

PROPOSED AGENDA 4/20/11

Meeting of the Gunn Memorial Library Geothermal Transition Committee

Topics to be covered by Peter Tavino PE

### **Description of Current Water Loop System:**

15 heat pumps throughout library with nominal tonnage of 37.5

(1 ton = 12,000 btu per hour.)

For heating dominant condition:

Heat pumps are sourced with circulated preheated fuel oil warmed, hot water.

Water to water Heating Capacity by today's standards =  $39800/36000 = 110\%$ .

(At 68 degrees Entering Water Temperature, and probably much hotter in effect)

For 20 year old equipment, estimate  $105\% = 37.5 \times 1.05 = 39.4$  tons = 472,500 btu/hr.

Rule of thumb: 3 ton nominal, 30,000 btu/hr. heating capacity handles a 1500 sq. ft house. Expect a 10,000 sq ft library to use  $(30/1.5) \times 10,000 = 200,000$  btu/hr peak heat loss at 0 to 10 degrees outside temperature. So existing system has  $472.5/200 = 2.4$  times needed Heating Capacity. Depending on actual heat loss calculation, to verify 200,000 btu/hr or not, 1989 system was probably oversized for future conversion to ground source.

Design Cooling in Washington, CT is always less than Heating, and heat pumps meeting heating capacity, have adequate cooling capacity as will be addressed after heating design.

### **Existing System Condition**

A.E. Olsen Service America has maintained the 15 heat pumps under its June 26, 1998 Service Agreement.

The efficiency of the 22 year old equipment must be determined so that the Committee can decide if capital investment should be made in replacement equipment at this time. Heat pump efficiency is determined by computer program called the VIP (Verification of Installed Performance) Sample printouts will be distributed.

Each of the existing 15 heat pumps would be analyzed by Peter Tavino PE and a qualified heating technician. Required measurements under 20 minute operating conditions include: Entering and Leaving Loop water temperature. Coil temperatures, duct air entering and leaving temperatures, and water and static air pressures at each. (This will be simplified if Pete's ports {P/T = pressure / temperature} were installed.) Amperage must be measured for each compressor and fan. These are compared to water

flow in gallons per minute. The VIP excel sheet computes these data and provides a resulting Coefficient of Performance (COP). For newly installed systems, the COP must be within 85% of rated COP to receive a CL&P rebate.

## Options

Once the 15 COPs are determined, the Committee can compare them to COPs of brand new two stage heat pumps, and decide if the old units should be removed and replaced with newer ones. If only a few are not performing efficiently, only they would be replaced. If all are acceptable, perhaps none need replacement. If an existing unit performs at COP 2.9 and a new unit would perform at 4.0 under similar conditions, the expected electricity saving can be compared to the cost of replacement.

During the VIP measurement program, the technician can report observations of any minor repairs needed.

With this final VIP report, total system Heating Capacity at 32 degree entering water temperature will be known. The vertical borehole design can be finalized for total depths and btu/ hr required from the bedrock.

A preliminary analysis of the Heating Capacity of the existing ClimateMaster heat pumps without preheated loop water shows that for Entering Water Temperature of 32 degrees during peak heating season, a 3 ton unit has Heating Capacity of 25,700 btu/hr =  $25.7/36 = 71\%$  of nominal tonnage. For 20 year old equipment, consider 65% of nominal tonnage.  $37.5 \text{ tons} \times 0.65 = 24.4 \text{ tons} = 292,500$ .  $292.5/200 = 1.46$  or 46% more than needed if peak heat loss is 200,000 btu/hr.

Whether a large water to water heat pump is needed to preheat loop water can be determined. See the GeoFurnace Manufacturing page 67 sent to Dan Whalen for specs on a 12 ton unit (actually side by side 6 ton units.) At 36 gallons per minute, a buffer tank would be required if all 15 units ran simultaneously at 3 gpm per ton =  $37.5 \times 3 = 112.5$  gpm. Buffered water rather than hot or chilled water opposite of season is preferred.

The capacity of the existing basement circulating pumps should be assessed to meet this flow versus a smaller flow for the oil warmed circulating loop water. Another benefit of the intermediate water to water unit is that the propylene glycol antifreeze for the boreholes would be limited to that loop and the single unit only. Interior circulating water need not be antifrozen, allowing better efficiency.

**Total cost in an ideal situation:**

VIP measurements with accessible P/T ports, etc. performed by a two technicians and Peter Tavino PE in one day	= \$2000
Energy Loss by ACCA method submittable to CCEF	= \$1000
Energy Audit with pre and post Blower Door Testing	= \$2000
Weatherization and sealing	= \$2000
Meeting with CL&P to discuss rebate formula and application of actual geothermal versus alternate upgrade	= \$500
Preparation of bid documents with prevailing wage requirements	= \$1500
Application to CCEF	<u>= \$500</u>

Total applied to rebates = \$9500

Rebate is \$1750 per ton from CCEF. If 12 ton unit installed = \$21,000

If 12 ton unit not installed, and boreholes only at 40% of 16.7 tons = \$11,690

CL&P rebate is separate but should be in the same range, depending on many factors to be discussed with Ian Russell. Say \$10,000 to \$20,000 average \$15,000.

CCEF and CL&P = \$30,000.

10% Federal Tax credit on all work not applicable to Library, but might be used by designer. Government buildings definition to be pursued.

**Engineer's Estimates pending actual low bids received.**

Cost of boreholes at \$23.00 per foot prevailing wage versus \$16 to \$18 normal 16.7 tons = 2500 LF	= \$57,600
Cost of new 12 ton unit	= \$20,000
Labor at prevailing wage to install unit	= \$10,000
Removal of Cooling Tower at prevailing wage	= \$5,000
Engineering Inspection and final applications	= \$1500
Replace 1 or 2 bad ClimateMasters	= \$10,000
Contingencies for interior & tower work	<u>= \$7500</u>
Total estimate	\$111,600
Minus rebates:	<u>- \$30,000</u>
Bottom Line	\$81,600
90% if designer tax credit available to Peter Tavino PEPC	= \$75,000