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Why Ice Storage?

Stored cooling, because of its lower first cost and operating cost, is now widely recognized as an excellent answer to the increasing cost of operating today’s cooling systems. Generating and storing cooling capacity at a constant rate during off-peak hours results in smaller cooling equipment being used, reducing maximum system peak electrical demand and taking advantage of lower, off-peak energy costs.

Ice storage, in particular, has emerged as the most practical method of storing cooling capacity. The high latent heat of fusion of ice permits large capacity storage in a relatively small space, and the low melting temperature of ice provides the cooling system with a constant source of low temperature chilled water.

Ice storage is a proven technology that has been used for decades in churches, dairies, breweries and theaters due to the advantages of lower first cost, reduced energy cost and minimum space requirements. Today with these advantages, ice storage provides lower cost cooling on a wider variety of process/batch cooling systems, industrial refrigeration and comfort cooling applications.

Lower First Cost

Cooling systems using BAC ICE CHILLER® Thermal Storage Units can be installed for the same or lower first cost than conventional instantaneous cooling systems. This important breakthrough results from:

**Smaller Refrigeration System**

When designed to operate on a 24-hour basis, or when the time available for building ice is significantly greater than the duration of the load, a smaller refrigeration system is required compared to a chiller sized for an instantaneous peak load.

**Smaller Electrical Equipment and Wiring**

Electrical equipment and wiring costs are also lower since the smaller mechanical equipment can reduce connected horsepower by over 50%.

For most system requirements, these significant savings will exceed any cost premium associated with the ice storage equipment.

Reduced Energy Cost

With less connected horsepower, ice storage can lower electrical demand charges by over 50%. In addition, total annual kilowatt-hours used can be less than with a conventional instantaneous cooling system. As an increasing number of electric utility companies impose rate schedules with higher peak demand charges and/or time-of-use rates, ice storage can provide even greater future savings in operating costs.

Space Savings

Ice has proven to be the most space efficient thermal storage system. Since ice storage systems utilize the latent heat of fusion, they require approximately one-fourth the volume of an equivalent capacity chilled water storage system.

Industrial Cooling

For industrial applications, stored cooling using ICE CHILLER® Thermal Storage Units provides many opportunities for savings: smaller compressors and likewise smaller system components and electrical equipment; shifting or leveling of energy usage peaks; and efficient use of equipment. Also, since ice storage systems are sized to operate primarily at full capacity, compressor wear from capacity adjustment is minimized, providing maintenance savings over the life of the compressor. Stored cooling from ICE CHILLER® Thermal Storage Units supplies consistently low temperature water, making them appropriate for daily and/or infrequent cooling loads in many industrial processes such as:

- Bakeries
- Dairies
- Breweries, Wineries, Distilleries
- Chemical/Plastics Manufacturers
- Laboratories
- Food Product Cooling
- Bottling Process
- Vegetable/Fruit Cooling
**Principle of Operation**

The basic ice storage system includes an ICE CHILLER® Thermal Storage Unit, a refrigeration system, and ice water pump as shown below in Figure 1.

When no cooling load exists, the refrigeration system operates to build ice on the outside surface of the coil. This refrigeration effect is provided by feeding refrigerant directly into the coil. To increase the heat transfer during the ice build cycle, the water is agitated by air bubbles from a low pressure distribution system beneath the coil. When the ice has reached design thickness, BAC’s exclusive ICE-LOGIC™ Ice Thickness Controller sends a signal to turn off the refrigeration system.

When chilled water is required for cooling, the ice water pump is started, and the meltout cycle begins. Warm water returning from the load circulates through the ICE CHILLER® Thermal Storage Unit and is cooled by direct contact with the melting ice. During this cycle, the tank water is agitated to provide more uniform ice melting and a constant supply water temperature of 34° to 36°F.

For a closed chilled water loop, see Figure 2. With this system, warm return water from the load is pumped through a heat exchanger and cooled by the ice water circuit from the ICE CHILLER® Thermal Storage Unit.
Energy Efficient Design

The ICE CHILLER® Thermal Storage Unit coils are designed for efficient energy use in building ice and constant leaving water temperatures during the meltout cycle.

Compared to traditional ice builders used in the past for industrial refrigeration, the ICE CHILLER® Thermal Storage Unit design with its smaller diameter coil circuits and thinner ice (Figure 3) results in more evaporator surface per ton-hour of latent storage. Ice builds to a thin 2.0 inches, which results in more than a 16% gain in refrigeration system efficiency by permitting compressor operation at higher suction pressures.

The BAC ICE CHILLER® Thermal Storage Unit is specifically designed to provide consistent 34°- 36°F supply water temperatures throughout the melt cycle. Two keys to maintaining this consistently low temperature are an extensive ice surface area and direct contact of the water to be cooled with the ice. As shown in Figure 3, the unique BAC coil design provides over 30% more ice surface than traditional designs. This provides a greater surface area for the warm return water to come into direct contact, making consistent cold temperatures available throughout the entire melt cycle.

The ICE CHILLER® Thermal Storage Unit is designed for efficient operation with either of two liquid refrigerant feed systems: gravity flooded with surge drum or pumped recirculation. With either arrangement, liquid refrigerant is supplied to the coils at a rate several times greater than that required to satisfy the load. This excess flow rate thoroughly wets the entire internal surface of the coil, assuring high heat transfer coefficients throughout to efficiently utilize the entire coil surface for ice building.

ICE-LOGIC™ ICE Thickness Controller

All BAC ICE CHILLER® Thermal Storage Units are furnished with the exclusive ICE-LOGIC™ ICE Thickness Controller. This state-of-the-art controller was designed by BAC to provide maximum operating efficiency by enabling the operator to limit the ice build to only the amount needed for the next cooling cycle.

The ICE-LOGIC™ Controller operates by sensing the difference in the electrical resistance between water and ice. When the desired amount of ice is built, the change in resistance opens a control relay which typically deactivated the refrigeration system. A series of probes are employed, accurately positioned to detect ice thickness corresponding to 20, 40, 60, 80, and 100 percent of design ice storage. The amount of ice required for the next cooling cycle can be conveniently set on the face of the control box. In addition, the ICE-LOGIC™ Controller contains the necessary logic to prevent unwanted compressor cycling after the desired ice build is complete. The controller requires approximately 20 percent of the ice to be melted before the control relay is activated. Lights on the face of the control panel indicate the current status of the relay.

By building only the amount of ice needed, the operating time for the refrigeration system and the kilowatt-hours of energy used are kept at the lowest possible levels for maximum system efficiency.
**Construction Details**

4 **AIR BLOWER**
Centrifugal regenerative blower for field mounting to supply low pressure air for agitation of the water. Blower is furnished with an inline air filter, check valve and rain shield for field installation.

5 **COVERS**
Sectional insulated tank covers are provided with a thermosetting hybrid polymer. Covers are interlocking and rain shedding.

6 **COIL**
The coil is constructed of multiple prime surface serpentine steel circuits and tested at 375 psig air pressure under water. It is encased in a steel frame, and the entire assembly is hot-dip galvanized after fabrication. For ammonia systems, purge connections are provided on each coil for oil maintenance.

7 **ICE-LOGIC™ ICE THICKNESS CONTROLLER**
An electronic, multi-point adjustable ice thickness control is mounted on the unit. A control relay is provided for deactivating the refrigeration system when a full build of ice is reached.

3 **EXTERIOR PANELS**
Exterior panels sealed at all seams provide a complete vapor barrier and protect the insulation. They are furnished with a thermosetting hybrid polymer.

2 **INSULATION**
Expanded polystyrene insulation is provided between the tank and the exterior panels. The insulation is three inches thick (R-13) on the tank sides and ends, two inches thick (R-8) on the bottom and one inch thick inside the covers.

8 **AIR DISTRIBUTOR**
Low pressure air from the air blower is distributed below the coils through multiple perforated Schedule 40 PVC pipes.

1 **TANK**
The tank is constructed of heavy gauge, hot-dip galvanized steel reinforced with full-length structural steel angles beneath and on all four sides. All seams are welded to ensure watertight construction. A zinc rich coating is applied to all exposed edges and welds.
Selection Flexibility

System Design Flexibility

The system design involving an ICE CHILLER® Thermal Storage Unit can range from full storage to partial storage of the cooling load requirements.

Full Storage
With full storage, the ICE CHILLER® Thermal Storage Unit generates and stores ice to handle the entire cooling load. The refrigeration system operates to build the ice only during no-load periods when utility rates are usually lowest. This design offers the maximum energy cost savings, but requires the largest ice storage capacity and refrigeration system.

Partial Storage
A partial storage system builds ice during no-load periods as with the full storage system. However, the refrigeration system continues to operate during the cooling load period. The compressor operation supplements the stored cooling capacity of the ICE CHILLER® Thermal Storage Unit to satisfy the cooling requirements. Since a portion of the cooling requirement is supplied by the refrigeration system, a partial storage system will require less storage capacity.

Parallel Chilled Water Evaporator
The most common type of partial ice storage is the parallel evaporator system. During the melt cycle, cooling is provided by the refrigeration system to a separate evaporator for direct water chilling. By using a separate evaporator, the refrigeration system gains system efficiency from operation at higher suction pressures.

The refrigeration system will operate continuously during full design load. At less than full load the compressor operates only as needed to supplement the ICE CHILLER® Thermal Storage Unit. When the load is less than 50% of design, this system can operate in the full storage mode. Systems which often operate at part load can benefit most from a partial system with equipment sizes typically over 50% smaller than required for full storage.

For additional information on ICE CHILLER® Thermal Storage Units and their system design options consult your BAC Representative.

System Load
The system load is the amount of cooling capacity that must be generated and stored, expressed in ton-hours or Btu. (1 ton-hour = 12,000 Btu = 83.3 pounds of ice). This load is equal to the area under the typical system load profile curve (figure 4) shown below.

TSU Selection

Full Storage
1. From the system load profile (figure 4) establish the required system cooling capacity in ton-hours. This is the ton-hours of storage required.
2. Determine the build time, which is the number of hours with no load that is available for ice building. If less than ten (10) hours, consult your BAC Representative.
3. For a gravity flooded ammonia feed system, continue the selection with the gravity flooded procedure on page J7. For a pump recirculated ammonia feed system, continue the selection with the pump recirculated procedure on page J8.

Parallel Chilled Water Evaporator Partial Storage
1. From the system load profile (figure 4), establish the required system cooling capacity in ton-hours and the number of hours this cooling is needed.
2. Determine the cooling capacity in tons of the compressor operating with the parallel evaporator (figure 5) during the cooling load hours established in Step 1.
3. Multiply the cooling capacity of the compressor operating with parallel evaporator found in Step 2 times the number of cooling load hours found in Step 1. This gives the capacity in ton-hours that will be handled by direct refrigeration during the cooling period.
4. Subtract the direct cooling ton-hours found in Step 3 from the total system cooling capacity found in Step 1. This is the storage capacity in ton-hours that are required in ice storage.
5. Determine the build time, which is the number of hours with the compressor dedicated to ice building. If less than (10) ten hours, consult BAC Representative.
6. For gravity flooded ammonia feed system, continue the selection with the gravity procedure on page J7. For a pump recirculated ammonia feed system, continue the selection with the pump recirculated procedure on page J8.
**Unit Selection – Ammonia**

**Application Notes**

1. To use the selection procedures outlined below, the ton-hours of storage capacity required and the available build time must first be known. For guidance on estimating these values refer to the TSU selection on pages J6 or contact your local BAC Representative.

2. The evaporator temperatures for each build time are “average” values. During the build cycle, the temperature will initially be about 8°F above the “average” and gradually drop through the cycle to about 4°F below the “average” when full ice is reached. Throughout the cycle the refrigeration system should be allowed to run fully loaded. Reciprocating and rotary screw compressors are suitable for this duty. If in doubt about the use of a particular compressor, review the application with the compressor manufacturer.

### Selection Procedure – Gravity Flooded

1. Enter Table 1 and read down the base ton-hours column to the capacity which meets or exceeds the ton-hours of storage required. Select either an E, F, or G series unit. (Units are grouped by tank width in Table 1. Refer to pages J9 thru J12 for unit dimensions.)

2. Read the selected unit from the model number column on the left.

3. Calculate the Storage Factor for the selected unit.

\[
\text{Base Ton-Hours} = \frac{\text{Storage Factor}}{\text{Ton-Hours of Storage Required}}
\]

4. Using the Storage Factor from Step 3 and the available build time, enter Table 2 to find the design evaporator temperature.

5. Determine the design compressor capacity in tons.

\[
\text{Ton-Hours of Storage Required} = \frac{\text{Compressor Tons}}{\text{Build Time (Hrs)}}
\]

6. Using the design conditions from Steps 4 and 5, select a compressor. (Note: The evaporator temperature must be adjusted for the system suction line losses to arrive at the compressor saturated suction temperature.)

7. Once the compressor has been selected, use the compressor manufacturer’s heat rejection data to size a BAC Evaporative Condenser or Cooling Tower.

**EXAMPLE:** Gravity Flooded Ammonia

Given: 16,700 lbs ice required storage capacity

14 hours available build time

To get Ton-Hours of storage required:

\[
16,700 \text{ lbs ice required storage capacity} = 201 \text{ Ton-Hours}
\]

### Table 1: Base Storage Capacity (ton-hours) For Gravity Flooded Ammonia Feed

<table>
<thead>
<tr>
<th>E-Series Units</th>
<th>F-Series Units</th>
<th>F-Series Units</th>
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<tr>
<td>TSU-1080E</td>
<td>968</td>
<td>TSU-1230F</td>
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</table>

4. Using the Storage Factor of 1.05 from Step 3 and the build time of 14 hours, enter Table 2 to find the design evaporator temperature of 19.9°F.

5. Calculate the design compressor capacity.

\[
\text{201 Ton-Hours of Storage Required} = 14.4 \text{ Tons}
\]

6. Based on the design evaporator conditions of 14.4 tons at a 19.9°F evaporator temperature (17.9°F saturated suction temperature, with 2.0°F estimated suction line losses), select an ammonia refrigerant compressor.

7. Select a BAC Evaporative Condenser or Cooling Tower to match the compressor manufacturer’s heat rejection requirements.
Selection Procedure – Pump Recirculated

1. Enter Table 3 and read down the base ton-hours column to the capacity which meets or exceeds the ton-hours of storage required. Select either an E, F, or G Series unit. (Units are grouped by tank width in Table 3. Refer to pages J9 thru J12 for unit dimensions.)

2. Read the selected unit from the model number column on the left.

3. Calculate the Storage Factor for the selected unit.

4. Using the Storage Factor from Step 3 and the available build time, enter Table 4 to find the design evaporator temperature.

5. Determine the design compressor capacity in tons.

6. Using the design conditions from Steps 4 and 5, select a compressor. (Note: The evaporator temperature must be adjusted for the system suction line losses to arrive at the compressor saturated suction temperature.)

7. Once the compressor has been selected, use the compressor manufacturer’s heat rejection data to size a BAC Evaporative Condenser or Cooling Tower.

EXAMPLE: Pump Recirculated Ammonia

Given: 700 Ton-Hours Required Storage
        11 Hours Available Build Time

1. Enter the base ton-hours column of Table 3 and find 771 ton-hours, which is the smallest value that meets or exceeds the 700 ton-hours of storage required.

2. Read to the left to find the selected model number, in this case a TSU-800F.

3. Calculate the Storage Factor.

4. Using the Storage Factor of 1.10 from Step 3 and the build time of 11 hours, enter Table 4 to find the design evaporator temperature of 17.7 °F.

5. Calculate the design compressor capacity.

6. Based on the design evaporator conditions of 63.6 tons at a 17.7 °F evaporator temperature (15.7 °F saturated suction temperature, with 2.0 °F estimated suction line losses), select an ammonia refrigerant compressor.

7. Select a BAC Evaporative Condenser or Cooling Tower to match the compressor manufacturer’s heat rejection requirements.
Engineering Data

Nominal 5’ wide units:
Models TSU-125E to TSU-235E and TSU-145F to TSU-270F

Do not use for construction. Refer to factory certified dimensions. This handbook includes data current at the time of publication, which should be reconfirmed at the time of purchase.

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Support
ICE CHILLER® Thermal Storage Units should be continuously supported on a flat level surface.

Notes:
1. All dimensions are in feet and inches. Weights are in pounds.
2. Lbs. of Ice Capacity is based on R-717. For other refrigerants, consult your BAC Representative.
3. Dimensions showing location of connections are approximate and should not be used for prefabrication of connecting piping.
4. Dimension is installed height. Coils are capped for shipping and storage. Add 3 inches for shipping height.
5. Refrigerant charge listed is operating charge for gravity flooded system at 15°F. For other feed systems, consult your BAC Representative.
Engineering Data

Nominal 8’ and 10’ wide units:
Models TSU-190E to TSU-505E and TSU-220F to TSU-580F

Do not use for construction. Refer to factory certified dimensions. This handbook includes data current at the time of publication, which should be reconfirmed at the time of purchase.

**E Series**

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<th>Model Number</th>
<th>LBS of Ice</th>
<th>Gravity Flooded</th>
<th>Pump Recirculated</th>
<th>Approx. Shipping Wgt (LBS)</th>
<th>Approx. Operating Wgt (LBS)</th>
<th>Air Pump HP</th>
<th>Water Volume (GAL)</th>
<th>Pull Down Volume (GAL)</th>
<th>Coil Volume (FT²)</th>
<th>R-717 Charge (LBS)</th>
<th>Water Conn In/Out</th>
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**F Series**

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<th>LBS of Ice</th>
<th>Gravity Flooded</th>
<th>Pump Recirculated</th>
<th>Approx. Shipping Wgt (LBS)</th>
<th>Approx. Operating Wgt (LBS)</th>
<th>Air Pump HP</th>
<th>Water Volume (GAL)</th>
<th>Pull Down Volume (GAL)</th>
<th>Coil Volume (FT²)</th>
<th>R-717 Charge (LBS)</th>
<th>Water Conn In/Out</th>
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<td>705</td>
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<td>7’ 10-1/2&quot;</td>
<td>18’ 0&quot;</td>
<td>6&quot;</td>
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Support

ICE CHILLER® Thermal Storage Units should be continuously supported on a flat level surface.

Notes:
1. All dimensions are in feet and inches. Weights are in pounds.
2. Lbs. of Ice Capacity is based on R-717. For other refrigerants, consult your BAC Representative.
3. Dimensions showing location of connections are approximate and should not be used for prefabrication of connecting piping.
4. Dimension is installed height. Coils are capped for shipping and storage. Add 3 inches for shipping height.
5. Refrigerant charge listed is operating charge for gravity flooded system at 15°F. For other feed systems, consult your BAC Representative.
**Engineering Data**

**Nominal 10' wide units (cont.):**
Models TSU-590E to TSU-1080E and TSU-675F to TSU-1230F

*Do not use for construction.* Refer to factory certified dimensions. This handbook includes data current at the time of publication, which should be reconfirmed at the time of purchase.

### E Series

<table>
<thead>
<tr>
<th>Model Number</th>
<th>LBS of Ice</th>
<th>Gravity Flooded</th>
<th>Pump Recirculated</th>
<th>Approx. Shipping Wgt (LBS)</th>
<th>Approx. Operating Wgt (LBS)</th>
<th>Air Pump (HP)</th>
<th>Water Volume (GAL)</th>
<th>Pull Down Volume (GAL)</th>
<th>Coil Volume (FT³)</th>
<th>R-717 Charge (LBS)²</th>
<th>Water Conn In/Out</th>
<th>W</th>
<th>L</th>
<th>A</th>
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<td>53</td>
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<td>9' 9-3/8''</td>
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<td>7''</td>
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<tr>
<td>TSU-1080E</td>
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<td>9' 9-3/8''</td>
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### F Series

<table>
<thead>
<tr>
<th>Model Number</th>
<th>LBS of Ice</th>
<th>Gravity Flooded</th>
<th>Pump Recirculated</th>
<th>Approx. Shipping Wgt (LBS)</th>
<th>Approx. Operating Wgt (LBS)</th>
<th>Air Pump (HP)</th>
<th>Water Volume (GAL)</th>
<th>Pull Down Volume (GAL)</th>
<th>Coil Volume (FT³)</th>
<th>R-717 Charge (LBS)²</th>
<th>Water Conn In/Out</th>
<th>W</th>
<th>L</th>
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<td>9' 9-3/8''</td>
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<td>6''</td>
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<td>13,700</td>
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<td>59</td>
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<td>9' 9-3/8''</td>
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<td>9' 9-3/8''</td>
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<td>9' 9-3/8''</td>
<td>41' 9''</td>
<td>7''</td>
<td></td>
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</tbody>
</table>

**Support**

ICE CHILLER® Thermal Storage Units should be continuously supported on a flat level surface.

**Notes:**

1. All dimensions are in feet and inches. Weights are in pounds.
2. Lbs. of Ice Capacity is based on R-717. For other refrigerants, consult your BAC Representative.
3. Dimensions showing location of connections are approximate and should not be used for prefabrication of connecting piping.
4. Dimension is installed height. Coils are capped for shipping and storage. Add 3 inches for shipping height.
5. Refrigerant charge listed is operating charge for gravity flooded system at 15 °F. For other feed systems, consult your BAC Representative.
Engineering Data
Nominal 12’ wide units:
Models TSU-840F to TSU-1520F and TSU-940G to TSU-1710G

Do not use for construction. Refer to factory certified dimensions. This handbook includes data current at the time of publication, which should be reconfirmed at the time of purchase.

**ICE CHILLER® Thermal Storage Units**

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<td>11’ 9”</td>
<td>23’ 11”</td>
<td>7”</td>
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<td>11’ 9”</td>
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<td>25,150</td>
<td>2,900</td>
<td>90</td>
<td>2,440</td>
<td>8”</td>
<td>11’ 9”</td>
<td>41’ 9”</td>
<td>7”</td>
<td></td>
</tr>
</tbody>
</table>

**Support**
ICE CHILLER® Thermal Storage Units should be continuously supported on a flat level surface.

**Notes:**
1. All dimensions are in feet and inches. Weights are in pounds.
2. Lbs. of Ice Capacity is based on R-717. For other refrigerants, consult your BAC Representative.
3. Dimensions showing location of connections are approximate and should not be used for prefabrication of connecting piping.
4. Dimension is installed height. Coils are capped for shipping and storage. Add 3 inches for shipping height.
5. Refrigerant charge listed is operating charge for gravity flooded system at 15°F. For other feed systems, consult your BAC Representative.
Engineering Specifications
For ICE CHILLER® Thermal Storage Units

Thermal Storage Unit - Furnish and install, as shown on plans, factory-assembled ICE CHILLER® Thermal Storage Unit(s) with all water-touched steel components hot-dip galvanized, all exposed edges and welds fully coated with zinc-rich compound, and exterior panels protected from corrosion with a thermosetting hybrid polymer.

Quality Assurance - The thermal storage unit manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO-9001:2000 to ensure consistent services.

Capacity - The ICE CHILLER® Unit(s) shall have a thermal storage capacity of ton-hours, operating with _____ refrigerant and a build time of _____ hours at a ____ °F/(°C) nominal evaporator temperature.

Tank - The tank shall be constructed of heavy gauge hot-dip galvanized steel and reinforced with full-length structural angles underneath and on all four sides. All seams shall be welded to ensure watertight construction. A zinc rich coating shall be applied to all exposed edges and welds.

Coil - The coil shall be constructed of prime surface serpentine steel circuits and shall be tested at 375 psig air pressure under water. The coil shall be encased in a steel frame and the entire assembly hot-dip galvanized after fabrication. For use with ammonia refrigerant, coil shall be complete with purge connection for oil maintenance.

Insulation - Expanded polystyrene insulation shall be provided between the tank and the exterior panels. The insulation shall be three inches thick (R-13) on the tank sides and ends, two inches thick (R-8) on the bottom and one inch inside the covers.

Exterior Panels - Exterior panels shall be sealed at all seams to provide a complete vapor barrier and to protect the insulation. They shall be furnished with a thermosetting hybrid polymer.

Covers - The ICE CHILLER® Unit(s) shall be provided with sectional, rain shedding, interlocking and insulated steel covers provided with a thermosetting hybrid polymer.

ICE Thickness Control
A multi-point adjustable, solid state, electronic resistivity type ice thickness control shall be provided. The sensing probe shall be mounted on the coil, and a control relay to deactivate the refrigeration system shall be installed in a NEMA 4 box mounted on the unit.

Air Blower - A centrifugal regenerative blower for field mounting shall supply low pressure air for agitation of the water. Blower shall be furnished with inline air filter, check valve and rain shield for field installation.

Air Distributor - Low pressure air shall be distributed through multiple perforated Schedule 40 PVC pipes.

Unit Size - Unit plan dimensions shall not exceed approximately _____ feet(m) by _____ feet(m) with an overall height not exceeding _____ feet(m). The operating weight shall not exceed _____ pounds(kg).

The ICE CHILLER® Thermal Storage Unit(s) shall be Baltimore Aircoil Company Model TSU- ____________
A dramatic increase in the city of Darwin, Australia’s power demand since the early 1990’s has been met by the introduction of an ammonia ice thermal storage system at its Channel Island Power Station.

The power station was built in 1985, and is operated by the Northern Territory Government utility - the Power and Water Authority (PAWA). The electricity consumption by Darwin has been steadily monitored over the years by PAWA. An assessment in 1995 clearly showed that demand was growing at a faster rate than earlier projections had identified, and that a solution was needed.

The decision to use an ice thermal storage system has not only eased the pressure, but also resulted in considerable savings for PAWA and the Government. The actual cost is one-third the installation cost of an extra turbine. The final system chosen by PAWA employs an ammonia ice thermal storage system plant, supplying ice water during peak periods to wet air coolers on the inlets of the three turbines.

**The first stage of the project includes the following major equipment:**

- Five 500 kW screw compressors, 1,500 kW (426 tons) each
- Five BAC Model CXV Evaporative Condensers
- 96 BAC ice coils, building 1,400 metric tons of ice that will provide 130,000 kWh (36,932 ton-hours) of storage
- Three BAC wet air cooler modules, cooling inlet air from 37˚C to 9˚C (98.6˚F to 48.2˚F)
- Two concrete tanks 15m (49’) x 15m (49’) x 7m (23’) high

The system is remarkable in its simplicity and efficiency of operation. During the night and morning off-peak periods, the refrigeration plant builds ice on the ice coils. At peak demand, ice water is pumped from the storage tanks and across a direct contact heat exchanger medium to cool air before it enters the turbine.

“The ice build period is off-peak, with no effect on the daily maximum demand,” John Rule Marketing Manager BAC Australia stated. “Also, the control of ice build can be coordinated with spinning reserve needs. The wet air cooler provides extra benefits in washing the air, removing dust, insects and smoke. The dirt is collected in an easily accessible basin for filtration cleaning. There are no finned coils to clog.”

“Using ammonia is a highly energy-efficient process, as well as being greenhouse friendly, and has essentially no affect on the ozone layer. This, combined with the piped natural gas system, means that greenhouse gas production is much less than that from a coal-fired power station.”