

ENHANCING THE VALUE OF A DISTRICT COOLING SYSTEM WITH CHILLED WATER THERMAL ENERGY STORAGE



*SAVING ENERGY & OPERATIONAL COSTS
WHILE LOOKING GOOD DOING IT*



Examples of TES Tanks



Edinburg, TX UT – Pan Am



Los Angeles, CA - USC



Orlando, FL - UCF



Lackland AFB, TX



San Antonio, TX - Airport



Raleigh, NC



San Antonio, TX – Microsoft



Danville, PA - Geisinger

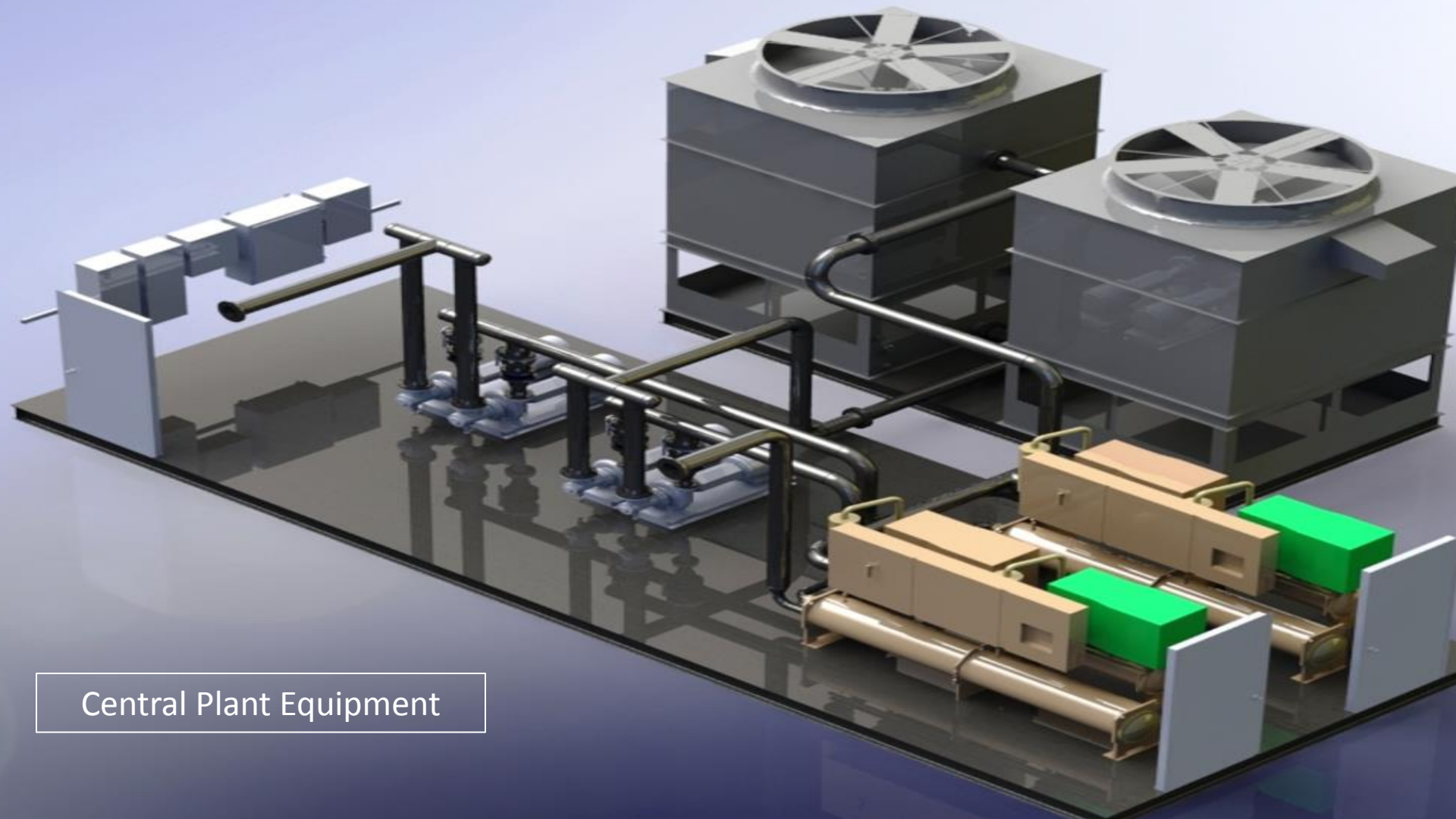


Jacksboro, TX – Brazos Elec

**College
Campuses**

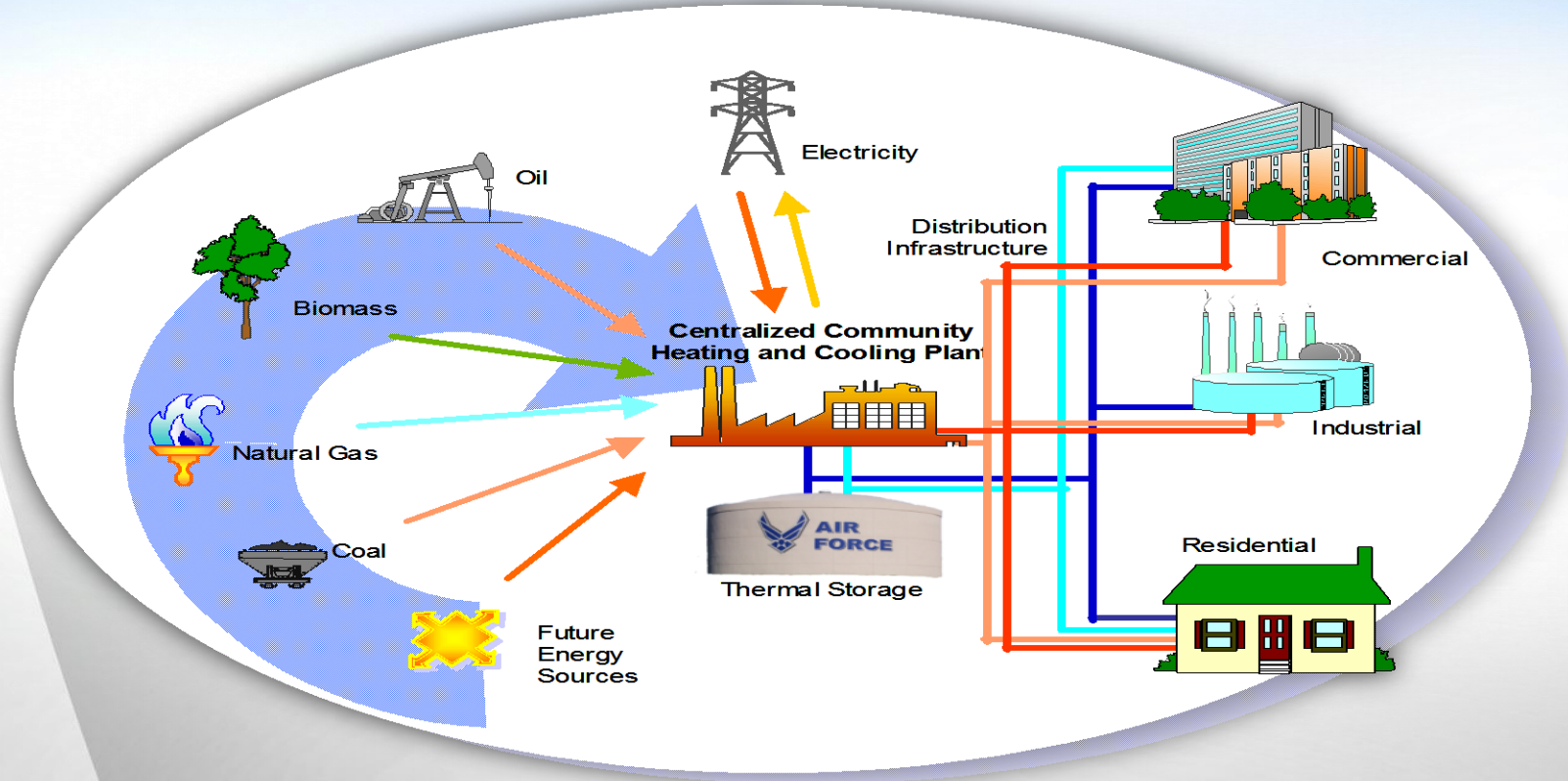
**Government &
Municipalities**

**Private Industry,
Power Plants &
Data Centers**

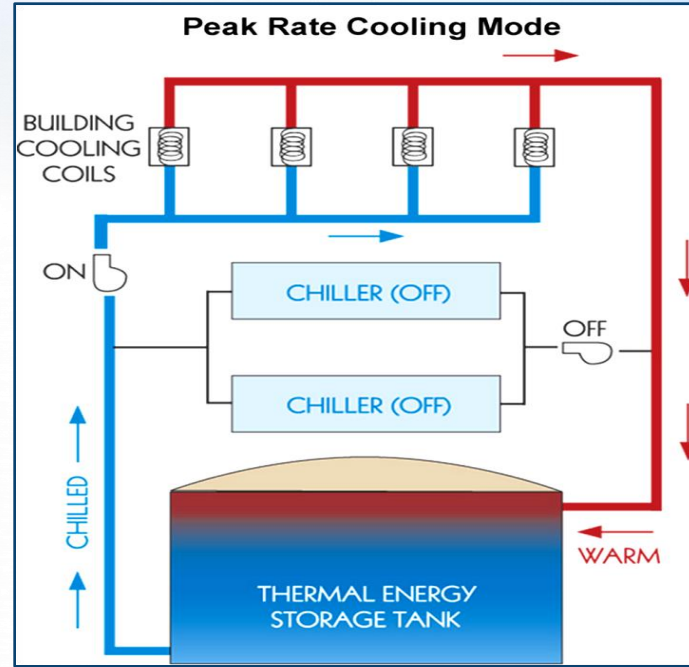
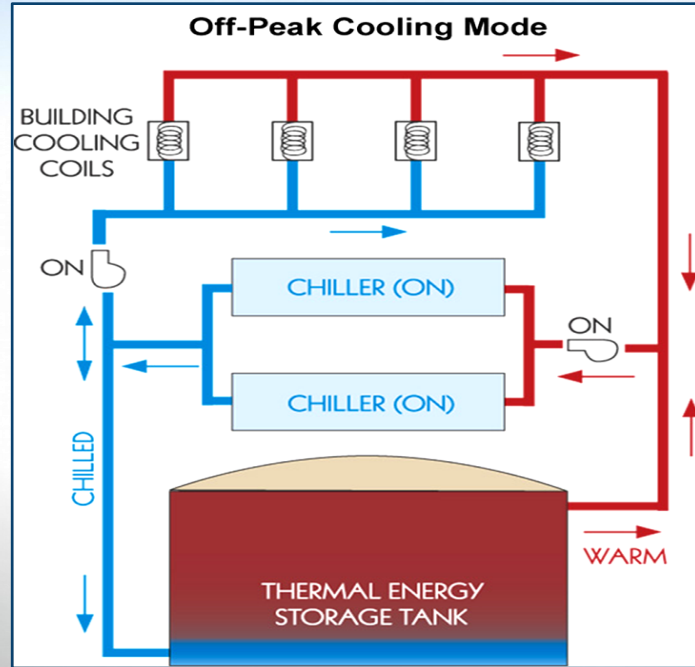


Central Plant Equipment

TES with Chilled Water District Cooling Systems

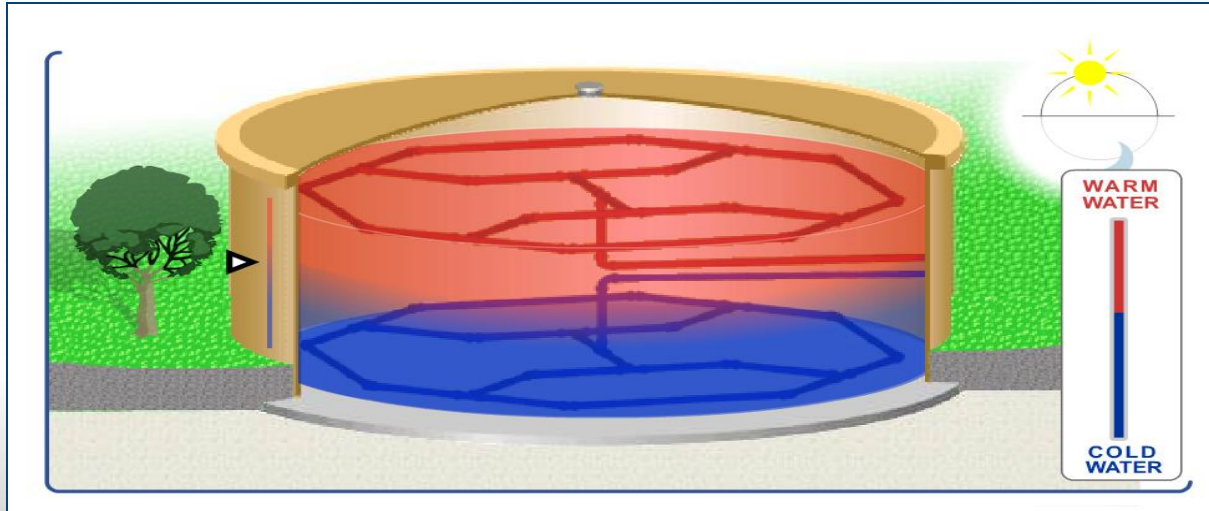


Chilled Water TES Concept



Stratified Chilled Water

Maximize the chilled water ΔT
to minimize the tank size

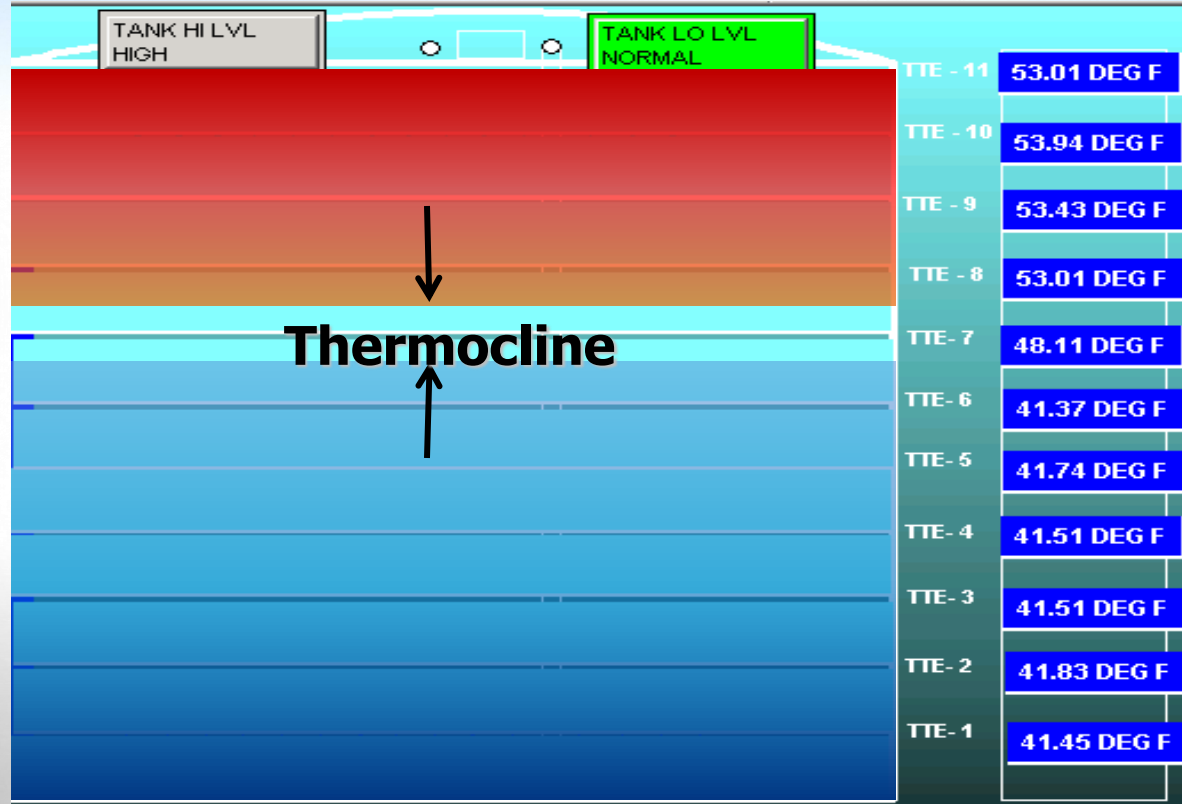


Daily Operation of a TES Tank



Actual Data during the Performance Test of a TES Tank

1 Hour into the Test



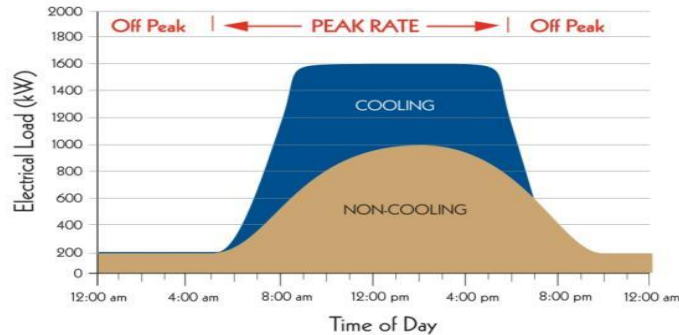
Financial Benefits

All TES systems must provide owners with financial benefits such as:

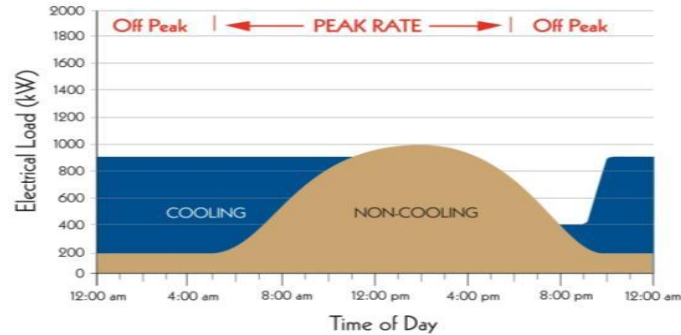
- **Energy Cost Savings** – Using electrons wisely
 - Time of Use Electric Rates – kW and kWh
- **Cost Avoidance** – when expanding the campus
 - Reduces the capital costs while reducing energy and operational costs
- **Insurance** – no downtime of critical processes
- **Incentives**
 - One time Incentives from the utility companies
 - Federal Tax Incentives – 179D

Electric Load Profile

LOAD PROFILE WITHOUT TES



LOAD PROFILE WITH TES



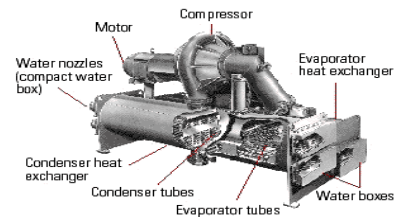
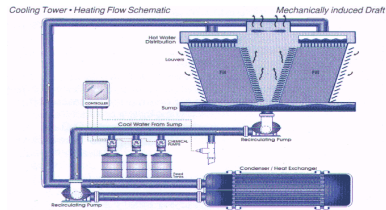
With TES:

- permanent peak electric load reduction
- energy reduction by taking advantage of cooler ambient conditions at nighttime and operating the chillers at their optimum conditions

Cost Avoidance on Campus Expansion Projects

Instead of adding more mechanical & electrical equipment such as chillers, pumps, instrumentation, and condensing equipment

Utilize the excess cooling capacity of the existing equipment, and add a TES system



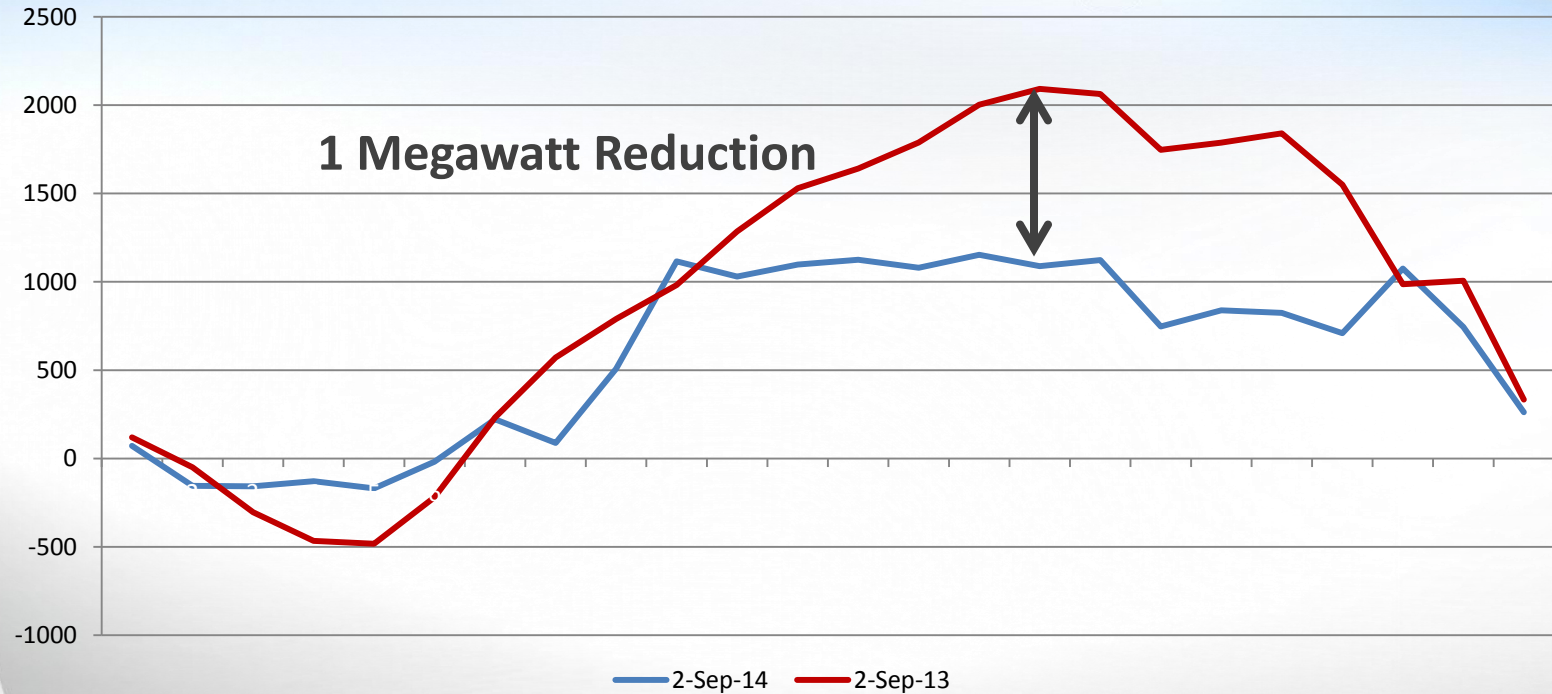
Lowest initial cost & reduces O&M

Bucknell University – Lewisburg, PA

- Project Overview:
 - Major campus expansion planned
 - Additional cooling capacity required
 - Instead of adding more chiller equipment, a TES tank was added for that cooling capacity, and it reduced the overall energy costs
- Energy Storage Overview:
 - 0.9 million gallon TES tank
 - 6,500 ton-hrs of energy storage



Peak Electric Demand Reduction



The TES tank provided the necessary cooling capacity for the campus expansion and lowered the energy costs at the campus

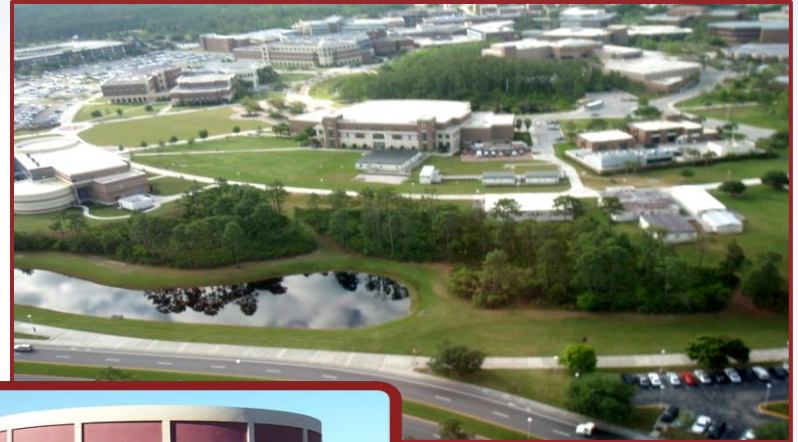
Orlando, FL – College Campus

System Overview:

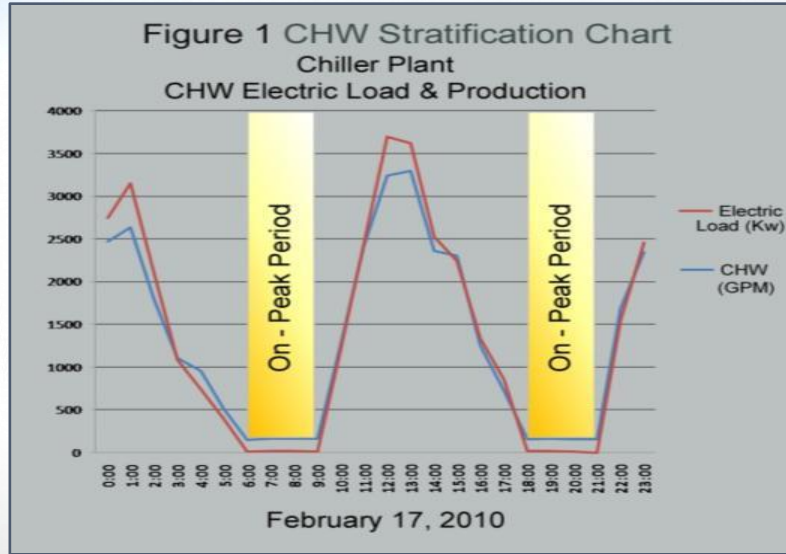
- District chilled water cooling system
- Expanding campus required additional cooling capacity

Energy Storage Overview:

- 3.0 million gallon TES tank
- 26,200 ton-hrs storage capacity or approximately



Orlando, FL – College Campus



Project Info:

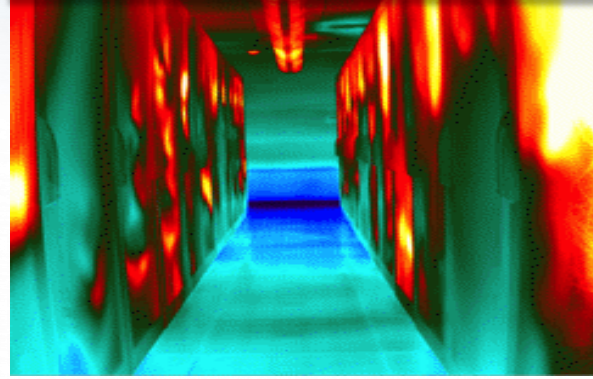
- \$700,000 – Estimated annual energy cost savings

Insurance – No Downtime of Mission Critical Facilities

SERVER FLOOR IN DATA CENTER



THERMAL IMAGE



When chillers go off unexpectedly, chilled water needs to continue to flow to prevent data processing servers from overheating

Watertight Concrete TES Tank



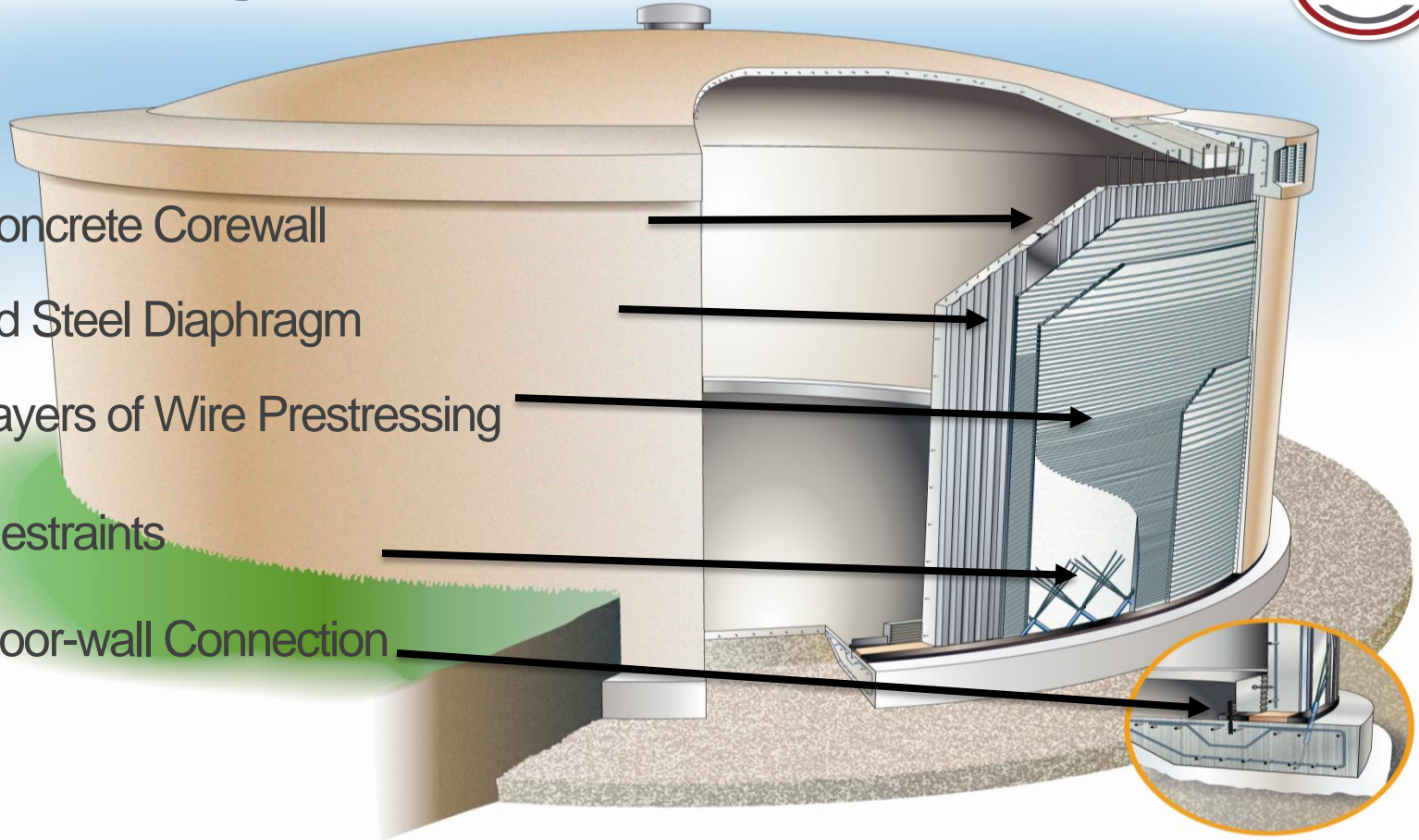
Precast Concrete Corewall

Embedded Steel Diaphragm

Multiple Layers of Wire Prestressing

Seismic Restraints

Flexible Floor-wall Connection



Construction of Prestressed Concrete TES Tank



Concrete TES Tank Flexibility

- Above Ground
- Partially Buried
- Fully Buried
- Fully Buried



sod covering

heavy loading

Numerous Architectural Enhancement Features to Blend in with Nearby Buildings



Blend in with the Environment



Blend in with the Campus



Columns



Columns with Arches



Multi-Color



FULLY BURIED





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