V. ELECTRICAL SYSTEMS

EXECUTIVE SUMMARY

Utility power will be provided by a 480V, 1200A service from TECO. Backup power will be provided by a 480V, 250KW generator. Continuous power will be provided via point of use UPS units provided by FPU. Artificial lighting will be provided via energy efficient LED fixtures. Manual lighting controls will utilize wall switch and dimming. Automatic lighting controls will include occupancy and ambient light sensing technologies. Surge and lightning protection will be for the building and incoming utilities. Grounding system will be robust to ensure safety and functionality. A fire alarm system will provide monitoring and occupant notification.

BASE DESIGN CRITERIA

Design Voltages

Type	Voltage
Building Service	480Y/277V , 3 phase, 4 wire + ground
Motors; ½ HP and larger	480V, 3 phase, 3 wire
Motors; less than ½ HP	120 or 208 Volts, 1 phase, 2 wire + ground
Lighting	277 Volts, 1 phase, 2 wire + ground
Specific Equipment	480 Volts, 3 phase, 3 wire + ground
Lab Support and Specialty Equipment	208Y/120V, 3 phase, 4 wire
Receptacles	120V, 1 phase, 2 wire + ground

Equipment Sizing Criteria

Branch Circuit Sizing Criteria

Type	Load
Lighting	Actual Installed VA
Receptacles	180 VA per outlet (duplex or single)
Multiple Outlet Assemblies	180 VA per 2'
Special Outlets	Actual Installed VA of Equipment Served
Motors	125% of Motor VA
Special Equipment	Actual Installed VA
Special Care Area Receptacles	300 VA per critical duplex
	600 VA per normal duplex
	1920 VA per dedicated receptacle at headwall

Diversity Factor

Diversity factors will be used in establishing power service, feeder and equipment capacities. The diversity factor represents the ratio of the sum of the individual non-coincident maximum demands of various subdivisions of the system to the maximum demand of the complete system and will be established using historical data from similar buildings in conjunction with industry standards.

Long Continuous Load/Demand Factors Criteria

Type	LCL Factor
Lighting (Continuous Loads)	125% of installed VA
General Receptacles	100% of first 10 kVA installed plus 50% of remainder
Motors	125% of VA of largest motor plus 100% of VA of all other motors
Fixed Equipment	100% of total installed VA

Load Calculation Criteria

Functional Area Load Density Criteria – Peak Connected

Functional Area	Service Load Density (VA/sq ft)	EM-SB Load Density (VA/sq ft)
Office Receptacle	4.0	0
Lighting	1.0	0.2
Lab	12.0	2.0
Lab Support	30.0	10.0
General Receptacle	2.0	0
Conference Rooms	2.0	0.25
Corridor	1.0	0.25
Public Space	4.0	0.25
Building Support	2.0	0

Notes:
1. VA/sf values is based on historical data from projects with similar program elements.
2. EM-SB = Emergency -Standby

Mechanical Equipment Load Density Criteria - Peak Connected

Mechanical System	Service Load Density (VA/sq ft)	EM-SB Load Density (VA/sq ft)
Ventilation (V)	2.6	1.5
Refrigeration Systems (Process and Comfort) (R)	0.7	0.1
Heating Systems (H)	0.3	0

Mechanical System	Service Load Density (VA/sq ft)	EM-SB Load Density (VA/sq ft)
Piping Systems (P)	1.2	0
Miscellaneous Equipment (M)	1.5	0.7
Elevators (EL)	0.9	0

Notes:
1. VA/sf values is based on historical data from projects with similar program elements.
2. EM-SB = Emergency - Standby

Load Tables

System Capacity and Calculated Demand Load

Building Load Summary		
	Normal Power	Emergency / Standby Power
kVA	804	202
VA/SF	18.7	4.7
W/SF	16.8	4.2

Notes:
1. Power factor is anticipated to be 90% and is derived from historical data on recent projects with similar program elements.

SYSTEMS DESCRIPTIONS

Electrical Service

System Description

The facility will be fed from single service distribution panel or switchboard. The service will be fed from a new 480V TECO transformer located adjacent to the building. The transformer will be fed from an existing TECO primary loop along Polytechnic Circle.

Design Criteria

The primary system service capacity will be designed to serve the calculated connected load of the facility plus an additional 20% for anticipated future loads.

Surge protection shall be provided at the main switchboard.

Switchboard distribution circuit breakers shall be fixed molded case breakers

Emergency/Standby Power System

System Description

Emergency power source for the facility will consist of an Emergency Power Supply (EPS) coupled to an emergency Power Supply System (EPSS). The EPS will include single diesel operated engine generator set.

The emergency power system will be a Level 1 system per NFPA 110.

The 250KW / 312.5KVA, 480Y/277V, Emergency/Standby generator will be diesel engine driven. The sub-base fuel tank will have adequate capacity to operate the generator at full load for at least 72 hours.

The emergency/standby power generator will be located adjacent to the building. The generator set will be mounted on a concrete pad in a custom sound attenuated enclosure with turn-down intake and turn-up exhaust.

The emergency/standby power will be distributed to multiple automatic transfer switches segregated by system. Segregated systems are as described below:

System	Associated Loads
Emergency Systems NEC Article 700	Egress Lighting
	Exit Signs
	Fire Alarm Detection and Annunciation Systems
	Elevator Cab Lighting
Optional Standby Systems NEC Article 702	Access Control System
	Telecommunication System
	Building Automation System (BAS) and Accessories
	Telecomm Rm HVAC
	Generator Set Accessories (lighting, receptacle, heaters, chargers)
	Lab refrigerators & freezers
	Lab servers
	Ventilation systems for labs with fume hoods (AHUs, EFs)

Design Criteria

The capacity of the generator will be sufficient to serve the facility, with approximately 20% future capacity.

Electrical Distribution

System Description

Normal Power Distribution

The normal distribution system shall include all electrical distribution equipment from the utility transformer to the branch distribution outlet device, not including those systems and devices as described in the following subsections.

Utility transformer secondary / service entrance will be distributed via 1200A rated aluminum cable and PVC conduit duct bank. The raceway will originate at the utility transformer and route into the main electrical room, where it will feed directly into the bottom of the main circuit breaker section.

Distribution to the distribution panelboards will consist of EMT conduit and aluminum cable for 100 amps and larger and copper cable for less than 100 amps. Feed-through distribution will not be used to allow minimal electrical interruption during servicing.

480Y/277V distribution will be accomplished in the main electrical room utilizing distribution panelboards and lighting/appliance panelboards. Panelboards may also be located in an electrical room on the east side of the building to handle the high concentration of mechanical equipment.

208Y/120V distribution will be accomplished with a main electrical room and distribution rooms as indicated on the drawings. The electrical rooms on the second floor will align vertically / stacked with first floor. The first level rooms will house the 480:208Y/120V distribution transformer and distribution panelboard. The distribution panelboard will feed the electrical panels located within the electrical room and located at the laboratory entries.

Emergency/Standby Power Distribution

As required by Code, the feeders and branch circuit wiring to emergency loads (lighting, fire alarm, telecommunications, etc.) will be in dedicated raceway.

The emergency and standby power feeds will originate at the generator output breakers and feed enclosed main disconnects. The emergency and standby power disconnects will feed the emergency and standby power automatic transfer switches.

The emergency automatic transfer switch will feed branch fused panelboard to achieve full selective coordination. The branch fused panelboard will serve the emergency lighting.

The standby automatic transfer switch will feed a standby distribution panel. The distribution panel will feed 480V equipment and 480:208Y/120V transformers and distribution panels in the main and branch electrical rooms on the first floor. The distribution panels will feed 208Y/120V branch circuit panelboards located at the lab entries.

Design Criteria

Building service and distribution equipment sizes will be based on estimated demand plus known or anticipated future loads.

Power distribution equipment will be sized to support 25% spare capacity (amperes) to accommodate functional changes over the life of the building.

Power distribution equipment will be sized to include 25% spare circuit breakers plus spaces for 25% future circuit breakers

Power factor correction will be considered in the design of the power distribution system to bring the calculated power factor to 90% or better.

Equipment and Components

Equipment	Description of Components
Switchboards	UL 891 construction Front access NEMA 1 enclosure Copper Bus Main Circuit Breaker Group mounted bolt-on feeder circuit breakers

Equipment	Description of Components
	Electronic trip circuit breakers with field-adjustable and field-changeable trip units will be used for all circuit breakers 225 amps and greater and for smaller sizes if special circumstances exist. Circuit breakers 800 amps and greater will be UL listed for applications at 100% of their continuous ampere rating in their intended enclosure
Switchboards & Distribution Panelboards	UL 891 listed, Front access NEMA 1 enclosure switchboards UL 489 listed, NEMA 1 distribution panelboards Copper Bus Main Lug, Main Circuit Breaker after transformer Fixed Group-mounted circuit breakers Electronic trip circuit breakers with field-adjustable and field-changeable trip units will be used for all circuit breakers 225 amps and greater and for smaller sizes if special circumstances exist.
Branch Panelboards	UL 67 listed 54 Pole maximum, NEMA 1 enclosure, recessed and/or surface mounted Copper Bus Main Lug Molded case with non-adjustable trip units to be used for all circuit breakers 225 amps and smaller All circuit breakers will be bolt-on style Panelboard covers will be hinged trim with door-in-door construction.
Distribution Transformers	480 Delta to 208Y/120 VAC, Wye, three-phase, four-wire; 3-coil, 2-winding type; 150°C rise above 40°C ambient Copper Winding Transformers will incorporate vibration isolation pads in their construction located between the core/coil assembly and the transformer case.
Automatic Transfer Switches	Three pole Copper Bus WCR as indicated on riser Solid Neutral Open Transition Transfer Controls: Solid State microprocessor Isolation Bypass: None 3 cycle for use with molded case breakers short circuit rating

Grounding System

System Description

A complete low-impedance grounding electrode system will be provided for this facility. The grounding electrode system will include the main water service line, structural steel, Ufer ground, and ground ring around the perimeter of the building. The equipment grounding system will extend from the building service entrance equipment to the branch circuit. All grounding system connections will be made using irreversible compression connections.

Bonding jumpers will be provided as required across pipe connections to water meters, dielectric couplings in a metallic cold water system, and across expansion/deflection couplings in conduit and piping systems.

All feeders and branch circuits will be provided with an equipment ground conductor. Under no circumstances will the raceway system be used as an equipment grounding conductor.

Design Criteria

The grounding electrode system will be designed in accordance with NEC article 250.

System resistance to ground will be 5.0 ohms or less.

All conductors above grade will be installed in steel conduit. All conductors below grade will be installed in PVC conduit with stub-up elbows.

Equipment and Components

The reference ground for the equipment grounding system will be established from a structural ground grid as follows:

A No. 4/0 AWG bare copper ground wire will be installed at 30" below grade around the entire perimeter of the building. 3/4" x 10 ft driven copper ground rods (test wells) will be installed and connected to this ground loop at not-greater-than 200' intervals with a No. 4/0 AWG bare copper conductor. Steel columns in exterior walls will also be connected to this ground loop with 3/0 AWG bare copper at intervals not to exceed 60'. Interior steel columns will be connected to the exterior ground loop on each side of the building at intervals not to exceed 200' with a No. 3/0 AWG bare copper conductor.

A "Ufer" ground will be provided in the footing of the building consisting of 20' of #4 wire located 3" from the bottom of the footing.

Wall-mounted copper ground bus will be located in the main electrical room, floor electrical rooms, voice/data rooms and select laboratories.

Distribution

A separate, insulated 3/0 AWG ground wire will be provided from the main electrical room ground bus to each floor's electrical room ground buses, underground incoming water service line ahead of meter, and underground gas line at the building entrance.

The main service entrance neutral will be bonded to the system ground bar within the switchboard by a removable bus bar link.

A code-sized, unbroken bond leader will be connecting the electrical room ground bar to the XO terminal of the local transformers.

A No. 3/0 AWG, bare copper, grounding electrode conductor will be extended to all voice/data rooms, so that those systems can be properly bonded.

A separate ground wire will be provided for all circuits.

Lightning Protection System

System Description

A lightning protection system will be provided to protect structure and associated appurtenances.

Design Criteria

System will comply with NFPA 780 - Standard for the Installation of Lightning Protection Systems. The installer will be certified with the Lightning Protection Institute and the installing Contractor will provide a UL Master Label for the completed system.

Equipment and Components

Materials will be rated Class I for structure heights of 75′ or less.

Air terminals will be solid copper with a tapered point, 10″ minimum height, and have a mounting base suitable for the location.

Conductors will be bare-stranded aluminum, except copper will be used where installation is in contact with earth or copper surfaces.

Ground rods will be copper-clad steel, 3/4″ diameter by 10′ long, with a bronze mechanical-type conductor clamp.

Distribution

The system layout and design will encompass all exterior surfaces of the facilities under a complete zone of protection as defined by NFPA 780. Air terminal spacing will not exceed 20 ft, except spacing up to 50′ is allowed for non-perimeter areas of flat roofs. Locations will comply with NFPA 780 and will generally follow the building roof ridges and/or perimeters.

One (1) down conductor will be provided for every 250 ft of building perimeter, with a minimum of two (2) conductors. Conductors will be configured to provide a two-way path to earth. Metal bodies will be bonded to the conductor system in accordance with NFPA 780.

A ground ring will be installed around the entire perimeter of the building connecting all down conductors together. Ground rods will be connected to the ground ring. The electric power service grounding system will be bonded to the Lightning Protection System.

Lighting Systems

System Description

A complete lighting system for all indoor and outdoor illumination will be provided. The indoor lighting system will consist primarily of energy-efficient LED lighting fixtures. The outdoor lighting system will consist of LED fixtures.

The indoor lighting control system will be digital room controller type. The control wiring between control devices will be CAT 5 cabling. The individual rooms will not tie into a central system, but they will have to option to upgrade to a central system in the future

The outdoor lighting controls will utilize photocells and BAS controlled relay with line voltage manual override switches.

Emergency/night lighting will be provided by unswitched branch circuits. These unswitched branch circuits will be fed from an emergency lighting panel. Exit signs and emergency egress lighting will be provided throughout the facility to illuminate egress corridors, stairwells, lobbies, etc. Exit and egress lighting circuits will originate from emergency system branch panels. Base design intent is that egress lighting circuits will be constant "on" with no toggle switch control.

Emergency lighting in conference rooms and classrooms will be switched / dimmed with normal lighting. Emergency lighting will be automatically adjusted to full output on loss of normal power or activation of the fire alarm system.

Illuminance Levels Design Criteria

Space	Average Maintained Footcandles
Office	30-40
Laboratory, Support, Technical Area	40-50
Wet Laboratory Bench and Table Top (Bio & Life, Chemistry, Teaching)	60-80
Dry Laboratory Bench and Table Top (Optics, Elec, Mech, Comp, Data Ana)	50-60
Student Project Labs Bench and Table Top	50-60
Lounge	20-30
Machine / Automotive	45-55
Classroom	45-55
Conference / Study	25-35
Corridor	10-20
Lobby	20-30
Mech / Elec / IT	25-35
Restrooms	10-20
Storage / Janitor	10-20
Task	40

Equipment and Components

Space	Fixture Type
Laboratory and Laboratory Support	Direct/indirect suspended pendants

Space	Fixture Type
Office	Recessed 2′ x 2′ troffers
Common Area	Recessed downlights
Circulation	Recessed downlights and 2′ x 2′ troffers
Building Support	4′ chain hung lensed industrial strip

EXIT signs will be State Fire Marshal approved LED type, located in all paths of egress.

Lamps

In general, LED lamps will have 3500K color temperature. Back of house and exterior LED lamps will be 4000K color temperature.

LED lamps to be LM-79 and LM-80 tested and have a minimum CRI of 80 to be supplied with applicable drivers or power supplies.

Lighting Control

Ambient light sensors and occupancy sensors will be utilized in select spaces to minimize energy consumption. Occupancy sensors will be combination infrared/ultrasonic type.

Dimmers will be provided in laboratories, lab support, shops, classrooms, conference rooms, a portion of the atrium, and private offices. All corridor lighting, except life-safety branch lighting, will be controlled by occupancy sensors.

Distribution

In general, lighting will be 277V.

All lighting circuit wiring will be in conduit and routed concealed within walls, partitions, or ceiling spaces. Surface-mounted conduit will be minimized and used only in non-finished spaces.

The ampacity of lighting circuits will be sized for 25% future growth plus 125% continuous loading factor per the National Electric Code.

Fire Alarm System

System Description

The fire alarm system will be a stand-alone, fully addressable system comprised of smoke detectors, heat detectors, duct detectors, one manual pull station, and audio/visual signaling devices.

Design Criteria

The fire alarm system will comply with requirements of NFPA 72 for a protected premises signaling system except as modified and supplemented by this document.

A main fire alarm control panel will be located in the first floor data closet.

A fire alarm annunciator panel will be mounted at the main building entrance.

Audio/visual devices will be installed in all areas of the building in accordance with the NFPA 72 and the ADA Guidelines.

Smoke detectors shall be installed as required by the Florida Building Code, Florida Fire Prevention Code and National Fire Alarm and Signaling Code.

Heat detectors will be installed in areas that are not feasible for smoke detectors and where required by code.

A manual pull station will be installed adjacent to the fire alarm control panel.

The fire alarm system will be connected to a remote monitoring station via wireless radio alarm communicator.

Equipment and Material

The fire alarm system will be an electronically multiplexed voice communication system.

Remote transponder panels will be used to provide supervised amplifiers and signal circuits for audio/visual devices and magnetic door holders.

The system will utilize individual, addressable photoelectric smoke detectors; addressable heat detectors; addressable manual pull station; and addressable monitor and control modules. The system will monitor all sprinkler supervisory and water flow switches and will interface with elevators, HVAC smoke control, and smoke fire dampers.

Distribution

All initiating and signaling devices will operate at 24VDC and will be installed in accordance with manufacturer's specifications.

All wiring will be installed in conduit. Minimum conduit size will be 3/4".

ELECTRICAL SYSTEM STANDARDS

Feeder and Branch Circuits

Secondary distribution and branch circuit system design will be based on a maximum of 5 % voltage drop from the transformer to the utilization equipment

Neutral conductors derived from harmonic mitigating transformers will be capable of carrying 100% of normal phase current from transformer to first distribution panelboard. Neutral conductors from distribution panelboard to downstream panelboard or device will not be increased in size

Feeder and branch circuit sizes will be based on the load supplied and adjusted for voltage drop.

Feeder and branch circuit ampacity will not be smaller than the upstream overcurrent device or downstream equipment bus.

Circuit Voltage Length	Wire Size
480Y/277 volt circuits over 150' in length	Increase wire size one size for each 150' of length
208Y/120 volt circuits over 100' in length	Increase wire size one size for each 100' of length

Receptacles

Refer to the Laboratory Functional and Technical Criteria, in other sections of this narrative for requirements in these programmed spaces.

Laboratories, lab support, classrooms, open offices, conference rooms, atriums, lobbies, lounge, catering, storage, and support rooms, will be provided with a receptacles as required.

Enclosed offices will be provided with a double duplex receptacle at desk location.

Restrooms will be provided with one receptacle.

Corridors will provide receptacles 50' on center.

Electrical rooms will be provided with one receptacle.

IT rooms will be provide with receptacles for wall equipment and mounted to racks.

Mechanical equipment will be provided with a receptacle within 25'.

Conference rooms 12 feet wide or larger areas will be provided with duplex receptacles spaced every 6 ft on walls. Provide floor boxes where glass walls are provided. Provide at least one (1) multi-service floor box in the middle of room under the table. All other conference rooms shall have at least one (1) duplex receptacle per wall and one (1) multi-service floor box in the middle of room under the table.

Duplex receptacles in office areas, lounges, lobbies, etc., shall be circuited with an average of (6) duplex receptacle's per 20A, single pole circuit.

Each workstation to receive minimum of (2) duplex receptacles that will be circuited with maximum of (3) workstations per 20A, single pole circuit.

Receptacles along laboratory benches shall be circuited with an average of (4) duplex receptacle's per 20A, single pole circuit.

Equipment such as refrigerators or freezers shall be connected to dedicated circuits.

Each fume hood to be provided with a minimum of (1) 20A single pole circuits.

Ground fault protection will be provided for outlets within 6' of a sink edge and other wet locations. Electrical outlets will be individually ground fault interrupted (GFCI) protected (not at the circuit breaker or first outlet on the circuit).

Dual channel surface mounted raceway will be provided in laboratories on walls and on Unistrut suspended below ceiling, as required.

Ceiling service panels will be installed in some laboratories, be inset into ceiling grid and will have twist-lock outlets for 120V and 208V service as required to support the laboratory. Each circuit will have a dedicated neutral. Shared neutrals will not be allowed. 208V outlets will not be used to provided two 120V circuits to the lab bench.

Benchtop-mounted work surface receptacle modules will be installed some laboratories. Circuits shall be routed through umbilical to casework.

Ceiling mounted cord reel receptacles shall be provided and shops and labs, as required.

Overcurrent Protective Device Coordination

Overcurrent protective devices supporting emergency / NEC Article 700 power systems will be selectively coordinated from source of emergency supply through final device. Selectivity on emergency branch shall be provided through the entire instantaneous region.

Overcurrent protective devices supporting normal and optional standby power systems / NEC 702 will be selectively coordinated with supply side overcurrent protection to the greatest extent possible given the material capabilities of breaker types selected with the exception of the instantaneous region devices in keeping with industry practice.

Overcurrent protective device will be selectively coordinated with supply side overcurrent protective devices as follows:

System	Seconds
Emergency System (NEC 700)	0.01
Optional Standby System (NEC 702)	0.10
Elevator Disconnecting Means	0.01
Normal Power System	0.10

Fault Current Ratings

Short circuit withstand and interrupting ratings will be provided for electrical distribution equipment, feeder conductors, etc. based upon the actual available fault current and system motor contribution.

Equipment will have ratings not less than the calculated symmetrical short circuit value at each point in the distribution system.

Equipment will be fully rated for the calculated available short circuit. Series ratings will not be allowed.

Conduit and Raceway

Conduit Types and Application	
Conduit Type	**Application**
Electrical Metallic Tubing (EMT)	Feeders and branch circuit wiring: building interior concealed, mechanical equipment rooms >6'AFF; Size 2" maximum
Rigid Metal Conduit (RMC)	Feeders and branch circuit wiring: areas subject to physical abuse, exterior above grade, building interior locations where EMT is not allowed.
Rigid Non-metallic Conduit (RNC) / PVC	Feeders and branch circuit wiring: Below grade (elbows to be RMC)

Conduit will be run concealed, unless installed in mechanical, electrical, telecom, interstitial areas and other similar unfinished spaces.

Minimum conduit size for power circuit will be 3/4" for homeruns and 1/2" for all other.

Conduits will be independently supported.

All conduit stub-ups from below floor or in floor (where specifically allowed) will be galvanized rigid steel.

EMT fittings will be set screw type with steel body.

Conduits may be installed below floor slabs on grade.

Light fixtures, smoke detectors, junction and pull boxes and other equipment that is installed on or directly above the ceiling will be serviced and maintained without damage to ceiling tiles and other building elements.

Raceways for 2-hour rated systems shall be installed in either: UL listed assemblies for 2 hour fire rated applications or in 2-hour rated enclosures.

For lighting conduit homeruns, a j-box will be located above light fixture in an accessible location to allow for future expansion.

No home run will terminate in a wall mounted device box. A separate J-box will be provided above device box above ceiling in an accessible location.

Wire and Cable

Cable Types		
Voltage Class	**Insulation**	**Notes**
600 V	THHN &THWN-2	Conductors #10 and smaller will be solid or stranded copper. Conductors larger than #10 will be stranded copper

All feeder conductors to be 98% conductivity copper or 65% conductivity aluminum as indicated in feeder schedules on drawing.

All branch wiring conductors will be 98% conductivity copper.

Minimum branch circuit wire size #12 AWG, for all areas.

Multi-wire branch circuits will be provided with dedicated neutral conductors for each phase, common neutral circuits will not be permitted.

Feeder conductors will be terminated using compression lugs. Mechanical lugs will not be used for feeders. Branch circuit conductors will typically be terminated using mechanical lugs.

MC cable will be allowed in offices walls only.

Conductor insulation color code will be as follows:

Conductor Color Code	
208Y/120V	**480Y/277V**
Phase A – Black	Phase A – Brown
Phase B – Red	Phase B – Orange
Phase C – Blue	Phase C – Yellow
Neutral – White	Neutral – Gray
Ground – Green	Ground – Green

Wiring Devices

Wiring devices will be specification grade, complete with all accessories

Receptacle and Switch Color Code	
Normal Power	White
Emergency Power	Red

Receptacles, switches, etc., will have faceplates with labeling indicating system panel and circuit identification.

Motors and Motor Control

Stand-alone motor disconnects (separate from starter or VFD) will be fused and will be installed at each motor.

Motors smaller than 60 HP that are not provided with a variable frequency drive (VFD) will be provided with an across the line combination magnetic motor starter. Motors 60 HP and larger that are not provided with a variable frequency drive (VFD) will be provided with reduced voltage motor starter. Refer to other sections of the narrative for VFD requirements.

Combination motor starters will use circuit breakers or motor circuit protectors in lieu of fuses to reduce the possibility of single phasing. For mechanical and HVAC equipment that are not provided with a VFD, individual combination motor starters will be located within sight of the motor.

Selected motors will have variable frequency drives (VFDs) as described in other sections of this narrative.

VFD drive specifications will require that the VFDs for the project be provided such that the Special Category harmonic limits recommended in IEEE 519-1992 be maintained. The engineer will perform harmonic analysis as defined in IEEE 519-1992 and employ as a minimum 6 pulse VFD with equivalent 5% impedance by employing a combination of line reactors and/or DC bus choke to achieve the equivalent impedance. VFD filters and active front end VFDs may be utilized as needed.

Grounding and Bonding

A separate, insulated equipment grounding conductor, sized per the National Electrical Code, will be provided within each raceway and cable tray, with each end terminated on a suitable lug, bus, enclosure, or bushing.

A grounding riser with ground box will be located in the vicinity of each electrical room.

Surge Protection

Surge Protective Devices (SPD) will be used as design dictates. A single SPD device will be installed on the load side of each main service disconnects, the generator feeder disconnects, first panel on the load side of a distribution transformer, and any panels serving circuits that leave the building envelope.

EMF and Harmonics

Electrical vaults and major electrical equipment rooms containing transformers larger than 300 kVA to not be located adjacent to occupied workstations.

The power service will be required to meet the requirements IEEE Standard 519 to insure proper service. Harmonic distortion will be limited to 5 % maximum at the utility transformer secondary lugs.

Electrical Rooms

Electrical equipment rooms will be positioned to facilitate unobstructed initial installation of large equipment, and unobstructed removal and replacement of defective equipment.

Adequate space will be provided for maintenance of electrical equipment and equipment removal.

Pipes and other equipment foreign to the electrical equipment will not be located in, enter, or pass through such spaces or rooms.

Panelboards will be grouped, surface-mounted, in dedicated ventilated rooms. Electrical rooms will be stacked vertical whenever practicable. Some panelboards will be distributed throughout the building and mounted in laboratories, classrooms, shops, mechanical rooms, and corridors, as required.

Mechanical rooms will be utilized for electrical equipment and panelboard placement where applicable for optimization of space.

Panelboards serving lighting and appliance circuits will be located on the same level as the circuits they serve and will be served from source of supply with a dedicated feeder. Emergency panels will be located in first floor the emergency main electrical room and will serve the entire building.

Feed through, subfed and double section panelboards will not be used unless required to comply with selective coordination requirements.

Specialty Conditions

Provide power and systems infrastructure for the following equipment and systems:

- Experiential lab – power connections and data outlets for Dynamometer
- Mechanical Engineering (ME) Lab – power connections and control for power partitions, and floor trenching for power routing.
- Environmental Lab – receptacle for water polishers, and power connections for dryer system and vacuum pump.
- Return air ceiling plenum will be used to return air from the spaces back to AHUs. Conductor and cable insulation for all electrical systems shall be plenum rated if installed within these spaces.

Prohibited Materials and Construction Practices

The entire Emergency/Standby power distribution system will consist of conduit and wire. Busway will not be used in any portion of this system

Use of wood strips and wood screws to support lighting fixtures.

Extra-flexible non-labeled conduit

Conduit installation in concrete slabs

Use of wire ties to support conduit

Suspension systems for conduits, fixtures, etc. connected to other utility equipment is prohibited. Any suspension system with multiple levels must be hung from trapeze suspension systems

Use of Incompatible Materials: Aluminum fittings and boxes will not be used with steel conduit. All materials in a raceway system will be compatible

Direct burial electrical cable

Acceptance Testing

Acceptance Tests	
Engine Generator	Automatic Transfer Switches

Accepted Manufacturers

Acceptable Manufacturers	
Low Voltage Distribution Equipment	Cutler Hammer, Square D, ABB-GE, Siemens
Generators	CAT, Cummins, MTU, Kohler
Automatic Transfer Switches	Russelectric, ASCO, Cummins, Zenith
Meters	Square D, Siemens, Cutler-Hammer
Lighting Controls	DLM/Watt Stopper, nLight/Acuity, Greengate/Eaton
Fire Alarm System	Gamewell, Notifier, Simplex
Wiring Devices	Cooper, Hubbell, Leviton, Pass & Seymour/Legrand
Surface Raceway	Wiremold/Legrand, Mono-Systems, Post Glover, Square D
Lighting Agencies	Envision, Tampa Bay, Sesco, Western Florida

END OF SECTION