Purdue University

Above Grade Thermal Energy Storage (TES) Location Comparison

November 30, 2012
Agenda

• Thermal Energy Storage (TES) Overview
• Comparison of Proposed Locations:
  – Location on Campus
  – Aesthetics
  – Operations
  – Financial
• Analysis of Options
• Conclusions
THERMAL ENERGY STORAGE (TES) OVERVIEW
Thermal Energy Storage (TES)

- Shifts Energy Demands from Day to Night
- Proven Technology
- Typical (non-peak) June Day:

![Graph showing energy demand and reduction](image-url)
Why TES is Used?

- Uses existing nighttime capacity
- Reduces overall energy consumption
- Reduces production equipment size
- Delays production (capital) equipment installation
- Lowers peak power demand
- Lowers chilled water energy costs
- Reduces maintenance costs
Thermal Energy Storage
College Campuses

- Very common on college campuses
  - Over 150 installations on over 120 campuses
- Very common in the Big Ten
  - Illinois, Iowa, Michigan, Nebraska
- Common at Large Universities
  - Arizona St., Cornell, Florida St., North Carolina, Virginia, Stanford, Texas, UC-Davis, UC-Irvine, USC, UCLA
- 50+ above grade TES tanks at colleges and universities
COMPARISON OF PROPOSED LOCATIONS
Northwest TES Location

Northwest Site

Wade Plant Site
Northwest Location Overview

- Steel Above Grade Tank
- 160’ diameter x 40’ tall
- Cut into hill
- Previously presented to Board of Trustees
Northwest Site
From Rec Sports Center
Northwest Site
From Intramural Fields
Northwest Site Financials

- Financials
  - TES Cost (2015$) $17-$19 million
Wade Plant TES Location

Northwest Site

Wade Plant Site
Wade Plant Location
Overview

- Steel Above Grade TES tank
- 100’ dia. x 95’ tall
- 2100 LF of pipe trench
Wade Plant Location
Distribution Piping

Connection to Existing Piping

24" Distribution Piping
Wade Plant Site
From US-231
Wade Plant Site
From Lynn Hall
• Financials
  – TES Cost (2015$) $18-$20 million
ANALYSIS OF OPTIONS
### Economics Cost Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Northwest Site</th>
<th>Wade Site</th>
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<tbody>
<tr>
<td>TES Cost (2015$)</td>
<td>$17-$19 million</td>
<td>$18-$20 million</td>
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- Northwest location has excellent economics
- Wade location has good economics
Northwest Site

Advantages:
- Lower first cost
- Utility area of campus
- Near campus loads
- Utilizes a difficult site
- Planning completed to meet 2015 cooling season

Disadvantages:
- Distribution piping near tank is at capacity
Advantages:
• Utility area of campus
• Distribution piping from tank to near Nelson Hall provides operational flexibility

Disadvantages:
• Additional distribution piping
• Campus disruption during installation of piping
  – Harrison Street
  – South University Drive
  – Parking west of ADDL
• Need to initiate planning process
  – Meeting 2015 Cooling Season is in Question
• Higher First Cost
Items to be addressed in Planning Stage:

• Soil (underground) conditions
  – Current cost estimate assumes poor soil conditions

• TES tank foundation design
  – Current cost estimate assumes most expensive foundation

• Hydraulic analysis of pumping
  – Current cost estimate includes extensive distribution piping

• FAA Approval

• Coordination
  – Distribution piping, parking replacement, etc.

• Detailed cost estimate