



# TES SYSTEMS AND CHP SYSTEMS CEM REFRESHER TRAINING

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FOR ENERGY MANAGEMENT AND EFFICIENCY PROFESSIONALS



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# THERMAL ENERGY STORAGE TECHNOLOGY-1 FOR ENERGY PROFESSIONALS

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ENERGY SPECIALIST CURRICULUM



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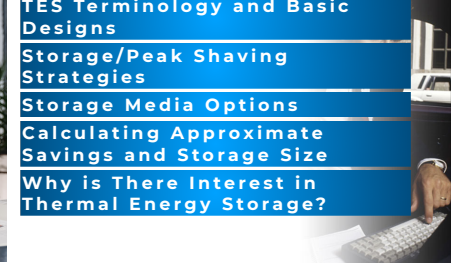
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## WHAT SHOULD YOU LEARN





TES Terminology and Basic Designs

Storage/Peak Shaving Strategies

Storage Media Options

Calculating Approximate Savings and Storage Size

Why is There Interest in Thermal Energy Storage?

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## WHY IS THERE INTEREST IN THERMAL ENERGY STORAGE?



- ✓ Reduced peak demand costs
- ✓ Some utilities offer rebates and rate incentives
- ✓ Reduced equipment size and cost (new)
- ✓ May be improved reliability due to production and storage
- ✓ Smaller fans and pumps (colder water with ice storage)



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## ECONOMIC PAYBACK TIME



- ✓ Typical simple payback of 5 to 7 years (maybe 3 to 5 in some cases) for existing buildings and chillers.
- ✓ Recent examples from ASHRAE and others are showing the payback may be immediate to 1 – 2 years for good design in new construction.



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## CONVENTIONAL AIR CONDITIONING OPERATION



- ✓ CAC system peaks at peak cooling time
- ✓ CAC system is sized to meet peak cooling load
- ✓ CAC system may have its lowest efficiency at the time it is needed the most



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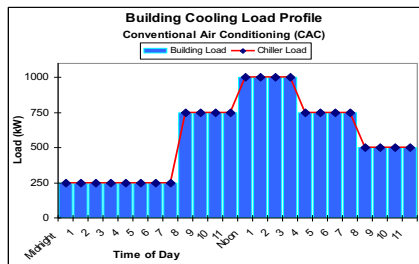
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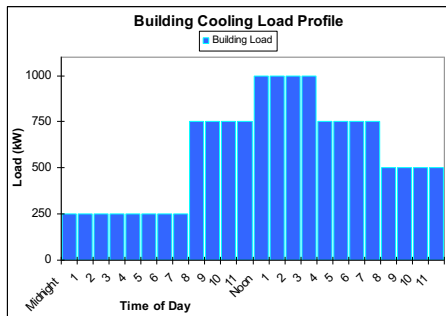
## CAC OPERATION



## OFF-PEAK AIR CONDITIONING OPERATION

- ☑ CAC together with storage is used to meet peak cooling loads
- ☑ Chilled water or ice is used for storage medium
- ☑ Daytime peak load is reduced or eliminated
- ☑ OPAC system operates at night when efficiencies are usually higher due to lower outside temperatures
- ☑ The Total Daily Cooling Load (plus system losses) must be met
- ☑ The Instantaneous Cooling Loads must also be met when they occur, just not directly from the chillers.
- ☑ We are simply decoupling the Load (demand) from the Chiller (supply)
- ☑ If we take advantage of optimal chiller loading (sweet spot) and cooler condenser temperatures, we may gain significant efficiencies.

## Building Cooling Load Profile



## OPAC OPERATING STRATEGIES

### ✓ Load leveling

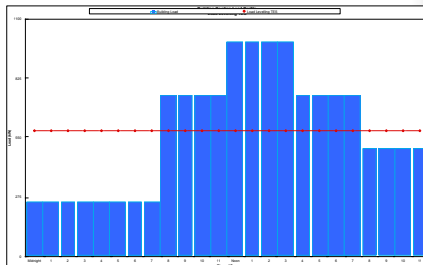
- ➔ Partial shifting of AC load to off-peak hours
- ➔ Chiller runs at constant load or near constant load for 24 hours per day
- ➔ Very cost effective for new construction
- ➔ Less costly to purchase
- ➔ Less space needed
- ➔ But ~ less savings

## LOAD LEVELING CHILLER LOAD CALCULATIONS

✓ Where would we need to operate the chiller(s) in order to satisfy the building load? Peak period between 12:00 p.m. to 8 p.m.

✓ Total kWh / Hours available to operate chillers

✓ For the Load Leveling Strategy, the chiller will operate 24 hours per day, at a load of: 1  
 $4,000 \text{ kWh} / 24 \text{ hours} = 583.3 \text{ kW}$

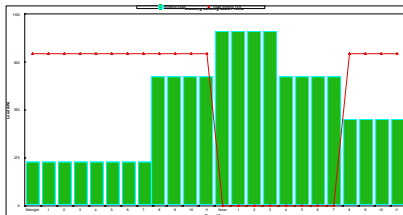


## LOAD SHIFTING

- ✓ Complete shifting of peak hour AC load to off-peak hours
- ✓ OPAC system must be sized to meet peak cooling load in kWh  
OPAC system must be sized to meet peak cooling load in kWh
- ✓ Usually more cost effective for retrofit situations because of large existing chiller load that can be moved mostly off peak
- ✓ More costly to purchase and install
- ✓ Requires more space for storage tanks
- ✓ But ~ more savings

## OPAC LOAD CALCULATIONS

- ✓ Total kWh Hours / Hours available to operate chillers
  - ⇒ A peak period from noon to 8 p.m. would only leave 16 hours to generate cooling capacity.
  - ⇒ For the Load Shifting Strategy, the chiller will operate at a load of:
  - ⇒  $14,000 \text{ kWh} / 16 \text{ hours} = 875 \text{ kW}$





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