

Geothermal Technologies Program 2010 Peer Review



Energy Efficiency &
Renewable Energy



HUMAN HEALTH SCIENCE BLDG GEO HEAT PUMP SYSTEMS

May 20, 2010

Principal Investigator

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Source Heat Pumps Demo Projects

This presentation does not contain any proprietary
confidential, or otherwise restricted information.

- **Timeline**

- Geothermal ground array bid package: April 2010
- Geothermal ground array construction: Summer 2010
- Main building construction begins: June 2010
- Substantial completion: Summer 2012
- Performance monitoring & reporting: 2012 through 2014

- **Budget**

- Total project: \$9,778,930
- DOE share: \$2,738,100
- Awardee share: \$7,040,830

- **Barriers**

(No funds received yet)

- Lack of experience with: Geothermal projects of this size, VRF heat pumps, large solar thermal systems, & desiccant cooling

- **Architect / Engineer:** Smithgroup

- **Construction Manager:** Christman Company

- **Geothermal Specialist:** Strategic Energy Solutions

Geothermal Heat Pump Demonstration

Utilize a ground sourced heat pump HVAC system.

Variable Refrigerant Flow Technology

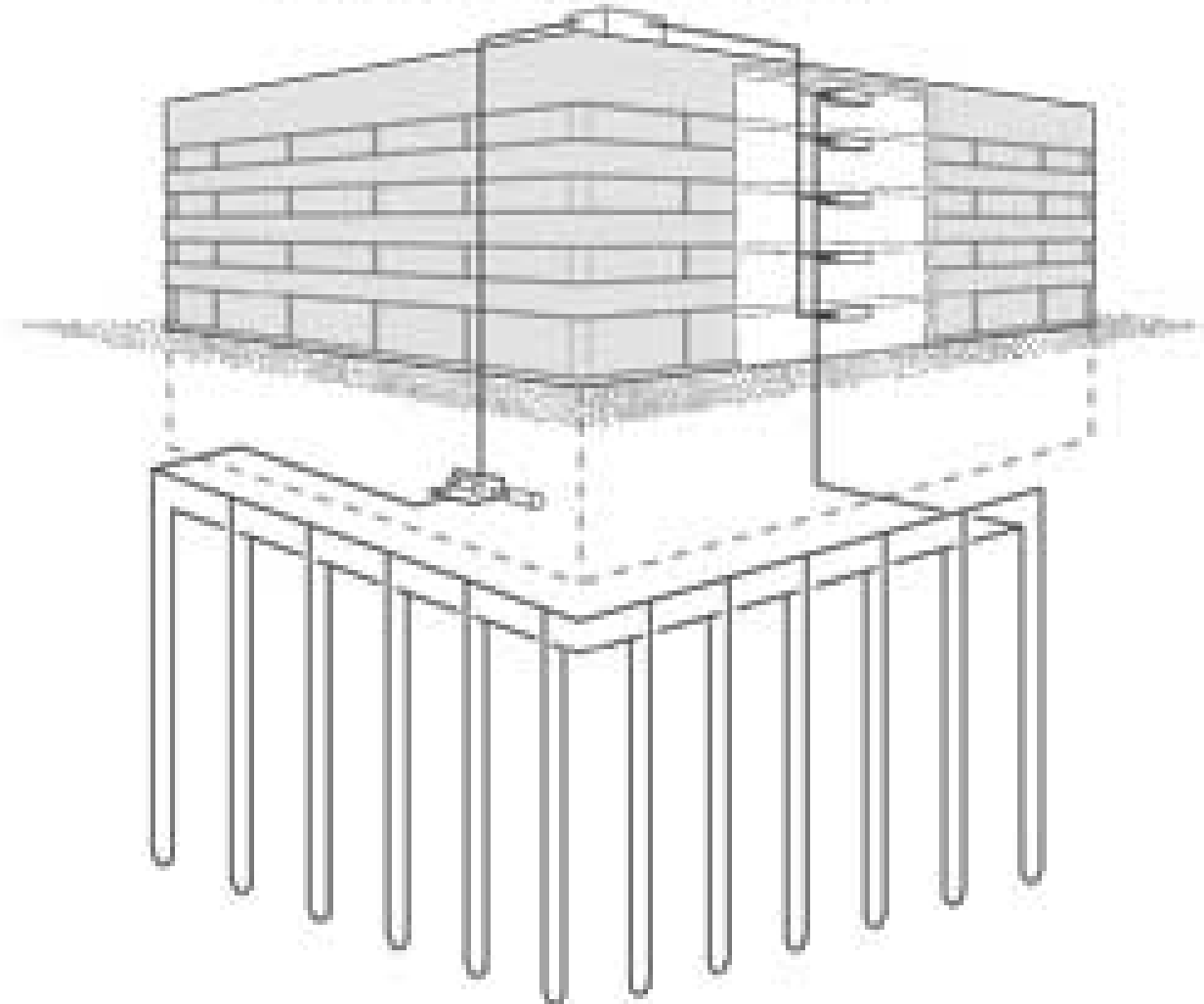
Utilize variable refrigerant flow (VRF) heat pumps, allows for less compressors and enhanced internal heat recovery.

Solar Thermal Desiccant Dehumidification

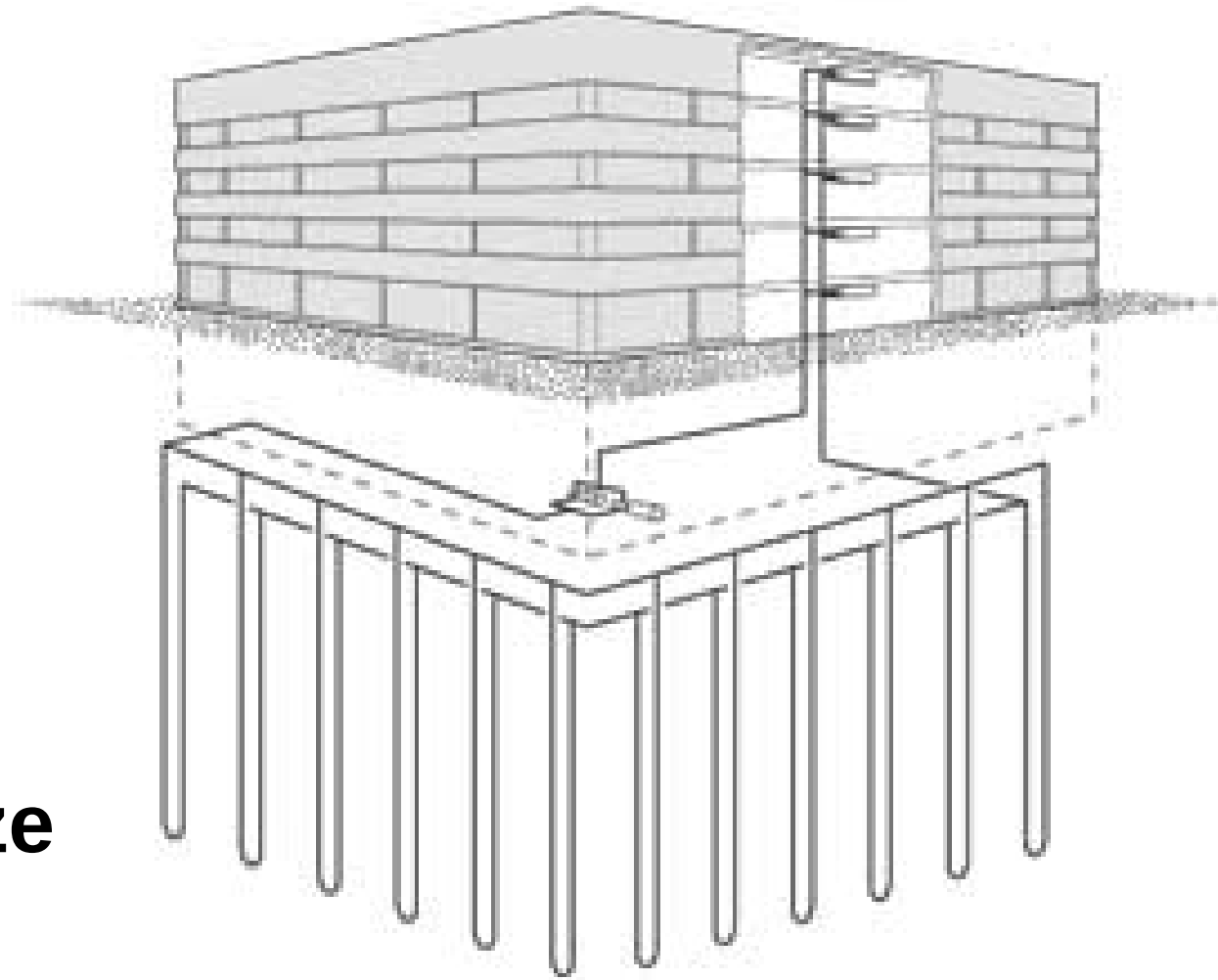
Dedicated outdoor air supply units will utilize a thermally regenerated desiccant dehumidification section. A large solar thermal system along with a natural gas backup boiler will provide the thermal regeneration energy.

Original Concept

Closed Hybrid Loop

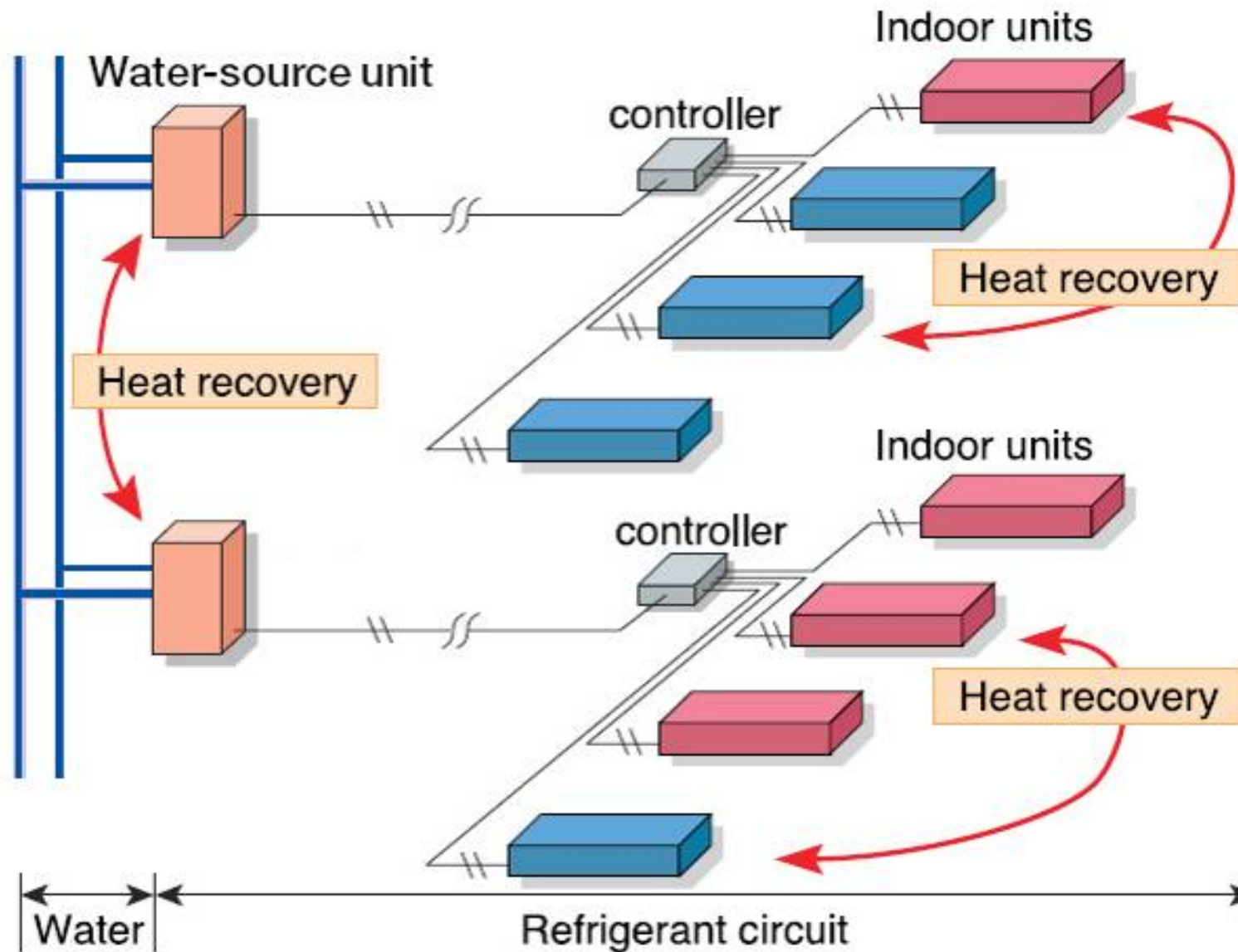


Closed Ground Loop

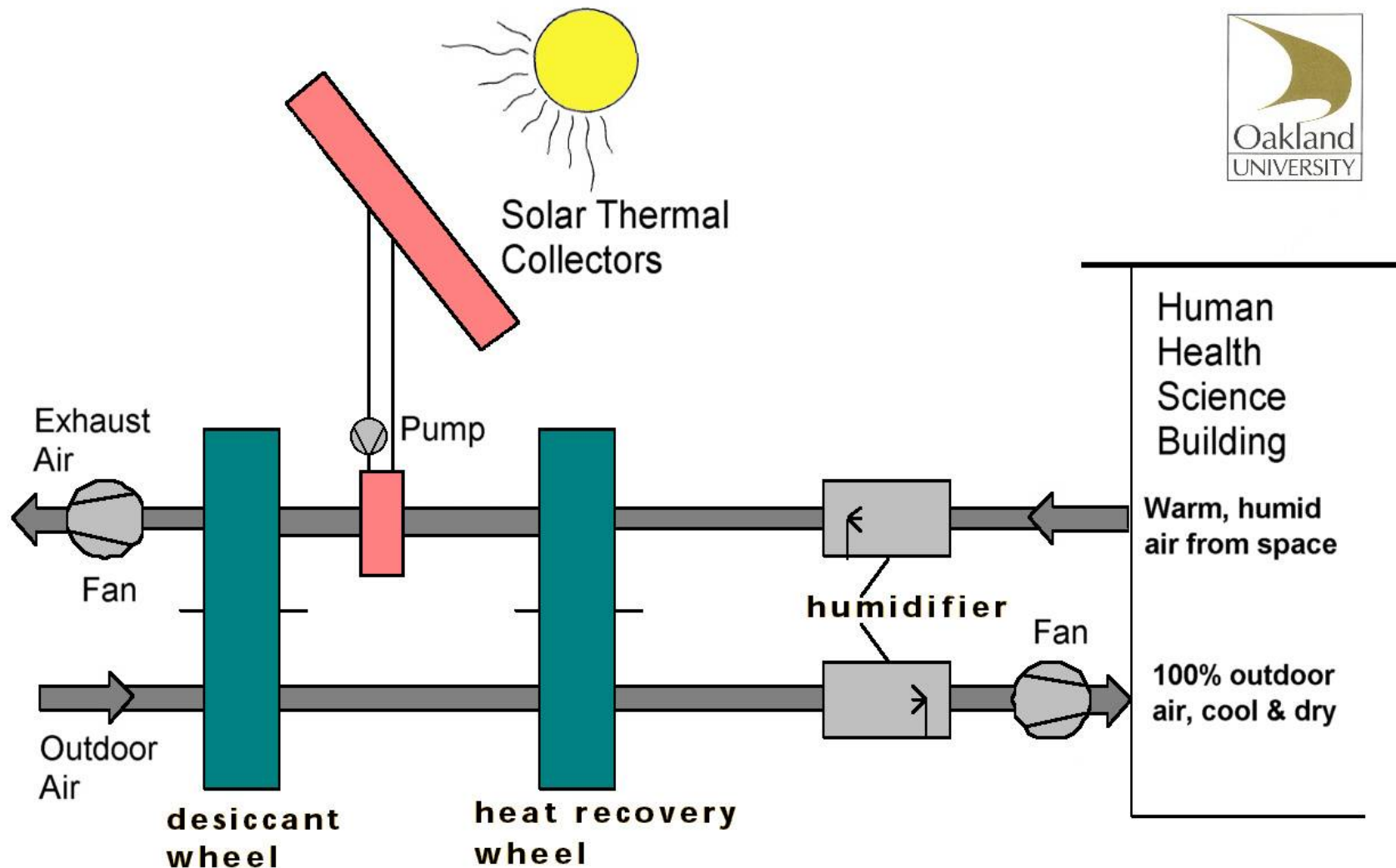


**Water
Only, No
Antifreeze**

Variable Refrigerant Flow

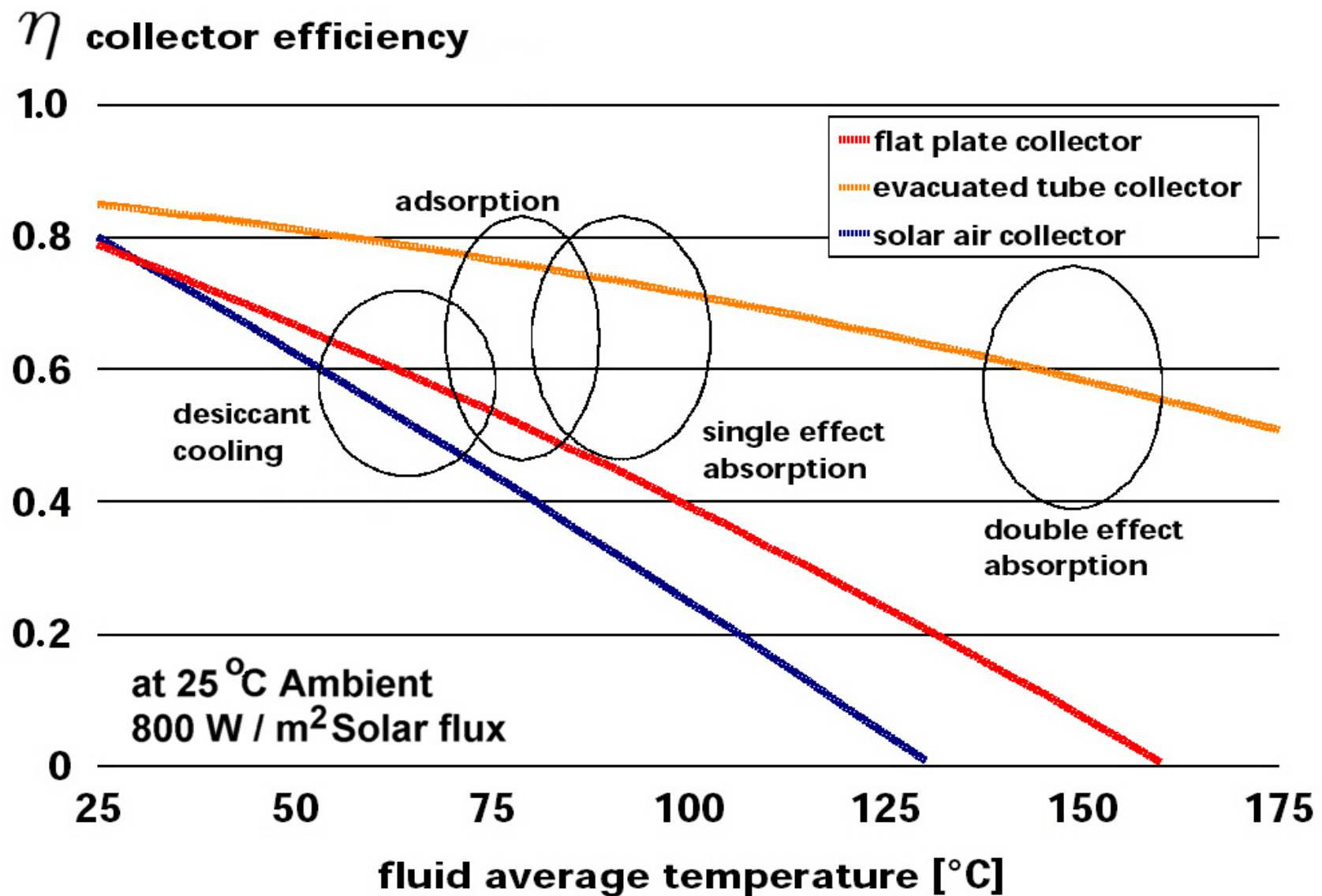


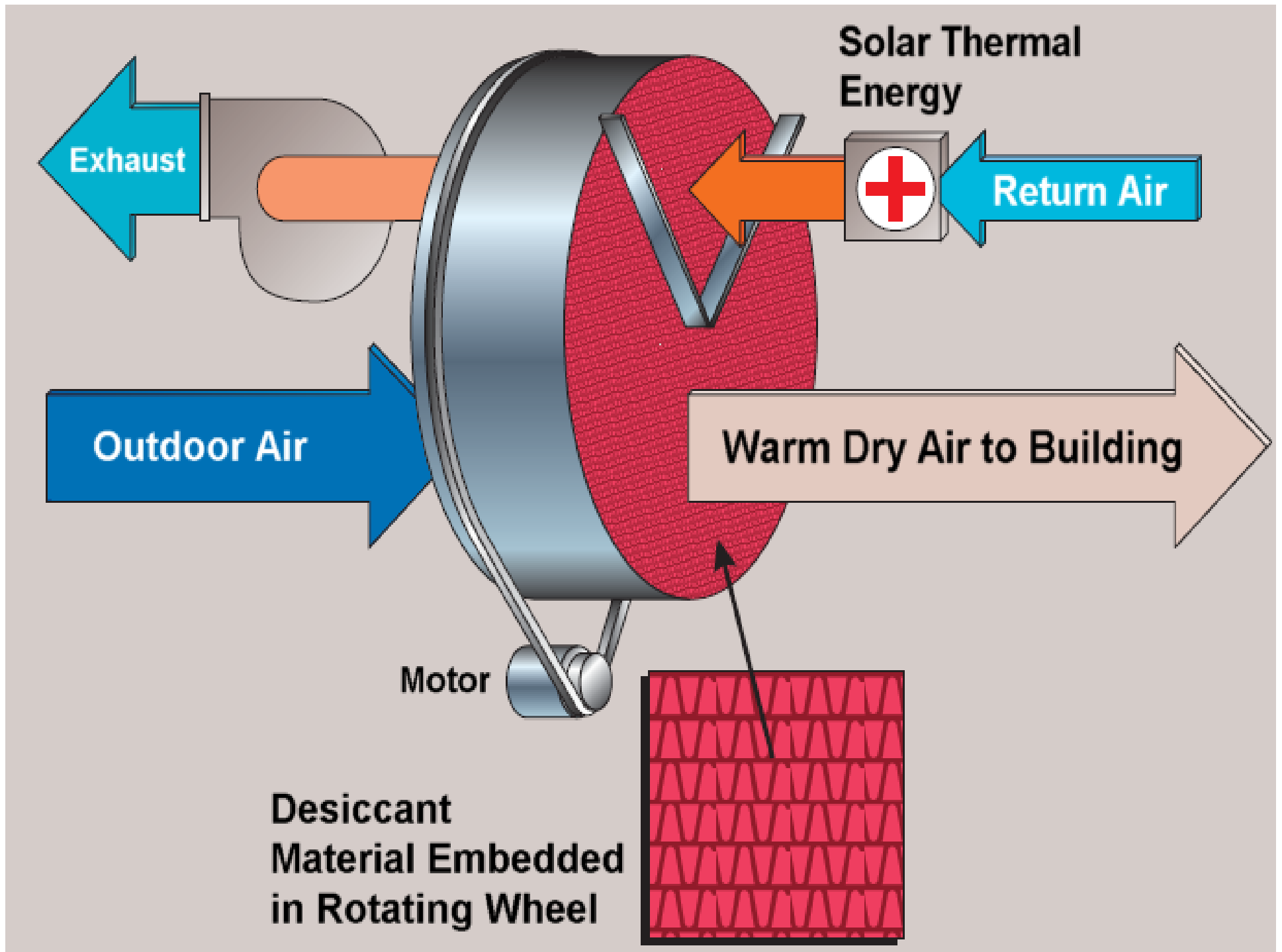
Solar Thermal Desiccant Cooling



Dedicated Outdoor Air Supply Unit

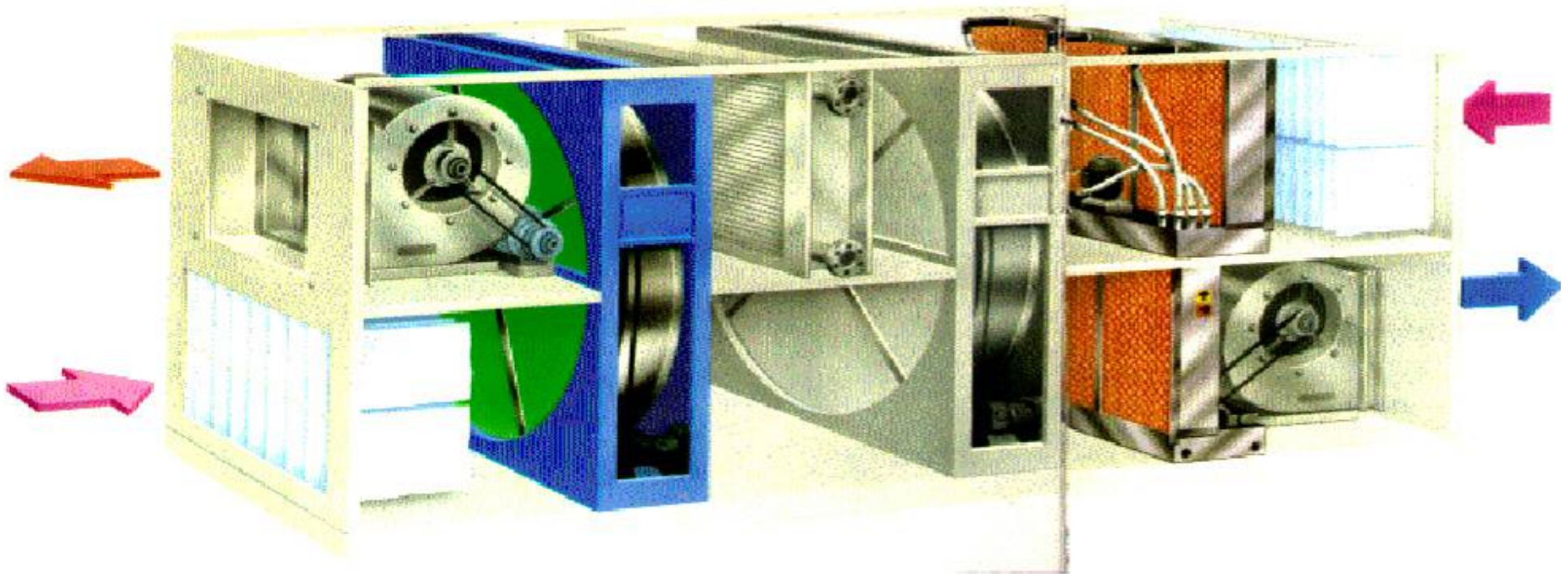
Choice of Thermally Activated Technology – Desiccant Cooling





Exhaust Air

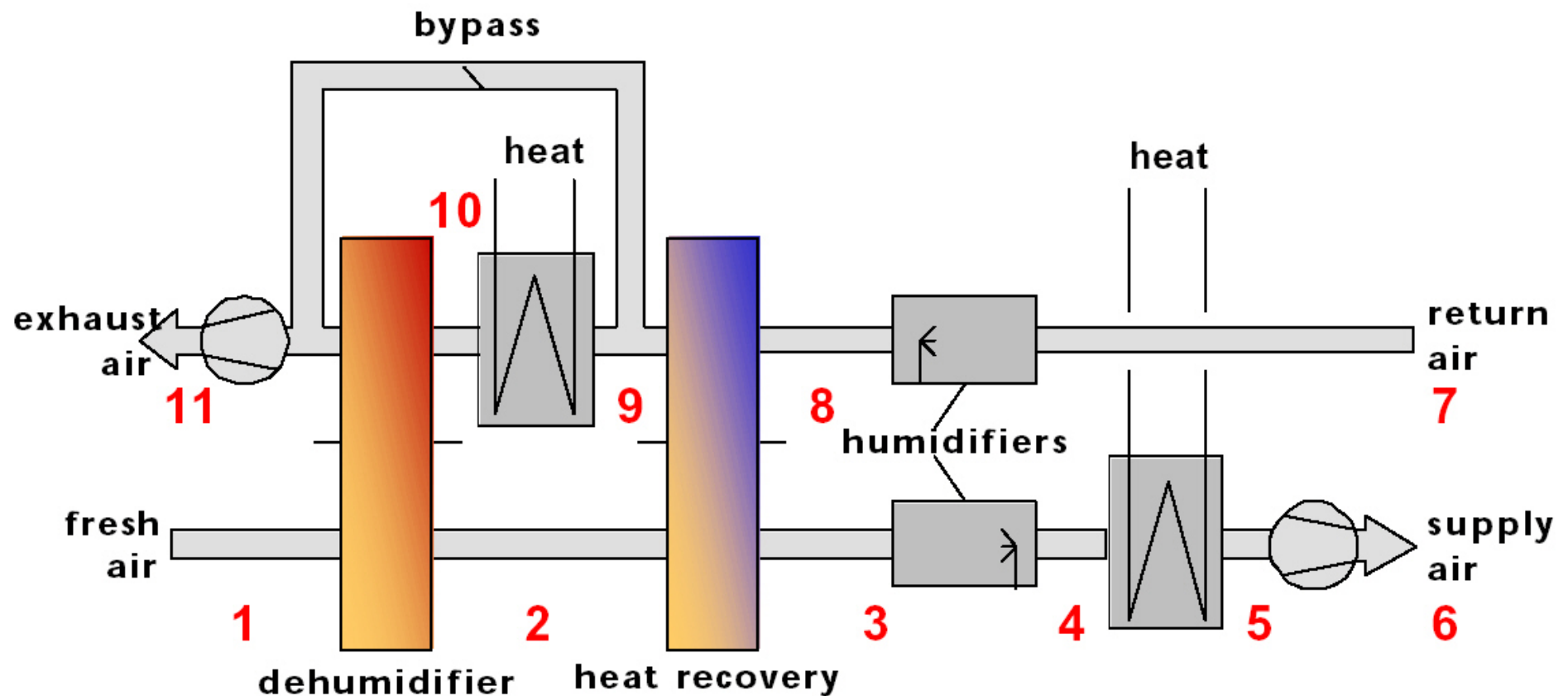
**Exhaust from
Space**



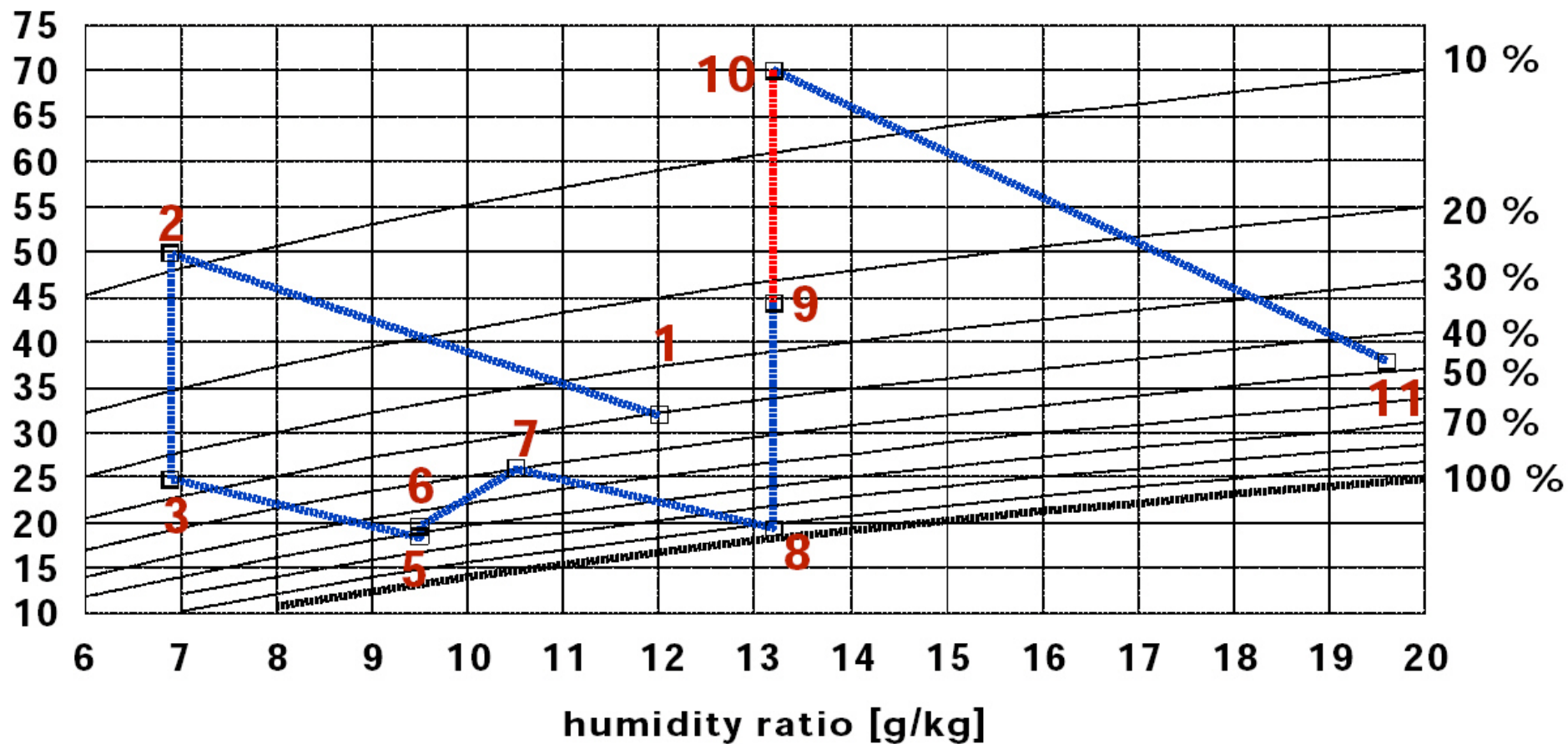
**Outdoor Air
Intake**

**Conditioned Air
to Space**

Technical Approach



temperature [$^{\circ}\text{C}$]





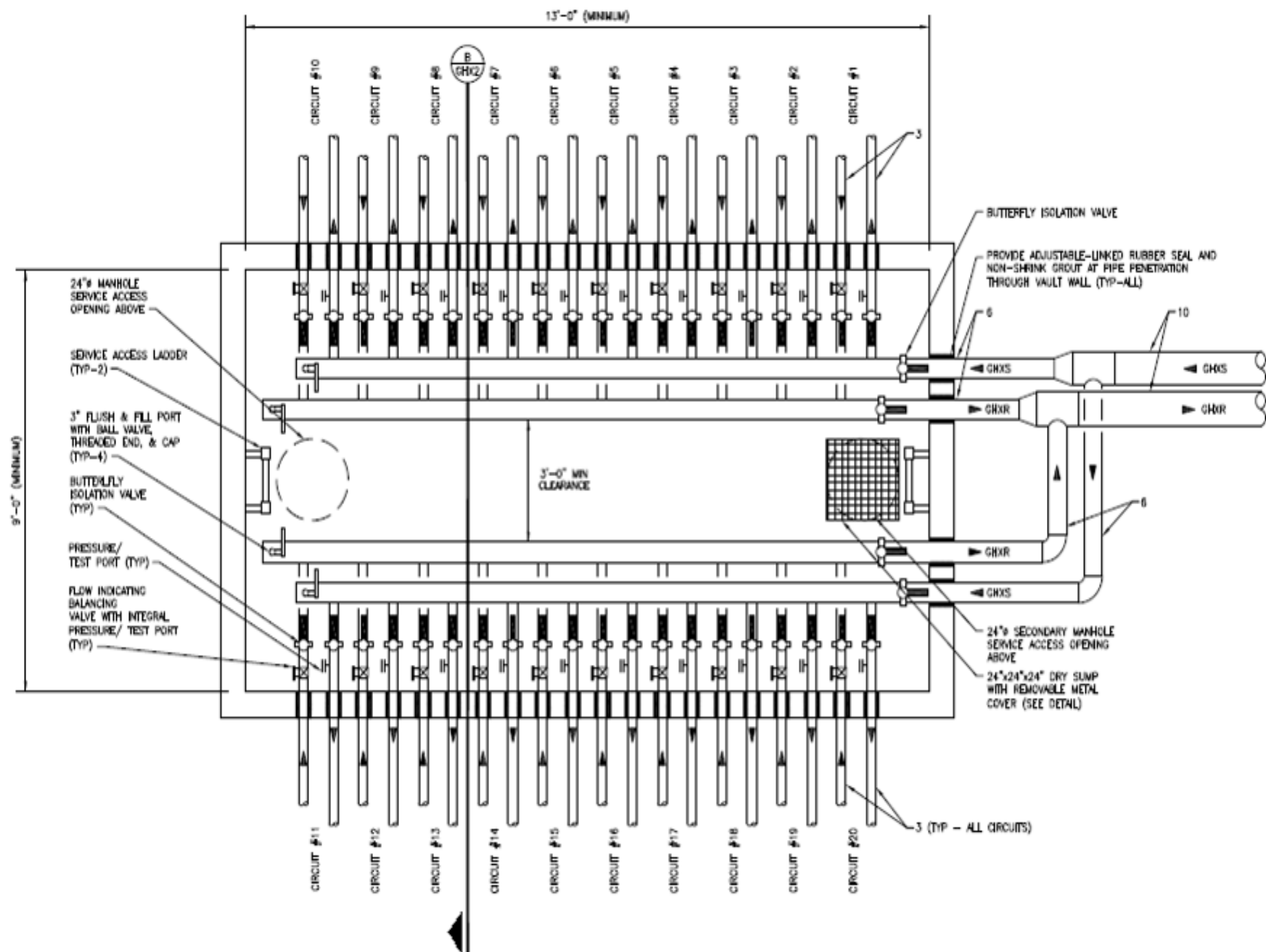
Geothermal Heat Pump Demonstration

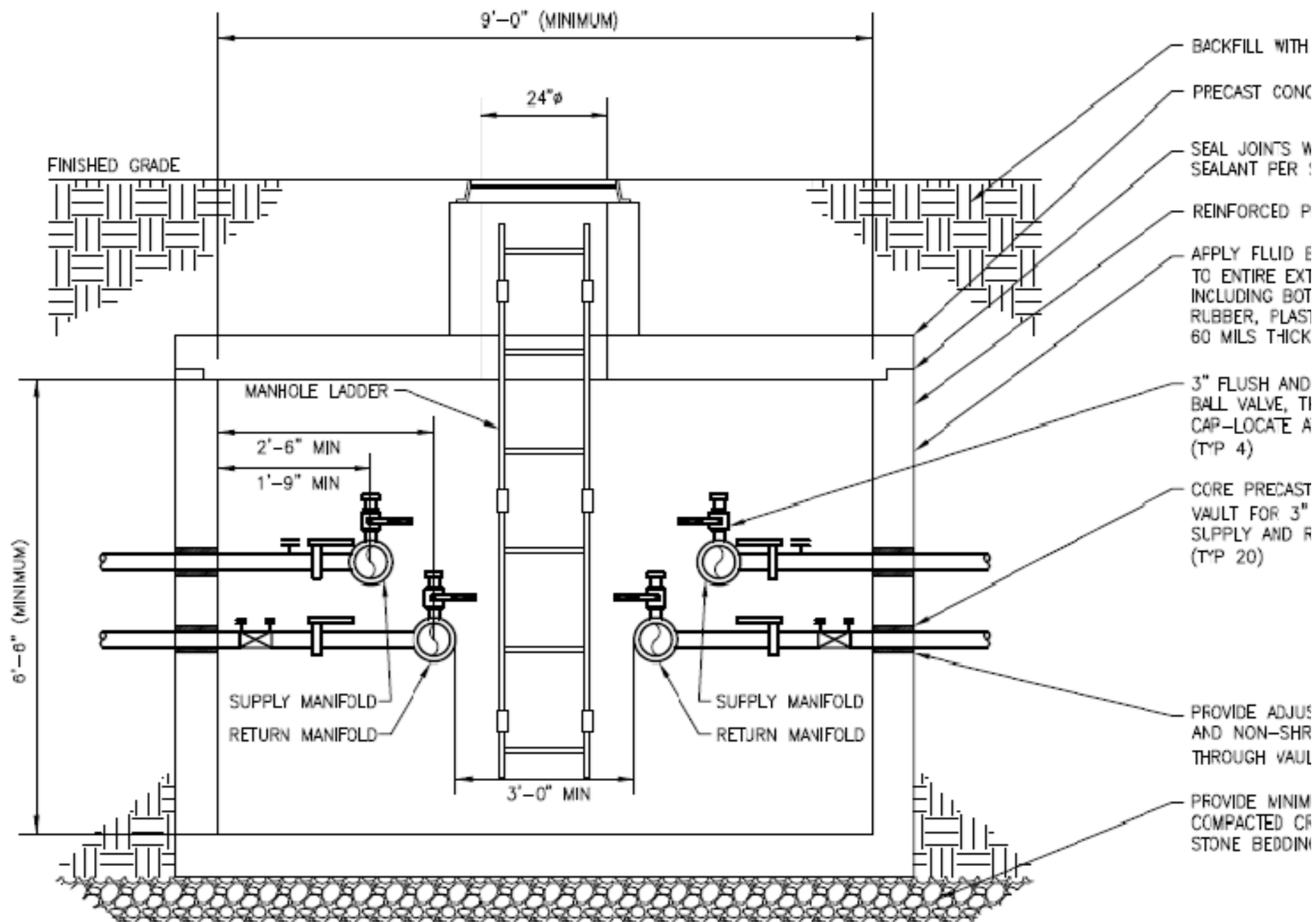
HEAT EXCHANGER INFORMATION	
Configuration	Vertical Closed Loop
Borehole Quantity	256
Borehole Depth	320 feet
Borehole Separation	25 feet
Number of Circuits	20
Thermal Conductivity *	1.23 BTU / (hr-ft-deg F)
Soil Diffusivity	0.83 foot ² / day
Undisturbed Ground Temperature *	53.0 deg F
GHX Pressure Drop	42 feet of head
FLUID INFORMATION	
Total Flow	1,225 GPM
Fluid	Water only
Minimum HP Unit Inlet Fluid Temp	40 deg F
Maximum HP Unit Inlet Fluid Temp	90 deg F

* From formation
thermal conductivity
test data taken July
30, 2009

Geothermal Heat Pump Demonstration

GROUT INFORMATION	
Grout Type	Thermally Enhanced Bentonite
Minimum Thermal Conductivity	0.88 BTU / (hr-ft-deg F)
FLUSH & PURGE INFORMATION	
Minimum Fluid Velocity	2 feet / second
Minimum Purge Flow (per circuit)	75 GPM
Purge Pressure Drop (per circuit)	47 feet of head
GHX CAPACITY INFORMATION	
Peak Heating	2,000,000 BTU / hour (166 tons)
Peak Cooling	4,920,000 BTU / hour (410 tons)
Heating EFLH	1,455 hours
Cooling EFLH	929 hours





- **Three Test Bores – Geothermal Conductivity Tests Completed**
- **Geothermal System Design is Complete**
- **Geothermal Bid Package Issued**
- **Full Project Design 90% Complete**
- **Formal Ground Breaking in April 2010**

- **Geothermal Well Field to be Constructed & Completed by September 2010**
- **Site Work & Foundation Bid Package Due to be Issued in May 2010**
- **Full Construction Bid Package Due to be Issued in Summer 2010**
- **Substantial Completion by Summer 2012**
- **Three Full Years of System Monitoring & Reporting**

- **Innovative Project with Proven Technologies, but New the United States**
 - Variable Refrigerant Flow Heat Pumps
 - Desiccant Dehumidification of Outdoor Air Ventilation with Solar Thermal Regeneration
- **Large 400 Ton System**
- **USGBC LEED Building Gold or Platinum Rating**



Thank you
www.oakland.edu/energy

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