Village of Teslin
Energy Audit - 2004
Teslin, Yukon

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And

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1 EXECUTIVE SUMMARY

An energy audit was completed on five municipal buildings in the Village of Teslin including;

- The Village municipal office,
- The post office/library
- The Arena,
- The community Hall and
- The curling unit

The audit showed that there are opportunities to reduce energy consumption at the Village. Highlights of the audit are itemized below;

1. Replace the existing standard flush water closets toilets with ultra low flush toilets or Dual flush toilets. This will reduce domestic water consumption pumping costs, chemical treatment, i.e. chlorination and sewage disposal costs. The estimated payback is less than 4 years per water closet replacement.
2. When the artificial ice plant is installed at the arena, a waste heat recovery system should be installed to heat the change rooms and the new mezzanine using closed water loop heat pump technology. The waste heat from the ice plant can also be used to produce domestic hot water for the change rooms and the Zamboni room. The estimated annual energy savings should be in the order of approximately $7,000 per annum. The estimated payback is 9.3 years.
3. Use of heat recovery ventilators at the Arena and reheat coils that utilize the waste heat from the ice plant heat recovery system should reduce energy consumption at the Arena by approximately $15,000 per year. The payback to install the heat recovery ventilators and the reheat coils (assuming that the waste heat recovery system is installed) will be 3.2 years.
4. The automatic building controls in two of the buildings (Municipal Building and the Community Hall) were not functioning per design intent. Operation and calibration of the building controls should be reviewed and refurbished as required. Aside from improving the physiological comfort of the occupants, the payback should be in the order of approximately 5 years.
5. The weather stripping at the overhead doors at the Municipal Building should be maintained and replaced as required.
6. The exit lights in all the buildings should be replaced with low energy LED lamps.

A summary of the energy initiatives is presented in table 1 on the following pages.

			Annual Savings			
Building	**Potential Upgrade**	**Capital Cost**	**Energy**	**$**	**Payback**	**Comments**
Sewage lift stations	construct force main and lift station	see comments	see comments			Reduce trucking costs, increase electrical costs. Estimate labour and trucking costs reduction = 75%
Pumphouse/ truck Fill Station	No upgrades Recommended			$0.00		
Individual Village Homeowner	Reduce water consumption - install ultra low flush water closets	$700.00	36,500 ltr	$210.00	3.4 yrs	per household. Estimated number of households is 100.
	Reduce water consumption - install dual flush water closets	$1,000.00	47,450 ltr	$265.00	3.8 yrs	per household
Total Village	Reduce water consumption - install ultra low flush water closets	$77,000.00	4,015,000 ltr	$23,100.00	3.3 yrs	
	Reduce water consumption - install dual flush water closets	$110,000.00	5,219,500 ltr	$29,150.00	3.8 yrs	
Arena	Install heat recovery system using waste heat off new Artificial Ice Plant. Replace existing propane furnaces	$65,000.00	11,000 ltr	$7,000.00	9.3 yrs	Reduce propane consumption. DOES NOT include costs of artificial ice plant.
	Install heat recovery ventilators in lieu of exhaust air fans	$50,000.00	see comments	$15,500.00	3.2 yrs	Total savings based on using waste heat from heat recovery system to reheat ventilation air.
	Use waste heat to produce domestic hot water	incl above		$0.00		Hot water production savings is included in heat recovery figures above.
	Upgrade arena support area lighting using T8 lamp	$4,320.00		$140.00	30.9 yrs	
	Upgrade arena support area lighting using Super T8 lamp	$4,320.00		$224.00	19.3 yrs	
	Upgrade lighting over ice surface when current fixtures are replaced or hours of use increase					Refer to Appendix G

Table 1 – Energy Initiative Summary

			Annual Savings			
Building	**Potential Upgrade**	**Capital Cost**	**Energy**	**$**	**Payback**	**Comments**
Community Hall	Upgrade/Refurbish controls	$8,000.00		$1,600.00	5.0 yrs	
	Replace water closets with ultra low flush water closets	$7,500.00	393,000 ltr	$2,200.00	3.4 yrs	Annual savings is a function of building operation schedule, function and washroom demand.
	Replace incandescent lamps with compact fluorescent lamps	$1,300.00		$1,650.00	10 mth	
	Replace T8 fluorescent lamps with super T8 lamps	$11,000.00		$720.00	15.3 yrs	
Curling Rink	Replace T12 fluorescent lamps with T8 lamps	$3,300.00		$108.00	30,8 yrs	
	Replace T12 fluorescent lamps with super T8 lamps	$3,300.00		$173.00	19.3 yrs	
Municipal Building	Install HRV, Refurbish controls	$20,000.00	118,000 MJ	$3,600.00	5.6 yrs	
	Reduce infiltration @ parking garages	$300.00		$1,000.00	0.0 yrs	
	Replace T12 fluorescent lamps with super T8 lamps	$10,700.00		$980.00	10.9 yrs	
Post Office/ Bank/ Library	Replace T12 fluorescent lamps with T8 lamps	$680.00		$52.00	13.1 yrs	
	Replace T12 fluorescent lamps with super T8 lamps	$680.00		$84.00	8.1 yrs	
Existing Exit Lighting	Replace existing exit lights with LED lamps	$540.00		$709.00	10 mths	

Table 1 (Cont) – Energy Initiative Summary

2 *BACKGROUND*

Lessoway Moir Partners (LMP) was retained by the Energy Solutions Centre Inc. on behalf of the Village of Teslin to undertake a review of the building and municipal systems in Teslin. Senior engineering personnel from both firms visited the community in August 2004.

This report itemizes the findings of the site visit and identifies areas for energy saving potential and upgrade. It includes opinions of probable costs associated with each of the proposed upgrades, as well as a payback analysis.

3 *INTRODUCTION*

The village of Teslin is located in southern Yukon on the Alaska Highway between Whitehorse and Watson Lake. The population was 401 (YTG census 2002). The Village infrastructure includes four sewage lift stations, one domestic water pumphouse, and five main municipal buildings. The municipal buildings are listed below:

	Municipal Buildings	Area (m^2)
1	Arena	416
2	Community Hall	705
3	Curling Rink	221
4	Municipal Centre	577
5	Post Office/Bank/Library	294

Table 2 – Municipal Buildings

Engineering and Architectural plans were available for the first four buildings. Plans were not located for the Post Office, Bank and Library building. Heat loss calculations in this report are based on the indicated thermal performance figures for the walls, ground floors and roofs shown in these plans.

The fifth building (Post Office) was originally two buildings that were combined in the past and had an exterior retrofit to complete them as one building. The heat loss calculations for this building are based on assumed thermal conductivities.

4 *VILLAGE MUNICIPAL WATER and SEWER SYSTEM REVIEW*

The Village draws its' potable water supply from a water well located at the Village pumphouse/truckfill station. Sewage service for most housing is provided through a piped sewer system. There are four sewage fill stations strategically located around the Village.

4.1 SEWAGE LIFT STATIONS

4.1.1 General Description

The sewage lift stations reviewed during the site visit appeared to be running efficiently and under control. The space and the equipment appeared to be well maintained. The building temperatures are maintained via an explosion proof electric heater. The unit heater thermostat setpoint was set at 15°C. The lights were off when not in use. Wet well level is maintained by level switches which cycle two Flygt™ submersible grinder pumps.

The sewage effluent gravity flows to four separate lift stations. At each lift station, the effluent is pumped twice; once from the lift station to an underground sewage holding tank and again from the sewage holding tank to a septic vacuum truck wherein it is then trucked to the Village sewage lagoon. Quest Engineering Limited (QEL) is working with the Village to install a new sewage forced main from the Village airport lift station to the sewage lagoon. When the new forced mains are constructed in 2005, the Village will be able to reduce overall pumping costs at each of the existing lift stations because the effluent will be pumped only once.

Plans were not available for the lift stations. Based on site observation, the buildings are stick frame construction built on a concrete slab on grade. The walls appeared to be approximately 150mm thick. Assuming that the walls are constructed with fibreglass batt insulation, the wall RSI value would be approximately 3.16 (R17). Roof insulation is not known. Overall, the building condition is good.

4.1.2 Energy Reduction Alternatives

There is no real potential for energy savings with respect to building operation.

The building envelope appears to be in good condition. Although the roof insulation is unknown, the capital cost to upgrade the roof insulation would be in the order of $5,000.00. The energy reduction would be approximately 0.15 kW for a net annual savings of approximately $50.00.

There is some operation savings potential due to reduced vacuum truck operation.

4.1.3 Capital Costs & Savings

Trucking costs are a major annual cost to the sewer system and it is estimated that trucking costs and associated labour costs will be reduced by approximately 75% when the forced main and lift station are installed.

4.2 SMARCHVILLE PUMPHOUSE/TRUCK FILL STATION

4.2.1 General Description

The water truck fill station was constructed in the mid 1980s. The equipment and interior space appear to be in good condition. Space temperature is maintained by an oil fired forced air furnace. The furnace is controlled by a thermostat with setpoint set at a low temperature and the lights are off when not in use.

Based on review of the plans, the pumphouse is a concrete block construction built on a concrete slab on grade. The walls are insulated with 126mm of rigid insulation. The roof insulation includes 300mm of fibreglass batt insulation. Overall, the building condition is good.

4.2.2 Energy Reduction Alternatives

There is no real potential for energy savings with respect to building operation.

4.2.3 Capital Costs & Savings

Not Applicable.

4.3 WATER CONSUMPTION

4.3.1 General Description

Typical household water use[1] is summarized in table 3 below.

Household Water Use	Percent
Toilet Flushing	40%
Bathing	30%
Drinking and cooking	5%
Dishwashing	6%
Cloths Washing	15%
Cleaning and miscellaneous	4%

Table 3 – Typical household water use

The Village of Teslin per capita consumption is approximately 120 lpcd[2, 3]. Assuming 3% annual growth, the estimated 2005 population would be 438 persons. At 120 lpcd and 438 persons, the estimated potable water consumption for the Village would be in the order of 52,500 litres/day.

4.3.2 Energy Reduction Alternatives

Installation of dual-flush toilets, ultra-low flush toilets or water-saving flapper valves in each household connected to the sewer system and at the municipal building would reduce potable water production, chlorine consumption and sewage production. Ultra-low flush toilets are rated at 6 litres per flush (lpf). Dual flush toilets are ultra low flush toilets that have two flush buttons; one rated at 3 lpf for liquid flushing, and one rated at 6 lpf for solids flushing.

Various flushing mechanisms that retrofit to existing toilets to reduce their flush volumes are also available on the market. These mechanisms are almost as effective for water conservation as a standard dual flush toilet, but are cheaper. Retrofitting a dual flush mechanism to an existing 13-lpf toilet provides slightly lower water saving compared to a standard dual flush toilet. It provides a flush of approximately 7 litres, which is slightly larger than the 6 and 3 litre flush alternatives of an ULF toilet. Water-saving flapper valves are also rated at about 7 lpf and the size of the flush is usually adjustable. Flush quality is sometimes a concern for these flushing mechanisms. The toilet bowls are usually designed for their original flush volumes. Reduced flush volumes sometimes can a negative impact on the flush efficiency, lowering the amount of waste that can be removed. This can mean that more flushes are required to flush out the deposited waste with some models. However, an adjustment can be made to the flush volume to counteract this in most cases.

Daily sanitary sewer waste production due to toilet flushing could be reduced by approximately 11,000 litres per day by using ULF toilets. The potable water reduction would be in the order of 14,000 litres per day if dual flush water closets were installed throughout the village. The potable water reduction would be in the order of 9,500 litres

[1] Environmental Engineering and Sanitation, 3rd edition, Salvato, J.A. John Willey and Sons, 1982.

[2] Lpcd: litres per capita per day

[3] Reference Quest Engineering Limited Sewage Study

per day if water-saving flapper valves were installed. These figures assume that only regular 13 lpf toilets are currently installed throughout the village.

A test is suggested to determine which approach is the most suitable approach in these facilities: dual-flush retrofit to existing toilets, installation of new dual-flush toilets, installation of ultra-low flush toilets or installation of water-saving flapper valves in existing toilets.

4.3.3 Capital Cost and Savings

The estimated water reduction potential was calculated based on the following assumptions.

1. Water volume per household is metered. Users pay $0.0056 per litre.
2. Average household = 4 persons.
3. Each household includes one regular flush water closets rated at 13 lpf.
4. 40% of the typical potable water consumption at the household is used to flush the water closets.
5. Dual flush water closets have two buttons; a 3 lpf button is used for liquid and a 6 lpf button is used for solids removal. Assume that 60% of regular use is 3 lpf.
6. Installation cost for ultra-low flush toilets is $700.00 each.
7. Installation cost for Capital cost per dual flush = $1,000.00

Tables 4 and 5 below identify potential water saving opportunities for the Village and the individual home owners.

4.3.3.1 Village:

Table 4 shows the water reduction potential for the entire Village if all water closets throughout the Village (estimated at 110 households) are replaced with either Ultra Low Flush toilets or Dual Flush toilets.

	Ultra low flush toilet	**Dual Flush Toilet**
Current estimated daily water consumption - toilet only	21,000 litres	21,000 litres
Estimated daily reduction if all toilets replaced	11,300 litres	14,200 litres
Estimated annual Cost Savings	$23,000/yr	$29,000/yr

Table 4 – Village Water Reduction Savings

4.3.3.2 Individual Home Owner:

Table 5 shows the water reduction potential per home Owner if the existing regular flush water closet was replaced with either Ultra Low Flow toilets or Dual Flush toilets.

	Ultra low flush toilet	Dual Flush Toilet
Current estimated daily water consumption - toilet only	192 litres	192 litres
Estimated daily reduction if all toilets replaced	100 litres	130 litres
Estimated annual Cost Savings	$210/yr	$265/yr
Simple straight line payback period	3.4 yrs	3.8 yrs

Table 5 – Home Owner Water Reduction Savings

5 VILLAGE MUNICIPAL BUILDINGS REVIEW

5.1 BUILDING MECHANICAL LOADS

The heating and ventilation loads for each building were estimated and compared to the actual energy consumption records for the past year. Details of these loads are presented in Appendix A. Appendix B has a summary of the energy use (both fuel and electricity consumption) for each building. The equipment associated with these numbers is summarized in the inventory list of Appendix C.

The utility costs of $0.819 per litre for oil, $0.74 per litre for propane, and $0.133 per kWh were used based on recent market prices[4]. These values are used throughout the report as the base prices for the fuels. As a result of energy cost spikes, these costs per litre figures are conservative and estimated savings referred to in this report are likely lower than what they would actually be with implemented upgrades.

The calculated heat loss for each building is summarized in the table below. Using the industry standard degree day method, the annual energy consumption was calculated and is also summarized in the table below:

Building	Heating Load, kW	Fuel Type	Calculated Fuel, litres	Actual Fuel, litres,[1]
Arena[2]	23	Propane	11957	11512
Community Hall	36	Oil	15139	20444
Curling Rink[2]	16	Oil	6940	
Municipal Building	41	Oil	17051	16679
Post/Library/Bank	15	Oil	6053	5076
NOTES:				

Table 6 – Municipal Building Energy Consumption

Notes:

1. Actual fuel and propane consumption is based on a 4 year average (2001 – 2004)

[4] April 15, 2005 ,North 60 Petro and Superior Propane

2. Arena and Curling rink heating kW based on viewing area since ice area is unheated.
3. Construction of the post office/library/bank building is unknown. R values and infiltration rates were assumed based on age of building.

5.2 BUILDING ELECTRICAL LOAD

Electrical energy consumption for the buildings investigated is comprised of;

1. lighting
2. general purpose outlets
3. mechanical equipment

Because the loading of the general outlets is not a fixed load, this report will focus on the buildings lighting loads. Refer to the attached sheets for the detailed information and calculations for each building option. For the purposes of this report the lighting load was estimated to be 80% of the total annual electrical load on each building. With this assumption in mind a load balance was done to accurately estimate the running time of existing lighting which in turn was used to approximate the cost savings from energy efficient upgrades. All rate calculations were based on the YECL rate guide as from July 1, 2005 for municipal governments.

5.3 ARENA

5.3.1 Existing Mechanical Systems

Three propane furnaces; one for each set of two change rooms and one for the common area provide heating. These furnaces are installed in the crawl space underneath the building. A propane-fired overhead radiant heater provides heating for the Zamboni room.

Manually operated washroom fans and an outside air duct to the furnaces provide ventilation.

Domestic hot water is provided via three propane-fired tanks; one in each set of change rooms and one in the Zamboni room.

The arena has a natural ice surface with fans blowing cold air from outside air louvers across the surface and out again through louvers at the other end. These fans can provide the necessary 3600 l/s of ventilation air and the airflow needed to maintain the natural ice surface.

5.3.2 Existing Lighting

The existing lighting in the arena consists of 36 175W Metal Halide (MH) fixtures and 48 T12 fluorescent fixtures.

Replacement of the existing metal halide lighting in the arena is not recommended due to the high cost of replacement. However, a design solution created by Doug MacLean of the Energy Solution Centre proposing replacement of existing fixtures with T8 fixtures has been attached as appendix G for your consideration when the light fixtures and ballasts are scheduled for replacement or the hours of operation increase (currently estimated at 420 hours/year).

5.3.3 Code Violations, system deficiencies and/or Operational Concerns

The following text lists deficiencies and/or concerns that were observed during the site visit. The reader is cautioned that the mandate of this report pertained to energy efficiency. It was not a detailed or thorough Code review. With this in mind, the following deficiencies were noted.

1. **CODE violation.** The horizontal propane fired furnaces are installed in the crawlspace. This area is classified as a service room per the National Building Code of Canada (NBCC). There is no fire separation between the crawlspace and the main floor contrary to NBCC 3.6.2.1(5).
2. **CODE violation**. There is no seismic restraint installed on the furnaces.
3. **CODE violation**. The volume of outdoor air does not meet ASHRAE[5] indoor air quality standards.
4. **CODE violation**. An insulated flexible outdoor air make-up air duct is installed to provide fresh air for each space served by the furnace. The duct has failed and become disconnected. Fresh air is being drawn from the stale, damp crawlspace and not the outdoors. Indoor air quality will suffer.
5. **OPERATION CONCERN.** Access to the furnaces is poor resulting in inadequate maintenance.
6. **OPERATION CONCERN**. Standing water was evident in the crawlspace below the changerooms. Although there is a vapour barrier installed on the ground, the plastic vapour barrier is split at some locations.

5.3.4 Energy Reduction Alternatives

5.3.4.1 Artificial Ice Plant

The Village has been negotiating with the Yukon Territorial Government (YTG) to install an artificial ice plant at the Arena. The ice plant would service the arena and possibly the Curling rink as well.

A copy of a proposal from CIMCO™ is included in Appendix D The CIMCO™ ice plant proposal was used for this study to determine the potential savings of heat recovery from an ice plant. Note that other ice plant and heat recovery systems with similar performance parameters are available and the CIMCO™ system was used for this study as an example of what can be gained through heat recovery from an ice plant.

The greatest energy savings that can be achieved is to recover the heat from the refrigeration units and use it for space or domestic water heating. CIMCO™ estimates that their system can produce in excess of 150 kW of waste heat energy when operating. The total waste heat energy is more than the total heat requirement for all the buildings combined in this report.

The waste heat energy is only available when the ice plant is operating. To utilize this waste heat efficiently, a large volume insulated water tank for thermal storage, e.g. an ice battery will be necessary. The tank would likely be installed in the existing mechanical room at the community hall. The heat recovered from the ice plant would be about 38°C and would be considered low grade heat. In order to utilize the low grade heat effectively, water to air and/or water to water heat pumps would be installed where applicable. For example, a water-to-air heat pump would provide space heating for the

[5] ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers

occupied arena spaces and a water to water heat pump could be used to produce domestic hot water.

Appendix E includes a schematic of the proposed heat recovery system assuming that the CIMCO™ system was installed.

5.3.4.2 Heating

It is recommended that the existing propane furnaces be replaced with either hydronic fan coil units tied to the existing boiler plant or water to air heat pumps that utilize waste heat from the proposed artificial ice plant. It is also recommended that the new fan coil or heat pump be installed in an accessible location. This would resolve the fire separation code violation and the furnace maintenance concern.

5.3.4.3 Ventilation

There is not a great deal of potential to reduce energy consumption since there is little to no outside air brought into the facility. ASHRAE requires a minimum outdoor air ventilation rate of 2.5 litres per second per square metre for change rooms, for a total 1000 L/s for an arena this size. The existing ventilation system includes a small exhaust fan operated by a local ON/OFF switch. The volumes do not meet ASHRAE Standards.

Exhaust air is ducted to the exterior. The current installation exhausts the warm building air directly to the exterior via washroom squirrel cage ceiling exhaust fans. Replacing these exhaust air fans with a heat recovery ventilator (HRV)[6] would reduce the energy consumption for the Arena due to reduced outdoor air reheat[7].

Published data for typical commercial single core heat recovery ventilators show that the HRV efficiency is between 70% and 50%. At 60% efficiency, an HRV will raise the outdoor air temperature from -43°C to -11°C. The building reheat load is thus reduced.

During the colder months, reheat or preheat of the outdoor air will be required to raise the supply air temperature from -11°C to 21°C. This can be accomplished by installation of a hydronic heating coil that utilizes the low grade heating water (assuming that the waste heat system is installed) or high grade heating water from the existing boiler plant.

It is also recommended that the HRV be interlocked with the light switch so that it is only operational when the room is occupied.

5.3.4.4 Domestic Hot Water

The existing propane fired domestic hot water heaters could be converted to a water to water heat pump domestic hot water heating system by the installation of water to water heat pumps. The heat pumps would be installed adjacent to the current hot water heaters or above and would utilize the existing hot water tanks for hot water storage.

5.3.4.5 Lighting

The existing fluorescents fixtures use T12 lamps and ballasts. The 34W lamp consumes approximately 40W due to ballast loses; new T8 lamps with electronic ballasts consume

[6] An HRV uses the exhaust air exiting the building to preheat cold outside air provided to the building. The exhaust air stream heat is transferred to the outdoor air stream as the two air streams are passed through a fixed plate heat exchanger.

[7] Fresh outdoor air must be introduced into the building to counter the exhaust air. This air is heated either directly (unit heater, coil) or indirectly (space load, i.e. lights, occupants, etc.).

30W per lamp and super T8 lamps consume 24W per lamp. There are two options for replacement of T12 lamps, a retrofit kit can be installed using the existing fixtures or new fixture can be used. The age and type of fixture will determine which option is the most cost effective and practical.

5.3.5 Capital Costs & Savings

5.3.5.1 Artificial Ice Plant

The incremental cost to install a heat recovery system on a conventional ammonia artificial ice plant refrigeration system is approximately $35,000[8]. The water-to-air and water-to-water heat pumps will add approximately $30,000 installed for a total cost of approximately $65,000 (2005 dollars), tax out and excluding design fees.

The rejected heat from the refrigeration process and subsequently used to heat the building and domestic hot water would reduce the propane consumption by approximately 11,000 litres annually. The estimated operating cost of the heat recovery/heat pump system would be approximately $1,200/yr. The net savings over a propane fired furnace and domestic hot water production system at the previously mentioned propane cost per litre would be approximately $7,000/yr[9]. The simple straight line payback for this system is 9.3 years.

5.3.5.2 Heating.

See section 5.3.5.1.

5.3.5.3 Ventilation

Heat Recovery Ventilators could be installed for approximately $50,000. The annual savings would be in the order of $12,700/annum. This would be further augmented by the using the waste heat recovery system to reheat the ventilation air resulting in an additional savings of approximately $15,500/annum. These numbers were calculated using the required ventilation rate of 1,000 l/s for the change rooms over the winter heating season. The savings from the HRVs augmented by heat recovered from the ice plant using a simple straight-line payback would pay for the system in 3.2 years.

It should be noted that the total savings for this ventilation alternative is relative to what it would cost to heat outside air directly and not relative to the present building that lacks adequate ventilation. The combined HRV and ice plant heat recovery system cost is estimated at a total of $115,000. With a combined annual savings of $22,500 the estimated straight lie payback for the total system is 5.1 years.

5.3.5.4 Domestic Hot Water

The estimated domestic hot water production savings are included in the artificial ice plant figures (ref section 5.3.5.1).

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[8] NOTE: This cost DOES NOT INCLUDE the cost of the artificial ice plant.

[9] The savings were determined using Water Furnace Energy Analysis software, which calculates expected energy usage, and the operating costs using current ASHRAE energy modelling methods. The energy analysis was modelled to match the current annual energy consumption determined from the previous years propane billing.

5.3.5.5 Support Area Lighting

For this report we have assumed the following:

1. Replacement of the existing fixtures with a unit price of $90 per fixture ($40 for parts and $50 for labour) and,
2. Hours of operation are 21 hours per week and 20 weeks per year.

Estimated Cost:	$ 4320
Calculated Annual Saving T8:	$ 140
Calculated Annual Saving Super T8:	$ 224
Simple Payback Period T8:	30.9 years
Simple Payback Period Super T8:	19.3 years

Note: Certain assumptions were made to arrive at the calculated payback period. If the fixtures operate for a longer number of hours per week the payback period will be reduced. Conversely shorter hours of operation will produce a longer payback period. Any increase or decrease in the actual costs of the materials and installation compared to the numbers used for this report will affect the payback period as well; a higher cost will increase the payback period and a lower cost will decease the payback period.

5.4 COMMUNITY HALL

5.4.1 Existing Mechanical Systems

Heating is provided by three oil-fired boilers and hydronic finned tube radiation installed along the perimeter of the building. The ventilation system includes one air handling unit for the common areas capable of 2218 L/s at 373 Pa external static pressure and a commercial exhaust air fan for the kitchen. No kitchen make-up air was evident at the time of the site visit, however there is a propane furnace that has been de-commissioned (no propane on site) that may have been used for make-up air purposes.

The air handling unit controls are generating a number of inefficiencies.

1. The unit was not running at the time of the site visit because the time clock controlling it was not functioning. Consequently, the unit either runs when not required, i.e. at night or does not operate at all.
2. The 3-way heating control valve is oversized. This will result in poor controllability of the heating coil. The control valve will tend to hunt (frequent cycling between full open and full closed).

The domestic hot water heater consists of an oil-fired Aero unit.

5.4.2 Existing Lighting

The community hall lighting consists of approximately 48 surface mounted incandescent fixtures and approximately 122 T12 fluorescent fixtures.

5.4.3 Code Violations, system deficiencies and/or Operational Concerns

The following text lists deficiencies and/or concerns that were observed during the site visit. The reader is cautioned that the mandate of this report pertained to energy efficiency. It was not a detailed or thorough Code review. With this in mind, the following deficiencies were noted.

1. **CODE violation**. The kitchen does not have a make-up air system.

2. **CODE violation**. The fuel oil tank is installed on two steel HSS beams which will cause locations stress concentration and possibly premature tank failure at the base. The tank should be installed on a secure concrete base.
3. **CODE violation**. The boilers, fuel oil tank and air handling units are not seismically restrained.
4. **CODE violation**. The fire separation between the mechanical room and the remainder of the building is lacking. Fire dampers are missing, mandoor and frame are not rated and mechanical pipe penetrations are not fire caulked. Some fire dampers did not have access doors to review operation.
5. **CODE Violation**. Mechanical room does not meet the requirements of CSA B139 insofar as there is no combustion air provided in the mechanical room.
6. **HEALTH Concern.** There is an insulated plywood structure located outside of the mechanical room. It appears that this structure is a well head for potable water. The fuel oil tank and the water well are within 5 meters of each other. There is a strong risk of ground water contamination if the fuel oil tank failed. Recommend relocation of the fuel oil tank.
7. **Operational Concern**: In general, the controls are in fair to poor condition. Deficiencies include:
   a. Air Handling Unit time clock doesn't work,
   b. The three way mixing valve on the air handling unit appears to be oversized,
   c. Control damper linkages are loose.
8. **Operation Concern**. The heating water system pressure seemed low during the site visit.
9. **Operation Concern**. We could not identify how to energize the kitchen exhaust air fan. Hand switches should be identified and if required, located in the kitchen.
10. **System Deficiency**. The domestic water line from the water well to the mechanical room is insulated with fiberglass batt insulation. The weather and elements are causing the insulation to fail. The water line should be reinsulated with closed cell polyurethane insulation and wrapped with multiple wraps of heavy duty water proof tape.

5.4.4 Energy Reduction Alternatives

5.4.4.1 Heating

Assuming that regular maintenance continues, the existing oil fired heating plant should be sufficient for 20 years more. The heating plant should be approximately 80% efficient since the boilers are less than 10 years old. Since the community hall is heated using high grade boiler water, retrofitting the heating system to utilize the low grade waste heat from the artificial ice plant would be cost prohibitive. An upgrade of the existing heating plant and heating system is not recommended.

5.4.4.2 Controls

Upgrading and/or refurbishing the controls would result in improved control and thus occupant comfort. Replacing the time clock will ensure that the air handling unit operates only when required. Replacing the radiation thermostats with programmable day/night setback type thermostat will result in some energy savings.

5.4.4.3 Domestic Water Consumption.

The existing water closets are Crane™ model Radcliff 3-144 rated at 13 lpf. Consideration should be given to replacing the water closets with ultra low flush toilets when replacement is due.

5.4.4.4 Domestic Hot Water Production

The existing domestic hot water heater is an oil fired unit and is not very old. If the artificial ice plant is installed and if a waste heat recovery system is installed, domestic hot water could be produced using a water to water heat pump designed and constructed to utilize the waste heat produced by the ice plant. The system would operate in conjunction with the existing oil fired domestic hot water heater to produce domestic hot water using the heat pump technology during the winter and using the oil burner during the summer.

The domestic hot water heater would remain in place and would serve as a storage tank during the winter months and as a hot water heater during the summer.

5.4.4.5 Lighting

The existing incandescent lamps should be replaced with more energy efficient compact fluorescent lamps. Compact fluorescent lamps consume less energy and output approximately the same level of light. Selection of replacement lamps should follow the manufacturers' recommendations for wattage. It should be noted that not all compact fluorescent are meant to be connected to dimmers. If dimming is a requirement careful attention should be paid to ensure lamps with dimmable ballasts are selected.

5.4.5 Capital Costs & Savings

5.4.5.1 Controls

A controls contractor should be retained to review and refurbish the existing controls including the 3-way control valve, control damper, fan interlocks and time clock. The estimated cost should not exceed $7,000.00.

The energy savings due to installation of programmable thermostats on the low voltage radiation and replacement of the existing 3-way control valve should be in the order of $1600/yr based on the following assumptions:

1. Normal occupied temperature = 20°C, night setback temperature = 15°C.
2. Building occupied 7 days per week from 1000hrs to 1800 hrs.
3. Replacement of the existing 3 way control and time clock improves heating system efficiency by 10 percent.

The cost to replace the thermostats should be in the order of $1,000.

The estimated cost to review and refurbish the controls and replace the thermostats should be in the order of $8,000. With the annual cost savings for these upgrades totalling $1,600 the anticipated straight line payback is 5.0 years.

5.4.5.2 Domestic water consumption.

Refer to discussion in section 4.3.3.2. The capital cost to replace the ten (10) water closets with ultra low flush toilets would be in the order of $7500.00. The payback would depend on the building schedule, function and washroom demand. High use toilets and/or flapper valves should be replaced first.

5.4.5.3 Domestic Hot Water Production

It's difficult to calculate the energy savings due to the addition of a water to air heat pump to the existing oil fired domestic hot water heater because the domestic hot water use is quite variable. At this time, it is recommended that the existing domestic hot water plant remain and if it is determined that the domestic hot water demand is high, installation of a water to water heat pump be reviewed.

5.4.5.4 Lighting

Compact fluorescent bulbs have a higher initial cost then conventional incandescent bulbs but the energy savings combined with the longer expected life span make replacement a viable option. Installing compact florescent bulbs as the incandescent bulbs burn out could be done to help offset the initial cost of compact fluorescent bulbs. For this report we have assumed that the hours of operation are 60 hours per week, 52 weeks per year.

Estimated Cost:	$ 1,330
Calculated Annual Saving:	$ 1,653
Simple Payback Period:	10 months

The existing fluorescents fixtures use T8 lamps and ballasts. The T8 lamps with electronic ballasts consume 30W per lamp and super T8 lamps consume 24W per lamp. The super T8 lamps can use the same or different ballasts as the existing T8 lamps and therefore replacement costs would be $90 per fixture. (The existing T8 lamps can be replaced with the super T8 as they burn out).

For this report we have assumed that the hours of operation are 60 hours per week, 52 weeks per year.

Estimated Cost:	$ 10,980
Calculated Annual Saving Super T8:	$ 718
Simple Payback Period Super T8:	15.3 years

Some areas have a higher lighting level than recommended by IES. These areas could have new fixtures with fewer lamps installed or reduce the number of fixtures. Reduction of lighting levels by reducing the number of lamps would be a low cost energy savings measure and would reduce the expected pay back time shown above.

If the higher level of light is desired sometimes but lower acceptable at other times; multiple switching of lamps or fixture could be considered. This would allow the user to have both a high and low option for room lighting.

5.5 CURLING RINK

5.5.1 Existing Mechanical Systems

The Curling Rink has natural ice and is normally unheated. It is equipped with two horizontal hydronic unit heaters fed from the boilers in the Community Hall, however these do not appear to be used.

5.5.2 Existing Lighting

The existing lighting in the curling rink consists of 45 175W Metal Halide (MH) fixtures and 37 fluorescent fixtures.

5.5.3 Energy Reduction Alternatives

This space uses only electric energy for lighting and has no potential mechanical energy savings.

Replacement of the existing metal halide lighting in the area and curling rink is not recommended due to the high cost of replacement and the current low hours of operation (420 hours/year). See appendix G for more information.

5.5.4 Capital Costs & Savings

The existing fluorescents fixtures use T12 lamps and ballasts. The 34W lamp consumes approximately 40W due to ballast loses; new T8 lamps with electronic ballasts consume 30W per lamp and super T8 lamps consume 24W per lamp. There are two options for replacement of T12 lamps, a retrofit kit can be installed using the existing fixtures or new fixtures can be used. The age and type of fixture will determine which option is the most cost effective and practical.

For this report we have assumed the following: replacement of the existing fixtures with a unit price of $90 per fixture ($40 for parts and $50 for labour) and that the hours of operation are 21 hours per week, 20 weeks a year.

Estimated Cost:	$ 3,330
Calculated Annual Saving T8:	$ 108
Calculated Annual Saving Super T8:	$ 173
Simple Payback Period T8:	30.8 years
Simple Payback Period Super T8:	19.3 years

5.6 MUNICIPAL BUILDING

5.6.1 Existing Mechanical Systems

Three oil fired boilers provide heating for this building. Terminal heat consists of hydronic baseboard radiation in the offices and hydronic unit heaters in the eight (8) vehicle bays.

Ventilation for the vehicle bays is achieved with individual exhaust fans and outside air provided to the space via barometric dampers. These exhaust fans are manually controlled with timer switches located in each of the bays. There is an air handling unit for the council chambers and administration offices however it was not functional at time of site visit. An electric hot water tank provides the domestic hot water for the building.

At the time of the site visit, the space thermostat in the office area was set at 15°C, there were many windows open, the space was hot and stuffy and one of the boilers was running continuously. Outside temperature was approximately 15°C.

5.6.2 Existing Lighting

The municipal building lighting consists of surface mounted and T-bar fluorescent fixtures. The drawings provided to this office indicate that the existing fixtures are already T8 and could be replaced by super T8 lamps as an energy savings measure.

Some areas have a higher lighting level than recommended by IES. These areas could have new fixtures with fewer lamps installed or a reduction in the number of fixtures. Reduction of lighting levels by reducing the number of lamps would be a low cost energy savings measure.

If the higher level of light is desired sometimes but lower acceptable at other times; multiple switching of lamps or fixture could be considered. This would allow the user to have both a high and low option for room lighting.

5.6.3 Code Violations, system deficiencies and/or Operational Concerns

The following text lists deficiencies and/or concerns that were observed during the site visit. The reader is cautioned that the mandate of this report pertained to energy efficiency. It was not a detailed or thorough Code review. With this in mind, the following deficiencies were noted.

1. **Operational Concern.** Operation of the building controls should be reviewed and refurbished as required. The boiler does not need to be running continuously during warm weather.
2. **System Deficiency**. The well head at the building water well is located below grade in an insulated pit. Although not enacted yet, the current installation does not meet the proposed YTG water well standards which require the well head to be continuous and terminate above grade.

5.6.4 Energy Reduction Alternatives

5.6.4.1 Controls

Significant energy saving potential revolves around the automatic building controls. The boilers do not need to be running to provide space heat when the occupants are too warm and have open windows. A controls review of the zone valves, thermostat set points, time clock operation, fan interlocks, and boiler set points will result in significant energy savings.

The existing time clock, which determines occupied and unoccupied modes, as well as the existing timer spring return timer switch located in the council chambers should be made operational.

Another controls-related energy reduction measure is provision of programmable thermostats with day/time temperature setback. This allows the space temperature to be automatically set back to 16°C during periods when the building is unoccupied resulting in reduced energy consumption.

5.6.4.2 Ventilation

Heating energy could be reduced through the installation of an HRV in conjunction with the existing air handling unit. It would replace exhaust fan EF-2 and provide for relief air whenever the air-handling unit is running.

5.6.4.3 Weather Stripping

Energy savings potential is also seen in reducing infiltration into the building. The vehicle bays in particular have visible gaps below the man doors that could be reduced using weather-stripping. This is not directly a mechanical measure but has effects on the mechanical systems.

5.6.5 Capital Costs & Savings

5.6.5.1 HRV and Controls

A ventilation upgrade that would include an HRV and controls review could be completed for approximately $20,000. The energy savings resulting from these upgrades would be approximately 118,000 MJ of energy per annum. This is equivalent to 4,400 litres of diesel heating oil for an annual saving of approximately $3,600 per year versus an operational heating and ventilation system without heat recovery. The straight-line payback is approximately 5.6 years.

5.6.5.2 Parking Bay Infiltration

Reducing infiltration is a low cost high return item in northern climates, however the exact energy saving is not easily estimated. An approximation is made here where the infiltration is reduced by 0.1 air changes per hour using sufficient weather-stripping around the doors, resulting in $1,000 savings for a capital investment of under $300.00.

5.6.5.3 Waste Heat Recovery

The Municipal Building is too far away from the proposed ice plant and heat recovery system. As well, the existing heating terminal systems, i.e. unit heaters, AHU heating coil and radiation are sized for use with high grade boiler water. Waste heat recovery for use at the Municipal Building is not a viable option at current energy prices.

5.6.5.4 Lighting

The existing fluorescents fixtures use T8 lamps and ballasts. The T8 lamps with electronic ballasts consume 30W per lamp and super T8 lamps consume 24W per lamp. The super T8 lamps use the same/different ballasts than the existing T8 lamps and therefore replacement costs would be $90 per fixture ($40 for parts and $50 for labour). (The existing T8 lamps can be replaced with the super T8 as they burn out).

For this report we have assumed that the hours of operation are 84 hours per week, 52 weeks a year.

Estimated Cost:	$ 10710
Calculated Annual Saving Super T8:	$ 981
Simple Payback Period Super T8:	11 years

5.7 POST OFFICE / BANK / LIBRARY

5.7.1 Existing Mechanical Systems

This building was originally two separate structures that were combined. An exterior envelope retrofit was completed in the late 1990s. An oil fired furnace located in the crawlspace below the library, with a sidewall chimney exiting the building at low level, provides heating for the entire building. A single thermostat is located in the library interior space at the south end of the building. There is a portable plug-in electric space heater located in the Post Office and there have been complaints by the occupants that the space gets uncomfortably cold.

There are no plans available for the building. The attic space is unheated and includes approximately 10" of loose fibreous blown-in insulation. An air barrier was not evident.

There is no outside air ventilation provided in the building.

An electric water heater provides the domestic hot water for the building.

5.7.2 Existing Lighting

The post office, bank and library lighting consists of T12 fluorescent fixtures.

5.7.3 Code Violations, system deficiencies and/or Operational Concerns

The following text lists deficiencies and/or concerns that were observed during the site visit. The reader is cautioned that the mandate of this report pertained to energy efficiency. It was not a detailed or thorough Code review. With this in mind, the following deficiencies were noted.

1. **CODE violation.** The oil fired furnace is located in the crawlspace. The space is not rated per NBCC service room requirements.

2. **CODE Violation.** The building lacks a ventilation system contrary to ASHRAE standards. However, since the building lacks a vapour barrier, the envelope is leaky and natural infiltration likely meets ASHRAE requirements.
3. **Code Violation.** The furnace and fuel oil tank are not seismically secured.
4. **System Deficiency.** Space temperature in the post office is maintained by a thermostat in the library. A second furnace installed in a fire-rated room with thermostatic control in the post office would greatly improve the post-office users physiological comfort level.
5. **System Deficiency**: The weather stripping on two of the double paned windows had failed.

5.7.4 Energy Reduction Alternatives

5.7.4.1 Reduce infiltration

Energy consumption could be reduced by completing an envelope retrofit, i.e. install an air barrier to reduce infiltration; patch holes in the exterior walls, e.g.where outside lights are located. These are not directly mechanical measures but will have great effects on the mechanical systems.

5.7.4.2 Lighting

The T12 (34W) lamps consume approximately 40W due to ballast loses; new T8 lamps with electronic ballasts consume 30W per lamp and super T8 lamps consume 24W per lamp. There are two options for replacement of T12 lamps, a retrofit kit and be installed using the existing fixtures or new fixture can be used. The age and type of fixture will determine which option is the most cost effective and practical.

5.7.5 Capital Costs & Savings

5.7.5.1 Reduce Infiltration

An envelope retrofit is a costly undertaking that realistically is not viable for this building. It is estimated that the yearly utility savings for this option would be less than $1,000. For a 10 year simple payback the allowable capital cost is $10,000. Very little can be done to this building for that amount of money.

5.7.5.2 Lighting

For this report we have assumed that the hours of operation are 40 hours per week and that the fixture will be replaced not retrofitted with a cost of $90 per fixture.

Estimated Cost:	$ 680
Calculated Annual Saving T8:	$ 52
Calculated Annual Saving Super T8:	$ 84
Simple Payback Period T8:	13.1 years
Simple Payback Period Super T8:	8.1 years

It was noted during the site visit that the library does not have sufficient lighting levels. Addition of fixtures or replacement of the existing system with a new layout is recommended. Alternatively, installing lighter coloured walls and flooring may be effective in raising room lighting levels. There would not be an energy saving associated with the library lighting upgrade but sufficient lighting is important and should be supplied.

5.8 UPGRADE EXISTING EXIT LIGHTS

The existing exit lights in the above mentioned buildings (excluding the municipal building) have two incandescent bulbs each, it is recommended to replace the existing incandescent lamps with LED lamps. LED lamps consume approximately 90% less energy, have a longer life and will give off a more even light output then the current incandescent lamps. It is important to choose a lamp designed to retrofit the existing fixtures. The replacement of the 20 existing fixtures was estimated at a unit cost of $27 per fixture.

Estimated Cost:	$540
Calculated Saving:	$709
Simple Payback Period:	10 months

End of Report

APPENDIX A

HEAT LOSS CALCULATIONS

Project:	**Teslin Energy Audit**
Building:	**Arena - Heat Loss to Rink Area**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:	R (ft^2-h-^{o}F/Btu	RSI (m^2-^{o}C/W)	
Wall	20	3.5	
Floor	65 Btuh/ft	0.06 kW/m	
Roof	40	7.0	
Window	3.5	0.4	ASHRAE Fundamentals 27.16 Commercial type
Door	5	0.9	vinyl frame double glazing with 13mm air

	^{o}F	^{o}C	
Design Outdoor Temperature	-45	-43	NBCC 2.5% winter design based on Whitehorse
Design Indoor Temperature	64	18	
Design Rink Temperature	5	-15	
Delta Temperature (DT)	59	33	
Air Change per hour	0.3		See Ashrae F27.2; construction - old, fairly leaky

Windows:			**Comments**
Area	72.0 ft2	6.7 m2	4%
Heat Loss:	1,222 Btuh	0.6 kW	Q=UADT
Exterior Doors:			
Area	205.0 ft2	19.1 m2	
Heat Loss:	2,435 Btuh	0.7 kW	Q=UADT
Exterior Walls:			
Area	1461.0 ft2	135.8 m2	
Heat Loss:	4,339 Btuh	1.3 kW	Q=UADT
Floor			
Perimeter	0.0 ft	0.0 m	
Heat Loss:	0 Btuh	0 kW	Q=UADT
Roofs:			
Area	4000.0 ft2	371.7 m2	
Heat Loss:	5,940 Btuh	1.7 kW	Q=UADT
Infiltration:			
Rate	185 cfm	87 Litres/s	
Building Volume	37,000 ft3	1048.2 m3	
Heat Loss:	11,868 Btuh	3.5 kW	Q=1.08*infilt rate (cfm) *DT
Total Heat Loss	25,805 Btuh	8 kW	
Ventilation Air			
Design Occupancy			
O/A			
O/A Heating			
[redacted]		8 kW	

Project:	**Teslin Energy Audit**
Building:	**Arena - Heat Loss to Exterior**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:	R (ft^2-h-^{o}F/Btu)	RSI (m^2-^{o}C/W)	
Wall	20	3.5	
Floor	65 Btuh/ft	0.06 kW/m	
Roof	40	7.0	
Window	3.5	0.4	ASHRAE Fundamentals 27.16 Commercial type
Door	5.0	0.9	vinyl frame double glazing with 13mm air

	^{o}F	^{o}C	
Design Outdoor Temperature	-45	-43	NBCC 2.5% winter design based on Whitehorse
Design Indoor Temperature	64	18	
Design Rink Temperature	5	-15	
Delta Temperature (DT)	110	61	
Air Change per hour	0.3		See Ashrae F27.2; construction - old, fairly leaky

			Comments
Windows:			
Area	0.0 ft2	0.0 m2	0%
Heat Loss:	0 Btuh	0.0 kW	Q=UADT
Exterior Doors:			
Area	163.0 ft2	15.1 m2	
Heat Loss:	3,579 Btuh	1.0 kW	Q=UADT
Exterior Walls:			
Area	1783.0 ft2	165.7 m2	
Heat Loss:	9,789 Btuh	2.9 kW	Q=UADT
Floor			
Perimeter	251.5 ft	76.7 m	
Heat Loss:	16,348 Btuh	5 kW	Q=UADT
Roof			
Area	480.0 ft	44.6 m	
Heat Loss:	1,318 Btuh	0.4 kW	Q=UADT
Infiltration:			
Rate	185 cfm	87 Litres/s	
Building Volume	37,000 ft3	1048.2 m2	
Heat Loss:	21,938 Btuh	6.4 kW	Q=1.08*inflit rate (cfm) *DT
Total Heat Loss	52,971 Btuh	15 kW	
Ventilation Air			
Design Occupancy			
O/A			
O/A Heating			
[redacted]		15 kW	

Project:	**Teslin Energy Audit**
Building:	**Arena**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:

1. E = CD*(86.4*Qls*DD)/(k*DT)
   ref: ASHRAE Fundementals handbook, 1989, SI ver, pg F28.2
   where:
   - E= fuel or energy consumption for estaimte period, kJ
   - CD = correction factor for heating effect vs. kelvin degree days
   - Qls = design heat loss incl. infiltration and ventilation, W
   - DD= Kelvin degree days, C
   - k = correction factor for heating system
   - DT = design temperature difference, C
2. Use degree day data for Teslin, YT
3. Fuel consumption = E/fuel heating value
4. Fuel = propane

INPUT DATA: (input yellow)

Heating Degree Days - Environment Canada Climatic Norms

Jan DD	1154.4	July DD	
Feb DD	916.4	Aug DD	
Mar DD	775.6	Sep DD	
Apr DD		Oct DD	542.6
May DD		Nov DD	847.5
Jun DD		Dec DD	1005.5
		Total DD:	5242

Correction factor CD:	0.7	
Heat loss day	23,282 W	
Heat loss night	23,282 W	
Ave occupied hours	24 hrs	
Ave unoccupied hours	0 hrs	
Correction factor k:	0.5	
Delta Temperature	61 C	
Propane heating value, MJ/L	25.3 MJ/L	ref: ASHRAE 1989, F15.6, table 6
Equipment efficiency	80%	

OUTPUT: Monthly Fuel oil Consumption

Jan	2,633 L	July	0 L
Feb	2,090 L	Aug	0 L
Mar	1,769 L	Sep	0 L
Apr	0 L	Oct	1,238 L
May	0 L	Nov	1,933 L
Jun	0 L	Dec	2,294 L

Total Annual Fuel Consumption 11,957 L

Cost per Litre $ 0.74 $ 8,848

Project:	**Teslin Energy Audit**
Building:	**Municipal Building**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:	R (ft^2-h-°F/Btu)	RSI (m^2-°C/W)	
Wall	28	4.9	
Floor	65 Btuh/ft	0.06 kW/m	
Roof	40	7.0	
Window	3.5	0.4	
Door	14	2.5	
	°F	°C	
Design Outdoor Temperature	-45	-43	NBCC 2.5% winter design based on Teslin
Design Indoor Temperature	70	21	
Delta Temperature (DT)	115	64	
Air Change per hour	0.4		See Ashrae F27.2; construction - old, fairly leaky

			Comments
Windows:			
Area	98.0 ft2	9.1 m2	1%
Heat Loss:	3,226 Btuh	1.6 kW	Q=UADT
Doors:			
Area	1204.0 ft2	111.9 m2	
Heat Loss:	9,907 Btuh	2.9 kW	Q=UADT
Roof:			
Area	6204.0 ft2	576.6 m2	
Heat Loss:	17,868 Btuh	5.2 kW	Q=UADT
Walls:			
Area	3142.0 ft2	292.0 m2	
Heat Loss:	12,927 Btuh	3.8 kW	Q=UADT
Floor			
Perimeter	320.0 ft	97.6 m	
Heat Loss:	20,800 Btuh	6 kW	Q=UADT
Infiltration:			
Rate	579 cfm	273 Litres/s	
Building Volume	86,856 ft3	2460.5 m2	
Heat Loss:	72,042 Btuh	21.0 kW	Q=1.08*infilt rate (cfm) *DT
Total Heat Loss	136,769 Btuh	41 kW	
Ventilation Air			
Design Occupancy			
O/A			
O/A Heating			
Total Heating:	**136,769 Btuh**	41 kW	

Heating Energy Estimation

Project:	**Teslin Energy Audit**
Building	**Municipal Building**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number	0403022001

ASSUMPTIONS:

1 E = CD*(86.4*Qls*DD)/(k*DT)
ref: ASHRAE Fundementals handbook, 1989, SI ver, pg F28.2
where:
E= fuel or energy consumption for estimate period, kJ
CD = correction factor for heating effect vs. kelvin degree days
Qls = design heat loss incl. infiltration and ventilation, W
DD= Kelvin degree days, C
k = correction factor for heating system
DT = design temperature difference, C

2 Use degree day data for Teslin, YT

3 Fuel oil consumption = E/fuel oil heating value

4 Fuel oil = # 2 diesel fuel oil

INPUT DATA: (input yellow)

Heating Degree Days - Environment Canada Climatic Norms

Jan DD	1154.4	July DD	130.1
Feb DD	916.4	Aug DD	183.7
Mar DD	775.6	Sep DD	326.9
Apr DD	526.8	Oct DD	542.6
May DD	357.8	Nov DD	847.5
Jun DD	199.8	Dec DD	1005.5
		Total DD:	6967.1

Correction factor CD:	0.75	
Heat loss day	40,627 W	
Heat loss night	40,627 W	
Ave occupied hours	24 hrs	
Ave unoccupied hours	0 hrs	
Correction factor k:	0.55	
Delta Temperature	64 C	
Fuel Oil heating value, MJ/L	38.2 MJ/L	ref. ASHRAE 1989, F15.6, table 6
Equipment efficiency	80%	

OUTPUT: Monthly Fuel oil Consumption

Jan	2,825 L	July	318 L
Feb	2,243 L	Aug	450 L
Mar	1,898 L	Sep	800 L
Apr	1,289 L	Oct	1,328 L
May	876 L	Nov	2,074 L
Jun	489 L	Dec	2,461 L

Total Annual Fuel Consumption 17,051 L

Cost per Litre $ 0.82 $ 13,965

Project:	**Teslin Energy Audit**
Building:	**Community Hall**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:	R (ft^2-h-°F/Btu)	RSI (m^2-°C/W)	
Wall	28	4.9	
Floor	65 Btuh/ft	0.06 kW/m	
Roof	40	7.0	
Window	3.5	0.4	ASHRAE Fundamentals 27.16 Commercial type
Door	5.0	0.9	vinyl frame double glazing with 13mm air
	°F	°C	
Design Outdoor Temperature	-45	-43	NBCC 2.5% winter design based on Whitehorse
Design Indoor Temperature	68	20	
Delta Temperature (DT)	113	63	
Air Change per hour	0.3		See Ashrae F27 2; construction - old, fairly leaky

			Comments
Windows:			
Area	24.0 ft2	2.2 m2	0%
Heat Loss:	778 Btuh	0.4 kW	Q=UADT
Doors:			
Area	231.0 ft2	21.5 m2	
Heat Loss:	5,239 Btuh	1.5 kW	Q=UADT
Roof:			
Area	7580.5 ft2	704.5 m2	
Heat Loss:	21,491 Btuh	6.3 kW	Q=UADT
Walls:			
Area	3554.8 ft2	330.4 m2	
Heat Loss:	14,397 Btuh	4.2 kW	Q=UADT
Floor			
Perimeter	351.4 ft	107.1 m	
Heat Loss:	22,842 Btuh	7 kW	Q=UADT
Infiltration:			
Rate	459 cfm	216 Litres/s	
Building Volume	91,779 ft3	2,600.0 m3	
Heat Loss:	56,202 Btuh	16.4 kW	Q=1.08*inflit rate (cfm) *DT
Total Heat Loss	120,948 Btuh	36 kW	
Ventilation Air			
Design Occupancy			
O/A			
O/A Heating			
Total Heating:	**120,948 Btuh**	36 kW	

Project	**Teslin Energy Audit**
Building:	**Community Hall**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location	Whitehorse
LMP Project Number	0403022001

ASSUMPTIONS:

1 E = CD*(86.4*Qls*DD)/(k*DT)

ref: ASHRAE Fundementals handbook, 1989, SI ver, pg F28.2

where

E= fuel or energy consumption for estaimte period, kJ

CD = correction factor for heating effect vs. kelvin degree days

Qls = design heat loss incl. infiltration and ventilation, W

DD= Kelvin degree days, C

k = correction factor for heating system

DT = design temperature difference, C

2 Use degree day data for Teslin, YT

3 Fuel oil consumption = E/fuel oil heating value

4 Fuel oil = # 2 diesel fuel oil

INPUT DATA: (input yellow)

Heating Degree Days - Environment Canada Climatic Norms

Jan DD	1154.4	July DD	130.1
Feb DD	916.4	Aug DD	183.7
Mar DD	775.6	Sep DD	326.9
Apr DD	526.8	Oct DD	542.6
May DD	357.8	Nov DD	847.5
Jun DD	199.8	Dec DD	1005.5
		Total DD:	6967.1

Correction factor CD	0.75	
Heat loss day	35,508 W	
Heat loss night	35,508 W	
Ave occupied hours	24 hrs	
Ave unoccupied hours	0 hrs	
Correction factor k:	0.55	
Delta Temperature	63 C	
Fuel Oil heating value, MJ/L	38.2 MJ/L	ref. ASHRAE 1989, F15.6, table 6
Equipment efficiency	80%	

OUTPUT: Monthly Fuel Oil Consumption

Jan	2,508 L	July	283 L
Feb	1,991 L	Aug	399 L
Mar	1,685 L	Sep	710 L
Apr	1,145 L	Oct	1,179 L
May	777 L	Nov	1,842 L
Jun	434 L	Dec	2,185 L

Total Annual Fuel Consumption **15,139 L**

Cost per Litre $ 0.82 $ 12,399

Project:	**Teslin Energy Audit**
Building:	**Curling Rink - Heat Loss to Exterior**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:	R (ft^2-h-°F/Btu)	RSI (m^2-°C/W)	
Wall	20	3.5	
Floor	65 Btuh/ft	0.06 kW/m	
Roof	40	7.0	
Window	3.5	0.4	ASHRAE Fundamentals 27 16 Commercial type
Door	5	0.9	vinyl frame double glazing with 13mm air
	°F	°C	
Design Outdoor Temperature	-45	-43	NBCC 2.5% winter design based on Whitehorse
Design Indoor Temperature	64	18	
Design Rink Temperature	14	-10	
Delta Temperature (DT)	110	61	
Air Change per hour	0.3		See Ashrae F27 2, construction - old, fairly leaky

			Comments
Windows:			
Area	0.0 ft2	0.0 m2	0%
Heat Loss:	0 Btuh	0.0 kW	Q=UADT
Doors:			
Area	21.0 ft2	2.0 m2	
Heat Loss:	461 Btuh	0.1 kW	Q=UADT
Roof:			
Area	2382.6 ft2	221.4 m2	
Heat Loss:	6,540 Btuh	1.9 kW	Q=UADT
Walls:			
Area	763.0 ft2	70.9 m2	
Heat Loss:	4,189 Btuh	1.2 kW	Q=UADT
Floor			
Perimeter	**266.5 ft**	**81.3 m**	
Heat Loss:	**17,323 Btuh**	**5 kW**	Q=UADT
Infiltration:			
Rate	95 cfm	45 Litres/s	
Building Volume	19,061 ft3	540.0 m2	
Heat Loss:	11,301 Btuh	3.3 kW	Q=1.08*infilt rate (cfm) *DT
Total Heat Loss	39,814 Btuh	12 kW	
Ventilation Air			
Design Occupancy			
O/A			
O/A Heating			
Total Heating:	**39,814 Btuh**	11.6 kW	

Project:	**Teslin Energy Audit**
Building:	**Curling Rink - Heat Loss to Rink Area**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:	R (ft^2-h-°F/Btu)	RSI (m^2-°C/W)	
Wall	20	3.5	
Floor	65 Btuh/ft	0.06 kW/m	
Roof	40	7.0	
Window	3.5	0.4	ASHRAE Fundamentals 27.16 Commercial type
Door	5	0.9	vinyl frame double glazing with 13mm air
	°F	°C	
Design Outdoor Temperature	-45	-43	NBCC 2.5% winter design based on Whitehorse
Design Indoor Temperature	68	20	
Design Rink Temperature	14	-10	
Delta Temperature	54	30	
Air Change per hour	0.3		See Ashrae F27.2, construction - old, fairly leaky

			Comments
Windows:			
Area	288.0 ft2	26.8 m2	64%
Heat Loss:	4,443 Btuh	2.2 kW	Q=UADT
Doors:			
Area	42.0 ft2	3.9 m2	
Heat Loss:	454 Btuh	0.1 kW	Q=UADT
Roof:			
Area	0.0 ft2	0.0 m2	
Heat Loss:	0 Btuh	0.0 kW	Q=UADT
Walls:			
Area	164.0 ft2	15.2 m2	
Heat Loss:	443 Btuh	0.1 kW	Q=UADT
Floor			
Perimeter	0.0 ft	0.0 m	
Heat Loss:	0 Btuh	0 kW	Q=UADT
Infiltration:			
Rate	95 cfm	45 Litres/s	
Building Volume	19,061 ft3	540.0 m2	
Heat Loss:	5,558 Btuh	1.6 kW	Q=1.08*infilt rate (cfm) *DT
Total Heat Loss	10,898 Btuh	4 kW	
Ventilation Air			
Design Occupancy			
O/A			
O/A Heating			
Total Heating:	**10,898 Btuh**	4 kW	

Project	**Teslin Energy Audit**
Building:	**Curling Rink**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:

1 E = CD*(86.4*Qls*DD)/(k*DT)
ref: ASHRAE Fundementals handbook, 1989, SI ver, pg F28.2
where:
E= fuel or energy consumption for estaimte period, kJ
CD = correction factor for heating effect vs. kelvin degree days
Qls = design heat loss incl. infiltration and ventilation, W
DD= Kelvin degree days, C
k = correction factor for heating system
DT = design temperature difference, C

2 Use degree day data for Teslin, YT

3 Fuel oil consumption = E/fuel oil heating value

4 Fuel oil = # 2 diesel fuel oil

INPUT DATA: (input yellow)

Heating Degree Days - Environment Canada Climatic Norms

Jan DD	1154.4	July DD	130.1
Feb DD	916.4	Aug DD	183.7
Mar DD	775.6	Sep DD	326.9
Apr DD	526.8	Oct DD	542.6
May DD	357.8	Nov DD	847.5
Jun DD	199.8	Dec DD	1005.5
		Total DD:	6967.1

Correction factor CD:	0.75	
Heat loss day	15,762 W	
Heat loss night	15,762 W	
Ave occupied hours	24 hrs	
Ave unoccupied hours	0 hrs	
Correction factor k:	0.55	
Delta Temperature	61 C	
Fuel Oil heating value, MJ/L	38.2 MJ/L	ref. ASHRAE 1989, F15.6, table 6
Equipment efficiency	80%	

OUTPUT: Monthly Fuel oil Consumption

Jan	1,150 L	July	130 L
Feb	913 L	Aug	183 L
Mar	773 L	Sep	326 L
Apr	525 L	Oct	541 L
May	356 L	Nov	844 L
Jun	199 L	Dec	1,002 L

Total Annual Fuel Consumption 6,940 L

Cost per Litre $ 0.82 $ 5,684

Project:	**Teslin Energy Audit**
Building:	**Post Office**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:	R (ft^2-h-°F/Btu)	RSI (m^2-°C/W)	
Wall	28	4.9	
Floor	65 Btuh/ft	0.06 kW/m	
Roof	40	7.0	
Window	3.0	0.4	ASHRAE Fundamentals 27.16 Commercial type
Door	5.0	0.9	vinyl frame double glazing with 13mm air
	°F	°C	
Design Outdoor Temperature	-45	-43	NBCC 2.5% winter design based on Whitehorse
Design Indoor Temperature	72	22	
Delta Temperature (DT)	117	65	
Air Change per hour	0.3		See Ashrae F27.2; construction - old, fairly leaky

Windows:			**Comments**
Area	51.2 ft2	4.8 m2	1%
Heat Loss:	1,998 Btuh	0.9 kW	Q=UADT
Doors:			
Area	63.0 ft2	5.9 m2	
Heat Loss:	1,474 Btuh	0.4 kW	Q=UADT
Roof:			
Area	3166.7 ft2	294.3 m2	
Heat Loss:	9,263 Btuh	2.7 kW	Q=UADT
Walls:			
Area	2204.3 ft2	204.9 m2	
Heat Loss:	9,211 Btuh	2.7 kW	Q=UADT
Floor			
Perimeter	161.0 ft	49.1 m	
Heat Loss:	10,465 Btuh	3 kW	Q=UADT
Infiltration:			
Rate	132 cfm	62 Litres/s	
Building volume	26,481 ft3	750.2 m2	
Heat Loss:	16,731 Btuh	4.9 kW	Q=1.08*infilt rate (cfm) *DT
Total Heat Loss	49,141 Btuh	15 kW	
Ventilation Air			
Design Occupancy			
O/A			
O/A Heating			
Total Heating:	**49,141 Btuh**	15 kW	

Project:	**Teslin Energy Audit**
Building:	**Post Office**
Date Prepared:	October 28 2004
Prepared by:	Jesse Musial
Location:	Whitehorse
LMP Project Number:	0403022001

ASSUMPTIONS:

1. E = CD*(86.4*Qls*DD)/(k*DT)
   ref: ASHRAE Fundementals handbook, 1989, SI ver, pg F28.2
   where:
   - E= fuel or energy consumption for estaimte period, kJ
   - CD = correction factor for heating effect vs. kelvin degree days
   - Qls = design heat loss incl. infiltration and ventilation, W
   - DD= Kelvin degree days, C
   - k = correction factor for heating system
   - DT = design temperature difference, C
2. Use degree day data for Teslin, YT
3. Propane consumption = E/propane heating value
4. Fuel = propane

INPUT DATA: (input yellow)

Heating Degree Days - Environment Canada Climatic Norms

Jan DD	1154.4	July DD	130.1
Feb DD	916.4	Aug DD	183.7
Mar DD	775.6	Sep DD	326.9
Apr DD	526.8	Oct DD	542.6
May DD	357.8	Nov DD	847.5
Jun DD	199.8	Dec DD	1005.5
		Total DD:	6967.1

Correction factor CD:	0.75	
Heat loss day	14,647 W	
Heat loss night	14,647 W	
Ave occupied hours	24 hrs	
Ave unoccupied hours	0 hrs	
Correction factor k:	0.55	
Delta Temperature	65 C	
Oil heating value, MJ/L	38.2 MJ/L	ref ASHRAE 1989, F15.6, table 6
Equipment efficiency	80%	

OUTPUT: Monthly Fuel oil Consumption

Jan	1,003 L	July	113 L
Feb	796 L	Aug	160 L
Mar	674 L	Sep	284 L
Apr	458 L	Oct	471 L
May	311 L	Nov	736 L
Jun	174 L	Dec	874 L

Total Annual Fuel Consumption 6,053 L

Cost per Litre $ 0.82 $ 4,957

APPENDIX B

ENERGY CONSUMPTION RECORDS

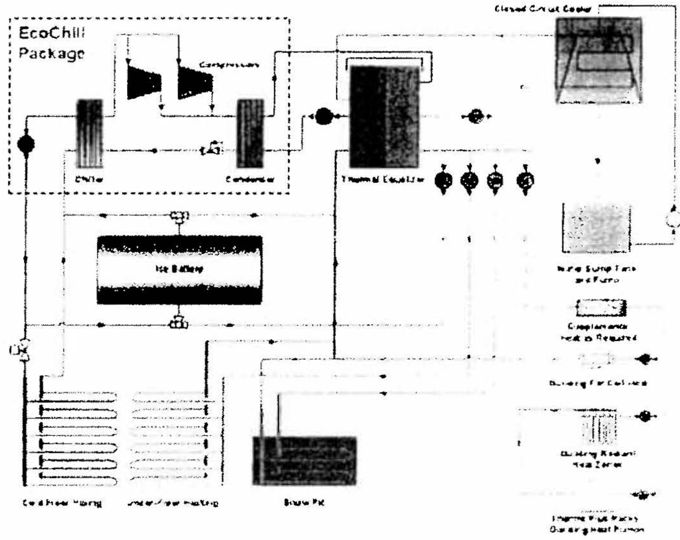
for Heating

Power

ECO-CHILL

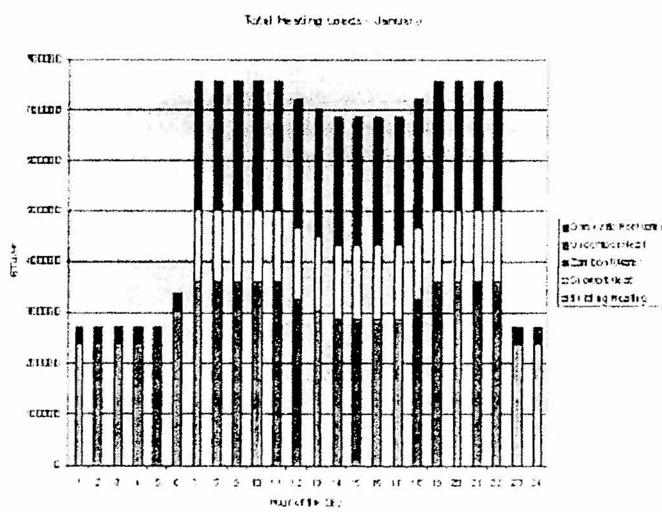
This option has been selected for the following Multi Purpose Facilities such as: City of Ft Saskatchewan - Dow Community Centre, City of Calgary - Nose Creek Recreation Facility, Grimshaw Alberta, Grimshaw Arena – City of Whitehorse – Jeux du Canada Games Centre plus numerous other facilities across Canada

ECO-CHILL –
Is an engineered solution to lowering energy costs in your facility. Using CIMCO's 90 years expertise in the ice rink business, Eco-Chill collects and recycles the energy used to maintain the ice surface, providing abundant heating for the building and hot water for showers, under-floor heating, ice resurfacing and snow melting.
Unlike Geo-Thermal heat pump systems that require thousands of feet of plastic tubing buried in the ground outside the building, Eco-Chill's unique energy recycling equipment is all contained within the plant mechanical room. This avoids long term environmental uncertainty of contaminating local ground water in the event of a leak in the ground source system



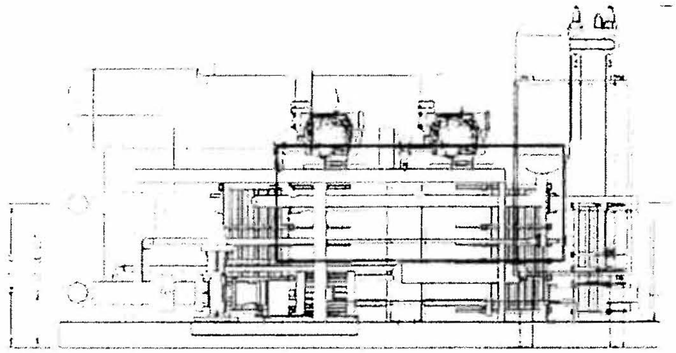
REDUCED ENERGY COSTS
ECO-CHILL

is designed to recycle 100% of the energy used to maintain the ice surface back into the building heating system. These heating loads can vary significantly over a 24 hour period, but by using computerized control and energy storage strategies, the heat can be made available when it is most needed.
Naturally this results in a significant reduction of energy costs. In addition, the system minimizes or eliminates the burning of fossil fuels. Reducing the release of damaging greenhouse gases into the atmosphere.



THE MODULAR CONCEPT INCLUDES:

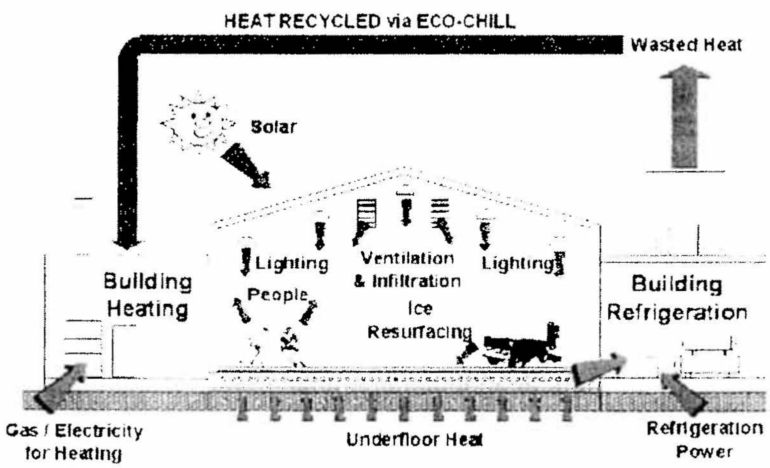
- **ECO-CHILL PACKs** – provide the essential refrigeration components, including low maintenance, high efficiency screw compressors, low refrigerant charge, compact stainless steel plate & frame heat exchangers and microprocessor controls. They are available in 40 Tr, 60 Tr, 80 Tr, 120 Tr and 150 Tr. capacities.



- **ICE LOGIC CONTROL** – provides total HVACR system management to accommodate specific requirements or activities schedule. The system provides precise infrared temperature control of the ice surface, event scheduling and zone temperature control
- **ICE BATTERY PACKS** – Provide convenient, energy boosting thermal storage. This allows you to take advantage of virtually all of the heat available from your refrigeration system, in order to meet the different heating requirements in the building, as well as giving the extra power that you need for peak demand.

This system will redirect the large amount of waste heat back into the building as:

- **Hot Water for Zamboni and/or showers**
- **Floor Radiant Heating in dressing rooms, lobby area**
- **Air Distribution in lobby area**



This option will:

- **Provide 1,014,720 BTU's of recoverable heat back into the building**
- **Remove enough emissions from the environment equivalent to 100 – 150 cars**
- **Save the client dollars otherwise spent on Gas or Oil costs:**
- **Eligibility for a Grant from the Federal Government (CBIP Grant)**

Eco Chill Packages

Flooded Ammonia Models

Eco Chill Pak	Capacity, TR	Compressor No. 1			Compressor No. 2			Compressor No. 3			Heat Output	COP
Model No.	@ 10 °F ET 100 °F CT	Model	BHP	Motor	Model	BHP	Motor	Model	BHP	Motor	BTU Hr	KWOut KW In
ECO-50A	47.[illegible]	OSKA 5361K	34	40	OSKA 5361K	34	40				[illegible]9,460	4.[illegible]
ECO-60A	64.[illegible]	OSKA 7441K	48	50	OSKA 7441K	48	50				1,014,720	4.15
ECO-80A	81.5	OSKA 7451K	56	60	OSKA 7461K	64	75				1,288,000	4.[illegible]
ECO-100A	99.6	OSKA 7471K	73	75	OSKA 7471K	73	75				1,566,770	4.21
ECO-125A	126.[illegible]	OSKA 7451K	56	60	OSKA 7451K	56	60	OSKA 7471K	[illegible]	75	1,995,225	4.21

- **Reduces energy costs (well over $300K in 20 years)**
- **Reduces maintenance costs as compared to standard systems**
- **Reduces consumption of non-renewable resources**
- **Pays back in less than 5 years**
- **Keeps recreational facilities available and affordable for future generations.**

ECO-CHILL OPTION WILL RANGE BETWEEN $ 20,000.00 TO $ 30,000.00 DEPENDING ON DESIGN

Propane - Village of Teslin, 2001-2004 Averages

Month		Arena	Litres
Jan-04	$	1,736.21	2,914
Feb-04	$	1,091.66	2,117
Mar-04	$	877.41	1,474
Apr-04	$	1,112.24	2,118
May-04	$	287.32	577
Jun-04	$	-	0
Jul-04	$	399.23	763
Aug-04	$	-	0
Sep-04	$	175.40	186
Oct-04	$	341.12	669
Nov-04	$	353.96	694
Dec-04	$	-	0
Totals	$	6,374.55	11,512

Propane - Village of Teslin, 2004

Month		Arena	Litres
Jan-04	$	1,683.25	3149.4
Feb-04	$	2,036.48	3810.3
Mar-04	$	591.23	1106.2
Apr-04	$	1,052.95	1970.1
May-04	$	339.54	635.3
Jun-04	$	-	0
Jul-04	$	-	0
Aug-04	$	-	0
Sep-04	$	171.20	12
Oct-04	$	-	0
Nov-04	$	-	0
Dec-04	$	-	0
Totals	$	5,874.65	10683.3

Propane - Village of Teslin, 2003

Month		Arena	Litres
Jan-03	$	1,400.52	2896
Feb-03	$	919.02	1900
Mar-03	$	-	0
Apr-03	$	1,508.74	3319
May-03	$	809.74	1674
Jun-03	$	-	0
Jul-03	$	-	0
Aug-03	$	-	0
Sep-03	$	-	0
Oct-03	$	877.14	1705
Nov-03	$	910.99	1771
Dec-03	$	-	0
Totals	$	6,426.15	13265

Propane - Village of Teslin, 2002

Month		Arena	Litres
Jan-02	$	1,043.35	1889.7
Feb-02	$	1,411.15	2758.7
Mar-02	$	1,179.66	2116.1
Apr-02	$	1,225.36	2078.4
May-02	$	-	0
Jun-02	$	-	0
Jul-02	$	-	0
Aug-02	$	-	0
Sep-02	$	530.41	732.4
Oct-02	$	487.34	970
Nov-02	$	504.83	1004.9
Dec-02	$	-	0
Totals	$	6,382.10	11550.2

Propane - Village of Teslin, 2001

Month		Rec Plex	Litres
Jan-01	$	2,817.73	3719
Feb-01	$	-	0
Mar-01	$	1,738.75	2675
Apr-01	$	661.90	1105
May-01	$	-	0
Jun-01	$	-	0
Jul-01	$	1,596.90	3052
Aug-01	$	-	0
Sep-01	$	-	0
Oct-01	$	-	0
Nov-01	$	-	0
Dec-01	$	-	0
Totals	$	6,815.28	10551

OIL - Village Of Teslin, 2001-2004 Averages

Month		Municipal Office	Litres		Rec Plex	Litres		Comm. Hall (Post Office)	Litres		Total	
Jan-04	$	1,382.45	2,342	$	1,892.77	3,191	$	547.27	924	$	3,822.49	
Feb-04	$	1,816.68	3,016	$	1,795.31	2,950	$	590.14	975	$	4,202.13	
Mar-04	$	1,493.28	2,368	$	1,681.77	2,652	$	472.69	740	$	3,647.74	
Apr-04	$	954.54	1,576	$	943.19	1,606	$	329.07	540	$	2,226.80	
May-04	$	249.30	402	$	772.01	1,207	$	82.63	133	$	1,103.94	
Jun-04	$	-	0	$	-	0	$	-	0	$	-	
Jul-04	$	-	0	$	-	0	$	-	0	$	-	
Aug-04	$	389.18	609	$	669.93	1,049	$	52.38	82	$	1,111.50	
Sep-04	$	884.99	1,458	$	1,347.96	2,174	$	270.25	437	$	2,503.19	
Oct-04	$	1,685.46	3,197	$	2,291.49	3,274	$	435.04	646	$	4,411.99	
Nov-04	$	548.74	942	$	627.63	1,110	$	181.89	315	$	1,358.26	
Dec-04	$	495.35	768	$	800.83	1,230	$	182.69	284	$	1,478.87	
Totals	$	9,899.97		$	12,822.90		$	3,144.04		$	25,866.90	Dollars
			16679			20444			5076		42199	Lts

OIL - Village Of Teslin, 2004

Month		Municipal Office	Litres		Rec Plex	Litres		Comm. Hall (Post Office)	Litres		Total	
Jan-04	$	1,089.49	1770.8	$	1,231.42	2001.5	$	556.12	903.9	$	2,877.03	
Feb-04	$	1,929.42	3136	$	1,845.75	3000	$	492.33	800.2	$	4,267.50	
Mar-04	$	1,448.27	2183.1	$	1,657.03	2497.8	$	612.78	923.7	$	3,718.08	
Apr-04	$	948.38	1384.9	$	-	0	$	326.65	477	$	1,275.03	
May-04	$	-	0	$	1,017.95	1486.5	$	-	0	$	1,017.95	
Jun-04	$	-	0	$	-	0	$	-	0	$	-	
Jul-04	$	-	0	$	-	0	$	-	0	$	-	
Aug-04	$	-	0	$	-	0	$	-	0	$	-	
Sep-04	$	-	0	$	-	0	$	-	0	$	-	
Oct-04	$	2,902.67	6981.77	$	3,791.54	5000	$	434.28	601.3	$	7,128.49	
Nov-04	$	-	0	$	-	0	$	-	0	$	-	
Dec-04	$	-	0	$	-	0	$	-	0	$	-	
Totals	$	8,318.23		$	9,543.69	0	$	2,422.16		$	20,284.08	Dollars
			15456.57			13985.8			3706.1		33148.47	Lts

OIL - Village Of Teslin, 2003

Month		Municipal Office	Litres		Rec Plex	Litres		Comm. Hall (Post Office)	Litres		Total	
Jan-03	$	1,387.45	2209	$	1,893.70	3015	$	336.65	536	$	3,617.80	
Feb-03	$	2,264.12	3486	$	2,338.82	3601	$	776.15	1195	$	5,379.09	
Mar-03	$	1,789.10	2365	$	2,124.23	2808	$	456.92	604	$	4,370.25	
Apr-03	$	-	0	$	-	0	$	-	0	$	-	
May-03	$	-	0	$	-	0	$	-	0	$	-	
Jun-03	$	-	0	$	-	0	$	-	0	$	-	
Jul-03	$	-	0	$	-	0	$	-	0	$	-	
Aug-03	$	1,556.73	2437	$	2,679.73	4195	$	209.53	328	$	4,445.99	
Sep-03	$	786.36	1252	$	1,257.43	2002	$	240.56	383	$	2,284.35	
Oct-03	$	1,852.26	2633	$	2,882.41	4083	$	603.88	857	$	5,338.55	
Nov-03	$	1,421.68	2264	$	1,260.82	2007	$	445.57	709	$	3,128.07	
Dec-03	$	1,981.41	3071	$	3,203.33	4919	$	730.74	1136	$	5,915.48	
Totals	$	13,039.11		$	17,640.47		$	3,800.00		$	34,479.58	Dollars
			19717			26630			5748		52095	Lts

OIL - Village Of Teslin, 2002

Month		Municipal Office	Litres		Rec Plex	Litres		Comm. Hall (Post Office)	Litres		Total	
Jan-02	$	1,366.32	2740.2	$	1,753.94	3517.6	$	513.33	1029.5	$	3,633.59	
Feb-02	$	1,579.02	3097	$	1,258.98	2469.3	$	482.93	947.2	$	3,320.93	
Mar-02	$	1,471.86	2883.8	$	1,580.68	3097	$	304.96	597.5	$	3,357.50	
Apr-02		1934.88	3373.7	$	2,179.89	3800.9	$	516.97	901.4	$	4,631.74	
May-02	$	-	0	$	-	0	$	-	0	$	-	
Jun-02	$	-	0	$	-	0	$	-	0	$	-	
Jul-02	$	-	0	$	-	0	$	-	0	$	-	
Aug-02	$	-	0	$	-	0	$	-	0	$	-	
Sep-02	$	2,435.00	4084.9	$	2,199.48	3689.8	$	481.70	808.1	$	5,116.18	
Oct-02	$	1,044.28	1618.5	$	971.82	1506.2	$	306.21	474.6	$	2,322.31	
Nov-02	$	-	0	$	-	0	$	-	0	$	-	
Dec-02	$	-	0	$	-	0	$	-	0	$	-	
Totals	$	9,831.36		$	9,944.79		$	2,606.10		$	22,382.25	Dollars
			17798.1			18080.8			4758.3		40637.2	Lts

OIL - Village Of Teslin, 2001

Month		Municipal Office	Litres		Rec Plex	Litres		Comm. Hall (Post Office)	Litres		Total	
Jan-01	$	1,686.54	2649.1	$	2,692.01	4228.4	$	782.99	1227.8	$	5,161.54	
Feb-01	$	1,494.16	2346.9	$	1,737.67	2729.4	$	609.15	956.8	$	3,840.98	
Mar-01	$	1,263.87	2040.4	$	1,365.15	2203.9	$	516.10	833.2	$	3,145.12	
Apr-01	$	934.91	1544	$	1,592.87	2630.6	$	472.66	780.6	$	3,000.44	
May-01	$	997.20	1609.6	$	2,070.10	3341.4	$	330.52	533.5	$	3,397.82	
Jun-01	$	-	0	$	-	0	$	-	0	$	-	
Jul-01	$	-	0	$	-	0	$	-	0	$	-	
Aug-01	$	-	0	$	-	0	$	-	0	$	-	
Sep-01	$	318.59	494.6	$	1,934.93	3003.9	$	358.72	556.9	$	2,612.24	
Oct-01	$	942.62	1554.8	$	1,520.20	2507.5	$	395.77	652.8	$	2,858.59	
Nov-01	$	773.28	1505.6	$	1,249.70	2433.2	$	281.97	549	$	2,304.95	
Dec-01	$	-	0	$	-	0	$	-	0	$	-	
Totals	$	8,411.17		$	14,162.63		$	3,747.88		$	26,321.68	Dollars
			13745			23078.3			6090.6		42913.9	Lts

Electricity - Village of Teslin, 2001-2004 Averages

Month	Comm Hall (Post Office)	Kilo Hrs	Rec Plex	Kilo HRS	Municipal Center	Kilo HRS	Total	
Jan-04	$ 146.42	1,123	$ 933.73	5,880	$ 559.74	4,125	$ 5,134.89	
Feb-04	$ 143.78	1,095	$ 981.35	5,530	$ 526.88	3,360	$ 4,893.01	
Mar-04	$ 139.80	1,059	$ 1,004.47	5,510	$ 461.72	3,375	$ 4,877.73	
Apr-04	$ 136.77	1,025	$ 965.47	4,810	$ 471.49	3,225	$ 4,628.73	
May-04	$ 131.01	965	$ 739.74	4,220	$ 458.62	3,030	$ 3,727.87	
Jun-04	$ 123.82	892	$ 690.80	3,470	$ 407.06	2,835	$ 3,310.17	
Jul-04	$ 130.74	964	$ 860.86	3,600	$ 469.60	2,940	$ 3,990.69	
Aug-04	$ 121.96	880	$ 693.69	3,530	$ 430.41	3,045	$ 3,502.55	
Sep-04	$ 118.40	804	$ 588.77	3,290	$ 477.75	3,105	$ 3,429.67	
Oct-04	$ 128.61	942	$ 699.84	2,860	$ 460.02	3,075	$ 3,849.46	
Nov-04	$ 130.80	962	$ 836.52	3,800	$ 473.68	3,360	$ 3,578.33	
Dec-04	$ 144.37	1,154	$ 1,015.96	6,667	$ 535.16	3,560	$ 4,802.49	
Totals	$ 1,596.46		$ 10,011.19		$ 5,732.11		$ 17,339.75	Dollars
		11862		53167		39035	104064	Kilo HRS

Electricity - Village of Teslin, 2004

Month	Comm Hall (Post Office)	Kilo Hrs	Rec Plex	Kilo HRS	Municipal Center	Kilo HRS	Total	
Jan-04	$ 158.13	1253	$ 1,004.84	5720	$ 696.37	4800	$ 8,832.34	
Feb-04	$ 134.23	1006	$ 988.66	5600	$ 518.45	3480	$ 8,247.34	
Mar-04	$ 116.15	819	$ 859.26	4640	$ 437.58	2880	$ 6,871.99	
Apr-04	$ 141.88	1085	$ 837.69	4480	$ 518.45	3480	$ 7,063.02	
May-04	$ 116.91	827	$ 546.56	2320	$ 437.58	2880	$ 4,248.05	
Jun-04	$ 117.02	828	$ 622.04	2880	$ 445.67	2940	$ 4,892.73	
Jul-04	$ 124.27	903	$ 719.08	3600	$ 510.37	3420	$ 5,856.72	
Aug-04	$ 121.47	903	$ 773.00	3600	$ 397.14	3420	$ 5,794.61	
Sep-04	$ 133.36	874	$ 713.70	4000	$ 478.01	2580	$ 6,199.07	
Oct-04	$ 131.43	977	$ 816.13	4320	$ 502.27	3360	$ 6,746.83	
Nov-04								
Dec-04								
Totals	$ 1,294.85		$ 7,880.96		$ 4,941.89		$ 14,117.70	Dollars
		9475		41160		33240	83875	Kilo HRS

Electricity - Village of Teslin, 2003

Month	Comm Hall (Post Office)	Kilo Hrs	Rec Plex	Kilo HRS	Municipal Center	Kilo HRS	Total	
Jan-03	$ 143.30	1087	$ 1,012.96	5920	$ 702.00	4860	$ 8,865.26	
Feb-03	$ 134.68	998	$ 937.28	5360	$ 539.83	3660	$ 7,969.79	
Mar-03	$ 128.12	948	$ 1,086.60	6680	$ 435.89	3000	$ 9,278.61	
Apr-03	$ 120.15	855	$ 1,039.02	5800	$ 432.10	2760	$ 8,246.27	
May-03	$ 134.95	1007	$ 990.24	5440	$ 494.05	3180	$ 8,066.24	
Jun-03	$ 114.89	806	$ 774.84	3840	$ 393.85	2520	$ 5,929.58	
Jul-03	$ 115.75	815	$ 904.24	4800	$ 477.86	3060	$ 7,112.85	
Aug-03	$ 106.85	723	$ 769.45	3800	$ 403.35	2580	$ 5,802.65	
Sep-03	$ 116.72	825	$ 699.36	3280	$ 469.78	3000	$ 5,390.86	
Oct-03	$ 128.54	947	$ 773.00	4000	$ 470.64	3180	$ 6,319.18	
Nov-03	$ 123.21	892	$ 977.88	5520	$ 462.55	3120	$ 7,975.64	
Dec-03	$ 149.23	1161	$ 1,333.70	8160	$ 599.32	4080	$ 11,403.25	
Totals	$ 1,516.39		$ 11,298.57		$ 5,881.22		$ 18,696.18	Dollars
		11064		62600		39000	112664	Kilo HRS

Electricity - Village of Teslin, 2002

Month	Comm Hall (Post Office)	Kilo Hrs	Rec Plex	Kilo HRS	Municipal Center	Kilo HRS	Total	
Jan-02	$141.73	1071	$948.93	8160	$457.48	4080	$1,548.14	
Feb-02	$153.93	1197	$848.77	4800	$616.79	3240	$ 1,619.49	
Mar-02	$134.86	1000	$867.13	4080	$524.26	4440	$ 1,526.25	
Apr-02	$129.64	946	$1,089.37	4760	$491.16	3720	$ 1,710.17	
May-02	$135.17	1003	$727.20	6320	$499.27	3360	$ 1,361.64	
Jun-02	$111.27	756	$565.12	3640	$395.28	3240	$ 1,071.67	
Jul-02	$109.25	735	$1,024.50	2520	$506.89	2700	$ 1,640.64	
Aug-02	$130.14	951	$781.25	5840	$507.37	3420	$ 1,418.76	
Sep-02	$111.75	761	$398.06	4040	$458.73	3480	$ 968.54	
Oct-02	$132.37	974	$650.78	1120	$493.13	3120	$ 1,276.28	
Nov-02	$129.37	943	$883.22	3240	$475.95	3540	$ 1,488.54	
Dec-02	$135.56	1161	$921.06	8160	$540.33	3300	$ 1,596.95	
Totals	$ 1,555.04		$ 9,705.39		$ 5,966.64		$ 17,227.07	Dollars
		10427		56680		41640	108747	Kilo HRS

Electricity - Village of Teslin, 2001

Month	Comm Hall (Post Office)	Kilo Hrs	Rec Plex	Kilo HRS	Municipal Center	Kilo HRS	Total	
Jan-01	$ 142.51	1079	$ 768.20	3720	$ 383.09	2760	$ 1,293.80	
Feb-01	$ 152.29	1180	$ 1,150.69	6360	$ 432.45	3060	$ 1,735.43	
Mar-01	$ 180.06	1467	$ 1,204.88	6640	$ 449.14	3180	$ 1,834.08	
Apr-01	$ 155.40	1212	$ 895.78	4200	$ 444.26	2940	$ 1,495.44	
May-01	$ 137.00	1022	$ 694.97	2800	$ 403.59	2700	$ 1,235.56	
Jun-01	$ 152.10	1178	$ 801.18	3520	$ 393.43	2640	$ 1,346.71	
Jul-01	$ 173.67	1401	$ 795.63	3480	$ 383.26	2580	$ 1,352.56	
Aug-01	$ 129.36	943	$ 451.06	880	$ 413.76	2760	$ 994.18	
Sep-01	$ 111.76	755	$ 543.94	1840	$ 504.49	3360	$ 1,160.19	
Oct-01	$ 122.10	868	$ 559.43	2000	$ 374.02	2640	$ 1,055.55	
Nov-01	$ 139.82	1051	$ 648.45	2640	$ 482.53	3420	$ 1,270.80	
Dec-01	$ 148.32	1139	$ 793.13	3680	$ 465.83	3300	$ 1,407.28	
Totals	$ 1,744.39		$ 9,307.34		$ 5,129.85		$ 16,181.58	Dollars
		13295		41760		35340	90395	Kilo HRS

APPENDIX C
EQUIPMENT INVENTORY

Teslin Energy Audit
Equipment Inventory

Building	Equipment	Description	Manufacturer	Model	Serial #	Spec
Municipal Building						
	Fire Suppression					
		Fire Alarm System				
		Dry Chem. Extinguishers				
	Heating					
		4 Stage Boiler Controller	Tekmar	2S4		
		Boiler	Burnham	6WNH	64331408	DOE Heating Cap. 221 MBH, net IBR 192 MBH
		Boiler	Burnham	6WNH	64331402	DOE Heating Cap. 221 MBH, net IBR 192 MBH
		Boiler	Burnham	6WNH	plate missing	DOE Heating Cap. 221 MBH, net IBR 192 MBH
		Burner	Reillo	40 R10?		1.65 usgph
		Recirculation Pump	Grundfos	UP1542F		
		Secondary Pump	Armstrong	H-53-3HP	0196	
		Secondary Pump	Armstrong	H-53-3HP	1194	
		Baseboard Radiation				
		CUH				
	Domestic Water					
		Domestic Water Heater	Jetglass	M150S6DS13	NF6791289	3000W, HW temp = 180°F
		Low Flush Toilets				
		Urinals	Kohler & Crane	Hydroflush		
		Lavatory				
	Ventilation					
		Air Handling Unit	Eng Air unit	LM-1		1650CFM @ .5" ESP, 20F EAT/70F LAT, 190/160F EWT/LWT 50% glycol, 6.8 usgpm, 20% O/A
Community Hall						
	Heating					
		Boiler	Weil McLain A/B	series 3	WTGO-8	net IBR 230,000
		Boiler Controller	Tekmar	2S4		
		Furnace	Climate Master Inc	EM-235-HB-R (2)	89H25296	btu input 211500 btu
		Propane Furnace				de-energized
		RHC				hydronic
		Electric Baseboards				
		Secondary Recirc Pump		816032-000	0696	3/4 HP, 230/3/60
		Secondary Recirc Pump		816032-000	0896	
	Fuel Oil System					
		Fuel Oil Tank				outside
	Domestic Water					
		DHWH	Aero	CF-50A		Oil Fired
		HW RHC	?	?	?	20/24 S/A
	Ventilation					
		AHU	Eng Air	LM-4C	14706	blower = 15/15, cap 4700cfm @ 1.5 ESP, BHP 208/3/60
	Kitchen					
		Cooler	Habco	Eagle Series ESR42		

Arena						
	Heating					
		Furnace	Carrier Weathermaker model 9200	58MX080-12 series 111	119A06001	
		Heat Detectors				
		Humidistat				
		Grilles				
	Domestic Water					
		Propane DHWH	Jetglass	M11TW50S5CX10	MG5061637	40 usgal, 58500 MBH input, direct vent 3"Φ
		DHWH	Jetglass	M11W50S5CXH10		40 lgal, 58000MBH
(Zamboni Room)		Propane DHWH	Jetglass	65T3703X	MH0777131	input 333000 Btu/hr, 8"Φ Flue
Pumphouse #1						
	2 Pumps	Fill 3000 usgal in 6 min				
	1 Pump	19 minutes				
Lift Station #4						
	Electric Heat					
	Exhaust fan					
	2 Flyght pumps	3101	3"			
	3085 pumps					
Lift Station #2						
	3805	2@15000gal				
Lift Station #1						
	3102					
Post Office/Library/Bank						
	Heating	Furnace	Summit	K6C 120	1332	100-120 MBH output
			Riello burner	BF5		

APPENDIX D

ARTIFICIAL ICE PLANT PROPOSAL

CIMCO REFRIGERATION

5909 - 83RD STREET, EDMONTON, AB T6E 4Y3

PH: (780) 468-1490 FX: (780) 469-1290

DATE: Thursday, August 26, 2004

TO: Village of Teslin

ATTN: Wes Wirth

FROM: Gerald R. Curran

SUBJECT: 60 Tr. Ice Plant with Optional ECOCHILL Design

Please find the following budget numbers for Proposed Ice Plant and piping for the arena and a 3 sheet curling floor , pricing will be based on plant delivery to Teslin, Yukon and includes room & board, expenses, and freight to site, Artificial Ice Plant will be a packaged unit requiring power wiring to our Motor Control Panel.

CIMCO will provide separate floor pricing and two (2) Ice plant pricing options and for your viewing.

1. Reciprocating Compressor system 65 Tr.
2. Screw compressor system.

CONCRETE COOLING FLOOR MATERIAL for an 85' x 185' (common to either plant selection)

CIMCO will supply and ASSIST the installation of the piping and chairs for the cooling floor system. The following information is as follows:

BRINE HEADERS - CIMCO will supply and install **6 " Schedule 80 PVC** brine headers to interconnect all the piping to the floor. The headers are to include:

- 256 nipples to allow one pipe under each board for proper freezing on surface
- Straight Through Design to form to the trench detail
- Steel brackets in trench for supports
- Nipples to be placed on 8 " center's to provide **4** " centers on floor.
- Clamps on each nipple will be double clamped for a positive seal

COOLING FLOOR RINK PIPING & SUPPORTS

- Supply and Install steel pipe chairs with 2 ¼ " lift for a **5 " concrete slab** to maintain proper elevation of pipe and at 3' centres down the entire length of the rink floor. This will keep pipe from sagging during the placement of concrete.
- Supply and install 1" standard .085 wall Rink Pipe on 4 " centers
- Supply and install PVC return bends to connect the supply line to the return line with double Murray Gold Seal clamps on each connection

COOLING FLOOR BRINE MAINS

CIMCO, will supply and install Schedule 80, 6 " PVC brine mains to connect the floor to the related components within the plant room.

COOLING FLOOR BRINE CHARGE

CIMCO, will supply, mix and install inhibited calcium brine to the required strength of (-8 dF) freezing point for the cooling floor.

CURLING RINK FLOOR MATERIAL
(SAND FLOOR)

BRINE HEADERS - CIMCO will supply and install 4 " Schedule 80 PVC brine headers to interconnect all the piping to the floor. The headers are to include:

- 126 nipples to allow one pipe outside of perimeter
- Straight Through Design to form to the trench detail
- Steel brackets in trench for supports
- Nipples to be placed on 8 " center's to provide 4 " centers on floor.
- Clamps on each nipple will be double clamped for a positive seal

COOLING FLOOR RINK PIPING & SUPPORTS

- Supply and Install steel pipe chairs on 4' centres down the entire length of the rink floor. This will keep pipe straight during the placement of sand.
- Supply and install 1" standard .085 wall Rink Pipe on 4 " centers
- Supply and install PVC return bends to connect the supply line to the return line with double Murray Gold Seal clamps on each connection

COOLING FLOOR BRINE MAINS

CIMCO, will supply and install Schedule 80, 4 " PVC brine mains to connect the floor to the related components within the plant room.

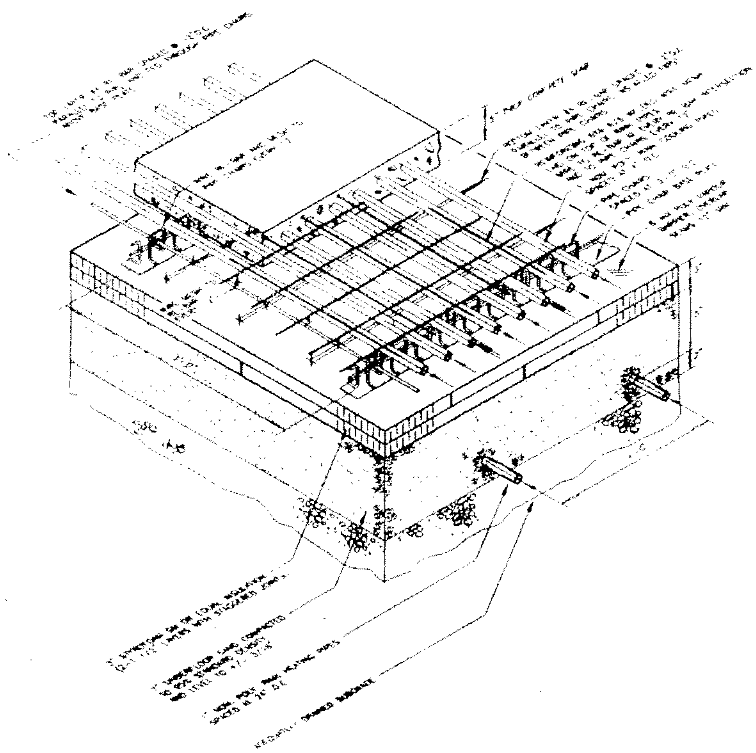
COOLING FLOOR BRINE CHARGE

CIMCO, will supply, mix and install inhibited calcium brine to the required strength of (-8 dF) freezing point for the cooling floor.

BUDGET PRICING..$ 81,060.00 GST Extra

EXCAVATION AND CONCRETE - General Idea of steps.

1. Remove 20" of existing fill
2. Insure base is well compacted granular
3. Supply and install 3 runs of sock wrapped weeping tile. Tile draining into existing header trench or owner provided outlet at slab edge
4. Install 3" of sand and level base
5. Install 1" Polypipe on 12" centers
6. Install remaining 8" of sand and level
7. Supply and install 6 mil poly vapour barrier
8. Install 3" of either Styrofoam SM or High Density Foam
9. Supply and install 10 m rebar @ 12" on centre bottom mat
10. Supply and install 6.6 x 6.6 W. W. M. top mat
11. Supply and install 5" of 27.5 M. P. A. superplasticized concrete
12. Supply and install slab edge form work
13. Wet cure slab
14. Supply "as built" survey of finished concrete slab



CONCRETE FLOOR ISOMETRIC

Labour Requirements –

The Town should have at least six people for at least 3 weeks to aid in construction of the cooling floors.

OPTION # 1 - ARTIFICIAL ICE PLANT 65 Tr. TWO (2) RECIPROCATING COMPRESSOR SYSTEM.

1. Two (2) Mycom reciprocating compressors, each rated at 32.7 Tr @ 10 °F SST & 85 °F SCT absorbing 38.4 brake horsepower rotating @ 1084 rpm. Compressors have water jacket cooling.
2. One Shell & tube Chiller (CFL-2010-2) sized for one Arena floor and one three sheet curling rink floor with a total flow capacity of 975 usgpm
3. Package to contain one (1) Arena cool floor pump c/w isolation valves
4. Package to contain one (1) Curling floor pump c/w isolation valves
5. One LRC-101 condenser **designed to operate at 85 °F condensing and equipped with two speed fan operation.** Condenser to be located outside of plant room with a height of 6' above Chiller elevation and a minimum of 8' from wall.
6. Electrical control panel is completely self contained and wired to all motors and mounted on package. Wiring on site will include from panel to condenser, condenser water pump and thermostats. (**Main power to our panel is by others)**
7. System is completely packaged taking up a space of approximately 16'L x 7' W x 8' H.
8. Completely installed on site

BUDGET PRICE ....$ 274,000.00 GST Extra

OPTION # 2 - ARTIFICIAL ICE PLANT 62 Tr. TWO (2) SCREW COMPRESSOR SYSTEM.

1. System comes with two (2) **Frick** model **RXF 19** Compressors each rated at a capacity of 30.3 ton's at 10 °F SST and 85 °F condensing temperature absorbing 40.5 bhp. This compressor is equipped with roller type main bearings with an LIO rating with no less than 100,000 hours
2. One Shell & tube Chiller (CFL-2010-2) sized for one Arena floor and one three sheet curling rink floor with a total flow capacity of 975 usgpm
3. Package to contain one (1) cool floor pump c/w isolation valves
4. Package to contain one (1) heat floor pump c/w isolation valves
5. One (1) heat exchanger sized for heat floor systems and a total flow of 140 usgpm
6. One LRC-101 condenser **designed to operate at 85 °F condensing and equipped with two speed fan operation.** Condenser to be located outside of plant room with a height of 6' above Chiller elevation and a minimum of 8' from wall.
7. Electrical control panel is completely self contained and wired to all motors and mounted on package. Wiring on site will include from panel to condenser, condenser water pump and thermostats. (**Main power to our panel is by others)**
8. System is completely packaged taking up a space of approximately 18'L x 7' W x 8' H.
9. Completely installed on site

BUDGET PRICE ....$ 314,765.00 GST Extra

COMPONENT	DIMENSIONS	WEIGHT	TRAILER SPACE REQUIRED
65 Tr Ice Plant Pkg.	28' Long x 8' wide	22,800 lbs	20'
....Condenser (one piece)	12' 6" Long x 5' 6" wide	4,700 lbs	13'
Misc. material	Pipe, Fittings, Tanks, Refrigerant, tools etc.	4,500 lbs	15'
		Approx - **32,000lbs**	

COMPONENT	DIMENSIONS	WEIGHT	TRAILER SPACE REQUIRED
Cooling Floor Piping	37 - Rolls ea. 4' x 4' x 4'	11,900 lbs	20'
Cooling floor pipe chairs	3 skids 6' x 4'	6000 lbs	6'
Piping, & misc.		3000 lbs	15'
6 - Pallets of Calcium	4' x 4' x 6	13500 lbs	8'
		Approx. - 34,400 lbs.	

NOTABLE OPTION FOR EITHER SYSTEM:

30002E Computer control system for energy savings. Can be viewed at www.cimcorefrigeration.com and click on new technology 3000E
....**$ 37,250.00**

PRICE ADDER FOR ENHANCED OPERATION CONDENSER

1. **15 % more Tubes**
2. **4 Rows finned for added heat transfer area**
3. **Operate without water below 0 °C**

Price..**$ 14,761.00 GST Extra**

PRICE ADDER FOR CONDENSER FAN VFD OPERATION

1. **VFD CONTROLLER**
2. **5 – 20 ma TRANSDUCER**
3. **Electrical**

Price..**$ 4,761.00 GST Extra**

WATER TREATMENT SYSTEM

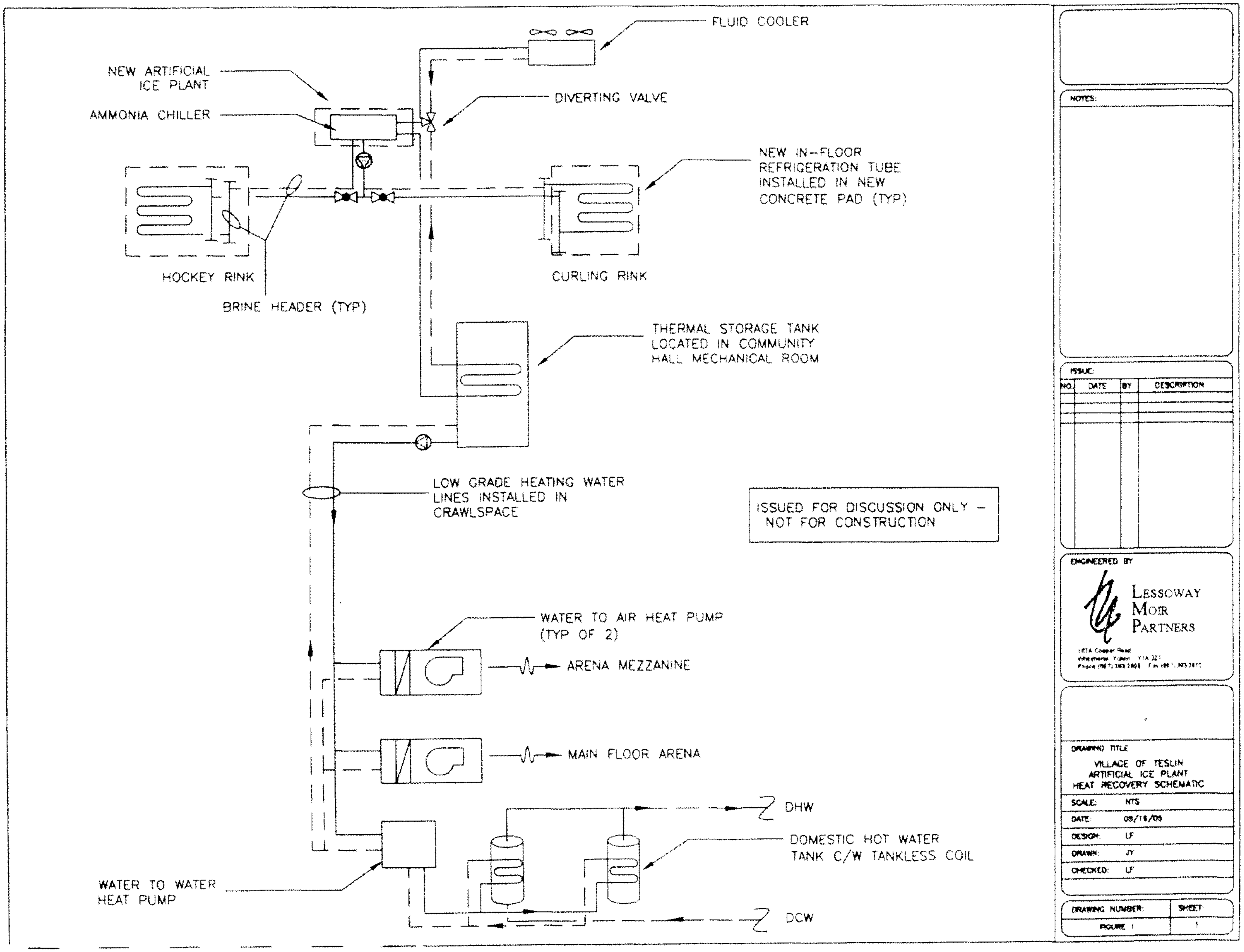
1. One (1) Water Treatment System and Chemical

Price..**$ 4,848.00 GST Extra**

THE FOLLOWING PAGES WILL PROVIDE INFORMATION IN REGARDS TO THE NEWEST DESIGN IN ENERGY RECOVERY AND MANAGEMENT. THE FEDERAL GOVERNMENT HAS RECOGNIZED THIS SYSTEM AS A CREDITABLE SOLUTION TO GREENHOUSE GAS REDUCTION AND WORTHY OF A GRANT.

APPENDIX E

HEAT RECOVERY SCHEMATIC



FLUID COOLER
NEW ARTIFICIAL ICE PLANT
AMMONIA CHILLER
DIVERTING VALVE
NEW IN-FLOOR REFRIGERATION TUBE INSTALLED IN NEW CONCRETE PAD (TYP)
HOCKEY RINK
CURLING RINK
BRINE HEADER (TYP)
THERMAL STORAGE TANK LOCATED IN COMMUNITY HALL MECHANICAL ROOM
LOW GRADE HEATING WATER LINES INSTALLED IN CRAWLSPACE
ISSUED FOR DISCUSSION ONLY - NOT FOR CONSTRUCTION
WATER TO AIR HEAT PUMP (TYP OF 2)
ARENA MEZZANINE
MAIN FLOOR ARENA
DHW
DOMESTIC HOT WATER TANK C/W TANKLESS COIL
WATER TO WATER HEAT PUMP
DCW
NOTES:
ISSUE:
NO. DATE BY DESCRIPTION
ENGINEERED BY
LESSOWAY MOIR PARTNERS
DRAWING TITLE
VILLAGE OF TESLIN ARTIFICIAL ICE PLANT HEAT RECOVERY SCHEMATIC
SCALE: NTS
DATE: 08/18/08
DESIGN: LF
DRAWN: JY
CHECKED: LF
DRAWING NUMBER: FIGURE 1
SHEET: 1

APPENDIX F
BUILDING PHOTOGRAPHS

F-1 ARENA

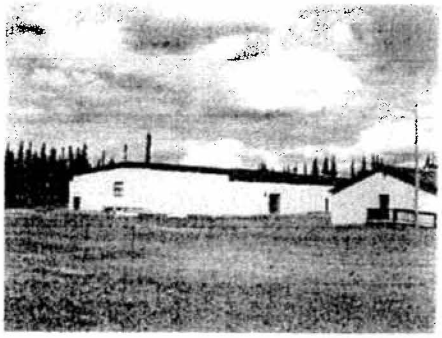


Figure 1 - Arena, Southwest Exposure

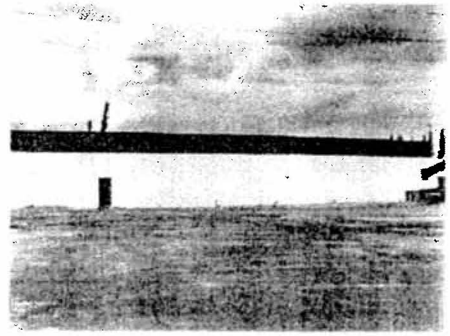


Figure 2 - Arena, Southern Exposure

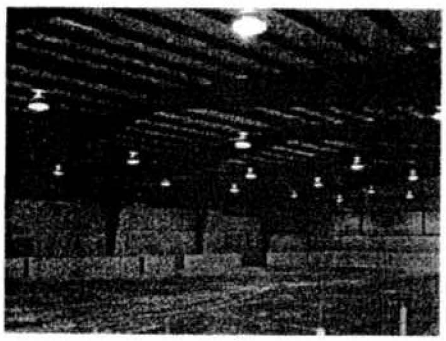


Figure 3 - Arena, Rink Area

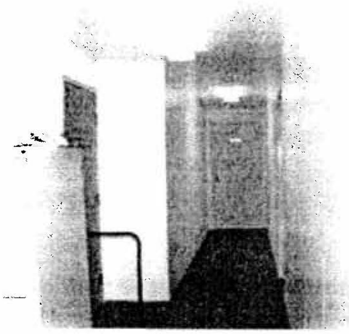


Figure 4 - Arena, Dressing Room Hallway

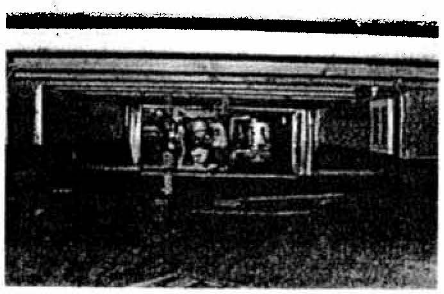


Figure 5 - Arena, Horizontal Propane Fired Furnace in Crawlspace

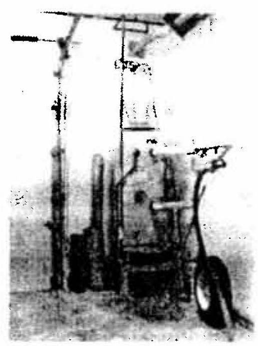


Figure 6 - Arena, Zamboni Room Water Heater

F-2 COMMUNITY HALL

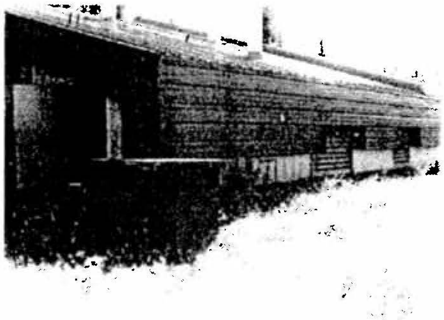


Figure 7 - Community Hall, Northwest Exposure at Mechanical Room

Figure 8 - Community Hall, Northwest Exposure

Figure 9 - Community Hall, Main Hall Entrance

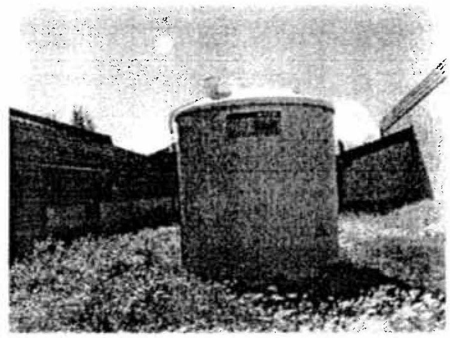


Figure 10 - Community Hall, Fuel Oil Tank

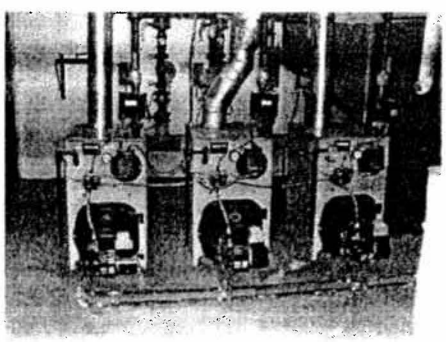


Figure 11 - Community Hall, Boilers

Figure 12 - Community Hall, Domestic Hot Water Heater and Decommissioned Gas Fired Furnace

F-3 CURLING RINK

Figure 13 - Curling Rink, Interior

Figure 14 - Curling Rink, Interior, Air Intake

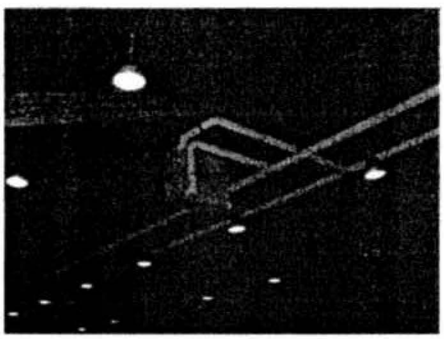


Figure 15 - Curling Rink, Unit Heater

Figure 16 - Curling Rink, Exhaust Fan

F-4 MUNICIPAL BUILDING

Figure 17 - Municipal Building, Eastern Exposure

Figure 18 - Municipal Building, Northeast Exposure

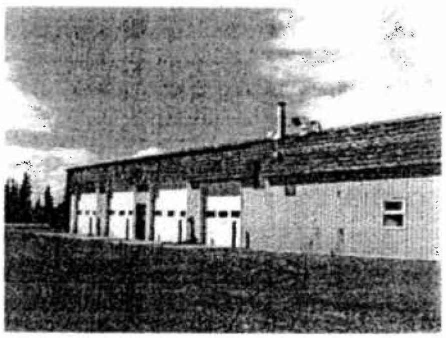


Figure 19 - Municipal Building, Southern Exposure

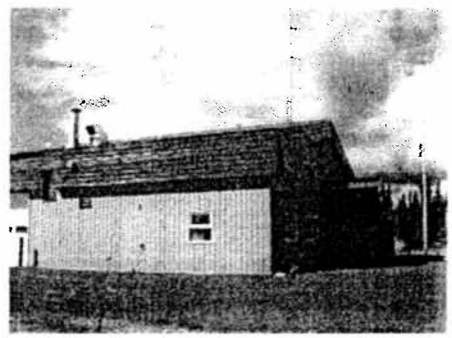


Figure 20 - Municipal Building, Southeast Exposure

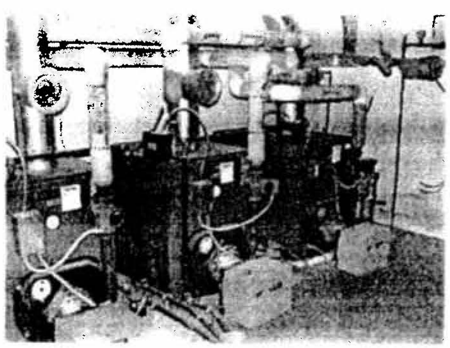


Figure 21 - Municipal Buidling, Boilers

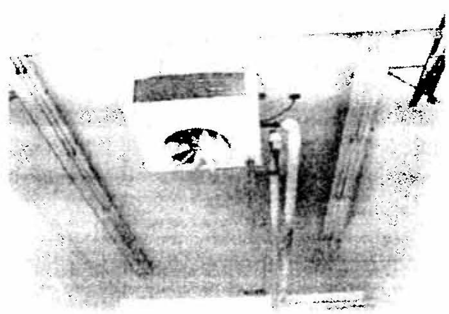


Figure 22 - Municipal Building, Typical Parking Bay Unit Heater

F-5 POST OFFICE/ BANK/LIBRARY

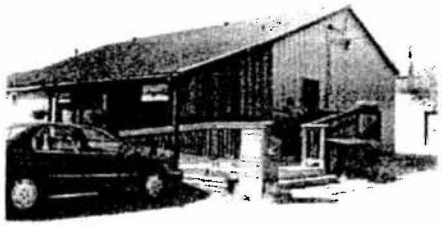


Figure 23 - Post Office/Bank/Library, Southeast Exposure

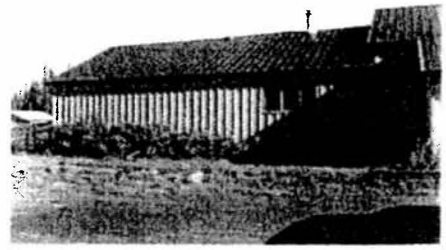


Figure 24 - Post Office/Bank/Library, Southern Exposure

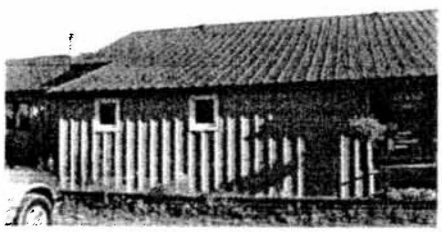


Figure 25 - Post Office/Bank/Library, Southern Exposure

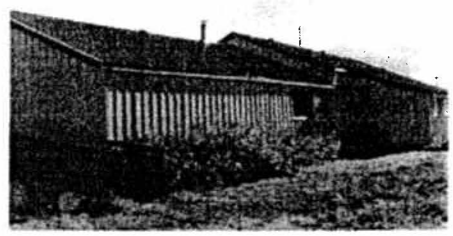


Figure 26 - Post Office/Bank/Library, Southwest Exposure

Figure 27 - Post Office/Bank/Library, Furnace

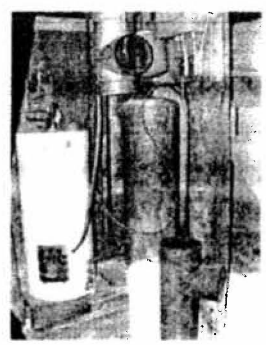


Figure 28 - Post Office/Bank/Library, Domestic Water Heater & Abandoned Chimney & Pressure Tank

APPENDIX G

ARENA LIGHTING CALCULATIONS

Teslin Arena Lighting

Proposed Measure:
Install High-Efficiency T8 Fixtures and Ballasts when Existing Fixtures Replaced

Estimated Additional Cost:
$6,888 for installation of T8 fixtures to meet the current lighting level
$11,512 for installation of T8 fixtures to meet an increased lighting level (40 fc) (fc = footcandles)
($22,680 for T8 fixtures less $11,168 for alternative of installing 400W MH fixtures = $11,512)

Estimated Savings:
$611 at the current light level, compared to using the existing 175W Metal Halide (MH) fixtures
$658 at an increased light level of 40 fc compared to using 400W Metal Halide fixtures

Payback:
10.5 years at current light level, and 420 hours of operation/year; 5.9 years at 1,260 hours/year
13.8 years at an increased light level (40 fc) & 420 hours of operation/year; 7.7 years at 1,260 hours/year

Project Description:
Install T-8 fixtures when existing fixtures are replaced and either maintain the existing lighting level or, alternatively, increase it to 40 footcandles. This can be done by:

- replacing 32 existing fixtures with 28 - 3 lamp T8 fixtures to maintain current light level, or
- replacing existing fixtures with 54 - 6 lamp tandem T8 fixtures to maintain an increased light level of 40 footcandles. (Savings are compared to the alternative of installing 32 400W Metal Halide fixtures.)

Notes:

This lighting design permits switching of 1, 2 or 3 lamps in each fixture so that there is much greater control over lighting levels.

Fixtures should have covers to retain heat and wire guards to protect against potential damage from hockey pucks.

"T8" or one inch diameter four foot long fluorescent lamps with electronic ballasts were introduced in the early 1980s, helping to significantly reduce lighting energy use in commercial and institutional buildings. (T8s are the "skinny" 1" fluorescent lamps. The older "T12" fluorescent lamps are 1-1/2" in diameter).

Manufacturers have continuously improved T8 performance and reliability. The product cost has also decreased. The recent (2002-3) development of high efficiency or "super" T8 lighting systems by three major lighting manufacturers is an improvement over existing T8s, older T12 lighting systems, and other alternative lighting systems. These new fluorescent lighting systems have improved system efficiency from approximately 85 lumens per Watt to closer to 100 lumens/Watt.

Additional advantages of high efficiency T8s over standard T8 systems include higher lamp lumen maintenance, that is, the lamps do not get nearly as dim with age. If long-life products are selected, an extended lamp life of 24,000 hours or more versus the normal 20,000 hours can be achieved. Savings can be achieved through the need for fewer fixtures, (since the lumens per Watt of electricity is higher) and/or through the use of low ballast-factor ballasts. Maintenance savings are achieved since lamps do not have to be replaced as often, and because fewer fixtures are needed to achieve the same lighting level.

Lighting Savings -- Teslin Arena

Conversion from Metal Halide (MH) to 4' High Efficiency T8 Fluorescent Fixtures

Case 1. Existing Lighting Level Maintained

Fixture	Energy Use (kW)	Number of Fixtures	Total Energy Use (kW)
MH	0.213	32	6.816
T8	0.083	28	2.324
Change			4.492
% Change			65.90

Savings

Demand Charge	7.38	/kW	
Energy Charge	0.137	/kWh	
Hours of Operation/year	420.00	hours/year	
Demand Saving:	$ 397.81	$ 397.81	(at 1260 hours/year)
Energy Saving:	258.47	$ 775.41	(at 1260 hours/year)
	$ 656.28	$ 1,173.22	

Capital and Labour Cost

28 fixtures @ $171/fixture:	$ 4,788.00
Labour @ $75/fixture:	2,100.00
	$ 6,888.00

Payback @ 420 hours per year	10.5	years
Payback @ 1260 hours per year	5.9	years

Conversion from MH to T8 Fixtures

Case 2. Lighting Level Increased to 40 fc

Fixture	Energy Use (kW)	Number of Fixtures	Total Energy Use (kW)
MH	0.458	32	14.656
T8	0.166	54	8.964
Change			5.692
% Change			38.84

Savings

Demand Charge	$ 7.38	/kW	
Energy Charge	$ 0.137	/kWh	
Hours of Operation/year	420.00	hours/year	
Demand Saving:	$ 504.08	$ 504.08	(at 1260 hours/year)
Energy Saving:	327.52	$ 982.55	(at 1260 hours/year)
	$ 831.60	$ 1,486.64	

Capital and Labour Cost

Tandem T8 Fixtures		Metal Halide Fixtures	
54 fixtures @ $270/fixture:	$ 14,580.00	32 fixtures @ $199/fixture:	$ 6,368.00
Labour @ $150/fixture:	8,100.00	Labour @ $150/fixture:	4,800.00
	$ 22,680.00		$ 11,168.00

Additional Cost to Achieve Savings	$ 11,512.00	
Payback @ 420 hours per year	13.8	years
Payback @ 1260 hours per year	7.7	years

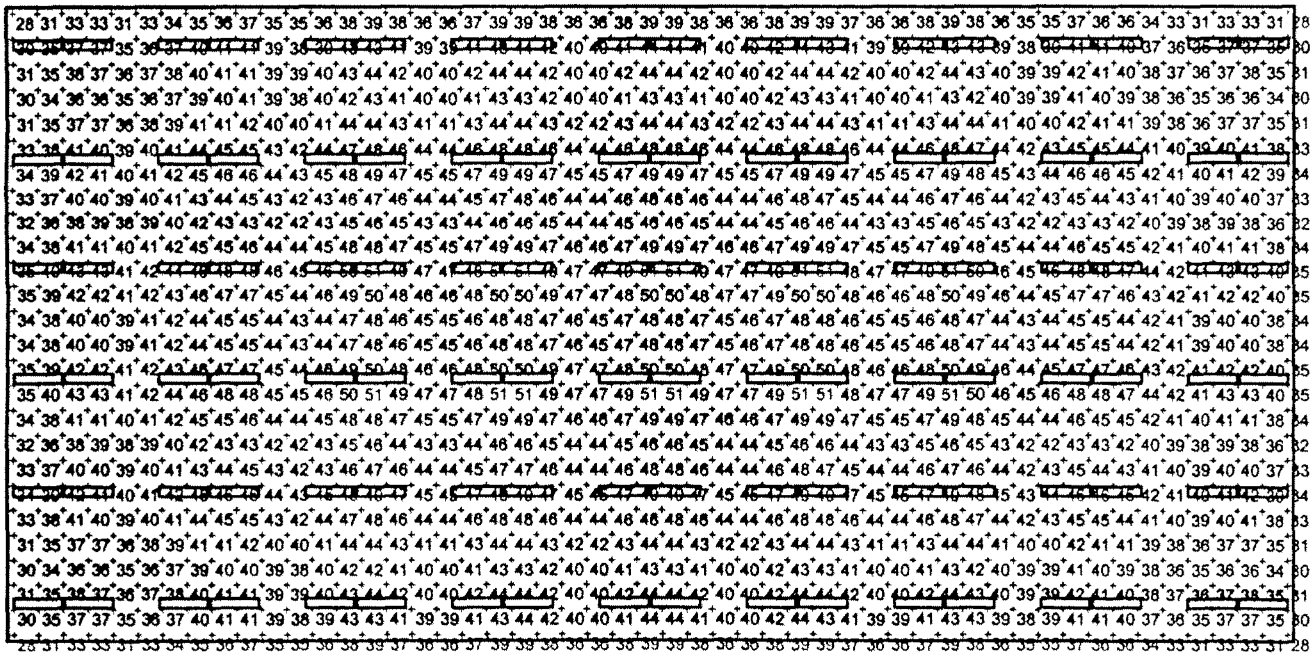
LUMINAIRE SCHEDULE

Symbol	Qty	Catalog Number	Description	Lamp	Lumens	LLF	Watts
	54	TMS8 3 32 SBL ND	MS8, 1 X 8, SIX LAMP, 32 WATT T8, NARROW DISTRIBUTION STRAIGHT BLADE WHITE LOUVER 4% UPLIGHT	SIX 32-WATT T8 LINEAR FLUORESCENT.	2900	0.75	166

SLS
20 Years
1985 - 2005
Division of SLS Group Industries Inc.

Reflectances 80/50/50%

Mounting Heigh - 18'



STATISTICS

Description	Avg	Max	Min	Max/Min	Avg/Min
0'AFF	42 fc	51 fc	28 fc	1.8:1	1.5:1

Calculated values include direct and interreflected components.

Teslin Ice Arena

Designer
Nikolay Smirnov

Date
Jul 14 2005

Scale

Drawing No.

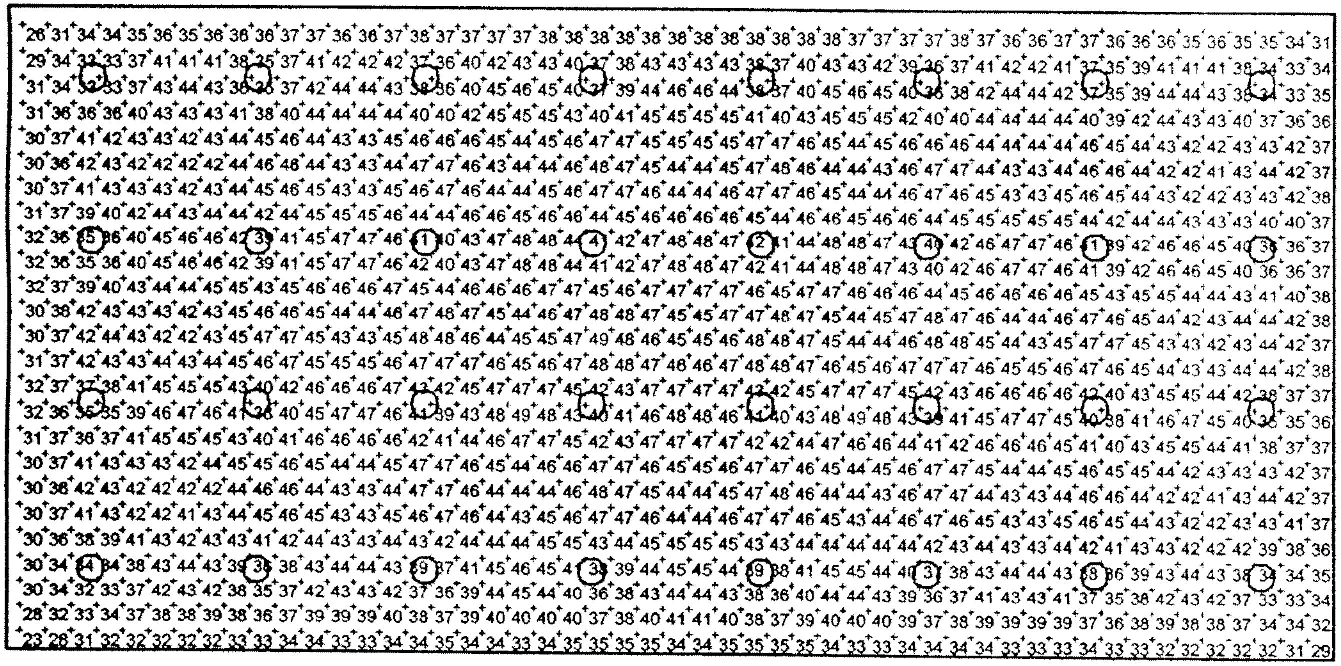
1 of 1

LUMINAIRE SCHEDULE

Symbol	Label	Qty	Catalog Number	Description	Lamp	Lumens	LLF	Watts
◯	A	32	THS 400M A16 (LEG 6,SC=1.6)	STANDARD ALUMINUM OPTICAL, 400 MH	ONE 400-WATT CLEAR BT-37 METAL HALIDE, VERTICAL BASE-UP POSITION.	36000	0.72	458

Reflectances 80/50/50%

Mounting Heigh - 18'



STATISTICS

Description	Avg	Max	Min	Max/Min	Avg/Min
Workplane	42 fc	49 fc	23 fc	2.1:1	1.8:1

Calculated values include direct and interreflected components.

SLS
20 Years
1985 - 2005

Ice Arena
Whitehorse, Yukon

Designer
Nikolay Smirnov

Date
Jul 12 2005

Scale

Drawing No.

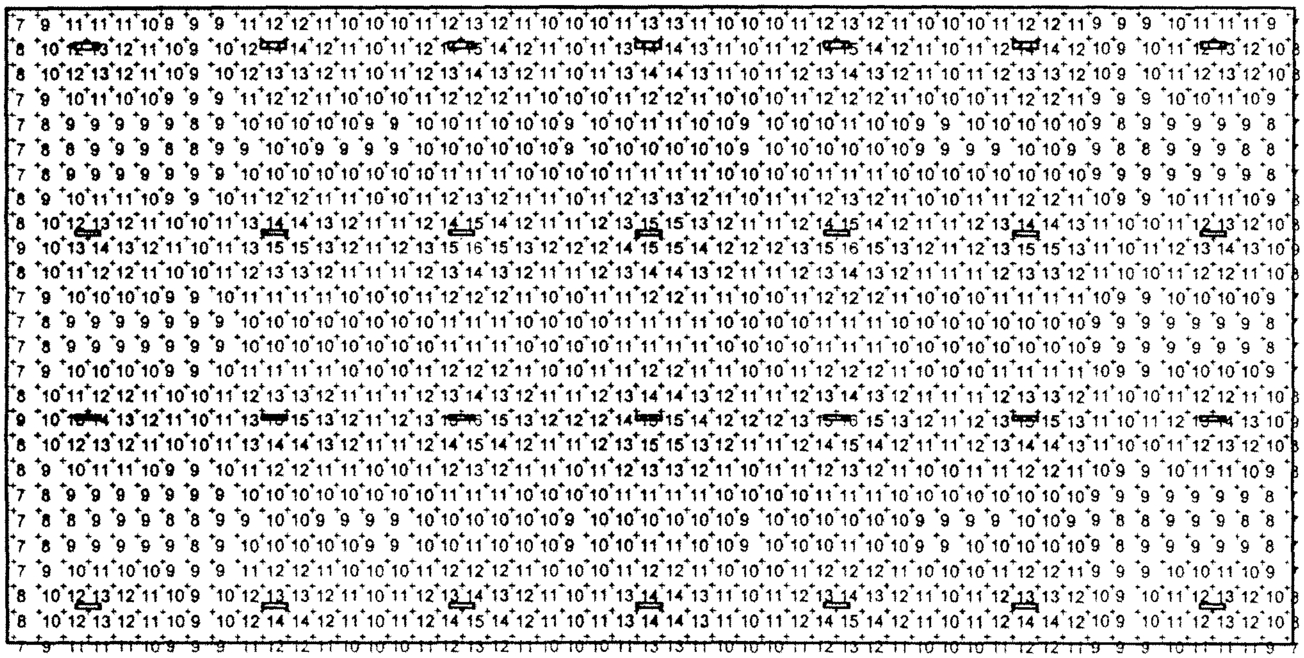
1 of 1

LUMINAIRE SCHEDULE

Symbol	Label	Qty	Catalog Number	Description	Lamp	Lumens	LLF	Watts
▯	LM-8	28	MS8 3 32 SBL ND	MS8, 1 X 4, THREE LAMP, 32 WATT T8, NARROW DISTRIBUTION STRAIGHT BLADE WHITE LOUVER 4% UPLIGHT	THREE 32-WATT T8 LINEAR FLUORESCENT	2900	0.75	83

Reflectances 80/50/50%

Mounting Heigh - 18'



STATISTICS

Description	Avg	Max	Min	Max/Min	Avg/Min
0' AFF	11 fc	16 fc	7 fc	2.3:1	1.5:1

Calculated values include direct and interreflected components.

SLS 20 Years 1985 - 2005 Division of SLS Group Industries Inc.

Teslin Ice Arena

Designer
Nikolay Smirnov

Date
Jul 14 2005

Scale

Drawing No.

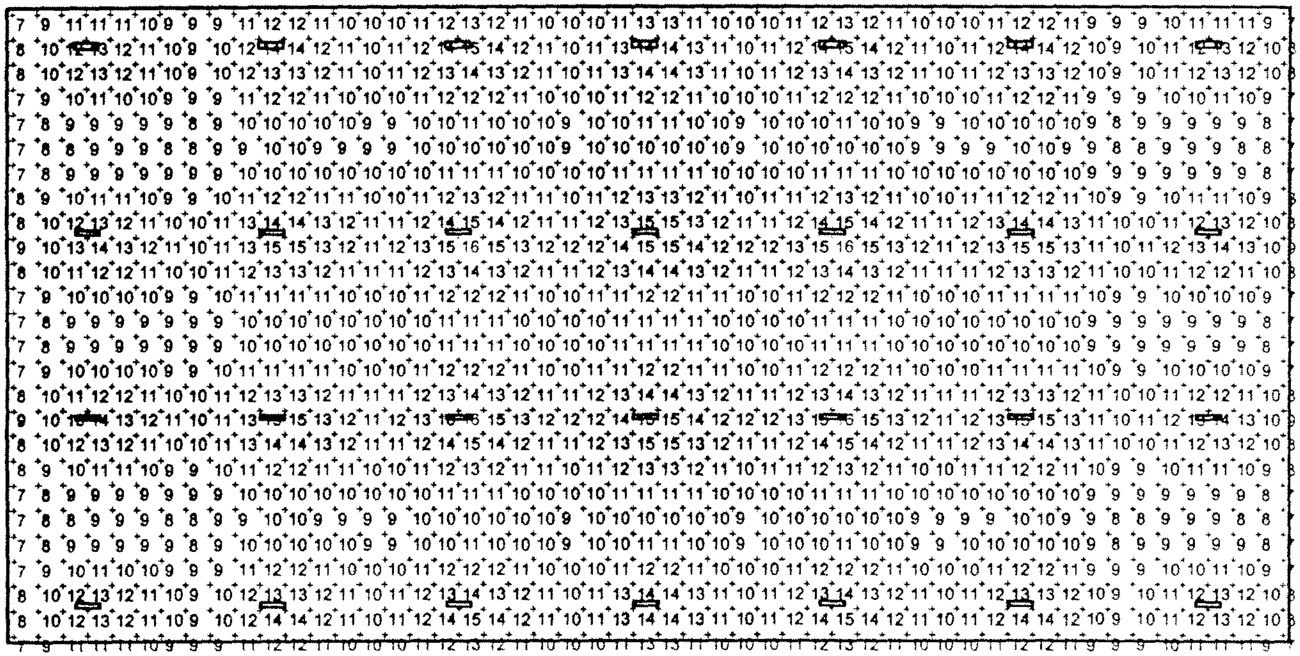
1 of 1

LUMINAIRE SCHEDULE

Symbol	Label	Qty	Catalog Number	Description	Lamp	Lumens	LLF	Watts
▯	LM-8	28	MS8 3 32 SBL ND	MS8, 1 X 4, THREE LAMP, 32 WATT T8, NARROW DISTRIBUTION STRAIGHT BLADE WHITE LOUVER 4% UPLIGHT	THREE 32-WATT T8 LINEAR FLUORESCENT	2900	0.75	83

Reflectances 80/50/50%

Mounting Heigh - 18'



STATISTICS

Description	Avg	Max	Min	Max/Min	Avg/Min
0' AFF	11 fc	16 fc	7 fc	2.3:1	1.5:1

Calculated values include direct and interreflected components.

SLS
20 Years
1985 - 2005
Division of S.S. Group Industries Inc.

Teslin Ice Arena

Designer
Nikolay Smirnov

Date
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1 of 1