Scope of Study

We studied the existing central plant to determine what modifications are needed to support the completion of the Master Plan Buildings.

- Identified the capacity of the existing systems at the central plant.
- Determined the total heating and cooling loads the central plant must support.
- Developed three central plant options to support the campus.
Existing Central Plant

- Three Chillers
  - 900-Ton Water Chiller
  - 400-Ton Ice Making Chiller
  - 350-Ton Absorption Chiller

- Two Cooling Towers
  - Two 1,125 GPM Condenser Water Pumps
  - One 2,710 GPM Condenser Water Pump
Existing Central Plant

- Three Chilled Water Pumps
  - Two pumps at 1,000 GPM
  - One pump at 1,950 GPM

- Six Ice TES Tanks
  - 700 Ton-Hours Each
  - 4,200 Ton-Hours Total
Existing Central Plant

- Seven Heating Hot Water Boilers
  - Two 5,000MBH Units
  - Five 2,000MBH Units

- Two Hot Water Campus Loop Pumps
  - 542 GPM Each

- Two Heat Exchangers
  - 5,900MBH Heating to Campus
  - 950-Ton Ice to Chilled Water
Existing Central Plant

- Ice chiller operates at night to charge ice TES
- 900-Ton chiller operates off-peak & low-peak to meet demand
- Ice TES discharges during peak and two hours of mid-peak
Existing Central Plant

- Solar Collector makes hot water for Absorption Chiller
- Absorber operates during peak to help reduce energy costs
- Solar system also provides heat to the campus when needed
Building Cooling Loads

• We analyzed the Utility Master Plan and the Chevron Energy Study
  – Neither study fully anticipated the future buildings
  – We used the information available to us and made calculations to find the peak loads the heating and cooling plant will support
  – We added one 60,000GSF general purpose building to the list for future needs
### Findings – Building List - Cooling

<table>
<thead>
<tr>
<th>Building</th>
<th>GSF</th>
<th>Design Peak Loads (Tons)</th>
<th>Building Notes</th>
<th>Labeled on Master Plan</th>
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<tbody>
<tr>
<td>FOREIGN LANGUAGE</td>
<td>16,130</td>
<td>40</td>
<td>Existing</td>
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<td>ENGINEERING</td>
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<td>SOUTH GYM</td>
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<td>LIBERAL ARTS (BUSINESS &amp; JOURNALISM)</td>
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<td>Existing</td>
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<td>MUSIC BUILDING &amp; RECITAL HALL</td>
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<td>ART</td>
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<td>MATH</td>
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<tr>
<td>PLANETARIUM</td>
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<tr>
<td>BEHAVIORAL SCIENCE</td>
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<td>HUMANITIES</td>
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<td>MOTION PICTURE/ TV STUDIO</td>
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<td>ALLIED HEALTH SCIENCE</td>
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<td>NORTH GYM &amp; DSPS GYM</td>
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<td>100</td>
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<tr>
<td>LIBRARY &amp; ACADEMIC RESOURCE CENTER</td>
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<td>Construction</td>
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<td>ATHLETIC TRAINING FACILITY</td>
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<td>MSCC</td>
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<td>CWDC &amp; ADMINISTRATION</td>
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<td>Future</td>
<td>V-XX</td>
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<tr>
<td>Existing Loads</td>
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<td></td>
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<tr>
<td>Total</td>
<td>842,849</td>
<td>2,357</td>
<td></td>
<td></td>
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<tr>
<td>Diversified Peak Loads</td>
<td>80%</td>
<td>1,886</td>
<td></td>
<td></td>
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</table>
Findings—Cooling Loads

- The total peak load is 1,886-Tons
  - We used a 80% Diversity Factor
  - The average load is 450-SF per Ton Cooling
Chilled Water Distribution

- The maximum chilled water flow was determined to be 2,829 GPM
  - We used a 80% Diversity Factor
  - We used a temperature difference of 16°F
  - The existing pumps will have reserve capacity
  - 3,950GPM available vs. 2,829GPM needed
Pipe Sizing – Chilled Water

- The 6” chilled water line in the east tunnel is too small
- We recommend increasing the pipe to 8” to the MAPA Building.
Heat Hot Water Distribution

- The campus uses a 40F temperature drop for the heating loop
- The future HHW pumping needs are within the existing hot water pumps’ capacity
- 1,050 GPM Needed vs. 1,084 Available
- We did not apply any diversity to the needed flow rate
Pipe Sizing – Heating Hot Water

- We found the line size in the east tunnel to be undersized.
- We recommend the line size be increased to 6” for the entire length of the east tunnel.
Plant Capacity for Heating

- The central plant heating system is big enough for the master plan build-out plus one more building.
- 23,050MBH available vs. 20,974MBH needed
Central Plant Options

- Use existing equipment plus three other solutions to expand the capacity of LAVC central plant

- Goals
  - Energy Efficient
  - Energy Costs
  - Utilize existing equipment
  - Construction costs
Central Plant Capacity vs. Load

Campus Loads vs. Central Plant Output

Time of Day

Tons

- Current Equipment
- Campus Demand (Tons)
Option One – Base Case

- Use the existing equipment with a modified sequence of operations
- Disadvantages
  - Very little peak shavings
  - No spare or redundant capacity
  - No spare capacity
Option Two – MAPA TES

- An ice TES system would be added to the MAPA building to reduce the peak loads the central plant

- Disadvantages
  - Takes up space at MAPA
  - Additional maintenance efforts needed to maintain new chiller and ice TES
  - Air-cooled chiller is less efficient than a water-cooled unit
Option Three – 1400-Ton Chiller

- The existing 900-ton chiller would be replaced with a 1400-ton unit
- The electrical cost savings are not attractive
- The payback period is too long
Option Four – Chilled Water TES

- The campus would add an 6900-ton-hr chilled water TES tank (585,000-gal)
- The 900-ton chiller will be replaced with a variable speed chiller of the same capacity, but with 39F LWT / 60F EWT
- The campus loop would be operated with a differential of 18-20F
Option Four – Chilled Water TES

- The TES tank would be approximately 25FT high and 65FT in diameter
- The tank would be underground and out of sight
- The chilled water tank will be able to handle the campus loads 85% of the year
- The life span of the chillers will be expanded because of reduce operating hours
Option Four – Chilled Water TES

- At night the 900-ton chiller will charge the TES tank
- When needed, at night the ice chiller will charge the ice TES
- The absorber will operate as designed
- During low-peak the chilled water TES and 900-ton chiller will meet loads
- During peak only the TES systems and absorber will operate
Option Four – Chilled Water TES

- Off peak loads will be met with the 900-ton chiller and the chilled water TES
- This option has the best peak shavings strategy
- This option has the highest first cost, but best life cycle cost
Option Four – Chilled Water TES
TES Tank Location

- We looked at three tank locations
  - Next to the Central Plant
  - Under the green field east of Student Services
  - Under the planned parking lot near Burbank Boulevard.
TES Tank Location

- Next to the plant is ideal mechanically, but will be difficult to construct.
- Locating the tank in the green field near Student Services would be intrusive to the campus and severely limit what could be done with the field in the future.
- The best spot is under the future parking lot near Burbank Boulevard.
TES Tank Location

Los Angeles Valley College
Construction Costs

- Option 1: $842,500
- Option 2: $1,580,000
- Option 3: $1,622,500
- Option 4: $2,653,900
## Comparing Energy Usage

<table>
<thead>
<tr>
<th>Option</th>
<th>Peak Demand (kW)</th>
<th>Peak Consumption (kWh)</th>
<th>Low Peak Consumption (kWh)</th>
<th>All Peak Consumption (kWh)</th>
<th>All Day Consumption (kWh)</th>
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</thead>
<tbody>
<tr>
<td>Opt. 1 - Current System</td>
<td>504</td>
<td>2,016</td>
<td>5,881</td>
<td>7,897</td>
<td>10,951</td>
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<td>Opt. 2 - MAPA Ice TES</td>
<td>295</td>
<td>1,138</td>
<td>5,598</td>
<td>6,736</td>
<td>11,391</td>
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<td>Opt. 3 - New VSD Chiller</td>
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<td>1,800</td>
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<td>Opt. 4 - Additional TES Tank</td>
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<td>0</td>
<td>4,231</td>
<td>4,230</td>
<td>10,335</td>
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## Simple Payback

<table>
<thead>
<tr>
<th>Peak Day Cost Comparison</th>
<th>Daily</th>
<th>Annually</th>
<th>1st Cost</th>
<th>Payback Years</th>
<th>Value after 20 yrs</th>
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<tbody>
<tr>
<td>Option One (Base Case)</td>
<td>$0</td>
<td>$0</td>
<td>$842,500</td>
<td>Never</td>
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<td>Option Four</td>
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</table>
Comparing All Options

- Options 2 & 4 are the most attractive
- Good payback periods for each
- Option 2 has lower first costs, but lower annual energy savings, and long payback.
- After 20-years Option 2’s equipment will be due for replacement.
- After 20-years Option 4’s equipment will still be in service
Questions?