

PART II – CSU FACILITIES PLANNING, DESIGN AND CONSTRUCTION STANDARDS

CHAPTER 03 – DRAWING AND DESIGN REQUIREMENTS BY DISCIPLINE

300 – PHASING AND STAGING DRAWINGS AND DESIGN

300.1 – University Base Map:

- A. The Project Representative shall provide CAD background Drawings for Project Team’s use in developing the Drawings.

300.2 – Site Access and Haul Routes:

- A. The Project Representative shall provide any known site access restrictions, limitations or special considerations to the Project Team.
- B. The Project Team shall prepare an exhibit that shows the following coordination items:
 - 1. Locate access point to construction site with consideration to minimally impact surrounding pedestrian circulation paths, vehicular, bicycle and bus traffic.
 - 2. Provide a means to deliver materials to the construction site.
 - 3. Identify the excavation haul route from the site to off-campus.

300.3 – Trailer Site and Parking:

- A. Include the location for the Project Team’s trailer.
- B. Include parking information on the Base Map as part of the Drawing set.
- C. Refer to Chapter 01 – General Project Information.

300.4 – Vicinity Plan:

- A. Show a graphic map of major highway and arterial access to the campus with distances along the primary freight delivery route.

301 – STAGING PLAN – GENERAL

301.1 – Project Limits:

- A. Project limit lines shall be clearly shown on the Drawings after consultation with the Project Representative.

301.2 – Utility Access:

- A. Locate and define available utilities during construction including but not limited to quality and capacity of communications, fire suppression, water, electrical power, gas, sewer, potable water, industrial water and storage areas.

301.3 – Environmental Controls:

- A. Locate, dimension and define erosion control, stormwater control, temporary drainage, security, spoils areas and locations of de-watering control areas.

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301.4 – Temporary Facilities:

- A. Locate and define delivery, pedestrian, bicycle and construction barriers, storage and laydown areas, security requirements, winter protection, signage, trailers, lighting, fencing, and other requirements as directed by the Project Representative.
- B. The Project Team shall provide guidelines for temporary structure orientation and appearance.
 - 1. In coordination with the Project Representative, the Project Team shall submit a Code Review for the temporary facilities to the Colorado State University (CSU) Building Department.
 - a. The duration of the temporary facility shall be stated in the Code Review.

301.5 – Temporary Traffic Control:

- A. Show and dimension vehicle, bicycle and pedestrian re-routing, including required temporary signage, signals, etc.
- B. Coordinate traffic control with prioritization for campus safety with the Project Representative.
- C. Refer to examples in the CSU Facilities Planning, Design and Construction Standards – Additional Documents.

301.6 – Hazard Locations:

- A. Show setback of Work and constraints.

301.7 – Landscape Protection:

- A. Show, dimension and define protection fence and setback and constraints of Work, including trenching.

302 – SEQUENCING PLANS

302.1 – General Requirements:

- A. The Project Team shall provide construction sequencing plans where construction sequences must be controlled to assure proper safety and operations at CSU.
- B. Include sequencing of pedestrian, bicycle or vehicular routing, signage, staging areas, etc.
- C. Refer to examples in the CSU Facilities Planning, Design and Construction Standards – Additional Documents.

303 – DEMOLITION AND SITE PREPARATION PLANS

303.1 – Civil Demolition Drawings:

- A. Indicate altered, discontinued and removed Work:
 - 1. Location and size of existing utilities or other elements
 - 2. Extent of known conditions and materials and the extent to which these are to be maintained, modified or removed

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3. Location, size and type of existing vegetation and extent to which existing vegetation is to be removed, pruned or protected and maintained
4. Location and extent of topsoil on-site or in stockpile, indications of directions for retention, stripping, stockpiling or spreading of topsoil
5. Symbols used for the demolition Work shall be the same as those used for new construction

303.2 – Structural and Architectural Demolition:

A. Indicate altered, discontinued and removed Work:

1. Location and size of structural members
2. Methods of closing openings
3. Extent of known materials and conditions to be removed
4. Symbols used for the demolition Work shall be the same as those used for new construction
5. Allowable loads on existing structures and constraints on loading
6. Locations of dust or protection barriers, including type of barriers
7. Include Drawings and constraints of barrier construction and protection of existing Work

303.3 – Systems Demolition Drawings:

A. Indicate altered, discontinued and removed Work:

1. Fire zone interruption
2. HVAC interruption and impact on other Systems
3. Temporary Occupant Egress Pathways
4. All interruptions to vehicle traffic, bicycle, and pedestrian movement or operational activities

304 – GENERAL DRAWING CONTENTS

304.1 – General Requirements:

A. Prior to commencing design, the Project Team shall study and be familiar with all parts of the CSU Facilities Planning, Design and Construction Standards, current edition, as issued in the Project-specific RFQ/RFP.

B. Gross Square Footage:

1. All definitions of areas and measurements shall follow industry standards as defined in the 'Postsecondary Education Facilities Inventory and Classification Manual (FICM): 2006 Edition'.

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2. Gross square footage is defined as follows:
 - a. The sum of all areas on all floors of a building included within the outside faces of its exterior walls, including all vertical penetration areas, for circulation and shaft areas that connect one floor to another.
 - b. Provide gross square footage summary per floor in chart with an overall total on Project Information Sheet.
- C. All electronic documents provided by the Project Team to the Project Representative shall be readable without password, security code or hardware lock.
 1. Native format documents may be write-protected, but shall be editable without password, security code or hardware lock when saved to a different filename.
- D. All Drawings shall present all information relative to the size, form, location and arrangement of all components and Systems of the Project, as applicable per discipline.
 1. The Drawings shall indicate complete design.
- E. All key annotations shall be described in a legend on the sheet where the key occurs.
 1. The legend shall be edited on each sheet to include only those keys that appear on the sheet; unedited boilerplate legends are not acceptable.

304.2 – Sequence:

- A. All Drawings are divided into specific groups. Drawings within a group are numbered consecutively, i.e. CE.01, CE.02, etc. The group designation shall always remain the same, regardless of the size or scope of the individual Project.
- B. If specific Projects do not include Work related to a group, that group shall be eliminated from the Drawings.
 1. When appropriate, the Project Team shall coordinate with the Project Representative to vary the sequence.
- C. The following sequence should be followed in accordance with each designation:
 2. General Drawings:
 - a. G0.xx General: Cover/Title Sheet
 - b. G1.xx General: General Information, Index, Symbols, Abbreviations, Base Map, Notes
 - c. G2.xx Building Code Analysis including Energy Code Compliance
 - d. G3.xx Phasing Plan
 - e. G4.xx Staging Plan
 3. Civil Drawings:
 - a. C1.xx Civil: Demolition
 - b. C2.xx Civil: Grading and Erosion Control Plan
 - c. C3.xx Civil: Profiles
 - d. C4.xx Civil: Details
 - e. C5.xx Civil: Parking and Traffic Marking
 - f. U0.xx Utility Notes
 - g. U1.xx Utility Demolition
 - h. U2.xx Utility Plan
 - i. U3.xx Utility Profiles

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- j. U4.xx Utility Details
 - k. CS0.xx Civil Structural: Notes
 - l. CS1.xx Civil Structural: Demolition
 - m. CS2.xx Civil Structural: Plan
 - n. CS3.xx Civil Structural: Sections
 - o. CS4.xx Civil Structural: Details
 - p. CE0.xx Civil Electrical Notes
 - q. CE1.xx Civil Electrical Demolition
 - r. CE2.xx Civil Electrical and Lighting Plan
 - s. CE3.xx Civil Electrical Riser Diagrams
 - t. CE4.xx Civil Electrical Fixture/Panel Schedules
 - u. CE5.xx Civil Electrical Details
 - v. CW.xx Civil Wayfinding and Traffic Signage
4. Landscape Drawings:
- a. L0.xx Index, Symbols, Abbreviations, Base Map, Notes
 - b. L1.xx Demolition and Site Preparation
 - c. L2.xx Landscape Plans
 - d. L3.xx Plant Materials List/Schedule
 - e. L4.xx Irrigation Plans
 - f. L5.xx Power and Field Controller Plans
 - g. L6.xx Sections/Elevation
 - h. L7.xx Detailed Plans/Enlargements
 - i. L8.xx Details
5. Structural Drawings:
- a. S0.xx Index, Symbols, Abbreviations, Base Map, Notes
 - b. S1.xx Demolition, Site Work
 - c. S2.xx Foundation Plans, Details
 - d. S3.xx Framing Plans
 - e. S4.xx Elevations
 - f. S5.xx Details
 - g. S6.xx Schedules
 - h. S7.xx Special Design
6. Architectural Drawings:
- a. A1.xx Demolition, Site Plan, Temp Work, Phasing Drawings
 - b. A2.xx Plans and Key Drawings
 - c. A3.xx Detailed Floor Plans
 - d. A4.xx Sections, Exterior Elevations
 - e. A5.xx Interior Elevations
 - f. A6.xx Reflected Ceiling Plans
 - g. A7.xx Vertical Circulation, Stairs, Elevators, Escalators
 - h. A8.xx Exterior Details
 - i. A9.xx Interior Details
 - j. A10.xx Perspective and Cutaway Views
7. Signage Drawings:
- a. W0.xx: Index, Symbols, Abbreviations, Key Plan, Notes, Nomenclature, Sign Type Summary
 - b. W1.xx: University Layout Plan, Site Facilities Signage Key Plan, Roadway Signage Key Plan
 - c. W2.xx: Sign Location Plans
 - d. W3.xx: Interior Sections, Elevations

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- e. W4.xx: Sign Schedule, Color/Finish Schedule, Pictographs, Lettering Spacing and Style
 - f. W5.xx: Sign Type and Unit Details, Sign Elevations, Mounting Conditions, Graphic Layouts
8. Mechanical Drawings:
- a. M0.xx Mechanical Symbols/Abbreviations/Notes/Table of Contents
 - b. M1.xx Site Plan/Demo (if applicable)
 - c. M2.xx Mechanical HVAC Duct Floor/Roof Plans
 - d. M3.xx Mechanical HVAC Piping Floor/Roof Plans
 - e. M4.xx Mechanical Zoning/Pressure Plans
 - f. M5.xx Control System Diagrams (Mechanical Flow Diagrams, SOO, BAS Control Matrix)
 - g. M6.xx Mechanical Details
 - h. M7.xx System Schematic Riser Diagrams (Air and Water)
 - i. M8.xx Mechanical Schedules
9. Plumbing Drawings:
- a. P0.xx General Notes
 - b. P1.xx Site Plan
 - c. P2.xx Floor Plans
 - d. P3.xx Riser Diagrams
 - e. P4.xx Piping Flow Diagram
 - f. P5.xx Details
10. Electrical Drawings:
- a. E0.xx General Notes, Drawing Index, Symbols, Abbreviations
 - b. E1.xx Site Plan
 - c. E2.xx Floor Plans, Lighting
 - d. E3.xx Floor Plans, Power
 - e. E4.xx Electrical Rooms
 - f. E5.xx Riser Diagrams
 - g. E6.xx Fixture/Panel Schedule
 - h. E7.xx Details
11. Technology/Telecommunication Drawings:
- a. T0.xx General Technology Notes
 - b. T1.xx Technology Site Plan
 - c. T2.xx Technology Floor Plans
 - d. T3.xx Security Floor Plans
 - e. T4.xx Security Riser Diagrams
 - f. T5.xx Security Details
 - g. T10.xx General Telecommunication Notes, Drawing Index, Symbols, Abbreviations
 - h. T11.xx Telecommunication Site Plan
 - i. T12.xx Telecommunication Floor Plans/Roof Plans
 - j. T13.xx Telecommunication Equipment Rooms and Layouts
 - k. T14.xx Telecommunication Functional Block Interconnection Diagrams
 - l. T15.xx Telecommunication Point-to-Point wiring Diagrams
 - m. T16.xx Telecommunication Electronic and Communications Systems Riser Diagrams
 - n. T17.xx Telecommunication Conduit/Raceway Riser Diagrams
 - o. T18.xx Telecommunication System Details
12. Fire Alarm Drawings:
- a. FA0.xx General Notes
 - b. FA1.xx Site Plan

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- c. FA2.xx Floor Plans
- d. FA5.xx Details

13. Fire Protection Drawings:

- a. FP0.xx General Notes
- b. FP1.xx Site Plan
- c. FP2.xx Floor Plans
- d. FP3.xx Riser Diagrams
- e. FP4.xx Flow Diagrams
- f. FP5.xx Details

14. Foodservice Drawings:

- a. FS0.xx General Notes
- b. FS1.xx Site Plan
- c. FS2.xx Floor Plan
- d. FS3.xx Equipment Plan
- e. FS4.xx Special Building Conditions Plan
- f. FS5.xx Details

305 – GENERAL DRAWINGS AND DESIGN

305.1 – Contents:

- A. The following shall be included on the General Drawing sheets, when applicable to the specific Project.
- B. The contents listed below are not all-inclusive and the Project Team can include other relevant Drawing sheets, when applicable.
 - 1. General Project and Project Team information, vicinity map and location details, sheet index of all Drawings, architectural abbreviations used, architectural legend of symbols used, other applicable notes
 - 2. Code summary, applicable codes, zoning classification, occupancy type, type of construction, number of stories, allowable areas and building height, total building height and area
 - 3. Fire resistance rating of building elements, Fire Suppression System information, number of fire walls, shaft enclosures, fire and smoke damper information
 - 4. Gross square footage as defined in Section 304.1
 - 5. Occupant load calculations, maximum travel distance, number of exits, life safety/egress plan
 - 6. Plumbing fixture calculations
 - 7. Accessibility information
 - 8. Hazardous material information

305.2 – Plans:

- A. The Project Team shall provide floor plans indicating fire resistance ratings of walls, partitions, stairwells, roofs, and other building elements.

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- B. The Project Team shall provide floor plans indicating safety egress from the facility(s), showing blocks of occupancy types, calculated quantity of occupants, calculated egress widths and egress schemes.
- C. The Project Team shall provide floor plans showing hazardous material location and control zones, when applicable to the Project.
- D. The Project Team shall provide critical dimensions for code compliance on separate large-scale plans, as appropriate.
 - 1. For example, accessibility dimensions in restrooms.

306 – CIVIL DRAWINGS AND DESIGN

306.1 – Contents:

- A. The following shall be included on the Civil Engineering Drawings, when applicable to the specific Project:
 - 1. Benchmarks, station points, survey markers, survey datum, manholes and inverts, geometric layout
 - 2. Existing contours, final contours, grading profiles, slopes, spot elevations
 - 3. Demolition, removals, stockpiles, spoils storage and disposal, haul routes, wash out
 - 4. Existing and final drainage flowlines, drainage structures, erosion control and Stormwater Control Measures (SCM).
 - 5. Site boundaries, easements, fences, gates, structures, appurtenances, lighting, signage
 - 6. Roadways, paving, curbs, gutters, ramps, parking lots, walkways, steps, traffic control (including detour routes for all modes of travel)
 - 7. All utilities, including but not limited to water (domestic and irrigation), sewer, stormwater, natural gas, electricity, communications (fiber, copper, coaxial), steam, chilled water
 - 8. Trees, shrubs and landscaped area, protection boundaries
 - 9. Existing irrigation main lines and boxes for controls and valves
 - 10. Utility and roadway profiles and sections
 - 11. Tunnels and sleeves for existing and final utilities and irrigation
 - 12. Roof storm drainage, foundation drainage
 - 13. Soil boring or test pit logs and utility pothole data including locations and elevations (depths)
- B. Categories:
 - 1. General Civil Notes
 - 2. General Agreement Layout Plan

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3. Abbreviations and Symbols
4. Agreement Quantities Schedules
5. Soil Boring Logs
6. Typical Cross-sections
7. Roadway Alignments and Alignment Data
8. Parking Plans
9. Site Grading Plans
10. Drainage Plans and Details
11. Utility Plans and Profiles
12. Paving Plans and Details
13. Striping Plans and Details
14. Electrical and Lighting Plans and Details
15. Signage Plans and Details
16. Cross-Sections

306.2 – Plans:

- A. The Civil Consultant shall coordinate grading, paving and utility equipment with the landscape design.
- B. The Civil Consultant shall coordinate utility equipment and service lines with mechanical design at the building edge.

306.3 – Scale and Layout:

- A. Use a standard scale and divide plans into multiple sheets if necessary to minimize clutter. Always show a bar scale, do not use only text to indicate scale.
- B. Except for linear projects, north should be towards the top of the page or to the left. Linear projects shown on plan and profile sheets may have north rotated so the pipe alignment is parallel to the sheet's long side.
- C. Leave all Drawing layers turned on and shown as grayscale to help minimize conflicts.
- D. When layout is divided among multiple sheets, call out match line or match points on each sheet.
- E. Where plans and System layouts are continued on another Drawing, place a note at the point of break in the plans or Systems layouts referencing the Continuation Drawing.
- F. When clustered utilities hinder interpretation at the scale drawn, provide a separate detail referenced to the area.

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306.4 – Profile Drawings:

- A. Show profiles with exaggerated vertical scale for clarity. Use industry standard scales.
- B. Show all existing and proposed utilities, call out minimum burial depths and crossing separation distances.

306.5 – Contours:

- A. Show contours. Clearly label all control points and existing bench marks.
- B. Indicate datum used for contours and elevations.
- C. Show contours beyond Project boundaries to a distance that facilitates meeting existing grades.

306.6 – Grading:

- A. Clearly show existing grades as grayscale, and proposed lines and grades as bold.
- B. Clearly label all control points and existing bench marks.

306.7 – Erosion Control:

- A. Show construction SCM to be used at beginning of Project. Use notes and/or a separate Erosion Control Drawing to indicate expected construction SCM changes as Work progresses.
- B. Show locations and details; use standard abbreviations as in general conformance with the “Urban Storm Drainage Criteria Manual, Volume 3 – Best Management Practices”, Urban Drainage and Flood Control District, Denver, Colorado, most recent edition.
- C. Address stormwater management plan requirements in notes on Drawings.

306.8 – Drainage:

- A. Show all drainage features including slope, size, and equipment. Positive drainage away from the building must accommodate all roof drainage and site drainage without resulting in rills or erosion gullies.
- B. No drainage into or adjacent to the building foundation is permitted. Foundation or Underdrain Systems shall be shown.
- C. Coordinate with mechanical to account for and indicate any foundation drain sump pump design and discharge.
- D. Clearly show surface infiltration areas and direct-connect storm pipes. Indicate whether receiving body (pipe, ditch or river) is owned by others and indicate any coordinate required during construction.
- E. Show all permanent SCMs with details for any rip rap, orifice plates, inlet/outlet structures and other equipment and transitions.

306.9 – Utilities:

- A. Show elevation of each manhole rim and invert to nearest hundredth of foot.

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- B. Show all existing utilities in grayscale and all proposed utilities in bold lines.
- C. Show point of entry at each building edge; coordinate with mechanical.
- D. Show each utility as a different line type, include a legend.
- E. Provide details of all utility equipment, manholes, vaults, connections and crossings.
- F. Show all utility equipment details including thrust blocks, vaults, valves, connections, crossings and fittings.
- G. Show trench details and pipe penetrations. Draw all utility vaults and tunnels to actual dimension.
- H. Dimension exact spacing to the inch between underground utilities

307 – LANDSCAPE DRAWINGS AND DESIGN

307.1 – Contents:

- A. The following shall be included on the Landscape Architectural Drawings, when applicable to the specific Project:
 - 1. Location of materials, assemblies, products and accessories
 - 2. Size, thickness and significant dimensions of all landscape elements
 - 3. Relationship of adjacent dissimilar materials

307.2 – Plans:

- A. Plan View Drawings shall present the following minimum information:
 - 1. North direction arrow, located in accordance with Drawing format requirements
 - 2. Floor elevation of adjacent structures using survey datum elevations and reference elevations if applicable
 - 3. Cross reference symbols or notations to sections, elevations, detailed plans, details or other related information in the Drawings so these Drawing elements can be readily located.
 - 4. Extent and location of all proposed materials, patterns and finishes for all landscape elements shall be clearly indicated.
 - 5. Existing and proposed utility locations in relation to proposed landscaping.
 - 6. Continuation: Where plans and System layouts are continued on another Drawing, place a note at the point of break in the plans or Systems layouts referencing the continuation Drawing.

307.3 – Grading, Drainage and Utilities:

- A. The Landscape Consultant shall be responsible for coordination of the landscape design with civil grading, paving and utility construction.

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- B. Landscape plans shall indicate contours, drainage, drainage structures, paving and ALL buried utilities.
- C. Landscape details shall coordinate aesthetic treatment of drainage and utility elements.

307.4 – Irrigation Plans:

- A. Irrigation plans shall present the following minimum information:
 - 1. Irrigation Drawings shall present all necessary information to show location and/or routing of all landscape Irrigation System components, including but not limited to: spray and rotor heads, non–pressure (lateral) piping, drip tubing, electric control valves, air relief valves quick coupling valves, isolation gate valves, pressure regulating valves, pressure (mainline) piping, effluent distribution piping, backflow preventers, master valves, water meters, point of connection and service line, field controllers, chemical/fertilizer injection assemblies, sleeving.
 - 2. If As–Builts are available or existing System has been surveyed, irrigation demolition plans shall be created.
 - 3. Location and size of all proposed System components including controllers
 - 4. Routing and sizing of all piping
 - 5. Description of requirements for point(s) of connection
 - 6. Description of field controller installation including electrical source and controller size
 - 7. Locate and show all buried utilities on proposed plans
 - 8. Locates for all buried devices shall be dimensionally located on Record Drawings.

307.5 – Irrigation Schedule:

- A. Schedule shall be structured in columns showing from left to right, the component or piping symbol, Manufacturer, model number, description of item, and appropriate detail number(s).
 - 1. Model number, Manufacturer and nozzle size for all spray and rotor heads
 - 2. Class of schedule and material type for all piping
 - 3. Manufacturer and model number of all System components

307.6 – Key Symbols:

- A. Electric control valves shall be labeled with industry standard symbol indicating valve size, controller and station number, and designed flow rate in gallons per minute
- B. Pressure setting of all regulating valves
- C. Location of all trees located within irrigated turf area
- D. Specific irrigation notes as required communicating design and installation intent
- E. Location and description of existing components, piping or conditions

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F. Construction notes describing any special irrigation conditions

1. Designed static water pressure

307.7 – Sections:

A. Sections and elevations shall be provided to indicate the correct vertical relationships, size and location of the landscape components.

307.8 – Details:

A. Construction details shall illustrate installation of all landscape planting, mulching, hardscape and irrigation components.

B. Details shall identify all required assembly parts, sizes and dimensions.

C. Details shall be numbered and appropriately keyed with overall landscape and irrigation plans and schedules.

308 – STRUCTURAL DRAWINGS AND DESIGN

308.1 – Contents:

A. All structural materials shall be defined with dimensions, sizes, and locations.

B. Structural Drawings shall be coordinated with other disciplines and shall include penetrations and other accommodations required for installation of other Systems.

C. Live load, dead load, snow load (including drift loading), wind load and equipment load design data shall be placed on the Structural Drawings for all areas of the building.

308.2 – Foundation Plans:

A. Foundation plans shall indicate location, size and type of foundations supporting the building.

B. Plan views shall locate supported columns, grade beams, basement walls (if any), location and size of footings, drilled piers (caissons) and piles, equipment pedestals, interior flatwork and any other items that are part of the foundation.

C. Cross sections and details shall be provided to show dimensions and shapes of all concrete items not completely defined in plan.

1. Show number and location of drilled piers (caissons) and piles (if any) along with type, size, and length.

D. Show reinforcing bars, anchor bolts and other embedded items, joints and penetrations. Give material properties for concrete, reinforcing steel and all other parts of foundations.

E. Foundation Plans shall indicate all required penetrations and references for any modifications to reinforcing or structure required for penetrations.

308.3 – Structural Steel Framing:

A. Show framing for each floor level, and elevations (top of steel) for all members.

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1. Locate all beams with respect to column lines or grid lines and give sizes.
 2. Locate all support points for equipment, posts, hangars, stairs, etc.
- B. Cut sections referring to structural steel details are required.
1. Define by notes all grades of steel used, types and sizes of connections (with details as required) designed by Engineer and refer to all standard Drawings, charts, tables, notes, etc. for information required to construct a safe and complete Floor System.

308.4 – Floor Plans:

- A. Show all plan dimensions of floor.
- B. Give outer limits, location and size of openings, elevations for all areas, floor types (concrete, grating, floor plate, etc.) and thickness, equipment supports, and any other items to be incorporated in the floor construction.
- C. Cut sections and indicate details shown on same or other sheets to show edge details, equipment pedestals, reinforcement, anchor bolts and all miscellaneous embeds.
1. Define reinforcement grades and sizes, bar grating or floor plate sizes and details, locate and dimension all floor construction joints, reinforcement lap, splices as required.
 2. Define and locate all penetrations including dimensions.
 3. Define all steel decking, whether used as concrete form or otherwise.
 4. Give material properties required for all concrete, steel, floor topping, or other materials used.
 - a. Each member must be drawn.
 - b. Notations such as “18 joist @ 4’-0” oc” are not acceptable due to the requirement to provide Composite Drawings.

308.5 – Roof Plans:

- A. Define all plan dimensions and openings as for floors.
- B. Give top of steel elevations, sizes and locations of all beams, purlins, and joists. Define roof type (concrete, steel deck, etc.)
- C. Provide framing as required around openings.
- D. Give loading requirements for steel deck roofs, such as live load, wind uplift, and attachment to framing for diaphragm action.
- E. Define roof slope and locate drains.
- F. Locate support points for all roof-mounted equipment such as HVAC equipment, tanks, etc.
1. Each member must be drawn.
 2. Notations such as “18 joist @ 4’-0” oc” are not acceptable due to the requirement to provide Composite Drawings.

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308.6 – Elevations and Wall Sections:

- A. Show all columns, beams, bracing on column lines.
- B. Size columns and bracing. Give size for all struts and beams not shown on floor plans.
- C. Show framing at doors, windows, etc.
- D. Provide details for any non–standard connections.
- E. On exterior walls, show Girt System.
 - 1. Show sizes, spacing, and locate sag rods.
 - 2. Detail special girts, parapet construction, framing around openings, etc.
 - 3. Coordinate types and sizes of siding with Architectural Drawings.

308.7 – Details, Schedules and Tables:

- A. In lieu of detailing repeated identical items on all views where they occur, design typical details on detail sheets and refer to them by letter or number designations.
 - 1. Include references to pertinent codes and standards.
 - 2. Give design criteria and loads as required.
 - 3. Show details to be used for treatment of concrete edges, joints, penetrations, and anchor bolts.
 - 4. Detail handrails and ladders and their anchorage to structure.

308.8 – Column Schedules:

- A. Show location and size of columns used.
- B. Detail splices and base plates, showing shear bars, anchor bolts, grout and any other required features.

308.9 – Bracing Connections:

- A. Show typical details for diagonal bracing.
- B. List all combinations of vertical, horizontal and diagonal connections between braces, beams and columns and reference by letter or number designations to plans and elevations.

308.10 – Beam and Joist End Connections:

- A. Detail typical connections, showing required tolerances, edge distances, pitch, gage, etc.
- B. Show manner of designating connections on plans.
- C. Provide list of connections to be used for given beam sizes when typical.

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308.11 – Non–Standard Connections:

- A. Detail all non–standard (atypical) connections on the detail sheets except where shown on Plan or Elevation Drawings.

308.12 – Stair Details:

- A. Show plan and elevations for all stairs, with riser and tread dimensions.
- B. Show reinforcing for concrete stairs.
 - 1. For steel stairs, show all member sizes, connections, bracing and supports.

308.13 – Girt Details:

- A. Show all girt bracket types, sag rods and joints between girt sections and all connections. Detail special built–up girt sections.

308.14 – Miscellaneous Details:

- A. Show details for all welded girders, trusses, built–up members, and assemblies used.
 - 1. Show all necessary views of crane girders, crane columns, and brackets and attachment to building, crane stops, clearance requirements, and dimensions relative to building column lines and elevations.
- B. Provide details for fabrication of floor plates, floor bracing and all other miscellaneous items to be installed by the Project Team.

308.15 – Welding, Bolting and Other Connections:

- A. The Project Team shall design all connections, including welded connections.
- B. All welds shall be defined using standard ANSI/AWS symbols, designating location, type, dimensions (size, root, length, pitch), preparation, backing, penetration, finish, etc.
 - 1. Joint configurations shall be detailed on a Project–specific basis covering all possible scenarios.
 - 3. The Consultant shall assure that the weld symbols are appropriate to the joint and that welding and inspection of the assembly shall be feasible.
- C. All bolted connections shall be annotated with the type of joint and the ASTM designation, type and size of bolt to be used.
 - 1. The Consultant shall assure that the bolting and inspection of the assembly shall be feasible.
- D. Special connectors and anchors shall be defined by type and size on the Drawings. Complete specification and installation data shall be written in the Specifications.

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308.16 – Structural Design:

A. Vibration Standards:

Vibration Requirement Table for Floor Systems

Space Type	vibration structural dynamic criteria, micro–inches, peak to peak maximum total motion (vertical)	Typical center bay minimum static stiffness that shall meet vibration structural dynamic criteria pounds/inch
Laser/Nanotech Labs	100	1,000,000
Research Labs	300	400,000
Classrooms, Offices	1000	100,000

B. Structural engineering calculations may be required to validate that proposed Floor Systems provide the required static stiffness.

1. Dynamic analysis of all component parts involved should use a time–history of total floor vibratory motion.
2. Vibration due to such impulses and excitations are often five to ten times greater than those due to ambient excitations from rotating machinery imbalance.

C. Structural and vibration design should consider the influence of all relevant sources of vibration, including but not limited to:

1. Human activity: footfall, cart excitations, door operation, amplified audio
2. Mechanical Systems and machinery imbalance
3. Mass movement of air and water in Building Systems
4. Wind and traffic

D. Performance to the more stringent criteria may require designs to control, isolate and transfer vibration forces from Mechanical Systems or mass fluid movements independent of the building structure.

309 – ARCHITECTURAL DRAWINGS AND DESIGN

309.1 – Contents:

A. The following items shall be included on the Architectural Drawings, when applicable to the specific Project:

1. Location of materials, assemblies, products, and accessories
2. Size, thickness, and significant dimensions of all building elements
3. Gauges, except for prefabricated and assembled units
4. Diagrams of specially fabricated connections
5. Relationships of adjacent dissimilar materials

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6. Soil boring or test pit logs including locations
 7. Gross and assignable square footage of the building, broken down by room, floor and wing.
- B. All Schedules shall be placed in the Specifications unless otherwise approved by the Project Representative.
- C. All symbols and abbreviations used in the Architectural Drawings shall be in a legend in the A0.xx Drawing group.
1. The legend shall be edited to include only those symbols and abbreviations that appear in the Drawings; unedited boilerplate legends are not acceptable.

309.2 – Room Numbering Standard:

- A. The Project Team shall follow the CSU Room Numbering Standard.
- B. Any changes to the numbering shall be submitted for approval by Facilities Management (FM).
- C. The Project Team shall give particular attention to assuring all sub consultants receive and use the approved room number layout and any subsequent changes for all Drawings and schedules.
- D. All rooms, including building service rooms, are assigned a room number according to the CSU Room Numbering Standard:
1. Room numbers are three digits with the first digit corresponding to the building's floor level. Floor number 1 shall be the lowest most level entered at grade or one-half flight above grade.
 - a. Exceptions:
 - i. Basement numbers shall have three digits running from 001 to 099.
 - ii. Buildings with more than ten levels above ground shall use five digits for the room number, with the first two digits indicating the floor level.
 - b. For example:
 - i. Basement 001 to 099
 - ii. 1st floor 100 to 199
 - iii. 2nd floor 200 to 299
 - iv. 10th floor 1000 to 9999
 2. Start at the main entrance. Room numbering shall begin at the main entrance to a floor, and each floor shall be numbered similarly.
 3. Numbers should be reserved for future room divisions.
 4. The room numbers on both sides shall increment as appropriate so rooms across from each other have matched order numbers, even and odd.
 - a. This allows for large rooms to be renovated into multiple smaller rooms allowing the new room numbers to be assigned without reassigning large sections of the floor.
 5. Proceed clockwise. If this is not possible due to the architectural design of the building, the numbering shall proceed in a logical progression.
 6. Prefixes:
 - a. Non-assignable Space:
 - i. Building circulation space shall always be preceded with an 'N' (non-assignable space).

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- ii. Building circulation consists of corridors, stairs, elevators, etc.
 - a) For example, N104 (non–assignable/circulation space)
 - b. Building Wings:
 - i. Buildings with more than 99 rooms on a single floor shall be separated into wings.
 - ii. Wings are indicated by alphabetic prefixes and shall be the first character of the assigned room number.
 - iii. Wing prefixes are assigned when the architectural design of a building dictates.
 - a) For example, E (for east), W (for west), or A, B, C, etc.
 - b) Note that an ‘N’ would not be used for a North wing because it would be confused with the ‘N’ used for non–assignable space.
 - c. Main and Intermediate Distribution Frame Rooms (MDF/IDF):
 - i. MDF/IDF rooms shall have a prefix of T.
 - ii. The room number shall follow the sequence of the rooms without a prefix.
 - a) For example, 201, T202, 203, etc.
- 7. Rooms entered from a main building hallway shall not be assigned a suffix.
- 8. Rooms entered from a secondary hallway or from within a room are assigned the same room number as the room it is entered from but with an alphabetical suffix attached, i.e., A, B, C, etc.
 - a. For example:
 - i. 124 (first floor room 124)
 - ii. EN1035 (building circulation space 1035 in the East Wing of the tenth floor)
 - iii. E306A (room 306A off of room 306 in the East Wing)
- 9. Labs are often grouped in clusters and therefore are better identified as suites with one number for the main area or entrance room and prefixed numbers for the adjoining rooms.
- 10. All re–numbering of renovated rooms shall be consistent with the existing numbering in adjacent spaces.
 - a. When the existing numbering is not consistent or is confusing, room numbers shall be assigned to renovated rooms to keep with the intent of the CSU Room Numbering Standard yet allow for a reasonable best solution.
- 11. Assignment Responsibility:
 - a. Initial assignment:
 - i. Room numbers are assigned by the Project Team for newly constructed buildings and remodels, or can be assigned by FM Space Management.
 - b. Final approval:
 - i. During the Schematic Design Review per the Design Review Process, the Project Team shall submit a room number layout for review and approval
- 12. The usage of each room should be indicated on the Drawings.
 - a. For example: Office, Restroom, Classroom, Telephone Room, etc.
- 13. Electronic computer aided Design Drawings of each floor plan shall be sent to FM Space Management prior to the final walk–through.

309.3 – Floor Plans:

A. Plan View Drawings shall present the following minimum information:

- 1. North direction arrow at top of Drawing if feasible, otherwise as Drawing constrains

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2. The floor elevation shall be keyed to CSU geographical database in at least one location on each floor plan. The elevation shall be clearly defined as finish floor or elevation of structural floor.
3. Identify and indicate the correct horizontal relationship, size and location of all components. Avoid repeating dimensions that are already on large-scale Drawings.
4. Cross reference symbols or notations to sections, elevations, insert plans, larger scale plans diagrams and other Drawing details. Identify type for all partitions.
5. Provide graphic scale for each plan view
6. Room numbers and functional room titles

309.4 – Reflected Ceiling Plans:

- A. Reflected Ceiling Plan Drawings shall delineate all Systems including but not limited to materials, soffits, ceilings, partitions, exterior walls, columns, lighting, sprinklers, monitoring devices, diffusers, grilles, registers, signage and furring elements.
- B. The reflected ceiling plans shall carry the same minimum information listed above.

309.5 – Roof Plans:

- A. Provide roof plans that indicate all penetrations and components of other disciplines including but not limited to lightning protection, Mechanical, Electrical, Plumbing, Access Systems and Communication Systems.
- B. Indicate traffic pads from all access points to and around roof mounted equipment, roof drains and areas requiring maintenance and access.
- C. Show stormwater flow directions, crickets, flashings and materials. Roof plans without these indications are not acceptable.

309.6 – Continuation:

- A. Where plans and System layouts are continued on another Drawing, place a note at the point of break in the plans or Systems layouts referencing the continuation Drawing.

309.7 – Sections:

- A. Sections shall completely define the character of all construction elements.
- B. Above or below grade elevations shall be keyed to the CSU geographical database.
- C. The Project Team shall provide design of each type of detail.
 1. The Project Team shall not use notes such as "similar to".

309.8 – Partition Types:

- A. The Project Team shall provide edited partition Drawings for every partition type in the Project.
 1. The Project Team shall not show partition types that are not in the Project or boilerplate partition sheets.

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309.9 – Exterior Elevations:

- A. Exterior elevations shall show all exterior planes of new or modified construction, and shall include all other Systems and profiles including but not limited to Civil, Landscape, Mechanical, Electrical, Plumbing, Fire Suppression, Lighting, Communications, Lightning Protection, Fences, Signage and Access Systems.
- B. Indicate the correct vertical relationships, size, and location of all components.

309.10 – Interior Elevations:

- A. Interior elevations shall show all interior plans of new or modified construction, and shall include all other Systems installed in or on the surfaces.

309.11 – Material Definition:

- A. Different materials shall be delineated to clearly define separation of materials.

309.12 – Demolition Plans:

- A. Demolition Drawings shall indicate altered, discontinued, and removed Work where extensive removal and/or demolition operations are required.
- B. Demolition Drawings shall include but not be limited to:
 - 1. Location and size of structural members
 - 2. Methods of closing openings
 - 3. Other information indicating the extent of known materials and conditions to be removed
 - 4. Symbols used for demolition work shall be the same as those used for new construction
 - 5. Complete design and detailing of Systems interruptions and protection of adjacent or affected Systems and operations from damage due to construction activities.
 - 6. Dust, fume, odor and noise control boundaries and details

309.13 – Interference Drawings:

- A. Composite Drawings:
 - 1. For 2–dimensional projects without Building Information Modeling (BIM), the Project Team shall coordinate and prepare Composite Drawings showing all disciplines on one Drawing.
 - 2. Each discipline shall be identified by a specific color.
 - 3. Show ceiling cavity spaces, utilities and structure.
 - 4. One set of plots shall be submitted to the Project Representative.
 - 5. The Project Team shall ensure that the Project Systems are completely coordinated and that no designed interferences exist.

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6. This includes conduit routings, roof drain lines, Sprinkler Systems, etc.

B. Interference Modeling:

1. For projects using Building Information Modeling (BIM), the Project Team shall use clash detection software to provide clash schedules and views.
2. Provide clash detection report to Project Representative once conflicts are resolved.

309.14 – Perspective and Cutaway Views:

A. The Project Team shall provide perspective and cutaway views of complex spaces and details to clarify the design.

1. These may be placed adjacent to relevant areas of Plan, Section and Elevation Drawings, on detail sheets or collected on A10.xx sheets as referenced Drawing details.

B. New buildings, major revitalizations and additions that are completed with BIM shall include Axonometric Drawings of the completed and coordinated model taken at the NW, NE, SW and SE orientations.

309.15 – Schedules:

A. Tabular schedules shall be created as spreadsheets, inserted into Drawings and separately included in the Written Report.

B. Partition Schedule

C. Opening Schedules (Doors, Windows, Glazing)

D. Finish Schedule

E. Hardware Schedule

F. Equipment Schedule

309.16 – Energy and Sustainability:

A. Unless otherwise determined by the Project Representative, the Project Team shall prepare as part of its Scope of Work:

1. Energy Code Compliance Drawing:

- a. The Construction Drawings shall show the energy factors, loads and calculation methods used to demonstrate compliance with the current Office of the State Architect (OSA) adopted edition of the International Energy Conservation Code (IECC).
- b. For larger projects, this may require an entire Drawing sheet (G2.xx).

2. Sustainable Design Report:

- a. In the Written Report, the Project Team shall identify relevant energy and resource conservation issues, strategies for achieving moderate, high and extraordinary levels of conservation performance and feasibility of incorporating these strategies into the Project.
- b. The Sustainable Design Report shall be included as an individual section in the Written Report for each design phase. Prior to submitting the report, the Project Team shall meet with the Project Representative to review the submittal requirements.

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- c. The Project Team may extract Drawings or sketches developed for submittal in the various design phases for use in the Sustainable Design Report. Mark-up and annotation of the documents may be included as part of the submittal.
 - d. Where the Project seeks certification by United States Green Building Council (LEED) or similar independent third-party verification, the Project Team shall submit the required information in compliance with the third-party submittal guidelines.
3. Utility Incentive Program Summary:
- a. The Project Team shall prepare energy design submittals as required for the relevant incentive programs including but not limited to Fort Collins Utilities, Platte River Power Authority, Xcel Energy and other resource utilities.
- B. At minimum, the Energy Code Compliance Drawing shall include:
1. Documentation of compliance method used from the current OSA adopted edition of IECC and/or ASHRAE 90.1–current edition.
 2. Calculation factors and loads in compliance with ANSI/ASHRAE/ACCA Standard 183–2007, *Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings*, including but not limited to:
 - a. Envelope factors (R-value, U-Factor, Solar Heat Gain Coefficient SHGC)
 - b. Lighting loads
 - c. Equipment loads
 - d. Occupant loads (including both hot and cold water usage)
 - e. HVAC Energy Efficiency Ratios (EER and SEER)
 3. COMcheck Summary (US Department of Energy)
 4. Fenestration certification requirements

310 – MECHANICAL (HVAC) DRAWINGS AND DESIGN

310.1 – Contents:

- A. Mechanical Drawings delineate equipment, materials, components, ductwork, piping and accessories to convey liquids, gases, air and control data for Heating, Ventilation and Air Conditioning Systems (HVAC).
- B. The Drawings shall indicate complete design.
- C. The Drawings establish the requirements for construction of the facility design, including pertinent services, equipment, and other features required for the performance of the mechanical equipment.
- D. The Drawings incorporate dimensions, symbols, reference to codes, conventions, schedules, diagrams, etc., in describing the size and routing of pipes, the kind of material to be used, equipment criteria, duct sizes and shapes, amount of flow and the temperature of material in pipes and ducts, valve types and location, floor and wall penetrations, tank construction, equipment, piping insulation, and other facets of mechanical design as are required.

310.2 – Mechanical Flow Diagrams:

- A. Flow diagrams are schematic illustrations of piping or duct circuits including equipment, components, sensors and control devices involved in the Mechanical System.

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- B. The purpose of flow diagrams shall be to define a Mechanical System with respect to flow directions, component sizes, control functions, sequence of operation and flow balances.
- C. Flow diagrams form a basis for detail design Drawings, construction and installation.
- D. Flow diagrams shall be submitted with the Schematic Design phase submittal or as a separate submittal before the halfway point of Design Development.
- E. Mechanical flow diagrams shall be required to illustrate the following:
 - 1. All HVAC Systems
 - 2. HVAC Air Flow
 - 3. Hydronic Piping Systems
 - 4. Building Automation Systems
- F. The need for additional flow diagrams shall be determined on a project-by-project basis by the Design Engineer (supervisory) or Project Representative.
- G. The need for additional flow diagrams shall be based on the complexity of piping the Mechanical System.

310.3 – Flow Diagram Requirements:

- A. General Requirements:
 - 1. All piping, ductwork, and equipment shall be represented on flow diagrams in schematic form.
 - 2. Accurate depiction of physical relationships is essential for clarity, e.g., a vessel with connections located on top, bottom, and sides should appear on the flow diagram with connections shown in approximately the same relationship.
 - 3. Piping specialties and special features shall bear a reasonable resemblance to the actual items or installations.
- B. Flow Direction:
 - 1. A flow direction arrow shall appear at each line junction or change of direction in order to illustrate the flow direction clearly.
- C. Limits of Construction:
 - 1. Purchased equipment packages, which are pre-assembled or pre-piped, shall be so designated with a dashed line to indicate the limits of the Vendor-supplied portion.
- D. Instruments and Controls:
 - 1. Symbols used to represent instruments and control loops shall be defined in a legend on the Drawings.

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E. Set Points:

1. Set points for relief valves, limit switches, control valves, dampers and operating temperatures shall be indicated.
2. Failure positions shall be called out for control valves and dampers (fail open, fail closed).
3. Other instrument set points or operating control points shall be called out as appropriate to aid design and construction.

F. Sequence of Operation:

1. For complex Systems or those Systems controlled by Direct Digital Control (DDC), a written logic description shall be added to the flow diagrams and included in the Project Technical Provisions of the Specifications.

G. Operating Controls:

1. Consideration shall be given to all anticipated operating conditions, including start-up and shutdown.
2. Flow diagrams shall show bypasses, and any valves, controls, etc., required for any anticipated operating condition.

H. Identification Tags:

1. The type of point shall be shown on the control instrument in the mechanical flow diagrams.

I. System Points List:

1. A matrix showing the Point Description (e.g. Discharge Air Temperature), Point Name (e.g. DA-T) Point Type (e.g. AI) and Remarks shall be on the same page as the mechanical flow diagram.
2. The point name shall be provided by the CSU Building Automation Services group.

J. Existing System Tie-in:

1. When new Mechanical Systems are to be tied into existing Systems or Systems being designed by others, each tie-in shall be identified on the Drawings by a hexagon symbol bearing a unique tie-in number.
2. The Project Team shall include a list of tie-ins on the Drawings as required for the Project.
3. The tie-in schedule shall note the tie-in number, piping, ductwork or other service, and the extent of interruption required to affect each tie-in.
4. This schedule shall be used to help coordinate construction with normal operations in order to minimize unscheduled down time.

K. Symbols:

1. Symbols used on flow diagrams for valves, instruments, and accessories shall conform to standards established by the legend.

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L. Gravity Drainage:

1. When a specific service requires positive gravity drainage, arrows and notes on the flow diagram shall illustrate the slope required.

M. Service Diagrams:

1. On all Systems requiring natural gas service, compressed air or other types of pressured Systems, provide as part of the Construction Documents flow diagrams indicating demand loads.
2. An example may be a flow diagram indicating gas service with regulator size, and inches of water demand calculations for each element or devices to be served by the gas service.
3. Include identification at each device the range of pressures acceptable for start-up, testing and operation of the device.

310.4 – Drawings for Piping:

A. Piping Drawings shall delineate the components required to convey the fluids.

B. Drawings shall be completely coordinated with other disciplines and existing Systems to ensure no conflicts occur in the documents.

C. Piping Drawings, or a set of Piping Drawings, delineate the kind, size, and routing of pipe, hose and tubing, the associated vessels and equipment, and other facets of mechanical design by incorporating dimensions, symbols, codes, conventions, schedules and diagrams.

D. When flow diagrams are required, they shall be completed prior to commencement of detail Piping Drawings.

E. The following rules shall be followed in the delineation of Piping Drawings:

1. Exposed pipe shall be shown as a single thick line and hidden, or buried pipe shall be shown as a thick dashed (hidden) line; however, in order to delineate clearances and special conditions, 6" and larger pipe shall be shown using a double line, drawn to scale, and showing the actual pipe dimensions.
2. When new and existing pipe and/or equipment is shown on the same Drawing, existing pipe and equipment shall be shown using a hidden line.
3. Pipe shall be identified as to size and service code (fluid in pipe).
4. Valve stems, hand wheels, etc., even though shown symbolically, shall be drawn to scale where a clearance problem may exist or where removal or operation may be critical.
5. The scale used for Piping Drawings shall be as follows:
 - a. General site routing plans:
 - i. 1/10" to 1/20" = 1'-0"
 - b. Piping plans (including double line piping):
 - i. 1/8" to 1/4" = 1'-0"
 - c. Sections and details:
 - i. 1/4" to 3/4" = 1'-0"

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- F. Pipe mains and branches shall be dimensionally located from the facilities structure, such as column lines, walls, ceiling, equipment, supports, etc., or from recognized bench marks; as required or justified by complexity or space constraints.
- G. Pipe(s) shown in elevation or section shall have their centerline or bottom of pipe elevations given above or below grade or floor elevation to a reference datum plane.
 - 1. All pipe elevations shall be identified on the Drawings and piping coordinated with other items vertically.
- H. When draining of horizontal lines is required or drip stations are called for, the slope in lines shall be called out by an arrow placed adjacent to the applicable line.
- I. Indicate slope in fraction of an inch per foot or the elevation given at both ends of the slope.
- J. Use line designations when more than one System or service is delineated on the Drawing.
- K. Call out line designations when pipe or tubing runs are grouped close together.
- L. Guides, anchors and expansion compensators shall be located and described.

310.5 – Drawings for Air Handling:

- A. HVAC Drawings delineate the components required to supply, move air by natural or mechanical means. Such air may or may not be conditioned, i.e., filtered, tempered and/or humidified.
- B. The delineation for these Drawings shall incorporate dimensions, symbols, codes, conventions, schedules, diagrams, etc., in describing the ducts blowers, filters, heating or cooling coils, roof exhausts, grilles, dampers, air conditioning units, pumps, and controls, ducts and equipment.
- C. The Drawings shall be completely coordinated with all other design disciplines to assure that there are no design or physical conflicts and that the Systems can be installed as delineated.
- D. HVAC Systems and Piping Systems for HVAC Systems may be combined on the same set of Drawings where practical and prior acceptance from the Project Representative has been issued.
 - 1. 310.3 – Flow Diagram Requirements and 310.4 – Drawings for Piping shall apply to the HVAC Drawings as needed.
- E. The following Drawing Delineation guidelines shall apply when detailing these Drawings:
 - 1. Drawings shall be prepared showing routing of ducts and piping and location of ducts, grilles, and required ventilation, exhaust, and/or air conditioning equipment.
 - a. The preferred scale for arrangements is 1/4" = 1'-0".
 - b. To aid in checking Drawings and resolving potential interferences among other components, such as piping, electrical, architectural, etc., the heating, ventilation, and Air Conditioning Drawing shall be prepared to the same scale as these other Drawings, where feasible.
 - 2. Duct layouts shall include grille sizes, cubic feet per minute (CFM), splitters, outlet control dampers, elbows, access doors, branches, volume control dampers, louver openings, booster heating equipment, test holes, and other miscellaneous components equipment and controls.
 - 3. When duct sizes are given, the first dimension is the side shown,

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- a. For example, 20" x 12" – the 20" dimension is the width and the 12" dimension is the depth where the duct is shown in plan.
4. Material for ducts, gauge of metal, type and spacing of joints and reinforcements, type and spacing of hangers, angle or change in size transitions, and cross bracing shall be covered in the Specifications.
5. Direction of flow shall be indicated by an arrow.
6. All parts such as coils, fans, dampers, filters, housings, compressors, and miscellaneous items shall be called out on the Drawing.
 - a. A schedule may be employed for this purpose.
 - b. A schedule lists the type, size, capacity, speed, pressure, type enclosure, fins per inch and rows, and other pertinent components in tabular form.
7. Direct Digital control diagrams for heating, ventilation, and Air Conditioning Systems shall show:
 - a. All controllers, sensors, thermistors, valves and damper actuators, relays, and accessories necessary to illustrate the functions and sequence of operation of all principal components in the System.
 - b. The set point of all control points.
 - c. The normally open or closed position of all valves and dampers.
 - d. The sequence of operation of the System through a complete winter–summer cycle, including the off and fire alarm conditions.

310.6 – Mechanical (HVAC) Design:

A. Vibration Standards:

1. Sources of vibration include machinery and mass movement of fluids.
 - a. Refer to Division 23 – HVAC.

B. Fans and other rotating machinery shall be designed with rigid frames mounted directly to structure.

1. Spring–mounts for fans are prohibited.

C. Building vibration performance criteria are presented in Section 308 – Structural Drawings and Design.

1. The Mechanical Engineer and Structural Engineer shall collaborate to assure the vibration performance criteria are met.
2. Performance to the more stringent criteria may require designs to control, isolate and transfer vibration forces from Mechanical Systems or mass fluid movements independent of the building structure.

D. Field Investigation:

1. CSU maintains an archive of Project Drawings from past Projects. However, CSU has not compiled Projects over time to maintain current, Conformed Building Drawings.

E. In addition, correspondence of the record documents to the actual construction performed is not assured, and subsequent modifications may not have been recorded.

1. The Mechanical Engineer shall study the available Drawings and be responsible for adequate field investigation to identify and verify critical dimensions, clearances and connections to existing

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Systems, especially where concealed to casual inspection during the limited time available to prospective bidders during a pre-bid site visit.

F. Design Overview:

1. The Mechanical Engineer shall be responsible for facility program analysis to determine the intent and objectives for heating, cooling, relative humidity, pressure gradient, etc. required by those programs that are applicable to the Project, such as LEED, BSL-3, FDA 21 part 11, etc.

G. Specific Sequencing:

1. The Mechanical Engineer shall design the specific sequencing required to assure controlled environments are stable, can be monitored and controlled.

311 – PLUMBING DRAWINGS AND DESIGN

311.1 – General Requirements:

- A. Plumbing Drawings shall delineate pipes, equipment, materials, components and accessories to convey liquids and gases, other than those used for HVAC Systems and for Fire Suppression Systems.
- B. The Construction Documents shall indicate complete design.
- C. 310.3 – Flow Diagram Requirements and 310.4 – Drawings for Piping shall apply to the Plumbing Drawings as needed.

311.2 – Plumbing Flow Diagrams:

- A. Plumbing flow diagrams shall illustrate the following:
 1. Plumbing waste and Storm Drainage Systems
 2. Plumbing Hot and Cold-Water Supply Systems
 3. Process Systems; Chemical Feed Systems
 4. Steam Piping Systems
 5. Gas Piping Systems
 6. Compressed Air and Specialty Gases Piping Systems
 7. Fuel Systems
 8. Automation and temperature controls for these Systems

311.3 – Drawings for Plumbing:

- A. Plumbing Drawings shall establish procedures for construction of the Plumbing System design, including pertinent utility connections, fixtures, equipment and piping.
 1. The delineation for these Drawings shall incorporate dimensions, symbols, codes, conventions, schedules, diagrams, etc., in describing the Plumbing System design.

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- B. Drawings shall be prepared showing routing of the conveyed fluid or gas piping.
1. The preferred scale for arrangements is 1/4" = 1'-0" to aid in checking drawings and resolving potential interferences among other components, such as ductwork, electrical equipment, etc.
 2. The Plumbing Drawing shall be prepared to the same scale as the drawings of the other disciplines, where feasible.
- C. Plumbing Drawings shall include pipe sizes and routing, direction of flow, valves, service locations, schedules of fixtures, equipment and valves, invert elevations for gravity drainage piping, and locations for vent piping roof penetrations.
- D. Materials for piping, insulation, valves, fixtures and equipment shall be covered in the Specifications of Division 22 – Plumbing.
- E. An isometric diagram shall be provided for each Piping System to five feet outside the building, with pertinent invert elevations indicated for gravity drainage.
- F. The Drawings for each Plumbing System shall include Load Charts for fixtures and equipment.
- G. Domestic Water:
1. Domestic Water Plumbing Drawings delineate the components required to supply domestic hot and cold water to plumbing fixtures and then to remove this water after use through a Sanitary Drainage and Vent System.
 2. Pipe Routing Drawings and isometric diagrams shall be prepared for domestic cold, hot water, re-circulating hot water, sanitary drainage and Vent Piping Systems.
 3. Indicate locations of water meters, water heaters, valves, cleanouts and tie-in locations for connection to water and sanitary utility services. Include invert elevations.
 4. Itemize all plumbing fixtures in a schedule(s) on the Drawings. The schedule shall list the type of fixture, water usage rate and connection sizes of hot, cold, sanitary and vent piping.
 - a. Water heaters may be scheduled in cases where several are required.
 5. Automatic (infra-red) lavatory valve operators and flush valves shall be coordinated with the Electrical Engineer and shown on the plumbing Drawings.
- H. Industrial Water:
1. Industrial Water Systems shall be delineated separately from Domestic Water Systems to avoid confusion and potential cross-connection.
- I. Stormwater (Roof Drains):
1. Roof drain plumbing plans shall be coordinated with architectural roof taper plans. Discharge locations shall be coordinated with landscape plans and paving plans.
- J. Reclaimed Water:
1. Reclaimed water requires special review and authorization by Project Representative and FM Engineering before proceeding beyond the conceptual phase.

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K. Deionized Water:

1. Standalone Systems at point of use are preferred. Central Building Systems must be recirculated back to source and have no dead legs.

L. Chilled Water:

1. Provide Building Cooling System schematic sheet, showing the following but not limited to equipment, coils, isolation valves, control valves, pumps, variable frequency drives (VFD), meters, temperature sensors, accessories, etc.
2. Provide a separate schematic for significant Cooling Sub-Systems.
 - a. For example, a process cooling loop serving lab equipment
3. Provide a schedule listing all of the design cooling loads in the building, by equipment, and a tallied design load for the building as a whole, including any assumed method for load diversity, if used.

M. Natural Gas and Fuel:

1. Provide a schedule listing all of the design gas loads in the building, by equipment, and a tallied design load for the building as a whole, including any assumed method for load diversity, if used.
2. Concealed gas or fuel pipe shall be Schedule 40 black iron with no concealed mechanical connections.

N. Steam:

1. Provide Building Steam and Heating System schematic sheet, including but not limited to equipment, coils, isolation valves, control valves, pumps, VFDs, meters, temperature sensors, accessories for both the steam and hydronic portions of the System, etc.
2. Provide a separate schematic for significant Steam or Heating Sub-Systems.
 - a. For example, a process steam distribution which supplies lab autoclave equipment
3. Provide schedule listing all of the design heating and process loads in the building, by equipment, and a tallied design load for the building as a whole, including any assumed method for load diversity, if used.

O. Compressed Air and Specialty Gases:

312 – ELECTRICAL DRAWINGS AND DESIGN

312.1 – General Requirements:

A. The Drawings shall indicate complete design.

B. The Electrical Drawings, in association with the Construction Specifications, shall:

1. Furnish sufficient information to permit installation of manufactured equipment that requires electrical service without conflict with Work of other disciplines.
2. Furnish sufficient information to manufacture equipment that is of special design, made exclusively for the Project.

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3. Components and Systems shall be UL listed.
4. Describe items so that they may be procured.
5. Furnish sufficient information to permit planning, construction, evaluation, recording, repair, and maintenance of facilities.
6. Furnish the above in sufficient completeness for accomplishment without the need of assistance from the Project Team.

C. Electrical Drawings shall generally include the following delineations as needed:

1. Legend of symbols
2. Block diagrams
3. One–line diagrams
4. Schematic diagrams
5. Connection diagrams
6. Power distribution plans
7. Lighting plans, outdoor, indoor
8. Site photometric plans
9. Communications plans and risers
10. Grounding plans and risers
11. Security plans and risers
12. Lightning protection plans
13. Fire alarm plans and risers
14. Panel, circuit and other schedules
15. Detail Drawings

D. Combinations of delineations may be shown on the same Drawing sheet.

E. Lighting and power shall always be on separate plans; small projects may have both plans on one Drawing sheet.

F. Electrical delineations shall not be incorporated into Architectural, Structural or Mechanical Drawings.

G. Electrical utility and exterior lighting shall be fully coordinated with the Civil Drawings.

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312.2 – Electrical Plans:

- A. Electrical plans consist of scaled delineations arranged to depict circuits and electrical equipment installation, and are supplemented by diagrams and Specifications. The electrical plans shall depict:
1. Electrical equipment arrangement
 2. Facility electrical power distribution, including underground distribution
 3. Facility grounding
 4. Facility lighting, indoor and outdoor
 5. Facility lightning protection (may be Design/Build performance specification, with Grounding System by Electrical Engineer)
 6. Fire alarm may be designed by Special Systems Consultant, or Design/Build performance specification, with main panels and power by Electrical Engineer.
 7. Facility security may be designed by Special Systems Consultant.
 8. Facility communications: may be designed by Special Systems Consultant.
- B. Electrical items such as wire, conduit, cable, electrical equipment, etc., shall be delineated by line work distinguishable from lines used to depict items shown for reference or orientation.
1. When screened or “grayed out” background plans are used for reference, the Project Team shall assure the contrast of the reference Drawing is sufficient to print and photocopy reliably. Faint, illegible backgrounds are not acceptable.
- C. Lines between boxes on power and lighting circuit plans shall indicate cable, conduit, duct, and wire runs. Separate lines for wires within these carriers are generally not shown except by symbol.
1. Conduit runs shall generally be indicated by straight lines run parallel to building lines, walls, floors, ceilings, etc. in a manner that makes them distinguishable from those building lines.
- D. Circuitry not depicting conduit routing shall be depicted by curved lines. When these lines are used without additional qualification, they may be interpreted as permitting the most direct, non-interfering route compliant with codes and workmanship standards.
1. Therefore, this System may be used only in accordance with the Electrical Engineer’s certification that the design is completely coordinated and causes no interference with architectural, structural, mechanical and all other Building Systems.
 2. Circuitry design and routing shall be completed prior to work in the field.
- E. Drawing scale, north orientation and order shall correspond to the Architectural Drawings.
- F. Dimensioned Location:
1. Buried, embedded, penetration and critical clearance installations shall be described by note and dimensioned from Project benchmarks, structural grid and layout geometry on the Drawings.
 2. Show location and elevation of wire ways, electrical bus and cable trays.

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3. All routing of exposed conduit and enclosures shall be complete. Exposed conduits, bus and trays shall be located and dimensioned with tolerances in coordination with the architectural elevations and aesthetic principles.

G. Marking:

1. If not fully explained by the Specifications, the requirements for electrical safety notices on equipment, doors, enclosures, etc., shall be included on the Drawings.

H. Future Space:

1. When space is specifically set aside for future installation of equipment, such space shall be indicated in dashed lines, dimensioned and labeled.

I. Spares:

1. Spare wires, cables, conduits, terminals, circuit breakers, etc., shall be shown and identified as spares.

J. Cross-Reference:

1. Provide references to applicable Drawings, including other discipline Drawings.
2. Reference specific Vendor Equipment Drawings only when equipment is known or received.

K. Arrows on Wires:

1. Limit use of arrowheads on lines representing wire, cable or conduits to indication of "home runs" returning to the local panel board without interruption.

L. Unless included in the specification, include the following items on the Drawings:

1. Extent of National Testing Laboratory acceptance of items
2. Compliance to the current OSA adopted edition of the National Electrical Code (NEC)
3. Marking or tagging requirements, including Underwriter's Label, wire size, fuse rating, etc.
4. Labeling of circuits and equipment

M. Load Balancing:

1. The plans shall be drawn so proximity to balance load conditions can be determined.

N. Show special conditions on the Drawing, including but not limited to:

1. Number, size and location of building expansion joints
2. Transitional details, such as a conduit passing from a floating floor to a rigid structure

O. Devices which have different energized and de-energized appearance shall be shown in the de-energized condition.

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1. For example, a circuit breaker or a switch that can be shown either closed or open shall be shown open.

312.3 – Power Plans:

- A. Power distribution plans depict primary and secondary power distribution, control and grounding, excluding lighting and communications.
- B. Plans shall show equipment arrangements, configuration and information to locate position and mount electrical equipment.
 1. FM Engineering may design primary utility power for projects.
 2. The Electrical Engineer shall coordinate the Project Drawings and indicate the line of demarcation for design responsibility.
- C. Primary Supply:
 1. Construction Documents shall show the primary supply cables to, and the secondary feeder cables or busways from, service entrance equipment.
- D. Secondary Circuits:
 1. Show connections of secondary circuits to utilization points and associated equipment such as panelboards, distribution transformers, converting equipment, etc.
- E. Panel Board Schedules:
 1. Show power panelboard schedules with phases balanced, the total connected load (KVA), NEC demand load (KVA) and the demand factor.
- F. Panel Board Drawings:
 1. Panel Boards, existing and new, shall be drawn to scale in plan and elevation, showing, identifying and dimensioning all equipment adjacent to the installation.
 2. If Manufacturer options are specified for panel boards, show the largest panel.
 3. Drawings shall clearly depict correct top-to-bottom and front-to-back positioning relative to adjacent equipment.
 4. Show clearances required by code in plan and section, including door swings and clear areas required for placement of parts.
 5. The Project Team is responsible for assuring coordination of clearances with Building Systems by other disciplines.
- G. Dimensioned Location:
 1. Equipment shall be dimensionally located from column lines, walls, ceilings, etc.

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H. Grounding:

1. Grounding design shall comply with NEC and be shown on the Drawings, including details of grounding bars.
2. Grounding paths shall be shown whether made through wires, buses, conduit, ducts, rods, or other items serving as ground conductors.
3. Include bonding information unless covered in Specifications.
4. Show grounding conductor sizes and locations.

I. Raceways:

1. Dimensionally locate and describe Raceway Systems and components (cable tray, conduit, pull boxes, wireway, etc.)
2. The Project Team is responsible for coordination and elimination of conflicts with Building Systems designed by other disciplines.
 - a. Refer to Chapter 04 – Drawing and Document Administration for BIM Requirements.

J. Equipment:

1. Identify equipment by note or in a material list.
2. Show clearances and dimensions of the largest “or equal” Manufacturer’s equipment on the Drawings.
3. Provide concrete housekeeping pads for floor-mounted electrical equipment.

K. Emergency Power:

1. Include and identify Standby and Emergency Power Systems and capacity.

L. Transformers:

1. Transformers shall be pad mounted on the floor if the transformer is greater than 50 KVA.
2. Document heat load of transformers on the Drawings and incorporate transformer heat loads in the HVAC cooling calculations.

M. Receptacles shall be defined by symbol and "home-run" circuit number.

1. Note default (typical) mounting height on the Drawings.
2. Note receptacle mounting height at specific location when different from the default height. Indicate the home run panel by panel designation and circuit.
3. Show intermediate pull boxes on the Drawings by size and assure access clearance is coordinated with all other Building Systems.

312.4 – Lighting Plans:

A. Definition:

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1. Lighting plans depict lighting circuits, lighting control circuits, fixtures and accessories, beginning with the power source at the source panel or the lighting transformer and panelboards and extending to the light fixtures.

B. Circuits:

1. Lighting circuits shall generally be shown separate from other circuits.
2. Lighting circuits may include feeders, transformers, panelboards, wires, cables, raceways, switches, lamps, outlets, emergency lighting batteries, relays, etc.

C. Delineation:

1. Delineation for Lighting Systems shall include runs from the service entrance equipment through the lighting control panelboards and conductors to the lights. Indicate size, material, etc. for wire, conduit, and special fittings.

D. Panels:

1. Show panelboard schedule and connection details. Indicate mounting height by note or in elevation if not covered in the specification.
2. Panel schedules shall describe equipment and its location by room number, augmented by position for rooms with multiple lighting circuits.

E. Symbols:

1. The lighting symbols shall include light fixture type number or letter code within or adjacent to them with their "home-run" branch circuit number, and a lower-case letter indicating switches by which they are controlled.
2. Note height if different from typical.
3. Night, emergency and security lighting circuits shall be distinguishable from general lighting.

F. Layout and Location:

1. Coordinate lighting layouts with mechanical and other electrical equipment. Indicate mounting height for switches and fixtures on elevations or by note.

G. Emergency Lighting:

1. Indicate the lighting circuits to which emergency battery-powered lighting units activated by power failures are connected and that they are connected on the line side of all switches per applicable code.

H. Lighting Control Symbols:

1. The lighting control symbols shall differentiate between Line Voltage and Low Voltage Systems.
2. Occupancy sensor symbols shall be unique so as to indicate type of technology used (infra-red, ultrasonic, dual technology, etc.), coverage (large room, corridor, wide angle) and voltage (line or low voltage).

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I. Lighting Control Matrix:

1. Drawings shall include a Lighting Control Matrix indicating the intent and performance of the Lighting Control Systems in each space.
2. For example,

Area	Normal Operation	Override Operation
Lobby	Auto ON during scheduled Business hours	Occ Sensor Override ON after hours, not to exceed 2 hours

312.5 – Communication Plans:

- A. Communication plans depict the interconnecting electrical circuits between devices such as telephones, computers, data network devices, closed–circuit video, audio and public address, etc. as well as the various alarm, Control and Signaling Systems such as fire detection and alarm, Energy Management and Control System, access control, etc.
- B. Communication Systems may be integrated together into common data communication links.
- C. Show communication equipment and the interconnecting wiring and/or cabling. When more than one System is shown on a plan, the graphic depiction of each shall be clearly differentiated.
- D. Raceway Systems and components (cable tray, pull boxes, conduit, wireway, etc.) shall be dimensionally located and described.

312.6 – Diagrams:

- A. The Project Team shall provide diagrams depicting the characteristics and relationships of the Electrical System by the use of symbols and lines showing flow, function, or physical connections.
- B. A set of Electrical Drawings shall include either a one–line diagram, schematic diagram, or both. Provide block or connection diagrams as needed.
- C. Arrange electrical diagrams so the main features are prominent and there is an even balance between blank space and lines. The blank space around symbols should be sufficient to avoid crowding of notes. Provide blank spaces for planned additions.
 1. Diagram line work shall be of medium line width except where otherwise specified in the respective paragraph for a particular diagram type.
 - a. When connecting lines are drawn parallel, the spacing between lines shall be legible after 50% reduction.
 2. Drawing titles shall include the diagram type. When combinations of electrical diagram types are included on the same Drawing, the entry for the type of Drawing in the title block shall be selected to adequately define the Drawing content.
 - a. Typically, if a Drawing combines all of the diagram types, the entry in the title block shall be ELECTRICAL DIAGRAMS.
 3. Use a boundary line enclosure to show circuit parts that are grouped.
 4. All lines between blocks or symbols shall be vertical or horizontal.
 - a. Lines shall be as direct and short as possible without the use of diagonal lines.

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- b. Lines shall have a minimum number of turns and crossings.
- c. Crossings shall be looped.
5. Use nomenclature or other designations for identification of blocks, symbols, equipment, etc. in accordance with the device, equipment marking or standards established for the facility.
6. Use a direction arrow for interface flow lines that are "from" or "to" features not included on the Drawing.
7. Provide notes concerning physical or functional information as needed to clarify the diagram.
8. More than one type of diagram may be included on one Drawing, but do not place diagrams on Plan Drawings.

312.7 – One-Line Diagrams:

- A. A single-line diagram is required for all new, remodel or modification design of any Service or Distribution System for power, control and communication.
- B. One-Line diagrams shall include:
 1. Service transformer size
 2. Service voltage and phase
 3. Graphic representation of bus arrangement and overcurrent devices on all main and sub distribution equipment
 4. Size and rating for overcurrent main and feeder units (Use of schedules for this data is not acceptable)
 5. Available spaces and spares in main and distribution boards and panels
 6. All branch panels (Designators and locations required)
 7. Dry type transformers (Designators, sizes and locations required)
 8. Available short circuit current at critical points of the System
 9. Arc-flash category rating on each piece of equipment down to branch panels
 10. Branch circuit panelboard main breaker or MLO ratings
 11. Metering equipment
 12. System ground components and configuration
 13. Standby engine-generator(s) and transfer switch(es)
 14. Transient Voltage Surge Suppression (TVSS) equipment
 15. Ground-fault protection of equipment on solidly grounded wye electric services of more than 150 volts phase-to-ground but not exceeding 600 volts phase-to-phase for each service disconnect rated 1000 amperes or more

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16. Uninterruptible Power Supply (UPS) Equipment and size
17. Motor Control Centers and other distribution gear
18. Feeders can be shown by description or by schedule. If a feeder schedule is used, it should be on the same sheet as the One-Line diagram.

C. One-Line diagram requirements are as follows:

1. Only one phase of a Multiphase System and one polarity of a DC System shall be used to simplify the circuit and to include the necessary essentials.
2. Descriptive nomenclature shall be placed above or to the right of the subject element or connecting line unless other placement has a distinct advantage for the particular application.
3. All symbols shall be of the single-line type.
4. A single-line diagram is termed functional if various line widths are used to separate categories of circuits. When this type of diagram is made, the line widths shall be defined.
 - a. No more than two widths of lines shall be used.
 - b. Heavy-width lines represent power circuits and medium-width lines represent control and measurement circuits.
5. Nominal voltages shall be used for supplementary information in the designations of Systems.
6. Power transformer impedance shall be indicated on the Record Drawings. The A/E shall provide a designated place on the Drawings for the Project Team to enter this information on the As-Built redline set.
7. Transformer voltage representation shall use the symbols dash (–) and slant (/) as follows:
 - a. The dash (–) is used to separate the voltage ratings of separate windings on a transformer (13.8 KV–480V).
 - b. The slant (/) is used to separate multiple voltages or indicate taps of the same winding (208Y/120).
 - c. Transformation ratios shall use the slant (/) as the separation between the values.
8. A one-line diagram may show only the power circuits, or, if extended, include secondary and control circuits in the simplified form.
9. The one-line diagram may include pertinent rating information about its items, such as voltages of potential transformers, ampere rating of current transformers, fault current, interrupting capacity, breaker frame and trip ratings of circuit breakers, motor horsepower ratings, load estimates, bus ampere and voltage rating.
10. A one-line diagram may also include wire and cable information, and further descriptions of elements such as: element categories, models, Drawing numbers, functional designations, length of cable.
11. Indicate distribution equipment, power, control and metering, and protective relay circuits from the incoming feeder to ultimate motor, lighting panel or other load, including item names.
12. Winding connection symbols shall be used adjacent to the symbols for the transformer windings.

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13. The quantity of a particular device may be indicated on a single–line symbol when it is necessary to define its quantity in relation to the graphical symbol.
 - a. The numeral indicating quantity is placed adjacent to the symbol.
 - b. The number 3 adjacent to the magnetic overload device indicates that there are three circuits like the one shown.
 - c. A note shall be included with the legend or notes indicating the function of the quantity numeral, e.g., "The Numeral Adjacent to Relays Denotes Quantity."

14. Device lists shall be incorporated on the Drawings and included as part of the legend, when functional designations are used. In addition, the meaning of each suffix used with a device function number should be listed if it is not included with a complete device function number. The following illustrates a device list.
 - a. 1A Master Element
 - b. 1M Master Element
 - c. 23 Temperature Control Device
 - d. 38 Bearing Protective Device
 - e. 43 Manual Transfer Switch
 - f. 47 Phase Sequence Voltage Relay
 - g. 49 Machine Thermal Relay
 - h. 51 AC Time Overcurrent Relay
 - i. 51N AC Time Overcurrent Relay (Neutral)
 - j. 52 AC Circuit Breaker
 - k. 52X Auxiliary Relay for 52
 - l. 86 Locking–out Relay

15. Protective relays may be included along with an indication by operator dash lines on the device that the relay acts upon.

16. Electrical values and other functional information shall be included as necessary to allow analysis of the circuit. Examples of some types of information that may apply are as follows:
 - a. Current, voltage and interrupting rating of circuit breakers
 - b. Primary and secondary voltages and kVA ratings of power transformers
 - c. Voltage and kVA or kW rating of generators
 - d. Voltage and HP rating and type of motors
 - e. Rating and type of load on feeder circuits
 - f. Ratings of power and control sources
 - g. Circuit breaker frame trip and interrupting current
 - h. Switches ampere rating
 - i. Ratings of instrument transformers, fuses, resistors, capacitors, and contractors, motor starters
 - j. Resistance to ground, inductance, and temperature ratings
 - k. Voltage and current waveforms
 - l. Bus amperage, voltage and fault current capacity

312.8 – Functional Designations:

- A. Functional designations are words, abbreviations, or meaningful number or letter combinations, usually derived from the function of an item, and used on Drawings, equipment, and instructional material to identify items of a complete Control System or equipment in terms of function.

- B. Switchgear and control device designations shall be applied as outlined under definitions. In general, on one complete Drawing or set of Drawings, only one System of designations shall be used.

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1. When using functional designations on individual equipment, supplementary letters or numbers shall have one meaning only and the meaning shall be clearly designated in a device list on the Drawing.

C. Switchgear Designations:

1. Switchgear designations are numbers that describe the functions performed by electric devices in switching circuits used in the generation, transmission, and distribution of electric power.
2. Supplementary letters and numbers are used with the basic designation to permit positive identification of an item.

D. A device function number, with appropriate suffix letter or letters where necessary, shall be used to identify the function of each device in all types of partial automatic and automatic, and in many types of manual, switchgear.

1. These numbers shall be used on Drawings, in publications, and in Specifications. In addition, for automatic switchgear, the number shall be placed on or adjacent to each device in the assembled equipment so that the device may be readily identified.
2. Designations shall be in accordance with designations for Electric Power Switchgear Devices and Industrial Control Devices.

E. Control Device Designations:

1. Control device designations are letters used to identify the function of electric control devices on power utilization equipment.
2. Suitable prefix numbers and letters are added to the basic designation to distinguish between devices performing similar functions.

F. The assignment of designations to devices on a specific equipment is governed solely by the function or functions performed by each device on a particular equipment and not by the type or nature of the device or its possible use for other functions in other equipment.

1. Thus, the same type of device may perform different functions in different equipment or even in the same equipment. It may, therefore, be identified by different designations.
2. Designations shall be in accordance with ANSI/IEEE C37.2 –1979, Electrical Power System Device Function.

312.9 – Symbols for Electrical Drawings:

A. Electrical and Electronic Symbols for Diagrams are graphical symbols providing coverage for electrical and electronic diagrams.

1. Correlation of symbols with parts lists, descriptions, or instructions may be established by means of reference and functional designations.
2. Symbols shall be in accordance with ANSI – Y32.2, Graphical Symbols for Electrical and Electronics Diagrams.
3. Notify the Project Representative of any inconsistency between the CSU Facilities Planning, Design and Construction Standards and the ANSI Standards.

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- B. Symbols for Electrical Plans are graphical symbols that provide coverage for architectural and Electrical Layout Drawings.
1. Functional electrical and electronic symbols should be used to provide full coverage for these Drawings.
 2. Symbols shall be in accordance with ANSI – Y32.9, Graphic Symbols for Electrical Wiring and Layout Diagrams used in Architecture and Building Construction.
- C. Labels for panelboards and electrical equipment shall designate the source location ("Fed from . ") and voltage.
- D. Panel names shall comply with the following conventions:
1. X – Y – # – Z
 - a. X: H for high voltage, L for low voltage
 - b. Y: P for power, L for lighting, M for mechanical, LP for combined light and power
 - c. #: B, 1, 2, 3, etc. for building level
 - d. Z: A, B, C, etc. for multiple panels

312.10 – Electrical Design:

A. Space and Clearance Responsibility:

1. By submitting the Bid Documents, the Project Team certifies that space allocations for equipment specified is adequate and compliant with all code requirements, including clearance requirements and free of conflicting space requirements of all other trades.

B. Load Data:

1. The Electrical Engineer shall provide NEC load calculation and complete load data for use by FM as it becomes apparent during the design stage.
2. Data shall include all connected and demand loads.

312.11 – Short Circuit Calculations and Coordination Study:

- A. The Electrical Engineer shall submit calculations of available fault current at all points within the Electrical Distribution System.
- B. Fault current calculations shall be based on the assumption of an infinite utility source at the primary side of the building transformer.
1. Interrupt or withstand ratings that exceed the values determined in these calculations are required for all electrical equipment specified in the design.
 2. Minimum impedance values which correspond to those used in the calculations shall be included in the Specifications for all transformers.
- C. On service sizes larger than 600 amperes, provide service feeder device coordination studies for Overcurrent and Ground Fault Protective Systems to assure selective tripping.
- D. Series rating breakers are not permitted without prior approval from FM Engineering.

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- E. Short circuit calculation and coordination study shall be performed using the latest version of SKM Power Tools.
1. The comprehensive method for short circuit calculation shall be used for Systems 600V and below. A–fault shall be used for Medium Voltage Systems.
 2. Perform an Equipment Evaluation and compare to short circuit ratings. Notify Project Representative in writing of existing circuit protective devices improperly rated for the calculated available fault current.
 3. Both the electronic .prj file and a hard copy shall be provided to CSU.

312.12 – Arc–Flash Study:

- A. The Electrical Engineer shall submit calculations of available flash hazard energy in calories per centimeter squared at each piece of equipment in the Electrical System down to branch panels.
1. This study shall be done after the short circuit calculations and protective devices coordination study have been completed.
 2. The Arc–Flash Study shall be electronically submitted to CSU for review.
- B. The Arc–Flash Study shall be performed using the latest version of SKM Power Tools.
1. The Arc–Flash Study Options (Standard and Unit) shall be as follows:
 - a. The Arc–Flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, 2015 Annex D.4.
 - b. The flash boundary calculation adjustment shall be Use Incident Energy Equation to Calculate Boundary for Equipment Below 1kV.
 - c. Equipment Below 240V:
 - i. Report Calculated values from Equations
 2. The Arc–Flash Study Options (Fault Current) shall be as follows:
 - a. Use a Global Max Arcing Time of two seconds for all voltages
 - b. Arcing Tolerances shall be:
 - i. Low Voltage Open Air Low Tolerance: –15%
 - ii. Low Voltage in Box Low Tolerance: –15%
 - c. Pre Fault voltage shall be:
 - i. No Load with Tap
 - d. Utility and Impedance Tolerances:
 - i. Regular
 - e. Check:
 - i. Transformer Tap and Transformer Phase Shift
 - f. Define Grounded as SLG/3P Fault \geq 5%
 - g. Reduce Generator/Synch motor fault contribution to 300% of Rated current after 10 cycles
 - i. Check:
 - a) Apply to Generators
 - ii. Check:
 - a) Recalculate Trip time using reduced current
 - h. Induction Motor Fault Contribution:
 - i. Include for 5 cycles
 - i. Treat Fuses as:
 - i. Specified in Library
 - j. Uncheck:

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- i. Use Equipment Specific Arc–Flash Equation in Protective Device Library
3. The Arc–Flash Study Options (Report Options) shall be as follows:
 - a. Report Option:
 - i. Bus
 - b. Color One–Line:
 - i. Bus
 - c. Device to Report in Labels and Summary View:
 - i. Main Device
 - d. Report Options when Equipment Evaluation Failed:
 - i. Report IE/PPE
 - e. Upstream Mis–Coordination Options:
 - i. Check Upstream devices for mis–coordination
 - ii. Upstream Levels to check: 2
 - f. Cleared Fault Threshold:
 - i. 80% of Total
 - g. Check:
 - i. Auto update Arc–Flash Results
 - h. Check
 - i. Report PPE Others 1,2,3,4,5
 - i. Check:
 - i. Report PPE Level
4. Arc–Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time shall be capped at two seconds based on IEEE 1584–2002 section B.1.2.
 - a. Where it is not physically possible to move outside of the flash protection boundary in less than two seconds during an arc–flash event, a maximum clearing time based on the specific location shall be utilized.
5. Arc–Flash Labels:
 - a. Provide a 4.75 in. x 7.75 in. thermal transfer type label of high adhesion material for each Work location analyzed.
 - i. Label material shall be gloss film (2.6 mil white polypropylene film with extreme water resistant gloss top coating.
 - ii. Label laminate shall be UV resistant (1.42 mil clear polyester film with UV protection, providing resistance to moisture, chemicals, acids, weather and aging.
 - iii. Label shall be printed by Leapin’ Lizards Labels of Fort Collins, or equal.
 - b. Label shall be “SKM Sample 05– Avery 6876– Portrait” template.
 - c. Labels shall be installed on all new equipment with appropriate hazard and PPE levels identified.

313 – FIRE SUPPRESSION DRAWINGS AND DESIGN

313.1 – General Requirements:

- A. The requirements of this Chapter apply to all Fire Suppression designers.
- B. A Fire Suppression Drawing delineates equipment, materials, components, piping and accessories to convey liquids and gases for the construction of Fire Suppression Systems.
- C. The Drawings shall indicate complete design. Drawings shall be complete and coordinated with other disciplines to ensure there are not conflicts and that the Systems can be installed as delineated.

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- D. 310.3 – Flow Diagram Requirements and 310.4 – Drawings for Piping shall apply to the Fire Suppression Drawings as needed.
- E. The Project Team shall be responsible for overall System Drawings, calculations, general compliance with relevant code and coordination with other disciplines to ensure that the Systems specified can be installed without spatial conflict.

313.2 – Fire Suppression Flow Diagrams:

- A. Fire Suppression flow diagrams shall illustrate the following:

1. Standpipe Systems and fire risers
2. Flow direction
3. Valves and alarms
4. Automation and temperature controls

313.3 – Fire Suppression Drawings:

- A. Fire Suppression Drawings delineate the components required to provide Fire Suppression to the design facility.
 1. This includes but is not limited to all methods of fire suppression, wet–pipe, dry–pipe, Deluge Systems, Carbon Dioxide Systems, Mist Systems, Foam Systems, Pre–Action Systems, fire extinguishers, fire hoses and standpipes, etc.
- B. These Drawings shall establish procedures for construction of the Fire Suppression System design, including water connections to the fire main, sprinkler heads, piping, alarms, valves, etc.
- C. The delineation for these Drawings shall incorporate dimensions, codes, conventions, schedules, diagrams, etc., in describing the Fire Suppression System design.
- D. To aid in checking Drawings and resolving potential interferences among other components, such as ductwork, electrical equipment, etc., the Fire Suppression Drawings shall be prepared to the same scale as the Drawings of other disciplines.
 1. Provide a scaled site plan showing the outline of the building and public water supply information (pipe main size and location, fire hydrant locations)
 2. Identify where and when the hydrant flow information was obtained that the Sprinkler System is based upon. Show actual hydrant flow test information.
 3. List the Sprinkler Information Number (SIN) in tabular form with sprinkler heat type, model number, quantity, etc. in the sprinkler head tabulation information block

313.4 – Detailing:

- A. The following rules shall apply when detailing these Drawings:
 1. Drawings shall be prepared showing routing of Fire Suppression piping.
 2. The preferred scale for arrangements is 1/4" = 1'–0".

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3. Fire Suppression Drawings shall include pipe sizes and routing, direction of flow, test connections points, riser diagrams showing valves and alarms, fire extinguisher and hose locations.
4. Materials for piping, valves, sprinkler heads, alarm devices and fire department connections shall be detailed in Division 21 – Fire Suppression.
5. Density and remote square footage requirements shall also be indicated.

314 – COMMUNICATIONS/ELECTRONIC SYSTEMS

314.1 – General Requirements:

A. Communications and Electronic Systems addressed in this section include:

1. Fire Alarm System
2. Telecommunication and Data Network System
3. Card Access System
4. Presentation Media Systems (AV)

B. Prior to submitting the fee proposal, the Project Team shall confer with the Project Representative having primary authority over specific Systems to determine the Scope of Work.

1. Unless otherwise directed in writing by the Project Representative, the Project Team shall provide complete design for the planning, procurement, coordination, construction, evaluation, recording and/or use of all Communication and Electronic Systems in the Project.

314.2 – System Authority:

A. Engineers and Consultants shall be responsible for coordinating their design with the following project requirements:

1. Fire Alarm System:
 - a. Office of Risk Management and Insurance – Fire/Life Safety Administrator
 - b. Fire Systems Group
2. Telecommunication and Data Network System:
 - a. Office of Telecommunications for physical infrastructure
 - b. Academic Computing and Networking Services (ACNS) for network equipment
 - c. Office of Instructional Services (OIS) for AV video infrastructure
3. Card Access System:
 - a. Access Services and Remodel and Construction Services
 - b. Telecommunications
4. Presentation Media Systems (AV):
 - a. Office of Instructional Services
 - b. Telecommunications
 - c. Remodel and Construction Services

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314.3 – Drawings:

- A. Communications and Electronic Systems Drawings and Specifications, shall:
1. Furnish sufficient information to permit installation of manufactured equipment that satisfies the design requirements.
 2. Furnish sufficient information to manufacture equipment of special design made exclusively to meet the requirement of the Project.
 3. Components, assemblies and systems shall be UL listed.
 4. Describe items so that they may be procured.
 5. Furnish sufficient information to permit planning, construction, evaluation, recording, repair, and maintenance of facilities.
 6. Where new equipment is required for installation in an existing room, layouts shall coordinate placement of the new equipment with existing equipment.
 - a. New equipment shall be drawn with a different line type from existing equipment to assure positive identification between new and existing equipment.

314.4 – Site Plans:

- A. The site plan shall identify all utilities and facilities required in support of the specified Communications and Electronic Systems including: conduits, duct banks, copper/optical fiber cable resources, devices, antennas and other equipment.
- B. Drawings shall indicate all required connections to the Grounding System.

314.5 – Floor Plans/Roof Plans:

- A. Plan Drawings shall show all device and equipment locations and their conduit interconnections.
- B. All device locations shall be coordinated with all disciplines including architectural finishes and features.
- C. When more than one System is shown on a plan, each shall be clearly distinguished from other Systems.
- D. Conduit routes shall be drawn to their specific termination equipment or terminal cabinet location or the termination location shall be indicated by schedule.
- E. All conduits shall be coordinated with the conduit riser and point-to-point diagrams.

314.6 – Equipment Room Layouts and Elevations:

- A. Equipment rooms shall comply with the CSU Telecommunication Design Standards and the CSU Facilities Planning, Design and Construction Standards.
- B. Plans and wall elevations shall indicate scaled layout of the space, all Communications and Electronic Systems and other equipment co-located in the room and plenum space above.

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C. Equipment room layouts shall provide sufficient detail for coordinated construction and include the following elements:

1. Interconnection between equipment
2. Conduit terminations
3. Grounding connections
4. Electrical connections and grounding bars
5. Floor mounted and wall hung equipment placement
6. Cable tray configurations
7. All penetration and fire sealant details
8. Clearance zones for servicing equipment
9. Locations and sizing of cooling equipment required

314.7 – Functional Block Interconnection Diagrams:

A. When required for general arrangement studies, functional explanations or for design discussion, the Project Team shall provide a block diagram of functions or groups of functions to describe the concepts and/or organization of the System.

B. Interconnecting lines shall establish the relationships between blocks and indicate the direction of information flow.

1. Diagrams:

- a. A block diagram shall be presented in as simple a form as possible, using rectangles to represent functional Electrical Systems, parts and/or major elements of an Electrical System or circuit.
- b. Various other symbols may be used as supplementary information to increase the utility of the diagram.
- c. Identifying nomenclature shall be included within the blocks.
- d. Block diagrams may be made for any level of Project activity.
- e. Related mechanical and other apparatus may be included as rectangular blocks.
- f. Mechanical connections between such elements shall be illustrated with dashed lines connecting the applicable blocks.
- g. Tabulations may be used when the form of the circuit involves multiple sources and common or similar circuits.
- h. If a block diagram must be divided and placed on more than one Drawing, the division of the circuit should be made at a point of minimum information transfer in a logical manner that shall eliminate confusion.
- i. Provide a keynote, abbreviation and symbol legend on the Drawing.

2. Connecting Lines:

- a. Lines connecting blocks shall indicate relationships, direction of flow of the System, sequence of operation, etc.
- b. The arrangement of lines and blocks shall show action or energy flow in functional sequence from top to bottom and/or left to right of the diagram, starting at the top left or top center and ending at the bottom right of the diagram.

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- c. Connection lines shall be labeled, where necessary, to make the meaning clear and unmistakable.
- d. When dashed lines are used for more than one purpose on a block diagram, these purposes shall be made clear by label, legend, or note.
- e. Connecting lines shall include arrows to further define the circuit flow.

314.8 – Point-to-Point Wiring Diagrams:

- A. Point-to-Point wiring diagrams shall be provided for Systems where interconnection to existing equipment is required at a specific interface location and configuration.
- B. For new Systems that do not require interconnection to existing Systems, System concepts and intent shall be conveyed through the Functional Block diagram, riser diagrams, floor plans, elevations and the Project Specifications.
- C. Point-to-Point wiring diagrams describe detailed wiring configuration and arrangement of the specific System showing the System color coded connections at the component level.
 1. All wiring by type and size required between all System components
 2. Indicate wire color coding
 3. Indicate terminal strip numbers and positions
 4. Indicate current, signal and data flow

314.9 – Systems Riser Diagrams:

- A. The Project Team shall provide riser diagrams for all Cabling Systems and indicate the distribution of major Systems components, Wiring Systems and their interconnection requirements:
 1. Equipment rooms
 2. Cable quantities
 3. Cable types
 4. Termination locations
 5. Keyed reference to related details
 6. In multi-floor facilities, riser diagrams shall be organized by level.
 7. For simpler designs not containing Cabling Distribution Systems, specific riser diagram information (e.g. major component location) may be incorporated into the Functional Block Diagram.

314.10 – Conduit/Cable Tray Riser Diagrams:

- A. The Project Team shall provide conduit riser diagrams to indicate the configuration, location, quantity and size of the conduit/cable tray infrastructure by the Communications System.
- B. In multi-level facilities, conduit riser diagrams shall be organized by level. All conduit riser diagrams shall indicate the following information:

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1. Equipment rooms (or conduit termination locations)
 2. Conduit quantities
 3. Conduit sizes
 4. Conduit identification schemes
 5. Interfaces to cable trays
 6. Grounding and bonding requirements
 7. Cable Tray Systems
- C. Terminal cabinets, equipment back boards and other conduit termination facilities and locations are considered part of an integrated conduit riser diagram and shall be shown on the conduit riser diagram.
- D. Branch conduits installed in support of devices need not be shown on the conduit riser diagram.
- E. The conduit riser diagram shall be coordinated with the System riser diagram with effective cross reference between systems cables and conduit/tray infrastructure.
- F. Provide System details indicating specific installation techniques and Systems configurations to call attention to specific conditions and requirements required to assure the installed System configuration is compliant with the design intent.
1. Details shall be provided for all conditions where specific direction cannot be properly conveyed or is indicated on other sheets.

314.11 – Communications and Electronic Systems Symbols:

- A. Communications and Electronic Systems symbols shall be coordinated with the Project Representative.
- B. If not otherwise indicated, symbols shall be in accordance with NFPA 170. Other symbols, if devised by the Project Team, shall be explained in the legend with indication "For this Project Only."

314.12 – Drawings:

- A. Subject to Project Representative acceptance, the Drawings for the Project need not contain all delineation types.
1. For example, projects consisting only of a single building and a relatively simple Communications and Electronic System may not need a block diagram(s) or single-line diagram(s) if the information normally found in them is effectively conveyed by other delineation types.
- B. Each delineation shall be identified by its type below the area where it is displayed, e.g., Schematic Diagram. These delineations shall not be included on Architectural, Structural, Civil, Mechanical or Electrical Drawings.

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314.13 – Specifications:

- A. Specifications shall include technical sections to describe all the Communications and Electronic System design requirements of the Project.
- B. Vendor Information Drawings may be included as reference Drawings subject to written approval from the Manufacturer.
- C. Purchase Specification Drawings may be included as reference Drawings.

314.14 – Fire Alarm System (FAS):

- A. Standard System:
 - 1. Refer to Division 28 – Electronic Safety and Security.
- B. All equipment shall be manufactured by Notifier unless otherwise directed by the Project Representative. This is considered the Main System at CSU.
 - 1. Some buildings located throughout the CSU’s Fort Collins Campuses still use equipment by other Manufacturers.
 - 2. New equipment shall be UL listed and compatible with both existing equipment and Notifier Systems.
- C. Submit all System designs developed for implementation on the CSU Campus to the Project Representative for distribution to:
 - 1. Fire Systems Group is responsible for the maintenance of all Fire Alarm Systems on the CSU campus.
 - 2. CSU Office of Risk Management and Insurance – Fire/Life Safety Administrator is responsible for integration of all building Fire Alarm Systems to the campus-wide network.
 - 3. Poudre Fire Authority review and approval is required for all Fire and Health, Life, Safety Systems.
- D. When additions to the main Fire Alarm System are required the Project Team shall perform a comprehensive site investigation, review CSU record documents and conduct interviews to determine the configuration of the existing System in the area to be modified or constructed. The Project Team shall determine:
 - 1. Signaling line capacity within the construction area
 - 2. Capacity of initiating circuit within the construction area
 - 3. Required device locations
 - 4. Interface point for both signaling and initiating circuits
 - 5. Determine the impact on the existing smoke zone(s) within the construction area
 - 6. Determine the impact on the sprinkler zone(s) within the construction area

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- E. The Project Team shall be responsible for the complete expansion to the existing Fire Alarm System, per Project requirements.
- F. Plans shall comply with the CSU Facilities Planning, Design and Construction Standards and include all devices and their locations.
 - 1. All conduit shall be indicated with interconnection to the existing System, all cable shall be specified and sequence of operation shall be defined.
 - 2. The specification shall require the Project Team to notify FM two weeks in advance before connection to the existing System so that Access Services and the Fire/Life Safety Administrator can review all required software graphical, control and point definition and coordinate activation with the existing campus network.

314.15 – New Facilities:

- A. The Project Team shall design a complete System, per Division 28 – Electronic Safety and Security.
- B. The new building System shall be tied into the campus–wide Notifier network by the CSU Office of Risk Management Fire Life Safety Systems Administrator.
 - 1. The Project Team shall meet with this department for specification of conduit, equipment and monitoring requirements.

314.16 – Code Compliance:

- A. All Fire Alarm System designs shall be compliant with current OSA adopted editions of the International Building Code (IBC) and the International Fire Code (IFC).
- B. The Specification and Project requirements shall require the Project Team to notify, cooperate and coordinate with Access Services and the Fire/Life Safety Administrator before activating the Fire Alarm System or making any connection to the campus network.

315 – TELECOMMUNICATIONS AND DATA NETWORK

315.1 – General Requirements:

- A. Consultant Design and Agreement Document Requirements:
 - 1. The Project Team shall study and comply with CSU Telecommunication Design Standards, currently posted online at: https://it.colostate.edu/wp-content/uploads/sites/6/2023/02/Networking-and-Telecommunications-Design-Standards_01-04-23.pdf

316 – CARD ACCESS SYSTEM (CAS)

316.1 – Consultant Design Agreement Document Requirements:

- A. Whenever a Project Team’s design scope includes security access, the Project Team shall initiate a meeting with the Project Representative, Remodel and Construction Services, and Access Services to review the specific access requirements.
- B. The Project Team shall be responsible for coordinating, specifying and Drawing security door conduit rough–in details, door frame details, door hardware, card readers, cabling and interconnecting

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conduits/raceways or cable tray routing as required to tie the new access control door to the existing System.

- C. Card Access Control System electronic interfaces and software shall be installed by Access Services unless the Project Representative requires the Project Team to design and specify this Work.
- D. Verify with the Project Representative the scope requirements during the Programming Phase of Design.
- E. The A/E shall specify a commissioning test of all CAS doors installed as part of the Work by the Project Team and Locksmith and Access Services.

317 – SECURITY IP CAMERA SYSTEM

317.1 – System Description:

- A. The CSU Campus utilizes the OnSSI digital recording platform.
- B. It is preferred that all cameras added to the OnSSI network are Axis Cameras.
- C. Alternative cameras must be approved by Project Representative.
- D. Recording Servers shall be supplied by Project Representative.

317.2 – Design Requirements:

- A. The Project Team and Project Representative shall determine the need for security cameras in the programming or schematic phase.
 - 1. Quantity and general location of security cameras shall be provided by the Project Representative.
- B. The Project Team shall be responsible for the design of camera view, and providing Drawings and Specifications for camera hardware, location, mounting, cabling and conduit/cable tray routing to the communications room and layout of equipment in the communications room as needed by the System.
- C. Final System connection and System software programming shall be completed by CSU.
- D. The Design Specifications shall require a System test by the installing Project Team and CSU to ensure proper operation of Project Team supplied and installed equipment and Work performed by CSU.

END OF CHAPTER