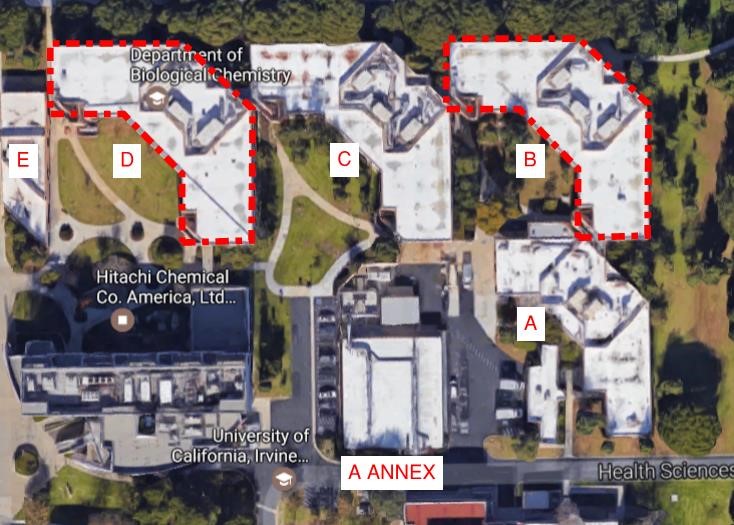
Detailed Project Program

CRII - 3 2017 Med Sci B Major Building Maintenance

Contract No. 999471 / Project No. 5112079

CRII - 3 2017 Med Sci D Major Building Maintenance

Contract No. 999472 / Project No. 5112080



Facilities Management

19172 Jamboree Road

Irvine, CA 92697-5444

Conformed September 20, 2017

DETAILED PROJECT PROGRAM (DPP)

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1. **INTRODUCTION**
   * + 1. Medical Sciences “B” Building (Med Sci B stack) is a 35,864 gross square foot, two-story laboratory and office building constructed as part of the Medical Sciences Unit One project in 1978. Medical Sciences "D" building (Med Sci D stack) is a 71,959 gross square foot, four-story laboratory and office building also constructed as part of the Medical Sciences Unit One project in 1978. As a research complex, the entire development operates continuously. The building occupancy is a type B Laboratory, with medical research in a BSL-2 environment. Though labeled for convenience, the four connected structures (A, B, C, and D “stacks”) and the disconnected buildings (E, Tamkin Lecture Hall, and Medical Sciences Annex) share some common electrical and mechanical systems. Medical Sciences C Room C-106 supplies the complex with compressed air, natural gas, and heating water, industrial hot water, domestic hot water, deionized water, vacuum, and steam. Chilled water and high temperature water (HTW) from the campus central plant enters the complex through this room. HTW is used in C-106 to make steam, domestic hot water, industrial hot water, and heating water.
       2. Existing Mechanical Systems – as designed:
          1. Medical Sciences B

As designed, there are three (3) air handlers units (AHU) on the roof. Air handlers are 40 hp, 30 hp, and 25 hp. Two (2) units are 100% outside air.

AHU-B1 serves the office areas and has a return air fan.

AHU-B2 serves the South wing labs with 100% outside air

AHU-B3 serves the West wing labs spaces with 100% outside air.

* + - * 1. Medical Sciences D

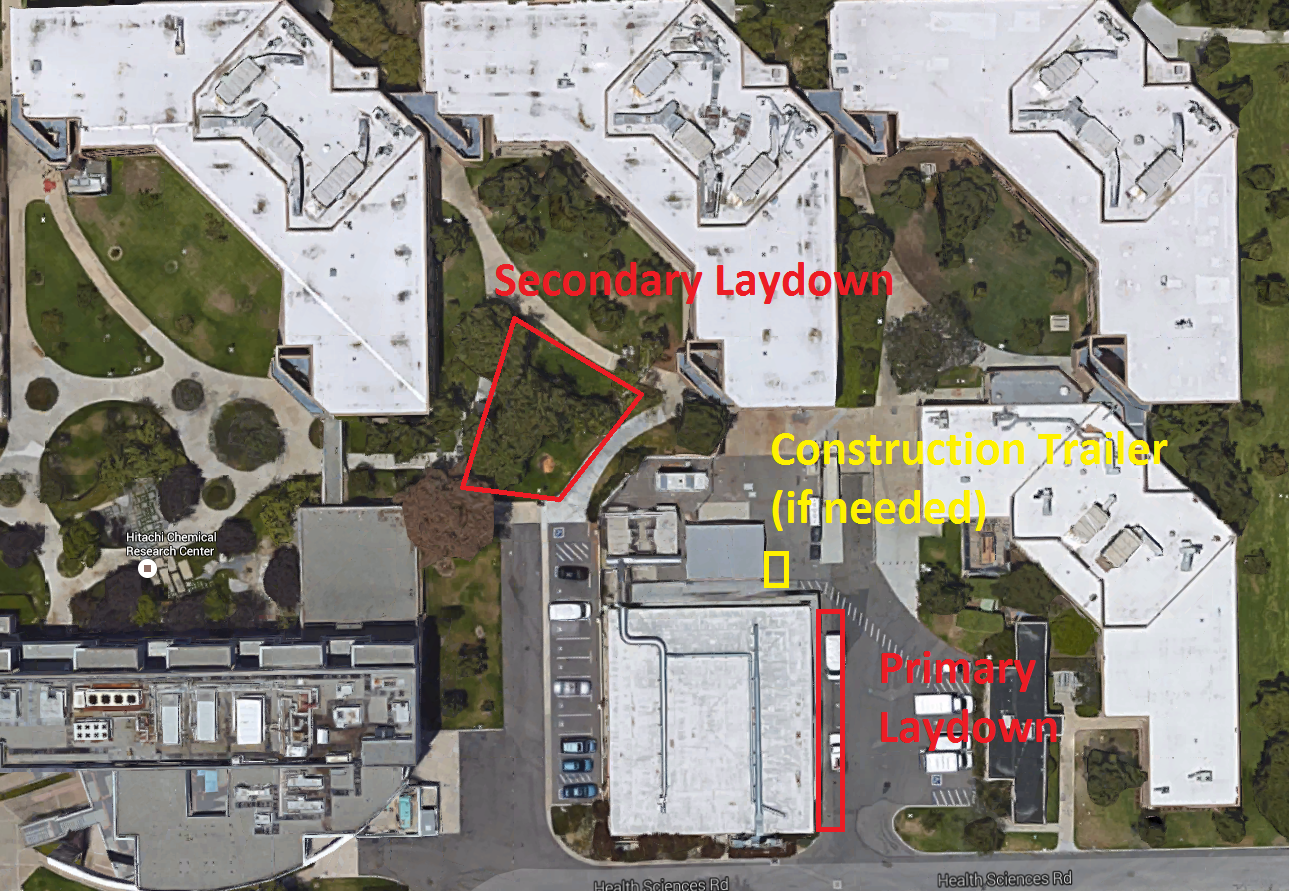
As designed, there are three (3) air handlers units (AHU) on the roof. Two (2) of Air handlers are 40 hp and one (1) is 50 hp. Two (2) units are 100% outside air.

AHU-D1 serves the office areas and has a return air fan.

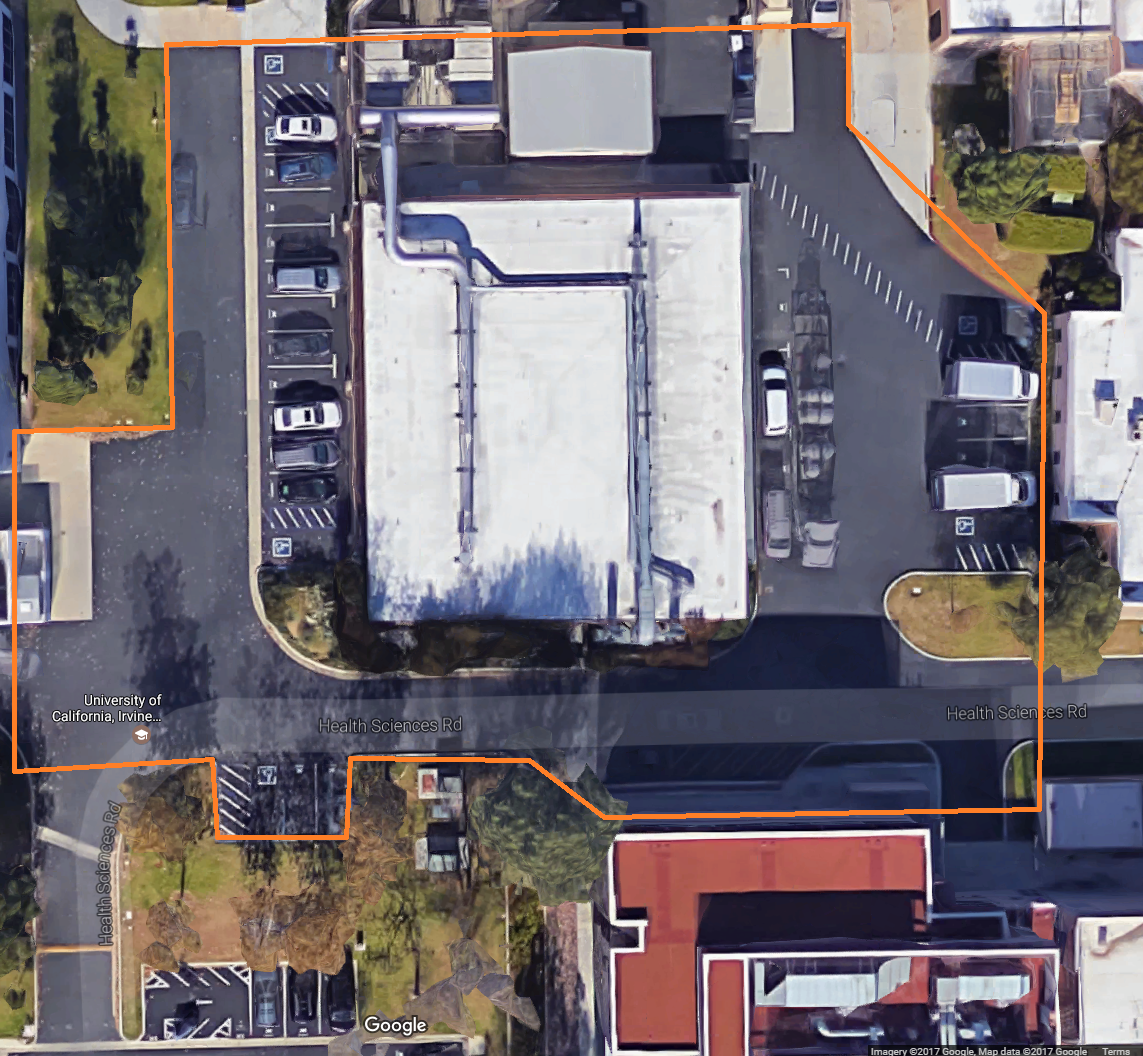
AHU-D2 serves the West wing labs with 100% outside air

AHU-D3 serves the South wing labs spaces with 100% outside air.

* + - * 1. Laboratory zone air control is partially variable volume via first-generation pneumatic-actuated Phoenix Controls airflow valves installed in the 1998 Energy ENVEST Retrofit project.
        2. Office air control is by pneumatic VAV terminal units as upgraded in the 1998 Energy ENVEST Retrofit project.
        3. Reheat valves are DDC via Siemens energy management system replaced during the 2009 SEP Energy Efficiency project #998551. Static pressure reset was installed on AH-B1 and AH-D1 during the same project.
        4. A Monitoring-Based Commissioning (MBCx) study was conducted during the 2011-2012 calendar year. Various control upgrades were made; see report in the University Furnished Information.
        5. There are 7 exhaust fans on the Med Sci B roof and 11 exhaust fans on Med Sci D roof. Exhaust fans range from fractional to 7½ hp.
        6. The University retained the services of Equal Air Balance to take readings of existing equipment and airflows at diffusers, registers, and grilles as they currently operate. Refer to University Furnished Information. The first generation Phoenix Control airflow valves were noted as “excessively noisy” and have been a constant source of complaints from the researchers. The report establishes the existing conditions and is not intended to indicate sizes or airflow requirements. The Design Builder shall determine those requirements based on University design criteria.
        7. Included in University Furnished Information is the University’s work order history for Med Sci B and D for the past three years showing the types of complaints and service requests Facilities Management has received. The Design Builder is to review and determine if a pattern has developed that should be addressed in the design of this project and any accepted alternates that add value to Design Builder’s RFP submission.
        8. The existing generator and emergency power system will not require modification as part of this project. Contractor shall not touch the emergency power system or place new equipment on the existing emergency power system.
      1. Existing Floor Plans
         1. Included in University Furnished Information are the floor plans for Med Sci B and D in pdf and AutoCAD files. The plans include the room numbers and assignable square footage (ASF). ASF is a term used to describe occupiable areas. It does not include walls, stairways, corridors, restrooms, parking facilities, or mechanical spaces. The areas shall be confirmed by Design Builder after award of contract. The location of doors and walls may not be shown exactly and correctly on these plans. Although updated based on a recent walk of the building to show the rooms as correctly as possible, the floor plans have not been measured.
      2. Laydown Areas
         1. An outdoor area for laydown and a construction trailer site have been identified. Refer to Figure below.



* + - * 1. Contractor parking in the service stalls between Med Sci A and Med Sci Annex, between Med Sci Annex and Hitachi Building, and along Health Sciences Road between Hitachi Building and Beckman Laser Institute shall be limited to four vehicles in four stalls total unless excess vehicles have been approved in advance in writing by the University's Representative. In the Figure below, the orange polygon bounds the area with contractor parking limitations. All other contractor or subcontractor vehicles shall be parked in AR or regular parking in lots 81, 82, or 84.



* + - 1. Known Conditions
         1. Electrical conduits are cast into the concrete roof decks. Contractor shall be responsible for any damage to electrical conduit inside the roof decks. Contractor shall be responsible for any measures necessary to determine locations of conduits and incorporate these project activities into the project schedule.
         2. Room B129 has a supplemental chilled water cooling unit.
         3. Access is limited to Room B141. Work in B141 shall be scheduled with the University's Representative for access and an escort will be provided by the University.
         4. Access is prohibited to Room B178.
         5. Cellular data arrays exist on the roof of Med Sci D, managed by UC Irvine Office of Information Technology (OIT) and Verizon Wireless. OIT and Verizon will relocate all equipment off the roof by January 1, 2018 to allow for roof work in 2018. Coordinate any activities that impact Verizon Wireless data array hardware or power with University's Representative.
         6. Room D226 contains equipment which is very sensitive to power disruptions. D226 also contains a supplemental chilled water cooling unit. Coordinate any electrical shutdowns for this space with two weeks advance notice to University's Representative (typical for all supplemental cooling units).
         7. Room D306 has a supplemental chilled water cooling unit.
         8. Many laboratories have installed catch pans below the ceiling to mitigate impacts of water infiltration from floor to floor. All catch pans shall remain as currently installed; if removed during construction for access, replace catch pans after construction.

# SCOPE OF WORK OVERVIEW

* + - 1. Base Bid
         1. The Med Sci B and D project Base Bid Scope of Work includes replacing the complete roof system and rooftop mechanical equipment. The base bid includes and is not limited to:

New single-ply roof and insulation.

New overflow roof drains.

New air handling units.

New exhaust fans and systems including stacks, stack bases, fans, motors, and controls.

Hazardous material abatement including asbestos and lead containing materials related to the roof and mechanical equipment. A hazardous material report has been provided with the RFP.

* + - 1. Bid Alternates
         1. Alternates are as follows:

Alternate #1 – Airflow valves, reheat coils, demand control ventilation, and ductwork upgrades

Alternate #2 – Autoclave replacements

Alternate #3 – Cold room upgrades

Alternate #4 – Laboratory safety upgrades

Alternate #5 – Mechanical room equipment replacement

Alternate #6 – Flooring and painting

* + - * 1. Design and construction for base bid and alternates shall comply with UCI Facilities Management Campus Standards and specifications as provided with the RFP. Although not every Campus Standard or specification requirement is listed in this DPP with each description, many are included to highlight major design and construction requirements that must be maintained. The University sustainability requirements require this project to recycle at least 85% of construction waste by weight. Hazardous materials abated are not counted as part of recycling, though they shall be logged.
        2. For base bid and alternates, provide energy savings calculations for any projected energy savings as outlined:

Provide calculations to show energy savings using software approved for submission to Southern California Edison (SCE) and Southern California Gas Company (SCG) as approved by the California Public Utilities Commission (CPUC), such as Trane Trace. Provide complete printouts of each input used for base and proposed cases.

It shall be clear to the reviewing committee what each single proposed option will save the University in kWh per year and natural gas therms per year. Chilled water savings should be calculated at 0.74 kW/ton and shown in kWh. Natural gas savings shall be calculated using 74% heating efficiency and shown in therms.

Payback calculations shall use utility costs of $0.105/kWh and $0.78/therm.

Calculations for each measure shall include only the incremental energy savings for each measure beyond the base scope of work.

Each energy efficiency measure shall have a rough order of magnitude construction cost to determine payback.

Complete the Energy Savings Analysis Excel spreadsheet included with RFP in University Furnished Information, and provide both electronic and hard copies of the spreadsheet. Spreadsheet shall include incremental savings of each measure. Provide savings numbers for all items included in base bid as a single line-item, then provide incremental savings from each successive alternate for the scope not included in base bid.

Provide a narrative describing the benefits of utility incentives and participation in Savings by Design as part of TAB 3 of the technical proposal.

# BASE BID

* + - 1. Roof Replacement
         1. The new roof assembly shall be watertight and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
         2. Remove complete building B and D existing single-ply roof membranes including associated wall and roof curb flashings and roof deck insulation down to the existing concrete decks.
         3. Relocate, add, or remove existing roof drains as necessary to provide proper drainage. Provide new roof drain sumps and insulate sump bodies inside the buildings; medium-sump roof drains are acceptable. Completely replace the existing horizontal storm drain piping from the drain bodies to the first vertical pipe. Provide new overflow drains and insulate sump bodies inside buildings; alternatively, provide scuppers by designing roof with slopes to accommodate them. Overflow drains or scuppers can spill out through side of building with nickel-bronze downspout nozzles with bird screen, Jay R. Smith Figure 1770. Locate outlets to spill overflow on landscaped areas away from walkways. Provide spill blocks.
         4. Install new tapered insulation to provide proper slope towards roof drains at minimum of ¼-inch per foot or greater for congested areas where greater slope will provide better drainage. Install new fully adhered 80 mil single-ply PVC membrane roof in “white” and associated flashing and counter flashing at termination points. Metal flashing to be stainless steel and constructed in accordance with Campus Standard details and specifications.
         5. University will hire an independent roofing consultant to develop and perform roof leak tests. Attend roof leak tests coordinated by University's Representative. Repair leaks identified during University's tests.
         6. Roof insulation shall have, at minimum thickness, a minimum of R-10 and an overall average of greater than R-20. Provide a minimum 20-year No Dollar Limit warranty on roof material and 5-year labor warranty.
         7. Temporarily lift all cold room condensing units prior to re-roofing and reinstall after roofing is complete. Maintain cold room operation while units are lifted. Provide new mounting/sleepers and rainproof cover that maintains roof warranty and complies with current electrical and mechanical code. The Lennox unit on the roof of Med Sci D is abandoned in place; demolish and dispose of Lennox condensing unit demolish and remove entire line set. Contracto shall assume refrigerant is still in the lines and shall be responsible for removing and legally disposing of refrigerant.
         8. Expansion joints at the top of exterior stairwells between Buildings (A and B, B and C, and C and D) currently leak. Repair or replace expansion joints and address water intrusion issues.
         9. Eliminate standing water at exposed elevated concrete landings in exterior stairwells of Med Sci B and D. Repair or replace bubbling deck membrane at these locations.
      2. Air Handling Unit Replacement
         1. Demolish existing air handling units, roof curbs, and exterior ductwork and supports. Although the existing air handlers have only chilled water coils, this project will extend existing capped heating water piping through the roof and provide preheat water coils and controls at each new air handler. Existing capped piping shall be flushed prior to connection. In cooperation with the University, select the new air handlers meeting University Standards and requirements for a complete and fully functioning system. Examine existing capacity compared to current usage and provide new units that meet the Campus Standard design criteria for new equipment while maximizing ability to turn equipment down to minimum air changes. Preheat coils are required and shall be sized to heat airflow from outside design condition 37°F to leaving supply air temperature of 60°F. Avoid installing ductwork higher than top of air handling units unless no other option is available.

Capacity sizing: Provide the number of air handling units that provides the University with the greatest energy efficiency. Provide a minimum of two air handlers for labs ; lab AHUs shall be in parallel and service both lab wings together, not separately as is presently the case. Size total air handler capacity for 132% of labs peak load, divided evenly among air handlers (e.g. two air handlers at 66% each, three air handlers at 44% each, etc.). Lab AHUs shall be sized not smaller than the total of six air changes per hour (ACH) for every lab space served. If Alternate #1 for centralized demand control ventilation (CDCV) system is provided, the AHU fan capacity shall not be reduced below the 6 ACH requirement. Additional 20% capacity beyond the 32% listed above is not required.

Air handler units shall be weather-resistant aluminum, stainless steel, or fiberglass construction, copper tubes and copper fins chilled water and preheat or reheat hot water coils, direct-drive fan(s) with IEEE 841 motor(s) controlled by Variable Frequency Drive (VFD) with shaft grounding kit(s) and mounted on new curbs. Curbs shall be concrete or manufacturer hot-dipped galvanized steel; wood is prohibited. Equipment shall comply with Campus Standards and specifications. Fans shall be direct drive. Direct-drive fan wall technologies, EC motors, and centrifugal direct-drive fans are acceptable; belt driven equipment is prohibited. IEEE-841 is not required if EC motors are provided, as EC motors are not available in IEEE-841. Refer to Campus Standards and specifications for coil sizing requirements and other details of construction and material requirements. Heating hot water coils may be single-row, provided all other campus specifications and standards are met. For maximum system efficiency, air handler fan and coil selections should consider the impact of selected alternates that change air flow or pressure requirements for the system.

Controls: Upgrade existing modular controllers and install new controllers with BACnet over ethernet/IP building modular controllers that shall be used for this project’s Work. Air handler control valves shall be pressure-independent control valves complying with campus master specifications. Air handlers shall be connected to and controlled by Siemens to match existing building automation system. Provide new sensors for air handler control, including all air handler temperature sensors, supply static pressure sensor(s), fire smoke detectors, etc.

Provide one roof-mounted convenience hose bibb with vacuum breaker on each roof to service mechanical equipment. Remove existing condensate hub drains and provide new sinks to suit new air handling units. Locate sinks next to AHU condensate drain outlets and avoid running piping across the roof. Coordinate AHU drain outlets to be located away from main service access side of the unit. Relocate existing vents through roof to maintain separation from AHU’s outside air intakes. Vents shall be at least 15 feet away from intakes or extend vertically to 2 feet above top of intake.

* + - 1. Exhaust System Replacement
         1. Demolish existing exhaust fans and ductwork on the roof. In cooperation with the University, select, furnish, install, and commission the new exhaust fans meeting University Standards and requirements for a complete and fully functioning system. Provide new stainless steel freestanding laboratory exhaust stacks.

Exhaust fans: Exhaust fans shall be AMCA Single-Width, Single-Inlet, Arrangement 8, direct-drive fans with IEEE 841 motors on VFD complying with campus standards and master specifications and mounted on concrete curbs. Exhaust system shall be minimum 2+1 design with fans serving a common rooftop plenum, each sized for one-half the exhaust air requirement or other amount determined by the Design Builder that provides the University with the most energy efficient system and one fan being standby. Belt driven equipment is prohibited. Exhaust fan plenum shall include an outside-air bypass damper if required by wind study performed. Bypass damper shall operate only at minimum flow conditions or other conditions as determined by the wind study and shall not operate continuously.

Wind Study: Design Builder shall hire a consultant to perform a wind study with a physical model to determine safe exhaust stack heights, exit velocities, and outside air intake locations, based on wind speed and direction. Exhaust fans shall be programmed to modulate fan speed and outside-air bypass damper (if a bypass damper is needed) to implement a control system to reset exit velocity if determined to be technically feasible. The appropriate system design will depend on the results of physical wind tunnel modeling. Ambient Air Technologies and CPP already have a wind tunnel models of the UCI campus. The goal is to minimize energy consumption by reducing exit velocities of the stacks when winds are relatively calm.

Exhaust Stacks: The buildings are laboratory buildings and form follows function; visible exhaust stacks are acceptable. Exhaust stacks shall be installed with outlets even with each other. Ensure that not less than 3 stack diameters are provided downstream of any points of connection to the stacks, unless the design-builder demonstrates to the University's satisfaction that fully developed flow can be provided with a shorter stack. Stacks shall be free-standing without any guy wires, or diagonal braces except short stiffeners at the bases of the stacks, where needed.

Separate exhaust fans exist solely for D478 autoclave canopy, B254, B256, and B260. Demolish exhaust fans and connect all laboratory exhaust drops to each building's new manifolded exhaust system.

* + - 1. Abatement
         1. Abate any hazardous materials (e.g. asbestos and lead) from any activities impacted by base scope of work or selected alternates. This includes, and is not limited to, roof insulation, roof flashing, roof mastics, ductwork mastics, ductwork insulation, and piping insulation. Refer to University Furnished Information for hazardous materials testing report for information on where hazardous materials are located.
      2. Building Shutdown Requirements
         1. Whole-building air shutdowns for major equipment construction and installation shall be completed with two (2) scheduled interruptions of building air (supply and exhaust) no more than three business days in length or one (1) block of five business days per building. Simultaneous interruptions of air to Med Sci B and Med Sci D are prohibited; Med Sci B and Med Sci D shall not have overlapping whole-building air shutdowns. Develop and submit a construction phasing sequence plan and prepare written switching procedures to allow coordination of air handling and exhaust equipment down-time. Outages are expected when transitioning from one air system to another, however the Design Build team shall become thoroughly familiar with the project scope of work and identify any additional outages that will be required for any reason.
         2. Any activities impacting the building interior that are required to fully complete the work beyond the allocated downtime (e.g. drilling, coring, fan testing, etc.) shall be completed between the hours of 9:00pm and 9:00 am or on weekends. Work isolated to the roof with no impact to the building interior such as insulation and roofing installation may be completed during normal working hours.
      3. Design Requirements
         1. See Part 10 of the DPP, Scope of Work, for design deliverables and the Campus Standards.

# ALTERNATE # 1

* + - 1. Interior Ductwork
         1. Demolish existing laboratory supply air ductwork from main trunk to corridor fire smoke dampers, including existing supply air terminal units. For laboratories with terminal units inside the labs, demolish ductwork from main duct point of connection up to and including airflow valve and reheat coil. Do not demolish or make friable Transite® exhaust ductwork unless hazardous materials procedures are implemented. Replace existing supply air ductwork, such as replacing flexible ductwork with galvanized ductwork and high-pressure-loss fittings with low-pressure-loss fittings, to reduce fan static pressure and reduce system leakage. Existing exposed-to-view flexible ductwork shall be replaced with hard duct. Suggested ducts for replacement are included in University Furnished Information, and Design-Builder should select duct replacements based on a pressure drop analysis of the duct system and minimizing work inside laboratories. Size ductwork based on Campus Standards for laboratory space cooling and maximum air change requirements. Provide ductwork fittings that minimize pressure drop. Provide round ducts for efficiency and durability. Remove existing and provide new diffusers, registers and grilles. Clean and seal remaining existing supply air ductwork. Should any interior duct liner exist, remove or encapsulate the liner. Remove filters and filter holders from ceiling diffusers with mounted filters after the duct has been cleaned.
         2. Survey existing fire dampers and replace any dampers that have failed or are missing with new fusible link dampers. Assume five dampers have failed and require replacement for bidding purposes. Testing shall be done prior to demolition. Any additional damper replacements will be addressed during construction.
         3. Room B129 - Demolish and dispose of cooling unit if it is possible to provide sufficient cooling from supply air ductwork. If unit is retained, replace ductwork for cooling unit with galvanized ductwork.
         4. Room D306 - Demolish and dispose of cooling unit if it is possible to provide sufficient cooling from supply air ductwork.
         5. Air distribution not touched or removed as part of an alternate does not need to be replaced. The design-builder shall determine extent of air ducts to be replaced based on several factors, such as system pressure drop, flow requirements, schedule limitation, and impact construction to building occupants.
      2. Zone Reheat Coils
         1. Demolish and recycle existing laboratory and office zone reheat coils. Furnish and install new reheat coils sized appropriately for the new interior ductwork airflows. Furnish and install new piping, appurtenances, and insulation complying with specifications and Campus Standards. Existing DDC control valves may be re-used with cartridge replacements as necessary to provide the new design flows.
      3. Laboratory Air Control Valves
         1. Furnish and install new digitally controlled laboratory pressure-independent venturi variable air volume control valves on supply, general exhaust, and fume hood and any other hood or exhaust inlet for laboratory zones. Basis of design shall be Phoenix Controls or Siemens; other manufacturers require approval prior to bid. Convert existing constant volume spaces to VAV. See University Furnished Information which identifies rooms that are currently constant volume based on air measurement report. Select the air control valves so that the minimum air flow range of the system is not more than two (2) air changes per hour. In any laboratory zone where the minimum ACH is greater than two (2) air changes per hour with fume hood sashes fully closed, the laboratory air control valves may be sized to the minimum fume hood flow. Ensure that each system can produce not less than six (6) air changes per hour. Purge air flow shall not be less than (6) air changes per hour. The maximum purge shall be the full flow of the supply air valves plus or minus the required pressurization offset.
         2. Provide emergency exhaust override that increases ventilation to maximum when activated. Provide local display units that display information about the space to users such as airflows, occupancy status, and temperature. Provide room pressurization monitoring. In lieu of a separate emergency exhaust overrides, pressure monitors, and local display units, Design Builder may provide those features on a single device.
         3. Demolish compressed air from existing control valves back to nearest metallic piping point that will remain active after project is complete and permanently cap. Soap test all capped lines and ensure air tightness.
      4. Office Terminal VAV Units
         1. Demolish existing pneumatic VAV components in zone office air control system. Furnish and install new direct-digital controllers and actuators for office zones. Set minimum office airflow CFM at 20% of maximum. Conventional terminal units will be accepted for office spaces on laboratory air handling units, provided that low-leak isolation dampers are provided to shut off air flow during nights, holidays, and weekends to save energy; the terminal units can properly function when exposed to the duct pressure required by the laboratory airflow valves; and are selected to meet noise criteria. Ensure conventional terminal units are only used to serve non-laboratory spaces (offices, lobbies, storage, etc.) and that spaces that are used as laboratories receive laboratory airflow controls.
      5. Centralized Demand Control Ventilation
         1. Furnish and install centralized demand control ventilation to reduce minimum existing six (6) air changes per hour (ACH) to 4 ACH when occupied and 2 ACH when laboratory is unoccupied. Provide dual (PIR/microphonic) technology motion sensors to reduce laboratory airflow control valves when unoccupied. Ultrasonic motion sensors are prohibited. Provide a Facilities Monitoring System (FMS) to sample air quality at a maximum of every fifteen minutes and, if total VOCs are exceeded, signal HVAC controls to increase airflow to maximum CFM setpoint until VOC’s are displaced and indoor air quality limits are maintained. Demand control ventilation system shall sample temperature, relative humidity, total VOCs, and particulates. The University has identified about 126 rooms as candidates for a reduction to 4 ACH occupied and 2 ACH unoccupied; these rooms are indicated on a floor plan and a room list is provided as University Furnished Information. A preliminary Aircuity energy savings analysis is provided as University Furnished Information. Base data and assumptions shown shall be used, unless otherwise approved by University.
         2. Provide professional cleaning service to fully clean laboratory suites prior to turn-over. Refer to Division 01.
      6. Access Requirements During Construction
         1. Construction, testing, and commissioning activities for activities in laboratories under Alternate #1 shall be completed within scheduled interruptions of no more than 5 consecutive business days per laboratory suite. Develop and submit a construction phasing sequence plan and prepare written switching procedures to allow coordination of laboratory down-time.
         2. Any activities required to fully complete the work outside of the allocated downtime (e.g. air balance, programming, punch list, insulation, etc.) shall be completed between the hours of 9:00 pm and 900 am or on weekends. Commissioning may be completed at project end, but all systems must be functional when spaces affected by this Alternate are turned back over to the University.
         3. The University will work with the design-build team to define the specific area impacted by the work and any equipment to move or hazards to remove. UCI will clear any chemical or radiological hazards from the space impacte dprior to work. UCI will clear benchtop glassware. Design-builder shall protect equipment in place to the maximum extent possible. Design-builder shall protect in place glassware on shelves, or package and relocate glassware that remains. UCI will work with the design-builder to minimize relocation of equipment and therefore recalibration. UCI will recalibrate equipment where necessary. Removal of hazards will be prior to the beginning of the design-builder's 5-day shutdown time.
         4. See University Furnished Information for locations of concealed spline ceiling. Concealed spline ceilings require extra work to access and reinstall. The Design Builder may, as their option, remove concealed spline and replace with lay-in tile ceiling.
      7. Hazardous Material Abatement
         1. Abate hazardous materials removed or otherwise affected by Alternate #1 activities. Refer to University Furnished Information for a hazardous materials testing report on where hazardous materials are located.
      8. Design Requirements
         1. See Part 10 of the DPP, Scope of Work, for design deliverables and the Campus Standards.

# ALTERNATE # 2

* + - 1. Autoclaves
         1. The goal of this alternate is to replace the existing central steam autoclaves with high-efficiency research steam autoclaves using electric heating for steam, and to demolish the existing steam system to Med Sci B and D stacks. Design-builder shall select the model and quantity of new autoclaves to meet the requirements in this section and to meet or exceed the existing autoclave number and capacity and match or improve existing cycle times.
         2. The basis of design for the high-efficiency steam autoclaves using internal electric heating elements is Priorclave, or equal.
         3. For each new autoclave, design-builder shall provide new electric service to autoclaves, including disconnects and transformers as required. Provide input water meeting requirements of autoclave manufacturer. Provide piping and appurtenances required for supplying and draining units. Refer to University Furnished Information for questionnaires completed by building occupants with more information about the use and requirements of the autoclaves.
         4. For each autoclave removed, demolish steam service back to farthest branch remaining in use after all demolition activities have completed and cap. This may require demolition of piping through more than one floor of the building. Demolish steam condensate drain from point of connection to end point, demolish tempering valve system, and demolish any other piping for steam autoclaves that is no longer required.
         5. Existing autoclaves are in the following rooms, and new autoclaves shall be installed in these rooms. The sizes indicated do not necessarily correspond with the size units needed or desired. Careful attention to the needs of the users, as expressed in the survey data, is an essential component of success in providing this alternate.

B274 - Two (2) units, with volumetric capacities estimated at 400L for the large unit and 130L for the smaller unit, design-builder to verify. Vacuum features are required on the smaller unit for solid and liquid cycles.

D254 - Two (2) units, with volumetric capacities estimated at 320L, design-builder to verify. Salvage the newer autoclave and turn over to the University. The new units shall be capable of running more than one liter of liquid in a single container at a single time.

D376 - One (1) unit, with a volumetric capacity estimated at 250L, design-builder to verify.

D466 - One (1) unit, with a volumetric capacity estimated at 100L, design-builder to verify.

D478 - One (1) unit, with a volumetric capacity estimated at 250L, design-builder to verify. Vacuum features are required, and the unit shall be capable of running liquid cycles.

* + - * 1. For all new autoclaves installed, provide canopy exhaust hood sized for the autoclave footprint; the concept is to nearly directly couple the exhaust to the shell of the autoclave. Connect autoclave communications/relays to automation system so that exhaust hood is enabled when autoclave is in operation and rejecting heat. The intent is to decrease cycle times by more rapidly cooling the unit; the unit's interlocks minimize the amount of steam released into the room by ensuring that the unit is cooled sufficiently.
        2. The industrial hot water system is softened. The industrial hot water supply is softened to one grain per gallon or less and, ideally, the new autoclaves will be able to use the soft hot water, as this will somewhat reduce cycle times. Nevertheless, for all autoclaves provided in this alternate, ensure that all manufacturer's water quality requirements are met. Provide whatever supplemental treatment processes are required to meet the manufacturer's requirements.
      1. Access Requirements During Construction
         1. Construction, testing, and commissioning activities for activities in Alternate #2 shall be completed within scheduled interruptions of no more than 5 consecutive business days per room. Alternatively, design-builder may provide a temporary autoclave facility within the Med Sci B-C-D complex, in which case Alternate #2 shall be completed within scheduled interruptions of no more than 10 consecutive business days per room. Only one autoclave room shall be under construction at a time. Develop and submit a construction phasing sequence plan and prepare written switching procedures to allow coordination of autoclave down-time.
         2. Any activities required to fully complete the work outside of the allocated downtime (e.g. punch list, insulation, etc.) shall be completed between the hours of 9:00 pm and 9:00 am or on weekends.
      2. Hazardous Material Abatement
         1. Abate hazardous materials from materials that are removed or otherwise affected by Alternate #2 activities. Refer to University Furnished Information for a hazardous materials testing report on where hazardous materials are located.
      3. Design Requirements
         1. See Part 10 of the DPP, Scope of Work, for design deliverables and the Campus Standards.

# ALTERNATE # 3

* + - 1. Upgrade and repair existing Cold Rooms as follows:
         1. Cold room scope of work shall be completed for B230A, B230B, B263, C104A, C135G, C224, C376, D230, D303, and D474. These rooms shall be 4°C cold rooms.
         2. Calculate cooling requirements for each room. While existing capacity may be compared to the calculated requirements, it shall not be the basis of sizing.
         3. Demolish existing condensing unit, evaporator, line sets, and electrical. Remove all building rooftop items related to refrigeration system. Furnish and install new air-cooled condensing unit, evaporator, and all piping, insulation, and electrical required for a fully functioning system. Condensing unit shall be located on top of cold room with suitable vibration isolation and adequate support, within the occupied corridor space and not on building roof. Because the condensing units are within an occupied space, provide condensing units meeting NC50 noise criteria or construct a wall between the condensing unit and corridor, with a louver to allow airflow, to provide NC50 in the corridor. Refrigerant shall be R-404A unless otherwise approved by University's representative. Controls shall be start/stop (pump down) operation.
         4. Evaporator

Low profile fan front design, 120 VAC, with Electrically Commutated Motors with carbon bladed fans

All refrigerant piping shall be copper suitable for bending and flaring and specifically cleaned for use in refrigeration systems and shall be insulated.

Condensate piping and traps may stay within the cold room and spill into the existing sinks to match existing.

Select system for low energy use and minimum head pressure requirements.

Evaporator Unit attached to ceiling of each environmental room of box with suitable, sturdy, corrosion resistant fasteners per structural engineer design requirements. Typically successful fasteners have been ¾-inch all-thread with lock washers.

Provide electric defrost heaters for all units. If energy analysis shows a savings, fan-powered defrost may be used on the 4°C environmental rooms.

* + - * 1. Replace cold room door, gaskets, heater, and closer. Cold room door shall be Commercial Cooling, Inc., or equal. Replace existing lighting with LED on occupancy sensor with manual override for if sensor fails. Sensor shall be rated for low temperature. Check and seal existing and new box penetrations and horizontal and vertical joints to reduce air infiltration.
        2. Provide control panels for installation complying with University detail in University Furnished Information. Control panels shall be configured for BACnet connectivity over ethernet/IP to the building management control system. Provide ethernet cable from cold room control panel to data closet and verify control panel can communicate with building automation server. Control panel capabilities shall include:

Unit using output based on set point for liquid line pump down.

Unit with input sensing temp for control, and alarms.

Unit able to interface with personal emergency alarm, and shut down the entire refrigeration system. condenser.

Unit able to control defrost for freezer, if applicable.

Unit able to sound local and remote alarms, and alert assigned people and groups.

Unit enclosed in metal box with door,

Door with temp display, alarm status, Alarm mute, and lock.

* + - * 1. Reuse existing personal emergency alarm, ensure local buzzer and lights. Shut down refrigeration system upon activation.
        2. Clean cold room prior to turnover to the University.
        3. Design Builder may elect to replace the cold room boxes in their entirety, so long as the replacement cold rooms provide the items in Section 6.1 and comply the Campus Standards and specifications.
      1. Access Requirements During Construction
         1. Construction, testing, and commissioning activities for activities in Alternate #3 shall be completed within scheduled interruptions of no more than 10 consecutive business days per room. Only one cold room shall be under construction at a time. Develop and submit a construction phasing sequence plan and prepare written switching procedures to allow coordination of cold room down-time.
         2. Any activities required to fully complete the work outside of the allocated downtime (e.g. programming, punch list, insulation, etc.) shall be completed between the hours of 9:00 pm and 9:00 am or on weekends.
      2. Hazardous Material Abatement
         1. Abate hazardous materials from materials that are removed or otherwise affected by Alternate #3 activities. Refer to University Furnished Information for a hazardous materials testing report on where hazardous materials are located.
      3. Design Requirements
         1. See Part 10 of the DPP, Scope of Work, for design deliverables and the Campus Standards.

# ALTERNATE # 4

* + - 1. Laboratory Improvements
         1. Furnish and install local eyewash units in rooms with both sinks and fume hoods. Eyewashes shall be installed on the sink closest to each fume hood. Provide domestic water plumbing to eyewashes. Tempering of the eyewash water is not required. Eyewashes basis of design is Guardian Equipment G1806(LH), Bradley S190-270B(L), or equal. Design-Builder shall select left or right-handed deck mounted eyewash based primarily on functionality and accessibility.
         2. Install catch pans under all ultra-low (-70°C or below) freezers in Med Sci B and D stack. Pans shall be stainless steel or other water resistant materials with three sides, with the open side at the front of the freezer. The pan shall slope toward the open side. Provide 1/8" deep break in pan at open side. Design-builder shall devise and submit to the University a method for pan installation that does not require freezers to be emptied. The goal is to minimize water infiltration between floors due to freezer defrost cycles or freezer failures.
      2. Access Requirements During Construction
         1. Construction, testing, and commissioning activities for activities under Alternate #4 shall be completed between the hours of 9:00 pm and 9:00 am or on weekends.
      3. Hazardous Material Abatement
         1. Abate hazardous materials from materials that are removed or otherwise affected by Alternate #4 activities. Refer to University Furnished Information for a hazardous materials testing report on where hazardous materials are located.
      4. Design Requirements
         1. See Part 10 of the DPP, Scope of Work, for design deliverables and the Campus Standards.

# ALTERNATE # 5

* + - 1. Mechanical Room Equipment Replacement
         1. Replace existing equipment in Med Sci C mechanical equipment room (C-106). Demolish existing and provide new for the following:

Steam Generators: Demolish and dispose of existing steam generators and provide new steam generators.

Heating Hot Water Converters: Demolish and dispose of heating hot water converters and provide new, high efficiency converters. Converters shall meet the combined load of Med Sci A-F at peak load in a variable volume, primary-only pumping arrangement. The original units were designed for primary-secondary pumping at constant volume.

Water Heat Exchangers: Demolish and dispose of existing industrial and domestic water heat exchangers. Provide new storage tank water heater(s) for converting high-temperature water to industrial hot water. The heat exchanger may be installed in the tank or separately with a circulating pump. Install new storage tank water heater for converting heating water to domestic hot water, instead of using high-temperature water to make domestic hot water as currently configured. Select tanks to meet maximum instantaneous load for Med Sci A-E, particularly during periods of high cage washer use in Med Sci A. The intent is to reduce cyclic loading of the High Temperature Water system by providing significant storage capacity. If Alternate #2 is implemented, ensure that IHW exchanger sizing incorporates autoclave water GPM requirements.

Include replacement of existing control valves, shut-off valves and appurtenances in the mechanical room for the new equipment.

Federal Pacific Motor Control Center: Demolish existing motor control system and replace with modern distribution panel.

* + - * 1. Sizing of the equipment shall use current Campus Standards sizing criteria for design temperatures, fouling factor, pressure drop, etc. Sizing shall follow these general minimum requirements:

| Equipment | Capacity | Notes |
| --- | --- | --- |
| HTW to HHW Exchangers | 2 units at not more than 12 MMBtu  Supply HHW temperature shall be 180°F. | Existing were designed for 1225 gpm and as redundant units. Size the new units at minimum 66% of peak capacity. Even as preheat coils are installed, the flows should not be as great as originally designed. Include preheat coil loads for other stack AHUs when sizing. |
| HTW to IHW Exchanger | 60 to 140°F with minimum 100 GPM Peak. Minimum 500 gallon storage tank. | Original system circulator was designed for 20 gpm. |
| HHW to DHW Heater | 60 to 140°F  Minimum 200 gallons storage tank. | Provide 140 to 110 mixing valve (to avoid *Legionella P.* issue) installed per manufacturer’s specific requirements. Provide additional circulating pump needed for proper operation of mixing valve.  Original flow was 28 gpm peak; current flow is probably less. Original system circulator was designed for 12 gpm. |
| HTW to 50-psig Steam Generator | 2 units at minimum 3000 lbm per hour each at 50 psig in the shell.  Water mass in the shell minimum 2000 lb (approx. 260 gallons at operating level).  Provide steam separator in header. | Existing pipe run to A-stack starts out at 4-inch transitions to 3-inch after a couple of take offs in the B-stack and runs about 350 feet total length with 14 elbows, at least, in between. This system has a capacity of 2000 lbm per hour with 45 psig steam at the start and 40 psi at the end. The 5-inch main header leaving the room has a capacity of 4800 lbm/hour at 40 psig and 5600 lbm/hour at 50 psig at 75 fps velocity.  At the same velocity, which is on the high end for wet process steam, the 3-inch line going to the cage wash area can handle 2070 lbm per hour at 50 psig.  There are options to increase pipe size or add a parallel line to reduce losses.  Goal of minimum 2000 lb mass is to reduce existing surge issues in the HTW system and increase time between blow downs in this once-through system. |

* + - 1. Condensate Recovery System
         1. Furnish and install condensate recovery system for Med Sci B, C, and D stacks. Omit condensate recovery for locations converted from steam to electric autoclaves if Alternate #2 is selected or provided in base bid. University has provided design drawings and specifications from a previously planned project for reference; refer to University Furnished Information. Provide complete Work shown on condensate recovery drawings provided by University only within Med Sci B, C, and D stacks and design for future connection and extension into Med Sci A stack. Ignore alternate shown on condensate return drawings. Piping shall be sized and installed for future Work and shall be provided with shutoff valve and piping capped or plugged. Provide capacity for future extension of condensate return in Med Sci A as shown on original design drawings by piping up tot eh entrance of Med Sci A stack and cap for future connection. Provide boiler feed water unit shown in room C106.
      2. Access Requirements During Construction
         1. Construction, testing, and commissioning activities for activities in Alternate #5 shall be completed in such a manner that minimizes down-time. Since each system has two units, leave one system operating while replacing the other. Schedule work for major interruption of heating systems to coincide with planned quarterly high temperature water outages. All other scheduled interruptions shall be no more than three consecutive business days per piece of equipment and scheduled with two weeks advance notice to University's Representative. Develop and submit a construction phasing sequence plan and prepare written switching procedures to allow coordination of equipment down-time.
      3. Hazardous Material Abatement
         1. Abate hazardous materials from materials that are removed or otherwise affected by Alternate #5 activities. Refer to University Furnished Information for a hazardous materials testing report on where hazardous materials are located.
      4. Design Requirements
         1. See Part 10 of the DPP, Scope of Work for design deliverables, and the Campus Standards.

# ALTERNATE # 6

* + - 1. Floor Coverings
         1. Remove existing floor covering (vinyl tile, sheet goods, etc.) in Med Sci B and D corridors on every floor and recycle or dispose of if a hazardous material in accordance with campus requirements. Refer to University Furnished Information for existing floor covering. Install new VCT and cove base where tile is removed. Provide threshold transitions as required.

D-stack Floor 2 corridor was refinished in 2015; omit sections of corridor refinished in 2015 from this project's scope. Refinishing in 2015 was implemented by removing VCT per the Asbestos Removal specification and polishing with the Spartan Chemical Company's "ISHINE" product or equal. Where VCT was replaced in areas with high moisture content, the moisture content was addressed by installing the VersaShield under new vinyl flooring. University-furnished documentation includes installation, submittal, and material safety data sheets for these products as an example to reference.

* + - * 1. Provide waterproofing around existing piping floor penetrations and seal penetrations at second, third, and fourth floor lab sinks to mitigate water seeping to floor below. Piping may be located behind casework but shall be accessed by going through cabinet sink back wall. Number of locations shall be based on the original construction drawings. Some spaces already have this upgrade but shall be checked if watertight and waterproofed.
        2. Polish existing laboratory flooring. Method for polishing laboratory flooring shall take into consideration circumstances where tiles or mastic are asbestos-containing. Refer to hazardous materials assessment report in University Furnished Information.
      1. Paint
         1. Paint corridor walls from floor to minimum eight-feet up the wall but not less than six-inches above the lowest mechanical equipment. Existing painted doors and door frames shall also be painted. Coordinate color selection with University's Representative.
      2. Ceilings
         1. Replace missing and damaged ceiling tiles in existing suspended ceiling locations. Refer to University Furnished Information for existing ceiling treatment.
      3. Access Requirements During Construction
         1. Each hazardous materials abatement activity shall be completed over a weekend, scheduled with the University. Construction, testing, and commissioning activities for activities under Alternate #4 shall be completed between the hours of 9:00 pm and 9:00 am or on weekends. Develop and submit a construction phasing sequence plan and prepare written switching procedures to allow coordination of laboratory down-time.
         2. Contractor shall move all equipment and contents or protect in place prior to work in laboratories. Work in conjunction with the University's Representative to determine the best way to leave in place that which cannot be moved.
      4. Hazardous Material Abatement
         1. Abate hazardous materials from materials that are removed or otherwise affected by Alternate #6 activities. Refer to University Furnished Information for a hazardous materials testing report on where hazardous materials are located.
      5. Design Requirements
         1. See Part 10 of the DPP, Scope of Work, for design deliverables and the Campus Standards.

# DESIGN CRITERIA

* + - 1. SITE CONSTRUCTION
         1. Site Description: The University of California, Irvine is located in the City of Irvine, California. The campus is bound by Campus Drive on the north, Culver/Bonita Canyon on the east, California Avenue, University Research Park and State Route 73 on the south, and University Drive on the west.
         2. Existing Campus Utilities shall be used at the building.
         3. Upon completion of project laydown area and hardscape and landscape areas damaged by construction of this project shall be returned to better than original materials and plantings. New plants shall be drought tolerant in accordance with Green and Gold Plan and approved prior to purchasing.
         4. Design Builder shall provide electric sub-meter for trailers and water meter to measure the electricity and water used during construction activities. University will bill for electric and water usage monthly. Utilities used inside the building will not be charged.
      2. EXTERIOR MATERIALS AND SYSTEMS
         1. Roof Systems:

The roofing system shall be a single-ply membrane system and shall extend over all mechanical equipment pads prior to the placement of the stainless steel cap and flashing assembly. The roofing system shall be constructed as to provide a minimum 20-year no dollar limit (NDL) warranty on roof material and 5-year labor warranty. The system shall be installed over tapered insulation, and roof insulation shall, at minimum thickness, a minimum of R=10 and an overall average of greater than R=20. The existing roof plan shows basic components which will require further verification and coordination as to the quantity, size and configuration of elements on and items penetrating the roof system.

Building components penetrating the roof system, such as roof drain, electrical conduit and mechanical ductwork & piping, shall have lead flashing and lead counter flashing with a stainless steel clamp band and sealant. Specific flashing details shall be developed based on the current Sheet Metal and Air Conditioning Contractors’ National Association’s (SMACNA) Architectural Sheet Metal Manual. This flashing is deliberately an addition to the standard detail for the typical single-ply roofing based on the University’s experience with single-ply roofing and is a requirement.

Provide Sarnaclad metal clad self-sealing roofing product underneath air handling units and exhaust fans.

The roofing system shall terminate at the parapet with a prefabricated surface-mounted reglet and spring lock counter flashing. The reglet is to be installed at a constant elevation above the roof surface. The elevation shall be based on the highest point of the roof at the parapet, plus a minimum of 8”. The continuous elevation shall be determined and clearly shown on the drawings.

The roof systems shall take into consideration the removal and replacement of same without destroying or bending the metal counter flashing system.

Roof system valleys shall be a minimum of 18” away from roof penetrations or directional changes.

Specific Roof System Design Criteria:

Parapet sheet metal assemblies shall be of a spring lock counter flashing with a surface mount receiver and sealant. Inside and outside corners shall be pre-manufactured and one piece.

Roof penetrations shall be circular and follow the recommendations of SMACNA. (See Figure 4-14C) for all penetrations 2” or larger. The base flashing shall be 4 pound lead with a 4” flange minimum. The multiple pipe penetration (see 4-14A) shall be of lead base flashing, structural support as required, and a 4-pound cap. Note: Pitch pockets are prohibited for any use.

Structural concrete columns shall be flashed similar to a pipe penetration, and shall have an 8” flange minimum.

Equipment pads shall be a minimum of 8” above the roof. The roofing shall overlap the pad and run flat over the pad with a minimum of three plys, prior to the placement of the stainless steel metal cap. The minimum 22-gage 316 stainless steel cap shall cap over the edge and turn down not less than 4 inches. Water shall drain away from the top of all equipment pads and equipment. Ensure that the cap does not deflect and create a puddle when equipment is placed on it. This may require slightly crowning the pad. This requirement is difficult and shall be met and demonstrated.

Flashing expansion and contraction joints shall be at 10’-0” on center maximum and 2’-0” each side of the pre-manufactured corners. Joints shall have covers and back-up plates type J5, per SMACNA. Type J1 through J4, shall not be used.

f. Provide walking pads around all sides of existing remaining and new mechanical and electrical equipment and roof drains. Provide walking pads from roof access to every piece of equipment that must be maintained.

* + - 1. INTERIOR MATERIALS AND SYSTEMS
         1. Ceilings

Ceilings shall be a combination of suspended acoustic tile, metal or gypsum board construction. Where suspended acoustical tile ceilings are provided, they shall consist of high quality tegular 2' x 2' acoustical tile suspended in a narrow profile exposed “T” suspension system. Suspended gypsum board ceilings shall be finished with a gypsum-surfacing compound and painted with a two coat paint finish. Soffits shall extend 6” above the ceiling with a finish to match the walls or soffit.

No hard ceiling access panels shall be allowed. Access shall be through accessible ceilings. Written approval by the University’s Representative is required only if that is impossible and an access panel must be installed.

Any existing ceiling damaged by the work of the project shall be repaired with materials to match existing.

* + - * 1. Walls

Existing walls if removed to allow construction to proceed or damaged during construction shall be repaired to match existing materials and as follows.

Fixed elements shall be structurally supported. Coordinate and provide structural bracing to meet equipment or casework needs.

New mechanical rooms shall have a 4” concrete curb under, or in front of drywall walls. The purpose of the curb is to contain water or hydraulic fluid if the building experiences a future pipe break or leak. At any doors, the concrete curb is to go out and around the actual door swing. An option at the walls is to provide 4” x 4” x 16” solid concrete masonry units set with an epoxy grout.

Dry walls shall be terminated with ‘J’ molding at all dissimilar materials or wall terminations. Corners shall have corner beads.

* + - * 1. Specific Interior Systems

The laboratory areas shall be designed with spill control as defined in the California Building Code. The intent is to not allow a spill to traverse from one level to another. Steel sleeves extending 4” above the floor level are required for floor penetrations. A 4” high concrete curb is required at shafts, and existing piping floor penetrations and new penetrations not receiving steel pipe sleeves.

* + - 1. STRUCTURAL DESIGN AND SYSTEMS
         1. General

The Design Builder shall design, engineer, and construct a complete structural system if required for the new mechanical equipment being placed on the roof. As a minimum, a California registered structural engineer shall review the existing construction and provide calculations documenting that the existing structure can support the system.

Close coordination of the mechanical and electrical systems and the structure is required and support or pads shall be constructed to reduce vibration into the building or structure.

Concrete pads on the roof shall be doweled into the existing concrete. Refer to Campus Standards and Master Specifications.

* + - * 1. Live loads (for loads not listed, see the California Building Code [CBC])

Roof loads: 20 psf (reducible per CBC)

At roof top mechanical: Perform structural analysis on existing roof structure to determine roof structure can safely hold the new mechanical equipment, new roof insulation, and new roofing material. This shall include the code minimum live load. If additional supports are required, they shall be provided as part of the contract. Note that original roof and floor live loads are listed in the 1976 Original Documentation drawing S1 provided as University-furnished information.

* + - * 1. The seismic design for mechanical equipment support and mechanical and electrical materials shall be based on both the dynamic and static lateral force procedures prescribed in the current CBC.
        2. Miscellaneous Structural Components

Provide calculations for anchorage of mechanical, electrical and plumbing distribution systems and fixed items, in accordance with the CBC. Show details on the appropriate discipline or on the structural drawings.

* + - 1. LABORATORY DESIGN CRITERIA
         1. Provide as needed a complete design, including installation and start-up of all laboratory furnishings including but not limited to fume hoods, fixtures and fittings, laboratory and controlled temperature rooms.
         2. Submit seismic calculations and details for environmental room installations.
         3. Light fixtures shall be oriented to be parallel to and above the front edge of the lab benches.
         4. Fume hoods shall be of the variable air volume (VAV) type or converted to VAV by sealing existing bypass. Hoods shall exhaust with constant face velocity depending on the sash location. Provide occupant zone presence motion sensors on VAV fume hoods to detect occupant directly in front of hood. Motion sensors shall allow reduction of face velocity from 100 fpm to 60 fpm when hood is unoccupied.
         5. Minimum fume hood airflow shall be the greatest of the following three at each height from fully closed to fully open:

25 CFM per sq. ft. of work surface.

100 fpm face velocity occupied.

60 fpm face velocity unoccupied.

* + - * 1. Condensate lines from evaporators in the environmental rooms and walk-in freezers shall be run down inside the wall to the enclosure below for connection to the waste line. The condensate lines shall not be exposed.
        2. HVAC, plumbing and electrical engineering shall comply with criteria established within this section and/or as shown on RFP documents.
      1. NOISE CONTROL
         1. Noise control requires specific attention to design and construction details, especially in mechanical and electrical systems. Med Sci researchers have complained about noise from the existing systems. New systems provided shall consider noise as discussed in this section; parts of the existing building would not comply with these requirements. The following features shall be addressed in the design of the mechanical and electrical systems:

Fan noise transmitted to spaces through the duct system or through the building structure. This noise is characterized by a low-frequency rumble and often includes annoying pure tones.

Noise generated by air flowing past dampers, terminal device louvers, and comprising mid-to-high frequency energy.

Noise generated by the excitation of duct wall resonance produced by fan noise, by pressure fluctuations caused by fan instability, and by high turbulence caused by discontinuance in the duct system.

Water circulation system noise caused by high velocities or abrupt pressure changes, which is generally transmitted through structural connections.

Leakage at existing joints in existing Transite® exhaust ducting.

Noise and vibration generated by the normal operation of fans, pumps, compressors, etc. Noise and vibration caused by out-of-balance forces need not be considered.

Air handling units shall have built in sound attenuators in lieu of duct silencers.

Provide sound testing and vibration recordings for HVAC equipment.

* + - * 1. Special design precautions are required in certain areas to maintain a high level of sound and vibration isolation. For example, conduits shall not directly link noise-sensitive spaces, nor shall they mechanically bridge vibration-isolated building elements using a rigid connection. Flexible conduit must be used for connections to isolated floor slabs, walls, and vibration-isolated mechanical/electrical devices. Duct silencers shall be considered when duct distance is not sufficient to provide adequate acoustical separation, or if low frequency noise is a concern and other options have been considered and found unacceptable
        2. The background noise criterion (NC) is a measure of the noise that shall not be exceeded by building mechanical, electrical and plumbing systems to achieve acceptable ambient sound levels for various space uses. Noise Criterion (NC) curves are used to describe acceptable noise environments for a variety of functional areas. The standard family of NC curves has been in use for years, and may be found in the “Sound and Vibration Control” Chapter of the HVAC Applications Handbook published by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
        3. The following internal noise criteria from mechanical services shall be followed for new equipment.

Laboratories: NC50 (measured at a workbench within 12-feet of a fume hood with sash closed).

Laboratory Support Areas: NC50

Open offices and Office Support Areas: NC35

Offices: NC35

Conference Spaces: NC30

* + - * 1. Selection of Equipment to Meet the Noise Criteria

Mechanical and electrical equipment shall be selected to ensure noise output characteristics consistent with the noise criteria. For equipment located in mechanical or electrical rooms or on the roof, the distance between the source and receiver as well as the nature of the intervening structures shall be taken into account in evaluating the acceptability of the noise output of each piece of equipment. For ducted equipment such as fans, air handling units, fan-coil units, VAV boxes, etc., the inlet, outlet and casing- radiated sound power levels shall be considered. Noisier equipment selections will require increased structure around them as well as enhanced sound attenuation measures – sound attenuation, duct/plenum lining, etc. – to satisfy the noise criteria.

Special attention shall be paid to the selection of equipment to be located in the ceiling plenum, including, but not limited to VAV boxes, fan-coil units, fans, air-handling units and air recirculation devices. Radiated noise from such equipment is often the controlling factor in achieving the required noise levels in the occupied spaces below. Air handling and fan units shall not be located in ceiling spaces.

Air diffusers, grilles and registers shall be selected and sized to meet the required noise criteria. Low NC requirements for certain rooms may require special measures to limit self-noise at diffusers, grilles and registers.

Fan air volume control shall be achieved by means of variable frequency drives. Inlet air guide vanes and other methods which may increase noise while decreasing air volume are not permitted

Sound traps shall be avoided wherever possible due to pressure drop inefficiencies from sound traps in the airstream.

Sound-attenuating devices, including sound traps, acoustical louvers, duct, plenum and equipment room liners, acoustical flexible ducting etc. shall be designed to meet the required noise criteria when used in conjunction with the other mechanical and electrical system components. Sound traps shall be selected and sized for adequate insertion loss and for appropriately low pressure drop, taking the manufacturer’s pressure drop multipliers for any non-ideal conditions (proximity to bends, fans, take-offs etc. and open inlet or discharge) into account. Duct sound traps are prohibited if provided at ductwork size. Sound trap shall be furnished inside air handling units or when used in ductwork shall be twice the normal duct size or larger to provide low pressure drop and shall be installed with more than minimum requirements by sound trap manufacturer.

Where existing slab-to-slab partitions occur for sound isolation, ducts shall penetrate only those partitions that have doors in them; penetration of “solid” partitions (no doors) shall be avoided. Where it is truly impossible to avoid penetrating a solid partition, sound attenuating material (such as acoustical lining) or a crosstalk control device (such as a sound trap) shall be introduced into the duct sufficient to ensure compliance with the sound isolation criteria prescribed elsewhere in this section.

A direct duct connection to the underside of rooftop air handling equipment is allowed when sound attenuators are installed within the air handling units. Rooftop air handlers without sound attenuators shall have side duct connections with a sufficient length of ducting at the roof to accommodate the necessary in-duct attenuation.

Piping shall be sized for flow velocities consistent with the noise criteria. In addition, significant active plumbing piping shall be sized for maximum flow velocities of not more than 8 feet per second.

* + - * 1. Vibration Isolation

HVAC, electrical and plumbing equipment, piping, and ducting shall be isolated as necessary to meet the noise and vibration criteria.

Vibration isolation systems shall be provided on rotating mechanical equipment greater than ½ hp located within the critical area, greater than 5 hp elsewhere in the building, and greater than 10 hp outside the building within 200 feet of the building.

Special design consideration shall be given to the duct layout reducing noise transfer between rooms, especially noise generated by loud equipment or discussions in adjacent rooms.

Ducts of equivalent diameter less than 24 inches do not require isolation provided flow velocities do not exceed 1,200 feet per minute.

Building code requirements shall be met for seismic restraint parameters. SMACNA guidelines shall be followed for seismic restraint. For suspended equipment and piping, use slack aircraft cables for seismic restraint. Seismic restraints shall be all-directional type and shall not short-circuit vibration isolation devices.

Provide the signature of a structural engineer who is licensed in the State of California for seismic restraint calculations.

Isolators shall operate in the linear portion of their load versus deflection curves. The load versus deflection curve for each isolator shall remain linear over a deflection range of 50% above the design deflection.

Provide vibration isolation mounting frames and/or brackets of sufficient strength and stiffness to carry the load of the equipment without causing mechanical distortion or stress to the equipment.

Provide UL listed, fire-retardant and airtight flexible connectors for sheet metal ducts. Clear width shall be 6 inches not including clamping section.

Provide flexible pipe connectors with flanges.

Engage manufacturer to provide technical supervision and certification of installation of vibration control products.

* + - * 1. Installation Practice

Comply with manufacturer’s instructions for installation and load applications to vibration control materials and isolation supports. Adjust to ensure that vibration isolation supports have the correct static deflection, do not bottom-out or coil-bind under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

Use recommended methods as outlined in the current editions of the ASHRAE Handbooks.

As necessary, use special noise and vibration control methods as outlined in "A Practical Guide to Noise and Vibration Control for HVAC Systems", published by ASHRAE.

Install a 5-foot (maximum) length of flexible acoustical duct between diffusers and grilles in occupied spaces.

Gaps around duct penetrations in ceiling or floor slabs or walls shall not exceed 1 inch and shall, at a minimum, be filled with 1.5 lb/cf fiberglass insulation to full depth a sealed from both sides with acoustical sealant. Enhanced penetration sealing/closure methods may be required in areas where a high level of sound isolation (NIC value) is required.

Pipe penetrations of slabs and walls shall be sleeved with a 25 gauge (minimum) metal sleeve protruding at least 2 inches from the slab or wall on either side. The sleeve shall be tight fitting in the wall and sized to allow a gap all around the pipe of not less than 1 inch and not more than 2 inches. The gap between the pipe and the sleeve shall be in filled with 1.5 lb/cf fiberglass insulation to full depth and sealed from both sides with acoustical sealant. No rigid contact is permitted between the pipe and the slab or wall or sleeve. Additional sound control measures may be required in areas where a high level of sound isolation (NC value) is required.

Where pipes or ducts penetrate the exposed roof slab, waterproof flashing shall be provided.

In any case where ductwork forms a sound leakage path between private or sound-insulated space provide crosstalk attenuation in the form of a sound trap or additional acoustical lining to maintain the required sound isolation rating.

* + - 1. HEATING, VENTILATION AND COOLING (HVAC) SYSTEMS
         1. General Requirements

Provide design, engineering, installation, start-up testing, adjusting and balancing and commissioning of a complete operational HVAC system for Med Sci C building. HVAC criteria may appear in other Sections throughout this document. Review complete documents and comply with the requirements. Conflicts shall be reported to the University’s Representative for resolution.

RFP is intended to describe the basic methodology of the project. Any indicated sizes, quantities and capacities are minimum requirements are based on schematic design calculations. The Design Builder shall confirm final sizes, through detailed calculation which are submitted to University for review and approval. Specifications herein identify minimum levels of quality, materials and workmanship that are to be followed without exception.

* + - * 1. Design Criteria

Climatic design parameters shall be in accordance with Campus Standards except if modified in this DPP. Laboratory and auxiliary spaces shall be considered a “critical facility." Special humidity control is not necessary for this building.

Building envelope shall be determined based on record drawings and any modifications made by this project.

Building Hours of Operation shall be 24 hours for laboratories and lab auxiliary rooms. Offices and administration areas hours shall be 8 AM to 6 PM Monday through Friday.

Occupancy (Unless otherwise noted below in specific requirements)

|  |  |
| --- | --- |
| Space | Basis |
| Laboratories | 100 ft2/person |
| Lab Support rooms | 1 person per room for <100 SF & above 200 ft2/person >100 SF |
| Conference Rooms | Room C100J- 10 persons, C240B- 8 persons, any others 20 ft2/person |
| Offices | 100 ft2/person |
| Lobbies, Foyers | 250 ft2/person |
| Corridors, hallways & toilets | zero |

Internal Heat Gains

|  |  |  |
| --- | --- | --- |
| Space | Lighting load | % gain to return air |
| Laboratories | 1.2 Watts/ft2 | 0 |
| Meeting Rooms | 1.0 Watts/ft2 | 0 if ducted and 20% if RA plenum |
| Offices | 1.2 Watts/ft2 | 0 if ducted and 20% if RA plenum |
| Lobbies, foyers | 0.8 Watts/ft2 | 0 if ducted and 20% if RA plenum |

These are lighting budget numbers only, actual heat gain from lighting shall be determined from lighting audit or by the electrical engineer if new LED lighting is provided.

Miscellaneous Internal Heat Gains

| Space | Load | Notes |
| --- | --- | --- |
| Research Laboratory | 5 Watts/ft2 |  |
| Auxiliary lab rooms | 12 Watts/ft2 | Refer to University Furnished Information for rooms identified as Auxiliary. |

The equipment heat gain listed above shall be the basis of design. Calculations shall include air handling unit fan motor heat if motor is in air stream.

Research laboratories are defined as those laboratories with exterior exposures.

Auxiliary lab rooms are the interior building lab spaces located between the exterior zone research labs and the main building corridors.

Spaces with additional internal heat gain equipment such as autoclaves shall use the internal heat gain stated by the equipment manufacturer.

Design-builders may propose reducing room internal heat gain if the Engineer of Record determines it is too large. UCI will work with the design-builder if adjustments are necessary.

Ventilation Requirements:

Ventilation shall comply with California Building Code, ASHRAE Standard 62 latest editions and Campus Standards.

Laboratories & Laboratory Support Areas: Laboratory wing shall be supplied with 100% outdoor air, no return air, with exhaust either through fume hoods or the general Laboratory exhaust.

Data/Telephone equipment rooms: Minimum three air changes exhaust per hour unless room has electronic equipment, in which case the minimum requirement is to maintain 90°F in room.

Fume exhaust systems (Note: branch duct and air valve shall be sized for sash at full height position, not 18 inches.) Main duct and exhaust fans shall be sized on based on the following:

Eight foot fume hood with sash at 18”= 1200 CFM

Six foot fume hood with sash at 18”= 900 CFM

Five foot fume hood with sash at 18” = 750 CFM

Four foot fume hood with sash at 18”= 600 CFM

Snorkel, constant volume = 100 & 200 CFM

Other fume hood sizes shall be calculated for a minimum required velocity of 100 fpm over the wide-open sash for any hood. Ensure sufficient exhaust capacity at each hood to provide this velocity.

The following tabulates the quantities of fume hoods and snorkels. Design Build team shall confirm number and sizes during site investigation phase:

| **Room No.** | **Fume Hood size/quantity** | | | |
| --- | --- | --- | --- | --- |
| **3’** | **4’** | **5’** | **Notes:** |
| B106 | 1 |  |  | Variable air volume |
| B110 | 1 |  |  | Variable air volume |
| B118 | 1 |  |  | Variable air volume |
| B120 | 1 |  |  | Variable air volume |
| B126 | 1 |  |  | Variable air volume |
| B156 | 1 |  |  | Variable air volume |
| B160 | 1 |  |  | Variable air volume |
| B168 | 1 |  |  | Variable air volume |
| B180 | 1 |  |  | Variable air volume |
| B206 | 1 |  |  | Variable air volume |
| B210 | 1 |  |  | Variable air volume |
| B216 | 1 |  |  | Variable air volume |
| B220 | 1 |  |  | Variable air volume |
| B226 | 1 |  |  | Variable air volume |
| B228 | 1 |  |  | Variable air volume |
| B256 | 1 |  |  | Variable air volume |
| B260 | 1 |  |  | Variable air volume |
| B268 |  |  | 1 | Variable air volume |
| B270 | 1 |  |  | Variable air volume |
| B280 | 1 |  |  | Variable air volume |
| B288 | 1 |  |  | Variable air volume |
| D206 |  | 1 |  | Variable air volume |
| D216 |  | 1 |  | Variable air volume |
| D226 | 1 |  |  | Variable air volume |
| D228 | 1 |  |  | Variable air volume |
| D260 | 1 |  |  | Variable air volume |
| D268 |  | 1 |  | Variable air volume |
| D270 |  | 1 |  | Variable air volume |
| D280 | 1 |  |  | Combination sash, variable air volume |
| D314 |  |  | 1 | Variable air volume |
| D326 |  |  | 1 | Variable air volume |
| D356 | 1 |  |  | Variable air volume |
| D370 | 1 |  |  | Variable air volume |
| D374 |  |  | 1 | Variable air volume |
| D388 | 1 |  |  | Variable air volume |
| D404 | 1 |  |  | Variable air volume |
| D426 | 4 | 1 |  | Variable air volume |
| D460 | 1 |  |  | Variable air volume |
| D468 | 1 |  |  | Variable air volume |
| D470 | 1 |  |  | Variable air volume |
| D480 | 1 |  |  | Variable air volume |
| D488 | 1 |  |  | Variable air volume |

* + - * 1. Future Capacity and Diversity

Design of the Laboratory air handling systems and exhaust fan systems shall include, and not limited to, fume hoods, and systems sufficient to comply with University campus requirements to include an additional an additional 20% capacity in the design of airside systems for future use. This shall include the supply, return, relief, and exhaust air for both the Laboratory and Office portions of the building. Additionally the Laboratory units shall include an additional 20% when sizing the coils and piping. Diversity shall only reduce equipment sizing in accordance with Campus Standards. Ductwork and airflow (CFM) to each space shall be based on total load without diversity.

The basis of design shall include Phoenix Controls Corporation, Siemens Industries, or equal, pressure-independent, venturi-style air valves, motion sensors with VAV fume hood to reduce face velocity from 100 fpm to 60 fpm when hoods are unoccupied. This allows the Design Builder to use diversity in sizing the capacity of the Laboratory supply air and exhaust fans system. This diversity shall be a maximum of 10% (assume all fume hoods occupied).

Ductwork air leakage and heat loss factors shall be added to suit design conditions and actual installation. Provide for heat gain in supply air ductwork exposed on roof or installed in unconditioned spaces.

Allowance for morning warm-up shall be included for office systems.

Pressure relationships: The Laboratory area shall be negative to the Office areas and the outside environment. The individual lab spaces shall remain negative to the corridor. In the event of a fire, shut down the associated air handler and leave the exhaust fans running, provided that less than 30 lbf is required to open any egress door. If field testing determines that greater than 30 lbf is required, air handlers shall run at a reduced speed such that less than 30 lbf is required.

Building Calculations: The following outlines the calculation steps for the Laboratory Building mechanical equipment. The equipment size shall be determined based on the highest CFM of the following three calculations:

Supply airflow required to offset each room’s load at the time of the building’s peak block load as determined by computer-generated heat gain calculations.

Minimum air changes per hour required for the spaces.

Exhaust airflow of fume hoods and ventilated cabinets, etc. Fume hood exhaust shall include the additional proposed future fume hoods at maximum CFM with sash at 18” open and without any diversity for variable airflow. Add 100% of exhaust CFM for the ventilation cabinets and any other exhausts to calculate the total exhaust air. Additional exhaust capacity shall be located at the locations of fume hoods on the original design drawings that do not currently exist.

Original construction of Med Sci B and D included six fume hoods per wing (24 hoods total in Med Sci B, 32 hoods total in Med Sci D).

Currently, 22 fume hoods are installed in Med Sci B; when calculating exhaust airflow per above, plan for the additional two hoods.

Currently, 27 fume hoods are installed in Med Sci D; when calculating exhaust airflow per above, plan for the additional five hoods.

Exhaust fan selection need not be increased if DPP-required extra 20% capacity is adequate for future fume hoods.

If any duct runs are replaced, the ductwork shall be sized to match original construction.

* + - * 1. Energy Conservation: The requirement is for the Design Builder to pursue an energy conscious design.
        2. The University requires the inclusion of the following energy conservation measures in the design if applicable to the project:

Control of minimum outside air for office AHU with CO2 sensors to provide outside air by measuring the level of CO2 in the building.

Pipe and duct insulation R values shall exceed Title 24 by at least 20% minimum. Master specifications should include the extra thickness and engineer needs to confirm thickness exceeds current code.

Variable volume air systems shall be used.

Variable frequency drive shall be provided rather than inlet guide vanes.

Fume hoods shall be VAV and use occupancy zone sensors to instantly provide 100-fpm face velocity upon an occupant walking up to fume hood. After a timed period without an occupant being within reach of the fume hood, the face velocity shall be reduced to 60-fpm.

Reduced coil and filter face velocity design for low air pressure drop to save fan horsepower year round.

Ductwork should be sized for low velocity, with fittings, transitions, and routes designed for low pressure drop and low pressure drop fittings.

Two-way valves for coils with variable pumping systems using a variable frequency drive.

Reset of discharge leaving air temperature setpoint for office AHU based on the least favorable room requirements.

* + - * 1. System Description

General

The Laboratories shall be served by dedicated air handling system.

The Offices and the Office support areas and conference rooms shall be served by a separate air handling system or may be combined with lab AHUs provided the return air is sent back to AHU and office areas can be isolated by control dampers to shutoff airflow at night and weekends.

The outside air intakes for AHUs shall be a minimum of 50 feet horizontally and 10 feet vertically below the exhaust stack position unless otherwise determined by wind study. In addition, outside air intakes shall avoid any loading docks.

Laboratory Air Handling Units

The Laboratory VAV air-handling unit(s) shall supply 100% outside air in a blow-through arrangement. System shall contain two separate units of the following minimum components; supply air fans, motorized fan isolation dampers, chilled water cooling coils, hot water pre-heating coil, filter section, sound attenuators (if required) and vibration isolators. Units shall be installed with isolation dampers to allow maintenance on one fan with the other still in operation.

Each Laboratory shall have a supply air valve and reheat coil, supply air diffusers, registers or DuctSox textile air dispersion product, exhaust grilles, general exhaust air valve, and fume hood exhaust air valves. These shall provide individual temperature control based zoning.

Pressure independent VAV airflow valves shall be provided to control airflow and maintain negative pressure in the lab while saving energy. Hot water heating coils shall be provided in the ductwork space heating and reheat if needed.

Supply air shall run continuously to provide makeup air to fume hoods except during loss of normal electrical power. The building’s generator is not sized for operating AHUs and so AHUs shall be on normal power.

Smoke and/or fire dampers shall be provided in the supply and exhaust air ductwork as required by CBC or DCFM.

Laboratory Exhaust

Lab exhaust shall be designed to be adaptable to changes of research protocols and building operations as much as possible. The systems shall be designed to be easily modified so that ventilation can be provided to new sources of hazards as they might appear in the Laboratory.

A combination of fume hood/general exhaust system allows maximum flexibility as fume hoods can be interchanged with general exhausts. The combined general exhaust also increases dilution of the exhaust air within the duct system thus, adding to the safety of the system.

Exhaust fans shall be direct-drive, arrangement-8 fans with stainless steel freestanding stacks without outlet nozzles. Fans shall be the most energy efficient fan available for the service. Exhaust fan motors shall have variable-frequency drive for control, soft-starting, and manual control of fan speeds during changeover, commissioning, and startup. Provide not less than three fans in parallel connected to a duct manifold, of which two fans shall provide the total exhaust air requirement. For a tight control, size outside air bypass for maximum pressure drop in the exhaust system. Use a combination of variable air volume for fan speed controls and bypass dampers to maintain a constant suction pressure and to maintain exhaust discharge velocity. Provide manual opposed blade dampers at bypass damper for adding pressure drop if needed. Oversizing this bypass will compromise control of the system.

Fume Hoods shall be tested and certified in accordance ANSI Z9.5 for fume hood containment using test method in ASHRAE Standard 110 after the new exhaust fans are installed.

Office Air Handling Unit

The Office building VAV air handling unit shall contain the following minimum components in a blow-through arrangement: supply air fan, chilled water cooling coil, hot water pre-heating coil, low pressure drop filter section, return air fan, sound attenuators, outside air economizer, outside air, return and relief dampers and vibration isolators.

VAV terminal air units shall provide zoning with hot water coils for space heating. Define zones by exposure and usage with a maximum of three exterior rooms and four interior rooms on a terminal unit. Usage must be similar to be combined. Retaining existing thermal zoning in office spaces is acceptable. Conference rooms, seminar, training, labs, etc. shall have individual zone controls. Terminal units shall be connected to lighting motion sensors so that if all spaces in the zone are unoccupied then the terminal unit shall close to minimum position after a 30 minute time delay. Wall temperature sensors shall override motion sensors should temperature in the space rise to 80°F. Heating CFM shall not be the minimum CFM and shall be based on heating CFM required for the space with a 20% pickup factor.

* + - * 1. Air Filtration: 12-inches thick low pressure drop filters in 24”x24” modules only, MERV 14. Pressure drop 0.28-inches W.C. at 2,000 cfm. Include 1.25-inches W.C. in fan static for dirty filter.
        2. General Exhaust

Re-use existing toilet exhaust fan and ductwork.

Toilets shall be equipped with motion sensors to shut down the exhaust fan(s) if all the toilet rooms the fan serves have had no occupants for 30 minutes.

* + - * 1. Exhaust Fans

Exhaust fans shall be AMCA Single-Width, Single-Inlet, Arrangement 8, direct-drive fans with IEEE 841 motors on VFD complying with campus standards and master specifications and mounted on concrete curbs. Exhaust system shall be minimum 2+1 design with fans serving a common rooftop plenum, each sized for one-half the exhaust air requirement or other amount determined by the Design Builder that provides the University with the most energy efficient system and one fan being standby. Belt driven equipment is prohibited. Exhaust fan plenum shall include an outside-air bypass damper if required by wind study performed. Bypass damper shall operate only at minimum flow conditions or other conditions as determined by the wind study and shall not operate continuously.

* + - * 1. Insulation – New installations and existing systems affected by the work of this project such as supply and return ductwork exposed to unconditioned spaces, chilled water supply and return piping, high temperature water supply and return piping, heating water supply and return piping, domestic and industrial hot water supply and recirculation piping, and steam piping and equipment shall be insulated. Supply and return ductwork in conditioned spaces shall not be insulated.
        2. Ductwork System

It is an objective to design the pressure distribution duct (between the AHU and terminal units or air valves) for pressure drops to 2.0 inches WG or less. Long duct runs shall be designed with special consideration of pressure loss since the maximum loss for any run shall be imposed upon the entire fan system. Review the existing longest runs and modify to reduce pressure loss and save energy.

Construction of ductwork shall be in accordance with SMACNA latest edition except as modified in Division 26 and for the appropriate duct pressure classification. Provide variations in duct size, and additional duct fittings as required to clear obstructions and maintain clearances. Base duct pressure classification on the maximum pressure the fan can produce at the maximum speed the fan can operate with the motor fitted.

Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations. Longitudinal seams shall use Pittsburgh lock. Button punch snap lock shall not be used on campus. Typically ducts over 48-inches wide will not be necessary. However, where necessary, on ducts over 48" wide consult with the University regarding the placement and use of internal reinforcement. Run outs to grilles, registers or diffusers on exposed ductwork shall be the same size as the flange outer perimeter on the grille, register, or diffuser.

To achieve acceptable concentration levels and desired concentration rates, the exhaust system shall combine and mix exhaust volumes from multiple uses. Exhaust concentrations of noxious or hazardous substances would be diluted both within ducts and at rooftop plenums prior to exhausting to the atmosphere.

Return air system shall be ducted in shafts, above ceilings and non-conditioned spaces. Return air plenums shall not be used for lab areas.

Ductwork Accessories - Provide a manual volume damper in the ductwork upstream of a terminal unit or air valve to reduce entering air pressure and sound level for the unit. This is extremely important for terminal units and air valves closer to the AHU and sensing a higher duct system pressure.

Duct Liner: shall be used only on a limited basis where required by the acoustical consultant and after approved by the University’s Representative. Supply air duct mains shall be provided with exterior duct insulation even if installed with duct liner.

* + - * 1. Terminal Units - Terminal units with reheat coils shall be provided with an access door. Internal liner shall be covered with suitable material to avoid degradation of the liner.
        2. Lab Air Valves - Laboratory airflow control system components shall be the products of a single manufacturer for single point responsibility, Phoenix Controls Corporation, Siemens Industry, or equal.
        3. Grilles, Registers and Diffusers

Air distribution within the Laboratories is critical. Supply diffusers shall be positioned such that air discharge does not affect the operation of the fume hoods.

The terminal velocity shall not exceed 50 fpm at 2 feet from the face of any fume hood and 50 fpm at 6 feet above the floor.

Spaces without fume hoods shall use a 2’x2’ module aerodynamically formed face panel. Diffuser shall not include volume dampers.

Return grilles shall be 2’x2’ to lay-in T-bar ceilings. Provide with 45° angled blades or perforated face.

Exhaust grilles shall be 45° angle blade types.

Fabric air diffusers (DuctSox or LabSox) are an acceptable alternative to supply diffusers in exposed areas.

* + - * 1. Controls

A direct digital control (DDC) BACnet control system shall be engineered and provided for the mechanical systems. Stand-alone modules shall control air handlers, pumps, etc. A common data highway shall link the modular controllers. Large valve and damper actuators shall be industrial-grade 120-volt electric actuators. Large dampers are considered economizer dampers larger than 5 sq. ft., supply air or exhaust air isolation dampers of any size, and valves with flow rates greater than 50 gpm. Electronic (24V) actuators with torque ratings in excess of the damper requirements are acceptable; if selected and installed actuators are insufficient, the design-builder will be responsible for increasing actuator torque at their own cost. Stacking actuators is prohibited. Splitting dampers into smaller sections does not mitigate these requirements and is unacceptable.

Laboratory Control Systems - The design of the lab control system shall maintain a safe working environment for the users. A closed-loop tracking system shall be provided. The control system shall include features to enable control of the following:

Supply and exhaust variable air volume.

Supply and exhaust offset based on lab use requirements.

Laboratory pressurization based on lab use requirements.

Pressure independent variable volume hood exhaust.

Room temperature control.

Laboratory Sequence of Operation:

As the static pressure in the exhaust and supply duct systems fluctuate, the laboratory air flow control valve shall modulate to maintain a fixed set-point air volume within one second.

As each fume hood’s sash opening increases or decreases, the sash sensor signal to the related fume hood monitor shall change proportionally. A sash sensor and monitor are mounted on each fume hood. Affected laboratory air flow control valves shall have one-second response time to new air volume setpoint.

With an operator at the VAV fume hood, the fume hood occupancy sensor shall detect the operator and shall send a signal to its associated fume hood monitor. This signal shall switch the monitor into its Standard Operation mode. Based on the combination of user status and sash position inputs, the fume hood monitor shall control its associated hood exhaust valve, thus maintaining a constant average face velocity at the fume hood opening (100 fpm).

When the operator walks away from the VAV fume hood and out of the fume hood occupancy sensor detection zone for a timed interval, a signal shall switch the monitor into its Standby Operation mode. Hood exhaust valve shall maintain a constant average face velocity of 60 fpm.

Each hood exhaust valve shall generate a feedback signal to the make-up air controller. The make-up air controller shall calculate the total hood exhaust volume from hood(s) exhaust valves and shall generate a total hood exhaust signal. The make-up air controller shall maintain a constant, adjustable net negative offset between the zone’s total exhaust and make-up air volumes. This offset shall not vary with changes in exhaust volume magnitude and represents the volume of air that enters the zone from the corridor or adjacent spaces. Labs shall remain negative to the corridor even in the event of a fire.

On a rise in lab temperature, the electronic thermostat or DDC controller shall send a thermal demand signal to the make-up air controller. This signal shall be proportionate to the supply air volume required to condition the lab. The make-up air command signal shall be generated by comparing the minimum ventilation setting, the make-up air for hood demand and the scaled thermal demand signals, and selecting the highest of these three.

The make-up air controller shall generate a signal to control the zone’s general exhaust valve. Signal shall equal the difference between make-up air and total hood exhaust; in addition, the room offset and constant supply and support supply volumes. Open the general exhaust valves when additional volume is required to maintain zone pressure. Should hood exhaust volume increase, the make-up air controller shall decrease the general exhaust valve.

The lab thermostat or DDC controller shall control the reheat coil.

When the differential static pressure across each hood exhaust valve drops below the valve’s minimum operating differential static pressure, the differential pressure switch shall open, causing the fume hood monitor to generate an audible and visual flow alarm. Upon a valve jam condition the monitor shall generate a flow alarm.

Fail-safe condition for exhaust valves shall be their maximum mechanical limits and the supply make-up air valves shall fail to their minimum mechanical limits.

* + - * 1. System Start-Up, Testing, Adjusting & Balancing - The work includes system start-up, test, adjust, and balance (TAB) of HVAC air and water distribution systems including equipment, ducts, piping and controls for the project. Include integration with the Campus centralized control system.
        2. Commissioning: Design Builder shall assist, work closely with, and cooperatively deliver a fully commissioned and functional system to the satisfaction of the University.
      1. PLUMBING SYSTEM
         1. Provide design, engineering, installation, and testing of roof storm drain and overflow drain plumbing system required for the project, including demolition. Existing building does not have overflow drain system.

Provide other plumbing modifications as necessary for the work as part of the project.

Existing roof drains shall be demolished and new installed concurrently to avoid the building not having a working roof drainage system at any time during construction.

* + - 1. FIRE SUPPRESSION SYSTEM
         1. This project does not involve installation of a fire suppression system. Where existing fire suppression systems are encountered, provide engineering, design, and construction of any modifications required by the work of this project. Design the system in conformance with the 2016 California Building Codes, NFPA-13, 14, and 24.
      2. ELECTRICAL SYSTEM
         1. Provide design, engineering, installation, and start-up of a complete and operational electrical system including demolition. Electrical criterion to be followed appears in other Sections throughout this document and RFP documents. Review the complete documents and comply with their requirements. Report any conflicts to the University’s Representative for resolution.
         2. Interior lighting and exterior lighting shall remain as installed and is not part of the project unless affected by the work of this project.
         3. Power system: Use existing circuits and/or conduits to the greatest extent possible to minimize disturbance to the occupants. Confirm existing wire sizes in the field prior to engineering new power circuits. Demolish existing and provide new power circuits for mechanical and electrical work provided by this project where required. No aluminum wiring shall be used or reused if found.
         4. Main electrical circuits and electrical panelboards shall only be shut down when adequate notice has been given to the University’s Representative as per contract requirements, and written acceptance has been issued by the University's Representative.
      3. FIRE ALARM SYSTEMS
         1. Fire Alarm System - existing addressable (multiplex) fire alarm system shall be protected and remain in operation during construction. If system needs to be turned off for any length of time a fire watch shall be provided.

Coordinate with University’s Representative if existing area smoke detection or heat detectors need to be turned off or covered to allow construction without having a false alarm.

Existing audio/visual alarm stations or pull stations shall remain and shall be relocated if blocked by work of this project.

* + - * 1. The fire alarm system shall shut down the office air handler in case of fire alarm signal. If the space that detected the fire is in a laboratory or laboratory air handler, the lab air handlers shall also be disabled. The fire alarm system shall also be connected to the sprinkler flow switches and valve supervisory switches. The fire alarm system is already connected to sprinkler flow switches and valve supervisory switches.
      1. PRODUCTS
         1. Products, equipment, materials, supplies, etc. are specified in Divisions 01 through 33.
      2. EXECUTION
         1. Design shall be in accordance with Scope of Work in the RFP and construction execution shall be in accordance with Division 01 through 33.