

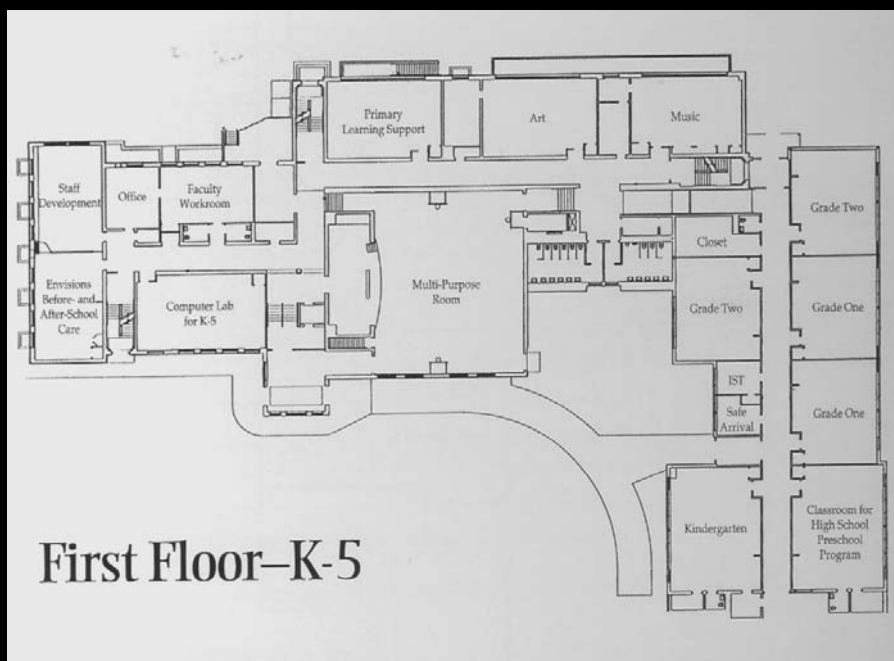
Neff Schools and the Geothermal Heat Pump Solution

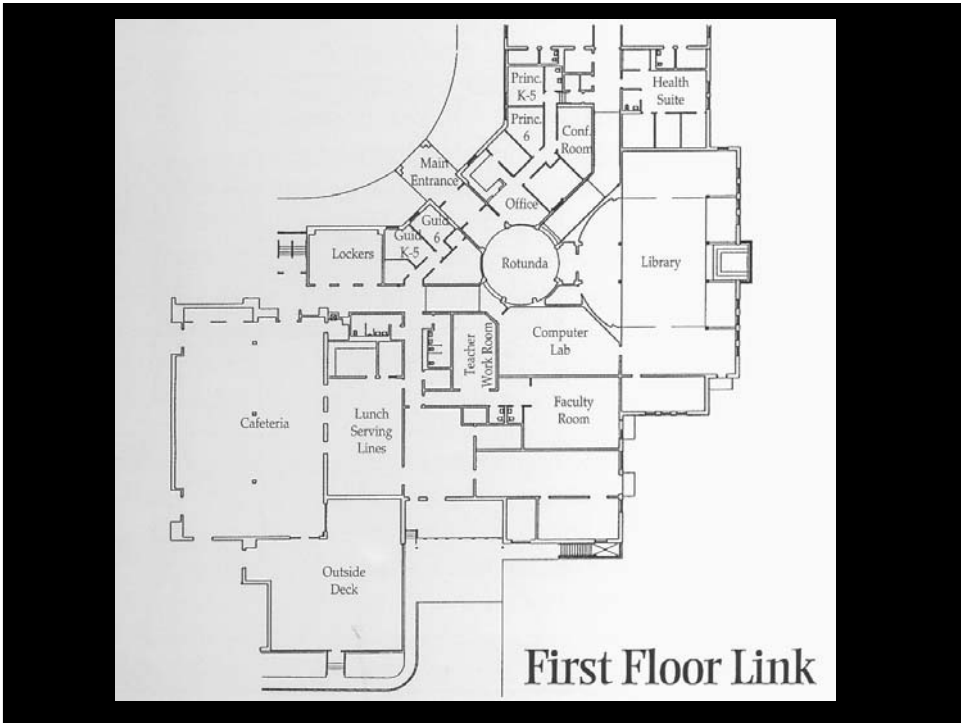
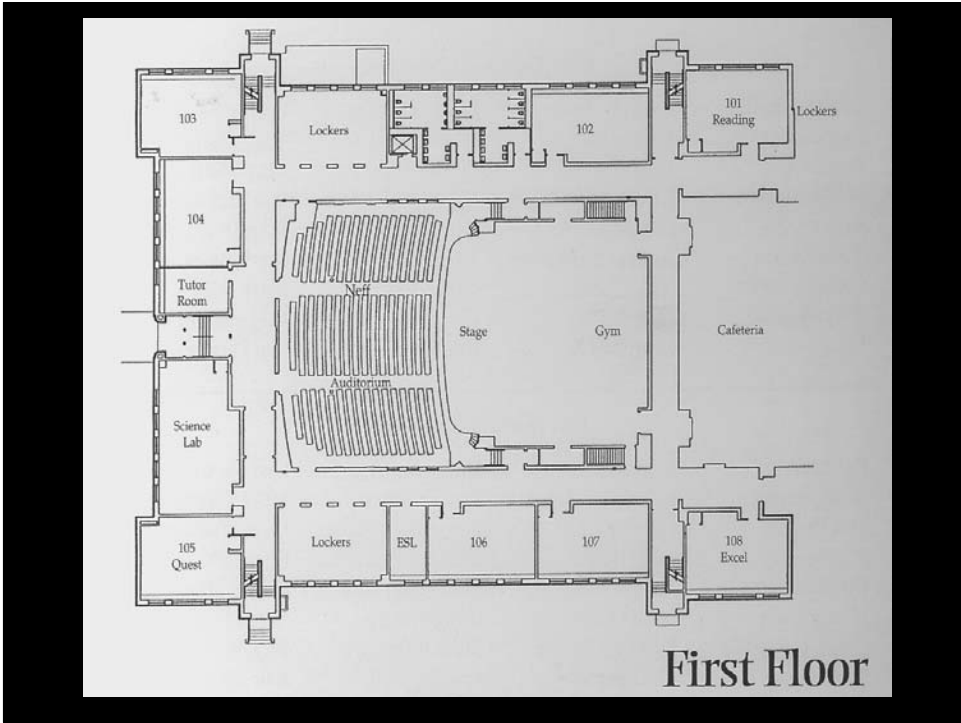
A presentation for:
Neighborhood Schools Committee
Pottstown School District

By:
David E. Anstrand, RA, REFP
January 19, 2010



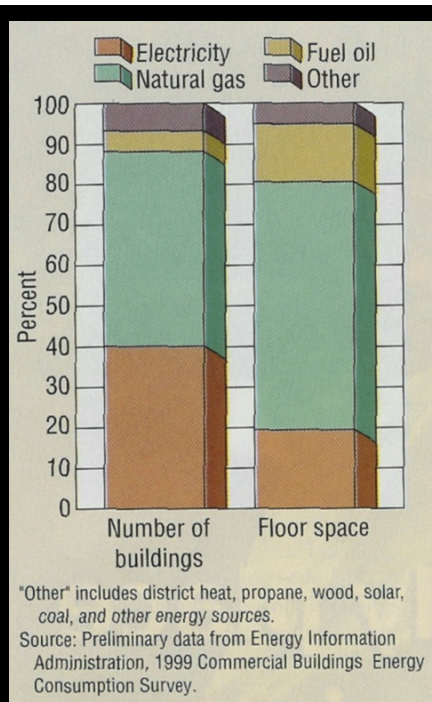
6th Grade School...Connector...K-5 School





John Henry Neff Schools

- 148,560 sf
- Serves as a 300 student K-5 and a 400 student 6th grade
- Two existing buildings were joined by a new “connector”
- Connector houses common facilities
- Completed in 1996



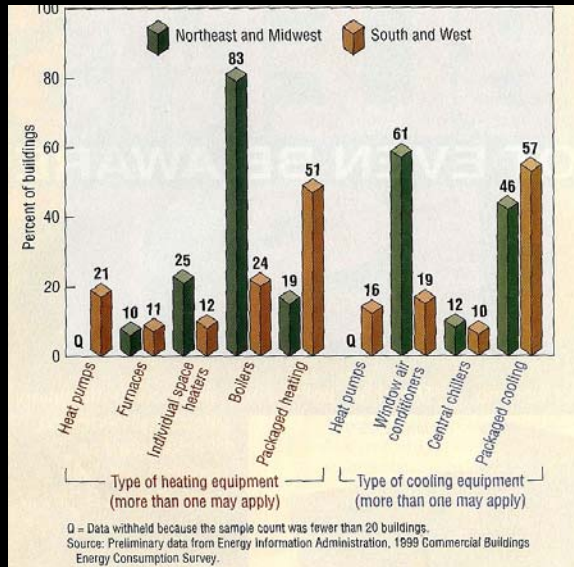
K-12 Heating Energy Source

...and Natural Gas prices have gone from what to what during the last year?

...on average \$6.61/1000cf last year to \$11.34/1000cf this year, a **72%** increase

Source: Exxon Mobil 2005 4th Quarter Report

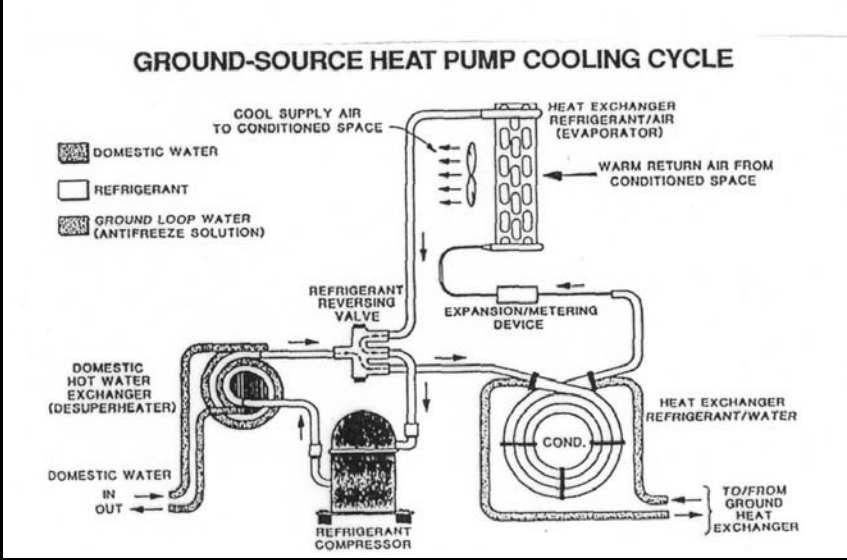
K-12 Buildings Heating and Cooling Systems



Water to Air Heat Pump



The Magic Box

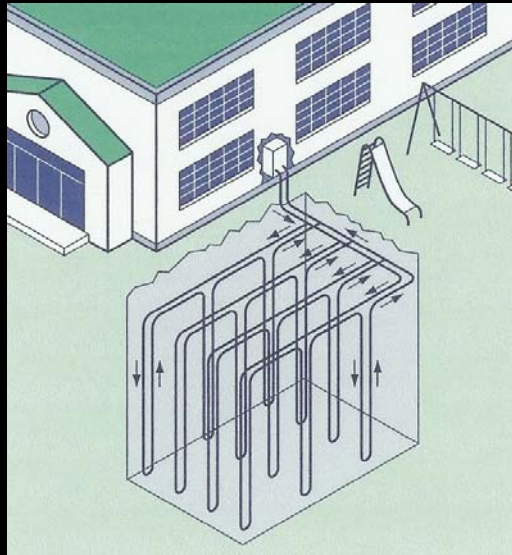


Geo Source well field. 140, 277 feet deep, bore holes organized into 20, seven bore hole circuits. The bore holes are on 15' centers.

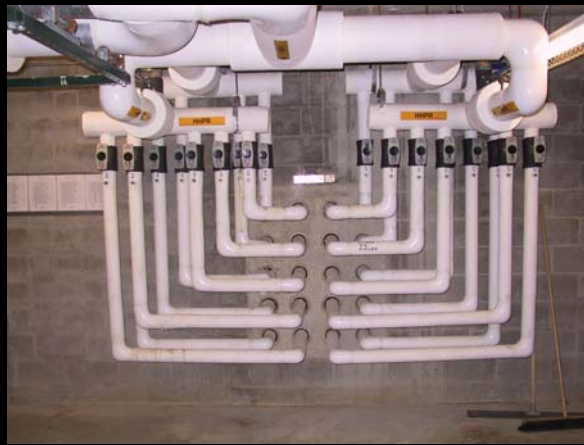


Circuits enter and leave the building under the snowy patch.

Well Field Diagram



Supply and return manifolds to and from the well field.
Both are located on the same wall of the pump room.



Valves to “partition” the well field



2-50 hp pumps to circulate building loop/well field water, only one operates at a time.

Variable frequency drive is used to control pump motor power.



Loop Pump Control

Loop water pumps are controlled by a variable frequency drive saving energy by varying the pump horse power from 15 hp to 50 hp

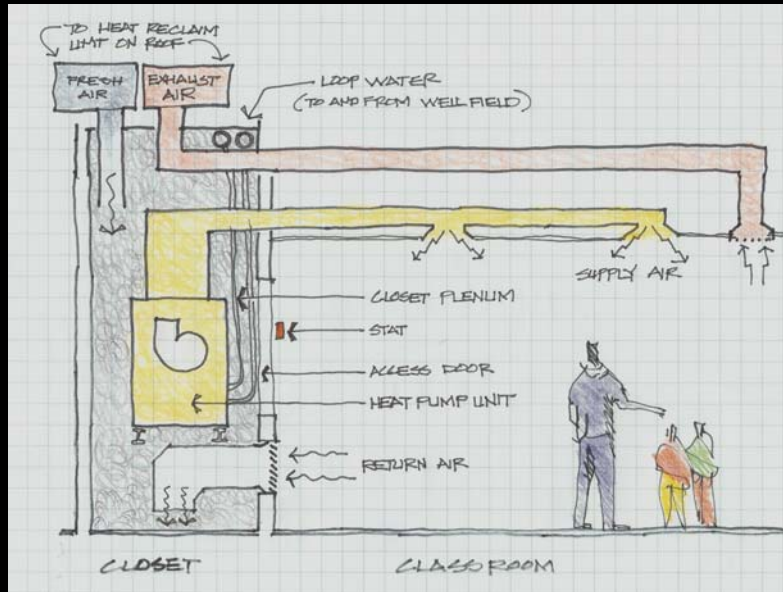


Heat Pump Closet

- Plenum
- Acoustically Treated
- Easy Access
- Ease of Servicing Components



Classroom HVAC System



Simple tempered air distribution – small duct run and two diffusers per 900 sf classroom



Exhaust air to heat reclaim unit. Fresh air from heat reclaim unit to the heat pump closet. System was designed to meet ASHREA 62-89



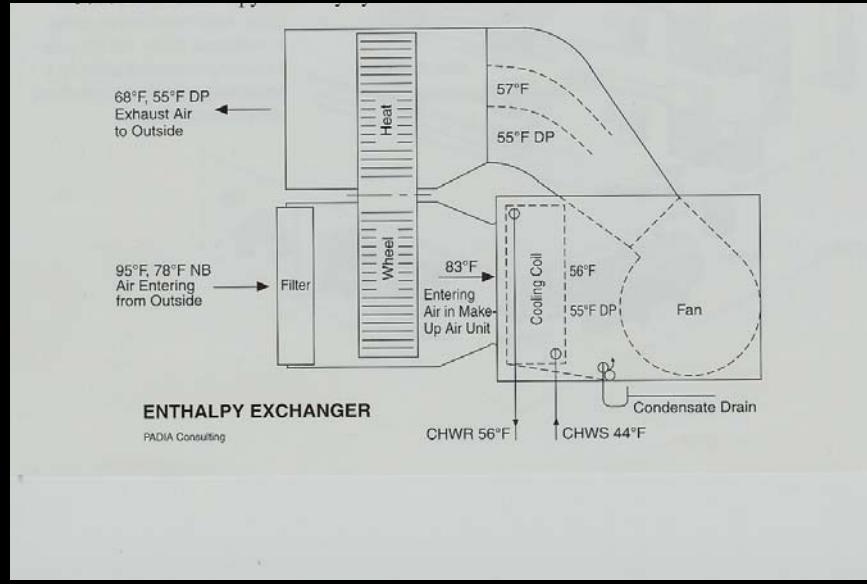
“You should be able to change filters with a maintenance or custodial person who has two donuts with their coffee every morning”



Desiccant wheel heat recover unit. Four roof mounted and this interior unit were used.



Heat Reclaim Unit



Neff Cafeteria



Three water to water heat pumps used to supply hot or chilled water to a conventional air handler supplying air to the cafeteria one level above.



Central DDC controller and incoming / outgoing loop temperature meter



Initial Research

- Electric utility company presentation at a school business officials' workshop
- Visit to Austin Independent School District
- Feasibility Study prepared by the project engineering consultant
- Visit to a heat pump manufacturer's plant in Waco, Texas
- Visit to Father McGivney High School outside of Toronto, Canada
- **Informed the Board of School Directors every step of the way.....no surprises!**
- Entered into a partnership agreement with our electric utility company

Feasibility Study to Compare Systems

- Standard four-pipe system with air cooled chiller and gas-fired boilers.
- Four-pipe system using direct-fired gas absorption chiller/heater.
- Geothermal heat pumps
- Closed loop water source heat pumps with gas-fired boilers and cooling tower.

8 Evaluation Criteria

- First cost
- Operational cost
- Maintenance cost
- Life cycle cost
- Environmental Impacts
- Operation and Maintainability
(comfort, control, flexibility and simplicity)
- Site and building impact
- Performance history

Board Accepted Our Mechanical Engineer's Recommendation

“... With the criteria and assumptions incorporated in this study and the recognition of inherent risk involved in an emerging technology, the recommendation is made to base the heating and cooling system around a high efficiency ground coupled heat pump system.”

What is a High Efficiency System?

- High efficiency water source heat pumps
- Variable frequency pump drive controls
- Partitioned well field
- Direct Digital Control
- Air to air heat recovery

How well does it work?

- Reduced maintenance during the past nine years.
- Seamlessly switches from heating to cooling (and visa versa).
- Indoor air quality is maintained.
- Individual control in each classroom (10 degree range)
- No in-ground fuel tank or outside cooling tower.
- Reduced requirements of central mechanical room space.
- The system is quiet.

Construction Costs

HVAC + Well field = \$ 13.69/s.f.

Note: 1995 Costs

Additional Considerations

- More extensive mechanical system electrical distribution
- Individual heat pump closet for each classroom/space (costs of door, frame, hardware, etc.)

Figure 3: Annual Energy Used per Building Square Foot (March 1997 - February 1998)

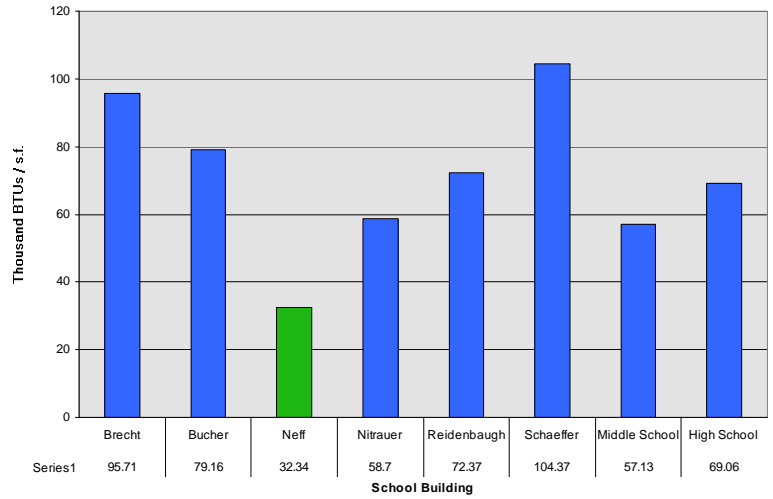
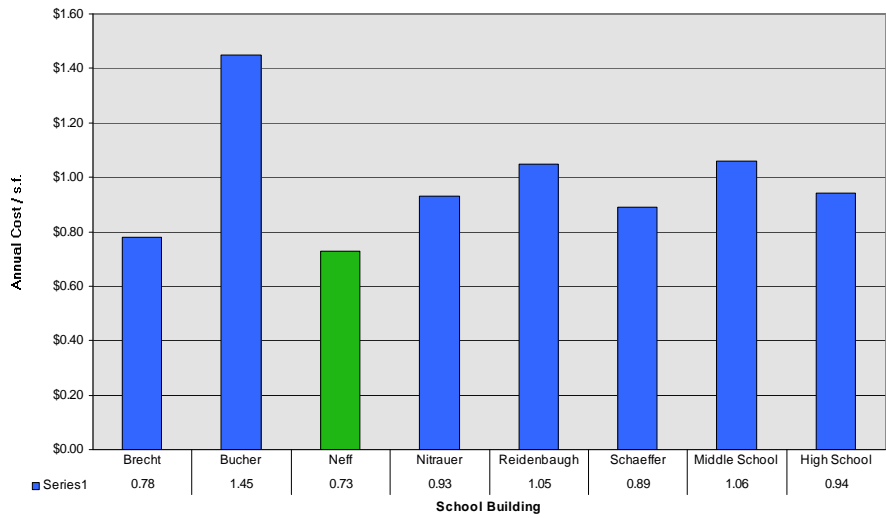


Figure 4: Comparison of MTSD Annual Total Energy Costs Per Square Foot (March 1997 - February 1998)



**Figure 5: Annual Total Energy Costs Adjusted to Neff Electrical Rates
(March 1997 - February 1998)**

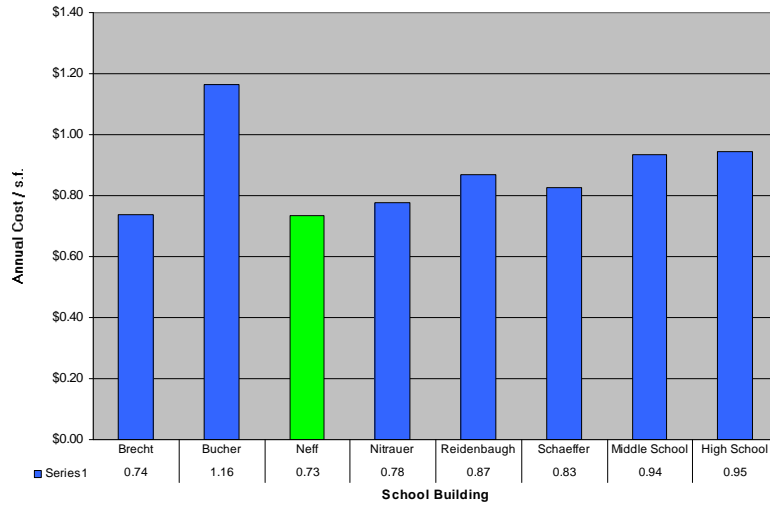
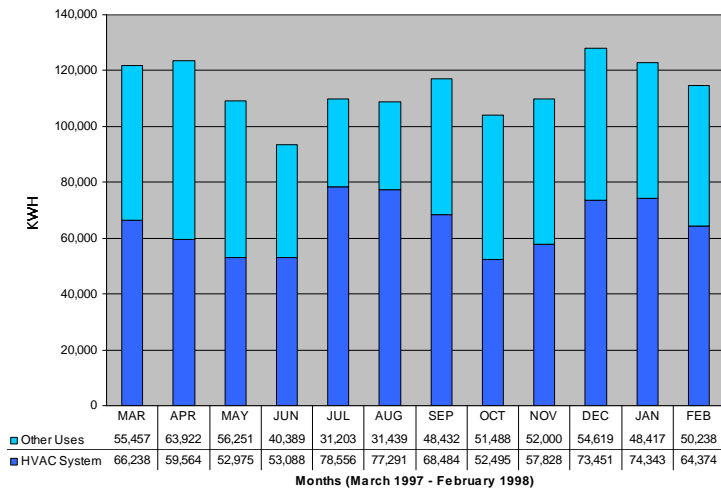


Figure 1: Neff HVAC Energy Use Compared to Total Electrical Energy



Questions?

