

NET ZERO – by accident!!

Central Maine Power (CMP) delivery service account detail.

September 2018 till /September 2019

GENERATION = 6430 kilowatts (kW)

USAGE = 4751 kW

1679 kW free power for CMP

Being a power provider was not our goal. It was to make our 1950's 3-bedroom ranch:

- More comfortable
- Have lower energy (oil & electricity) bills
- Have enough heated garage space for our 3 vehicles

prior to our retirement. What a pleasant surprise - \$12.46 monthly bill.

My career was working for a large wholesale distributor selling heating, ventilating, & air conditioning equipment; performing load calculations (Manual J), duct layouts (Manual D), radiant floor and hydronic piping designs for the customers.

Geothermal heat pumps were slow to penetrate the New England market. The perception was

“It’s too cold here” – **HOGWASH**.

My employer recognized a profit opportunity and since I was their designer, sent me to the International Ground Source Heat Pump Association (ISGHPA) certification training. Additionally, I attended Heat Spring Energy’s Design Series classes:

- 201 – closed loop
- 202 – open loop
- 203 – standing column well (SCW).

In 203 Dr. Albert Koenig taught the mathematics of standing column well.

- James Harrell (deceased), Lafayette PA, original designer, 1993 patent
- Carl Orio, Atkinson NH, in conjunction with the Army Corp of Engineers Cold Regions Labs made improvements
- Dr. Koenig, W. Conshohocken PA, through laboratory research and numerous field tests found the design formulas so bleed (dumping 10 to 20% of the well water flow to maintain water temperatures at or above 45°F during the coldest winter periods) is not required. His formulas are designed to maintain water temperatures of 48°F.

During these coldest winter periods, closed loop (horizontal trench or vertical bore) systems see entering water temperatures (EWTs) to the heat pump as low as 25°F. The colder the EWTs the lower the coefficient of performance (COP).

- Water to Air (W2A) – SCW is 30% greater
- Water to Water (W2W) – SCW is 32% greater

Well pumps are typically 3 horsepower and consume large amounts of power when running compared to fractional horsepower hydronic circulators. Closed loop systems use these circulators. The dilemma was how to make a closed loop system run at the high efficiency of a SCW.

EUREKA – heat transfer surface area

IGSHPA has specifications for the type of pipe that is approved – HDPE – same black pipe used for drinking water wells. We took the heat transfer data for this material, made minor adjustments to Dr. Koenig’s formulas and came up with our 5X1 down well heat exchanger. The design uses IGSHPA and National Sanitation Foundation approved materials. It is easily installed in the same size bore used for water wells.

BUT DOES IT PERFORM??

Measuring EWTs throughout the winter heating season showed a low of 46°F, not occurring until the first week of March.

When the energy star window upgrade started, we discovered our exterior walls had only R-7 fiberglass insulation. It was therefore decided to remove the exterior vinyl siding and install R-10 foam board over the plywood sheathing and wood siding. The attic had only R-11 fiberglass blankets between the ceiling joists. These were checked to insure they fit snugly and enough blown insulation was added to bring the value to R-49. The floor above the basement had no insulation, so R-30 was installed. The house had wall to wall carpet, which was removed. Legend Versa-Therm radiant floor panels were installed above the subfloor and covered with tile or engineered hardwood. Because of the high output of this panel, only 105°F water is required to maintain 70°F indoor temperature. Additionally, these panels are approved for chilled water, so the floors provide the winter heating and summer cooling. Domestic hot water is provided by a heat pump water heater. All appliances are electric.

CONCLUSION – without the geothermal system and it’s high EWTs provided by the 5X1 well exchanger, the solar panels would not have provided enough power.