Executive Summary

The New Learning Center is a building at the Lutheran Theological Seminary at Philadelphia. It is a four level building including the basement. The existing mechanical system is a DOAS system with fan coils controlled by chilled and hot water. This is a very effective and efficient system, but this report explores other mechanical system possibilities.

The main goals put forth by the owner were to have a system that would fit into a small plenum height, have an energy efficient system to result in low emissions and yearly operation costs, and provide individual comfort and control for the occupants. The existing mechanical system was successful at all three parts, so the new design would attempt to make at least one portion even better.

To attempt to lower the energy consumption used by The New Learning Center, a geothermal system was examined. There were two alternatives, Alternative 1 sized the ground loop for the heating capacity and included a cooling tower for the extra cooling capacity needed and Alternative 2 sized the ground loop for the largest capacity, cooling, needed. The geothermal loop feeds the HVAC equipment. The heat pumps for individual control and the 100% outdoor air rooftop units all operate on the same heat pump loop.

The positives of a geothermal system are that it reduces yearly energy consumption, and therefore emissions and yearly operation cost, as well as the elimination for the need of boilers and chillers. The negatives include the increased size of electrical system, higher initial cost, and increased construction cost and time. The individual comfort and control is equivalent with the performance of the fan coil design. The one additional benefit is the geothermal designs have a fourth rooftop unit with the ability for dehumidification, which would address the current humidity issues in the basement zones.

After complete analysis, my recommendation to the owner would the implementation of the geothermal heat pump system with a cooling tower. The initial cost is higher and the electrical system costs an additional $2.20 per square foot, but the geothermal systems make up for it in energy consumption. Along with the lower operation cost, The New Learning Center will qualify for a tax rebate of $0.60 per square foot yearly by the Energy Policy Act of 2005. The geothermal heat pump system will save the owner over $725,000 in a 20 year life cycle cost and therefore would be my recommendation.