ICE-CEL

INTEGRATED SOLUTIONS BY DB

ICE-CEL

Tube-In-Tank
Ice Thermal Storage Systems

DUNHAM-BUSH®

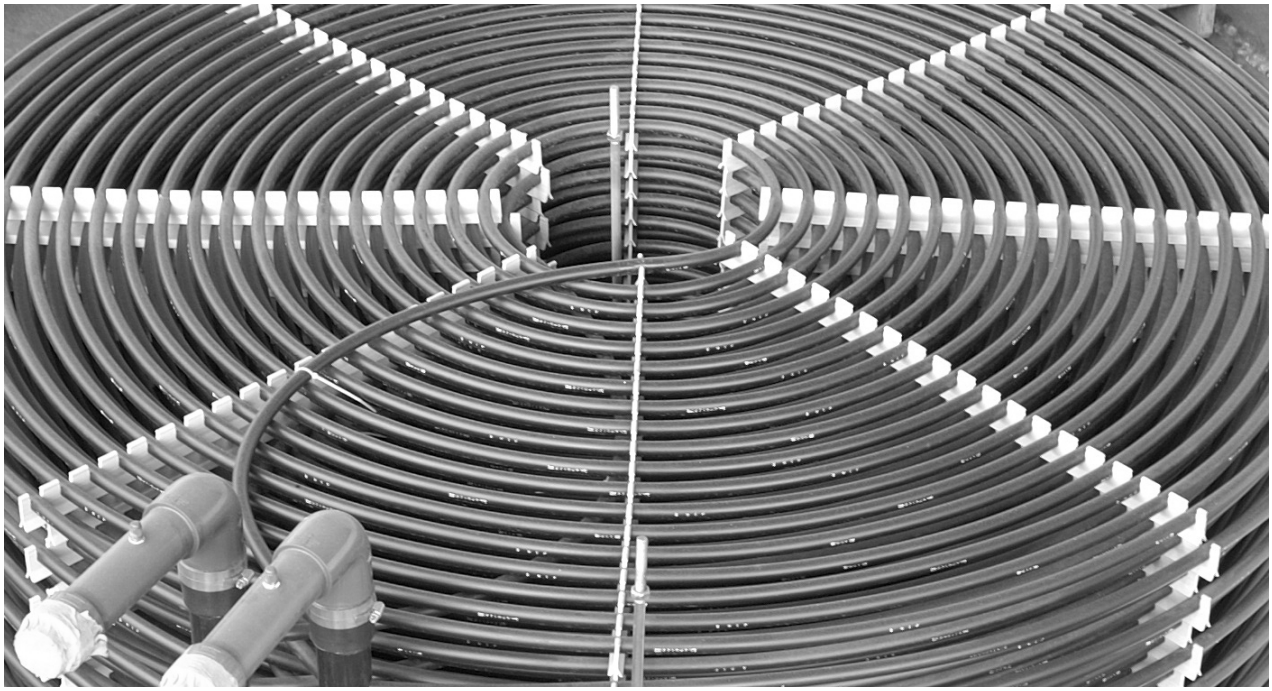
Products that perform...By people who care

WHY THERMAL STORAGE?

Thermal storage is a technology that has come of age. It meets today's need for flexible energy management. Whether you're the owner of a large building, a school executive, a hospital administrator or a manufacturer, you realize that energy costs are a major part of your annual budget, and a somewhat uncontrollable one. Today, you can do something about that. You can begin to manage your energy usage.

Thermal storage allows you to produce cooling when most convenient or least costly and use it for air conditioning or process cooling when you need it. You'll find that thermal storage is remarkably economical. In many cases, the equipment is no more costly than conventional, inflexible cooling systems. If you're adding cooling capacity to a given building or process, thermal storage can often provide it with no additional refrigeration equipment.

Building air conditioning systems using Ice-Cel thermal storage can be designed which cost little or no more than conventional chiller-only systems.



Ice-Cel is a modular ice thermal storage tank. The tank is filled with water, in which is submerged a polyethylene tube heat exchanger. A glycol solution at about 26°F [-3.3°C] flowing inside the tubes causes the surrounding water to freeze. The chilled glycol solution is typically provided by a chiller having about 24 TR [84 kW] of cooling capacity. When fully frozen, the Ice-Cel stores 240 TR-hours [844 kWh] of cooling capacity, so it requires about 10 hours operation of a 24 TR [84 kW] chiller to fully freeze the water in the tank.

Then to serve a cooling load, the ice can be melted at a rate dictated by load, ranging from 0 to 50 TR [0 to 176 kW]. For example, the Ice-Cel could serve a steady load of 20 TR [70 kW] for 12 hours. In providing cooling, the glycol solution flows from the Ice-Cel to the load device (such as an air handler) at a temperature of typically 34°F - 38°F [1.1°C - 3.3°C].

HOW TO USE IT

Ice-Cel is used mainly to store cooling capacity for air conditioning Most central air conditioning systems serving big buildings use electrically-driven liquid chillers. Chillers are often idle at night because little if any cooling is required at that time. When Ice-Cel thermal storage tanks are added to the system, the chiller can operate at night to store cooling capacity in the Ice-Cel. Then when cooling is needed during the day, it can be supplied by the Ice-Cel. This cooling can either supplement or replace the cooling available from daytime operation of the chiller.

ADVANTAGES OF THERMAL STORAGE

Demand Charge: Most big building utility rates include a heavy demand charge based on peak demand, which is usually experienced in summer daytime. Ice-Cel allows some of this peak demand to be shifted to low-demand nighttime periods, thus reducing demand charges for the entire year.

Energy Cost: Many electric utilities offer time-of-day or time-of-use electric rates, where each kWh of electric energy used at night costs less than in the daytime. In some cases, the nighttime rate is less than half the daytime rate. Ice-Cel, by utilizing the chiller at night, takes advantage of this incentive.

Rebates: Many electric utilities offer up-front rebates for equipment that will shift peak loads to off-peak hours. Thermal storage usually qualifies. In some cases, the rebate is large enough to pay for the purchase of Ice-Cel tanks.

Colder Air: With Ice-Cel thermal storage, chilled liquid is available at temperatures of 38°F [3.3°C] or less. rather than the 44°F or 45°F [6.6°C or 7.2°C] commonly available from liquid chillers. This lower temperature allows air handling units and ducts to be downsized and air handler fan power to be reduced. The result is colder air distribution, and lower room humidity. With lower humidity, a room's thermostat can be set slightly higher for the same comfort level, thus reducing air conditioning load. The net result is reduced installed cost and operating cost.

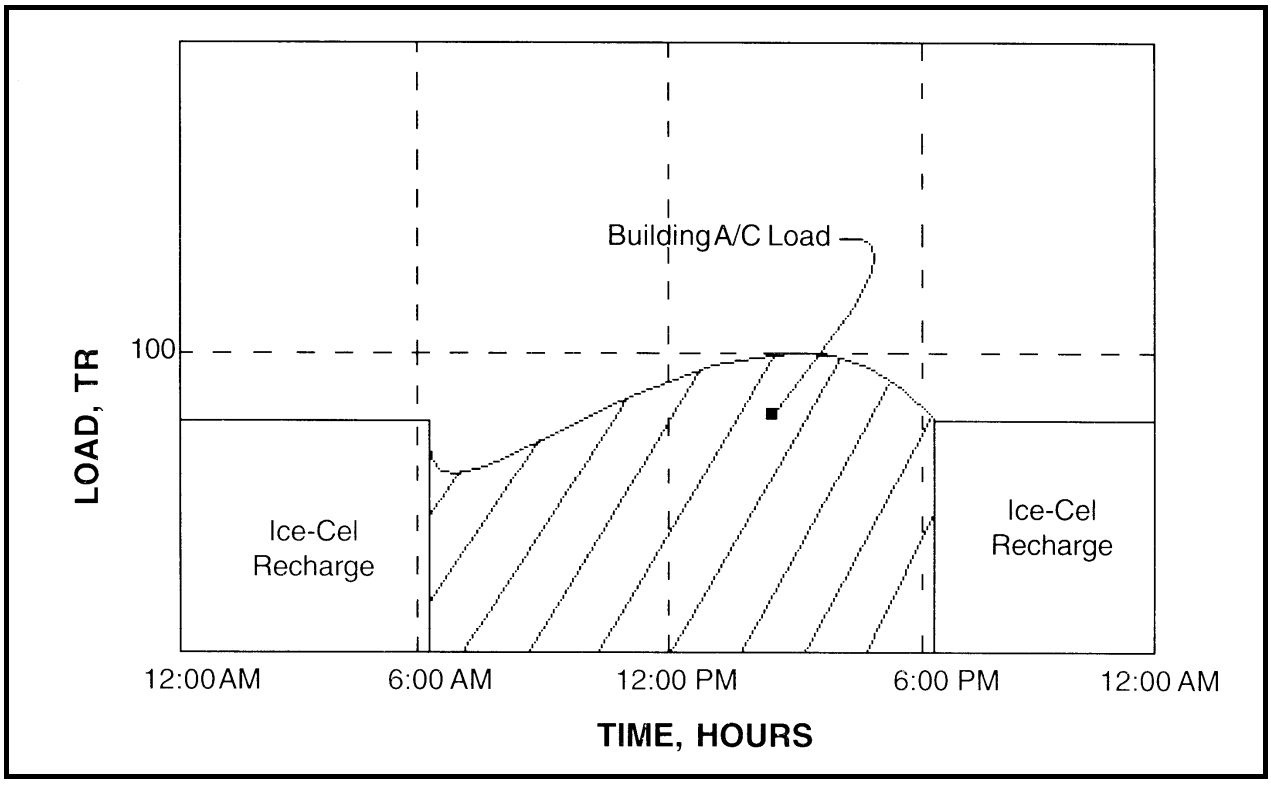
Standby Cooling Capacity: With Ice-Cel thermal storage,standby cooling capacity is available for peak load periods. So cooling capacity exceeds the instantaneous capacity of the installed chillers. This can be valuable for batch process cooling. where high short-term loads are encountered.

Ease of installation: Ice-Cel can be easily piped into an existing system, and it's easy to control. In fact, of the various types of thermal storage, the tube-in-tank is simplest, most compact, easiest to install and simplest to control. The Dunham-Bush Ice-Cel is specifically designed for ease of rigging and installation.

OPERATING STRATEGIES

THERE ARE TWO BASIC STRATEGIES

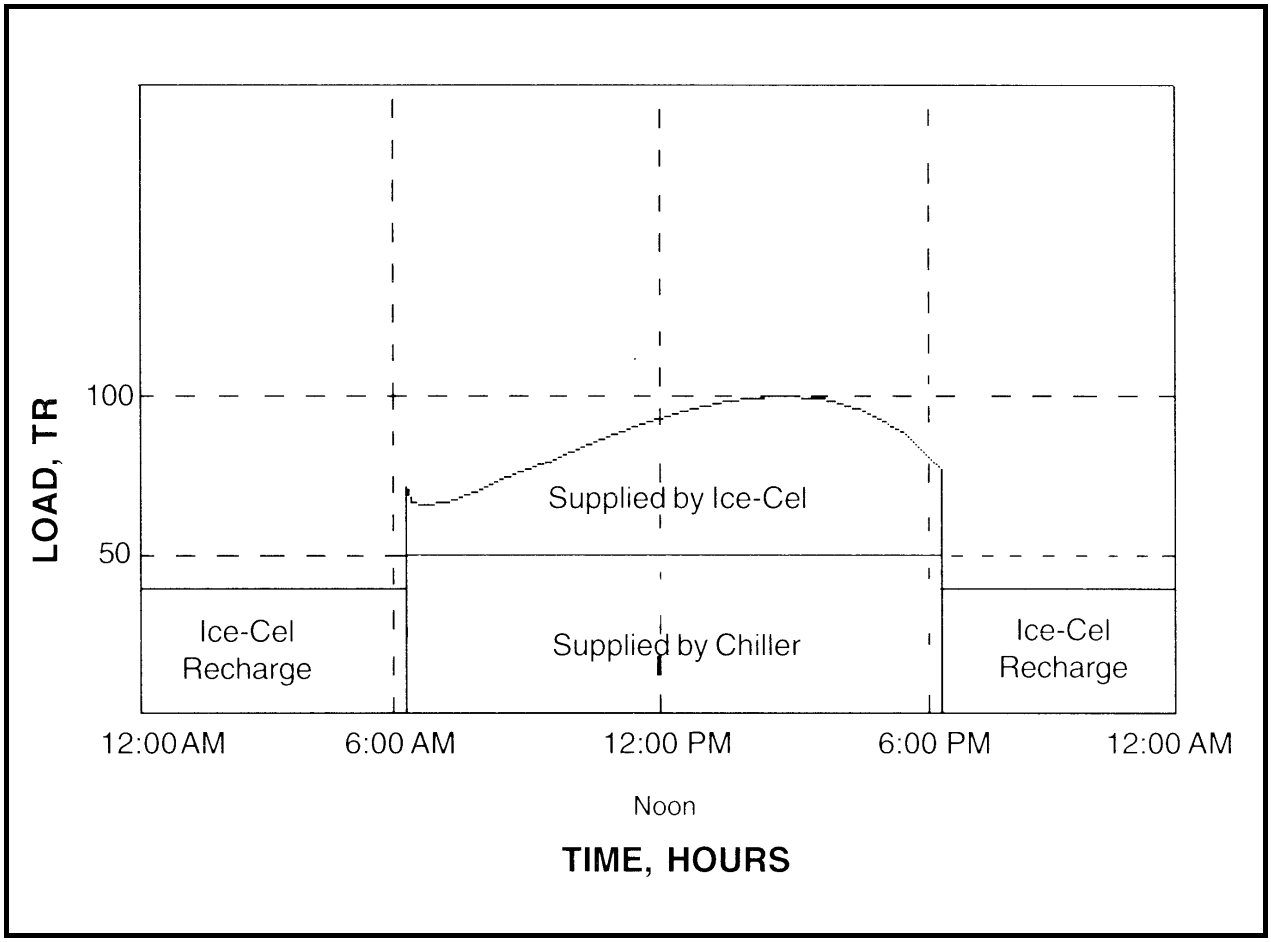
1. Full Storage



With full storage, the Ice-Cel tanks are applied with enough cooling capacity to meet the maximum expected daily cooling demand, and chiller capacity is provided to replenish the ice during the nighttime recharge period. For example, consider a building with 100 TR [352 kW] maximum cooling demand, operating from 7 a.m. to 7 p.m., with an 80% load factor. The maximum daily cooling demand is 12 hours x 100 TR x 0.80 = 960 TR-hours [3375 kWh]. If this is completely furnished by Ice-Cels, it will require 960/ 240 = 4 cels. To recharge the Ice-Cels during a 12 hour nighttime period will require chiller capacity of 960/ 12 = 80 TR [281 kW]. The advantage of full storage is that the chiller will not operate during the daytime peak demand period.

OPERATING STRATEGIES

2. Partial Storage



With Partial Storage, the liquid chiller is used at night to recharge the Ice-Cel and during the day to supplement the Ice-Cel in serving the air conditioning load. Using the same building example as above, we might choose to use 2 Ice-Cels, with 480 TR-hours storage capacity.

Then to recharge the Ice-Cel in 12 hours, we need chiller capacity of 480/12=40 TR [141 kW]. During the day, this chiller doing air conditioning duty will have about 57 TR [200 kW] capacity because of higher suction temperature.

Comparing the results of Full Storage vs. Partial Storage:

	Full Storage	**Partial Storage**
Capital Cost	100%	50%
Chiller Demand Reduction	100%	50%

ICE-CEL CONSTRUCTION

The Ice-Cel tank is a double-wall fiberglass tank with 1.8 inches [45 mm] of urethane foam insulation between the two walls. A removable cover of the same construction is provided. The tank insulation is so effective that heat leakage in 80°F [27°C] ambient air is limited to 0.14 TR [0.5 kW] or about 1% of total storage per day.

The heat exchanger consists of horizontal rows of serpentine coils of 0.75 inches [19 mm] OD polyethylene tubing held in a rigid bundle by radial plastic spacer bars.

Each coil of tubing is connected to vertical inlet and outlet headers of the same polyethylene material. Tubes are thermally welded into the headers to form one homogeneous heat exchanger no fittings or joints to leak. The heat exchanger is tested to 150 psig [1034 kPa] and rated for a maximum operating pressure of 100 psig [689 kPa].

All metal parts within the Ice-Cel that support the heat exchanger and secure it within the tank are made of corrosion-resistant materials; stainless or zinc-coated steel.

The Ice-Cel design is protected by U.S. Patent 5,109,920 and other patents pending.

PHYSICAL SPECIFICATIONS

Model		TS 240	TS 205	TS 180	TS 120
Diameter	**inches [m]**	101 [2.57]	89 [2.26]	89 [2.26]	89 [2.26]
Height	**inches [m]**	98.2 [2.50]	102 [2.59]	94.7 [2.40]	72.6 [1.84]
Volume of glycol solution	**USgal [l]**	310 [1174]	260 [985]	230 [870]	167 [632]
Volume of water	**USgal [l]**	2201 [8333]	1800 [6814]	1620 [6132]	1190 [4504]
Weight, empty	**lbs[kg]**	2826 [1282]	2491 [1130]	2251 [1021]	1861 [844]
Weight, total operating	**lbs[kg]**	23847 [10817]	20093 [9114]	18023 [8175]	14198 [6440]

ICE-CEL LOCATION

Because they are modular and of rugged construction, Ice-Cels can be located in any convenient place where there is a reasonably flat deck capable of supporting the weight. Typically, Ice-Cels are mounted on a concrete slab or structural framework, either in an equipment room or outdoors. They are also well suited to be buried in the ground.

GLYCOL SOLUTIONS

Ethylene glycol solutions have been most popular for ice thermal storage systems because of good heat transfer properties and low cost. However, recent EPA regulations regarding the toxic nature of ethylene glycol have made it less desirable to building owners.

Propylene glycol solution, which is non-toxic and therefore avoids EPA regulation, is also acceptable in Ice-Cel systems, providing performance equal to ethylene glycol at somewhat higher pressure drop.

Whichever glycol solution is chosen, it is important that the correct inhibitors be included in the solution, compatible with the materials of typical HVAC systems: copper, steel, brass and plastic. Uninhibited or automotive glycols are unacceptable in HVAC Systems.

PERFORMANCE SPECIFICATIONS

Model		TS 240	TS 205	TS 180	TS 120
Total storage capacity based on heating tank water to 50°F	**TR-hours**	240	205	180	120
Latent storage capacity based on melting ice to water at 32°F	**TR-hours**	210	180	160	109

For detailed performance data, contact your Dunham-Bush sales representative.

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