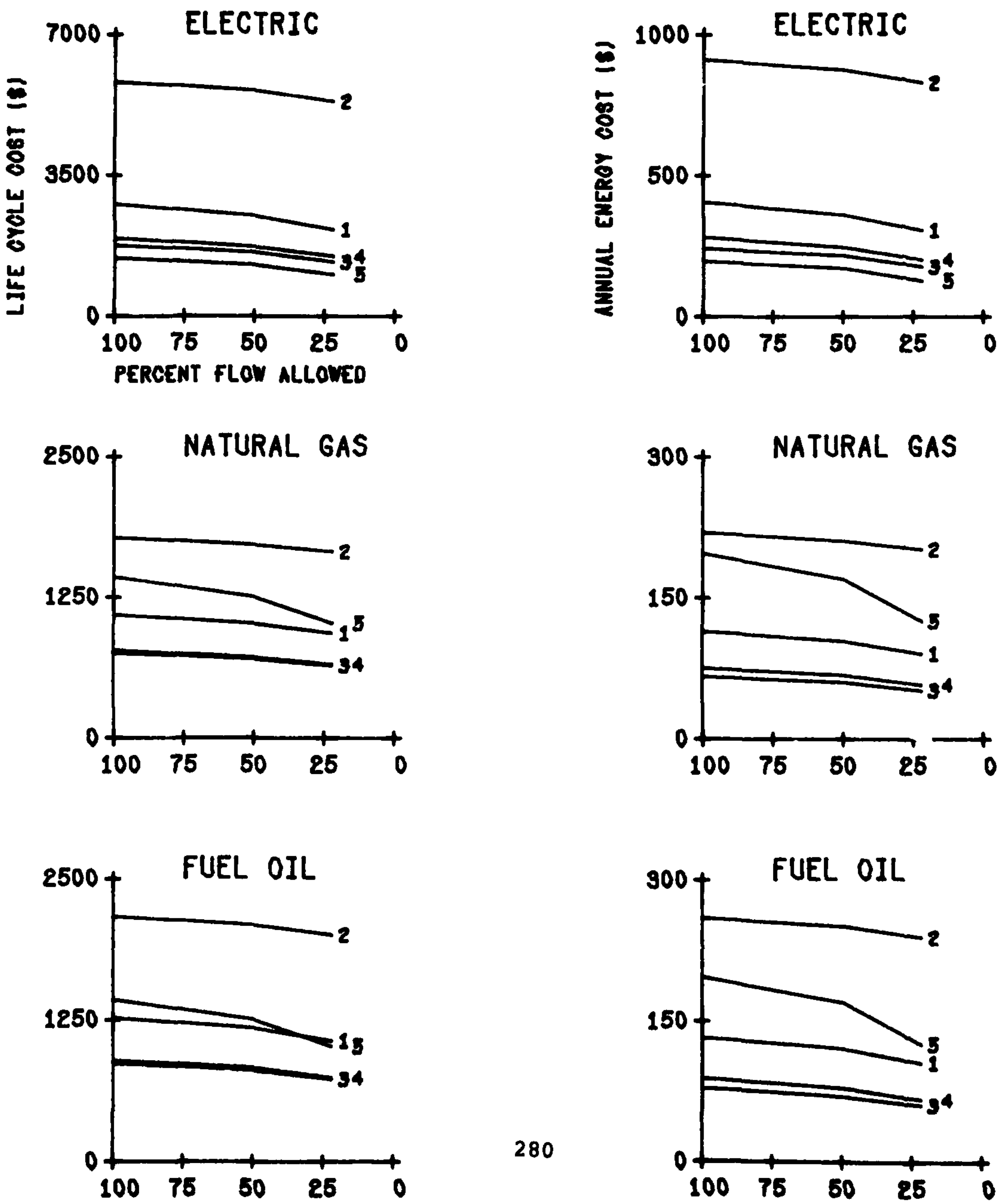
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	2	20.00

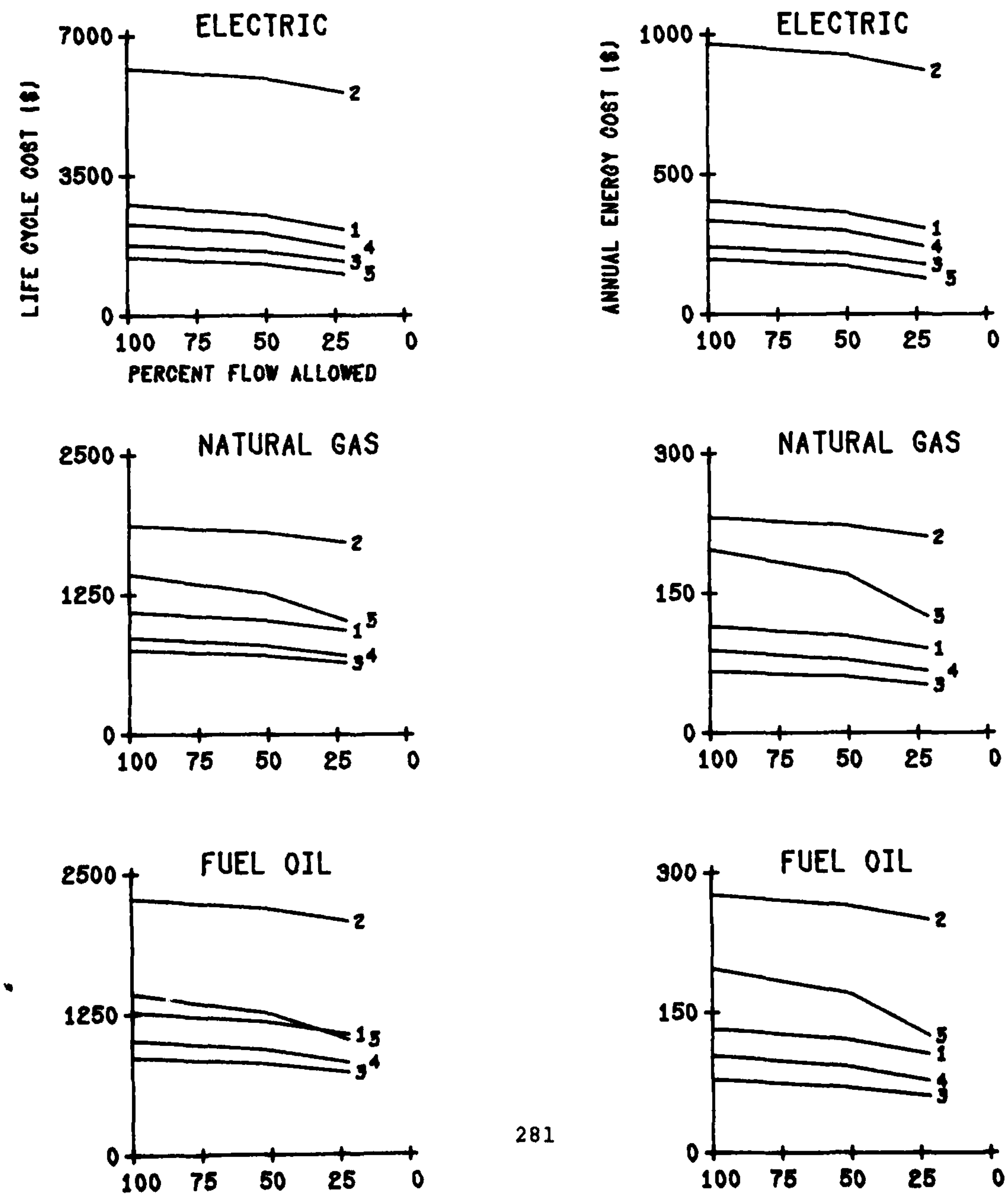
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	2	50.00

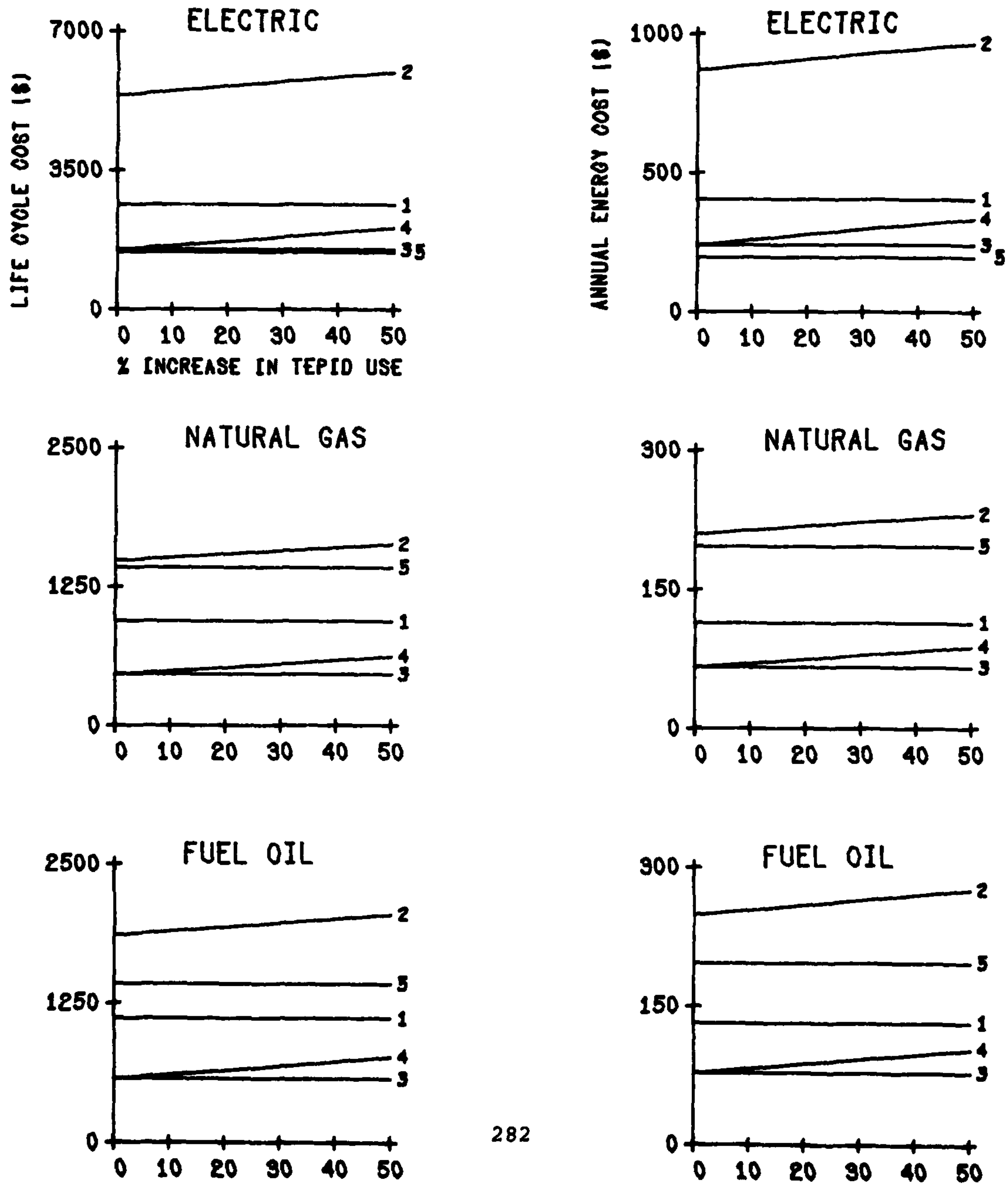
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	2	100.00	100.00

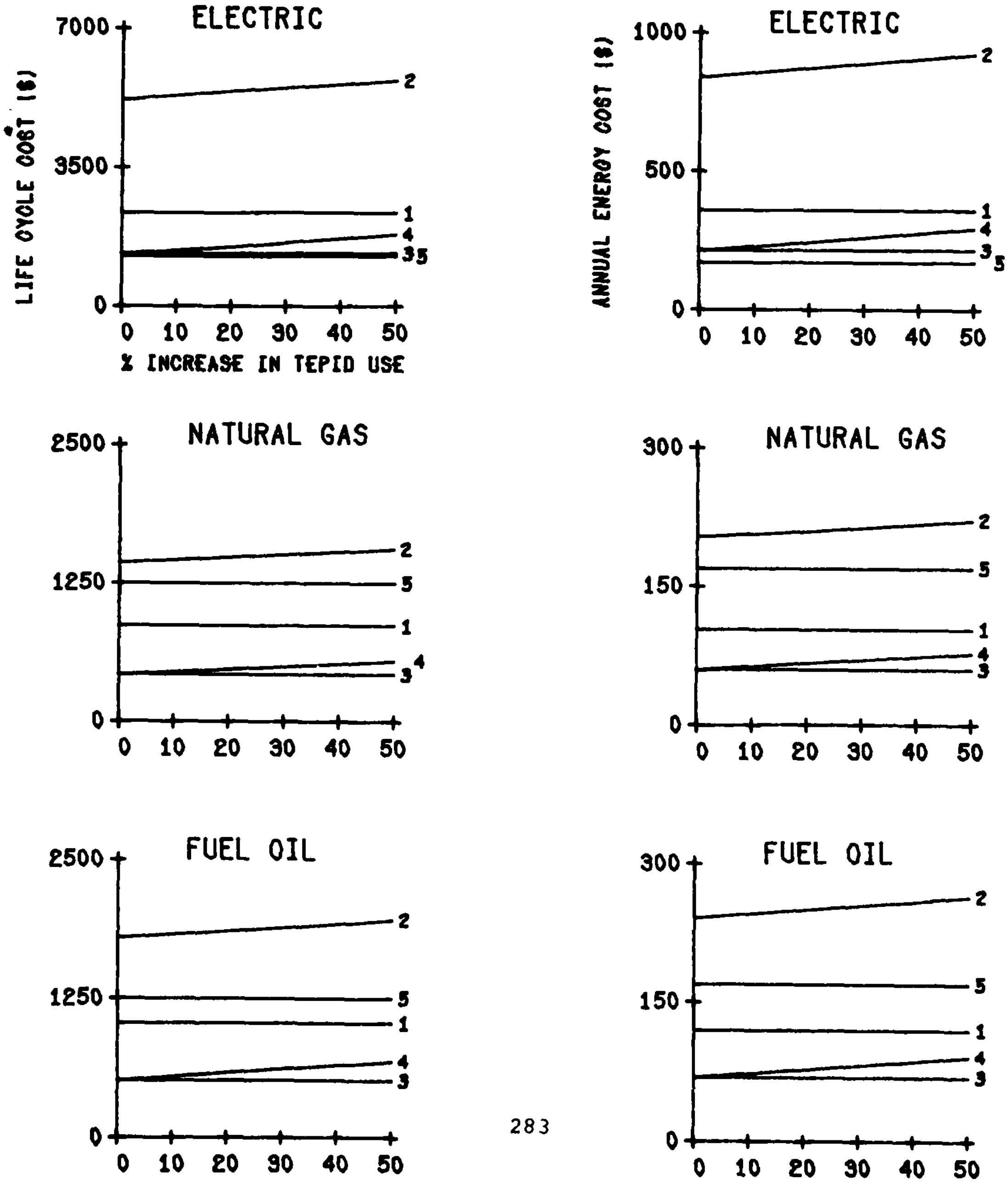
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	2	50.00	85.00

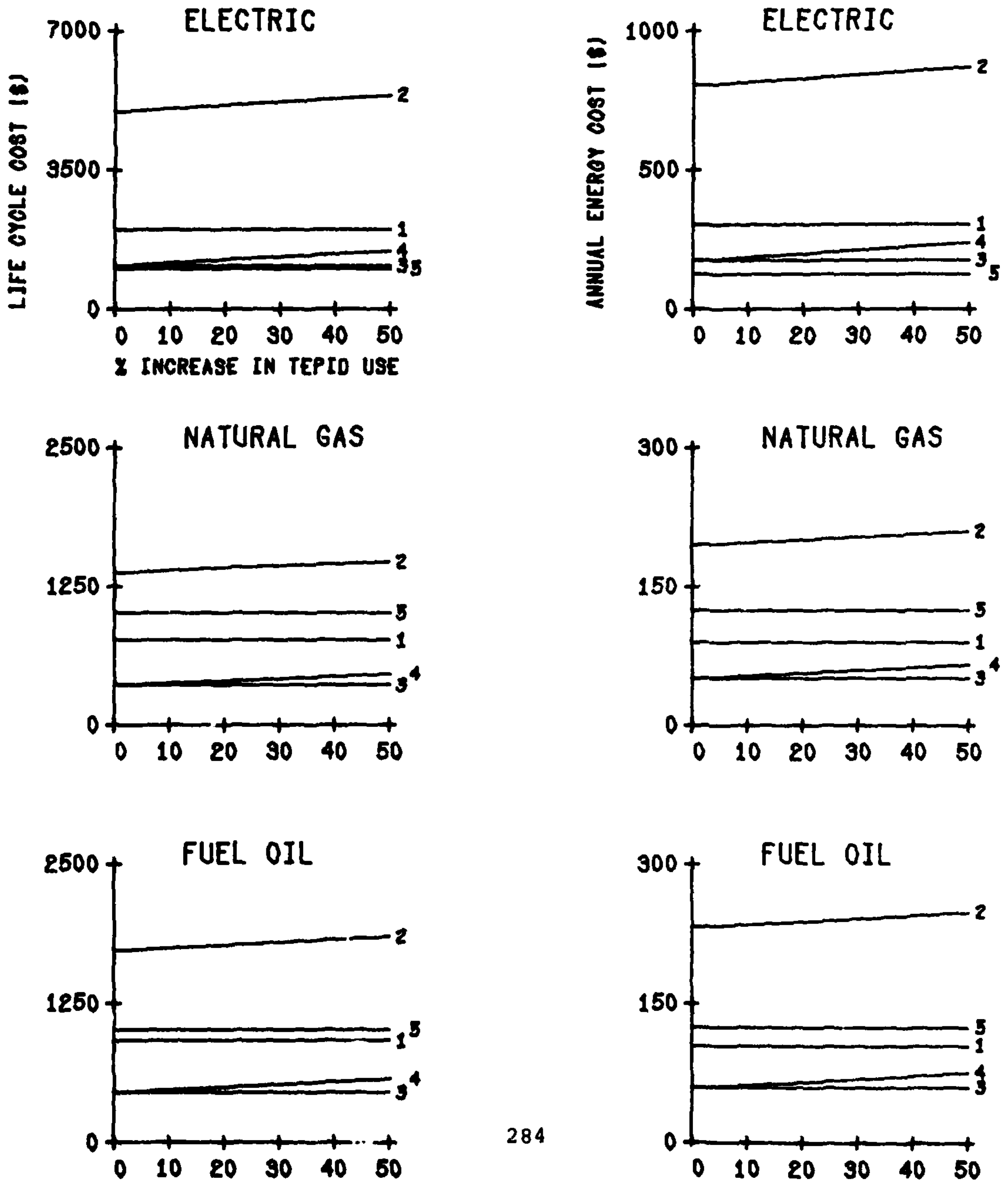
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	2	22.00	66.00

****** RETROFIT ******



AD-A112 649   JOHNS-MANVILLE SALES CORP   DENVER CO RESEARCH AND DEV--ETC   F/G 13/1
INVESTIGATION OF SINGLE VERSUS DUAL - HOT AND COLD BUILDING WAT--ETC(U)
OCT 81   P B BRUCE, M S RAMSEY, P B SHEPHERD   DAAK70-78-D-0002

UNCLASSIFIED   USAFESA-T-2091   NL

4 OF 6
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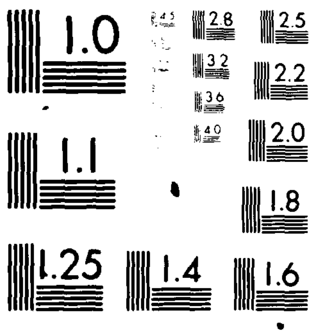
A112649



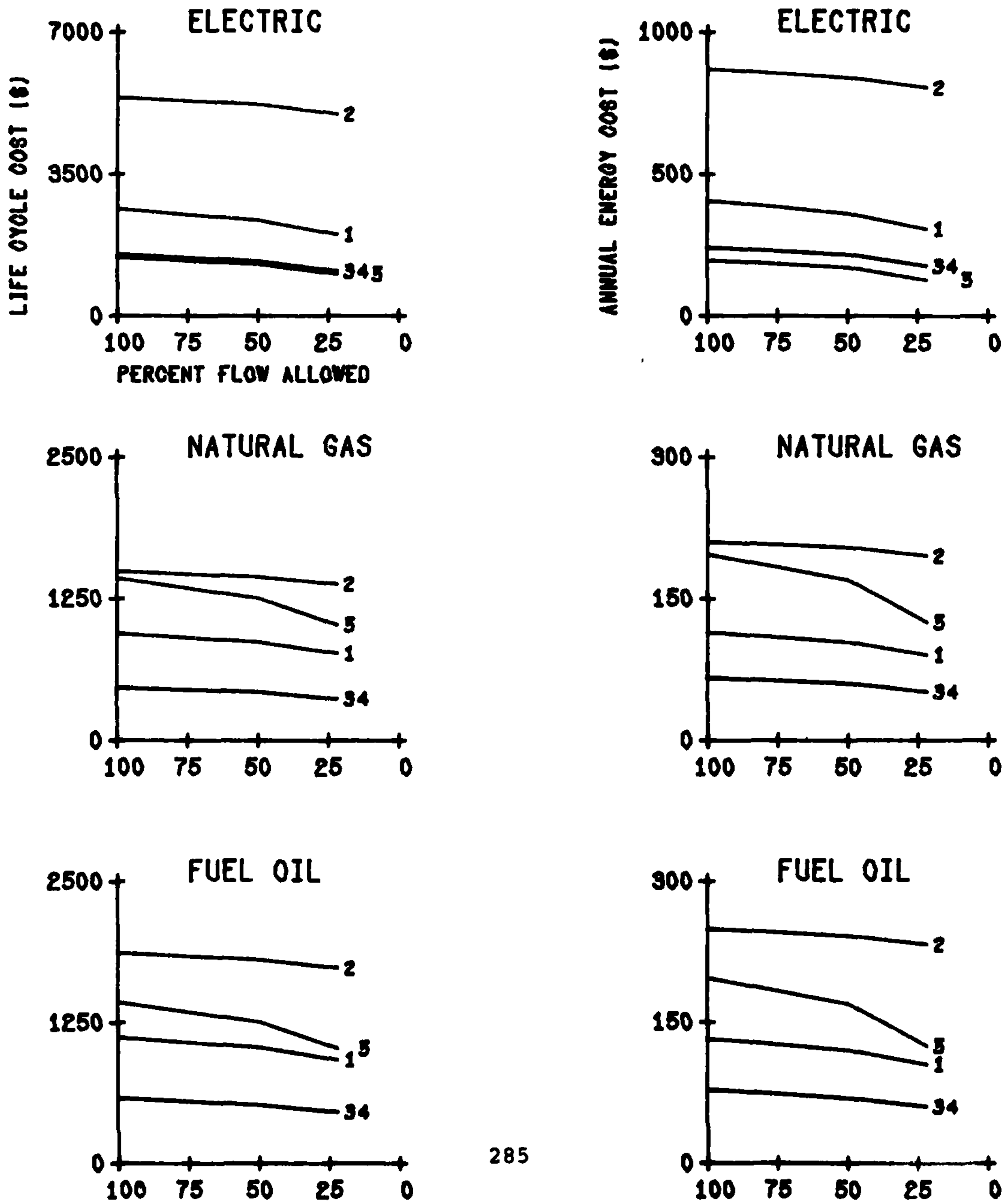
MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	2	0.00

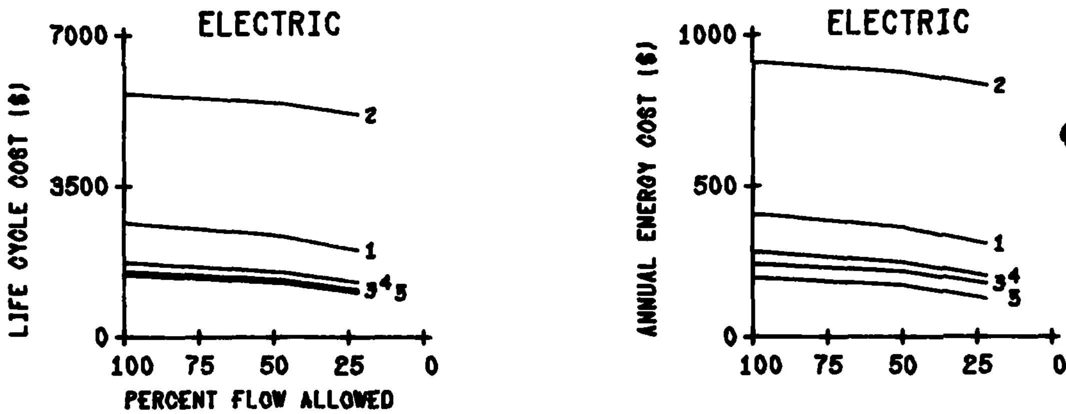
****** RETROFIT ******

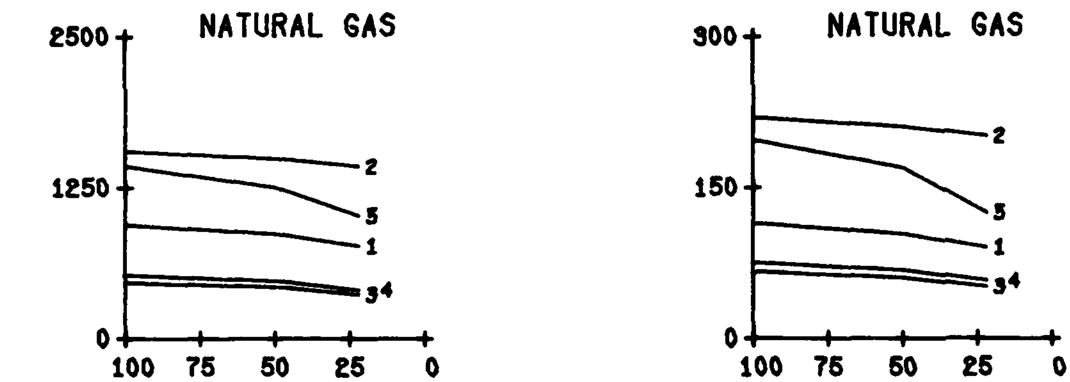


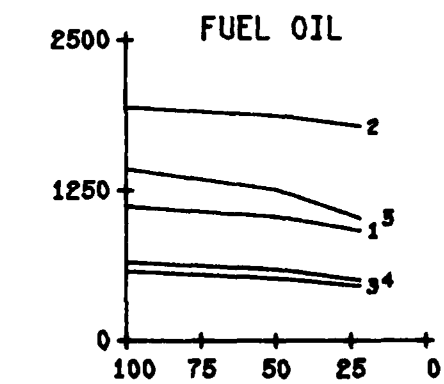
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

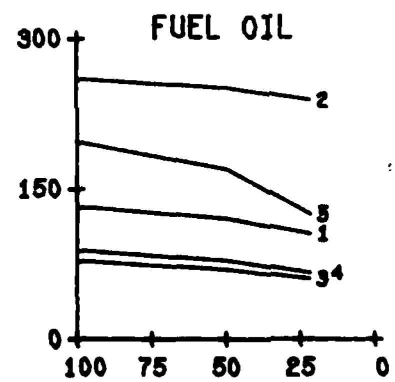
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	2	20.00

****** RETROFIT ******





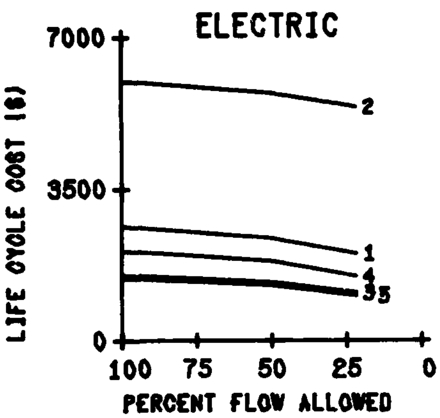


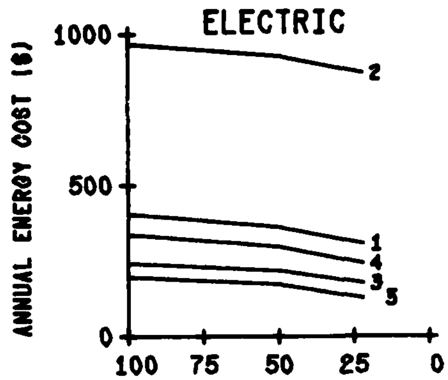


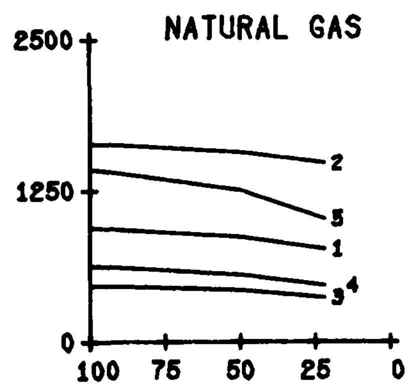
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

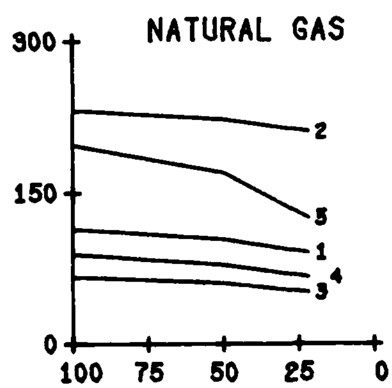
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	2	50.00

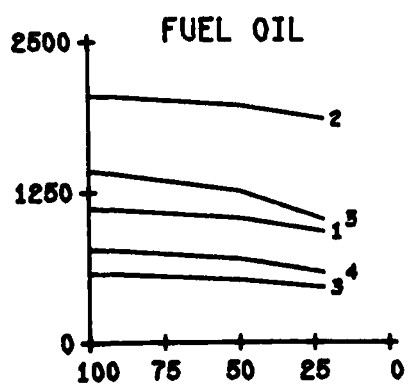
****** RETROFIT ******

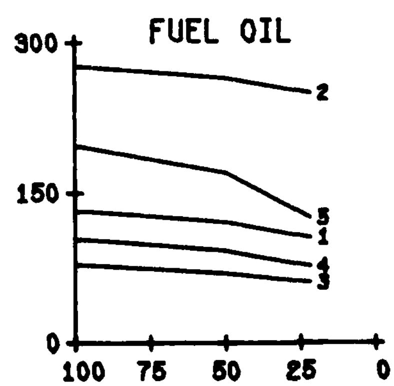








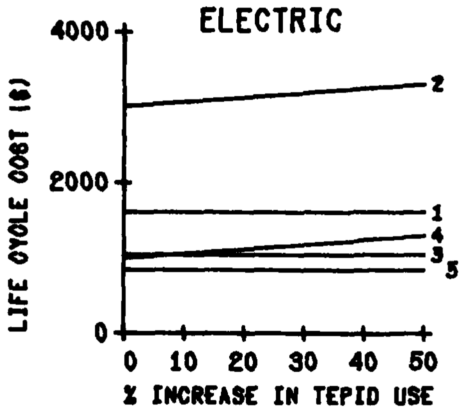


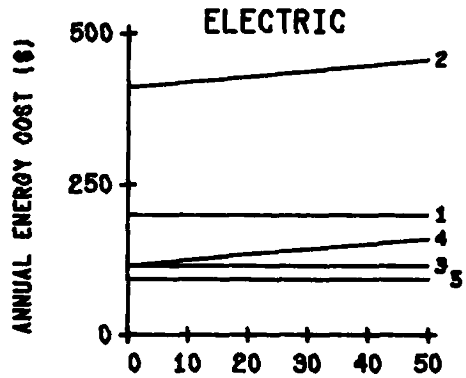


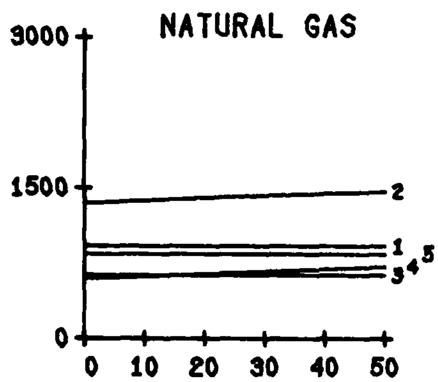
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

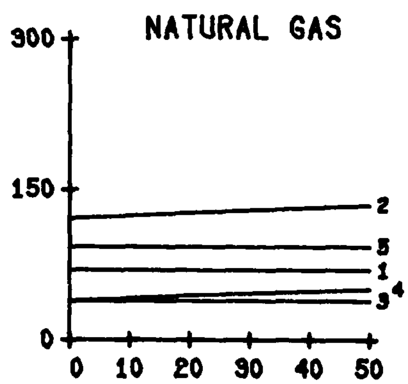
BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	8	100.00	100.00

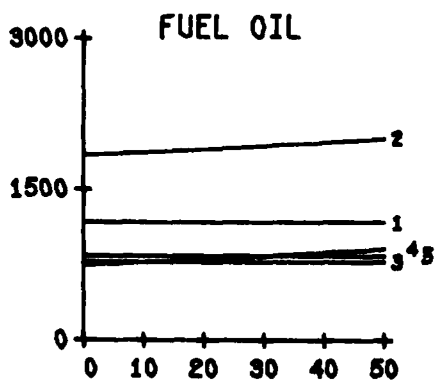
*** NEW CONSTRUCTION ***

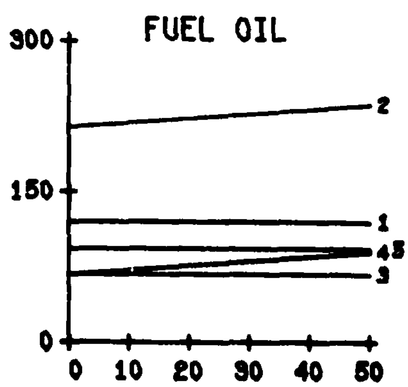








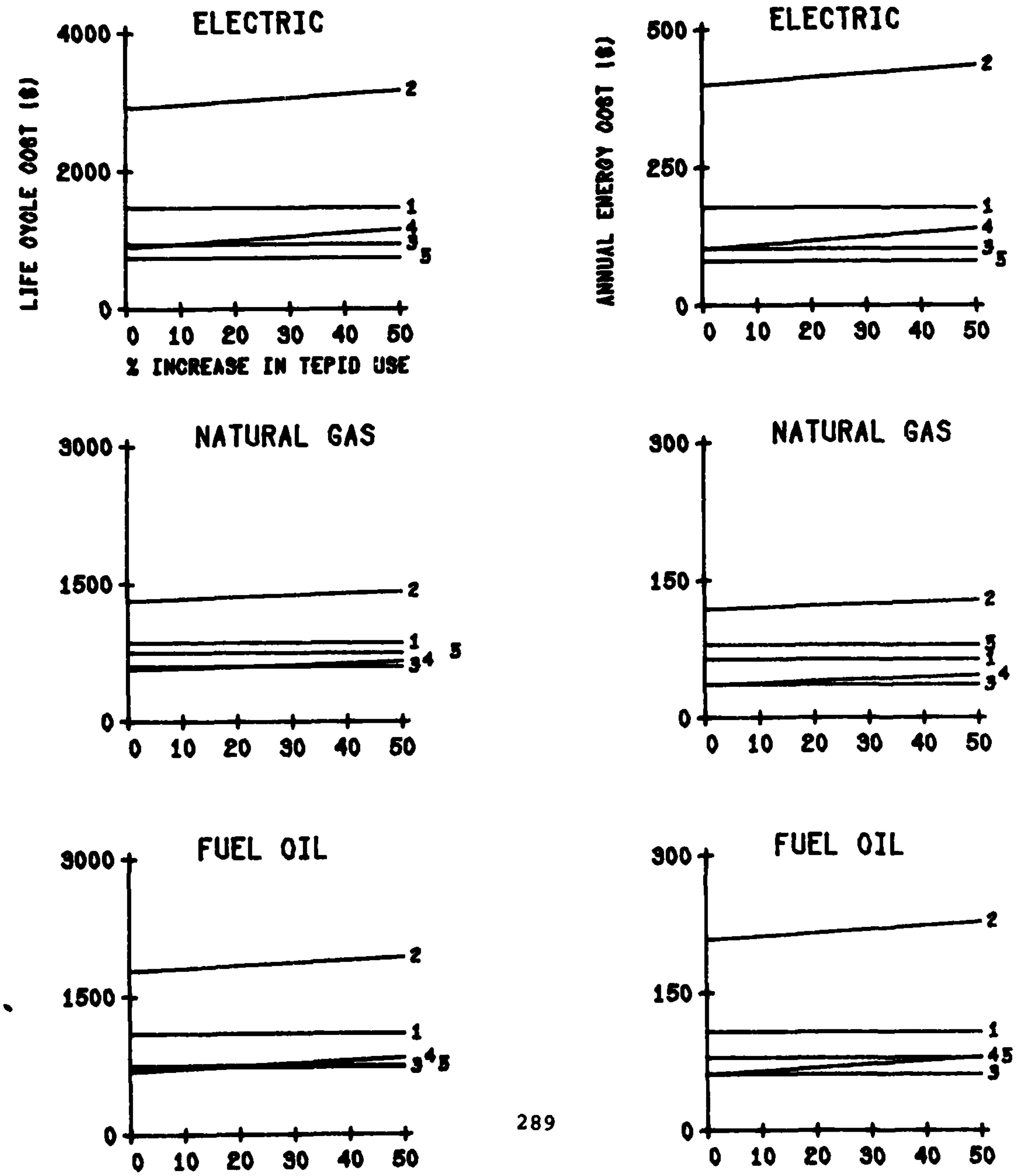




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	8	50.00	85.00

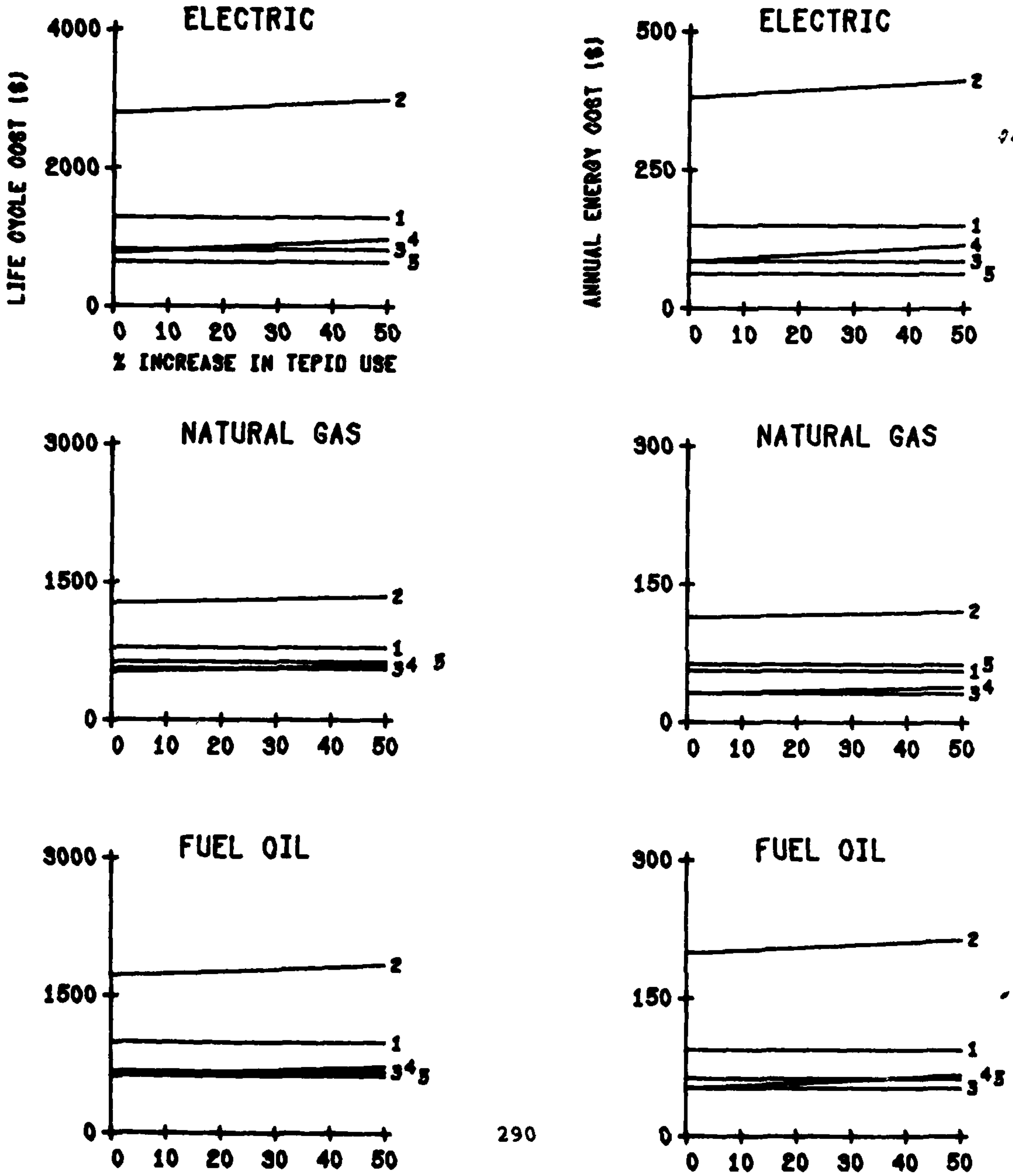
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	8	22.00	66.00

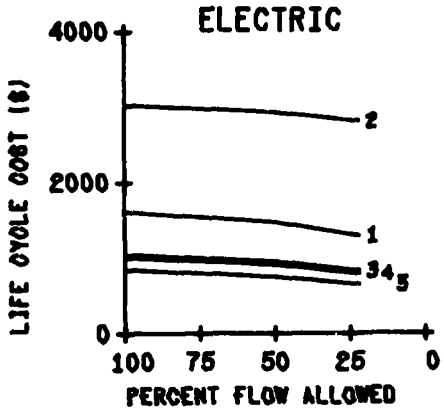
*** NEW CONSTRUCTION ***

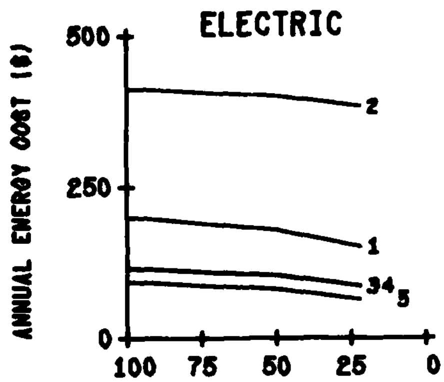


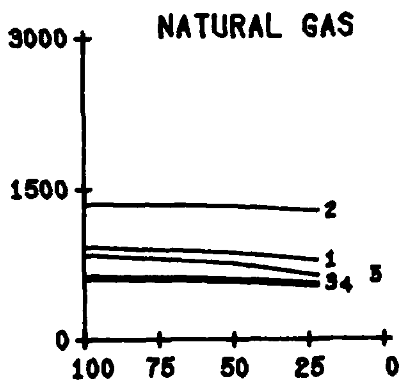
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

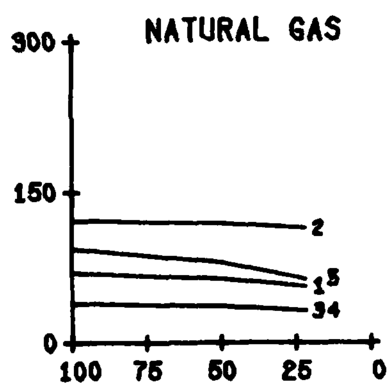
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	8	0.00

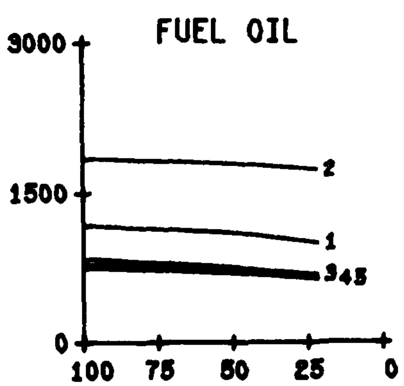
*** NEW CONSTRUCTION ***

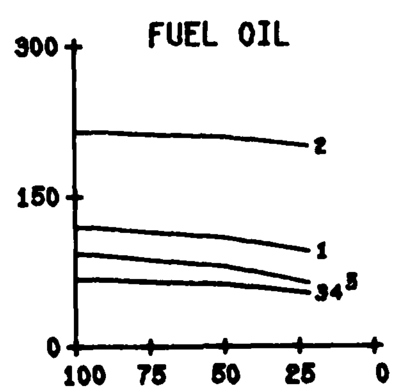








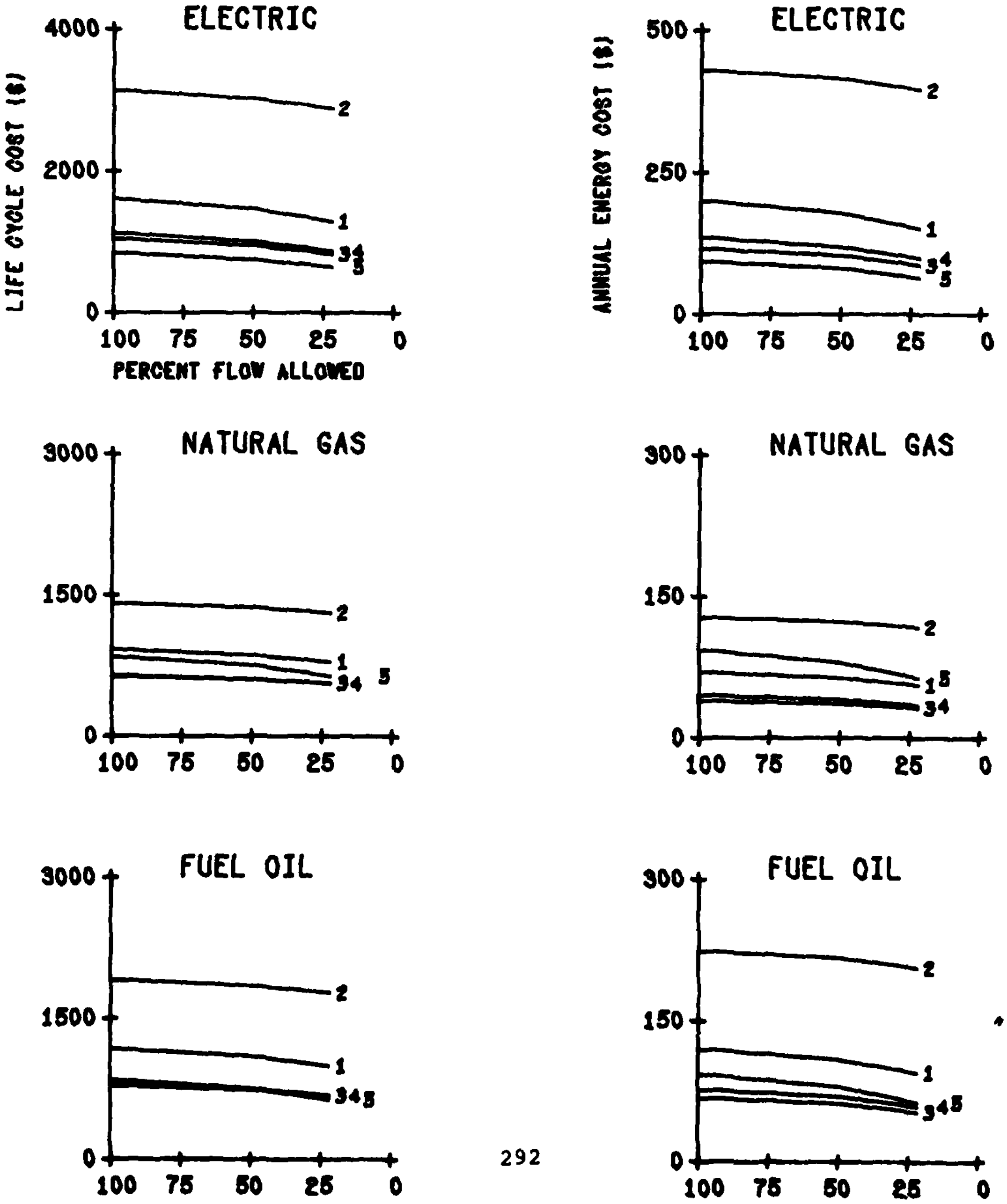




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	8	20.00

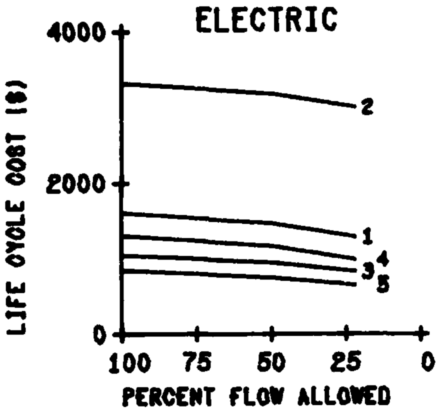
*** NEW CONSTRUCTION ***

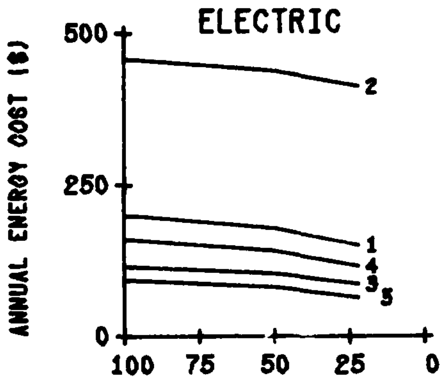


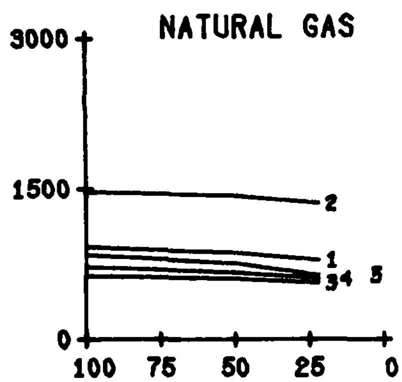
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

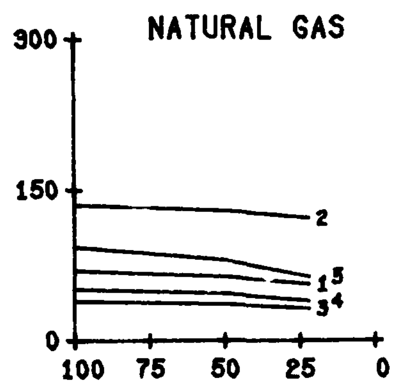
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	8	50.00

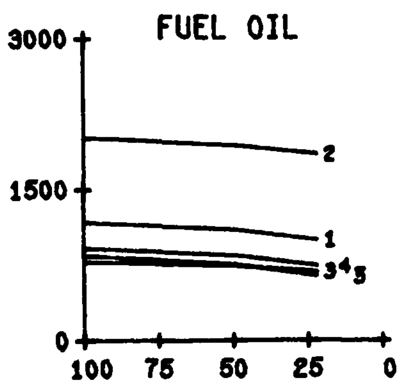
*** NEW CONSTRUCTION ***

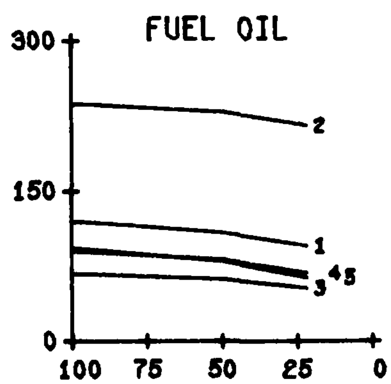








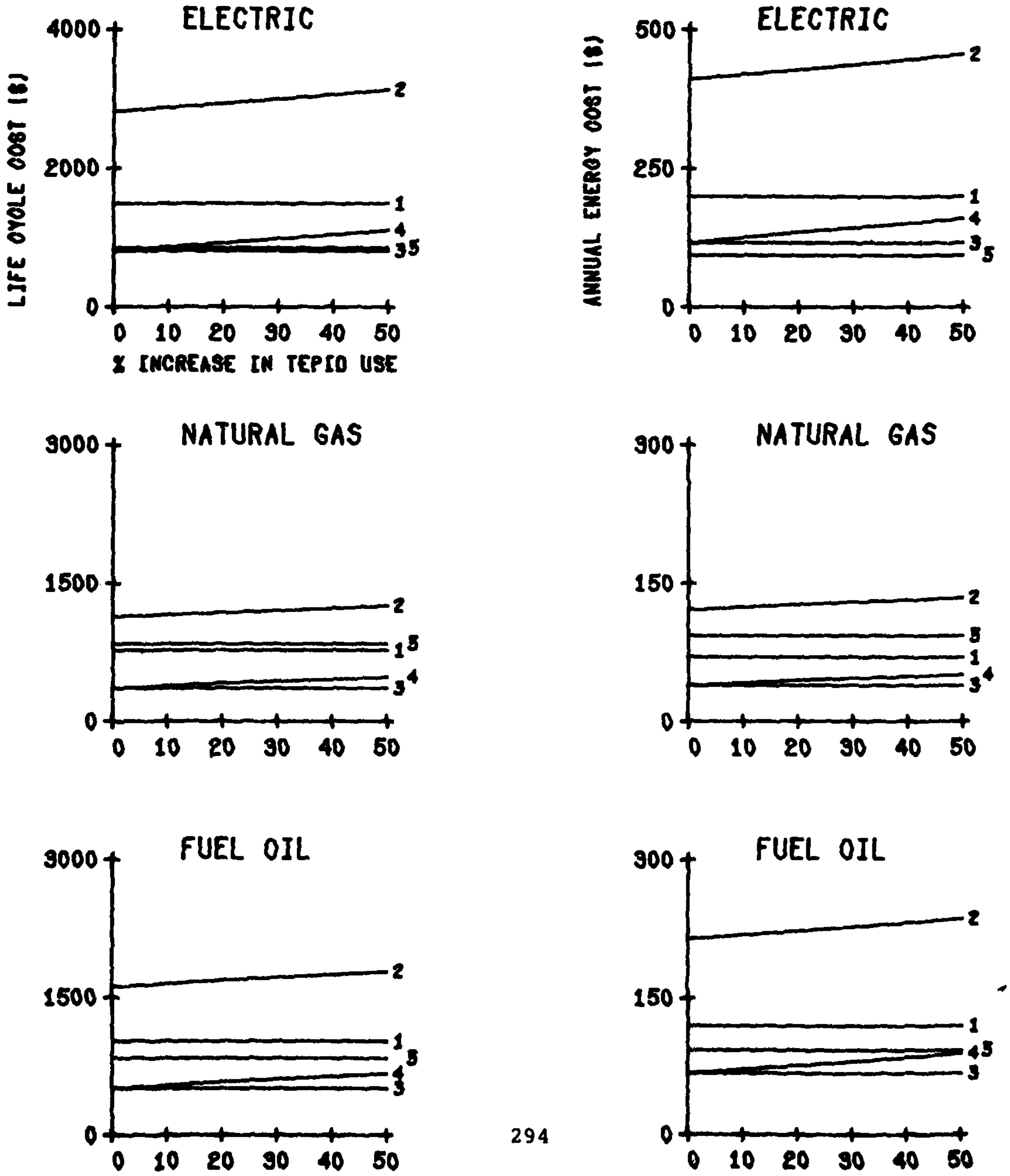




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	8	100.00	100.00

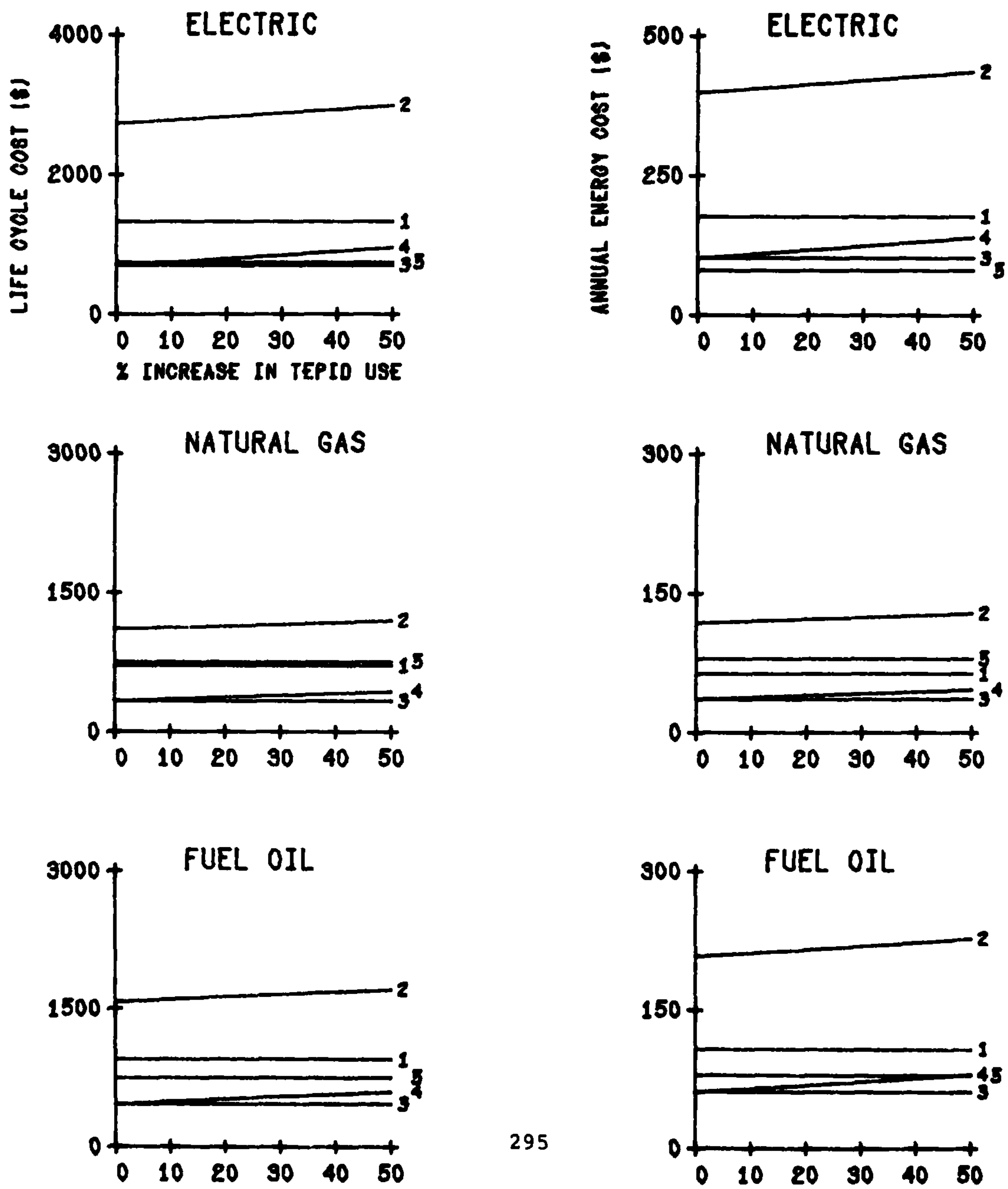
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	8	50.00	85.00

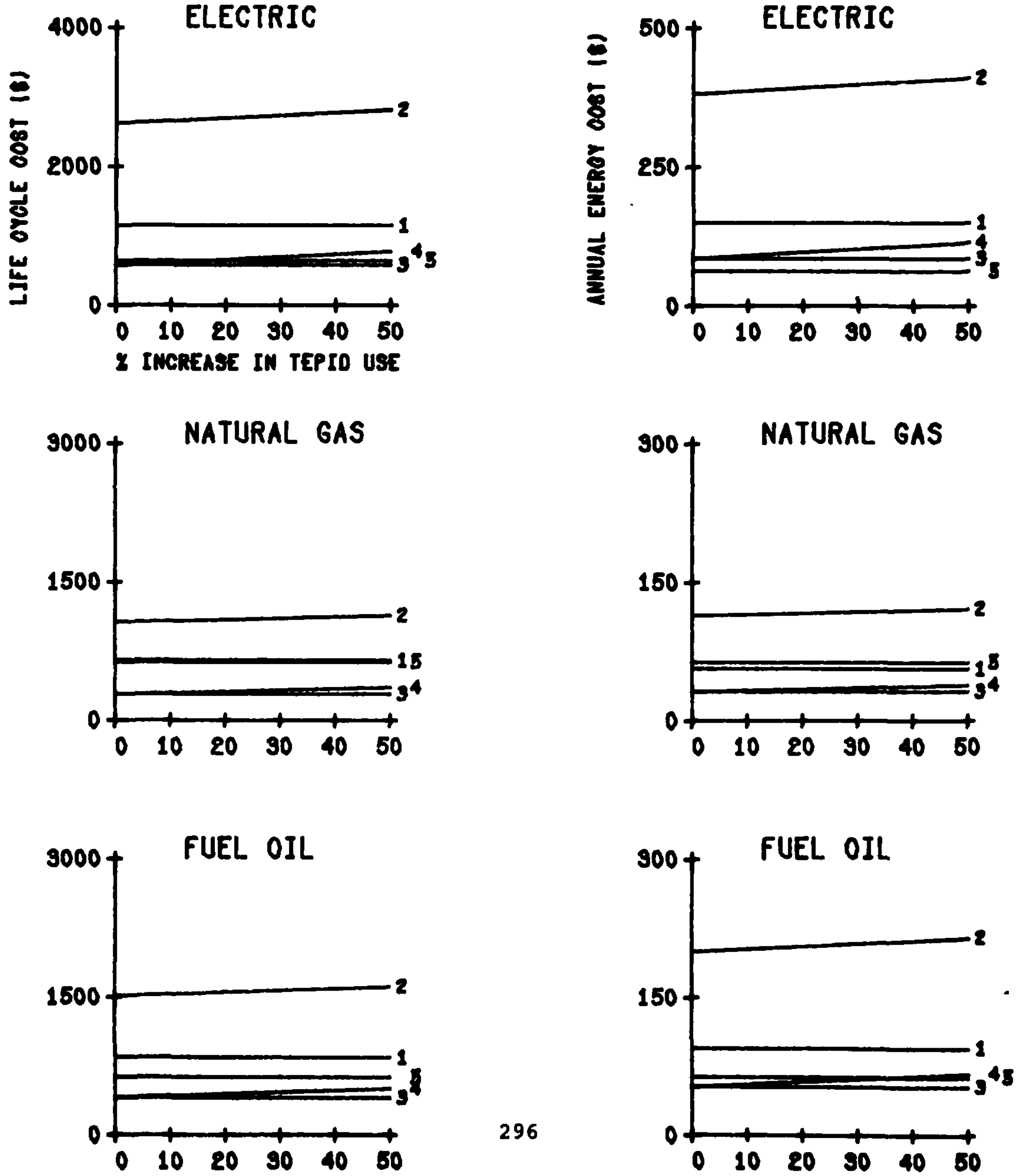
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	8	22.00	66.00

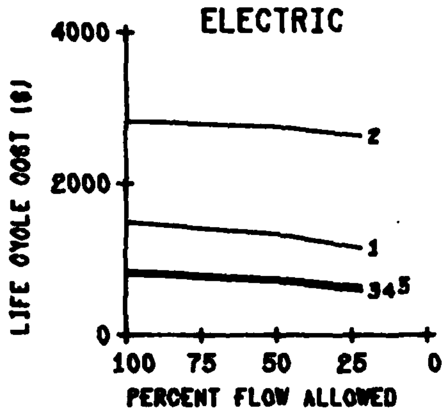
****** RETROFIT ******

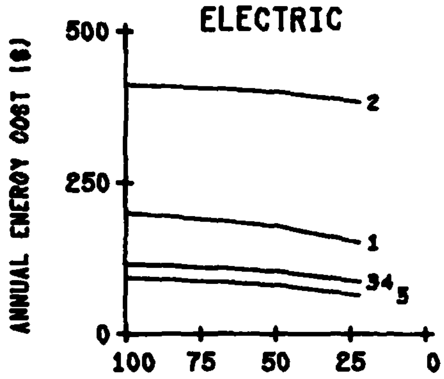


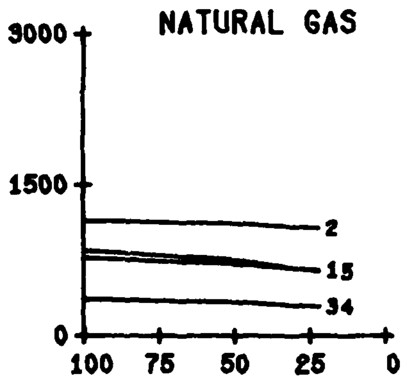
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

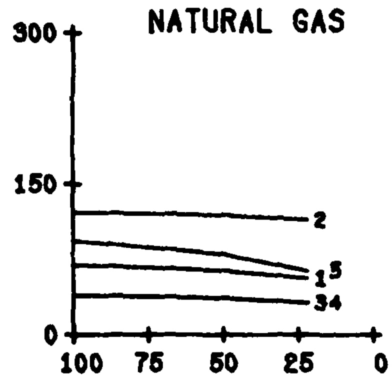
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	8	0.00

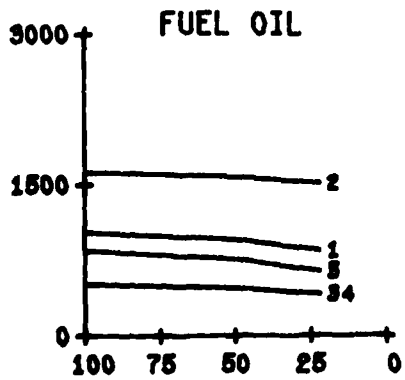
****** RETROFIT ******

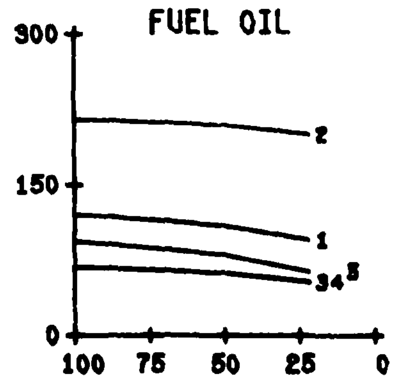








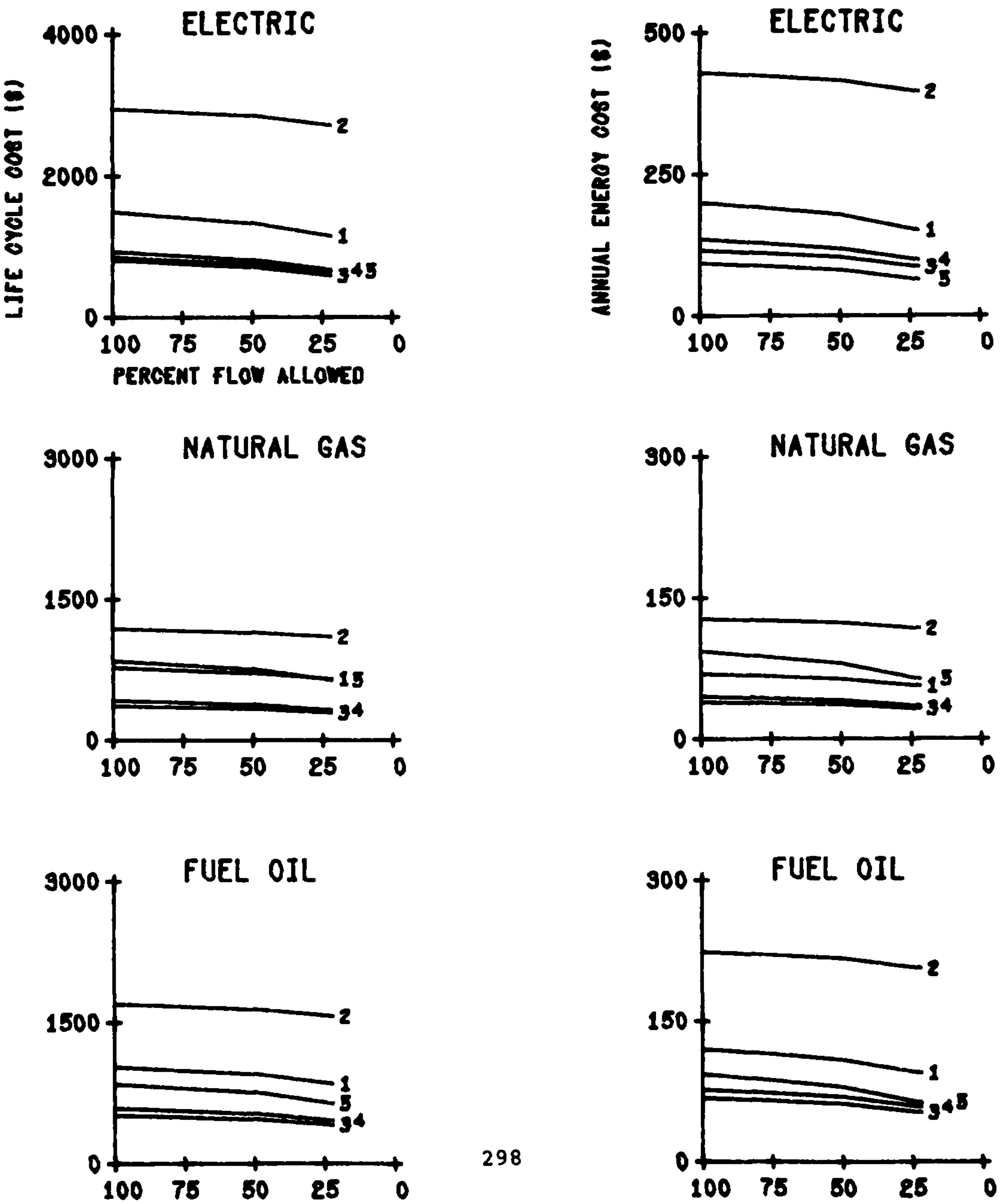




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	8	20.00

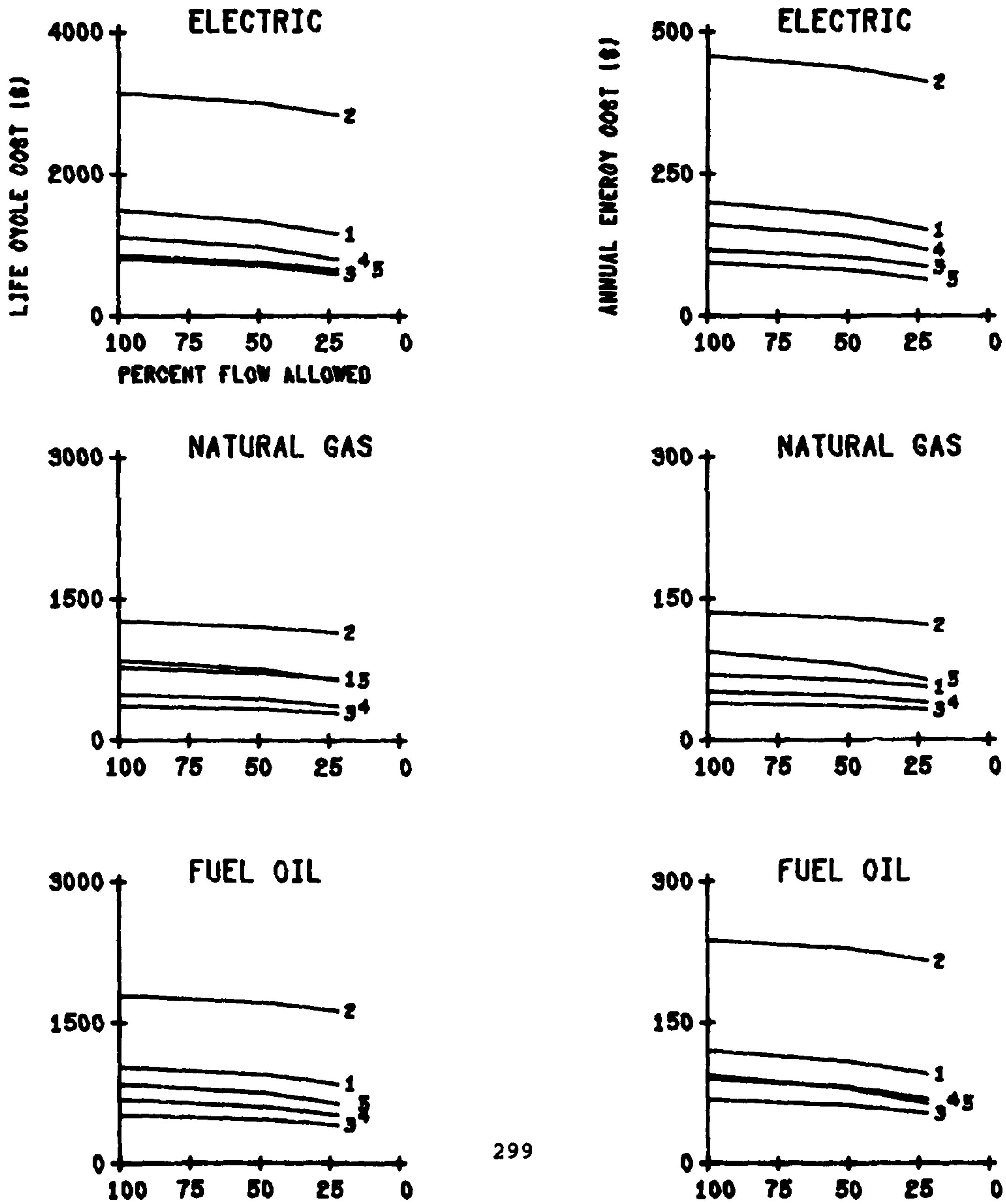
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	8	50.00

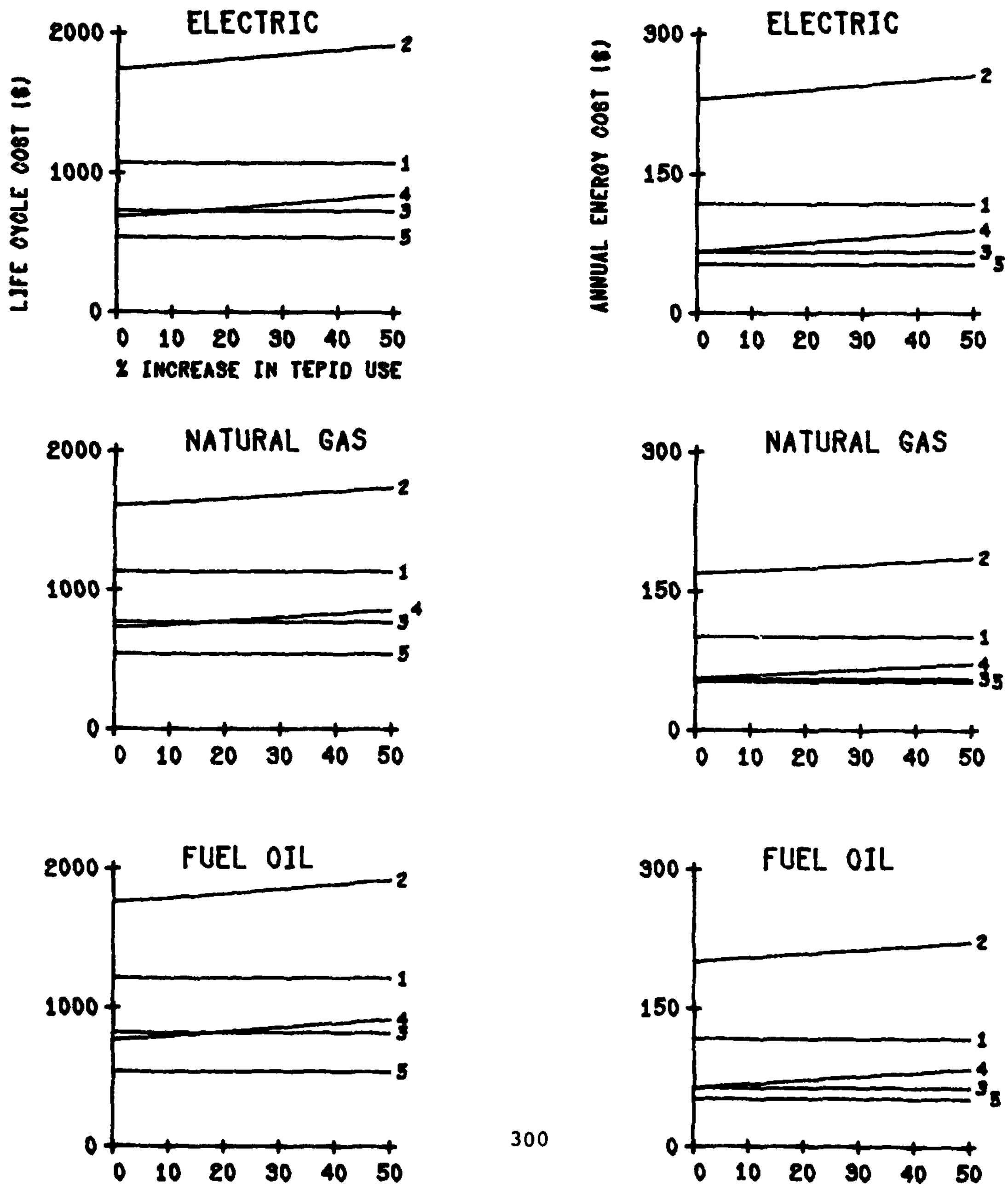
****** RETROFIT ******



JOHNS-MANVILLE PESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	10	100.00	100.00

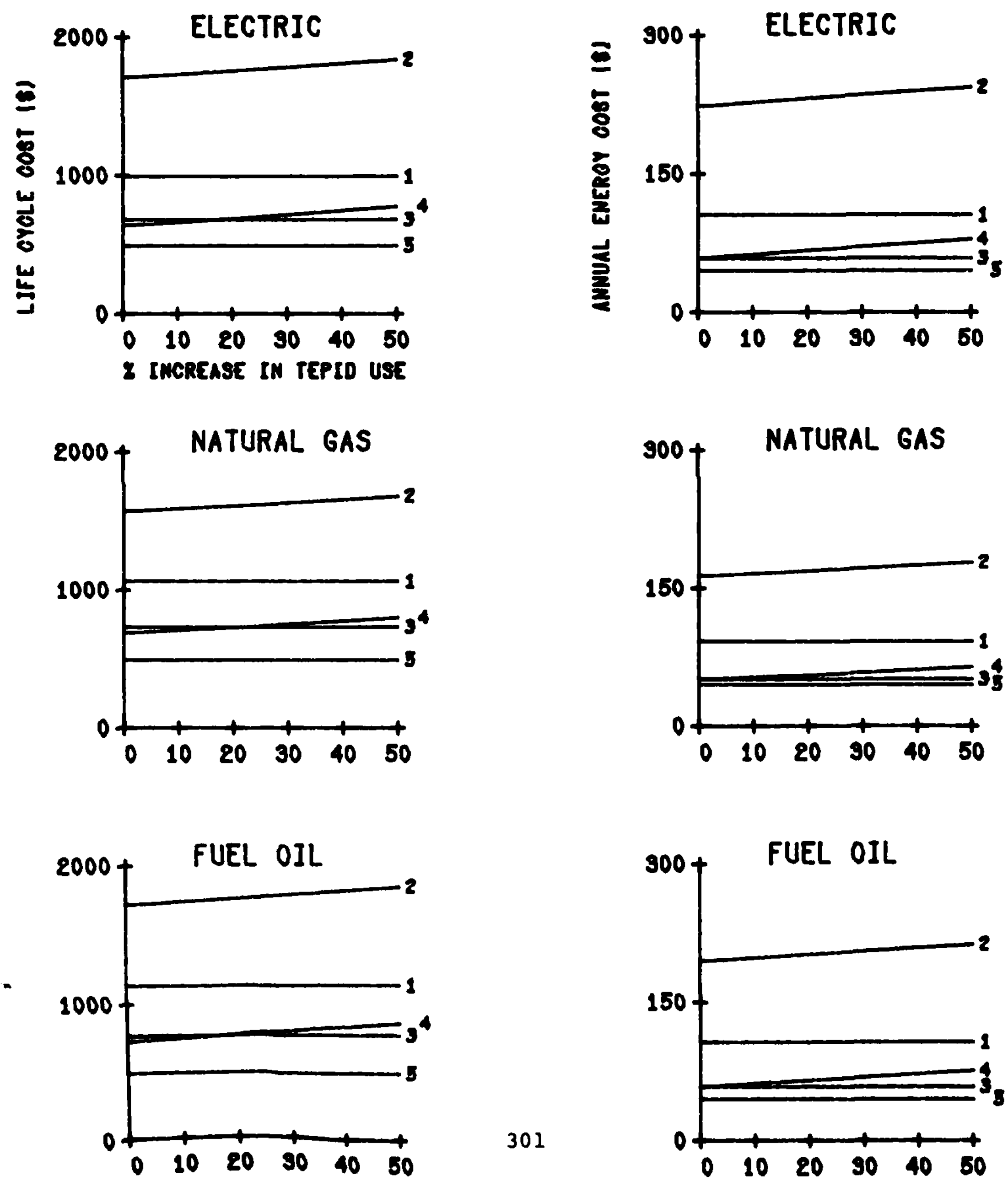
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	10	50.00	85.00

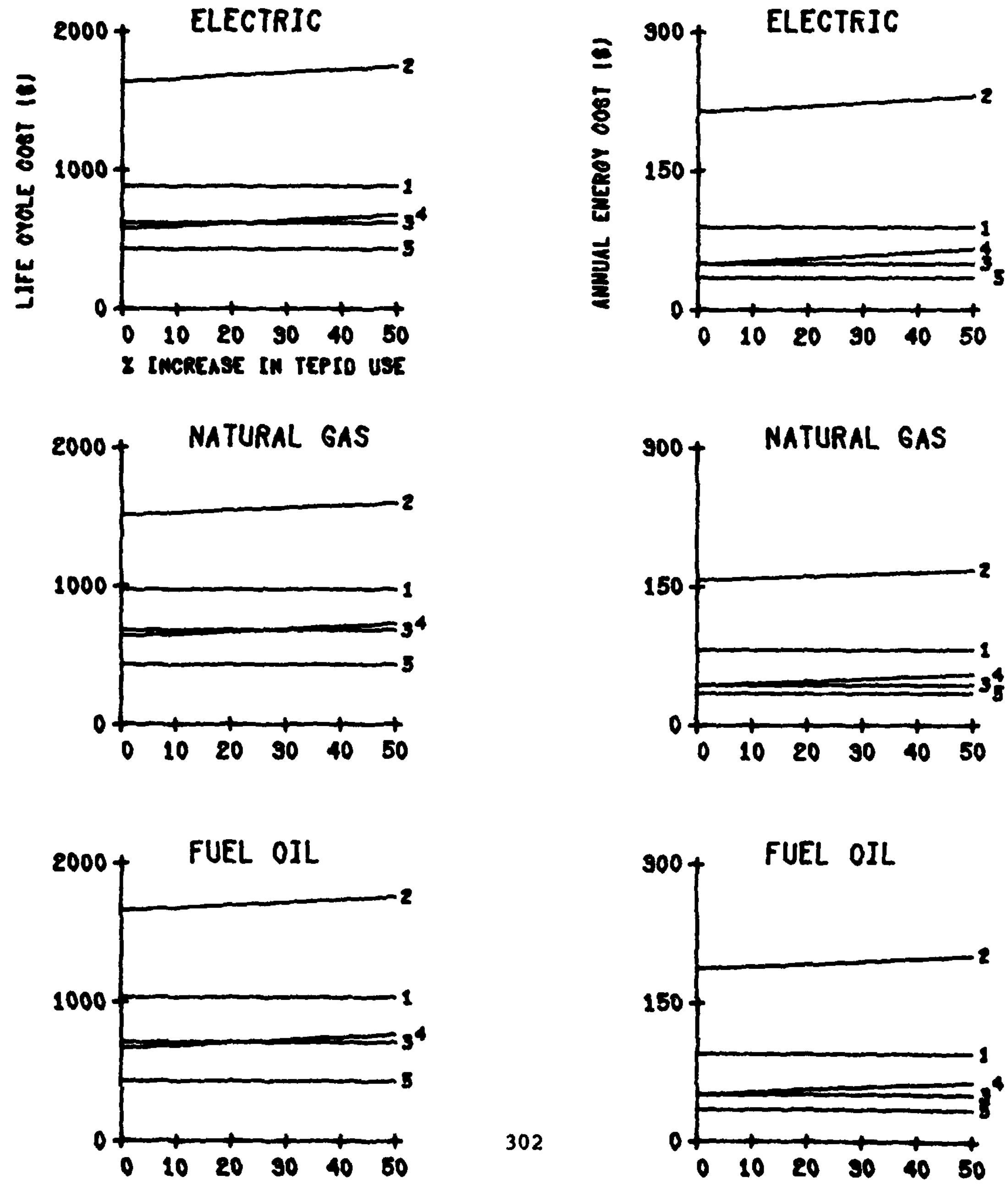
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	10	22.00	66.00

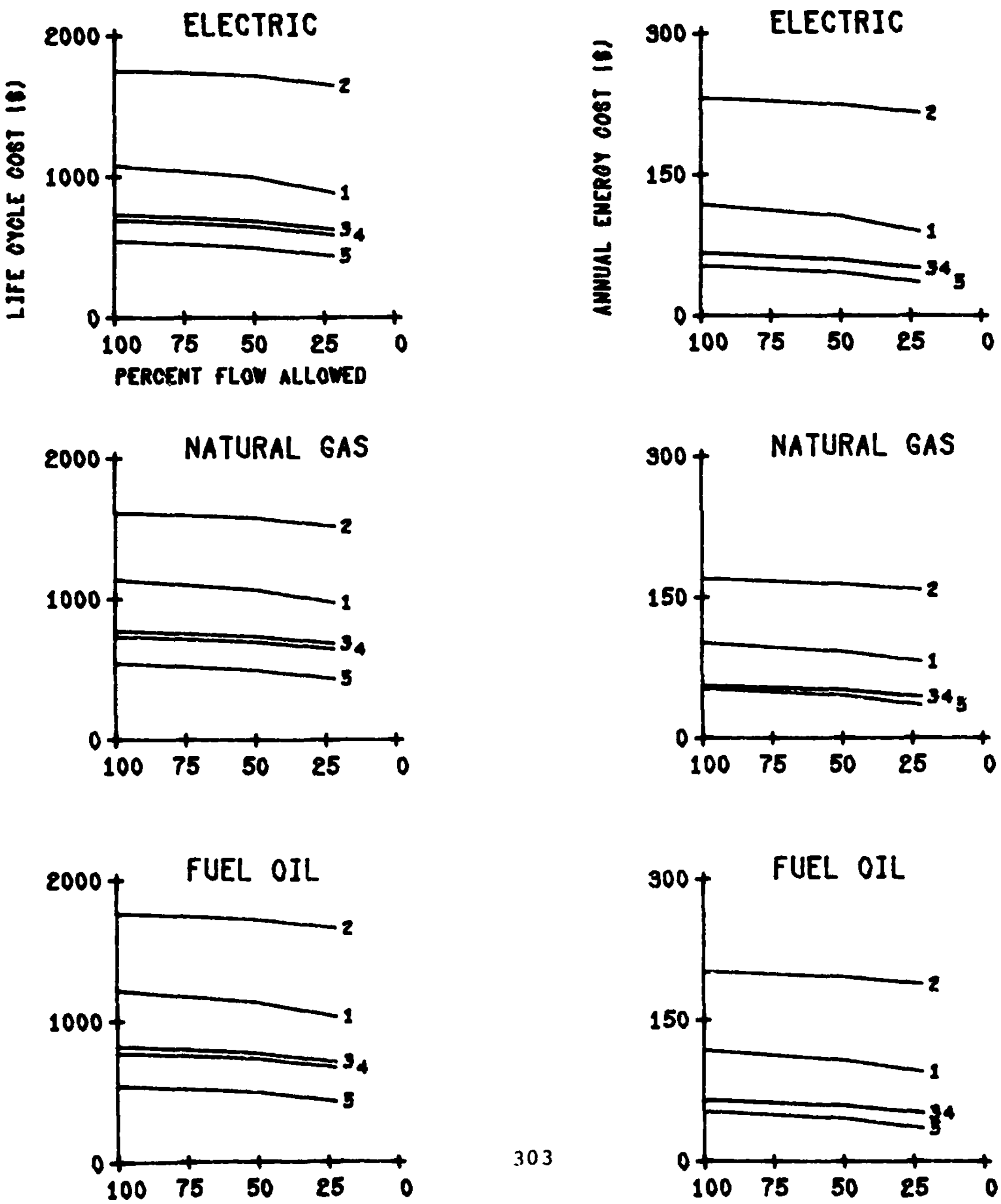
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	10	0.00

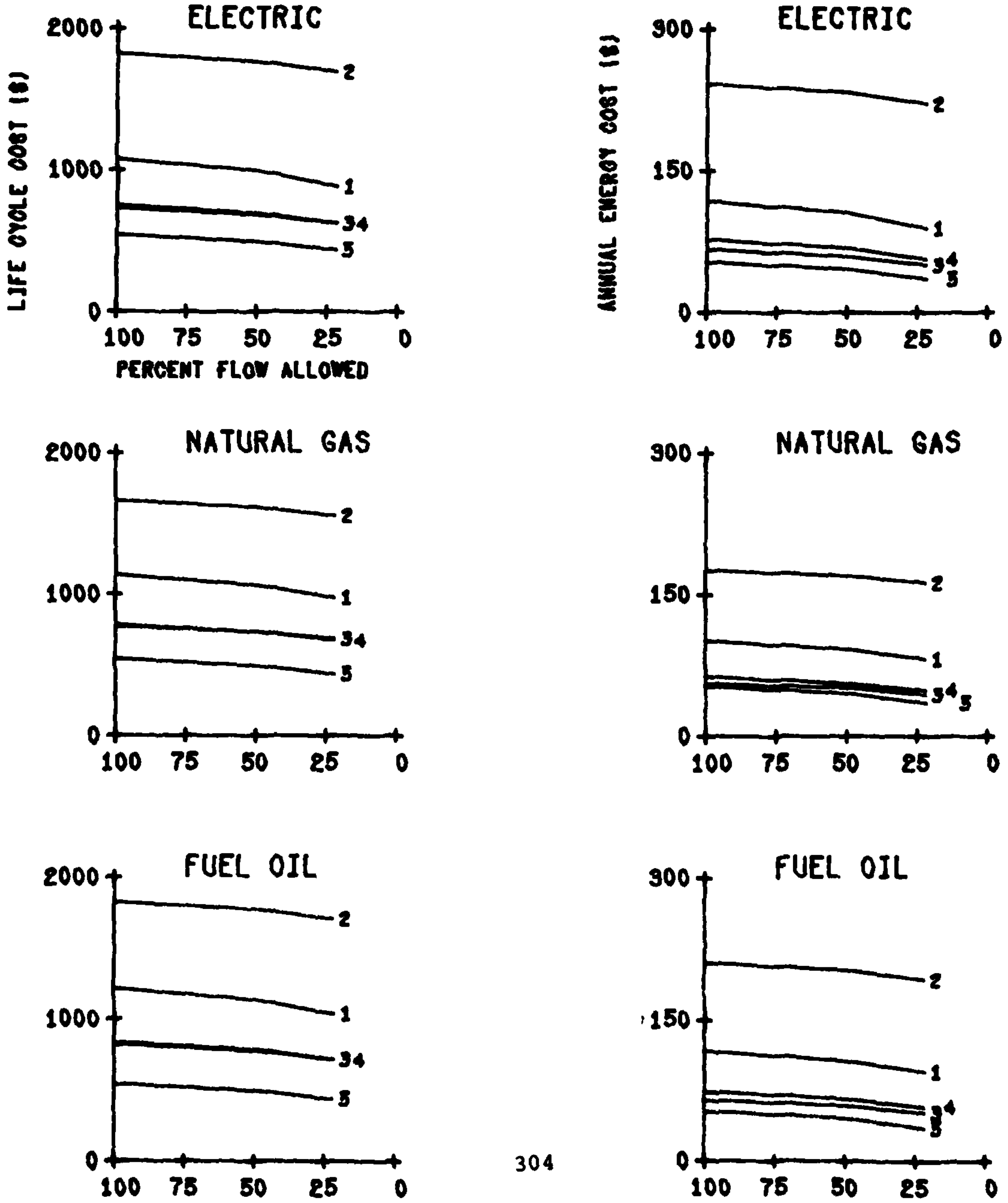
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	10	20.00

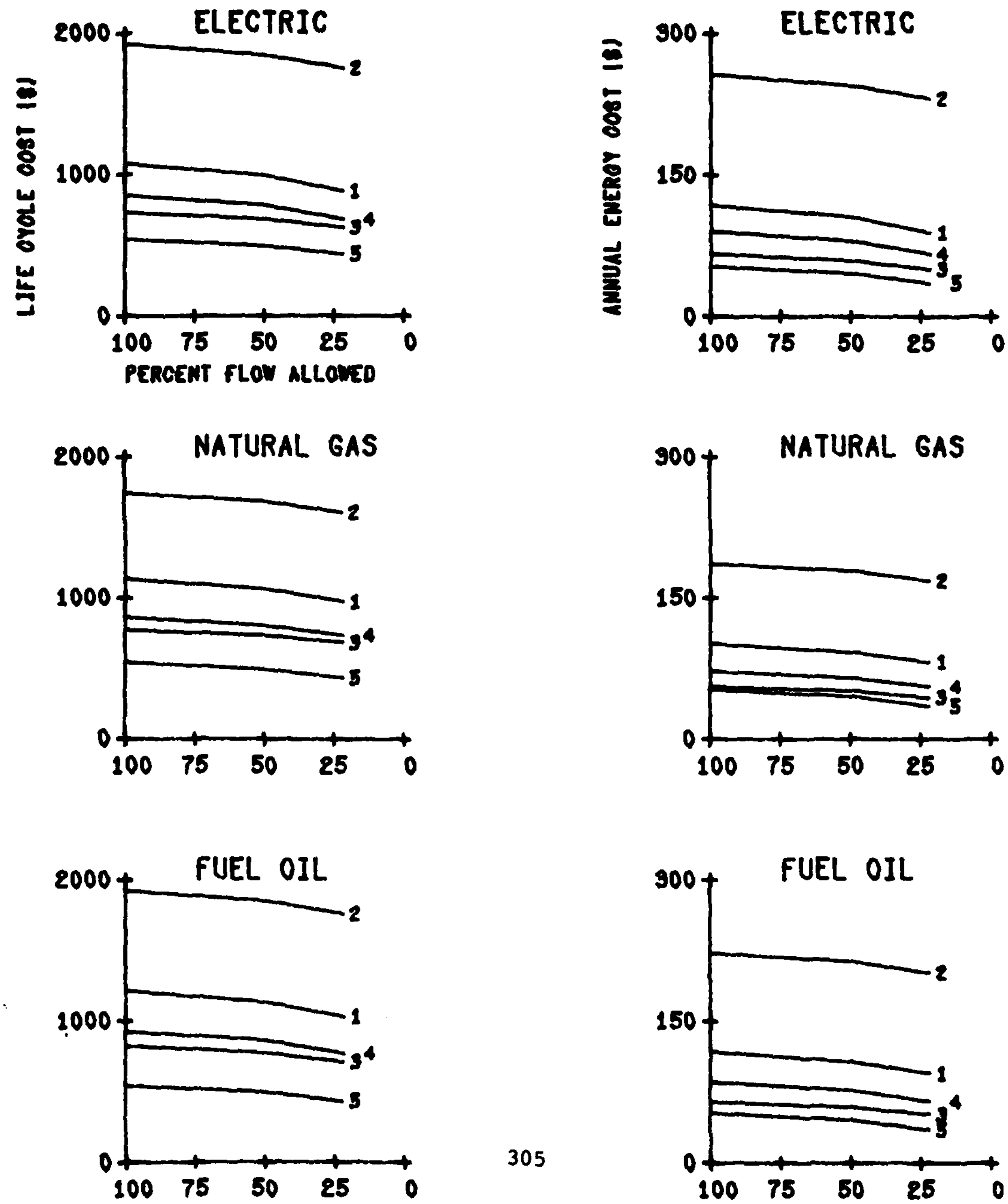
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	10	50.00

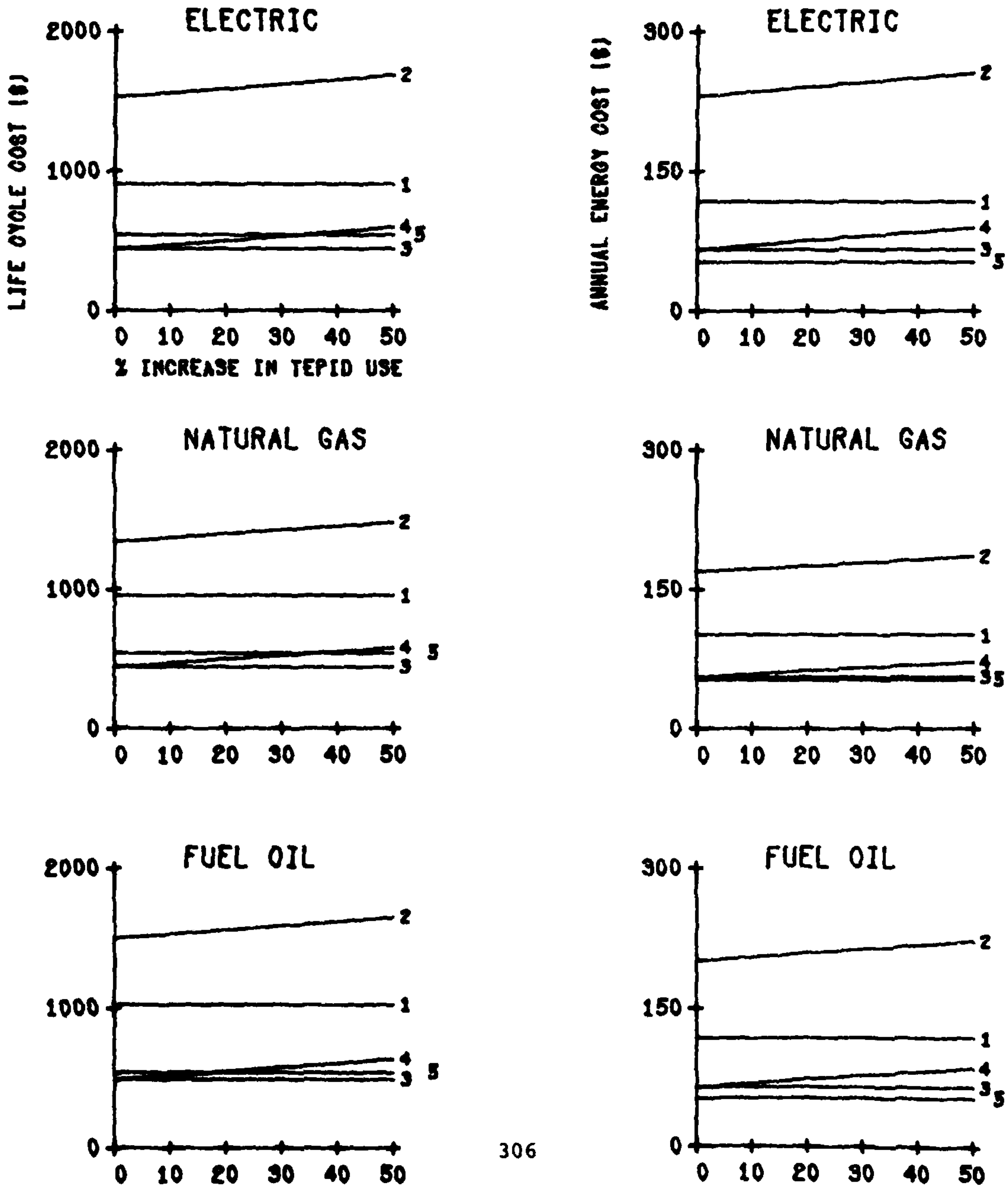
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	10	100.00	100.00

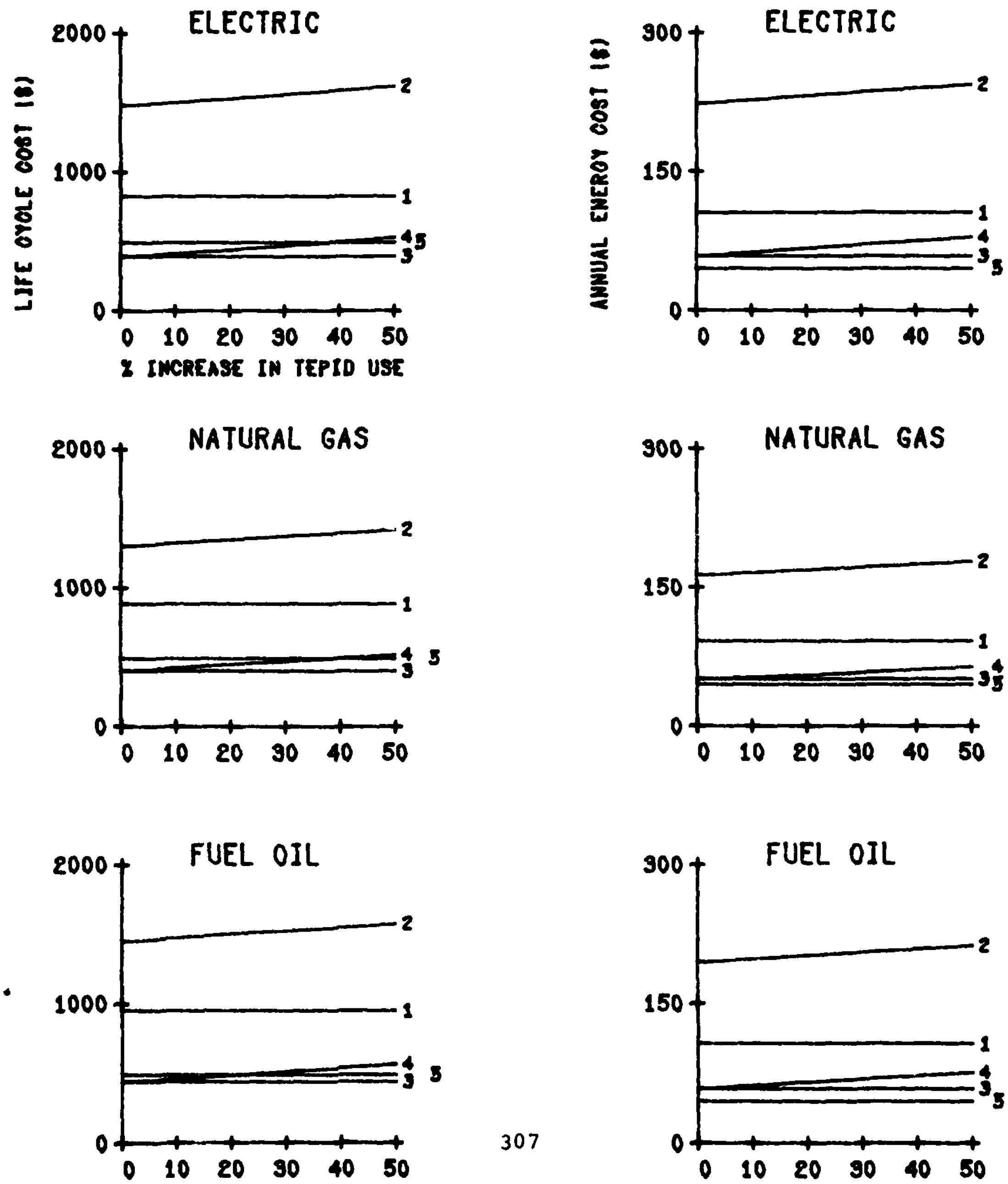
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	10	50.00	85.00

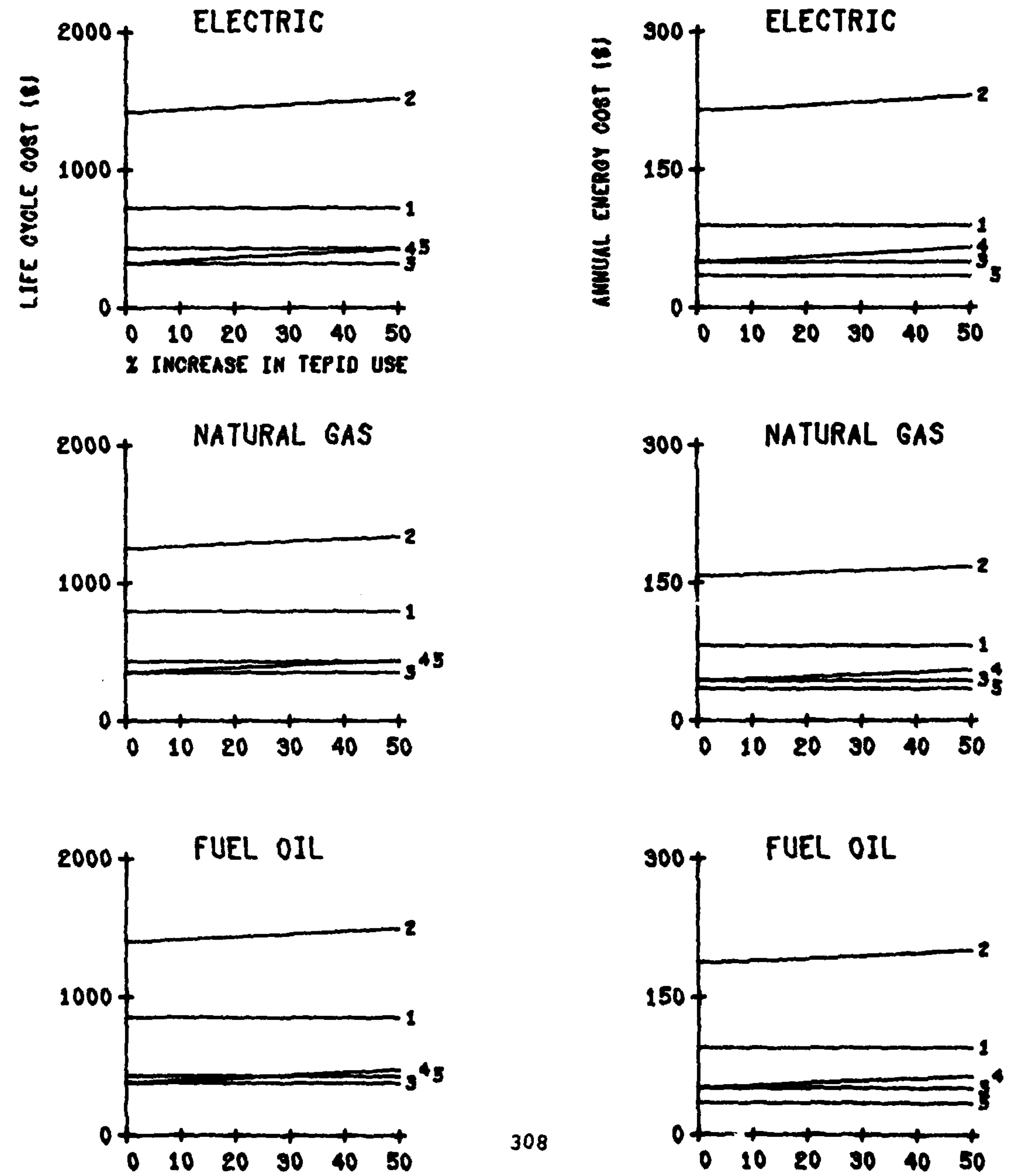
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
4	10	22.00	66.00

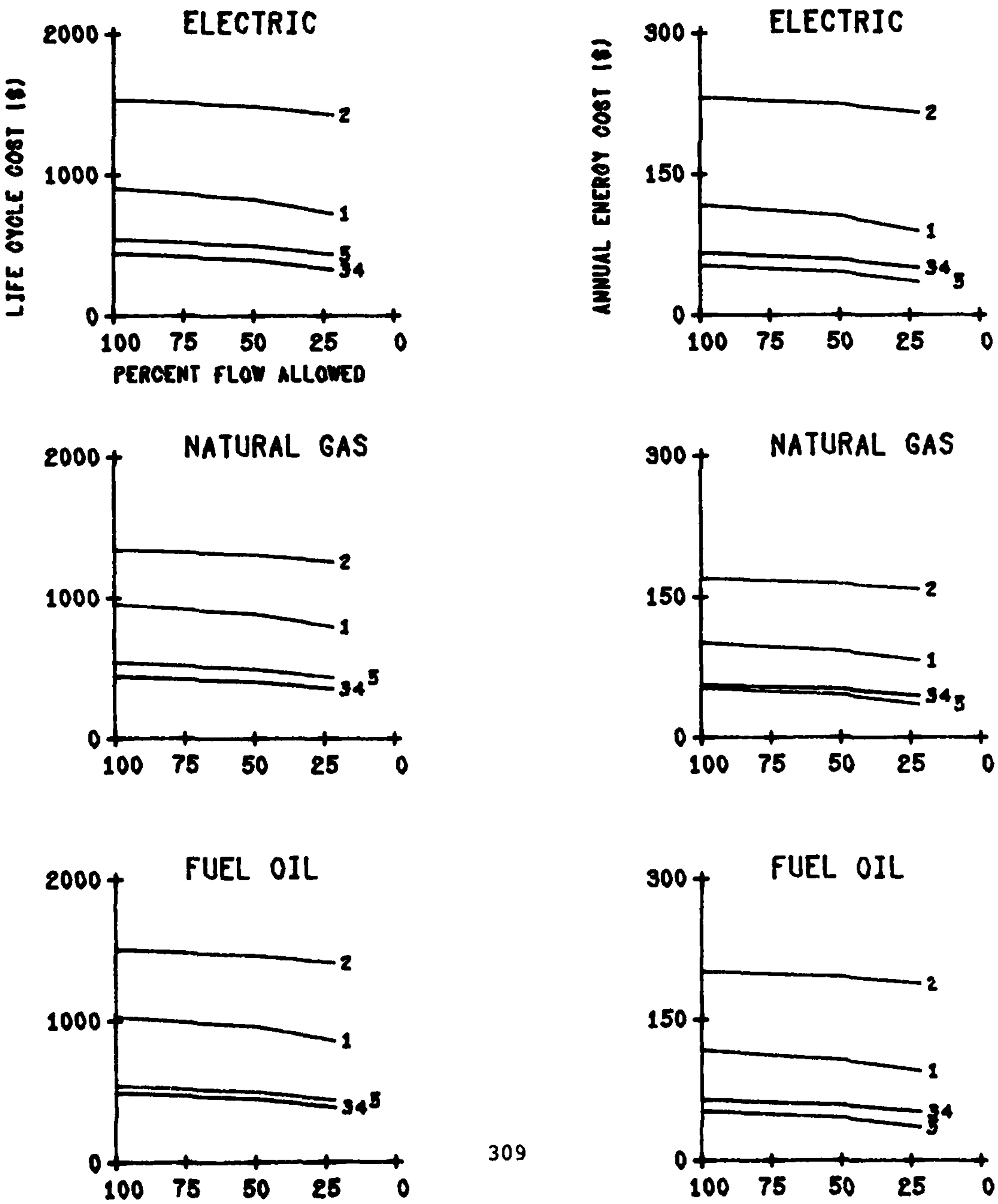
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	10	0.00

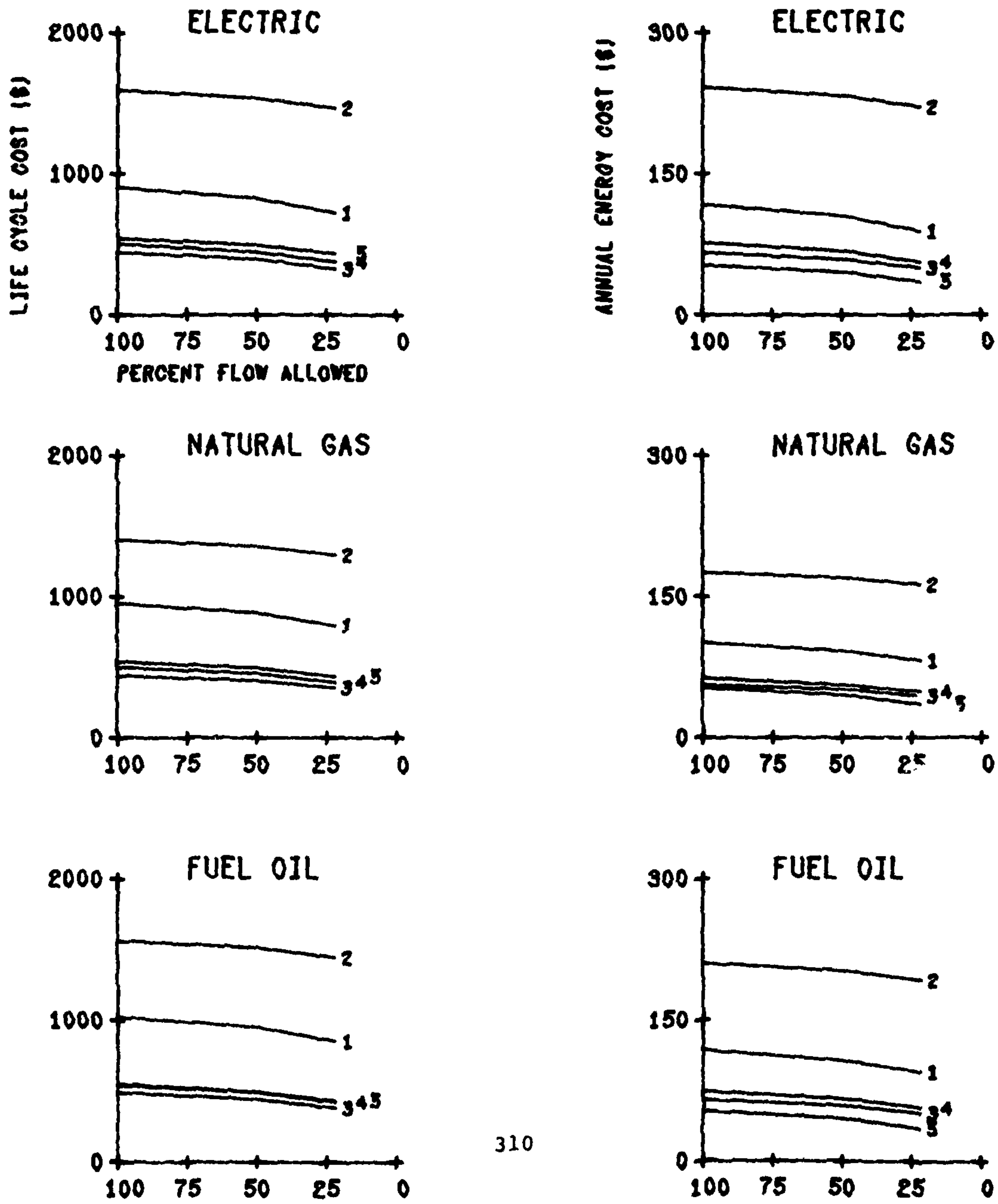
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	10	20.00

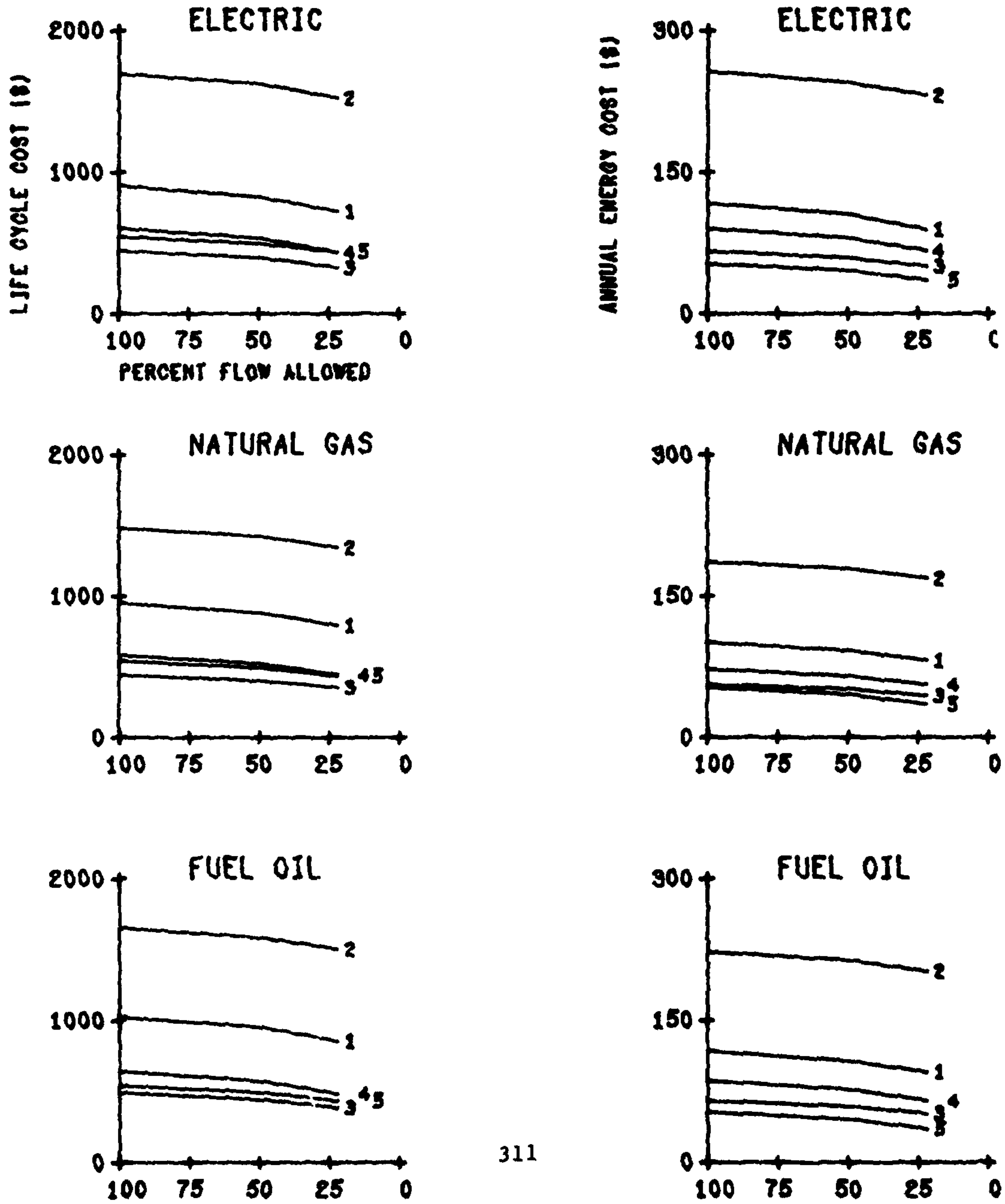
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
4	10	50.00

****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

BUILDING: CODE = 6 NAME = WAREHOUSE

FXTR TYPE	FXTR NAME	QTY	TEMP REQ CODE	HOT/TEPID FLOW RATE (GPM)	EST USAGE (GPH/FXTR) HOT/TEP	COLD
1	LAVATORY FAUCET	2	2	2.25	2.00	2.00
2	JANITORIAL FAUCET	1	2	3.75	7.00	7.00
3	TOILET	2	3	0.00	5.46	5.46
5	DRINKING FOUNTAIN	1	3	0.00	0.50	0.50

----- CENTRAL HEATER -----

CODE	NAME	EFFECIENCY
1	ELEC	0.95
2	GAS	0.75
3	OIL	0.70

CENTRAL HEATER STORAGE TANK

HEIGHT (IN)	DIAMETER (IN)
32.00	16.60

CENTRAL HEATER R VALUE(S) = 2.50

ADDITIONAL STANDBY LOSS FACTOR FOR GAS/OIL HEATERS = 2.90
CENTRAL HEATER LOCATION (C=COND SPACE, U=UNCOND) = C
REMAINING LIFE OF HEATER (YRS) = 4
ALTERNATIVE SYSTEM HEATER LIFE EXTENSION (YRS) = 3

NORMAL HEATED WATER LINE LENGTH(S) (FT) = 90.00

-------- HEATED WATER LINES --------

DIAMETER (IN)	EXTRA LENGTH COOLER (FT)	TOILET (FT)	PERCENT CONDITIONED SPACE
0.545	40.00	10.00	100.00

NUMBER OF PIPE COOLDOWN CYCLES PER DAY= 1.20

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

-------------- CONSTANT TEMPERATURES (F) --------------

******** HOT *******			******* TEPID ******			WATER	
WATER SUPPLY	MIN ALLOW	MAX ALLOW	WATER SUPPLY	MIN ALLOW	MAX ALLOW	COOLER OUTLET	ROOM
140.	130.	150.	105.	95.	115.	40.	68.

FOR DOE REGIONS:	2	8	10
AMBIENT TEMP (F)	51.00	51.00	60.00
GROUND WATER TEMP (F)	45.00	50.00	55.00
MIN GRD WATER TEMP (F)	39.00	45.00	49.00
MAX GRD WATER TEMP (F)	51.00	55.00	61.00

PERCENT INCREASED TEPID USE (NO COLD SYSTEMS) = 0.00 20.00 50.00

PERCENT OF FLOW (FLOW RESTRICTION) = 100.00 50.00 22.00
CORRESPONDING PERCENT USAGE = 100.00 85.00 66.00

WATER COOLER EFFECIENCY (%) = 70.00

NUMBER OF HOURS IN WORK DAY = 8.00
NUMBER WORK DAYS IN YEAR = 250.00

-------------------- POINT-OF-USE HEATERS --------------------

CODE	NAME	STORAGE TANK HEIGHT (IN)	STORAGE TANK DIAMETER (IN)	MAX FXTR DEMAND (GPH)	INSTALLED COST
4	INSTANTANEOUS 4.6 KW				237.00
5	INSTANTANEOUS 10 KW				400.00
6	INSTANTANEOUS 20 KW				420.00
7	MINITANK 1/2 GAL	6.00	5.00	6.25	200.00
8	MINITANK 1 GAL	8.00	6.06	12.00	260.00

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

FOR DOE REGION:	2	8	10
FOR FXTR TYPE 1 ($/FXTR) -			
INSTALLED COST	53.50	50.24	67.97
RETURN CR NEW	25.00	22.00	30.00
RETURN CR RETROFIT	0.00	0.00	0.00
FOR FXTR TYPE 2 ($/FXTR) -			
INSTALLED COST	53.50	50.24	67.97
RETURN CR NEW	25.00	22.00	30.00
RETURN CR RETROFIT	0.00	0.00	0.00
CREDIT - NO HOT/COLD SUPPLY	150.00	140.00	185.00
CENTRAL HTR TYPE 1 ($) -			
INSTALLED COST	195.28	187.90	228.08
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 2 ($) -			
INSTALLED COST	226.72	218.35	263.92
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 3 ($) -			
INSTALLED COST	226.72	218.35	263.92
RETURN CREDIT	0.00	0.00	0.00
COST OF ENERGY -			
ELECTRICITY ($/KWH)	0.070	0.036	0.022
NATURAL GAS ($/MBTU)	3.710	2.330	3.500
FUEL OIL ($/GAL)	0.581	0.541	0.550
10 YR PRESENT WORTH FACTORS -			
ELECTRICITY	6.183	6.841	6.601
NATURAL GAS	7.067	9.325	7.950
FUEL OIL	7.440	7.547	7.452

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2430E 08	0.2796E 08	0.1454E 08	0.1454E 08	0.1305E 08	0.1163E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	498.44	573.52	298.40	298.40	267.65	238.63
INS COST ($)	355.78	355.78	355.78	355.78	660.00	*********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	660.00	*********
TLEC CST ($)	3081.85	3546.13	1845.05	1845.05	1654.93	1475.48
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3437.63	3751.91	2200.83	2125.83	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2329E 08	0.2721E 08	0.1390E 08	0.1390E 08	0.1240E 08	0.1099E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	477.75	558.19	285.27	285.27	254.52	225.50
INS COST ($)	355.78	355.78	355.78	355.78	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	660.00	1260.00
TLEC CST ($)	2953.94	3451.34	1763.85	1763.85	1573.72	1394.28
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3309.72	3657.12	2119.63	2044.63	2233.72	2654.28

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2201E 08	0.2626E 08	0.1309E 08	0.1309E 08	0.1018E 08	0.1018E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.54	538.78	268.63	268.63	208.86	208.86
INS COST ($)	355.78	355.78	355.78	355.78	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	711.00	711.00
TLEC CST ($)	2791.93	3331.28	1660.99	1660.99	1291.42	1291.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3147.71	3537.06	2016.77	1941.77	2002.42	2002.42

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2430E 08	0.3027E 08	0.1454E 08	0.1686E 08	0.1305E 08	0.1395E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	498.44	621.01	298.40	345.89	267.65	286.11
INS COST ($)	355.78	355.78	355.78	355.78	660.00	*********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	660.00	*********
TLEC CST ($)	3081.85	3839.71	1845.05	2138.64	1654.93	1769.07
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3437.63	4045.49	2200.83	2419.42	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2329E 08	0.2940E 08	0.1390E 08	0.1609E 08	0.1240E 08	0.1318E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	477.75	603.09	285.27	330.16	254.52	270.39
INS COST ($)	355.78	355.78	355.78	355.78	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	660.00	1260.00
TLEC CST ($)	2953.94	3728.92	1763.85	2041.42	1573.72	1671.85
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3309.72	3934.70	2119.63	2322.20	2233.72	2931.85

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2201E 08	0.2829E 08	0.1309E 08	0.1512E 08	0.1018E 08	0.1221E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.54	580.39	268.63	310.25	208.86	250.45
INS COST ($)	355.78	355.78	355.78	355.78	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	711.00	711.00
TLEC CST ($)	2791.93	3588.57	1660.99	1918.28	1291.42	1548.71
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3147.71	3794.35	2016.77	2199.06	2002.42	2259.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2430E 08	0.3375E 08	0.1454E 08	0.2033E 08	0.1305E 08	0.1742E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	498.44	692.23	298.40	417.11	267.65	357.34
INS COST ($)	355.78	355.78	355.78	355.78	660.00	*********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	660.00	*********
TLEC CST ($)	3081.85	4280.10	1845.05	2579.02	1654.93	2209.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3437.63	4485.87	2200.83	2859.80	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2329E 08	0.3268E 08	0.1390E 08	0.1938E 08	0.1240E 08	0.1646E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	477.75	670.43	285.27	397.50	254.52	337.73
INS COST ($)	355.78	355.78	355.78	355.78	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	660.00	1260.00
TLEC CST ($)	2953.94	4145.28	1763.85	2457.78	1573.72	2088.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3309.72	4351.06	2119.63	2738.56	2233.72	3348.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2201E 08	0.3134E 08	0.1309E 08	0.1817E 08	0.1018E 08	0.1525E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.54	642.81	268.63	372.67	208.86	312.89
INS COST ($)	355.78	355.78	355.78	355.78	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	355.78	205.78	355.78	280.78	711.00	711.00
TLEC CST ($)	2791.93	3974.51	1660.99	2304.22	1291.42	1934.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3147.71	4180.29	2016.77	2585.00	2002.42	2645.65

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3618E 08	0.3784E 08	0.2122E 08	0.2122E 08	0.1305E 08	0.1163E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	135.23	153.41	79.75	79.75	267.65	238.63
INS COST ($)	387.22	387.22	387.22	387.22	660.00	**********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	**********
TLEC CST ($)	954.59	1070.12	562.57	562.57	1654.93	1475.48
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1341.81	1307.34	949.79	874.79	2314.93	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3490E 08	0.3693E 08	0.2042E 08	0.2042E 08	0.1240E 08	0.1099E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	130.34	148.06	76.60	76.60	254.52	225.50
INS COST ($)	387.22	387.22	387.22	387.22	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	1260.00
TLEC CST ($)	920.26	1034.44	540.47	540.47	1573.72	1394.28
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1307.47	1271.66	927.69	852.69	2233.72	2654.28

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	0.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3329E 08	0.3577E 08	0.1939E 08	0.1939E 08	0.1018E 08	0.1018E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	124.16	141.29	72.61	72.61	208.86	208.86
INS COST ($)	387.22	387.22	387.22	387.22	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	711.00	711.00
TLEC CST ($)	876.77	989.24	512.47	512.47	1291.42	1291.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1263.99	1226.46	899.69	824.69	2002.42	2002.42

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3618E 08	0.4078E 08	0.2122E 08	0.2416E 08	0.1305E 08	0.1395E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	135.23	164.29	79.75	90.63	267.65	286.11
INS COST ($)	387.22	387.22	387.22	387.22	660.00	*********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	*********
TLEC CST ($)	954.59	1147.01	562.57	639.46	1654.93	1769.07
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1341.81	1384.23	949.79	951.68	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3490E 08	0.3970E 08	0.2042E 08	0.2319E 08	0.1240E 08	0.1318E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	130.34	158.35	76.60	86.89	254.52	270.39
INS COST ($)	387.22	387.22	387.22	387.22	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	1260.00
TLEC CST ($)	920.26	1107.13	540.47	613.16	1573.72	1671.85
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1307.47	1344.35	927.69	925.38	2233.72	2931.85

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3329E 08	0.3834E 08	0.1939E 08	0.2196E 08	0.1018E 08	0.1221E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	124.16	150.82	72.61	82.15	208.86	250.48
INS COST ($)	387.22	387.22	387.22	387.22	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	711.00	711.00
TLEC CST ($)	876.77	1056.62	512.47	579.85	1291.42	1548.71
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1263.99	1293.84	899.69	892.07	2002.42	2259.71

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3618E 08	0.4517E 08	0.2122E 08	0.2856E 08	0.1305E 08	0.1742E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	135.23	180.60	79.75	106.95	267.65	357.34
INS COST ($)	387.22	387.22	387.22	387.22	660.00	**********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	**********
TLEC CST ($)	954.59	1262.34	562.57	754.79	1654.93	2209.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1341.81	1499.56	949.79	1067.01	2314.93	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3490E 08	0.4386E 08	0.2042E 08	0.2735E 08	0.1240E 08	0.1646E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	130.34	173.77	76.60	102.32	254.52	337.73
INS COST ($)	387.22	387.22	387.22	387.22	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	1260.00
TLEC CST ($)	920.26	1216.17	540.47	722.20	1573.72	2088.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1307.47	1453.39	927.69	1034.42	2233.72	3348.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3329E 08	0.4219E 08	0.1939E 08	0.2582E 08	0.1018E 08	0.1525E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	124.16	165.12	72.61	96.45	208.86	312.89
INS COST ($)	387.22	387.22	387.22	387.22	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	711.00	711.00
TLEC CST ($)	876.77	1157.69	512.47	680.92	1291.42	1934.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1263.99	1394.91	899.69	993.14	2002.42	2645.65

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3783E 08	0.3998E 08	0.2227E 08	0.2227E 08	0.1305E 08	0.1163E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	158.00	178.58	93.42	93.42	267.65	238.63
INS COST ($)	387.22	387.22	387.22	387.22	660.00	*********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	*********
TLEC CST ($)	1174.03	1308.71	693.51	693.51	1654.93	1475.48
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1561.25	1545.93	1080.73	1005.73	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3647E 08	0.3900E 08	0.2141E 08	0.2141E 08	0.1240E 08	0.1099E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	152.19	172.64	89.68	89.68	254.52	225.50
INS COST ($)	387.22	387.22	387.22	387.22	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	1260.00
TLEC CST ($)	1131.00	1267.54	665.92	665.92	1573.72	1394.28
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1518.22	1504.76	1053.14	978.14	2233.72	2654.28

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3474E 08	0.3777E 08	0.2031E 08	0.2031E 08	0.1018E 08	0.1018E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	144.82	165.12	84.94	84.94	208.86	208.86
INS COST ($)	387.22	387.22	387.22	387.22	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	711.00	711.00
TLEC CST ($)	1076.51	1215.39	630.97	630.97	1291.42	1291.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1463.73	1452.61	1018.19	943.19	2002.42	2002.42

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3783E 08	0.4312E 08	0.2227E 08	0.2541E 08	0.1305E 08	0.1395E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	158.00	191.62	93.42	106.45	267.65	286.11
INS COST ($)	387.22	387.22	387.22	387.22	660.00	*********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	*********
TLEC CST ($)	1174.03	1405.72	693.51	790.52	1654.93	1769.07
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1561.25	1642.94	1080.73	1102.74	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3647E 08	0.4197E 08	0.2141E 08	0.2438E 08	0.1240E 08	0.1318E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	152.19	184.97	89.68	102.00	254.52	270.39
INS COST ($)	387.22	387.22	387.22	387.22	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	1260.00
TLEC CST ($)	1131.00	1359.26	665.92	757.64	1573.72	1671.85
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1518.22	1596.48	1053.14	1069.86	2233.72	2931.85

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	20.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3474E 08	0.4053E 08	0.2031E 08	0.2306E 08	0.1018E 08	0.1221E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	144.82	176.55	84.94	96.37	208.86	250.48
INS COST ($)	387.22	387.22	387.22	387.22	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	711.00	711.00
TLEC CST ($)	1076.51	1300.40	630.97	715.99	1291.42	1548.71
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1463.73	1537.62	1018.19	1028.21	2002.42	2259.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3783E 08	0.4783E 08	0.2227E 08	0.3013E 08	0.1305E C8	0.1742E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	158.00	211.18	93.42	126.01	267.65	357.34
INS COST ($)	387.22	387.22	387.22	387.22	660.00	*********
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	*********
TLEC CST ($)	1174.03	1551.24	693.51	936.04	1654.93	2209.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1561.25	1788.46	1080.73	1248.26	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3647E 08	0.4643E 08	0.2141E 08	0.2883E 08	0.1240E 08	0.1646E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	152.19	203.46	89.68	120.50	254.52	337.73
INS COST ($)	387.22	387.22	387.22	387.22	660.00	1260.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	660.00	1260.00
TLEC CST ($)	1131.00	1496.84	665.92	895.22	1573.72	2088.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1518.22	1734.06	1053.14	1207.44	2233.72	3348.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	NEW	22.0	66.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3474E 08	0.4466E 08	0.2031E 08	0.2719E 08	0.1018E 08	0.1525E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	144.82	193.69	84.94	113.51	208.86	312.89
INS COST ($)	387.22	387.22	387.22	387.22	711.00	711.00
RET CR ($)	0.00	150.00	0.00	75.00	0.00	0.00
TOT COST ($)	387.22	237.22	387.22	312.22	711.00	711.00
TLEC CST ($)	1076.51	1427.93	630.97	843.51	1291.42	1934.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1463.73	1665.15	1018.19	1155.73	2002.42	2645.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2430E 08	0.2796E 08	0.1454E 08	0.1454E 08	0.1305E 08	0.1163E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	498.44	573.52	298.40	298.40	267.65	238.63
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	3081.85	3546.13	1845.05	1845.05	1654.93	1475.48
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	3215.23	3646.34	1945.27	1945.27	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2329E 08	0.2721E 08	0.1390E 08	0.1390E 08	0.1240E 08	0.1099E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	477.75	558.19	285.27	285.27	254.52	225.50
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	2953.94	3451.34	1763.85	1763.85	1573.72	1394.28
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	3087.32	3551.56	1864.07	1864.07	2233.72	2654.28

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2201E 08	0.2626E 08	0.1309E 08	0.1309E 08	0.1018E 08	0.1018E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.54	538.78	268.63	268.63	208.86	208.86
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	2791.93	3331.28	1660.99	1660.99	1291.42	1291.42
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	2925.30	3431.50	1761.21	1761.21	2002.42	2002.42

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2430E 08	0.3027E 08	0.1454E 08	0.1686E 08	0.1305E 08	0.1395E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	498.44	621.01	298.40	345.89	267.65	286.11
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	3081.85	3839.71	1845.05	2138.64	1654.93	1769.07
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	3215.23	3939.93	1945.27	2238.86	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2329E 08	0.2940E 08	0.1390E 08	0.1609E 08	0.1240E 08	0.1318E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	477.75	603.09	285.27	330.16	254.52	270.39
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	2953.94	3728.92	1763.85	2041.42	1573.72	1671.85
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	3087.32	3829.13	1864.07	2141.64	2233.72	2931.85

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2201E 08	0.2829E 08	0.1309E 08	0.1512E 08	0.1018E 08	0.1221E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.54	580.39	268.63	310.25	208.86	250.48
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	2791.93	3588.57	1660.99	1918.28	1291.42	1548.71
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	2925.30	3688.79	1761.21	2018.50	2002.42	2259.71

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2430E 08	0.3375E 08	0.1454E 08	0.2033E 08	0.1305E 08	0.1742E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	498.44	692.23	298.40	417.11	267.65	357.34
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	3081.85	4280.10	1845.05	2579.02	1654.93	2209.45
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	3215.23	4380.31	1945.27	2679.24	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2329E 08	0.3268E 08	0.1390E 08	0.1938E 08	0.1240E 08	0.1646E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	477.75	670.43	285.27	397.50	254.52	337.73
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	2953.94	4145.28	1763.85	2457.78	1573.72	2088.21
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	3087.32	4245.49	1864.07	2558.00	2233.72	3348.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2201E 08	0.3134E 08	0.1309E 08	0.1817E 08	0.1018E 08	0.1525E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.0000E 00	0.0000E 00
TAE COST ($)	451.54	642.81	268.63	372.67	208.86	312.89
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	2791.93	3974.51	1660.99	2304.22	1291.42	1934.65
RPLC HTR ($)	133.37	100.21	100.21	100.21	0.00	0.00
TLC COST ($)	2925.30	4074.72	1761.21	2404.44	2002.42	2645.65

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 4 1

- - - SUPPLY SYSTEM MODEL - - -	1	2	3	4	5	6
TAE USE (BTU)	0.3618E 08	0.3784E 08	0.2122E 08	0.2122E 08	0.1305E 08	0.1163E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	135.23	153.41	79.75	79.75	267.65	238.63
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	954.59	1070.12	562.57	562.57	1654.93	1475.48
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1109.44	1186.48	678.92	678.92	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	0.0	GAS	0 0 0 0 4 1

- - - SUPPLY SYSTEM MODEL - - -	1	2	3	4	5	6
TAE USE (BTU)	0.3490E 08	0.3693E 08	0.2042E 08	0.2042E 08	0.1240E 08	0.1099E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	130.34	148.06	76.60	76.60	254.52	225.50
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	920.26	1034.44	540.47	540.47	1573.72	1394.28
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1075.10	1150.79	656.82	656.82	2233.72	2654.28

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 1 1

- - - SUPPLY SYSTEM MODEL - - -	1	2	3	4	5	6
TAE USE (BTU)	0.3329E 08	0.3577E 08	0.1939E 08	0.1939E 08	0.1018E 08	0.1018E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	124.16	141.29	72.61	72.61	208.86	208.86
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	876.77	989.24	512.47	512.47	1291.42	1291.42
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1031.62	1105.59	628.83	628.83	2002.42	2002.42

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3618E 08	0.4078E 08	0.2122E 08	0.2416E 08	0.1305E 08	0.1395E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	135.23	164.29	79.75	90.63	267.65	286.11
INS COST ($)	0.00	0.00	0.00	0.00	660.00	**********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	**********
TLEC CST ($)	954.59	1147.01	562.57	639.46	1654.93	1769.07
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1109.44	1263.36	678.92	755.81	2314.93	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3490E 08	0.3970E 08	0.2042E 08	0.2319E 08	0.1240E 08	0.1318E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	130.34	158.35	76.60	86.89	254.52	270.39
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	920.26	1107.13	540.47	613.16	1573.72	1671.85
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1075.10	1223.49	656.82	729.51	2233.72	2931.85

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3329E 08	0.3834E 08	0.1939E 08	0.2196E 08	0.1018E 08	0.1221E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	124.16	150.82	72.61	82.15	208.86	250.48
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	876.77	1056.62	512.47	579.85	1291.42	1548.71
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1031.62	1172.97	628.83	696.21	2002.42	2259.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.3618E 08	0.4517E 08	0.2122E 08	0.2856E 08	0.1305E 08	0.1742E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	135.23	180.60	79.75	106.95	267.65	357.34
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	954.59	1262.34	562.57	754.79	1654.93	2209.45
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1109.44	1378.69	678.92	871.14	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.3490E 08	0.4386E 08	0.2042E 08	0.2735E 08	0.1240E 08	0.1646E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	130.34	173.77	76.60	102.32	254.52	337.73
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	920.26	1216.17	540.47	722.20	1573.72	2088.21
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1075.10	1332.52	656.82	838.55	2233.72	3348.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 1 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.3329E 08	0.4219E 08	0.1939E 08	0.2582E 08	0.1018E 08	0.1525E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	124.16	165.12	72.61	96.45	208.86	312.89
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	876.77	1157.69	512.47	680.92	1291.42	1934.65
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1031.62	1274.04	628.83	797.28	2002.42	2645.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3783E 08	0.3998E 08	0.2227E 08	0.2227E 08	0.1305E 08	0.1163E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	158.00	178.58	93.42	93.42	267.65	238.63
INS COST ($)	0.00	0.00	0.00	0.00	660.00	**********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	**********
TLEC CST ($)	1174.03	1308.71	693.51	693.51	1654.93	1475.48
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1328.88	1425.06	809.86	809.86	2314.93	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3647E 08	0.3900E 08	0.2141E 08	0.2141E 08	0.1240E 08	0.1099E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	152.19	172.64	89.68	89.68	254.52	225.50
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	1131.00	1267.54	665.92	665.92	1573.72	1394.28
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1285.85	1383.89	782.27	782.27	2233.72	2654.28

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3474E 08	0.3777E 08	0.2031E 08	0.2031E 08	0.1018E 08	0.1018E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	144.82	165.12	84.94	84.94	208.86	208.86
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	1076.51	1215.39	630.97	630.97	1291.42	1291.42
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1231.36	1331.74	747.32	747.32	2002.42	2002.42

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3783E 08	0.4312E 08	0.2227E 08	0.2541E 08	0.1305E 08	0.1395E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	158.00	191.62	93.42	106.45	267.65	286.11
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1174.03	1405.72	693.51	790.52	1654.93	1769.07
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1328.88	1522.07	809.86	906.87	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3647E 08	0.4197E 08	0.2141E 08	0.2438E 08	0.1240E 08	0.1318E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	152.19	184.97	89.68	102.00	254.52	270.39
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	1131.00	1359.26	665.92	757.64	1573.72	1671.85
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1285.85	1475.61	782.27	873.99	2233.72	2931.85

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3474E 08	0.4053E 08	0.2031E 08	0.2306E 08	0.1018E 08	0.1221E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	144.82	176.55	84.94	96.37	208.86	250.48
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	1076.51	1300.40	630.97	715.99	1291.42	1548.71
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1231.36	1416.76	747.32	832.34	2002.42	2259.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.3783E 08	0.4783E 08	0.2227E 08	0.3013E 08	0.1305E 08	0.1742E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	158.00	211.18	93.42	126.01	267.65	357.34
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1174.03	1551.24	693.51	936.04	1654.93	2209.45
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1328.88	1667.59	809.86	1052.39	2314.93	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.3647E 08	0.4643E 08	0.2141E 08	0.2883E 08	0.1240E 08	0.1646E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	152.19	203.46	89.68	120.50	254.52	337.73
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1260.00
TLEC CST ($)	1131.00	1496.84	665.92	895.22	1573.72	2088.21
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1285.85	1613.19	782.27	1011.57	2233.72	3348.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	2	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 1 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.3474E 08	0.4466E 08	0.2031E 08	0.2719E 08	0.1018E 08	0.1525E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.0000E 00	0.0000E 00
TAE COST ($)	144.82	193.69	84.94	113.51	208.86	312.89
INS COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	711.00	711.00
TLEC CST ($)	1076.51	1427.93	630.97	843.51	1291.42	1934.65
RPLC HTR ($)	154.84	116.35	116.35	116.35	0.00	0.00
TLC COST ($)	1231.36	1544.28	747.32	959.87	2002.42	2645.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2338E 08	0.2597E 08	0.1363E 08	0.1363E 08	0.1214E 08	0.1073E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	246.64	273.97	143.77	143.77	128.10	113.17
INS COST ($)	338.61	338.61	338.61	338.61	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	660.00	*********
TLEC CST ($)	1687.33	1874.29	983.57	983.57	876.37	774.26
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2025.95	2072.91	1322.19	1256.19	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2241E 08	0.2527E 08	0.1303E 08	0.1303E 08	0.1154E 08	0.1013E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	236.47	266.65	137.48	137.48	121.81	106.88
INS COST ($)	338.61	338.61	338.61	338.61	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	660.00	1220.00
TLEC CST ($)	1617.70	1824.15	940.51	940.51	833.31	731.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1956.32	2022.77	1279.13	1213.13	1493.31	1951.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2119E 08	0.2439E 08	0.1227E 08	0.1227E 08	0.1016E 08	0.9377E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	223.57	257.36	129.51	129.51	107.27	98.91
INS COST ($)	338.61	338.61	338.61	338.61	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	637.00	711.00
TLEC CST ($)	1529.50	1760.65	885.98	885.98	733.83	676.67
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1868.12	1959.27	1224.60	1158.60	1370.83	1387.67

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2338E 08	0.2809E 08	0.1363E 08	0.1575E 08	0.1214E 08	0.1285E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	246.64	296.36	143.77	166.16	128.10	135.56
INS COST ($)	338.61	338.61	338.61	338.61	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	660.00	*********
TLEC CST ($)	1687.33	2027.43	983.57	1136.70	876.37	927.39
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2025.95	2226.05	1322.19	1409.32	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2241E 08	0.2728E 08	0.1303E 08	0.1504E 08	0.1154E 08	0.1213E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	236.47	287.81	137.48	158.64	121.81	128.05
INS COST ($)	338.61	338.61	338.61	338.61	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	660.00	1220.00
TLEC CST ($)	1617.70	1968.94	940.51	1085.30	833.31	875.99
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1956.32	2167.56	1279.13	1357.92	1493.31	2095.99

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2119E 08	0.2625E 08	0.1227E 08	0.1413E 08	0.1016E 08	0.1123E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	223.57	276.98	129.51	149.12	107.27	118.53
INS COST ($)	338.61	338.61	338.61	338.61	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	637.00	711.00
TLEC CST ($)	1529.50	1894.85	885.98	1020.18	733.83	810.87
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1868.12	2093.47	1224.60	1292.80	1370.83	1521.87

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2338E 08	0.3128E 08	0.1363E 08	0.1893E 08	0.1214E 08	0.1603E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	246.64	329.94	143.77	199.73	128.10	169.14
INS COST ($)	338.61	338.61	338.61	338.61	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	660.00	*********
TLEC CST ($)	1687.33	2257.13	983.57	1366.40	876.37	1157.10
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	2025.95	2455.75	1322.19	1639.02	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2241E 08	0.3029E 08	0.1303E 08	0.1805E 08	0.1154E 08	0.1514E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	236.47	319.56	137.48	190.39	121.81	159.79
INS COST ($)	338.61	338.61	338.61	338.61	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	660.00	1220.00
TLEC CST ($)	1617.70	2186.11	940.51	1302.47	833.31	1093.16
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1956.32	2384.73	1279.13	1575.09	1493.31	2313.16

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2119E 08	0.2904E 08	0.1227E 08	0.1692E 08	0.1016E 08	0.1402E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	223.57	306.41	129.51	178.55	107.27	147.95
INS COST ($)	338.61	338.61	338.61	338.61	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	338.61	198.61	338.61	272.61	637.00	711.00
TLEC CST ($)	1529.50	2096.15	885.98	1221.49	733.83	1012.18
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1868.12	2294.77	1224.60	1494.11	1370.83	1723.18

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3500E 08	0.3533E 08	0.2005E 08	0.2005E 08	0.1214E 08	0.1073E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	82.53	88.68	47.70	47.70	128.10	113.17
INS COST ($)	369.07	369.07	369.07	369.07	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	*********
TLEC CST ($)	766.55	806.73	441.69	441.69	876.37	774.26
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1135.62	1035.80	810.76	744.76	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3378E 08	0.3448E 08	0.1930E 08	0.1930E 08	0.1154E 08	0.1013E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	79.55	85.75	45.80	45.80	121.81	106.88
INS COST ($)	369.07	369.07	369.07	369.07	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	1220.00
TLEC CST ($)	739.20	782.43	424.47	424.47	833.31	731.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1108.27	1011.50	793.54	727.54	1493.31	1951.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3224E 08	0.3340E 08	0.1835E 08	0.1835E 08	0.1016E 08	0.9377E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	75.77	82.04	43.40	43.40	107.27	98.91
INS COST ($)	369.07	369.07	369.07	369.07	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	637.00	711.00
TLEC CST ($)	704.55	751.65	402.66	402.66	733.83	676.67
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1073.62	980.72	771.73	705.73	1370.83	1387.67

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3500E 08	0.3802E 08	0.2005E 08	0.2274E 08	0.1214E 08	0.1285E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	82.53	94.95	47.70	53.96	128.10	135.56
INS COST ($)	369.07	369.07	369.07	369.07	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	*********
TLEC CST ($)	766.55	865.14	441.69	500.09	876.37	927.39
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1135.62	1094.21	810.76	803.16	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3378E 08	0.3702E 08	0.1930E 08	0.2184E 08	0.1154E 08	0.1213E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	79.55	91.67	45.80	51.72	121.81	128.05
INS COST ($)	369.07	369.07	369.07	369.07	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	1220.00
TLEC CST ($)	739.20	837.65	424.47	479.69	833.31	875.99
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1108.27	1066.72	793.54	782.76	1493.31	2095.99

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3224E 08	0.3576E 08	0.1835E 08	0.2070E 08	0.1016E 08	0.1123E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	75.77	87.52	43.40	48.89	107.27	118.53
INS COST ($)	369.07	369.07	369.07	369.07	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	637.00	711.00
TLEC CST ($)	704.55	802.83	402.66	453.85	733.83	810.87
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1073.62	1031.90	771.73	756.9[illegible]	1370.83	1521.87

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3500E 08	0.4205E 08	0.2005E 08	0.2677E 08	0.1214E 08	0.1603E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	82.53	104.34	47.70	63.35	128.10	169.14
INS COST ($)	369.07	369.07	369.07	369.07	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	*********
TLEC CST ($)	766.55	952.74	441.69	587.70	876.37	1157.10
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1135.62	1181.81	810.76	890.77	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3378E 08	0.4083E 08	0.1930E 08	0.2565E 08	0.1154E 08	0.1514E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	79.55	100.55	45.80	60.60	121.81	159.79
INS COST ($)	369.07	369.07	369.07	369.07	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	1220.00
TLEC CST ($)	739.20	920.48	424.47	562.52	833.31	1093.16
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1108.27	1149.55	793.54	865.59	1493.31	2313.16

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3224E 08	0.3929E 08	0.1835E 08	0.2424E 08	0.1016E 08	0.1402E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	75.77	95.76	43.40	57.12	107.27	147.95
INS COST ($)	369.07	369.07	369.07	369.07	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	637.00	711.00
TLEC CST ($)	704.55	879.61	402.66	530.63	733.83	1012.18
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1073.62	1108.68	771.73	833.70	1370.83	1723.18

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3657E 08	0.3729E 08	0.2101E 08	0.2101E 08	0.1214E 08	0.1073E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	142.13	149.27	81.99	81.99	128.10	113.17
INS COST ($)	369.07	369.07	369.07	369.07	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	*********
TLEC CST ($)	1071.80	1120.82	617.93	617.93	876.37	774.26
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1440.87	1349.89	987.00	921.00	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3527E 08	0.3638E 08	0.2020E 08	0.2020E 08	0.1154E 08	0.1013E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	136.97	145.01	78.77	78.77	121.81	106.88
INS COST ($)	369.07	369.07	369.07	369.07	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	1220.00
TLEC CST ($)	1033.03	1089.53	593.73	593.73	833.31	731.21
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1402.10	1318.60	962.80	896.80	1493.31	1951.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3362E 08	0.3524E 08	0.1919E 08	0.1919E 08	0.1016E 08	0.9377E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	130.44	139.62	74.68	74.68	107.27	98.91
INS COST ($)	369.07	369.07	369.07	369.07	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	637.00	711.00
TLEC CST ($)	983.92	1049.91	563.08	563.08	733.83	676.67
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1352.99	1278.98	932.15	866.15	1370.83	1387.67

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3657E 08	0.4017E 08	0.2101E 08	0.2389E 08	0.1214E 08	0.1285E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	142.13	160.40	81.99	93.12	128.10	135.56
INS COST ($)	369.07	369.07	369.07	369.07	660.00	*********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	*********
TLEC CST ($)	1071.80	1204.81	617.93	701.93	876.37	927.39
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1440.87	1433.88	987.00	1005.00	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3527E 08	0.3911E 08	0.2020E 08	0.2293E 08	0.1154E 08	0.1213E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	136.97	155.53	78.77	89.29	121.81	128.05
INS COST ($)	369.07	369.07	369.07	369.07	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	1220.00
TLEC CST ($)	1033.03	1168.95	593.73	673.15	833.31	875.99
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1402.10	1398.02	962.80	976.22	1493.31	2095.99

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3362E 08	0.3777E 08	0.1919E 08	0.2171E 08	0.1016E 08	0.1123E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	130.44	149.37	74.68	84.44	107.27	118.53
INS COST ($)	369.07	369.07	369.07	369.07	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	637.00	711.00
TLEC CST ($)	983.92	1123.52	563.08	636.70	733.83	810.87
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1352.99	1352.59	932.15	939.77	1370.83	1521.87

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	100.0	100.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3657E 08	0.4449E 08	0.2101E 08	0.2821E 08	0.1214E 08	0.1603E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	142.13	177.09	81.99	109.81	128.10	169.14
INS COST ($)	369.07	369.07	369.07	369.07	660.00	**********
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	**********
TLEC CST ($)	1071.80	1330.81	617.93	827.92	876.37	1157.10
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1440.87	1559.88	987.00	1130.99	1536.37	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	50.0	85.0	50.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3527E 08	0.4319E 08	0.2020E 08	0.2701E 08	0.1154E 08	0.1514E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	136.97	171.32	78.77	105.07	121.81	159.79
INS COST ($)	369.07	369.07	369.07	369.07	660.00	1220.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	660.00	1220.00
TLEC CST ($)	1033.03	1288.07	593.73	792.27	833.31	1093.16
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1402.10	1517.14	962.80	1095.34	1493.31	2313.16

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	NEW	22.0	66.0	50.0	OIL	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3362E 08	0.4155E 08	0.1919E 08	0.2550E 08	0.1016E 08	0.1402E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	130.44	164.00	74.68	99.07	107.27	147.95
INS COST ($)	369.07	369.07	369.07	369.07	637.00	711.00
RET CR ($)	0.00	140.00	0.00	66.00	0.00	0.00
TOT COST ($)	369.07	229.06	369.07	303.07	637.00	711.00
TLEC CST ($)	983.92	1233.94	563.08	747.11	733.83	1012.18
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1352.99	1463.01	932.15	1050.18	1370.83	1723.18

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2338E 08	0.2597E 08	0.1363E 08	0.1363E 08	0.1214E 08	0.1073E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	246.64	273.97	143.77	143.77	128.10	113.17
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1687.33	1874.29	983.57	983.57	876.37	774.26
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1815.66	1970.72	1080.00	1080.00	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2241E 08	0.2527E 08	0.1303E 08	0.1303E 08	0.1154E 08	0.1013E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	236.47	266.65	137.48	137.48	121.81	106.88
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	1617.70	1824.15	940.51	940.51	833.31	731.21
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1746.03	1920.58	1036.94	1036.94	1493.31	1951.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2119E 08	0.2439E 08	0.1227E 08	0.1227E 08	0.1016E 08	0.9377E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	223.57	257.36	129.51	129.51	107.27	98.91
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	1529.50	1760.65	885.98	885.98	733.83	676.67
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1657.83	1857.08	982.41	982.41	1370.83	1387.67

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2338E 08	0.2809E 08	0.1363E 08	0.1575E 08	0.1214E 08	0.1285E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	246.64	296.36	143.77	166.16	128.10	135.56
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1687.33	2027.43	983.57	1136.70	876.37	927.39
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1815.66	2123.86	1080.00	1233.13	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2241E 08	0.2728E 08	0.1303E 08	0.1504E 08	0.1154E 08	0.1213E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	236.47	287.81	137.48	158.64	121.81	128.05
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	1617.70	1968.94	940.51	1085.30	833.31	875.99
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1746.03	2065.37	1036.94	1181.73	1493.31	2095.99

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2119E 08	0.2625E 08	0.1227E 08	0.1413E 08	0.1016E 08	0.1123E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	223.57	276.98	129.51	149.12	107.27	118.53
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	1529.50	1894.85	885.98	1020.18	733.83	810.87
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1657.83	1991.28	982.41	1116.61	1370.83	1521.87

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2338E 08	0.3128E 08	0.1363E 08	0.1893E 08	0.1214E 08	0.1603E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	246.64	329.94	143.77	199.73	128.10	169.14
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1687.33	2257.13	983.57	1366.40	876.37	1157.10
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1815.66	2353.56	1080.00	1462.83	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2241E 08	0.3029E 08	0.1303E 08	0.1805E 08	0.1154E 08	0.1514E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	236.47	319.56	137.48	190.39	121.81	159.79
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	1617.70	2186.11	940.51	1302.47	833.31	1093.16
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1746.03	2282.54	1036.94	1398.90	1493.31	2313.16

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2119E 08	0.2904E 08	0.1227E 08	0.1692E 08	0.1016E 08	0.1402E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	223.57	306.41	129.51	178.55	107.27	147.95
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	1529.50	2096.15	885.98	1221.49	733.83	1012.18
RPLC HTR ($)	128.33	96.43	96.43	96.43	0.00	0.00
TLC COST ($)	1657.83	2192.58	982.41	1317.92	1370.83	1723.18

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3500E 08	0.3533E 08	0.2005E 08	0.2005E 08	0.1214E 08	0.1073E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	82.53	88.68	47.70	47.70	128.10	113.17
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	**********
TLEC CST ($)	766.55	806.73	441.69	441.69	876.37	774.26
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	915.69	918.79	553.75	553.75	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3378E 08	0.3448E 08	0.1930E 08	0.1930E 08	0.1154E 08	0.1013E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	79.55	85.75	45.80	45.80	121.81	106.88
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	739.20	782.43	424.47	424.47	833.31	731.21
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	888.33	894.48	536.53	536.53	1493.31	1951.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3224E 08	0.3340E 08	0.1835E 08	0.1835E 08	0.1016E 08	0.9377E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	75.77	82.04	43.40	43.40	107.27	98.91
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	704.55	751.65	402.66	402.66	733.83	676.67
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	853.68	863.70	514.72	514.72	1370.83	1387.67

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3500E 08	0.3802E 08	0.2005E 08	0.2274E 08	0.1214E 08	0.1285E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	82.53	94.95	47.70	53.96	128.10	135.56
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	766.55	865.14	441.69	500.09	876.37	927.39
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	915.69	977.19	553.75	612.15	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	20.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3378E 08	0.3702E 08	0.1930E 08	0.2184E 08	0.1154E 08	0.1213E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	79.55	91.67	45.80	51.72	121.81	128.05
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	739.20	837.65	424.47	479.69	833.31	875.99
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	888.33	949.70	536.53	591.75	1493.31	2095.99

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3224E 08	0.3576E 08	0.1835E 08	0.2070E 08	0.1016E 08	0.1123E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	75.77	87.52	43.40	48.89	107.27	118.53
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	704.55	802.83	402.66	453.85	733.83	810.87
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	853.68	914.89	514.72	565.91	1370.83	1521.87

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3500E 08	0.4205E 08	0.2005E 08	0.2677E 08	0.1214E 08	0.1603E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	82.53	104.34	47.70	63.35	128.10	169.14
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	766.55	952.74	441.69	587.70	876.37	1157.10
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	915.69	1064.80	553.75	699.76	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	50.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3378E 08	0.4083E 08	0.1930E 08	0.2565E 08	0.1154E 08	0.1514E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	79.55	100.55	45.80	60.60	121.81	159.79
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	739.20	920.48	424.47	562.52	833.31	1093.16
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	888.33	1032.54	536.53	674.58	1493.31	2313.16

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3224E 08	0.3929E 08	0.1835E 08	0.2424E 08	0.1016E 08	0.1402E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	75.77	95.76	43.40	57.12	107.27	147.95
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	704.55	879.61	402.66	530.63	733.83	1012.18
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	853.68	991.66	514.72	642.68	1370.83	1723.18

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3657E 08	0.3729E 08	0.2101E 08	0.2101E 08	0.1214E 08	0.1073E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	142.13	149.27	81.99	81.99	128.10	113.17
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1071.80	1120.82	617.93	617.93	876.37	774.26
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1220.94	1232.87	729.99	729.99	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3527E 08	0.3638E 08	0.2020E 08	0.2020E 08	0.1154E 08	0.1013E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	136.97	145.01	78.77	78.77	121.81	106.88
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	1033.03	1089.53	593.73	593.73	833.31	731.21
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1182.16	1201.59	705.79	705.79	1493.31	1951.21

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3362E 08	0.3524E 08	0.1919E 08	0.1919E 08	0.1016E 08	0.9377E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	130.44	139.62	74.68	74.68	107.27	98.91
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	983.92	1049.91	563.08	563.08	733.83	676.67
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1133.05	1161.97	675.14	675.14	1370.83	1387.67

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3657E 08	0.4017E 08	0.2101E 08	0.2389E 08	0.1214E 08	0.1285E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	142.13	160.40	81.99	93.12	128.10	135.56
INS COST ($)	0.00	0.00	0.00	0.00	660.00	**********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	**********
TLEC CST ($)	1071.80	1204.81	617.93	701.93	876.37	927.39
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1220.94	1316.87	729.99	813.98	1536.37	**********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	20.0	OIL	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3527E 08	0.3911E 08	0.2020E 08	0.2293E 08	0.1154E 08	0.1213E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	136.97	155.53	78.77	89.29	121.81	128.05
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	1033.03	1168.95	593.73	673.15	833.31	875.99
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1182.16	1281.01	705.79	785.20	1493.31	2095.99

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3362E 08	0.3777E 08	0.1919E 08	0.2171E 08	0.1016E 08	0.1123E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	130.44	149.37	74.68	84.44	107.27	118.53
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	983.92	1123.52	563.08	636.70	733.83	810.87
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1133.05	1235.58	675.14	748.75	1370.83	1521.87

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3657E 08	0.4449E 08	0.2101E 08	0.2821E 08	0.1214E 08	0.1603E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	142.13	177.09	81.99	109.81	128.10	169.14
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1071.80	1330.81	617.93	827.92	876.37	1157.10
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1220.94	1442.86	729.99	939.98	1536.37	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3527E 08	0.4319E 08	0.2020E 08	0.2701E 08	0.1154E 08	0.1514E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	136.97	171.32	78.77	105.07	121.81	159.79
INS COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	1220.00
TLEC CST ($)	1033.03	1288.07	593.73	792.27	833.31	1093.16
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1182.16	1400.13	705.79	904.33	1493.31	2313.16

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	8	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3362E 08	0.4155E 08	0.1919E 08	0.2550E 08	0.1016E 08	0.1402E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	130.44	164.00	74.68	99.07	107.27	147.95
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	983.92	1233.94	563.08	747.11	733.83	1012.18
RPLC HTR ($)	149.13	112.05	112.05	112.05	0.00	0.00
TLC COST ($)	1133.05	1346.00	675.14	859.17	1370.83	1723.18

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2246E 08	0.2398E 08	0.1271E 08	0.1271E 08	0.1123E 08	0.9824E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	144.80	154.61	81.94	81.94	72.45	63.33
INS COST ($)	431.98	431.98	431.98	431.98	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	660.00	*********
TLEC CST ($)	955.87	1020.59	540.89	540.89	478.25	418.04
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1387.86	1267.58	972.88	882.88	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2154E 08	0.2334E 08	0.1215E 08	0.1215E 08	0.1068E 08	0.9271E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	138.86	150.47	78.37	78.37	68.88	59.76
INS COST ($)	431.98	431.98	431.98	431.98	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	660.00	894.00
TLEC CST ($)	916.67	993.26	517.36	517.36	454.72	394.52
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1348.66	1240.25	949.35	859.35	1114.72	1288.52

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2037E 08	0.2253E 08	0.1145E 08	0.1145E 08	0.9363E 07	0.8571E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	131.34	145.22	73.86	73.86	60.35	55.25
INS COST ($)	431.98	431.98	431.98	431.98	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	637.00	711.00
TLEC CST ($)	867.02	958.65	487.56	487.56	398.42	364.71
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1299.01	1205.64	919.55	829.55	1035.42	1075.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2246E 08	0.2591E 08	0.1271E 08	0.1464E 08	0.1123E 08	0.1175E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	144.80	167.04	81.94	94.37	72.45	75.76
INS COST ($)	431.98	431.98	431.98	431.98	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	660.00	*********
TLEC CST ($)	955.87	1102.68	540.89	622.98	478.25	500.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1387.86	1349.67	972.88	964.97	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2154E 08	0.2516E 08	0.1215E 08	0.1398E 08	0.1068E 08	0.1109E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	138.86	162.23	78.37	90.13	68.88	71.52
INS COST ($)	431.98	431.98	431.98	431.98	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	660.00	894.00
TLEC CST ($)	916.67	1070.88	517.36	594.97	454.72	472.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1348.66	1317.87	949.35	936.96	1114.72	1366.13

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2037E 08	0.2422E 08	0.1145E 08	0.1314E 08	0.9363E 07	0.1026E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	131.34	156.12	73.86	84.76	60.35	66.15
INS COST ($)	431.98	431.98	431.98	431.98	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	637.00	711.00
TLEC CST ($)	867.02	1030.59	487.56	559.50	398.42	436.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1299.01	1277.58	919.55	901.49	1035.42	1147.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2246E 08	0.2880E 08	0.1271E 08	0.1753E 08	0.1123E 08	0.1464E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	144.80	185.70	81.94	113.03	72.45	94.42
INS COST ($)	431.98	431.98	431.98	431.98	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	660.00	*********
TLEC CST ($)	955.87	1225.82	540.89	746.11	478.25	623.27
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1387.86	1472.81	972.88	1088.10	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2154E 08	0.2790E 08	0.1215E 08	0.1671E 08	0.1068E 08	0.1383E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	138.86	179.86	78.37	107.77	68.88	89.16
INS COST ($)	431.98	431.98	431.98	431.98	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	660.00	894.00
TLEC CST ($)	916.67	1187.30	517.36	711.39	454.72	588.55
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1348.66	1434.29	949.35	1053.38	1114.72	1482.55

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2037E 08	0.2675E 08	0.1145E 08	0.1568E 08	0.9363E 07	0.1279E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	131.34	172.47	73.86	101.10	60.35	82.49
INS COST ($)	431.98	431.98	431.98	431.98	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	431.98	246.98	431.98	341.98	637.00	711.00
TLEC CST ($)	867.02	1138.51	487.56	667.41	398.42	544.57
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1299.01	1385.49	919.55	1009.40	1035.42	1255.57

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3382E 08	0.3282E 08	0.1887E 08	0.1887E 08	0.1123E 08	0.9824E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	118.92	117.15	66.59	66.59	72.45	63.33
INS COST ($)	467.82	467.82	467.82	467.82	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	*********
TLEC CST ($)	943.91	924.64	527.87	527.87	478.25	418.04
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1411.74	1207.47	995.70	905.70	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3266E 08	0.3203E 08	0.1818E 08	0.1818E 08	0.1068E 08	0.9271E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	114.78	114.07	64.08	64.08	68.88	59.76
INS COST ($)	467.82	467.82	467.82	467.82	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	894.00
TLEC CST ($)	911.24	901.16	508.19	508.19	454.72	394.52
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1379.07	1183.99	976.02	886.02	1114.72	1288.52

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3119E 08	0.3104E 08	0.1730E 08	0.1730E 08	0.9363E 07	0.8571E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	109.54	110.17	60.91	60.91	60.35	55.25
INS COST ($)	467.82	467.82	467.82	467.82	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	637.00	711.00
TLEC CST ($)	869.87	871.41	483.25	483.25	398.42	364.71
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1337.70	1154.24	951.08	861.08	1035.42	1075.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3382E 08	0.3526E 08	0.1887E 08	0.2132E 08	0.1123E 08	0.1175E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	118.92	125.70	66.59	75.14	72.45	75.76
INS COST ($)	467.82	467.82	467.82	467.82	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	*********
TLEC CST ($)	943.91	992.64	527.87	595.87	478.25	500.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1411.74	1275.47	995.70	973.70	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3266E 08	0.3434E 08	0.1818E 08	0.2049E 08	0.1068E 08	0.1109E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	114.78	122.15	64.08	72.17	68.88	71.52
INS COST ($)	467.82	467.82	467.82	467.82	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	894.00
TLEC CST ($)	911.24	965.45	508.19	572.47	454.72	472.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1379.07	1248.28	976.02	950.30	1114.72	1366.13

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3119E 08	0.3318E 08	0.1730E 08	0.1944E 08	0.9363E 07	0.1026E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	109.54	117.66	60.91	68.41	60.35	66.15
INS COST ($)	467.82	467.82	467.82	467.82	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	637.00	711.00
TLEC CST ($)	869.87	931.01	483.25	542.84	398.42	436.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1337.70	1213.84	951.08	920.67	1035.42	1147.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	50.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3382E 08	0.3893E 08	0.1887E 08	0.2498E 08	0.1123E 08	0.1464E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	118.92	138.53	66.59	87.97	72.45	94.42
INS COST ($)	467.82	467.82	467.82	467.82	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	*********
TLEC CST ($)	943.91	1094.63	527.87	697.86	478.25	623.27
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1411.74	1377.46	995.70	1075.69	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	50.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3266E 08	0.3781E 08	0.1818E 08	0.2395E 08	0.1068E 08	0.1383E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	114.78	134.28	64.08	84.30	68.88	89.16
INS COST ($)	467.82	467.82	467.82	467.82	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	894.00
TLEC CST ($)	911.24	1061.88	508.19	66[illegible].91	454.72	588.55
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1379.07	1344.71	976.02	1046.74	1114.72	1482.55

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	50.0	GAS	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3119E 08	0.3640E 08	0.1730E 08	0.2265E 08	0.9363E 07	0.1279E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	109.54	128.91	60.91	79.65	60.35	82.49
INS COST ($)	467.82	467.82	467.82	467.82	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	637.00	711.00
TLEC CST ($)	869.87	1020.39	483.25	632.23	398.42	544.57
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1337.70	1303.22	951.08	1010.06	1035.42	1255.57

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3531E 08	0.3460E 08	0.1974E 08	0.1974E 08	0.1123E 08	0.9824E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	139.17	137.87	78.03	78.03	72.45	63.33
INS COST ($)	467.82	467.82	467.82	467.82	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	*********
TLEC CST ($)	1036.17	1023.22	580.55	580.55	478.25	418.04
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1504.00	1306.05	1048.38	958.38	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3407E 08	0.3377E 08	0.1900E 08	0.1900E 08	0.1068E 08	0.9271E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	134.23	134.32	75.05	75.05	68.88	59.76
INS COST ($)	467.82	467.82	467.82	467.82	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	894.00
TLEC CST ($)	999.49	997.37	558.51	558.51	454.72	394.52
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1467.32	1280.20	1026.34	936.34	1114.72	1288.52

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3250E 08	0.3271E 08	0.1807E 08	0.1807E 08	0.9363E 07	0.8571E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	127.97	129.82	71.28	71.28	60.35	55.25
INS COST ($)	467.82	467.82	467.82	467.82	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	637.00	711.00
TLEC CST ($)	953.03	964.64	530.58	530.58	398.42	364.71
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1420.86	1247.47	998.41	908.41	1035.42	1075.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3531E 08	0.3721E 08	0.1974E 08	0.2236E 08	0.1123E 08	0.1175E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	139.17	148.16	78.03	88.32	72.45	75.76
INS COST ($)	467.82	467.82	467.82	467.82	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	*********
TLEC CST ($)	1036.17	1099.87	580.55	657.20	478.25	500.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1504.00	1382.70	1048.38	1035.03	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3407E 08	0.3624E 08	0.1900E 08	0.2148E 08	0.1068E 08	0.1109E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	134.23	144.54	75.05	84.78	68.88	71.52
INS COST ($)	467.82	467.82	467.82	467.82	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	894.00
TLEC CST ($)	999.49	1069.85	558.51	630.98	454.72	472.13
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1467.32	1352.68	1026.34	1008.81	1114.72	1366.13

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3250E 08	0.3501E 08	0.1807E 08	0.2036E 08	0.9363E 07	0.1026E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	127.97	138.83	71.28	80.30	60.35	66.15
INS COST ($)	467.82	467.82	467.82	467.82	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	637.00	711.00
TLEC CST ($)	953.03	1031.82	530.58	597.76	398.42	436.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1420.86	1314.65	998.41	975.59	1035.42	1147.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3531E 08	0.4114E 08	0.1974E 08	0.2629E 08	0.1123E 08	0.1464E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	139.17	163.59	78.03	103.75	72.45	94.42
INS COST ($)	467.82	467.82	467.82	467.82	660.00	*********
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	*********
TLEC CST ($)	1036.17	1214.85	580.55	772.18	478.25	623.27
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1504.00	1497.68	1048.38	1150.01	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3407E 08	0.3995E 08	0.1900E 08	0.2519E 08	0.1068E 08	0.1383E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	134.23	158.63	75.05	99.37	68.88	89.16
INS COST ($)	467.82	467.82	467.82	467.82	660.00	894.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	660.00	894.00
TLEC CST ($)	999.49	1178.55	558.51	739.69	454.72	588.55
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1467.32	1461.38	1026.34	1117.52	1114.72	1482.55

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	NEW	22.0	66.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3250E 08	0.3845E 08	0.1807E 08	0.2380E 08	0.9363E 07	0.1279E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	127.97	152.35	71.28	93.82	60.35	82.49
INS COST ($)	467.82	467.82	467.82	467.82	637.00	711.00
RET CR ($)	0.00	185.00	0.00	90.00	0.00	0.00
TOT COST ($)	467.82	282.82	467.82	377.82	637.00	711.00
TLEC CST ($)	953.03	1132.58	530.58	698.52	398.42	544.57
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	1420.86	1415.41	998.41	1076.35	1035.42	1255.57

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	0.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2246E 08	0.2398E 08	0.1271E 08	0.1271E 08	0.1123E 08	0.9824E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	144.80	154.61	81.94	81.94	72.45	63.33
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TL [illegible] CST ($)	955.87	1020.59	540.89	540.89	478.25	418.04
RPL HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1111.65	1137.64	657.94	657.94	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	0.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2154E 08	0.2334E 08	0.1215E 08	0.1215E 08	0.1068E 08	0.9271E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	138.86	150.47	78.37	78.37	68.88	59.76
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	916.67	993.26	517.36	517.36	454.72	394.52
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1072.45	1110.32	634.41	634.41	1114.72	1288.52

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	0.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2037E 08	0.2253E 08	0.1145E 08	0.1145E 08	0.9363E 07	0.8571E 07
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	131.34	145.22	73.86	73.86	60.35	55.25
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	867.02	958.65	487.56	487.56	398.42	364.71
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1022.80	1075.70	604.61	604.61	1035.42	1075.71

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2246E 08	0.2591E 08	0.1271E 08	0.1464E 08	0.1123E 08	0.1175E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	144.80	167.04	81.94	94.37	72.45	75.76
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	955.87	1102.68	540.89	622.98	478.25	500.13
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1111.65	1219.73	657.94	740.03	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	20.0	ELEC	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2154E 08	0.2516E 08	0.1215E 08	0.1398E 08	0.1068E 08	0.1109E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	138.86	162.23	78.37	90.13	68.88	71.52
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	916.67	1070.88	517.36	594.97	454.72	472.13
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1072.45	1187.93	634.41	712.02	1114.72	1366.13

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	20.0	ELEC	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2037E 08	0.2422E 08	0.1145E 08	0.1314E 08	0.9363E 07	0.1026E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	131.34	156.12	73.86	84.76	60.35	66.15
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	867.02	1030.59	487.56	559.50	398.42	436.65
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1022.80	1147.64	604.61	676.55	1035.42	1147.65

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	50.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2246E 08	0.2880E 08	0.1271E 08	0.1753E 08	0.1123E 08	0.1464E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	144.80	185.70	81.94	113.03	72.45	94.42
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	955.87	1225.82	540.89	746.11	478.25	623.27
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1111.65	1342.87	657.94	863.16	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	50.0	ELEC	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2154E 08	0.2790E 08	0.1215E 08	0.1671E 08	0.1068E 08	0.1383E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.1415E 07	0.0000E 00
TAE COST ($)	138.86	179.86	78.37	107.77	68.88	89.16
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	916.67	1187.30	517.36	711.39	454.72	588.55
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1072.45	1304.35	634.41	828.44	1114.72	1482.55

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	50.0	ELEC	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2037E 08	0.2675E 08	0.1145E 08	0.1568E 08	0.9363E 07	0.1279E 08
ASH CTR (BTU)	0.5852E 07	0.3492E 07	0.2851E 07	0.2851E 07	0.7921E 06	0.0000E 00
TAE COST ($)	131.34	172.47	73.86	101.10	60.35	82.49
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	867.02	1138.51	487.56	667.41	398.42	544.57
RPLC HTR ($)	155.77	117.05	117.05	117.05	0.00	0.00
TLC COST ($)	1022.80	1255.56	604.61	784.46	1035.42	1255.57

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3382E 08	0.3282E 08	0.1887E 08	0.1887E 08	0.1123E 08	0.9824E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	118.92	117.15	66.59	66.59	72.45	63.33
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	943.91	924.64	527.87	527.87	478.25	418.04
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1124.17	1060.08	663.31	663.31	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	0.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3266E 08	0.3203E 08	0.1818E 08	0.1818E 08	0.1068E 08	0.9271E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	114.78	114.07	64.08	64.08	68.88	59.76
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	911.24	901.16	508.19	508.19	454.72	394.52
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1091.50	1036.60	643.63	643.63	1114.72	1288.52

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	0.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3119E 08	0.3104E 08	0.1730E 08	0.1730E 08	0.9363E 07	0.8571E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	109.54	110.17	60.91	60.91	60.35	55.25
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	869.87	871.41	483.25	483.25	398.42	364.71
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1050.12	1006.86	618.70	618.70	1035.42	1075.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3382E 08	0.3526E 08	0.1887E 08	0.2132E 08	0.1123E 08	0.1175E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	118.92	125.70	66.59	75.14	72.45	75.76
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	943.91	992.64	527.87	595.87	478.25	500.13
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1124.17	1128.08	663.31	731.31	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	20.0	GAS	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3266E 08	0.3434E 08	0.1818E 08	0.2049E 08	0.1068E 08	0.1109E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	114.78	122.15	64.08	72.17	68.88	71.52
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	911.24	965.45	508.19	572.47	454.72	472.13
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1091.50	1100.89	643.63	707.92	1114.72	1366.13

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	20.0	GAS	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3119E 08	0.3318E 08	0.1730E 08	0.1944E 08	0.9363E 07	0.1026E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	109.54	117.66	60.91	68.41	60.35	66.15
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	869.87	931.01	483.25	542.84	398.42	436.65
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1050.12	1066.45	618.70	678.29	1035.42	1147.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	50.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3382E 08	0.3893E 08	0.1887E 08	0.2496E 08	0.1123E 08	0.1464E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	118.92	138.53	66.59	87.97	72.45	94.42
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	943.91	1094.63	527.87	697.86	478.25	623.27
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1124.17	1230.08	663.31	833.31	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	50.0	GAS	0 0 0 0 4 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3266E 08	0.3781E 08	0.1818E 08	0.2395E 08	0.1068E 08	0.1383E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	114.78	134.28	64.08	84.30	68.88	89.16
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	911.24	1061.88	508.19	668.91	454.72	588.55
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1091.50	1197.32	643.63	804.35	1114.72	1482.55

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	50.0	GAS	0 0 0 0 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.3119E 08	0.3640E 08	0.1730E 08	0.2265E 08	0.9363E 07	0.1279E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	109.54	128.91	60.91	79.65	60.35	82.49
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	869.87	1020.39	483.25	632.23	398.42	544.57
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1050.12	1155.84	618.70	767.67	1035.42	1255.57

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3531E 08	0.3460E 08	0.1974E 08	0.1974E 08	0.1123E 08	0.9824E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	139.17	137.87	78.03	78.03	72.45	63.33
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1036.17	1023.22	580.55	580.55	478.25	418.04
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1216.42	1158.66	715.99	715.99	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	0.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3407E 08	0.3377E 08	0.1900E 08	0.1900E 08	0.1068E 08	0.9271E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	134.23	134.32	75.05	75.05	68.88	59.76
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	999.49	997.37	558.51	558.51	454.72	394.52
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1179.75	1132.82	693.95	693.95	1114.72	1288.52

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	0.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3250E 08	0.3271E 08	0.1807E 08	0.1807E 08	0.9363E 07	0.8571E 07
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	127.97	129.82	71.28	71.28	60.35	55.25
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	953.03	964.64	530.58	530.58	398.42	364.71
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1133.29	1100.08	666.03	666.03	1035.42	1075.71

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3531E 08	0.3721E 08	0.1974E 08	0.2236E 08	0.1123E 08	0.1175E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	139.17	148.16	78.02	88.32	72.45	75.76
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1036.17	1099.87	580.55	657.20	478.25	500.13
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1216.42	1235.31	715.99	792.65	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	20.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3407E 08	0.3624E 08	0.1900E 08	0.2148E 08	0.1068E 08	0.1109E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	134.23	144.04	75.05	84.78	68.88	71.52
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	999.49	1069.85	558.51	630.98	454.72	472.13
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1179.75	1205.29	693.95	766.42	1114.72	1366.13

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	20.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3250E 08	0.3501E 08	0.1807E 08	0.2036E 08	0.9363E 07	0.1026E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	127.97	138.83	71.26	80.30	60.35	66.15
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	953.03	1031.82	530.58	597.76	398.42	436.65
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1133.29	1167.26	666.03	733.20	1035.42	1147.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	100.0	100.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3531E 08	0.4114E 08	0.1974E 08	0.2629E 08	0.1123E 08	0.1464E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	139.17	163.59	78.03	103.75	72.45	94.42
INS COST ($)	0.00	0.00	0.00	0.00	660.00	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	*********
TLEC CST ($)	1036.17	1214.85	580.55	772.18	478.25	623.27
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1216.42	1350.29	715.99	907.63	1138.25	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	50.0	85.0	50.0	OIL	0 0 0 0 4 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3407E 08	0.3995E 08	0.1900E 08	0.2519E 08	0.1068E 08	0.1383E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.1415E 07	0.0000E 00
TAE COST ($)	134.[illegible]	158.63	75.05	99.37	68.88	89.16
INS COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	660.00	894.00
TLEC CST ($)	999.49	1178.55	558.51	739.69	454.72	588.55
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1179.75	1314.00	693.95	875.13	1114.72	1482.55

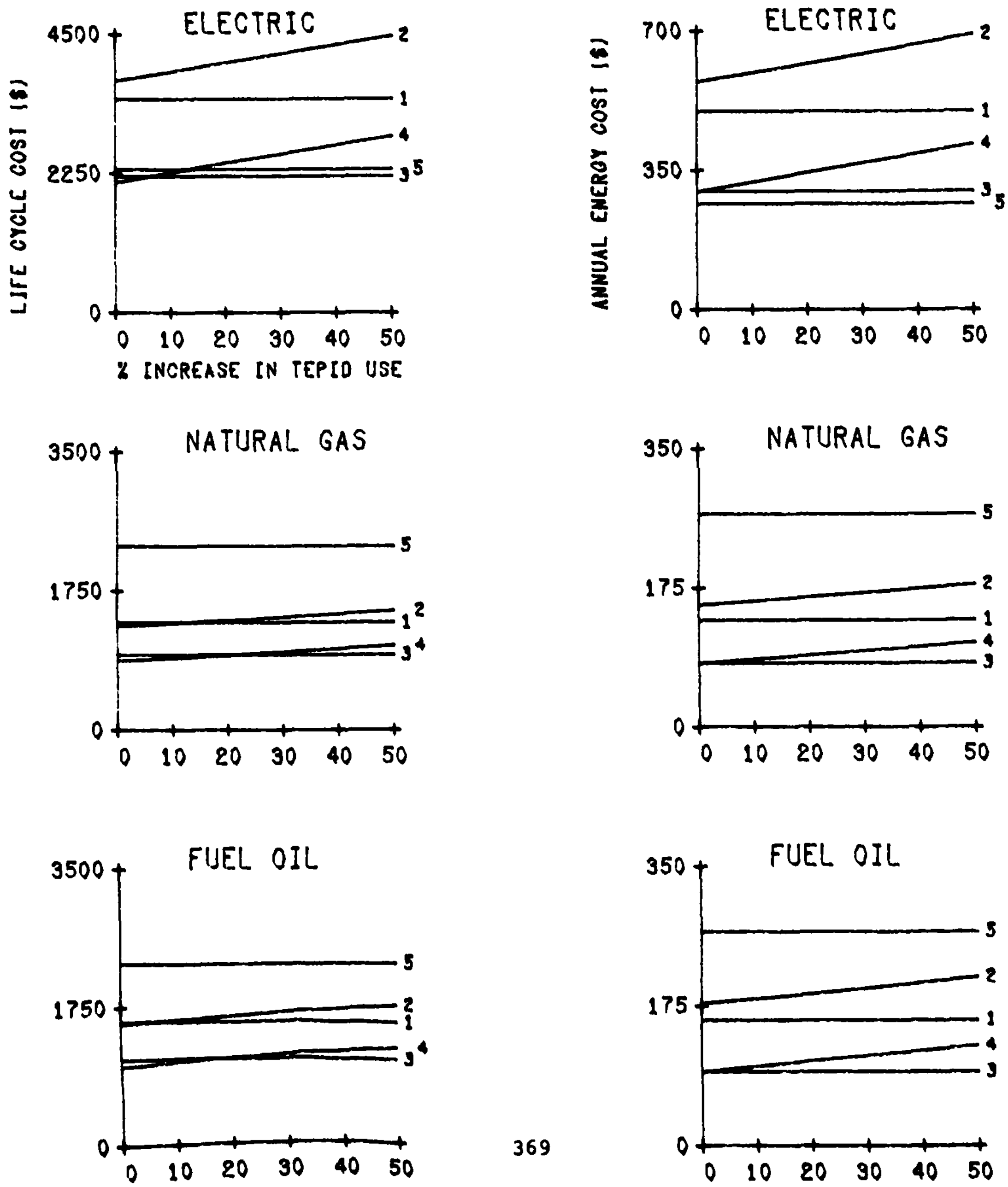
BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
6	10	RETROFIT	22.0	66.0	50.0	OIL	0 0 0 0 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.3250E 08	0.3845E 08	0.1807E 08	0.2380E 08	0.9363E 07	0.1279E 08
ASH CTR (BTU)	0.1284E 08	0.7084E 07	0.6444E 07	0.6444E 07	0.7921E 06	0.0000E 00
TAE COST ($)	127.97	152.35	71.28	93.82	60.35	82.49
INS COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	0.00	0.00	0.00	637.00	711.00
TLEC CST ($)	953.03	1132.58	530.58	698.52	398.42	544.57
RPLC HTR ($)	180.25	135.44	135.44	135.44	0.00	0.00
TLC COST ($)	1133.29	1268.02	666.03	833.97	1035.42	1255.57

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	2	100.00	100.00

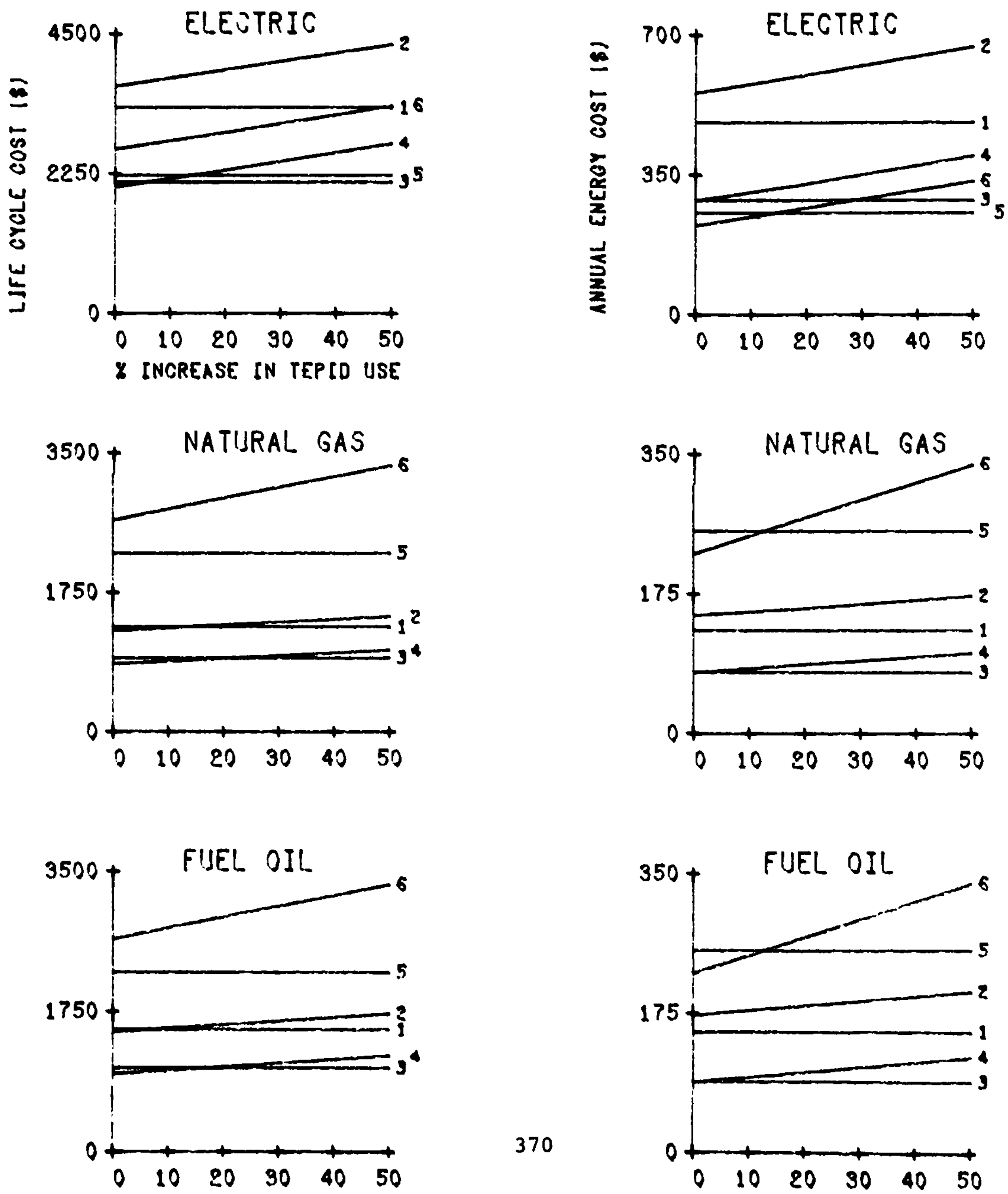
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	2	50.00	85.00

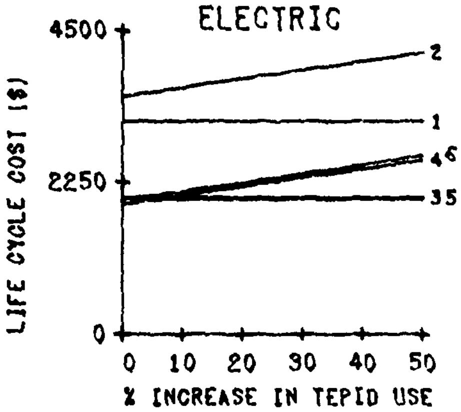
*** NEW CONSTRUCTION ***

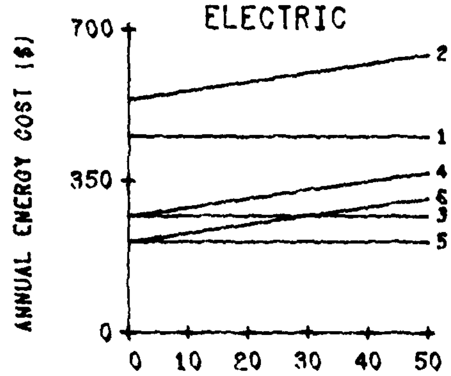


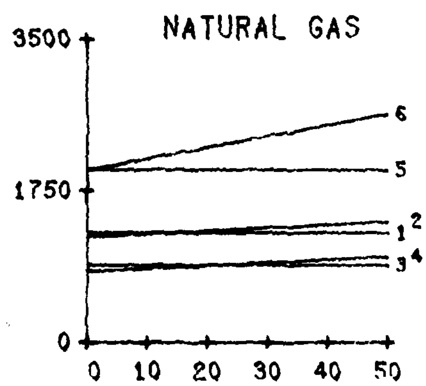
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

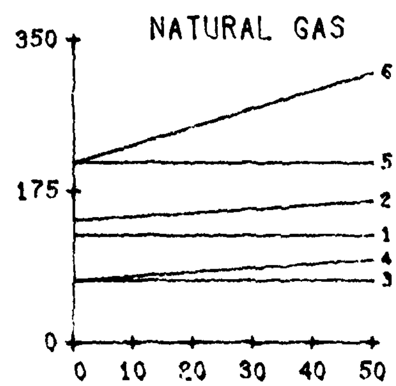
BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	2	22.00	66.00

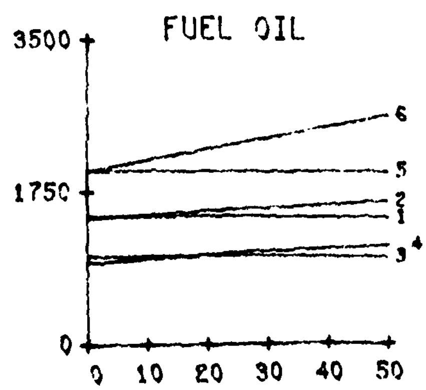
*** NEW CONSTRUCTION ***

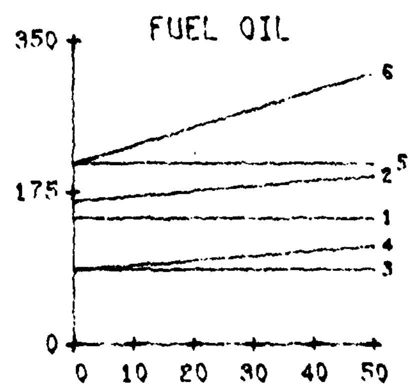








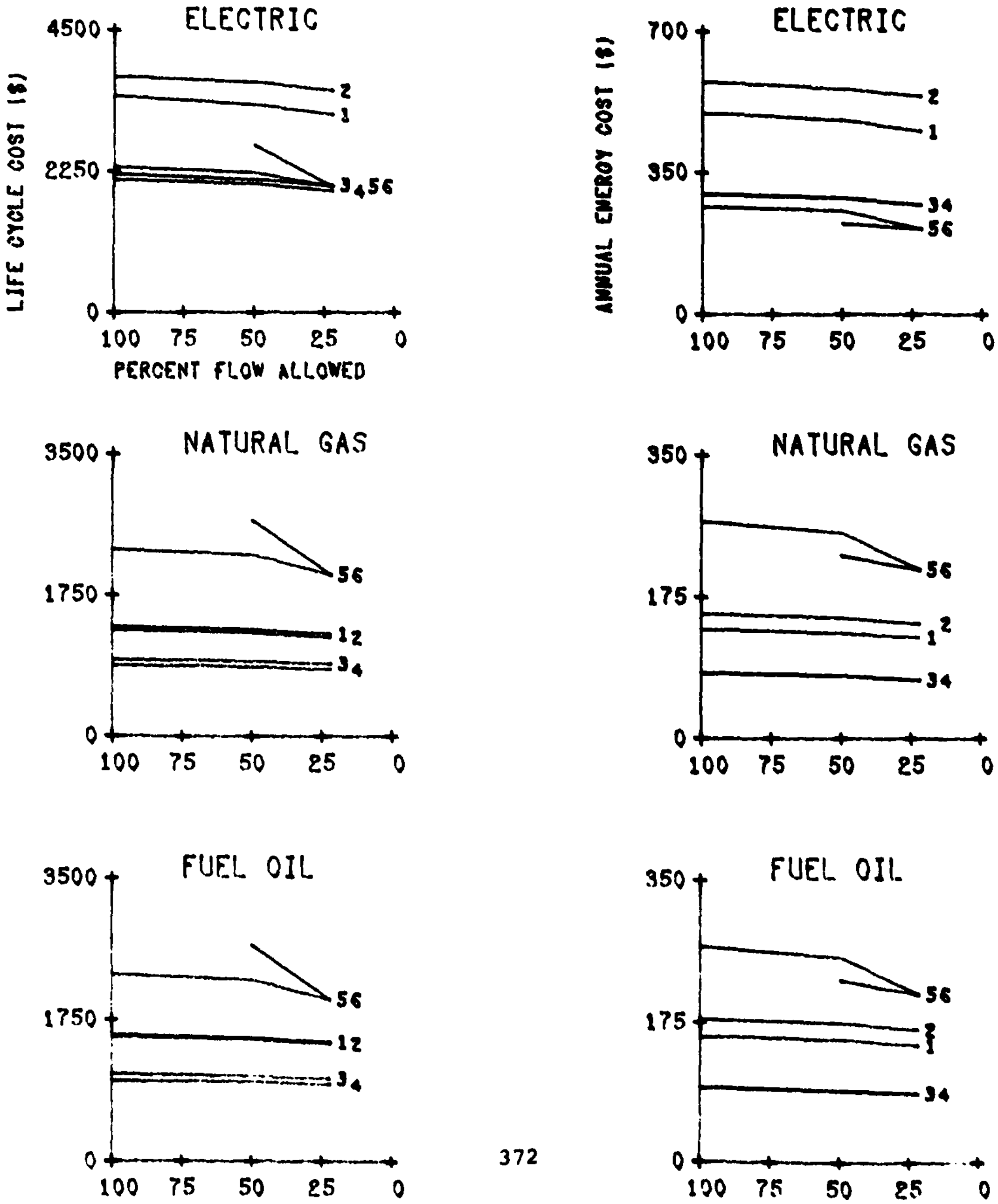




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	2	0.00

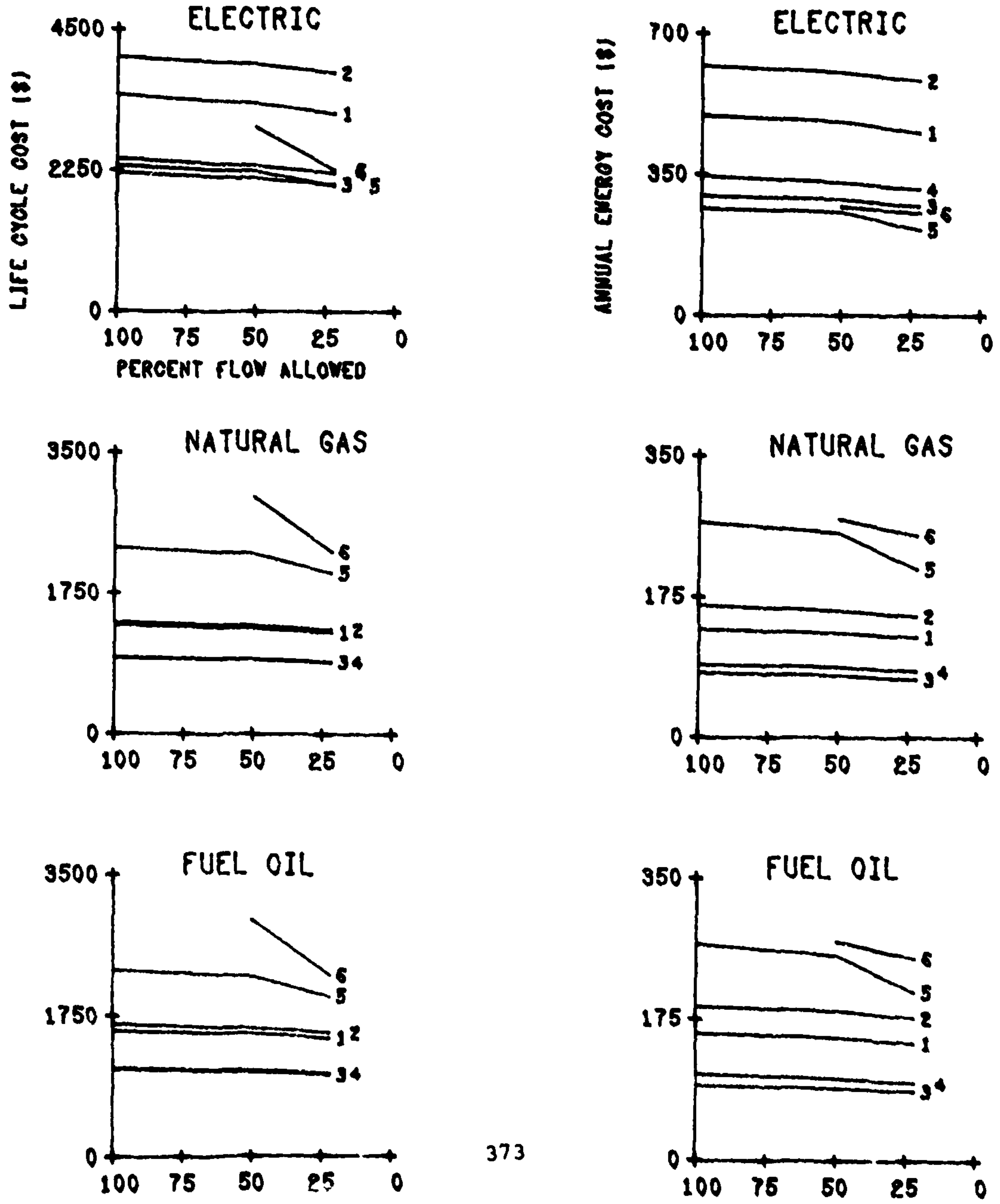
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	2	20.00

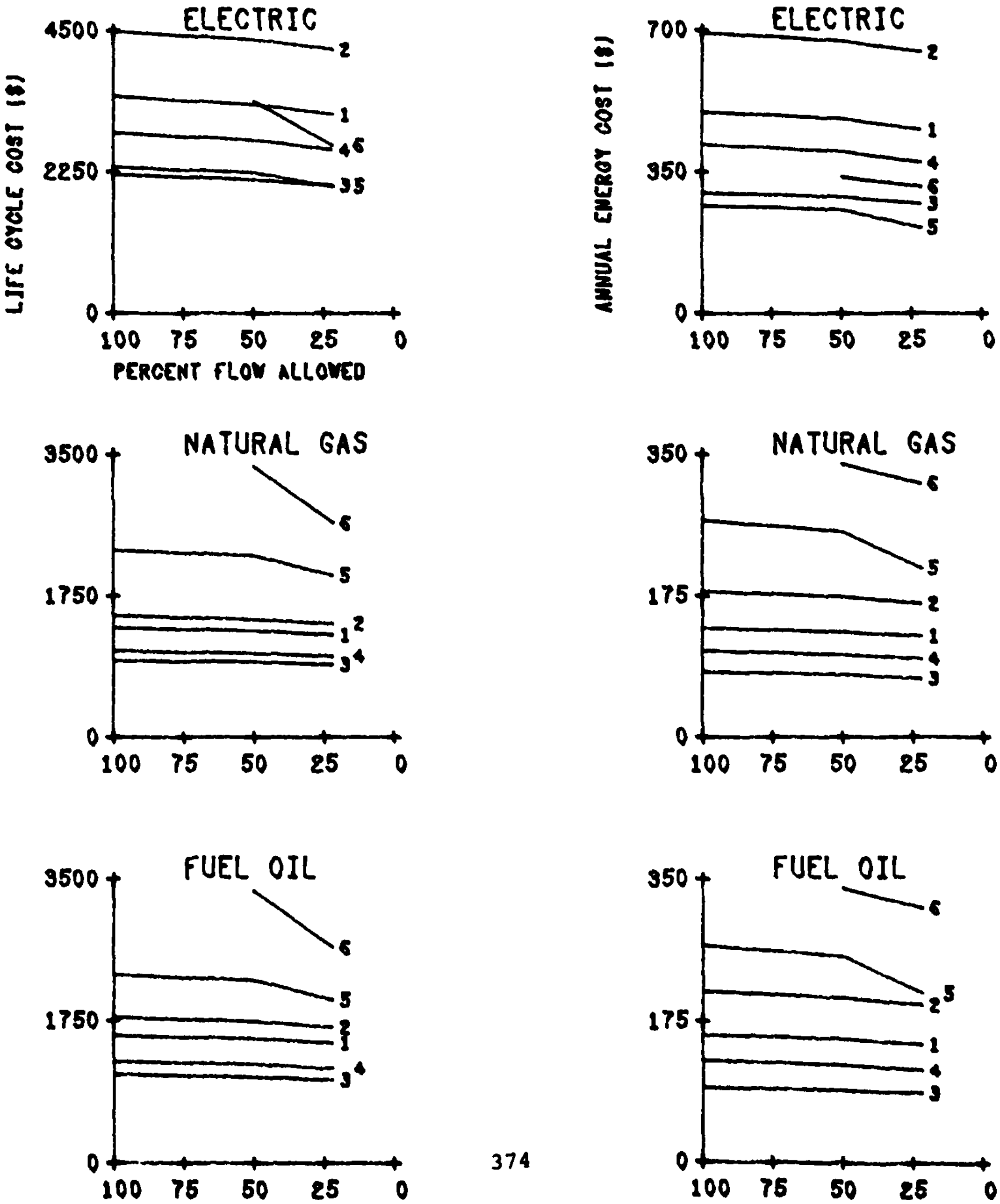
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	2	50.00

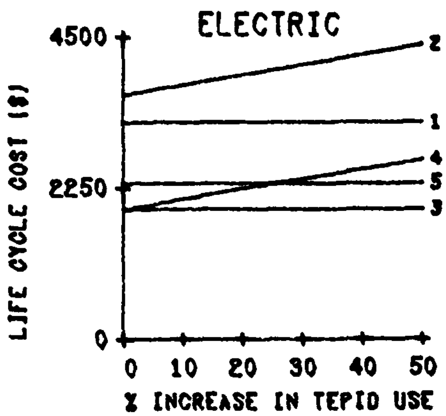
*** NEW CONSTRUCTION ***

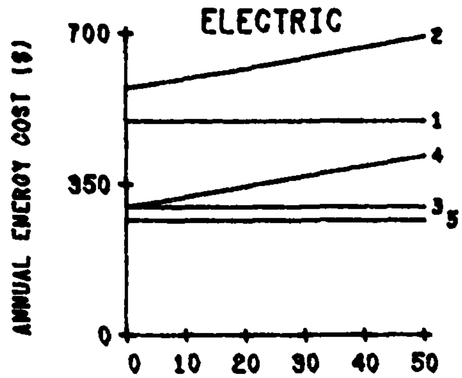


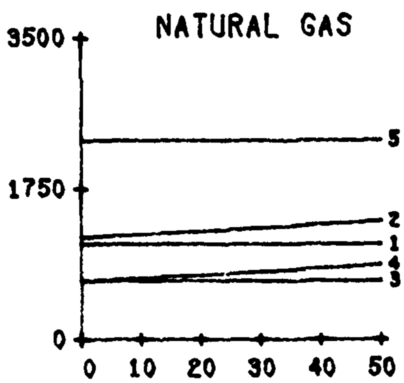
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

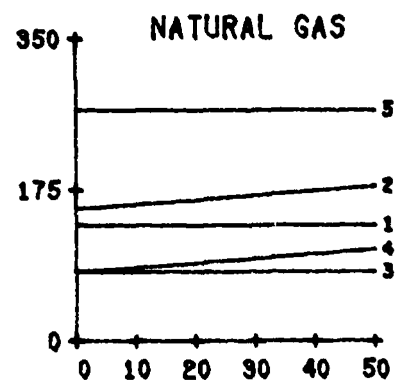
BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	2	100.00	100.00

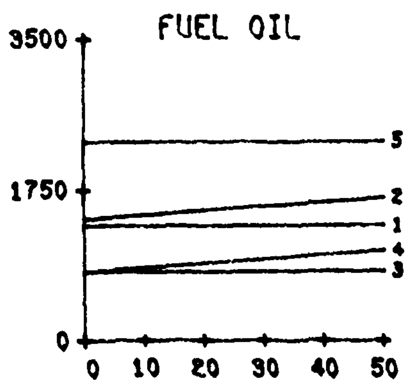
****** RETROFIT ******

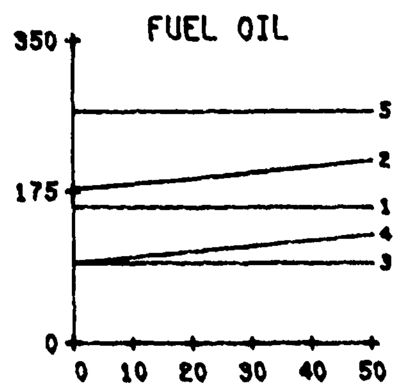








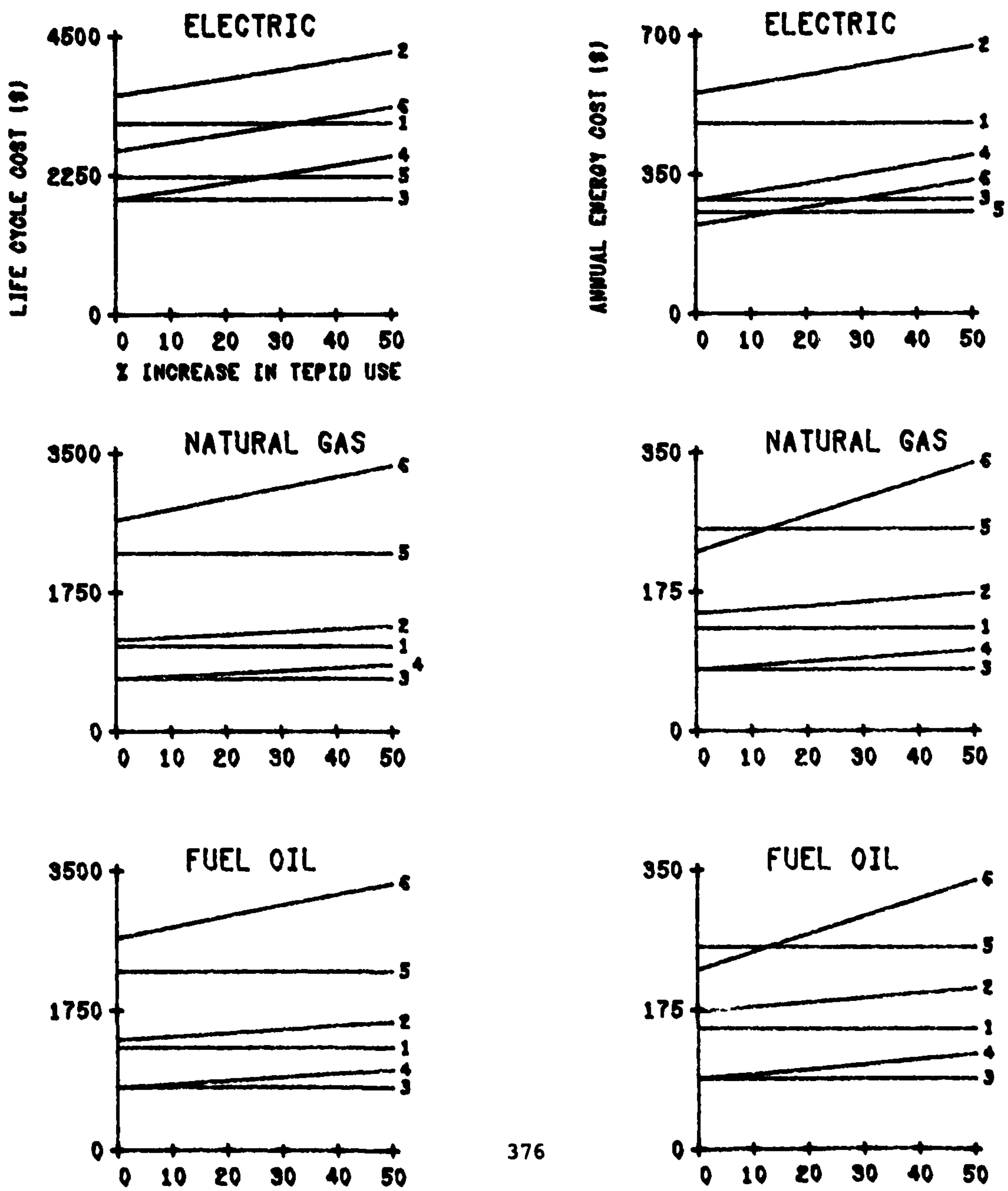




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	2	50.00	85.00

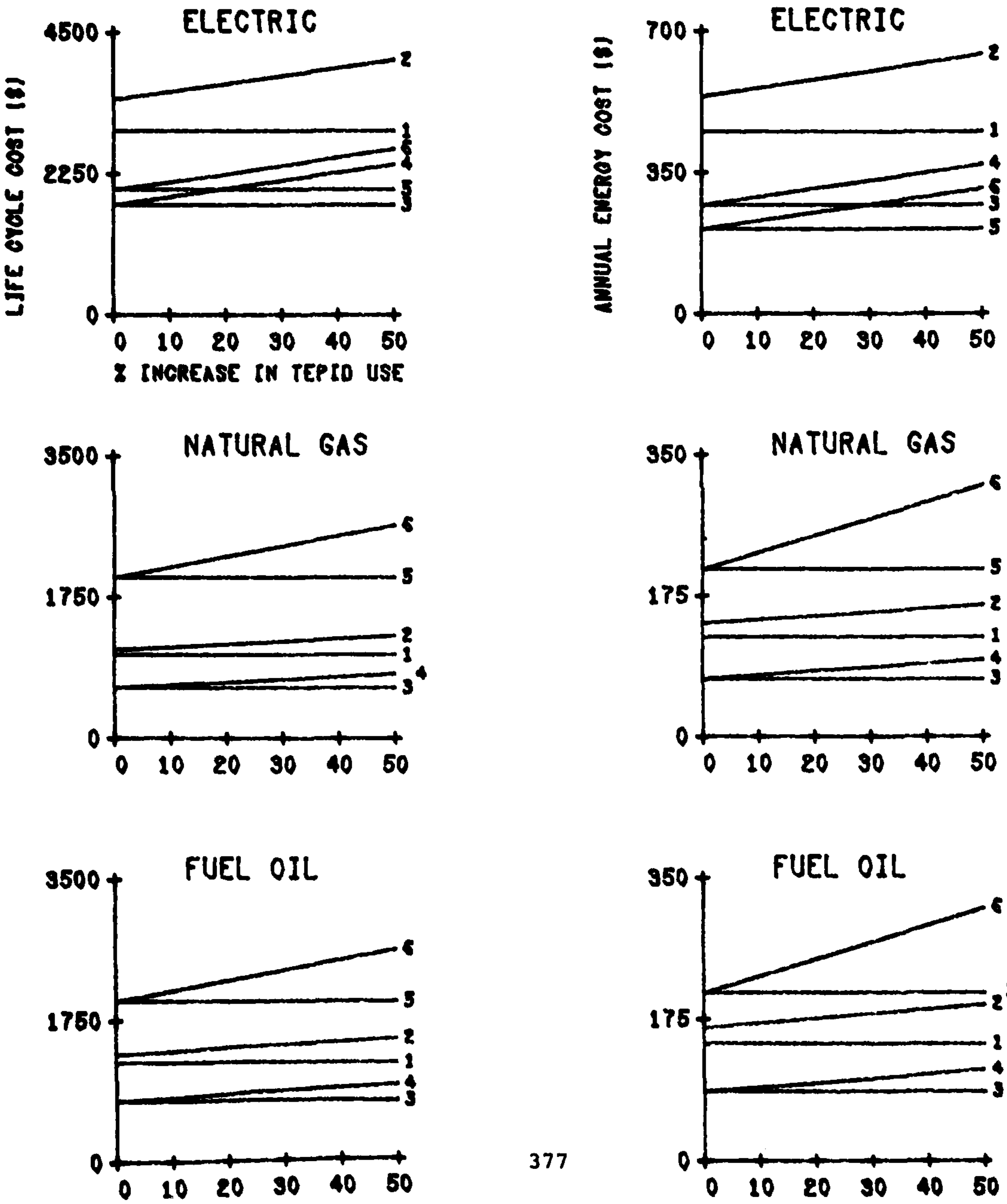
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	2	22.00	66.00

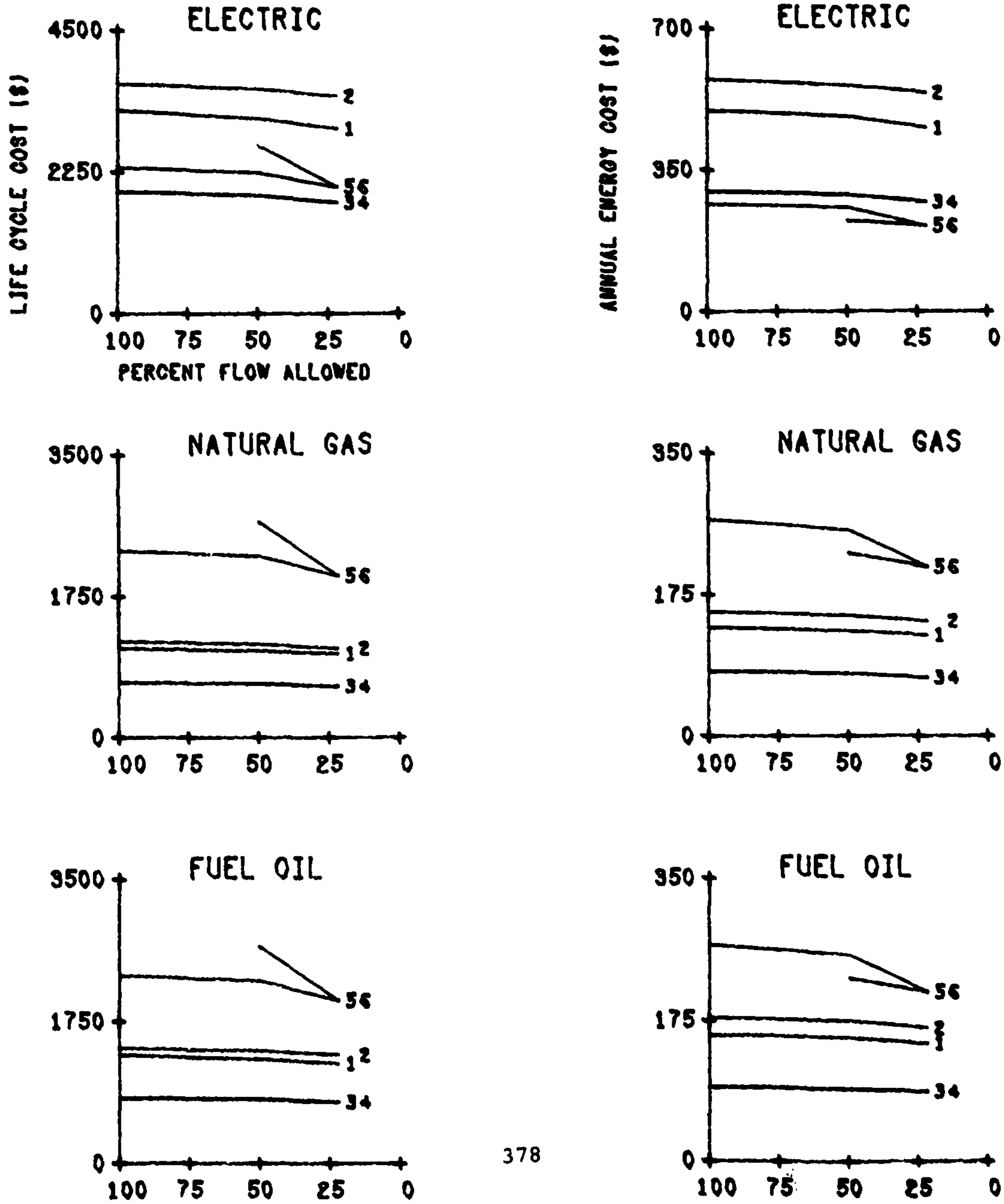
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	2	0.00

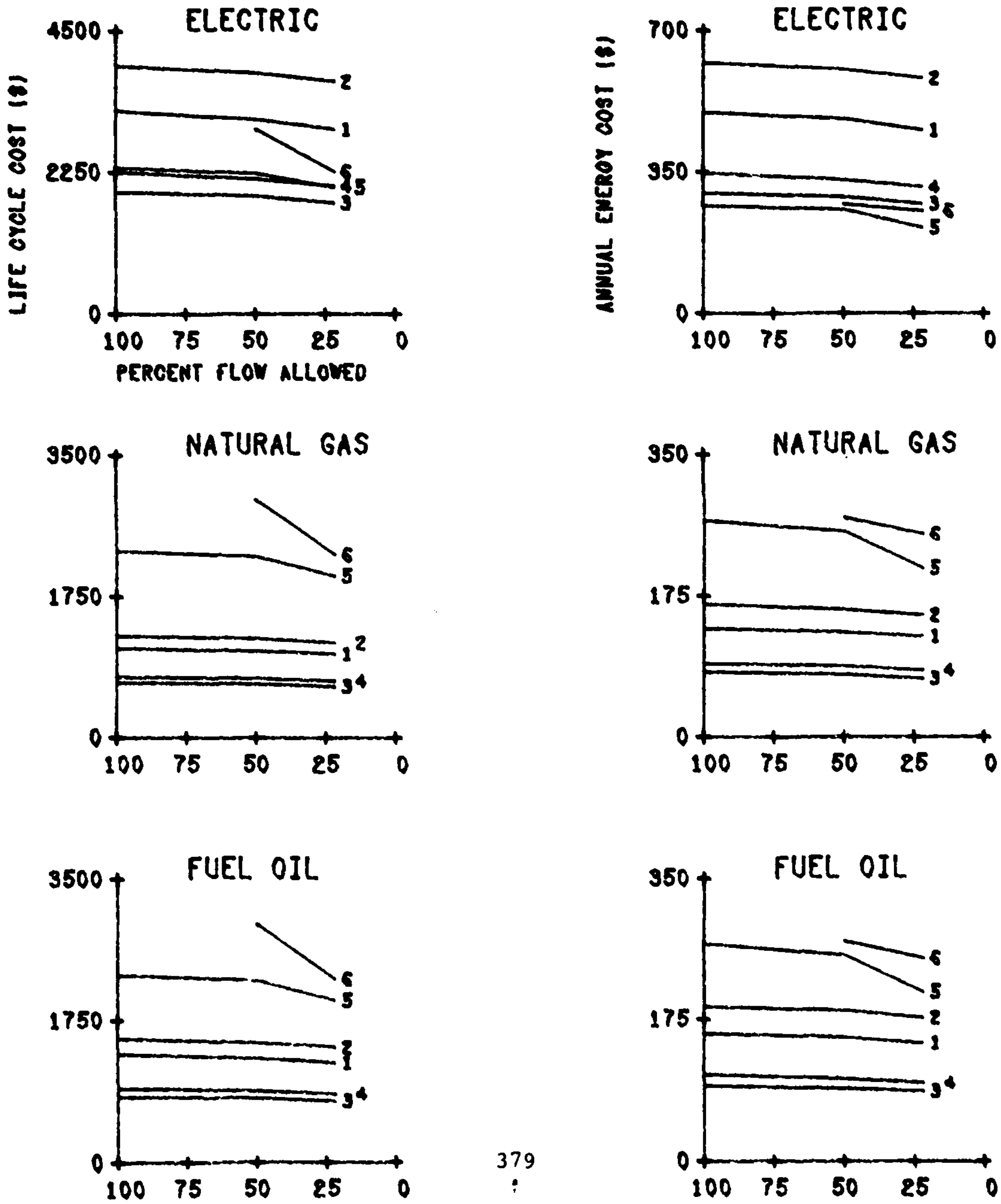
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	2	20.00

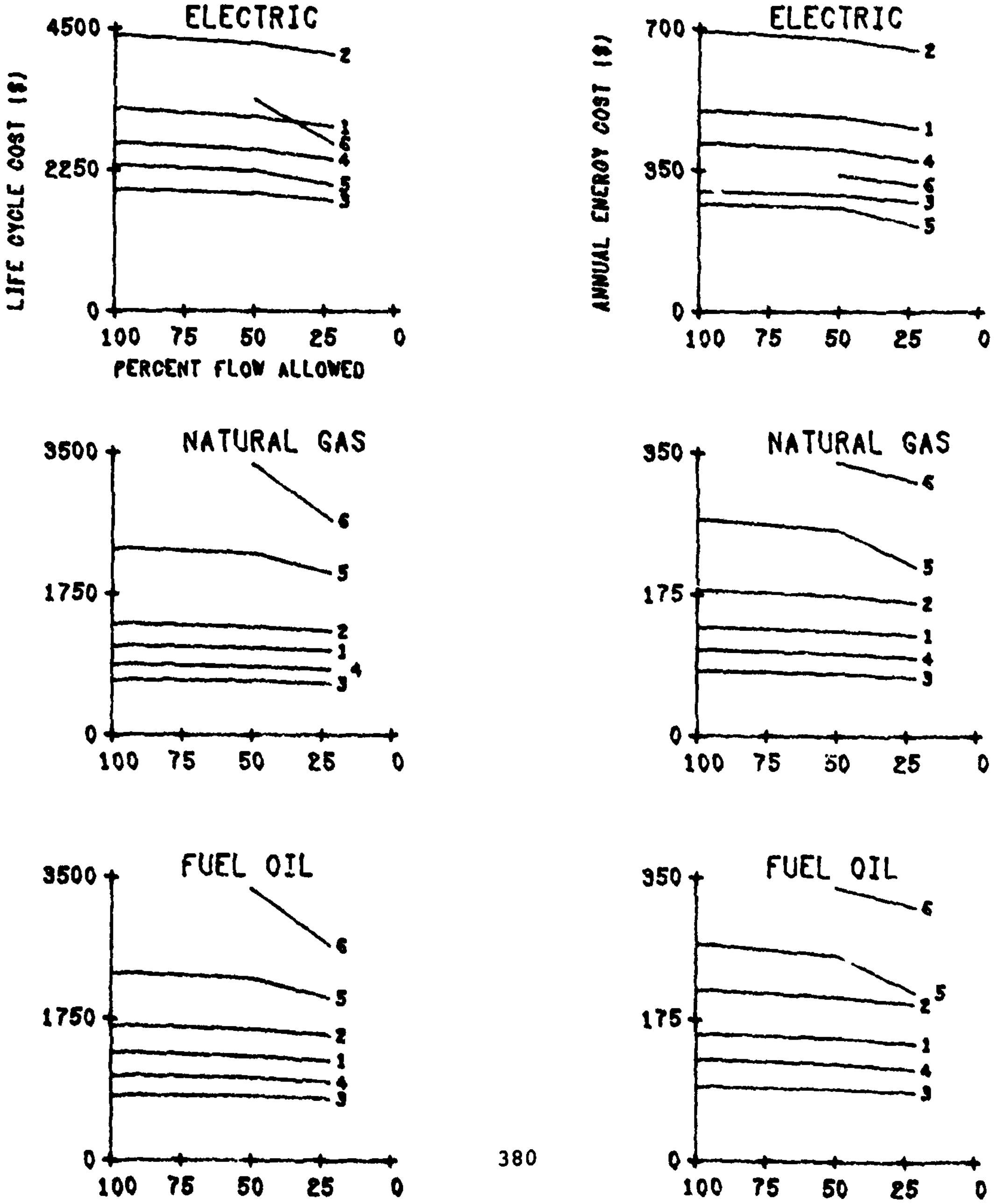
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

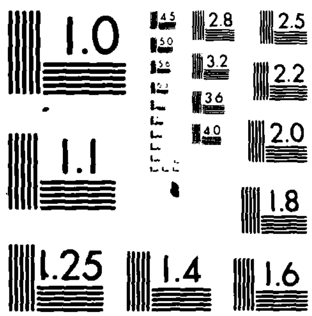
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	2	50.00

****** RETROFIT ******



AD-A112 649 JOHNS-MANVILLE SALES CORP DENVER CO RESEARCH AND DEV--ETC F/G 13/1
INVESTIGATION OF SINGLE VERSUS DUAL - HOT AND COLD BUILDING WAT--ETC(U)
OCT 81 P B BRUCE, M S RAMSEY, P B SHEPHERD DAAK70-78-C-0002
UNCLASSIFIED USAFESA-T-2091 NL

5 of 6
AD
A112649



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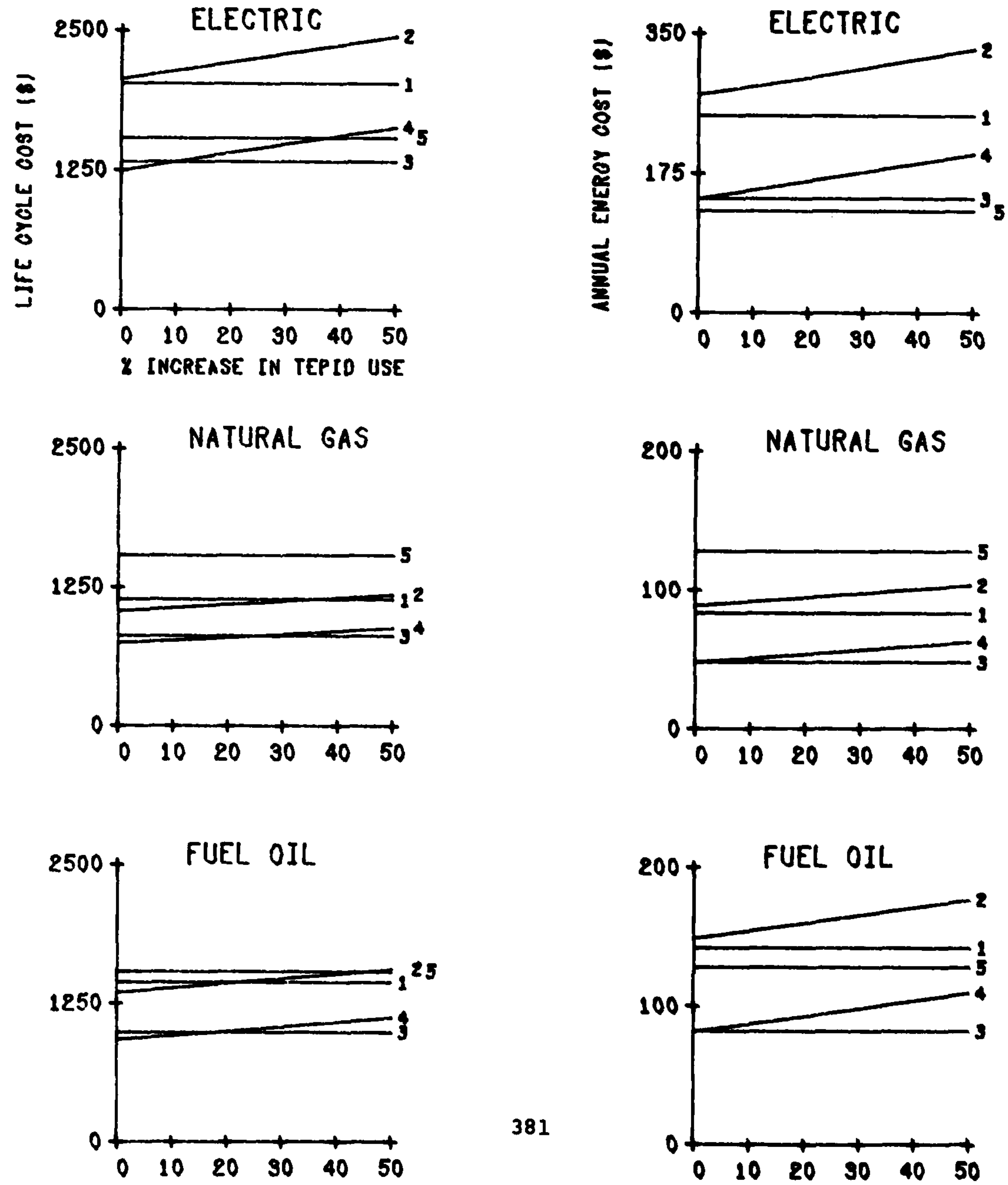
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	8	100.00	100.00

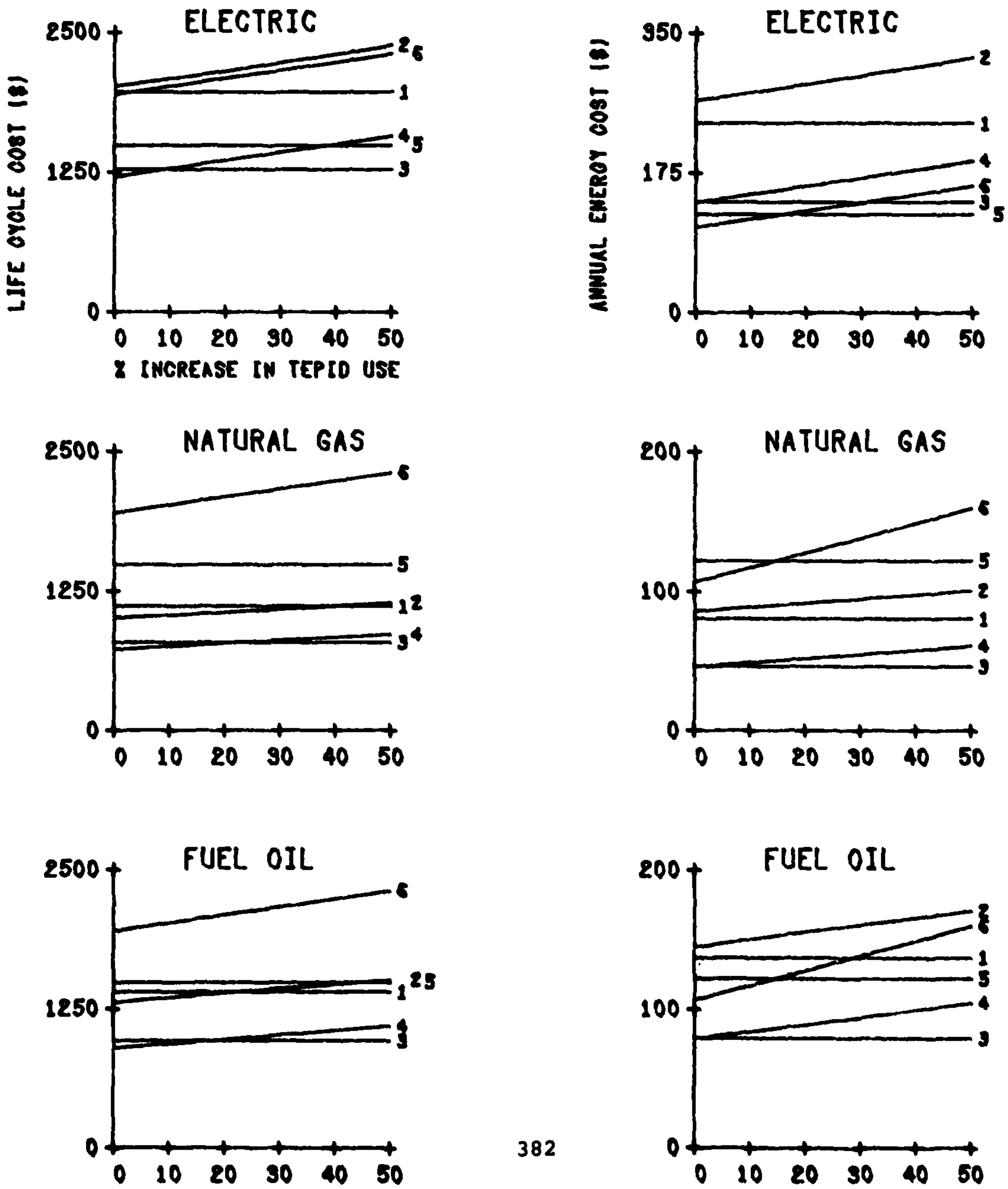
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	8	50.00	85.00

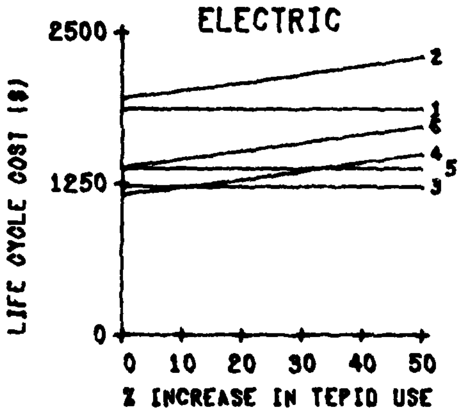
*** NEW CONSTRUCTION ***

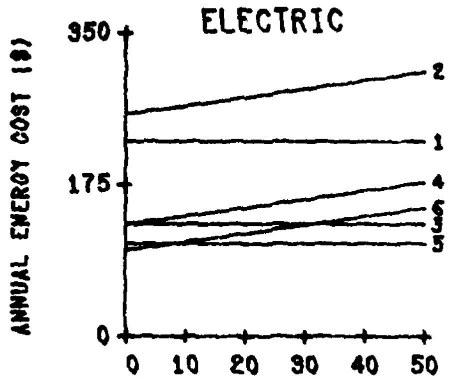


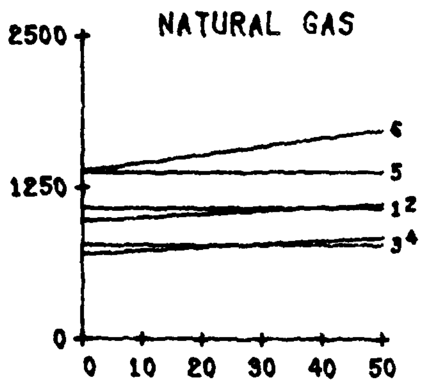
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

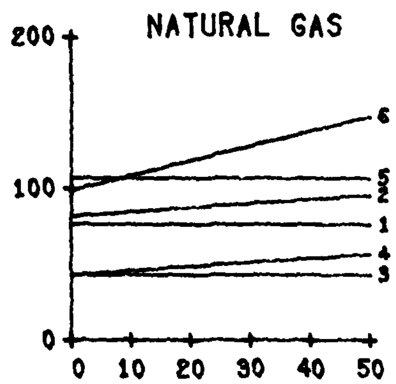
BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	8	22.00	66.00

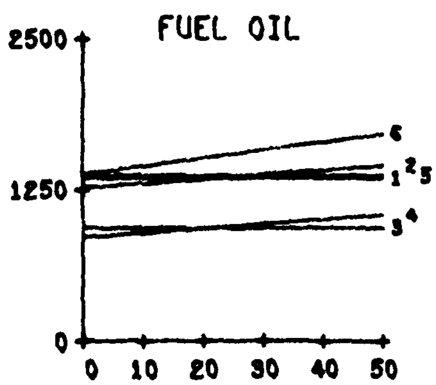
*** NEW CONSTRUCTION ***

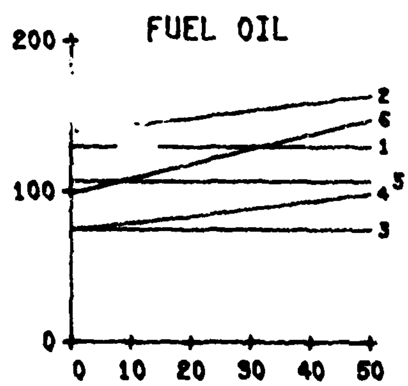








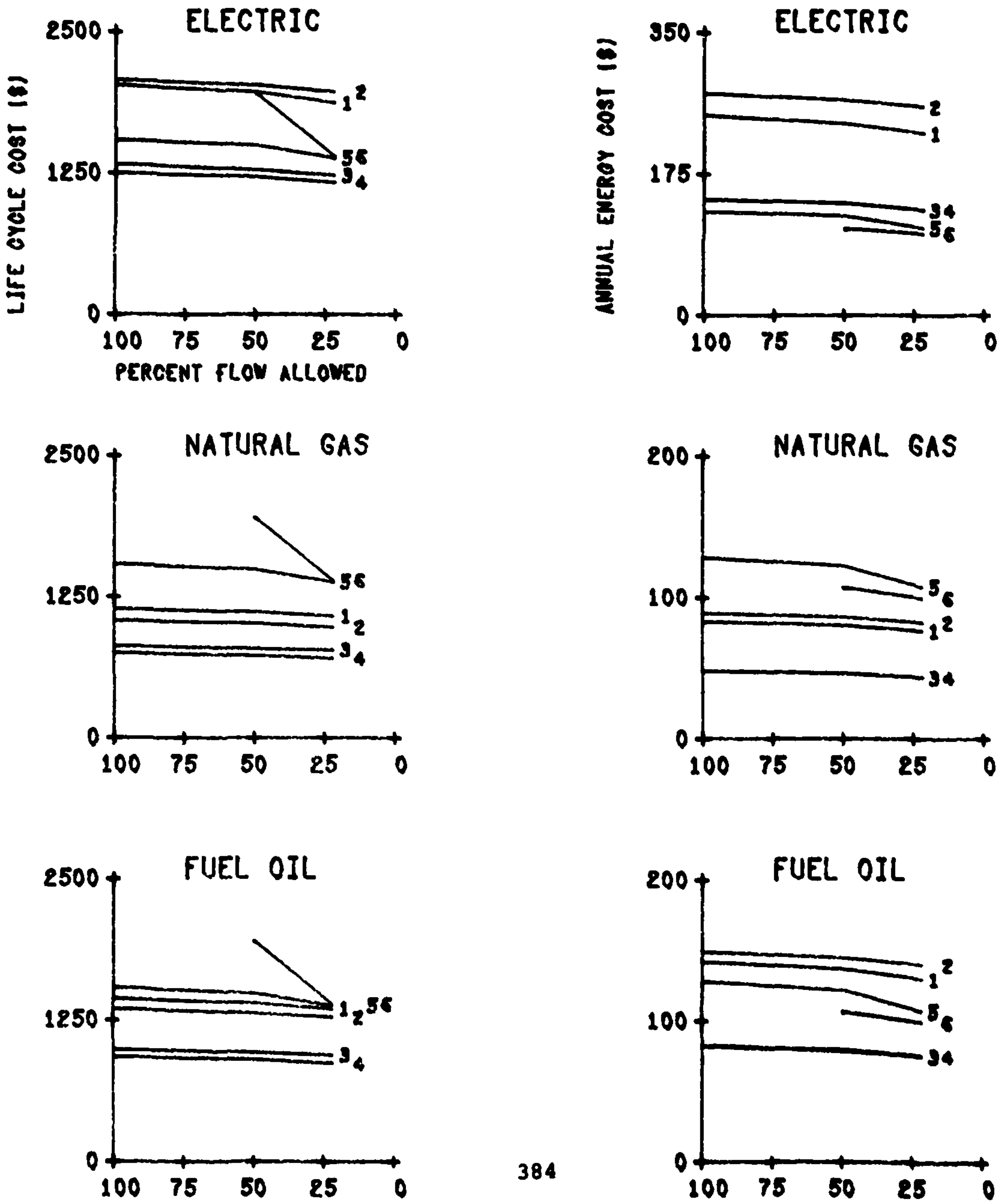




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	8	0.00

*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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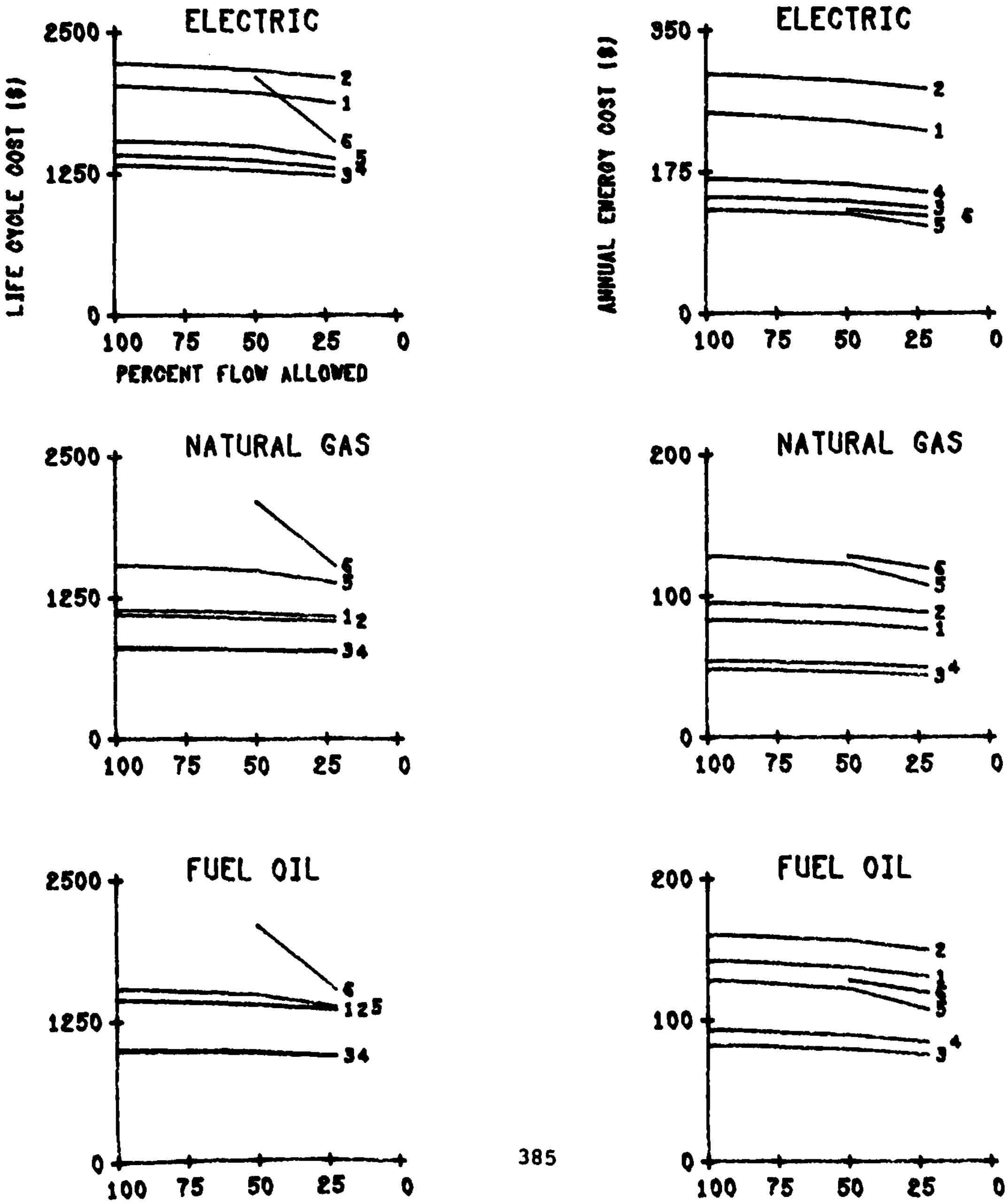
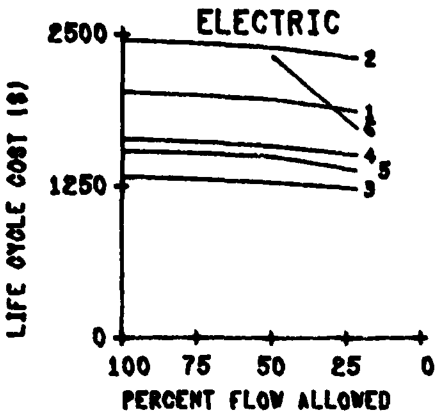
*** NEW CONSTRUCTION ***

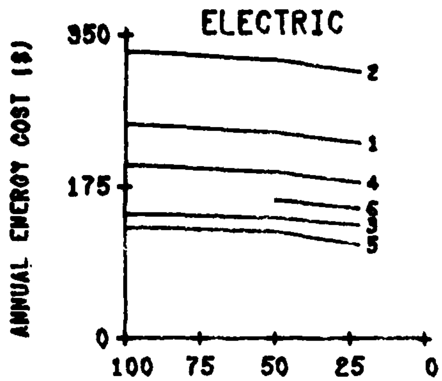


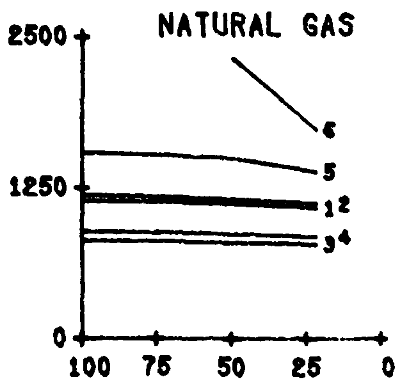
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

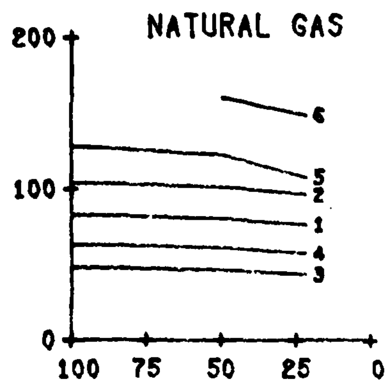
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	8	50.00

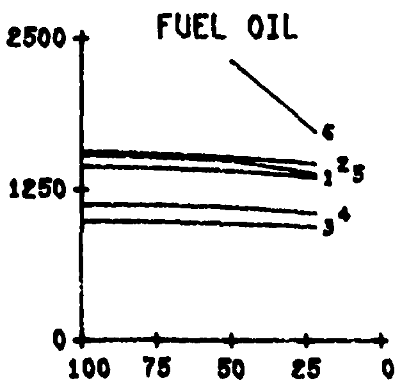
*** NEW CONSTRUCTION ***

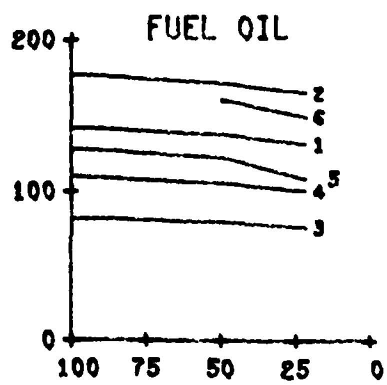








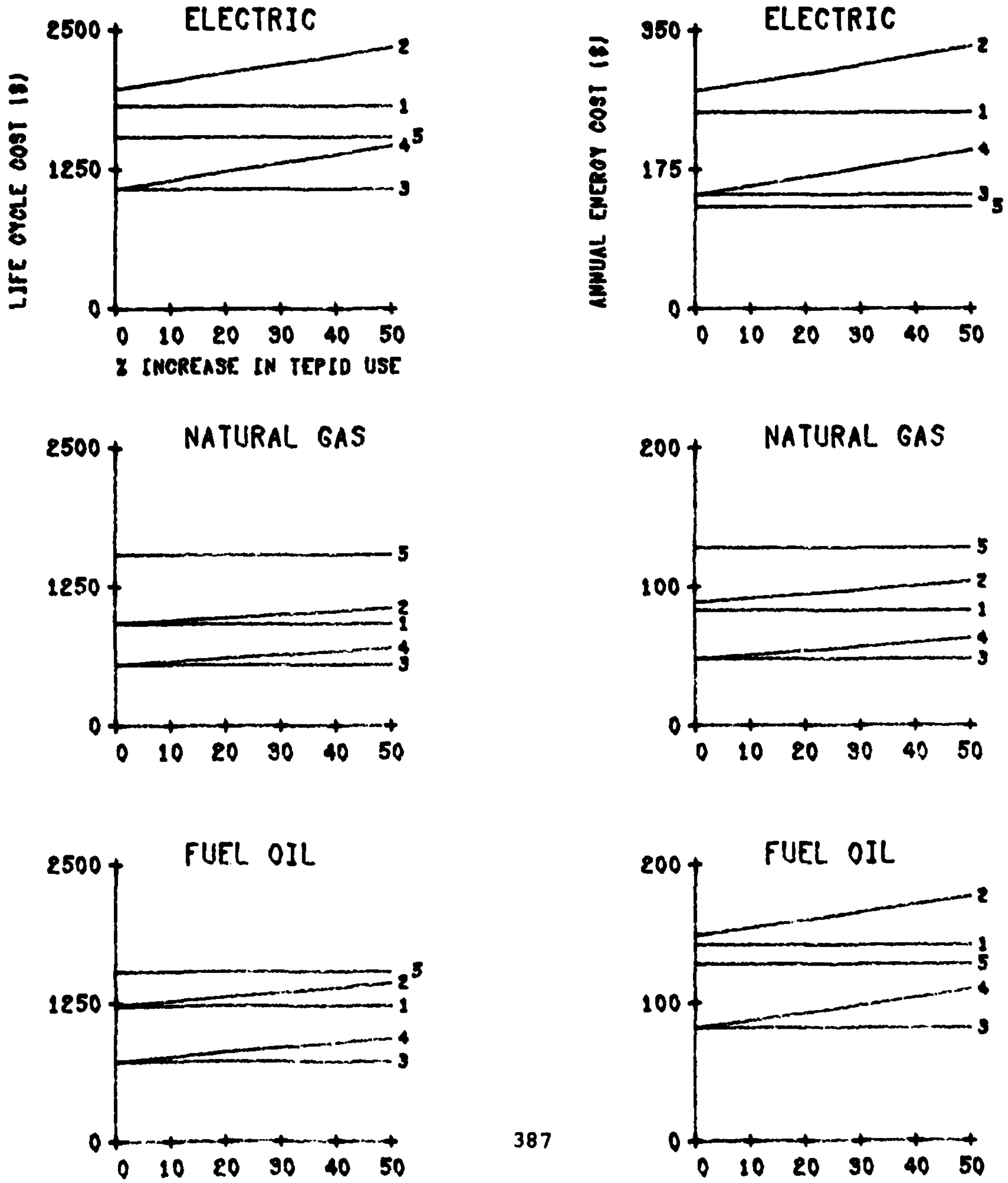




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	8	100.00	100.00

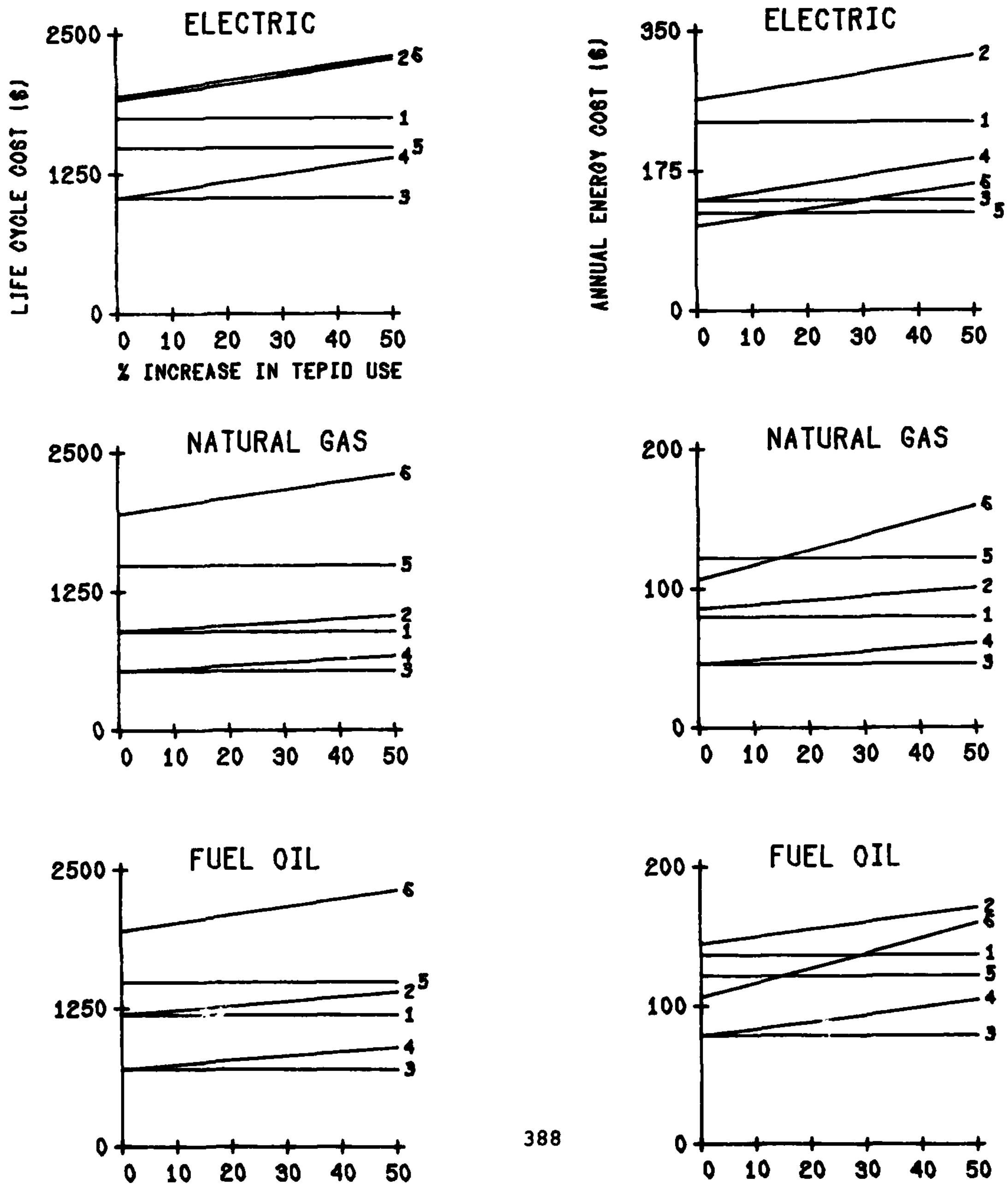
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	8	50.00	85.00

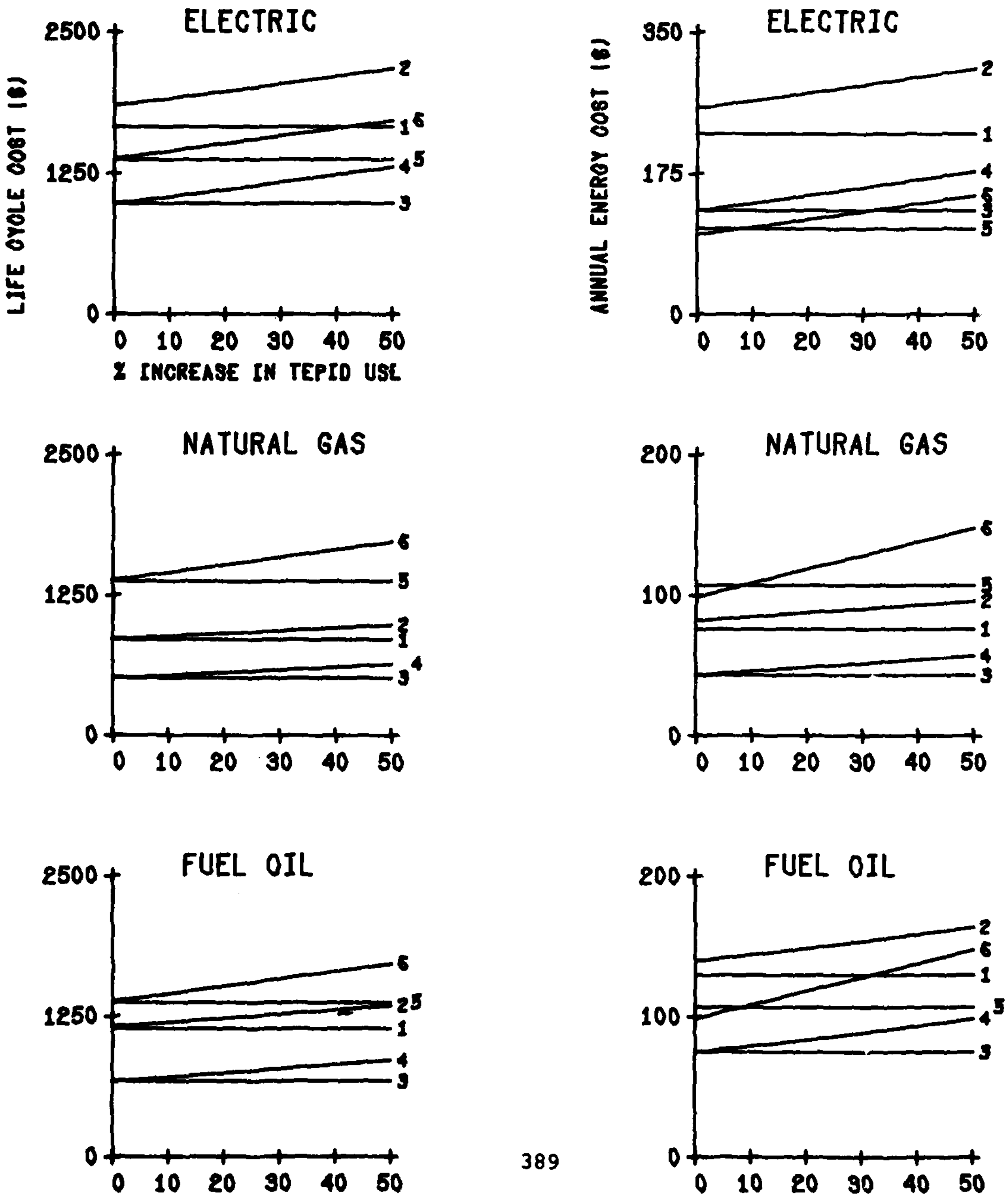
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	8	22.00	66.00

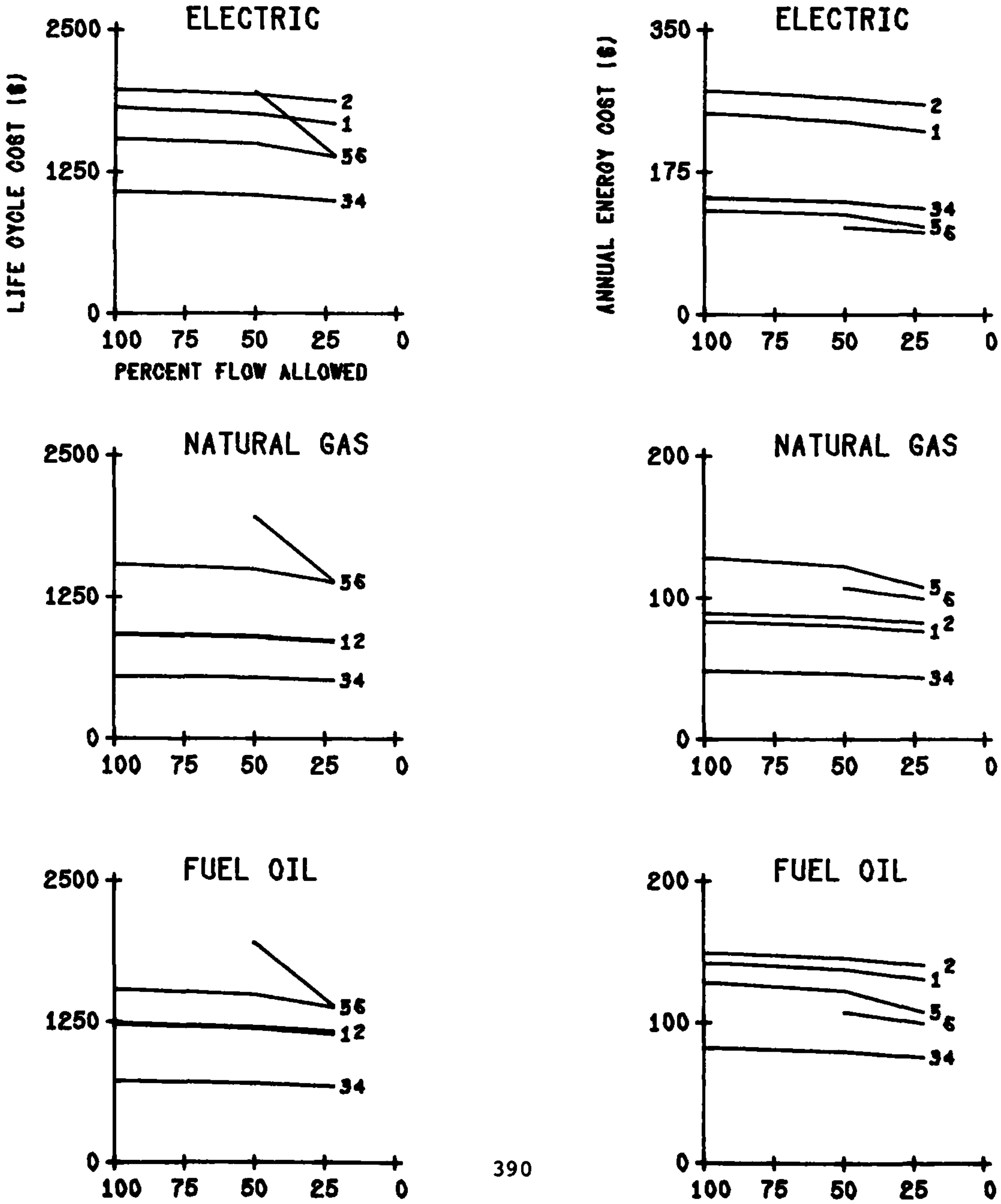
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	8	0.00

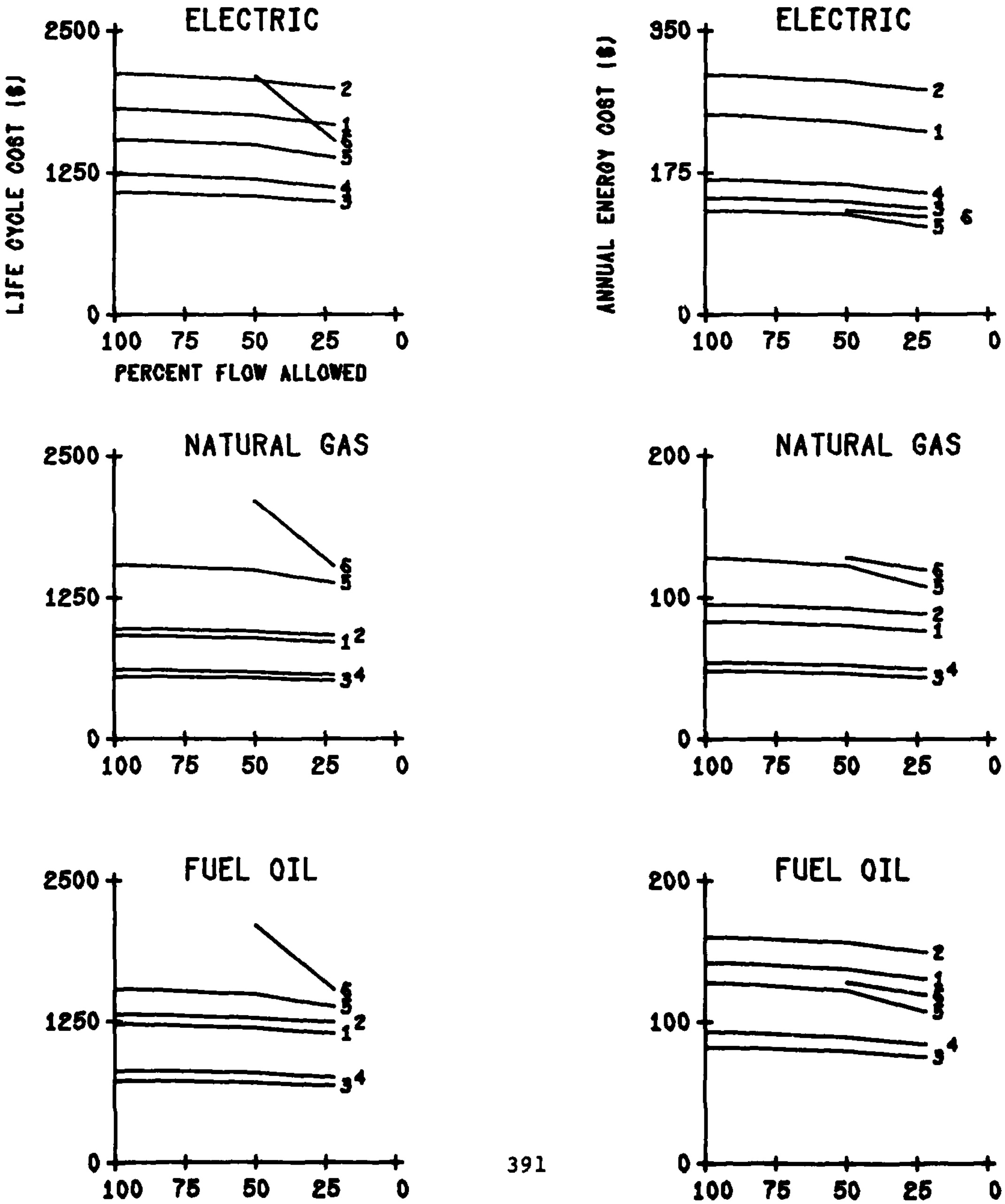
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	8	20.00

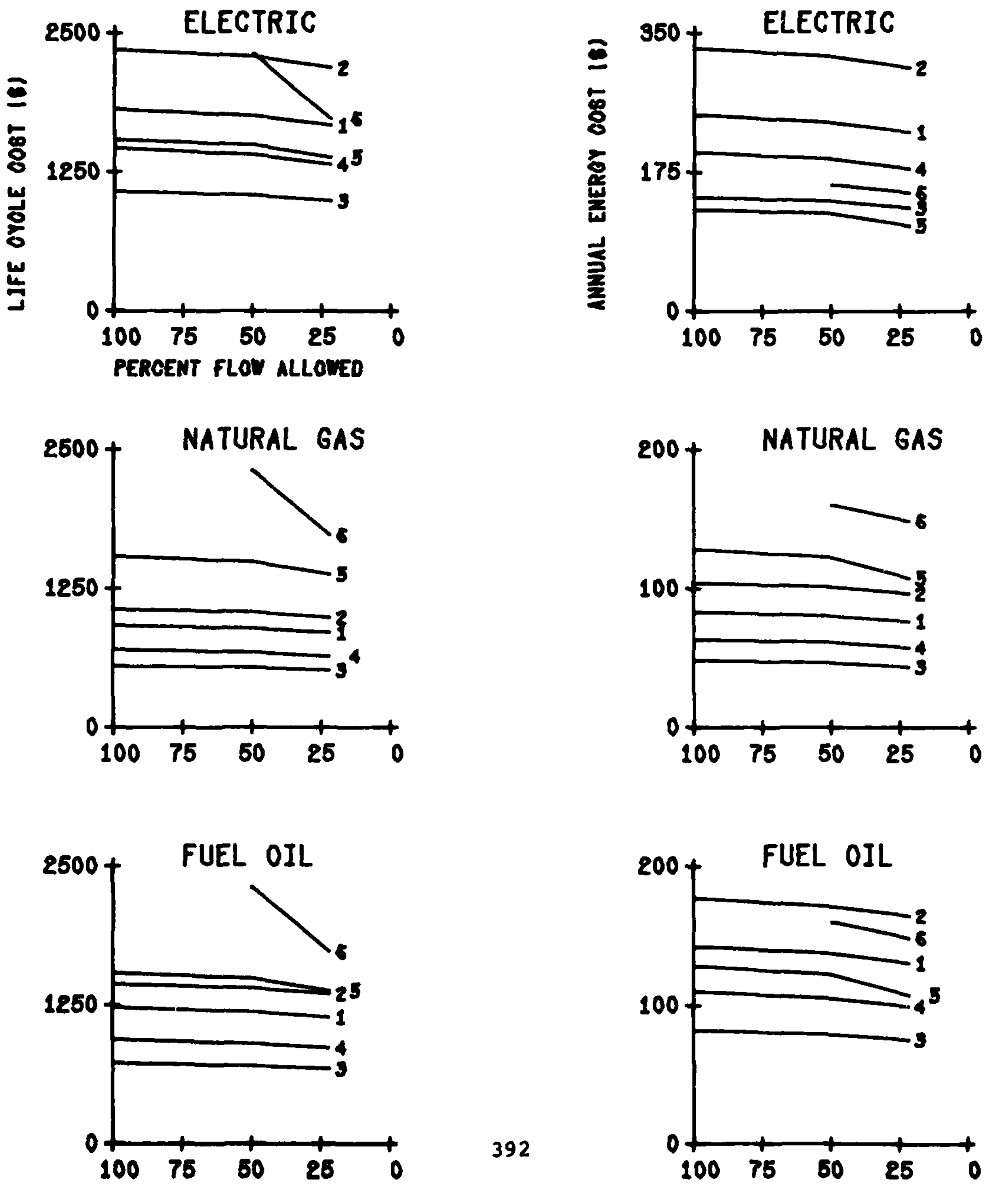
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	8	50.00

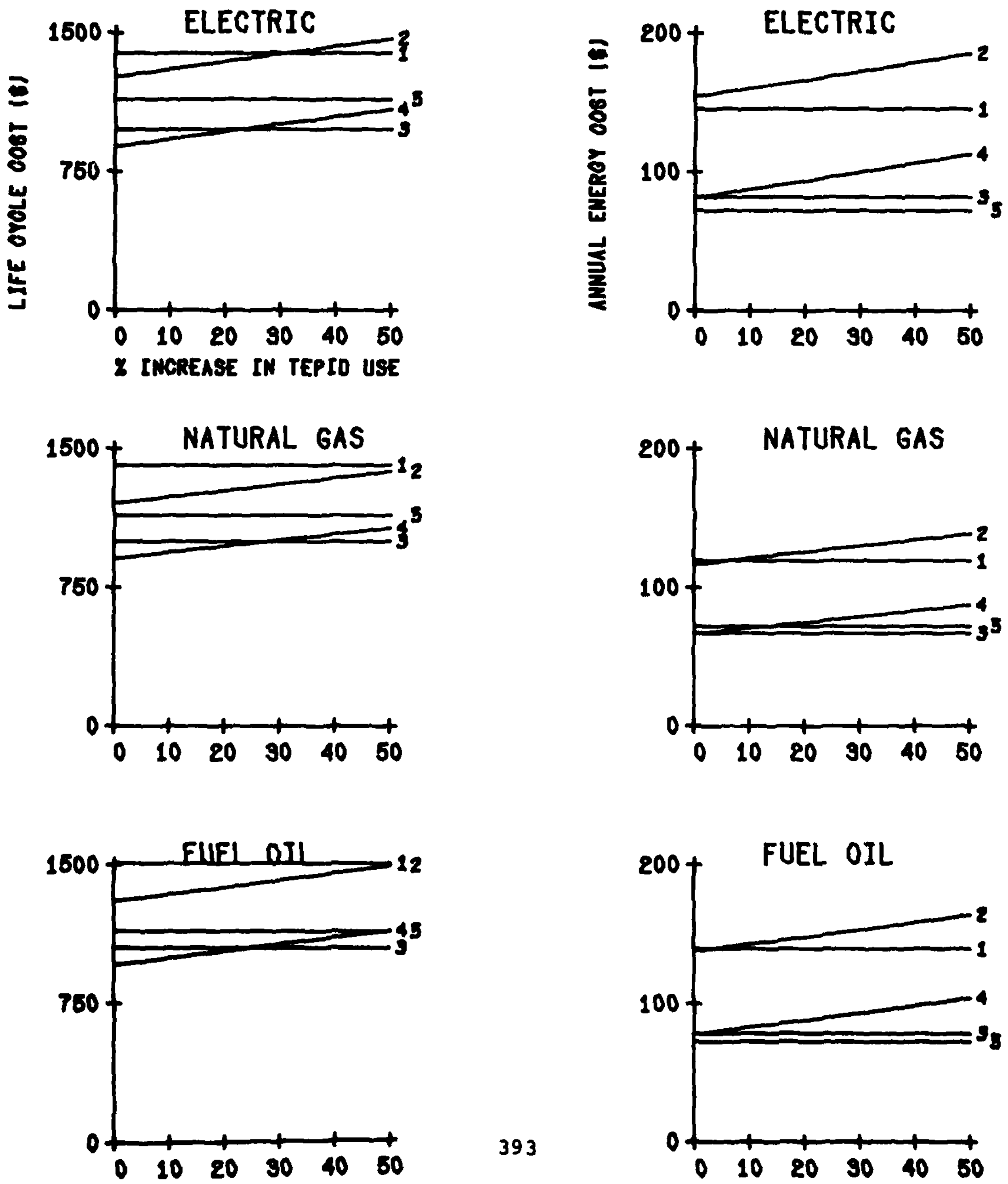
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	10	100.00	100.00

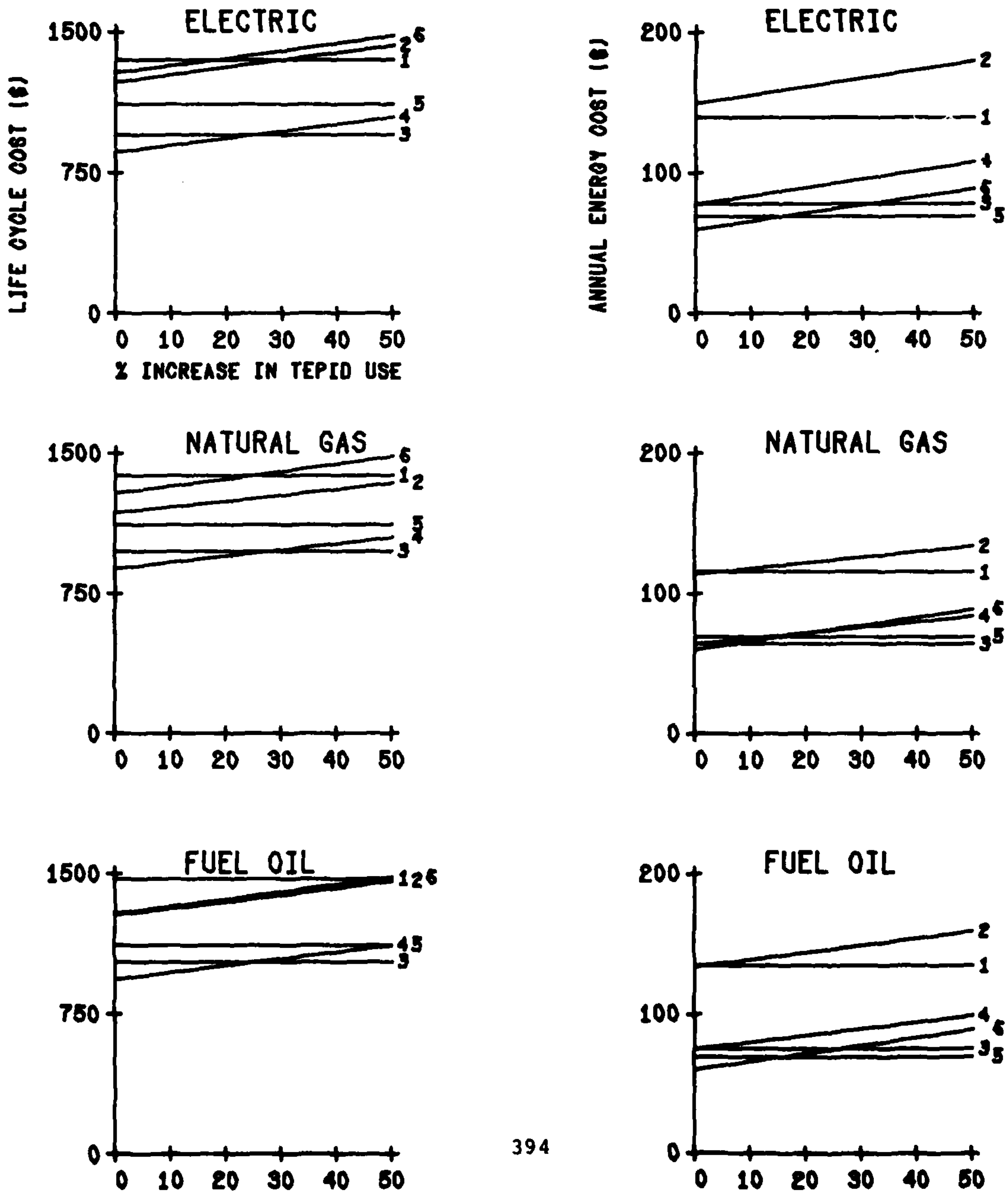
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	10	50.00	85.00

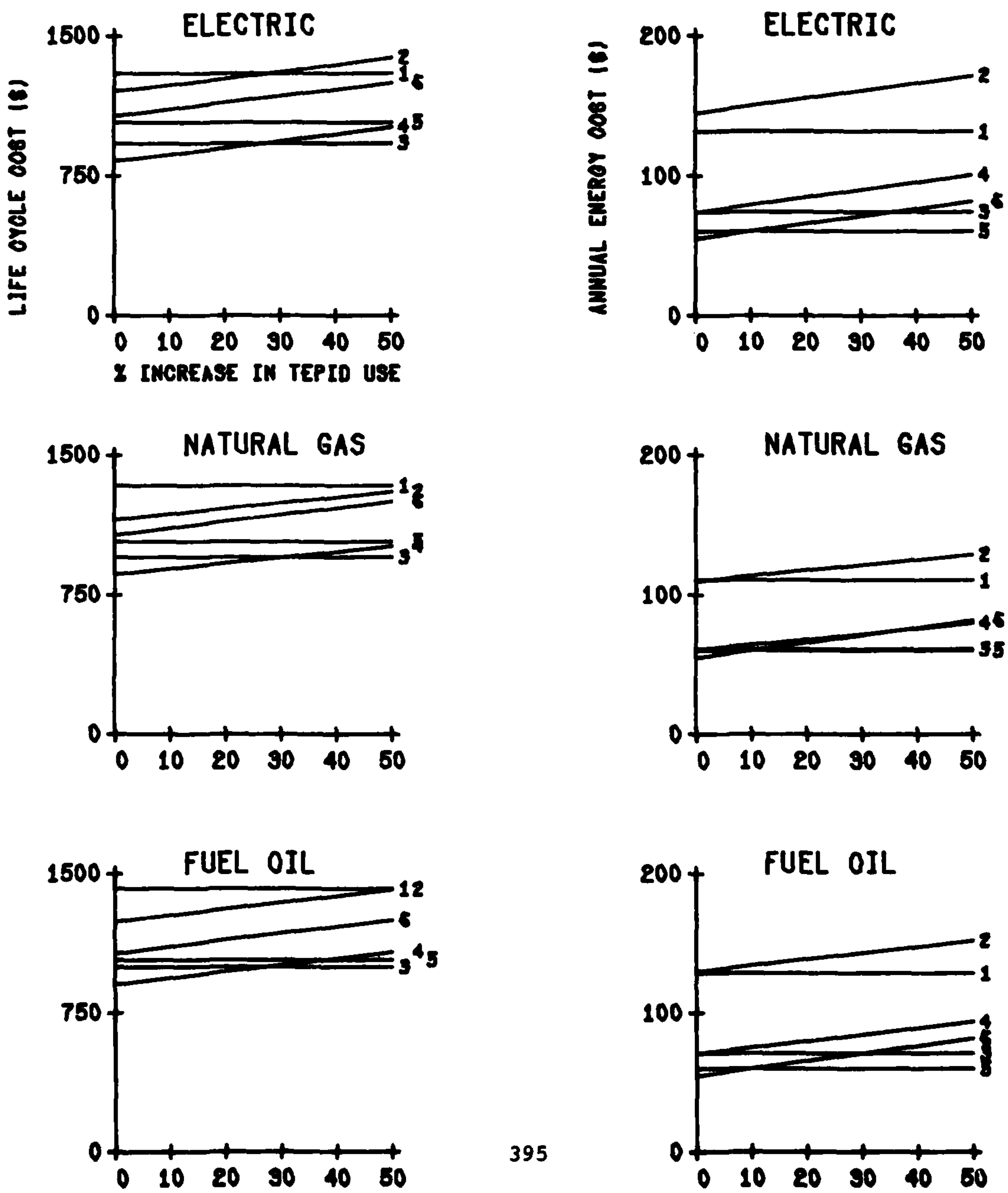
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	10	22.00	66.00

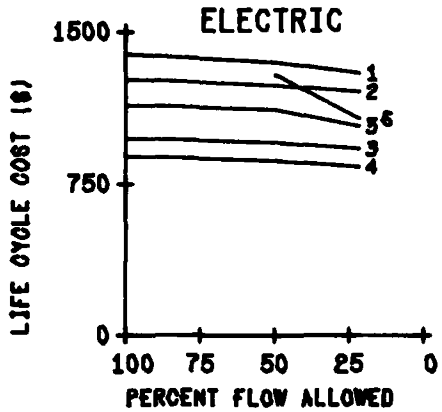
*** NEW CONSTRUCTION ***

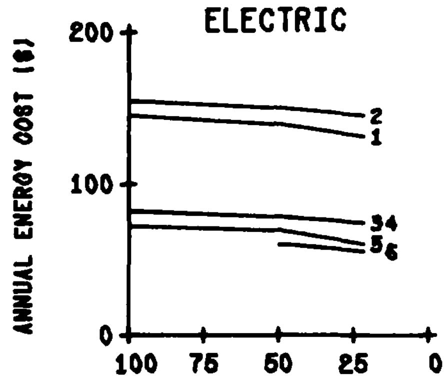


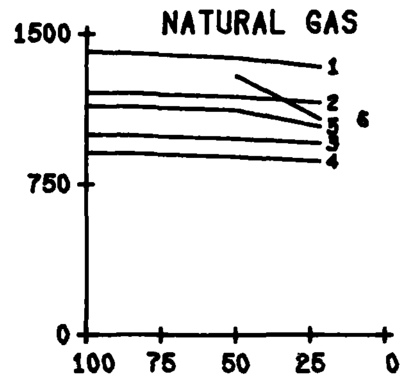
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

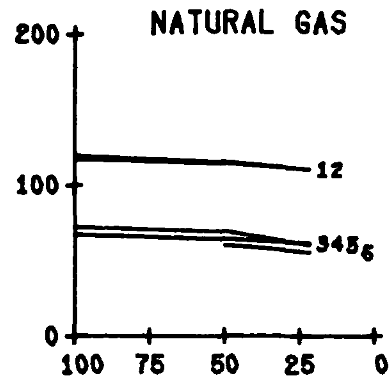
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	10	0.00

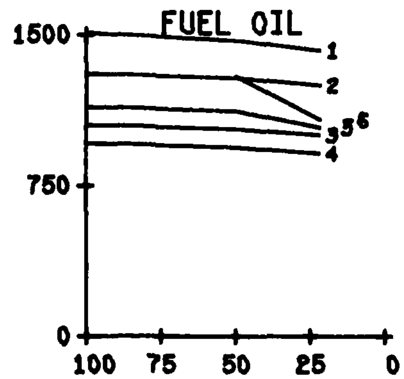
*** NEW CONSTRUCTION ***

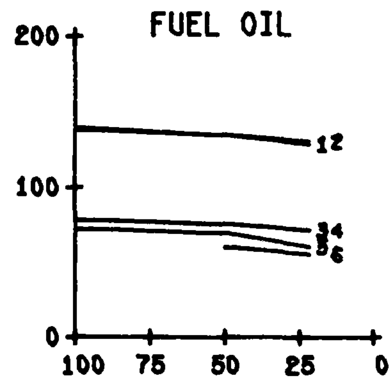








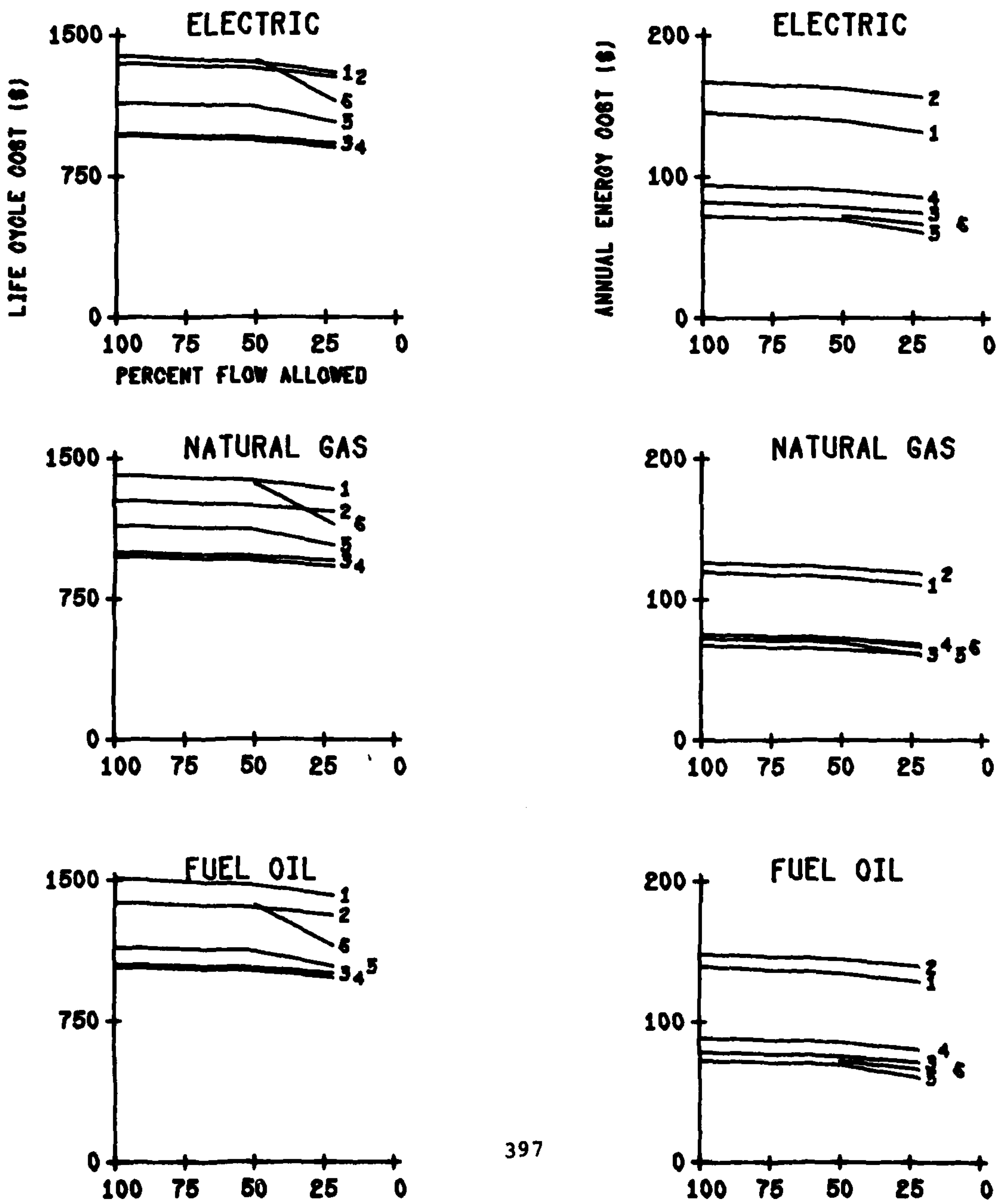




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	10	20.00

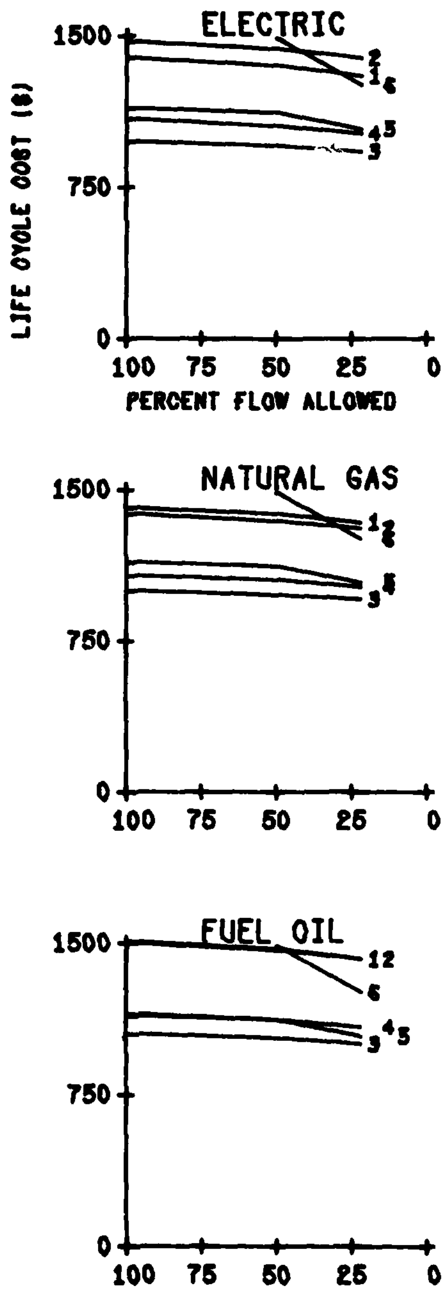
*** NEW CONSTRUCTION ***

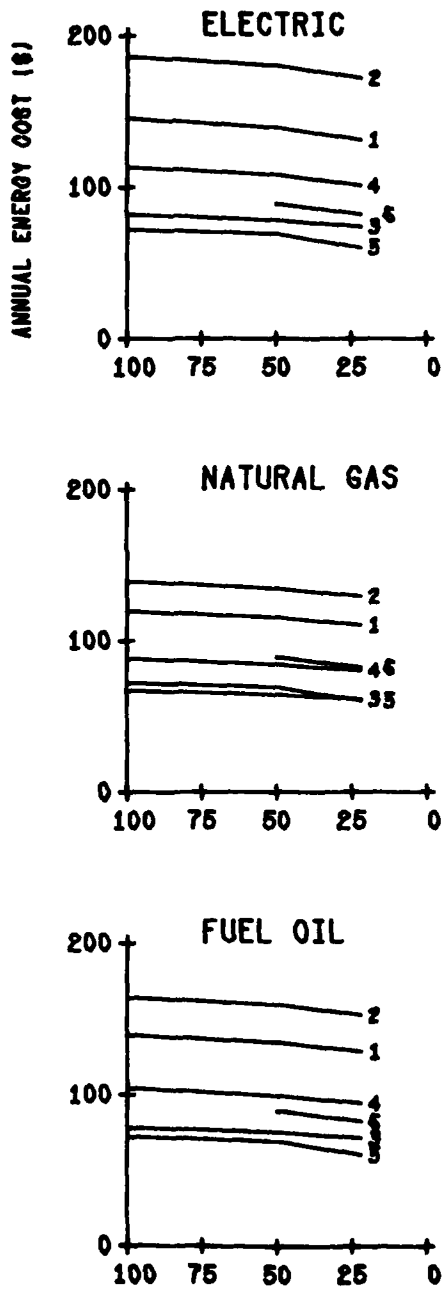


JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	10	50.00

*** NEW CONSTRUCTION ***

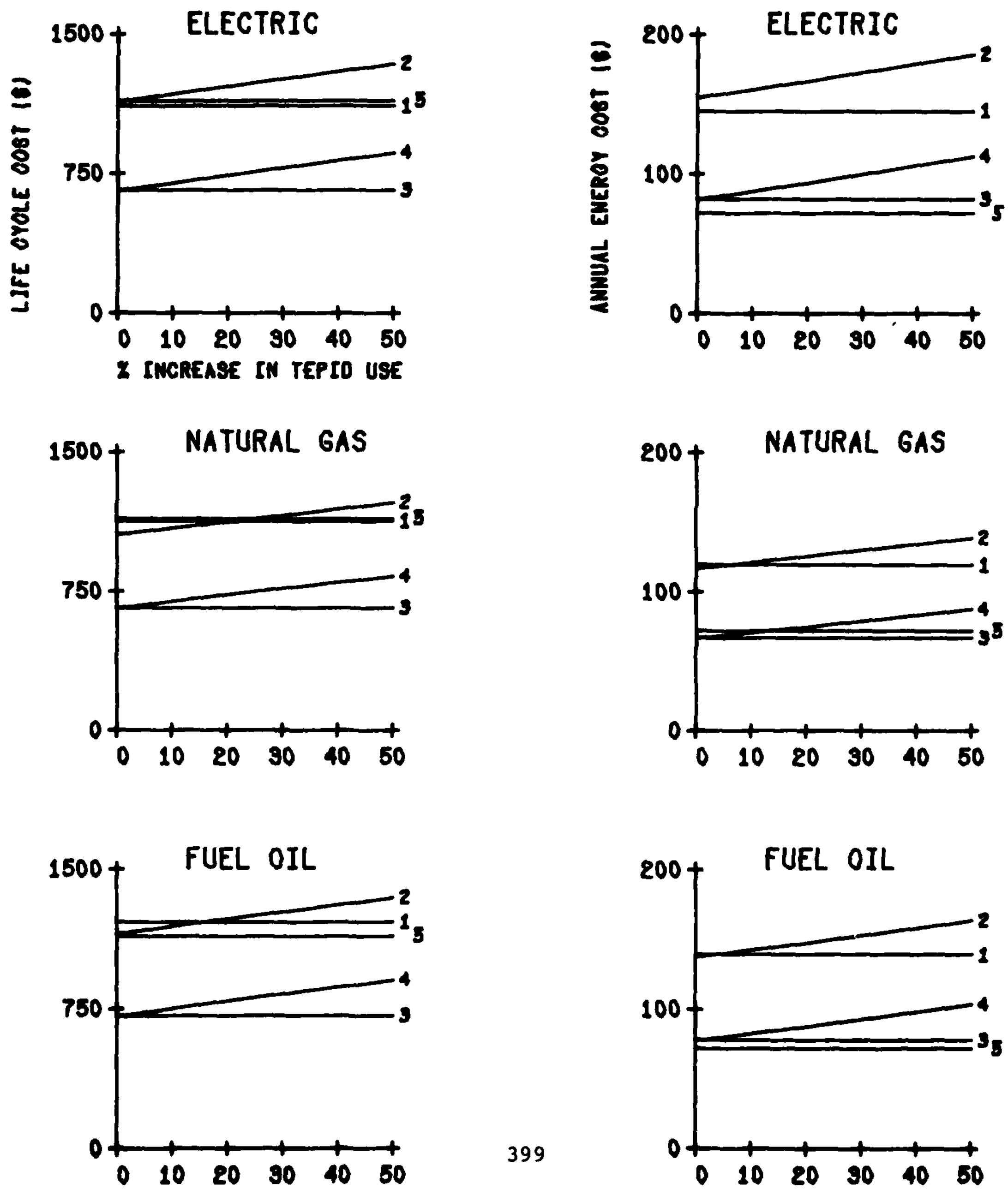




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	10	100.00	100.00

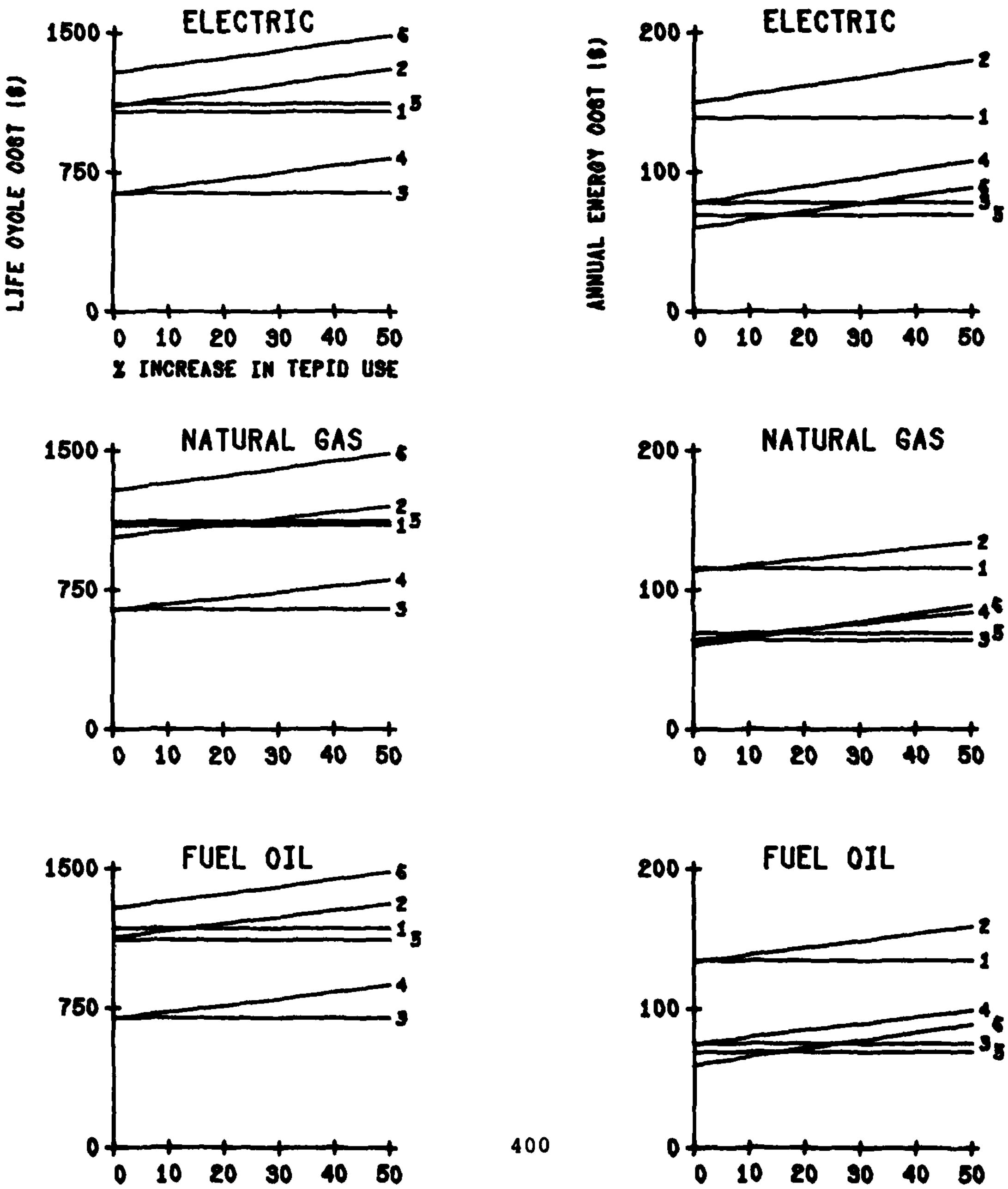
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	10	50.00	85.00

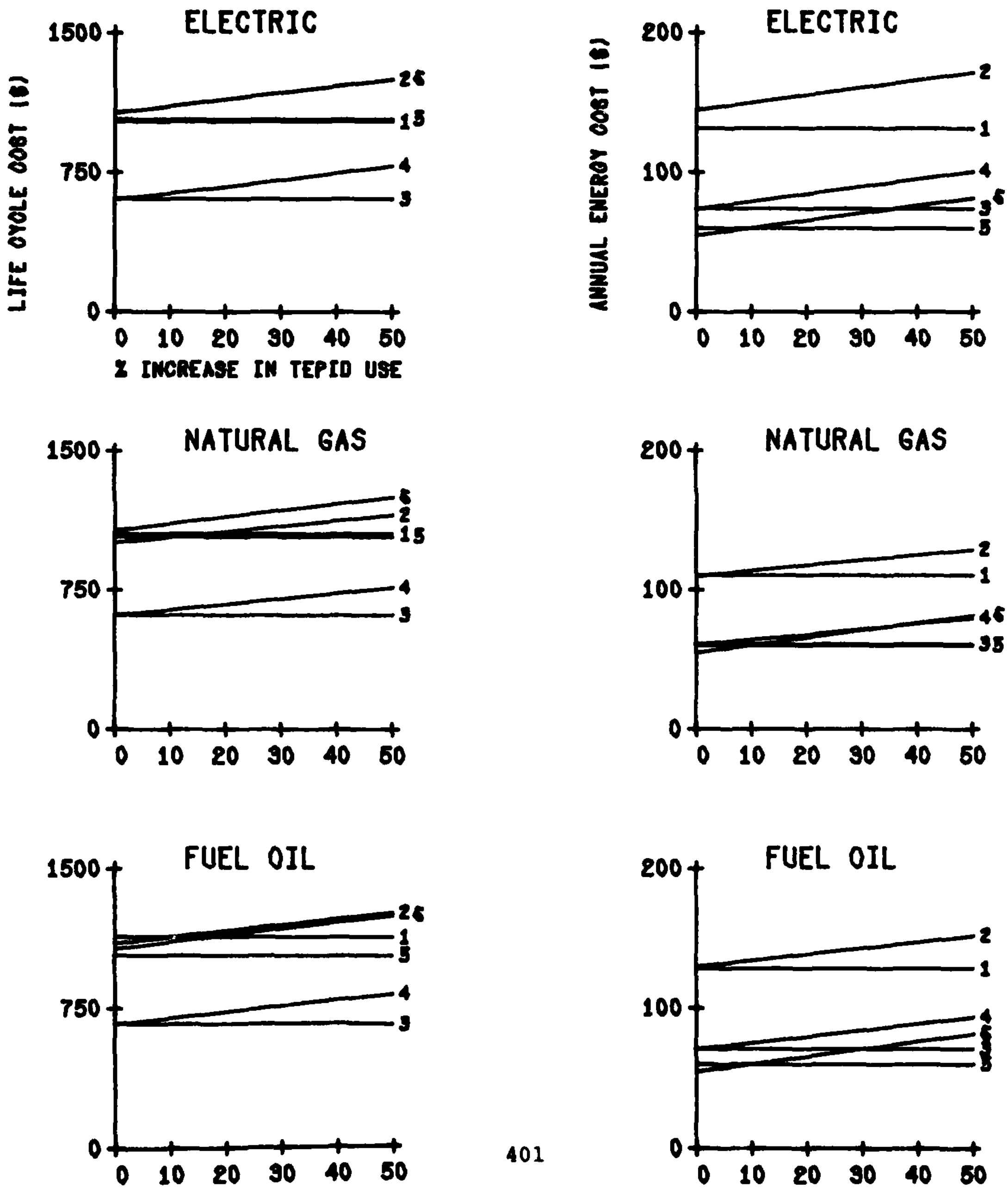
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
6	10	22.00	66.00

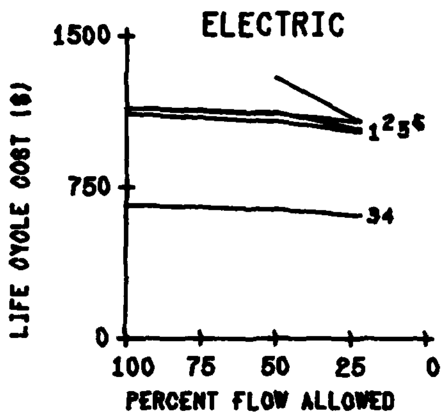
****** RETROFIT ******

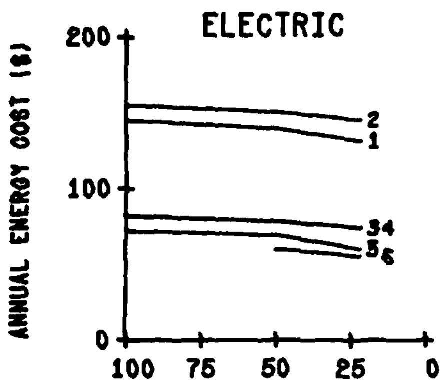


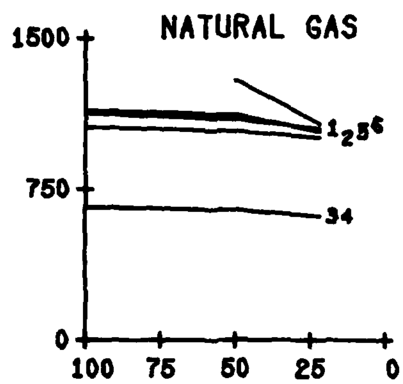
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

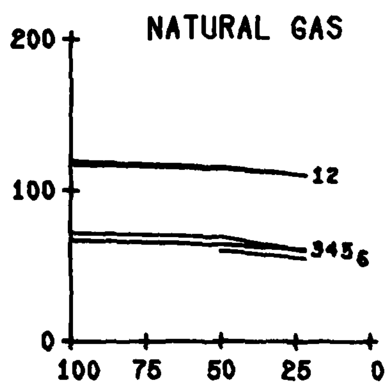
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	10	0.00

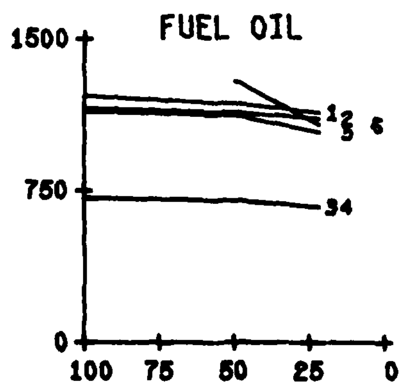
****** RETROFIT ******

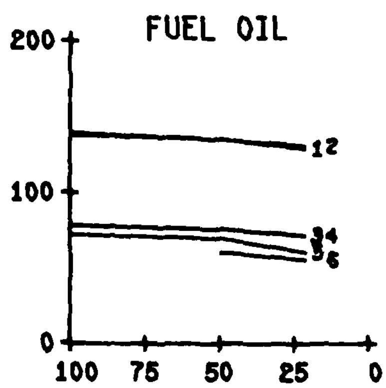








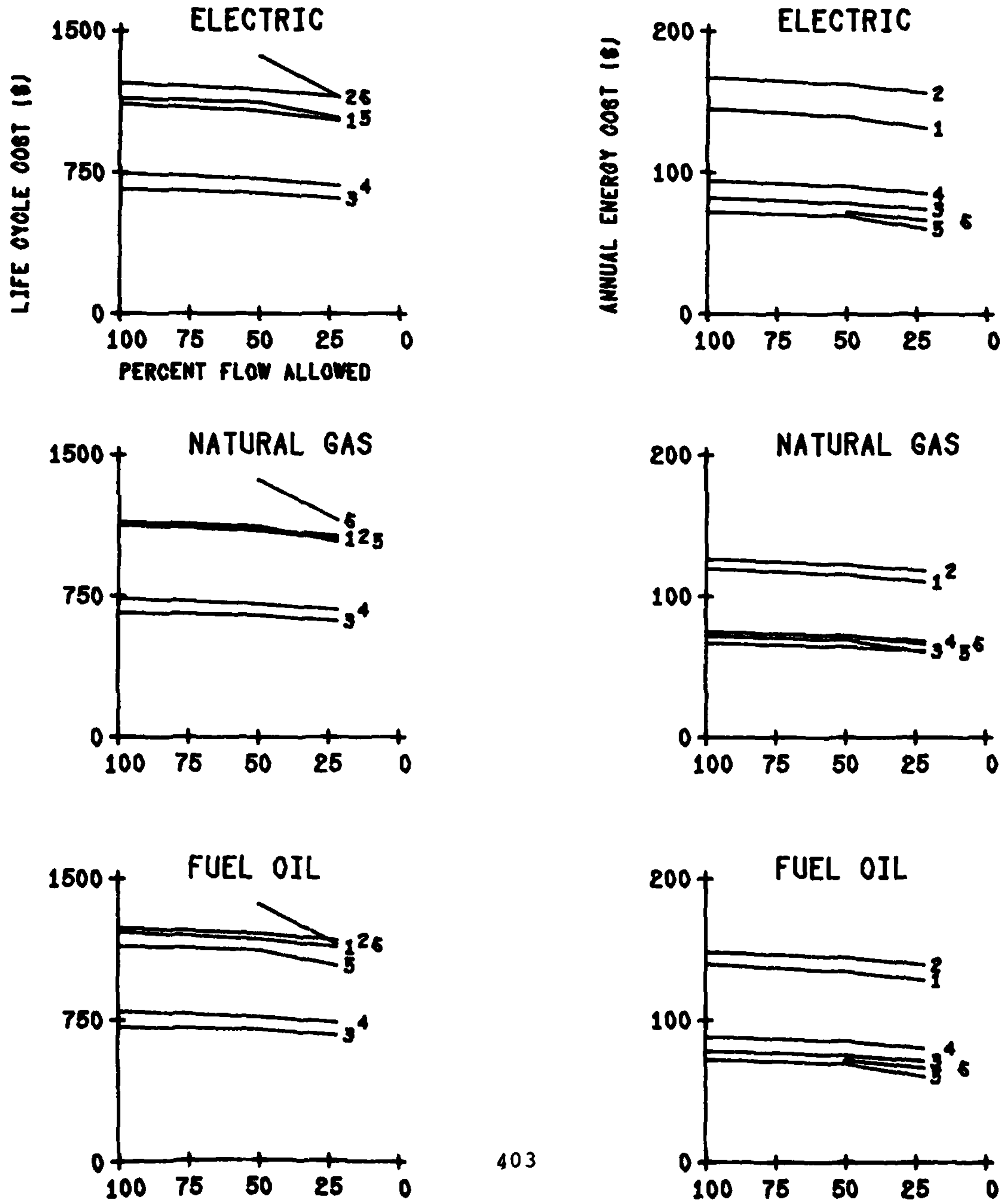




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	10	20.00

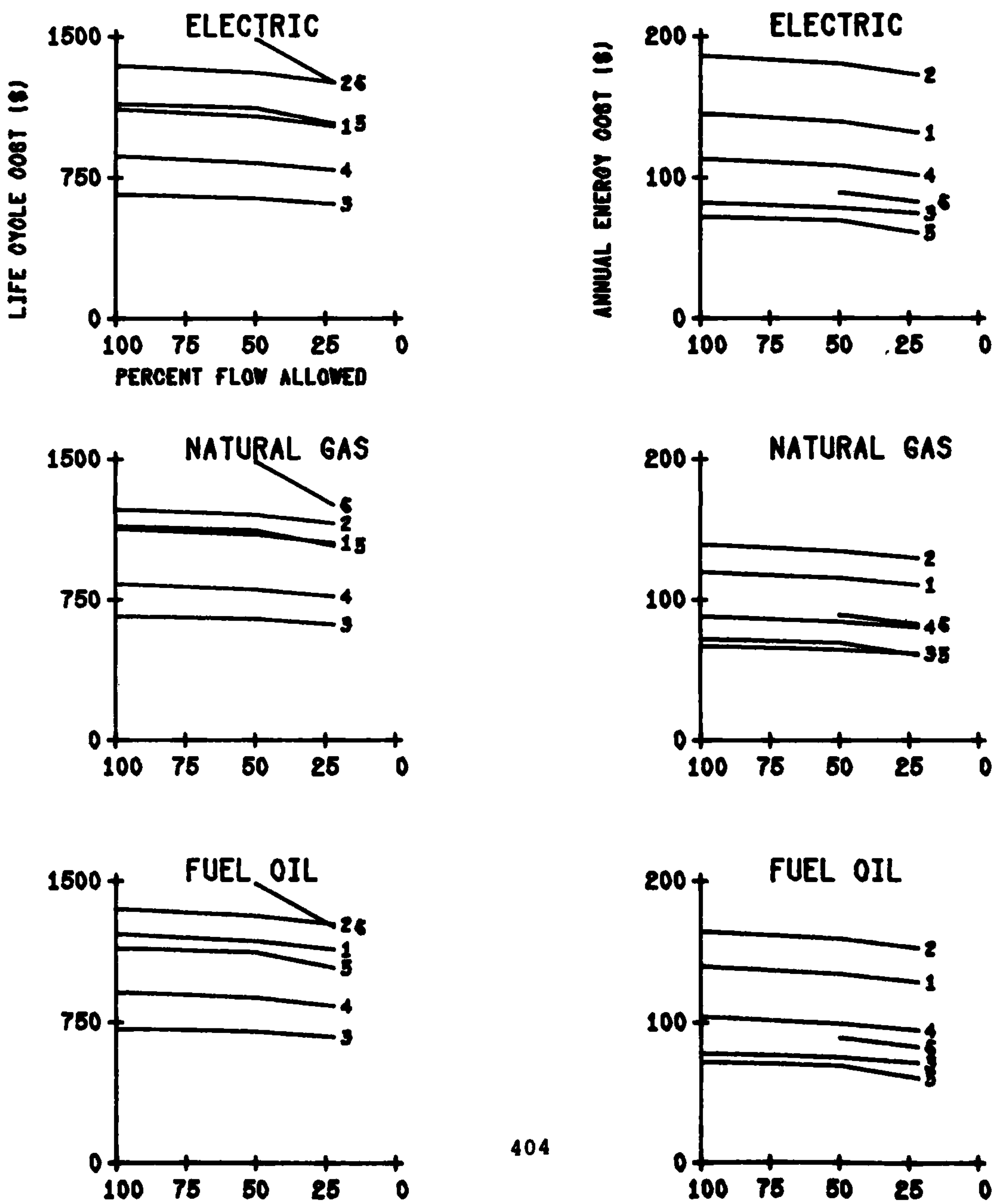
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
6	10	50.00

****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

BUILDING: CODE = 5 NAME = EXCHANGE (NO FOOD)

FXTR TYPE	FXTR NAME	QTY	TEMP REQ CODE	HOT/TEPID FLOW RATE (GPM)	EST USAGE (GPH/FXTP) HOT/TEP	COLD
1	LAVATORY FAUCET	4	2	2.25	6.00	6.00
2	JANITORIAL FAUCET	1	1	3.75	20.00	20.00
3	TOILET	4	3	0.00	17.50	17.50
5	DRINKING FOUNTAIN	2	3	0.00	2.66	2.66

----- CENTRAL HEATER -----

CODE	NAME	EFFECIENCY
1	ELEC	0.95
2	GAS	0.75
3	OIL	0.70

CENTRAL HEATER STORAGE TANK

HEIGHT (IN)	DIAMETER (IN)
40.00	19.17

CENTRAL HEATER R VALUE(S) = 2.50

ADDITIONAL STANDBY LOSS FACTOR FOR GAS/OIL HEATERS = 2.90
CENTRAL HEATER LOCATION (C=COND SPACE, U=UNCOND) = C
REMAINING LIFE OF HEATER (YRS) = 8
ALTERNATIVE SYSTEM HEATER LIFE EXTENSION (YRS) = 1

NORMAL HEATED WATER LINE LENGTH(S) (FT) = 120.00

-------- HEATED WATER LINES --------

DIAMETER (IN)	EXTRA LENGTH COOLER (FT)	TOILET (FT)	PERCENT CONDITIONED SPACE
0.785	40.00	10.00	100.00

UMBER OF PIPE COOLDOWN CYCLES PER DAY= 1.20

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

---------------- CONSTANT TEMPERATURES (F) ----------------

******** HOT WATER SUPPLY	MIN ALLOW	******* MAX ALLOW	******* TEPID WATER SUPPLY	MIN ALLOW	****** MAX ALLOW	WATER COOLER OUTLET	ROOM
140.	130.	150.	105.	95.	115.	40.	68.

FOR DOE REGIONS:	2	8	10
AMBIENT TEMP (F)	51.00	51.00	60.00
GROUND WATER TEMP (F)	45.00	50.00	55.00
MIN GRD WATER TEMP (F)	39.00	45.00	49.00
MAX GRD WATER TEMP (F)	51.00	55.00	61.00

PERCENT INCREASED TEPID USE (NO COLD SYSTEMS) = 0.00 20.00 50.00

PERCENT OF FLOW (FLOW RESTRICTION) = 100.00 50.00 22.00
CORRESPONDING PERCENT USAGE = 100.00 85.00 66.00

WATER COOLER EFFECIENCY (%) = 70.00

NUMBER OF HOURS IN WORK DAY = 12.00
NUMBER WORK DAYS IN YEAR = 300.00

---------------------- POINT-OF-USE HEATERS ----------------------

CODE	NAME	STORAGE TANK HEIGHT (IN)	STORAGE TANK DIAMETER (IN)	MAX FXTR DEMAND (GPH)	INSTALLED COST
4	INSTANTANEOUS 4.6 KW				237.00
5	INSTANTANEOUS 10 KW				400.00
6	INSTANTANEOUS 20 KW				420.00
7	MINITANK 1/2 GAL	6.00	5.00	6.25	200.00
8	MINITANK 1 GAL	8.00	6.06	12.00	260.00

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION INPUT

FOR DOE REGION:	2	8	10
FOR FXTR TYPE 1 ($/FXTR) -			
INSTALLED COST	113.20	106.86	141.55
RETURN CR NEW	50.00	45.00	60.00
RETURN CR RETROFIT	0.00	0.00	0.00
FOR FXTR TYPE 2 ($/FXTR) -			
INSTALLED COST	113.20	106.86	141.55
RETURN CR NEW	50.00	45.00	60.00
RETURN CR RETROFIT	0.00	0.00	0.00
CREDIT - NO HOT/COLD SUPPLY	565.00	530.00	700.00
CENTRAL HTR TYPE 1 ($) -			
INSTALLED COST	260.88	252.12	299.68
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 2 ($) -			
INSTALLED COST	301.88	291.40	346.48
RETURN CREDIT	0.00	0.00	0.00
CENTRAL HTR TYPE 3 ($) -			
INSTALLED COST	301.88	291.40	346.48
RETURN CREDIT	0.00	0.00	0.00
COST OF ENERGY -			
ELECTRICITY ($/KWH)	0.070	0.036	0.022
NATURAL GAS ($/MBTU)	3.710	2.330	3.500
FUEL OIL ($/GAL)	0.581	0.541	0.550
10 YR PRESENT WORTH FACTORS -			
ELECTRICITY	6.183	6.841	6.601
NATURAL GAS	7.067	9.325	7.950
FUEL OIL	7.440	7.547	7.452

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	0.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1451E 09	0.2718E 09	0.1124E 09	0.1124E 09	0.1065E 09	0.1065E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2977.17	5576.56	2305.50	2305.50	2186.01	2186.01
INS COST ($)	826.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	*********	*********	*********	*********	*********
TLEC CST ($)	18407.85	34479.89	14254.95	14254.95	13516.12	13516.12
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	19234.73	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	0.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1341E 09	0.2628E 09	0.1054E 09	0.1054E 09	0.9959E 08	0.9959E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2752.22	5391.12	2162.14	2162.14	2042.64	2042.64
INS COST ($)	826.87	1246.87	1246.87	1246.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	996.87	1246.87	996.87	*********	*********
TLEC CST ($)	17016.98	33333.32	13368.53	13368.53	12629.69	12629.69
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	17843.86	34330.20	14615.41	14365.41	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	0.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1202E 09	0.2514E 09	0.9656E 08	0.9656E 08	0.9073E 08	0.9073E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2467.28	5156.23	1980.54	1980.54	1861.05	1861.05
INS COST ($)	826.87	1063.87	1063.87	1063.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	813.87	1063.87	813.87	1368.00	1368.00
TLEC CST ($)	15255.22	31880.99	12245.72	12245.72	11506.88	11506.88
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	16082.10	32694.87	13309.59	13059.59	12874.88	12874.88

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	20.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1451E 09	0.2809E 09	0.1124E 09	0.1215E 09	0.1065E 09	0.1156E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2977.17	5763.04	2305.50	2491.98	2186.01	2372.49
INS COST ($)	826.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	*********	*********	*********	*********	*********
TLEC CST ($)	18407.85	35632.89	14254.95	15407.95	13516.12	14669.12
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	19234.73	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	20.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1341E 09	0.2705E 09	0.1054E 09	0.1131E 09	0.9959E 08	0.1073E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2752.22	5549.63	2162.14	2320.65	2042.64	2201.15
INS COST ($)	826.87	1246.87	1246.87	1246.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	996.87	1246.87	996.87	*********	*********
TLEC CST ($)	17016.98	34313.36	13368.53	14348.57	12629.69	13609.74
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	17843.86	35310.24	14615.41	15345.45	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	20.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1202E 09	0.2574E 09	0.9656E 08	0.1025E 09	0.9073E 08	0.9674E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2467.28	5279.31	1980.54	2103.62	1861.05	1984.12
INS COST ($)	826.87	1063.87	1063.87	1063.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	813.87	1063.87	813.87	1368.00	1368.00
TLEC CST ($)	15255.22	32641.97	12245.72	13006.69	11506.88	12267.86
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	16082.10	33455.85	13309.59	13820.57	12874.88	13635.86

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	50.0	ELEC	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1451E 09	0.2946E 09	0.1124E 09	0.1351E 09	0.1065E 09	0.1293E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2977.17	6042.76	2305.50	2771.70	2186.01	2652.21
INS COST ($)	826.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	*********	*********	*********	*********	*********
TLEC CST ($)	18407.85	37362.39	14254.95	17137.45	13516.12	16398.62
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	19234.73	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	50.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1341E 09	0.2821E 09	0.1054E 09	0.1247E 09	0.9959E 08	0.1189E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2752.22	5787.39	2162.14	2558.41	2042.64	2438.91
INS COST ($)	826.87	1246.87	1246.87	1246.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	996.87	1246.87	996.87	*********	*********
TLEC CST ($)	17016.98	35783.45	13368.53	15818.65	12629.69	15079.82
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	17843.86	36780.32	14615.41	16815.53	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	50.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1202E 09	0.2664E 09	0.9656E 08	0.1115E 09	0.9073E 08	0.1057E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2467.28	5463.92	1980.54	2288.23	1861.05	2168.74
INS COST ($)	826.87	1063.87	1063.87	1063.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	826.87	813.87	1063.87	813.87	1368.00	1368.00
TLEC CST ($)	15255.22	33783.44	12245.72	14148.16	11506.88	13409.33
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	16082.10	34597.32	13309.59	14962.04	12874.88	14777.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	0.0	GAS	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1902E 09	0.3372E 09	0.1397E 09	0.1397E 09	0.1065E 09	0.1065E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	725.09	1871.44	908.84	908.84	2186.01	2186.01
INS COST ($)	867.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	*********	*********	*********	*********	*********
TLEC CST ($)	5103.55	12556.21	6001.44	6001.44	13516.12	13516.12
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5971.43	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	0.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1764E 09	0.3264E 09	0.1309E 09	0.1309E 09	0.9959E 08	0.9959E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	670.84	1793.82	873.28	873.28	2042.64	2042.64
INS COST ($)	867.87	1287.87	1287.87	1287.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	1037.87	1287.87	1037.87	*********	*********
TLEC CST ($)	4723.30	12047.92	5753.30	5753.30	12629.69	12629.69
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5591.18	13085.80	7041.18	6791.18	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	0.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1588E 09	0.3126E 09	0.1197E 09	0.1197E 09	0.9073E 08	0.9073E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	602.13	1695.49	828.25	828.25	1861.05	1861.05
INS COST ($)	867.87	1104.87	1104.87	1104.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	854.87	1104.87	854.87	1368.00	1368.00
TLEC CST ($)	4241.65	11404.09	5438.98	5438.98	11506.88	11506.88
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5109.53	12258.97	6543.86	6293.86	12874.88	12874.88

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	20.0	GAS	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1902E 09	0.3487E 09	0.1397E 09	0.1512E 09	0.1065E 09	0.1156E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	725.09	1914.17	908.84	951.56	2186.01	2372.49
INS COST ($)	867.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	*********	*********	*********	*********	*********
TLEC CST ($)	5103.55	12858.16	6001.44	6303.39	13516.12	14669.12
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5971.43	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	20.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1764E 09	0.3362E 09	0.1309E 09	0.1407E 09	0.9959E 08	0.1073E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	670.84	1830.13	873.28	909.60	2042.64	2201.15
INS COST ($)	867.87	1287.87	1287.87	1287.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	1037.87	1287.87	1037.87	*********	*********
TLEC CST ($)	4723.30	12304.58	5753.30	6009.96	12629.69	13609.74
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5591.18	13342.46	7041.18	7047.84	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	20.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1588E 09	0.3202E 09	0.1197E 09	0.1273E 09	0.9073E 08	0.9674E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	602.13	1723.69	828.25	856.45	1861.05	1984.12
INS COST ($)	867.87	1104.87	1104.87	1104.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	854.87	1104.87	854.87	1368.00	1368.00
TLEC CST ($)	4241.65	11603.38	5438.96	5638.27	11506.88	12267.86
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5109.53	12458.26	6543.86	6493.15	12874.88	13635.86

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	50.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1902E 09	0.3660E 09	0.1397E 09	0.1685E 09	0.1065E 09	0.1293E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	725.09	1978.26	908.84	1015.65	2186.01	2652.21
INS COST ($)	867.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	*********	*********	*********	*********	*********
TLEC CST ($)	5103.55	13311.09	6001.44	6756.32	13516.12	16398.62
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5971.43	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	50.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1764E 09	0.3508E 09	0.1309E 09	0.1554E 09	0.9959E 08	0.1189E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	670.84	1884.61	873.28	964.08	2042.64	2438.91
INS COST ($)	867.87	1287.87	1287.87	1287.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	1037.87	1287.87	1037.87	*********	*********
TLEC CST ($)	4723.30	12689.57	5753.30	6394.95	12629.69	15079.82
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5591.18	13727.45	7041.18	7432.83	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	50.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1582E 09	0.3316E 09	0.1197E 09	0.1387E 09	0.9073E 08	0.1057E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	602.13	1765.99	828.25	898.75	1861.05	2168.74
INS COST ($)	867.87	1104.87	1104.87	1104.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	854.87	1104.87	854.87	1368.00	1368.00
TLEC CST ($)	4241.65	11902.31	5438.98	5937.20	11506.88	13409.33
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5109.53	12757.19	6543.86	6792.08	12874.88	14777.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	0.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2022E 09	0.3577E 09	0.1472E 09	0.1472E 09	0.1065E 09	0.1065E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	857.86	2088.47	991.39	991.39	2186.01	2186.01
INS COST ($)	867.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	*********	*********	*********	*********	*********
TLEC CST ($)	6353.14	14586.55	6776.89	6776.89	13516.12	13516.12
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	7221.02	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1873E 09	0.3462E 09	0.1378E 09	0.1378E 09	0.9959E 08	0.9959E 08
ASH CTR (BTU)	0.2176E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	793.55	2004.48	949.48	949.48	2042.64	2042.64
INS COST ($)	867.87	1287.87	1287.87	1287.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	1037.87	1287.87	1037.87	*********	*********
TLEC CST ($)	5879.03	14018.98	6469.46	6469.46	12629.69	12629.69
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6746.91	15056.86	7757.34	7507.34	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1686E 09	0.3317E 09	0.1259E 09	0.1259E 09	0.9073E 08	0.9073E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	712.06	1898.10	896.39	896.39	1861.05	1861.05
INS COST ($)	867.87	1104.87	1104.87	1104.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	854.87	1104.87	854.87	1368.00	1368.00
TLEC CST ($)	5278.51	13300.06	6080.06	6080.06	11506.88	11506.88
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6146.38	14154.94	7184.94	6934.94	12874.88	12874.88

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	20.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2022E 09	0.3700E 09	0.1472E 09	0.1596E 09	0.1065E 09	0.1156E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	857.86	2139.68	991.39	1042.60	2186.01	2372.49
INS COST ($)	867.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	*********	*********	*********	*********	*********
TLEC CST ($)	6353.14	14967.55	6776.89	7157.88	13516.12	14669.12
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	7221.02	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	20.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1873E 09	0.3567E 09	0.1378E 09	0.1483E 09	0.9959E 08	0.1073E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	793.55	2048.01	949.48	993.01	2042.64	2201.15
INS COST ($)	867.87	1287.87	1287.87	1287.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	1037.87	1287.87	1037.87	*********	*********
TLEC CST ($)	5879.03	14342.83	6469.46	6793.31	12629.69	13609.74
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6746.91	15380.71	7757.34	7831.19	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	20.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1686E 09	0.3398E 09	0.1259E 09	0.1340E 09	0.9073E 08	0.9674E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	712.08	1931.90	896.39	930.19	1861.05	1984.12
INS COST ($)	867.87	1104.87	1104.87	1104.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	854.87	1104.87	854.87	1368.00	1368.00
TLEC CST ($)	5278.50	13551.52	6080.06	6331.52	11506.88	12267.86
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6146.38	14406.40	7184.94	7186.40	12874.88	13635.86

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CEN'ER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATIO' ESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	100.0	100.0	50.0	OIL	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2022E 09	0.3885E 09	0.1472E 09	0.1781E 09	0.1065E 09	0.1293E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	857.86	2216.49	991.39	1119.42	2186.01	2652.21
INS COST ($)	867.87	*********	*********	*********	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	*********	*********	*********	*********	*********
TLEC CST ($)	6353.14	15539.04	6776.89	7729.37	13516.12	16398.62
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	7221.02	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	50.0	85.0	50.0	OIL	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1873E 09	0.3724E 09	0.1378E 09	0.1640E 09	0.9959E 08	0.1189E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	793.55	2113.30	949.48	1058.30	2042.64	2438.91
INS COST ($)	867.87	1287.87	1287.87	1287.87	*********	*********
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	1037.87	1287.87	1037.87	*********	*********
TLEC CST ($)	5879.03	14828.59	6469.46	7279.07	12629.69	15079.82
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6746.91	15866.47	7757.34	8316.95	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	NEW	22.0	66.0	50.0	OIL	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1686E 09	0.3520E 09	0.1259E 09	0.1462E 09	0.9073E 08	0.1057E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	712.08	1982.59	896.39	980.89	1861.05	2168.74
INS COST ($)	867.87	1104.87	1104.87	1104.87	1368.00	1368.00
RET CR ($)	0.00	250.00	0.00	250.00	0.00	0.00
TOT COST ($)	867.87	854.87	1104.87	854.87	1368.00	1368.00
TLEC CST ($)	5278.50	13928.70	6080.06	6708.70	11506.88	13409.33
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6146.38	14783.58	7184.94	7563.58	12874.88	14777.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	0.0	ELEC	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1451E 09	0.2718E 09	0.1124E 09	0.1124E 09	0.1065E 09	0.1065E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2977.17	5576.56	2305.50	2305.50	2186.01	2186.01
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	18407.85	34479.89	14254.95	14254.95	13516.12	13516.12
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	18529.55	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	0.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1341E 09	0.2628E 09	0.1054E 09	0.1054E 09	0.9959E 08	0.9959E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2752.22	5391.12	2162.14	2162.14	2042.64	2042.64
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	17016.98	33333.32	13368.53	13368.53	12629.69	12629.69
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	17138.68	33753.32	13788.53	13788.53	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	0.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1202E 09	0.2514E 09	0.9656E 08	0.9656E 08	0.9073E 08	0.9073E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2467.28	5156.23	1980.54	1980.54	1861.05	1861.05
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	15255.22	31880.99	12245.72	12245.72	11506.88	11506.88
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	15376.92	32117.99	12482.72	12482.72	12874.88	12874.88

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	20.0	ELEC	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1451E 09	0.2809E 09	0.1124E 09	0.1215E 09	0.1065E 09	0.1156E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2977.17	5763.04	2305.50	2491.98	2186.01	2372.49
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	18407.85	35632.89	14254.95	15407.95	13516.12	14669.12
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	18529.55	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	20.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1341E 09	0.2705E 09	0.1054E 09	0.1131E 09	0.9959E 08	0.1073E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2752.22	5549.63	2162.14	2320.65	2042.64	2201.15
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	17016.98	34313.36	13368.53	14348.57	12629.69	13609.74
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	17138.68	34733.36	13788.53	14768.57	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	20.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1202E 09	0.2574E 09	0.9656E 08	0.1025E 09	0.9073E 08	0.9674E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2467.28	5279.31	1980.54	2103.62	1861.05	1984.12
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	15255.22	32641.97	12245.72	13006.69	11506.88	12267.86
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	15376.92	32878.97	12482.72	13243.69	12874.88	13635.86

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	50.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1451E 09	0.2946E 09	0.1124E 09	0.1351E 09	0.1065E 09	0.1293E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2977.17	6042.76	2305.50	2771.70	2186.01	2652.21
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	18407.85	37362.39	14254.95	17137.45	13516.12	16398.62
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	18529.55	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	50.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1341E 09	0.2821E 09	0.1054E 09	0.1247E 09	0.9959E 08	0.1189E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2752.22	5787.39	2162.14	2558.41	2042.64	2438.91
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	17016.98	35783.45	13368.53	15818.65	12629.69	15079.82
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	17138.68	36203.45	13788.53	16238.65	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	50.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1202E 09	0.2664E 09	0.9656E 08	0.1115E 09	0.9073E 08	0.1057E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	2467.28	5463.92	1980.54	2288.23	1861.05	2168.74
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	15255.22	33783.44	12245.72	14148.16	11506.88	13409.33
RPLC HTR ($)	121.70	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	15376.92	34020.44	12482.72	14385.16	12874.88	14777.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	0.0	GAS	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1902E 09	0.3372E 09	0.1397E 09	0.1397E 09	0.1065E 09	0.1065E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	725.09	1871.44	908.84	908.84	2186.01	2186.01
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5103.55	12556.21	6001.44	6001.44	13516.12	13516.12
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5244.37	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	0.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1764E 09	0.3264E 09	0.1309E 09	0.1309E 09	0.9959E 08	0.9959E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	670.84	1793.82	873.28	873.28	2042.64	2042.64
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	4723.30	12047.92	5753.30	5753.30	12629.69	12629.69
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4864.12	12467.92	6173.30	6173.30	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	0.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1588E 09	0.3126E 09	0.1197E 09	0.1197E 09	0.9073E 08	0.9073E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	602.13	1695.49	828.25	828.25	1861.05	1861.05
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	4241.65	11404.09	5438.98	5438.98	11506.88	11506.88
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4382.46	11641.09	5675.98	5675.98	12874.88	12874.88

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	20.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1902E 09	0.3487E 09	0.1397E 09	0.1512E 09	0.1065E 09	0.1156E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	725.09	1914.17	908.84	951.56	2186.01	2372.49
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5103.55	12858.16	6001.44	6303.39	13516.12	14669.12
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5244.37	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	20.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1764E 09	0.3362E 09	0.1309E 09	0.1407E 09	0.9959E 08	0.1073E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	670.84	1830.13	873.28	909.60	2042.64	2201.15
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	4723.30	12304.58	5753.30	6009.96	12629.69	13609.74
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4864.12	12724.58	6173.30	6429.96	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	20.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1588E 09	0.3202E 09	0.1197E 09	0.1273E 09	0.9073E 08	0.9674E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	602.13	1723.69	828.25	856.45	1861.05	1984.12
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	4241.65	11603.38	5438.98	5638.27	11506.88	12267.86
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4382.48	11840.38	5675.98	5875.27	12874.88	13635.86

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	50.0	GAS	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1902E 09	0.3660E 09	0.1397E 09	0.1685E 09	0.1065E 09	0.1293E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	725.09	1978.26	908.84	1015.65	2186.01	2652.21
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5103.55	13311.09	6001.44	6756.32	13516.12	16398.62
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5244.37	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	50.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1764E 09	0.3508E 09	0.1309E 09	0.1554E 09	0.9959E 08	0.1189E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	670.84	1884.61	873.28	964.08	2042.64	2438.91
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	4723.30	12689.57	5753.30	6394.95	12629.69	15079.82
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4864.12	13109.57	6173.30	6814.95	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	50.0	GAS	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1588E 09	0.3316E 09	0.1197E 09	0.1387E 09	0.9073E 08	0.1057E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	602.13	1765.99	828.25	898.75	1861.05	2168.74
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	4241.65	11902.31	5438.98	5937.20	11506.88	13409.33
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4382.48	12139.31	5675.98	6174.20	12874.88	14777.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	0.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2022E 09	0.3577E 09	0.1472E 09	0.1472E 09	0.1065E 09	0.1065E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	857.86	2088.47	991.39	991.39	2186.01	2186.01
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	6353.14	14586.55	6776.89	6776.89	13516.12	13516.12
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	J.00
TLC COST ($)	6493.97	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1873E 09	0.3462E 09	0.1378E 09	0.1378E 09	0.9959E 08	0.9959E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	793.55	2004.48	949.48	949.48	2042.64	2042.64
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5879.03	14018.98	6469.46	6469.46	12629.69	12629.69
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6019.86	14438.98	6889.46	6889.46	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1686E 09	0.3317E 09	0.1259E 09	0.1259E 09	0.9073E 08	0.9073E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	712.08	1898.10	896.39	896.39	1861.05	1861.05
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	5278.50	13300.06	6080.06	6080.06	11506.88	11506.88
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5419.32	13537.06	6317.06	6317.06	12874.88	12874.88

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	20.0	OIL	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.2022E 09	0.3700E 09	0.1472E 09	0.1596E 09	0.1065E 09	0.1156E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	857.86	2139.68	991.39	1042.60	2186.01	2372.49
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	6353.14	14967.55	6776.89	7157.88	13516.12	14669.12
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6493.97	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	20.0	OIL	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1873E 09	0.3567E 09	0.1378E 09	0.1483E 09	0.9959E 08	0.1073E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	793.55	2048.01	949.48	993.01	2042.64	2201.15
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5879.03	14342.83	6469.46	6793.31	12629.69	13609.74
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6019.86	14762.83	6889.46	7213.31	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	20.0	OIL	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1686E 09	0.3398E 09	0.1259E 09	0.1340E 09	0.9073E 08	0.9674E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	712.08	1931.90	896.39	930.19	1861.05	1984.12
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	5278.50	13551.52	6080.06	6331.52	11506.88	12267.86
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5419.32	13788.52	6317.06	6568.52	12874.88	13635.86

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	100.0	100.0	50.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.2022E 09	0.3885E 09	0.1472E 09	0.1781E 09	0.1065E C9	0.1293E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	857.86	2216.49	991.39	1119.42	2186.01	2652.21
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	6353.14	15539.04	6776.89	7729.37	13516.12	16398.62
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6493.97	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	50.0	85.0	50.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1873E 09	0.3724E 09	0.1378E 09	0.1640E 09	0.9959E 08	0.1189E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	793.55	2113.30	949.48	1058.30	2042.64	2438.91
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5879.03	14828.59	6469.46	7279.07	12629.69	15079.82
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6019.86	15248.59	6889.46	7699.07	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	2	RETROFIT	22.0	66.0	50.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1686E 09	0.3520E 09	0.1259E 09	0.1462E 09	0.9073E 08	0.1057E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	712.08	1982.59	896.39	980.89	1861.05	2168.74
INS COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1368.00	1368.00
TLEC CST ($)	5278.50	13928.70	6080.06	6708.70	11506.88	13409.33
RPLC HTR ($)	140.82	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5419.32	14165.70	6317.06	6945.70	12874.88	14777.33

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	0.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1393E 09	0.2529E 09	0.1065E 09	0.1065E 09	0.1007E 09	0.1007E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1469.40	2668.32	1123.97	1123.97	1062.99	1062.99
INS COST ($)	786.42	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	*********	*********	*********	*********	*********
TLEC CST ($)	10052.17	18254.02	7689.10	7689.10	7271.96	7271.96
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10838.59	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	0.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1287E 09	0.2444E 09	0.9996E 08	0.9996E 08	0.9418E 08	0.9418E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1357.90	2578.95	1054.43	1054.43	993.45	993.45
INS COST ($)	786.42	1206.42	1206.42	1206.42	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	981.42	1206.42	981.42	*********	*********
TLEC CST ($)	9289.41	17642.60	7213.38	7213.38	6796.24	6796.24
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10075.83	18624.02	8419.80	8194.80	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	0.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1153E 09	0.2337E 09	0.9161E 08	0.9161E 08	0.8741E 08	0.8583E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1216.67	2465.74	966.35	966.35	922.08	905.37
INS COST ($)	786.42	1023.42	1023.42	1023.42	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	798.42	1023.42	798.42	1220.00	1368.00
TLEC CST ($)	8323.26	16868.14	6610.80	6610.80	6307.97	6193.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9109.68	17666.56	7634.22	7409.22	7527.97	7561.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	20.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1393E 09	0.2613E 09	0.1065E 09	0.1148E 09	0.1007E 09	0.1091E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1469.40	2756.23	1123.97	1211.88	1062.99	1150.90
INS COST ($)	786.42	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	*********	*********	*********	*********	*********
TLEC CST ($)	10052.17	18855.42	7689.10	8290.51	7271.96	7873.36
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10838.59	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	20.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1287E 09	0.2515E 09	0.9996E 08	0.1070E 09	0.9418E 08	0.1012E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1357.90	2653.67	1054.43	1129.15	993.45	1068.18
INS COST ($)	786.42	1206.42	1206.42	1206.42	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	981.42	1206.42	981.42	*********	*********
TLEC CST ($)	9289.41	18153.80	7213.38	7724.57	6796.24	7307.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10075.83	19135.21	8419.80	8705.99	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	20.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1153E 09	0.2392E 09	0.9161E 08	0.9711E 08	0.8741E 08	0.9133E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1216.67	2523.76	966.35	1024.37	922.08	963.39
INS COST ($)	786.42	1023.42	1023.42	1023.42	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	798.42	1023.42	798.42	1220.00	1368.00
TLEC CST ($)	8323.26	17265.07	6610.80	7007.72	6307.97	6590.58
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9109.68	18063.49	7634.22	7806.14	7527.97	7958.58

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	50.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1393E 09	0.2738E 09	0.1065E 09	0.1273E 09	0.1007E 09	0.1216E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1469.40	2888.10	1123.97	1343.75	1062.99	1282.77
INS COST ($)	786.42	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	*********	*********	*********	*********	*********
TLEC CST ($)	10052.17	19757.52	7689.10	9192.61	7271.96	8775.47
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10838.59	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	50.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1287E 09	0.2622E 09	0.9996E 08	0.1176E 09	0.9418E 08	0.1118E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1357.90	2765.76	1054.43	1241.24	993.45	1180.26
INS COST ($)	786.42	1206.42	1206.42	1206.42	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	981.42	1206.42	981.42	*********	*********
TLEC CST ($)	9289.41	18920.58	7213.38	8491.36	6796.24	8074.22
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10075.83	19902.00	8419.80	9472.78	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	50.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1153E 09	0.2475E 09	0.9161E 08	0.1053E 09	0.8741E 08	0.9958E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1216.67	2610.79	966.35	1111.40	922.08	1050.42
INS COST ($)	786.42	1023.42	1023.42	1023.42	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	786.42	798.42	1023.42	798.42	1220.00	1368.00
TLEC CST ($)	8323.26	17860.46	6610.80	7603.11	6307.97	7185.97
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9109.68	18658.88	7634.22	8401.53	7527.97	8553.97

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	0.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1825E 09	0.3133E 09	0.1320E 09	0.1320E 09	0.1007E C9	0.1007E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	444.13	1033.41	507.98	507.98	1062.99	1062.99
INS COST ($)	825.69	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	*********	*********	*********	*********	*********
TLEC CST ($)	4081.87	8669.34	4098.22	4098.22	7271.96	7271.96
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4907.57	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	0.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1692E 09	0.3031E 09	0.1237E 09	0.1237E 09	0.9418E 08	0.9418E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	410.34	991.52	485.93	485.93	993.45	993.45
INS COST ($)	825.69	1245.69	1245.69	1245.69	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	1020.69	1245.69	1020.69	*********	*********
TLEC CST ($)	3775.69	8336.95	3901.51	3901.51	6796.24	6796.24
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4601.39	9357.65	5147.21	4922.21	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	0.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1524E 09	0.2903E 09	0.1133E 09	0.1133E 09	0.8741E 08	0.8583E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	367.53	938.46	457.99	457.99	922.08	905.37
INS COST ($)	825.69	1062.69	1062.69	1062.69	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	837.69	1062.69	837.69	1220.00	1368.00
TLEC CST ($)	3387.87	7915.91	3652.36	3652.36	6307.97	6193.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4213.57	8753.61	4715.06	4490.06	7527.97	7561.65

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BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	20.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1825E 09	0.3238E 09	0.1320E 09	0.1425E 09	0.1007E 09	0.1091E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	444.13	1058.00	507.98	532.58	1062.99	1150.90
INS COST ($)	825.69	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	*********	*********	*********	*********	*********
TLEC CST ($)	4081.87	8898.72	4098.22	4327.59	7271.96	7873.36
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4907.57	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	20.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1692E 09	0.3121E 09	0.1237E 09	0.1327E 09	0.9418E 08	0.1012E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	410.34	1012.42	485.93	506.83	993.45	1068.18
INS COST ($)	825.69	1245.69	1245.69	1245.69	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	1020.69	1245.69	1020.69	*********	*********
TLEC CST ($)	3775.69	8531.92	3901.51	4096.48	6796.24	7307.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4601.39	9552.62	5147.21	5117.18	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	20.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1524E 09	0.2973E 09	0.1133E 09	0.1202E 09	0.8741E 08	0.9133E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	367.53	954.69	457.99	474.22	922.08	963.39
INS COST ($)	825.69	1062.69	1062.69	1062.69	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	837.69	1062.69	837.69	1220.00	1368.00
TLEC CST ($)	3387.87	8067.30	3652.36	3803.74	6307.97	6590.58
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4213.57	8905.00	4715.06	4641.44	7527.97	7958.58

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	50.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1825E 09	0.3397E 09	0.1320E 09	0.1584E 09	0.1007E 09	0.1216E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	444.13	1094.90	507.98	569.47	1062.99	1282.77
INS COST ($)	825.69	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	*********	*********	*********	*********	*********
TLEC CST ($)	4081.87	9242.78	4098.22	4671.66	7271.96	8775.47
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4907.57	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	50.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1692E 09	0.3256E 09	0.1237E 09	0.1462E 09	0.9418E 08	0.1118E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	410.34	1043.79	485.93	538.20	993.45	1180.26
INS COST ($)	825.69	1245.69	1245.69	1245.69	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	1020.69	1245.69	1020.69	*********	*********
TLEC CST ($)	3775.69	8824.37	3901.51	4388.94	6796.24	8074.22
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4601.39	9845.07	5147.21	5409.64	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	50.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1524E 09	0.3077E 09	0.1133E 09	0.1307E 09	0.8741E 08	0.9958E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	367.53	979.04	457.99	498.58	922.08	1050.42
INS COST ($)	825.69	1062.69	1062.69	1062.69	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	837.69	1062.69	837.69	1220.00	1368.00
TLEC CST ($)	3387.87	8294.38	3652.36	4030.83	6307.97	7185.97
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4213.57	9132.08	4715.06	4868.53	7527.97	8553.97

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	0.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1938E 09	0.3320E 09	0.1389E 09	0.1389E 09	0.1007E 09	0.1007E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	764.48	1529.94	699.87	699.87	1062.99	1062.99
INS COST ($)	825.69	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	*********	*********	*********	*********	*********
TLEC CST ($)	5752.58	11271.59	5100.43	5100.43	7271.96	7271.96
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6578.27	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1796E 09	0.3213E 09	0.1301E 09	0.1301E 09	0.9418E 08	0.9418E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	707.23	1473.72	663.48	663.48	993.45	993.45
INS COST ($)	825.69	1245.69	1245.69	1245.69	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	1020.69	1245.69	1020.69	*********	*********
TLEC CST ($)	5323.06	10863.82	4828.35	4828.35	6796.24	6796.24
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6148.75	11884.52	6074.05	5849.05	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	0.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1616E 09	0.3078E 09	0.1189E 09	0.1189E 09	0.8741E 08	0.8583E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	634.71	1402.50	617.39	617.39	922.08	905.37
INS COST ($)	825.69	1062.69	1062.69	1062.69	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	837.69	1062.69	837.69	1220.00	1368.00
TLEC CST ($)	4779.00	10347.32	4483.72	4483.72	6307.97	6193.65
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5604.70	11185.01	5546.42	5321.42	7527.97	7561.65

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	20.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1938E 09	0.3433E 09	0.1389E 09	0.1502E 09	0.1007E 09	0.1091E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	764.48	1573.65	699.87	743.58	1062.99	1150.90
INS COST ($)	825.69	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	*********	*********	*********	*********	*********
TLEC CST ($)	5752.58	11601.47	5100.43	5430.30	7271.96	7873.36
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6578.27	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	20.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1796E 09	0.3309E 09	0.1301E 09	0.1397E 09	0.9418E 08	0.1012E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	707.23	1510.87	663.48	700.64	993.45	1068.18
INS COST ($)	825.69	1245.69	1245.69	1245.69	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	1020.69	1245.69	1020.69	*********	*********
TLEC CST ($)	5323.06	11144.22	4828.35	5108.75	6796.24	7307.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6148.75	12164.92	6074.05	6129.44	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	20.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1616E 09	0.3152E 09	0.1189E 09	0.1264E 09	0.8741E 08	0.9133E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	634.71	1431.35	617.39	646.24	922.08	963.39
INS COST ($)	825.69	1062.69	1062.69	1062.69	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	837.69	1062.69	837.69	1220.00	1368.00
TLEC CST ($)	4779.00	10565.03	4483.72	4701.44	6307.97	6590.58
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5604.70	11402.73	5546.42	5539.13	7527.97	7958.58

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	100.0	100.0	50.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1938E 09	0.3603E 09	0.1389E 09	0.1672E 09	0.1007E 09	0.1216E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	764.48	1639.21	699.87	809.15	1062.99	1282.77
INS COST ($)	825.69	*********	*********	*********	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	*********	*********	*********	*********	*********
TLEC CST ($)	5752.58	12096.29	5100.43	5925.12	7271.96	8775.47
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6578.27	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	50.0	85.0	50.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1796E 09	0.3454E 09	0.1301E 09	0.1541E 09	0.9418E 08	0.1118E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	707.23	1566.60	663.48	756.37	993.45	1180.26
INS COST ($)	825.69	1245.69	1245.69	1245.69	*********	*********
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	1020.69	1245.69	1020.69	*********	*********
TLEC CST ($)	5323.06	11564.81	4828.35	5529.34	6796.24	8074.22
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6148.75	12585.51	6074.05	6550.04	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	NEW	22.0	66.0	50.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1616E 09	0.3264E 09	0.1189E 09	0.1376E 09	0.8741E 08	0.9958E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	634.71	1474.62	617.39	689.51	922.08	1050.42
INS COST ($)	825.69	1062.69	1062.69	1062.69	1220.00	1368.00
RET CR ($)	0.00	225.00	0.00	225.00	0.00	0.00
TOT COST ($)	825.69	837.69	1062.69	837.69	1220.00	1368.00
TLEC CST ($)	4779.00	10891.61	4483.72	5028.01	6307.97	7185.97
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5604.70	11729.31	5546.42	5865.71	7527.97	8553.97

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	0.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1393E 09	0.2529E 09	0.1065E 09	0.1065E 09	0.1007E 09	0.1007E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1469.40	2668.32	1123.97	1123.97	1062.99	1062.99
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	10052.17	18254.02	7689.10	7689.10	7271.96	7271.96
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10169.78	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	0.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1287E 09	0.2444E 09	0.9996E 08	0.9996E 08	0.9418E 08	0.9418E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1357.90	2578.95	1054.43	1054.43	993.45	993.45
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	9289.41	17642.60	7213.38	7213.38	6796.24	6796.24
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9407.03	18062.60	7633.38	7633.38	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	0.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1153E 09	0.2337E 09	0.9161E 08	0.9161E 08	0.8741E 08	0.8583E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1216.67	2465.74	966.35	966.35	922.08	905.37
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	8323.26	16868.14	6610.80	6610.80	6307.97	6193.65
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	8440.87	17105.14	6847.80	6847.80	7527.97	7561.65

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	20.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1393E 09	0.2613E 09	0.1065E 09	0.1148E 09	0.1007E 09	0.1091E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1469.40	2756.23	1123.97	1211.88	1062.99	1150.90
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	10052.17	18855.42	7689.10	8290.51	7271.96	7873.36
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10169.78	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	20.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1287E 09	0.2515E 09	0.9996E 08	0.1070E 09	0.9418E 08	0.1012E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1357.90	2653.67	1054.43	1129.15	993.45	1068.18
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	9289.41	18153.80	7213.38	7724.57	6796.24	7307.43
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9407.03	18573.80	7633.38	8144.57	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	20.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1153E 09	0.2392E 09	0.9161E 08	0.9711E 08	0.8741E 08	0.9133E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1216.67	2523.76	966.35	1024.37	922.08	963.39
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	8323.26	17265.07	6610.80	7007.72	6307.97	6590.58
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	8440.87	17502.07	6847.80	7244.72	7527.97	7958.58

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	50.0	ELEC	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1393E 09	0.2738E 09	0.1065E 09	0.1273E 09	0.1007E 09	0.1216E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1469.40	2888.10	1123.97	1343.75	1062.99	1282.77
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	10052.17	19757.52	7689.10	9192.61	7271.96	8775.47
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	10169.78	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	50.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1287E 09	0.2622E 09	0.9996E 08	0.1176E 09	0.9418E 08	0.1118E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	1357.90	2765.76	1054.43	1241.24	993.45	1180.26
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	9289.41	18920.58	7213.38	8491.36	6796.24	8074.22
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	9407.03	19340.58	7633.38	8911.36	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	50.0	ELEC	0 1 5 1 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1153E 09	0.2475E 09	0.9161E 08	0.1053E 09	0.8741E 08	0.9958E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	1216.67	2610.79	966.35	1111.40	922.08	1050.42
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	8323.26	17860.46	6610.80	7603.11	6307.97	7185.97
RPLC HTR ($)	117.61	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	8440.87	18097.46	6847.80	7840.11	7527.97	8553.97

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	0.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1825E 09	0.3133E 09	0.1320E 09	0.1320E 09	0.1007E 09	0.1007E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	444.13	1033.41	507.98	507.98	1062.99	1062.99
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	4081.87	8669.34	4098.22	4098.22	7271.96	7271.96
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4217.81	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	0.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1692E 09	0.3031E 09	0.1237E 09	0.1237E 09	0.9418E 08	0.9418E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	410.34	991.52	485.93	485.93	993.45	993.45
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	3775.69	8336.95	3901.51	3901.51	6796.24	6796.24
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3911.63	8756.95	4321.51	4321.51	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	0.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL

	1	2	3	4	5	6
TAE USE (BTU)	0.1524E 09	0.2903E 09	0.1133E 09	0.1133E 09	0.8741E 08	0.8583E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	367.53	938.46	457.99	457.99	922.08	905.37
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	3387.87	7915.91	3652.36	3652.36	6307.97	6193.65
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3523.81	8152.91	3889.36	3889.36	7527.97	7561.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	20.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1825E 09	0.3238E 09	0.1320E 09	0.1425E 09	0.1007E 09	0.1091E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	444.13	1058.00	507.98	532.58	1062.99	1150.90
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	4081.87	8898.72	4098.22	4327.59	7271.96	7873.36
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4217.81	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	20.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1692E 09	0.3121E 09	0.1237E 09	0.1327E 09	0.9418E 08	0.1012E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	410.34	1012.42	485.93	506.83	993.45	1068.18
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	3775.69	8531.92	3901.51	4096.48	6796.24	7307.43
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3911.63	8951.92	4321.51	4516.48	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	20.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1524E 09	0.2973E 09	0.1133E 09	0.1202E 09	0.8741E 08	0.9133E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	367.53	954.69	457.99	474.22	922.08	963.39
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	3387.87	8067.30	3652.36	3803.74	6307.97	6590.58
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3523.81	8304.30	3889.36	4040.74	7527.97	7958.58

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	50.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1825E 09	0.3397E 09	0.1320E 09	0.1584E 09	0.1007E 09	0.1216E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	444.13	1094.90	507.98	569.47	1062.99	1282.77
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	4081.87	9242.78	4098.22	4671.66	7271.96	8775.47
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4217.81	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	50.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1692E 09	0.3256E 09	0.1237E 09	0.1462E 09	0.9418E 08	0.1118E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	410.34	1043.79	485.93	538.20	993.45	1180.26
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	3775.69	8824.37	3901.51	4388.94	6796.24	8074.22
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3911.63	9244.37	4321.51	4808.94	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	50.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1524E 09	0.3077E 09	0.1133E 09	0.1307E 09	0.8741E 08	0.9958E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	367.53	979.04	457.99	498.58	922.08	1050.42
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	3387.87	8294.38	3652.36	4030.83	6307.97	7185.97
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	3523.81	8531.38	3889.36	4267.83	7527.97	8553.97

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	0.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1938E 09	0.3320E 09	0.1389E 09	0.1389E 09	0.1007E 09	0.1007E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	764.48	1529.94	699.87	699.87	1062.99	1062.99
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5752.58	11271.59	5100.43	5100.43	7271.96	7271.96
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5888.51	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1796E 09	0.3213E 09	0.1301E 09	0.1301E 09	0.9418E 08	0.9418E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	707.23	1473.72	663.48	663.48	993.45	993.45
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5323.06	10863.82	4828.35	4828.35	6796.24	6796.24
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5458.99	11283.82	5248.35	5248.35	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	0.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1616E 09	0.3078E 09	0.1189E 09	0.1189E 09	0.8741E 08	0.8583E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	634.71	1402.50	617.39	617.39	922.08	905.37
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4779.00	10347.32	4483.72	4483.72	6307.97	6193.65
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4914.93	10584.32	4720.72	4720.72	7527.97	7561.65

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	20.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1938E 09	0.3433E 09	0.1389E 09	0.1502E 09	0.1007E 09	0.1091E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	764.48	1573.65	699.87	743.58	1062.99	1150.90
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5752.58	11601.47	5100.43	5430.30	7271.96	7873.36
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5888.51	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	20.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1796E 09	0.3309E 09	0.1301E 09	0.1397E 09	0.9418E 08	0.1012E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	707.23	1510.87	663.48	700.64	993.45	1068.18
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5323.06	11144.22	4828.35	5108.75	6796.24	7307.43
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5458.99	11564.22	5248.35	5528.75	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	20.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1616E 09	0.3152E 09	0.1189E 09	0.1264E 09	0.8741E 08	0.9133E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	634.71	1431.35	617.39	646.24	922.08	963.39
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4779.00	10565.03	4483.72	4701.44	6307.97	6590.58
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4914.93	10802.03	4720.72	4938.44	7527.97	7958.58

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	100.0	100.0	50.0	OIL	0 1 1 1 1 1

	- - - - - - - - - - - SUPPLY SYSTEM MODEL- - - - - - - - -					
	1	2	3	4	5	6
TAE USE (BTU)	0.1938E 09	0.3603E 09	0.1389E 09	0.1672E 09	0.1007E 09	0.1216E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	764.48	1639.21	699.87	809.15	1062.99	1282.77
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5752.58	12096.29	5100.43	5925.12	7271.96	8775.47
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5888.51	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	50.0	85.0	50.0	OIL	0 1 5 1 1 1

	- - - - - - - - - - - SUPPLY SYSTEM MODEL- - - - - - - - -					
	1	2	3	4	5	6
TAE USE (BTU)	0.1796E 09	0.3454E 09	0.1301E 09	0.1541E 09	0.9418E 08	0.1118E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	707.23	1566.60	663.48	756.37	993.45	1180.26
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5323.06	11564.81	4828.35	5529.34	6796.24	8074.22
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5458.99	11984.81	5248.35	5949.34	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	8	RETROFIT	22.0	66.0	50.0	OIL	0 1 5 1 5 1

	- - - - - - - - - - - SUPPLY SYSTEM MODEL- - - - - - - - -					
	1	2	3	4	5	6
TAE USE (BTU)	0.1616E 09	0.3264E 09	0.1189E 09	0.1376E 09	0.8741E 08	0.9958E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	634.71	1474.62	617.39	689.51	922.08	1050.42
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4779.00	10891.61	4483.72	5028.01	6307.97	7185.97
RPLC HTR ($)	135.93	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4914.93	11128.61	4720.72	5265.01	7527.97	8553.97

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	0.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1334E 09	0.2340E 09	0.1007E 09	0.1007E 09	0.9497E 08	0.9497E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	860.25	1506.65	649.15	649.15	612.18	612.18
INS COST ($)	1007.42	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	*********	*********	*********	*********	*********
TLEC CST ($)	5678.52	9958.62	4285.09	4285.09	4041.04	4041.04
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6685.95	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	0.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1232E 09	0.2261E 09	0.9451E 08	0.9451E 08	0.8877E 08	0.8877E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	794.67	1457.69	609.22	609.22	572.25	572.25
INS COST ($)	1007.42	1427.42	1427.42	1427.42	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	1127.42	1427.42	1127.42	*********	*********
TLEC CST ($)	5245.65	9622.26	4021.47	4021.47	3777.42	3777.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6253.08	10749.69	5448.90	5148.90	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	0.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1103E 09	0.2161E 09	0.8666E 08	0.8666E 08	0.8251E 08	0.8092E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	711.61	1393.15	558.63	558.63	531.87	521.66
INS COST ($)	1007.42	1244.42	1244.42	1244.42	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	944.42	1244.42	944.42	1220.00	1368.00
TLEC CST ($)	4697.35	9196.21	3687.56	3687.56	3510.92	3443.51
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5704.78	10140.64	4931.99	4631.99	4730.92	4811.51

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	20.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1334E 09	0.2416E 09	0.1007E 09	0.1082E 09	0.9497E 08	0.1025E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	860.25	1557.49	649.15	697.99	612.18	661.02
INS COST ($)	1007.42	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	*********	*********	*********	*********	*********
TLEC CST ($)	5678.52	10281.01	4285.09	4607.48	4041.04	4363.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6685.95	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	20.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1232E 09	0.2325E 09	0.9451E 08	0.1009E 09	0.8877E 08	0.9521E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	794.67	1499.21	609.22	650.73	572.25	613.76
INS COST ($)	1007.42	1427.42	1427.42	1427.42	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	1127.42	1427.42	1127.42	*********	*********
TLEC CST ($)	5245.65	9896.29	4021.47	4295.50	3777.42	4051.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6253.08	11023.72	5448.90	5422.93	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	20.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1103E 09	0.2211E 09	0.8666E 08	0.9166E 08	0.8251E 08	0.8592E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	711.61	1425.38	558.63	590.87	531.87	553.89
INS COST ($)	1007.42	1244.42	1244.42	1244.42	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	944.42	1244.42	944.42	1220.00	1368.00
TLEC CST ($)	4697.35	9408.99	3687.56	3900.34	3510.92	3656.28
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5704.78	10353.42	4931.99	4844.77	4730.92	5024.29

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	50.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1334E 09	0.2529E 09	0.1007E 09	0.1196E 09	0.9497E 08	0.1139E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	860.25	1630.75	649.15	771.25	612.18	734.28
INS COST ($)	1007.42	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	*********	*********	*********	*********	*********
TLEC CST ($)	5678.52	10764.59	4285.09	5091.07	4041.04	4847.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6685.95	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	50.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1232E 09	0.2422E 09	0.9451E 08	0.1106E 09	0.8877E 08	0.1048E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	794.67	1561.48	609.22	713.00	572.25	676.03
INS COST ($)	1007.42	1427.42	1427.42	1427.42	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	1127.42	1427.42	1127.42	*********	*********
TLEC CST ($)	5245.65	10307.34	4021.47	4706.56	3777.42	4462.50
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6253.08	11434.77	5448.90	5833.99	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	50.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1103E 09	0.2286E 09	0.8666E 08	0.9916E 08	0.8251E 08	0.9343E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	711.61	1473.74	558.63	639.22	531.87	602.25
INS COST ($)	1007.42	1244.42	1244.42	1244.42	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1007.42	944.42	1244.42	944.42	1220.00	1368.00
TLEC CST ($)	4697.35	9728.16	3687.56	4219.51	3510.92	3975.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5704.78	10672.59	4931.99	5163.94	4730.92	5343.45

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	0.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1748E 09	0.2893E 09	0.1243E 09	0.1243E 09	0.9497E 08	0.9497E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	622.13	1121.57	510.34	510.34	612.18	612.18
INS COST ($)	1054.22	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	*********	*********	*********	*********	*********
TLEC CST ($)	4916.24	8595.48	3835.32	3835.32	4041.04	4041.04
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5970.47	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	0.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1621E 09	0.2799E 09	0.1166E 09	0.1166E 09	0.8877E 08	0.8877E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	576.00	1082.05	481.84	481.84	572.25	572.25
INS COST ($)	1054.22	1474.22	1474.22	1474.22	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	1174.22	1474.22	1174.22	*********	*********
TLEC CST ($)	4553.94	8300.64	3613.22	3613.22	3777.42	3777.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5608.17	9474.86	5087.45	4787.45	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	0.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1459E 09	0.2680E 09	0.1068E 09	0.1068E 09	0.8251E 08	0.8092E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	517.56	1031.99	445.74	445.74	531.87	521.66
INS COST ($)	1054.22	1291.22	1291.22	1291.22	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	991.22	1291.22	991.22	1220.00	1368.00
TLEC CST ($)	4095.02	7927.16	3331.88	3331.88	3510.92	3443.51
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5149.25	8918.39	4623.11	4323.11	4730.92	4811.51

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	20.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1748E 09	0.2989E 09	0.1243E 09	0.1339E 09	0.9497E 08	0.1025E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	622.13	1155.16	510.34	543.93	612.18	661.02
INS COST ($)	1054.22	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	*********	*********	*********	*********	*********
TLEC CST ($)	4916.24	8862.52	3835.32	4102.37	4041.04	4363.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5970.47	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	20.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1621E 09	0.2881E 09	0.1166E 09	0.1247E 09	0.8877E 08	0.9521E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	576.00	1110.60	481.84	510.39	572.25	613.76
INS COST ($)	1054.22	1474.22	1474.22	1474.22	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	1174.22	1474.22	1174.22	*********	*********
TLEC CST ($)	4553.94	8527.62	3613.22	3840.20	3777.42	4051.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5608.17	9701.85	5087.45	5014.43	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	20.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1459E 09	0.2743E 09	0.1068E 09	0.1131E 09	0.8251E 08	0.8592E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	517.56	1054.16	445.74	467.91	531.87	553.89
INS COST ($)	1054.22	1291.22	1291.22	1291.22	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	991.22	1291.22	991.22	1220.00	1368.00
TLEC CST ($)	4095.02	8103.41	3331.88	3508.13	3510.92	3656.28
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5149.25	9094.65	4623.11	4499.36	4730.92	5024.29

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	50.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1748E 09	0.3133E 09	0.1243E 09	0.1483E 09	0.9497E 08	0.1139E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	622.13	1205.54	510.34	594.31	612.18	734.28
INS COST ($)	1054.22	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	*********	*********	*********	*********	*********
TLEC CST ($)	4916.24	9263.09	3835.32	4502.94	4041.04	4847.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5970.47	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	50.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1621E 09	0.3003E 09	0.1166E 09	0.1370E 09	0.8877E 08	0.1048E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	576.00	1153.43	481.84	553.22	572.25	676.03
INS COST ($)	1054.22	1474.22	1474.22	1474.22	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	1174.22	1474.22	1174.22	*********	*********
TLEC CST ($)	4553.94	8868.10	3613.22	4180.69	3777.42	4462.50
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5608.17	10042.33	5087.45	5354.92	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	50.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1459E 09	0.2838E 09	0.1068E 09	0.1226E 09	0.8251E 08	0.9343E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	517.56	1087.41	445.74	501.16	531.87	602.25
INS COST ($)	1054.22	1291.22	1291.22	1291.22	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	991.22	1291.22	991.22	1220.00	1368.00
TLEC CST ($)	4095.02	8367.79	3331.88	3772.51	3510.92	3975.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5149.25	9359.02	4623.11	4763.74	4730.92	5343.45

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	0.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1855E 09	0.3064E 09	0.1306E 09	0.1306E 09	0.9497E 08	0.9497E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	737.58	1296.72	577.38	577.38	612.18	612.18
INS COST ($)	1054.22	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	*********	*********	*********	*********	*********
TLEC CST ($)	5477.75	9460.66	4162.66	4162.66	4041.04	4041.04
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6531.98	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1719E 09	0.2964E 09	0.1223E 09	0.1223E 09	0.8877E 08	0.8877E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	682.77	1252.09	543.77	543.77	572.25	572.25
INS COST ($)	1054.22	1474.22	1474.22	1474.22	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	1174.22	1474.22	1174.22	*********	*********
TLEC CST ($)	5072.11	9140.32	3915.06	3915.06	3777.42	3777.42
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6126.34	10314.55	5389.29	5089.29	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	0.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1546E 09	0.2839E 09	0.1119E 09	0.1119E 09	0.8251E 08	0.8092E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	613.34	1195.57	501.21	501.21	531.87	521.66
INS COST ($)	1054.22	1291.22	1291.22	1291.22	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	991.22	1291.22	991.22	1220.00	1368.00
TLEC CST ($)	4558.29	8734.56	3601.43	3601.43	3510.92	3443.51
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5612.52	9725.78	4892.66	4592.66	4730.92	4811.51

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	20.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1855E 09	0.3167E 09	0.1306E 09	0.1409E 09	0.9497E 08	0.1025E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	737.58	1337.11	577.38	617.77	612.18	661.02
INS COST ($)	1054.22	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	*********	*********	*********	*********	*********
TLEC CST ($)	5477.75	9761.70	4162.66	4463.70	4041.04	4363.43
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6531.98	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	20.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1719E 09	0.3052E 09	0.1223E 09	0.1311E 09	0.8877E 08	0.9521E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	682.77	1286.43	543.77	578.11	572.25	613.76
INS COST ($)	1054.22	1474.22	1474.22	1474.22	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	1174.22	1474.22	1174.22	*********	*********
TLEC CST ($)	5072.11	9396.20	3915.06	4170.94	3777.42	4051.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6126.34	10570.43	5389.29	5345.17	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	20.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1546E 09	0.2906E 09	0.1119E 09	0.1187E 09	0.8251E 08	0.8592E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	613.34	1222.23	501.21	527.87	531.87	553.89
INS COST ($)	1054.22	1291.22	1291.22	1291.22	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	991.22	1291.22	991.22	1220.00	1368.00
TLEC CST ($)	4558.29	8933.24	3601.43	3800.12	3510.92	3656.28
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5612.52	9924.47	4892.66	4791.35	4730.92	5024.29

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	100.0	100.0	50.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1855E 09	0.3321E 09	0.1306E 09	0.1563E 09	0.9497E 08	0.1139E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	737.58	1397.71	577.38	678.37	612.18	734.28
INS COST ($)	1054.22	*********	*********	*********	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	*********	*********	*********	*********	*********
TLEC CST ($)	5477.75	10213.26	4162.66	4915.26	4041.04	4847.01
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6531.98	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	50.0	85.0	50.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1719E 09	0.3183E 09	0.1223E 09	0.1442E 09	0.8877E 08	0.1048E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	682.77	1337.94	543.77	629.62	572.25	676.03
INS COST ($)	1054.22	1474.22	1474.22	1474.22	*********	*********
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	1174.22	1474.22	1174.22	*********	*********
TLEC CST ($)	5072.11	9780.03	3915.06	4554.77	3777.42	4462.50
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	6126.34	10954.25	5389.29	5729.00	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	NEW	22.0	66.0	50.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1546E 09	0.3008E 09	0.1119E 09	0.1289E 09	0.8251E 08	0.9343E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	613.34	1262.22	501.21	567.86	531.87	602.25
INS COST ($)	1054.22	1291.22	1291.22	1291.22	1220.00	1368.00
RET CR ($)	0.00	300.00	0.00	300.00	0.00	0.00
TOT COST ($)	1054.22	991.22	1291.22	991.22	1220.00	1368.00
TLEC CST ($)	4558.29	9231.27	3601.43	4098.15	3510.92	3975.45
RPLC HTR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5612.52	10222.50	4892.66	5089.38	4730.92	5343.45

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	0.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1334E 09	0.2340E 09	0.1007E 09	0.1007E 09	0.9497E 08	0.9497E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	860.25	1508.65	649.15	649.15	612.18	612.18
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5678.52	9958.62	4285.09	4285.09	4041.04	4041.04
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5818.32	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	0.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1232E 09	0.2261E 09	0.9451E 08	0.9451E 08	0.8877E 08	0.8877E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	794.67	1457.69	609.22	609.22	572.25	572.25
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5245.65	9622.26	4021.47	4021.47	3777.42	3777.42
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5385.45	10042.26	4441.47	4441.47	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	0.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1103E 09	0.2161E 09	0.8666E 08	0.8666E 08	0.8251E 08	0.8092E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	711.61	1393.15	558.63	558.63	531.87	521.66
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4697.35	9196.21	3687.56	3687.56	3510.92	3443.51
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4837.15	9433.21	3924.56	3924.56	4730.92	4811.51

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	20.0	ELEC	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1334E 09	0.2416E 09	0.1007E 09	0.1082E 09	0.9497E 08	0.1025E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	860.25	1557.49	649.15	697.99	612.18	661.02
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5678.52	10281.01	4285.09	4607.48	4041.04	4363.43
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5818.32	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	20.0	ELEC	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1232E 09	0.2325E 09	0.9451E 08	0.1009E 09	0.8877E 08	0.9521E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	794.67	1499.21	609.22	650.73	572.25	613.76
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5245.65	9896.29	4021.47	4295.50	3777.42	4051.45
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5385.45	10316.29	4441.47	4715.50	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	20.0	ELEC	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1103E 09	0.2211E 09	0.8666E 08	0.9166E 08	0.8251E 08	0.8592E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	711.61	1425.38	558.63	590.87	531.87	553.89
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4697.35	9408.99	3687.56	3900.34	3510.92	3656.28
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4837.15	9645.99	3924.56	4137.34	4730.92	5024.29

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	50.0	ELEC	0 1 1 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1334E 09	0.2529E 09	0.1007E 09	0.1196E 09	0.9497E 08	0.1139E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	860.25	1630.75	649.15	771.25	612.18	734.28
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5678.52	10764.59	4285.09	5091.07	4041.04	4847.01
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5818.32	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	50.0	ELEC	0 1 5 1 1 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1232E 09	0.2422E 09	0.9451E 08	0.1106E 09	0.8877E 08	0.1048E 09
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.0000E 00	0.0000E 00
TAE COST ($)	794.67	1561.48	609.22	713.00	572.25	676.03
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5245.65	10307.34	4021.47	4706.56	3777.42	4462.50
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5385.45	10727.34	4441.47	5126.56	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	50.0	ELEC	0 1 5 1 5 1

	SUPPLY SYSTEM MODEL 1	2	3	4	5	6
TAE USE (BTU)	0.1103E 09	0.2286E 09	0.8666E 08	0.9916E 08	0.8251E 08	0.9343E 08
ASH CTR (BTU)	0.1184E 08	0.8549E 07	0.5618E 07	0.5618E 07	0.1584E 07	0.0000E 00
TAE COST ($)	711.61	1473.74	558.63	639.22	531.87	602.25
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4697.35	9728.16	3687.56	4219.51	3510.92	3975.45
RPLC HTR ($)	139.80	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4837.15	9965.16	3924.56	4456.51	4730.92	5343.45

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT OF-USE MODELS
5	10	RETROFIT	100.0	100.0	0.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1748E 09	0.2893E 09	0.1243E 09	0.1243E 09	0.9497E 08	0.9497E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	622.13	1121.57	510.34	510.34	612.18	612.18
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	4916.24	8595.48	3835.32	3835.32	4041.04	4041.04
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5077.88	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	0.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1621E 09	0.2799E 09	0.1166E 09	0.1166E 09	0.8877E 08	0.8877E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	576.00	1082.05	481.84	481.84	572.25	572.25
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	4553.94	8300.64	3613.22	3613.22	3777.42	3777.42
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4715.57	8720.64	4033.22	4033.22	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	0.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1459E 09	0.2680E 09	0.1068E 09	0.1068E 09	0.8251E 08	0.8092E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	517.56	1031.99	445.74	445.74	531.87	521.66
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4095.02	7927.16	3331.88	3331.88	3510.92	3443.51
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4256.66	8164.16	3568.88	3568.88	4730.92	4811.51

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	20.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1748E 09	0.2989E 09	0.1243E 09	0.1339E 09	0.9497E 08	0.1025E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	622.13	1155.16	510.34	543.93	612.18	661.02
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	4916.24	8862.52	3835.32	4102.37	4041.04	4363.43
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5077.88	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	20.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1621E 09	0.2881E 09	0.1166E 09	0.1247E 09	0.8877E 08	0.9521E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	576.00	1110.60	481.84	510.39	572.25	613.76
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	4553.94	8527.62	3613.22	3840.20	3777.42	4051.45
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4715.57	8947.62	4033.22	4260.20	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	20.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1459E 09	0.2743E 09	0.1068E 09	0.1131E 09	0.8251E 08	0.8592E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	517.56	1054.16	445.74	467.91	531.87	553.89
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4095.02	8103.41	3331.88	3508.13	3510.92	3656.28
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4256.66	8340.41	3568.88	3745.13	4730.92	5024.29

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	50.0	GAS	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1748E 09	0.3133E 09	0.1243E 09	0.1483E 09	0.9497E 08	0.1139E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	622.13	1205.54	510.34	594.31	612.18	734.28
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	4916.24	9263.09	3835.32	4502.94	4041.04	4847.01
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5077.88	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	50.0	GAS	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1621E 09	0.3003E 09	0.1166E 09	0.1370E 09	0.8877E 08	0.1048E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	576.00	1153.43	481.84	553.22	572.25	676.03
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	4553.94	8868.10	3613.22	4180.69	3777.42	4462.50
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4715.57	9288.10	4033.22	4600.69	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	50.0	GAS	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1459E 09	0.2838E 09	0.1068E 09	0.1226E 09	0.8251E 08	0.9343E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	517.56	1087.41	445.74	501.16	531.87	602.25
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4095.02	8367.79	3331.88	3772.51	3510.92	3975.45
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4256.66	8604.79	3568.88	4009.51	4730.92	5343.45

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	0.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1855E 09	0.3064E 09	0.1306E 09	0.1306E 09	0.9497E 08	0.9497E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	737.58	1296.72	577.38	577.38	612.18	612.18
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5477.75	9460.66	4162.66	4162.66	4041.04	4041.04
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5639.39	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	0.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1719E 09	0.2964E 09	0.1223E 09	0.1223E 09	0.8877E 08	0.8877E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	682.77	1252.09	543.77	543.77	572.25	572.25
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5072.11	9140.32	3915.06	3915.06	3777.42	3777.42
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5233.74	9560.32	4335.06	4335.06	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	0.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1546E 09	0.2839E 09	0.1119E 09	0.1119E 09	0.8251E 08	0.8092E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	613.34	1195.57	501.21	501.21	531.87	521.66
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4558.29	8734.56	3601.43	3601.43	3510.92	3443.51
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4719.92	8971.56	3838.43	3838.43	4730.92	4811.51

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BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	20.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1855E 09	0.3167E 09	0.1306E 09	0.1409E 09	0.9497E 08	0.1025E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	737.58	1337.11	577.38	617.77	612.18	661.02
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5477.75	9761.70	4162.66	4463.70	4041.04	4363.43
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5639.39	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	20.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1719E 09	0.3052E 09	0.1223E 09	0.1311E 09	0.8877E 08	0.9521E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	682.77	1286.43	543.77	578.11	572.25	613.76
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5072.11	9396.20	3915.06	4170.94	3777.42	4051.45
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5233.74	9816.20	4335.06	4590.94	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	20.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1546E 09	0.2906E 09	0.1119E 09	0.1187E 09	0.8251E 08	0.8592E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	613.34	1222.23	501.21	527.87	531.87	553.89
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4558.29	8933.24	3601.43	3800.12	3510.92	3656.28
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4719.92	9170.24	3838.43	4037.12	4730.92	5024.29

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION RESULTS

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	100.0	100.0	50.0	OIL	0 1 1 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1855E 09	0.3321E 09	0.1306E 09	0.1563E 09	0.9497E 08	0.1139E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	737.58	1397.71	577.38	678.37	612.18	734.28
INS COST ($)	0.00	*********	*********	*********	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	*********	*********	*********	*********	*********
TLEC CST ($)	5477.75	10213.26	4162.66	4915.26	4041.04	4847.01
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5639.39	*********	*********	*********	*********	*********

BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	50.0	85.0	50.0	OIL	0 1 5 1 1 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1719E 09	0.3183E 09	0.1223E 09	0.1442E 09	0.8877E 08	0.1048E 09
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.0000E 00	0.0000E 00
TAE COST ($)	682.77	1337.94	543.77	629.62	572.25	676.03
INS COST ($)	0.00	420.00	420.00	420.00	*********	*********
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	420.00	420.00	420.00	*********	*********
TLEC CST ($)	5072.11	9780.03	3915.06	4554.77	3777.42	4462.50
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	5233.74	10200.03	4335.06	4974.77	*********	*********

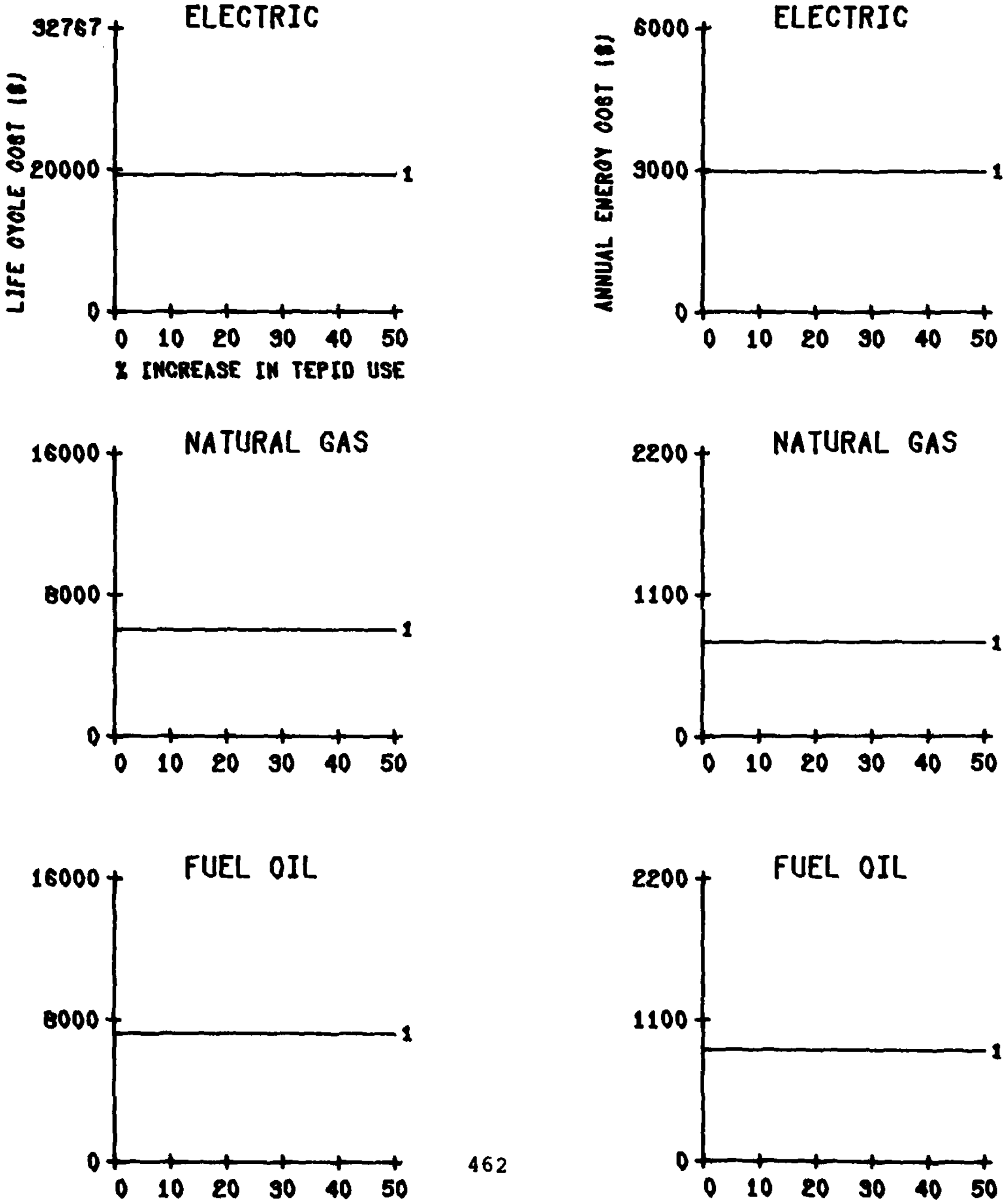
BLDG TYPE	DOE REGION	COST ANALYSIS	PERCENT FLOW	PERCENT USAGE	PERCENT INC TEPID USE	CENTRAL HEATER	POINT-OF-USE MODELS
5	10	RETROFIT	22.0	66.0	50.0	OIL	0 1 5 1 5 1

SUPPLY SYSTEM MODEL	1	2	3	4	5	6
TAE USE (BTU)	0.1546E 09	0.3008E 09	0.1119E 09	0.1289E 09	0.8251E 08	0.9343E 08
ASH CTR (BTU)	0.2178E 08	0.1365E 08	0.1072E 08	0.1072E 08	0.1584E 07	0.0000E 00
TAE COST ($)	613.34	1262.22	501.21	567.86	531.87	602.25
INS COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
RET CR ($)	0.00	0.00	0.00	0.00	0.00	0.00
TOT COST ($)	0.00	237.00	237.00	237.00	1220.00	1368.00
TLEC CST ($)	4558.29	9231.27	3601.43	4098.15	3510.92	3975.45
RPLC HTR ($)	161.63	0.00	0.00	0.00	0.00	0.00
TLC COST ($)	4719.92	9468.27	3838.43	4335.15	4730.92	5343.45

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	2	100.00	100.00

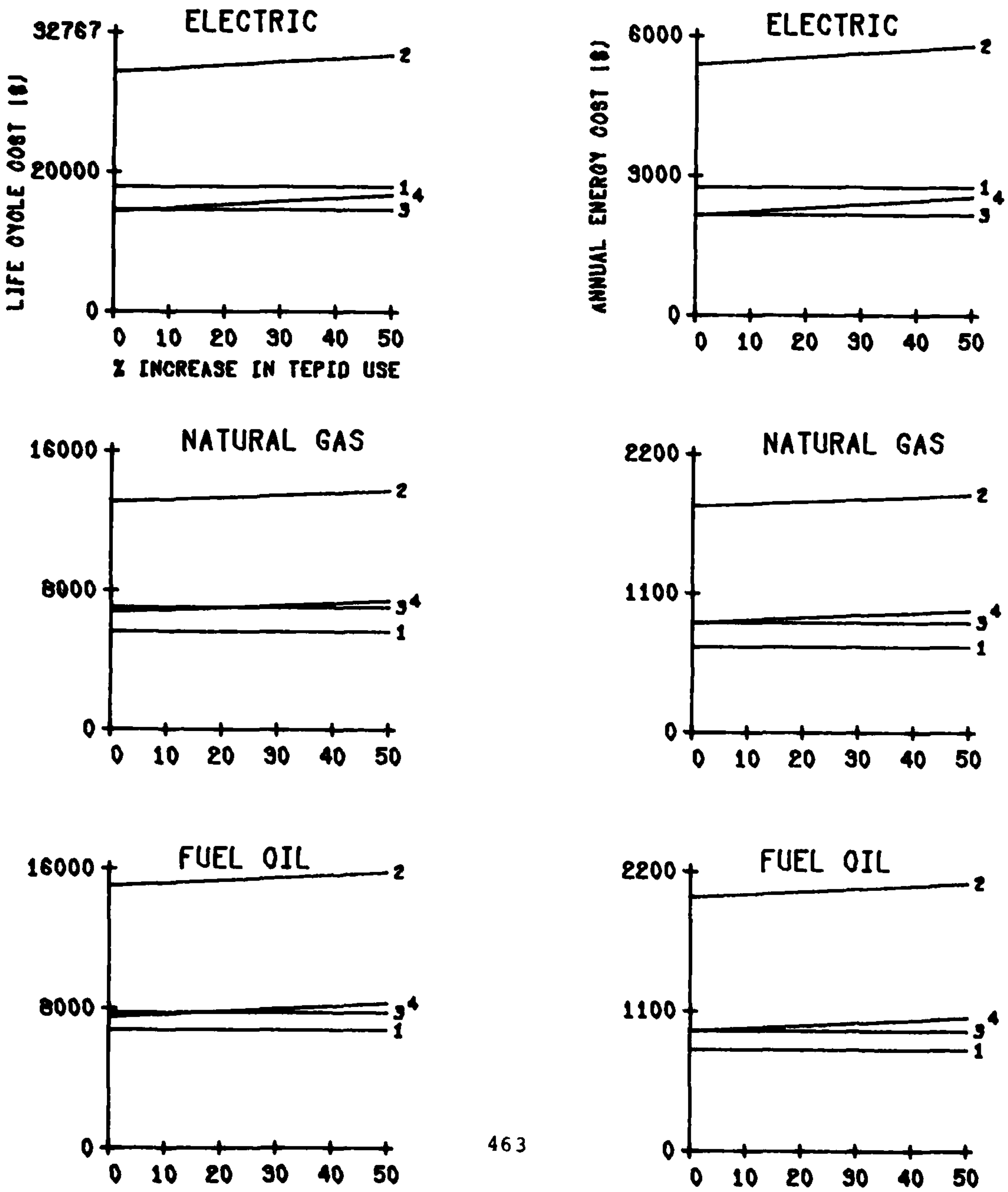
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	2	50.00	85.00

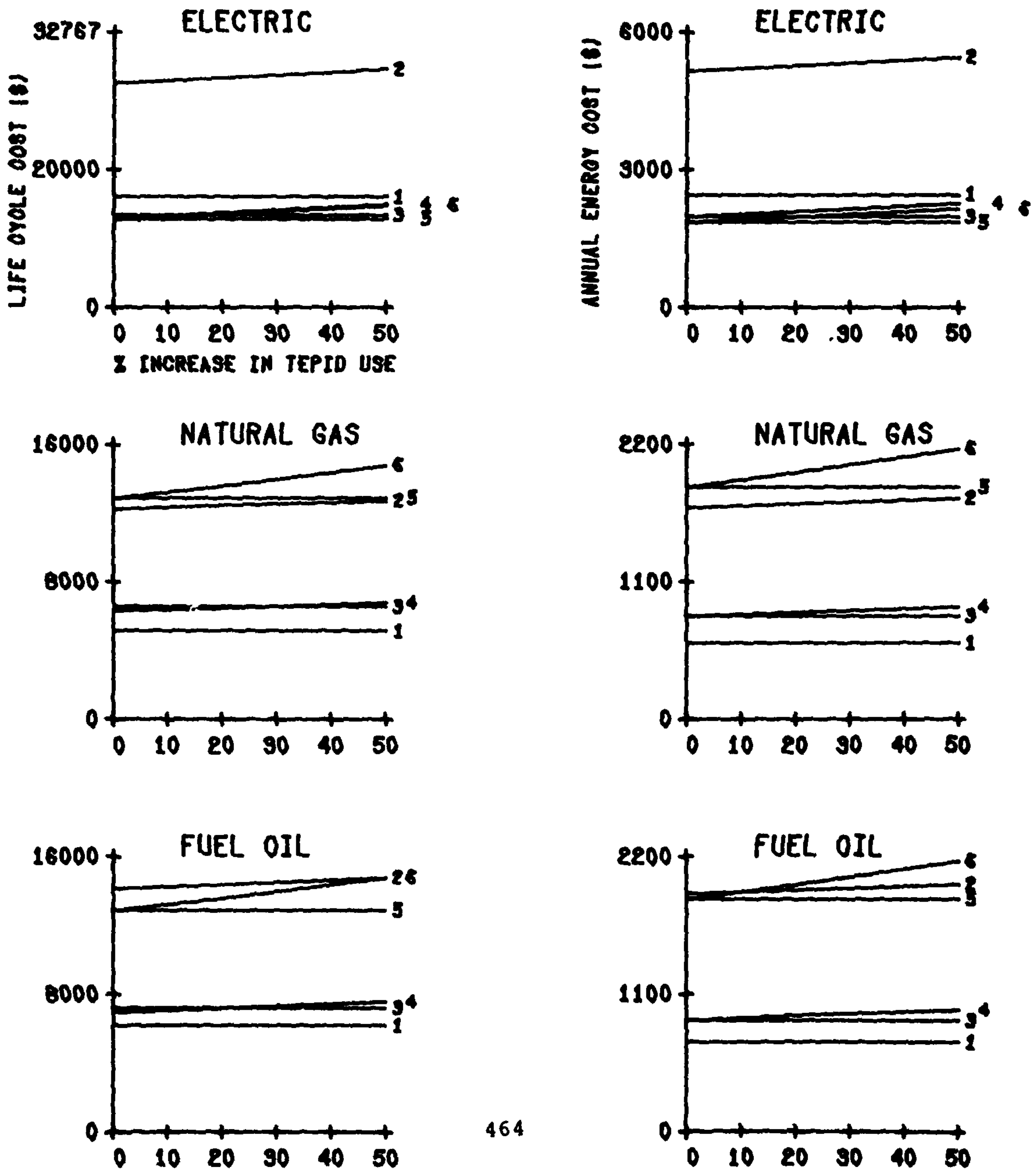
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	2	22.00	66.00

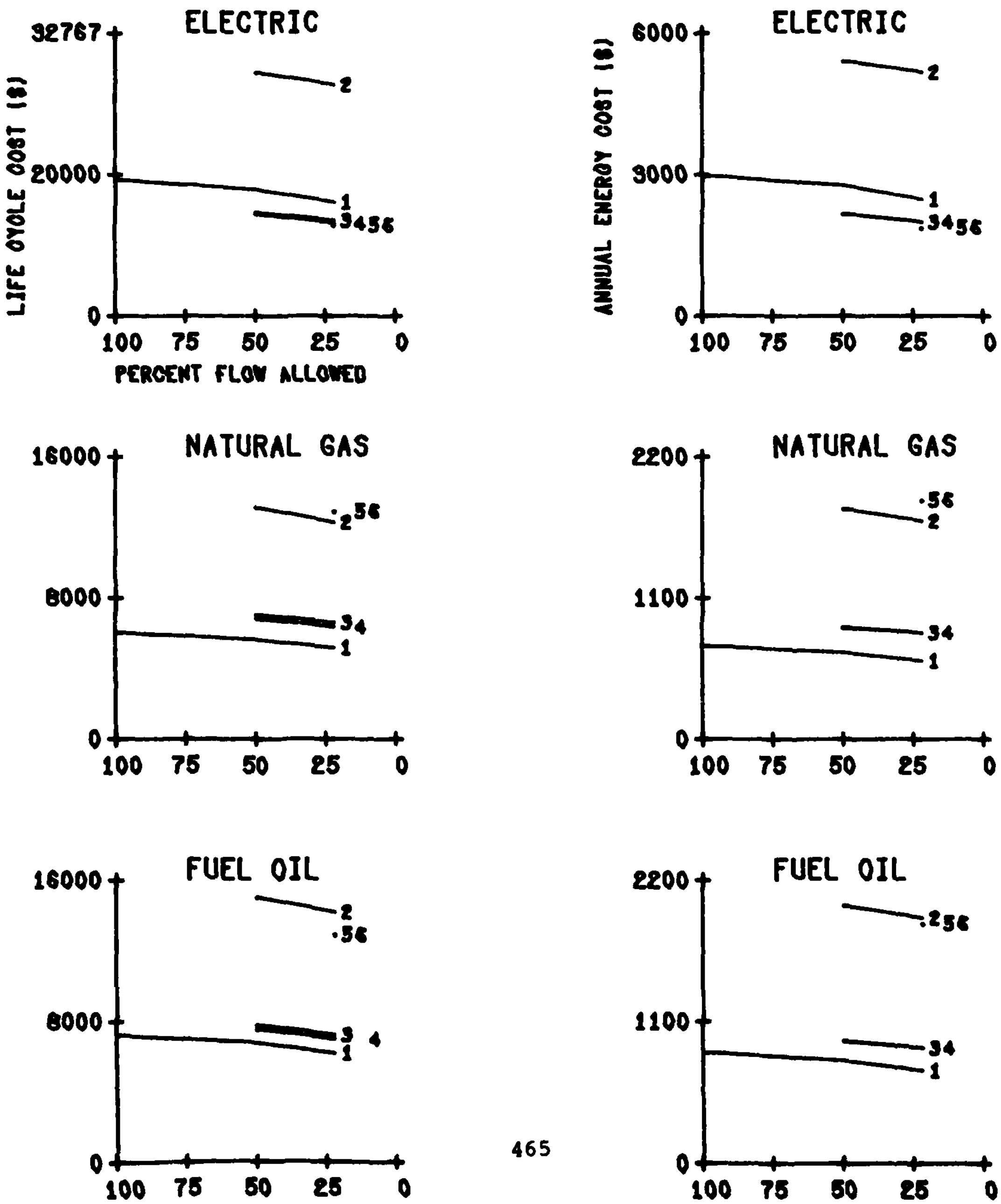
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	2	0.00

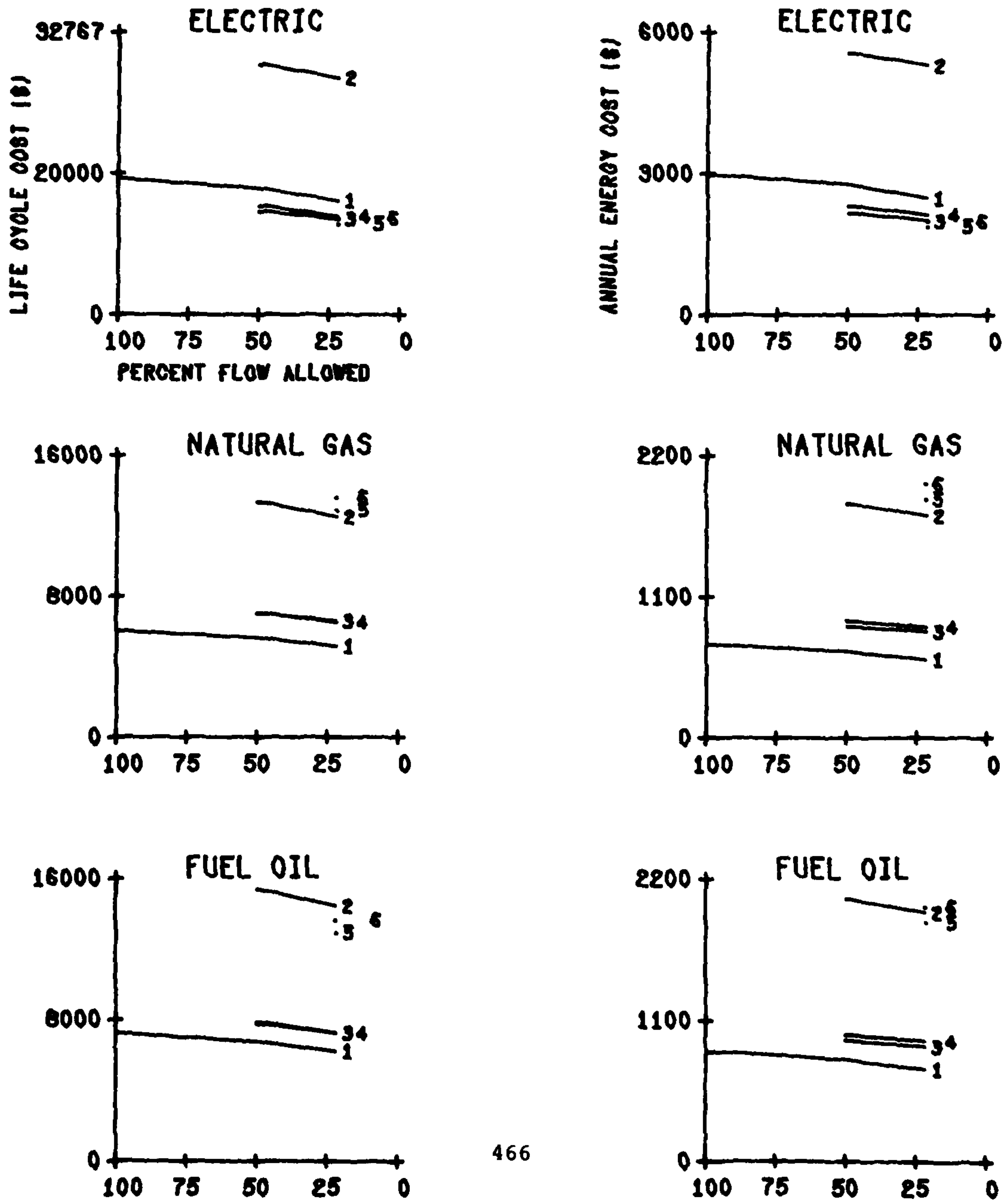
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	2	20.00

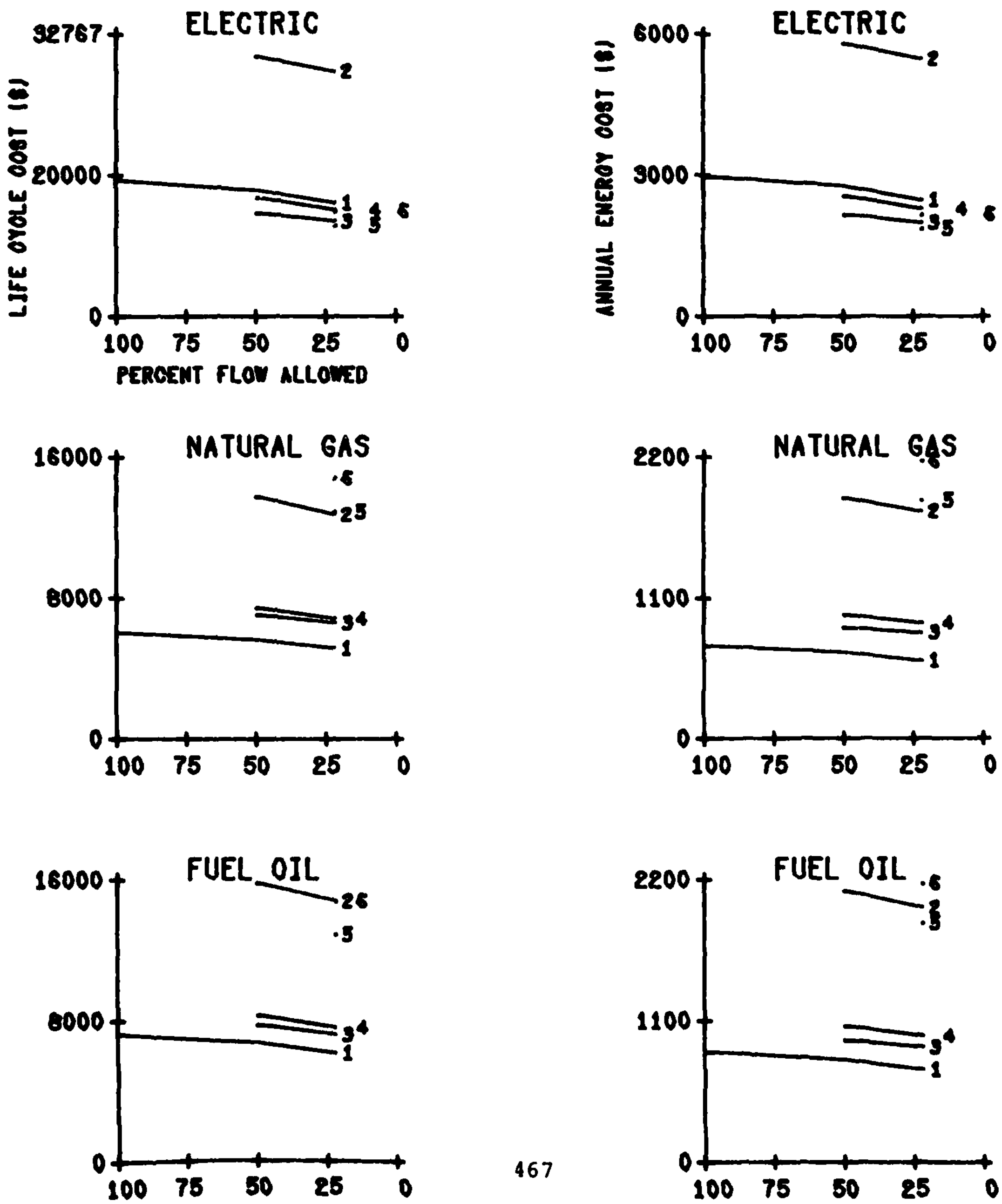
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	2	50.00

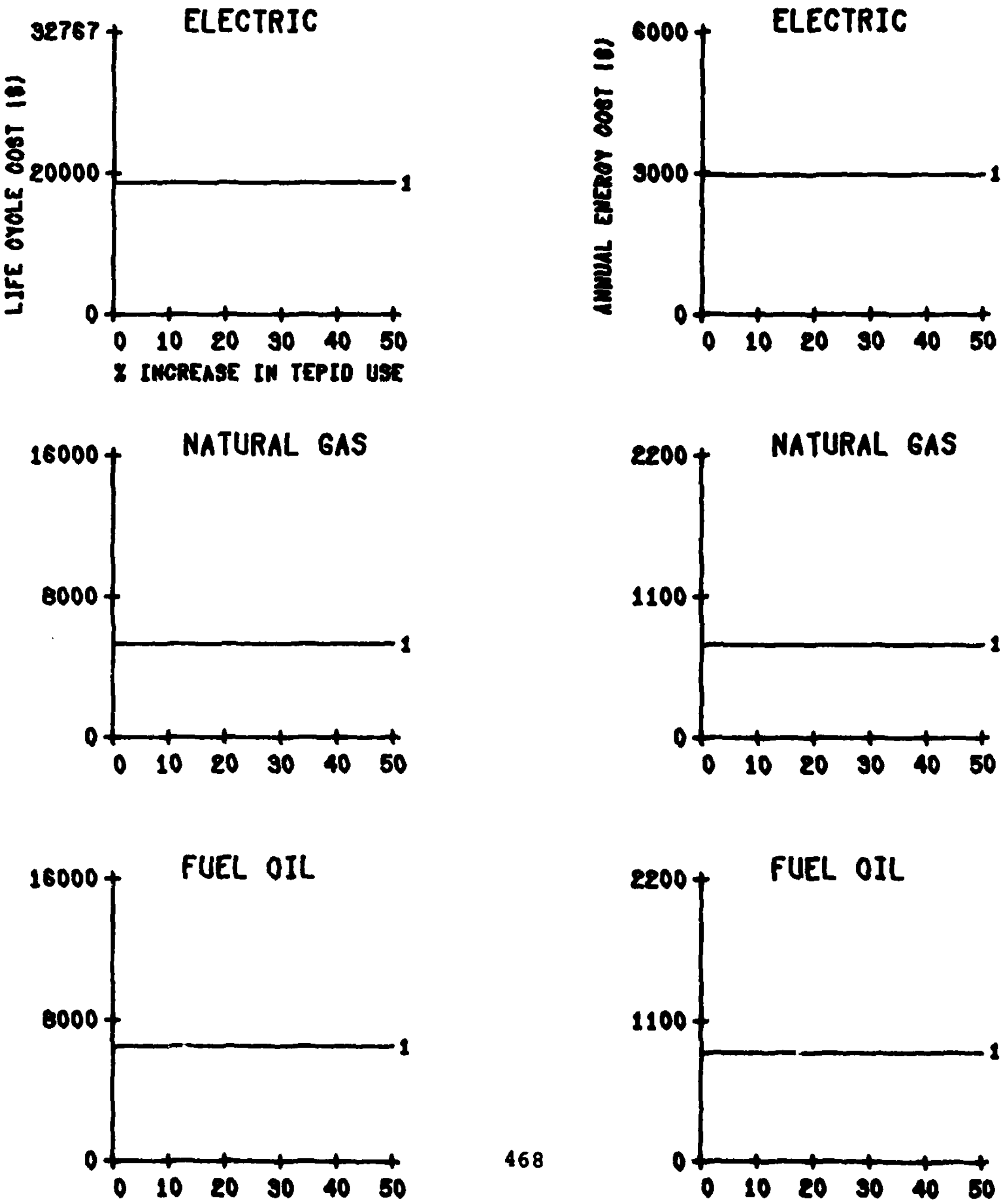
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	2	100.00	100.00

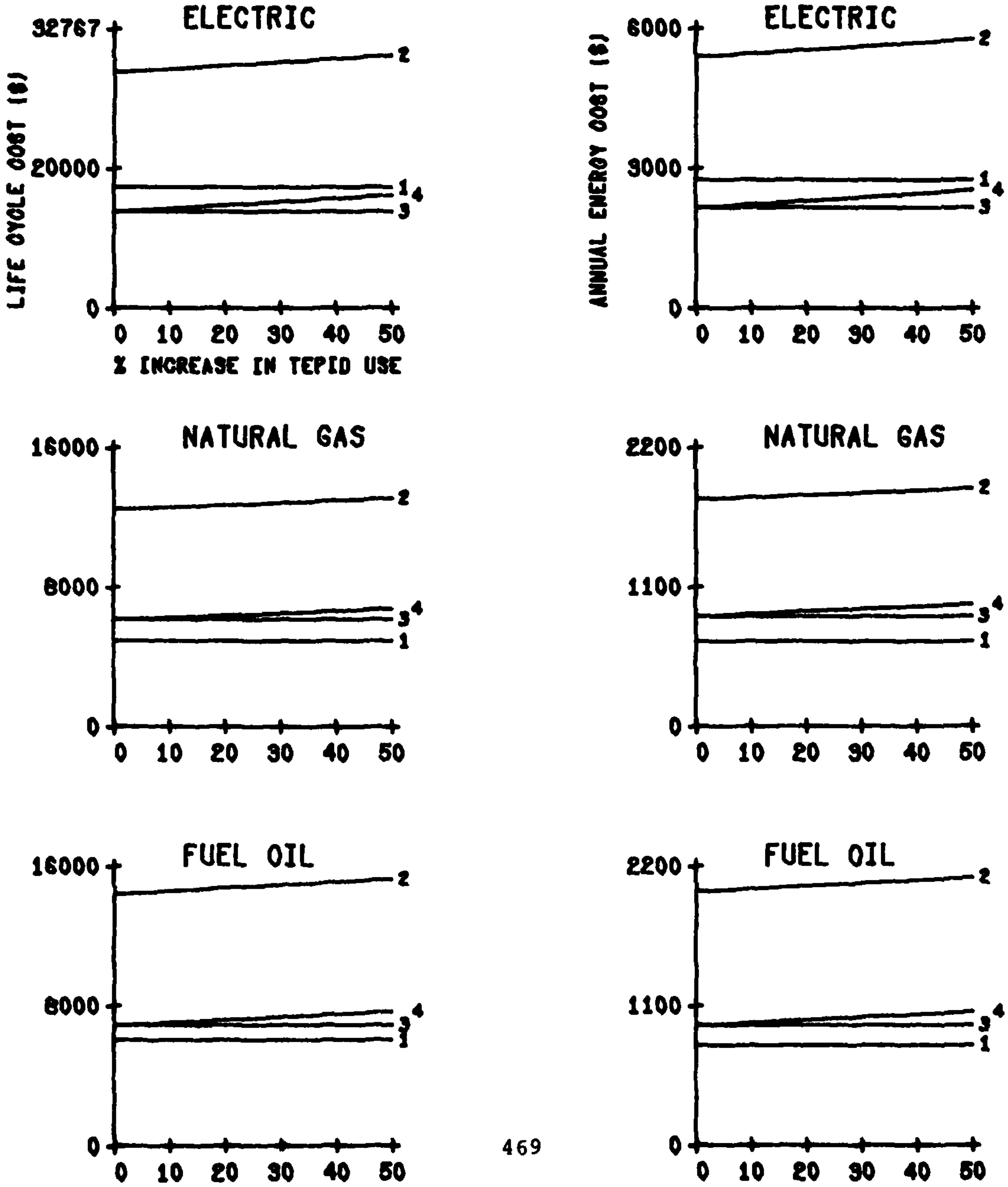
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	2	50.00	85.00

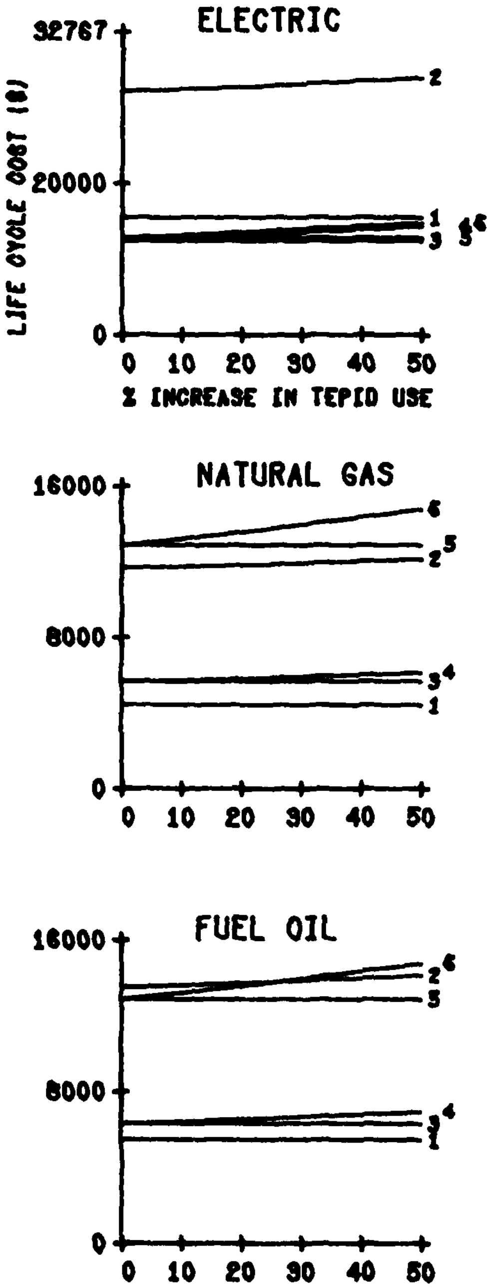
****** RETROFIT ******

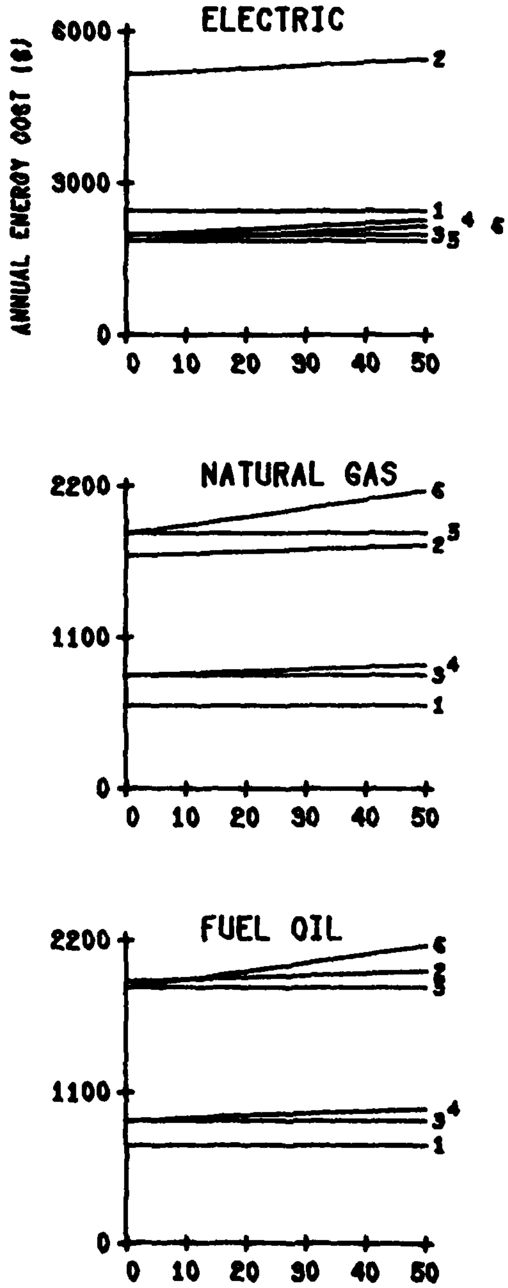


JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	2	22.00	66.00

****** RETROFIT ******

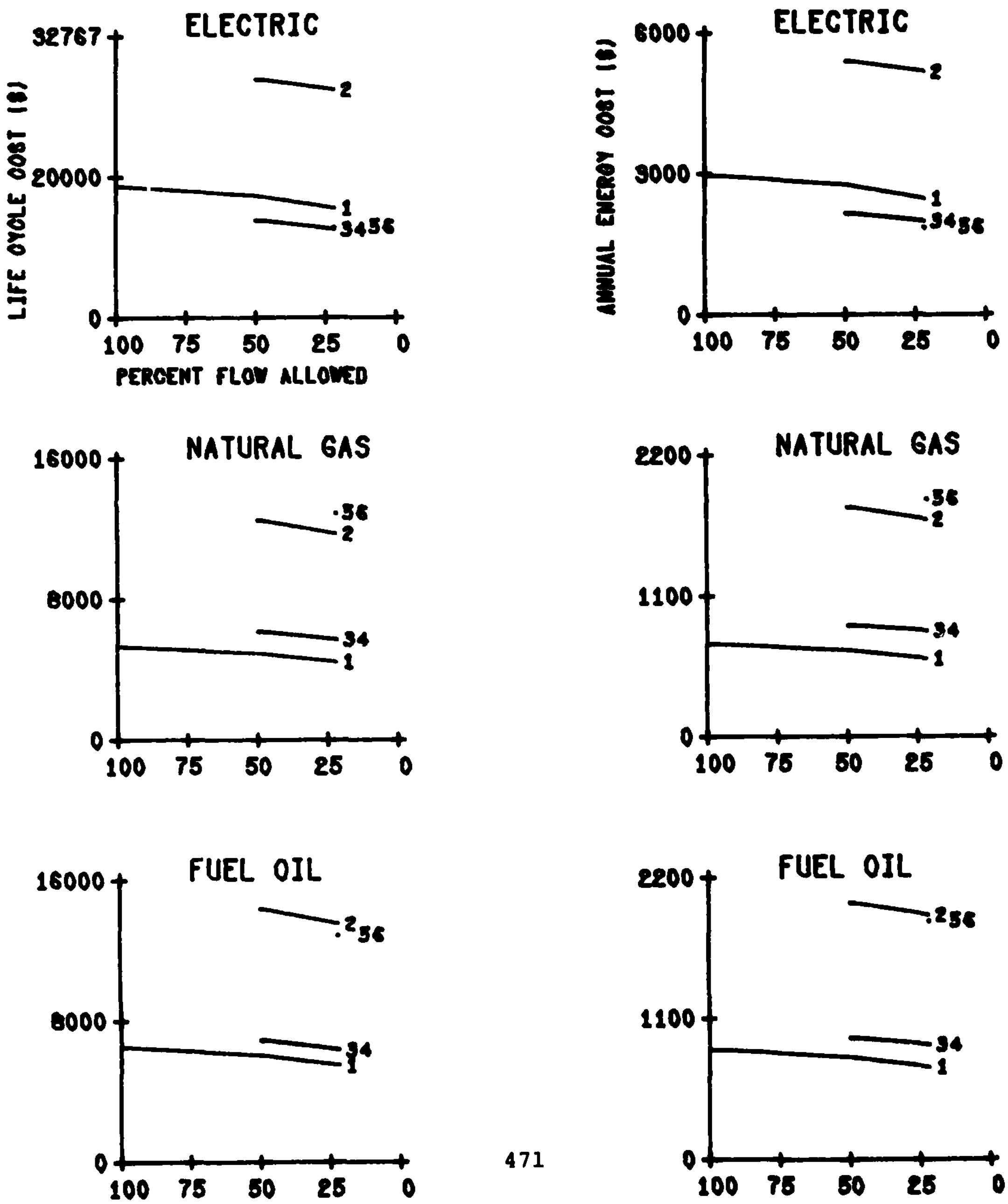




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	2	0.00

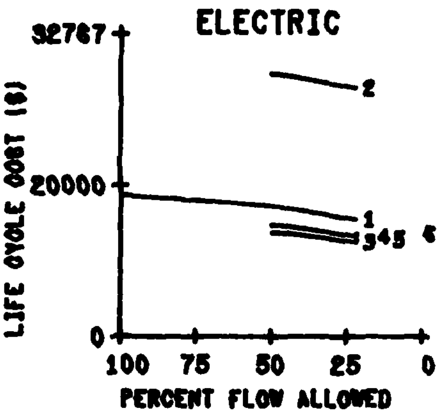
****** RETROFIT ******

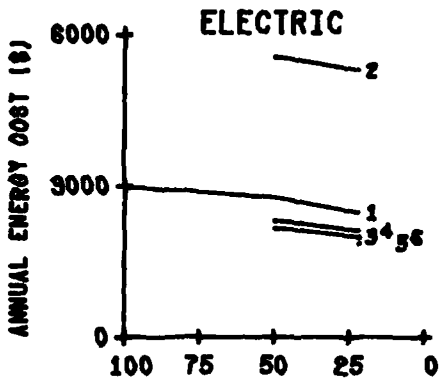


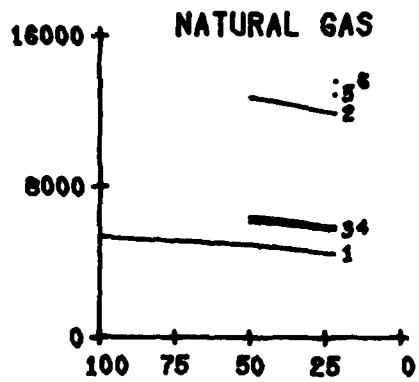
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

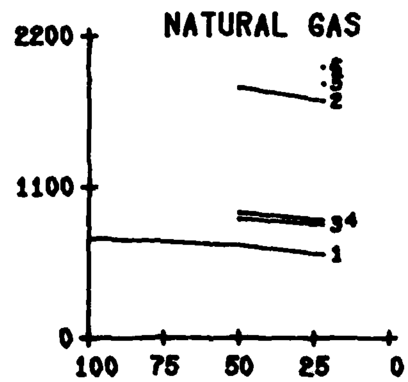
BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	2	20.00

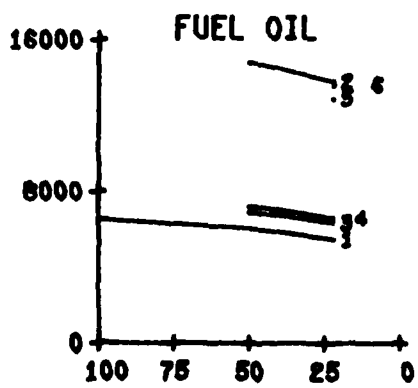
****** RETROFIT ******

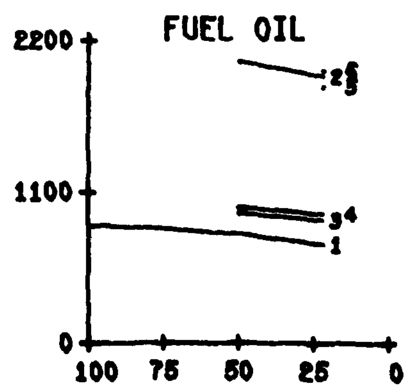








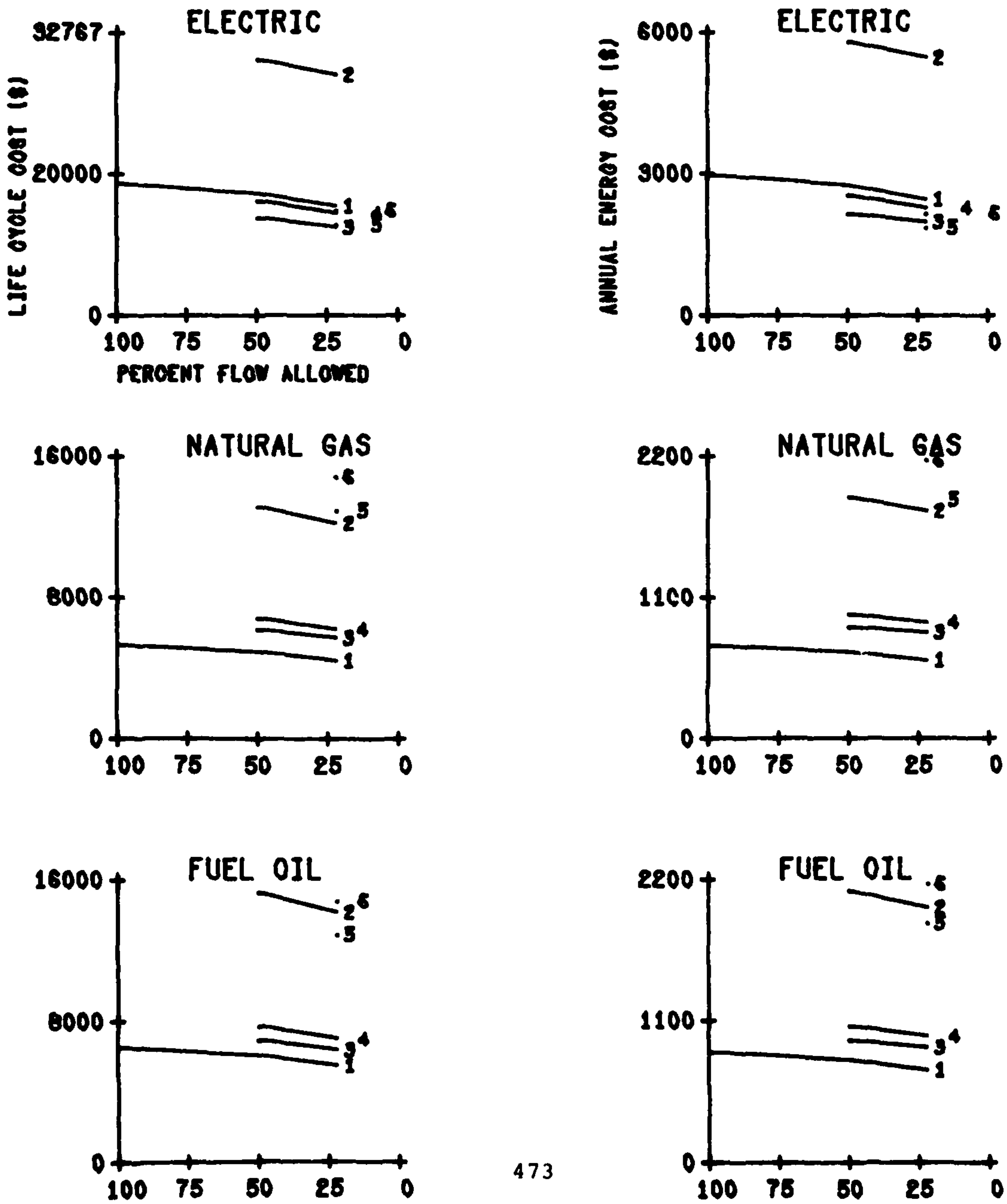




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	2	50.00

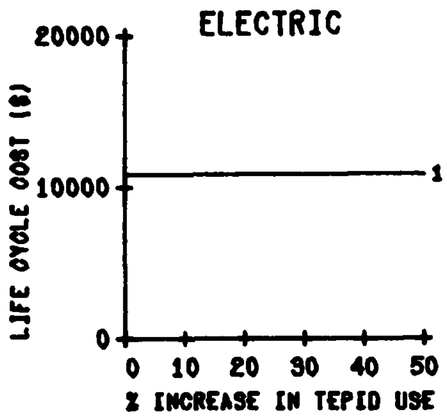
****** RETROFIT ******

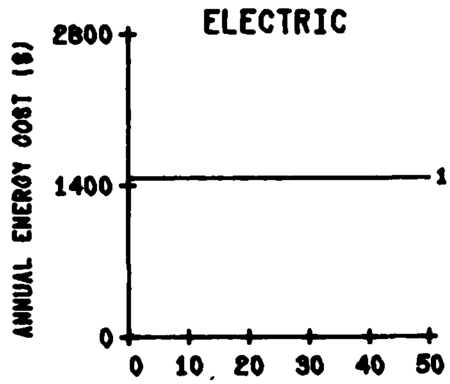


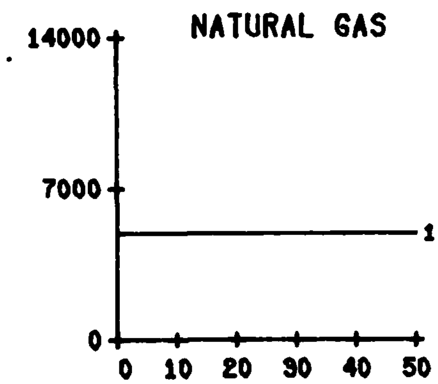
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

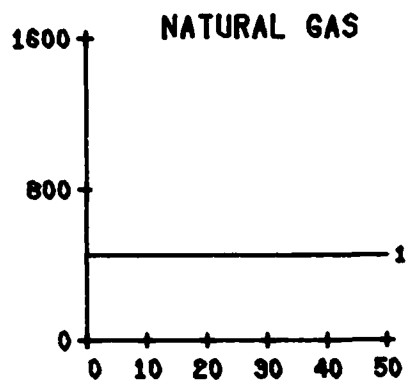
BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	8	100.00	100.00

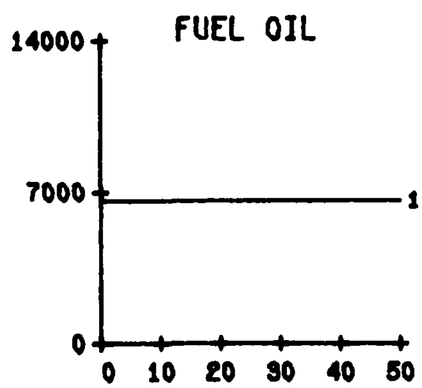
*** NEW CONSTRUCTION ***

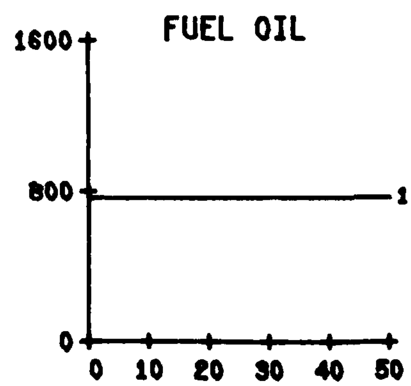








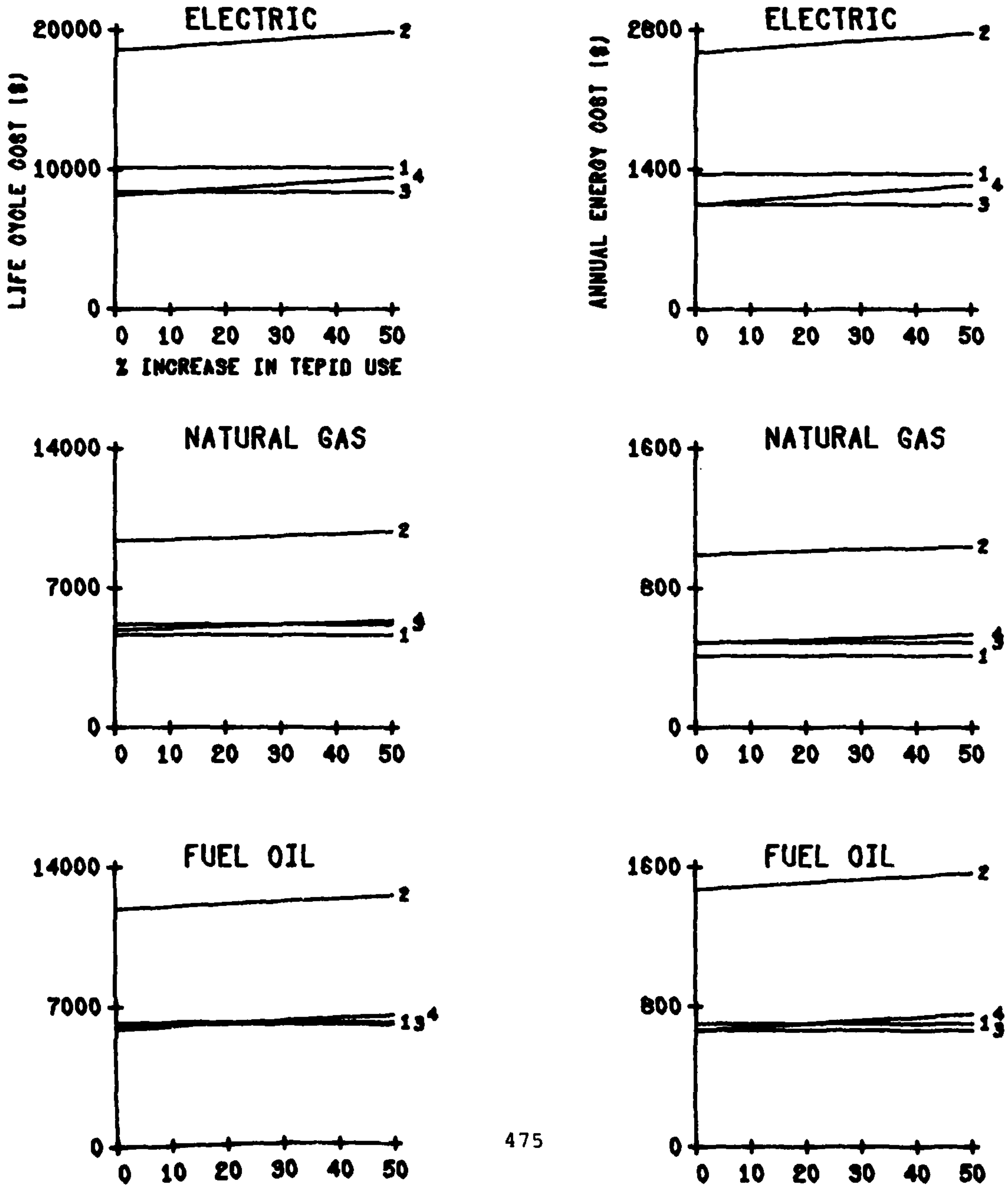




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	8	50.00	85.00

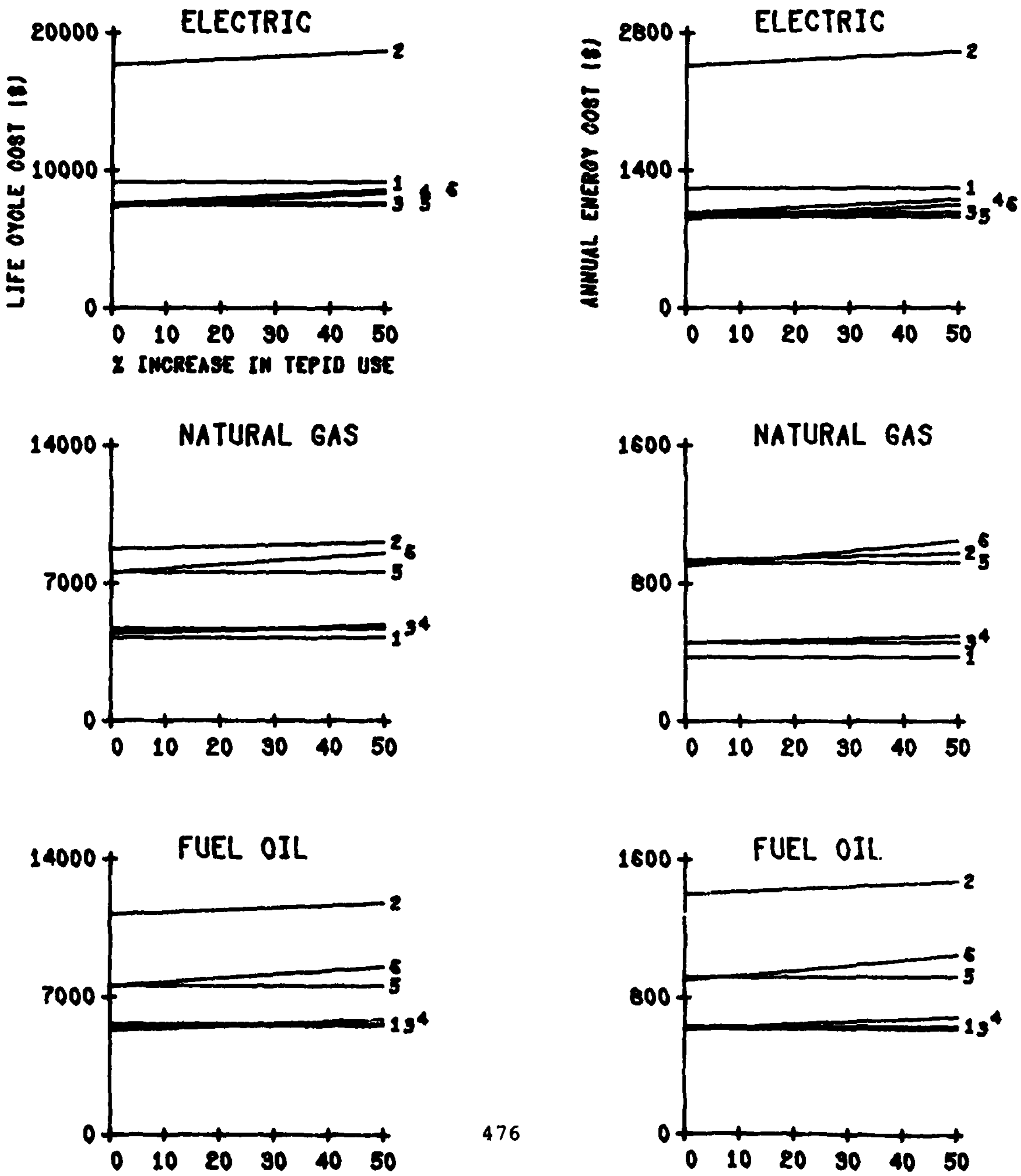
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	8	22.00	66.00

*** NEW CONSTRUCTION ***



AD-A112 649 JOHNS-MANVILLE SALES CORP DENVER CO RESEARCH AND DEV--ETC F/G 13/1
INVESTIGATION OF SINGLE VERSUS DUAL - HOT AND COLD BUILDING WAT--ETC(U)
OCT 81 P B BRUCE, M S RAMSEY, P B SHEPHERD DAAK70-78-C-0082

UNCLASSIFIED USAFESA-T-2091 NL

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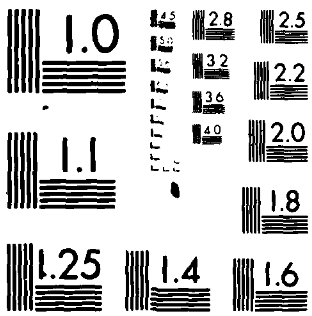

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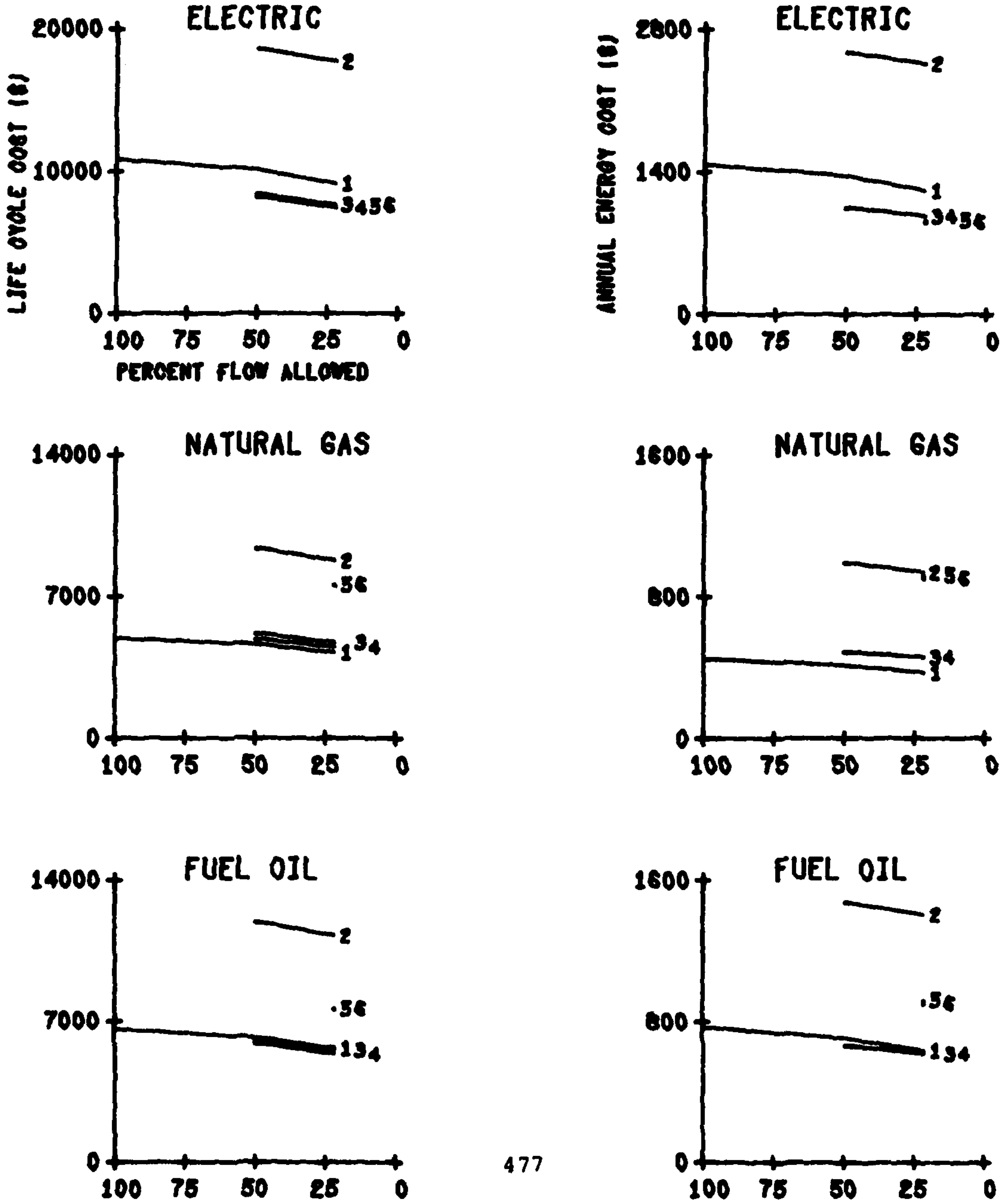
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	8	0.00

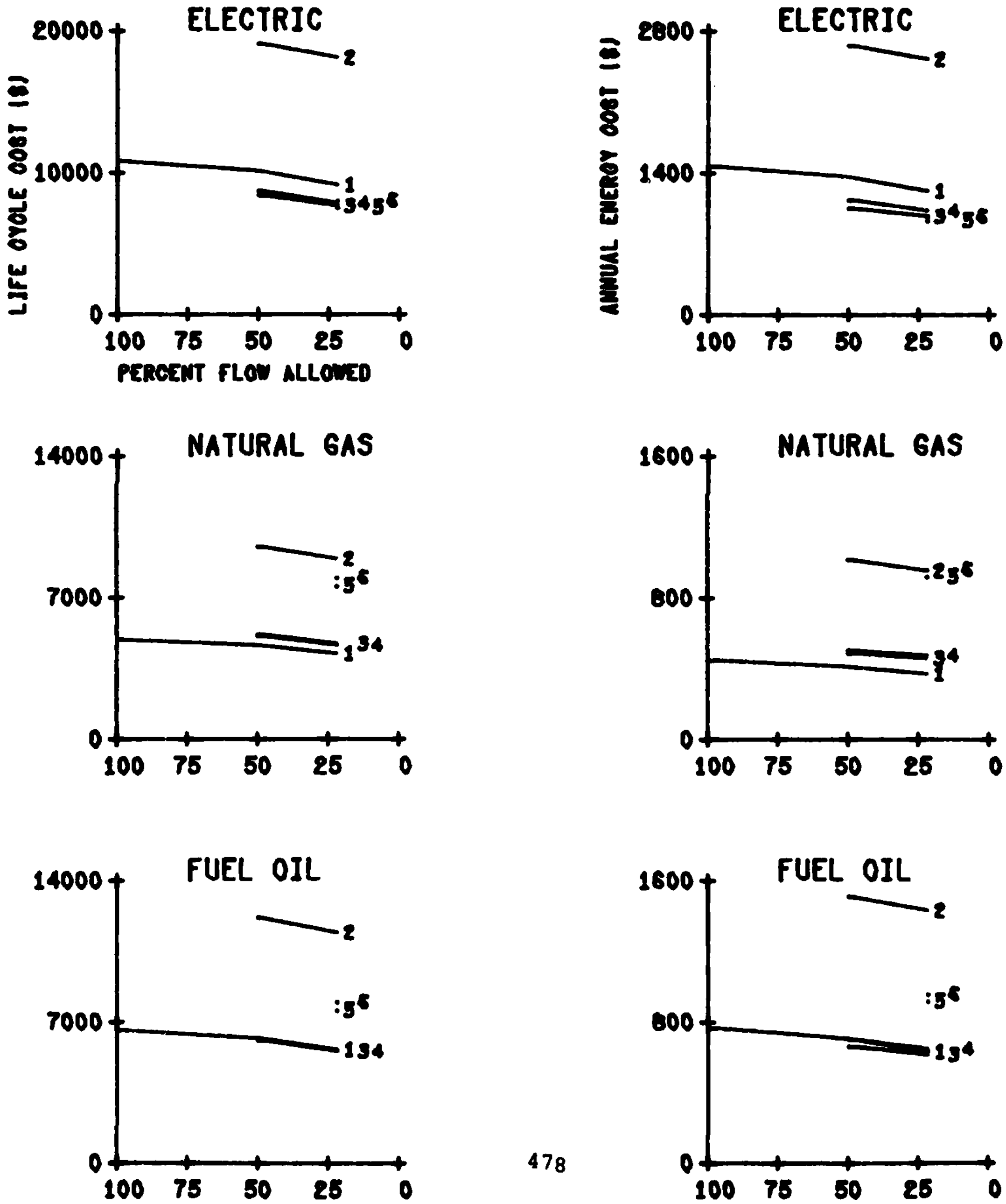
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	8	20.00

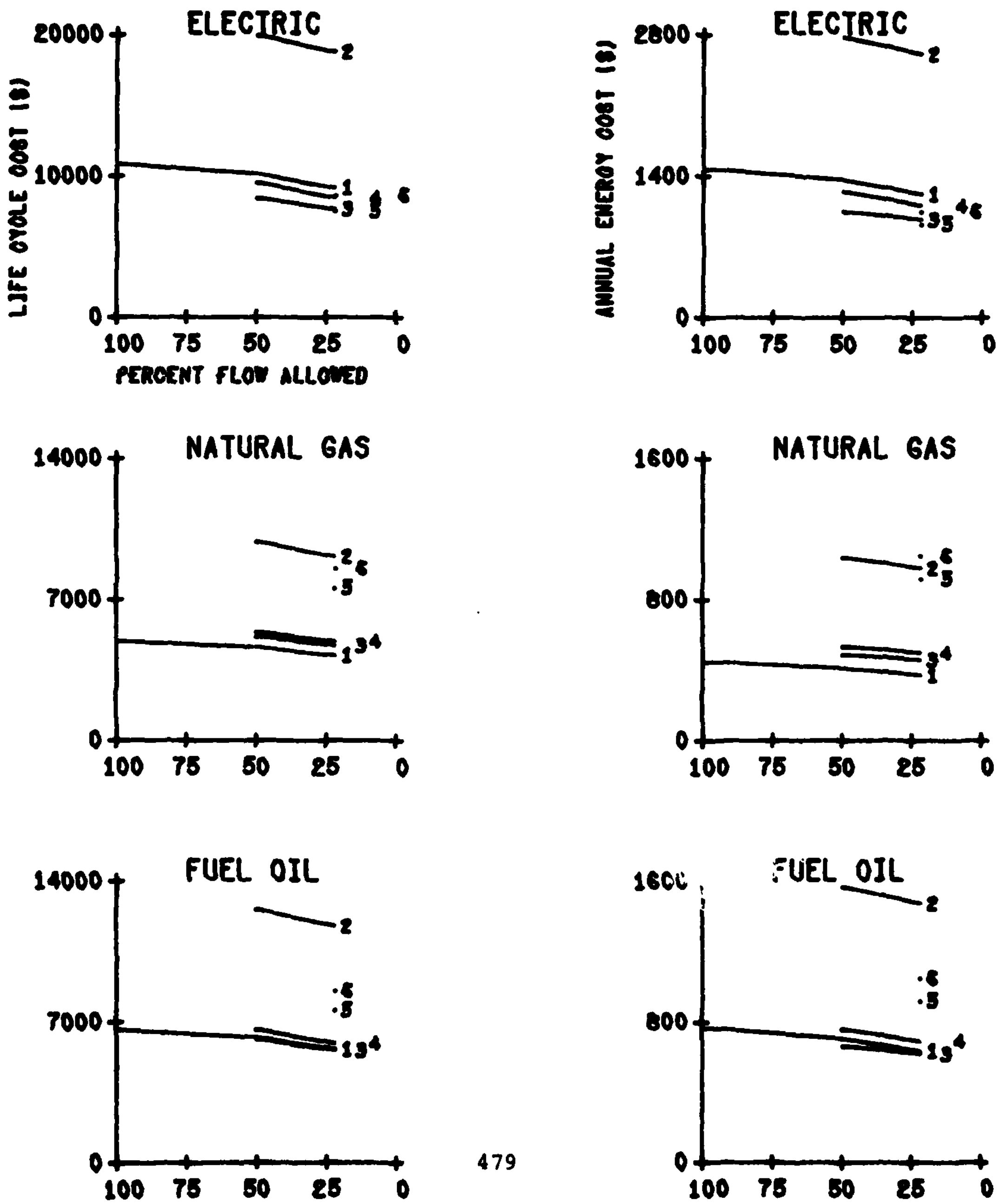
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	8	50.00

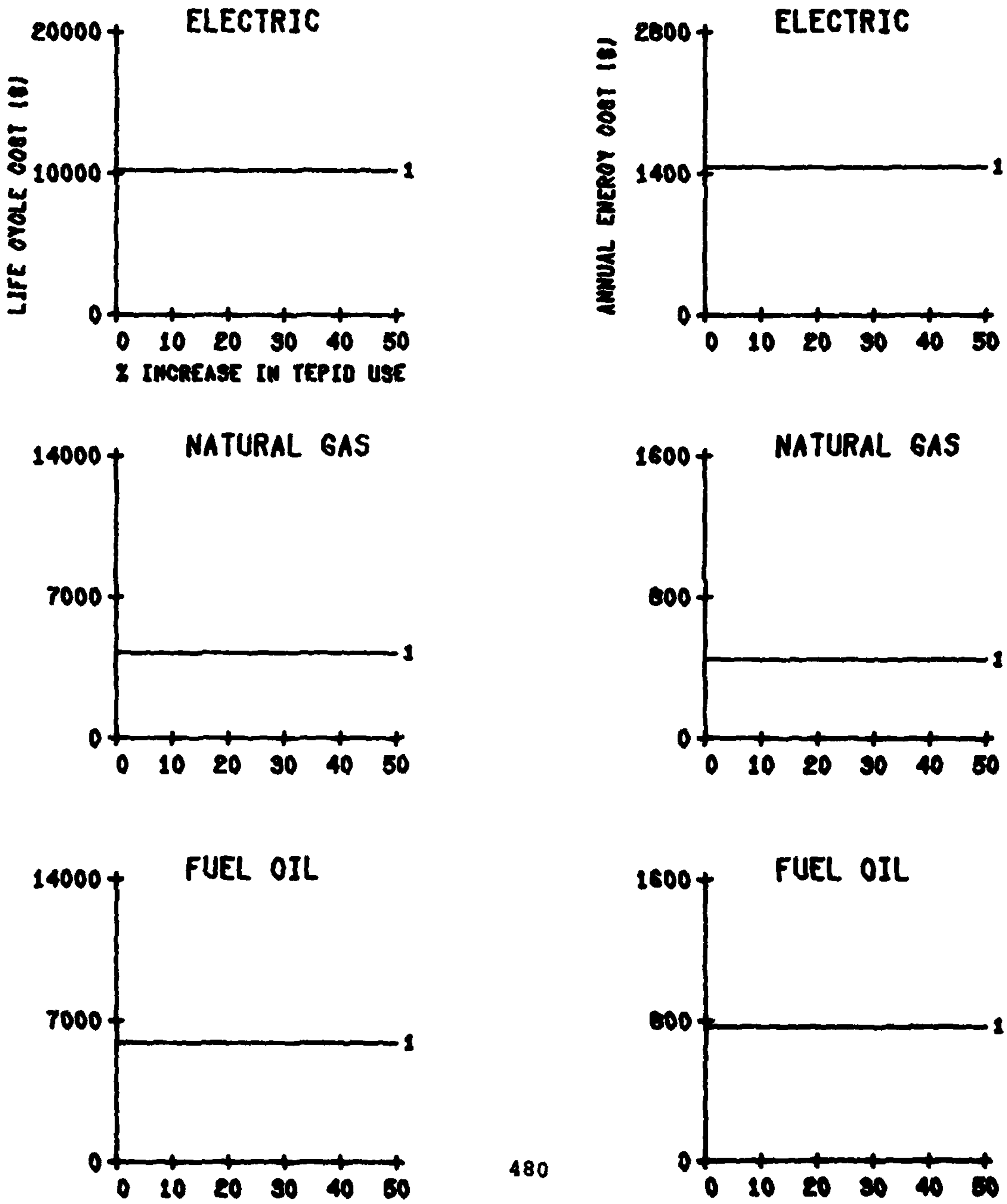
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	8	100.00	100.00

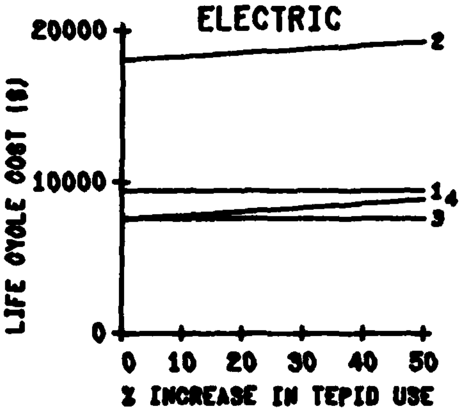
****** RETROFIT ******

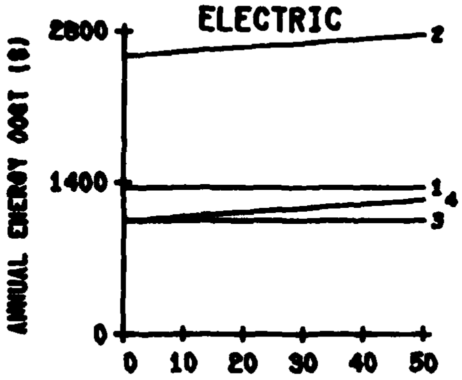


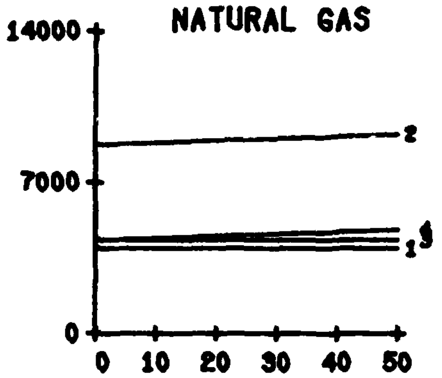
JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

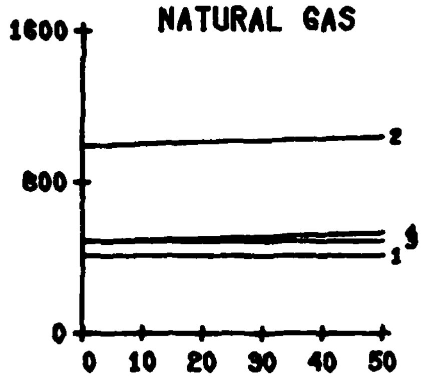
BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	8	50.00	85.00

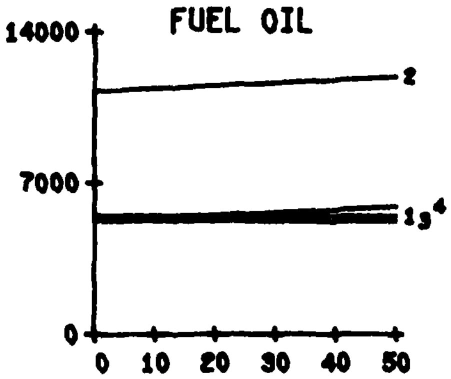
****** RETROFIT ******

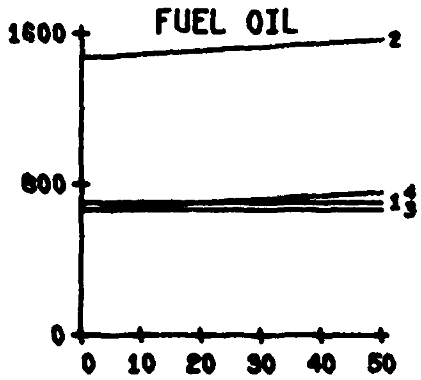








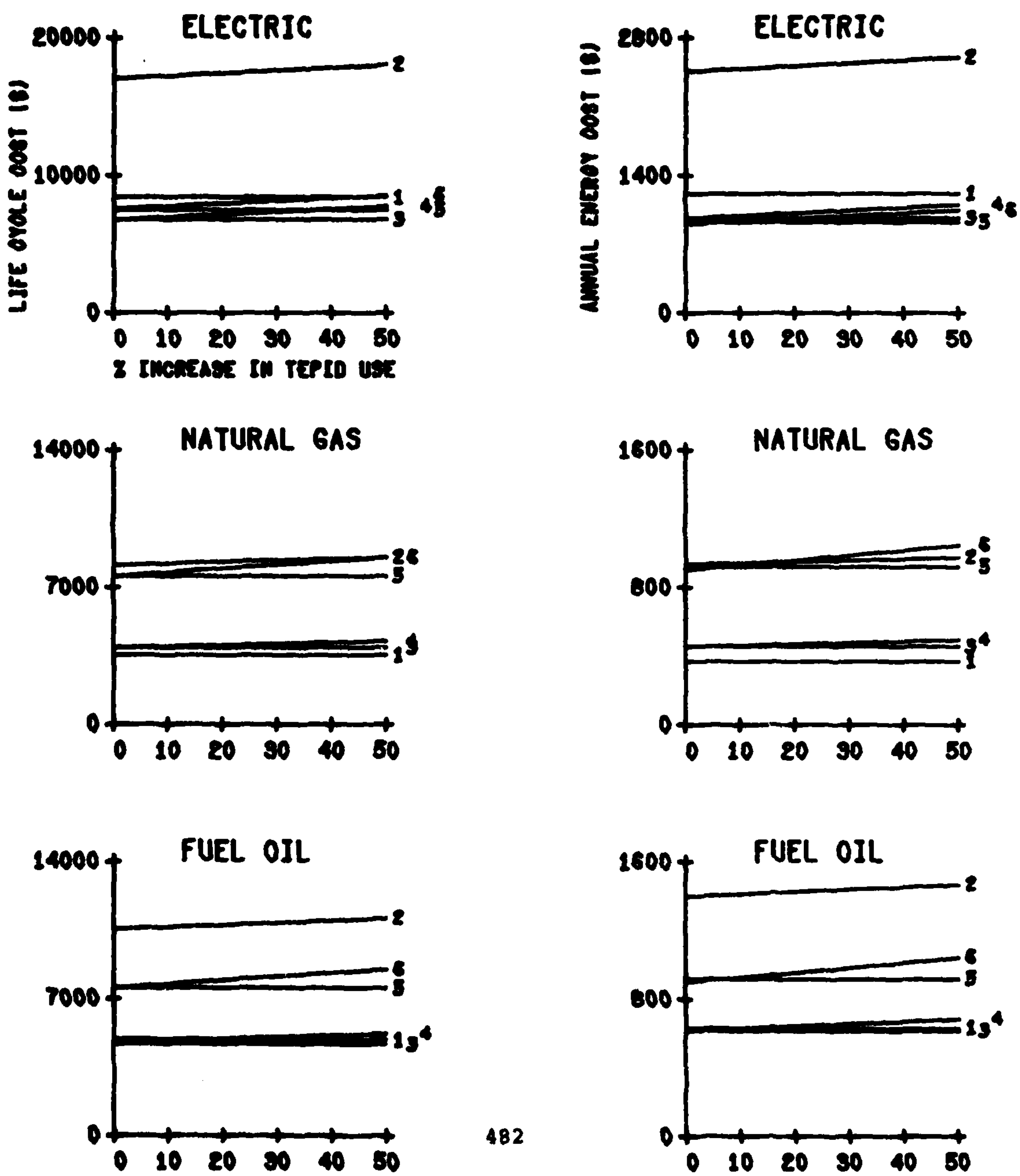




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	8	22.00	66.00

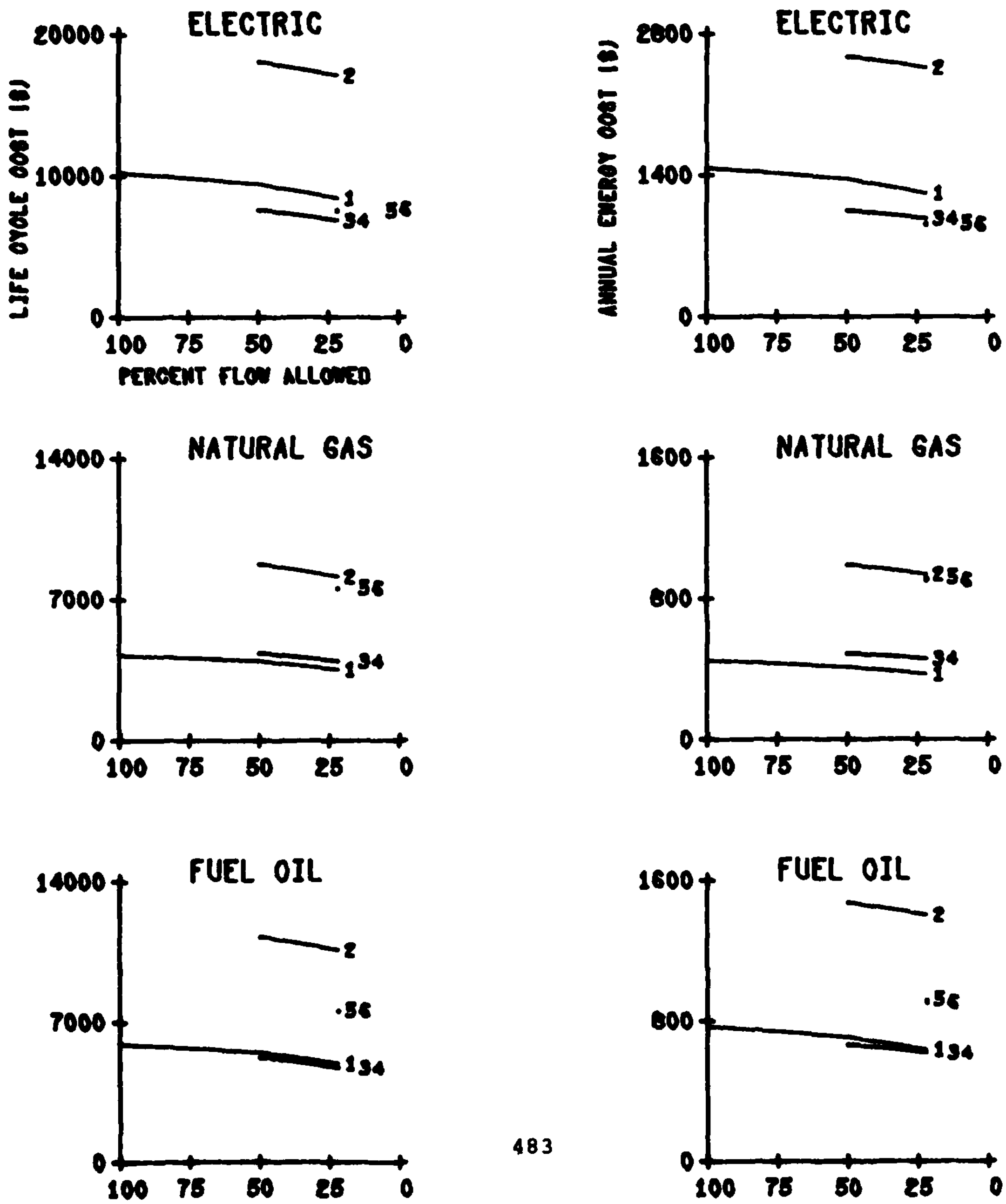
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
5	8	0.00

****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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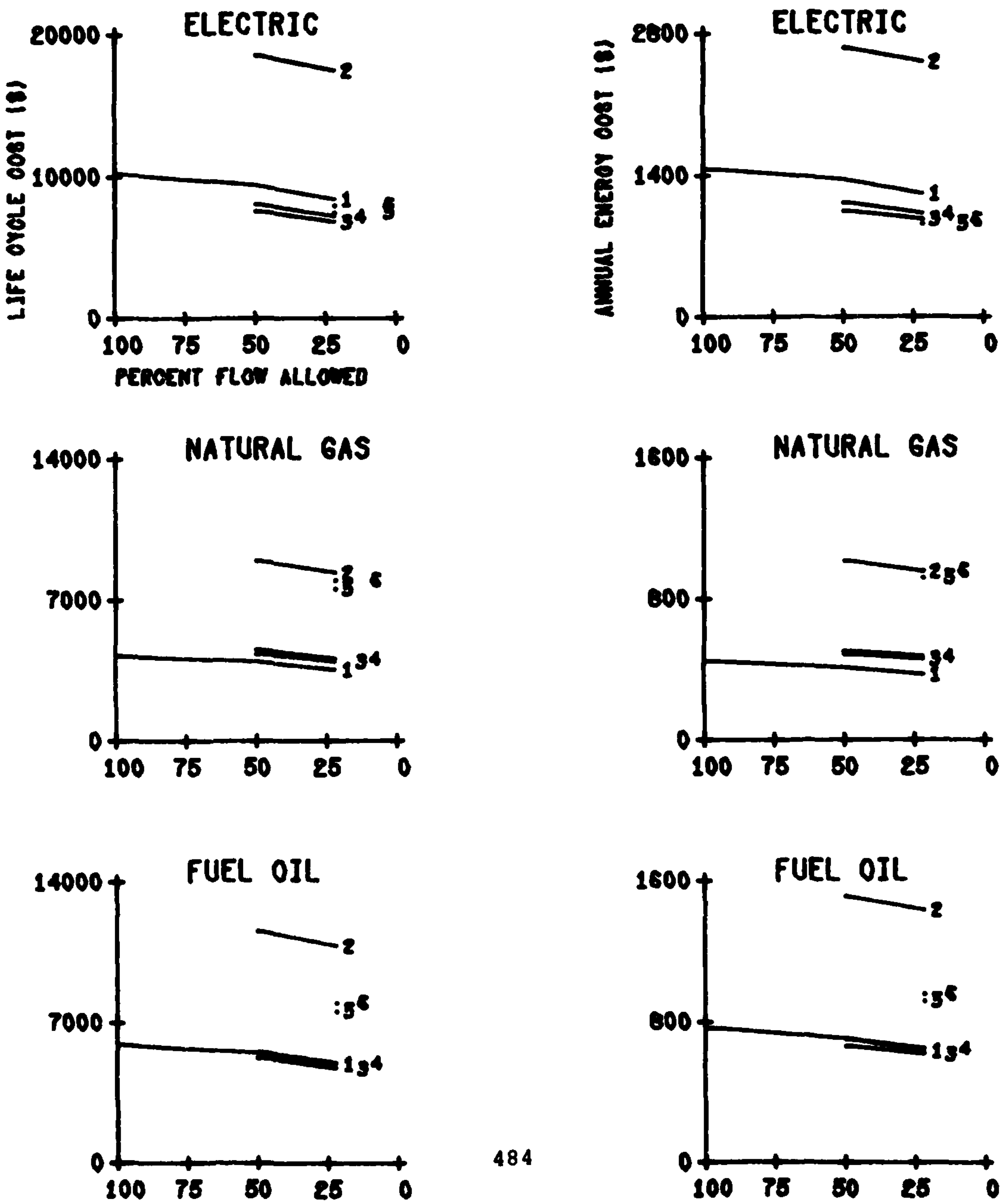
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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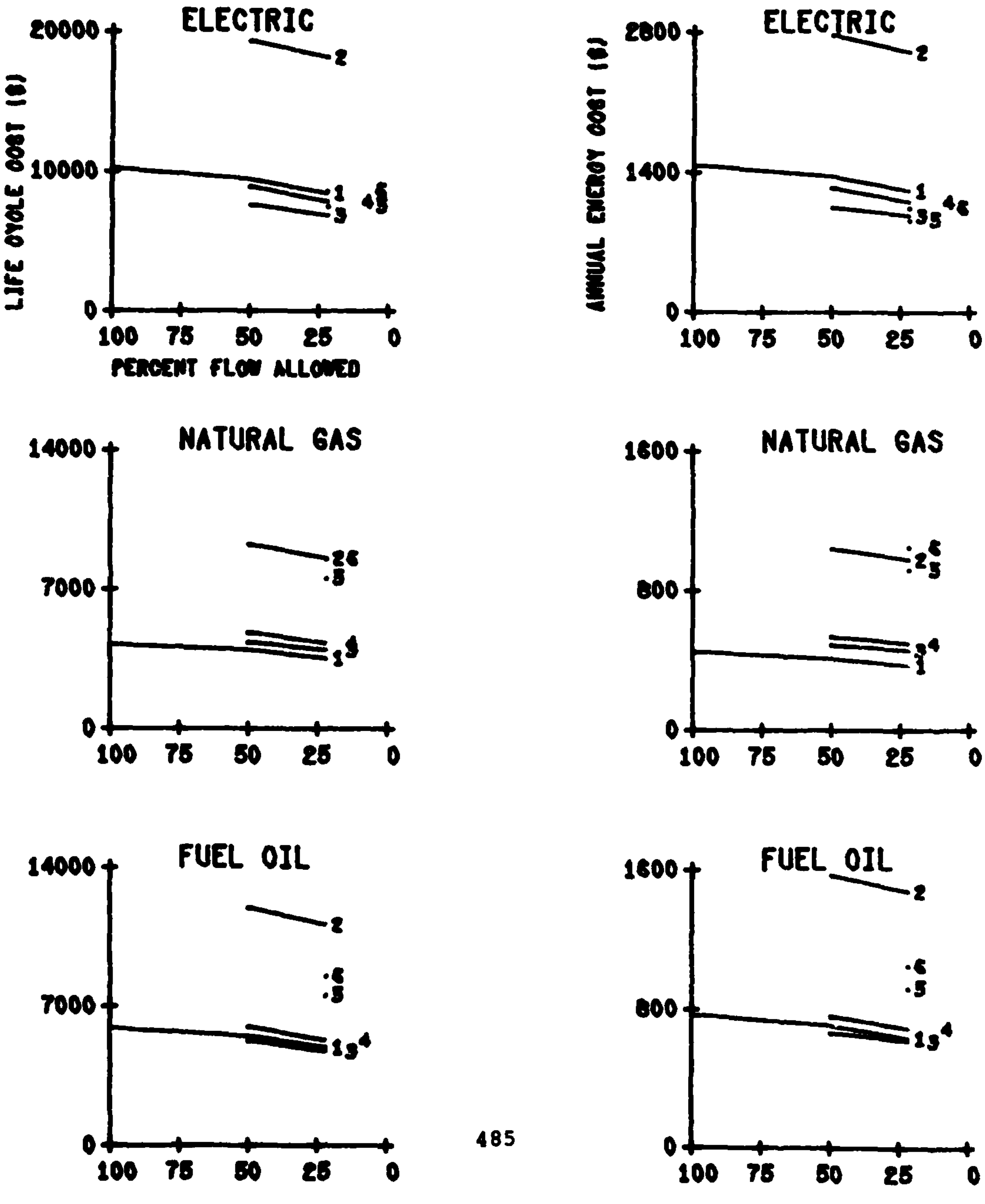

JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
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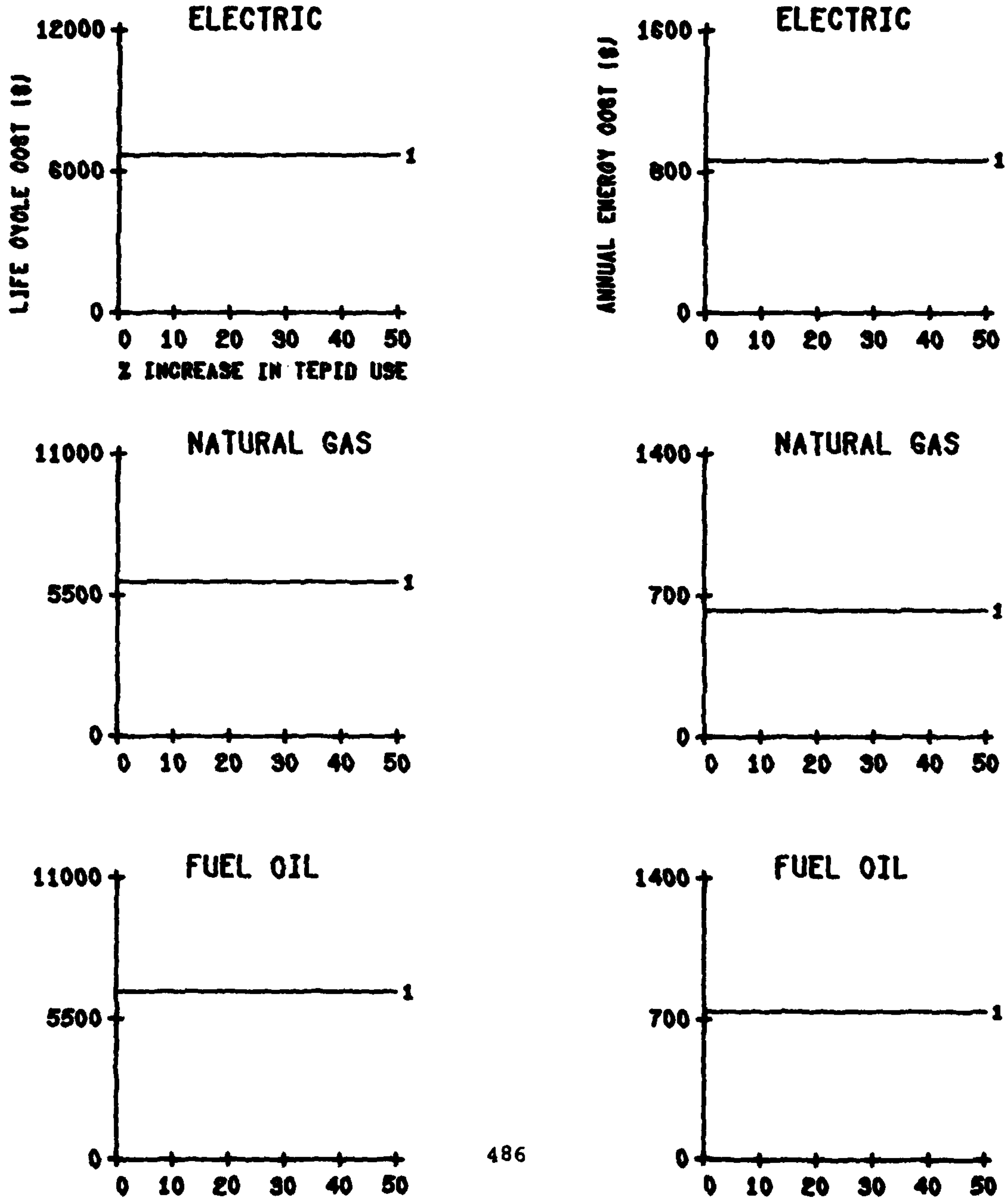
*** NEW CONSTRUCTION ***



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BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
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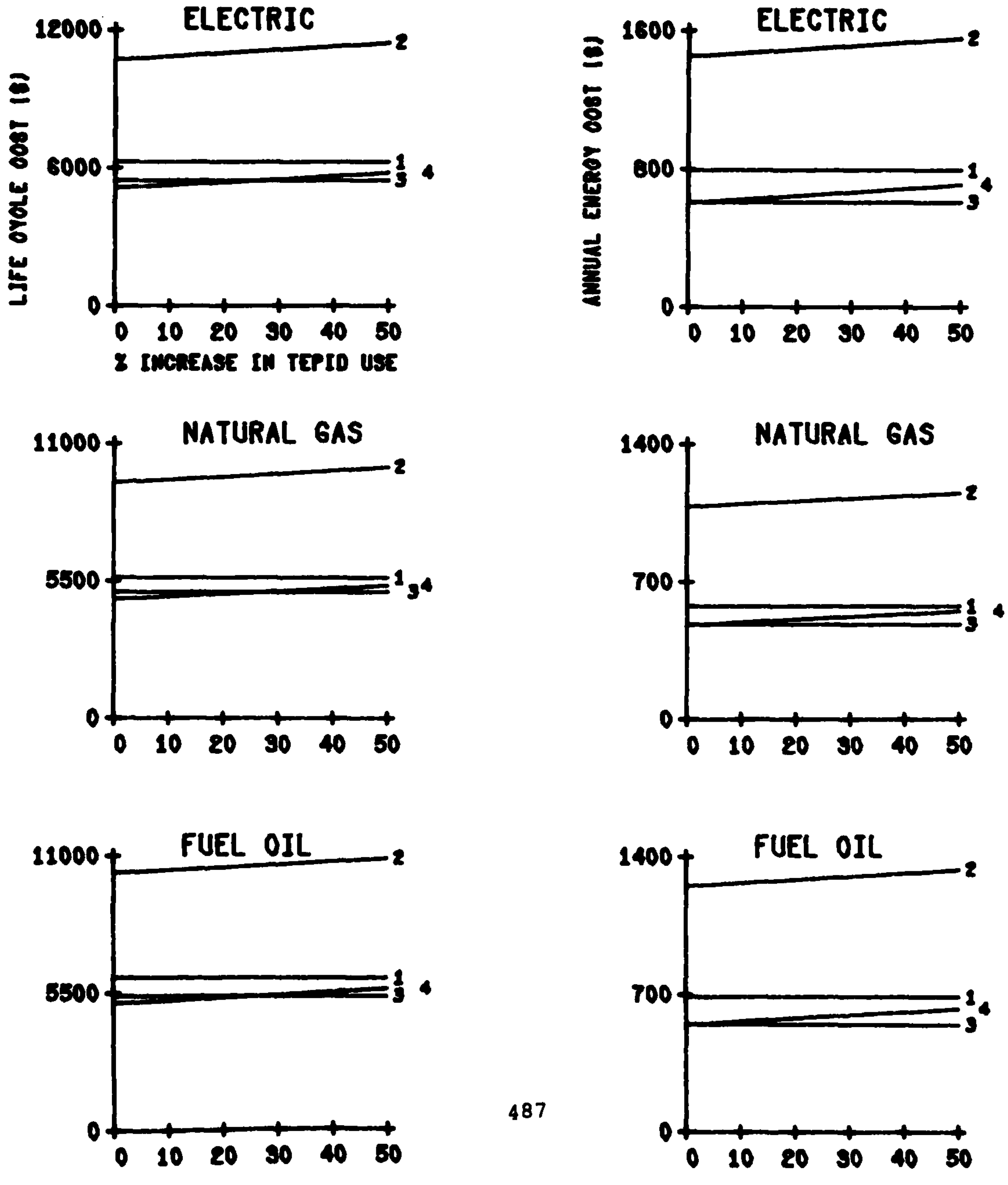
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
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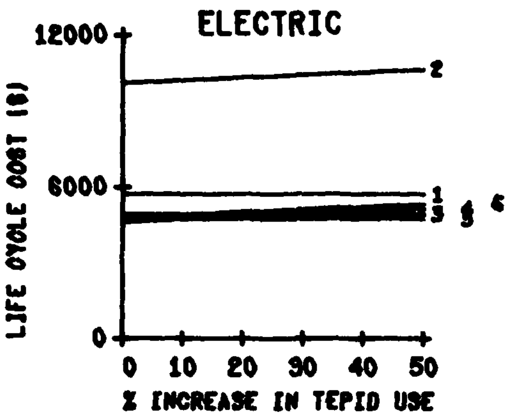
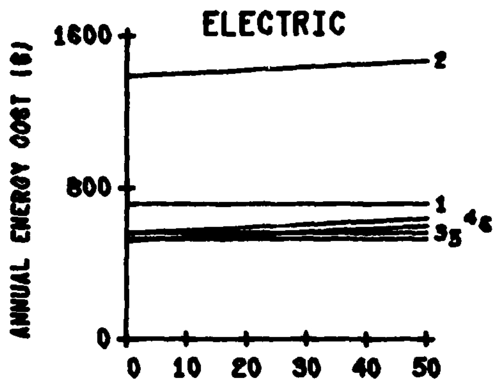
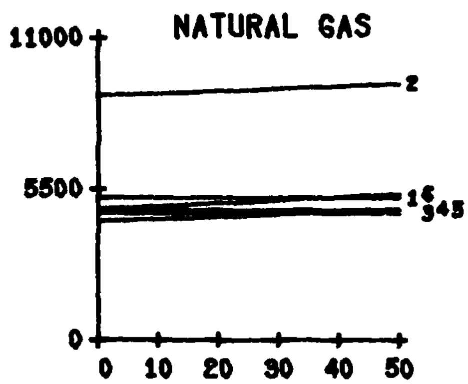
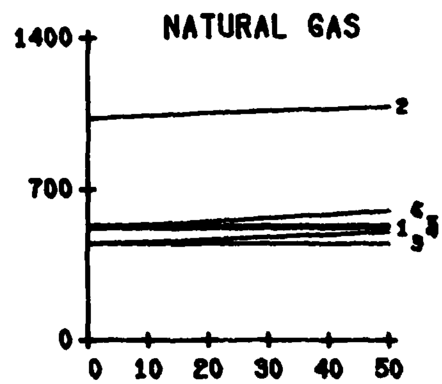
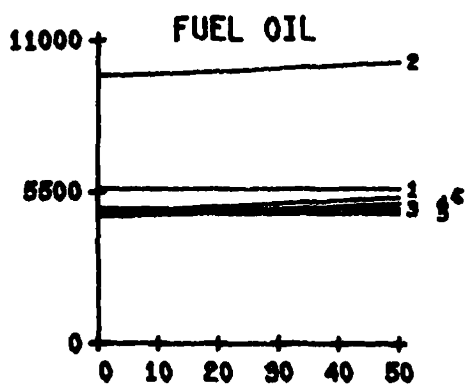
*** NEW CONSTRUCTION ***

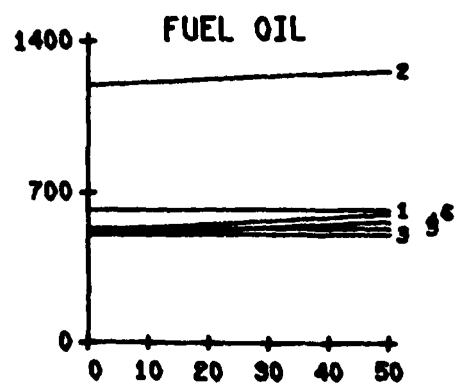












JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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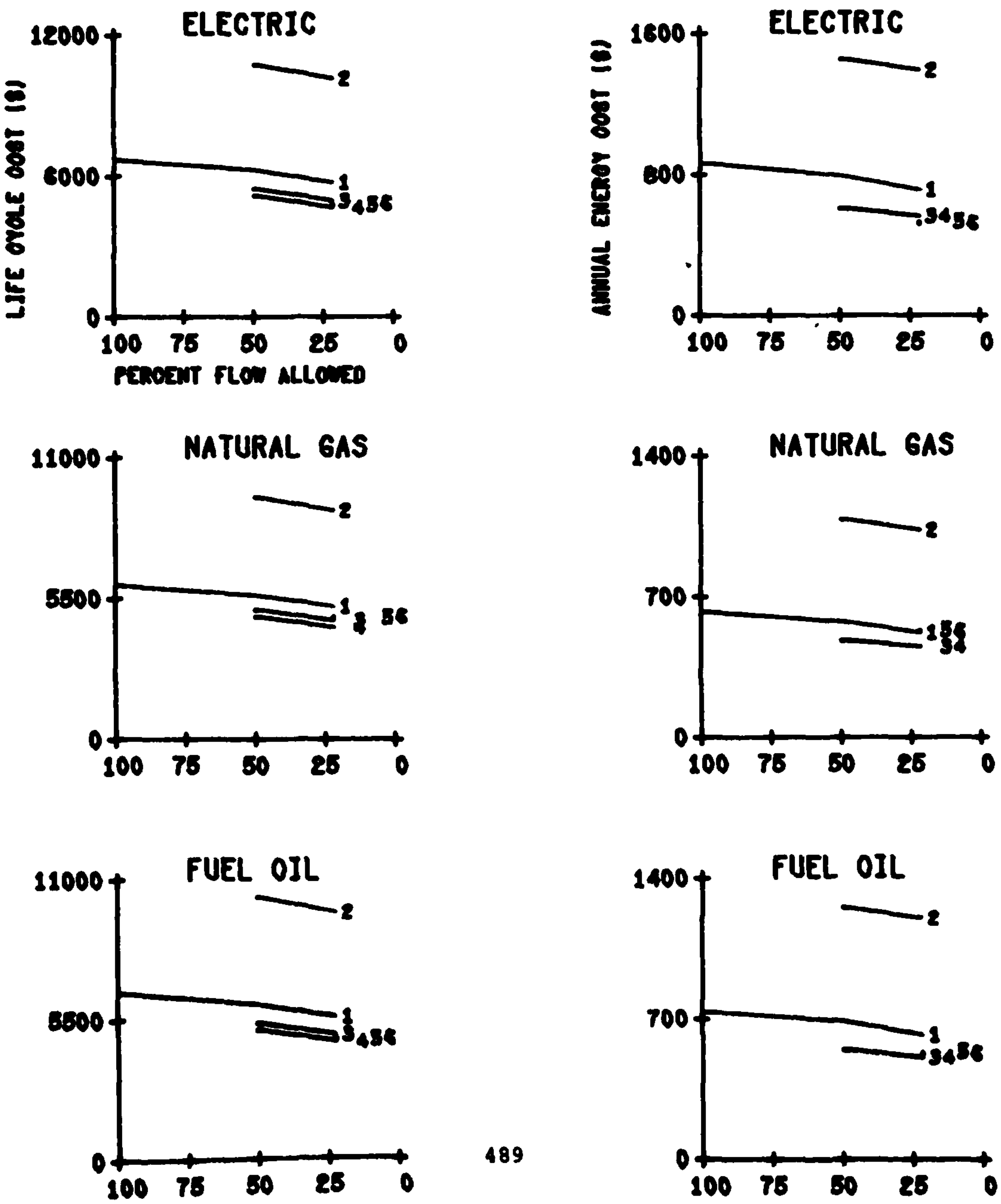
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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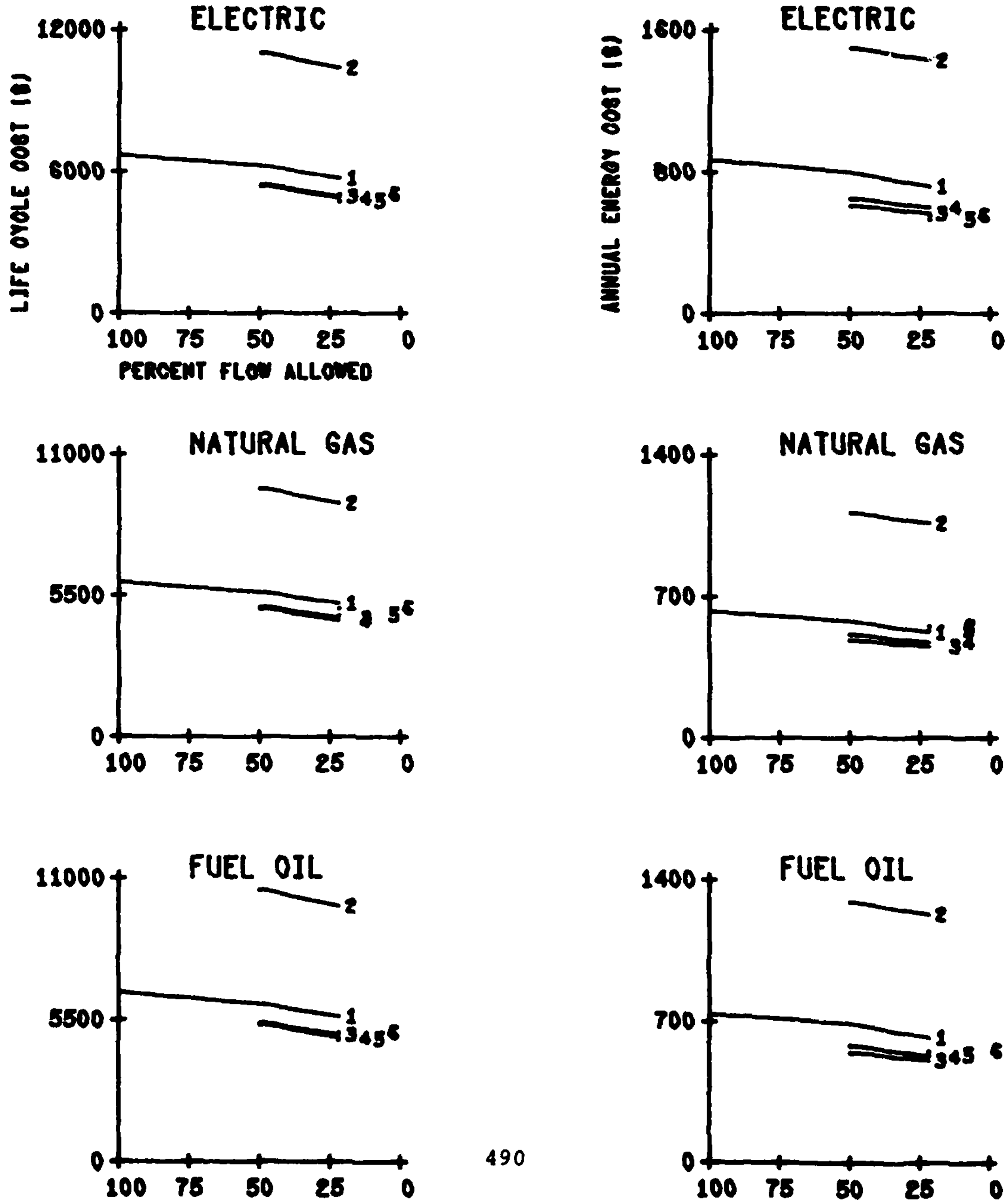
*** NEW CONSTRUCTION ***



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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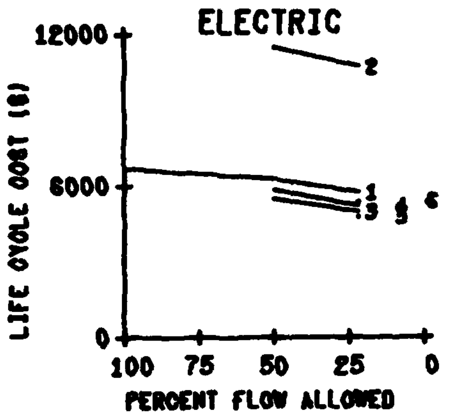
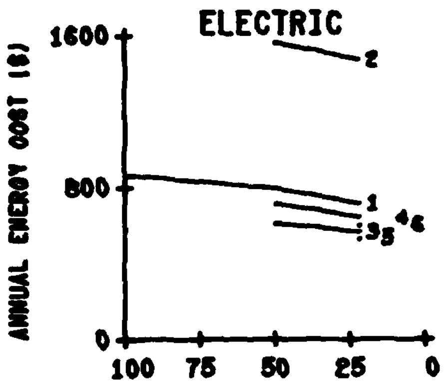
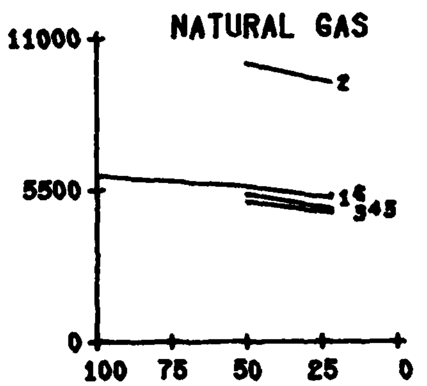
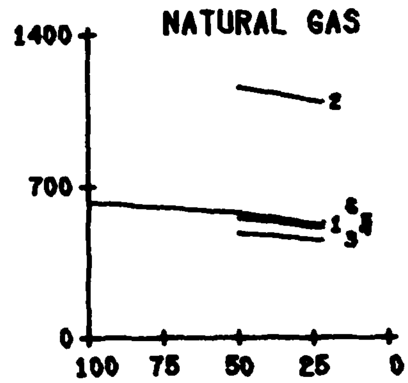
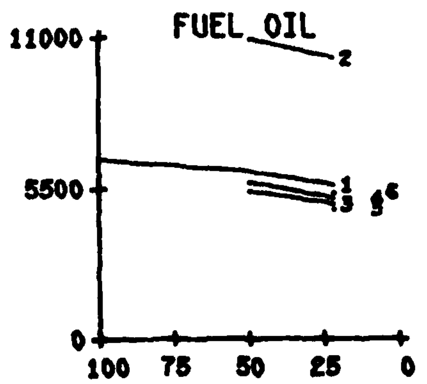
*** NEW CONSTRUCTION ***

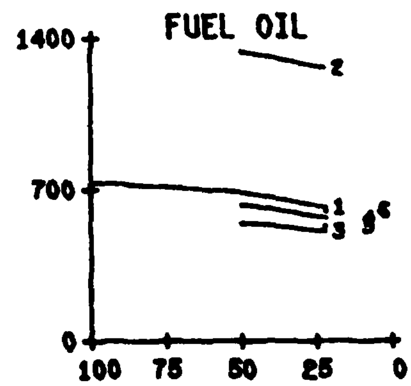












JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
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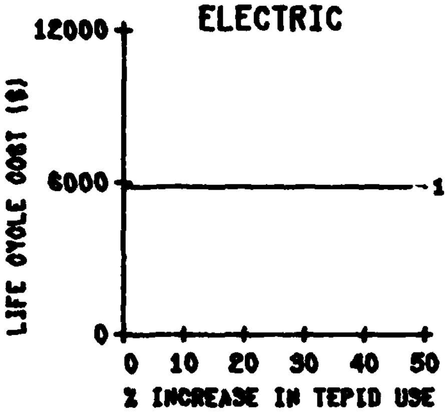
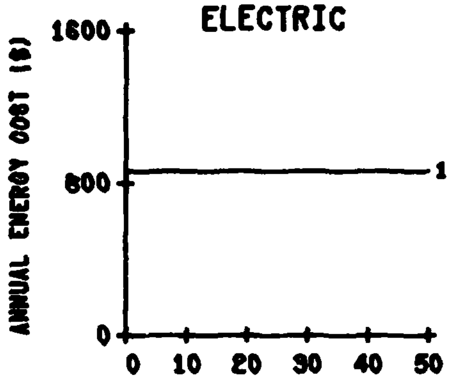
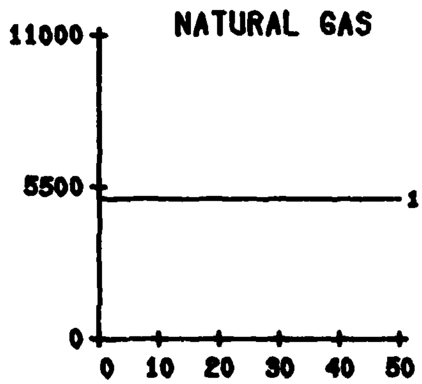
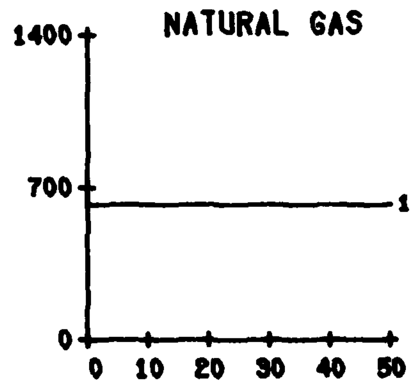
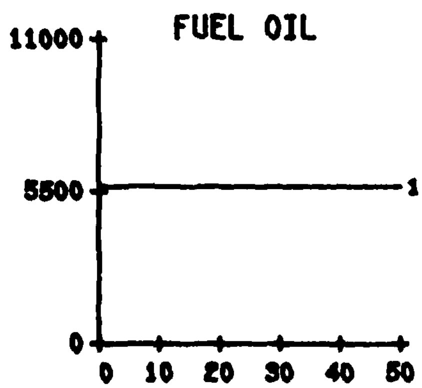
****** RETROFIT ******

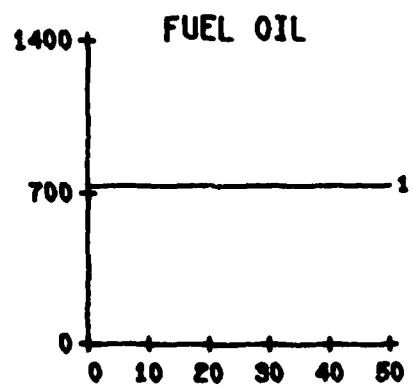












JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
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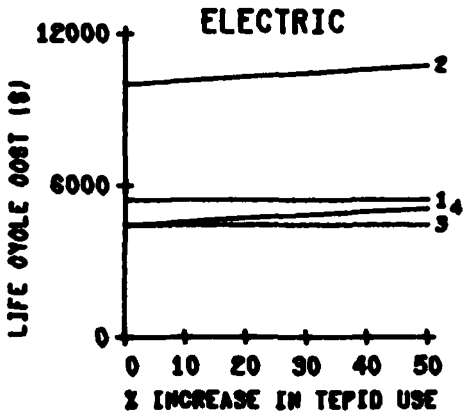
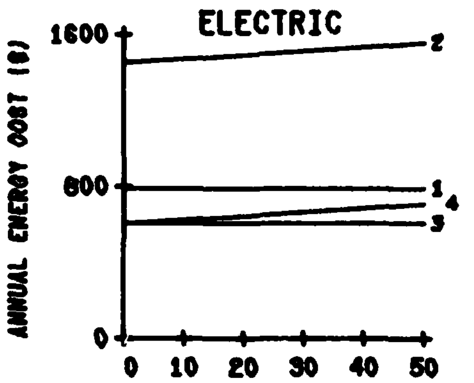
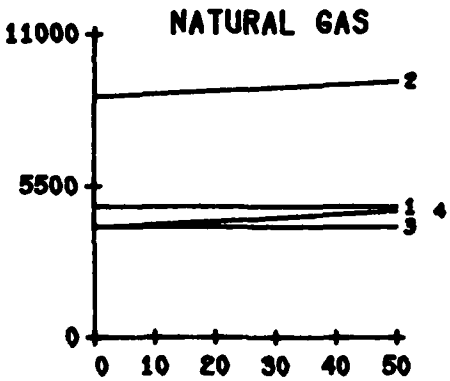
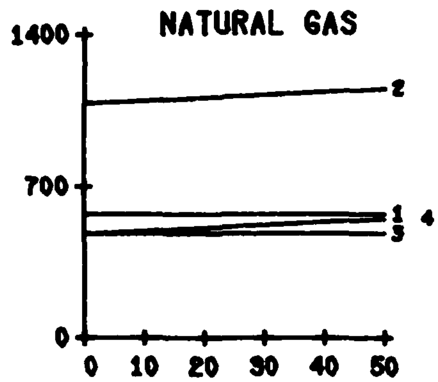
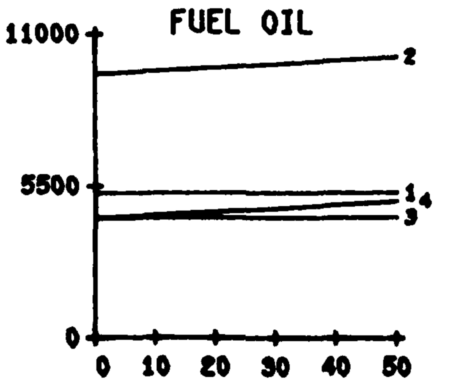
****** RETROFIT ******

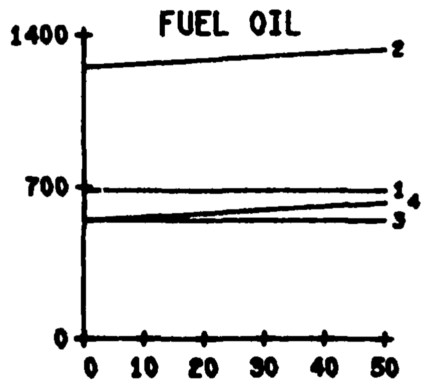








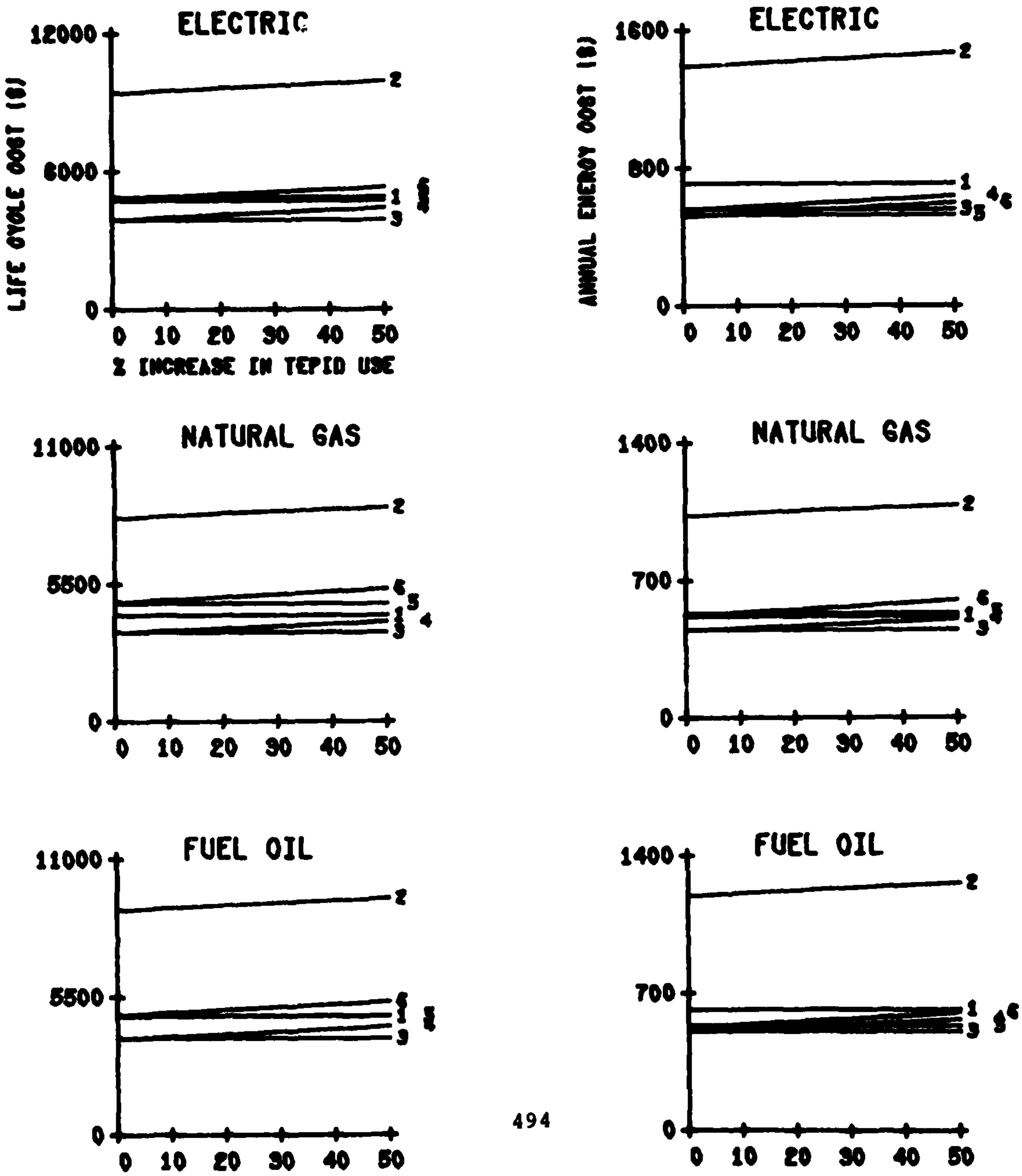




JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT FLOW	PERCENT USAGE
5	10	22.00	66.00

****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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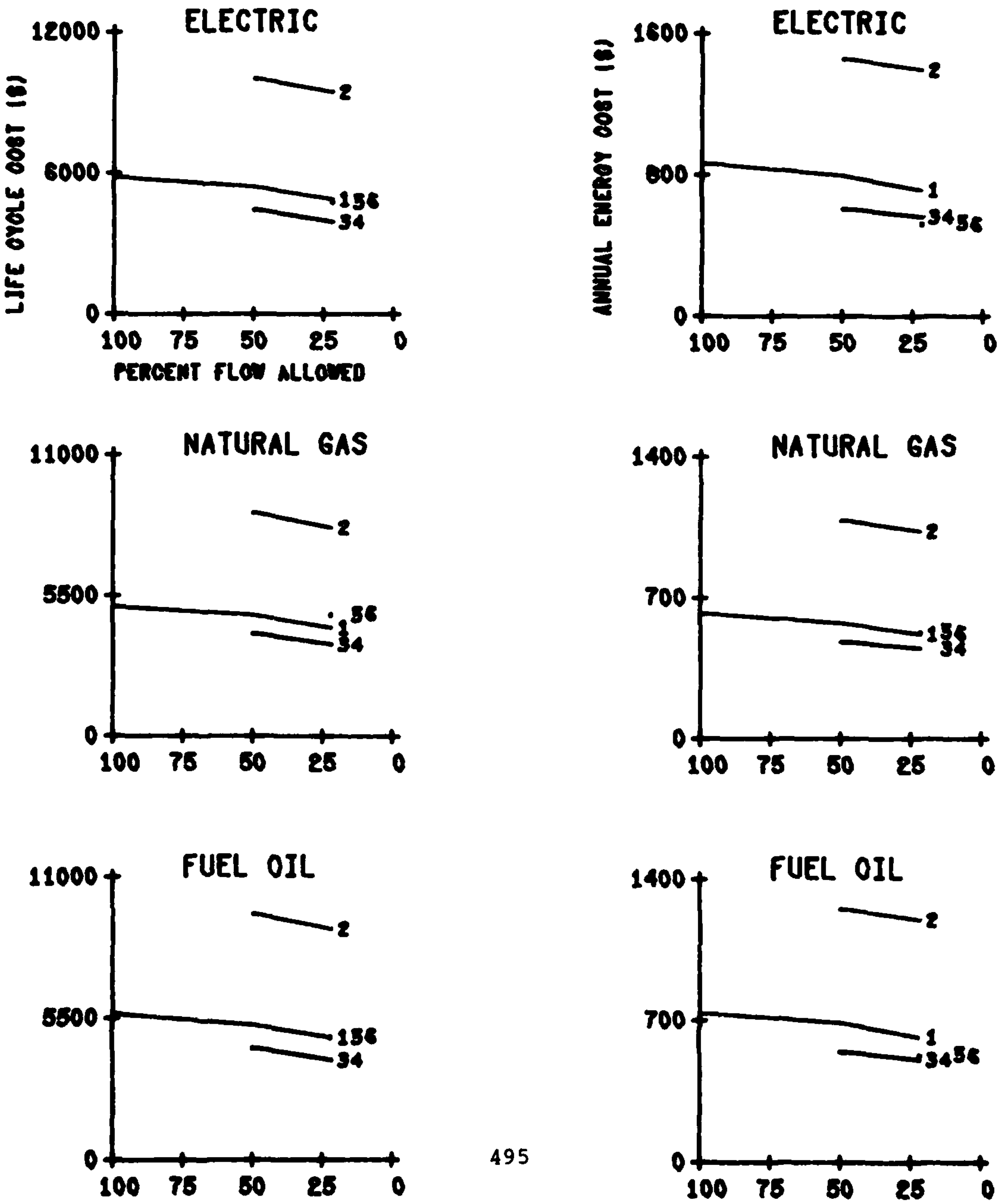
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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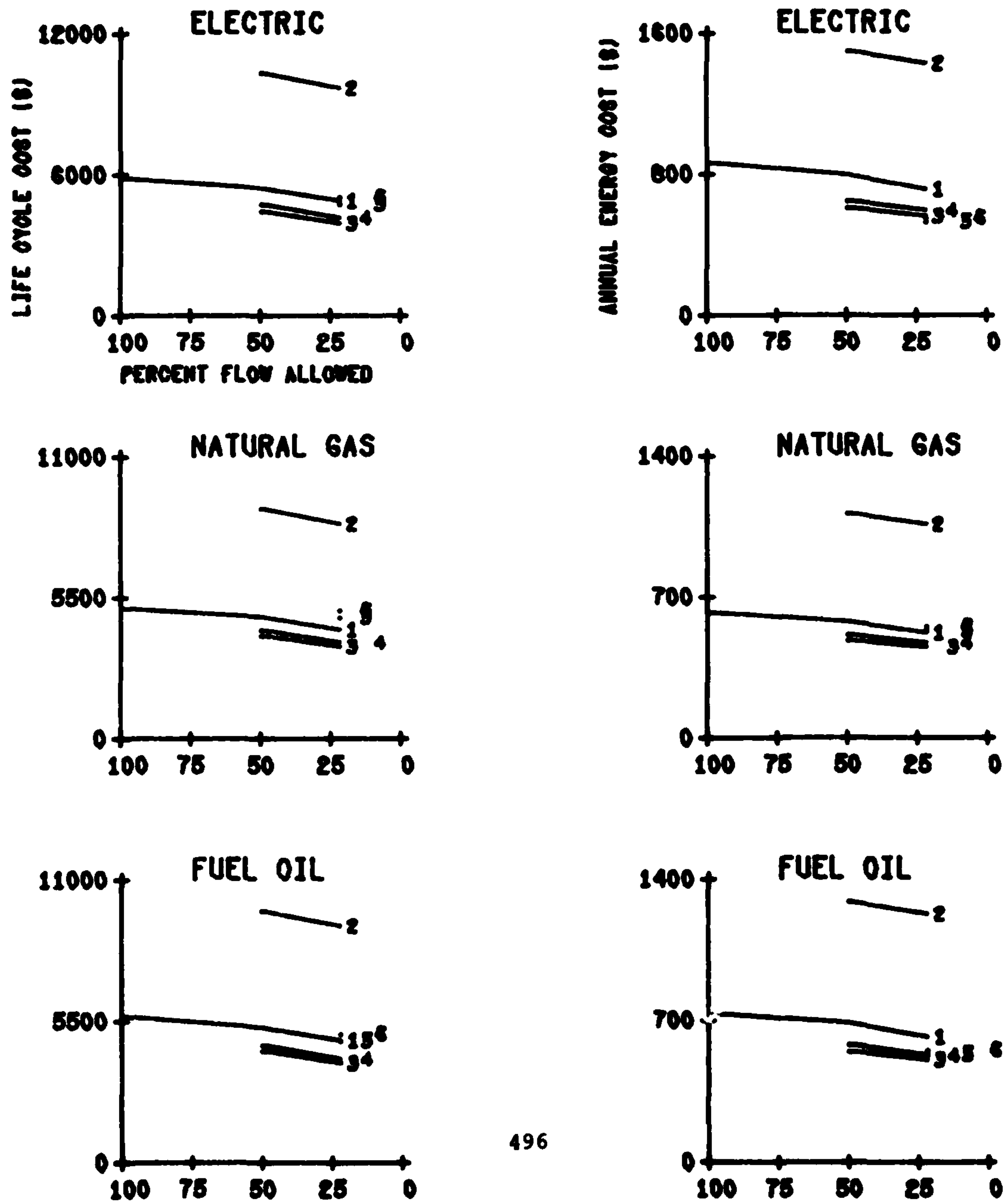
****** RETROFIT ******



JOHNS-MANVILLE RESEARCH & DEVELOPMENT CENTER
BUILDING HEATED WATER SUPPLY SYSTEM SIMULATION

BLDG CODE	DOE REGION	PERCENT INC TEPID USE
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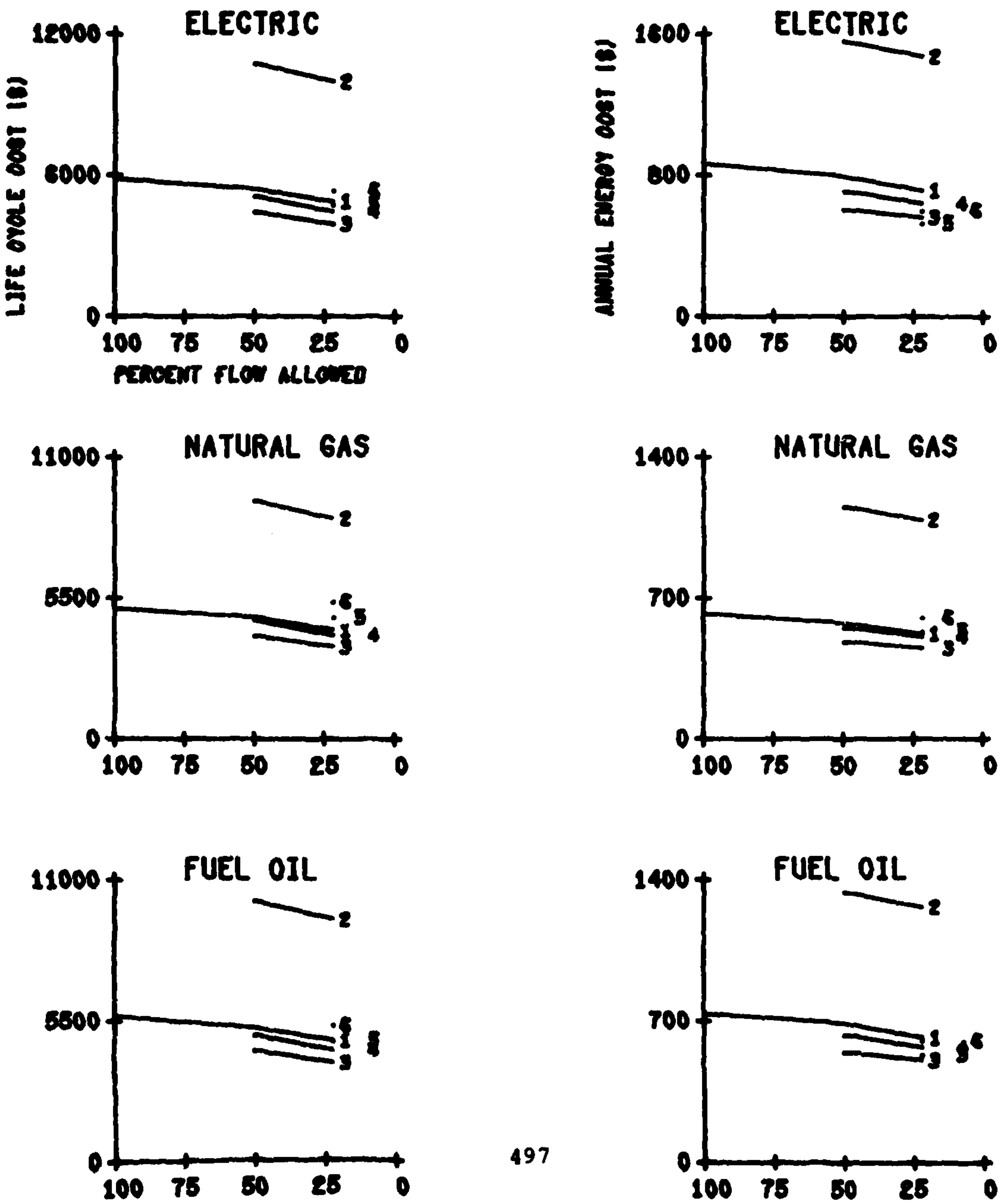
****** RETROFIT ******



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