



# KPE

ENGINEERS • ARCHITECTS  
FORENSIC EXPERTS

*What differentiates KPE from other firms is KPE design professionals are also forensic engineering experts. Our staff use the lessons learned from investigating construction defects and the design errors of others to maximize the quality of KPE's own designs.*

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INSIGHT from Your Trusted Facility Design Team

## Centralized Geo-Exchange Heat Pump Plants

A geothermal or geo-exchange heat pump system is a heating and/or air conditioning system that uses the Earth's ability to transfer heat to and from the ground. The systems operate based on the stability of the underground temperatures. A geo-exchange system differs from a conventional furnace or boiler by its ability to transfer heat versus the standard method of producing heat. As energy costs continue to rise and pollution concerns continue to be a hot topic, geo-exchange systems may hold a solution to both of these concerns.

In a conventional geo-exchange heat pump system, multiple units with compressors are located throughout a building. A central plant system has a single unit or series of units located in a central mechanical room. The heart of the system is a heat recovery chiller/heater, a single unit that will heat the building in the winter, cool it in the summer, do both in the spring and fall. It can even preheat the domestic hot water if demand is high enough. A central plant can be connected to a two-pipe or a four-pipe building system and can also be coupled with a Variable Refrigerant Flow, also called Variable Refrigerant Volume (VRF/VRV) system. The air-side equipment consists of standard air handlers, unit ventilators or fan coils.



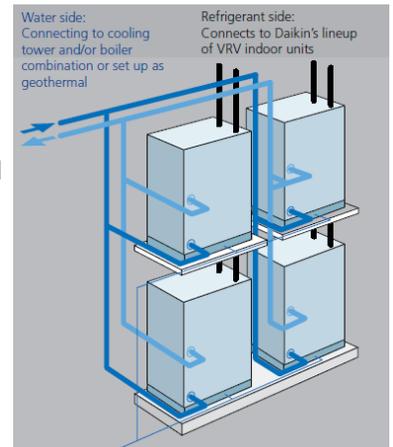
**Central Heat Pump Plant: 4-Pipe System**

In a four-pipe geo-exchange system, there is a set of pipes designated for each hot and chilled water supply and return. These pipes run to each terminal unit, allowing for either heating or cooling, depending on the set point of the space. The respective water supplies are routed through the small heat pump coils by two pumps in parallel to supply each unit with the correct amount of water depending on heating or cooling demand. The average energy efficiency ratio (EER) of a ground-source heat pump is 16 while the average rooftop unit has an EER of about 10.

In a VRF/VRV geo-exchange system, there is one pipe designated for supply and one for return on the geo-exchange water loop. Geo-exchange water loops exchange heat with the refrigerant loops within the central heat pump plant. The fan coils are connected to the large heat pumps via small refrigerant piping. The refrigerant volume is variably controlled so the exact amount of cooling or heating is provided to the space. Near each fan coil unit is a controller which switches the refrigerant from heating to cooling, depending on the set point and load of the space. The average energy efficiency ratio (EER) of a VRF ground-source heat pump is 17-18.

### Advantages of Centralized Geo-Exchange Systems

- ◆ Zones for comfort and controllability.
- ◆ Compressors in mechanical room and not above space means less noise.
- ◆ Service primarily located in mechanical room.
- ◆ Makes construction easier.
- ◆ With VRF, no water pipes in the thermal zones, only small refrigerant lines.



**Central Heat Pump Plant: VRF/VRV**

### KPE Centralized Geo-Exchange Projects:

- Davenport Community Schools—Davenport, IA
  - ◆ Adams Elementary (4-Pipe)
  - ◆ West High (4-Pipe)
  - ◆ Blue Grass Elementary (4-Pipe)
  - ◆ Sudlow Intermediate (VRF)
  - ◆ Young Intermediate (VRF)
- Iowa Public Employees' Retirement System (IPERS) — Des Moines, IA (VRF)
- East Mills Elementary School—Hastings, IA (VRF)
- Nebraska School for the Blind—Nebraska City, NE (VRF)

For more information on KPE, please visit our website [www.kpe-inc.com](http://www.kpe-inc.com).