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Executive Summary

The project will construct an approximately 3500 gsf central chilled water plant to replace dispersed chillers at the Infectious Disease Research Center (IDRC) on Foothills Campus. There are currently twelve distributed chillers serving the IDRC complex and ARBL. Due to the nature of the research, all of this equipment is fully redundant (i.e. twice the number of chillers are installed than are needed for cooling). Much of this equipment is at end of life and the remainder will be so within ten years. With the construction of the new CVID building, the University had a choice to install more distributed equipment or transition to a central chilled water plant. Life cycle cost analysis showed that the most cost-effective solution was to make the transition to a central plant.

The estimated budget is $6.4M. The project will be financed with funds from the CVID project (in lieu of a chiller/cooling tower for the building), and a loan to be paid back over a period of 5 years from energy savings and annual VPUO maintenance funding.

The project is designed and estimated to take 12 months to complete. CSU anticipates a multi-prime delivery method, with multiple bid packages.

Justification

Utility Services

Utility Services recommends abandoning the distributed equipment paradigm for cooling at IDRC. Heating at the IDRC site already follows the central model with excellent results. Distributed equipment with life left in it can be sold to recoup some cost. Finally, retirement of the distributed inventory will allow existing Facilities personnel to maintain the central plant with no change in staffing.

Physical Condition/functionality of Existing Space

There are currently twelve distributed chillers serving the IDRC complex and ARBL. Due to the nature of the research, all of this equipment is fully redundant (i.e. twice the number of chillers are installed than are needed for cooling). The newest air-cooled equipment at IDRC is nearly halfway through its lifespan and in ten years all of it will need replacement. Estimates are that $950K in CM funds will be necessary to replace the four oldest air-cooled chillers, one of which is currently at reduced capacity due to component failure.

New Space Requirements

<table>
<thead>
<tr>
<th>Room type</th>
<th>Number</th>
<th>Total GSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller Plant</td>
<td>1</td>
<td>3480</td>
</tr>
</tbody>
</table>

Alternative analysis

While the first-cost is greater for a central plant than for replacement of the existing distributed chiller inventory, the cost of ownership is dramatically smaller. The following graph illustrates order of magnitude comparisons for 50-year ownership cost.
The difference in ownership cost is primarily due to the significant reduction of installed equipment through centralized redundancy and a diversity of peak loads. Central equipment is of higher quality and has a longer useful life. Controlled Maintenance (replacements) over 50 years will be roughly half with a central plant. Centralized equipment requires more maintenance than distributed equipment on a unit by unit basis, however, the central plant has roughly a third of the installed equipment, and thus maintenance dollars are roughly 20% less. There is a reduction in annual energy use (estimated at $25k in today’s dollars) due to higher efficiencies and less equipment.

**Benefits of the Project**

In addition to the life cycle cost savings there are intangible benefits as well. Air-cooled chillers are noisy and central plants are quiet. There are neighbors very close to the south of IDRC, with an established history of complaints, including a current complaint being addressed from the Bella Vira development southeast of the IDRC complex. A central plant is more robust better able to respond to growth and load variation. It is simpler and cheaper to modify the central plant than it is distributed equipment. In many cases, growth can be absorbed into the existing central plant capacity due to inherent diversity. Finally, a central plant consolidates the cooling footprint, freeing space for other use and avoiding equipment sprawl. One desire at IDRC, for example, is to consolidate deliveries to the back side of RBL. Removal of chillers will enable that effort.

**Design Criteria**

**Site Constraints**

The chiller plant will be outside the secured area of the Judd Harper Complex, to the NW of the cGMP building.
Flood Mitigation Analysis
Not applicable to anticipated building site. See flood plain map in appendix.

LEED Goal

The project is waived due to the size of the project and specialized program. The following Sustainable Design Strategies have been considered.

Sustainability measures employed in this project will directly affect all buildings connected to it on the Foothills Campus. The replacement of aging air-cooled chillers with connections to a central chilled water system has the potential to reduce energy use for each building on the campus. This approach can also increase the resilience of the campus by including redundant chilled water generation, limiting the negative effects of maintenance downtime and equipment failure.

Any future new construction or renovations of buildings on the campus seeking LEED certification (such as the CVID building) can benefit from certain measures taken, including the use of high efficiency chillers, low environmental impact refrigerant, cooling tower makeup water treatment, and ice thermal storage. Increasing the number of points available to a project by connecting to the chilled water plant can give project teams more flexibility in meeting LEED goals. Relevant LEED v4.0/v4.1 credits include:

- Water Efficiency Credit 3: Cooling Tower and Process Water Use (LEED v4.1)
- Energy and Atmosphere Credit 2: Optimize Energy Use (LEED v4.0/v4.1)
- Energy and Atmosphere Credit 4: Grid Harmonization (LEED v4.1)
- Energy and Atmosphere Credit 7: Enhanced Refrigerant Management (LEED v4.0/v4.1)

Cooling Tower and Process Water Use (LEED v4.1)

Under LEED v4.1, projects are allowed to take credit for cooling towers associated with district energy systems. To earn one point, a potable water test must be conducted to measure concentrations of
CaCO₃, total alkalinity, SiO₂, Cl-, and conductivity, then the maximum number of cycles achieved without exceeding these concentrations is calculated to document compliance for one point. One additional point can be achieved by increasing the maximum number of cycles by 25% through water treatment/maintenance or using a minimum of 20% nonpotable water for cooling tower makeup.

Optimize Energy Use (LEED v4.0/v4.1)
Projects may take into account the performance of connected district energy systems in the energy model. High efficiency chillers, cooling towers, and pumps can increase the calculated energy savings and contribute to the number of points a project can earn under this credit.

Grid Harmonization (LEED v4.1)
The use of thermal ice storage may qualify projects for points under Case 3: Load Flexibility and Management Strategies by satisfying the requirements of Peak Load Optimization (reduce on-peak load by at least 10% compared to peak electrical demand) and/or Flexible Operating Scenarios (move at least 10% of peak load by a time period of 2 hours). As this credit is new under LEED 4.1, further research is needed to determine if projects can take credit for strategies used in a district energy system.

Enhanced Refrigeration Management (LEED v4.0/v4.1)
Projects must take into account any refrigerants used in connected district energy systems to earn the point for this credit, so using low-impact refrigerants in the chillers contributes.

Utility Incentive Programs
This project is included in Xcel’s Energy Efficient Buildings (EEB) rebate program along with the CVID building. Nexant is the third-party rebate program administrator assigned to this project.

Architectural
The building will be a premanufactured metal building. Panel colors will be chosen by Facilities Management based on standard manufacturer options.
Mechanical Narrative
The plant will initially provide chilled water for the new CSU Center for Vector-Borne and Infectious Disease (CVID) only and will be sized to provide chilled water to six existing buildings on the Foothills Campus. The project design will consist of a 3,480 square foot facility centrally located on the Foothills Campus. The facility will house two 600-ton chillers with one 150-ton pony chiller and associated cooling towers, pumps, and equipment as well the required electrical, fire protection, and other support systems. Through a phased approach, the plant will eventually replace a total of 12 associated existing air-cooled chillers that need major repairs and/or replacement. There will also be underground chilled water piping installed running from the new plant to the CVID and stub-outs to serve as attachment points for piping serving the existing buildings mentioned below.

- Research Innovation Center (RIC)
- Regional Biocontainment Lab (RBL)
- CGMP Pharmaceutical Mfg. (CGMP)
- Animal Reproduction and Biotechnology Lab (ARBL)
- Bio-Environmental Hazards Research Building (BRB)

<table>
<thead>
<tr>
<th>Building Name</th>
<th>Building Number</th>
<th>Building Floor Area (sf)</th>
<th>Required Cooling Capacity (tons)</th>
<th>Required Chilled Water Flow (gpm)</th>
<th>Required Pipe Diameter (in)</th>
<th>Connection Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVID</td>
<td>32454</td>
<td>217</td>
<td>342</td>
<td>6</td>
<td></td>
<td>1</td>
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<tr>
<td>BHRB</td>
<td>1424</td>
<td>19447</td>
<td>104</td>
<td>164</td>
<td>4</td>
<td>2</td>
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<tr>
<td>RBL</td>
<td>1426</td>
<td>43941</td>
<td>460</td>
<td>724</td>
<td>8</td>
<td>3</td>
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<tr>
<td>CGMP</td>
<td>1429</td>
<td></td>
<td>0</td>
<td></td>
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<td>4</td>
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<tr>
<td>RIC</td>
<td>1428</td>
<td>69755</td>
<td>280</td>
<td>441</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>ARBL</td>
<td>1402</td>
<td>34587</td>
<td>215</td>
<td>339</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

CSU Standards
The CSU Building Construction Standards Manual is available at: http://www.fm.colostate.edu/constr_standards

The CSU Standards are to be used as guidelines for design. They are divided into 3 parts for use by Architects and Engineers: the first part is administrative; the second part discusses requirements for design and deliverables at each stage of the design process; the third part consists of the technical standards arranged by CSI division. The Standards are a work in progress, and as such, any question about the applicability of a standard should be discussed with the project manager. The Standards should never be referenced or copied in Contract Documents – the design is expected to embody and conform to the Standards. Contractors are not to be directed to review the Standards as a contract requirement.

CSU INCLUSIVITY STANDARDS-not applicable to this project

LIST OF APPLICABLE CODES
Approved building codes and standards have been adopted by the Office of the State Architect (herein referred to as State Buildings Program (SBP)) and other state authorities, and are identified below as the minimum requirements to be applied to all construction projects at state agencies and institutions of higher education owned facilities.
Applicable codes:

2018 INTERNATIONAL BUILDING CODE
2018 INTERNATIONAL MECHANICAL CODE
2018 INTERNATIONAL ENERGY CONSERVATION CODE
2017 NATIONAL ELECTRICAL CODE
2018 INTERNATIONAL PLUMBING CODE
2018 INTERNATIONAL FUEL GAS CODE
2018 INTERNATIONAL FIRE CODE
2010 ADA STANDARDS FOR ACCESSIBLE DESIGN
2009 ICC/ANSI A117.1

Project schedule, cost estimates and financing

Schedule/phasing
The project is designed and estimated to take 12 months to complete. CSU anticipates a multi-prime delivery method, with multiple bid packages.

Financing
The estimated budget is $6.4M. The project will be financed with funds from the CVID project (in lieu of a chiller/cooling tower for the building), and a loan to be paid back over a period of 5 years from energy savings and annual VPUO maintenance funding.

Cost estimate/methodology
Cost estimates were developed by Facilities Management staff. CSU standards specify that the A/E document 20% of the construction budget in bid alternates, to cover potential volatility in the construction market as the project progresses.

Appendices
  a. Utility map
  b. Site map
  c. Floor plans
  d. Elevations
  e. Foothills Campus Flood Plain
  f. Budget Estimate
MAIN LEVEL
0' - 0"
ROOF EAVE
19' - 6"
FLAT METAL PANEL WALL SYSTEM BY PRE-ENGINEERED METAL BUILDING MANUFACTURER; BUTLER eSTYLEWALL II OR EQUIVALENT

CONTINUOUS GUTTER TO DOWNSPOUT
NEW TRANSFORMER, RE: ELEC
MOBILE BACKUP GENERATOR, RE: ELEC

RE: MECH AND PLUMBING DRAWINGS FOR ALL ROOF AND WALL PENETRATIONS
NOTE: PERSPECTIVE DRAWINGS ARE FOR DISCUSSION PURPOSES ONLY AND ARE NOT INTENDED TO BE USED AS A BID OR CONSTRUCTION DOCUMENT.

NOTE: AXONOMETRIC DRAWINGS ARE FOR DISCUSSION PURPOSES ONLY AND ARE NOT INTENDED TO BE USED AS A BID OR CONSTRUCTION DOCUMENT.
This map is a user generated static output from the City of Fort Collins FCMaps Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.
### Foothills Chiller Plant cost estimate

<table>
<thead>
<tr>
<th>Remarks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Professional Services</strong></td>
<td></td>
</tr>
<tr>
<td>Site Survey, Geotechnical</td>
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</tr>
<tr>
<td>Consultants - Architects, Engineers, Vibration, Acoustics</td>
<td>476,900</td>
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<tr>
<td>Commissioning and Advertisements</td>
<td>10,000</td>
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<tr>
<td>FM project development fee</td>
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<tr>
<td>Independent Code Review, code insp, material tests</td>
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<tr>
<td>PFA plan review</td>
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<tr>
<td><strong>Total Professional Services</strong></td>
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<tr>
<td><strong>Construction</strong></td>
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<tr>
<td>New Space - 3400 gsf</td>
<td>2,491,525</td>
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<tr>
<td>Site Work Service/Utilities</td>
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<td>Site Improvements/Landscaping</td>
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<tr>
<td><strong>Subtotal Construction Costs</strong></td>
<td>5,109,000</td>
</tr>
<tr>
<td><strong>Equipment &amp; Furnishings</strong></td>
<td></td>
</tr>
<tr>
<td>Fixed Equipment</td>
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<tr>
<td>Moveable Equipment</td>
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</tr>
<tr>
<td>CSU Communications/AV</td>
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<tr>
<td>CSU Notifier system</td>
<td>6,000</td>
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<tr>
<td><strong>Total Equipment and Furnishings Costs</strong></td>
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</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
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<tr>
<td><strong>Total Miscellaneous Costs</strong></td>
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<td><strong>Subtotal Project Cost</strong></td>
<td>5,923,055</td>
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<tr>
<td><strong>Project Contingency</strong></td>
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<tr>
<td>Project Contingency 58%</td>
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<tr>
<td><strong>Total Contingency</strong></td>
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<td>**Budget- Occupancy in Jan 2022 **</td>
<td>$6,399,955</td>
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</tbody>
</table>

This opinion of probable cost is made on the basis of experience, qualifications and best judgement of a professional cost consultant familiar with the construction industry, combined with the professional experience of Facilities Management. FM cannot guarantee that proposals, bids or actual construction costs will not vary from this cost estimate due to market conditions at the time of the bid.