Hybrid Wet/Dry Cooling Solutions

Baltimore Aircoil Company

Industry Standards

ISO Certification

CTI Certified Performance

Factory Mutual (FM)

ASHRAE 90.1

ASHRAE Standard 90.1 Update

- 90.1 – 2007 Addendum “L”
  - Requires CTI certification for both OPEN and CLOSED circuit cooling towers (using water).

CTI Certification

BAC certified with:

- Water
- Ethylene Glycol
- Propylene Glycol

Only Manufacturer to offer certified glycol ratings!

Aqueous glycol solutions rated from 5% to 60% in 5% intervals (plus 33.3%)

Why Use Evaporative Cooling?

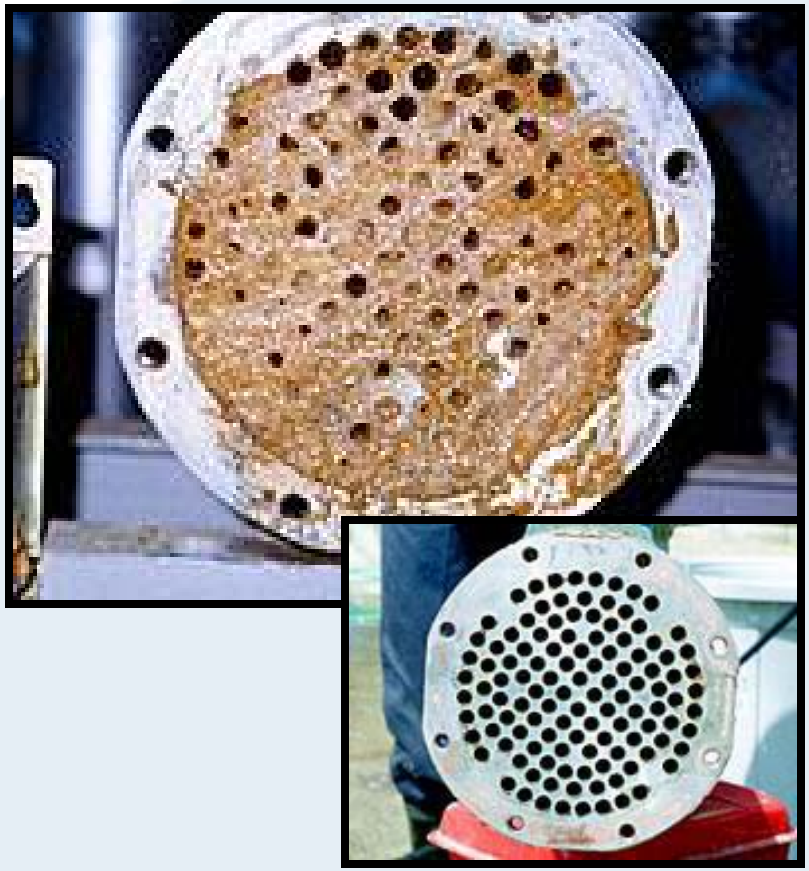
- Evaporative cooling technology
  - Cools water close to wet bulb temperature
    - Wet bulb is lower than dry bulb (summer conditions)
      - Reduces refrigeration equip size
      - Reduces operating cost
      - Reduces maintenance cost
  - Energy & space efficient
    - 1,000 BTU/lb of water evaporated

Open Cooling Towers

Open Cooling Towers . . .

. . .expose system components to airborne contaminants

Fouled Tube Exchanger



Fouled Plate Exchanger

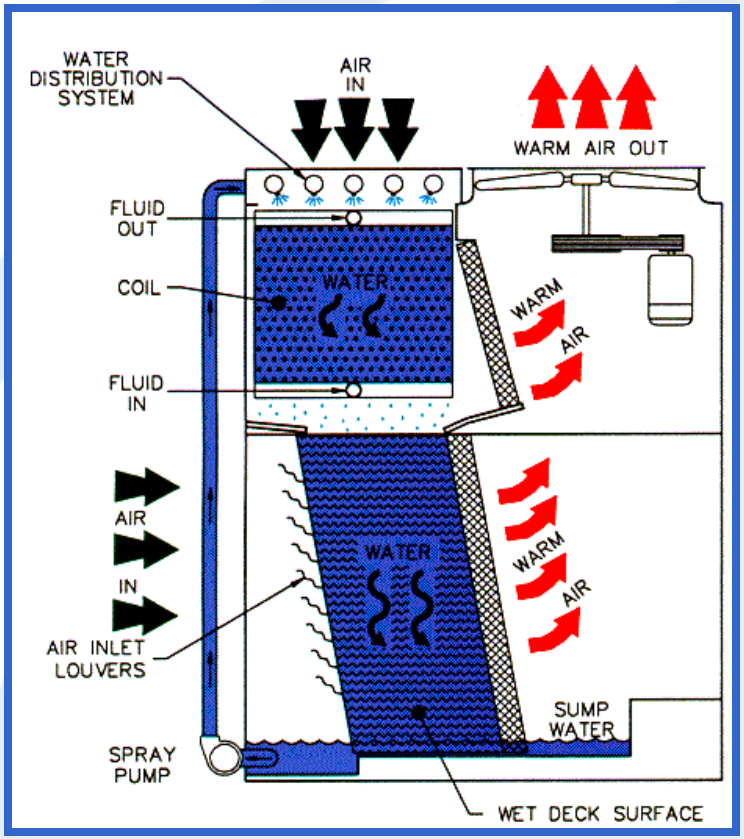
Closed Circuit Cooling Solutions

- Isolate the cooling fluid from airborne contaminants
  - Maintain system efficiency and extend time frame between maintenance intervals
  - Reduce maintenance and operating costs
- Dry operation during off peak conditions
  - Increases winter operating reliability
  - Reduces annual water consumption and costs
- Higher energy cost, first cost and larger footprint than open cooling towers
  - May be justified on mission critical applications

Typical Closed Circuit Cooling Applications

- Computer room cooling units
- Water source heat pumps
- Self-contained units
- Jacket water cooling
  - Induction furnaces
  - Air compressor
- Process fluid (other than water) cooling

Closed Circuit, Combined Flow Cooling Towers Principle of Operation



Induced draft single flow

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Hybrid Wet / Dry Cooling Systems

Address potential concerns over . . .

- Water
  - Availability
  - Quality
  - Treatment
  - Winter Operation
  - Maintenance
- Plume abatement
  - Aesthetic concerns
  - Safety issues

Hybrid Wet / Dry Cooling Towers

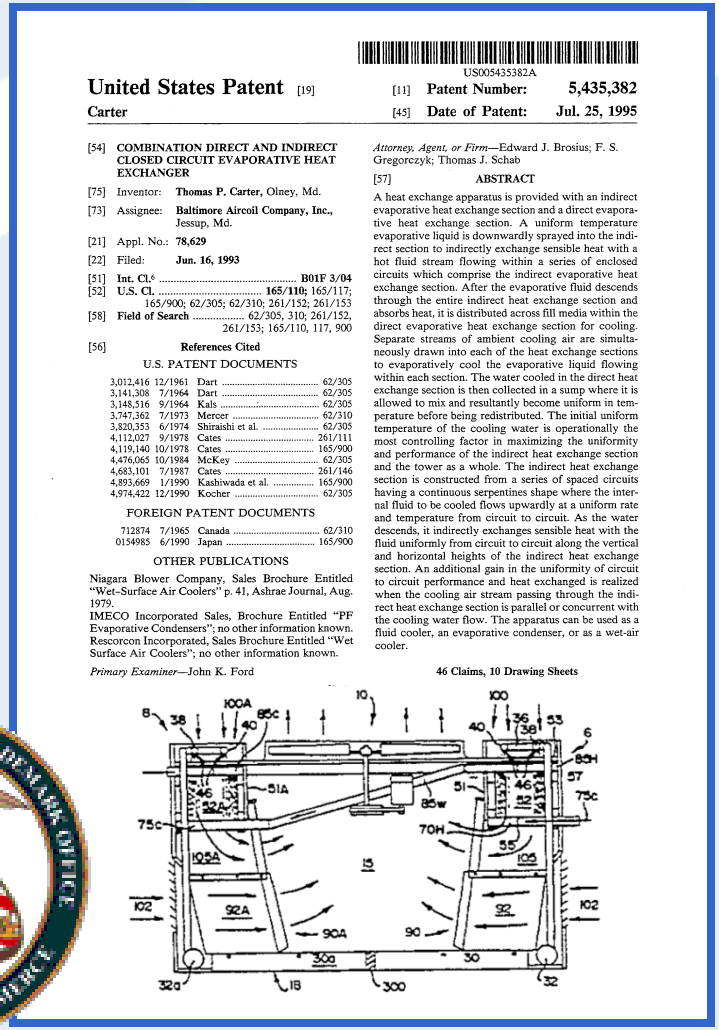
A closed circuit evaporative cooling product that uses water:

- Only when needed

- Only as much as needed

Combined Flow Technology

- Patented technology
- Introduced in 1995



US005435382A

United States Patent [19]

Carter

[11] **Patent Number: 5,435,382**

[45] **Date of Patent: Jul. 25, 1995**

[54] **COMBINATION DIRECT AND INDIRECT CLOSED CIRCUIT EVAPORATIVE HEAT EXCHANGER**

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[73] Assignee: **Baltimore Aircoil Company, Inc.,** Jessup, Md.

[21] Appl. No.: **78,629**

[22] Filed: **Jun. 16, 1993**

[51] **Int. Cl.**[6] **B01F 3/04**

[52] **U.S. Cl.** **165/110;** 165/117; 165/900; 62/305; 62/310; 261/152; 261/153

[58] **Field of Search** 62/305, 310; 261/152, 261/153; 165/110, 117, 900

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Primary Examiner—John K. Ford

Attorney, Agent, or Firm—Edward J. Brosius; F. S. Gregorczyk; Thomas J. Schab

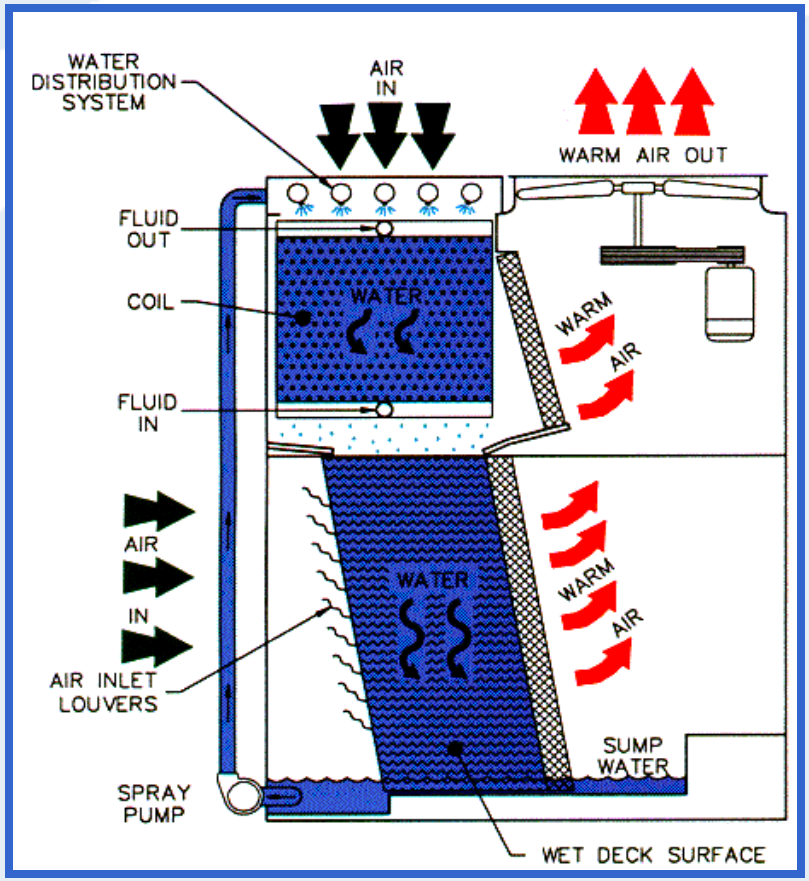
[57] **ABSTRACT**

A heat exchange apparatus is provided with an indirect evaporative heat exchange section and a direct evaporative heat exchange section. A uniform temperature evaporative liquid is downwardly sprayed into the indirect section to indirectly exchange sensible heat with a hot fluid stream flowing within a series of enclosed circuits which comprise the indirect evaporative heat exchange section. After the evaporative fluid descends through the entire indirect heat exchange section and absorbs heat, it is distributed across fill media within the direct evaporative heat exchange section for cooling. Separate streams of ambient cooling air are simultaneously drawn into each of the heat exchange sections to evaporatively cool the evaporative liquid flowing within each section. The water cooled in the direct heat exchange section is then collected in a sump where it is allowed to mix and resultantly become uniform in temperature before being redistributed. The initial uniform temperature of the cooling water is operationally the most controlling factor in maximizing the uniformity and performance of the indirect heat exchange section and the tower as a whole. The indirect heat exchange section is constructed from a series of spaced circuits having a continuous serpentines shape where the internal fluid to be cooled flows upwardly at a uniform rate and temperature from circuit to circuit. As the water descends, it indirectly exchanges sensible heat with the fluid uniformly from circuit to circuit along the vertical and horizontal heights of the indirect heat exchange section. An additional gain in the uniformity of circuit to circuit performance and heat exchanged is realized when the cooling air stream passing through the indirect heat exchange section is parallel or concurrent with the cooling water flow. The apparatus can be used as a fluid cooler, an evaporative condenser, or as a wet-air cooler.

46 Claims, 10 Drawing Sheets

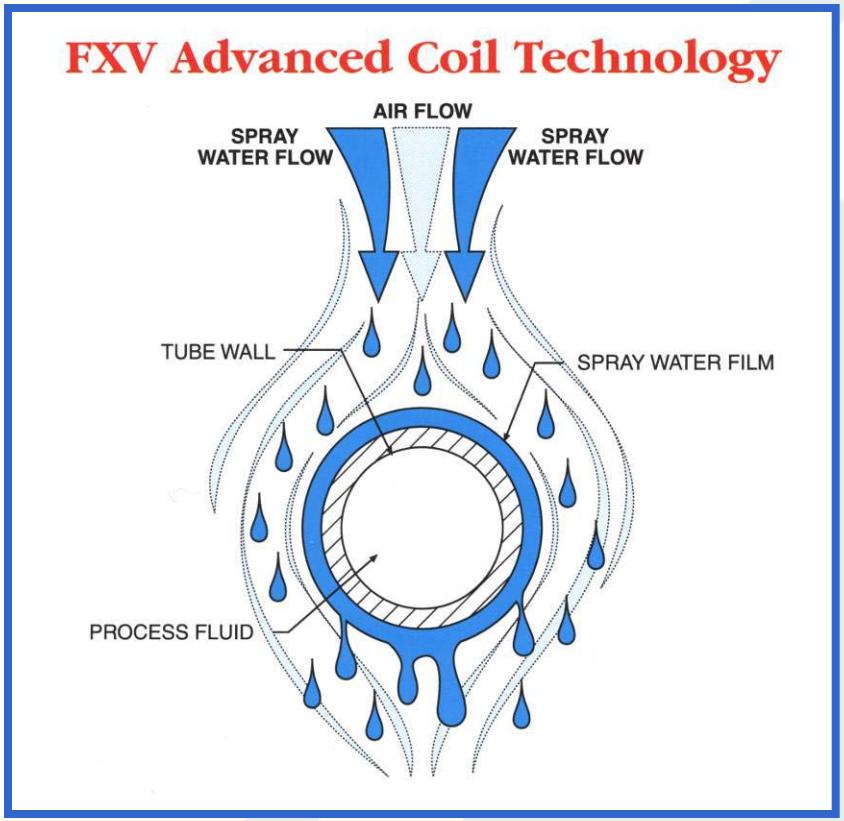
Advanced Coil Technology Story

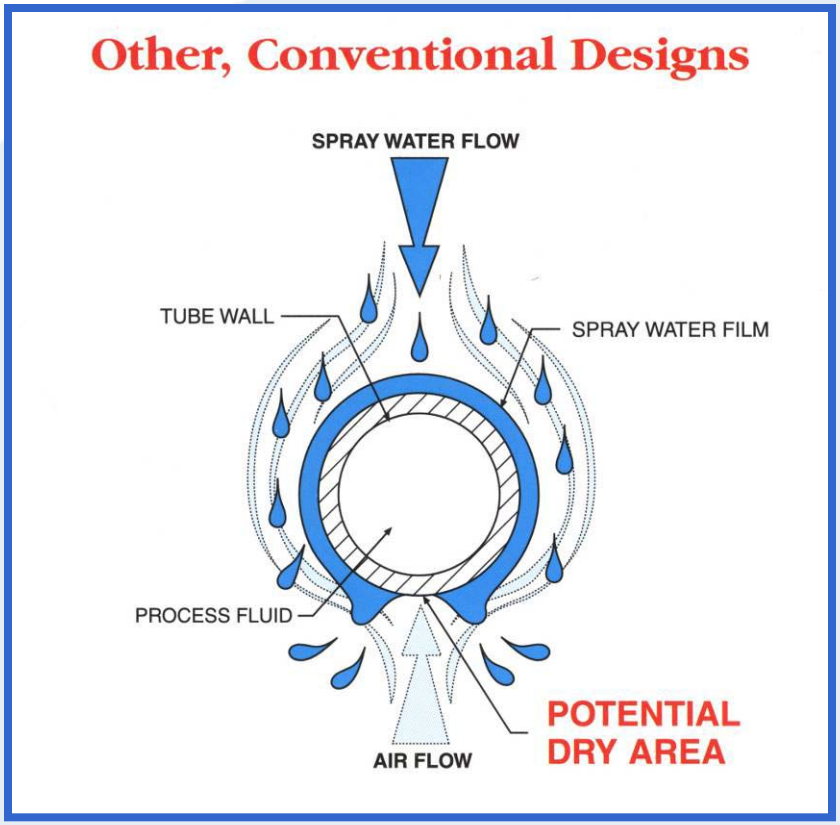
- 70% to 80% of evaporation occurs in the fill pack, not in the coil section
- Colder spray water for reduced fouling & scaling potential (LSI)
- Higher flow of spray water over the coil



Advanced Coil Technology Story

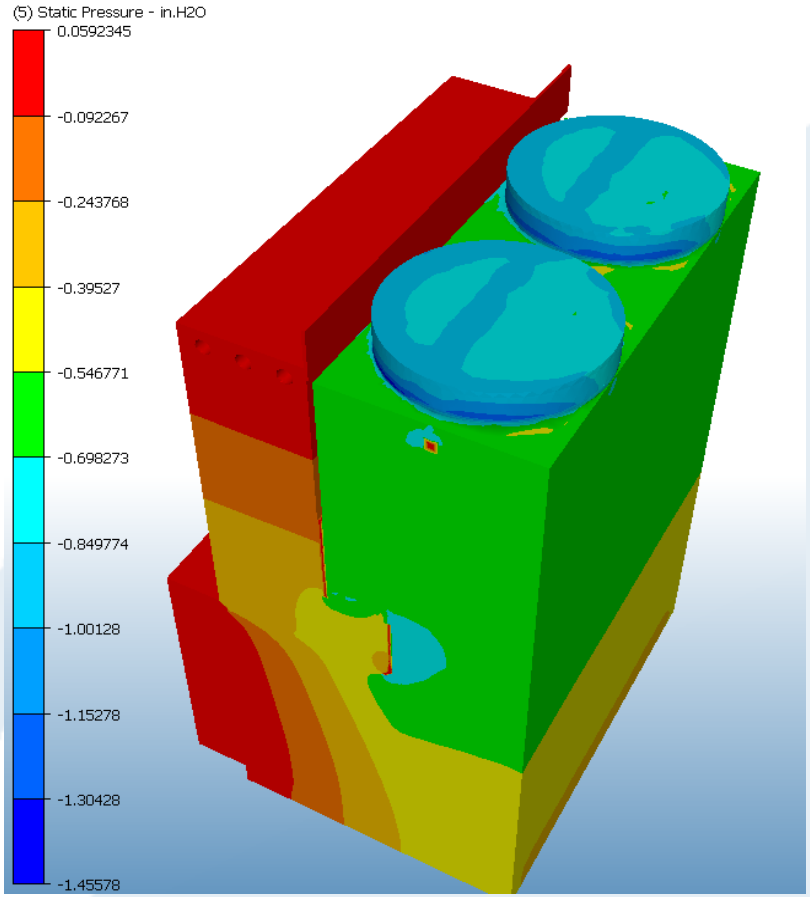
Increased Water Flow – Parallel to Airflow





Improved Airflow Through Unit

Higher Thermal Performance



Reduced Stress on Fan System for Longer Life

Computer Optimized Design Using CFD

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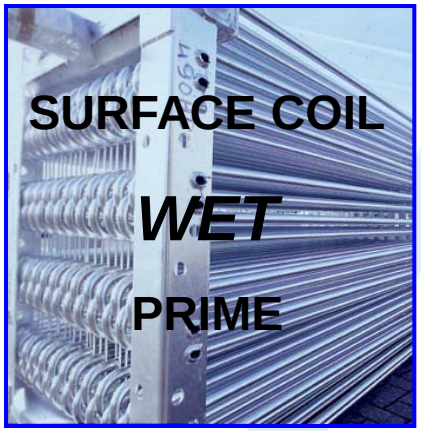
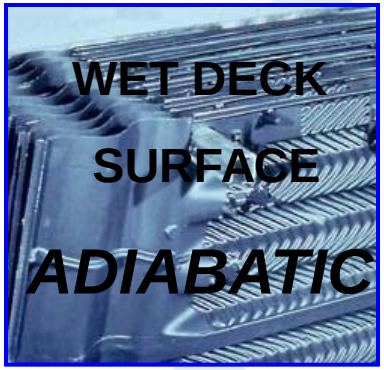
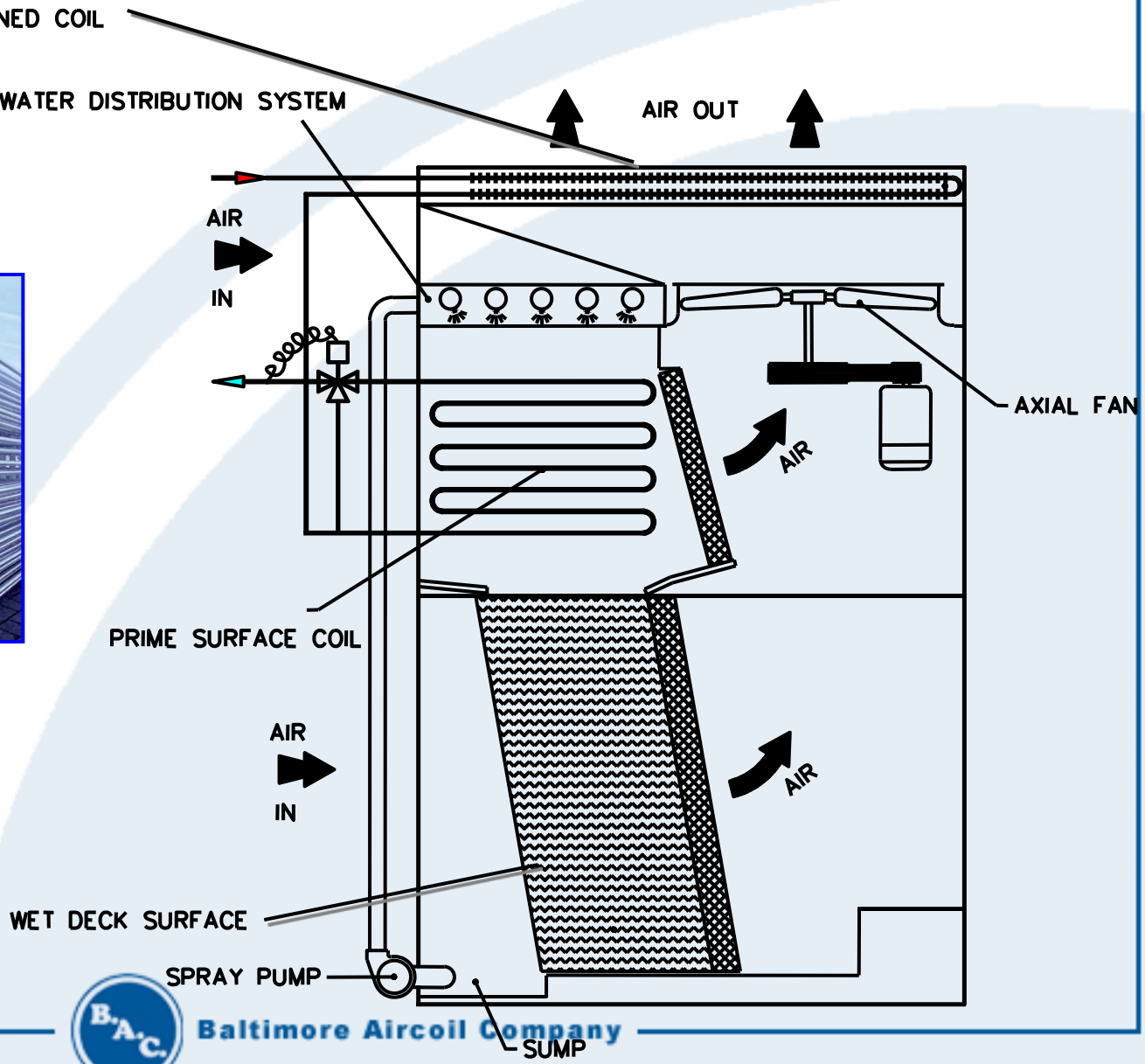
Three Heat Transfer Systems

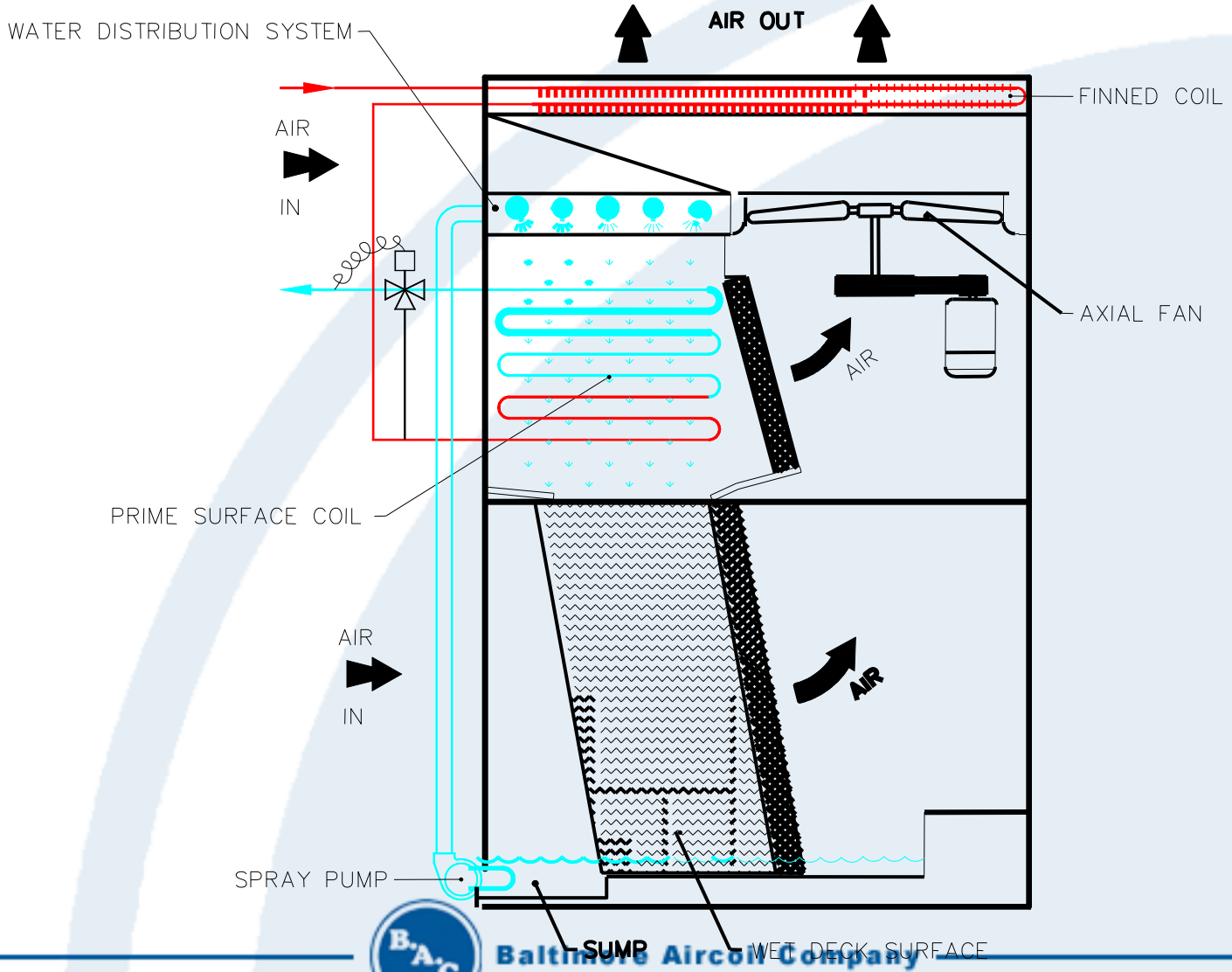






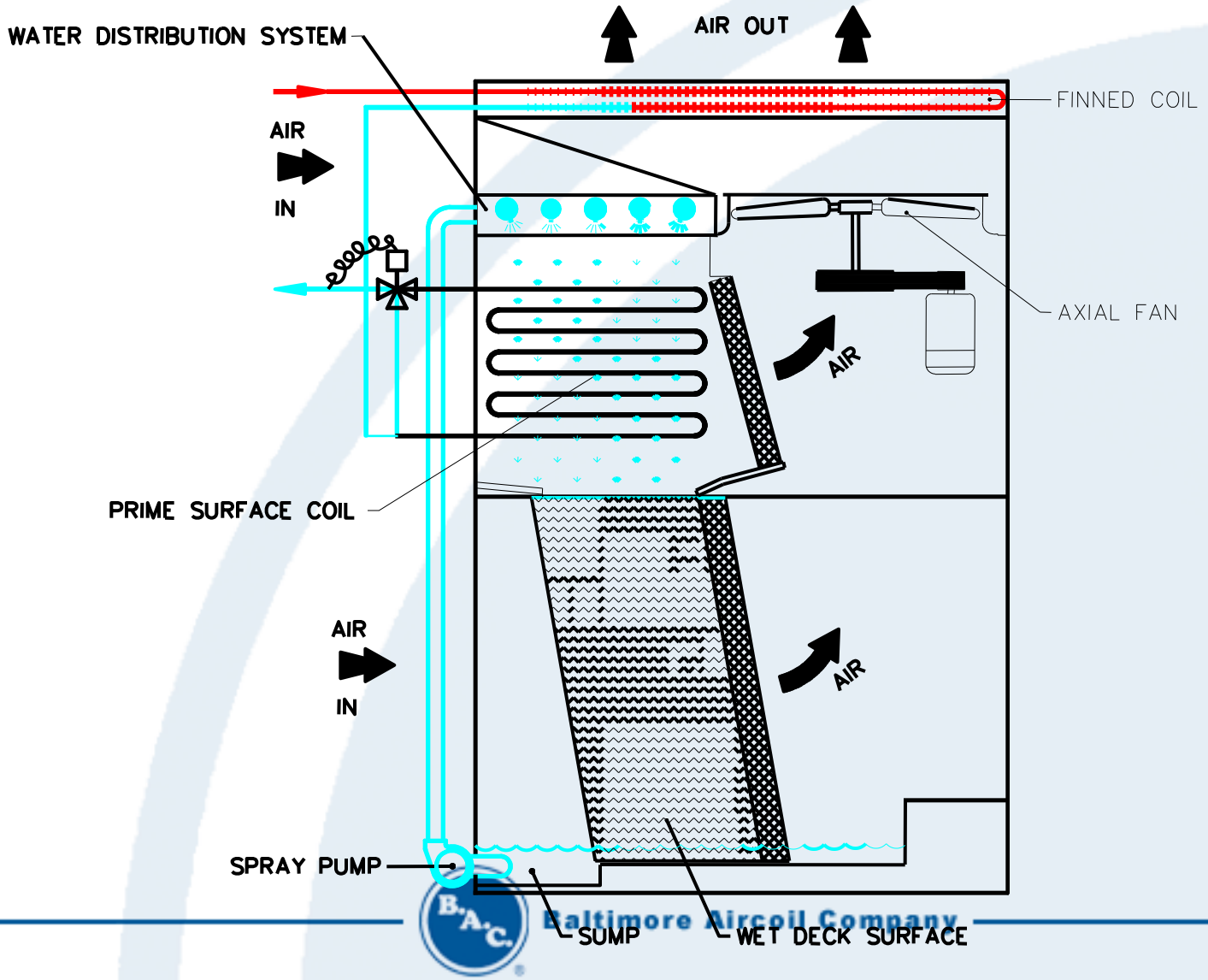
Dry / Wet Operation

3-way valve - modulating flow to wet coil



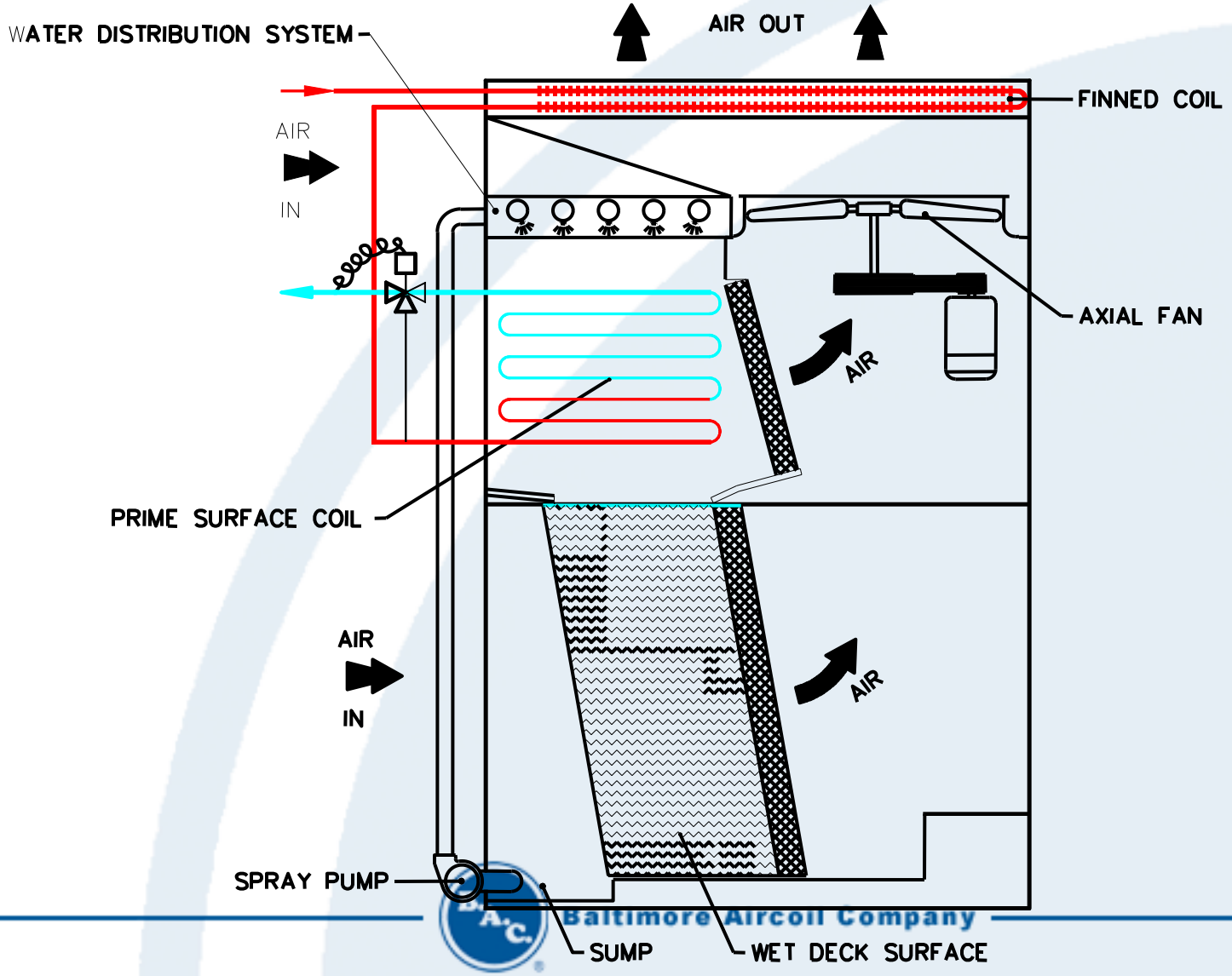
Adiabatic Operation

3-way valve - full bypass of wet coil



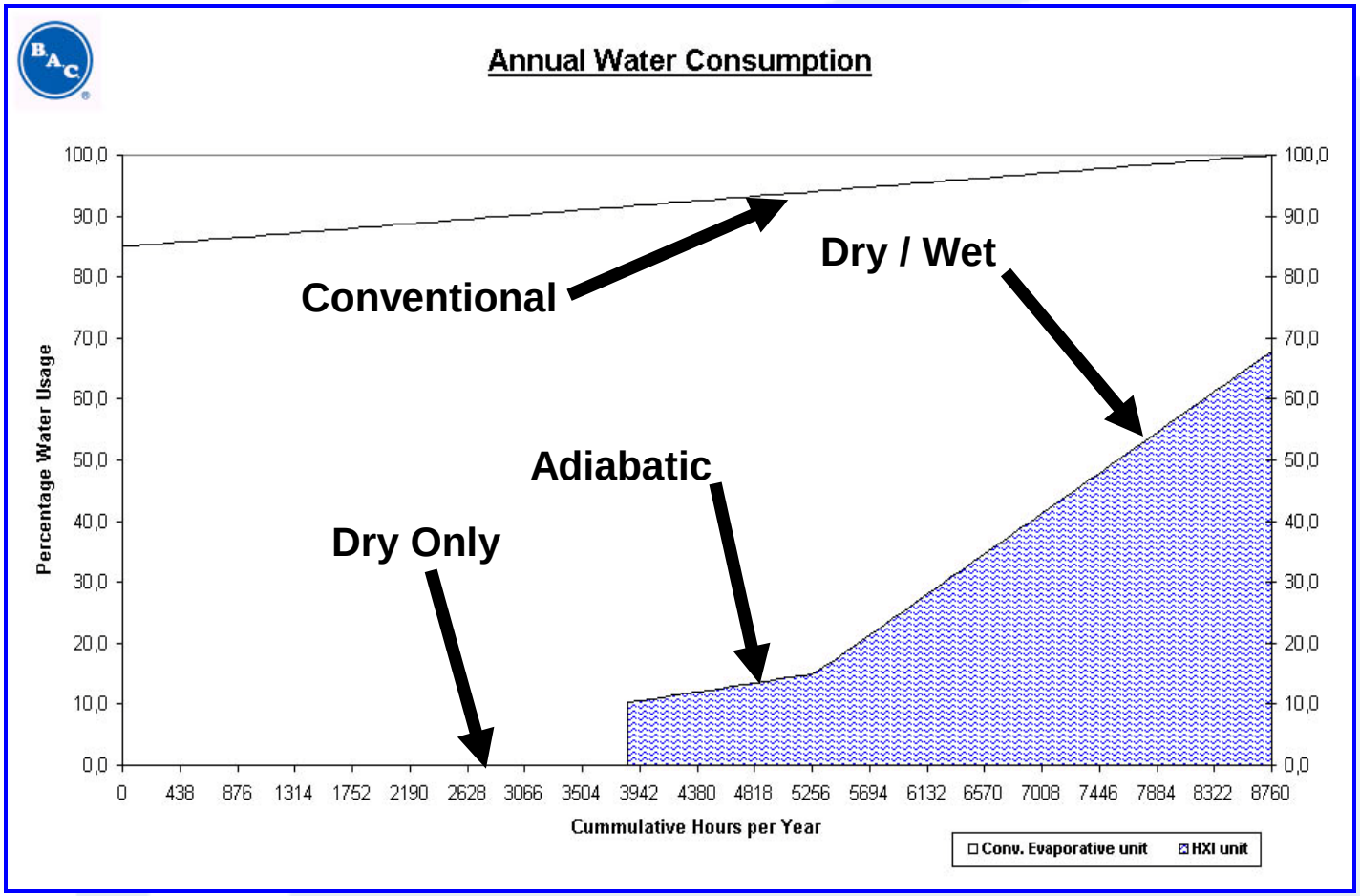
Dry Operation

3-way valve - no bypass



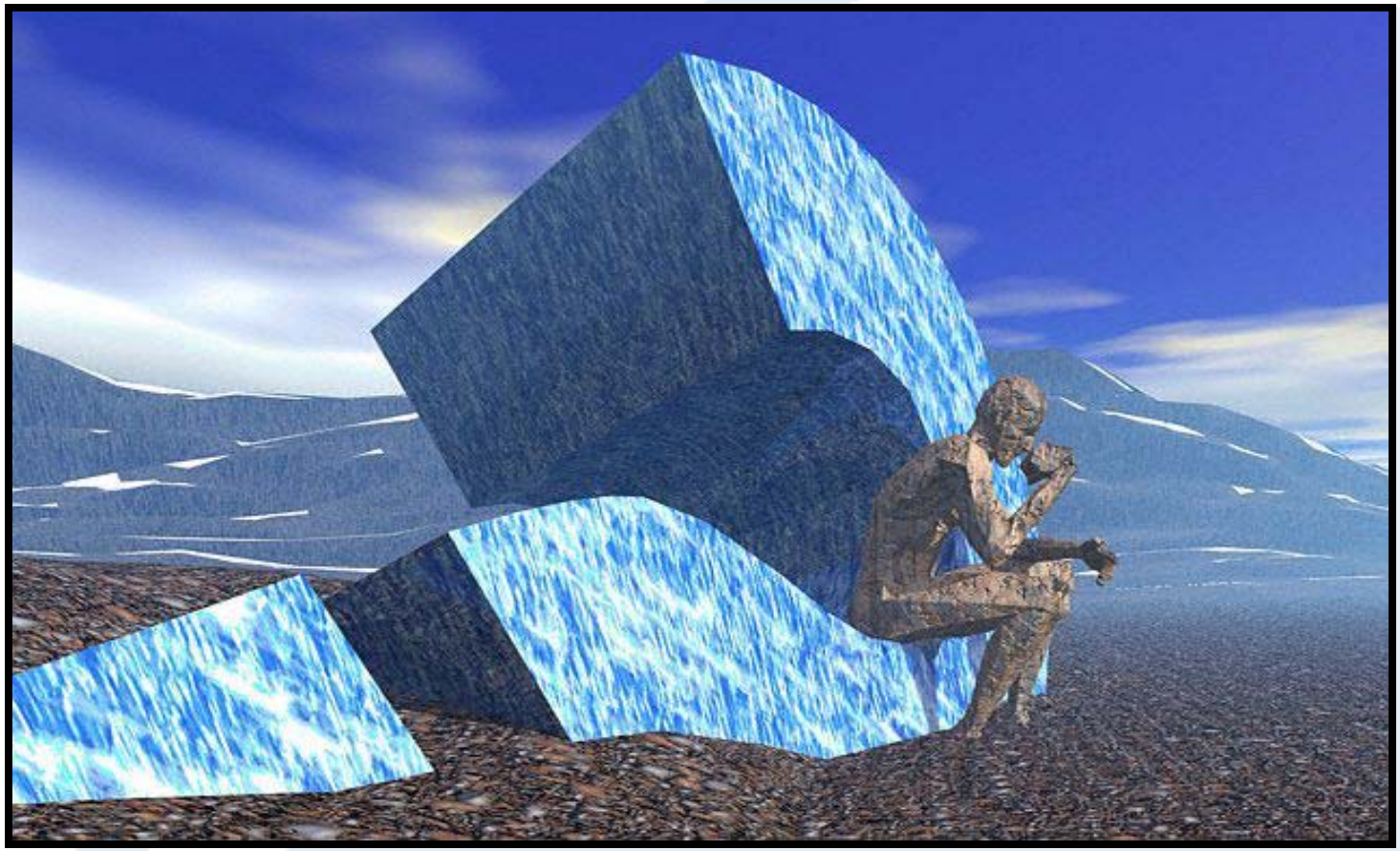
Water Usage Graph

Percentage Water Use



Cumulative Hours per Year

Wet / Dry Tower Advantages

- Contaminant-free closed loop cooling
- Low summertime fluid temperatures
- Up to 70% water savings
- Dry operation in sub-freezing conditions
- Inherently plume-free
- All-in-one product simplicity

Questions?