# PhaseStor PCM based Thermal Storage Solution Ft Irwin Technology Demonstration June 2017

# PhaseStor Technology Description

**Technology:** The bio-based BioPCM® (phase change material) is used to store thermal energy within a specified temperature range (-31°F to +275C°F). Pressurized heat exchangers containing process fluid are fully immersed in BioPCM® derived from organic non food-grade fatty acids.

PCM is specifically formulated for large scale thermal storage applications. The technology is unique, in that it remains in solid form regardless of charge state (solid to semi-solid transition).


**600,000 Btu Demonstration Tank**

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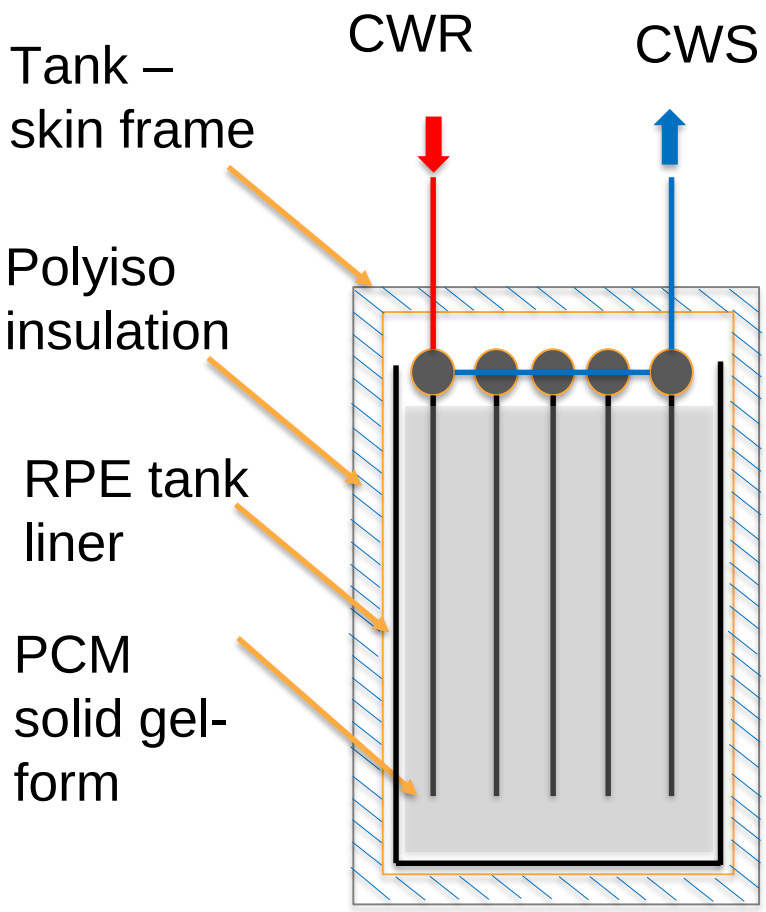
# Technology Description




**Sample System Operation**

- Process fluid (CHW) flows under pressure through heat exchangers
- Heat exchangers are submerged in solid gel BioPCM® Phase Change material set to desired freeze/ transition temperature (40ºF - 45ºF)
- ***Charging cycle*** - set supply water from chiller to 6ºF-8ºF below BioPCM® freeze/transition temperature
- ***Discharge*** - bypass return water from load 6ºF - 10ºF above freeze temperature through the heat exchanger and return to the building supply line.

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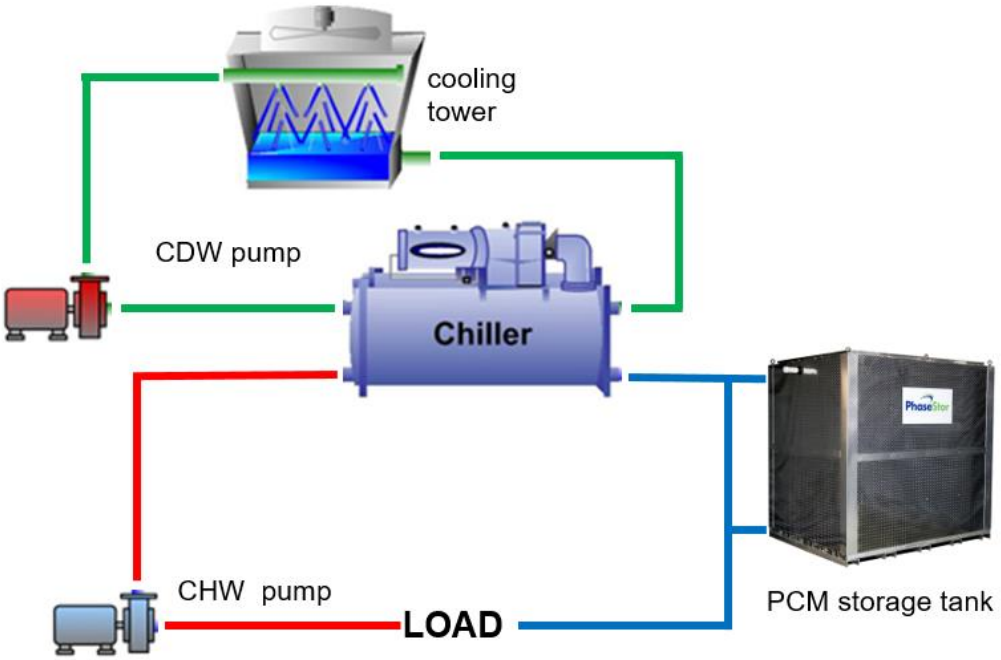
# Simpler PhaseStor Solution

***PhaseStor Systems***

A retrofit to conventional non-storage chilled water plant requires the addition of*:*

- Storage tank
- Valves & controls




***Lower Energy Costs***

When designed and sized to avoid peak demand PhaseStor systems require less energy consumption because the chiller operates at higher temperatures and less run time as well as less pumping.

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# Design & Manufacture

Heat exchanger piping manifold assembly

Polypropylene Heat exchanger in various sizes and configurations

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# Design & Manufacture

- Aluminum frame tanks can be assembled in place for easy shipping and rigging.
- Large scale (300 ton-hr and 450 ton-hr) PhaseStor modular heat exchange systems available

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# Demonstration Installation

- Ft. Irwin CA
- Demonstration site  - 18,500 sft Military Education Center
- 70 ton chilled water system

Building 1020 Education Center

PhaseStor Install, rear service yard, B1020

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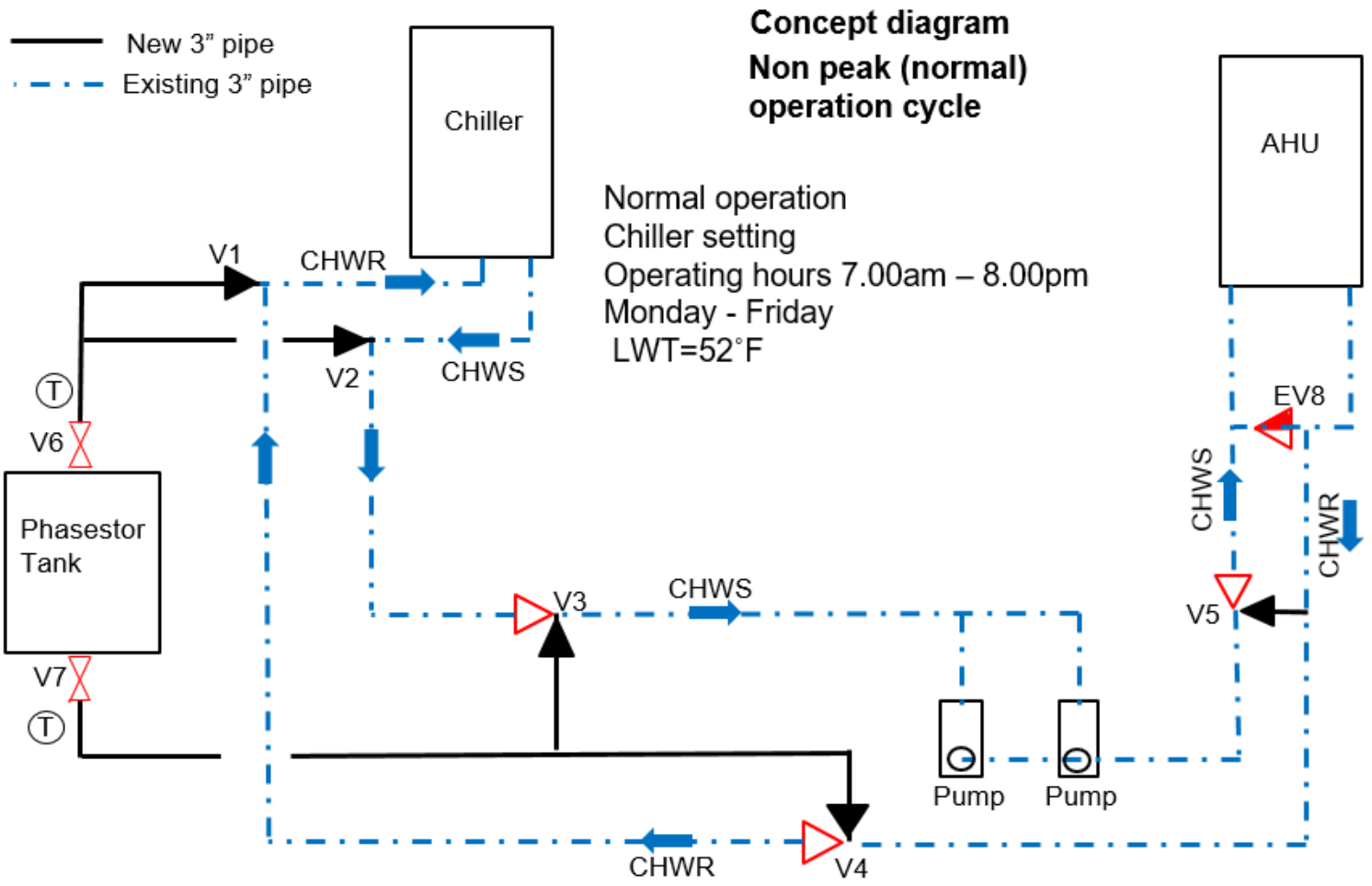
# Installation Design




**SK-04**
**B1020 CONCEPT SCHEMATIC**
**SR - 04.05.17**

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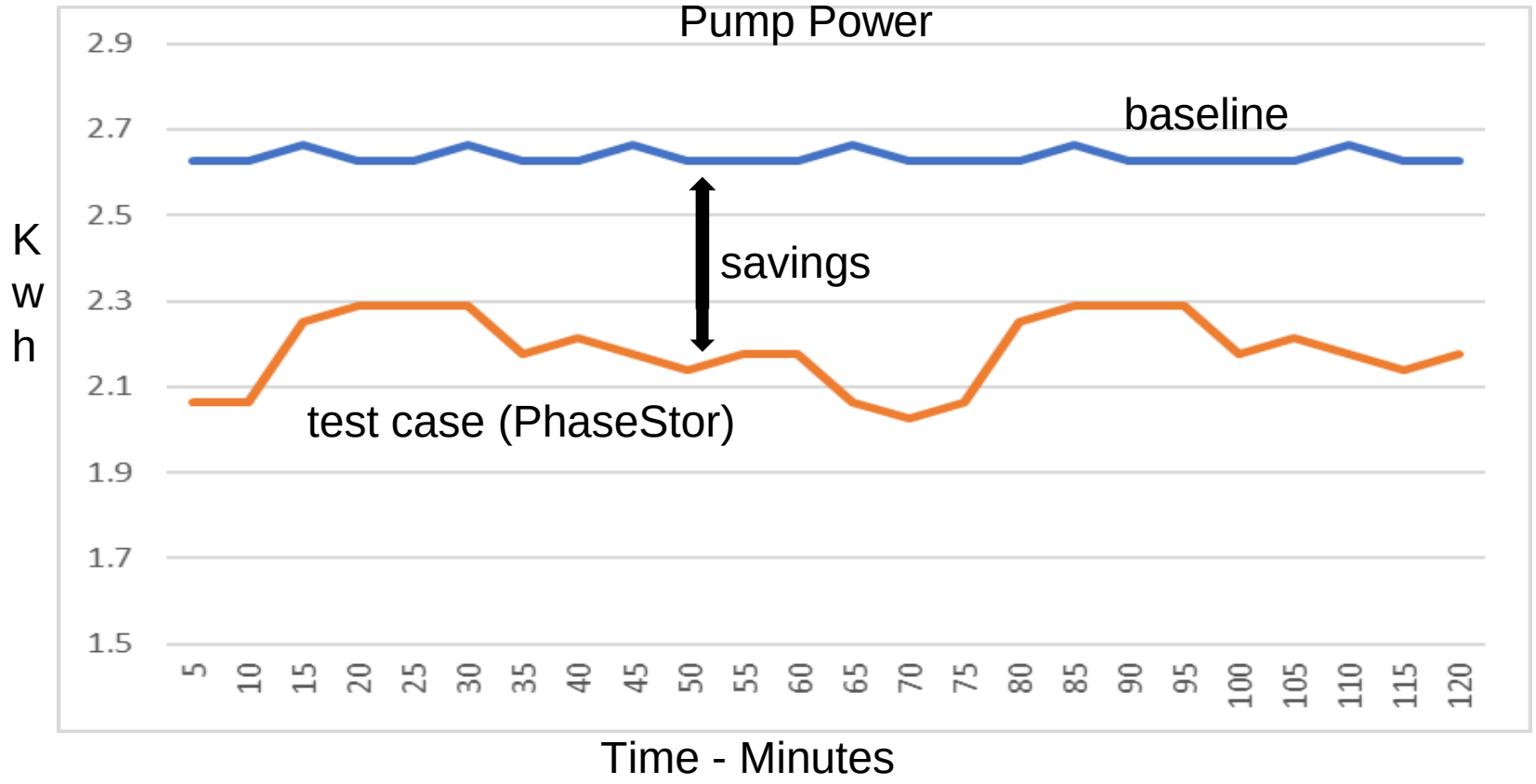
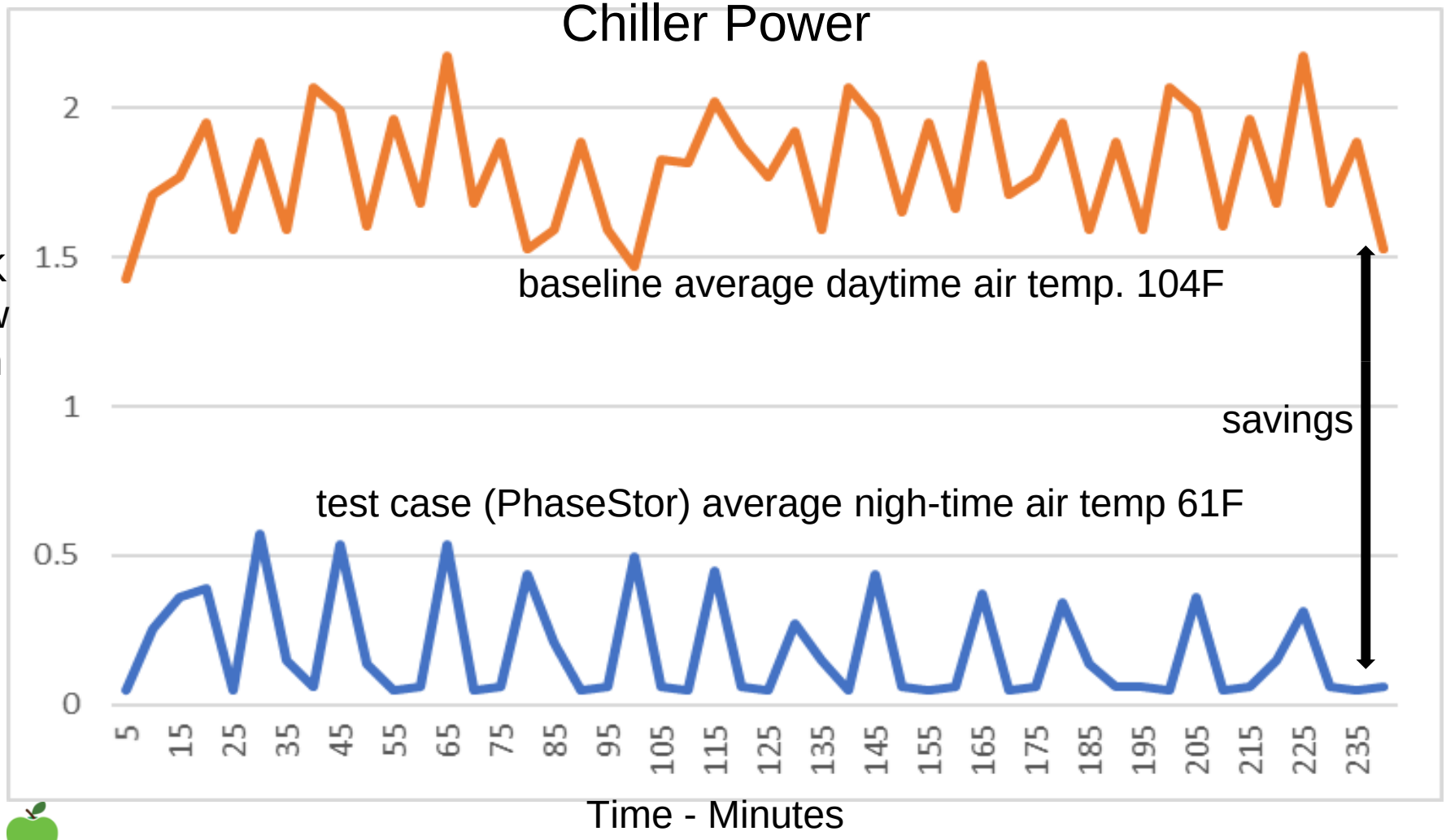
# Preliminary Test Results

Chilled water pump kWh reduction, Reduction due to ability to reduce flow rate as there is increased thermal control  (no chiller cycling or surge)



# Preliminary Test Results

Reduction in chiller energy when charging PhaseStor at night-time (low ambient air temperature)

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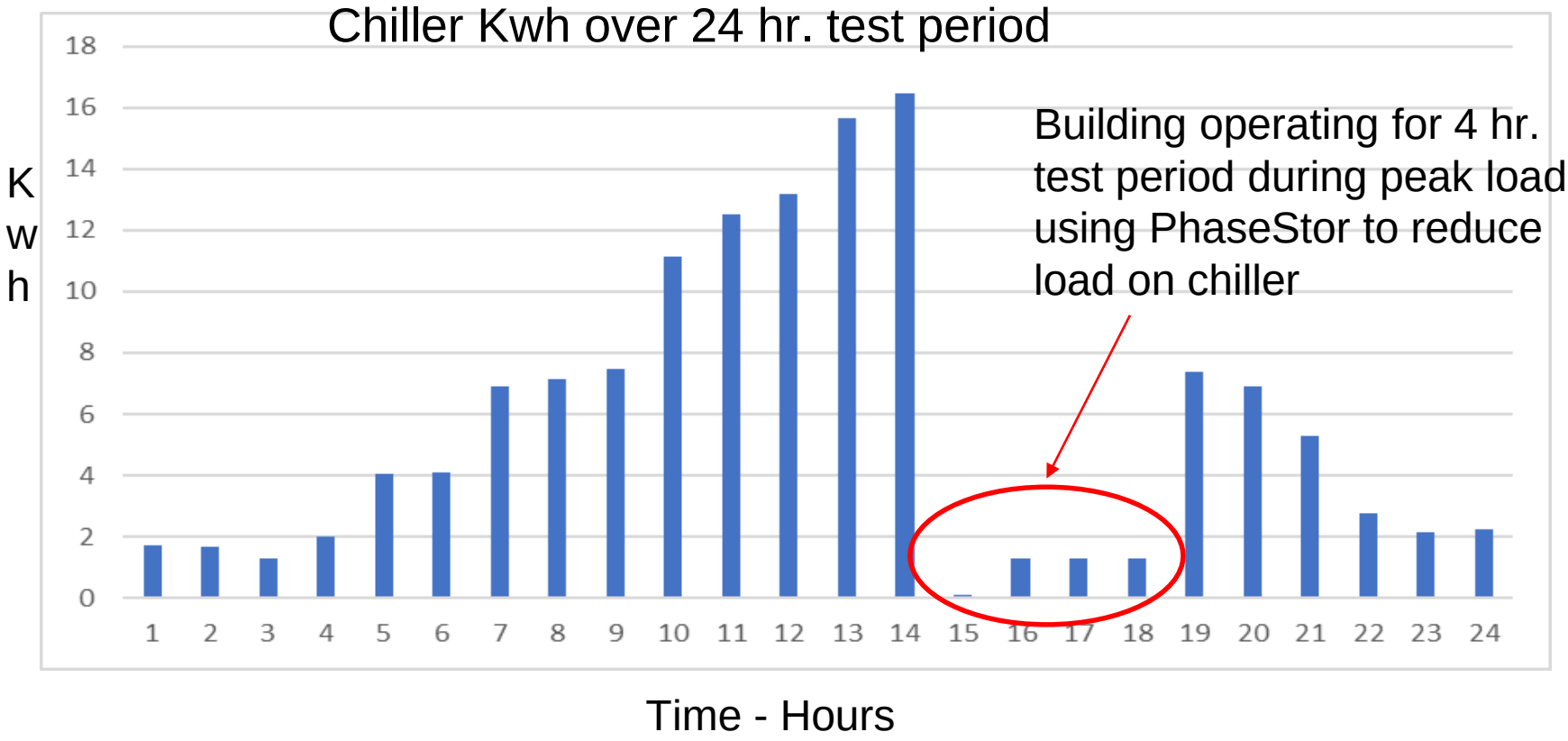
# Preliminary Test Results

70 ton Chiller, kWh use over 24 hr. demonstration cycle
Average (day-time) ambient air temperature :104F

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# Installation References

**Projects:**

- Microsoft -WA
- Ennis Paints - NC
- 1888 Mills - GA
- Ft. Irwin - CA



# PhaseStor Advantages

**Heat Energy Storage**

- **Much Smaller Footprint - BioPCM® thermal capacity is 50x greater than water**
- **Installed system will provide greater than 20x chilled water storage**
- **Less equipment and maintenance required than chilled water or ice storage**

**Chiller Water Applications**

- **Minimal Material Expansion & Contraction Issues**
- **No Need for Glycol**
- **Less Pumping**
- **Store Energy at any Temperature (-50°C to 275°C)**

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# PhaseStor Applications

- **Dedicated server backup and thermal support**
- **Heating & Cooling System Resilience**
- **Cooling & Heating System Security**
- **Thermal / Electric Demand Response (Chillers)**
- **Peak Demand Management (Chillers)**
- **Increase Chiller / Cooling System Capacity**
- **Solar Thermal Storage**
- **Many other temperature controlled industrial applications**

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