MECHANICAL

Code Analysis:

1. All mechanical systems will be designed and constructed in accordance with the following codes and standards in addition to the codes listed in the project specifications.
    a. 2018 Edition of the International Mechanical Code
    b. ASHRAE Data Books for design standards
    c. National Fire Protection Association Standards (NFPA 13,14,20,45, 90A, 101)
    d. 2012 Edition of the International Building Code
    e. ASHRAE 90.1-2016
    f. ASHRAE 62.1-2016
    g. AHRAE Fundamentals Handbook
    h. ASHRAE latest edition guidelines
    i. AMCA 99 for Spark Resistant Construction
    j. ASTM standards
    k. SMACNA standards 1995 editions

Outdoor Design Conditions:

1. Summer	97.1°FDB, 75.9°FWB (ASHRAE 1%)
2. Winter	30.3°FDB (ASHRAE 99%)

Indoor Design Conditions:

1. Offices and Conference Rooms	75°FDB, 50% RH - Summer 70°FDB – Winter
2. Laboratories	72°FDB, 50%RH – Summer 70°FDB – Winter
3. Electrical Rooms	80°FDB – Summer (no heat)
4. IT Rooms	72ºFDB – Summer (no heat)

Outside Air:

1. As per ASHRAE STD. 62.1-2016, Ventilation for Acceptable Indoor Air Quality, Ventilation Rate Procedure.

	People Rate	Area Rate
a. Offices/ Conference Rooms	5 CFM/person	0.06 CFM/ft^2
b. Multi-use Room	7.5 CFM/person	0.06 CFM/ft^2
c. Laboratories/Instrument Rooms	>10 CFM/person Or Min 10 ACHR	0.18 CFM/ft^2
d. Corridors		0.06 CFM/ft^2
e. Storage Rooms		0.12 CFM/ft^2

Exhaust

1. As per ASHRAE STD. 62.1-2016, Ventilation for Acceptable Indoor Air Quality, Ventilation Rate Procedure.
    a. Chemical Fume Hoods 100 fpm face velocity
        i. 8-ft bench hoods – 880 CFM
        ii. Vacuum Pump Exhaust – 25 CFM
        iii. Tall Flammable Storage Cabinets – 50 CFM
        iv. Snorkels – 100 CFM
        v. Glove box exhaust – 100 CFM
        vi. Rotovap enclosure exhaust - 150
    b. Science Labs Min 1.0 CFM/ft^2 or 10 ACHR (Occupied), 10 ACHR (Unoccupied)

Lighting Loads for Cooling Requirements:

1. Offices, Conference Rooms As per AHSRAE 90.1-2016 Standard
2. Laboratories As per ASHRAE 90.1-2016 Standard

Heat Gain to Space From People:

1. Heat gain data is as per the 2016 ASHRAE Fundamentals.

Space	Sensible Heat (BTUH)	Latent Heat (BTUH)
Meeting Rooms/Lecture Halls	250	200
Offices	250	200
Laboratories	250	200

U Values for Building Components:

1. The 72 wing is an existing building. U-values will be determined from the existing drawings.

Chilled Water and Heating Water Pipe Sizing Criteria:

1. Chilled water and heating water flows are calculated based on FDG's requirements of 14°F ΔT (42°F - 56°F) for chilled water and 20°F ΔT (180°F - 120°F) for hot water. The pipes will be sized for a maximum of 8 ft/sec, and a maximum friction pressure loss rate of 4 ft of water per 100 equivalent feet of piping and per ASHRAE 90.1 2016.

Demolition:

1. The existing fume hood exhaust ductwork and exhaust fans that serve the Ground floor will be completely removed.
2. The ductwork and terminal units serving the Ground floor fume hood makeup will be removed, and the makeup air connection to the exterior chase will be removed.

3. The supply air ductwork and terminal units will be removed and the branch duct to the floor from the risers will be demoed.
4. The HWS/R piping associated with the demoed terminal box reheat coils on the Ground floor will be removed.
5. Selected sections of the existing process chilled water piping will be demoed where abandoned in place or required for renovation.
6. Exhaust fan 1317 on the roof will be demoed along with it's duct located in the chase and the exhaust stack at the roof level.
7. Sections of ductwork from the new supply air risers (installed as part the 1st and 2nd floor renovation) in the chases will be demoed where they are undersized.
8. The two process chilled water pumps are to be removed and returned to the owner's designated location.

Hydronic Systems

1. Process Chilled Water Distribution System:
    a. Process chilled water will be routed from the existing risers in the chases to the far end of the corridor.
    b. Branch piping will serve the new FCU located on the ground floor along with the cold room water cooled condenser.
    c. Three additional valved and capped take-offs will be provided for future use.
    d. Two new process chilled water pumps will be provided.
2. Heating Water System:
    a. There are existing 6" HS/R risers in the North chase installed during the 4th floor renovation. New 3" HS/R branch piping will be installed on the Ground floor to serve the new terminal unit heat coils being installed on the floor.
    b. The space terminal unit coils will have 2-way heating control valves. Isolation ball valves will be provided up to two inches and butterfly valves above two and one half inches.

Air Side Systems:

1. FCU:
    a. Liu's Mass Spec Lab will be equipped with a Liebert FCU with a hydronic cooling coil, electric reheat coil, humidifier and manufacturer's controller to provide tight temperature and humidity control.
2. AHU's:
    a. The new supply air ductwork on the Ground floor will be connected to the existing duct risers in the interior chases that are served by existing AHU's
    a. that were installed during the 1st and 2nd floor renovation.

3. Ductwork:
    a. New supply air and exhaust air ductwork will connect to existing duct risers in the exterior and interior chases.
    Due to the high concentration of fume hoods in two of the areas, several new exhaust duct risers will have to be installed in the exterior chases. These new risers will extend up to the roof to connect into exhaust fan plenum on the roof.

    b. Lab exhaust ductwork will be stainless steel.
    c. General exhaust ductwork will be galvanized up to the GE terminal. It will be stainless steel from the GE terminal to the main.

4. Offices:
    a. The office areas will be served by single duct VAV boxes with re-heat coils.

4. Wet Laboratories:
    a. Each laboratory will be part of the lab-trac control system. The lab-trac control system will monitor the total exhaust requirement for each room and provide the necessary CFM to maintain proper make-up air and room pressurization. Each supply valve for the lab-trac control system will have a hot water coil. The lab-trac control system will maintain a minimum of ten (10) air changes per hour in the laboratories.
    b. Chemical fume hood's sash position monitor will be part of the lab-trac system and fume hoods will be manifolded together. **The lab-trac system will maintain 100 feet per minute face velocity for each hood based on sizing criteria required by TAMU EH&S.**

5. Corridors:
    a. The existing corridors will have new VAV air terminals as required to control lab room offsets and building pressurization. The corridor terminal units will be located above the office areas and the supply air will be side walled into the corridor. Piping will be routed down the corridors. Medium pressure duct will be routed from the existing risers in the chases to where it will serve the new terminals.

Miscellaneous:

1. No piping will be routed above the electrical room.
2. Rooftop ductwork and interior lab exhaust duct will be Type 304 stainless steel.
3. Building controls will be CFCI. DDC control hardware will be Siemens.

Important Considerations:

1. The work done on the ground floor will require re-balancing the HVAC system for the ground through 2nd floor.

2. The AHU's and Lab exhaust system installed as part of the previous project for the 1st and 2nd floor were sized to serve the existing ground floor loads. Based on discussions with the chemistry department during that design, the ground floor was not expected to be renovated as heavy lab spaces. The currently shown renovation exceeds the existing loads for that floor. This should not be a problem since there will be some diversity in the system based on it serving three floors with varying loads. Refer to M001 for diversity calculations.

ELECTRICAL

Code Analysis:

1. The electrical systems will be designed and constructed in accordance with the following Codes and standards in addition to the Codes listed in project specifications.
    a. 2017 Edition of the National Electrical Code (NFPA 70)
    b. 2016 Edition of NFPA
    c. 2015 Edition of the International Building Code
    d. 2013 Edition of ASHRAE 90.1 Energy Conservation Standard
    e. Americans with Disabilities Act of 1990.

Electrical Service:

1. The existing normal service to the building consists of a 2000A, 480Y/277V main switchboard. This switchboard is served from an existing 1000kVA pad mount transformer. Panel 1HDP1 is feed from the switchboard. A new feeder will be installed from panel 1HDP1 to a new distribution panelboard, GHDP1, located in the new ground floor electrical room.

Electrical Demolition:

1. Partial power and lighting systems on the ground floor of the chemistry complex 1972 Wing will be demolished and replaced, as described below. The existing 800A, 208Y/120V bus risers will remain. The existing electrical equipment will remain but will essentially be abandoned since new electrical rooms and panels will be installed. The existing fire alarm system will remain in service during renovation work in the building. Fire alarm devices on the ground floor will be removed and returned to the Owner. New fire alarm devices will be installed in the renovation area of the ground floor.

Electrical Renovation – Normal Power Distribution System:

1. A new 250A, 480Y/277V distribution panelboard will be installed at the new ground floor electrical room and connected to the existing electrical service. This panelboard will serve 480-volt mechanical loads, lighting panelboards, and a 112.5kVA, 480-208Y/120V transformer with a non-linear load rating of K-13. The transformer will serve a 400A, 208Y/120V distribution panelboard at the new ground floor electrical room. These new distribution panelboards will distribute power to 208Y/120V branch circuit panelboards. The panelboards serving the respective laboratory spaces will be flush mounted adjacent to the laboratory entrance and will be equipped with a shunt trip main circuit breaker. The shunt trip will be actuated by an “emergency power off” (EPO) pushbutton located at the laboratory exit.

Emergency and Standby Power Distribution System:

1. The emergency system on ground floor will consist of a new 100A, 480Y/277V lighting branch circuit panelboard in the ground floor electrical room to serve life safety lighting loads. The panels will be served from existing 480Y/277V emergency panel 1EH1.
2. A new 400A, 480Y/277V fused disconnect switch located in the ground floor electrical room will connect into the existing stand-by system 480Y/277V panel MSHDP1 located in the basement. The new fused disconnect switch will serve a 112.5kVA, 480-208Y/120V transformer with a non-linear load rating of K-13. The transformer will serve a 400A, 208Y/120V distribution panelboard in the new electrical room on the ground floor. These new standby distribution panelboards will distribute power to 208Y/120V standby branch circuit panelboards. The standby panelboards serving the laboratories, support spaces, and equipment rooms will be flush mounted adjacent to the laboratory entrance or associated equipment support room and will be equipped with a shunt trip main circuit breaker. The shunt trip will be actuated by an "emergency power off" (EPO) pushbutton located at the laboratory exit.
3. The standby electrical distribution system will serve the fume hood exhaust fans, selected AHUs and mechanical loads, fume hoods, freezers, refrigerators, and other selected laboratory equipment, selected receptacles in laboratories, telecommunications equipment, and other loads selected by the Owner.

Design Criteria:

1. Loads:

Offices/Conference Rooms:	Lighting *	1.1 VA/sf
	Receptacles	5 VA/sf
Laboratory & Laboratory Support:	Lighting *	1.4 VA/sf
	Receptacles	25 VA/sf connected load
		8 VA/sf demand load
Mechanical and Electrical Rooms:	Lighting *	1.5 VA/sf
	Receptacles	2 VA/sf
Corridors/Public Spaces:	Lighting *	0.5 VA/sf
	Receptacles	0.5VA/sf

* NEC 220.12 requires branch lighting circuits to be sized for a connected load of 3 VA/sf. NEC 220.42 requires a demand factor of 100% for feeder circuit lighting loads. The lighting load indicated in this analysis is based upon ASHRAE 90.1 limits for lighting load density.

Uninterruptible power supply (UPS) systems, where required for this project, will be provided by the Owner.

2. Lighting Levels – foot candles (fc :)

Offices	30 – 40 fc
Conference Rooms	50 – 60 fc
Laboratory & Laboratory Support	70 – 80 fc at bench top
Corridors	10 – 20 fc
Mechanical, Electrical, Communications	30 – 50 fc

3. Lighting and Luminaires:
    a. The offices and conference rooms will have recessed 2'x 4' LED luminaires with acrylic diffusers. Office luminaires will be controlled by occupancy sensors. Corridors will have surface mount LED luminaires with acrylic lenses. Electrical rooms, mechanical rooms, telecommunications rooms, storage, and other unfinished areas will have industrial strip LED luminaires controlled by occupancy sensors or local timers. LED luminaires will be used for downlight applications. Low-height LED fluorescent luminaires will be investigated during subsequent stages of design for use in areas with limited plenum height.
    b. The laboratories will have continuous row, pendant mounted, direct/indirect LED luminaires. Laboratory lighting controls incorporating daylighting, time based control, and dimmer switches will be evaluated in subsequent phases of the laboratory design. Low-height LED linear luminaires will be investigated during subsequent stages of design for use in areas with limited plenum height.
    c. Emergency lighting will be provided in the renovated areas of the building to meet or exceed the requirements of NFPA 101 Life Safety Code (LSC), NFPA 110, and the International Building Code (IBC).
    d. Exit signs will be die-cast aluminum type with LED lamps.
    e. Dimming systems, where required, will employ LED sources with electronic dimming ballasts. Incandescent sources are not anticipated to be used in this project. Specialty luminaires shall be as designated by the Architect.

4. Motor Starters and VFDs:
    a. Motor starters and Variable Frequency Drives (VFDs) are provided under Division 23 by the vendor of the driven equipment.
    b. Motor starters and Variable Frequency Drives (VFDs) are installed by Division 26, except where furnished as a factory-installed component of the driven equipment.

Fire Alarm System:

1. The existing fire alarm system will remain in service during renovation work in the building. Existing fire alarm devices on the ground floor will be removed and

returned to the Owner. New fire alarm devices will be installed in the renovated areas of the ground floor and connected to the existing fire alarm system in order to comply with current fire alarm code. The entire lens of fire alarm visual notification devices (strobes and combination speaker/strobes) will be installed between 80 and 96 inches above finished floor level.

2. Security/Communications/Data Conduit System:

A separate, empty raceway and conduit system will be provided for the security and data/communications systems. The security and data/communications systems are specified by other disciplines; refer to design narrative and specification sections for applicable systems.

PLUMBING / FIRE PROTECTION

Code Analysis:

1. All plumbing systems will be designed and constructed in accordance with the following codes and standards in addition to the codes listed in Code Review Section.

   a. 2018 Edition of the International Plumbing Code
   b. Americans with Disabilities Act of 1990.
   c. American Society of Sanitary Engineers Standards as applicable.
   d. American Society of Plumbing Engineers Data Books for design standards.
   e. 2016 Edition of the NFPA Standards. (NFPA 13, 14, 20, 45 and 101)
   f. 2018 Edition of the International Building Code
   g. ASHRAE 90.1-2013, items concerning Plumbing Systems

Demolition:

General:

1. The existing building has plumbing utility risers in multiple locations that serve each floor of the building. These risers include domestic hot water, domestic cold water, distilled water, compressed air, nitrogen, natural gas and acid waste and vent stacks.
2. The plumbing lab utilities serving the ground floor will be demolished. The existing plumbing utilities are routed to lab sinks, cup sinks, fume hoods and counter gas turrets.
3. The existing plumbing utilities serving the labs routed throughout the ground floor will be removed, extending back to chases where the existing plumbing utility risers reside. The existing risers will remain. The existing lab sinks, cup sinks and floors drains on the ground floor will be removed. All existing plumbing piping penetrating the floor will be removed. The voids left in the slab will be filled with concrete.

Existing plumbing utilities located on the Ground Floor that serve the 1st Floor labs will remain. The existing risers are to remain with pipe taps for new piping serving the renovated ground floor.

4. The distilled water equipment, water heaters, air compressor, and nitrogen equipment that serves the building will remain operation.

Acid Waste:

1. The acid waste piping in the basement which extends up to the ground floor, will be removed back to the mains with the removed branch lines capped at the main. The acid waste piping on the ground floor, will be removed back to the mains with the removed branch lines capped at the main. The acid vent piping on the ground floor will be removed extended back to the existing acid vent stacks. New acid waste piping will be provided to serve the renovation of the ground floor and connected to the existing acid waste system.

Domestic Water:

1. The domestic hot and cold water piping on the ground floor serving the lab areas will be removed extending from the lab spaces to the existing floor shutoff valves from the existing domestic hot and cold water risers. Existing domestic hot and cold water located on the basement floor that supplies water to the renovated lab areas will be removed where extending up to the floor above.

Compressed Air:

1. The existing compressed air system which serves turrets and fume hoods located throughout the ground floor will be removed. The compressed air piping will be removed extending from the lab areas to the existing floor shut-off valves at the existing compressed air risers.

Distilled Water:

1. Existing distilled water risers are provided throughout the building. The existing distilled water risers are not currently circulated. The existing distilled water piping system that serves various outlets on the basement and ground floors will be removed, extending to the existing floor shut-off valves in the plumbing utility chase. New distilled water piping will be extended from the floor shut-off valves to lab sinks that require distilled water.

Natural Gas:

1. The natural gas piping located on the ground floor serving turrets and fume hoods located throughout different rooms will be removed. The natural gas piping will be removed extending to the existing floor shut-off valve located in chases located along the exterior walls of the building.

Nitrogen:

1. The existing nitrogen piping system, located on the ground floor, that serve various outlets will be removed, extending to the existing floor shut-off valve in a plumbing utility chase. New nitrogen piping will be provided to serve the lab areas, extending from the existing floor shut-off valve.

Renovation:

General:

1. The renovated ground floor will consist of adding fume hoods, lab sinks, floor drains, emergency showers, lab gas bench turrets. Plumbing utilities will be provided to these items from the existing plumbing utility risers and stacks.

Domestic Water:

1. Domestic hot and cold water will be extended from the existing domestic hot and cold water shut-off valves at pipe chases. Domestic cold water will also be routed to emergency shower and cup sinks. Domestic hot and cold water will be routed to lab sinks. The domestic hot and cold water piping and fittings will be type "L" copper tube.

Compressed Air:

1. Compressed air piping will be extended from the existing floor shut-off valves to the fume hoods, counter top turrets and equipment requiring compressed air. A pressure regulating valve will be provided on the compressed air lines serving the fume hoods, in order to reduce the air pressure to 50 psi. The compressed air piping will be type "L" hard drawn copper cleaned for oxygen service. The joints will be brazed with a nitrogen purge. The air compressor & air dryer will be relocated and installed.

Natural Gas:

1. New natural gas piping will be provided extending from the existing floor shut-off valve to the fume hoods. An electric actuated automatic shut-off valve will be provided on each gas supply line serving the lab areas.

Nitrogen:

1. Nitrogen piping will be extended from the existing floor shut-off valves to the fume hoods and counter top turrets, this is a house nitrogen system. The nitrogen piping will be type "L" hard drawn copper cleaned for oxygen service. The joints will be brazed with a nitrogen purge.
2. There is also nitrogen required at Glove Boxes and also in one other location that requires a higher purity level than the house nitrogen system. For this system nitrogen is piped from cylinders to locations indicated. There will be two banks of cylinders with an automatic cylinder switchover manifold to switch from the lead depleted bank of cylinders to the reserve bank of cylinders. The nitrogen piping will be type "L" hard drawn copper cleaned for oxygen service. The joints will be brazed with a nitrogen purge.

Specialty Gases:

1. Specialty gas piping will be extended from a valve for connection to gas cylinders, located in the Cylinder Rooms, to fume hoods. The specialty gas piping will be type 316 polished stainless steel cleaned for oxygen service. The joints will be orbitally welded or swagelock type joints.

Hydrogen:

1. Hydrogen piping will be extended from valves for connection to gas cylinders, located in the Cylinder Rooms, to a valved and capped location at the Glove Boxes. The hydrogen piping will be type 316 polished stainless steel cleaned for oxygen service. The joints will be orbitally welded or swagelock type joints.

Distilled Water:

1. Since the existing distilled water risers are not circulated then the new piping system serving the ground floor will not be circulated. Distilled water piping will be extended from the existing shut-off valves at pipe chases. The distilled water piping will be routed to lab sinks. The distilled water pipe and fittings will be schedule 40 high purity polypropylene with socket heat fused joints.

Acid Waste:

1. The acid waste and vent system will be connected to the new cup sinks, lab sinks, emergency shower floor drains and any new other floor drains. The acid waste drainage piping from the various plumbing fixtures will collect to the acid waste piping located on the Ground and basement floors. The acid vent piping will connect to the existing acid vent stack located above the ceiling of the Ground and basement floors. The acid waste and vent piping will be chemical resistant borosilicate glass with mechanical joints. The cup sinks and lab sinks will have drum traps constructed of acid resistant borosilicate glass.

Fire Protection:

1. The existing wet automatic sprinkler system will be reworked to comply with NFPA 13 and FM Global requirements, to be coordinated with the renovated ground floor. The reworked sprinkler system will be hydraulically calculated to deliver adequate water pressure and floor coverage, based on a design density of 0.20 gpm per square foot over the most remote 2500 square feet for the Lab Areas and Lab Support Areas. The reworked sprinkler system will be hydraulically calculated to deliver adequate water pressure and floor coverage, based on a design density of 0.10 gpm per square foot over the most remote 1500 square feet for the office type areas and administrative areas.