An Evaluation of Extending a Land Line to Manitoba's Remote Communities Case Study: Churchill, Manitoba

by
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A Practicum Submitted
in Partial Fulfillment of the
Requirements for the Degree,

Master of Natural Resources Management

Natural Resource Institute
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Cynthia N. Kohuska, P. Eng.

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of Master of Natural Resources Management.

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Abstract

The production of diesel generated electricity in remote communities in Manitoba is costly, and service to the consumer is generally limited to 15 amperes. The Province of Manitoba and the Federal Government subsidize Manitoba Hydro's cost of production of diesel generated electricity. By extending the land line to a remote community the cost of supplying electricity decreases and the service to the consumer improves. The land line was extended to Churchill in May, 1987. A cost/benefit analysis and an environmental assessment were performed by others and are reviewed in this practicum. An evaluation of converting 24 facilities to electricity for space heating was performed to determine the benefits for converting space heating to electricity. Because electric service in Churchill is no longer restricted, electricity is now an option for a heating source. The evaluation of converting the 24 facilities to electricity for space heating concluded that the consumers would reduce energy consumption and energy costs if they converted their heating systems to electricity, in spite of the fact that there has been a decrease in propane costs subsequent to the availability of electricity for heating purposes.

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TABLE OF CONTENTS

FIGURES AND TABLES

Figures

Tables

APPENDICES

1. Introduction

Diesel generated electricity is costly to produce. The costs of production to Manitoba Hydro (henceforth referred to as the Utility) are subsidized by the Province of Manitoba and the Federal Government. In Manitoba, the cost of diesel generated electricity to the consumer is not the actual cost of production, but rather the price set by the Public Utilities Board (PUB) for Provincial rates. In most communities a qualification to its use is most consumers are restricted to a 15 ampere service.

If the land transmission line is extended to a remote community, the consumers would no longer be restricted to a 15 ampere service and electricity would hence become an option as a heating source.

The land line was extended to Churchill in May, 1987. Churchill will be used as a case study. Upon reviewing the process of extending the land line to Churchill and the resulting benefits to the consumer, recommendations for guidelines to follow when considering extending the land line to other remote communities will be proposed. The cost/benefit analysis and the environmental assessment study, performed by others, will be reviewed, and an evaluation of converting heating systems to hydro-electric power will be performed on 24 commercial facilities in Churchill.

The extension of the land line to Churchill was completed as a result of the conclusions from both the cost/benefit analysis and the environmental assessment study. The results of converting facilities to electricity for space heating purposes concluded that the consumers would benefit both in the reduction of energy consumed and the reduction in costs for heating their facilities.

The extension of the transmission line to Churchill is hence beneficial to the Utility, the Federal Government, the Provincial Government, and the consumers of Churchill.

1.1 Background

The four main heating energy resources used in Manitoba are natural gas, fuel oil, propane, and electricity (interview with Manitoba Energy and Mines personnel). Other energy resources used for heating purposes include wood, solar, and wind energy (Manitoba Energy and Mines personnel). In addition to Winnipeg, natural gas is used in southern Manitoba for customers that are on the natural gas pipe line (Figure 1).

Electricity is produced largely by hydro generation and distributed throughout most of the province via transmission lines (Figure 2). In Manitoba, remote communities are defined as those which have neither all-weather road access nor a transmission interconnection with the Utilities central supply network (Unies, pg.2). Diesel fuel, propane and fuel oil are transported into these communities via winter roads or railways. In 1983 there were 16 remote communities in Manitoba that were considered for expansion of the land line (Figure 3) (Unies, pg.2).

In Manitoba's remote communities there is a limited choice of sources for residential heating. Heating requirements are met with propane, fuel oil, or wood. Diesel generated electricity is restricted to energy for lights, motors, fans, and other small electric appliances (Unies, pg. 8). With limited power available electric service in most of these communities is limited to 15 amperes per customer. If a transmission line is extended into a remote community the consumer will have the additional choice of electrical energy as a source for heating. The condition of the consumer's existing heating system, the cost of the energy for the available fuels, and the operating costs and maintenance of the systems will all be factors

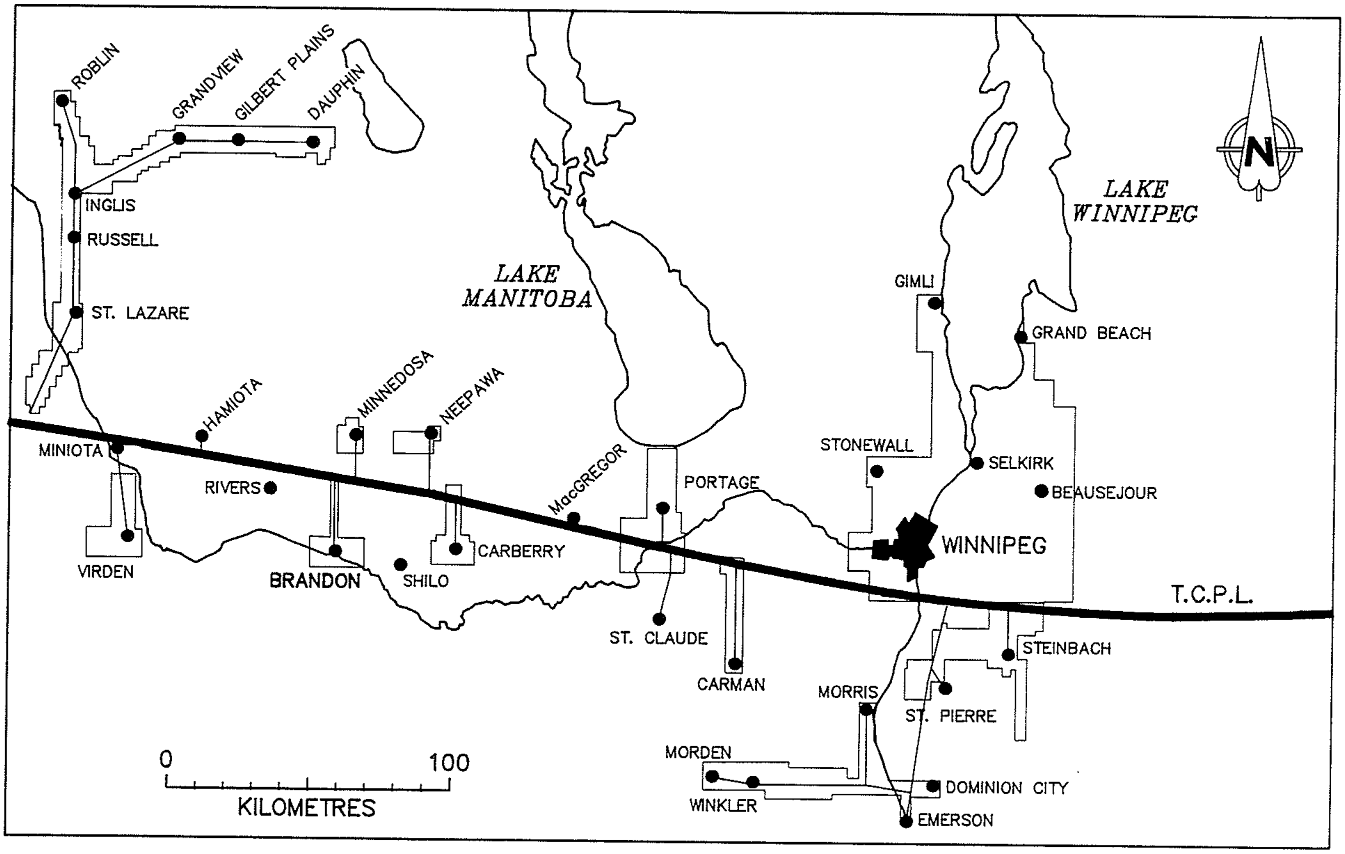

Figure 1
Natural Gas Line - Manitoba Distribution
(ICG Utilities)

in the decision-making process for converting existing fuel powered heating systems to electricity.

Churchill, prior to the construction of the transmission line, was a unique remote community in Manitoba. Restrictions placed on customers in Churchill differed from all other remote communities in that a consumer would pay a subsidized energy rate if limited to a 15 ampere service, however, if the service was greater than 15 amperes, the customer would pay the actual cost of production. There was to be no electric heat or electric hot water.

Churchill has been chosen as a case study to assess the end-use of converting to hydro-electricity for space heating requirements in a remote community. The costs of converting individual facilities to an electric heat system will not be discussed in detail as that is beyond the scope of this practicum. An estimated cost of conversion will be discussed in Chapter 4, Section 4.1(d).

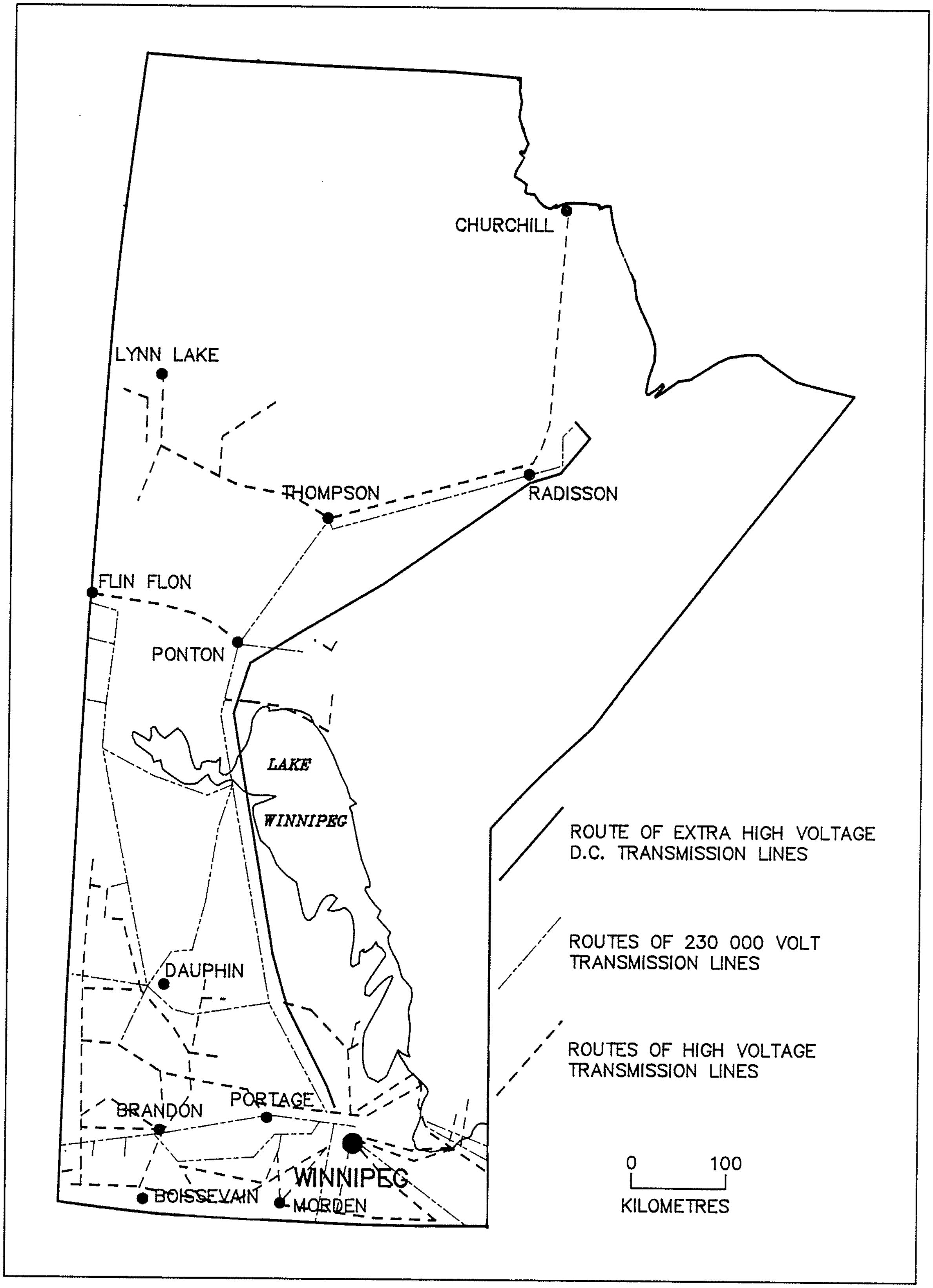

Figure 2
Transmission Line Distribution - Manitoba
(Manitoba Hydro)

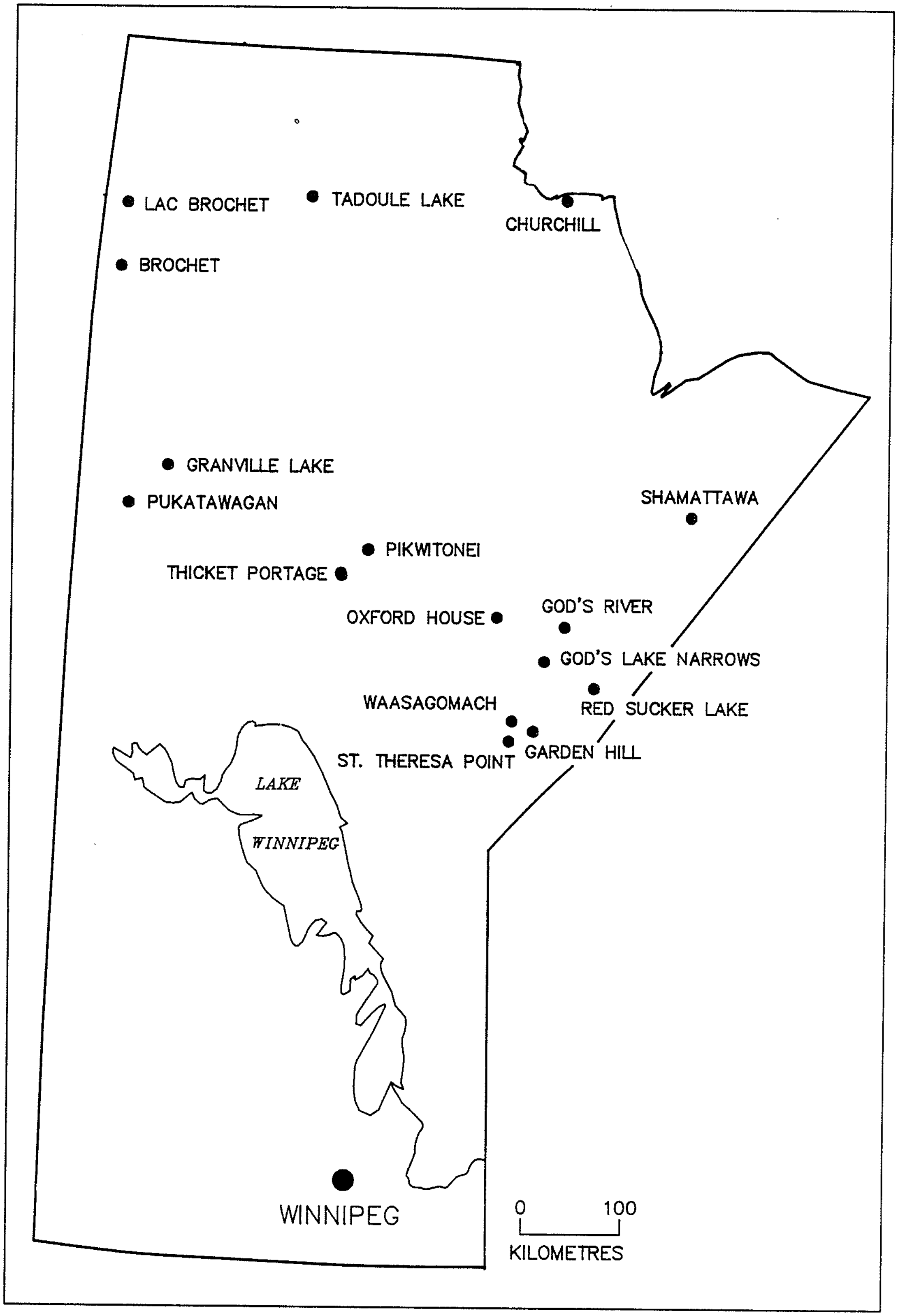

Figure 3
Remote Communities in Manitoba
(Unies, pg. 4)

1.2 Objectives

The purpose of this practicum is to analyse the effects of the extension of the land line to remote communities. A case study will be performed on Churchill, Manitoba. Objectives include:

1) the documentation of energy requirements in remote communities.
2) the documentation of the electrical development of Churchill from 1980 to 1988.
3) the determination of the environmental costs and effects of hydro development in remote communities.
4) the determination of the costs of diesel generated electricity, and the effects of converting to hydro-generated electricity.
5) the projection of the consumer end-use consumption and costs subsequent to the extension of the transmission line to the remote community of Churchill.
6) the assessment of the effects of the transmission line on fuel costs in a remote community.
7) the recommendation of guidelines to follow for use in future conversion decisions in remote communities.

This practicum will include a review of the cost/benefit analysis of the transmission line extension performed by Manitoba Hydro, a review of the environmental assessment study along the transmission line route, an attempt to determine if there are any benefits to the consumer for conversion to electric heat in both the reduction of energy requirements and in energy costs subsequent to a land line extension into a remote community, the end use benefits of hydro-generated electricity, and an analysis of the effect on the cost of propane fuel subsequent to transmission line extension to Churchill.

1.3 Churchill, Manitoba

Churchill is located at the mouth of the Churchill River on Hudson Bay (Figure 4) (Lane and Chartier, Pg. 62). The community was founded in the seventeenth century and until the early twentieth century functioned primarily as a fur trading post. From 1930 until the early 1960's, the importance of Churchill increased. It became a northern terminal for a railway leading to Hudson's Bay, it developed into a seaport, northern air transport facility, and a defence centre. In the 1960's these functions began to decline. With the closure of the defence centre and reduction of the importance of the seaport (Unies, pg. 10), the focus of the community began to change. By the early 1980's, tourism began to increase and continues to be one of the major income sources for the people of the community (Kroeker, pg. 35). A new town complex and hospital have increased Churchill's importance as a northern medical centre. Currently, Churchill is a seaport centre, a service area, and a tourist site. As well it is a northern centre, whose population and facilities support offshore trade and social and resource development in Canada's north.

The population of Churchill reached a maximum of 5,000 in the late 1950's, but gradually declined and by 1980 had a population of approximately 1,000 (Statistics Canada, 1987). It has remained at that level to this day (LGD Churchill, 1989).

There are approximately 35 businesses, and 400 residence (220 row homes, 100 apartments, and 80 private dwellings) in Churchill (Leeies, pg. 3). In 1980 the majority of buildings were heated by propane. Until the extension of the electrical grid in May 1987, electricity was being produced by a diesel generated station.

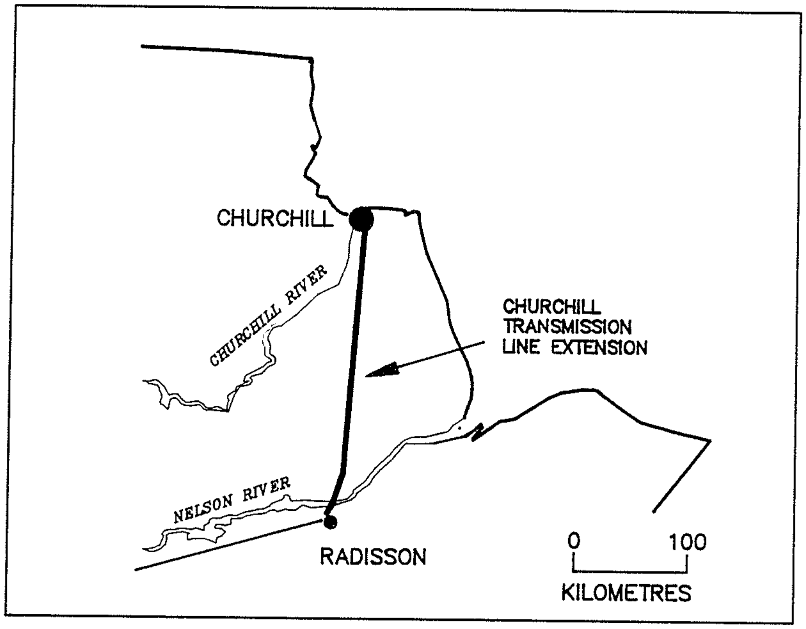

Figure 4
Transmission Line Extension to Churchill, Manitoba completed in 1987

Since the late sixties, the Utility had been investigating the extension of the hydro electric power grid into Churchill. With anticipated increases in fuel oil costs, the Utility performed a study (Manitoba Hydro, SPD 80-20) to compare the costs of repairing, operating, and maintaining the diesel generating system versus extending the main grid service into Churchill.

The original study which the Utility performed was in 1980. After several revisions, a final financial analysis was completed in 1983. In 1989 this report was updated to recalculate energy consumption estimates that were based on assumptions that had been made in earlier studies. Chapter 4 of this practicum will outline the final cost/benefit report. Construction of the transmission line commenced in 1986 with a target date of May 1987 to begin power supply (Figure 4).

The financial analysis performed by the Utility was based soley on the operation and maintenance costs of the diesel generating system versus the construction, operation and maintenance costs of the transmission line. The end-use analysis of heating with electricity based on energy consumption and energy costs to the consumer was not discussed in detail by the Utility. This practicum will detail the energy reduction in converting from a combustible fuel heating energy source to a hydro-generated electrical heating source. It will also include a discussion on the energy costs of the various heating sources.

The results of the audits of 24 individual facilities are reported in Chapter 6 of this practicum. These facilities represent the main business and commercial establishments in Churchill. Costs for heating with fuel oil and propane, and costs for heating with hydro-electricity were calculated using energy costs at November 1988 rates. Neither Provincial nor Federal government-owned buildings, nor the port are included in the 24 facilities that are under discussion. The 24 facilities analysed were chosen randomly. The operating procedures for commercial facilities are readily monitored, and energy data is available. Several of these facilities have converted to electric heat subsequent to the audit. Residential homes or apartments were not included in the study.

Converting to electricity for space heating has historically resulted in a reduction of energy consumption and energy costs relative to propane or fuel oil consumptions and costs (Kohuska, pg. 16). The assessment undertaken in this practicum required energy audits on a number of facilities. Chapter 6 discusses these in depth energy audits which included a visit to the facility, an analysis of 12 months of energy costs, and a physical inspection of each building to collect the required data. All data were entered into a computer program that aided in energy consumption calculations. Once energy flows of facilities were calculated, the calculations to convert the facilities to electric heat were performed.

1.4 Summary

Electricity is diesel generated in remote communities in Manitoba. Assessments have been performed to determine the feasibility of extending the hydro-electric transmission grid to various remote communities. In May 1987, the grid was extended to Churchill. With the availability of hydro electricity as a heating energy source, residents in Churchill have the option of continuing to use propane or fuel oil as their source of heat or converting their heating systems to electric. This practicum will investigate if heating with electricity will reduce the energy consumption of a facility and reduce heating costs which client's incur.

2. Heating in Remote Communities

As previously mentioned, in Manitoba a community is considered remote if it "has neither all weather road access to the Provincial highway system nor transmission interconnection with Manitoba's central supply network" (Unies, pg. 2). As a result of the 15 ampere load restriction placed on facilities in remote communities, heating energy in remote communities is provided by fuel oil, propane, or wood. Churchill, being a unique remote community was not restricted to 15 ampere services, however if customers chose to have a larger service, they would be required to pay cost of production. The restriction of no electric heat or hot water was still in effect in Churchill.

The Governments of Canada and Manitoba have engaged consultants to assess energy needs of Manitoba's remote communities as a whole, and to determine needs of individual communities in detail. Where diesel generators need replacing, the Utility has performed in-house reports comparing costs of land line extension versus replacing diesel generators. These cost/benefit analyses assume that a high percentage of the facilities will convert to electric heat (personal interview, Bagnall, October, 1989). One of these studies led to a Federal/Provincial/Manitoba Hydro cost-shared project to extend a transmission line into the remote community of Churchill.

A study to extend the transmission line to Churchill was performed by the Utility. Included in their study was a complete report on the condition of the existing diesel system, on the energy requirements, the diesel system rates, consumer and consumption, consumption and rate projections, capital costs for replacing diesel generators, and on operating costs, maintenance costs, inventory costs, and diesel fuel oil costs. These costs were compared to the Churchill extension project costs, consumption and rate projections, capital costs, operating costs, and environmental costs. Costs and benefits to the Utility, the Provincial Government and to the Federal Government were also considered.

The final decision on whether to extend the transmission line to Churchill or to continue to provide electric energy with the existing diesel generating system was based partially on the results of the cost/benefit analysis. Because of the high energy costs to both Manitoba and Canada, both Governments found it in their best interests to opt for hydro-electric energy (Bagnall, pg. 6). Canada, Manitoba and the Utility agreed to share the cost of constructing the transmission line.

3. Energy in Churchill

3.1 Energy Requirements

The 24 commercial and institutional facilities in Churchill analysed in this practicum represent 29 percent of total electrical consumption; 29 percent of fuel oil consumption; and 61 percent of propane consumption of all commercial and institutional facilities in Churchill in 1985. As Churchill is at the tree line, the availability of wood is limited, and will not be considered as an alternative heating source. Annual consumption from all other sources is listed in Appendix B.

3.2 Energy Costs

The cost of diesel fuel, fuel oil, and propane are higher in remote communities than in other areas throughout the Province (Unies, pg. 33). Cost of transportation and storage of the fuels is included in consumer's price of fuel. In Churchill, the volume of fuel consumed for heating energy on a per capita basis is inordinately high as temperatures are extremely low for long periods of time during the winter season. The actual heating season in Churchill, determined by the degree days, is longer than most other communities in Manitoba (Table 1).

Table 1

Degree Days in Manitoba, 1982 - 1986
(based on $65^{o}F$)

Location	1983	1984	1985	1986	1987	30 yr average
Churchill	16100	16000	16400	16400	15300	16500
Thompson	13700	13900	14300	14000	12300	14400
The Pas	11800	11600	12400	11300	10200	12300
Lynn Lake	14000	13900	14700	14000	12500	14500
Winnipeg	10100	10100	11000	10000	8600	10700

NOTE: All degree day values are taken from Environment Canada Annual Degree Day Summaries, and the 30 Year Climatic Norms Summary

Manitoba is divided into three rate zones for hydro billing purposes:

i) Zone 1 - legal boundary of Winnipeg.

ii) Zone 2 - 100 or more metered services with a minimum of 15 customers per kilometre of distribution.

iii) Zone 3 - less than 100 metered services per kilometre or diesel generated electricity.

The rates that local residents were charged prior to the extension of the land line were Zone 3 rates (Appendix C). Diesel generators operate at a high cost, but the rates are heavily subsidized by the Federal and Provincial Governments. The Zone 3 rates charged are hence ten to twenty percent the actual cost of diesel generated electricity (Unies, pg. 8). Subsequent to the land line extension, Churchill consumers were put on Zone 2 rate structure.

Prior to the introduction of hydro-generated electricity, propane and fuel distributors had a monopoly on heating requirements in Churchill, and prices of the fuels were set accordingly. Once the transmission line was completed, fuel suppliers re-evaluated their billing structure and restructured billing methods to lower the cost of fuel to the consumer and propane and fuel oil prices dropped (Appendix C). The propane company developed a billing program modelled on the Hydro rate structure. They were trying to be competitive with the Utility by offering incentives to consumers who wanted to install high efficiency propane furnaces. As of October, 1989, the customer could purchase these units at five percent above cost with free installation (interview with Stittco personnel). Subsequent to the line being in operation, propane and fuel oil distributors no longer have a monopoly over heating fuel requirements; they have decreased their prices and provided attractive incentives for people to retain fossil fuels as a heat source.

3.3 Diesel Generated Electricity

The principal energy requirements in Churchill are for heating, lighting, and equipment (such as fans, motors, and appliances) operation (Unies, pg. 8). The following nine diesel generators provided electrical energy for lighting, and equipment operation:

3 - 1136 kW generators
2 - 2500 kW generators
1 - 2340 kW generator
3 - 1000 kW generators (Bagnall, pg. 15).

At the time that Churchill became part of the Provincial transmission grid, three 1136 kW units and three 1000 kW units were functional, but reported to be fully depreciated and in need of replacement (Bagnall, pg. 15). If the transmission line had not been constructed, these units would have had to be replaced prior to 1991. The cost of replacement was estimated to be over $3.8 million (in 1985 dollars). In addition, maintenance and fuel oil inventory costs were additional expenses as well as diesel fuel costs for operating the generators (Bagnall, pg. 15).

A diesel electric generator is approximately 30 percent efficient in converting the energy of the fuel to electricity (Manitoba Hydro, pg. 3). In 1986, of the 8.89 million litres of fuel consumed in Churchill only 2.40 million litres were converted into useable energy. In 1986/87, 25.75 million kWh of electricity were consumed in Churchill (interview with Mr. I Baker, Manitoba Hydro, September, 1988). Seasonal efficiency of the diesel generators during this period was 27 percent.

Prior to extension of the grid, diesel fuel consumption in Churchill was 8.89 million litres. For the basis of this study, base load electricity requirements (not including heating) were assumed to remain constant at 25.75 million kWh/year. The existing electrical consumption prior to extension of the transmission line included lights, motors, fans and electrical appliances. This consumption was considered to be the base load, and was not weather-dependent. Any additional electrical consumption after the transmission line was extended will be the result of facilities converting to electricity for heating.

By introducing the transmission line to Churchill, a significant amount of energy use has been eliminated as the requirements for diesel oil to generate electricity had been eliminated. Not only did the cost of continually purchasing a non- renewable energy resource diminish, but the operating costs of maintaining the diesel generators, the inventory costs and the costs of replacing the six generators that needed immediate attention and the three others that would require replacement within the next several years were eliminated.

4. Hydro-Electric Energy Supply

4.1 Review of Feasibility Study Land Line Extension to Churchill

Five studies were conducted to analyse the cost of meeting electric energy needs of Churchill. In 1980, the Utility performed a financial analysis to evaluate the proposed extension of the hydro grid into Churchill (Manitoba Hydro, SPD 80-20 - Study 1). One year after the Hydro study, Manitoba Energy and Mines (MEM) expanded on the study to include net benefits to the consumers which included estimates of savings of oil import compensation payments, costs of converting from oil to electric heating, and the substantially reduced costs of energy for government consumers (Study 2). This analysis was reviewed, and revised in 1982 by Mr. R. Bagnall of MEM (Study 3) and again in 1983 by Mr. Bagnall and Mr. R. Kabaluk of the Utility (Study 4). The fifth study (final report) summarized the previous two studies. This fifth study, will be reviewed here. In 1989 an addendum to the final report was completed.

The final report compared direct costs to the Utility of the existing diesel system versus the proposed transmission system. The report showed that the projected costs for the diesel system over a 20 year period were less than those of the proposed transmission system over the same period. However, if the Federal and Provincial Governments provided a financial contribution to the construction costs of the transmission system, then the Utility and the Federal and Provincial Governments would benefit financially in that the savings in subsidy costs over a 20 year period will more than pay for the capital construction costs (Bangall, pg. 3).

The final report of the cost/benefit analysis was divided into five sections;

1. introduction to Churchill; and energy consumption in Churchill, (this will be omitted in the review, as the practicum covers this in greater detail than the MEM study)
2. feasibility study for the proposed extension
3. estimate of the volume of diesel oil the proposed extension would replace
4. financial evaluation of the existing diesel system from the Utilities perspective
5. net benefits for the proposed system.

4.1 (a) Feasibility Study

The final report included capital and operating costs of the proposed system, the actual electrical consumption by consumers in Churchill, and various rates that were applicable to the consumers.

Cost of construction of the transmission line, designed with the capability of supplying 25 to 30 MVA at Churchill (Bagnall, pg. 6), after escalation to 1985 dollars, was estimated to be $24.8 million. There were two stations required: a line termination at Radisson, which would include a 138 KV breaker at a cost of $1.1 million, and a 138 KV - 7.2 KV Station at Churchill estimated to cost $3.7 million dollars (Bagnall, pg. 6). This brought the total capital cost of the project to $29.6 million dollars (1985).

The salvage value of the lines was assumed to be zero. Hydro lines are written off over a period of 40 years. Although the project was only evaluated over a 20 year period, any revenues beyond 20 years would little more than cover costs, and the present value for the future net revenue would be small (Bagnall, pg. 6).

Maintenance costs of the transmission line are relatively low. They were assumed to be 0.75 percent of the capital costs for the transmission line, and 1.7 percent of the capital costs for the stations (Bagnall, pg. 7). Total annual costs were estimated at $268,235 and projected to escalate at 10 percent per year for two years, and then 9 percent per year for the remaining years (Bagnall, pg. 7).

Because of the remoteness of Churchill it was recommended that stand-by diesel generators remain at Churchill in the event of power outages. An estimate of six outages per year would increase operating and maintenance costs to $291,300 in 1985 dollars. These costs were estimated to escalate at 10 percent per year for the first two years, and then nine percent per year for the remaining years (Bagnall, pg. 7).

The opportunity costs of transmitting power to Churchill depend on the existence of excess productive capacity. If capacity is higher than market demand, opportunity costs are small; if all power produced has a market, then opportunity costs would be the expected revenue from sales of the energy (Bagnall, pg. 7). In 1982 and 1983, it was assumed the Utility could sell any surplus energy to out-of-Province utilities at interruptible rates. The average value of interruptible electricity was projected to be 15.4 mills per kWh in 1985. This value was used to calculate the opportunity cost of electricity diverted to Churchill. An escalation of 6.3 percent per year as the rate of increase of the cost of electricity was used. This was the estimated rate of inflation at the time of the study.

The 15.4 mills per kWh were common bus, before export and hence before losses. Total foregone revenue to Churchill would include the value of consumption in Churchill plus the value of line losses from Gillam to Churchill. Losses in 1985 were expected to be 1.3 percent of the energy provided at Gillam, and the losses increase by the square of the load growth factor (Bagnall, pg. 8).

By 1989, when it was assumed that the anticipated conversions to electric heat would be completed, the expected line losses would be two percent of energy input.

Total consumption of electricity in Churchill was determined as follows. Energy consumption for 1979-80 for all classes of consumers were totalled. In 1985, the transmission line was assumed to be in operation. Within a five year period, consumers would commence conversion to electricity for space heating. With an average of 80 residential conversions per year and 26 general service customers per year, the 75 percent conversion would occur by 1989. A steady energy requirement would follow after 1989. Total consumption on an annual basis would increase from 25,749,600 kwh/year to 46,000,000 kWh/year. This number was recalculated in the addendum to the final report (1989). It was estimated 50 percent of the consumers would convert to electric heat. The revised electrical consumption was 45,000,000 kWh/year. (Bagnall, pg. 1)

The evaluation determined the net cash flow per year over a 20 year period. The net cash flow was calculated by taking the estimated annual revenue (Churchill consumers), deducting the maintenance costs, diesel stand-by costs, capital investment, and foregone energy sales. If the present value was positive, the proposed extension would be economically viable, if negative, then this amount would be required as a subsidy to make the project viable.

Results of the feasibility analysis indicated present value of the project over a period of 20 years as $-25.972 million as of the beginning of 1985 (Bagnall, pg. 12).

4.1 (b) Oil Import Compensation

This section of the final report examined the reduction in costs to Canadians through reduced oil import compensation payments. Compensation payments are made to refineries who import oil at the world oil price when it exceeds the Canadian price. The payment per barrel is the difference between the world price at Montreal and the Canadian Blended price (Bagnall, pg. 13). For the 20 year analysis, it was calculated that diesel oil consumption would be reduced by 1,117,548 barrels with associated oil import compensation payment savings of $5,017,695. These numbers represent the amount of fuel oil and the estimated associated costs that would be replaced by hydro-electric power at Churchill.

4.1 (c) Existing Diesel System

This section examined the existing diesel system in much the same manner as the proposed system. Capital and operating costs and consumption and rates were calculated. Results of the evaluation were compared with those from the conversion feasibility study.

The existing diesel generators would be required either as stand-by (if conversion took place) or as the power supply for the existing system. Because of this, no attempt was made to define their worth. It was determined that several generators were in need of replacement. The cost of this was determined to be $3,832,500 (1990 dollars) (Bagnall, pg. 15).

Maintenance costs for the diesel system are significantly higher than those of a transmission line. Annual diesel system costs were $28,500 for administration, $227,000 for overhead, and $963,600 for parts and labour. Total costs were estimated to be $1,219,200 annually for a 20 year period as of the beginning of 1985. They were assumed to escalate at 10 percent per year for the first two years and nine percent per year for the next 18 years of the project evaluation.

The results of the evaluation of the existing diesel system were determined by taking the revenue and deducting operating costs, fuel costs, inventory costs and investment to determine the net cash flow. The net cash flow was determined to be $-20,870,510 over 20 years.

Although the net cash flow of the diesel system was less than the net cash flow over a 20 year period for the proposed line project, the extra benefits to the consumers were considered to make the land line extension preferable. Full cost customers would realize added financial benefits as they would pay the lower central system rates (Bagnall, pg. 21).

4.1 (d) Net Benefits of Hydro Extension

Under the diesel system, the Federal, Provincial and municipal Governments pay cost of production for energy. Under the land line system, they pay PUB rates. Small business and residential consumers would convert from the PUB diesel generated electricity rates to PUB hydro generated electricity rates.

Average energy consumption was assumed to be the same under both diesel generated and hydro generated systems (Bagnall, pg.22). Consumption data from communities using diesel generated electricity have been compared to those who use hydro-electricity, and it has been found that average consumption is higher in areas where electricity is hydro generated (Bagnall, pg. 26). This could be partly attributed to higher costs of diesel generated electricity and load restrictions placed on diesel generated power users. As a result, the estimated consumption, once the transmission line is in place, would be on the conservative side.

Comparing costs of the two systems should take into account the cost of converting to electric heat for the consumer as opposed to the existing costs of heating with propane or fuel oil. The cost of converting to electric heat was estimated to be $4,720 per residence and $9,440 per business as of the beginning of 1985. These costs were escalated each year by an inflation factor (Bagnall, pg. 23).

The diesel system costs include costs of generating electricity by diesel fuel, as well as costs for heating with propane and fuel oil.

The hydro direct costs over a twenty year period total $46,280,760, while the diesel total costs total $85,730,200 over the same period. This illustrates a reduction of total costs by 46 percent with the transmission line in place.

Benefits would accrue to all classes of customer. Federal, Provincial and local Governments would benefit because of lower central rate systems. Oil import compensation payments would be reduced. Consumers who convert to electric heat would benefit from reduced cost in relation to using propane.

4.1 (e) Discussion

The initial study appears to be in error on three points: heating source assumptions, conversion assumptions, and marketing procedures. It was as a result of these errors that the cost/benefit analysis was revised five times.

(a) Heating Source Assumptions

It was initially assumed that most of the facilities were heated with fuel oil and the original calculations for the financial analysis were based on this assumption. It was later determined that propane was used by the majority of the consumers. When this incorrect assumption was determined, the financial analysis was reworked. Obtaining fuel consumption information from the fuel suppliers prior to initiation of the feasibility analysis would have avoided these initial errors.

In addition to this, the billing methods for propane consumers, as well as the historical energy costs were not compiled. In all five studies it had been assumed that Churchill consumers are on PUB rates, but it was recently determined that this is not the case. As a result, rates for propane and fuel oil can be set by suppliers without application to any regulatory authority allowing them to compete with and undercut PUB regulated energy sources. This fact should have been known prior to the initial calculations.

(b) Conversion Assumptions

The Utility presented the proposal for the extension of the land line to Churchill to the customers. Verbal agreements were made with the larger consumers to convert to electricity for heating requirements (Manitoba Housing Authority, Local Government District of Churchill) (interview, Bagnall, September, 1989). As a result the line was sized to accommodate the base load electrical requirements, and a heating load of 75 percent of the facilities (Bagnall, pg. 1). Subsequent to the completion of the transmission line, few consumers converted to electricity for heating. The addendum to the final report assumed a 50 percent conversion rate. In retrospect, it may have been prudent to have all agreements in writing.

(c) Marketing

During the construction phase, Churchill had an influx of Hydro construction workers. Within a month of on-line electricity, the majority of the hydro employees vacated Churchill (interview with hotel owners, Churchill, October 1987). The promotion of electricity for heating was non-existent. At that time the other fuel companies, concerned with the new competing energy source, began to market their products effectively.

Many of the heating systems were in poor condition and required replacement. The fuel suppliers realized that consumers, once installing a new heating system, would be committed to that energy source. The propane company marketed a high efficiency furnace and, in addition, dropped propane prices to be competitive with the Utility. As previously stated, propane and fuel oil prices are not under PUB jurisdiction in Churchill. The suppliers were able to alter their prices and become directly competitive with the Utility (which is under PUB rates).

Due to the Utilities lack of marketing combined with the marketing procedures of the propane company, many of the facilities have converted to high efficiency propane units. Several commercial facilities have converted to electric heat, but this has been through the MEM Business/Community CHEC Program (MEM Audits).

4.2 Review of Environmental Assessment Study

An environmental assessment of the transmission line route (TLR) was performed by ID Systems Ltd. (IDS) in August, 1984. The study included the impact along the TLR on the landforms, wildlife, hunting, trapping, fishing, present land use, social impacts, and archeological potential.

The environmental assessment was performed during 1984 in two phases. In phase one, an environmental inventory of the area's resources were catalogued. Specific reference to the potential environmental impacts of the construction of a transmission line were addressed. An interim report of the first phase was reviewed by the Provincial Technical Advisory Committee (TAC) and a list of concerns was made. Concerns were discussed with the Utility and either resolved or left to be assessed in the second phase of the study.

In phase two, on-site evaluations of potential environmental impacts of the transmission line construction on resources were made, as well as on-site evaluations of potential socio-economic impacts on the people of Churchill, Gillam and other residents located along the route (IDS, pg. 3).

4.2 (a) Landforms

The TLR area falls mainly in the Hudson Bay Coastal Lowlands physiographic region. The southern portion of the TLR, is in the precambrian shield physiographic region. Landform zones within the study area include recent alluvial and marine deposits, continuous peat mantle, hummocky disintegration morain, and patternless drift plains.

IDS classified the study area into four distinct landform units based on the physical appearance and relative uniformity of each unit (IDS, pg. 8). The four units are uplands, lowlands, Tyrell Sea Beach, and treed lowlands. From field observations, it was concluded that within each landform unit the line construction impacts would be largely the same, regardless of ultimate location within the unit zone.

It was noted that the areas of concern were located in permafrost zones and at river banks. To prevent unnecessary terrain disturbance it was recommended that construction should begin after freeze-up and should be discontinued prior to spring break-up (IDS, pg. 15). Specific recommendations made by IDS with regards to landforms can be found in their final report.

4.2 (b) Vegetation

Vegetation along the TLR has been classified as a "lowland complex" with scattered areas of tundra vegetation near Churchill and coniferous forest predominating at the Gillam end of the study areas (IDS, pg. 19). The vegetation has been grouped into the following categories: heath, sedge meadow, scrub and scrub forest, open spruce forest, closed spruce forest, and larch forest.

The impacts on the vegetation were expected to be minimal because most of the construction would be during the winter months. Areas designated as special vegetation sights were avoided in route selection.

4.2 (c) Wildlife

Much of the wildlife in the area is located within the Cape Churchill Wildlife Management Area. Wildlife consists of polar bears, caribou and moose, some species of migratory birds, timber wolf, arctic fox, wolverine, beaver, marten, lynx, otter, mink, muskrat, ermine and squirrels (IDS, pg. 27).

The impact of the transmission line construction on wildlife was considered negligible to non-existent (IDS, pg. 29). The concerns were of increased hunting after the transmission line corridor was in place. Access to new hunting grounds would be available along the transmission line, however, because of the considerable travel distances, IDS assumed that the impact would be negligible.

4.2 (d) Trapping

The TLR passed through ten registered traplines. Furbearing animals in the area include coloured and arctic fox, squirrel, timber wolf, wolverine, beaver, fisher, lynx, marten, mink, muskrat, otter, and ermine (IDS, pg. 34). Initial impact on trapping would be caused by right-of-way clearing, winter road construction, travel along winter road, and transmission line construction.

Long term affects of the transmission line would be to provide easier access for the trappers. Shrubs and successional plant species would also be established along the edge of the right-of-way clearing, possibly providing new habitat for prey species (IDS, pg. 37).

4.2 (e) Fishing

Although the TLR passed over numerous streams and rivers, the impact of the fishing in the area was considered to be limited. A major impact of the TLR would result if problems arose from improper construction procedures when constructing stream crossings. If guidelines provided by the Provincial Government in the "Recommended Fish Protection Procedures for Stream Crossings in Manitoba" were followed, and clearing of vegetation at crossing sites was minimal, it was determined that there would be little or no impact on the fisheries.

4.2 (f) Present Land Use

Present land use along the TLR was minimal, and was therefore not a consideration in the TLR construction.

4.2 (g) Social Impacts

The social impact of the TLR were determined to have little effect on the people of Gillam. The impacts to the community of Churchill far exceeded those of any other community in the area. Benefits to the hotels and businesses during construction was determined to be significant to the economy of the town. Churchill, usually experiencing the majority of economic activity during the summer months and tourist season, would see economic growth during the off season period of construction.

4.2 (h) Cultural Resources

There were no known archeological sites along the TLR. The historical sites in the Churchill area were not impacted by the TLR, therefore they were of no importance to the environmental assessment.

4.3 Summary

Construction of a transmission line over a long distance to remote communities is not cost effective to the Utility if the Utility were to incur all costs of the land line extension. Under existing agreements, the Provincial and Federal Governments make compensation payments to the Utility for diesel generation of power resulting in no extra cost to the Utility. Therefore, Provincial and Federal governments benefit from the land line extension.

Churchill is an exception to the norm for remote communities. It has a rather large population and houses both a hospital and a port facility. A cost/benefit analysis on the extension of the power grid to Churchill cannot be used for comparison to other facilities in Manitoba. However the errors in marketing and the actual construction costs can be used as a lesson for any extension of the power grid.

To consumers, the introduction of another competitive energy source has reduced their heating costs substantially. As far as energy reductions to the consumer (the end-user), electrical energy is 100 percent efficient (ASHRAE Fundamentals, pg.28.5), while combustible equipment has efficiencies varying from 50 percent-90 percent. Additional benefits of extending the land line to remote communities are the reduction of the reliance on non-renewable energy resources, and the reduction of our dependence on imported fuels.

Where diesel generators are in need of replacement, a 20 year financial analysis comparing costs of the extension of the land line into remote communities to the cost of replacing and operating the diesel generating systems has indicated that the latter is the least costly to the Utility. Benefits to the Governments who subsidize the Utility exceed the direct costs to the Utility.

Environmental and social costs of hydro-electricity versus diesel generated electricity must also be considered when making the final decision. With the acknowledgment of the deleterious effects on the environment, of acid rain, and the continual depletion of the world's non-renewable resources, hydro-electricity is a more desirable energy source.

When investigating hydro development, the Utility has a series of criteria which they follow. The following seven point list summarizes this criteria:

(i) economics

(ii) financial analysis - long term, immediate, and customer rates

(iii) environmental - residual impact on the environment of hydro project, compared with other options ie) nuclear, coal, diesel

(iv) system reliability and performance

(v) system operating flexibility

(vi) other factors such as export sales

(vii) risks - what is the risk involved, what happens if power requirements are not met.

The Utility recognizes that there are environmental effects of any hydro development. They compare these effects with those that alternatives will have on the environment. Recent data regarding the greenhouse effect takes precedence over degradation of the immediate area that the transmission line construction or hydro dam construction will effect. (presentation on Hydro Planning, October 27, 1989)

The original financial analysis concluded that the Utility should not extend the power grid into Churchill. For the Utility to incur all costs of construction, the project was rejected. When the Provincial and Federal Governments agreed to cost share the projects, the Utilities costs were reduced substantially.

Now, two years after the line has been in operation, the Utility is looking for answers as to why the anticipated loads are not in demand. It can be suggested that this appears to be largely a result of the marketing procedure or lack thereof.

The environmental impact assessment was performed in 1984, and met the required standards for an environmental assessment at this time. At termination of the study, it was concluded that the line would have little or negligible impact on the resources in the area. The major concerns were of degradation of the terrain along the TLR during the construction period, and the access route along the transmission line for hunters and trappers in the years to come.

Winter construction of the transmission line ensured that effects to the vegetation and soils were kept to a minimum.

The destruction of the vegetation along the right-of-way was considered insignificant. In the vicinity of special vegetation sites, route selection was chosen to avoid the area. Because of the remoteness of the transmission line and the travel distance to it, it was considered that the impact of the line on hunting, fishing, and trapping would be negligible.

5. Methods

5.1 Electric Heat Conversions

The savings achieved by converting combustible fuel heating systems to electric heat can be calculated. Combustible fuel powered heating systems do not run at 100 percent efficiency, but electrical heating systems are accepted to be 100 percent efficient to the end user (Unies, pg.4). Since 1980, MEM has been performing energy audits on industrial, institutional, and commercial establishments throughout the province. Energy conservation technology is a fairly recent discipline, hence the conversion calculations employed by MEM had, up until October 1986, not been verified. In the summer of 1986 a program was established by MEM as an adjunct to its energy audits performed on industrial, institutional, and commercial establishments. Through this program, energy bills from 19 post-retrofit projects were collected and the projects evaluated. The intent of this program was to determine the success of electric conversion retrofits.

Results of the evaluation program indicate that the electric conversions have a high rate of success for both reducing energy consumption and energy costs. It has been estimated that total energy savings from both 1987 and 1988 results would be 1.9 million kWh. Actual savings exceeded the estimate by about 400,000 kWh/year. These results indicate that the calculations employed for the energy analyses were slightly conservative.

Calculations for converting heating systems from fuel oil and propane to electric heat for 24 facilities in Churchill took into consideration the underestimation of the efficiency of the heating systems in the follow up analysis. Inefficiencies of existing systems in most of the Churchill facilities were measured with a furnace efficiency meter. A furnace efficiency meter measures the instantaneous efficiency of a heating system at the time of the test. Seasonal efficiency of the heating system is estimated by studying the on/off time of a heating system and adjusting the instantaneous efficiency accordingly.

Through the follow up analysis, it has been found that energy savings are achieved by converting from a petroleum energy source to hydro-electricity. The dollar savings that are achieved are dependant on the prices of the fuels at the time of the calculations. Since savings vary considerably each time there is a change in fuel price, documentation of the date of follow up and the energy prices used for the savings calculations are important.

5.2 Advantages and Disadvantages of Hydro-electricity

Ignoring the cost variance of the different fuels, hydro produced electricity has several benefits over propane and fuel oil for remote communities.

1) Hydraulic energy, harnessed to produce electrical energy is a renewable energy resource.
2) Delivered electrical energy is 100 percent efficient when harnessed for resistance heating.
3) Electricity is a Manitoba produced energy resource.
4) Electricity is a clean, safe energy resource with which to heat.
5) Electricity does not produce unwanted by-products to the environment (at the end-use stage).
6) Once the transmission line is put into a remote community, hydro power is generally available at all times.
7) The customer does not have to ensure that a supply of fuel oil or propane is available.

The disadvantages of hydro electric generated electricity are predominately found prior to the end use analysis. These disadvantages will be listed at this time, but will not be considered in this study.

1) The inundation of lands required when constructing and operating hydro-electric dams.
2) The environmental problems (if any) encountered when constructing and maintaining the transmission line.
3) Line losses and resistance losses when transmitting hydro-electrical currents over a long distance.
4) Blackouts that can occur during storms, that would cut out power to the remote community.

Items one, two, and three are important to mention, but have already been considered during the initial cost/benefit analysis. Item four can affect any customer that is a user of hydro-electric power, no matter where the customer is located in the Province.

5.3 The Energy Audit

Twenty four commercial and institutional facilities in Churchill had in depth energy audits performed on them to determine where the purchased energy was being used. The energy analysis methods used in this study were based on those developed by MEM through their energy analysis for commercial, industrial and institutional facilities throughout the province. These MEM techniques have been continually improved and verified over the past five years. The following outlines the methods used in the energy audit.

To obtain an energy balance for a building, the actual energy that has been purchased by the facility (energy in) must equal the energy usage (energy out). The initial step in an energy audit is to collect the utility bills for a one year period for each facility. The actual degree day data for the 12 months of bills submitted is used since weather related energy consumption changes as the weather changes.

Once the ‘energy in’ has been established, a breakdown of where the purchased energy is consumed is calculated. This is done by performing an ‘energy audit’ on the facilities. The audit comprises the following activities: constructing a computer model of a building, establishing the energy profile (where the purchased energy is going), and calculating the energy reduction from converting combustible heating systems to hydro-electricity for heating purposes.

A computer model of each facility is used. Data needed for the model are obtained by physically measuring each building, determining the construction of each building by inspecting the building or examining the architectural drawings (if available), determining the operating temperatures within each building, and by studying the ventilation system (if applicable). Once all the data are gathered they are entered into a computer program that performs the heat loss calculations. A sample audit is found in Appendix D.

With the energy profile established, the energy usage of each building is identified. The energy flow of the facility is outlined in the following areas: transmission losses, infiltration losses, ventilation losses, stack losses, and electrical consumption. When the energy profile (determined using the computer model) balances with the actual energy purchased (a comparison with the actual energy bills), the energy savings for converting to electric heat is calculated.

The heating load of any facility is the weather related energy consumption and includes transmission, infiltration, ventilation, and internal heat gain. The heating load is the amount of heat required to heat the facility. It is a weather dependant load. The heating load is directly proportional to the amount of insulation in the building and the air tightness. Other factors that determine the heating load of the facility are ventilation, and operating temperatures.

Stack losses are the losses incurred during the combustion process of a heating system. The amount of stack losses are indicative of the efficiency of the heating system in the facility. There are two efficiencies that can be determined:

(i) instantaneous efficiency, and
(ii) seasonal efficiency.

The instantaneous efficiency is the rated efficiency of the heating system. This number can be read directly off the name plate data of the furnace or boiler. It is calculated by dividing the rated output of the unit by rated input. Seasonal efficiency of a heating system considers efficiency over the entire heating season. It takes into account such factors as running time of the heating unit, and start/stop cycle of the unit. The more the heating system cycles, the lower the efficiency (ASHRAE, pg. 28.5).

Original electrical consumption breakdown is not important for this study, however equipment kW load is very important when determining peak monthly demand. A schedule of equipment (including lights) is made during the audit. This is done so that the base load in kW can be added to the size of the heating system (calculated once the heating load is known). The maximum demand once conversion to electric heat is performed can be determined. This number is required when determining the rate zone and electrical charges each facility incurs.

The assumptions made when determining the demand are that the original electrical requirements remain constant (this is considered the base load), and that hot water not originally heated with electricity is converted. The size of the new heating system is calculated under design conditions. Design conditions are the heating requirements under the worst possible weather conditions.

Demand charges that are incurred in facilities can often account for the majority of the electrical costs. Homes and small businesses usually have a maximum draw of less than 50 kVA. Larger facilities, those where demand peaks over 50 kVA, must be assessed in detail to determine potential peak monthly demand. Since demand charges are often significant charges, it is to the benefit of the consumer to calculate the maximum potential demand, in order that the consumer knows what the potential costs may be. Often the benefits of energy reduction in remote communities do not offset the additional demand costs. In these cases, hybrid electric/propane or an electric/fuel oil system may be of more benefit to the customer.

5.4 Data Methods

Once the energy audit is performed, heating load of the facilities and monthly breakdown of energy consumption are retrieved. Monthly energy consumption is determined from the energy audit in order to re-calculate monthly consumption and energy costs at November, 1988 prices.

Each project is analysed using a LOTUS 1-2-3 spreadsheet. The electrical and heating fuel consumption is taken directly from the audit along with the energy consumption breakdown of the heating fuel. The monthly heating load consumption is calculated by multiplying the monthly heating degree days by the heating load. Once the monthly consumption of the heating load is determined, original electrical consumption is added to determine total monthly electrical consumption.

To calculate the size of a heating system the following data are required: heating load, degree days, number of days in heating season, indoor temperatures, average outdoor temperatures, design outdoor temperatures, T(a) (average indoor temperature - average outdoor temperature), and T(d) (average indoor temperature - design outdoor temperature). The heating load is taken directly from the energy audit results. The heating load is the energy used for heating both ventilation air and space temperatures. Degree days, number of days in the heating season, and indoor temperatures are also taken from the audit.

Average outdoor temperature (T(oa)), delta T(a), and delta T(d) are calculated using the following formulae:

$$T(oa) = \left(65 - \frac{\text{degree days}}{\text{heating days}}\right);$$

$$\text{delta } T(a) = T(\text{inside}) - T(oa);$$

$$\text{delta } T(d) = T(\text{inside}) - T(\text{design}).$$

Design temperature, or the coldest possible temperature for design purposes is $-50^{o}F$ in Churchill.

Once the required data is determined, the size of the heating system is calculated. The size of the heating system at average temperature conditions is:

$$\text{Size (average)} = \frac{\text{kWh heating load}}{\text{days in heating season x 24 hours}}$$

The ratio of delta T(a):delta T(d) is calculated. The size of the heating system at average temperature conditions is multiplied by the ratio to find the size of the heating system at design conditions. The ratio is found to be approximately 2.5 times T(a) in all projects. For consistency, all heating systems are sized to be 2.5 times the requirements at T(a) conditions.

Once the size of the heating system is determined, the remaining electrical load of the facility is assessed to estimate highest possible peak demand. This number is calculated by tabulating all electrical loads including heating, lighting, motors, fans, hot water, and any other miscellaneous electrical equipment. For facilities that have a peak monthly demand higher than 50 kVA, the monthly demand is estimated by totalling the maximum potential load that can occur over a 15 minute time period.

When the size (in kW) of the heating system is calculated, and a schedule of other electrical equipment is tabulated, the billing structure for the facility is determined. As previously mentioned, the 24 audited facilities are under general service small billing structure. If monthly demand is under 50 kVA, energy charge is based on the two step structure. Where demand is greater than 50 kVA, customers receive the benefit of the lower block of energy. For larger facilities, demand charges are often higher than energy charges and therefore must be carefully monitored (MEM Audits). For facilities that border 50 kVA, with monthly consumption greater than 11,790 kWh, it is often desirable to be on a demand billing structure. With monthly electrical consumption over 11,790 kWh, the consumers purchase energy at the the lowest energy rate.

Costs for heating with electricity and heating with combustible fuels were calculated at the energy rates as of November, 1988. Since the prices of propane, fuel oil, and electricity are constantly changing, it is important to document the date the rates are applicable when the calculations are made. As energy rates change, new rates can be incorporated into the formulae for a rapid update of energy costs and associated savings.

6. Results and Conclusions from the Energy Audits

6.1 Results

Of the twenty four facilities audited in Churchill, one facility was served by electric heat, 15 facilities used propane for heat; 5 facilities were served by oil heat; and 3 facilities used both propane and fuel oil. Original total energy consumption of all 24 projects was 7,690,627 kWh/year at a cost of $360,061/year (November 1988 prices). Propane accounted for 60 percent of the energy and 60 percent of the cost; fuel oil totalled 19 percent of the energy, and 14 percent of the cost; and electrical consumption accounted for 21 percent of the energy and 26 percent of the cost.

In November, 1988, the average cost per kWh of propane, fuel oil, and electricity respectively were: $0.0468, $0.047, and $0.0564. The propane and fuel oil costs did not take into account the inefficiencies of the heating system. If an average efficiency of 65 percent was applied, propane and fuel oil costs equate to $0.0720/kWh and $0.0723/kWh respectively for an efficiency rate to 100 percent.

Prior to the assumed conversion to electric heat, two facilities were on a demand billing structure with the remaining facilities on the general service rate structure. After assumed conversion, an additional fourteen facilities would have reverted to the demand billing structure. In three facilities, the assumed monthly demand was close to 50 kVA. Since assumed monthly energy consumption far exceeded 11,790 kWh/month, it would have been economical for the client to ensure peak demand was over 50 kVA (about 55 kVA). The consumer would have paid the lower energy charge for being on a demand billing structure. On the demand billing structure, the consumer would pay $0.01609/kWh for all consumption over 11,790 kwh/month as opposed to $0.04336/kWh on general service less than 50 kVa.

Total energy consumption for all facilities subsequent to assumed conversion to electric heat was 5,552,034 kWh/year or $238,772/year, a savings of 2,138,593 kWh/year or $78,167/year. All projects realized a savings except one fuel oil conversion where there was an increase of $27/year. Energy savings varied from 16 percent per facility to 41 percent per facility; and dollar savings (at November, 1988 prices) varied from 12 percent to 55 percent per facility. Table 2 summarizes the breakdown of consumption and costs for each individual project. All calculations are found in Appendix E.

6.2 Discussion

Since the energy saved is a function of the efficiency of the heating system, it is expected that every facility that converts to electric heat will save energy. For the projects analysed, the energy saving should be accurate since an energy balance on each facility was achieved prior to calculating any savings. A furnace efficiency test was performed on the heating systems in each facility. The seasonal efficiency was estimated once the furnace efficiency test was performed. The average seasonal efficiency of the heating systems was 65%. None of the projects had a high efficiency heating system.

Actual dollar savings that were calculated may vary slightly due to the fact that peak monthly demand was estimated. The demand was estimated by totalling total kW from existing equipment and maximum draw from the assumed new heating system. Monthly demand draw was estimated at the maximum not to enhance the savings.

Assumed energy consumption costs for each facility were readily calculated as the assumed consumption was calculated directly from the heating load and associated degree day data. As the weather changes from year to year, consumption changes. By sizing the heating system at design temperature of -50^{o}F, the demand costs are already considered for the coldest temperature of -50^{o}F.

Table 2

Results from Converting to Electric Heat
Churchill Projects

Facility Number	Original Consumption kWh/yr	Original Consumption $/yr	Assumed New Consumption kWh/yr	Assumed New Consumption $/yr	Net Reduction kWh/yr	Net Reduction $/yr
1	792,985	32,252	637,091	26,460	155,894	5,792
2	359,535	16,808	212,324	8,918	147,211	7,890
3	50,399	2,821	50,399	2,821	-	-
4	192,032	8,154	134,028	6,574	58,004	1,580
5	346,098	15,015	246,675	10,438	99,423	4,577
6	138,162	6,002	87,129	4,525	51,033	1,477
7	411,479	17,582	315,891	11,202	95,588	6,380
8	129,000	5,720	87,000	4,519	42,000	1,201
9	203,396	8,628	129,256	6,354	74,140	2,274
10	74,676	3,412	52,510	2,918	22,166	494
11	437,660	17,638	311,560	13,540	126,100	4,098
12	473,179	18,777	278,216	10,767	194,963	8,010
13	261,380	11,752	194,030	10,416	67,350	1,336
14	201,309	7,980	142,630	7,100	58,679	880
15	102,913	4,702	75,884	4,003	27,029	699
16	82,265	3,370	62,832	3,397	19,433	(27)
17	524,006	20,130	443,006	16,850	81,000	3,280
18	146,714	5,900	102,660	5,245	44,054	655
19	205,837	7,837	138,049	6,591	67,788	1,246
20	330,613	12,319	208,364	9,340	122,249	2,979
21	319,131	14,270	268,040	10,352	51,091	3,918
22	817,650	32,851	635,340	23,816	182,310	9,035
23	736,308	28,196	474,220	21,191	262,088	7,005
24	353,900	14,823	264,900	11,435	89,000	3,388
	7,690,627	316,939	5,552,034	238,772	2,138,593	78,167

original and new consumption calculated at November 1988 rates

6.3 Current Situation

As of January 1990, the transmission line had been supplying power to Churchill for almost three years. As of January 1990, few facilities in Churchill had converted to electric heat. A number of the facilities that required new heating systems replaced their old propane furnaces with high efficiency units. Of the 24 facilities audited in this practicum, only 6 facilities have converted to electricity for space heating. All six of these facilities obtained financing from MEM for energy conservation projects.

At the time the land line was extended into Churchill, the propane company embarked on an intensive marketing program. They were aware of the fact that many of the facilities required new heating systems. Incentives were offered to consumers to upgrade their existing propane heating system. High efficiency furnaces were offered to clients at five percent above cost by the propane supplier, and a free 24 hour maintenance guarantee was included in the package.

Heat users continuing to use propane should take into account:

1) Current prices for propane are lower in Churchill than anywhere else in the province (Appendix C). Economically this is not logical. Transportation of the fuel to Churchill is costly, but remoteness of Churchill is not reflected in the consumers price of fuel.
2) Many of the heating systems in the facilities in Churchill require replacement (November 1989). Once a consumer makes a commitment for a new heating system the commitment is likely made for the expected life of the system.

7. Remote Communities in Manitoba

There are 15 communities designated as remote in Manitoba that are being considered for expansion of the land line (figure 3, page 4) now that the land line has been extended to Churchill. Plans are currently (March 1990) being made to extend the land line to Oxford House, God's River, God's Lake Narrows, Red Sucker Lake, Waasagomach, St. Theresa Point and Garden Hill (The North East Project, Figure 5). Future plans for land line extension include Lac Brochet, Brochet and Tadoule Lake.

In 1983, Unies prepared a report for Energy, Mines, Resources Canada on Energy Profiles for Remote Communities. The purpose of the report was to define the remote communities, and the unique energy requirements of these communities. Total population of the remote communities in early 1983 was approximately 11,000 (Unies, pg. 5). Birth rates exceed the provincial average and population increase is rapid (Unies, pg. 5).

The main heating sources in the remote communities is fuel oil and wood. Propane accounts for less than 2 percent of total annual consumption. (Unies, pg. 18). Fuel oil is also used for the generation of electricity. Fuel oil and propane are transported to the communities via a winter road. Wood is a local energy source. Table 3 lists the 1983 total annual consumption of each energy source in the remote communities.

Winter roads are usually constructed during January or February, and are often impassable by late March. As a result of this, the year's fuel supply must be moved in before the end of March (Unies, pg. 13). Concerns that arise as a result of transportation and storage of fuel oil include the following:

1) If insufficient fuel is delivered by winter road, supplementary shipments are shipped via air; an expensive mode of transportation.

2) Oil spillage along winter roads during transportation can result in environmental damage.
3) There is a risk of fire hazard at the fuel oil storage sites, and environmental damage in the event of spillage, particularily to surface water aquifers.

The viability of extending the land line to the remote communities has been analysed in the past by the Utility, the Federal Government and the Provincial Government. Diesel generators operate at a high cost, but the electrical rates in the communities are similar to other communities in the province serviced by the main electrical distribution system. The service in the remote communities is heavily subsidized by the Provincial and Federal Governments (Unies, pg. 8).

Benefits of extending the land line to these communities would be realized by the Provincial and Federal Governments, the Utility, and the consumer. The Provincial and Federal Governments would no longer have to subsidize the Utility for supplying diesel generated electrical power. The Utility would no longer have to maintain and operate the diesel generators, and the consumers would realize an increase in their living standards by converting from a 15 ampere service to a 100 ampere service.

The environmental impact assessment of the transmission line route for the North East Project was initiated in late 1989. Boundaries of the environmental assessment study area have been identified. As of March, 1990 the requirements of the environmental impact assessment study have been listed, these include three alternate route selections, preferred route, line characteristics, environmental considerations, construction, operation and maintenance considerations, and a time schedule of events.

Environmental considerations being assessed include wildlife, fisheries, surface and ground water, forestry, heritage resources, and socio-economic concerns. The joint Federal/ Provincial North Central Project has, as of February 1990, established a North Central Project Technical Advisory Committee comprising members of both Provincial and Federal Government departments, representatives from the Utility, and other interested parties such as Ducks Unlimited Canada, the Manitoba Naturalist Society, and the Sierra Club of Western Canada.

The Federal Government is responsible for the environmental assessment study and the review process and the Provincial Government is responsible for the regulatory process (notes from TAC Meeting, March 1990).

Table 3

Energy Profile in Remote Communities
Total Annual Energy Consumption

Community	Population	Annual Source Fuel Consumption: Fuel Oil Elec. (%)	Fuel Oil Space Heating	Propane (%)	Wood (%)	Total kWh (* 10^6)
Brochet	640	32.5	25.2	0.3	42.0	12.4
Garden Hill	1800	33.2	18.0	0.1	48.7	37.4
God's Lake Narrows	1250	31.7	19.5	0.1	48.6	22.9
God's River	250	34.9	12.5	0.3	52.3	5.8
Granville Lake	140	30.7	15.7	0.5	53.1	1.6
Lac Brochet	380	34.1	23.7	1.0	41.1	4.3
Oxford House	1250	27.0	18.4	-	54.6	23.7
Pikwitonei	240	30.6	22.0	0.2	47.2	6.1
Pukatawagan	1100	39.3	16.2	0.3	44.2	13.4
Red Sucker Lake	425	29.5	19.6	0.3	50.6	7.7
St. Theresa Point	1450	31.2	17.9	0.1	50.8	25.6
Shamattawa	680	27.0	17.5	0.5	55.0	10.0
Tadoule Lake	215	25.4	18.2	1.3	55.1	4.1
Thicket Portage	200	30.1	25.9	0.4	43.6	6.1
Waasagomach	730	34.4	21.7	0.2	43.7	14.0
Total and Average %	10750	31.4%	19.5%	0.4%	48.1%	195.1

Values are total energy content of source fuel consumption

(Unies, pg. 18)

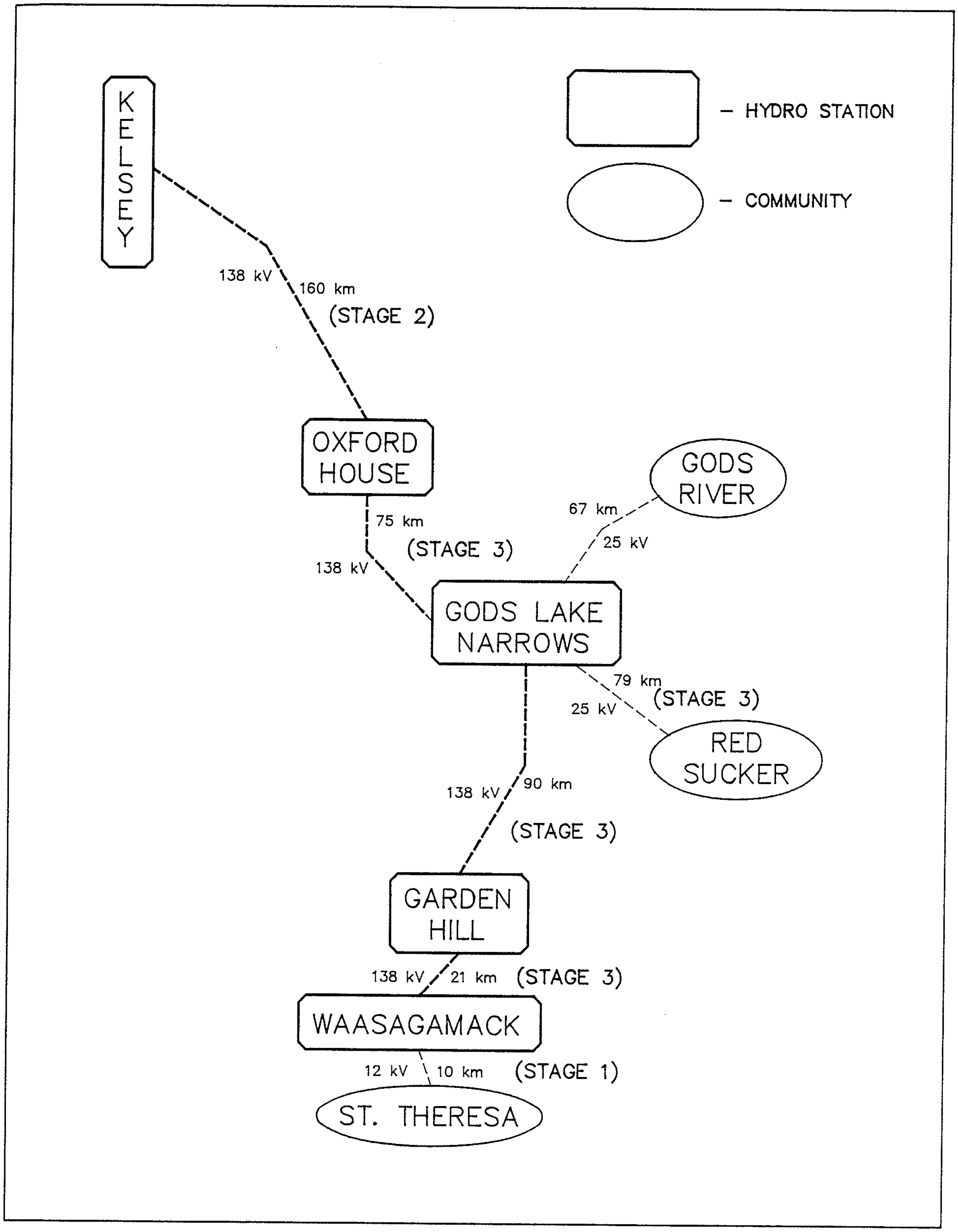

Figure 5
North East Project

8. Summary, Conclusions and Recommendations

Fifteen communities in Manitoba designated as remote are being considered for expansion of the central supply system. Analysis of extending the land line into these communities has been on-going with the Utility for several years. In 1989, the Federal and Provincial Governments, and the Utility commenced a joint study to examine the feasibility of extending the land line to the communities in the north east part of the province. Future consideration for extension of the land line to the remaining communities is planned for the late 1990's.

8.1 Summary

The final report (Study 5) resulted in the recommendation of extending the land line to Churchill. The diesel generators that were in use required replacement. The cost of replacement combined with the removal of the Provincial and Federal Governments subsidizing the Utility for supplying diesel generated electricity in Churchill convinced the Utility, the Federal Government, and the Provincial Government that it would be in all of their best interests to cost share the transmission line extension to Churchill.

An environmental assessment study performed by IDS concluded that the impact of the transmission line extension would have on the resources of the area, and on the environment would be negligible.

When the land line commenced delivery of hydro-electric power to consumers in Churchill, consumers were given another option for a heating energy source.

The end-use analysis performed in this practicum illustrates that 22 of 24 facilities consuming energy in Churchill would benefit from converting their combustible fuel heating systems to electric heating systems. At November 1988 prices, these consumers would realize a reduction in energy bills of up to 25 percent.

8.2 Conclusions

The current energy sources in the remaining 15 remote communities are diesel generated electricity, fuel oil, wood and propane. A feasibility study was initiated in 1989 to investigate the extension of the land line to seven of the remote communities. As of March 1990 the guidelines for the environmental assessment study were in the process of being outlined.

The decision making process for extending a land line to a remote community is based on economics. In 1987 the transmission line commenced the transmission of hydro-generated electrical power to Churchill. Churchill was the first remote community to benefit from a land line extension. The standard of living for the residents of Churchill has improved, and the energy costs for the end-users has decreased.

The environmental assessment study of the Churchill TLR concluded that the transmission line would not have any significant detrimental effects on the environment. Construction of the line was restricted to winter months to limit the disturbance of the permafrost terrain.

By converting to hydro-electricity from diesel generated electricity, annual diesel oil consumption was reduced by 8.89 million litres. The only diesel fuel for generating electricity in Churchill would be that which is in storage for the stand-by generator.

Total costs for energy to the 24 facilities studied prior to the land line extension to Churchill amounted to $316,000/year (November 1988). If the 24 facilities converted to electric heat, the new costs were estimated to be

$239,000/year (November 1988). This would be a reduction of $78,000/year, or 25 percent.

Once the land line started supplying power to Churchill, the propane company reduced propane costs to be directly competitive with electricity. Incentives were offered to consumers to convert to high efficiency propane furnaces. To secure the desired electrical load, the Utility should embark upon a marketing program for electric space heating to ensure that a many consumers as possible will install electric heating systems as opposed to propane or fuel oil.

8.3 Recommendations

The following points suggest a model to consider when determining the feasibility of extending the land line to remote communities:

1) A cost/benefit analysis should be performed. A detailed energy consumption profile for the commercial, institutional, and residential sectors should be documented.
2) An environmental study of the supply of hydro-electricity to a remote community is essential. The study should not only consider the impact of the transmission line on the environment, but should also weigh any negative effects of the transmission line against the hazards to the environment of transporting and storing combustible fuels.
3) An end-use energy analysis for commercial and institutional facilities should be performed. The results should be supplied to the consumer.
4) The Utility should market the use of electricity for space heating. Without an intense marketing program the desired load in the remote communities may not be met.

These recommendations should be assigned to a multi-disciplinary task force to ensure thoroughness and communication between disciplines. The people in the communities who will be affected by the land line should be consulted and informed of the benefits the land line will provide.

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APPENDIX A

GLOSSARY OF TERMS AND COMMON CONVERSIONS

Glossary of Terms

ASHRAE - The American Society of Heating, Refrigeration, and Air Conditioning Engineers Inc.

Audit, diagnostic - The analysis of a potential opportunity to save energy which could involve the assessment of the current process operation and records, and the calculation of savings, and operating costs so that the viability of the project can be established.

Audit, walk through - The visual inspection of a facility to observe how energy is used or wasted.

Celsius (^{o}C) - The temperature measuring scale (formerly centigrade) in which the freezing point of water is taken at 0^{o} and the vaporization at 100^{o}. Absolute zero on this scale is -273.15^{o}.

Combustible - capable of uniting with air or oxygen in a reaction initiated by heating, accompanied by the subsequent evolution of heat and light i.e., capable of burning. The heat producing constituents of a fuel.

Combustible Loss - The unliberated thermal energy loss from unburned combustible matter.

Combustibility - that property of a material which measures its tendency to burn.

Combustion - The rapid chemical combination of oxygen with the combustible elements of a fuel resulting in the production of heat.

Combustion Rate - The quantity of fuel fired per unit of time.

Common Bus - Energy cost at main transmission line. Factored into the common bus is the average cost of generation and average cost of transmission. Distribution is not factored into common bus.

Computer - An electronic device which receives inputs, processes them and produces outputs. It consists of a central processing unit, memory and input/output circuits.

Degree Day - A measure to correlate the outside temperature with the energy required for heating based on the assumption that heating is required when the average daily temperature is less than 18^{o}C or 65^{o}F. Thus, one heating degree day results from an average of 17^{o}C (63 F) for 24 hours. The degree days are accumulated to provide a means of comparing the influence of weather on energy usage over a period of time.

Demand - the amount of power required at any particular time in one facility.

Efficiency - The ratio of the output to the input. The efficiency of a boiler is the ratio of the heat absorbed by water and steam to the heat in the fuel fired.

Energy - The capacity for doing work; taking a number of forms that may be transformed from one into another, such as thermal (heat), mechanical (work), electrical and chemical; in customary units, measured in kilowatt hours (kWh) or megajoules.

Energy Type - A specific fuel or energy used by the facility.

Energy, waste - Energy which is lost without being fully utilized. It may include energy in the form of steam, exhaust gases, or discharge water.

Fahrenheit (^oF) - The temperature scale of The British System of units in which the freezing point of water is assigned the value of 32^o and the vaporization point the value of 212^o, with 180 even divisions between, and corresponding divisions above and below. Absolute zero on this scale is -495.67^o.

Infiltration (or exfiltration) - Uncontrolled movement of air out of or into the facility around openings in the building envelope such as around windows and doors.

Internal Heat Gain - Free Energy. The energy provided by the sun, people, lights, and equipment.

Kilovolt Amp (kVA) - A measure of draw of electricity.

Kilowatt Hour (kWh) - A measure of electricity, a unit of energy.

Load, base - The thermal or electrical loads that occur continually and at about the same level.

Load, peak - the highest electrical or thermal load occuring during the period of time being considered.

Loaded - When a device or system is operating at maximum or full load capacity.

Mean Temperature - The average of the minimum and maximum temperatures.

Miscellaneous Electrical Equipment - Electrical equipment such as lights, motors and fans.

Monthly Mean Temperature - The monthly average of daily means.

Power - The rate at which energyis expended. Expressed in kilowatts.

Power Factor - The ratio of power passing through a circuit to the product of the voltage and current.

Seasonal Efficiency - A total heat energy output divided by the total energy input over the period of a full heating season.

Simple Payback - The time required for an expenditure to be repaid by the related annual dollar savings.

Stack Losses - The loss of energy due to the inefficiencies of the heating system.

Thermal Resistance - A number indicating the insulating value or resistance to heat flow of a material or assembly.

Transducer - An element or device which receives information in the form of one quantity and converts it to information in the form of the same or another quantity.

Transmitter - A transducer which responds to a measured variable by means of a sensing element, and converts it to a standardized tranmsission signal which is a function only of the measured variable.

Transmission Loss - The heat conducted through the building envelope as a result of the temperature difference between inside and outside. It is the heat lost directly through the building walls, roof, etc.

Ventilation - Controlled air movement out of or into a building.

NOTE: ALL DEFINITIONS ARE REFERENCED FROM MANITOBA ENERGY AND MINES, ENERGY AUDIT REPORTS MINES AND RESOURCES CANADA, ENERGY MANAGEMENT SERIES, 1987

Common Conversions

1 barrel (35 Imp gal) (42 US gal)	= 159.1 litres
1 gallon (Imp)	= 1.20094 gallon (US)
1 horesepower (boiler)	= 9809.6 watts
1 horsepower	= 2545 Btu/hour
1 horsepower	= 0.746 kilowatts
1 joule	= 1 N-m
Kelvin	= (^{o}C + 273.15)
1 kilowatt-hour	=3600 kilojoules
1 Newton	= 1 kg-m/s2
1 therm	= 10^{5}Btu
1 ton (refrigerant)	= 12002.84 Btu/hour
1 ton (refrigerant)	= 3516.8 watts
1 watt	= 1 joule/second
Rankine	= (^{o}F + 459.67)

Cubes

1 yd^3	= 27 ft^3
1 ft^3	= 1728 in^3
1 cm^3	= 1000 mm^3
1 m^3	= 106 cm^3
1 m^3	= 1000 L

Squares

1 yd^2	= 9 ft^2
1 ft^2	= 144 in^2
1 cm^2	= 100 mm^2
1 m^2	= 10000 cm^2

SI PREFIXES

Prefix	Symbol	Magnitude	Factor
tera	T	1 000 000 000 000	10^{12}
giga	G	1 000 000 000	10^{9}
mega	M	1 000 000	10^{6}
kilo	k	1 000	10^{3}
hecto	h	100	10^{2}
deca	da	10	10^{1}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	u	0.000 001	10^{-6}
nano	n	0.000 000 001	10^{-9}
pica	p	0.000 000 000 001	10^{-12}

UNIT CONVERSION TABLES
METRIC TO IMPERIAL

From	Symbol	To	Symbol	Multiply By
Celsius	°C	Fahrenheit	°F	(°C x 9/5) + 32
centimetres	cm	inches	in	0.3937
joules	J	Btu	Btu	9.480×10^{-4}
kilograms	kg	pounds	lb	2.205
kilowatts	kW	horsepower	hp	1.341
kilowatt-hours	kWh	Btu	Btu	3413
litres	L	gallons (Imp)	gal (Imp)	0.21998
litres	L	gallons (US)	gal (US)	0.2642
watt	W	Bt/hour	Bt/h	3.413

UNIT CONVERSION TABLES
IMPERIAL TO METRIC

From	Symbol	To	Symbol	Multiply By
British Thermal Unit	Btu	joules	J	1054.8
Btu	Btu	kilogram-metre	kg-m	107.56
Btu	Btu	kilowatt-hour	kWh	2.928×10^{-4}
Btu/hour	Btu/h	watt	W	0.2931
Fahrenheit	oF	Celsius	°C	(°F-32)/1.8
foot	ft	metre	m	0.3048
gallons (Imp)	gal (Imp)	litres	L	4.546
gallons (US)	gal (US)	litres	L	3.785
horsepower	hp	watts	W	745.7
horsepower-hours	hp-h	joules	J	2.684×10^{6}
inches	in	centimetres	cm	2.540
pounds	lb	kilograms	kg	0.4536

CONVERSION TABLE
PURCHASED UNIT TO kWh

Energy Type	Purchased Unit	Conversion Factor to kWh
Electricity	kWh	multiply by 1
Light fuel oil	imperial gallons	multiply by 48.7984
	litres	multiply by 10.7341
Diesel	imperial gallons	multiply by 48.7984
	litres	multiply by 10.7341
Propane	liquid cu. ft.	multiply by 729.1591
	vapour cu. ft.	multiply by 0.7494
	imperial gallons	multiply by 32.2392
	litres	multiply by 7.0916

NOTE: All converisons are based upon energy information provided in the April 23, 1983 Energy Statistics Handbook published by Energy, Mines and Resources Canada.

APPENDIX B

ANNUAL ENERGY CONSUMPTION - CHURCHILL, MANITOBA

1982 Fuel Consumption by Sector
Churchill, Manitoba

FACILITY TYPE	ENERGY SOURCE (MILLION kWh's)			ESTIMATED HEATING SYSTEM EFFICIENCY (%)		ELECTRICAL CONVERSION 100 % CONVERSION RATE				ELECTRICAL CONVERSION 75 % CONVERSION RATE					
	ELECTRICITY	FUEL OIL	PROPANE	FUEL OIL	PROPANE	FUEL OIL KWH/YR	FUEL OIL DEMAND	PROPANE KWH/YR	PROPANE DEMAND	FUELOIL KWH/YR	FUELOIL DEMAND	PROPANE KWH/YR	PROPANE DEMAND	ELECTRICITY	DEMAND
Industrial															
harbour	3,400,000	6,100,000	700,000	70%	70%	4,270,000	624	490,000	72	3,202,500	468	367,500	54	3,400,000	389
other	400,000													400,000	46
Airport	1,500,000	13,400,000	600,000	70%	70%	9,380,000	1371	420,000	61	7,035,000	1029	315,000	46	1,500,000	172
Town Centre	3,300,000	7,900,000		70%		5,530,000	808			4,147,500	606			3,300,000	378
Institutional	3,500,000	4,700,000	3,000,000	65%	65%	3,055,000	447	1,950,000	285	2,291,250	335	1,462,500	214	3,500,000	401
Commercial	2,000,000		4,600,000		65%			2,990,000	437			2,242,500	328	2,000,000	229
Residential	8,800,000	1,100,000	21,700,000	60%	65%	660,000	96	14,105,000	2062	495,000	72	10,578,750	1547	8,800,000	1007
TOTAL	22,900,000	33,200,000	30,600,000			22,895,000	3347	19,955,000	2917	17,171,250	2510	14,966,250	2188	22,900,000	2621
						PEAK DEMAND	8368		7293		6276		5470		

APPENDIX C

ENERGY COSTS - CHURCHILL, MANITOBA

MANITOBA HYDRO BILLING STRUCTURE

The Utility has divided the Province into three Rate Zones for billing purposes. Zone 1 is the rate zone for the legal boundary of Winnipeg. Zone 2 is considered a medium density zone where there are 100 metered services or more with at least 15 customers per kilometre of distribution line. Zone 3, the low density zone, is the rate applied to consumers where there are less than 100 metered services. Diesel generated electricity rates for any remote community are based on the Zone 3 hydro rates.

Prior to the extension of the grid into Churchill, Churchill residential and small commercial consumers were billed on a Zone 3 rate. Many users paid full-cost diesel rates (Government Agencies in particular). Since the extension of the electric grid into Churchill, Churchill changed to Zone 2 rates. All electrical energy is charged at the same rates as any other Zone 2 customer in Manitoba.

The rate zones are further subdivided into two categories: the residential rates; and the general service rates. For the purpose of this practicum, only the general service rate structure was important. The general service rate structure has been further subdivided into general service small (with two billing structures), general service medium, and general service large. All audited facilities were under the general service small category (demand <200 kVA).

The energy rates under general service small vary, depending on the amount of energy required. There are three rate steps listed under the general service small, however, not all consumers realize the benefits of the lowest rate structure. The first 1090 kWh is charged at the highest rate, the next 11,700 kWh/month is at a lower rate, and any consumption over 12 790 kWh/month is charged at the lowest rate, the run out rate. The monthly demand draw indicates the rate of energy the facility is charged. If monthly demand peaks under 50 kVA, the first 1090 kWh/month are charged at the highest rate, and any energy over

1090 kWh/month is charged at the second rate. If monthly consumption is over 12 790/month, the lowest energy rate is not available if draw is not over 50 kVA. Under this rate structure, energy charges are determined on a monthly basis. If the customer peaks over 50 kVA, and energy consumption is greater than 12 790 kWh/month, they receive the benefits of the lower rate of electricity. If however, the customer peaks under 50 kVA, but consumption is over 12 790 kWh/month, they will not receive the benefit of the lower rate of electricity. Table 4 illustrates the Zone 2 rate structure for the past three years.

Table 4

Electrical Rates in Churchill, Manitoba, 1986 - 1988
(Manitoba Hydro, 1986, 1987, 1988)

April 1, 1986 : Zone 3 - Diesel

Basic Charge: $13.99
First 1090 kWh: $ 0.06120/kWh
balance at: $ 0.03770
(7% tax)

April 1, 1987 : Zone 2

General Service

Basic Charge:	$12.95
First 1090 kWh:	$ 0.06335
balance at:	$ 0.04145

Power Standard

Basic Charge:	$11.74
First 1090 kWh:	$ 0.06440
next 10,950 at:	$ 0.04145
balance at:	$ 0.0614
Demand Charge:	
first 50 kVA:	no charge
balance:	$6.62/kVA

(7% tax)

Monthly Billing Demand:
the greatest of the following expressed in kVA:

a) measured demand; OR
b) 80% of the highest measure demand in any of the previous months of Dec. Jan. or Feb.

April 1, 1988 : General Service Rates - Zone 2
Utility owned transformation, Billing Demand not exceeding 200 kVA

Under 50 kVA

Basic Charge:	$13.45
First 1090 kWh:	$ 0.06548
balance at:	$ 0.04336

Over 50 kVA Monthly Demand

Basic Charge:	$13.45
First 1090 kWh:	$ 0.06548
next 11,700 at:	$ 0.04336
balance at:	$ 0.01691
Demand Charge:	
First 50 kVA:	no charge
balance at:	$7.26/kVA

(7 % tax)

Table 5

Commercial Propane and Fuel Oil Costs in Churchill, Manitoba, 1986 - 1988

Propane

April, 1986: $41.46/cubic foot (liquid)
(7% tax)

April, 1987: $39.20/cubic foot (liquid)
(7% tax)

April, 1988:

first 35,314.4 cubic feet at: $33.55/cubic foot
next 105,943.2 cubic feet at: $29.31/cubic foot
all over 141,257.6 cubic feet at:$24.72/cubic foot
(7% tax)

Fuel Oil

April, 1986: $1.82/gallon (tax included)

April, 1987: $1.75/gallon (tax included)

April, 1988: $1.71/gallon (tax included)

Table 6

Propane Rates
March 14, 1989

Centre	Supplier	Residential	Commerical
Snow Lake	Stittco	24-28 c/Litre	22.6-29.6 c/Litre
Thompson	Stittco	28 c/Litre	24-28 c/Litre
		* +.5c/Litre for out of town customers	
The Pas	Stittco	22.5 c/Litre	21-26 c/Litre
Lynn Lake	Stittco	24 c/Litre	21.6 - 25.6/Litre
Gillam	Stittco	---	25.6/Litre
Winnipeg	PetroCanada	22.0 c/Litre	23.6 c/Litre
Brandon	PetroCanada	22.0 c/Litre	23.6 c/Litre
Dauphin	PetroCanada	22.5 c/Litre	24.1 c/Litre
Churchill	Stittco	up to 7,500 Litre/yr	24 c/Litre
		7,500 - 25,000	23 c/Litre
		25,000 - 75,000	22 c/Litre
		all over	21 c/Litre

APPENDIX D

SAMPLE AUDIT

SPACE HEATING ANALYSIS

This analysis computes the energy (heat) loss from the building's envelope that would result from the stated operating and physical conditions.

It will also compute savings in dollars and energy that would result from changes in the initial physical and operating conditions.

SPACE HEATING ANALYSIS

OPERATING CONDITIONS

LABEL SAMPLE: PROPANE HEAT

VOLUME OF CONDITIONED SPACE (CF)	48000
DEGREE DAYS (DEG F)	15436
HEATING DAYS	303
OPERATING HOURS/WEEK	80
OPERATING TEMP (DEG F)	70
SETBACK HOURS/WEEK	88
SETBACK TEMP (DEG F)	70
HEATING FUEL TYPE	6
FUEL COST ($/UNIT)	35.84324
HEATING PLANT EFF (%)	58
INTERNAL HEAT GAIN (%)	15

6 PROPANE

SPACE HEATING ANALYSIS

WINDOW SPECIFICATIONS

LABEL	FRONT WINDOW
WINDOW HEIGHT (FT)	3
WINDOW WIDTH (FT)	5
WINDOW R VALUE (R)	1.53
WINDOW INFILTRATION (CFH/FT)	25

SPACE HEATING ANALYSIS

WALL SPECIFICATIONS

LABEL	WALL1	WALL2	WALL3	WALL4	WALL5
WALL LENGTH (FT)	148	41	41	10	80
WALL HEIGHT (FT)	10	10	10	9	9
WALL R VALUE (R)	15	15	40	12	15
OPERATING HOURS/WEEK	80	80	80	80	80
OPERATING TEMP (DEG F)	70	70	70	70	70
SETBACK HOURS/WEEK	88	88	88	88	88
SETBACK TEMP (DEG F)	70	70	70	70	70
INTERNAL HEAT GAIN (%)	15	15	15	15	15
TEMP DROP (DEG F)	55.9	55.9	55.9	55.9	55.9
SLAB EDGE LOSS (BTUH/FT)	30	30	30	0	30
WINDOW TYPE					
FRONT WINDOW		1	1		
DOOR TYPE					
FRONT DOOR	1				
EXIT DOOR					1

SPACE HEATING ANALYSIS

DOOR SPECIFICATIONS

LABEL	FRONT DOOR	EXIT DOOR
DOOR HEIGHT (FT)	7	7
DOOR WIDTH (FT)	3	3
DOOR R VALUE (R)	1.53	2
DOOR INFILTRATION (CFH/FT)	150	150

SPACE HEATING ANALYSIS

WALL SPECIFICATIONS (continued)

LABEL	WALL6
WALL LENGTH (FT)	110
WALL HEIGHT (FT)	8
WALL R VALUE (R)	12
OPERATING HOURS/WEEK	80
OPERATING TEMP (DEG F)	70
SETBACK HOURS/WEEK	88
SETBACK TEMP (DEG F)	70
INTERNAL HEAT GAIN (%)	15
TEMP DROP (DEG F)	55.9
SLAB EDGE LOSS (BTUH/FT)	30

WINDOW TYPE

DOOR TYPE

EXIT DOOR	1

SPACE HEATING ANALYSIS

ROOF SPECIFICATIONS

LABEL	ROOF1	ROOF2	ROOF3	ROOF4	ROOF5
ROOF LENGTH (FT)	74	26	26	45	45
ROOF WIDTH (FT)	30	15	15	20	20
ROOF R VALUE (R)	15	15	40	12	12
OPERATING HOURS/WEEK	80	80	80	80	80
OPERATING TEMP (DEG F)	70	70	70	70	55
SETBACK HOURS/WEEK	88	88	88	88	88
SETBACK TEMP (DEG F)	70	70	70	70	55
STRATIFICATION DIFF (DEG F)	0	0	0	0	0
INTERNAL HEAT GAIN (%)	15	15	15	15	15
TEMPERATURE DROP (DEG F)	55.9	55.9	55.9	55.9	40.9

SKYLIGHT TYPE

AUDIT:1 MAR 30 1990

SPACE HEATING ANALYSIS SUMMARY

EXISTING CONDITIONS

	HEAT LOSS KWH/YEAR	HEAT LOSS $/YEAR
WALL HEAT LOSS		
WALL1		
SECTION LOSS	11,591	10,980
DOORS	1,636	1,549
SLAB EDGE	9,457	8,959
INFILTRATION	6,465	6,124
WALL2		
SECTION LOSS	3,138	2,973
WINDOWS	1,168	1,107
SLAB EDGE	2,620	2,482
INFILTRATION	862	817
WALL3		
SECTION LOSS	1,177	1,115
WINDOWS	1,168	1,107
SLAB EDGE	2,620	2,482
INFILTRATION	862	817
WALL4		
SECTION LOSS	894	847
WALL5		
SECTION LOSS	5,553	5,260
DOORS	1,251	1,185
SLAB EDGE	5,112	4,843
INFILTRATION	6,465	6,124
WALL6		
SECTION LOSS	8,530	8,081
DOORS	1,251	1,185
SLAB EDGE	7,029	6,659
INFILTRATION	6,465	6,124

SPACE HEATING ANALYSIS SUMMARY

EXISTING CONDITIONS

(CONTINUED)

	HEAT LOSS KWH/YEAR	HEAT LOSS $/YEAR
ROOF HEAT LOSS		
ROOF1		
SECTION LOSS	17,636	16,707
ROOF2		
SECTION LOSS	3,098	2,935
ROOF3		
SECTION LOSS	1,162	1,101
ROOF4		
SECTION LOSS	8,937	8,466
ROOF5		
SECTION LOSS	6,541	6,196
TOTAL TRANSMISSION LOSSES	101,570	96,217
TOTAL INFILTRATION LOSSES	21,118	20,005
TOTAL INTERNAL HEAT GAIN	-18,403	0
TOTAL COMBUSTION LOSSES	75,516	84,161
TOTAL NET HEAT LOSS	179,801	200,383

INFILTRATION IS EQUIVALENT TO 0.21 AIR CHANGES/HOUR

APPENDIX E

ELECTRIC HEAT CONVERSION CALCULATIONS

Summary - Electric Heat Conversions

FACILITY NUMBER	ORIGINAL CONSUMPTION (KWH/YR)	ORIGINAL COSTS ($/YR)	NEW CONSUMPTION (KWH/YR)	NEW COSTS ($/YR)	NET ENERGY REDUCTION (KWH/YR)	ENERGY COST DIFFERENCE	PROPANE (KWH/YR)	ORIGINAL PROPANE ($/YR)	FUEL FUEL OIL (KWH/YR)	FUEL OIL ($/YR)	ORIGINAL ELECTRICITY (KWH/YR)	ORIGINAL ELECTRICITY ($/YR)	TOTAL ORIGINAL COSTS ($/YR)
1	792,985	$32,252	637,091	$26,460	155,894	$5,792	623,455	$22,669			169,530	$9,583	$32,252
2	359,535	$16,808	212,324	$8,918	147,211	$7,890	312,775	$11,990			46,760	$4,818	$16,808
3	50,399	$2,821	50,399	$2,821	0	$0					50,399	$2,821	$2,821
4	192,032	$8,154	134,028	$6,574	58,004	$1,580	89,415	$3,512	70,127	$2,450	32,490	$2,192	$8,154
5	346,098	$15,015	246,675	$10,438	99,423	$4,577	306,018	$11,714			40,080	$3,301	$15,015
6	138,162	$6,002	87,129	$4,525	51,033	$1,477	125,082	$4,913			13,080	$1,089	$6,002
7	411,479	$17,582	315,891	$11,202	95,588	$6,380	249,639	$9,591			161,840	$7,991	$17,582
8	129,000	$5,720	87,000	$4,519	42,000	$1,201	105,000	$4,124			24,000	$1,596	$5,720
9	203,396	$8,628	129,256	$6,354	74,140	$2,274	177,996	$6,981			25,400	$1,647	$8,628
10	74,676	$3,412	52,510	$2,918	22,166	$494	64,166	$2,520			10,510	$892	$3,412
11	437,660	$17,638	311,560	$13,540	126,100	$4,098	354,800	$13,311			82,860	$4,327	$17,638
12	473,179	$18,777	278,216	$10,767	194,963	$8,010	409,579	$15,344			63,600	$3,433	$18,777
13	261,380	$11,752	194,030	$10,416	67,350	$1,336	147,900	$5,809	93,800	$3,277	19,680	$2,666	$11,752
14	201,309	$7,980	142,630	$7,100	58,679	$880	10,527	$413	154,152	$5,385	36,630	$2,182	$7,980
15	102,913	$4,702	75,884	$4,003	27,029	$699	76,853	$3,018			26,060	$1,684	$4,702
16	82,265	$3,370	62,832	$3,397	19,433	($27)			72,056	$2,517	10,209	$853	$3,370
17	524,006	$20,130	443,006	$16,850	81,000	$3,280			407,000	$14,219	117,006	$5,911	$20,130
18	146,714	$5,900	102,660	$5,245	44,054	$655			121,054	$4,229	25,660	$1,671	$5,900
19	205,837	$7,837	138,049	$6,591	67,788	$1,246			190,288	$6,648	15,549	$1,189	$7,837
20	330,613	$12,319	208,364	$9,340	122,249	$2,979			305,623	$10,677	24,990	$1,642	$12,319
21	319,131	$14,270	268,040	$10,352	51,091	$3,918	142,991	$5,616			176,140	$8,654	$14,270
22	817,650	$32,851	635,340	$23,816	182,310	$9,035	520,310	$19,256			297,340	$13,595	$32,851
23	736,308	$28,196	474,220	$21,191	262,088	$7,005	649,988	$23,709			86,320	$4,487	$28,196
24	353,900	$14,823	264,900	$11,435	89,000	$3,388	261,500	$10,054			92,400	$4,769	$14,823
	7,690,627	$316,939	5,552,034	$238,772	2,138,593	$78,167	4,627,994	$174,544	1,414,100	$49,402	1,648,533	$92,993	$316,939
					2,138,593	$78,167							

ALL ORIGINAL CONSUMPTION AND NEW CONSUMPTION ARE CALCULATED AT NOV 88 PUB COSTS

0

30-Mar-90	FILE NUMBER:	1
ORIGINAL ELECTRICAL CONSUMPTION		169,500 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION		623,485 KWH/YR
TOTAL ORIGINAL CONSUMPTION		792,985 KWH/YR

PROPANE	623,455 KWH/YR
FUEL OIL	0 KWH/YR
TOTAL FUEL	623,455 KWH/YR

TRANSMISSION	511,475 KWH/YR
INFILTRATION	111,980 KWH/YR
(IHG)	(155,864)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	155,864 KWH/YR
TOTAL FUEL	623,455 KWH/YR
HEATING LOAD	467,591 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	467,591 KWH/YR
ENERGY SAVINGS	155,894 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION	ORIGINAL ELECTRIC CONSUMPTION	TOTAL ELECTRIC CONSUMPTION	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
JAN87	2227.5	14.54%	67998	15000	82998	$1,849.82	199	$1,157.46	$3,007.28
FEB87	2046.2	13.36%	62464	17100	79564	$1,790.32	199	$1,157.46	$2,947.78
MAR87	1952.8	12.75%	59612	16800	76412	$1,735.73	199	$1,157.46	$2,893.19
APR87	1339.2	8.74%	40881	15900	56781	$1,395.66	199	$1,157.46	$2,553.12
MAY87	1088.8	7.11%	33237	15000	48237	$1,247.65	160	$854.50	$2,102.15
JUN87	652	4.26%	19903	6900	26803	$876.34	100	$388.41	$1,264.75
JUL87	338.9	2.21%	10345	5100	15445	$756.79	50	$0.00	$756.79
AUG87	452.5	2.95%	13813	13800	27613	$890.37	100	$388.41	$1,278.78
SEP87	579.8	3.79%	17699	15900	33599	$994.07	160	$854.50	$1,848.57
OCT87	1119.2	7.31%	34165	18900	53065	$1,331.29	175	$971.03	$2,302.31
NOV87	1588.5	10.37%	48491	14400	62891	$1,501.51	199	$1,157.46	$2,658.97
DEC87	1932.1	12.61%	58980	14700	73680	$1,688.41	199	$1,157.46	$2,845.87
	15317.5		467591	169500	637091	$16,057.95		$10,401.62	$26,459.57
				CHECK	637091				

TOTAL COSTS (TAX INCLUDED): $26,459.57

HEATING DAYS	302 DAYS
HEATING LOAD	467,591 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	64.51 KW
SIZE AT DESIGN	161.28 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE DEMAND

ENSURE PEAK DEMAND DOES NOT GO HIGHER THAN 199 KVA - INSTALL DEMAND CONTROL EQUIPMENT

30-Mar-90 FILE NUMBER: 2

ORIGINAL ELECTRICAL CONSUMPTION	46,760 KWH/YR	PROPANE	312,775 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION	312,775 KWH/YR	FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION	359,535 KWH/YR	TOTAL FUEL	312,775 KWH/YR

TRANSMISSION	95,003 KWH/YR
INFILTRATION	41,977 KWH/YR
(IHG)	(36,627)KWH/YR
VENTILATION	9,527 KWH/YR
STACK LOSSES	73,253 KWH/YR
TOTAL FUEL	183,133 KWH/YR
HEATING LOAD	109,880 KWH/YR
HOT WATER	111,368 KWH/YR
TOTAL ELECTRICITY	165,564 KWH/YR
ENERGY SAVINGS	147,211 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION	ORIGINAL ELECTRIC CONSUMPTION	TOTAL ELECTRIC CONSUMPTION	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
JUL85	365.2	2.25%	3732	3570	7302	$378.95	50	$0.00	$378.95
AUG85	401.8	2.48%	4106	5300	9406	$476.56	50	$0.00	$476.56
SEP85	598.7	3.69%	6117	3690	9807	$495.21	50	$0.00	$495.21
OCT85	1109.5	6.85%	11337	5100	16437	$699.57	55	$38.84	$738.41
NOV85	1881	11.61%	19220	5930	25150	$857.22	65	$116.52	$973.74
DEC85	2207.5	13.62%	22556	3405	25961	$871.90	65	$116.52	$988.42
JAN86	2242.4	13.84%	22913	3405	26318	$878.35	65	$116.52	$994.87
FEB86	2206.1	13.62%	22542	4000	26542	$882.40	65	$116.52	$998.93
MAR86	2118.6	13.08%	21648	3250	24898	$852.66	60	$77.68	$930.34
APR86	1478.2	9.12%	15104	5200	20304	$769.54	60	$77.68	$847.23
MAY86	931.7	5.75%	9520	2510	12030	$598.33	55	$38.84	$637.17
JUN86	662.6	4.09%	6770	1400	8170	$419.26	55	$38.84	$458.10
	16203.3		165564	46760	212324	$8,179.95		$737.98	$8,917.93
				CHECK	212324				

TOTAL COSTS (TAX INCLUDED): $8,917.93

HEATING DAYS	303 DAYS
HEATING LOAD	109,880 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	15.11 KW
SIZE AT DESIGN	37.78 KW

GENERAL SERVICE OR DEMAND BILLING
STRUCTURE: DEMAND

WITH OTHER ELECTRIC EQUIPMENT IN BUILDING, WINTER DEMAND WILL PEAK AT 65 KVA FOR 4 MONTHS

0

30-Mar-90	FILE NUMBER:	3		
ORIGINAL ELECTRICAL CONSUMPTION		50,399 KWH/YR	PROPANE	0 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION		0 KWH/YR	FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION		50,399 KWH/YR	TOTAL FUEL	0 KWH/YR

TRANSMISSION	42,070 KWH/YR
INFILTRATION	11,900 KWH/YR
(IHG)	(13,500)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	0 KWH/YR
TOTAL FUEL	40,470 KWH/YR
HEATING LOAD	40,470 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	0 KWH/YR
ENERGY SAVINGS	0 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
APR86	1478.2	9.20%	0	3800	3800	$216.49
MAY86	931.7	5.80%	0	3660	3660	$210.00
JUN86	662.6	4.13%	0	4000	4000	$225.77
JUL86	444.9	2.77%	0	2100	2100	$137.62
AUG86	402.8	2.51%	0	2000	2000	$132.98
SEP86	739.1	4.60%	0	2980	2980	$178.45
OCT86	1126.1	7.01%	0	5204	5204	$281.63
NOV86	1995.5	12.43%	0	5058	5058	$274.86
DEC86	2051.6	12.78%	0	5300	5300	$286.08
JAN87	2227.5	13.87%	0	6536	6536	$343.43
FEB87	2046.2	12.74%	0	6274	6274	$331.27
MAR87	1952.8	12.16%	0	3487	3487	$201.97
	16059.0		0	50399	50399	$2,820.55
				CHECK	50399	

HEATING DAYS	300 DAYS
HEATING LOAD	40,470 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	1.94 KW
SIZE AT DESIGN	4.85 KW
GENERAL SERVICE OR DEMAND BILLING STRUCTURE:	GENERAL SERVICE

30-Mar-90	FILE NUMBER:	4

ORIGINAL ELECTRICAL CONSUMPTION	32,490 KWH/YR			
ORIGINAL OTHER FUEL CONSUMPTION	159,542 KWH/YR	PROPANE	89,415 KWH/YR	
		FUEL OIL	70,127 KWH/YR	
TOTAL ORIGINAL CONSUMPTION	192,032 KWH/YR	TOTAL FUEL	159,542 KWH/YR	

TRANSMISSION	75,881 KWH/YR
INFILTRATION	32,390 KWH/YR
(IHG)	(13,733)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	51,266 KWH/YR
TOTAL FUEL	145,804 KWH/YR
HEATING LOAD	94,538 KWH/YR
HOT WATER	14,000 KWH/YR
TOTAL ELECTRICITY	101,538 KWH/YR
ENERGY SAVINGS	58,004 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
APR87	1339.2	8.26%	8384	2900	11284	$563.73	50	$0.00	$563.73
MAY87	1088.8	6.71%	6817	2550	9367	$474.76	50	$0.00	$474.76
JUN87	652.0	4.02%	4082	2840	6922	$361.34	50	$0.00	$361.34
JUL87	338.9	2.09%	2122	2340	4462	$247.20	50	$0.00	$247.20
AUG87	452.5	2.79%	2833	1700	4533	$250.50	50	$0.00	$250.50
SEP87	579.8	3.58%	3630	2670	6300	$332.48	50	$0.00	$332.48
OCT87	1119.2	6.90%	7007	1740	8747	$446.01	50	$0.00	$446.01
NOV87	1588.5	9.79%	9945	3080	13025	$637.84	55	$38.84	$676.68
DEC87	1932.1	11.91%	12096	1910	14006	$655.59	55	$38.84	$694.44
JAN88	2605.3	16.06%	16311	3480	19791	$760.26	55	$38.84	$799.10
FEB88	2406.4	14.84%	15066	4140	19206	$749.67	55	$38.84	$788.51
MAR88	2115.4	13.04%	13244	3140	16384	$698.61	55	$38.84	$737.45
	16218.1		101538	32490	134028	$6,178.01		$194.21	$6,372.21
				CHECK	134028				

TOTAL COSTS (TAX INCLUDED): $6,372.21

HEATING DAYS	303 DAYS
HEATING LOAD	94,538 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	13.00 KW
SIZE AT DESIGN	32.50 KW

GENERAL SERVICE OR DEMAND BILLING
STRUCTURE: DEMAND ENSURE THAT PEAK WINTER DEMAND REACHES 55 KVA

0

30-Mar-90	FILE NUMBER:	5				
ORIGINAL ELECTRICAL CONSUMPTION		40,080 KWH/YR		PROPANE	306,018 KWH/YR	
ORIGINAL OTHER FUEL CONSUMPTION		306,018 KWH/YR		FUEL OIL	0 KWH/YR	
TOTAL ORIGINAL CONSUMPTION		346,098 KWH/YR		TOTAL FUEL	306,018 KWH/YR	

TRANSMISSION	173,229 KWH/YR
INFILTRATION	50,118 KWH/YR
(IHG)	(33,502)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	81,362 KWH/YR
TOTAL FUEL	271,207 KWH/YR
HEATING LOAD	189,845 KWH/YR
HOT WATER	32,880 KWH/YR
TOTAL ELECTRICITY	206,285 KWH/YR
ENERGY SAVINGS	99,733 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION	ORIGINAL ELECTRIC CONSUMPTION	TOTAL ELECTRIC CONSUMPTION	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
JAN84	2578.7	16.04%	33080	3820	36900	$1,069.82	65	$116.52	$1,186.34
FEB84	1968.3	12.24%	25249	3000	28249	$913.30	65	$116.52	$1,029.82
MAR84	2126.0	13.22%	27272	5030	32302	$986.64	60	$77.68	$1,064.32
APR84	1201.9	7.47%	15418	2000	17418	$717.32	55	$38.84	$756.16
MAY84	1045.3	6.50%	13409	3760	17169	$712.82	55	$38.84	$751.66
JUN84	582.7	3.62%	7475	2500	9975	$502.98	50	$0.00	$502.98
JUL84	327.6	2.04%	4202	3700	7902	$406.83	50	$0.00	$406.83
AUG84	217.8	1.35%	2794	3000	5794	$309.00	50	$0.00	$309.00
SEP84	752.6	4.68%	9654	2580	12234	$607.81	50	$0.00	$607.81
OCT84	1049.6	6.53%	13464	3500	16964	$709.11	55	$38.84	$747.95
NOV84	1652.9	10.28%	21203	3500	24703	$849.14	60	$77.68	$926.83
DEC84	2577.4	16.03%	33063	4000	37063	$1,072.77	65	$116.52	$1,189.30
	16080.8		206285	40390	246675	$8,857.54		$621.46	$9,478.99
				CHECK	246675				

TOTAL COSTS (TAX INCLUDED): $9,478.99

HEATING DAYS	365 DAYS
HEATING LOAD	189,845 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	21.67 KW
SIZE AT DESIGN	54.18 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND — PEAK WINTER DEMAND OF 65 KVA FOR 3 MONTH/YEAR

0

30-Mar-90 FILE NUMBER: 6

ORIGINAL ELECTRICAL CONSUMPTION	13,080 KWH/YR			
ORIGINAL OTHER FUEL CONSUMPTION	125,082 KWH/YR		PROPANE	125,082 KWH/YR
			FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION	138,162 KWH/YR		TOTAL FUEL	125,082 KWH/YR

TRANSMISSION	55,560 KWH/YR
INFILTRATION	26,828 KWH/YR
(IHG)	(8,339)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	51,033 KWH/YR
TOTAL FUEL	125,082 KWH/YR
HEATING LOAD	74,049 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	74,049 KWH/YR
ENERGY SAVINGS	51,033 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
APR85	1511.8	9.28%	6871	1090	7961	$409.53
MAY85	1015.6	6.23%	4616	1090	5706	$304.91
JUN85	634.9	3.90%	2885	1090	3975	$224.63
JUL85	365.2	2.24%	1660	1090	2750	$167.77
AUG85	401.8	2.47%	1826	1090	2916	$175.48
SEP85	598.7	3.67%	2721	1090	3811	$217.00
OCT85	1109.5	6.81%	5042	1090	6132	$324.71
NOV85	1881	11.54%	8549	1090	9639	$487.38
DEC85	2207.5	13.55%	10033	1090	11123	$556.23
JAN86	2242.4	13.76%	10191	1090	11281	$563.59
FEB86	2206.1	13.54%	10026	1090	11116	$555.93
MAR86	2118.6	13.00%	9629	1090	10719	$537.48
	16293.1		74049	13080	87129	$4,524.65
				CHECK	87129	

HEATING DAYS	303 DAYS
HEATING LOAD	74,049 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	10.18 KW
SIZE AT DESIGN	25.46 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: GENERAL SERVICE

30-Mar-90	FILE NUMBER:	7
ORIGINAL ELECTRICAL CONSUMPTION	161,840 KWH/YR	
ORIGINAL OTHER FUEL CONSUMPTION	249,639 KWH/YR	
TOTAL ORIGINAL CONSUMPTION	411,479 KWH/YR	

PROPANE	249,639 KWH/YR
FUEL OIL	0 KWH/YR
TOTAL FUEL	249,639 KWH/YR

TRANSMISSION	35,000 KWH/YR
INFILTRATION	5,000 KWH/YR
(IHG)	(14,000)KWH/YR
VENTILATION	60,000 KWH/YR
STACK LOSSES	30,000 KWH/YR
TOTAL FUEL	116,000 KWH/YR
HEATING LOAD	86,000 KWH/YR
HOT WATER	134,301 KWH/YR
TOTAL ELECTRICITY	153,151 KWH/YR
ENERGY SAVINGS	96,489 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
JUL85	365.2	2.25%	3452	10760	14212	$699.55	50	$0.00	$699.55
AUG85	401.8	2.48%	3798	8200	11998	$596.83	50	$0.00	$596.83
SEP85	598.7	3.69%	5659	12180	17839	$724.94	55	$38.84	$763.78
OCT85	1109.5	6.85%	10487	13500	23987	$836.18	55	$38.84	$875.02
NOV85	1881	11.61%	17779	13420	31199	$966.67	60	$77.68	$1,044.35
DEC85	2207.5	13.62%	20865	16900	37765	$1,085.47	60	$77.68	$1,163.15
JAN86	2242.4	13.84%	21195	21050	42245	$1,166.53	60	$77.68	$1,244.21
FEB86	2206.1	13.62%	20852	12000	32852	$996.57	60	$77.68	$1,074.26
MAR86	2118.6	13.08%	20025	16140	36165	$1,056.52	60	$77.68	$1,134.20
APR86	1478.2	9.12%	13972	11500	25472	$863.04	55	$38.84	$901.88
MAY86	931.7	5.75%	8806	17090	25896	$870.73	55	$38.84	$909.57
JUN86	662.6	4.09%	6263	10000	16263	$794.70	50	$0.00	$794.70
	16203.3		153151	162740	315891	$10,657.72		$543.77	$11,201.50
				CHECK	315890.5				

TOTAL COSTS (TAX INCLUDED): $11,201.50

HEATING DAYS	303 DAYS
HEATING LOAD	86,000 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	11.83 KW
SIZE AT DESIGN	29.57 KW

GENERAL SERVICE OR DEMAND BILLING
STRUCTURE: DEMAND — WITH ELECTRIC HEAT, AND EQUIPMENT PEAK DEMAND WILL BE 60 KVA

30-Mar-90 FILE NUMBER: 8

ORIGINAL ELECTRICAL CONSUMPTION	24,000 KWH/YR			
ORIGINAL OTHER FUEL CONSUMPTION	105,000 KWH/YR	PROPANE	105,000 KWH/YR
		FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION	129,000 KWH/YR	TOTAL FUEL	105,000 KWH/YR

TRANSMISSION	54,000 KWH/YR
INFILTRATION	9,000 KWH/YR
(IHG)	0 KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	42,000 KWH/YR
TOTAL FUEL	105,000 KWH/YR
HEATING LOAD	63,000 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	63,000 KWH/YR
ENERGY SAVINGS	42,000 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
JUL85	365.2	2.25%	1420	2000	3420	$198.86
AUG85	401.8	2.48%	1562	2000	3562	$205.46
SEP85	598.7	3.69%	2328	2000	4328	$240.98
OCT85	1109.5	6.85%	4314	2000	6314	$333.12
NOV85	1881	11.61%	7314	2000	9314	$472.29
DEC85	2207.5	13.62%	8583	2000	10583	$531.19
JAN86	2242.4	13.84%	8719	2000	10719	$537.48
FEB86	2206.1	13.62%	8578	2000	10578	$530.94
MAR86	2118.6	13.08%	8237	2000	10237	$515.15
APR86	1478.2	9.12%	5747	2000	7747	$399.63
MAY86	931.7	5.75%	3623	2000	5623	$301.05
JUN86	662.6	4.09%	2576	2000	4576	$252.51
	16203.3		63000	24000	87000	$4,518.66
				CHECK	87000	

HEATING DAYS	303 DAYS
HEATING LOAD	63,000 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	8.66 KW
SIZE AT DESIGN	21.66 KW
GENERAL SERVICE OR DEMAND BILLING STRUCTURE	GENERAL SERVICE

0

30-Mar-90 FILE NUMBER: 9

ORIGINAL ELECTRICAL CONSUMPTION	25,400 KWH/YR			
ORIGINAL OTHER FUEL CONSUMPTION	177,996 KWH/YR		PROPANE	177,996 KWH/YR
			FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION	203,396 KWH/YR		TOTAL FUEL	177,996 KWH/YR

TRANSMISSION	98,166 KWH/YR
INFILTRATION	24,017 KWH/YR
(IHG)	(18,327)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	75,206 KWH/YR
TOTAL FUEL	179,062 KWH/YR
HEATING LOAD	103,856 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	103,856 KWH/YR
ENERGY SAVINGS	74,140 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
AUG85	401.8	2.47%	2563	1800	4363	$242.60	50	$0.00	$242.60
SEP85	598.7	3.68%	3819	2380	6199	$327.78	50	$0.00	$327.78
OCT85	1109.5	6.81%	7077	2775	9852	$497.26	50	$0.00	$497.26
NOV85	1881	11.55%	11997	2775	14772	$669.45	55	$38.89	$708.35
DEC85	2207.5	13.56%	14080	3000	17080	$711.20	55	$38.89	$750.10
JAN86	2242.4	13.77%	14302	810	15112	$675.61	55	$38.89	$714.50
FEB86	2206.1	13.55%	14071	810	14881	$671.42	55	$38.89	$710.31
MAR86	2118.6	13.01%	13513	2650	16163	$694.61	55	$38.89	$733.51
APR86	1478.2	9.08%	9428	2100	11528	$575.04	55	$38.89	$613.94
MAY86	931.7	5.72%	5943	2370	8313	$425.85	55	$38.89	$464.75
JUN86	662.6	4.07%	4226	2000	6226	$329.06	50	$0.00	$329.06
JUL86	444.9	2.73%	2838	1930	4768	$261.39	50	$0.00	$261.39
	16283.0		103856	25400	129256	$6,081.26		$272.26	$6,353.53
				CHECK	129256				

HEATING DAYS	303 DAYS
HEATING LOAD	103,856 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	14.28 KW
SIZE AT DESIGN	35.70 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND

WITH OTHER EQUIPMENT IN FACILITY, PEAK DEMAND WILL BE 55 KVA FOR 7 MONTHS/YEAR

0

30-Mar-90	FILE NUMBER:	10	
ORIGINAL ELECTRICAL CONSUMPTION		10,510 KWH/YR	
ORIGINAL OTHER FUEL CONSUMPTION		64,166 KWH/YR	
TOTAL ORIGINAL CONSUMPTION		74,676 KWH/YR	

PROPANE	64,166 KWH/YR
FUEL OIL	0 KWH/YR
TOTAL FUEL	64,166 KWH/YR

TRANSMISSION	23,000 KWH/YR
INFILTRATION	30,000 KWH/YR
(internal heat gain)	(11,000)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	23,000 KWH/YR
TOTAL FUEL CONSUMPTION	65,000 KWH/YR
HEATING LOAD	42,000 KWH/YR
HOT WATER (50% EFFIC)	0 KWH/YR
TOTAL FUEL FOR CONVERSION	42,000 KWH/YR
ENERGY SAVINGS (KWH)	22,166 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
JAN86	2242.4	13.67%	5743	1500	7243	$376.22
FEB86	2206.1	13.45%	5650	838	6488	$341.20
MAR86	2118.6	12.92%	5426	1200	6626	$347.60
APR86	1478.2	9.01%	3786	1094	4880	$266.39
MAY86	931.7	5.68%	2386	650	3036	$181.05
JUN86	662.6	4.04%	1697	868	2565	$159.19
JUL86	444.9	2.71%	1139	600	1739	$120.89
AUG86	402.8	2.46%	1032	442	1474	$108.56
SEP86	739.1	4.51%	1893	440	2333	$148.42
OCT86	1126.1	6.87%	2884	565	3449	$200.21
NOV86	1995.5	12.17%	5111	1290	6401	$337.14
DEC86	2051.6	12.51%	5254	1023	6277	$331.42
	16399.6		42000	10510	52510	$2,918.49
				CHECK	52510	

HEATING DAYS	303 DAYS
HEATING LOAD	42,000 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMPERATURE	5.78 KW
SIZE AT DESIGN (-50 F)	14.44 KW
GENERAL SERVICE OR DEMAND BILLING STRUCTURE:	GENERAL SERVICE

0

30-Mar-90	FILE NUMBER:	11			
ORIGINAL ELECTRICAL CONSUMPTION		82,860 KWH/YR	PROPANE	354,800 KWH/YR	
ORIGINAL OTHER FUEL CONSUMPTION		354,800 KWH/YR	FUEL OIL	0 KWH/YR	
TOTAL ORIGINAL CONSUMPTION		437,660 KWH/YR	TOTAL	354,800 KWH/YR	

TRANSMISSION	114,300 KWH/YR
INFILTRATION	148,900 KWH/YR
(IHG)	(39,500)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	120,500 KWH/YR
TOTAL FUEL	344,200 KWH/YR
HEATING LOAD	223,700 KWH/YR
HOT WATER	10,000 KWH/YR
TOTAL ELECTRICITY	228,700 KWH/YR
ENERGY SAVINGS	126,100 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (kwh)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
JAN86	2242.4	13.67%	31271	6000	37271	$1,076.54	100	$388.41	$1,464.95
FEB86	2206.1	13.45%	30765	4440	35205	$1,039.16	100	$388.41	$1,427.57
MAR86	2118.6	12.92%	29545	3600	33145	$1,001.88	100	$388.41	$1,390.29
APR86	1478.2	9.01%	20614	12660	33274	$1,004.22	85	$271.89	$1,276.11
MAY86	931.7	5.68%	12993	6000	18993	$745.82	85	$271.89	$1,017.71
JUN86	662.6	4.04%	9240	10980	20220	$768.03	70	$155.36	$923.39
JUL86	444.9	2.71%	6204	4800	11004	$550.74	50	$0.00	$550.74
AUG86	402.8	2.46%	5617	12000	17617	$857.55	50	$0.00	$857.55
SEP86	739.1	4.51%	10307	5400	15707	$686.37	70	$155.36	$841.73
OCT86	1126.1	6.87%	15704	2760	18464	$736.25	75	$194.21	$930.45
NOV86	1995.5	12.17%	27828	11280	39108	$1,109.78	100	$388.41	$1,498.19
DEC86	2051.6	12.51%	28611	2940	31551	$973.03	100	$388.41	$1,361.44
	16399.6		228700	82860	311560	$10,549.35		$2,990.76	$13,540.11
				CHECK	311560				

TOTAL COSTS (TAX INCLUDED): $13,540.11

HEATING DAYS	300 DAYS
HEATING LOAD	223,700 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	31.07 KW
SIZE AT DESIGN	77.67 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND

ESTIMATED PEAK DEMAND OF 100 KVA FOR 5 MONTHS

0

30-Mar-90	FILE NUMBER:	12			
ORIGINAL ELECTRICAL CONSUMPTION		63,600 KWH/YR			
ORIGINAL OTHER FUEL CONSUMPTION		409,579 KWH/YR	PROPANE	409,579 KWH/YR	
			FUEL OIL	0 KWH/YR	
TOTAL ORIGINAL CONSUMPTION		473,179 KWH/YR	TOTAL FUEL	409,579 KWH/YR	
	TRANSMISSION	182,436 KWH/YR			
	INFILTRATION	42,960 KWH/YR			
	(IHG)	(45,080)KWH/YR			
	VENTILATION	0 KWH/YR			
	STACK LOSSES	143,860 KWH/YR			
	TOTAL FUEL	324,176 KWH/YR			
	HEATING LOAD	180,316 KWH/YR			
	HOT WATER	68,600 KWH/YR			
	TOTAL ELECTRICITY	214,616 KWH/YR			
	ENERGY SAVINGS	194,963 KWH/YR			

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
SEP83	660.1	4.29%	9211	5300	14511	$713.42	50	$0.00	$713.42
OCT83	950.8	6.18%	13267	5300	18567	$738.11	65	$116.52	$854.64
NOV83	1310.2	8.52%	18282	5300	23582	$828.85	65	$116.52	$945.37
DEC83	2411.3	15.68%	33646	5300	38946	$1,106.85	70	$155.36	$1,262.21
JAN84	2578.7	16.77%	35982	5300	41282	$1,149.11	70	$155.36	$1,304.48
FEB84	1968.3	12.80%	27465	5300	32765	$995.00	70	$155.36	$1,150.37
MAR84	2126	13.82%	29665	5300	34965	$1,034.82	70	$155.36	$1,190.18
APR84	1201.9	7.81%	16771	5300	22071	$801.51	65	$116.52	$918.03
MAY84	1045.3	6.80%	14586	5300	19886	$761.97	60	$77.68	$839.65
JUN84	582.7	3.79%	8131	5300	13431	$663.31	50	$0.00	$663.31
JUL84	327.6	2.13%	4571	5300	9871	$498.17	50	$0.00	$498.17
AUG84	217.8	1.42%	3039	5300	8339	$427.08	50	$0.00	$427.08
	15380.7		214616	63600	278216	$9,718.21		$1,048.71	$10,766.92
				CHECK	278216				

TOTAL COSTS (TAX INCLUDED): $10,766.92

HEATING DAYS	365 DAYS
HEATING LOAD	180,316 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	20.58 KW
SIZE AT DESIGN	51.46 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND ESTIMATED PEAK DEMAND OF 70 KVA

0

30-Mar-90	FILE NUMBER:	13	
ORIGINAL ELECTRICAL CONSUMPTION	19,680 KWH/YR	PROPANE	147,900 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION	241,700 KWH/YR	FUEL OIL	93,800 KWH/YR
TOTAL ORIGINAL CONSUMPTION	261,380 KWH/YR	TOTAL FUEL	241,700 KWH/YR

TRANSMISSION	167,000 KWH/YR
INFILTRATION	26,800 KWH/YR
(IHG)	(33,100)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	51,600 KWH/YR
TOTAL FUEL	212,300 KWH/YR
HEATING LOAD	160,700 KWH/YR
HOT WATER	27,300 KWH/YR
TOTAL ELECTRICITY	174,350 KWH/YR
ENERGY SAVINGS	67,350 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND KVA	DEMAND COSTS ($)	TOTAL COSTS ($)
OCT85	1109.5	6.76%	11778	900	12678	$628.37	60	$77.68	$706.06
NOV85	1881.0	11.45%	19967	950	20917	$780.64	65	$116.52	$897.16
DEC85	2207.5	13.44%	23433	1300	24733	$849.68	80	$233.05	$1,082.73
JAN86	2242.4	13.65%	23804	1080	24884	$852.41	80	$233.05	$1,085.45
FEB86	2206.1	13.43%	23418	900	24318	$842.18	80	$233.05	$1,075.22
MAR86	2118.6	12.90%	22490	1680	24170	$839.48	80	$233.05	$1,072.53
APR86	1478.2	9.00%	15692	1100	16792	$705.99	65	$116.52	$822.51
MAY86	931.7	5.67%	9890	2170	12060	$599.73	60	$77.68	$677.41
JUN86	662.6	4.03%	7034	1400	8434	$431.47	25	$0.00	$431.47
JUL86	444.9	2.71%	4723	4000	8723	$444.88	25	$0.00	$444.88
AUG86	402.8	2.45%	4276	2200	6476	$340.64	25	$0.00	$340.64
SEP86	739.1	4.50%	7846	2000	9846	$496.99	50	$0.00	$496.99
	16424.4		174350	19680	194030	$7,812.46		$1,320.59	$9,133.05
				CHECK	194030				

TOTAL COSTS (TAX INCLUDED): $9,133.05

HEATING DAYS	300 DAYS
HEATING LOAD	160,700 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	22.32 KW
SIZE AT DESIGN	55.80 KW
GENERAL SERVICE OR DEMAND BILLING STRUCTURE	DEMAND ESTIMATED PEAK DEMAND OF 80 KVA

0

30-Mar-90	FILE NUMBER:	14		
ORIGINAL ELECTRICAL CONSUMPTION		36,630 KWH/YR	PROPANE	10,527 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION		164,679 KWH/YR	FUEL OIL	154,152 KWH/YR
TOTAL ORIGINAL CONSUMPTION		201,309 KWH/YR	TOTAL FUEL	164,679 KWH/YR

TRANSMISSION	113,500 KWH/YR
INFILTRATION	44,000 KWH/YR
(IHG)	(55,000)KWH/YR
VENTILATION	3,500 KWH/YR
STACK LOSSES	58,500 KWH/YR
TOTAL FUEL	164,500 KWH/YR
HEATING LOAD	106,000 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	106,000 KWH/YR
ENERGY SAVINGS	58,679 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
JAN83	2414.0	15.01%	15905	3120	19025	$922.88
FEB83	2237.8	13.91%	14744	2500	17244	$840.25
MAR83	2124.7	13.21%	13999	3120	17119	$834.44
APR83	1532.5	9.53%	10097	2000	12097	$601.45
MAY83	1085.2	6.75%	7150	4410	11560	$576.53
JUN83	677.5	4.21%	4464	2000	6464	$340.08
JUL83	380.9	2.37%	2510	4070	6580	$345.46
AUG83	302.9	1.88%	1996	2000	3996	$225.57
SEP82	660.1	4.10%	4349	3670	8019	$412.25
OCT83	950.8	5.91%	6265	4000	10265	$516.42
NOV83	1310.2	8.14%	8633	3440	12073	$600.30
DEC83	2411.3	14.99%	15888	2300	18188	$884.01
	16087.9		106000	36630	142630	$7,099.63
				CHECK	142630	

HEATING DAYS	260 DAYS
HEATING LOAD	106,000 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	16.99 KW
SIZE AT DESIGN	42.47 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: GENERAL SERVICE

0

30-Mar-90	FILE NUMBER:	15		
ORIGINAL ELECTRICAL CONSUMPTION		26,060 KWH/YR	PROPANE	76,853 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION		76,853 KWH/YR	FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION		102,913 KWH/YR	TOTAL FUEL	76,853 KWH/YR

TRANSMISSION	43,793 KWH/YR
INFILTRATION	11,567 KWH/YR
(IHG)	(5,536)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	26,828 KWH/YR
TOTAL FUEL	76,652 KWH/YR
HEATING LOAD	49,824 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	49,824 KWH/YR
ENERGY SAVINGS	27,029 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
OCT87	1119.2	6.89%	3432	1970	5402	$290.80
NOV87	1588.5	9.78%	4871	2710	7581	$391.89
DEC87	1932.1	11.89%	5924	3250	9174	$465.82
JAN88	2605.3	16.03%	7988	3580	11568	$576.90
FEB88	2406.4	14.81%	7378	2410	9788	$494.32
MAR88	2115.4	13.02%	6486	3470	9956	$502.10
APR88	1367.8	8.42%	4194	1190	5384	$289.97
MAY88	1192.9	7.34%	3658	2560	6218	$328.66
JUN88	551.0	3.39%	1689	840	2529	$157.54
JUL88	338.9	2.09%	1039	1040	2079	$136.65
AUG88	452.5	2.78%	1387	1450	2837	$171.83
SEP88	579.8	3.57%	1778	1590	3368	$196.44
	16249.8		49824	26060	75884	$4,002.93
				CHECK	75884	

HEATING DAYS	285 DAYS
HEATING LOAD	49,824 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	7.28 KW
SIZE AT DESIGN	18.21 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: GENERAL SERVICE

0

30-Mar-90	FILE NUMBER:	16		
ORIGINAL ELECTRICAL CONSUMPTION		10,209 KWH/YR	PROPANE	0 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION		72,056 KWH/YR	FUEL OIL	72,056 KWH/YR
TOTAL ORIGINAL CONSUMPTION		82,265 KWH/YR	TOTAL FUEL	72,056 KWH/YR

TRANSMISSION	37,687 KWH/YR
INFILTRATION	10,260 KWH/YR
(IHG)	4,676 KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	20,116 KWH/YR
TOTAL FUEL	72,739 KWH/YR
HEATING LOAD	52,623 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	52,623 KWH/YR
ENERGY SAVINGS	19,433 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
JAN83	2414.0	15.01%	7896	1650	9546	$483.08
FEB83	2237.8	13.91%	7320	217	7537	$389.86
MAR83	2124.7	13.21%	6950	850	7800	$402.06
APR83	1532.5	9.53%	5013	598	5611	$300.50
MAY83	1085.2	6.75%	3550	700	4250	$237.35
JUN83	677.5	4.21%	2216	1487	3703	$212.00
JUL83	380.9	2.37%	1246	600	1846	$125.83
AUG83	302.9	1.88%	991	169	1160	$94.00
SEP82	660.1	4.10%	2159	400	2559	$158.92
OCT83	950.8	5.91%	3110	921	4031	$227.21
NOV83	1310.2	8.14%	4286	1000	5286	$285.42
DEC83	2411.3	14.99%	7887	1617	9504	$481.14
	16087.9		52623	10209	62832	$3,397.38
				CHECK	62832	

HEATING DAYS	260 DAYS
HEATING LOAD	52,623 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	8.43 KW
SIZE AT DESIGN	21.08 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: GENERAL SERVICE

0

30-Mar-90 FILE NUMBER: 17

ORIGINAL ELECTRICAL CONSUMPTION	117,006 KWH/YR	PROPANE	0 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION	407,000 KWH/YR	FUEL OIL	407,000 KWH/YR
TOTAL ORIGINAL CONSUMPTION	524,006 KWH/YR	TOTAL FUEL	407,000 KWH/YR

TRANSMISSION	383,000 KWH/YR
INFILTRATION	40,000 KWH/YR
(IHG)	(97,000)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	81,000 KWH/YR
TOTAL FUEL	407,000 KWH/YR
HEATING LOAD	326,000 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	326,000 KWH/YR
ENERGY SAVINGS	81,000 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
DEC85	2207.5	13.33%	43469	10180	53649	$1,364.12	115	$504.93	$1,869.06
JAN86	2242.4	13.54%	44156	10000	54156	$1,373.19	115	$504.93	$1.878.13
FEB86	2206.1	13.33%	43441	11530	54971	$1,387.77	115	$504.93	$1,892.70
MAR86	2118.6	12.80%	41718	11000	52718	$1,347.49	115	$504.93	$1,852.42
APR86	1478.2	8.93%	29108	16700	45808	$1,223.93	100	$388.41	$1,612.34
MAY86	931.7	5.63%	18346	11000	29346	$929.61	80	$233.05	$1,162.65
JUN86	662.6	4.00%	13047	3450	16497	$699.87	65	$116.52	$816.40
JUL86	444.9	2.69%	8761	7500	16261	$794.61	50	$0.00	$794.61
AUG86	402.8	2.43%	7932	7920	15852	$775.63	50	$0.00	$775.63
SEP86	739.1	4.46%	14554	11000	25554	$861.80	80	$233.05	$1,094.84
OCT86	1126.1	6.80%	22174	6695	28869	$921.08	100	$388.41	$1,309.49
NOV86	1995.5	12.05%	39294	10031	49325	$1,286.82	115	$504.93	$1.791.75
	16555.5		326000	117006	443006	$12,965.93		$3,884.10	$16,850.03
				CHECK	443006				

TOTAL COSTS TAX INCLUDED: $16,850.03

HEATING DAYS	303 DAYS
HEATING LOAD	326,000 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	44.83 KW
SIZE AT DESIGN	112.07 KW
GENERAL SERVICE DEMAND: DEMAND	ESTIMATED PEAK WINTER DEMAND OF 115 KVA

0

30-Mar-90	FILE NUMBER:	18			
ORIGINAL ELECTRICAL CONSUMPTION		25,660 KWH/YR			
ORIGINAL OTHER FUEL CONSUMPTION		121,054 KWH/YR	PROPANE	0 KWH/YR	
			FUEL OIL	121,054 KWH/YR	
TOTAL ORIGINAL CONSUMPTION		146,714 KWH/YR	TOTAL FUEL	121,054 KWH/YR	

TRANSMISSION	64,000 KWH/YR
INFILTRATION	21,000 KWH/YR
(IHG)	(8,000)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	44,000 KWH/YR
TOTAL FUEL	121,000 KWH/YR
HEATING LOAD	77,000 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	77,000 KWH/YR
ENERGY SAVINGS	44,054 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)
JAN86	2242.4	13.67%	10529	3000	13529	$667.85
FEB86	2206.1	13.45%	10358	1270	11628	$579.68
MAR86	2118.6	12.92%	9947	1000	10947	$548.09
APR86	1478.2	9.01%	6940	3610	10550	$529.68
MAY86	931.7	5.68%	4375	1900	6275	$331.30
JUN86	662.6	4.04%	3111	2710	5821	$310.26
JUL86	444.9	2.71%	2089	1700	3789	$215.98
AUG86	402.8	2.46%	1891	2600	4491	$248.56
SEP86	739.1	4.51%	3470	1700	5170	$280.06
OCT86	1126.1	6.87%	5287	1170	6457	$339.78
NOV86	1995.5	12.17%	9369	2880	12249	$608.50
DEC86	2051.6	12.51%	9633	2120	11753	$585.46
	16399.6		77000	25660	102660	$5,245.21
				CHECK	102660	

HEATING DAYS	303 DAYS
HEATING LOAD	77,000 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	10.59 KW
SIZE AT DESIGN	26.47 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: GENERAL SERVICE

0

30-Mar-90 FILE NUMBER: 19

ORIGINAL ELECTRICAL CONSUMPTION	15,549 KWH/YR	PROPANE	0 KWH/YR
ORIGINAL OTHER FUEL CONSUMPTION	190,288 KWH/YR	FUEL OIL	190,288 KWH/YR
TOTAL ORIGINAL CONSUMPTION	205,837 KWH/YR	TOTAL FUEL	190,288 KWH/YR

TRANSMISSION	94,000 KWH/YR
INFILTRATION	36,000 KWH/YR
(IHG)	(13,000)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	63,000 KWH/YR
TOTAL FUEL	180,000 KWH/YR
HEATING LOAD	117,000 KWH/YR
HOT WATER	11,000 KWH/YR
TOTAL ELECTRICITY	122,500 KWH/YR
ENERGY SAVINGS	67,788 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
JAN86	2242.4	13.67%	16750	1000	17750	$723.33	55	$38.84	$762.17
FEB86	2206.1	13.45%	16479	918	17397	$716.94	55	$38.84	$755.78
MAR86	2118.6	12.92%	15825	1400	17225	$713.84	55	$38.84	$752.68
APR86	1478.2	9.01%	11042	1000	12042	$598.87	55	$38.84	$637.71
MAY86	931.7	5.68%	6960	1100	8060	$414.11	55	$38.84	$452.95
JUN86	662.6	4.04%	4949	1387	6336	$334.17	45	$0.00	$334.17
JUL86	444.9	2.71%	3323	1200	4523	$250.05	45	$0.00	$250.05
AUG86	402.8	2.46%	3009	2200	5209	$281.85	45	$0.00	$281.85
SEP86	739.1	4.51%	5521	1500	7021	$365.92	45	$0.00	$365.92
OCT86	1126.1	6.87%	8412	1063	9475	$479.77	55	$38.84	$518.61
NOV86	1995.5	12.17%	14906	1918	16824	$706.57	55	$38.84	$745.41
DEC86	2051.6	12.51%	15325	863	16188	$695.06	55	$38.84	$733.90
	16399.6		122500	15549	138049	$6,280.48		$310.73	$6,591.21
				CHECK	138049				

TOTAL COSTS (TAX INCLUDED): $6,591.21

HEATING DAYS	303 DAYS
HEATING LOAD	117000 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	16.09 KW
SIZE AT DESIGN	40.22 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND (WITH LIGHTS, HOT WATER ETC. PEAK AT 55 KVA FOR 8 MONTHS)

0

30-Mar-90 FILE NUMBER: 20

ORIGINAL ELECTRICAL CONSUMPTION	24,990 KWH/YR		
ORIGINAL OTHER FUEL CONSUMPTION	305,623 KWH/YR	PROPANE	0 KWH/YR
		FUEL OIL	305,623 KWH/YR
TOTAL ORIGINAL CONSUMPTION	330,613 KWH/YR	TOTAL FUEL	305,623 KWH/YR

TRANSMISSION	151,691 KWH/YR
INFILTRATION	52,058 KWH/YR
(IHG)	(20,375)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	122,249 KWH/YR
TOTAL FUEL	305,623 KWH/YR
HEATING LOAD	183,374 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	183,374 KWH/YR
ENERGY SAVINGS	122,249 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
JUL86	444.9	2.77%	5078	2000	7078	$368.57	50	$0.00	$368.57
AUG86	402.8	2.51%	4597	2100	6697	$350.91	50	$0.00	$350.91
SEP86	739.1	4.60%	8436	2100	10536	$528.99	50	$0.00	$528.99
OCT86	1126.1	7.01%	12853	2200	15053	$672.78	65	$116.52	$789.30
NOV86	1995.5	12.42%	22776	2150	24926	$843.81	70	$155.36	$999.18
DEC86	2051.6	12.77%	23416	1890	25306	$850.40	80	$233.05	$1,083.45
JAN87	2227.5	13.86%	25423	2000	27423	$887.08	80	$233.05	$1,120.13
FEB87	2046.2	12.74%	23354	2100	25454	$852.97	80	$233.05	$1,086.02
MAR87	1952.8	12.15%	22288	2300	24588	$837.97	70	$155.36	$993.33
APR87	1339.2	8.34%	15285	2100	17385	$713.18	65	$116.52	$829.71
MAY87	1088.8	6.78%	12427	2150	14577	$716.49	50	$0.00	$716.49
JUN87	652	4.06%	7442	1900	9342	$473.59	50	$0.00	$473.59
	16066.5		183374	24990	208364	$8,096.76		$1,242.91	$9,339.67
				CHECK	208364				

TOTAL COSTS (TAX INCLUDED): $9,339.67

HEATING DAYS	303 DAYS
HEATING LOAD	183,374 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	25.22 KW
SIZE AT DESIGN	63.04 KW

ESTIMATED PEAK DEMAND OF 80 KVA

0

30-Mar-90 17 21

ORIGINAL ELECTRICAL CONSUMPTION	176,140 KWH/YR		
ORIGINAL OTHER FUEL CONSUMPTION	142,991 KWH/YR	PROPANE	142,991 KWH/YR
		FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION	319,131 KWH/YR	TOTAL FUEL	142,991 KWH/YR

TRANSMISSION	81,900 KWH/YR
INFILTRATION	20,000 KWH/YR
(IHG)	(10,000)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	51,000 KWH/YR
TOTAL FUEL	142,900 KWH/YR
HEATING LOAD	91,900 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	91,900 KWH/YR
ENERGY SAVINGS	51,091 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
APR86	1478.2	9.20%	8459	13200	21659	$794.06	52	$15.54	$809.60
MAY86	931.7	5.80%	5332	12000	17332	$715.76	52	$15.54	$731.30
JUN86	662.6	4.13%	3792	12500	16292	$696.95	52	$15.54	$712.48
JUL86	444.9	2.77%	2546	13000	15546	$683.45	52	$15.54	$698.99
AUG86	402.8	2.51%	2305	12700	15005	$673.66	52	$15.54	$689.20
SEP86	739.1	4.60%	4230	14250	18480	$736.53	52	$15.54	$752.07
OCT86	1126.1	7.01%	6444	15895	22339	$806.37	55	$38.84	$845.21
NOV86	1995.5	12.43%	11420	16500	27920	$907.33	60	$77.68	$985.02
DEC86	2051.6	12.78%	11741	16800	28541	$918.57	65	$116.52	$1,035.09
JAN87	2227.5	13.87%	12747	16300	29047	$927.74	65	$116.52	$1,044.26
FEB87	2046.2	12.74%	11710	16800	28510	$918.01	65	$116.52	$1,034.53
MAR87	1952.8	12.16%	11175	16195	27370	$897.39	65	$116.52	$1,013.92
	16059.0		91900	176140	268040	$9,675.83		$675.83	$10,351.66
				CHECK	268040				

TOTAL COSTS (TAX INCLUDED): $10,351.66

HEATING DAYS	303 DAYS
HEATING LOAD	91,900 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	12.64 KW
SIZE AT DESIGN	31.59 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND

ENSURE PEAK DEMAND IS OVER 50 KVA DURING WINTER MONTHS - WITH EQUIPMENT DEMAND SHOULD PEAK AT 65 KVA

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30-Mar-90 FILE NUMBER: 22

ORIGINAL ELECTRICAL CONSUMPTION	297,340 KWH/YR		
ORIGINAL OTHER FUEL CONSUMPTION	520,310 KWH/YR	PROPANE	520,310 KWH/YR
		FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION	817,650 KWH/YR	TOTAL FUEL	520,310 KWH/YR

TRANSMISSION	320,000 KWH/YR
INFILTRATION	80,000 KWH/YR
(IHG)	(62,000)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	182,000 KWH/YR
TOTAL FUEL	520,000 KWH/YR
HEATING LOAD	338,000 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	338,000 KWH/YR
ENERGY SAVINGS	182,310 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
APR86	1478.2	9.20%	31112	24191	55303	$1,402.81	100	$388.41	$1,791.22
MAY86	931.7	5.80%	19610	23641	43251	$1,184.73	85	$271.89	$1,456.62
JUN86	662.6	4.13%	13946	21490	35436	$1,684.25	50	$0.00	$1,684.25
JUL86	444.9	2.77%	9364	21190	30554	$1,457.75	50	$0.00	$1,457.75
AUG86	402.8	2.51%	8478	21490	29968	$1,430.56	50	$0.00	$1,430.56
SEP86	739.1	4.60%	15556	23694	39250	$1,112.35	100	$388.41	$1,500.76
OCT86	1126.1	7.01%	23701	25692	49393	$1,295.88	120	$543.77	$1,839.65
NOV86	1995.5	12.43%	42000	27590	69590	$1,661.31	160	$854.50	$2,515.81
DEC86	2051.6	12.78%	43181	26490	69671	$1,662.77	160	$854.50	$2,517.27
JAN87	2227.5	13.87%	46883	26193	73076	$1,724.38	160	$854.50	$2,578.88
FEB87	2046.2	12.74%	43067	27190	70257	$1,673.38	160	$854.50	$2,527.88
MAR87	1952.8	12.16%	41101	28489	69590	$1,661.31	160	$854.50	$2,515.81
	16059.0		338000	297340	635340	$17,951.47	.	$5,864.99	$23,816.46
				CHECK	635340				

TOTAL COSTS (TAX INCLUDED): $23,816.46

HEATING DAYS 303 DAYS

HEATING LOAD 338,000 KWH/YR

SIZE OF HEATING SYSTEM AT AVERAGE TEMP. 46.48 KW

SIZE AT DESIGN 116.20 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND

ESTIMATED PEAK WINTER DEMAND OF 160 KVA

0

30-Mar-90 FILE NUMBER: 23

ORIGINAL ELECTRICAL CONSUMPTION	86,320 KWH/YR		
ORIGINAL OTHER FUEL CONSUMPTION	649,988 KWH/YR	PROPANE	649,988 KWH/YR
		FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION	736,308 KWH/YR	TOTAL FUEL	649,988 KWH/YR

TRANSMISSION	375,000 KWH/YR
INFILTRATION	56,000 KWH/YR
(IHG)	(43,100)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	260,000 KWH/YR
TOTAL FUEL	647,900 KWH/YR
HEATING LOAD	387,900 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	387,900 KWH/YR
ENERGY SAVINGS	262,088 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
SEP84	752.6	4.52%	17549	7193	24742	$1,188.10	50	$0.00	$1,188.10
OCT84	1049.6	6.31%	24474	8295	32769	$995.09	105	$427.25	$1,422.34
NOV84	1652.9	9.94%	38542	6900	45442	$1,224.38	160	$854.50	$2,078.88
DEC84	2577.4	15.49%	60100	7500	67600	$1,625.29	185	$1,048.71	$2,674.00
JAN85	2323.8	13.97%	54186	7800	61986	$1,523.72	185	$1,048.71	$2,572.43
FEB85	2258.1	13.57%	52654	7200	59854	$1,485.15	185	$1,048.71	$2,533.86
MAR85	2091.6	12.57%	48772	6900	55672	$1,409.47	185	$1,048.71	$2,458.18
APR85	1511.8	9.09%	35252	6835	42087	$1,163.68	160	$854.50	$2,018.18
MAY85	1015.6	6.11%	23682	6766	30448	$953.08	120	$543.77	$1,496.85
JUN85	634.9	3.82%	14805	6970	21775	$796.15	100	$388.41	$1,184.56
JUL85	365.2	2.20%	8516	6800	15316	$679.28	60	$77.68	$756.97
AUG85	401.8	2.42%	9369	7161	16530	$807.11	50	$0.00	$807.11
	16635.3		387900	86320	474220	$13,850.50		$7,340.95	$21,191.45
				CHECK	474220				

TOTAL COSTS (TAX INCLUDED): $21,191.45

HEATING DAYS	303 DAYS
HEATING LOAD	387,900 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	53.34 KW
SIZE AT DESIGN	133.35 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND ESTIMATED PEAK WINTER DEMAND OF 185 KVA

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30-Mar-90	FILE NUMBER:	24		
ORIGINAL ELECTRICAL CONSUMPTION		92,400 KWH/YR		
ORIGINAL OTHER FUEL CONSUMPTION		261,500 KWH/YR	PROPANE	261,500 KWH/YR
			FUEL OIL	0 KWH/YR
TOTAL ORIGINAL CONSUMPTION		353,900 KWH/YR	TOTAL FUEL	261,500 KWH/YR

TRANSMISSION	170,000 KWH/YR
INFILTRATION	33,000 KWH/YR
(IHG)	(30,500)KWH/YR
VENTILATION	0 KWH/YR
STACK LOSSES	91,500 KWH/YR
TOTAL FUEL	264,000 KWH/YR
HEATING LOAD	172,500 KWH/YR
HOT WATER	0 KWH/YR
TOTAL ELECTRICITY	172,500 KWH/YR
ENERGY SAVINGS	89,000 KWH/YR

DEGREE	DAYS	% HEATING LOAD	MONTHLY CONSUMPTION (KWH)	ORIGINAL ELECTRIC CONSUMPTION (KWH)	TOTAL ELECTRIC CONSUMPTION (KWH)	ENERGY COSTS ($)	DEMAND (KVA)	DEMAND COSTS ($)	TOTAL COSTS ($)
APR86	1478.2	9.20%	15878	7900	23778	$832.40	65	$116.52	$948.93
MAY86	931.7	5.80%	10008	7900	17908	$871.03	50	$0.00	$871.03
JUN86	662.6	4.13%	7117	7800	14917	$732.29	50	$0.00	$732.29
JUL86	444.9	2.77%	4779	7850	12629	$626.11	50	$0.00	$626.11
AUG86	402.8	2.51%	4327	7090	11417	$569.87	50	$0.00	$569.87
SEP86	739.1	4.60%	7939	7150	15089	$675.18	65	$116.52	$791.71
OCT86	1126.1	7.01%	12096	7660	19756	$759.63	68	$139.83	$899.46
NOV86	1995.5	12.43%	21435	7500	28935	$925.71	80	$233.05	$1,158.75
DEC86	2051.6	12.78%	22038	7900	29938	$943.85	85	$271.89	$1,215.73
JAN87	2227.5	13.87%	23927	7800	31727	$976.23	85	$271.89	$1,248.11
FEB87	2046.2	12.74%	21980	7900	29880	$942.80	85	$271.89	$1,214.68
MAR87	1952.8	12.16%	20976	7950	28926	$925.55	80	$233.05	$1,158.60
	16059.0		172500	92400	264900	$9,780.65		$1,654.63	$11,435.27
				CHECK	264900				

TOTAL COSTS (TAX INCLUDED): $11,435.27

HEATING DAYS	303 DAYS
HEATING LOAD	172,500 KWH/YR
SIZE OF HEATING SYSTEM AT AVERAGE TEMP.	23.72 KW
SIZE AT DESIGN	59.30 KW

GENERAL SERVICE OR DEMAND BILLING STRUCTURE: DEMAND

ESTIMATED PEAK DEMAND WITH EQUIPMENT - 85KVA