The Natural Connection Heat Pump Cycle

THE NATURAL CONNECTION

The Natural Connection Heat Pump Cycle

Why Natural Connection?

Several Reasons

- It is a bridge to the next technology
- It mimics nature while using and implementing existing technology.
- It utilizes natural energy sources.
- It is a play on “Nature”.
- It seems to work.

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The book “Biomimicry” Janine M. Beynus, Copyright © 1997

Chapter 1 is titled “Echoing Nature”

We should strive to “Echo” or “Mimic” “Nature” as closely as possible now as long as it makes <u>economic sense</u> because it is a beginning.

What is "Biomimicry"?

According to her book Ms. Beynus defines it this way: BI-O-MIM-IC-RY [From the Greek bios, life. And mimesis. Imitation]

1. ***Nature as a model.*** *Biomimicry is a new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems, e.g., a solar cell inspired by a leaf.*

2. ***Nature as a measure.*** *Biomimicry uses an ecological standard to judge the "rightness" of our innovations. After 3.8 billion years of evolution, nature has learned: What works. What is appropriate. What lasts.*

3. ***Nature as a mentor.*** *Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can* extract *from the natural world, but on what we can* learn *from it,*

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"Let's be independent together [1,2] "

- I believe, in the beginning (now), the largest difference in societal effects on the planet will be made by the behavior of each of us independently.

1 - "Let's be independent together" Hermie to Rudolph the Red Nosed Reindeer in "Rudolph the Red Nosed Reindeer."

2 - Written by Romeo Miller Produced by Arthur Rankin and coproduced by Jules Bass in 1964.

Vàclav Havel, president of the Czech Republic Said

"We must draw our standards from the natural world. We must honor with the humility of the wise the bounds of that natural world and the mystery which lies beyond them, admitting that there is something in the order of being which evidently exceeds all our competence."

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WARMTH

Animals in nature use the sun for warmth.
It makes sense we would do the same.

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The Solar Collector

- The collector required is a low to medium temperature glazed unit.
- Solar collectors capture the energy produced by the sun.

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EVAPORATION

- As a way to keep a human body cool we have the ability to sweat.
- Evaporation of this sweat (moisture) cools our bodies.
- Use the same technology to cool our homes.

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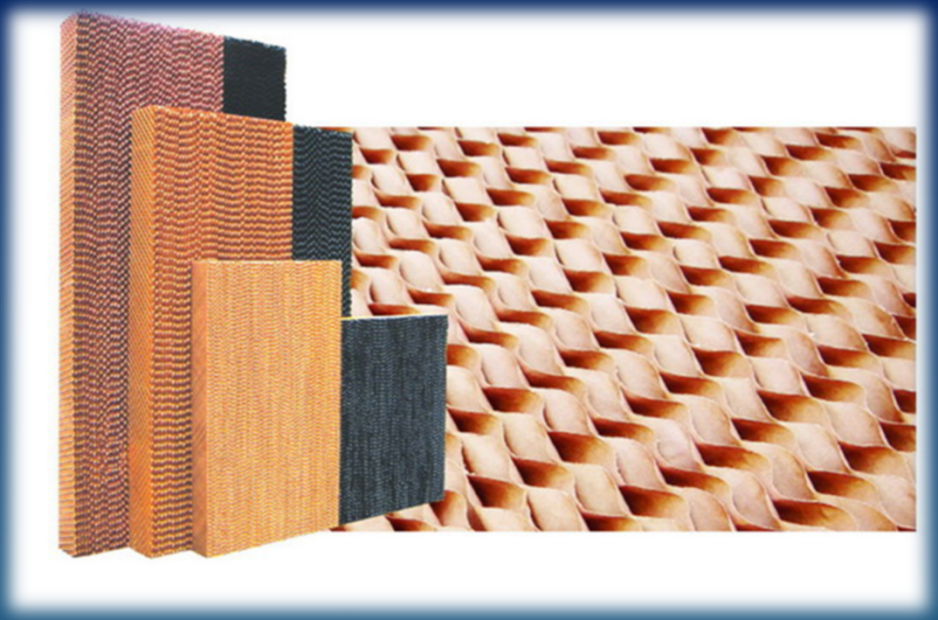
EVAPORATIVE COOLING PAD



- The evaporative cooling pad is a corrugated surface which is kept wet to allow and promote evaporation.
- Provides cooling naturally.

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THE SOLAR STORY

- There are reasons solar energy is not widely accepted today.
  - It is expensive relative to other forms of energy.
  - It is unreliable due to cloudy days & darkness.
  - The industry is populated by corporations using questionable marketing practices & mark ups.
  - It is difficult to research.
  - It is not well understood.
  - It requires storage for later use which can be expensive.
- Why Now?
  - There currently exists a convergence of knowledge and technologies.
  - We have a need.
  - Energy prices are conducive to the technology.
  - Energy prices will grow making use of the technology more desireable.
  - Manufacturing efficiencies make product production at necessary prices possible.

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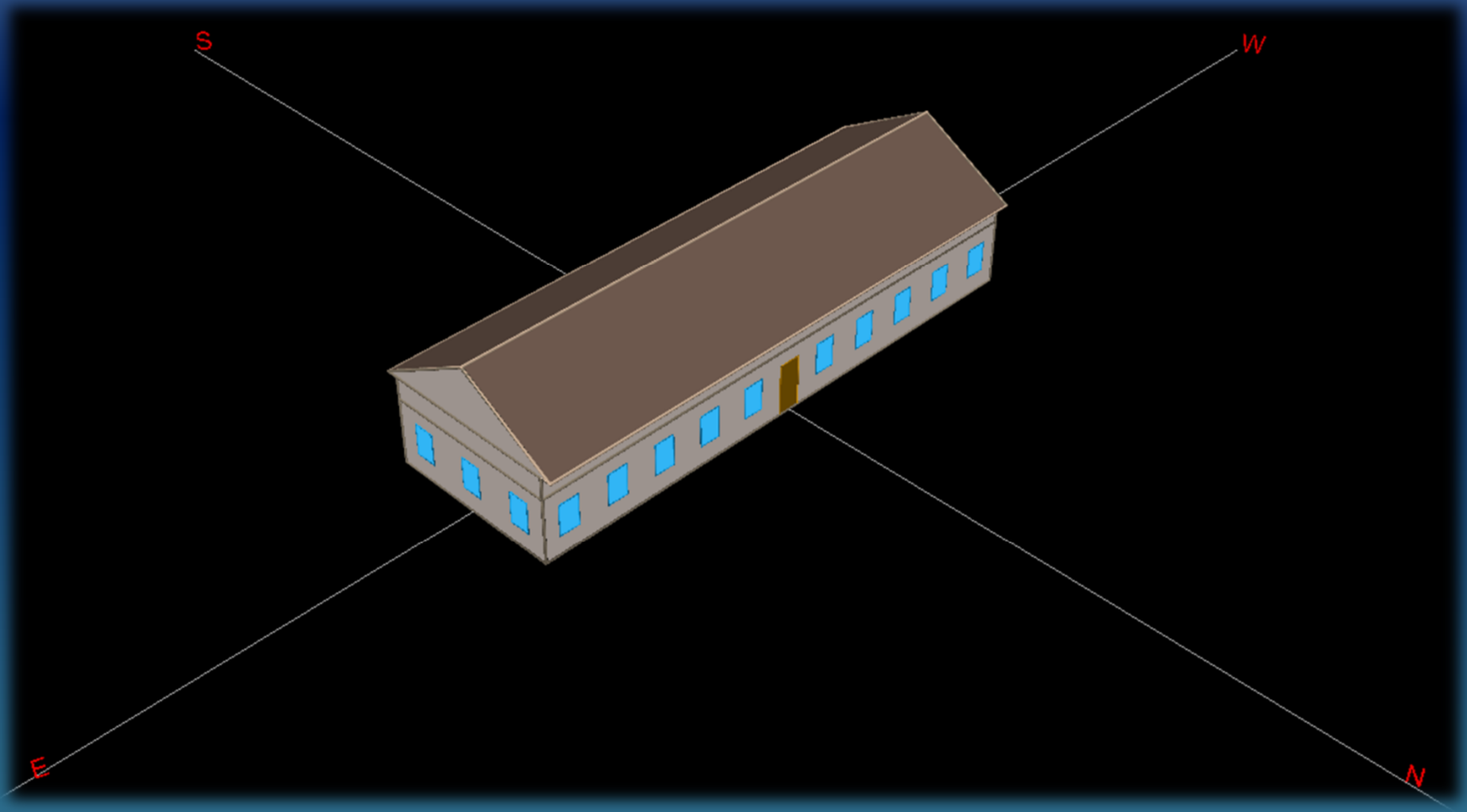

A model of a residence was created using Equest

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THE MODEL

- A typical home:
  - Eighteen hundred square feet
  - R-11 insulation in the walls
  - R-19 insulation in the ceiling (bottom of truss, none on roof)
  - Two doors
  - Windows cover twenty percent of the wall surface
  - Structure is on a crawl space
  - Equipped with heat pump

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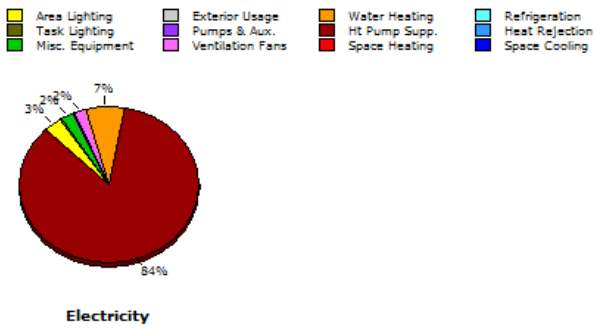
Project/Run: NBHP-1 - Baseline Design — Run Date/Time: 03/06/11 @ 10:50

Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h	Steam Btu/h	Chilled Water Btu/h
Space Cool	-	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	-	-	-
HP Supp.	9.88	-	-	-
Hot Water	0.84	-	-	-
Vent. Fans	0.23	-	-	-
Pumps & Aux.	0.05	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	0.27	-	-	-
Task Lights	0.03	-	-	-
Area Lights	0.39	-	-	-
Total	11.69	-	-	-



Electricity

eQUEST 3.64.7130 — Annual Peak Demand by Enduse — Page 1

An energy model run on Equest indicates the residence's peak demand to be eighty four percent space heat. (Heat pump supplimental heating)

A percentage of eighty four percent of the demand would be eliminated greatly assisting the local utility.

However the system must also benefit the owner.

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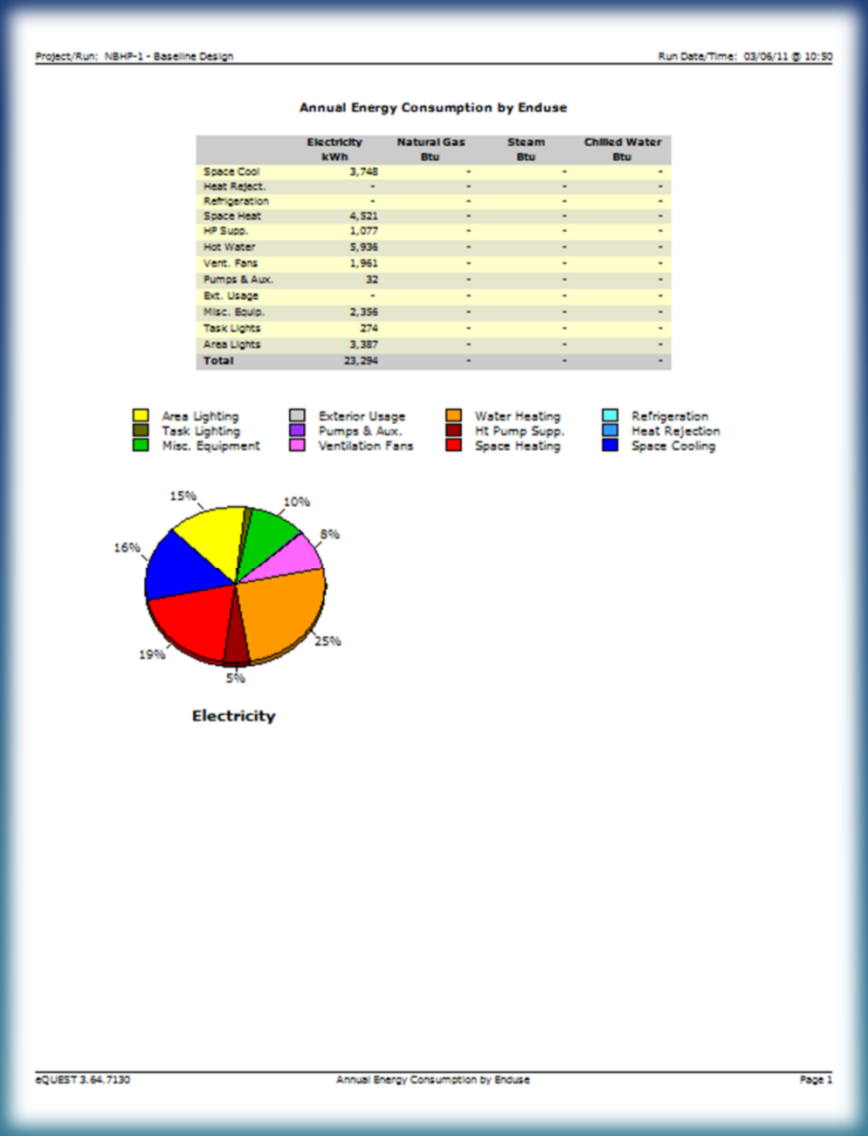

Project/Run: NBHP-1 - Baseline Design — Run Date/Time: 03/06/11 @ 10:50

Annual Energy Consumption by Enduse

	Electricity kWh	Natural Gas Btu	Steam Btu	Chilled Water Btu
Space Cool	3,748	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	4,521	-	-	-
HP Supp.	1,077	-	-	-
Hot Water	5,936	-	-	-
Vent. Fans	1,961	-	-	-
Pumps & Aux.	32	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	2,356	-	-	-
Task Lights	274	-	-	-
Area Lights	3,387	-	-	-
Total	23,294	-	-	-

Area Lighting, Task Lighting, Misc. Equipment, Exterior Usage, Pumps & Aux., Ventilation Fans, Water Heating, Ht Pump Supp., Space Heating, Refrigeration, Heat Rejection, Space Cooling

Electricity

eQUEST 3.64.7130 — Annual Energy Consumption by Enduse — Page 1

An energy model run on Equest indicates the residence's annual energy use assuming equipment with a SEER of thirteen and a COP of three to be 23,294 kWh or a total annual energy bill of $2,329 or an average monthly bill of $194.

The total expenditure for home conditioning is indicated to be 40% of the total or $78 per month.

The assumption is that the proposed system will save 60% of the energy used or $47 per month.

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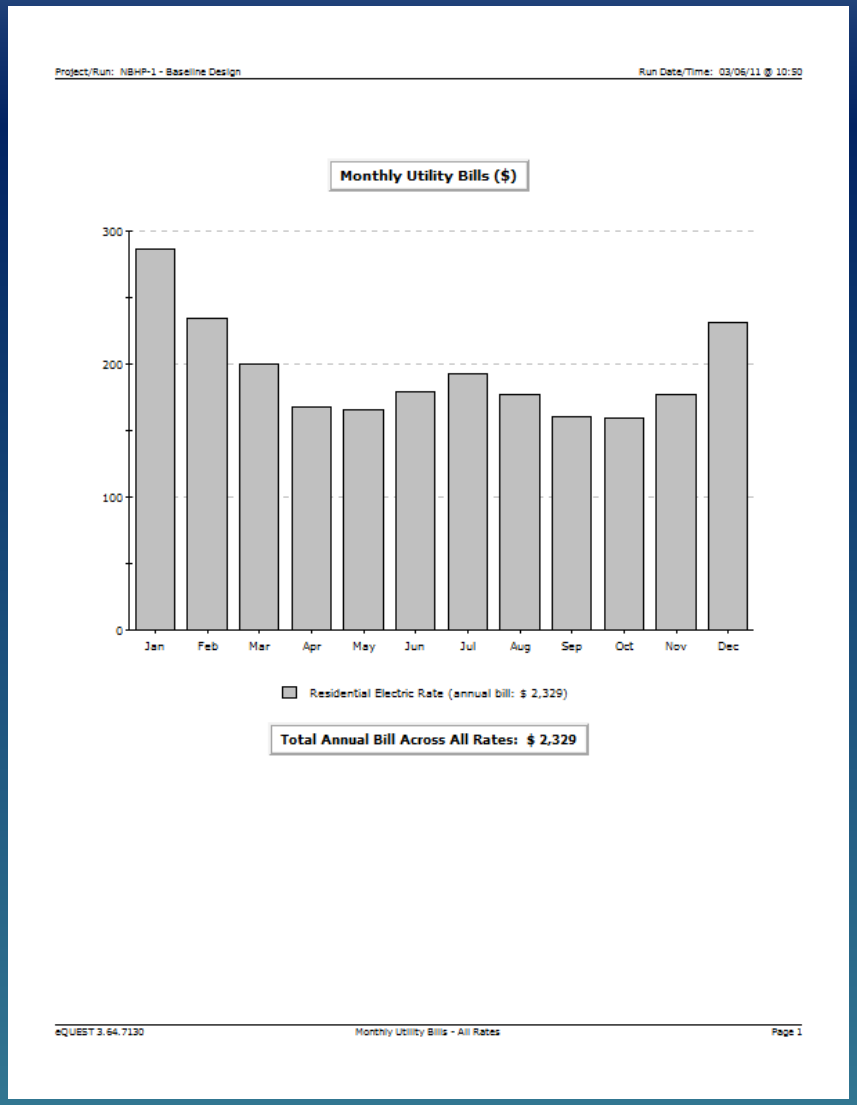

An energy model run on Equest indicates the residence's monthly energy cost at ten cents per kWH to be as indicated at left. High just under three hundred dollars and low around one hundred and seventy dollars for an 1800 square foot residence. Costs seem reasonable.

If you choose to believe Equest we have roughly three hundred and two dollars per panel available to install the entire system.

Simple payback for the entire system is roughly twelve years. This is less than the life expectancy of all components providing benefit to the owner.

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System Cost & Simple Payback

At right there is a system cost estimate based solely on my opinion of probable cost.

This system must be delivered to the owner with a simple payback of fifteen years or less. These are delivered and installed costs. They will be challenging however will be hit.

Saving $47 for 12 months saves $564 annually. Over 15 years this will save $8460 meaning simple payback will occur between ten and fifteen years after purchase at today's energy cost.

System Cost Estimate			
(3 tons) serving 1800 squre feet with 900 square feet of panel. (educated guess)			
900 gallon Tank	1	$450.00	$450.00
Tank Shipping	1	$450.00	$450.00
Tank Install	1	$450.00	$450.00
Pump	1	$80.00	$80.00
Pump	1	$80.00	$80.00
Piping	1	$150.00	$150.00
Coil	1	$150.00	$150.00
Evaporative Cooling	1	$80.00	$80.00
Solar Panels	28	$150.00	$4,200.00
Enclosure	1	$275.00	$275.00
Controls	1	$50.00	$50.00
Insulation	1	$200.00	$200.00
Total installed cost			$6,615.00

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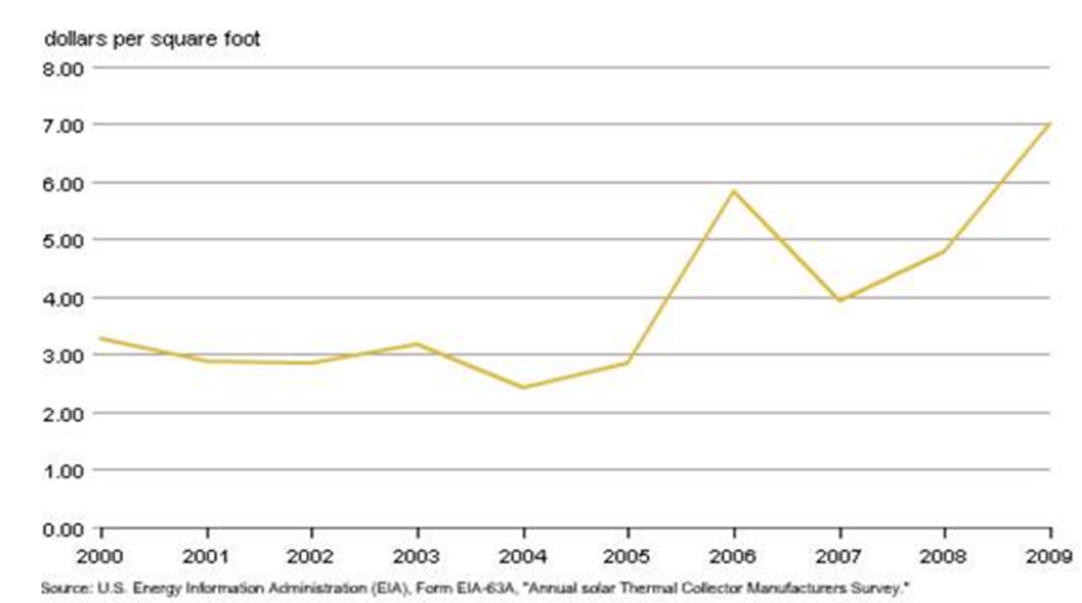
Collector Cost

- At right there is a chart indicating the average collector cost in 2009 was seven dollars per square foot. **Current pricing should be verified!**
- According to the US Energy Information Administration the average price for low-temperature collector was $1.94 per square foot in 2009, a nearly 3-percent increase from $1.89 per square foot in 2008.
- A collector size of 32 square feet results in a cost of $62.08. Almost exactly where the natural Connection technology needs it to be. The system must be delivered to the owner with a simple payback of fifteen years or less. The cost of solar collectors are critical to making this happen.



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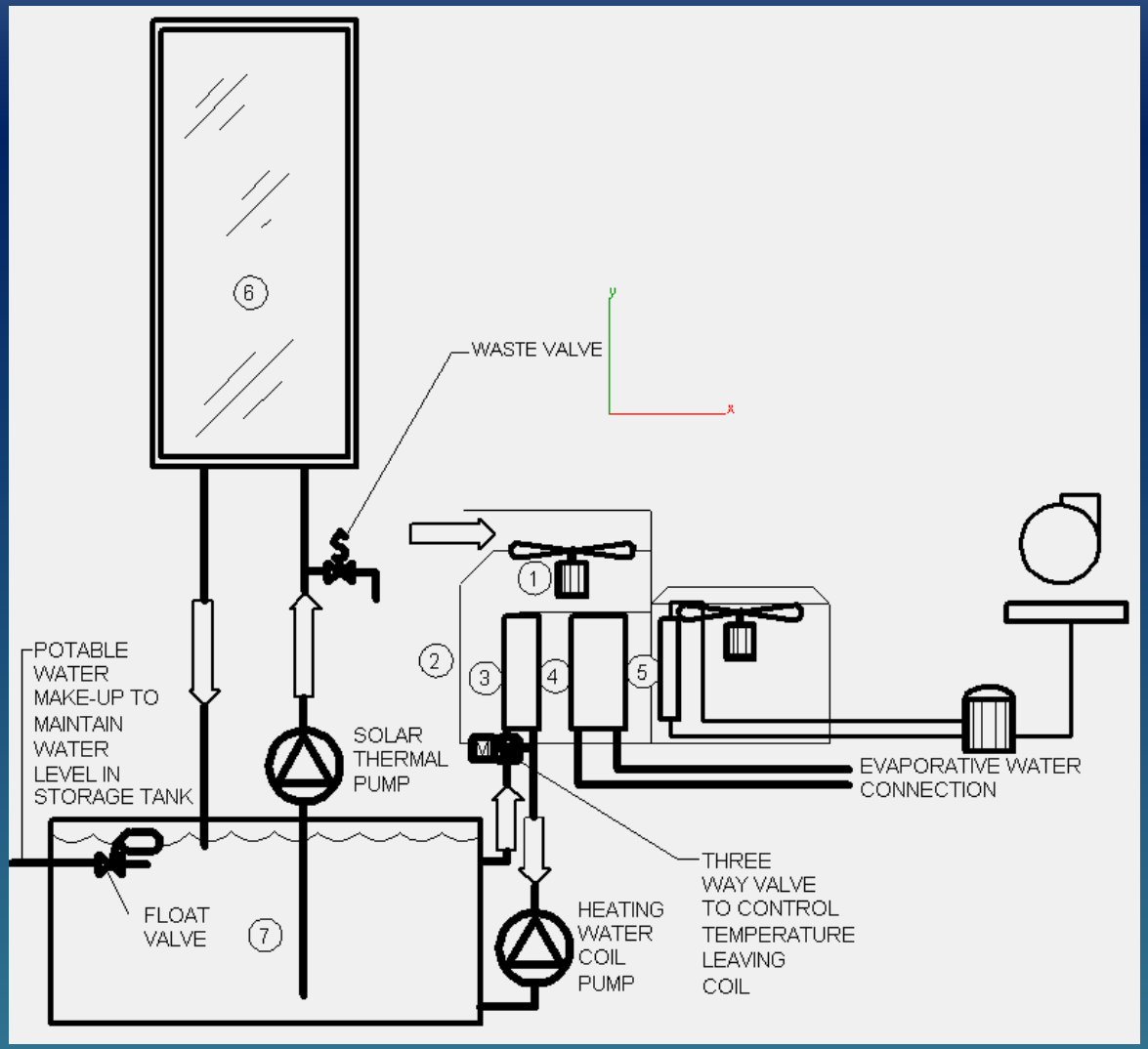
Cycle

- So what cycle are we discussing?
- Well let's quickly review it.



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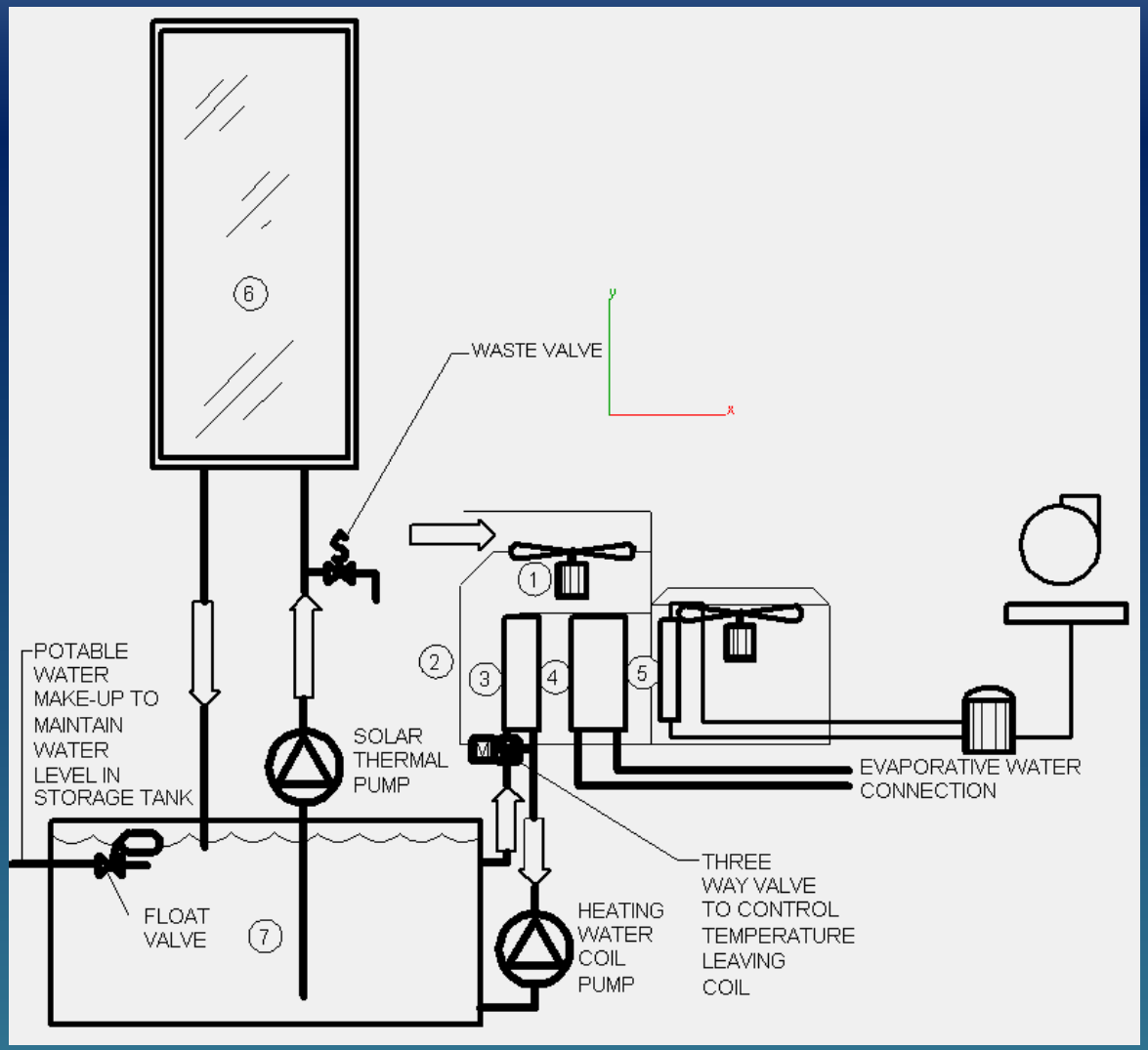
Cycle

One (1): A fan in series with the existing heat pump outdoor unit fan enables movement of an equivalent air volume.

If new equipment, Motor may be deleted because main fan can be used for the entire air flow requirement.

Freeze protection is not required at this location.



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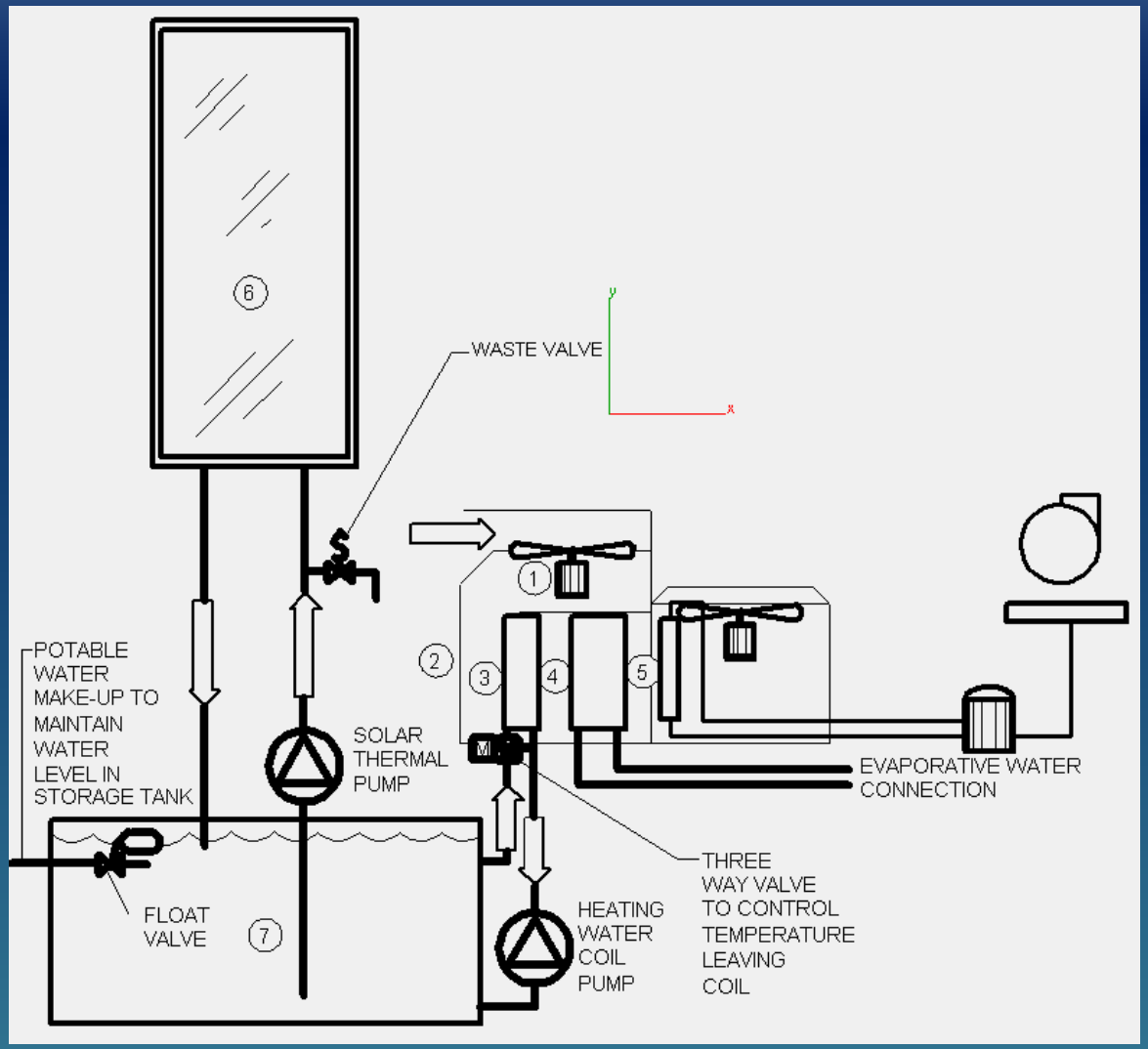
Cycle

Two(2): A cabinet encloses and directs air flow. It will permit mounting of additional fan (if required), coil, three way valve (if variable speed ECM motor is used on pump a two way valve will be used), evaporator pad & controls, as well as a wiring/control enclosure. In most cases it will have to enclose three sides of the heat pump outdoor unit in order to take full advantage of the existing coil.



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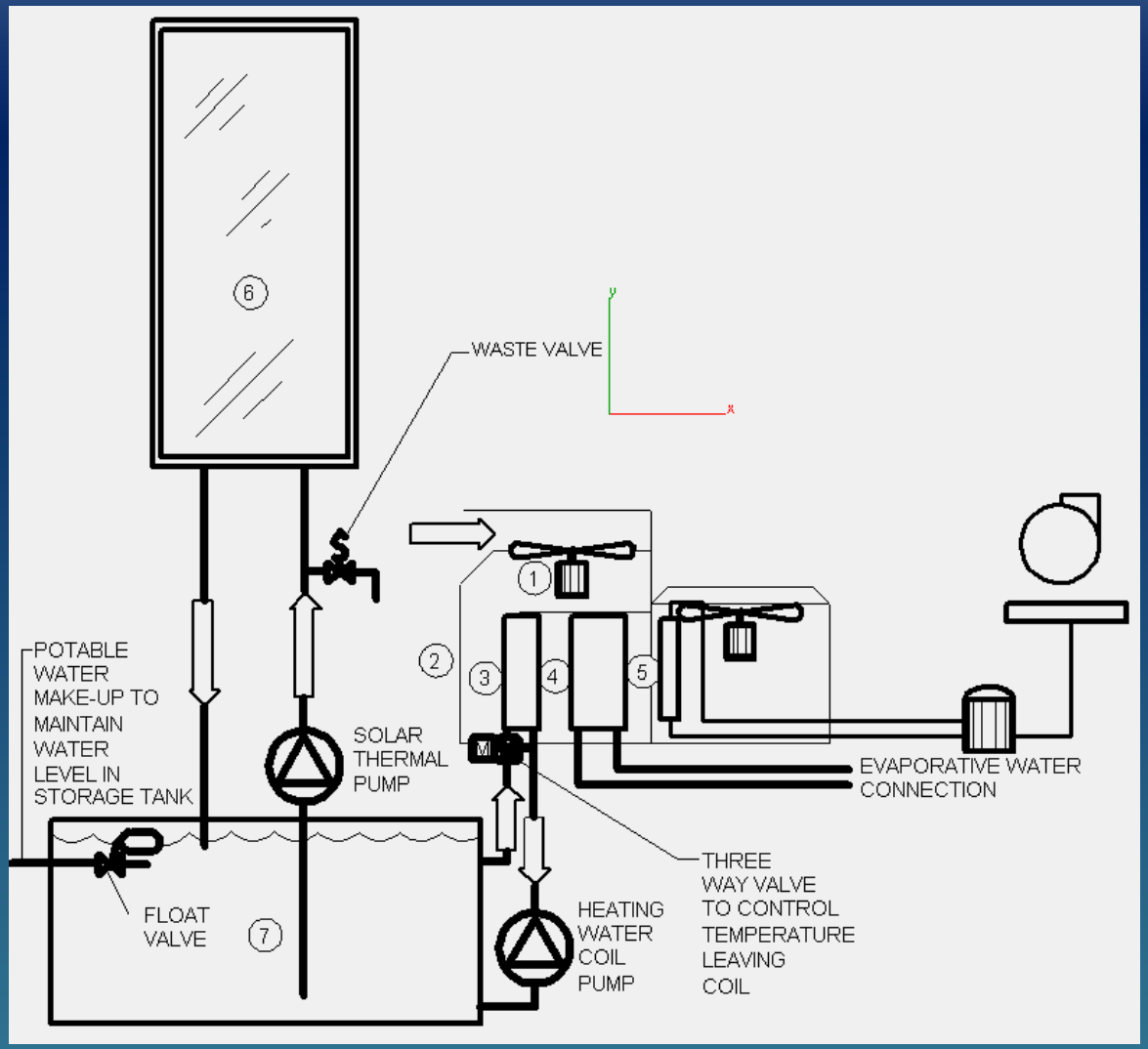
Cycle

Three (3): The heating coil will operate to warm ambient air using water from the storage tank. Water shall be removed from the tank at an upper elevation to take advantage of stratification to remove warmer water. Water shall be returned to the tank at a lower elevation to promote stratification of cooler water at lower elevations in the tank.



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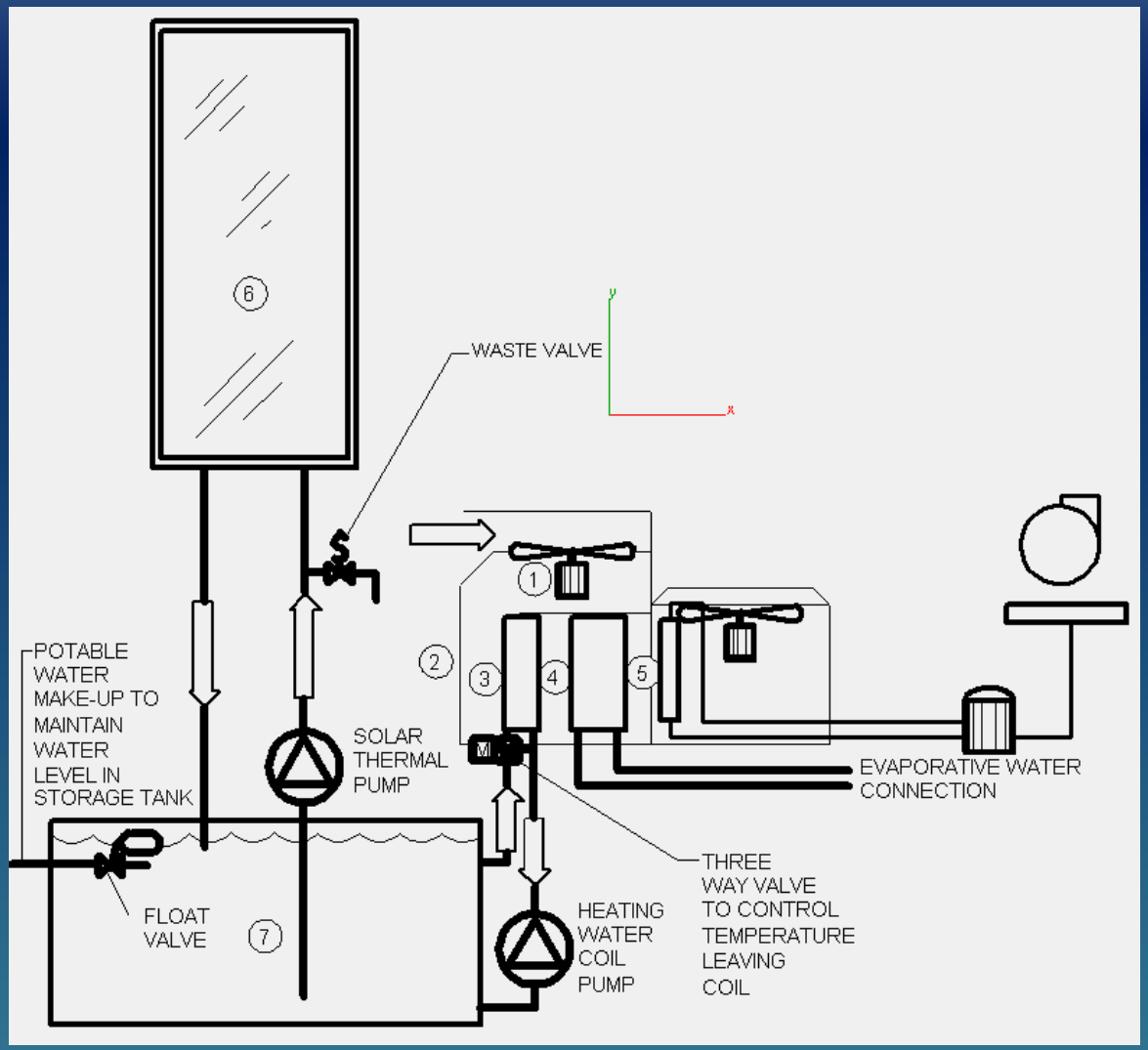
Cycle

Three (3) Continued: Freezing of the coil is probable due to its function of warming ambient air. If the coil is permitted to freeze damage will result. Antifreeze with a plate heat exchanger with a possible additional pump, or a plate heat exchanger located in the tank perhaps with no pump with refrigerant allowed to migrate due to it's changing state (like a heat pipe) could be used however this may increase cost & complexity. Requiring drainage of the coil back to the storage tank to prevent freezing is the lowest cost option.



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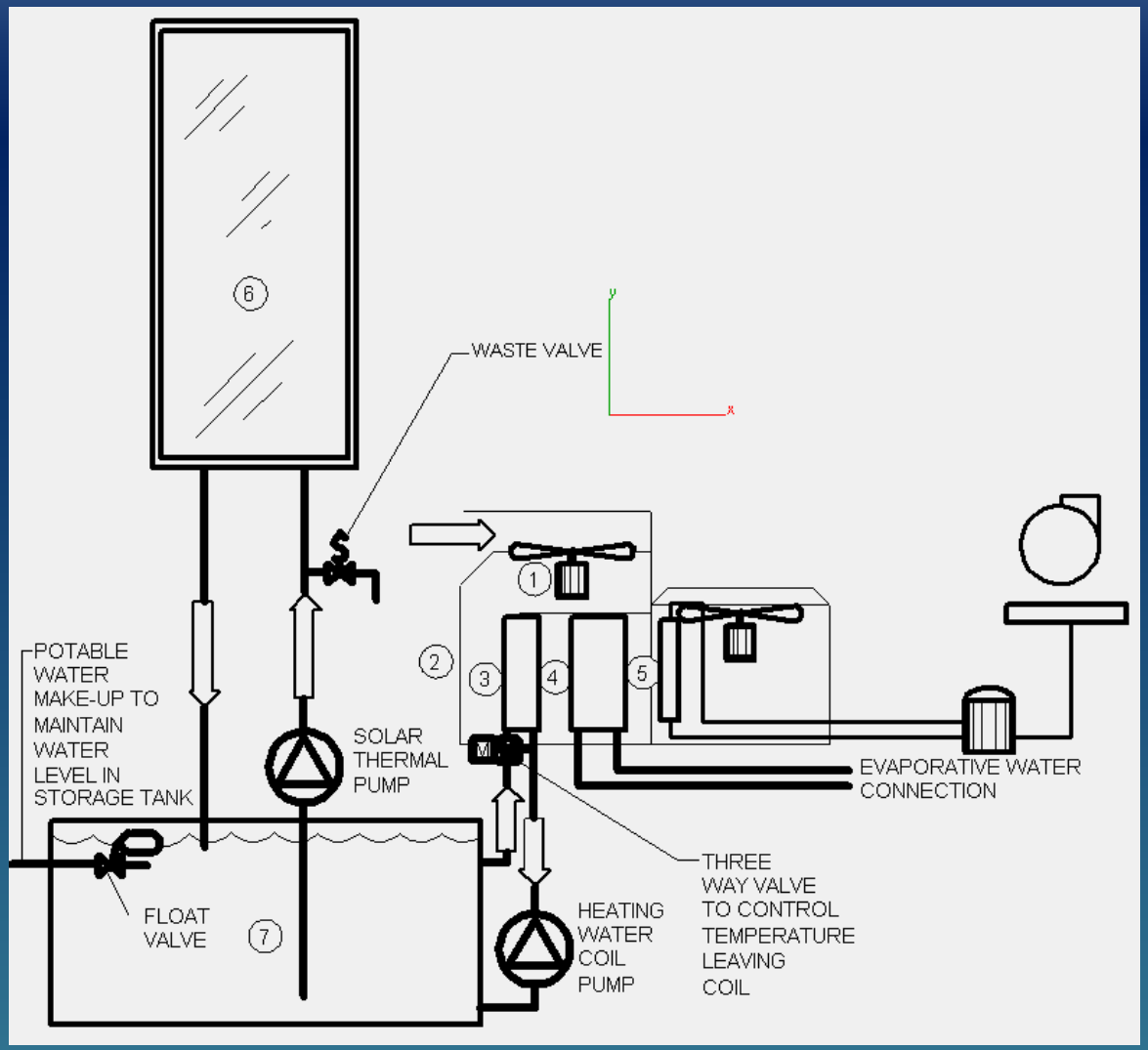
Cycle

Four (4): The evaporation cooling pad is to be used to lower the ambient air temperature towards the wet bulb prior to use by the heat pump. Water is expected to be potable, under pressure, requiring only a solenoid valve to activate its supply. Water can be naturally obtained and condensate from the air conditioning process can be reused to further reduce environmental impact. The evaporator pad shall be deactivated and the supply pipe drained prior to freezing conditions so freezing will not be an issue.



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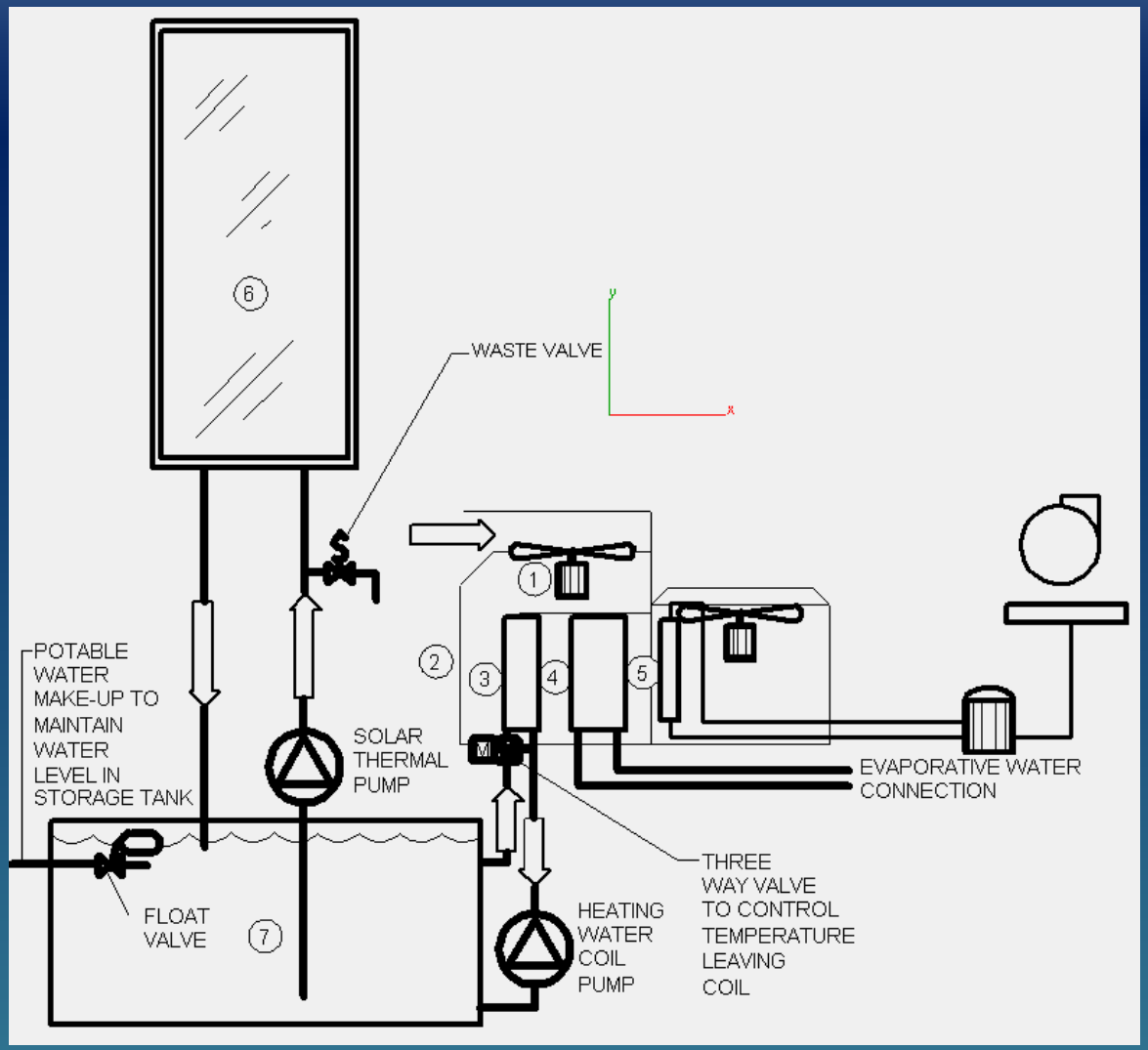
Cycle

Five (5): Air leaving the evaporator pad and hydronic coil enters the outdoor heat pump coil. In the summer the ambient air will have been cooled towards the wet bulb thus making the cooling cycle of the heat pump more efficient. In the winter the ambient air will have been warmed hopefully eliminating operation of electric strip heat except under the most extreme conditions and making the heating cycle of the heat pump more efficient under other conditions. Freezing is not an issue at this location.



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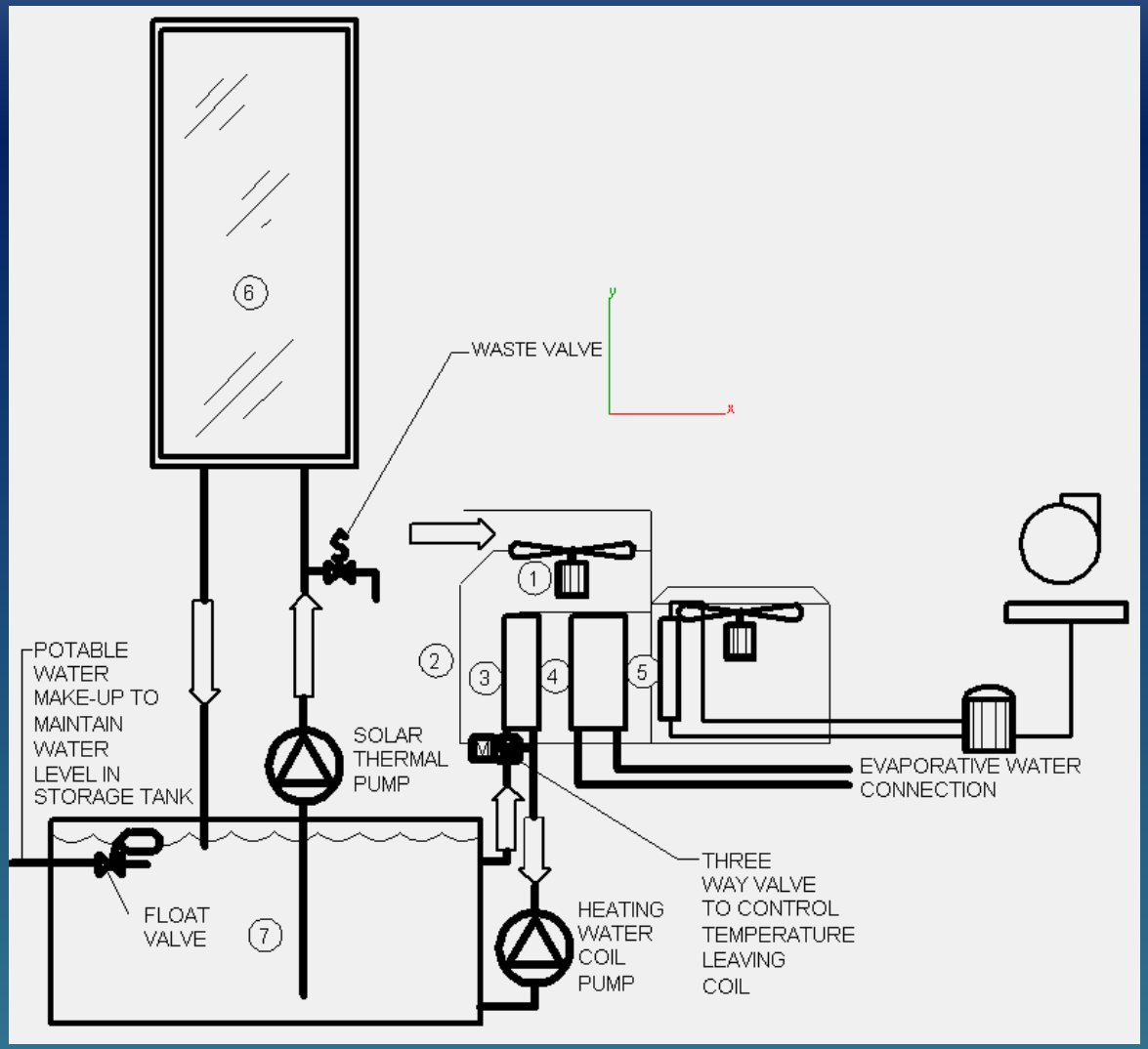
Cycle

Six (6): A typical Solar Rating and Certification Corporation (SRCC) approved solar thermal panel will deliver 25000 BTU per day. Provide roughly twenty-eight (28) 25,000 BTU/Day panels (900 square feet of panel for an 1800 square foot residence. Requiring Solar thermal panels to be delivered at $150.00 each. This is the hard part but it can be **done.**



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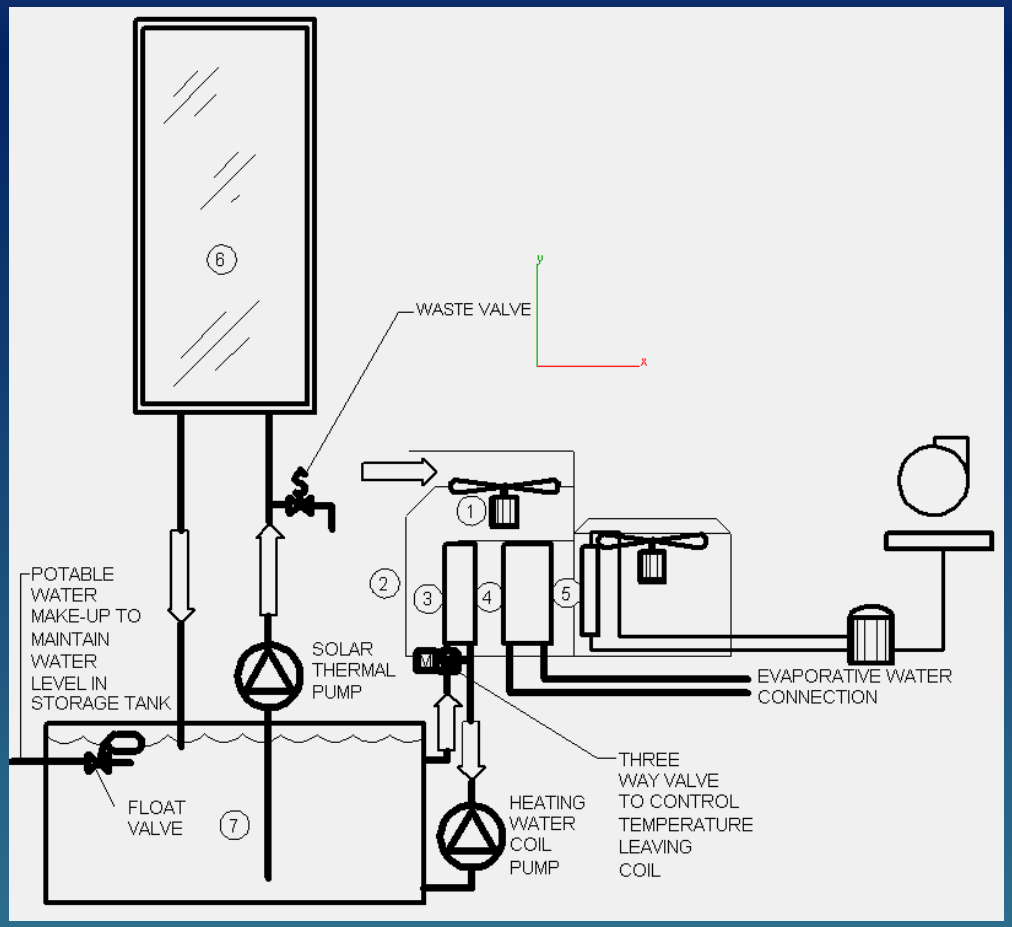
Cycle

Six (6) continued: Freezing of solar panels & piping will happen when the solar temperature falls below freezing. Piping is at risk any time the ambient temperature is below freezing. Therefore it shall be insulated. Water flowing through the pipe at elevated temperatures along with the insulation will prevent freezing. Solar thermal panels and piping shall be designed and installed to drain back to the storage tank. This shall happen whenever the water temperature returning to the storage tank is less than the water temperature in the tank or when the solar temperature is less than fifty degrees F.



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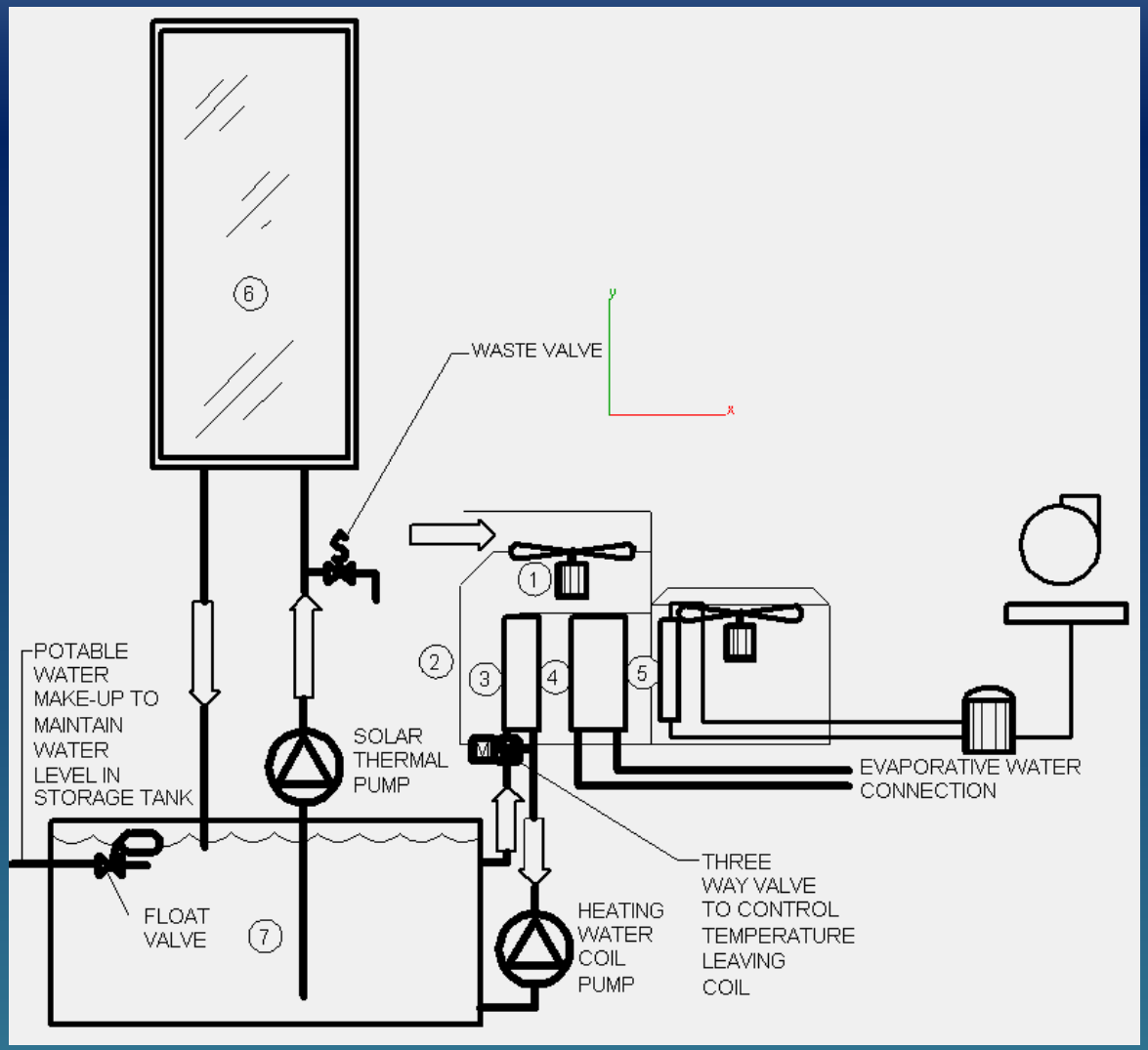
Cycle

Seven (7): The non-potable water storage tank water level will be controlled by a float valve, similar to the one used in a cooling tower to control basin water level. Other electronic means may be used. A readily available non-potable below grade water storage tank at 600 gallons per ton will be required. A pre-insulated tank insulated with six inches of waterproof insulation will need to be developed. In the mean time available storage tanks with 4" of field applied polyisocyanurate insulation can be used.



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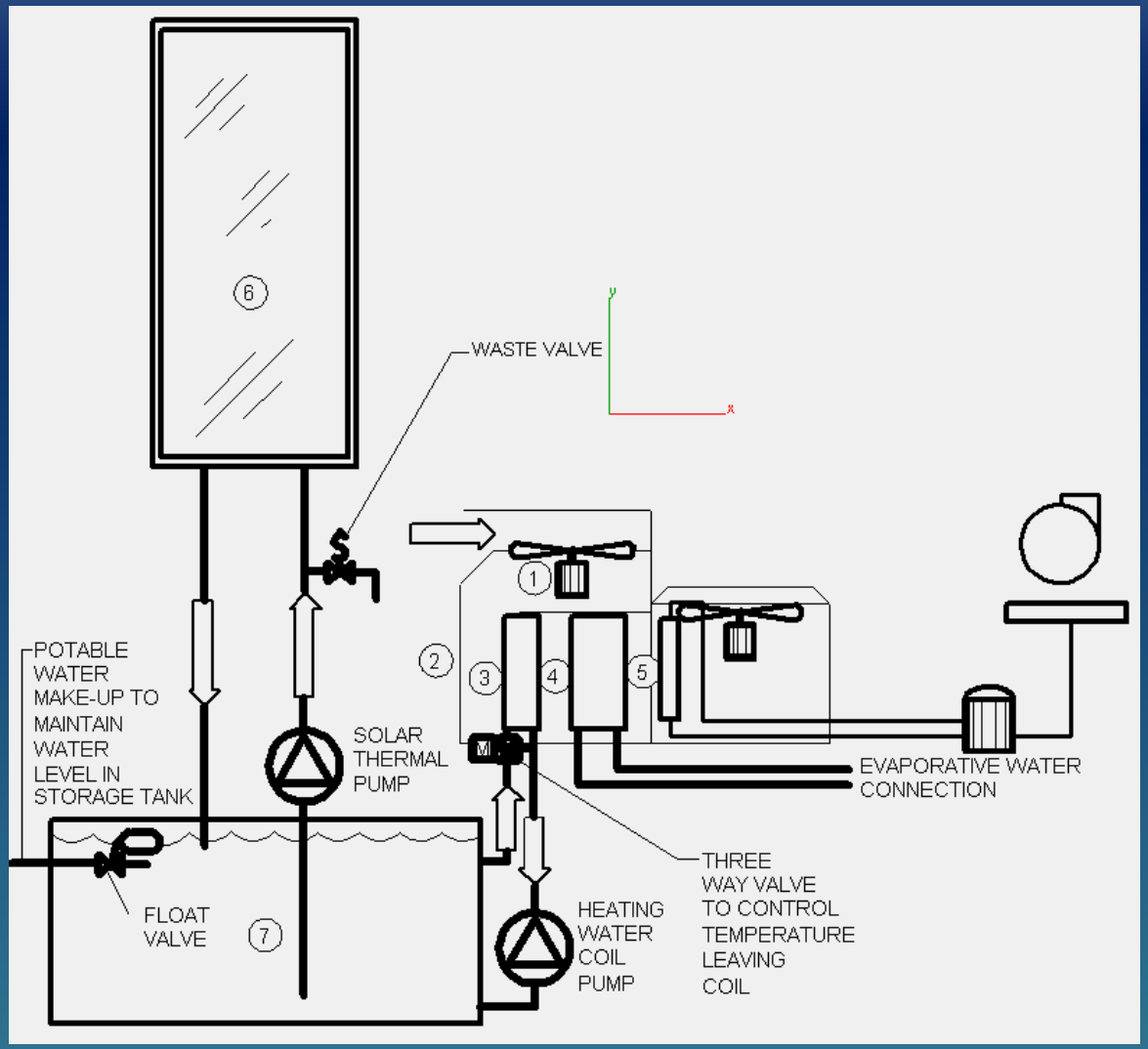
Cycle

Seven (7) continued: Storage required is one gallon per square foot with an anticipated temperature rise of approximately forty degrees F (Sixty to One hundred degrees F). The tank is buried below the frost line making freezing a non-issue.



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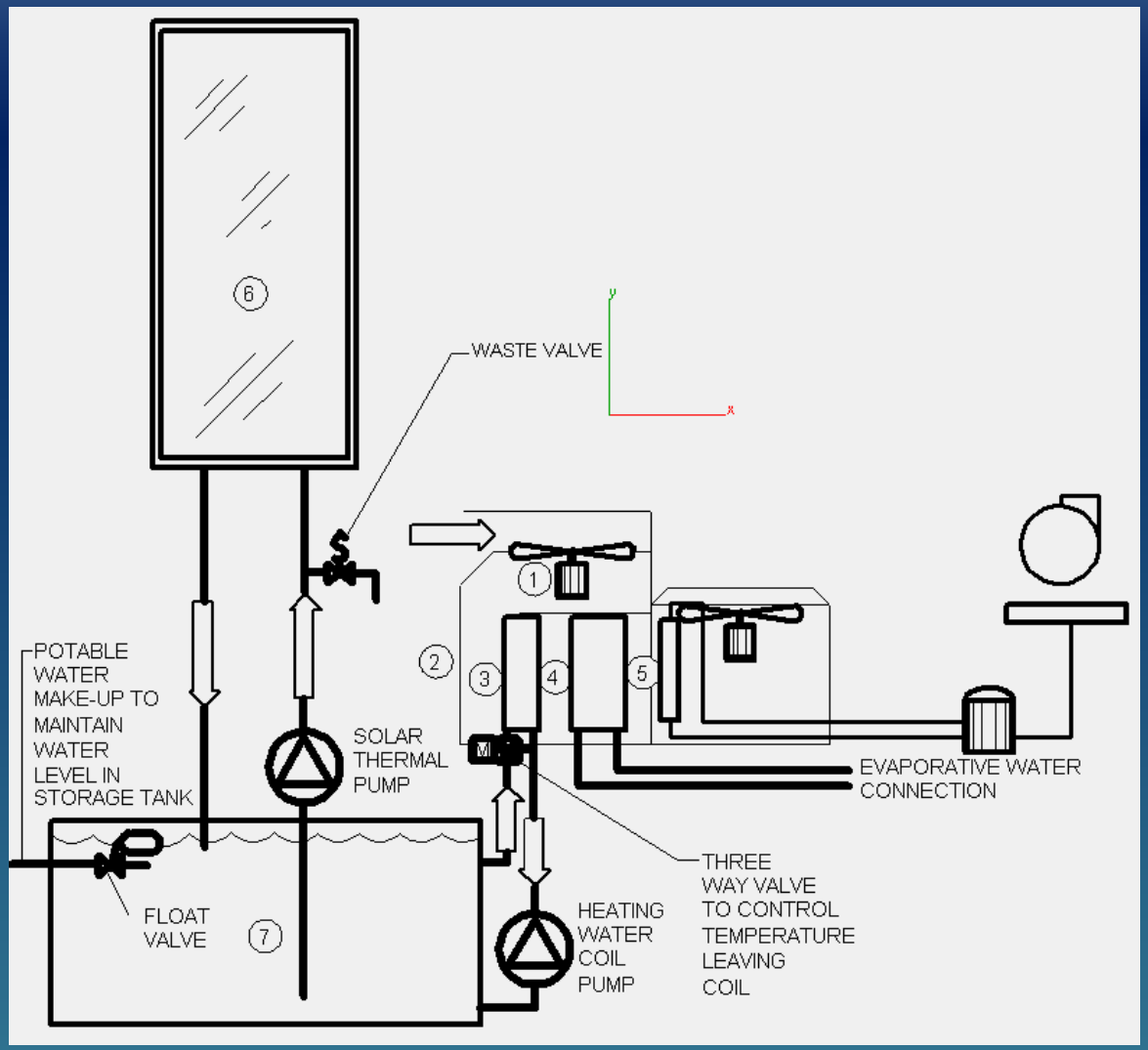
Cycle

PUMPS: The system will require two pumps. They will be fractional horsepower and each will be powered by a 115 volt, single phase circuit each. They will operate at the same time. The solar thermal pump operates to pump water from the storage tank to the solar thermal panels. The heating water coil pump operates to pump water from the storage tank to the ambient air heating coil and associated valve.



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