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REPORT TO THE DEPARTMENT OF ENERGY ON

GRANT NUMBER: DE-FG01-89CE28310

ELECTRIC THERMAL STORAGE DEMONSTRATION PROGRAM

I. BACKGROUND AND GENERAL INFORMATION

In early 1989, MMWEC, a joint action agency comprised of 30 municipal light departments in Massachusetts and one affiliate in Rhode Island, responded to a Department of Energy request to proposal for the Least Cost Utility Planning (LCUP) program. The MMWEC submission was for the development of a program, focused on small rural electric utilities, to promote the use of electric thermal storage heating systems (ETS) in residential applications.

The promotion of ETS centered around the concept of, "making conservation as easy as buying electricity," with one-stop shopping for equipment, zero interest loans, installation, customer training and equipment maintenance. Each light department was to set-up the service and MMWEC was to provide grant and program management including centralized purchasing of equipment and promotion of the program. Eight MMWEC member light departments stated they would be interested in participating in the program.

However, due to MMWEC personnel changes and the time between submission and notice of award, the level of interest in participation declined among the member light departments. Of the original eight systems interested in participating only four remained.

This change in the level of member interest caused MMWEC to revise the program description for a much less ambitious and costly program to the participating member light departments.

The modified MMWEC LCUP grant proposal focused on the demonstration, as opposed to the mass marketing of ETS in each of the four remaining light departments. These demonstrations of ETS technology were to be in public buildings selected by the light department. Sites were either new or existing elderly housing units or the light department offices and buildings.

Program Participants Characteristics and Background

The four light departments participating in the ETS demonstration program were: Boylston, Holden, Pascoag and Sterling. Each of these light departments are small, rural and municipally-operated. The following town descriptions provide some background information on each light department, its size and composition and a summary of what was accomplished in their ETS effort.

Boylston Light Department

Located in Central Massachusetts, Boylston Light Department was created in 1912 and is presently comprised of six employees. The number of meters served is 1,665 having an average consumption of 12,708 kilowatt hours usage annually. The customer base is 64% residential. Total 1989 sales were approximately 21 million kilowatt hours. The summer peak is 3.8 megawatts and the winter peak is 4.9 megawatts.

Boylston's participation in the program was the installation of ETS equipment in housing for the elderly. The housing was new construction and originally planned for electric resistance heat. Since Boylston was the only system to install a large (278 kilowatt) thermal storage system as a part of the grant program, a more detailed description of this project is provided in Section III.

Holden Light Department

Located in central Massachusetts, the Holden Light Department was created in 1912. Holden Light Department currently has seventeen employees and serves 6,392 meters having an average consumption of 13,040 kilowatt hours. The customer base is 50% residential. Annual sales in 1989 were approximately 83,000,000 kilowatt hours and revenue from sales was over $8,000,000. Summer peak is 14 megawatts and winter peak is 17 megawatts.

Holden completed a number of tasks related to ETS demonstration program. Of primary importance to Holden's effort was the survey on customer knowledge and attitudes toward ETS which was conducted to provide the light department information on the customers' understanding of thermal storage, customer interest in having thermal storage installed and the level of incentive required for a customer to participate in such a program. Survey results are included in this report as Appendix One. Holden also completed the development of an off-peak thermal storage rate and installed ETS equipment in the light department offices at their expense. Although a site for the installation of equipment was selected, an installation project was not completed.

Pascoag Light Department

Located in northern Rhode Island and an affiliate member of MMWEC, Pascoag Light Department was created in 1887.

The light department has 10 employees and serves 3,701 meters which have an average

annual consumption of 8,159 kilowatt hours. Total kilowatt hours sales were 30,199,388 kilowatt hours and the customer base is 61% residential. Summer peak is 6.0 megawatts and winter peak is 7.1 megawatts.

Pascoag completed installations in two separate locations, both the light department main office and the operations center/switch yard building were retrofitted with thermal storage equipment. A total of 40 kilowatts of ETS were installed in Pascoag. The impact of the new ETS load upon Pascoag was determined to be too small to show any effect upon the peak or typical day load shapes. A copy of an informational package which was provided to customers is attached as Appendix Two.

Sterling Light Department

Also located in central Massachusetts and created in 1910, Sterling Light Department has 11 employees and serves 2,563 meters which have an average annual consumption of 11,614 kilowatt hours. Total kilowatt hour sales were 29,766,000 in 1989 and the customer base is 63% residential. The summer peak is 5.7 megawatts and the winter peak is 6.2 megawatts.

Sterling was an early thermal storage enthusiast and initiated ETS projects in six residences in mid-1989. The light department developed an off-peak rate, coordinated a zero interest loan program with a local bank, arranged for ETS equipment with a supplier and provided customers with equipment below the retail price. This approach was similar to the program description initially submitted by MMWEC in response to DOE's request for proposal for LCUP funds. Sterling had planned to do a demonstration project as a part of the revised LCUP grant at their local housing for the elderly site but was unable to coordinate it with

the agency in charge of the housing. An unfortunate note to Sterling's effort was that the ETS project unexpectedly received approval to proceed from the agency in charge in late November, after the grant expired. A copy of Sterling Light Department's ETS promotional brochure is contained in Appendix Three.

II. TECHNOLOGY REVIEW OF ELECTRIC THERMAL STORAGE EQUIPMENT

Developmental History

Electric Thermal Storage was originally developed in Europe at the end of the second world war and has seen wide acceptance. The level of acceptance seen in Europe has not occurred in the United States for a number of reasons. Primary among the reasons for low acceptance of ETS is that thermal storage did not appear in the U.S. until the 1970's. The European companies manufacturing the ETS equipment began to promote thermal storage in the U.S. once interest in it began to be seen. Continued lagging market share, especially in new construction is due to the lack of awareness of the technology as a space heating option by electrical contractors, builders, homeowners and the utility industry. A few of the exceptions in the utility industry have been, Pennsylvania Power and Light, New York State Electric and Gas and Central Vermont Public Service, (an early proponent). Many other utilities have conducted pilot programs to assess customer acceptance and load shape impacts on their systems. The New England Power Service Company has completed several site specific evaluations, primarily in multi-family housing and both the South Kentucky RECC and the Eastern Kentucky Power Cooperative have jointly conducted a three year pilot study on equipment and customer acceptance.

American manufacturers also began appearing in the 1970's but they focused upon large centralized

units as opposed to the European focus on smaller room-sized heating units. Most U.S. companies still import their room-size ETS equipment from Europe. New U.S. companies have begun to have more of a presence in the market and new applications such as, crushed rock storage and thermal storage additions to heat pumps have begun to appear.

Technology Description

An Electric Thermal Storage device is, in simple terms, a series of electric resistance coils which heat a storage medium, in most cases ceramic bricks, which are housed in a well insulated container. Controls to vary the amount of charge received by the bricks and to set the room temperature are also a part of the equipment. A diagram of a typical unit is included in Appendix Four - ETS Equipment.

As was previously mentioned, there are, in general, two types of storage units, room unit heaters and centralized furnaces. Manufacturers are identified and their ETS products are described in detail in Appendix Two.

Individual room units are by far the most prevalent type of ETS system and are comprised of two types of units known as static and dynamic. A static unit has only resistance coils and ceramic bricks, there are no moving parts such as fans and they have limited control. Heat is discharged from the unit through vents and by radiant heat from the unit container. Static units are limited in use to those area that have lower heating needs or can do without heat such as a, hallway, entry way or bathroom. Static units need to be sized larger than dynamic units because of their uncontrolled means of discharge. Dynamic units incorporate fans for a more thorough and consistent distribution of heat and better unit controls for fan operation and charging level. In addition, dynamic unit operation is controlled at a central control point. A control panel provides

for a more consistent charging of the individual ETS units, outdoor temperature adjusted charging and they also regulate charging times to the off-peak. In addition, the control panel can offer access for a utility load control device to ensure that the ETS equipment operates only in the off-peak hours.

Equipment Sizing Considerations

To determine the appropriate sizing of either room or central units an hourly heat loss analysis needs to be conducted on either a room-by-room basis for sizing individual room units, or the entire house for a central storage furnace. Heat loss analysis is essential to the proper sizing of the ETS unit. Equipment manufacturers like to provide this service to contractors and architects, or will provide the installer or designer with training on how to size an installation. Inadequately sized equipment will result in poor performance affecting not only the comfort of occupants but the reputation of the utility company, the equipment supplier, electrical contractor and builder.

The second component to determining the size of an ETS system is the off-peak charging period allowed by the utility. This time period depends upon each utility's load shape and the hour or hours of peak demand on the system. ETS charging periods can be any number of hours per day, but the shorter the charging period, the larger the equipment needs to be sized, in order to store an adequate charge in the shorter charging period. The ETS equipment installed in Boylston at the housing for the elderly has an eight-hour charging period from 11 p.m. to 7 a.m. For the ETS equipment used at this site, which are units supplied by American TechnoTherm, an eight hour charging period corresponds to a sizing factor of two. Or if, for example, the site was to be heating by electric resistance heating, the size in kilowatts of that resistance system would be

multiplied by two to obtain the appropriate size for an ETS. The sizing factor accounts not only for the number of off-peak hours allowed for charging the ETS equipment but to also provide active heating to the residence during the charging hours. In the Boylston example cited above, the housing for the elderly had already been designed for 139 kilowatts of electric resistance heat and the number of hours for off-peak charging were set by the utility. The sizing factor or the sizing multiplier for ETS equipment, in the Boylston case, two, is determined by dividing the product of the hourly heat loss, the design day heating degree day and an adjustment factor by the indoor temperature. This quotient is then divided by the number of hours allowed for charging and finally the result is again divided by the hourly heat loss to obtain the sizing factor.

III. REVIEW AND FINDINGS FROM COMPLETED PROJECTS

Boylston and Pascoag light departments completed ETS demonstration projects. Both projects were very different in the ultimate end-user and in the size of the heating load. While Boylston installed ETS equipment in multi-unit housing complex for the elderly with over 18,000 square feet of occupied space and 272 kilowatts of ETS load, Pascoag had two buildings, the main light department office and the operations center with a combined square footage of 5,000 and 35 kilowatts of installed ETS equipment.

The Boylston ETS project site, known as Sunshine Village, is a multi-unit elderly housing site comprised of two separate buildings having a total of 24 apartments and a community building.

Initially designed to be heated by electric resistance units, Sunshine Village would have added 136

kilowatts to the Boylston Light Department's winter peak of nearly 5 megawatts if ETS equipment had not been installed.

Although the architect had already completed plans for electric resistance heat in the housing units, there was very little modification in the plans needed to incorporate the ETS units. The electrical contractor was familiar with ETS installation procedures, having previously installed equipment in another multi-family housing complex. The only additional construction item needed for the installation of ETS equipment was a Romex cable to connect each ETS unit to its respective control panel. The charging level and operation periods of the 24 ETS units were divided among three separate control panels which are located in a secured closet on the first floor of each building. The existing design for the electrical service was adequate for the additional load of ETS equipment. One 4 and one 6 kilowatt dynamic ETS units were installed in each apartment and 2.7 and 3.6 kilowatt static heaters were placed in hallways and entryways.

Equipment installation was completed in the fall of 1990, which enabled a comparison of winter peak day and typical day load shapes for 1990 and 1991.

Standard electric meters were used in this installation since Boylston's ETS rate is a flat charge of 8 cents per kwh with no demand charge for all electricity consumed on-peak or off-peak.

LOAD IMPACT

Assumptions

In order to determine load impacts, two assumptions had to be made. The first assumption is that

the 1991 peak day load includes the ETS installation at Sunshine Village. This is assured since the system was in operation during the 1990-1991 heating season. The second assumption is the impact on the Boylston load of a hypothetical Sunshine Village having 139 kilowatts of resistance heat instead of thermal storage. An estimate of the additional load, shown as "without storage" on Exhibit A, placed upon the Boylston system by the 139 kilowatts of resistance heat was determined from the "Database Inputs"- Temperature Sensitive Use Profile for Electric Heating, used for the NEPOOL Forecast of New England Electric Energy and Peak Load 1991-2006. The NEPOOL electric heat data are hourly and were used to create a load shape for the elderly housing as if it had resistance heat.

Description of Load Impacts

The effect of the installation of 278 kilowatts of ETS on the Boylston peak day load shape can be seen in Exhibit A. The comparison of the resultant system load shapes does show how the ETS equipment would lower the expected winter peak day peak. A look at the 1991 to 1990 actual peak day peaks, which both occur at 8 a.m., shows very little change between the two years. The actual difference in the two peaks (4560 and 4520 kilowatts, 1991 to 1990), was 40 kilowatts or less than a 1% increase. Since winter peaks are temperature driven and the measure of heating need, heating degree days, for the two peak days are 51 and 50 heating degree days, respectively for 1991 and 1990, or a 2% increase between 1990 and 1991. From the heating degree day data, it could be assumed that ETS had no impact on the increase in peak demand between the two years. A marginal peak day impact of 4 kilowatts could be attributed to the additional dynamic ETS units fan motors, however this impact is too small to be measured in the available data. The peak day difference between the two days is more likely to be attributed to existing customers increased demand for electricity for the marginally colder day experienced in 1991.

EXHIBIT A

BOYLSTON
WINTER PEAK DAY

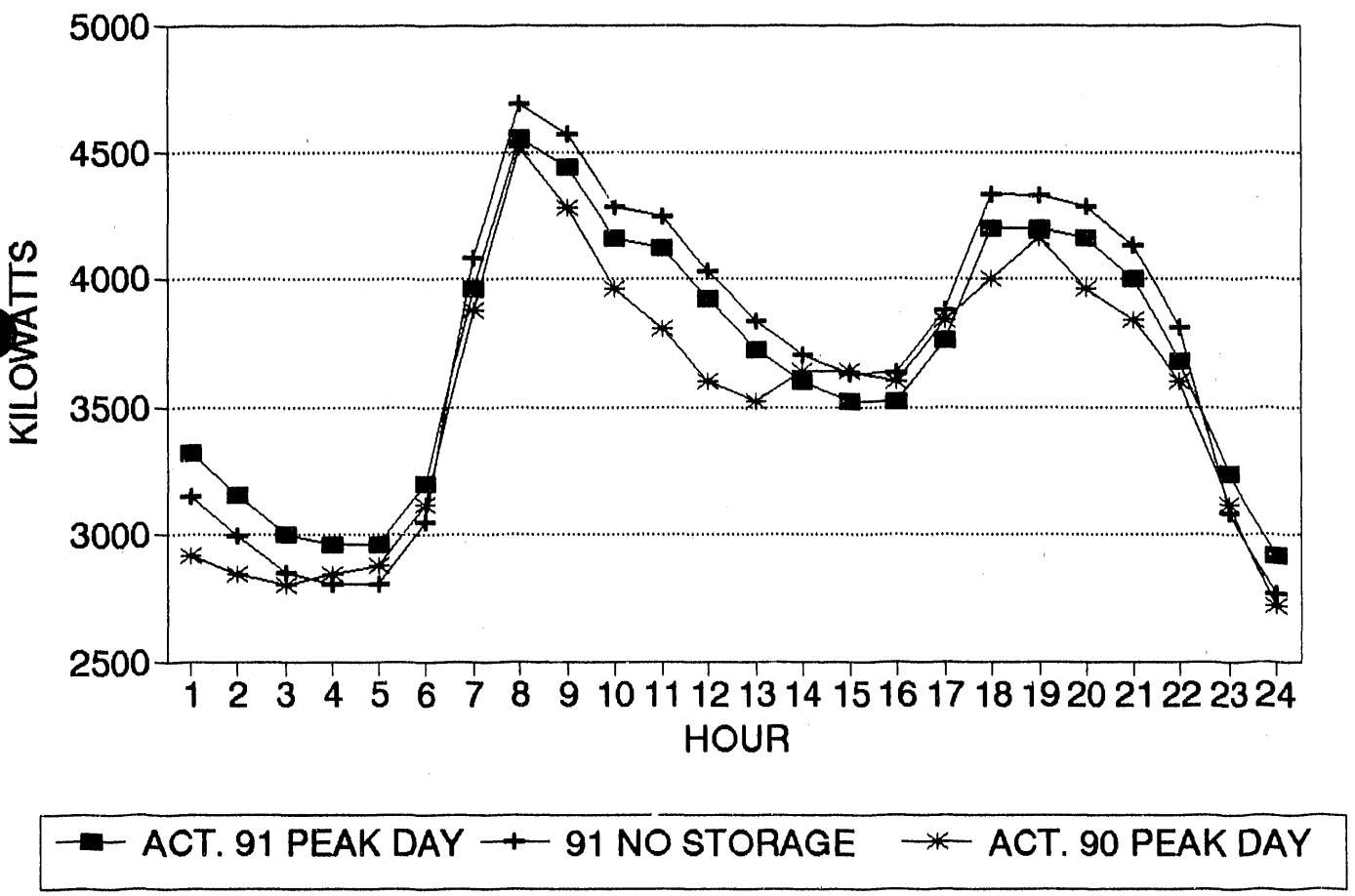
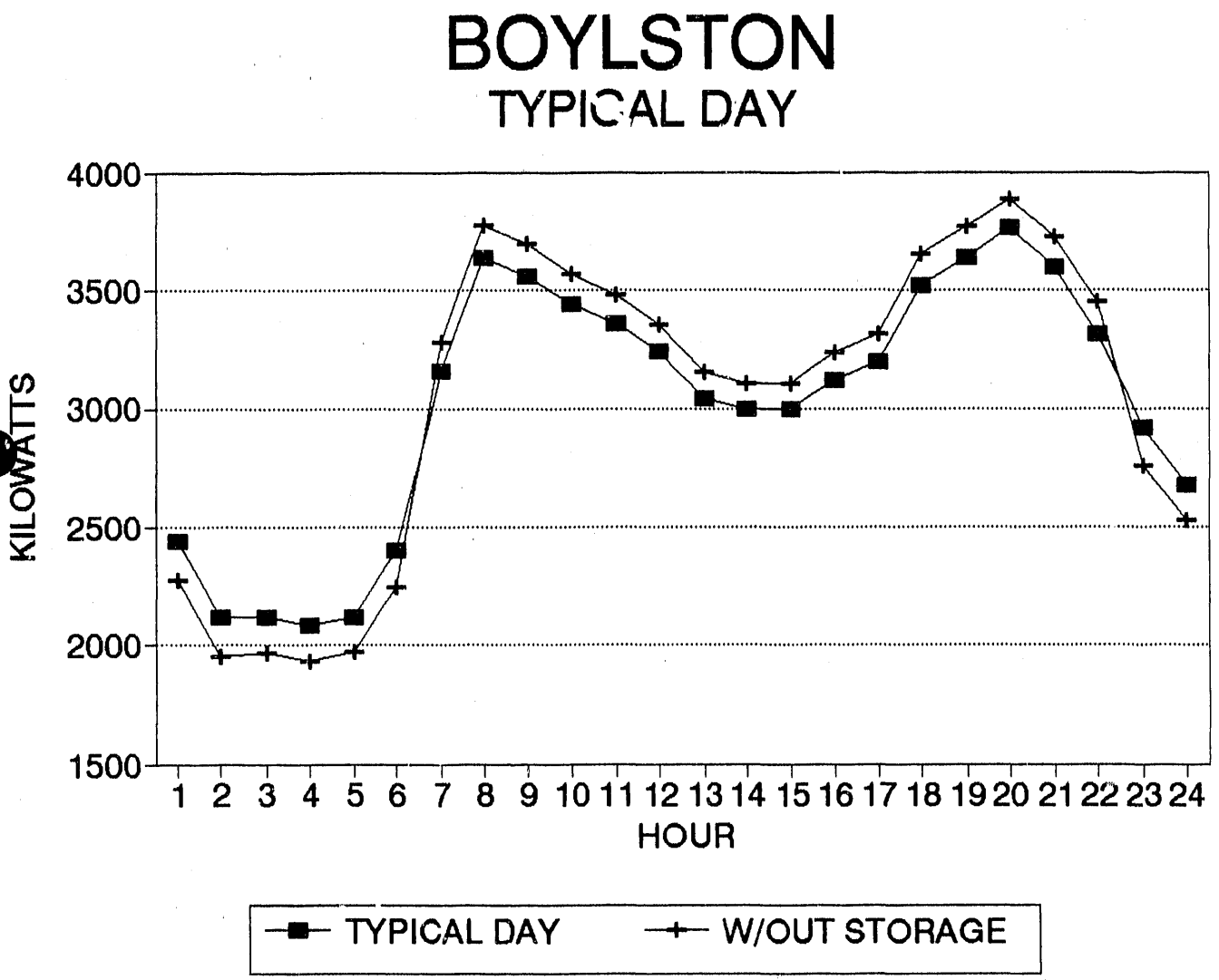


EXHIBIT B


BOYLSTON
TYPICAL DAY
KILOWATTS
4000
3500
3000
2500
2000
1500
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
HOUR
TYPICAL DAY
W/OUT STORAGE

Off-Peak Impact

The most evident impact of ETS on the system load shape can be seen between the hours of eleven p.m. and six a.m., which comprise the majority of the off-peak charging hours for the ETS equipment. These hours, when total system load drops considerably, allow for a better look at smaller load impacts and reveal the increase in off-peak consumption due to the charging of the ETS equipment. One of the benefits to utilities that is touted by ETS equipment manufacturers and suppliers is the load leveling effects of ETS. Although some minor load leveling is shown in this graph, a greater number of ETS units could show a more pronounced effect on the load shape. Given this minor leveling of the peak day load, the 1991 daily load factor improved by 2.7 percent to slightly over 80 percent from the previous year peak day load factor of 78 percent.

Exhibit B displays the load shapes for a typical winter day in 1991 with and without ETS. The typical day load shape displays more of a dual peak nature than the peak day. Historically the typical winter day peak in Boylston is set in the evening as opposed to the morning peak seen in the winter peak day. As in Exhibit A, the reduction in the peak and the off-peak increase are evident.

The small positive changes evident in the maintenance of the daily peak between 1990 and 1991, the increased off-peak consumption and the load factor improvement show the impact even a small shift in load caused by ETS can have upon a small electric system. From the load data alone, additional installations of ETS would seem to be of value to Boylston for the reasons of maintenance of the peak day load and an increased load factor from greater off-peak usage. Further evaluation needs to be done to determine the optimum amount of ETS heating for Boylston.

COST SAVINGS TO BOYLSTON

Boylston is a part of the New England Power Pool (NEPOOL) which controls the dispatch of all utility generating units in New England by their operating economies. NEPOOL requires all utilities to maintain adequate capacity. To ensure that each utility has adequate capacity, NEPOOL sets the annual capability responsibility for each utility adding approximately 18 percent above the anticipated demand. Boylston's current capability responsibility is 5,855 kilowatts. Since Boylston's peak in the winter of 1990-91 was 4,560 kilowatts and well within its capability responsibility, no capacity savings were realized. Nor were there any savings from avoiding short term energy purchases since existing resources were adequate to meet Boylston's energy needs. The impact of ETS on the longer term power needs of the Boylston light department is also uncertain. MMWEC's most current projections on power supply needs shows that Boylston has a surplus until 1998.

The further development of ETS in the near term, within five years, may offer Boylston a means to reduce its capability responsibility by reducing its peak demand. Since capability responsibility in determined on an annual basis a reduced annual winter peak, which is when Boylston sets its peak, could result in lower capability responsibility requirements in the future. This could provide Boylston with the opportunity to prevent the addition of a new generation resource for its resource mix, which could quite possibly be a more expensive peaking unit. In addition to capacity needs reduction, the increase in off-peak energy consumption due to ETS could prevent Boylston from dumping any excess, unneeded power, onto the grid at a price which is lower than its purchased power costs.

If the constrained market for electricity which existed when the grant was received in 1989 had been sustained due to continued economic expansion and insufficient generation resources, the savings in avoided power or capacity purchases would be much clearer.

Cost Analysis

To determine if there were any cost savings to Boylston, MMWEC analyzed the 1991 peak day and typical January day through its IOLD program. IOLD is power cost analysis software comprised of data bases for generation mix, fuel costs, hourly loads and generator availability information. A front-end program reads all the data and creates input files to the IOLD program which then models own-load (an individual utility's mix of base, intermediate and peaking generation), power plant dispatches and creates hourly production costs and generation amounts by power plant. Actual data for peak and typical day hourly loads, fuel costs, generation mix and availability were used in this analysis. Typical day (February 27, 1991) hourly load data was modified by removing the ETS load during the off-peak hours. The modified hourly load duration for resistance heat was then added to the typical day load for all hours.

Scenarios

Four scenarios were analyzed for daily costs - peak day thermal storage, peak day resistance, typical day thermal storage and typical day resistance. Each of these scenarios were analyzed for two cases an "all units" generation mix case and a "minus one baseload unit generation mix case. The "minus one baseload unit" was done as a sensitivity analysis to determine if savings cost savings varied based on the generation mix.

Findings

From these analyses, it was shown that there are savings for the 1991 peak day and for the typical winter day ranging from about two to five percent of the total daily cost. Savings occurred in three of the four scenarios but the greatest savings were found in the typical day scenario for the "all units" case and in the peak day scenario "minus one baseload unit" case. Significant savings also occurred in the the peak day "all units" scenario. The savings in these cases result from the change in the generation mix brought about by either the addition of off-peak ETS, which allowed for continued use of low cost baseload units during the off-peak, or from the additional on-peak load due to the resistance that would have been in operation if not for ETS.

For instance, in the typical day, "all units" scenario, which had the greatest daily savings of all scenarios, the savings resulted from the reduction of off-peak baseload and an increase in the on-peak load which would have occurred with resistance heating. The graph in Exhibit C presents the total hourly cost of power for both the ETS and the resistance heat scenarios in the typical day - all units case. This case had the greatest savings, approximately forty-one dollars, primarily due to the lower off-peak costs, when compared to the other cases for peak and typical day.

The other two scenarios which had significant savings in daily energy cost were, Peak Day, Minus One Baseload (Exhibit D) and Peak Day - All Units, (Exhibit E). The Peak Day - Minus One Baseload case for ETS had a savings of $38.00 over the resistance heat scenario. The Peak Day - All Units case for ETS had a savings of over $27.00 from the resistance scenario. In general, for all cases, the on-peak costs for the resistance heat scenario always exceeded those of the ETS

EXHIBIT C

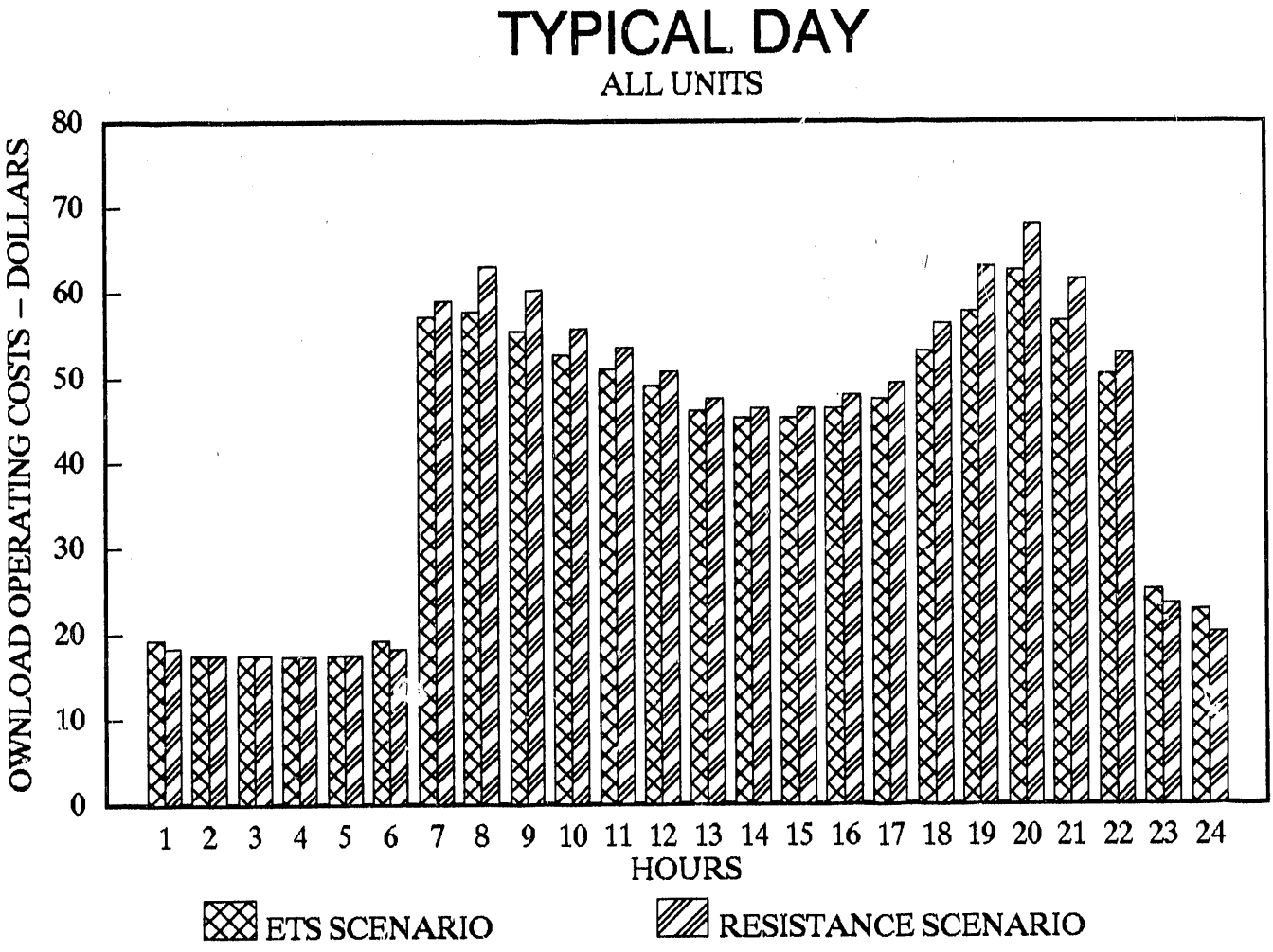

TYPICAL DAY
ALL UNITS
OWNLOAD OPERATING COSTS – DOLLARS
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
HOURS
ETS SCENARIO
RESISTANCE SCENARIO

EXHIBIT D

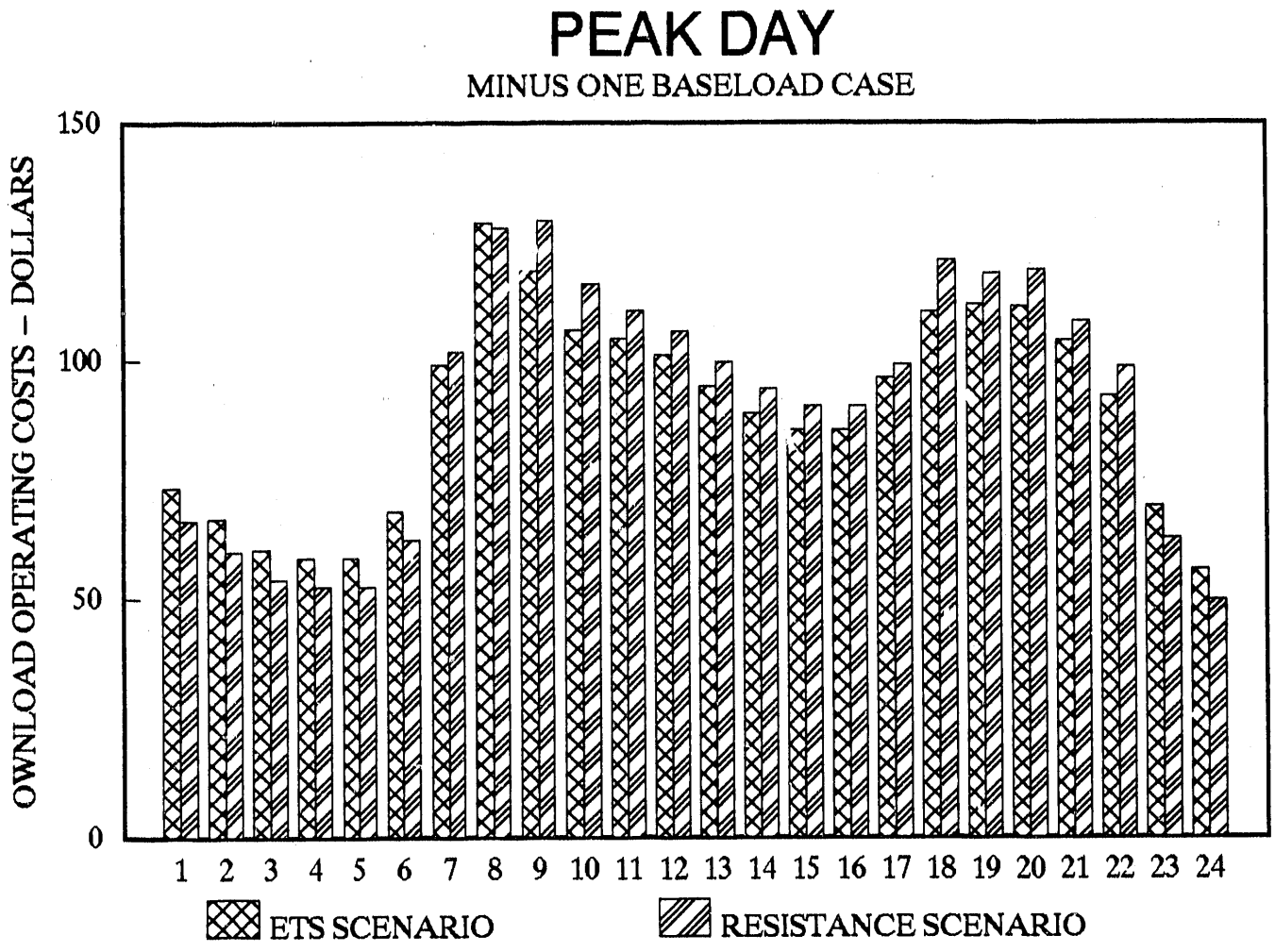

PEAK DAY
MINUS ONE BASELOAD CASE
OWNLOAD OPERATING COSTS – DOLLARS
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ETS SCENARIO
RESISTANCE SCENARIO

EXHIBIT E

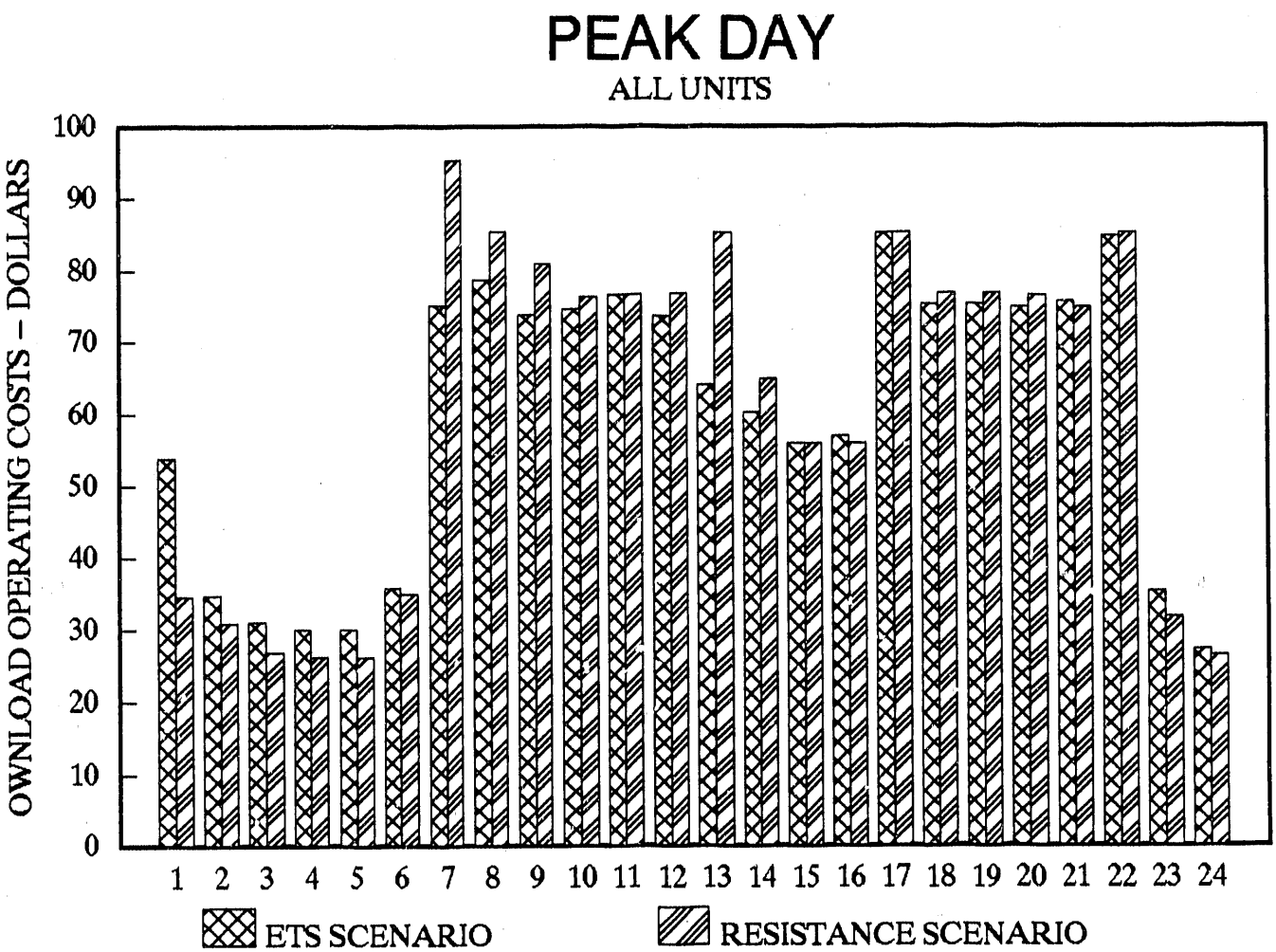
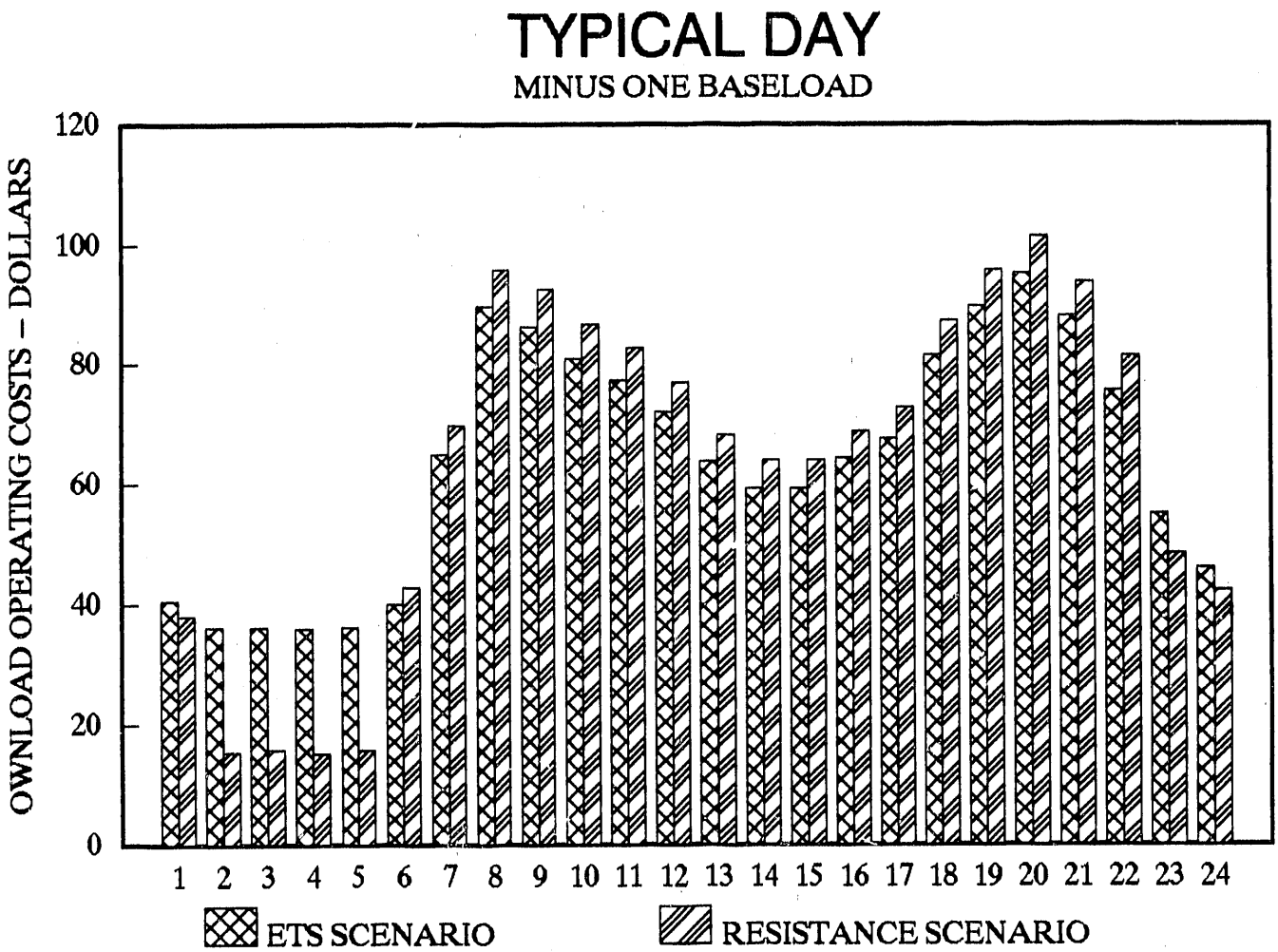

PEAK DAY
ALL UNITS
OWNLOAD OPERATING COSTS – DOLLARS
100
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ETS SCENARIO
RESISTANCE SCENARIO

EXHIBIT F


TYPICAL DAY
MINUS ONE BASELOAD
OWNLOAD OPERATING COSTS – DOLLARS
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ETS SCENARIO
RESISTANCE SCENARIO

scenario, due to the need for more expensive generation.

The exception to the above positive savings cases was the typical day "minus one baseload plant" case (Exhibit F) where there was a cost increase due to ETS operation. This loss occurred because with the loss of a major baseload plant, another higher cost power plant was brought on-line to serve the increased off-peak need attributable to ETS. The percentage loss for the day was only three quarters of one percent or about $7.00.

SUMMARY

Because of Boylston's small size, we were able to measure with a reasonable degree of confidence, that the addition of a small amount of thermal storage provides some benefit to the light department load shape. From the data available and the analyses performed, Boylston should see a savings in its energy costs ranging from just under two percent in the peak day "all units" and "minus one baseload" cases to slightly less than four percent for the typical day "all units" case.

From the above analyses, it appears that Boylston Light Department can benefit from energy cost savings in the present and the reduction in need for future capacity savings from additional ETS installations. Further evaluation of the electric space heating loads available for conversion to ETS and the maximum economically feasible amount of load shifting to be attained before negative impacts occur on Boylston's system are needed prior to initiating a future ETS program.

APPENDIX ONE

HOLDEN MUNICIPAL LIGHT DEPARTMENT

Survey of Electric Customers and a Report on their Responses

The following questionnaire and presentation of its results is the work of David Fleury, Douglas Folsom and Manish Kumar, former students at the Worcester Polytechnic Institute. The following represents only a portion of their final report to the Holden Municipal Light Department.

QUESTIONNAIRE

It would be a great help to our project if you could kindly take some time and answer the following questions.

Name: _____

Address: _____

_____

1) Are you concerned with the size of your electric bill during the winter months?

   very_____ somewhat_____ not concerned_____

2) Have you considered converting to another heating systemsuch as wocd, oil, or gas? yes_____ no_____

3) Have you invested in energy conservation (such as insulation) in your current residence? yes_____ no_____

4) Would you give serious thought to purchasing the kind of thermal storage system described prteviously?

   ____yes, I would consider such a system _____no

5) If no, why not? (check all that apply)

   _____do not own property

   _____plan to move

   _____too expensive

   _____initial cost too high for the for the savings in future

   _____not interested in investing in equipment to lower electric bills at this time

_____other_____

6) How many rooms do you have in your present residence?

_____ Bedrooms ____ Other

7) Which of the following best describes your home?

___ single family ___ townhouse

___ single family attached ___ apartment
(twin/duplex) ___ condominium

8) How long have you lived in your present residence?

___ less than 2 years ___ between 2 and 10 years

___ over 10 years

9) Do you rent or own your place of residence?
(please circle one)

rent own

10) What is the average age of the bill payer(s) in the household?
(please circle one)

18 - 35 yrs 36 - 64 yrs 65 yrs and above

11) Under which of the following does your household income fall?

___ 10,000 - 30,000

___ 31,000 - 60,000

___ 60,000 and above

"YES" TO QUESTION NUMBER FOUR

Hello, I'm _____, a student at WPI. We're doing a project for the Holden Light Department and we trust that you have received the information we sent you regarding ETS. I was wondering if you had any questions pertaining to our project or ETS. (Allow them to ask questions and record)

I would like to find out your level of interest in electric thermal storage systems.

12) How would you describe your interest in electric thermal storage?

Very interested?
Somewhat interested?
Not at all interested?

The Light Department may be able to help customers purchase an electric thermal storage system.

13) How would you describe your interest if the Light Department offered the option to pay for the system by installments at moderate interest rates?

Very interested?
Somewhat interested?
Not at all interested?

14) How would you describe your interest if the Light Department offered a zero or low percent loan?

Even better than above?
Very interested?
Somewhat interested?
Not interested?

Thank you very much for your cooperation.

"NO" TO QUESTION 4, DON'T OWN, MOVING

Helllo, I'm _____, a student at WPI. We're doing a project for the Holden Light Department and we trust that you have received the information we sent you regarding ETS. I was wondering if you had any questions pertaining to our project or ETS. (Allow them to ask question and record)

I see from your questionnaire return that you are not interested in ETS because you < don't own / plan to move from > your present residence.

12) If you did < own your residence / not plan to move >, how would you describe your interest in electric thermal storage?

Very interested?
Somewhat interested?
Not at all interested?

The Light Department may be able to help customers purchase electric thermal storage devices.

13) Again, if you did < own / not plan to move >, how would you describe your interest if the Light Department offered the option to pay for the system by installments at moderate interest rates?

Very interested?
Somewhat interested?
Not at all interested?

14) How would you describe your interest if the Light Department offered a zero or low percentage loan?

Even better than before?
Very interested?
Somewhat interested?
Not interested at all?

Thank you very much for your cooperation. It will be of great help to our project.

"NO" TO QUESTION 4, TOO EXPENSIVE, INSUFFICIENT SAVINGS

Hello, I'm _____, a student at WPI. We're doing a project for the Holden Light Department and we trust that you have received the information we sent you regarding ETS. I was wondering if you had any questions pertaining to our project or ETS. (Allow them to ask questions and record)

I see from your questionnaire that you are not interested in electric thermal storage because you feel that < it is too expensive / initial cost too high for savings >.

The Light Department may be able to help customers purchase electric thermal storage devices

13) How would you describe your interest in electric thermal storage if the Light Department were to offer you the option of paying for these units in installments at moderate interest rates?

Very interested?
Somewhat interested?
Not interested at all?

14) How would you describe your interest if the Light Department were to offer a zero or low percentage loan?

Even more than before?
Very interested?
Somewhat interested?
Not interested at all?

Thank you very much for your cooperation. It will be of great help to our project.

5.3 HOLDEN'S ELECTRIC CUSTOMERS

As was stated in Chapter IV of this report, 203 high consumption electric heat customers formed the sample that was polled. Each member of the sample was sent a brief informational letter and questionnaire on November, 3 1989. Over the next several weeks, 88 of the 203 questionnaires were returned. This amounts to roughly a 44% return. 70 of the 88 were contacted by telephone, roughly 80%. The questionnaire response percentages were compiled for both the sample of 70 and the sample of 88 and no significant differences were observed. Therefore, it can be assumed that the telephone interview percentages are also similar, and those observed for the 70 telephone interviews can also be applied to the sample of 88. This fundamental assumption is important to understand when examining our data.

Each response to our questionnaire was processed using SPSSX, Statistical Program for the Social Sciences, to determine the frequency of each response. These frequencies, and combinations thereof, yielded some very interesting data.

The first question of the questionnaire dealt with the customers concern with their electric bills. 69.3% of the customers who returned their questionnaires indicated that they were very concerned with the size of their electric bills. Also, or 26.1%, indicated that they were somewhat

concerned about the size of their monthly electric bill. Adding the two frequencies yielded that 95.5% of those customers who returned the questionnaire were at least somewhat concerned about the amount that they payed for electricity (See Table 5.4). This was not surprising given the high rate that these customers are charged for electricity in Holden. This high percentage indicates that there is tremendous potential for the acceptance of money saving technology, such as electric thermal storage, in the town of Holden. It should be noted that those who were not interested were less likely to respond to the questionnaire on the topic.

Table 5.4 Frequencies of Question One

(Concern with Electric Bills)

CHOICE	FREQUENCY	PERCENT
very concerned	61	69.3
somewhat concerned	23	26.1
not concerned	2	2.3
no response	2	2.3
TOTAL	88	100.0

Question number two inquired if the customer had considered switching from electric heat to another form of home heating. Exactly 50% responded that they had not considered switching from electric heat to some other method (See Table 5.5).

Table 5.5 Frequencies of Question Two

(Considered Switching Systems)

CHOICE	FREQUENCY	PERCENT
Yes	42	47.7
No	44	50.0
No Response	2	2.3
TOTAL	88	100.0

The third question on the questionnaire asked if the customer had invested in energy conservation measures in their present residence. 76.1% of the responses indicated that they had taken energy conservation measures in their homes (See Table 5.6). This, in conjunction with the 95.5% of the returns that were at least somewhat concerned with their electric bills, indicated that a large majority of the people who responded are energy concious people. This strengthens the feeling that there is potential for acceptance of a technology that could substantially reduce monthly electric bills in Holden.

Table 5.6 Frequencies of Question Three

(Invested In Conservation)

CHOICE	FREQUENCY	PERCENT
Yes	67	76.1
No	18	20.5
No Response	3	3.4
TOTAL	88	100.0

Question four was the most important question on the questionnaire. It dealt with interest in electric thermal storage. Question four asked if the customers would give serious thought to purchasing an electric thermal storage system. 72.7% of the customers who returned their questionnaires answered positively (See Table 5.7). Based on the brief exposure to electric thermal storage, this percentage is good. A high percentage, such as this, is emphasized by the high percentages of concern with electric bills and energy conciousness. All of this together indicates the potential for success with an electric thermal storage program in Holden.

Table 5.7 Frequencies of Question Four

(Consider ETS)

CHOICE	FREQUENCY	PERCENT
Yes	64	76.1
No	23	26.1
No Response	1	1.1
TOTAL	88	100.0

Question five provided seven reasons why one would not consider purchasing an electric thermal storage system. It was reserved for those people who responded that they were not interested in electric thermal storage. 23 out of 88 people who returned a questionnaire responded that they would not consider electric thermal storage, thus qualifying them

to respond to question five. However, some of the people who showed an interest to question four also expressed some concerns by checking the appropriate response to question five. From the responses that were received, a very interesting trend developed. 8 out of 23, or 34.78%, indicated that they were not the owners of the residence in which they lived. 5 out of 23, or 21.74%, responded that they planned to move in the near future and would not invest such a large amount of money on their present home. These percenages were expected to be low, given the nature of the people in the town. However, 8 out of 23, or 34.78%, said that electric thermal storage was too expensive for the savings in the future, and 10 out of 23, or 43.48%, indicated that the initial cost of electric thermal storage was too high to be considered. These percentages were lower than expected because the initial cost of the technology is quite high. 13 out of 23, or 56.52%, by far the highest percentage, responded that they did not know enough about electric thermal storage at the present time to consider it. This indicates that a substantial number of people are unsure about what electric thermal storage involves. 4 out of 23, or 17.39%, responded that they were not interested in investing in ways to reduce their electric bills at this time (See Table 5.8). In difficult times like these, in the town of Holden, this low percentage was also expected.

Table 5.8 Frequencies of Question Five

(Why Not Consider ETS)

CHOICE	FREQUENCY	PERCENT
Do Not Own Property	8	9.1
Plan To Move	5	5.7
Too Expensive	8	9.1
Initial Cost Too High	10	11.4
Do Not Know Enough About ETS	13	14.8
Not Interested In Investing To Save Money	4	4.5
Other	11	12.5

Finally, 11 out of 43, or 47.83%, said that they had other reasons for not considering electric thermal storage. A large number of people, both in the space provided and over the phone, expressed some re-occurring concerns. One of the main concerns was to be sent more information concerning the technology. Some of these people even indicated that they were interested in learning of the results of this study. The fact that there was such an overwhelming interest in more information indicates that there is the possibility of an even higher percentage of interest than is reported here. Other than information questions, there were also a great deal of questions regarding the asthetics of electric thermal storage. People seem to be very concered about the units

disrupting the room that they heat by being unsightly. The last concern that was expressed most frequently was for an exact percentage rate for the financing options available. These questions and major concerns have no statistical basis, but are only impressions that were gotten from our data. There was no statistical analysis done on this data using the methods above.

All of the preceeding numbers and precentages indicate one thing. There is not one predominant reason why the customers surveyed would not consider electric thermal storage as a means of heating their homes. However, the relatively high percentages associated with lack of information and initial cost indicate that there is the need for more exposure to electric thermal and financing assistance of some kind.

The first five question on the questionnaire dealt solely with energy issues. The next six were designed to find out as much about the sample as possible. From this cross-section of the town, the demographics of the entire town were inferred. Relationships between these demographical characteristics and the interest in electric thermal storage were analyzed and noted in the next chapter. From the final six questions some very interesting characteristics presented themselves. The average number of bedrooms per household surveyed was 3.012 and the average number of other rooms such as kitchen, dining room, den or family room, was 4.316. Almost 96% of our sample owned their present residence and

84% of our sample have done so for more then 2 years. In addition, the age groupings were as follows: 25% of the 88 returns were between 18 and 35 years of age; 55.7% of the 88 returns were between 36 and 64 years of age; and only 14.8% of the 88 responses were over 65 years of age. Also, the income groupings were as follows: only 15.9% claimed their yearly income to be between $10,000 and $30,000; 37.5% claimed that their annual houshold income was between $30,000 and $60,000; and 36.4% claimed a household income of over $60,000 a year (See Tables 5.9 - 5.15). All of these points combine to indicate that Holden is a young, well established, single family, residential community. These points also indicate, because the average age is so low, income is so high and there is such a high percentage of residential dwellings, that there is potential for the success of an electric thermal storage system.

Table 5.9 Frequencies of Question Six (Bedrooms)
(Number of Rooms)

NUMBER	FREQUENCY	PERCENT
1	1	1.1
2	22	25.0
3	36	40.9
4	23	26.1
5	1	1.1
No Response	5	5.7

Table 5.10 Frequencies of Question Six (Other Rooms)

(Number of Rooms)

NUMBER	FREQUENCY	PERCENT
2	6	6.8
3	17	19.3
4	21	23.9
5	17	19.3
6	10	11.4
7	4	4.5
8	1	1.1
No Response	12	13.6

Table 5.11 Frequencies of Question Seven

(Type of Home)

CHOICE	FREQUENCY	PERCENT
Single Family	64	72.7
Townhouse	7	8.0
Apartment	2	2.3
Condominium	10	11.4
No Response	5	5.7
TOTAL	88	100.0

Table 5.12 Frequencies of Question Eight

(Period Lived in Current Residence)

CHOICES	FREQUENCY	PERCENT
Less Than 2 Years	10	11.4
Between 2 and 10 Years	41	46.6
Over 10 Years	33	37.5
No Response	4	4.5
TOTAL	88	100.0

Table 5.13 Frequencies of Question Nine

(Rent or Own)

CHOICES	FREQUENCIES	PERCENT
Rent	5	5.7
Own	79	89.8
No Response	4	4.5
TOTAL	88	100.0

Table 5.14 Frequencies of Question Ten

(Average Age of Bill Payer(s))

CHOICE	FREQUENCY	PERCENT
18 to 35	22	25.0
36 to 64	49	55.7
65 and Over	13	14.8
No Response	4	4.5
TOTAL	88	100.0

Table 5.15 Frequencies of Question Eleven

(Household Income)

CHOICE	FREQUENCY	PERCENT
$10,000 to $30,000	14	15.9
$31,000 to $60,000	33	37.5
$60,000 and Above	32	36.4
No Response	9	10.2
TOTAL	88	100.0

The telephone interviews produced even more data to be considered. The questions that were asked on the telephone were also analyzed using SPSSX. The frequency of responses is

presented here.

The first question asked over the telephone (Question 12) was designed to determine the customers level of interest in electric thermal storage, based on the information provided by the informational letter. 34.1% of the people who responded to the questionnaire classified themselves as very interested in electric thermal storage. 33.0% classified themselves as somewhat interested in the technology. Only 3.4% responded that they were not interested in ETS at all. By adding the two positive response percentages, a comparison can be made between this question and question four on the questionnaire. The telephone interviews yielded an interest percentage of 67.0%, while the questionnaire yielded an interest percentage of 72.7%. This deviation can be attributed to the 29.5% who were not asked this question (See Table 5.16). If these people were omitted from the calculation of percentages, the telephone interview produced a much higher percentage of interest, 83.8%. This shows that, by allowing the customer to ask questions during the telephone interview, their interest substantially increased with the additional information. All things aside, interest in electric thermal storage is very high in the town of Holden.

Table 5.16 Frequencies of Question Twelve

(Level of Interest Over Telephone)

CHOICE	FREQUENCY	PERCENT
Very Interested	30	34.1
Somewhat Interested	29	33.0
Not Interested	3	3.4
No Response	26	29.5
TOTAL	88	100.0

The second and third questions asked on the phone dealt with interest in several financing options. The second question (Question 13) asked if the customer would be interested in electric thermal storage if the town allowed them to pay for the systems in installments at a moderate interest rate. 29.5% of the people interviewed responded that they were very interested if given this option. 35.2% responded that they were somewhat interested in the technology if a moderate interest installment plan was offered. Adding these two percentages yeilds a 64.8% of interest if a moderate rate plan is offered. 14.8% responded that they were not interested if given this option, a substantial increase from the previous question. 20.5% were not asked this question because they could not be reached (See Table 5.17).

Table 5.17 Frequencies of Question Thirteen

(Interest in ETS if Moderate Interest Loan Offered)

CHOICE	FREQUENCY	PERCENT
Very Interested	26	29.5
Somewhat Interested	31	35.2
Not Interested	13	14.8
No Response	18	20.5
TOTAL	88	100.0

The third question of the telephone interview (Question 14) dealt with the customers interest in electric thermal storage if they were offered the option of an installment plan at a 0% interest rate. 27.3% indicated that they would be more interested in the technology if this option was offered as opposed to the previous alternative. 19.3% considered themselves very interested if this option was offered. 18.2% classified themselves as somewhat interested if a 0% rate was offered. Adding these all together yeilds a percentage of 64.8% who are interested in this type of financing option, 27.3% of which prefer this option to the previous option. This percentage of interest is exactly the same as the percentage of interest if a moderate rate was to be offered. 14.8% were, again, not interested at all if a 0% installment plan was offered. Once again, 20.5% were not asked this question because they could not be

reached (See Table 5.18).

Table 5.18 Frequencies of Question Fourteen

(Interest in ETS if Zero or Low Percentage Loan Offered)

CHOICE	FREQUENCY	PERCENT
Even Better	24	27.3
Very Interested	17	19.3
Somewhat Interested	16	18.2
Not Interested	13	14.8
No Response	18	20.5
TOTAL	88	100.0

These findings were difficult to analyze because they were contrary to what was expected. From this data, it was determined that the type of financing plan had little effect on the interest in electric thermal storage. This was consistant with the concerns expressed in the questionnaire. It appeared from the questionnaire that the initial cost was a fairly significant concern. The financing options did nothing to reduce the initial cost, and, as a result, had very little effect on interest in electric thermal storage.

APPENDIX TWO

PASCOAG FIRE DISTRICT

Report to Customers

PASCOAG FIRE DISTRICT

ELECTRIC THERMAL STORAGE HEATING PROGRAM

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PASCOAG FIRE DISTRICT ELECTRICAL THERMAL STORAGE (ETS)
PROJECT SUMMARY

June 12, 1991

The Pascoag Fire District recently installed an electrical thermal storage heating system at both the office and power station. The program, partially funded by a DOE grant through MMWEC, will be used to demonstrate and show the benefits of ETS as an alternate to regular electrical resistance heating. The units replace both existing and planned resistance heating installations.

Through this program, Pascoag will keep 40KW off its peak which is usually set during the evening hours in the month of December. 40KW calculates to approximately $5000.00 savings per year in wholesale power costs. These savings will be passed on to all customers through our capacity charge. The ETS system will also be coordinated with the EMETCON load management system which will allow accurate peak shaving and valley filling thereby increasing our load factor.

The units will be available for inspection by customers who may wish to purchase ETS systems for their homes. We will also provide information to them in the form of a brochure which will explain the time-of-use rate, thermal storage heating, and list the manufactures of the ETS units. Customers who choose to install an ETS system will save money each month by shifting much of their KWH consumption to off peak periods. They may also qualify for a low interest loan through RISE which can be used for the installation.

The PFD has filed with the PUC and is presently testing a time-of-use rate to be used for this purpose. The time-of-use rate is actually two rates on one meter. During peak periods the rate is higher than off peak periods which encourages the customer to shift his usage to the off peak period. PFD'S peak period for the TOU rate is 3pm-9pm during summer months, 11am-1pm and 3pm-9pm during the winter months. The on peak energy charge is $.0345 per KWH and the off peak charge is $.0133 per KWH.

Total project costs to date are $11840.27 of which $6659.00 was paid for by the DOE grant.

PASCOAG FIRE DISTRICT ETS PROJECT COSTS

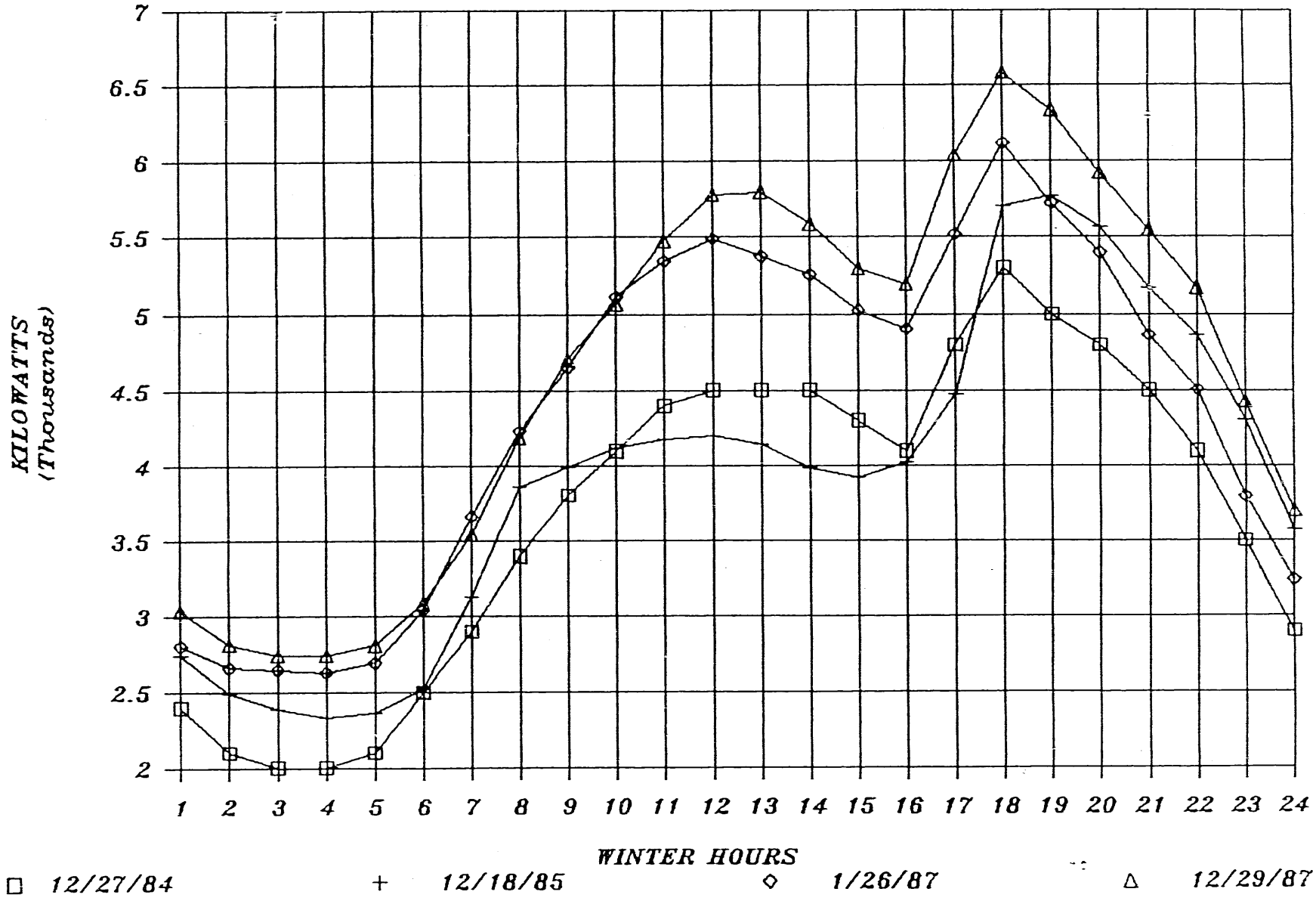
ETS EQUIPMENT	$6,097.64
	$1,100.00
OTHER ELECTRICAL EQUIPMENT	$650.00
MISC	$100.00
TOTAL EQUIPMENT	$7,947.64
LABOR	$3,892.63
TOTAL JOB COST	$11,840.27
DOE GRANT	($6,659.00)
PFD ACTUAL COST	$5,181.27

PASCOAG FIRE DISTRICT PROJECTED YEARLY SAVINGS
ETS VS RESISTANCE HEATING

ETS KW POWER PLANT	21
ETS KW OFFICE	19
TOTAL KW	40
KW COST	$125.00
SAVINGS	$5,000.00

PASCOAG FIRE DISTRICT

PEAK DAY HOURLY LOAD SHAPES



DOE's Northeast Rural Utility Grantees

What's Happening

April 1991

Overview

It has been a year since the kick-off meeting in Boston, and it's time to check in on the progress of the Northeast Rural Utility projects.

Originally nine awards were made in response to DOE's solicitation to Northeast rural utilities. One of the grantees, Allegheny Electric Cooperative, was unable to complete its project to develop an ice harvester with cool storage for dairy farms due to the high cost of the equipment. But the other eight have been going strong!

Brookhaven National Laboratory is monitoring the progress of the eight active projects. All were scheduled for completion in March 1991; six of the grantees have since requested no-cost extensions. The Bangor Hydro and Fitchburg projects will be completed this spring.

When all of the projects are completed, Brookhaven will prepare a summary report which describes the projects and consolidates the results. We are also discussing the possibility of having a workshop of all the grantees to present and discuss each project's results. If you have comments on this or suggestions for other ways to effectively share project results, please let me know.

Barbara Pierce
Brookhaven National Laboratory
516-282-3123

Demonstration of Demand Based Conservation Measures

Bangor Hydro-Electric Company
Contact: Stephen Desmond
207-945-5621

Bangor's project was designed to develop a comprehensive marketing strategy for the implementation of several water heating and space heating technologies in the context of an integrated least-cost utility plan. The project included demand-side data development and least-cost analysis. The analysis was conducted using LCG's Electric Utility Planning System (UPLAN), an integrated demand side/supply side and financial planning system.

The project focused on the detailed evaluation of five DSM programs: water heater cycling by radio control; water heater cycling by time-of-use meter; water heater storage; storage space heating; and time-of-use rates. A base case was developed, and load shapes and low, medium, and high penetration cases were created for each of the DSM programs. The strategic value to the utility of all anticipated water and space heating DSM programs was carefully analyzed.

The project also developed an Electricity Cost Index (ECI) to compare the impacts of different DSM programs on electricity rates. The ECI uses a weighted average of electricity costs over time; more weight is given to costs in an earlier year, and more weight is given to a year in which greater energy is served. A more traditional approach, present value of revenue requirement, measures only the absolute cost of a demand side measure.

Application of the ECI method showed that DSM programs which either shift energy usage from peak times to off-peak times or promote valley filling will actually reduce the rates of all customers.

The Bangor staff are quite enthusiastic about the project and feel that many of the results should be directly applicable to other utilities with substantial water heating or electric space heating loads, and whose load shapes exhibit relatively low off-peak loads.

Full-Cost Space Heater Program

Burlington Electric Department
Contact: Thomas Buckley
802-658-0300

Burlington Electric Department (BED) is a winter-peaking utility. The purpose of this project is to design and implement a pilot version of a program to eliminate the use of on-peak electric heat. BED is providing 44 customers with supplementary gas heating systems to replace currently used electric heat. Existing electric heat is left in place, and controlled with load management switches.

All 44 installations have been completed, and the evaluation is getting underway. The evaluation will consist of a billing analysis to determine electricity savings, and a customer survey. If time and resources permit, gas use will be included in the analysis. The project will be completed by the end of June.

In the meantime, BED is starting up their full-scale program based on the pilot. The pilot program verified planning assumptions such as the unit cost and the cost of displaced energy, and gave BED the confidence it needed to go ahead with the full-scale program.

While the full-scale program will require customer co-funding, it will use the same technology and field operation as the pilot program. Good luck!

Innovative Approaches to Commercial Lighting

Central Vermont Public Service Corporation
Contact: Peter Lind
802-747-5446

This project will develop and test innovative marketing and rebate strategies designed to increase market penetration of energy-efficient lighting in the rural commercial sector. The project will also collect information on energy efficient lighting technologies and apply it through actual retrofit and monitoring in four commercial buildings.

Demonstrations are underway at a library, a sporting goods store, an elementary school, and a high school. Early results based on pre- and post-retrofit monitoring show average savings of 30%, compared to projections of 44%.

The second phase of the project will offer incentives to selected customers near each of the demonstration sites. Customers have been selected and implementation is waiting for regulatory approval. Developing strong ties with trade allies is an essential part of the overall project; contractor education and product availability are two important issues.

CVPS expects that the results of this project will be useful to rural utilities nationwide who face similar problems of low customer density, diverse needs and lack of product availability.

Small Commercial Lighting Program

Fitchburg Gas and Electric
Contact: Ed Mailloux
508-343-6931

Fitchburg's project was designed to compare the market penetration and cost-effectiveness of two different approaches to lighting programs for the small commercial sector: direct utility investment in efficient lighting equipment versus the more traditional approach of rebates and incentive programs.

Small commercial (<30 kW/month) represents about 85% of Fitchburg's commercial market. Two groups of 107 customers each were selected; one group was offered full cost installation of cost-effective measures, and the other, using the same marketing techniques, was offered an incentive based on estimated savings potential. More than 50% of the first group chose to participate while less than 3% of the second group participated.

A billing analysis and pre- and post-retrofit end-use metering were done for each participant. Total savings were smaller than estimated because participation rates were less than anticipated. Some unexpected market barriers were encountered, such as unlisted telephone numbers for follow-up. Many of the businesses are so small that even minimal investment in efficiency is unrealistic. Analysis of customer motivation and barriers to participation is underway. The final report should be ready by the end of June.

Based on these results, Fitchburg has concluded that a full-cost program is the only way to reach this market segment. The utility now knows how much savings can be expected, and what the average cost per customer will be. Assuming regulatory approval, a full-scale program will be implemented this summer.

Electric Thermal Storage

Massachusetts Municipal Wholesale Electric Company (MMWEC)
Contact: Kin Boas
413-589-0141

Four of the 32 member utility systems have gotten together to develop and implement demonstrations of electric thermal storage systems. To date, two of the systems have been installed, one in a utility office and one in elderly housing. The other two will also be in elderly housing.

The system currently installed in elderly housing is estimated to have avoided 100 kW of peak, because it replaced a planned installation of electric resistance heating. The two systems not yet installed will be retrofits and will be monitored.

The primary objective of the project is to develop an understanding in the local design and construction community of the benefits of thermal storage heating. Tours and other outreach activities will take place in the fall. A secondary objective is to determine the effect of off-peak thermal storage heating on existing load shapes and the load factor improvement to each utility. The project has been extended through October.

New York State Farmstead Demand-Side Management Assessment

Niagara Mohawk Power Corporation
Contact: Peter LaSure
315-428-5826

Niagara Mohawk, together with Central Hudson Electric & Gas, Rochester Gas & Electric, and N.Y. State Electric & Gas, is assessing the conservation and load-management potential on New York farmsteads.

This comprehensive project began with a survey of existing market and technology data sources, many of which have been invaluable to the success of the project. Market segments were then defined and estimates of market size for the various farmstead technologies were developed.

To reduce the number of technologies to be considered in program design, potential technologies were screened based on such criteria as commercial availability and widespread applicability. For the selected technologies, more detailed information, including load shape data, was developed.

The project is now entering the program design phase and will use results from the previous tasks and SRC's COM-

PASS model to develop prototypical farmstead DSM programs. The project has been extended through June.

The project is also sponsoring a workshop, the **New York State Farmstead Demand-Side Management Conference**, to be held in Cooperstown on April 30 - May 2. Hope to see you there!

WRAP Program Evaluation

Northeast Utilities
Contact: Sara Ellison
203-721-2751

Northeast Utilities is using its grant to evaluate its WRAP program, which is a no-cost weatherization service provided to low-income electric and gas customers in Connecticut. The WRAP program consists of five plans, each with different customer characteristics, allowable expenditures, and applicable measures. It is a joint utility and state agency planned activity; all parties interested in low-income residential issues contribute to a collaborative planning effort.

The evaluation will determine energy savings and cost-effectiveness of the measures installed, examine effects of the program on customer delinquent bill payment, identify additional weatherization needs of low income households, and perform a process evaluation. Special emphasis is being placed on differences between urban and rural participants.

Preliminary results for 1988 and 1989 participants show approximately 6-7% savings for participants with electric heat and hot water. There are inconsistencies for the 1989 participants, however, possibly because a full year of post-installation data is not available. Gas customer data have not yet been analyzed. On average, urban participants saved 7-8% of their electricity, while rural participants saved between 5-6%. In general, the benefit/cost ratio was higher for urban residents than rural; one of the five plans showed the opposite results.

Preliminary analysis of delinquent bill payment patterns shows a slight improvement overall, with better results among rural customers. Northeast Utilities is able to collect approximately 93% of their billings of low-income customers.

NU uses the results of the project to refine and improve its programs, and is working on reducing the costs. The project has been extended through June to allow analysis of data from this past winter which include installations of larger measures, so it will be interesting to see how the results change.

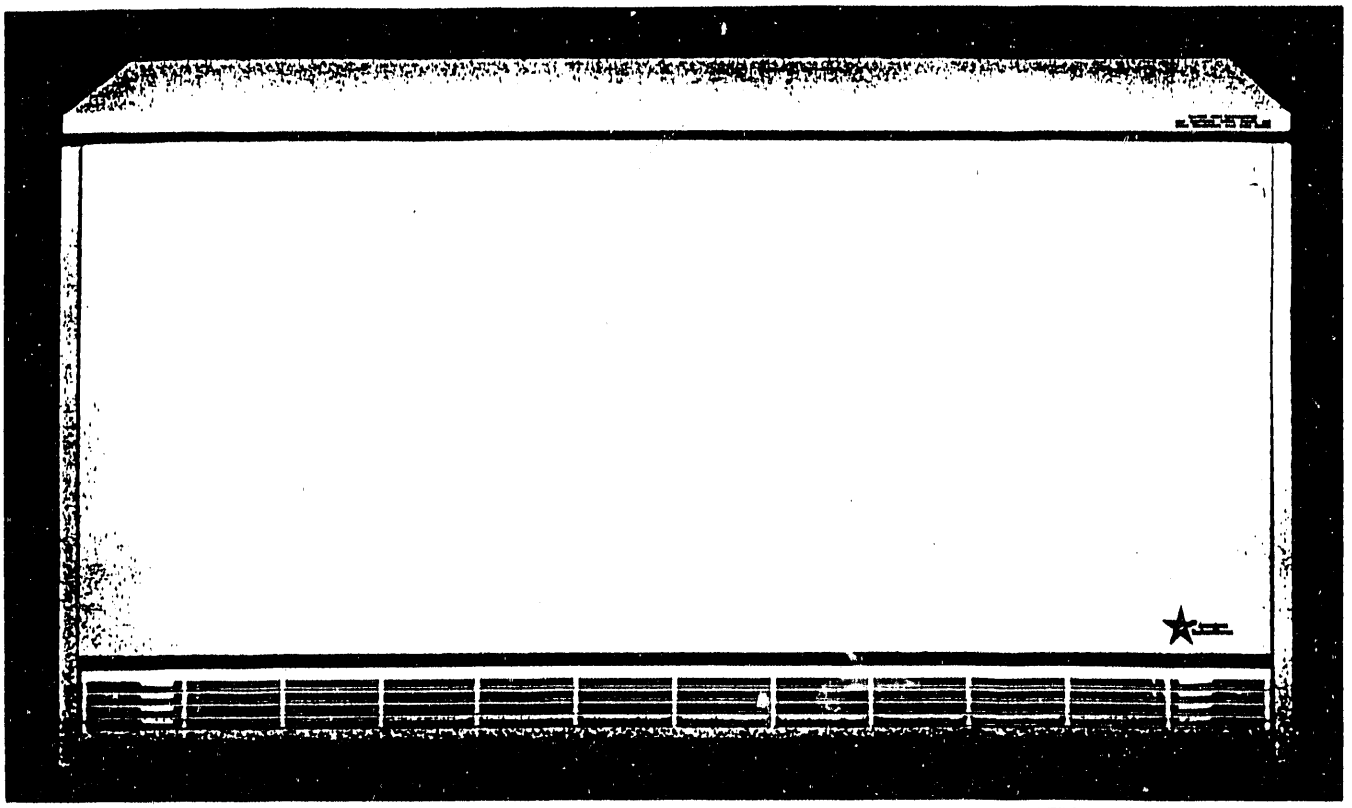
Small Commercial

Washington Electric Cooperative
Contact: Dean Shattuck
802-223-5245

This project will focus on one segment of the rural small commercial market - grocery stores. At least twelve small grocery stores will be surveyed and several generic energy efficiency improvement scenarios will be developed. All electric end-uses will be considered. Three test sites will be selected for implementation of alternative scenarios, and the results monitored and published.

This project will be part of WEC's overall DSM plan which will be filed this spring. In-depth surveys of selected stores should begin in May. Details of the program (such as incentive levels) are under development; WEC hopes to work with the Vermont Electric Cooperative as well as the Vermont Retail Grocers' Association.

Electric Thermal Storage Heating



New "Five Series" Standard Slimline. Fast Installation No Internal Field Wiring Connections. Model ETS-505 Shown Above

If utility companies in your area offer Time-of-Day Rates or Off-Peak Rates... You can take advantage of the most modern advances in space heating!

Off-Peak or Time-of-Day rates can be 40% to 70% less than what the utility charges for their basic residential rate. You can take advantage of these discounts with substantial savings and no disruption of your everyday lifestyle. Commercial customers who purchase electricity on demand rates should experience similar savings.

AMERICAN TECHNOTHERM Electric Thermal Storage (ETS) heating is easy for a contractor to install, easy to operate and is virtually maintenance free. Low-cost electricity is used during off-peak hours, converted to heat and stored for use throughout the day in thermostatically controlled individual heaters.

AMERICAN TECHNOTHERM ETS heaters can be very effectively utilized for load leveling on demand rates which results in a substantial savings on your overall electric bill.

AMERICAN TECHNOTHERM makes it possible to enjoy all the advantages of dependable, safe, maintenance-free electric heating with savings up to 50% or more on electric bills. AMERICAN TECHNOTHERM heaters can be less expensive to operate than even gas or fuel systems.

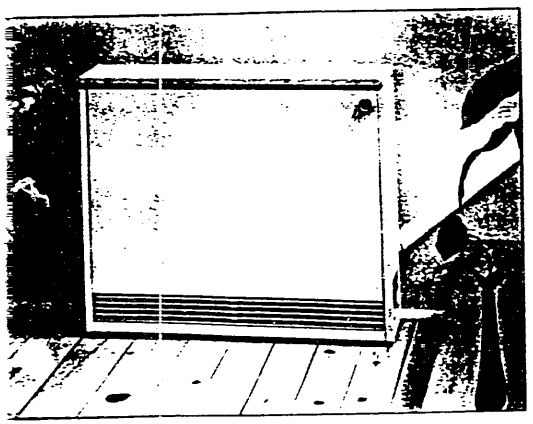
American TechnoTherm
CORPORATION

What is Electric Thermal Storage Heating?

Electric Thermal Storage heating is a highly efficient, reliable and comfortable means of heating your home, office, or business. AMERICAN TECHNOTHERM ETS heaters are being used in millions of locations around the world where comfort, economy, and convenience are demanded by knowledgeable homeowners and leading engineers. Thermal storage heat is welcomed by electric power companies because it uses a precise and predictable electric load during a time of day when they have a surplus of available electric supply.

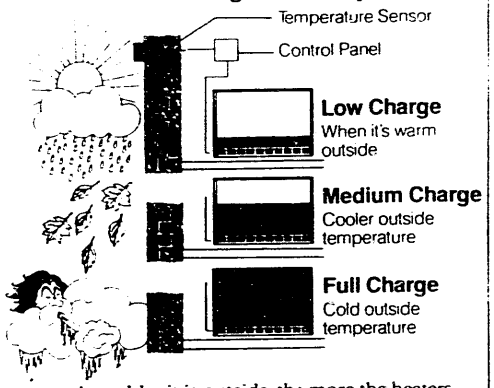
Most electric companies will offer you an incentive to use thermal storage heating. This comes in substantially lower cost electric rates when you use your electricity during off-peak hours. AMERICAN TECHNOTHERM ETS heaters use only this cheaper off-peak electricity, converting it to heat during those off-peak hours and storing it away for use as you need it throughout the day. In this way, you draw electricity for heating only during off-peak hours, yet you have an abundant supply of heat 24 hours a day.

AMERICAN TECHNOTHERM ETS heaters are compact, attractive units designed to blend into any room's decor. Unlike heating with other fuels, the ETS heaters do not require maintenance. They can be totally automatically controlled, continuously adjusting the amount of electricity used according to the outside temperature. They take up very little room and can even be recessed into the wall. AMERICAN TECHNOTHERM ETS heaters can be easily installed by any qualified electrician.



Slimline

Automatic Charge Control System



. . . the colder it is outside, the more the heaters charge. No overheating, no inefficiency.

The Utility's role: Why do they do it?

Each night, the electric company is faced with a problem. During the day when everyone uses the most electricity, the utility operates at full capacity. At night, electricity demand falls off sharply, so the utility has huge surpluses of unused generating power. Since electric companies buy electricity based upon what their peak usage is during the day, the more usage they can shift to off-peak, the less they must pay for their overall electric use. This gives them a tremendous incentive to lower that daytime demand by offering substantial discounts to people like yourself who can defer their power consumption into the off-peak hours. That off-peak rate is usually 40% to 70% off the daytime rate.

The AMERICAN TECHNOTHERM ETS heating system takes advantage of the lower costs. It is timed to come on only when the electric rates are lowest, but the system doesn't just come on "full blast." An automatic charge control measures the outside temperature and determines how much energy actually needs to be stored in the system to meet the heating requirements of the day. In this way, the system can take on a partial or full heating charge based entirely upon the level of comfort you set on your thermostat.

As the ETS system is "on," the electricity is converted to heat and stored in special high thermal mass ceramic bricks. These Magnesite bricks are used for their special ability to store immense quantities of heat. During the day, the stored heat is released as needed into the home. Then, at night, the heat charge is "topped off," ready to meet the heating requirements of the day to come.

About The Company

The roots of AMERICAN TECHNOTHERM, which is a wholly American owned and managed company, were started over 15 years ago in Burlington, Vermont. We have consistently imported, sold and serviced ETS units built by several different European manufacturers as our primary business through the years. We maintain nation wide toll free telephone lines to provide customer and technical assistance. Our sales engineers are always available to provide assistance with system design, sizing and performance criteria.

Technical perfection in a fully-automatic, economical, clean electric heating system.

The concept is simple. An AMERICAN TECHNOTHERM ETS heating system will:

- ☐ Use electricity only when the power company's rates are the lowest (usually at night).
- ☐ Turn that cheap electricity into heat which can be easily stored.
- ☐ Store enough heat to meet your daily needs.
- ☐ Use the stored heat (but no electricity) during the rest of the day when the electricity rates cost much more.

What are the advantages of AMERICAN TECHNOTHERM Electric Thermal Storage Heaters?

Savings: An AMERICAN TECHNOTHERM ETS heating system can save as much as 50% to 70% over other electrical heating systems, and just as much over fuel-fired systems.

Comfort: No other heating system offers the precise combination of comfortable radiant heating and convection assistance that will maintain the ideal warmth for you. There are no ups and downs in room temperatures; no drafts; no cold rooms where you don't want them.

Control: Each room is controlled independently by its own thermostat to the temperature you desire. The whole system can adjust itself automatically to changing outside temperatures to assure you have all the heat you need while saving every bit of energy possible.

Quiet: The small fans in the heaters are very quiet low-volume devices that cannot be heard, even when you are right next to the heater.

Efficiency: 100% efficient. All the electricity you pay for is converted into heat. Nothing goes up the chimney as fumes or smoke. There are no losses through pipes, ductwork, or cold basements.

Simplicity: An AMERICAN TECHNOTHERM ETS heating system needs no fuel storage, no pipework to freeze up, no radiators to leak, not even a chimney! ETS heaters can also be easily retrofitted with a minimum of effort.

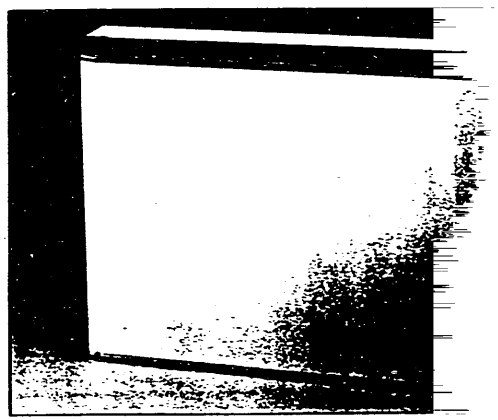
Investment: When you add an AMERICAN TECHNOTHERM ETS heating system in your home, you add an important and valuable resale feature should you ever decide to move.

Maintenance-Free: ALL AMERICAN TECHNOTHERM ETS heating systems include a guarantee that assures the quality and reliability of all the components in the system.

Fluid Regulator Control. A more precise balancing of outside sensor data versus residual heat and core temperature.

Convenient Front Access. Assures easy, fast assembly and service. Can be tested while fully assembled.

New Softer, More Neutral Color.



ETS-Static Series

Technical Data

MODEL NUMBER	ETS 205	ETS 305	ETS 405	ETS 505	ETS 605	ETS755
Wattage	2KW	3KW	4KW	5KW	6KW	7.5KW
Storage	16KWH	24KWH	32KWH	40KWH	48KWH	60KWH
Voltage				Amperage		
208 VAC	9.6A	14.4A	19.2A	24.0A	28.9A	36.1A
240 VAC	8.3A	12.5A	16.7A	20.9A	25.0A	31.3A
277 VAC	7.2A	10.8A	14.4A	18.0A	21.6A	27.1A
Physical Data						
Length	25.6"	33.5"	41.3"	49.2"	49.2"	49.2"
Height	26.4"	26.4"	26.4"	26.4"	26.4"	26.4"
Depth	10.0"	10.0"	10.0"	10.0"	10.0"	11.8"
Weight (LBS)	232#	331#	430#	529#	529#	639#
Elements	3	3	3	3	6	8

* The actual "Electrical Rating" of each ETS Heater is determined by the combination of the heating element rating and the supply circuit voltage. This provides the ability for closer "matching" actual heater outputs to the electric power rate (available charge times) and the heating requirements of different structures.

System Control Equipment

A variety of versatile control devices are available to allow easy operation of your AMERICAN TECHNOTHERM Electric Thermal Storage heating system and any applicable rate. The design of our modular control system permits utilization of the components which best suit your application and provide optimum savings performance. A selection of control panels is available to adapt your system for Time-of-Day rates, Special Storage Heat rates or Demand Limited rates. These control panels are available for both residential and commercial/industrial applications.

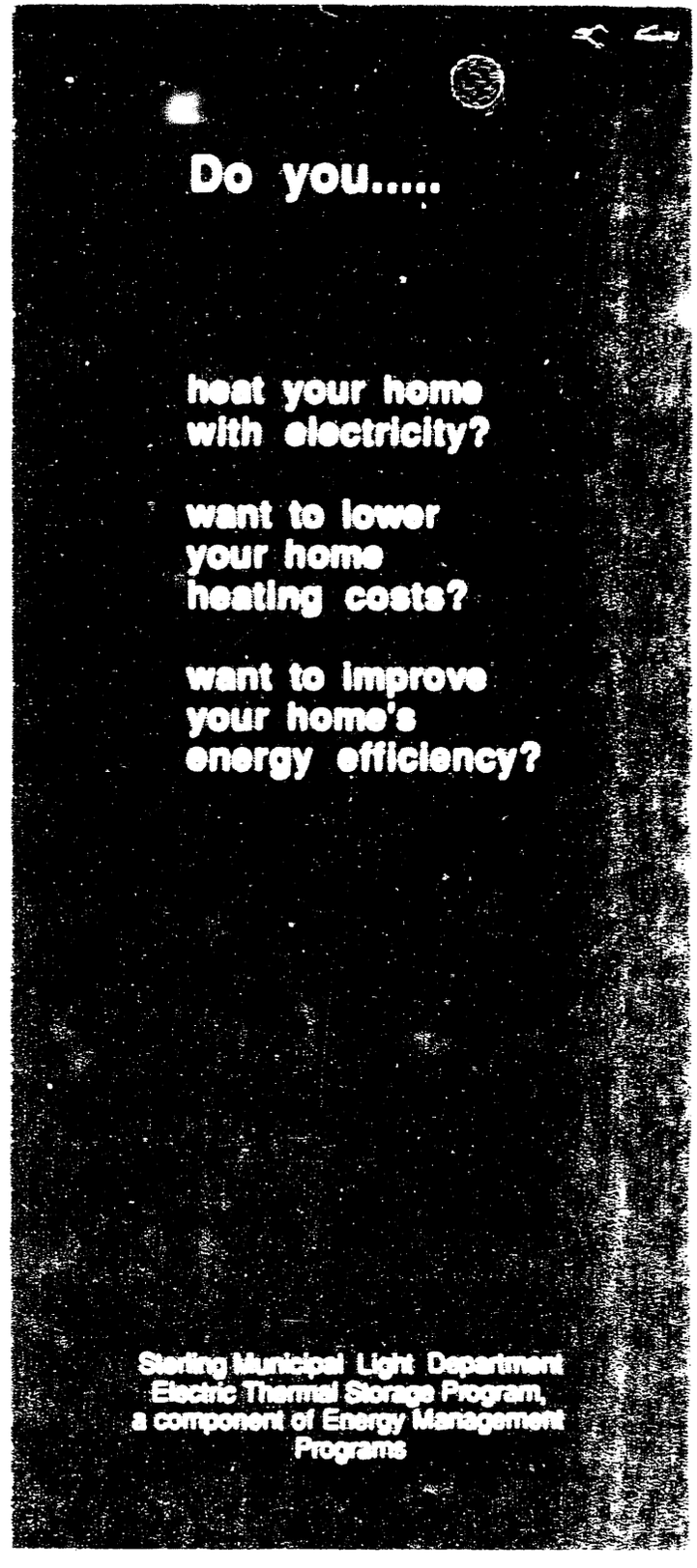
American TechnoTherm
CORPORATION

1 Barnes Avenue, Fort Ethan Allen, Colchester, Vermont 05446
(802) 655-4061 1-800-451-3268 TWX 510 299 0057 Telefax (802) 655-7927

APPENDIX THREE

STERLING MUNICIPAL LIGHT DEPARTMENT

Electric Thermal Storage (ETS) Program Brochure


Do you.....
heat your home with electricity?
want to lower your home heating costs?
want to improve your home's energy efficiency?
Sterling Municipal Light Department
Electric Thermal Storage Program,
a component of Energy Management Programs

If you answered **yes** to these questions, Sterling Municipal Light Department's Electric Thermal Storage (ETS) program is the answer for lower home heating costs, added comfort and improved efficiency.

The ETS program

The program, specially-designed to introduce electric heat customers to improved heating technology, offers heat storage system purchase and installation assistance. Sterling Municipal Light

- determines the size of the heat storage unit to meet your heating requirements
- prepares the quote including materials, installation and payback period
- places the order
- arranges for an electrical contractor to install the unit.

To help you invest in the system, the Clinton Savings Bank offers 0% financing with the support of the Sterling Municipal Light Department.

After you have installed the system, Sterling sends a monthly savings analysis so you can compare heating costs.

What is electric thermal storage heating?

Electric thermal storage heating is a system that literally stores and distributes heat in your home. The system takes advantage of lower electrical rates, because it's timed to go on at night when the rates are lowest. During this time, the electricity generates heat which is stored in thermal mass ceramic bricks in individual heaters. During the day when the electric rates are higher, the stored heat is released as needed into your home.

How does the system know how much heat needs to be stored?

The system automatically measures the outside temperature and adjusts the amount of heat to be stored. On a cold winter night, the heater is fully charged. During a cool spring or autumn night the system automatically adjusts and reduces the charge level.

How is the size of the unit determined?

The number and size of the individual heaters are based on the size of your home. Each heater is compact and designed to blend into the room's decor. In addition, each heater has its own thermostat so you select the desired temperature.

"I've never had a warmer house; the heat is so even and quiet. I'm thrilled with the system. You can't stress the benefit of off-peak electric pricing enough."

Kirk Bodwell, Sterling MA
Sterling Municipal Light Department ETS customer since October, 1988

The ETS program can help you save on your heating costs and help the department reduce its overall supply costs. Supply costs are based on our day time or peak demand so when you shift to off-peak use you are lowering daytime use and costs.

APPENDIX FOUR

ETS EQUIPMENT

Electric Thermal Storage **A Comfortable Alternative**

How Does ETS Work?

It's really pretty simple. ETS cabinets are filled with bricks made out of special materials that store heat. Electric elements, similar to those found in electric ovens, pass through the bricks. When the unit is charging, some of the heat from the elements is released into the room to provide immediate comfort. The rest of the heat is stored in the bricks until it's needed.

Space-age insulation around the core helps the bricks retain the stored heat. After the ETS unit has been charged, fans inside the heater move air around the bricks. The air is warmed and returned to the room. Since the process is controlled by a thermostat, you can get as much or as little of the heat as you want — whatever is most comfortable.

What makes the bricks so special?

High-density iron oxide ceramic bricks surround the elements to absorb the heat. A high density compound accomplishes two things. First, it holds more heat for a longer period of time. Second, it requires less space, and that means a slimmer, more attractive cabinet.

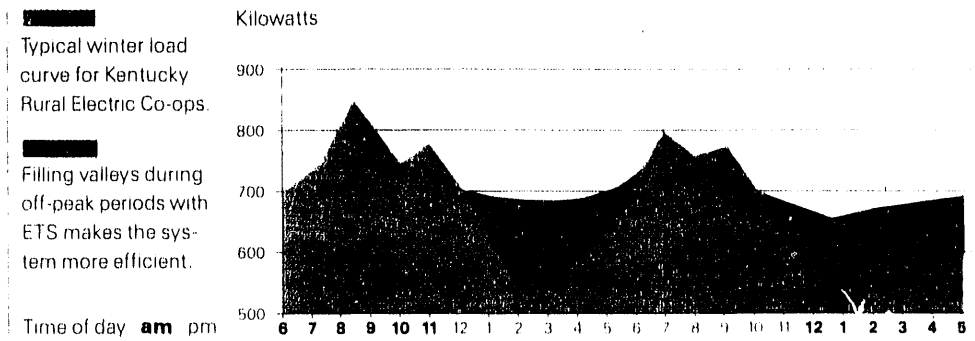
Although each brick measures only 7" by 8" by 1¾" high, it weighs 10 pounds. Nine bricks are required for each heating element. The heating elements are also crafted from special long-life material. That enables the manufacturer to offer a full three-year warranty on all parts.

At maximum charge, the core of the ETS unit reaches about 1400 degrees. The heat is stored in the bricks until you need it. In one test, the core temperature was about 250 degrees three days after the unit was shut off!

But with heat that intense, is it safe?

Perfectly. When we say space-age insulation, we mean it. Actually, there are two types of insulation used — both highly resistant to heat transfer. One is aluminum silicate spun into a tightly woven blanket. The other is chemically identical to tiles used to cover space shuttles. Their combined resistance to heat loss has obvious benefits to making the unit more efficient, but it also makes it safer.

At maximum charge — and remember, that core temperature is about 1400 degrees — the skin temperature of an ETS heater is about 180 degrees. That sounds high. But compare it to a wood stove. The skin temperature can be as high as 600 degrees. Another way to compare would be to consider that if you accidentally touched an ETS unit with your hand, it would be uncomfortable, but you could react before



any burn would occur. With a wood stove, your hand would be burned immediately.

But why store heat?

An ETS unit can store enough heat during an eight-hour charge to keep an area warm for the remaining 16 hours. That means that an ETS unit charged at night will provide plenty of warmth all day. Nighttime is an "off-peak" period for your rural electric cooperative — a time when electricity usage is low. That means there is a large amount of generating capacity that is not being used. Because there is little demand for that excess capacity, the Public Service Commission allows a discount on the rate your co-op can charge for the electricity ETS uses during that off-peak time. That makes ETS financially attractive to you. It also benefits all consumer-members in the co-op because system operating efficiency is improved.

How much will I save?

Participating cooperatives offer consumers substantial rate discounts on electricity ETS uses during off-peak periods. In other words, if your co-op is offering a 40 percent discount and your electric rate is 6 cents per kilowatt-hour (kwh), the rate for ETS would be 3.6 cents. That represents savings of 2.4 cents per kwh if you use ETS instead of another form of resistance electric heat to replace your wood stove.

When comparing ETS to a wood stove, though, your benefits are measured in savings of time, convenience, cleanliness and safety because there are no logs to split and carry in, no ashes to carry out and no open flame. Even though the cost of operating ETS is slightly higher, it's worth it to many people to eliminate the hassles. During a typical Kentucky winter, the additional daily cost of operating ETS instead of buying seasoned hardwood is about what you would pay for a soft drink! But think about it. Isn't the time you spend splitting logs, hauling in wood and carrying out ashes worth more than that?

Will ETS keep my whole house warm?

Yes and no. It depends on a number of things including the size of your house and the floor plan.

Someone in a large house may have a wood stove that is used to heat a family room, with some spillover heat going into the kitchen, living room and dining room. In a smaller house, the same wood stove probably could heat most rooms. The same is true with ETS if one large unit is used. But smaller units also can be installed in bedrooms. This means you could heat a very large house almost exclusively with ETS.

Is it reliable?

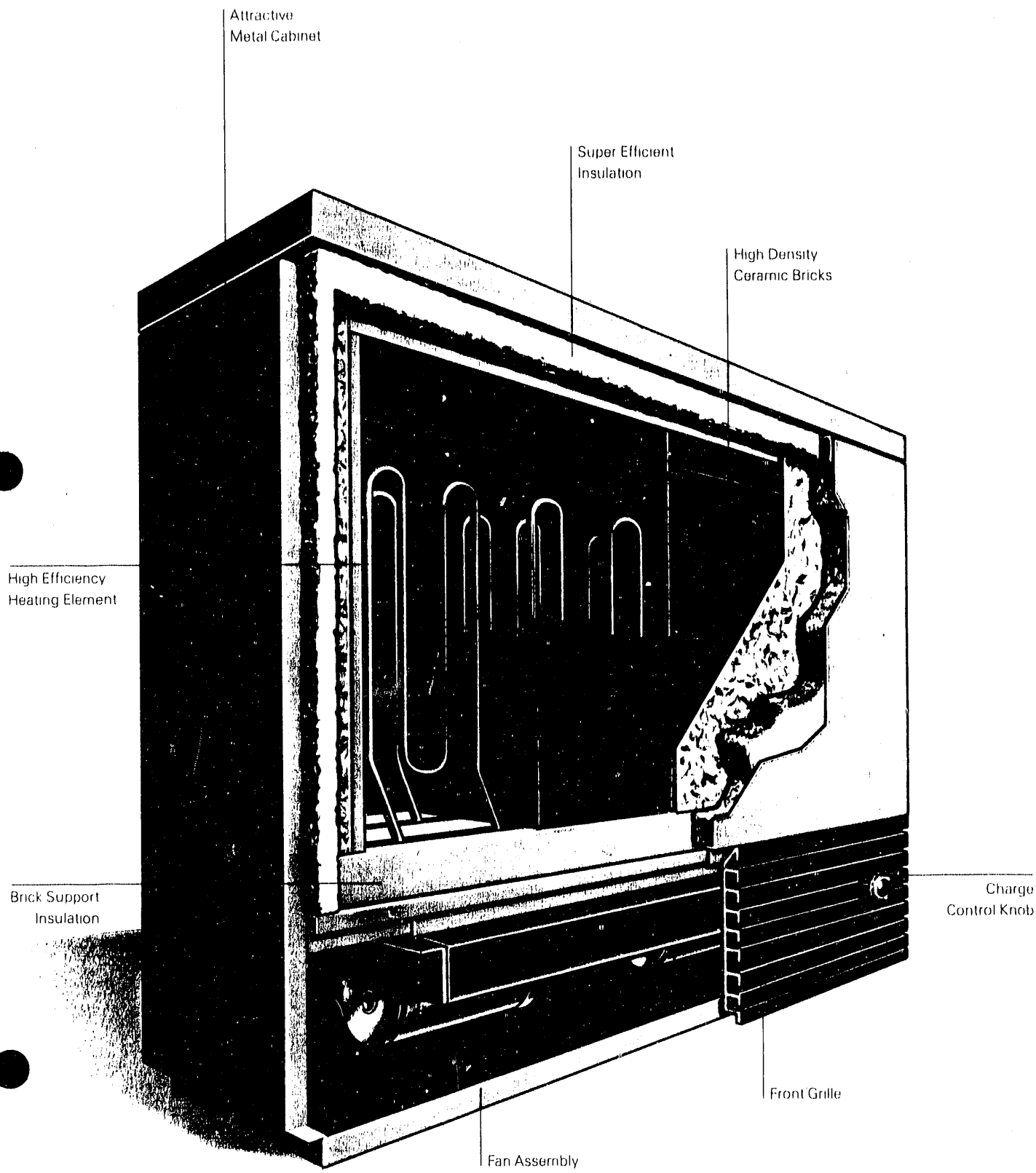
Yes indeed. The system is reliable because it is so simple. The only moving parts are a damper and fan assembly that force the heated air into your room. The rest of the unit is steel, brick, and insulation.

Though relatively new to the United States, ETS technology has been used throughout Europe for more than 40 years.

With rising insurance costs, federal regulations, and frustration with the task of chopping wood and carrying ashes, the popularity of wood stoves is fading. The problem consumers face is finding a convenient, comfortable, economical alternative. ETS answers that problem.

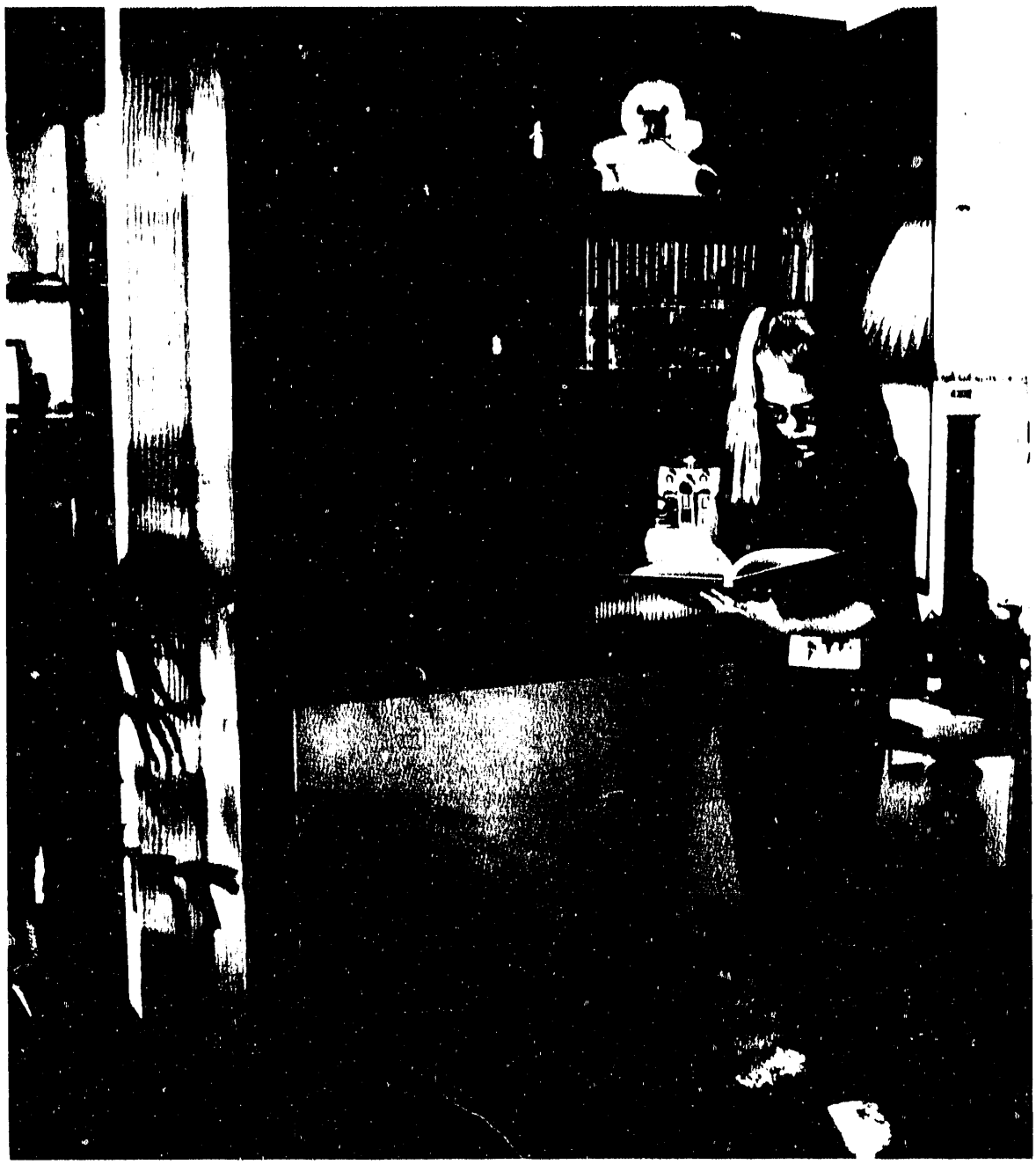
If you want to find out whether you are a candidate for ETS heating, call your hometown rural electric cooperative.

Electric Thermal Storage — another one of the comfortable alternatives from your rural electric cooperative.


Attractive
Metal Cabinet
Super Efficient
Insulation
High Density
Ceramic Bricks
High Efficiency
Heating Element
Brick Support
Insulation
Charge
Control Knob
Front Grille
Fan Assembly

STEFFES ETS, INC.

Presents Electric Thermal Storage Heaters Made in America.

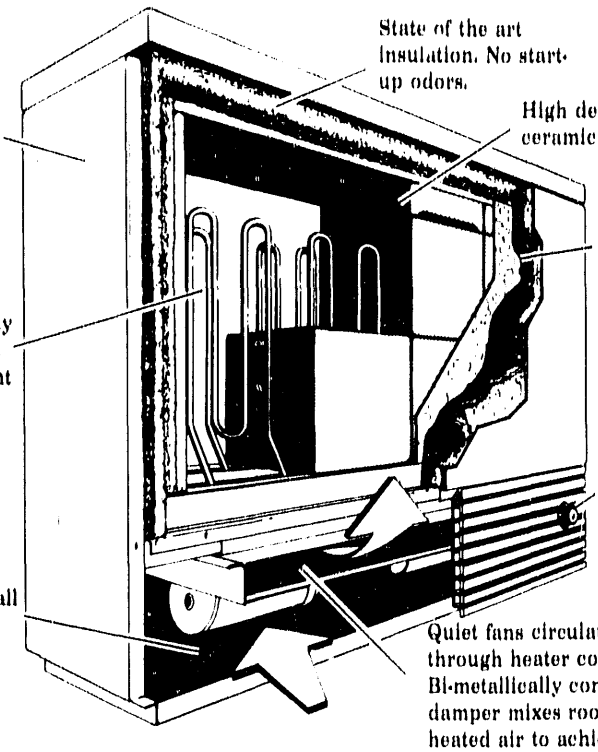


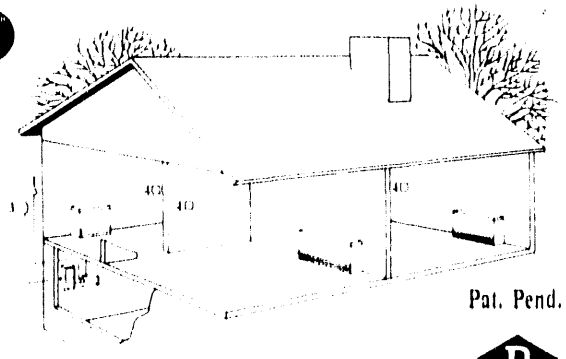
What is Electric Thermal Storage Heating?

Electric thermal storage heating is a clean, safe, comfortable and reliable method of heating your home or office. This heating choice is growing in popularity in America because it is 100% efficient and provides consumers with considerable savings in heating costs.

These savings are realized by taking advantage of off-peak electric rates offered by electric utilities. These off-peak hours are the times during the day when a utility has a surplus of available electricity. Because of this surplus, the utility charges lower rates for electricity used during that time. Electric thermal storage heaters convert electricity into heat during these off-peak hours and stores that heat in specially designed high density ceramic bricks capable of storing vast amounts of heat for extended periods of time. During the day, as a room thermostat calls for heat, fans in the heater circulate the stored heat evenly and quietly throughout the room.

The Steffes ETS Heater





Pat. Pend.

ARL LISTED

Electric Thermal Storage Heating

1 Outdoor sensor monitors outside air temperature.

2 Control panel automatically adjusts heater charge level accordingly for optimum comfort and energy savings.

3 Utility meter records off-peak power usage.

4 Individual room thermostats regulate temperature in each area of the home. (Numbers 1 and 2 are optional) Heater charge level may be manually controlled by the consumer.

Heater Specifications

Heater Model No.	Power Rating (kW)	Heating Element Voltage (VAC)	Fan Voltage (VAC)	Length	Height	Depth	Number of Bricks	Weight (Lbs.)
212S	2.4	240 std., 208, & 277 opt.	230 std., 115 opt.	22"	27"	9¼"	18	255
312S	3.6	240 std., 208, & 277 opt.	230 std., 115 opt.	30"	27"	9¼"	27	365
412S	4.8	240 std., 208, & 277 opt.	230 std., 115 opt.	38"	27"	9¼"	36	480
512S	6	240 std., 208, & 277 opt.	230 std., 115 opt.	46"	27"	9¼"	45	592

Safety and efficiency are built into every Steffes ETS unit

Comfort
Radiant and convection heating combine to provide even, cozy warmth when and where you desire it. When coming in from the biting cold you get that nice "warm to the bone" feeling with a Steffes storage heater in the room.

Efficiency
The Steffes ETS is 100% efficient. Superior cabinet insulation retains stored heat longer to be released by thermostatically controlled fans as the room requires.

Safety
All Steffes ETS heaters have quality mounting brackets, providing positive stability and correct heater-to-wall spacing.

Ease of installation
All internal wiring is factory installed, reducing installation time and costs.

Installation Clearance
The 1⅞ inch wall clearance is automatically set by the wall mounting bracket. If recessing into the wall, book shelf, china hutch or other cabinets, leave a 2 inch clearance on each side of the heater, a 4 inch clearance on top of heater, and leave the front of heater exposed to the room.

Serviceability
Heating elements can be removed from the unit without disturbing either the bricks or insulation.

Access to all electrical and mechanical parts is possible through front air discharge grille opening.

Versatility
Heaters from 2.4 to 6 kilowatts are available to fit into all sizing requirements.

Contemporary design
Baked enamel earth-tone colors complement the clean cabinet design to fit with any decor.

Warranty
Three years limited parts warranty.

For More Information Contact:

Or

Steffes ETS, Inc.
P.O. Box 327
Dickinson, ND 58601

701-225-6602

Creda

SUPER SLIM STORAGE HEATERS

Whatever your heating needs, off-peak heating products from Fostoria Industries are technologically advanced to provide for maximum efficiency and energy cost savings.

Now, as a welcome addition to the Fostoria line of ETS furnaces and ROP room units, we are proud to announce the Creda TSR and TSF series of room storage heaters.

Tested and Approved

Creda is the largest manufacturer of heating equipment in the United Kingdom for both domestic and industrial applications. All Creda heaters have been tested and approved by the British Electrotechnical Approvals Board and in the USA by Applied Research Laboratories (ARL). Now Creda has brought their years of ETS experience to North America by marketing their heaters through Fostoria Industries, Fostoria, OH.

Superb Comfort Heating

Storage heaters from Creda give you superb comfort heating throughout the home in the best, simplest and most economical way. The TSR and TSF heaters have just two adjustable controls, conveniently mounted on top of the heater under a flush-fitting cover. With one you select the amount of heat to be stored overnight and with the other you choose the room temperature level to suit you. Should you elect to go away for a day or two, you simply turn down the Auto-Set and Room Temperature controls. The room will be kept aired until you are ready to turn up the controls again. With the Auto-Set, the Creda units show their self-control by sensing changes in weather and automatically adjusting the amount of heat stored in the heater to accommodate these changes. What could be simpler than that?

Economical

Economical operation was one of the prime concerns of Creda when designing their line of off-peak heaters. Improved insulation made of "opacified silicaceous aerogel" was implemented in both TSF and TSR Creda heaters. This insulation was first developed to ensure temperature stability in spacecraft. The design team at Creda put this insulation into their heaters in order to guard against heat loss and provide the warmth you want in the most economical way possible. Both the TSR and the TSF models consume electricity during off-peak hours, giving you the advantage of considerable savings using the off-peak rates available from your local utility.

Neater, Quicker Installation

Aesthetics were also considered in the development of Creda heaters. The TSR heaters have no wall mounted thermostats so this means a cleaner look for your room. An added benefit is a simpler, quicker job for your installer and less cost for you. In the past, storage heaters were rather bulky. Creda has slimmed down the profile of their heaters so that they blend in with their background. Another bonus is the fact that the Creda units stand clear of the floor. These wall secured heaters have supporting feet which your carpet. Both the TSR and TSF models have a seashell ivory front panel, with champagne bronze color top and side panels.

House Warming Invitation

So consider this to be your invitation to a House-Warming — it could be yours with the addition of Creda TSF or TSR heaters supplied by Fostoria Industries.

TSR SUPA-SLIM		**TSR 12(M)**	**TSR 18(M)**	**TSR 24(M)**	
Cat. No.		79047	79057	79067	
Height (inc. feet)		28"	28"	28"	
Width		22"	31"	40"	
Depth (inc. spacer)		6½"	6½"	6½"	
Input Rating		1.68kW	2.52kW	3.36kW	
Charge Acceptance	7 hrs: 8 hrs:	11.76kWh 12.6kWh	17.64kWh 18.5kWh	23.52kWh 25kWh	
Weight		159lb	234lb	309lb	
TSR SUPA-AUTO		**TSR 12(A)**	**TSR 18(A)**	**TSR 24(A)**	
Cat. No.		79045	79055	79065	
Height (inc. feet)		28"	28"	28"	
Width		22"	31"	40"	
Depth (inc. spacer)		6½"	6½"	6½"	
Input Rating		1.68kW	2.52kW	3.36kW	
Charge Acceptance	7 hrs: 8 hrs:	11.76kWh 12.6kWh	17.64kWh 18.5kWh	23.52kWh 25kWh	
Weight		159lb	234lb	309lb	
TSF STORAGE FAN HEATERS		**TSF 16**	**TSF 24**	**TSF 32**	**6kW**
Cat. No.		70158	70168	70178	70131
Height		28¾"	28¾"	28¾"	31¾"
Width		31"	40"	40"	49"
Depth (inc. spacer)		8⅛"	8⅛"	9⅜"	12¾"
Net storage capacity		14.38kWh	21.5kWh	28.3kWh	37kWh
Input Rating		2.36kW	3.56kW	4.76kW	6k
Charge acceptance		16.48kWh	24.9kWh	33.3kWh	42kWh
No. of elements		3	4	4	3
No. of core blocks		12	16	16	44
Weight		238lb	322lb	441lb	629lb

TSR SUPA-SLIM

For those who still prefer manual charge to automatic — there's an ideal alternative in the Supa-Slim heaters.

They are similar in all respects to the Supa-Auto — slim, warm-hearted and economical — but of course do not have the Auto-Control.

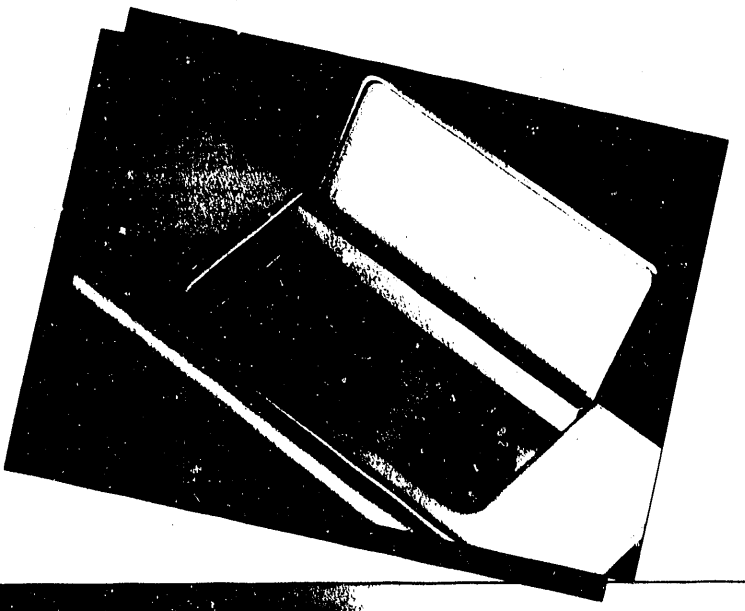
In the Creda Supa-Slim you have two simple controls; one to select the amount of overnight heat storage, the other to choose the room comfort level you need. Like the Supa-Auto, the heater is wall-mounted to stand clear of the carpet (just a small adjustment of the carpet fitting and it covers the supporting feet).

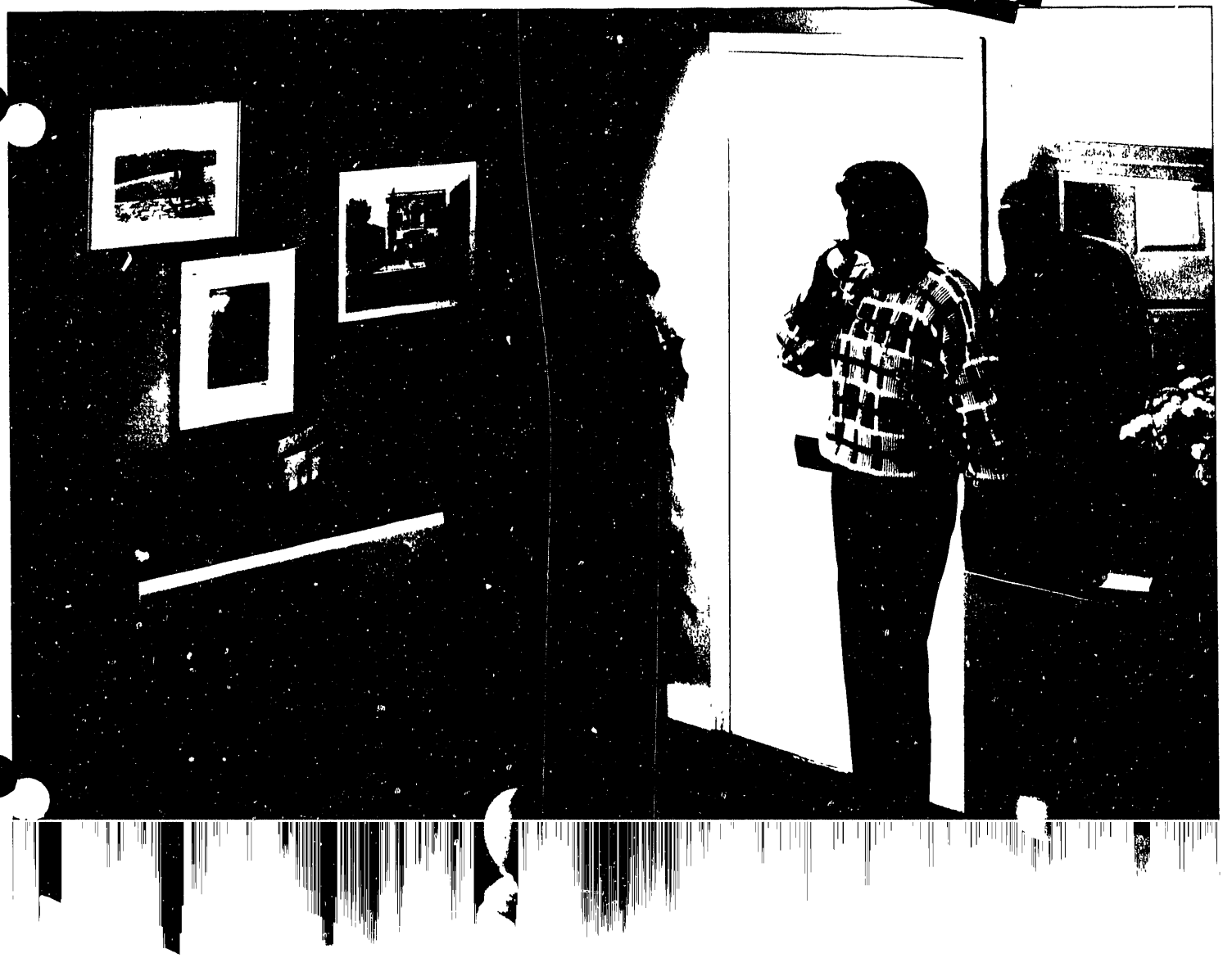
Exclusive Room Temperature Control

No other storage heater will give you such fine responsive manual temperature control as the Creda TSR.

Room temperature can be easily regulated. So you can boost it or reduce it. You simply turn up or down, according to your needs, the Creda patented Room Temperature Control under the flush lift-up cover on top of the heater.

You see, the TSR is unique in that it will hold back stored heat thermostatically in maintaining the set temperature. So there's no overheating and there's more warmth available if it is wanted.





TSR SUPA-AUTO

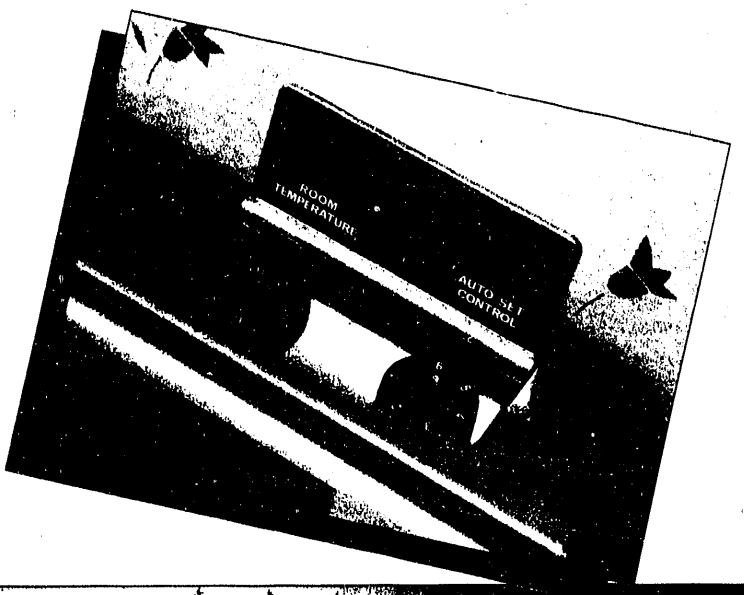
Unobtrusively handsome with its slim lines — st 6½ inches deep — the TSR Supa-Auto is ll-secured and stands clear of the floor on supporting feet.

With slight adjustment to the carpet fitting, the feet slip under the carpet. So they are hidden and the floor left clear for cleaning.

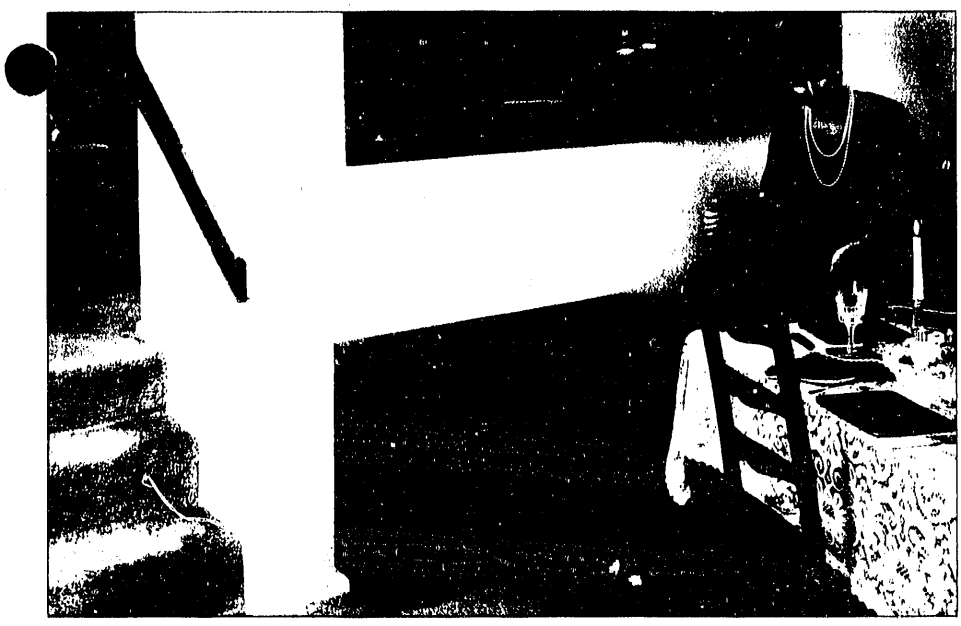
The TSR Supa-Auto is so simple to operate: you just set the Room Temperature Control to the comfort level you need. A thermostat then varies the rate at which the heat is given out.

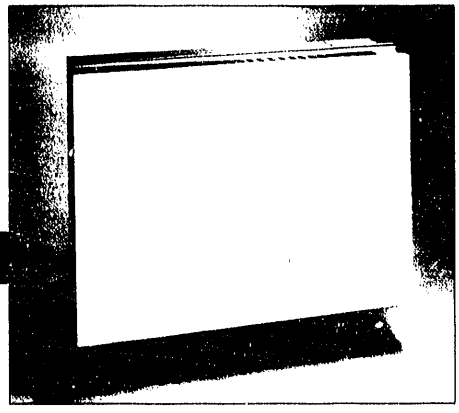
The amount of heat to be stored overnight is governed by the scientifically designed Auto-Set control. It will automatically regulate the amount of heat storage according to changes of outside weather conditions.

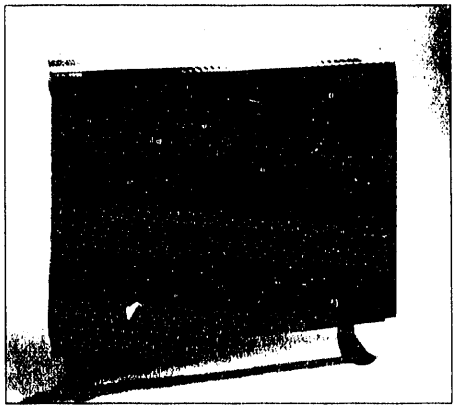
So at all times it is looking after your well-being, in physical comfort and your pocket. Automatically.



TSR ACCESSORIES







New Decorative Panels

Once again TI Creda are at the forefront of style and design in the storage heating market with a new range of decorative front panels that are compatible with all Creda TSR storage heaters and TSF storage fan heaters.

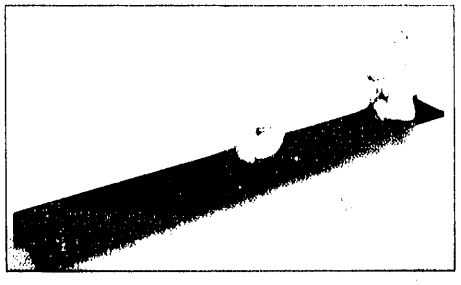
Their appealing looks give that little extra sophistication to modern room decor.

Offered as an optional extra, they come in two styles, embossed or a colored panel in a choice of shaded colors. All are finished with a high temperature stove enamel paint.

Shelf Kit

This handsome aluminum shelf in champagne bronze is available in kit form, for wall-mounting above TSR storage heaters.

There are three sizes, corresponding to heater widths. Assembly and fixing is simple and the kits include easy-to-follow instructions, as well as all necessary components.



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SUPER SLIM
STORAGE HEATERS

EPRI

Thermostone III™ Heat Storage Furnace

Low First Cost Space Heating and Load Management for Residential and Small Commercial Buildings

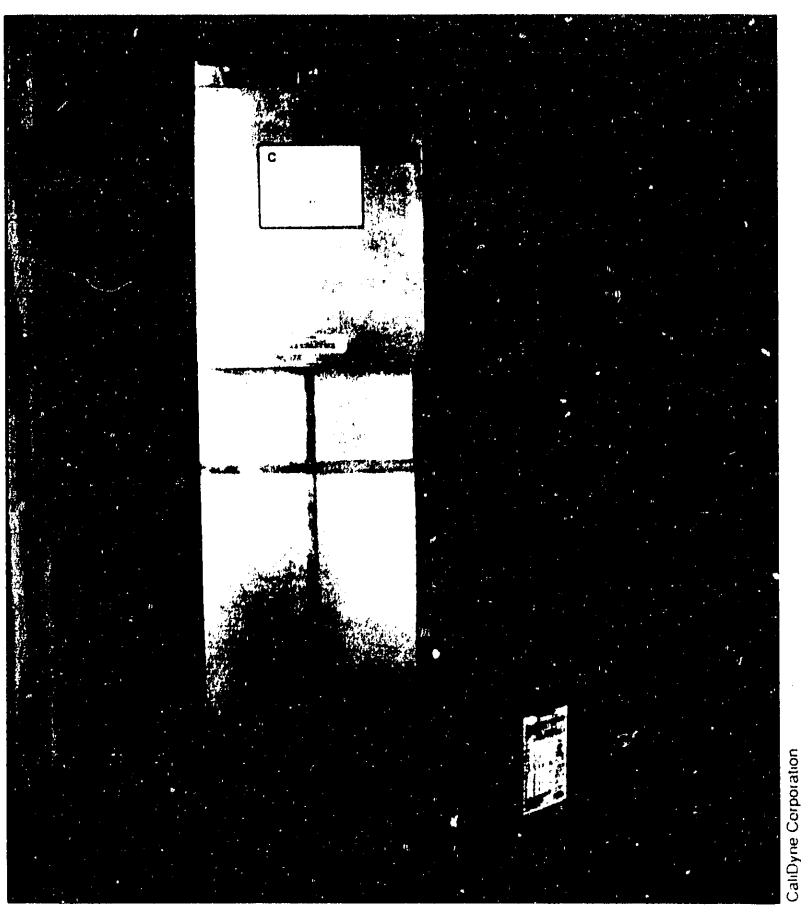
A new electric forced-air furnace has been developed that allows utilities to shift space heating demand to off-peak hours and shave load from the next day's peak. The furnace, which uses inexpensive crushed basalt rock as its thermal storage medium, offers significantly lower customer capital costs than those of other heat storage systems.

Electric thermal storage (ETS) systems have been used for space heating in Europe for nearly 40 years. They generate heat during off-peak nighttime hours, store it in a medium, then use it during daytime periods of peak demand. Greater use of ETS systems could benefit the hundreds of utilities in the United States seeking to improve their winter load factors, but the high initial cost of equipment has hindered consumer acceptance.

Thermostone III™, developed by EPRI and manufactured by CaliDyne Corporation, stores heat in crushed rock, reducing system installed cost by 15 to 40 percent over ETS furnaces using ceramic storage media.

Thermostone III™ is available in three sizes—each with a different storage capacity—and can meet the heating needs of most homes and small commercial facilities. An electronic control system, linked to temperature sensors in the furnace, above the air handler, and outdoors, allows efficient operation by minimizing storage energy requirements. A variable speed blower supplements this system and, with the thermostat control, allows consistent comfort. When the desired amount of heat is stored for the next day's needs, the only additional electricity consumed is by the air handler. During periods of warmer temperatures when heat demand is lower, the control system selects a partial charge so power is not wasted.

Utilities offer market incentives to promote thermal storage, including low, off-peak electric rates and cash rebates. Combined with the Thermostone III™'s lower cost, these incentives can shorten payback periods and increase market penetration of ETS heating.



CaliDyne Corporation

Thermostone III™ consists of an insulated steel, hexagonal, rock storage chamber and an adjoining rectangular cabinet which holds a fan and conventional heater

ELECTRIC POWER RESEARCH INSTITUTE

Utility Benefits

- **Effective customer-side tool for load management.** Makes more efficient use of baseload capacity, helping to defer new power plant construction.
- **Accommodates any off-peak schedule** and remote control power line carrier or radio signal commands.
- **Random start timing protects utilities** from developing a secondary peak in a service area.

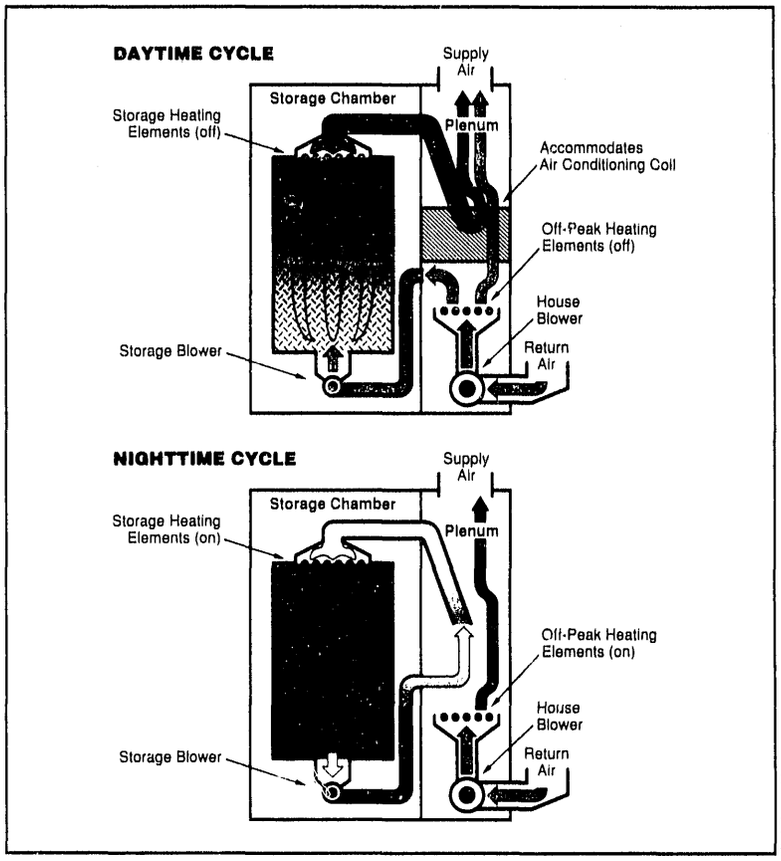
Customer Benefits

- **Comfort.** Provides uniform indoor temperatures, even on the coldest days.
- **Lower installed cost.** Qualifies for certain utility rebate and incentive programs.
- **Energy cost savings.** Daytime heat is provided at substantially discounted nighttime electricity prices.
- **Central air conditioning provision.** Optional air conditioning system is available from factory or distributor.
- **Low maintenance.** Normal cleaning and changing of air filters are required.
- **Quality construction.** Galvanized steel exterior protects against rust.

Technical Features

- Storage capacity of 130, 160, or 190 kWh
- Variable speed storage blower
- Self-contained, solid-state control system
- Perlite insulation surrounding storage chamber

For ease of installation, Thermostone III™ is delivered in modular sections. After assembly, crushed basalt rock is poured into the storage chamber.



CaliDyne Corporation

At night the furnace's conventional heater provides space heating while separate heating elements at the top of the storage chamber are activated to heat the crushed rocks. A variable speed blower at the bottom of the chamber draws air past these heating elements and down through the rocks, charging them to temperatures as high as 1050°F. When daytime comes, the fan reverses to push air through the hot rocks and mix it with return air to provide space heating.

For further information contact
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Residential Program
(415) 855-2902

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3412 Hillview Avenue
P.O. Box 10412
Palo Alto, CA 94303

EPRI

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Conservation/ Productivity/ Load Management

Electric Thermal Storage

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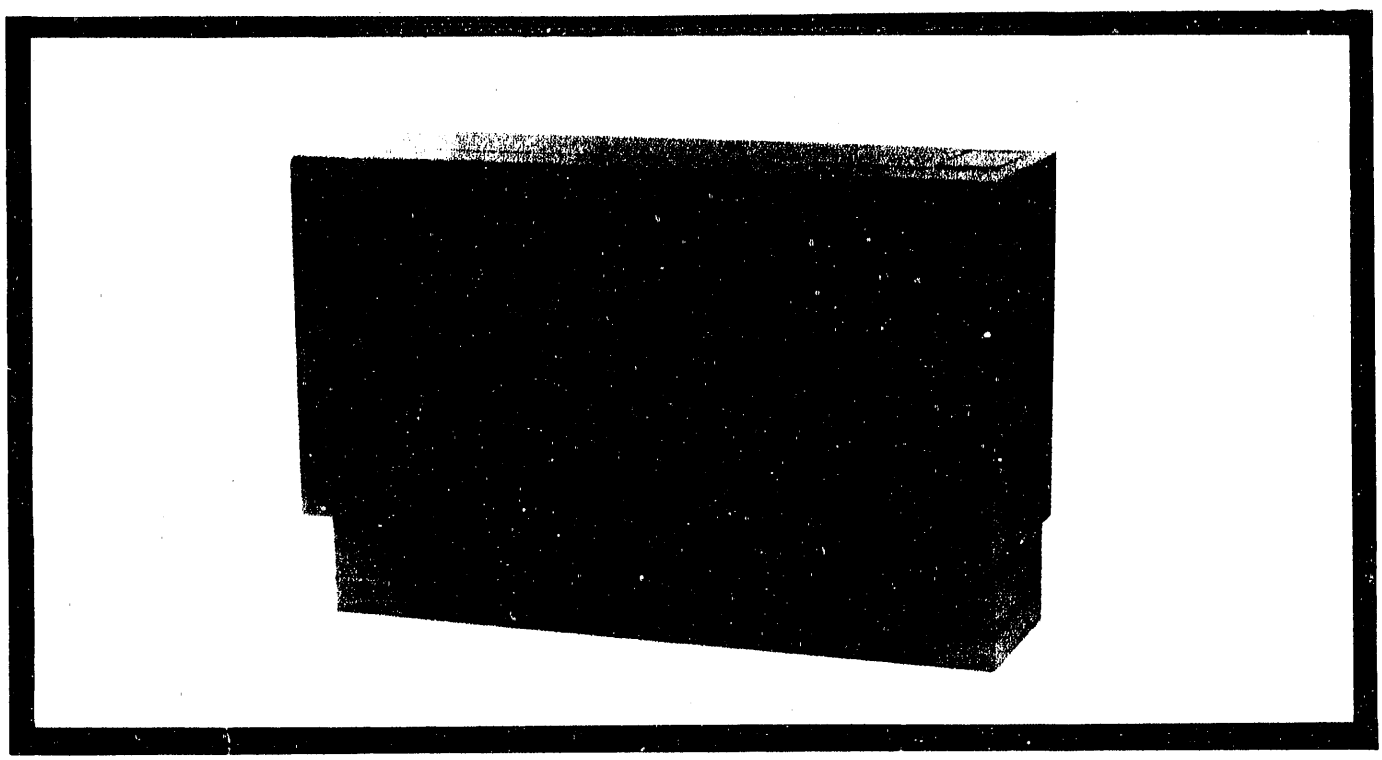
OFF-PEAK® HEATING

Residential ☐ Commercial ☐ Industrial

ELECTRIC THERMAL STORAGE



E.T.S. ROOM UNIT HEATER

ELECTRIC THERMAL FOSTORIA STORAGE

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UL

WHAT IS HEAT STORAGE?

Heat storage is the heating of a storage medium for later release of the heat when the heat energy is not available or the cost is higher. In its simplest form, early cavemen probably heated the walls of their caves with fire to provide warmth late into the night. In colonial times, settlers would heat bricks, wrap them in cloth, and place the hot bricks at the foot of the bed to provide warmth during cold nights.

Electric thermal storage (ETS) first came into use to heat bomb shelters in England during the bombardments of World War II. This was an effort to make maximum use of the generation facilities, which were constantly being damaged and to provide heat even if extended power outages occurred. During production hours when generation capacity and energy was extremely important to produce war material, energy was not required for space heating. After the war, England and Germany continued to promote off-peak energy usage so that home heating did not coincide with production hours and, therefore, place high demand on the generation capacity needed to rebuild their damaged economies.

The idea has now come to America to help consumers reduce electric bills by enabling them to take advantage of low-cost off-peak energy. ETS benefits the utilities by leveling out daily fluctuations of power usage and allowing their power plants to operate at maximum efficiency. Electric thermal storage can also reduce the magnitude of future rate increases by delaying utilities need for construction of new, additional generating plants.

ETS room storage heaters allow consumers to take advantage of off-peak electric rates, often one-half to one-third that of normal electric rates by storing large amounts of inexpensive energy in the form of heat for later release when the electric rates are higher. ETS room units may be used throughout the home to provide the total space heating requirement or applied in the ETS warm room concept.

The ETS warm room concept promotes the use of a single large ETS room unit in a central area of the home. In mild weather the total heating requirement can be provided with low cost off-peak energy. In colder weather the room unit provides a "warm spot" allowing a lower temperature throughout the majority of the home.

HOW RESIDENTIAL USERS BENEFIT FROM ETS

When utilities offer special time-of-day rates, residential customers can benefit from ETS by using low-cost energy to provide home heating. ETS provides all the benefits of electric heat--it is clean, efficient, and flameless. The room units provide localized heating and the warm cabinet permits strategic personal heating similar to a wood stove. Comfort levels utilizing room storage heaters are rated highly by consumers because of the radiant heat. In event of an extended power outage, stored heat in the room units will usually provide radiant heat until power is restored.

Storage units in residential applications operate from signals provided by the utility or consumer furnished time clocks, which allow heat input only during specified off-peak periods.

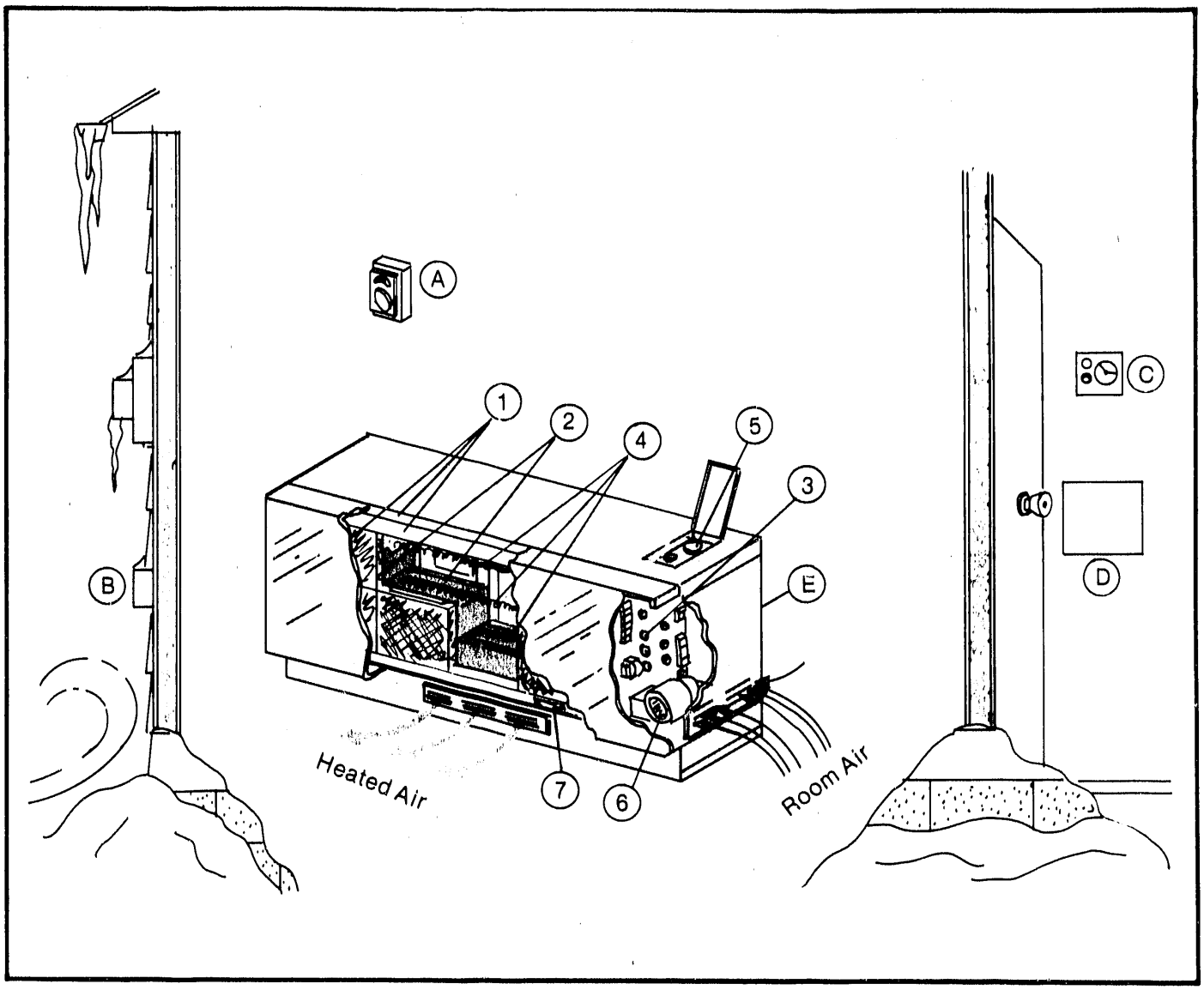
HOW COMMERCIAL / INDUSTRIAL USERS BENEFIT FROM ETS

Commercial / Industrial consumers benefit from ETS because heat can be stored while offices are closed, between shifts, during breaks, during hours when no shifts are operating, or anytime demand drops below peak levels.

Where electric heating is currently used, savings will result from reduced demand charges and/or lowered contract demand. In many cases, reduced contract demand can result in year-round savings.

Savings can also result from consumption of low-cost energy below established demand levels where kilowatt hour costs are less than the currently used heating fuel.

ETS units in commercial applications are controlled by time clocks in fixed shift operations or by demand limiters in variable shift applications.



HOW THE ETS SYSTEM WORKS

A. Heat is drawn out of storage by a fan under control of a room thermostat. One unit can heat two rooms with optional through the wall extended discharge duct to reduce equipment requirements and conserve floor space.

B. Outdoor sensors determine the charging rate of heat storage (charge level) based on outdoor temperature.

C. Charging controller signals storage equipment when to start heating (charging). Signal may be provided by time clock, utility, or a demand limiter.

D. For installations with a large number of room units (six or more), central control panels operate any number or combination of room units, hot water heaters, baseboard, central thermal storage furnaces, or dual-fuel heaters.

E. Room unit charges according to weather conditions and user control setting.

HOW THE ETS HEATER WORKS

1. Space-age insulation provides maximum heat retention. Best insulated room storage unit in the industry.
2. Special heat storage bricks store heat until needed, provide largest storage capacity of any room storage line.
3. Simple non-electronic charging controls for ease of service, low maintenance cost, and high reliability provide staging and charging control.
4. Reliable factory installed elements provide heat input for off-peak heating and core charging.
5. User-adjustable charge controller allows fine tuning of charge level.
6. Thermostat operated fan forces heat into space.
7. Bimetal operated airflow damper controls air discharge temperature by mixing bypass air with heated air from the core.

STANDARD FEATURES

Extra thick, multi-layer, space age insulation reduces room unit heater standby loss to the lowest in the industry.

The largest storage capacity of any ETS room unit line, using a combination of special refractory brick for maximum storage capacity.

Simple non-electronic controls for load staging, ease of service, low maintenance cost, and simple operation by user. High volume fan provides even heating.

Only American produced high temperature ceramic ETS room heater!

Multiple overheat safety controls for dependable, safe operation.

Attractive styling blends with any decor.

OPTIONAL FEATURES

- Extended discharge available to provide stored heat to an additional room. This unique feature will conserve valuable floor space, reduce heating equipment cost, and may result in a lower connected load, important in commercial applications. Where ETS Warm Room Concept is utilized even greater savings may be realized with less investment.
- Outdoor sensors control heating input based on outdoor temperature.
- Central control systems available for larger installations.
- Transformer kit for single unit operation.
- Automatic return override timer for emergency heat.
- Outside air intake provides make-up air where required.
- Hot water heater interlocks are available to combine operation of hot water heater and ETS heater for maximum year round savings.

Model	KW Input	KWH Storage	Depth (Inches)	Width (Inches)	Height (Inches)	Approx. Net Weight (Pounds)
ROP2	2	20	26.8	14.7	40	347
ROP3	3	20	26.8	14.7	40	347
ROP4	4	32	31.5	14.7	40	510
ROP5	5	42	31.5	14.7	49	675
ROP5.7	5.7	42	31.5	14.7	49	675
ROP6	6	42	31.5	14.7	49	675

Available in 24OV, 208V, and (277V) single-phase. Actual storage capacity listed. To transpose to equivalent European rating method multiplying listed storage by 1.20.

Become your own Energy Management Expert

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Off-Peak Controls

ETS Room Heaters

Ducted ETS Furnaces

Plenum Heaters

Industrial ETS Heaters

FOSTORIA - -We offer more Off-Peak® load management options than anyone.

Vaillant Electric Thermal Storage Heaters

ETS-series

UL Listed

Take advantage of the most modern advances in electric space heat.

What is Electric Thermal Storage heating?

The concept is simple. Vaillant ETS-Electric Thermal Storage heaters

- use electricity only when the electric power company's rates are the lowest (usually at night)
- turn that cheap electricity into heat which is easily stored
- store just enough heat to meet your daily need.
- [illegible] the stored heat (but no electricity) during the day when the electricity rates cost much more.

Electric Thermal Storage heating is a highly efficient, reliable and comfortable way of heating your home, office or business. Vaillant ETS-Electric Thermal Storage heaters are being used in locations around the world where comfort, economy and convenience are demanded by home owners and leading engineers.

Electric Thermal Storage systems are welcomed by electric power companies because they use a precise and predictable electric load during the off-peak time when the power companies have a surplus of available electric supply. Many electric companies offer an incentive to use Electric Thermal Storage heating.

This comes in substantially lower cost electric rates when you use your electricity during off-peak hours.

Vaillant ETS-Electric Thermal Storage heaters use only this cheap off-peak electricity converting it to heat during those off-peak hours and storing it for use as you need it throughout the day.

How do they work?

Electric power companies are faced with a problem each night. During the day when everyone uses the most electricity, the utilities operate at full capacity. At night electricity demand falls off sharply, so the power companies have huge surplus of unused generating power. This gives the electric companies a tremendous possibility to offer substantial discounts to people like yourself who can defer their power consumption into off-peak hours.

The Vaillant ETS-Electric Thermal Storage heaters take advantage of these lower costs. The heaters are timed to come on only during these off-peak hours when the electric rates are lowest.

An automatic charge control measures the outside temperature and determines – based on the residual heat and core temperature of the heater – how much energy needs to be stored in the heater to meet the heating requirements of the day.

In the Vaillant ETS-Electric Thermal Storage heaters, electricity is converted to heat and stored in special high thermal mass ceramic bricks. These special Magnesite-bricks are used for their ability to store immense quantities of heat.

During the day the stored heat is released into the home as needed and controlled by the room thermostat. At night during the off-peak hours the heat charge is "topped off" ready to meet the heating requirements of the day to come.

What are the benefits of the Vaillant ETS-Electric Thermal Storage heater?

Savings

Off-peak rates can be 40-70% less than basic residential rates. You can take advantage of these discounts with substantial savings. Vaillant ETS-Electric Thermal Storage heaters can save up to 50% or more over other electric heating systems.

Comfort

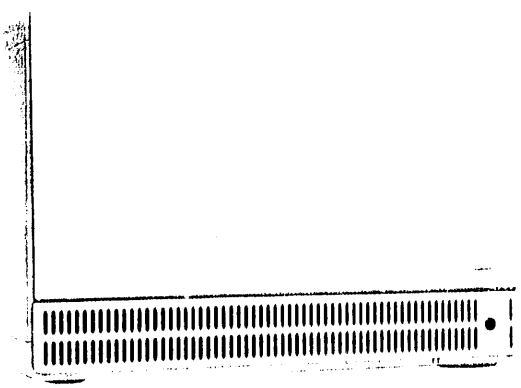
Vaillant ETS-Electric Thermal Storage heaters offer the precise combination of comfortable radiant heating and convection assistance that will maintain the ideal warmth for your.

Controls

Each room is controlled independently by its own room thermostat to the temperature you desire. The whole system can adjust itself automatically to changing outside temperature to assure you have all the heat you need while saving every bit of energy possible.

Efficiency

100% efficient. All the electricity you pay for is converted into heat. Nothing goes up the chimney. There are not any losses through pipes, ductwork or cold basements.



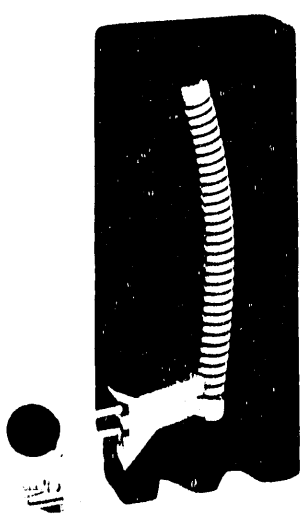
ETS-300

Simplicity

Vaillant ETS-Electric Thermal Storage heaters need no fuel storage, no pipework to freeze up, no radiators to leak, not even a chimney.
ETS-heaters can also be easily retrofitted by any qualified electrician with a minimum of effort.

Maintenance-free

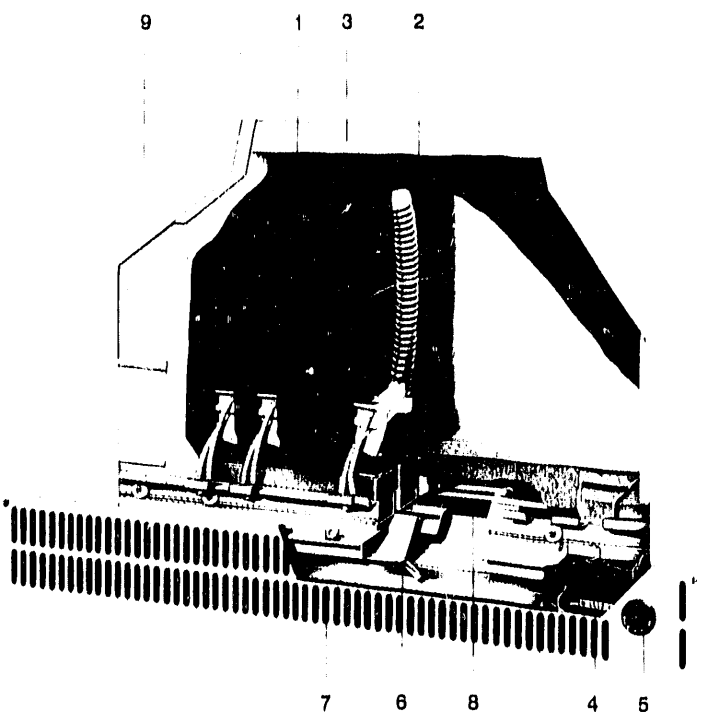
The quality and reliability of all components used in the Vaillant ETS-Electric Thermal Storage heaters assure a virtually maintenance-free operation.



Single core brick
with heating element

Product-features

- Self-cooling exit air grille. By drawing intake air through the lower part of the same grille that warm air is emitted from, the grille is prevented from reaching the high surface temperatures otherwise possible.
- Increased elements distribution. Even dispersion of heat across the entire heat surface instead of "hot spot" in the centre is achieved by using more and smaller elements distributed across the entire brick core.
- Air-exit mixing mechanism. A new design air damper mechanism ensures moderate exit temperatures.
- Air flow over elements. By circulating fan-blown air directly over the elements heat can be provided immediately upon energizing the element instead of waiting for the bricks to heat up.
- New elements design. New style elements drums prevent any contact between the element wire and the storage brick medium.
- Fluid regulator control. A more precise balancing of outside sensor data versus residual heat and core temperature.
- Automatic charging system. The colder it is outside, the more the heater charge. No overheating, no inefficiency.
- New soft line cabinet design.
- Single brick type. Eliminates inventory mix-ups or miscounts. Assures the simplest method of "bookshelf" type assembly possible.



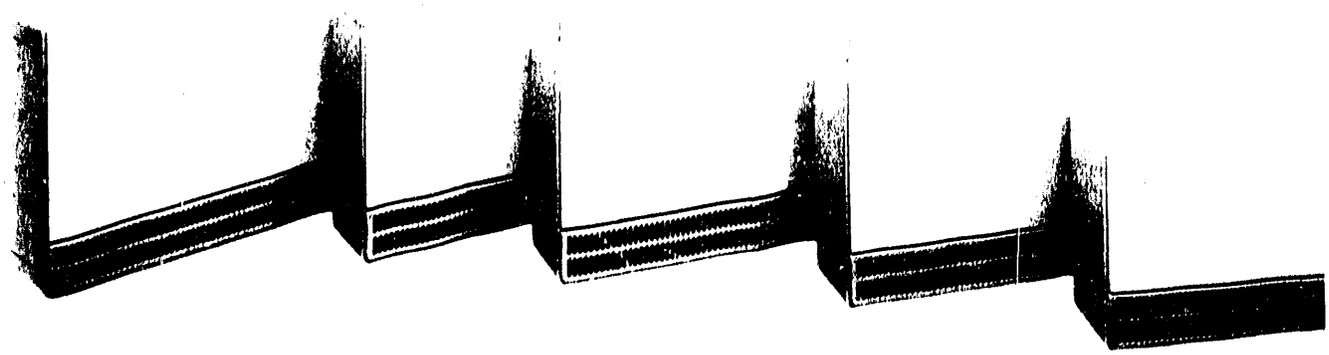
- Convenient front access. Assures easy, fast assembly and service. Can be tested while fully assembled.
- Elements can be changed at any time without removing bricks.

1 Core brick
2 Heating element
3 Insulation (mineralwool)
4 Terminal block
5 Temperature control knob
6 Automatic air mixing flap
7 Air grill
8 Fan
9 Jacket

System control equipment

A variety of control devices are available to allow easy operation of your Vaillant ETS-Electric Thermal Storage heaters. The design of our control panel system assures the utilization of components which best suits your application and provide optimum savings performance.

Technical Data



Complete product range

ETS-200	2	9.6	8.3	7.2	16 KWH	21.2"	26"	9.8"	233	6
ETS-300	3	14.4	12.5	10.8	24 KWH	37.8"	26"	9.8"	356	9
ETS-400	4	19.2	16.7	14.4	32 KWH	37.8"	26"	9.8"	480	13
ETS-500	5	24.0	20.9	18.0	40 KWH	49.2"	26"	9.8"	564	15
ETS-600	6	28.9	25.0	21.6	48 KWH	49.2"	26"	9.8"	662	18

Vaillant

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MINNEAPOLIS MN 55422
PHONE (612) 544-6807
FAX (612) 546-5617

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American TechnoTherm
CORPORATION

Electric Thermal Storage Heating

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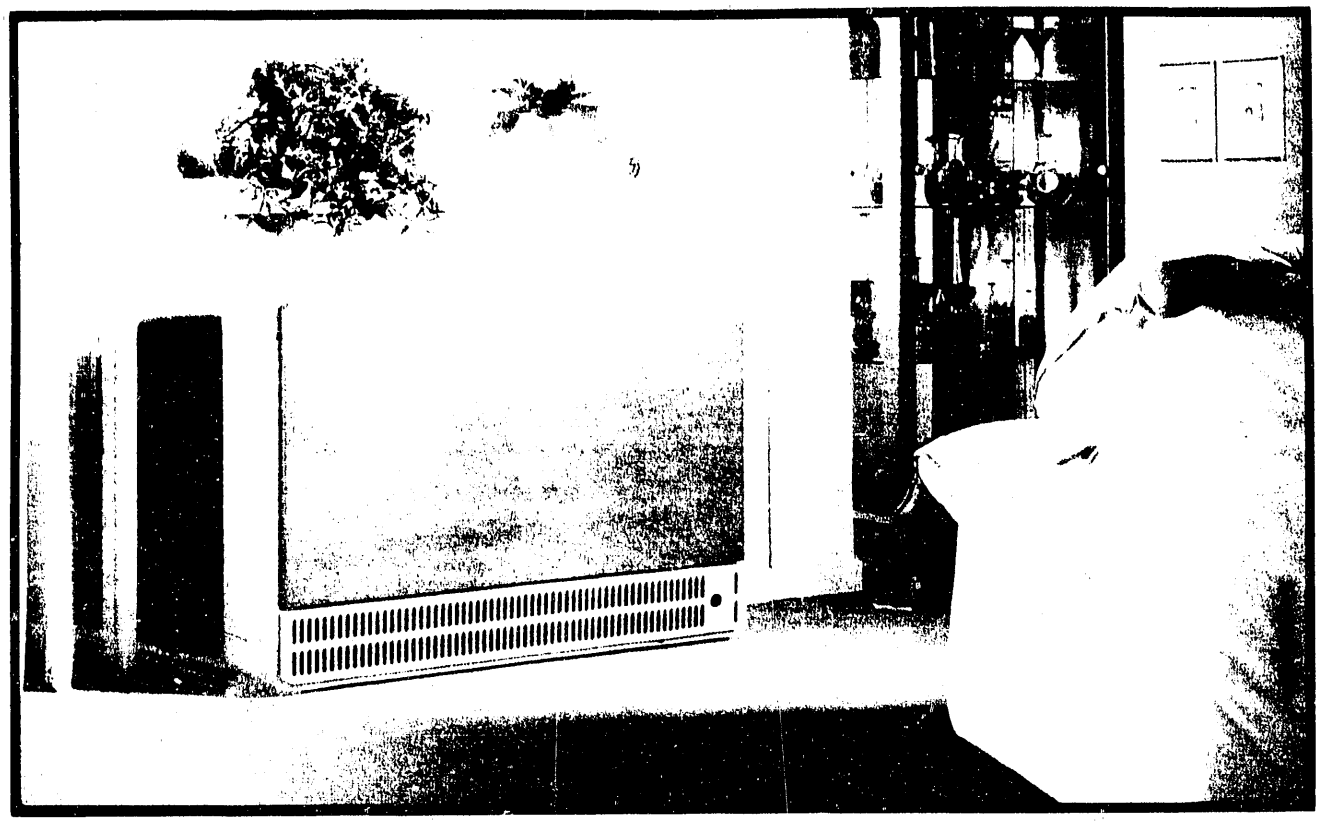
If utility companies in your area offer Time-of-Day Rates or Off-Peak Rates...



You can take advantage of the most modern advances in space heat!

Off-Peak or Time-of-Day rates can be 40% to 70% less than what the utility charges for their basic residential rate. You can take advantage of these discounts with substantial savings and no disruption of your everyday lifestyle. Commercial customers who purchase electricity on demand rates should experience similar savings.

AMERICAN TECHNOTHERM Electric Thermal Storage (ETS) heating is easy for a contractor to install, easy to operate and is virtually maintenance free. Low-cost electricity is used during off-peak hours, converted to heat and stored for use throughout the day in thermostatically controlled individual heaters.

AMERICAN TECHNOTHERM ETS heaters can be very effectively utilized for load leveling on demand rates which results in a substantial savings on your overall electric bill.

AMERICAN TECHNOTHERM makes it possible to enjoy all the advantages of dependable, safe, maintenance-free electric heating with savings up to 50% or more on electric bills. AMERICAN TECHNOTHERM heaters can be less expensive to operate than even gas or fuel systems.

Announcing Technical Perfection in a Fully Automatic, Economical, Non-Polluting Electric Heating System

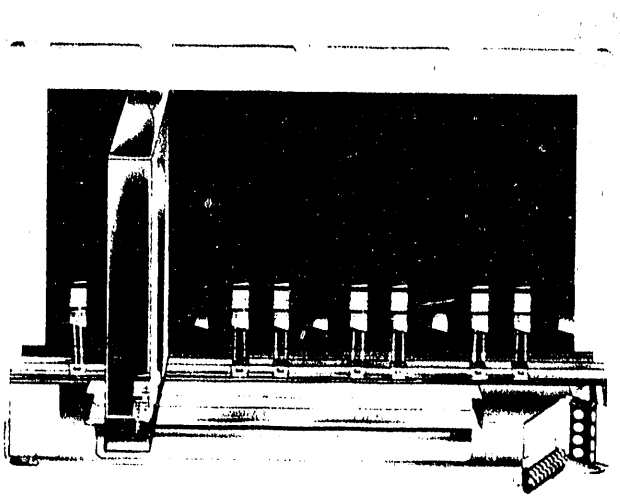
The concept is simple. An AMERICAN TECHNOTHERM ETS heating system will:

☐ Use electricity only when the power company's rates are the lowest (usually at night).

☐ Turn that cheap electricity into heat which can be easily stored.

☐ Store enough heat to meet your daily needs.

☐ Use the stored heat (but no electricity) during the rest of the day when the electricity rates cost much more.



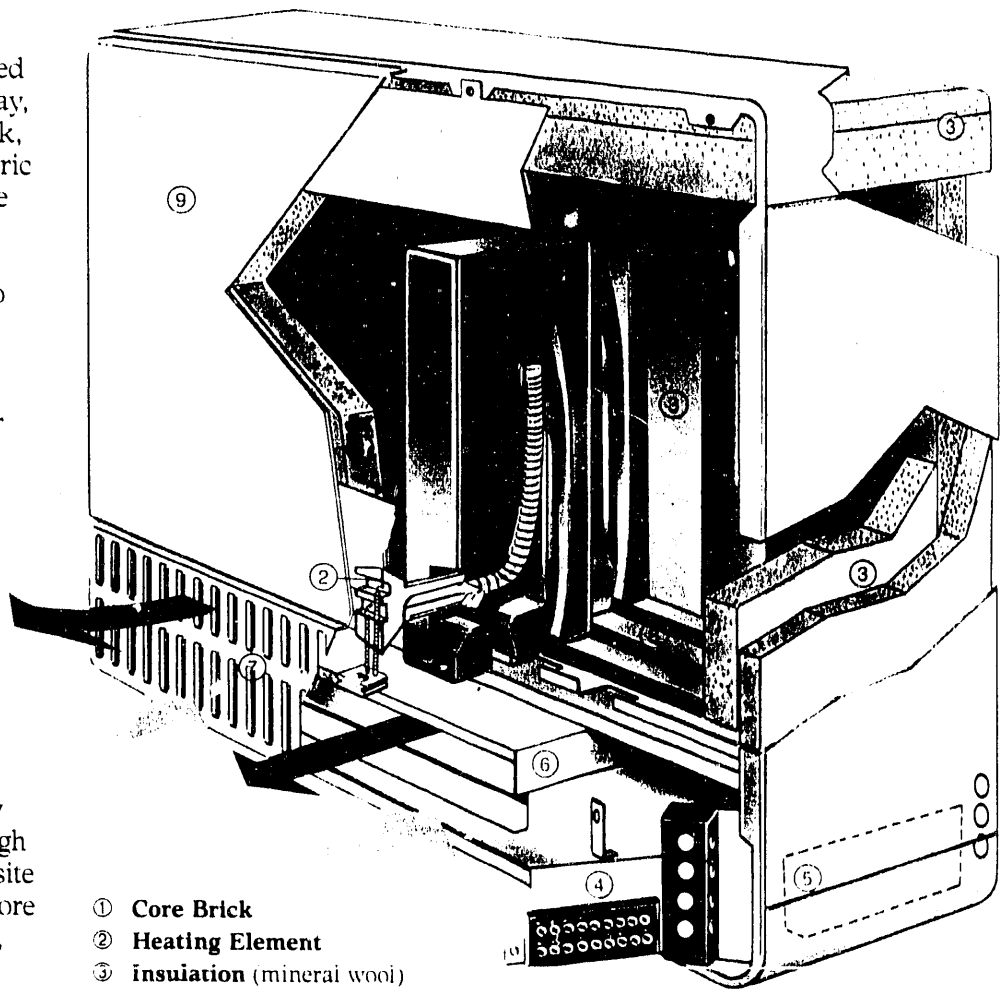
Convenient Ease of Installation "Bookshelf" Brick Assembly

The Utility's Role: Why Do They Do It?

Each night, the electric company is faced with a problem. During the day when everyone uses the most electricity, the utility operates at full capacity. At night, electricity demand falls off sharply, so the utility has huge surpluses of unused generating power. Since electric companies buy electricity based on what their peak usage is during the day, the more usage they can can shift to off-peak, the less they must pay for their overall electric use. This gives them a tremendous incentive to lower that daytime demand by offering substantial discounts to people like yourself who can defer their power consumption into the off-peak hours. That off-peak rate is usually 40% to 70% off the daytime rate.

The AMERICAN TECHNOTHERM ETS heating system takes advantage of the lower costs. It is timed to come on only when the electric rates are lowest, but the system doesn't just come on "full blast." An automatic charge control measures the outside temperature and determines how much energy actually needs to be stored in the system to meet the heating requirements of the day. In this way, the system can take on a partial or full heating charge based entirely upon the level of comfort you set on your thermostat.

As the ETS system is "on," the electricity is converted to heat and stored in special high thermal mass ceramic bricks. These Magnesite bricks are used for their special ability to store dense quantities of heat. During the day, the stored heat is released as needed into the home. Then, at night, the heat charge is "topped off," ready to meet the heating requirements of the day to come.



① **Core Brick**
② **Heating Element**
③ **Insulation** (mineral wool)
④ **Terminal Block**
⑤ **Cable Conduit** (raceway)
⑥ **Automatic Air By-Pass**
⑦ **Air Grill** (in and outlet)
⑧ **Ceramic Insulation Bricks**
⑨ **Front Panel**

What Are the Advantages of American TechnoTherm Electric Thermal Storage Heaters?

Advantages:

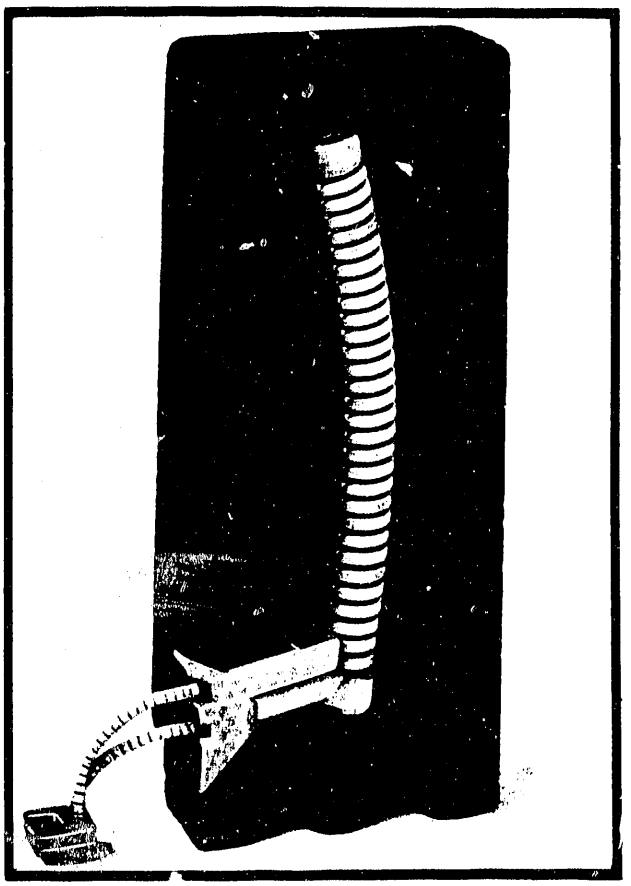
Savings: An AMERICAN TECHNOTHERM ETS heating system can save as much as 50% to 70% over other electrical heating systems, and just as much over fuel-fired systems.

Comfort: No other heating system offers the precise combination of comfortable radiant heating and convection assistance that will maintain the ideal warmth for you. There are no ups and downs in room temperatures; no drafts; no cold rooms where you don't want them.

Control: Each room is controlled independently by its own thermostat to the temperature you desire. The whole system can adjust itself automatically to changing outside temperatures to assure you have all the heat you need while saving every bit of energy possible.

Quiet: The small fans in the heaters are very quiet low-volume devices that cannot be heard, even when you are right next to the heater.

Efficiency: 100% efficient. All the electricity you pay for is converted into heat. Nothing goes up the chimney as fumes or smoke. There are no losses through pipes, ductwork, or cold basements.



☐ **Fast Heat Recovery**
☐ **Air Passage Directly Over Elements**
☐ **Element Change Without Brick Removal**

Simplicity: An AMERICAN TECHNOTHERM ETS heating system needs no fuel storage, no pipework to freeze up, no radiators to leak, not even a chimney! ETS heaters can also be easily retrofitted with a minimum of effort.

Investment: When you add an AMERICAN TECHNOTHERM ETS heating system in your home, you add an important and valuable resale feature should you ever decide to move.

Maintenance-Free: All AMERICAN TECHNOTHERM ETS heating systems include a guarantee that assures the quality and reliability of all the components in the system.

Improvements:

☐ Fluid Regulator Control. A more precise balancing of outside sensor data versus residual heat and core temperature.

☐ Self-Cooling Exit Air Grill. By drawing intake air through the lower part of the same grill that warm air is emitted from, the grill is prevented from reaching the high surface temperatures otherwise possible.

☐ New Element Design. New style element drums prevent any contact ever between NICHROME element wire and the storage brick medium ensuring there is no deterioration from chemical aggression.

☐ Lever Air Mixing Mechanism. A new design damper mechanism ensures moderate exit temperature. There are no sliding surfaces which can be defeated by surface debris.

☐ Increased Element Distribution. Even dispersion of heat across entire heater surface instead of "hot spot" in center is achieved by using more and smaller elements distributed across the entire brick core.

☐ Air-Flow Over Elements. By circulating fan-blown air directly over the elements, heat can be provided immediately upon energizing the elements instead of waiting for the bricks to heat up.

☐ New More Contemporary Softline Cabinet Design.

☐ New Softer, More Neutral Color.

☐ Single Brick Type. Eliminates inventory mixups or miscounts. Assures the simplest method of "Bookshelf" type assembly possible.

☐ Convenient Front Access. Assures easy, fast assembly and service. Can be tested while fully assembled.

☐ Elements Can Be Changed At Any Time Without Removing Bricks.

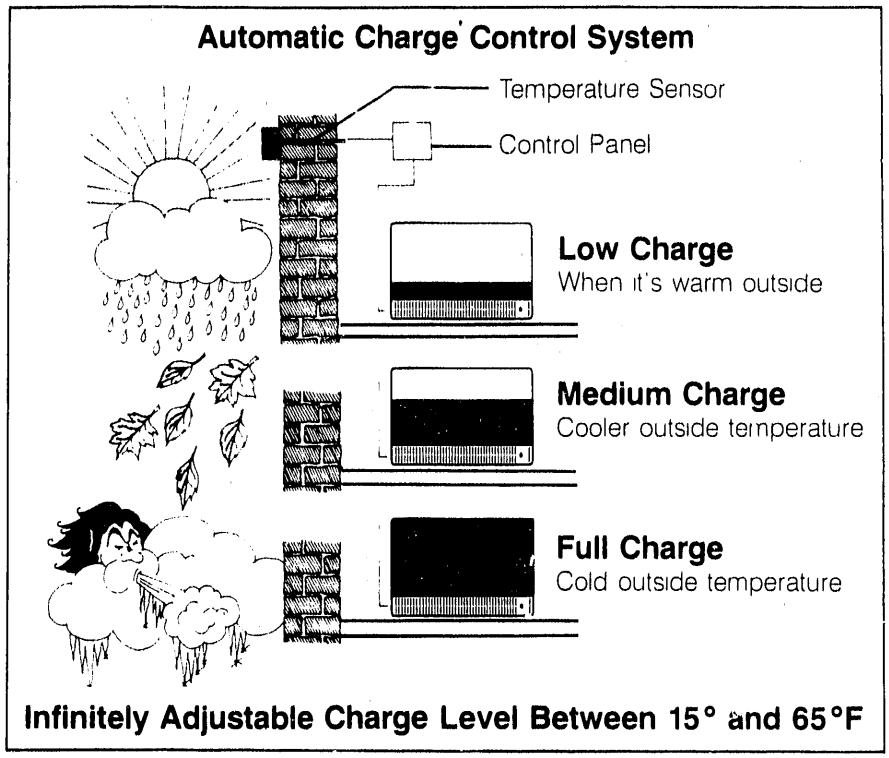
☐ Smaller Sizes. Most units are shorter in length in the improved models.

What is Electric Thermal Storage Heating?

Electric Thermal Storege heating is a highly efficient, reliable and comfortable means of heating your home, office, or business. AMERICAN TECHNOTHERM ETS heaters are being used in millions of locations around the world where comfort, economy, and convenience are demanded by knowledgeable homeowners and leading engineers. Thermal storage heat is welcomed by electric power companies because it uses a precise and predictable electric load during a time of day when they have a surplus of available electric supply.

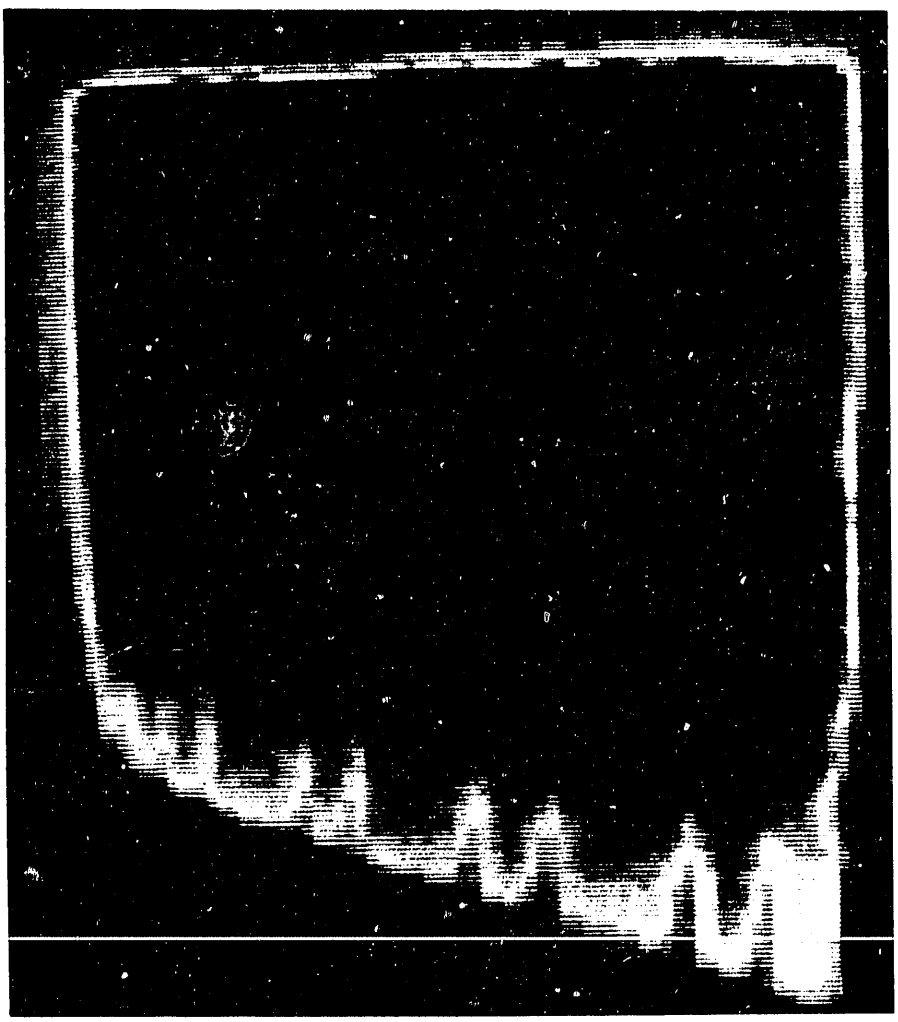
Most electric companies will offer you an incentive to use thermal storage heating. This comes in substantially lower cost electric rates when you use your electricity during off-peak hours. AMERICAN TECHNOTHERM ETS heaters use only this cheaper off-peak electricity, converting it to heat during those off-peak hours and storing it away for use as you need it throughout the day. In this way, you draw electricity for heating only during off-peak hours, yet you have an abundant supply of heat 24 hours a day.

AMERICAN TECHNOTHERM ETS heaters are compact, attractive units designed to blend into any room's decor. Unlike heating with other fuels, the ETS heaters do not require maintenance. They can be totally automatically controlled, continuously adjusting the amount of electricity used according to the outside temperature. They take up very little room and can even be recessed into the wall. AMERICAN TECHNOTHERM ETS heaters can be easily installed by any qualified electrician.



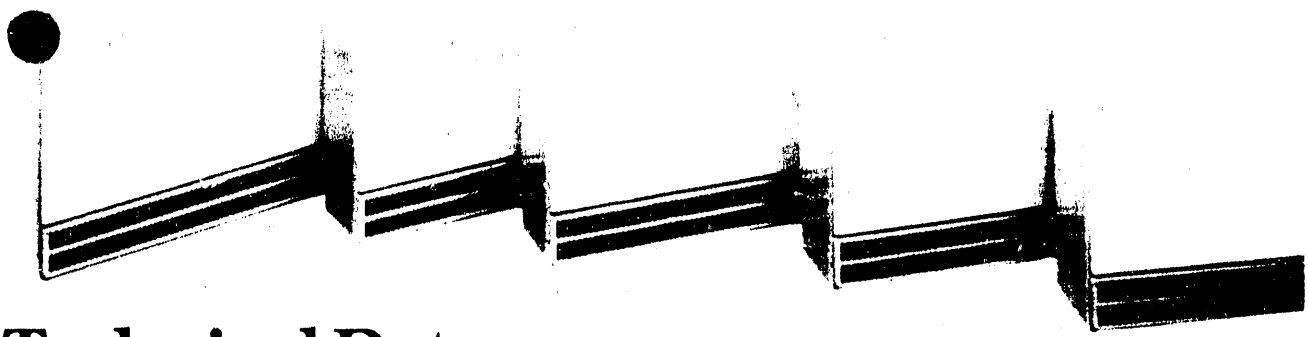
Automatic Charging System

...the colder it is outside, the more the heaters charge. No overheating, no inefficiency.



Infrared Profile

Balanced heat distribution across the entire heater. No hot spots!



Technical Data

Heater Model No.	Power Rating KW	Heater Current Rating 208V Amps	240V Amps	277V Amps	Maximum Storage Capacity	A Length	B Height	C Depth	Weight Lbs.	Number of Bricks
ETS-200	2	9.62	8.33	7.22	16 KWH	21.2"	26"	9.8"	233	6
ETS-300	3	14.42	12.50	10.83	24 KWH	37.8"	26"	9.8"	356	9
ETS-400	4	19.23	16.66	14.44	32 KWH	37.8"	26"	9.8"	480	13
ETS-500	5	24.04	20.83	18.05	40 KWH	49.2"	26"	9.8"	564	15
ETS-600	6	28.85	25.00	21.66	48 KWH	49.2"	26"	9.8"	662	18
ETS-750	7.5	36.05	31.25	27.07	60 KWH	49.2"	26"	12.6"	852	N.A

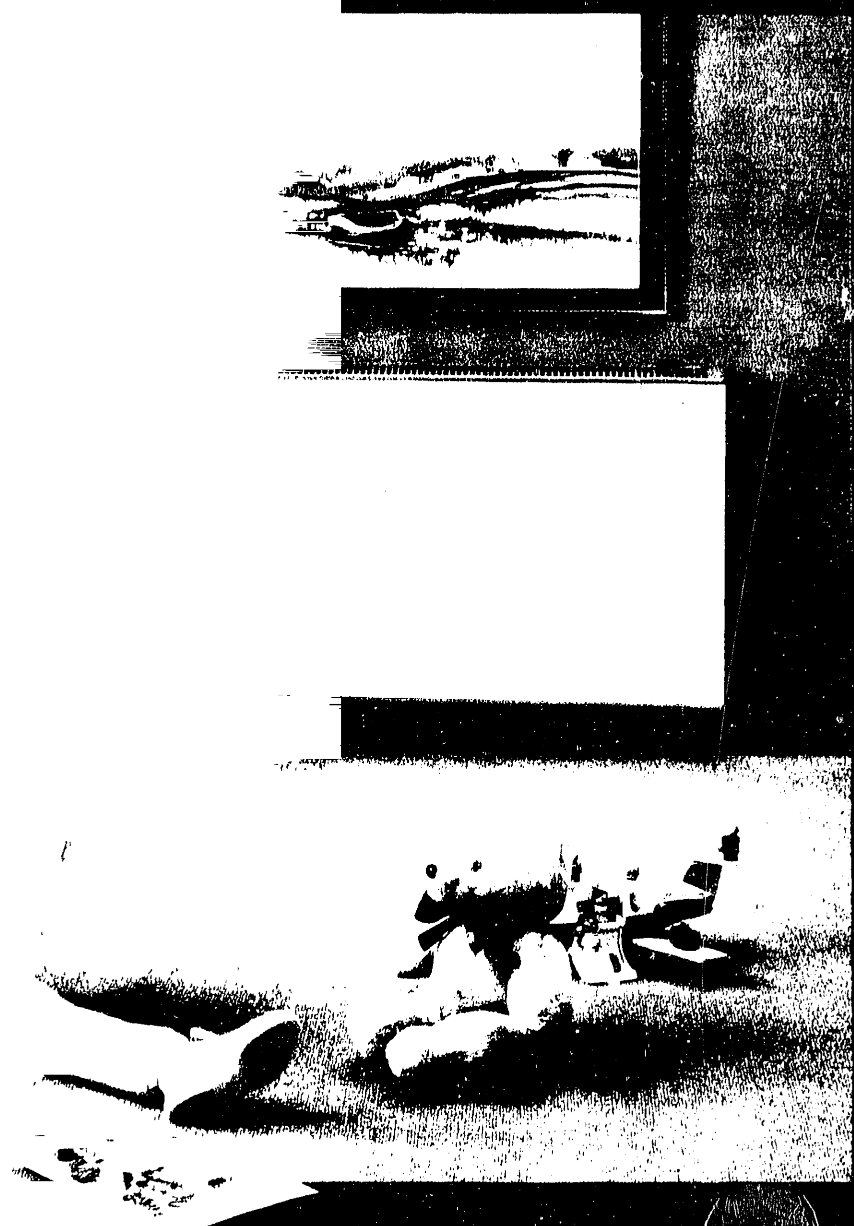
Heater for available ETS 750

System Control Equipment

A variety of versatile control devices are available to allow easy operation of your AMERICAN TECHNOTHERM Electric Thermal Storage heating system and any applicable rate. The design of our modular control system permits utilization of the components which best suit your application and provide optimum savings performance. A selection of control panels is available to adapt your system for Time-of-Day rates, Special Storage Heat rates or Demand Limited rates. These control panels are available for both residential and commercial/industrial applications.

American TechnoTherm CORPORATION

... inexpensive
nighttime
...ectric rates.



MARLEY

STATIC ELECTRIC THERMAL STORAGE HEATERS

How Marley warmed up a good idea.

At the turn of the century, before modern heating systems, people heated bricks — then placed them between the bed sheets for warmth and comfort. Today Marley Electric Storage Heaters use this age old concept of "storing heat in bricks."

Ceramic bricks are interwoven with electric heating elements and stacked in attractive, well insulated cabinets. The heating elements are energized with electricity during low-cost nighttime hours.

These elements produce enough heat during the nighttime to keep your living space warm at night, and at the same time, store enough heat in the ceramic bricks to provide for the next day's entire heating requirements. During the day the stored heat is circulated to the living space to maintain a comfortable temperature.

You get these outstanding benefits, too:

- **Savings from 30% to 60%** when compared to on-peak electric heating rates.
- **100% efficiency.** Every dollar spent is converted to heat energy.
- **Cleanliness.** Like other electric heating systems Marley ETS units are clean to operate.
- **Comfort.** Passive radiant heating provides even, cozy warmth. Damper-controlled convection heating adds warmth when and where you want it.

Heat your home during the day with low-cost nighttime electricity rates.

The amount of heat stored each night is automatically determined by a built-in thermostat. As the indoor temperature changes, (determined by outside temperature) the length of the charge period is automatically calculated to provide the exact amount of heat required for the next 24-hour period.

Most important, you're in complete control. Input and output controls are located on top of the heater. And a comfort level control is located on the right hand side. They let you regulate the amount of overnight heat storage and determine room comfort levels.

How the Marley Static ETS System works: Marley Static Electric Storage Heaters operate on the radiation and convection principles of heat transfer.

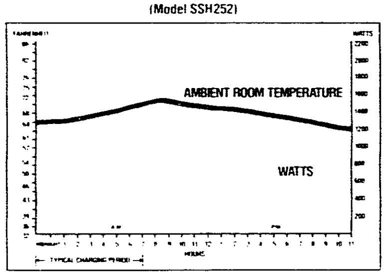
When additional heat is required, a damper opens to provide convection heating. (1) Cool air is drawn into the vents at the bottom of the heater. (2) The air passes through the heated ceramic bricks and (3) is dispersed into the room through vents at the top of the heater.

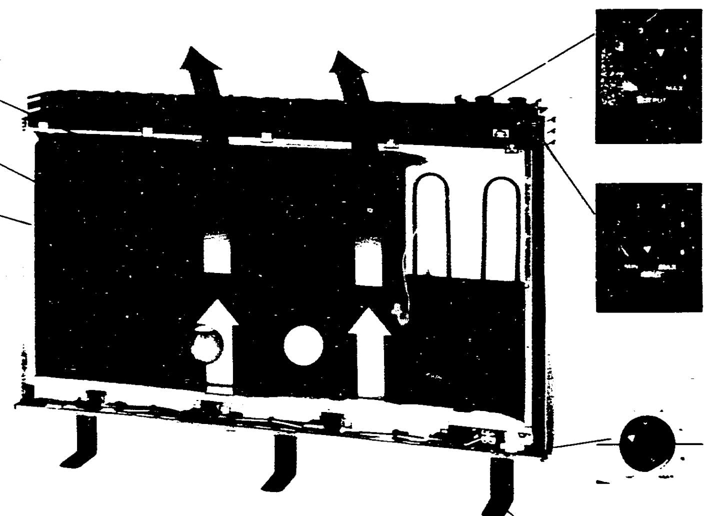
Special alloy heating elements ...

Ceramic bricks store vast amounts of heat for extended periods of time.

Space age insulation stops heat loss. ...

PERFORMANCE CURVES
(Model SSH252)





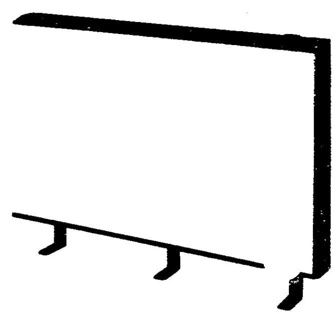
Heat output control. The setting of this control determines the charge level at which the mechanical damper starts to open. The purpose of the damper is to maintain or increase the heat output as the charge level decreases.

Heat input control. An adjustable, built-in thermostat responds to the temperature in the storage heater (not the room) and limits the maximum charge the heater will take. It can be turned down to reduce the charge, if less stored heat is required.

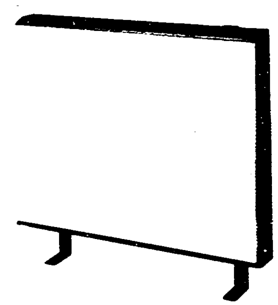
Comfort level control. A bulb and capillary type thermostat that varies the amount of heat stored in response to the temperature it senses, i.e., it tells the heater to store more heat on cold nights ... less heat on warm nights.

Fits snug against the wall. Support legs hidden underneath the carpet, provide cleaner, less cluttered appearance.

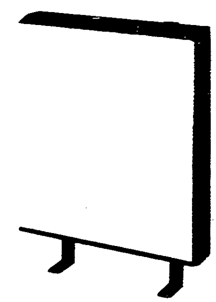
Three convection models with varying degrees of heat output meet every comfort need.



Model SSH342. Largest, most powerful Marley static ETS heater with an average heat output of 1000 watts.



Model SSH252. Average heat output of this medium range Marley ETS heater is 750 watts. Design and appearance are the same as the other units.



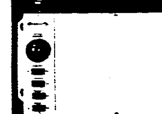
Model SSH172. Smallest of the Marley static ETS heaters — with an average heat output of 500 watts.

Four optional controls help make your Marley Static ETS Heater totally automatic.

You can wire them directly to an electric meter that automatically puts your Marley ETS heater on the night service rate when costs are low.

Again, when Marley ETS heaters are energized with this low-cost electricity during these off-peak times, the electric heating elements produce enough heat to warm your home at night. And enough heat is stored to provide the entire supply of heat needed for the next day at the same low cost.

Or Models SYS450 and SYS920 ... extra warmth is required during the day, an on-peak override timer is available to provide an additional ... hours of charging. On Model SYS905 an on-peak override switch is available to provide continuous additional charging.



SYS450 Off-Peak Load Control Panel. ...

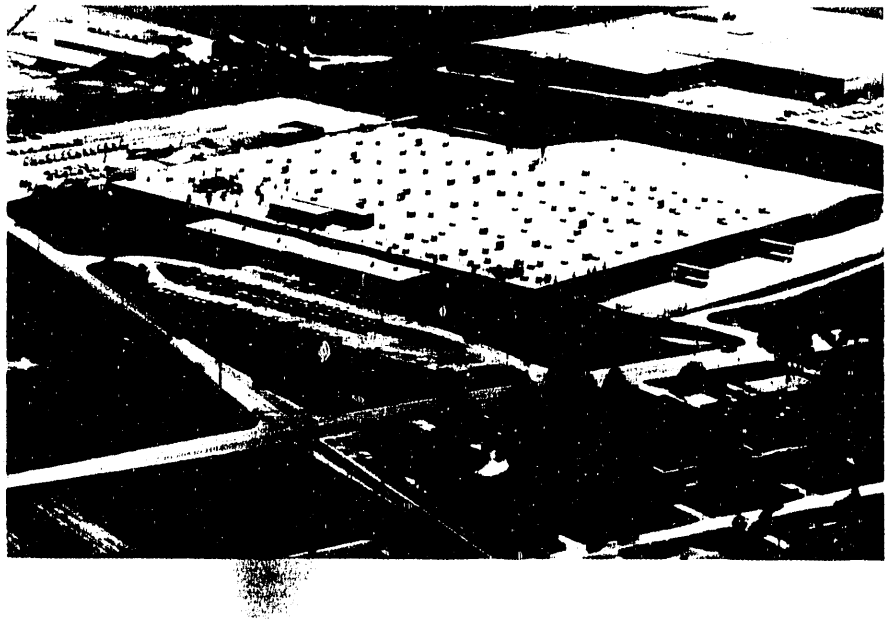
SYS920 Off-Peak Load Controller with Override. ...

SYS910 Off-Peak Load Controller. ...

SYS905. 24-Volt. Off-Peak Load Controller With Override. ...

MARLEY
Static Heaters & Accessories

CATALOG NO.	DESCRIPTION	RATING	VAC	AMPS	QTY. OF BRICKS	DIMENSIONS LENGTH	HEIGHT	DEPTH	WEIGHT
SSH172	1.7 KW 240V STATIC HEATER	1.7 KW	240	7.1	8	20 11/16"	27 15/16"	5 7/8"	31 lbs.
SSH252	2.5 KW 240V STATIC HEATER	2.5 KW	240	10.6	12	29 11/16"	27 15/16"	5 7/8"	45 lbs.
SSH342	3.4 KW 240V STATIC HEATER	3.4 KW	240	14.2	16	38 11/16"	27 15/16"	5 7/8"	58 lbs.
No. 30	STATIC BRICKS	—	—	—	4/carton	11 11/16"	9 1/4"	8 1/2"	72 lbs.
SYS450	STATIC CONTROL PANEL	—	—	—	—	15"	10"	4 5/8"	12 lbs.
SYS910	LOAD CONTROLLER	—	—	—	—	4 9/16"	4 1/2"	2"	1 lb.
SYS920	LOAD CONTROLLER W/OVERRIDE	—	—	—	—	6 3/8"	4 1/2"	2"	3 lbs.
SYS905	24 volt LOAD CONTROLLER	—	—	—	—	6 3/8"	4 1/2"	2"	1 lb.



This is the home of Marley ETS Electric Storage Heaters.

Marley is a recognized leader in the manufacture of a full line of zoned electric heating products with nationwide distribution. This 400,000 sq. ft. facility in Bennettsville, S.C. houses our R&D engineering and manufacturing facilities all under one roof.

FOR TECHNICAL ASSISTANCE CALL OUR TOLL-FREE HOTLINE. PROFESSIONAL HELP IS JUST A PHONE CALL AWAY.

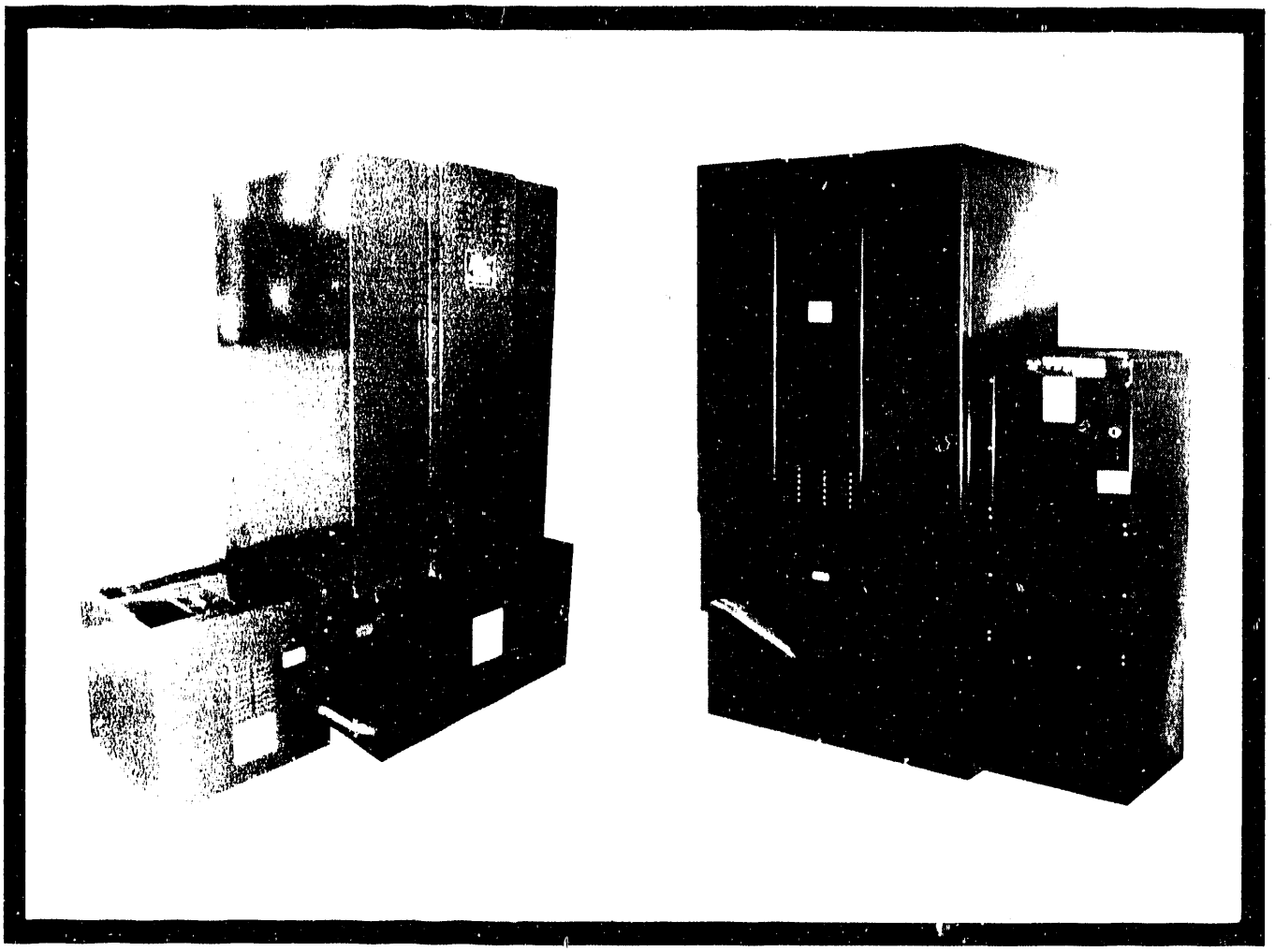
Our Marley Electric Heating pros will be happy to answer your questions on installation problems, sizing and performance characteristics. They'll also help you determine which equipment is right for the job. Call today.
1-800-642-HEAT

MARLEY

Marley Electric Heating Co.
Rt. 3, Bennettsville, S.C. 29512

•OFF-PEAK HEATING

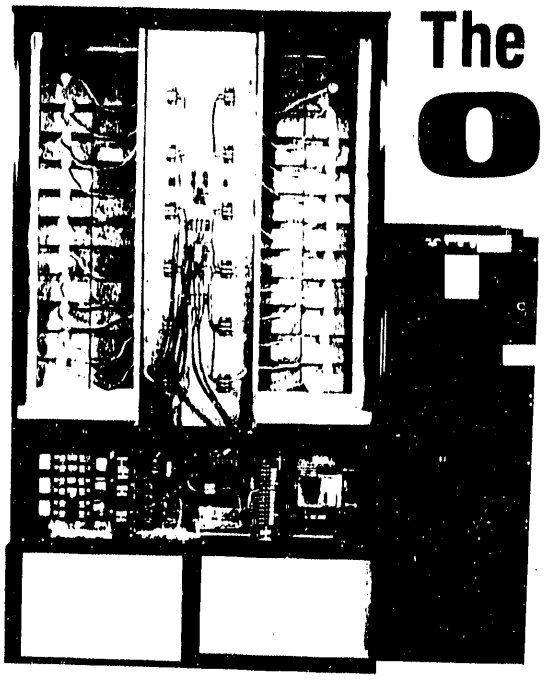
For DUCTED APPLICATIONS



Store tomorrow's heat...tonight!

ELECTRIC THERMAL FOSTORIA STORAGE

fostoria® INDUSTRIES, INC.
SPECIAL PRODUCTS DIVISION



The Residential OFF-PEAK® ETS Furnace

ELECTRIC THERMAL STORAGE

uses electricity from your utility during off-peak demand times which occur at night. It stores up to sixteen hours of heat at a high temperature in a brick core. During the day when utility power demand is highest, the stored heat is extracted from the core and fan forced into your home to maintain a desired temperature. The charge controller selects the amount of stored heat required for the next day. It activates the heating elements within the core to store heat when the outdoor temperature and the temperature within the core indicate the need for more stored heat.

During mild weather, only a partial charging of the heat storage core will be required.

Night-time heating is provided by the night heating elements which operate automatically while the storage elements are recharging the heat storage core.

Safety devices prevent excess build-up of stored off peak heat. In the event of mechanical difficulty with the off peak storage, emergency overrides will provide backup heat until a serviceman can correct charging problems.

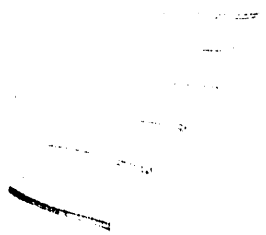
A cooling cabinet is available and can be supplied with your off peak furnace. Your dealer can supply a split system air conditioner and install it conveniently at any time for comfortable summertime cooling.

Off-Peak Heater Components

CORE BRICK

Storage Core Brick

The section of the system where heat is stored is made of olivene brick specially designed for heat storage. These bricks are fitted together to form air passages. The directly heated air is tempered with by-pass air to obtain the desired outlet temperature.



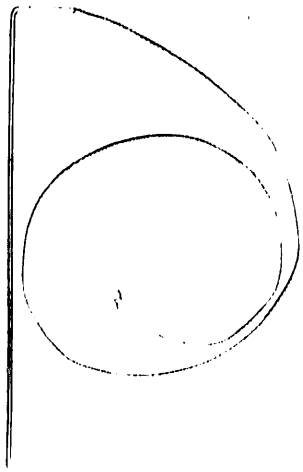
HEATING ELEMENTS

Heating Elements

The heating elements are made of nichrome wire coils sandwiched between the layers of brick. The element design specifies heavy gauge wire and carries a five year warranty.

The Charge Control Thermocouple

The thermocouple an electronic thermometer, measures the temperature of the core and signals the solid state charge controller. The charge controller turns the elements off when the signal matches the predetermined amount of stored heat needed for the next day.

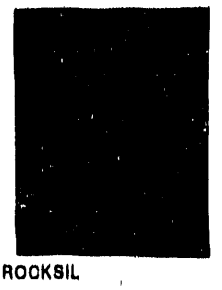


THE CHARGE CONTROL THERMOCOUPLE

Insulation

The heat storage unit is surrounded with space age insulation to maintain core temperatures and to reduce surface temperatures. Ridged board type insulation is positioned next to the blocks on the sides and bottom of the core to provide inlet and outlet air passages and to define the outer airways. Dense long fibre insulating blankets with high temperature resistance is used on all sides and the tops of the core.

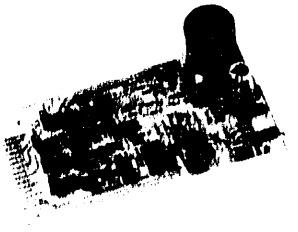
MICROTHERM



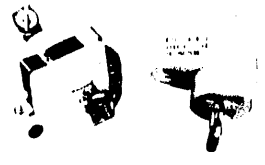
ROCKSIL

The Solid State Charge Controller

The controller is a printed circuit board operating only during the off-peak period. The signal from the outdoor thermistor determines the required amount of stored heat—the signal from the thermocouple determines the amount of heat present in the core; then the charge controller activates the correct number of heating elements within the core to obtain the predetermined amount of stored heat required for the next on-peak period.



SOLID STATE CHARGE CONTROLLER



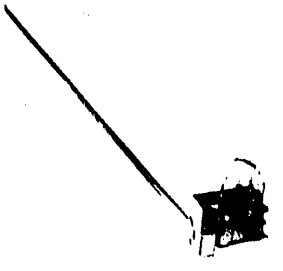
LIMIT CONTROLS

Limit Controls

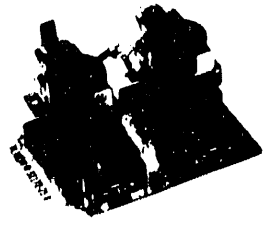
Limits are connected in series with the core heating elements. If overheating occurs, they de-energize the elements directly.

Hydraulic Core Limit

The control is inserted deep in the core and connected in series to the safety contactor and the solid state charge controller to prevent overheating of the heat storage core.



HYDRAULIC CORE LIMIT



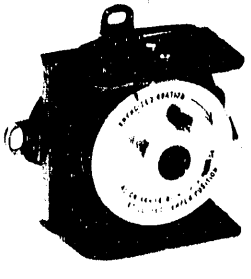
TIME DELAY RELAY

Time Delays Relays

Time Delay Relays sequence the heating elements of the storage core as called for by the Charge Controller.

The Dampers

The Dampers control the air flow through the heat storage core and the volume of by-pass air. By mixing the correct proportion of heated and bypass air, the dampers maintain a constant preset outlet temperature.



DAMPER MOTORS

The Damper Motor

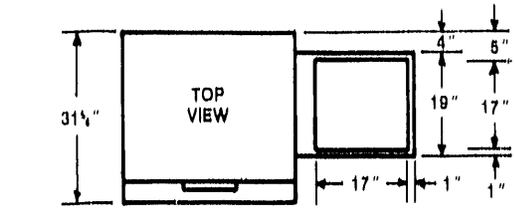
The damper motor under the control of the mixed air thermostat, position the dampers which route the air flow for heat extraction from the hot core.

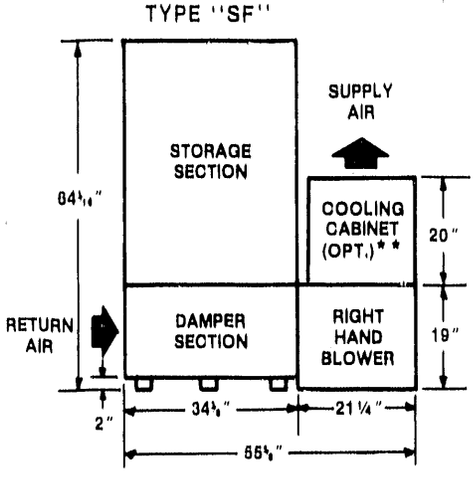
Mixed Air Thermostat

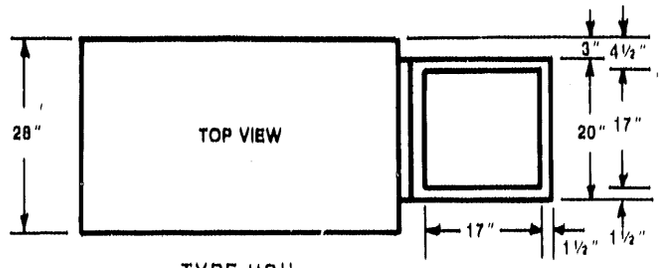
Located in the discharge air stream in the fan section, the mixed air thermostat controls movement of the bimetal damper motor. By varying the percentage ratio of heated core air and bypass air the preset discharge air temperature is constantly maintained.

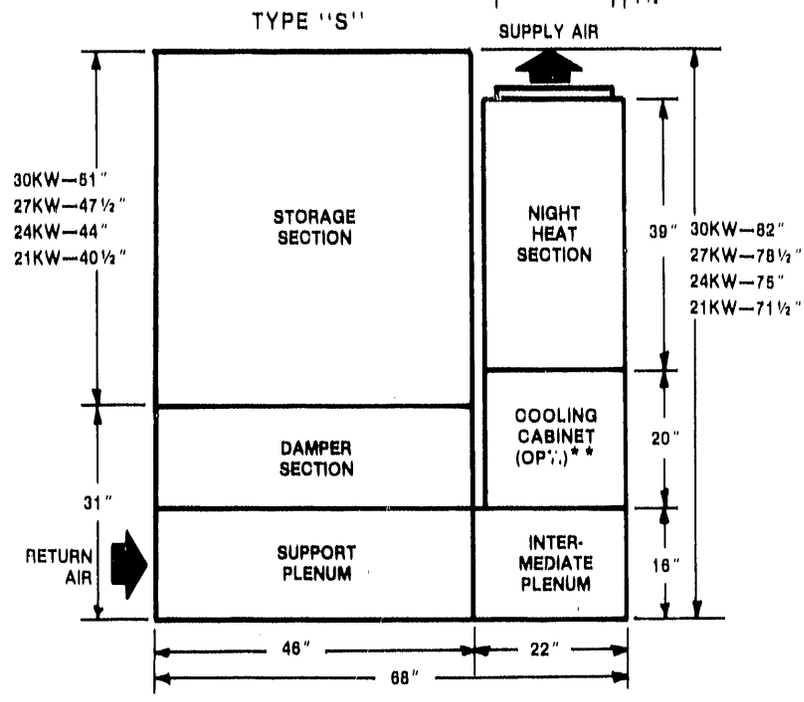
MIXED AIR THERMOSTAT

Planning for installation of your OFF-PEAK ETS Furnace









Location: The Fostoria Off-Peak Furnace should be installed in a heated or semi-heated area of the house. Because this furnace gives off some heat continuously, the area surrounding it must be properly ventilated.

Clearance: Minimum of 3 inches from sides, 6 inches from top, 36 inches in front for service access.

Floor Loading: The floor on which the furnace is set must be able to withstand loading of 375 lbs./sq. ft. for Gen I type S furnaces and 240 lbs./sq. ft. for Gen II type SF furnaces. Concrete floors are ideal. Furnace must be accurately positioned prior to loading the core brick. If a move is attempted, the core bricks may shift resulting in damage to the elements and insulation.

Insulation: Do not add external insulation to any part of the unit. Additional insulation would obstruct the normal ventilation of the cabinet and cause it to overheat.

Sizing: Since all the heating can be accomplished in 1/3 of the day, the total connected load will be three times the heat loss when an eight hour charge and sixteen hour discharge period is utilized. Consult the factory for sizing.

SPECIFICATIONS:

Fostoria Item No.	Model No.	Ship Wt. Lbs.	Total Input KW	System Voltage	Heating Amps.	Fan Amps.	System Air Flow CFM	Storage KW	Storage Amps.	Capacity KWH	Night Heat KW	Night Heat Amps.
*	21SF21	1695	21	240	87.5	4.3	800	14	58.3	112	7	29.2
0821990	21S21	2480	31	240	129.2	3.1	1180	21	87.5	140	10	41.7
0824990	21S24	2665	35.6	240	150.0	3.1	1180	23.6	100.0	160	12	50.0
0827990	21S27	2875	39.8	240	168.8	3.1	1180	26.3	112.5	180	13.5	56.3
0830990	21S30	3060	43.9	240	187.5	3.1	1180	28.9	125.0	200	15	62.5

*806220 Right hand blower *806230 Left hand blower * *Optional cooling cabinet (080200)

ELECTRIC THERMAL STORAGE FOSTORIA

fostoria INDUSTRIES, INC.
SPECIAL PRODUCTS DIVISION

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