THE UNIVERSITY OF UTAH

3.0 DFCM REQUIREMENTS

3.5 ELECTRICAL

DFCM DESIGN MANUAL
UNIVERSITY OF UTAH SUPPLEMENT

January 15, 2016

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PREFACE

University of Utah Supplement

GENERAL INTRODUCTION TO THE UNIVERSITY OF UTAH SUPPLEMENT:

The DFCM Design Manual "Design Requirements" (State of Utah, Department of Administrative Services, Division of Facilities Construction and Management, referred to herein as "DFCM Manual" or "Manual") dated June 11, 2009 including highlighted updates is the basis for A/E design services provided for all University of Utah projects.

This document accepts the DFCM Manual as the University of Utah standard, and supplements the Manual with requirements which are needed to satisfy University organization and mission objectives.

The reader is directed first to the DFCM Manual, then to this supplement where added requirements are preceded by "***ADDED***" and paragraph alterations required to accommodate University processes are preceded by "***REVISED***."

To remain consistent with the DFCM Manual, this supplement is organized in a format matching that of the parent Manual. Only portions of the parent Manual are reproduced in this supplement, either as navigation guides or as altered paragraphs. DFCM text is presented in a gray font. University additions and insertions are presented in normal font.

ADDED:

1. This electrical engineering supplement is intended to provide A/Es with specific requirements and minimum standards acceptable to the University for use in the construction or remodeling of buildings or facilities on campus. The A/E is expected to incorporate these requirements and standards into the project documents to ensure that the finished product meets the specific needs of the University. Any deviation will require a Project Variance Request or Change Request and subsequent approval by the Design Standards Committee in accordance with Design Process section 1.4.

2. The Facility Operations Electric Shop maintains electrical systems and equipment on campus, and together with staff electrical engineers, provides significant input and oversight to this supplement. The Electric Shop is responsible for the operation and maintenance of several critical electrical systems which serve research, life safety, health care, environmental, and other functions on campus.

3. The number of approved manufacturers for equipment and supplies described throughout this supplement is necessarily limited due to immediate critical response requirements, product performance parameters, site tests for quality and endurance, parts storage limitations, product training and familiarity, and other specific system needs. The products of other manufacturers and improved technologies are welcome for review and site testing at the University prior to being listed in this supplement with subsequent approval for use in construction specifications.

ADDED:

REVISIONS SUMMARY
for the University of Utah Supplement:

REVISION DATE	LOCATION	SUMMARY OF CHANGE
15 January 2016	3.5 C. (2), (4), G. (7)	Update to language MC Cable and Aluminum bus barn
1 May 2015	- - -	DFCM quoted text and numbering revised to correspond with DFCM changes. University standards unchanged.
1 November 2014	3.5 part 1 / B / 12 / b / i / vii	PanelBoard Labeling updated the standards
1 November 2014	3.5 Part 1/C / 6 / d	Dimming Added requirement
1 November 2014	3.5 Part 1/ C. / (7)	Exterior Lighting Several changes made to provide a standard for Walkway, Parking Lot, and Parking Terrace Lights that w fixture across campus.
1 November 2014	3.5/ part 2 / P. / (8)	Security Complete rewrite of the CCURE standards
1 May 2014	3.5 / l. /(11)	Engine Generator sets for U of U projects Added to standard the requirement for generators to be designed with a secure enclosure around them.
1 May 2014	3.5 / part 2 / N / 6	Conduit Capacity Updated standard to allow for 1" conduits in place of the previous standard of ¾"
1 November 2013	3.5 / P. / f.	Total Raceways Added Requirement
7 October 2013	3.5 / B. / (7) / a. / 1) b./ c.	University of Utah Electrical Requirements. Added new requirements
7 October 2013	3.5 / I. / (3) / b. / 4) / e)	Electrical. Added Manufacturer
21 September 2012	3.5 / P. / (4) / e.	Manhole Ladders. Added ladder attachment requirements
15 June 2012	Preface #2	Addition to General Introduction. Removed the reference to the emergency phone detail drawing.
15 June 2012	3.5 / P. / (3) / a.	Duct Banks. Added a reference to new Detail Drawing COM-3.
15 June 2012	- - -	General. The entire electrical engineering section (Part 1) was updated and re-written. The guide spec format previously provided in Part 1 was abandoned, and guide spec requirements considered germane and essential to University operations were either relocated into, or revised as part of the re-written section.
15 June 2012	Detail Drawings	Part 1 Electrical Engineering Detail Drawings. All Part 1 detail drawings have been removed or relocated. ***Pole Light and Electrical Manhole Drawings*** (Removed):

		The re-write of the electrical engineering section changed certain requirements formerly found in the pole light and electrical manhole drawings, rendering them obsolete. These have been removed. Current University lighting and manhole requirements are now adequately described in the re-written electrical engineering section. ***EA Security Door Drawings*** (Removed): All EA security door drawings have been removed from, and are not currently part of the University Supplement to the DFCM Design Manual. ***Manhole Ring /Cover and Communications Duct Bank*** (Revised and Relocated): Drawings ELEC-6 *Manhole Ring and Cover Detail* and ELEC-9 *Communications Duct Bank* apply only to communications. These were revised; changed to COM-3 and COM-4, and moved to Part 2 Communications and Security Wiring Systems.
06 January 2012	- - -	University Design Standards. The former University Design Standards Chapters 1through 12 were reformatted and re-issued as the University of Utah Supplement to the DFCM Design Manual. Chapter 9 Electrical was reformatted to become supplement Part 1 of DFCM's 3.5 Electrical.
06 January 2012	- - -	Campus Design & Construction. CD&C was changed to *Construction Project Delivery* and is shown as *Construction Project Delivery* or *Facilities Management* in this document.
06 January 2012	- - -	Plant Operations. Plant Operations was changed to *Facility Operations*
06 January 2012	3.5 / O. / 16612 / b. / 1)	Engine Generator Sets. Added a second transfer switch for critical research buildings

Revisions Summary (*continued*)

REVISION DATE	LOCATION	SUMMARY OF CHANGE
15 June 2012	3.5 / P. / (4) / e. / 2) / a)	Manhole Cover. Added a reference to new Detail Drawing COM-4.
06 January 2012	3.5 / O. / 16612 / c. / 2)	Engine Generator Sets. Added requirements for full load tests
06 January 2012	- - -	University Design Standards. The former University Design Standards Chapters 1through 12 were reformatted and re-issued as the U of U Supplement to the DFCM Design Manual.
06 January 2012	- - -	Campus Design & Construction. CD&C has changed to *Construction Project Delivery* (in this document CD&C was replaced by *Facilities Management*)
25 January 2011	3.5 / H. / (2) / z.	Variable Frequency Drives. Added GE to list of approved variable frequency drive manufacturers
25 January 2011	3.5 / O. / 16612 / 6.	Engine Generators. Added Caterpillar to list of approved engine generator set manufacturers
25 January 2011	3.5 / O. / 16730	Clock Systems. The section regarding building clock system requirements was re-written
10 December 2009	3.5 / B. / (1) / h.	Contractor to Repair Damage. Added requirement for repair inspection by Electric Shop
10 December 2009	3.5 / B. / (1) / l.	Clean-Up. Electrical rooms and equipment must be cleaned during and at end of project
10 December 2009	3.5 / O. / 16110 / c.	Security Conductors in Conduit. Low voltage security conductors in conduit
10 December 2009	3.5 / O. / 16110 / b.	Parallel to Walls. Removed requirement to be parallel to walls
10 December 2009	3.5 / O. / 16110 / g.	Condulets. Restrictions on condulets changed
10 December 2009	3.5 / O. / 16120 / b.	Power Conductor Color Coding. Power conductor neutral 480v changed to grey
10 December 2009	3.5 / O. / 16120 / b.	Power Conductor Color Coding. Added green power conductor ground
10 December 2009	3.5 / O. / 16140 / a.	Label Outlet Box & Cover. Label outlet box and cover with circuit and panel
10 December 2009	3.5 / O. / 16150 / a.	Motor Soft Starting System. Motor soft start required at 10 HP and above

10 December 2009	3.5 / H. / (2) / l.	VFD Screened Labels. Removed screened labels
10 December 2009	3.5 / H. / (2) / r.	VFD Label for Control Signal. Added label on VFD identifying control signal
10 December 2009	3.5 / H. / (2) / z.	VFD Manufacturers. Revised approved manufacturers
10 December 2009	3.5 / I. / (9)	Distribution Panels. Removed fusible type panels
10 December 2009	3.5 / I. / (9)	Distribution Panels. Added Cutler Hammer
10 December 2009	3.5/ I. / (10)	Branch Panels. Added Cutler Hammer

Revisions Summary (*continued*)

REVISION DATE	LOCATION	SUMMARY OF CHANGE
10 December 2009	3.5 / H. / (1) / a.	MCC. Removed fusible MCC
10 December 2009	3.5 / O. / 16167	Labels. Permanent plastic engraved labels are required
10 December 2009	3.5 / O. / 16302 / b. / 2)	Manhole Cable Supports. Added “or equal”
10 December 2009	3.5 / O. / 16302 / b. / 4)	Manhole Grounding Conductors. Removed “and neutral conductor”
10 December 2009	3.5 / O. / 16302 / b. / 6)	Manhole Cable Racks. Removed “porcelain” sleeves
10 December 2009	3.5 / O. / 16302 / b. / 8)	Manhole Entrance Hatch. Added required location of the entrance hatch
10 December 2009	3.5 / O. / 16302 / b. / 13)	Manhole Bell End Entrances. Added “or equal”
10 December 2009	3.5 / O. / 16303 / c.	Duct Bank Elbows & Offsets. Added composite resin
10 December 2009	3.5 / O. / 16304 / b.	Cables. Added approved manufacturers
10 December 2009	3.5 / O. / 16304 / c.	Cables. Added high voltage splices and terminations
10 December 2009	3.5 / O. / 16304 / c.	Cables. Replaced “dead” with “load”
10 December 2009	3.5 / O. /	Cables. Removed fiberglass fire resistant tape over 3M

	16304 / d.	
10 December 2009	3.5 / O. / 16304 / e.	Cables. Replaced “neutral” with “ground” in three places
10 December 2009	3.5 / O. / 16304 / g.	Cables. Added requirement for cable tags
10 December 2009	3.5 / O. / 16304	Cables. Deleted special order uncoated #19 awg wire / trunk lines
10 December 2009	3.5 / O. / 16304	Cables. Deleted cable factory tests

Revisions Summary (*concluded*)

REVISION DATE	LOCATION	SUMMARY OF CHANGE
10 December 2009	3.5 / O /. 16304	Cables. Deleted DC Hi-Pot Testing
10 December 2009	3.5 / O. / 16360	HV Solid Dielectric Switches. Removed SF-6 gas switches
10 December 2009	3.5 / O. / 16360	HV Solid Dielectric Switches. Added solid dielectric switches, revised requirements
10 December 2009	3.5 / F. / (~~1~~) / c.	Grounding. Added termination to ground buss
10 December 2009	3.5 / I. / (3) / c.	Transformer Overcurrent Protection. Replaced vacuum interrupter SF-6 w/ solid dielectric
10 December 2009	3.5/ C. / (7) / c., g. & (10) / a.	Exterior Lighting. Revised requirements for outdoor lighting
10 December 2009	3.5 / O. / 16612 / a.	Generator Sets. Removed indoor generator sets
10 December 2009	3.5 / O. / 16612 / e.	Generator Sets. Added opacity test
10 December 2009	3.5 / O. / 16721 / l. / 2)	Fire Protection Fan Shutdown. Added separate enclosure for relays
10 December 2009	3.5 / O. / 16721 / l. / 2)	Fire Protection Fan Shutdown. Added “no shut down for fume hood fans”
10 December 2009	ELEC-1	Walkway Light Assembly. Revised
10 December 2009	ELEC-2	Drawing Detail. Removed
10 December 2009	ELEC-3	Parking Lot Light Assembly. Revised
10 December 2009	ELEC-5	Manhole Section. Added note regarding manhole opening
10 December 2009	ELEC-8	Manhole Exploded View. Revised

10 December 2009	EA-1	CCure Door Detail. EA-1 Revised
10 December 2009	EA-2	CCure Door Detail. EA-2 Revised
10 December 2009	EA-3	CCure Door Detail. EA-3 Revised

DESIGN REQUIREMENTS

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3.0 DFCM REQUIREMENTS

3.5 Electrical

REVISED:

The latest adopted edition of the following Codes and Standards are to be considered a minimum requirement for Section 3.5. Where items contained in this section are in conflict with any of the following codes or standards, the more stringent requirement shall apply: National Electrical Code – NEC; International Building Code – IBC; International Energy Conservation Code; Illuminating Engineering Society of North America – IESNA Handbook; UL 96A; NFPA 780; Utah State Fire Marshal's Rules R710; National Fire Alarm Code – NFPA 72; and Agency/Institution Design Standards (comply with the latest edition of the design standards of the project agency or institution. If conflicts exist between DFCM and these design standards, obtain written clarification from representatives of DFCM and the agency/institution). Deviations from Codes, Standards, or standard industry installation practices (*i.e.*, NEC Code Exceptions, etc.) shall be identified and submitted to Facilities Management through the University Project Manager for review during design and before bidding. Final Construction Documents shall not be submitted for bidding until all such deviations have been approved in writing by the Facility Operations Electric Shop, staff electrical engineer(s), and University Project Manager.

ADDED:

(1) Fire alarm systems shall comply with R710-4 Buildings under the jurisdiction of the Utah Fire Prevention Board, the fire alarm requirements of National fire Protection Association Pamphlets 72 1993 Edition, National Electric Code, NFPA 70 1993 Edition.

(2) National Electric Code – NFPA 70

(3) Standard for Electrical Safety in the Workplace – NFPA 70E

(4) Life Safety Code – NFPA 101

(5) Standard for Emergency and Standby Power Systems – NFPA 110

(6) National Electrical Safety Code (NESC) State Approved Version

(7) EPA Non-road Diesel Emission Standards

(8) Electronic Industries Alliance/Telecommunication Industries Association 568/569 (EIA/TIA)

A. Lighting

REVISED:

(1) All lighting shall meet or exceed the current energy code for lighting power density, control requirements, and other requirements. All lighting shall utilize the most efficient fixtures available to meet the project requirements and budget. Incandescent lighting shall generally not be used, but may be used with the approval of the DFCM representative in the following applications: theaters/stages, television studios, and art galleries. However, in these applications, LED lighting shall be strongly considered. Exterior Lighting shall be LED unless approved by the DFCM Director for DFCM managed projects, or by the University Project Manager for University managed projects. Refer to Section 5.0 for additional requirements on lighting energy requirements.

(4) Interior Lighting:

ADDED:

a. Maintainability

1) Lighting equipment selected and positioned in the project as part of the A/E's design shall be maintainable. The layout and location of light fixtures shall include consideration for lamp replacement. Placement of lighting fixtures in locations which cannot be reasonably serviced and re-lamped shall not be allowed.

2) Where lamp replacement will reasonably require the use of special equipment such as telescoping poles, man lifts, or fixture lowering devices, these shall be specified to be supplied as part of the contract.

3) Placement of lighting above stairways and atriums shall be avoided unless convenient re-lamping provisions are included as part of the design.

b. Spare Fixture Lenses

Require the Contractor to provide 10% of each type and size specified with a minimum 2 of each. Coordinate storing and delivery of spare lenses with the University Project Manager.

c. Lighting Control

A lighting control system should be provided for the interior lighting of all new buildings.

d. Dimming

1) When dimming is required, LED lighting shall be specified.

e. Fluorescent

1) Fluorescent ballasts shall be programmed start.

2) Premium lamps and ballasts shall be specified.

3) Do not specify, nor allow compact fluorescent downlight fixtures.

f. Metal Halide

1) Metal halide shall be specified with:

a) High power factor, normal ambient, 180 degrees C insulation class

b) Auto transformer with capacitor and igniter for lamps 150 watts or less

c) Constant wattage autotransformer with capacitor for lamps above 150 watts

g. LED

1) LED lighting shall be used for following applications:

a) Under-cabinet lighting applications

b) Task lighting

c) Cove lighting

d) Downlights

e) Emergency lighting and exit signs

f) Dimming applications

h. Emergency Lighting

1) Design an LED emergency lighting system for the path of egress (required in all University buildings). Any deviation will require a Project Variance Request and subsequent approval by the Design Standards Committee in accordance with Design Process section 1.4.

2) In addition to the path of egress, emergency lighting shall be provided in the following locations:

a) Where critical experiments or other activities warrant continued occupancy of the space during a power outage.

b) Transformer Vaults / Pads

c) Main Electrical Rooms

d) Emergency Generator Areas

e) Telecommunication Rooms

f) Mechanical Spaces

g) Any other specific locations where emergency lighting is deemed necessary.

3) Emergency lighting and illuminated exit signs shall be powered from an alternate power source.

a) Whenever possible, the alternate power source shall be an engine generator set.

b) Emergency lighting in all new buildings shall be connected to a new emergency generator or to an existing generator at a nearby building.

c) When the project's emergency power needs will draw from a nearby generator at another building, confirming capacity calculations (starting and load calculations) for the existing off-site generator shall be submitted to Facilities Management through the University Project Manager for review and approval prior to completing the design.

d) Remodeling projects at buildings with no access to an emergency generator may warrant the use of rechargeable batteries as the source of alternate power. If battery power is considered, the A/E must submit a request for its use to Facilities Management through the University Project Manager, and obtain written approval. When used, battery powered systems shall include automatic chargers and exercisers.

4) Emergency Exit Signs.

a) Emergency exit signs shall be typically specified as long life LEDs.

b) Photo luminescent exit signs may be approved in areas where they can be installed in accordance with all applicable UL and/or FM ratings and applications. Photo luminescent products specified for the project must be able to demonstrate minimum illumination to charge the sign.

c) Exit signs containing tritium shall not be allowed. Exceptional circumstances warranting their use will require approval from the University Department of Radiological Health through the University Project Manager, and a Project Variance Request and subsequent approval by the Design Standards Committee in accordance with Design Process section 1.4.

i. Lighting Fixture Product Data Sheets

The A/E shall submit color catalog descriptions / product data sheets (including fixture materials, dimensions, and maintainability information) both at the Design Development phase submittal and at the Construction Document phase submittal for all interior lighting fixtures intended for the project. Submit these in electronic format (PDF) to the University Project Manager who will distribute them to the appropriate Facility Operations staff electrical engineer and Electric Shop. University approval is required at each of the two phase reviews.

REVISED:

The technical standard for exterior lighting applies to all University properties. The aesthetic standard for exterior lighting applies to Lower Campus, Health Sciences Campus and Ft. Douglas. Aesthetics for all other areas should be consistent with the architectural context of the area.

(5) Exterior Lighting: Exterior Lighting shall be LED unless approved by the DFCM Director on state projects managed by DFCM. Provide break-way fuses for all phase conductors for all outside pole-mounted lighting fixtures. Provide a shorting fuse insert for neutral fuse holder. Do not use common neutral multi-wire circuits for this type of lighting. (these requirements regarding shorting fuse inserts and common neutral generally do not apply to University projects). Where outdoor lighting is specified on University projects, close coordination with Facilities Management (including the University Project Manager, Facility Operation staff electrical engineers, and the Facility Operations Electric Shop) will be required during design.

ADDED:

a. Exterior Lighting Controls

1) A lighting control system for building facade lighting and landscape lighting shall be included in the design of all new University buildings.

2) Each outdoor lighting circuit shall be controlled by a magnetically held 50A, 3P, 480V lighting contactor with a hand-off-auto selector switch and a photocell (120 v) in its own enclosure.

b. In-Concrete, In-Ground, and Bollard Lights Not Allowed

'In-concrete' light fixtures (especially in exterior stairs and walls), 'in-ground' light fixtures, and bollard lighting systems are not allowed. Any deviation will require a Project Variance Request submitted through the University Project Manager, who will distribute for review and approval to Facility Operations staff engineers, the Electric Shop, and the Design Standards Committee in accordance with Design Process section 1.4.

c. Pole Lights

1) General

a) Exterior pole lights throughout campus are to be standardized for uniformity in appearance, light pattern, and light distribution; quality of unit fabrication, engineering, and assembly; and, reliability for long term University maintenance. Poles shall be standardized as either 10' for walkways & landscape on Main Campus and the Health Sciences Campus,16' for walkway & landscape at Ft. Douglas or 20' for Parking lots and Roadways. Light pattern and distribution requirements shall be coordinated with the University Lighting Specialist.

b) Colors of the poles lights shall be determined by the area in which they are located. Health Sciences shall have silver colored fixtures and poles, Main Campus shall have black fixtures and poles, and Fort Douglas shall have bronze fixtures and poles.

c) Poles shall have a powder coated finish.

d) Poles on the Main Campus and Health Sciences Campus shall be aluminum, 10' tall x 4-1/2" straight round with the fixture end fabricated to match the appropriate fixture fitting, and all poles shall have a surface mounted round hinged base. Poles at Ft. Douglas shall be aluminum, 16' tall x 4-1/2" straight fluted with fixture end fabricated to match appropriate fixture fittings, with decorative base cover shroud.

e) Exterior light fixtures and poles specified for campus construction projects shall be restricted

to the fixtures, equipment, and installation methods described herein.

2) Circuit Conductors / Conduit

a) Circuit conductors shall be 3P, 5W (phases A, B, C, neutral and ground) and extend from the beginning of the circuit through each fixture to the end of the circuit. Minimum conductor size shall be #6 copper with a full-sized neutral and #8 ground.

b) The incoming electrical conduit at each pole shall be buried at a minimum of 2' below grade.

c) Electrical conduit shall run from pole to pole without in-ground J-boxes.

d) Require the Contractor to assemble all buried PVC conduit using both primer and glue at every joint. Glue-only joints shall not be approved (glue without primer tends to crack allowing water to flood the conduit).

e) Minimum conduit size for outdoor lighting shall be 1-1/4" schedule 40 PVC.

3) Fusing

a) Each fixture shall be specified with fusing inside of the hinged pole base.

b) Fusing shall be provided for each ungrounded conductor.

c) Fusing shall be Cooper Bussman type KTK-6, 6 amp 600 volt, with a Cooper Bussmann HEB-JJ in-line fuse holder with rubber insulating boots. Crimp style fuses shall not be allowed.

4) Concrete Bases

a) All outdoor lighting concrete pole bases shall be sized to accommodate the weight being supported. The designer shall be responsible for determining proper sizing and reinforcing based on the soil conditions as well as other site specific considerations. As a minimum, the following guidelines shall be followed:

Pole Height (feet)	Base Diameter (feet)	Base Height (overall in feet)	Below Grade Minimum Depth (feet)	#5 Rebar Vertical Reinforcing Bars (quantity)
10	2.0	3.0	2.0	8 equally spaced
20	2.0	6.0	5.0	8 equally spaced

The concrete base shall have #3 rebar horizontal ties at 12" on center. All exposed edges shall have a 3/4" chamfer. Bases shall be formed using Sonoco Sonotube or equal concrete forms.

b) Refer to the table below for concrete base height above grade and requirements for a mow strip.

Pole Location	Mow Strip Required (6" W x 3" D)	Base Height Above Grade (inches)
Planting Area	Yes	12.0
Near Sidewalk or Curb (Planting Area)	Yes	12.0
Near Sidewalk or Curb	No	12.0
Parking Lot	No	30.0

Require the Contractor to install light poles a minimum of 36" from center of base to edge of from sidewalks to avoid damage by snowplows.

c) Bases in or adjacent to parking areas shall be painted yellow.

6) Hinged Bases

a) A hinged base is required for each pole light.

b) The folding direction of each hinged base shall allow for a full 90 degree tilt.

c) Hinge direction shall not be directed onto a slope or into traffic. Coordinate hinge direction to allow for future maintainability with minimum interference to landscape, obstacles, pedestrians or vehicular traffic.

d) Pole and hinged base shall be either Sterner Lighting by Hubble Lighting, Inc. or LSI Industries, Inc.

7) Walkway Lighting Fixtures

a) All walkway lighting fixtures on the Main Campus and the Health Sciences Campus shall be LED Fixtures.

b) Fixtures shall be Dark-Sky compliant.

c) Approved LED walkway fixtures for the Main Campus and Health Sciences Campus are as follows:

Cree – Beta Edge (60 LED, 350mA, 4300k) ARE-EDR-3M-R5-06-D-XX-BK-350-43k

Hubbell – AAL Largent (60 LED, 350mA, 4200k) SLVT-T3-60LED-NW-BLK

Cooper – Mesa LED (63 LED, 350mA, 4000k) MSA-B03-LED-E1-XX-T3-BK

d) Walkway fixtures on the Ft. Douglas campus shall be a 175 watt, metal halide, acorn type fixture.

e) An approved walkway fixture for the Ft. Douglas campus is the **Hadco R52 GANN2XNNG175MH.**

f) Approved Equals of other manufacturer swill be considered.

g) LED fixtures shall have individually focused LEDs without prisms and without flat lenses.

h) Fixture optics shall typically be IESNA Type II, but shall be designed for the proper application.

i) Specify 277V unless directed otherwise by Facilities
Management through the University Project Manager.

j) All fixtures shall be required to have 60 LEDs, 4000-4500K color temperature, and a driver producing

8) Roadway / Parking Lot Lighting Fixtures

a) All Parking Lot lighting fixtures shall be LED Fixtures

b) Approved LED Parking Lot fixtures are as follows:

Cree – Beta Edge (120 LED, 350mA, 6000k) ARE-EDR-5M-R3-12-D-XX-BK-350

Hubbell – AAL Largent (56 LED, 350mA, 5000k) SLVT-T5-56LED-5K-700

Cooper – Mesa LED (126 LED, 350mA, 6000k) MSA-B06-LED-5xx-T3-BK-7060

c) Fixture optics shall typically be Type V (symmetric), but shall be designed for the proper site application.

d) Specify 277V unless directed otherwise by Facilities Management through the University Project Manager.

e) All fixtures shall be required to have, 5000-5500K color temperature, and a driver producing 350mA.

8) Parking Terrace Lighting Fixtures

a) All Parking Lot lighting fixtures shall be LED Fixtures

b) Approved LED Roadway / Parking Lot fixtures are as follows:

Cree – 304 Series
PKG-304-5M-XX-04-X-UL-SV-350-ML

Lithonia – D Series
DSXPG LED-30C-350-40K-TM-MVOLT-XXX- PIR360SS-DWHXD

Cooper – VPL VALET
VPL-B02-E1-SQ-WH-XX-OSX

c) Fixture optics shall typically be Type V (symmetric), but shall be designed for the proper site application.

d) Specify 277V unless directed otherwise by Facilities Management through the University Project Manager.

e) Occupancy sensors shall be required as part of the lighting system in all parking terraces.

10) Lighting Fixture Product Data Sheets

The A/E shall submit color catalog descriptions / product data sheets (including fixture materials, dimensions, and maintainability information) both at the Design Development phase submittal and at the Construction Document phase submittal for all exterior lighting fixtures intended for the project.

B. Raceways to 600 V

ADDED:

(7) Conduits and Raceways

a. General

All conductors shall be run in approved conduits or other approved raceways.

b. Conduit Requirements

1) Minimum conduit size shall be 3/4" except for fire alarm systems and CCure security door control wiring where the minimum conduit size shall be 1/2".

2) Where conduits are exposed to weather, wet environments, or to potential mechanical injury, specify steel galvanized rigid conduit (GRC) or intermediate metal conduit (IMC).

3) Minimum conduit size for outdoor lighting shall be 1-1/4" schedule 40 PVC.

4) Flexible conduit in lengths greater than six feet shall not be allowed.

5) Recessed lighting systems shall not be wired with permanent flex conduit running from fixture to fixture. This provision shall not be interpreted to exclude properly installed and supported UL listed plug-in wring systems.

6) Conduits will not be allowed for splices or junction boxes.

7) All EMT conduit fittings shall be fabricated from steel.

8) Fittings made from pot metal shall not be allowed.

9) Conduit installed with wrinkles, kinks, or not in accordance with recognized industry standards shall be replaced by the Contractor at no additional cost to the project.

10) Conduit installed in concrete suspended slabs or in concrete walls shall be PVC. If needed for the design of the project, obtain written approval from the structural engineer prior to any

design submission.

11) Conduit installed inside masonry walls shall be PVC or EMT.

c. Fire Alarm Circuits

For raceways containing fire alarm circuits, all conduit connectors and junction box covers shall be painted red.

d. Signal Conductors (Low Voltage)

Low voltage signal conductors (30 V / 1,000 V.A., or less) and conductors used for mechanical equipment controls shall be run in raceways.

e. Security Conductors (Low Voltage)

1) Low voltage security conductors shall be specified in conduit. *Exception*: When approved by UCard, security conductors may be routed in a cable tray installed above a UCard approved secured ceiling.

2) Loose routing of security cables shall not be allowed.

C. Conductors

REVISED:

(2) Aluminum conductors may be considered for feeders and services in sizes #1/0 and larger where approved by the DFCM Director and the user/agency of the project. Aluminum conductors are allowed on University of Utah campus between the building transformer and the building main distribution panel.

(4) Metal Clad Cable.
Type MC Cable is allowed only when concealed in ceilings or walls. MC Cable must be protected from physical damage and supported directly from the building or structure by use of a listed support. MC Cable home runs are not allowed. Home runs must be in conduit from the electrical panel or cabinet to the first junction or pull box. MC Cable used for Fire Alarm System Signaling or Initiation Circuits must have an overall outer coating of red. MC Cable is allowed on University of Utah facilities except in the following locations: Laboratories, Research facilities or work areas, and Mechanical, and Electrical Rooms. Where allowed, the MC Cable shall be labeled at each junction box, fixture, and receptacle. MC Cable shall not be used to penetrate floors or be encased in concrete.

(8) Size / Stranded Requirements

a. Minimum size conductors for power and light circuits shall be #12.

b. Conductors for control and fire alarm circuits may be smaller, but shall meet the requirements of the circuits they serve.

c. All conductors #12 and larger shall be stranded.

(9) Neutrals

a. All neutrals on distribution systems shall be sized to handle nonlinear loads.

b. Branch Circuit Neutral Conductors

1) Lighting Circuits

A common neutral shall be allowed to serve not more than three circuits each connected to a separate phase and installed in a single raceway.

2) Outlet Circuits

a) A separate neutral shall be installed for each phase conductor.

b) Not more than three circuits, including separate neutral conductors, may be installed in a single raceway.

c) Conductor ampacity should be corrected based on applicable de-rating factors.

(10) Splices

Splices for wire sizes #10 and smaller shall be screw on type. Crimp on splices designed to be used without wire stripping shall not be allowed.

(11) Color Coding

Color coding for conductors on University projects shall follow the following table:

CONDUCTOR	208Y / 120V System	480Y / 277V System
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow

Shared/Single Neutral	White	Gray
Neutral A (dedicated)	White w/Black Stripe	Gray w/Black Stripe
Neutral B (dedicated)	White w/Red Stripe	Gray w/Orange Stripe
Neutral C (dedicated)	White w/Blue Stripe	Gray w/Yellow Stripe
Equipment Ground	Green	Green

D. Grounding: Provide a separate green grounding conductor enclosed with phase conductors in all raceways on the load side of the service entrance.

ADDED:

(2) NEC and NESC Compliance

Design each grounding system in accordance with NEC and NESC.

(3) Insulated Conductors

Specify all ground conductors shall be insulated cables.

(4) Feeders

a. 480v Feeders

Raceways used for 480 volt feeders shall include a code sized green insulated ground conductor.

b. 208v Feeders

1) Raceways

a) Raceways used for 208 volt feeders shall include two code sized insulated ground conductors. These ground conductors include:

(*i*) Common or Equipment Ground

One ground conductor shall be used for the common (or equipment) ground, and shall be connected to an electrical panel's bonded ground bus at each end.

(*ii*) Isolated Ground

One ground conductor shall be used as an isolated ground system for sensitive equipment. This conductor shall be connected to an

electrical panel's insulated ground bus at each end.

(5) Panels and Distribution Boards

a. 480v Panels

480 volt panels and distribution boards shall include a bonded ground bus.

b. 208v Panels

208 volt panels and distribution boards shall include both a bonded ground bus and an insulated ground bus. The insulated ground bus is intended to provide an isolated ground system for sensitive equipment.

(6) Branch Circuits

a. Raceways used for single or multiple branch circuits shall include a code sized green insulated ground conductor.

b. Circuits used for isolated ground outlets shall be run in separate raceways; or, shall have a separate green insulated ground conductor installed and tagged with identification at all outlet and junction boxes.

(7) Conduits

a. All metallic conduits shall be properly grounded and bonded.

b. Specify a separate code sized insulated ground conductor, terminated to an insulated/isolated ground buss for each of the following applications:

1) Conduits serving as panel or other feeders.

2) Conduits serving branch circuits

3) Conduits serving outlets anticipated to power computers or word processors.

4) Conduits serving isolated ground receptacles.

5) Full length of all plug strips and other surface wire ways.

6) All flex conduits.

E. Medium Voltage

(1) Medium Voltage Conductors:

ADDED:

a. Cables and Terminations

1) Medium voltage cables shall be single conductor cable rated to 15.5kV. Conductor shall be stranded, class B annealed copper, covered with an extruded semi-conducting ethylene propylene rubber (EPR) strand screen, 220 mil EPR insulation extruded EPR semi-conducting insulation screen 5 mil bare copper shielding tape with 12-1/2% minimum overlap, 80 mil flame retardant PVC jacket overall, 15kV type ungrounded neutral with 133% insulation level.

2) Each cable shall be individually wrapped using fire retardant electric arc proofing tape for its entire length where it is not located inside of a duct bank (*i.e.*, inside each manhole, vault, transformer, switchgear section, etc.).

3) Each cable shall be individually mounted to the manhole with Unistrut supports (or equal) using porcelain or ZSI, Inc. Cush-A-Grip cable clamps (or prior approved equal).

4) All feeders entering a manhole shall ring the manhole a minimum of 360 degrees prior to terminating onto a switch or exiting the manhole.

5) Each medium voltage feeder which is part of the main distribution line shall consist of (3) #500MCM 15kV cables with (1) #4/0 THWN Cu ground.

6) Each medium voltage feeder branching from the main line to a transformer shall consist of (3) 4/0 15kVcables with (1) #4/0 THWN Cu ground.

7) Each ground conductor shall be grounded at each manhole or transformer/switch vault.

8) Conductors shall be color coded by phase with colored tape.

    a) The University phasing scheme is: Phase A – Red, Phase B – Yellow, and Phase C – Blue.

    b) Phase designation shall be provided near each entrance or exit point inside a manhole, vault or pad location, at 10’ on center inside a manhole, at any switch section the feeder connects to, and inside the primary compartment of each transformer.

9) Feeder Identification Tags

    a) Feeder identification tags shall be provided for each cable, attached to phase B using a black weather resistant zip tie, in each manhole or transformer vault.

b) See B. / (11) Labeling & ID Tags / b. / 3) / c. MV Cable for tag requirements.

10) Cable terminations shall be molded product, 600A dead break and 200A load break. Splices shall be either heat shrink or cold shrink style.

11) Acceptable Manufacturers

a) Cable

Okonite, Kerite Company, General Cable Corporation and Superior Essex

b) Splices

3M, Raychem TE

c) Terminations

Thomas & Betts Elastimold, Cooper Power Systems, 3M and Richards Manufacturing

d.) Switches

1) General

a) The University's underground medium voltage electrical distribution system is sectionalized by load break switches. Extensions to the underground distribution system shall be designed with load break switches described herein, mounted on concrete pads, and enclosed by a block wall with a lockable metal gate.

(*i*) Switches shall not be allowed in manholes, unless approved in writing by Facilities Management through the University Project Manager.

2) Enclosure / Screen Wall

a) Design an enclosure or screen wall for exterior transformer(s) and/or switch(es). Enclosure / screening requirements described herein apply to both switches and transformers (transformer equipment requirements are provided below under I. Electrical Distribution).

b) Switch(es) may be combined with transformer(s) within the same enclosure or screened setting.

c) The design of the enclosure / screen wall shall be consistent with the architectural design of the adjacent

building and/or surrounding environment. Locate the equipment and appropriately screened setting in such a way that it is complimentary to and compatible with its surroundings.

d) Each switch or transformer shall be mounted on a concrete pad.

e) Design the enclosure / screen wall with accessibility for maintenance and future removal / replacement of the switch and/or transformer.

f) Location and screening details shall be submitted for approval during project design to Facilities Management through the University Project Manager.

g) Switches and transformers are to be specified with cabinet locks which will suffice for basic equipment security [see 4) *Cabinet Door Standardized Locks* below]. If the equipment must also be placed within a gated secure enclosure, add the following features:

(*i*) Generally, each unit located within the secure enclosure shall have its own metal access gate facing the unit's primary maintenance access panels.

(*ii*) The gate width for each opening shall be sized sufficiently wider than the unit it faces to allow direct removal and replacement of the entire unit.

(*iii*) The enclosure and metal gate(s) shall be rugged, maintenance free, designed to discourage entry by the public, and include an appropriate no-maintenance drainage system.

(*iv*) Design each gate in the enclosure to be locked with an ASSA catalog #65190B padlock. Due to security keying constraints, no other lock will be approved. See 4) *Cabinet Door Standardized Locks* below for cabinet lock requirements. Require the Contractor to coordinate with Facilities Management Key Shop through the University Project Manager for standardized keying instructions.

3) Solid Dielectric Switch Requirements

a) SF6 and oil switches shall not be allowed.

b) New switches shall be 15kV, 600A, pad style with switching contacts contained within a solid dielectric medium.

c) Specify combination of 600A dead break and 200A load break “vacuum fault interrupting” (VFI).

d) Require switch sections with single blade per phase, externally operable, with “quick-make”, “quick-break” mechanism.

e) Specify bushings located on the front of each switch section, disconnecting handle mounted on the side.

f) Include overcurrent protected ways with a VFI and electronic controller contained in a submersible enclosure.

g) Require parking stands adjacent to each entry bushing.

h) Specify a window in each section with visible trip flags.

i) Require a disconnect handle in each section with provisions for being locked in the “on” or “off” position using the University of Utah standardized cabinet door lock described below.

j) Include contacts for future SCADA switch position monitoring.

k) Specify entry termination(s) suitable for standard 600A dead break molded elbows for incoming and outgoing lines.

l) Require VFI ways with entry terminations suitable for standard 200A load break molded elbows.

m) Specify that the switch shall be mounted on a stainless steel support structure with adequate seismic bracing.

n) Require a painted NEMA 3R enclosure.

o) Include additional spare ways for future needs of the campus electrical system.

p) Acceptable Manufacturers

(*i*) Thomas & Betts Elastimold

(*ii*) G & W Electric Company

4) Cabinet Door Standardized Locks

a) Specify specific padlocks for each lockable cabinet door. Exterior rated weatherproof industrial grade padlocks shall be ASSA catalog #65190B, #2 padlocks, with re-keyable cores and non-retaining key.

b) All padlocks shall be keyed alike with the University's master electrical key.

c) Require the Contractor to coordinate with Facilities Management Key Shop through the University Project Manager.

5) Labels and Identification Tags

a) A switch identification tag shall be provided to identify the switch and its service information.

b) See B. / (11) Labeling & ID Tags / b. / 3) / d) and e) for tag and attachment requirements.

(2) Medium Voltage Duct Banks.

ADDED:

a. Communication Duct Banks

Communication duct bank requirements are <u>not</u> provided in this section. See 3.5 Electrical Communications and Security Wiring Systems for communication duct bank requirements.

b. Spare Ducts in Medium Voltage Duct Banks

The A/E's design shall include spare ducts within the duct bank in consideration of future needs of the campus electrical system.

c. Assembly Requirements for Medium Voltage Duct Bank

1) A duct bank shall be an assembly of conduits with, supports, rebar, etc., encased in concrete and buried as described below.

2) Primary ducts in a straight-line, or near straight-line duct bank (not at building or manhole entries) shall be 5" schedule 40 PVC conduits, spaced a minimum of three inches between ducts.

3) Duct bank turns greater than 30 degrees shall require 5"diameter elbows of either galvanized rigid conduit wrapped with PVC tape, or fiberglass sweep elbows, connected to straight length conduit with smooth transitions.

4) Each conduit in the duct bank at building entry, vault, or

manhole entry shall be a 10 ft. length of rigid conduit, wrapped in PVC, connected to up-line conduit with smooth bore couplings, and threaded at the open end. Terminate each conduit opening in the building, vault or manhole with a flush mounted "bell-end" threaded into each conduit opening. Metal bell-ends shall be galvanized, rigid metal, and installed flush in the wall.

5) Each duct bank shall have a minimum of two (2) 1" schedule 40 PVC conduits located at the top of the duct bank (for future SCADA and 120V power connections in the manhole). Require these conduits to be terminated with a small extension into the manhole to allow for future connection to or extension of the conduit.

6) Rebar in the duct bank shall consist of U-shaped #3 cross rebar installed at 36" on center along the entire length of the duct bank. The cross rebar shall be pounded a minimum of 12" into the ground below the bottom of the duct bank.

7) The duct bank shall contain two (2) 4/0 bare copper grounds running throughout its entire length. The ground cables shall be terminated at grounds within each manhole or vault.

d. Concrete Encasement

1) Concrete encasement shall be a minimum of three inches between conduits, and four inches between conduits and earth.

2) Require the Contractor to either mix red dye in the concrete, or sprinkle red dye on top of freshly poured concrete while still wet.

e. Soil Cover Requirements

1) Coordinate site grading and landscaping to provide a minimum of 36" cover between finished grade and the top of the duct bank.

2) Require the Contractor to install a yellow metallic locator ribbon during backfill. The locator ribbon shall be placed directly above the centerline of the duct bank and 12" below finished grade.

f. After Installation

1) After installation, direct the Contractor to pull a mandrel through each duct to insure that no debris has collected in the duct. The mandrel shall be not less than 12 inches long, and the mandrel diameter shall not be less than 1-1/2 inches diameter smaller than the duct diameter.

2) Direct the Contractor to insert a full length polypropylene pull rope in each unused conduit, connect a plastic conduit plug to each end of the rope, and seal the plugs to each end of all unused conduits with silicone sealant.

g. Labeling Requirements

1) Require the Contractor to install a permanent engraved label on each end of the duct bank near the duct bank's placement within the building/manhole/vault.

2) Additionally, the Contractor shall be required to install a permanent engraved label for each conduit leaving the manhole. Specific instructions are provided in B. / (11) / b. / 3) / b) herein.

ADDED:

(4) University Manholes

a. General

Manholes will be included in the design of the University's underground medium voltage electrical distribution system in accordance with the requirements below. *Note*: Communications manholes have separate requirements. See 3.5 Electrical Communications and Security Wiring Systems for communications manhole requirements.

b. Site Location

1) The placement of manholes on campus shall be carefully considered with Facilities Management through the University Project Manager.

2) The A/E shall develop the proposed distribution design layout and manhole locations using information found in the University Campus Master Plan. The distribution design shall address the electrical power needs for the project and include the needs of existing buildings and future facilities identified in the Campus Master Plan.

3) Manhole placement shall include consideration for reasonable pulling tension.

4) Access hatches for manholes shall be located in landscaped areas and not in parking lots and roadways.

c. Manhole Size

University manholes shall be 10'wide x 16'long x 9'high (inside

dimensions).

d. Manhole Fabrication and Accessory Requirements

1) Manhole Fabrication Requirements

a) The manhole shell shall be fabricated with 8" reinforced concrete walls, roof and floor, either cast in place or pre-cast. Knock out panels shall be provided as needed for the project.

b) Manhole construction shall be suitable for an H20 highway loading.

c) Require a full width lift off panel on the roof for equipment access.

d) The access opening shall be located in the corner of the manhole opposite the location of the medium voltage switch.

e) Grade rings are preferred to be poured in place to match existing grade or slope.

f) Specify waterproofing for manhole openings, including the manhole entrance, air vents, etc. Require the Contractor to seal openings, grade rings, etc., with Sika "Sikadur Combiflex" sealing system or prior approved equal.

g) Each manhole shall have openings for two 12" schedule 80 PVC air vents. The vent openings shall be located on opposite walls, one located near the bottom of one short wall, and the other near the top of the opposite short wall. See "Manhole Accessory Requirements" below.

h) Specify flush mounted cast-in horizontal cable supports, equal to galvanized Unistrut, for the manhole walls.

(*i*) Specify a minimum of (3) evenly spaced rows of Unistrut supports with the lowest support at 12" above the finished floor of the manhole, and the remaining two installed at 3'-8" and 6'-4" above the manhole floor.

(*ii*) These Unistrut cable supports shall circle the full interior, on all four walls of the manhole.

i) Each manhole shall have four (4) iron ring pulling eyes cast into the manhole walls, one near the floor of each wall, centered on the wall.

j) Each manhole floor shall be sloped to a grate drain and matching frame in the center which will drain to a rock sump provided under the manhole floor.

2) Manhole Accessory Requirements

a) Entry Hatch

(*i*) Specify a 4’ x 4’ galvanized steel “floor/vault/sidewalk” style hatch with two (2) 2’ x 4’ doors.

(*ii*) Cover and frame shall be 1/4" galvanized steel.

(*iii*) Cover shall be diamond-patterned with a hot-dipped galvanized finish.

(*iv*) Specify a formed channel frame with full anchor angle welded around the perimeter, designed for the collection and draining of water. The hatch frame shall have a 1-1/2” drain coupling welded under the frame assembly, suitable for connection to an auxiliary drain pipe. The collection system shall be adequately sized to divert storm water or landscape irrigation from entering the manhole.

(*v*) Hatch operators shall be compression springs enclosed in telescopic tubes to provide lift assistance for each cover door. An automatic hold-open arm with grip release handle shall be specified for each door.

(*vi*) Specify 3/8" forged brass heavy duty hinges with stainless steel hinge pins. Hinges shall be recessed into the doors to provide a flush surface.

(*vii*) Specify a stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle. The access cover for the exterior handle shall be a screw plug insert which is gasketed and flush with the cover.

(*viii*) Require the Contractor to connect a full size drain from the frame drain coupling to a gravel sump (separate from the manhole air vent drywells).

(*ix*) The access hatch covers and entire assembly shall be designed to withstand an H-20 wheel loading.

b) The manhole ladder shall extend from floor to hatch entry point. The ladder shall be all stainless steel, 14" wide, with 1-1/2" x ½" runners and 3/4" knurled risers at 12" on center. The ladder shall be securely bolted to the structure at the top and bottom of the manhole with stainless steel bolts.

c) Design a full width lift off panel in the manhole roof for equipment access.

d) University manholes shall have two (2) 12" schedule 80 PVC air vents attached to opposite short walls.

(*i*) Air vent entries shall be located near the bottom of one short wall, and near the top of the opposite short wall.

(*ii*) Each air vent riser shall extend below the manhole wall entry into a gravel drywell (1 cubic yard of gravel). This extension will allow rain and irrigation water flowing down from the topside air vent termination box to bypass the manhole wall entry and continue down into the gravel drywell.

(*iii*) The A/E's design shall show the location of the joint air vent termination box. Both air vents shall be routed into a 24" x 24" concrete box with a powder coated expanded metal top (color to match or blend with the landscape surroundings). The vents shall extend up into the concrete box 12" above finished grade, flush with the expanded metal top. The vent outlets and concrete box shall be located in landscaped areas (sidewalks and parking areas must be avoided).

e) Include specifications for an appropriate rock sump under the manhole grate drain.

f) In addition to the flush mounted “cast-in” horizontal Unistrut supports, require the Contractor to install vertical, surface mounted, cable supports over the cast-in horizontal supports, equal to galvanized Unistrut. Vertical cable supports shall be installed in a minimum of four (4) columns along each long wall, and two (2) columns along each short wall.

g) Require the Contractor to install a grounding ring, consisting of a 4/0 bare copper conductor, circling the entire manhole. Require the following connections to this ground ring:

(*i*) Two (2) 3/4" x 10’ copper clad ground rods located in opposite corners.

(*ii*) All Unistrut support racks.

(*iii*) Each bell end at each duct bank.

(*iv*) Each ground conductor running through the duct bank.

h) Each manhole shall have two (2) evenly spaced, ceiling mounted, vapor tight, wet location, 120V, compact fluorescent, cast aluminum “jelly jar” light fixtures with cast guard. A light switch, enclosed in a cast iron box with weatherproof flip cover, shall be located near the manhole entrance.

i) Each manhole shall have one (1) 20A, 120V duplex receptacle in a cast iron box with weatherproof flip cover, located on a wall near the top.

j) Require the Contractor to install a University furnished manhole identification tag at each manhole. Specific instructions are provided in B. / (11) / b. / 3) / h) herein.

k) Cable entering / leaving the manhole shall enter / exit through 10’-0” rigid conduit with bell ends at the manhole interior wall.

l) Require the Contractor to ring the manhole with each cable before terminating.

m) Support each cable in the manhole at Unistrut cable supports with rubber cush-grips.

n) Specify and/or detail all required safety connections (*i.e.*, deadbreak connectors with cable clamps, drain wire, neutral grounds, etc.).

(5) Transformer Vaults on Campus

a. Transformer vaults shall be designed at locations where vault doors open directly to the outside.

b. Vault doors shall be sufficiently sized to allow full access for removal and replacement of the transformer(s) and switch(es).

c. Design adequate outside ventilation for transformer cooling per manufacturer's requirements. Transformer fan cooling shall not be allowed.

d. Transformers with external wiring to open insulators shall be oriented in the vault with the high voltage side against a wall.

e. Transformers and associated switch gear shall be set on individual concrete housekeeping pads 6" above floor level.

f. Generators shall not be allowed to be located in transformer vaults.

F. Motor Controllers

(1) Motor controllers:

ADDED:

a. Combination Starters

1) Combination starters shall be specified as full voltage, non-reversing magnetic type. Disconnect shall be quick make, quick break. Starters shall have electronic resettable thermal overload elements for all three phases. Minimum starter size shall be NEMA 1. Starters shall be specified with hand-off-auto selector switch.

2) Acceptable Manufacturers

a) Eaton Corporation Cutler-Hammer

b) GE Energy

c) Siemens AG

b. Electronic Solid State Starters (where applicable)

1) An electronic soft start system shall typically be specified for each motor 10HP and above. Soft start systems shall incorporate the features of the combination starter in addition to the following:

a) 18 Pulse converter design to maintain minimal AC line distortion.

b) Adjustable ramp start of 0.5-180 seconds.

c) Adjustable current limit of 0-85% of locked rotor current.

d) Adjustable soft stop from 0-60 seconds.

e) Electronic timing relay adjustable from 0.1-60 seconds.

f) Automatic fault isolation.

g) Elapsed time meter located on the front door of the starter.

2) Acceptable Manufacturers

a) Eaton Corporation Cutler-Hammer

b) GE Energy

c) Schneider Electric Square D

d) Siemens AG

c. Motor Control Centers (MCC)

1) All motor control centers shall be specified with:

a) Copper busing.

b) CU/AL rated lugs.

c) Circuit breaker type.

d) Two normally open and two normally closed spare contacts for all controllers.

e) No external control wiring. Auxiliary contacts shall be used.

2) Specify wiring standard to be Class-B.

3) Require the Contractor to install a permanent engraved label(s) to clearly identify each controller and any spares/spaces. Specific instructions are provided in B. / (11) / b. / 3) / j) above.

4) Acceptable Manufacturers

a) Eaton Corporation Cutler-Hammer

b) GE Energy

c) Schneider Electric Square D

d) Siemens AG

(2) Variable Frequency Drives:

ADDED:

a. General Requirements

VFD specifications shall require complete schematic drawings, catalog sheets and wiring diagrams showing actual components, including part numbers, and how they are all interconnected. All of these items shall be included in the Operation and Maintenance Manuals with test certificates, warranties and a listing of qualified service personnel responsible for all warranty work.

b. Specific VFD Requirements

1) Each drive shall be specified as a complete system and shall be assembled in a single NEMA rated enclosure suitable for the conditions in which it is to be located.

2) Where multi motor units are used, each motor shall have separate overload protection.

3) Variable frequency drives shall be rated for continuous operation at 10 percent (minimum) over the full load current rating of the motor served.

4) Inverter shall be altitude compensated, and sized for the elevation at which it is installed. Inverter shall be mounted on a removable panel to facilitate maintenance. Inverter shall be VT rated.

5) Specify remote signal connection terminals (0-10 VDC = 0-100% speed, or, 4-20 mA = 20-100% speed). Label the VFD cabinet specifying which control signal is used.

6) AC line reactors shall be specified.

7) Specify surge suppressors for the line side conductors feeding each variable frequency drive.

8) Specify reactive filters for the load side conductors feeding each variable frequency drive.

9) Cooling fans and filters are required in all variable frequency drive enclosures. Filters are to be replaced with new at Substantial Completion.

10) Short circuit protection shall be provided through an externally operated, door interlocked fused disconnect, circuit breaker, or motor circuit protector (MCP). MCP shall allow for trip adjustment sufficient to start the motor across the line in the bypass mode and normally will be set at a minimum setting for maximum protection in the VFD mode. The door interlocked handle must be capable of being locked in the off position and be pad lockable.

11) Overcurrent protection shall be provided in the VFD system through electronic motor overload (MOL) circuits with instantaneous trip, inverse time trip, and current limit functions which shall be adjustable and optimized for the application.

12) Over- and under-voltage protection, over-temperature protection, ground fault protection, and control/microprocessor fault protection shall be provided. These protective circuits shall cause an orderly shutdown of the VFD, provide indication of the fault condition, and require a manual restart, except for an under-voltage condition. Under-voltage from a power loss shall be set to automatically restart after a time delay and return to normal power.

13) Control power for operator devices shall be 120 volts with primary and secondary fuses.

14) Specify integral harmonic mitigation to ensure maximum total harmonic distortion is 3% for voltage and 12% for current.

    a) See J. Power Quality / (6) below for additional requirements.

15) Require the capability to connect each VFD to the University's building management system (see 3.5 Mechanical Part 1).

16) The VFD shall have a three contactor bypass arrangement.

17) All wiring for the VFD will be hot emboss marked for ease of troubleshooting.

18) Each complete variable frequency drive package shall be listed and carry the label of at least one of the following:

a) UL - Underwriters Laboratory

b) ETL - ETL Testing Laboratories, Inc.

19) Specifications shall require a five year warrantee for parts and labor.

20) Vendor start up shall be specified for each variable frequency drive system.

c. Inverter Protective Features / Required Alarms

1) Overcurrent Shut-Off

2) Regenerative Overvoltage

3) Electronic Thermal Protector

4) Heatsink Overheat

5) Instantaneous Power Failure

6) Ground Fault

d. Door Mounted Operator Devices

Door mounted operator devices shall be industrial oil tight similar to those found on motor control centers.

e. Required Door Mounted Operator Controls

1) Hand/Off/Auto switch

2) Local/Remote switch

3) Frequency Setting Speed Pot

4) Power On light

5) VFD Enable light

6) VFD Fault light

7) External Fault light (safeties interlock)

8) Bypass switch (for motors over 5 HP)

f. Required Termination Points on Field Connection Terminal Strip

1) Safeties Interlock (N.C. contacts located remote)

2) Remote Start/Stop Contact (N.O. contacts located remote)

3) Remote VFD Fault Contacts (N.C.)

4) Remote VFD/Bypass Enable Contacts (N.O.)

5) Remote Electronic Signal Input

g. Environmentally Controlled Room

Each motor controller shall be installed inside the building in an environmentally controlled room. Written approval must be obtained from the University Project Manager, Facility Operations staff electrical engineer, and Electric Shop for any exterior installation, including controllers serving rooftop equipment.

h. VFD Local Vendor Requirements

1) The vendor must be actively engaged in supplying pulse width modulated adjustable speed (variable frequency) drives and custom built up systems as a certified manufacturer's representative, and must have a minimum of two years of experience in supply and manufacturer authorized installations.

2) The vendor must maintain full time service personal on call 24 hours/day as well as authorized parts and service facilities within 250 miles of the University with a demonstrated record of satisfactory service for at least the last two years.

3) When a project requires "built-up" assemblies which are not "factory-standard" products, require the installing vendor to have UL 508C or ETL certification. Certification is to be submitted with the shop drawings.

i. Label Requirements

Require the Contractor to install a permanent engraved label mounted to the exterior face of the controller. Specific instructions are provided in B. / (11) / b. / 3) / k) above.

j. Acceptable VFD Manufacturers – No Others Approved

1) Danfoss

2) GE Energy

3) Mitsubishi Electric Automation

4) Rockwell Automation Allen Bradley

5) Yaskawa Electric America

(3) VFD Manual Bypass

Provide a manual bypass of the VFD as part of controller.

ADDED:

a. A manual isolation bypass switch shall be specified for VFD's rated over 5 HP. The manual isolation bypass switch shall be on the line side of the inverter allowing maintenance operations to be safely performed while the system is operating in bypass mode. The bypass shall include minimum of two (2) mechanically interlocked contactors.

b. Do not design a VFD system for motors 5 hp or less.

G. Electrical Distribution

(1) Overcurrent and Ground Fault Protection:

ADDED:

a. For all electrical distribution systems at the University of Utah, selective coordination and short circuit studies shall be completed by the A/E and submitted as part of the Construction Documents phase submittal. The A/E shall assume an infinite bus on the primary side of all building transformers. Settings for all adjustable trip breakers shall be provided to the Contractor prior to electrical system startup.

b. Electrical service to all University buildings shall be 120/208V, 3P, 4W or 277/480V, 3P, 4W, or both.

(3) Transformers:

ADDED:

a. Distribution Transformers for University Buildings

1) Transformers shall be pad mounted on the exterior of the building or in a vault with adequate access to the exterior allowing replacement of the transformer. Transformers shall meet the following requirements as a minimum:

a) Pad mounted.

b) All copper windings with a delta primary and wye secondary.

c) FR3 insulation fluid (vegetable oil based) with nitrogen blanket.

d) Four (4) 2-1/2% full capacity primary winding taps, with two above and two below the rated primary voltage with an externally operated de-energized tap changer.

e) Transformer primary shall have two (2) sets of three (3) 200A bushing wells (loop feed style) that will accept load break elbows or lightning arrestors. Lightning arrestors shall be provided and installed on second set of bushings.

f) Each transformer shall be capable of being readily and easily locked. Provide exterior weatherproof, industrial grade rated padlocks for each transformer lockable cabinet door. Specify the padlock to be an ASSA catalog #65190B, #2 padlock, rekeyable core, non-retaining key. Due to security keying constraints, no other lock will be approved. Require the Contractor to coordinate with Facilities Management Key Shop through the University Project Manager for standardized keying instructions.

g) Transformer sound levels shall comply with NEMA Standard TR.

h) For transformers larger than 750 KVA / 208-240V secondary, and 1500 KVA / 480V secondary, the low voltage bushings shall be wall mounted with additional insulated support for the bushings.

2) Transformers shall have a 12470V primary rating. If fed from an existing feeder that is not on the new campus standard 12470V system, the transformer shall be specified to be dual rated to allow for future transition to 12470V.

3) Each transformer is to be protected on the primary side by a separate solid dielectric vacuum fault interrupting switch. The specified VFI shall coordinate with the existing University electrical distribution, and settings shall be provided to the Contractor.

4) Require the Contractor to install a permanent engraved label mounted to the exterior of the transformer. Specific instructions are provided in B. / (11) / b. / 3) / f) herein.

5) Acceptable Manufacturers

a) Cooper Power Systems

b) GE Energy

c) Eaton Corporation Cutler-Hammer

d) Schneider Electric Square D

e) MGM Transformer Company

b. Step Down Transformers for University Buildings

1) When electrical power is needed at a voltage other than that provided by the building's electrical service, the needed voltage may be provided by including a step down transformer in the system design.

2) Step down transformers shall be specified with the following requirements:

a) Dry-type, K rated.

b) Pad mounted.

c) Copper windings.

d) Specify a K-20 rating with 200% neutral for transformers smaller than 300kVA intended to handle non linear loads.

e) Specify a K-13 rating with 200% neutral for transformers 300kVA and above intended to handle non linear loads.

f) Temperature rise rating shall be 115 degrees through 15kVA and 150 degrees for 30kVA and larger.

g) Fan-assisted transformers shall not be allowed.

h) See J. / (5) Step Down Transformers below for more requirements.

3) Require the Contractor to install a permanent engraved label mounted to the exterior of the transformer. Specific instructions are provided in B. / (11) / b. / 3) / g) herein.

4) Acceptable Manufacturers

a) Eaton Corporation Cutler-Hammer

b) GE Energy

c) Schneider Electric Square D

d) Siemens AG

e) Synergy Energy, Inc.

c. Enclosure / Screen Wall for Exterior Transformers

See G. Medium Voltage / (1) Medium Voltage Conductors / b. Switches / 2) Enclosure / Screen Wall for specific requirements regarding screening / enclosing exterior transformers.

(5) Utility Metering:

ADDED:

a. Specify a complete metering system with the capability to connect by Ethernet to the main campus utility management system.

b. Provide an empty raceway from each service meter to the closest telecom room.

c. For buildings over 2,000 square feet, specify-a digital power meter with the following:

1) True RMS metering.

2) Standard CT and PT inputs.

3) 0.2% Accuracy for current and voltage.

4) Min/Max displays for metered data.

5) On-board clock and calendar.

6) Standard RS-485 communications.

7) Set-point controlled alarm/relay functions.

8) On-board event and data logging.

9) Waveform capture.

10) High speed triggered 12 cycle event capture.

11) Date/time for each min/max.

12) Optional voltage/power module for direct connection to 480Y/277V systems.

13) Non volatile memory.

14) Front panel features:

a) LCD digital electronic display with ability to show:

Real Time / Instantaneous Readings	Demand Readings	Energy Readings	Power Analysis Values
Current (per phase, N, G, 3phase)	Current (per phase present, peak)	Accumulated energy – real	Crest factor (per phase)
Voltage (L-L, L-N)	Average power factor (3phase total)	Accumulated energy – reactive	K-factor demand (per phase)
Real power (per phase, 3phase)	Demand real power (3phase total)		Displacement power factor (per phase, 3phase)
Reactive Power (per phase, 3phase)	Demand apparent power (3phase total)		Fundamental Voltages (per phase)
Apparent Power (per phase, 3phase)			Fundamental Currents (per phase)
Power Factor (per phase, 3phase)			Fundamental Real Power (per phase)
Frequency			Harmonic Power
THD (current and voltage)			Unbalance (current and voltage)
K-factor (per phase)			Phase Rotation

b) Kilo/Mega units LEDs.

c) Meter indication LEDs.

d) Setup/rest parameter.

e) Phase select button with phase indication LEDs.

f) Model select button with mode indication LEDs.

g) Select meter buttons.

h) Communication port.

d. Acceptable Digital Power Meter Manufacturers

1) Electro Industries/Gauge Tech (EIG) “Shark”

2) GE Energy

3) Schneider Electric Square D “Power Logic”

(6) Switchboards and Panel boards:

ADDED:

a. Switchboards / distribution boards for University of Utah projects shall be specified with:

1) Copper busing.

2) CU/AL rated lugs.

3) Circuit breaker type.

4) Fully rated.

5) Minimum of 50% spare and space capacity.

b. For remodeling projects, match new switchboards and distribution boards to the manufacturer/style of existing units in the building.

c. Include with the panel schedule, where applicable, information identifying the conductor insulation color for (*a*) all ungrounded conductors, (*b*) grounded conductors, and (*c*) equipment and isolated grounding conductors.

d. Labeling Requirements

1) Specify a permanent engraved label for all switchboards mounted on the outside face of switchboard.

2) Specify a permanent engraved label to clearly identify each switchboard breaker and spare/space.

3) Specific instructions are provided in B. / (11) / b. / 3) / i) herein.

e. Acceptable Manufacturers for Switchboards / Distribution Boards

1) Eaton Corporation Cutler-Hammer

2) GE Energy

3) Schneider Electric Square D

4) Siemens AG

(7) Panel boards:

ADDED:

a. University panel boards shall be specified with:

1) Copper busing. Aluminum alloy bus bar is allowed in Building Main Distribution Panels rated 800 amps and above.

2) CU/AL rated lugs.

3) Circuit breaker type with bolt-on style breakers.

4) Fully rated.

5) Minimum of 50% space capacity.

6) Equipment and isolated ground bus.

b. For remodeling projects, match new panel boards to the manufacturer/style of existing units in the building.

c. Panel board covers shall be hinged door-in-door style. Each door shall have a flush, stainless steel cylinder lock with catch and coil spring loaded door pull. All panels shall be keyed alike, but inner and outer doors shall not be keyed alike.

d. Panel boards shall have a sufficient number of spare conduits stubbed into ceiling spaces (or alternate locations approved by the University Project Manager and Electric Shop) to allow for full future utilization of the spare capacity available in the panel board.

e. Panel boards shall have sufficient space inside the cabinet for future cable pulls.

f. Provide a permanent engraved label for all panel boards mounted inside the door for flush panels and on the outside face of the door for surface panels. Specific instructions are provided in B. / (11) / b. / 3) / i) above.

g. Acceptable Manufacturers for Panel boards

1) Eaton Corporation Cutler-Hammer

2) GE Energy

3) Schneider Electric Square D

4) Siemens AG

ADDED:

(9) Disconnecting Means for University of Utah Projects

a. Equipment disconnecting means (thermal switch, disconnects, fused disconnects, circuit breakers, etc.) are to be provided at the unit or immediately next to the unit served. Installation of the disconnecting means at a remote location from equipment, or using a circuit breaker at the power panel as disconnecting means for equipment are not acceptable installation methods.

b. Final location of the equipment disconnects and controllers (air handlers, condensing units, exhaust fans, roof top units, pumps, etc.) are to be

coordinated with the Facility Operations staff electrical engineer and Electric Shop through the University Project Manager prior to issuing construction documents.

c. The A/E's design shall facilitate compliance to OSHA CFR 1910.147, Control of Hazardous Energy (Lock Out Tag Out).

(10) Outlets

a. Outlets shall utilize standard NEMA configurations. Minimum outlet rating shall be 20A.

b. A minimum of one electrical convenience outlet powered from the emergency electrical system shall be provided at each transformer vault/pad, main electrical room(s), and generator location.

c. Special purpose outlets (208V, 1p, 20A) shall be provided for University supplied pressure washers at each air handler, roof top unit, or any other mechanical equipment with heating/cooling coils.

d. Outlets shall be color coded based on the power source and size of the device as follows:

1) Normal power – White

2) Emergency power – Red

3) UPS Power – Blue

4) Isolated Ground (Clean Power) – Orange

5) All devices greater than 20A – Black

6) The entire body of the wiring device should be the same color (*i.e.*, a wiring device with an orange triangle on a white body is not an acceptable wiring device for isolated ground receptacle).

(11) Engine Generator Sets for University of Utah Projects

a. Each new building on campus shall be designed with an emergency generator to provide power for life safety, legally required standby systems, and optional standby systems.

b. A secure enclosure or area shall be designed around the generator.

c. Each generator shall meet the following requirements as a minimum:

1) Diesel fuel operated.

2) Skid mounted fuel tank providing capacity for 8 hours of operation at full load.

3) Four pole automatic transfer switch (ATS) with manual bypass. A separate ATS shall be provided for each type of emergency load served.

a) During design, consideration should be given to adding a secondary transfer switch for generator testing at buildings with critical research equipment. The monthly generator test normally interrupts building power for approximately 10 seconds. This could adversely affect research activities so a second transfer switch for non-life safety systems is required at buildings with critical research equipment.

4) Waterproof, level II sound attenuated enclosure.

5) Critical silencer including flexible exhaust fitting.

6) Meet the latest EPA Tier Standard.

7) See J. Power Quality / (8) below for additional requirements.

d. Generators shall not be installed in transformer vaults or switch rooms.

e. Each generator installation shall be tested at full load for a minimum of 2 hours using load banks.

1) Fuel and suitable load bank equipment shall be specified as the responsibility of the Contractor for the test.

2) Follow testing requirements found in NFPA 110 (tested under load, transfer switch operation verified).

3) Require the Contractor to schedule inspection(s) by the code official(s) for code compliance, including verification of testing under load and transfer switch operation.

4) For ‘research critical’ buildings, design the transfer system such that operation of the secondary transfer switch will easily protect non-life safety research processes / systems during the monthly generator test.

f. Require generator emission data to be submitted through the University Project Manager to the University Department of Environmental Health and Safety for review and generator approval.

1) During design, coordinate early with the University Project Manager to establish a timeline and application / submittal requirements for generator approval by the jurisdiction having authority.

g. Acceptable Manufacturers for Engine Generator Sets

1) Caterpillar

2) Cummins Onan

3) Detroit Diesel

4) Generac Power Systems

5) Kohler Power Systems

(12) Uninterruptible Power Supplies for University of Utah Projects

a. Uninterruptible power systems shall not be designed for whole building or overall project applications. Any intent to design a building-wide or large UPS system must be approved in writing early in the design phases by Facility Operations staff electrical engineer and Electric Shop through the University Project Manager.

1) Local UPS units are generally the responsibility of the end user department which will occupy the completed project. Each user department will typically furnish and install its own electronic systems and include local UPS units with their in-house purchases.

b. If approved for large system applications:

1) UPS systems shall include all equipment to automatically provide the specified voltage, current and frequency at its output terminals when utility, generator or battery power is available at its input terminals.

2) The system shall be rated for continuous duty at full load.

3) The system shall include local and remote monitoring and alarm facilities to provide advance warning of UPS equipment failure or power system failure to allow computer shutdown.

4) The system shall be designed to be serviced where it is installed without removal of any part for return to manufacturer or service facility.

5) See J. Power Quality / (9) below for additional requirements.

6) UPS Vendor Requirements:

a) The vendor supplying the UPS system shall be “local” with office and staff based along the Wasatch Front.

b) The vendor must be actively engaged in supplying UPS systems as a certified manufacturer's representative, and must have a minimum of two years of experience in supply and manufacturer's authorized installations.

c) The vendor must maintain full time service personal on call 24 hours/day as well as authorized parts and service facilities within 250 miles of the University with a demonstrated record of satisfactory service for at least the last two years.

7) Acceptable Manufacturers for Large UPS Systems

a) Emerson Network Power Liebert

b) MGE UPS Systems, Inc.

c) Mitsubishi Electric Automation, Inc.

d) Toshiba Corporation

H. Power Quality

REVISED:

(1) Performance Approach

a. The A/E shall include as a basis of design an evaluation of potential Harmonic Risks to the Electrical Distribution System and provide a plan to mitigate these risks. The Power Quality Plan shall be approved by the DFCM representative for DFCM managed projects, or by the University Project Manager for University managed projects. Power Quality Testing may be performed by the DFCM or the University after the facility is occupied to determine the effectiveness of the Power Quality Mitigation approach.

(2) Prescriptive Approach

a. Electrical Services.

REVISED:

i. Services of 300 KVA or larger shall be 277/480 volt at the Service Main Disconnecting means except for those proven to be unnecessary and approved by the DFCM Director for DFCM managed projects, or by the University Project Manager, Facility Operations staff electrical engineer, and Electric Shop for University managed projects.

c. Power Factor.

REVISED:

All new Construction or Upgrade of existing Electrical Services shall meet the minimum requirement of 95% and Maximum of 98% Power Factor. The DFCM Representative for State projects, or the Facility

Operations staff electrical engineer and Electric Shop through the University Project Manager for all University projects shall approve the method and layout of Power Factor Correction Capacitors prior to installation.

d. Step Down Transformers

REVISED:

a. All Step Down transformers shall be Energy Star Nema TPI K-rated or HMT with 200% Neutral capability, unless proven unnecessary and approved by the DFCM Representative for State projects, or the Facility Operations staff electrical engineer and Electric Shop through the University Project Manager for all University projects. The K-Rating shall be as determined by Manufacture recommendations for the equipment they serve. See I. Electrical Distribution / (3) / b. Step Down Transformers above for additional University of Utah requirements.

e. Variable Frequency Drives.

REVISED:

For motors 15 HP and larger, provide a minimum power quality performance of 12% current THD and 3% voltage THD measured at the VFD input terminals. This shall be accomplished by using Harmonic filters or a minimum of 12 pulse drive that will comply with the power quality performance requirements. For motors less than 15 hp provide AC Line Reactors and/or DC link chokes with a minimum of 3% Impedance. Provide output filtering if the motor is located more than 50 feet from the drive. See H. Controller / above for additional University of Utah requirements.

g. Generators.

REVISED:

For new construction a service that is to be backed up by a Generator shall be designed to have no more than 12% Current THD or 3% Voltage THD. For Existing Services to be backed up by a Generator Power Quality Testing shall be performed to determined that there is not more than 12% Current THD or 3% Voltage THD and that there is not a leading Power Factor. If there is it shall be corrected prior to bringing the Generator online. See I. Electrical Distribution / (11) Engine Generator Sets above for additional University of Utah requirements.

h. Uninterruptible Power Supplies.

REVISED:

Provide a minimum Power Quality performance of 12% current THD and 3% voltage THD measured at the UPS input terminals. Provide filtering if necessary. See I. Electrical Distribution / (12) above for additional University of Utah requirements.

.(3) Miscellaneous Electrical

ADDED:

e. Building Clock Systems for University of Utah Projects

a. A self-correcting clock system will be installed in University buildings either as called for in the project program, or to extend / replace existing building clock systems. The new clock system will consist of the following:

1) Clocks and Clock System Controls

a) Self-correcting clocks will operate on A/C power, shall correct via a wireless signal and be compatible with the current University system. Battery operated clocks will not be approved.

b) The clock system shall be limited to the products of SimplexGrinnell; Primex Wireless; or, Sapling, Inc. All other manufacturers must be reviewed and approved by University Facilities Management prior to bid.

c) The clock system will be furnished and installed by the Contractor; however, the Contractor is required to coordinate with the University Electronics Shop prior to ordering / installing the equipment.

2) Front-End Controller

The clock system's wireless front end controller shall be located in one of the building's telecommunications rooms where an Ethernet connection is available. Coordinate with the Electronics Shop for an approved location to install the device. The front-end controller will monitor the precise time from an internet based master clock and relay time signals wirelessly to building clocks.

3) Installation and Set-Up

a) The University's Plant Operations Electronics Shop must be contacted for coordination.

b) The Electronics Shop will:

(*i*) Review the intended system for approval prior to the Contractors' initial material order,

(*ii*) Coordinate with the Contractor for equipment location prior to installation, and

(*iii*) Work with the Contractor during system set-up.

f. Spare Fuse Cabinets

Provide spare fuse cabinet(s) in the design, located in the vicinity of the building main switchboard. Provide 10% spare fuses of each type and size specified with of minimum of three of each.

g. TVSS / SPD

Transient Voltage Surge Suppression Devices (TVSS) / Surge Protective Devices (SPD) shall be provided on building incoming electrical services, and on distribution and power panels serving sensitive electronic equipment.

h. Communication Protocols

Data communication protocol for integration of electrical systems with the building management system shall be compatible with BACnet data communication protocol. This requirement shall be applicable to all electrical systems, including, but not limited to, lighting control systems, non-local UPS systems, emergency generators, transfer switches, paralleling switchgear, power monitoring, power metering, VFDs, motorized shade controllers, etc.

(5) Fire Alarm

a. Provide addressable fire alarm systems…

ADDED:

(i) General

1) Fire alarm systems shall be fully addressable, analog and shall operate as non coded, continuous sounding systems with reverseolarity remote signal transmission.

2) All necessary provisions shall be made in the design of the fire alarm system to allow for automatic reporting of all alarms from the project fire alarm system to the remote station receiving console in Building #0301 via telephone lines.

(ii) Compatibility

All equipment, devices and installations shall be compatible with the existing system of operation.

(iii) Approved Manufacturer / Installer

1) Fire Alarm System

a) The only approved manufacturer shall be FCI (Honeywell Gamewell Fire Control Instruments) furnished and installed by Nelson Fire Systems. No

other manufacturers / suppliers / installers will be approved.

2) Fire Extinguisher Electronic Notifying Pressure Switch Monitoring System

a) Specify an electronic notifying pressure switch fire extinguisher monitoring system. The only approved manufacturer shall be MIJA, Inc., model en.Gauge. No other manufacturer will be approved.

(iv) Fire Extinguisher Monitoring System

1) During design, coordinate with the University Fire Marshall through the University Project Manager to determine the type of monitoring system (wireless or hard-wired), and type of fire extinguishers (A, B, C, D, CO_2, Halon, etc,) to be used in the project.

2) For new buildings, design a hard wired fire extinguisher monitoring system, supervised through the building's fire alarm system.

3) For existing buildings provide fire extinguishers with wireless monitoring systems.

a) At or before the design development phase review, coordinate with the University Fire Marshall through the University Project Manager to determine the locations of wireless receivers and high power repeaters, and fix their locations on project drawings.

(v) Control Panel General Requirements

1) The fire alarm control panel shall detect the operation of any signal initiating device, display the description of the device and the area of the alarm, and print out the alarm type, location, time, and date.

2) The panel shall operate all alarm and auxiliary devices and close all fire and smoke doors.

(vi) Required System Features

1) Trouble lamp and buzzer.

2) Self-restoring silencing switch.

3) Automatic locking of all alarm signals until the device is returned to its normal condition and the panel manually reset.

4) Supervision of circuits such that a fault condition in any circuit, or group of circuits, will not affect the proper operation of any other circuit.

5) Circuit fuses for each signal initiating and alarm circuit which, if blown, shall cause the audible and visual trouble signals to operate.

6) Digital transmitter with terminals and other necessary hardware / software to permit the transmission of trouble and alarm circuits over telephone lines to a remote station receiving panel.

7) A key operated "Drill Switch" to simulate the operation of an initiating device. The switch shall not trip the device which transmits a signal to the fire department, operates elevator return systems or operates fire doors.

8) Fire alarm panels shall be red, baked enamel, lockable, 16 gauge steel, with hinged door cabinets.

9) Batteries shall be gel cell type. The system will be provided with an automatic tester and charger.

10) The battery system shall have an additional 25% spare ampere-hour capacity above that required.

11) The battery system shall be capable of operating the fire alarm system at full load for 24 hours and still provide five minutes of alarm sounding at the end of the 24 hour period.

12) Visually indicating call stations.

13) Horn/strobe indicating devices with a minimum rating of 97dB and a temporal pattern signal. Electron indication devices are not acceptable.

14) External indicating appliances allowing for notification in the direction of parking lot, playground, or other people space areas.

15) Uniquely addressable detectors, removable base, with indicating lamps.

16) Connection of all fire protection systems within the building, including special extinguishing systems and elevator lobby detectors.

17) A Fire Marshall approved key plan drawing of the entire building graphically displaying the location and address of all initiation and notification devices. The key plan drawing shall indicate area occupancies and smoke separation walls. Key

plan(s) shall be mounted in a high quality plastic sign holder at the main fire alarm control panel.

18) Pre-signal systems of any type will not be allowed.

19) Wiring Requirements

a) Unless otherwise specified, minimum wire size shall be 16 gauge for audible alarm circuits, and 18 gauge for signal initiating circuits.

b) Strobes shall be wired separately from audible devices, including combination horn/strobe units.

c) Speaker and strobe wiring shall be installed in separate raceways.

(vii) Fire System Telephone Line

1) At the appropriate stage of construction, direct the Contractor to submit a formal written request to the University Project Manager who will arrange for the necessary fire system telephone line. This request must be made a minimum of two weeks prior to the final connection.

2) The Contractor shall provide two connections from the fire alarm control panel to the telephone panel, and finally to the appropriate telephone line(s) at the project end.

3) The University Department of Environmental Health and Safety (EH&S) shall make the final connection to the telephone line at the system head-end in Building #0301.

(viii) System Test

A complete system test, including all connections into the fire alarm panel, comprehensive operational review, and testing of all fire alarm devices and wiring shall be accomplished by a representative of the equipment supplier or manufacturer, qualified by the manufacturer to perform such work.

(ix) Labeling

1) Provide permanent engraved labels at each fire alarm control, notification appliance (NAC), power supply, transponder, and speaker system panel. Specific instructions are provided in B. / (11) / b. / 3) / l) above.

2) Provide self-adhesive labels for all initiation and notification devices. Specific instructions are provided in B. / (11) / c. / 4) / g) above.

(x) Final Inspection

Upon completion of the work, require the Contractor to request a final inspection through the University Project Manager to the University Fire Marshall and University Building Official. During the final inspection, all fire alarm devices shall be tested by the Contractor and witnessed by these University officials.

(xi) Warrantee Period

Specify that the accepted fire alarm system shall carry a full three year parts and labor warrantee. Require the Contractor, the equipment supplier, and the installer to provide continued emergency response services (responding within four hours of any reported system failure) through the full term of the warrantee.

ADDED:

I. University of Utah Electrical Design Requirements

(1) Pre-Design Responsibilities

a. A pre-design meeting with Facilities Management is required for new facilities or extensive remodeling of existing facilities. This meeting will be arranged by the University Project Manager, and include a Facility Operations staff electrical engineer and representative of the Facility Operations Electric Shop. The purpose of this meeting will be to identify special electrical considerations and requirements for the project.

b. The A/E's electrical engineer shall visit the project site and identify all conditions affecting the proposed electrical design.

c. Record as-built drawings, specs, utility maps, etc., applicable to the project may be requested through the University Project Manager.

d. Underground high temperature hot water piping at the site will require special precautions, especially if located in the vicinity of, or will require crossing by, buried conduit or a duct bank. See 3.8 Mechanical.

(2) Energy Management Buildings

a. Several buildings on campus were retrofitted with energy efficient equipment as part of an on-going energy management plan. Prior to design, the A/E must determine if the project will affect any of these buildings.

b. If the A/E's design will update or remodel any portion of these buildings, the A/E shall match the existing lighting fixtures, electrical systems, and mechanical equipment previously installed by retrofit. The A/E shall request information regarding design limitations and operational requirements from Facilities Maintenance through the University Project

Manager.

c. Energy efficiency and operating characteristics of existing and new fixtures and equipment must not be diminished by the A/E's design.

(3) Mutual Responsibility

Mutual responsibility requirements described in the General Conditions are often neglected, especially by subcontractors. The A/E shall add emphasis where appropriate by using drawing notes and / or references in project specifications which require the electrical contractor to communicate, coordinate, and cooperate with other intersecting trades working on the project.

(4) Maintainability

a. The University has selected materials and equipment which will satisfy specific maintenance and operational needs of the campus electrical system. Materials and equipment described herein have been tested, evaluated, and approved by the Facility Operations staff electrical engineers and Electric Shop.

b. For other materials and equipment needed for the project but not described herein, the A/E is directed to investigate and recommend products with regard to product quality and maintainability. The A/E shall select material and equipment for the project which are fabricated by reputable manufacturers, having readily available spare parts, and who are likely to remain viable with a quality product offering in the future.

(5) Material & Equipment Selected for the Project

a. List of Intended Equipment

The A/E's or its electrical engineer shall prepare a comprehensive list of all electrical fixtures and equipment intended for insertion into the project design. The A/E shall submit this list to Facilities Management through the University Project Manager, who will distribute to the Facility Operations staff electrical engineer and the Electric Shop for review and comment. The A/E's electrical engineer shall not proceed with design until receipt of equipment approval from Facilities Management.

b. Substitutions

Equipment or material substitution requests will only be approved by addendum prior to bid. A/E recommendations must be submitted for review by Facilities Management. See (10) c. below.

c. New Materials and Equipment

The project specifications shall require that the electrical contractor provide and install only new materials and equipment. Any exception must be submitted to Facilities Management through the University Project Manager who will distribute to the Facility Operations staff electrical engineer and Electric Shop. Written approval by Facilities Management is required for any exception.

d. UPS Systems [also see I. Electrical Distribution / (12) herein]

1) Local UPS units are generally the responsibility of the end user department which will occupy the completed project. Each user department will typically furnish and install its own electronic systems and include local UPS units with their in-house purchases.

2) Large UPS systems must be approved in writing early in the design phases by Facility Operations staff electrical engineer and Electric Shop through the University Project Manager.

(6) Protective Device Coordination

a. The electrical design shall include a protective relay coordination study for new buildings and for the main service upgrades at existing buildings.

b. The protective relay coordination study shall extend to distribution panels rated at 225 amps and above.

c. The proposed settings shall be submitted through the University Project Manager to the Facility Operations staff electrical engineer and Electric Shop and for review and approval.

(7) Arc Flash Study

a. The A/E shall perform or model an arc flash study as part of its design services to meet requirements of NFPA 70 and NFPA 70E.

1) Results of the study shall be submitted to the University, and appropriately applied to the review documents.

b. The arc flash analysis shall include the following at each distribution bus:

1) Bolted Fault Current

2) Arc Fault Current

3) Protective Device Settings

4) Protective Device Characteristic and Arc Fault Duration

5) System Voltages and Equipment Class

6) Working Distances

7) Calculated Incident Energy

c. Calculated Arc Flash Protective Boundary

The results of the study shall be used to specify appropriate labels specific to each panel, identifying the ARC flash hazard class based upon NFPA 70E.

(8) Short Circuit Selective Coordination

Short circuit selective coordination shall be required for emergency circuits.

(9) Commissioning

Commissioning of electrical systems shall be required on new projects with estimated electrical cost over $250,000.

(10) Seismic Support

Submit plans and calculations showing compliance to seismic requirements directed by NEC and IBC. The submittal form and additional information can be found at www.facilities.utah.edu "Building Official" section.

(11) Specification and Drawing Requirements

a. Scope Statement

Provide a summary description of the electrical scope of work in the project specifications. The purpose is to help orient the Contractor by outlining the major tasks required to complete the project.

b. Specifications

All parts of the electrical system shall be completely specified.

c. Substitution Requests

1) The University's 'boiler-plate,' which is added to and precedes the A/E's specifications, will provide directions to bidders and suppliers regarding substitution requests for material and equipment.

2) The University's 'boiler-plate' will require bidders to send substitution requests directly to the A/E. Each request is to be evaluated within the limitations found in this supplement.

3) The A/E's recommendations for approval or rejection must be

sent to Facilities Management through the University Project Manager, who will distribute to the Electric Shop and the Facility Operations staff electrical engineer for their review.

4) The A/E will adjust the list of approved materials and equipment in accordance with the University comments. The revised list of approved materials and equipment shall be inserted into an A/E authored addendum, which will be submitted to the University Project Manager and Facilities Business Services for distribution to contractors prior to the bid.

5) All addenda will be distributed only by Facilities Business Services. The A/E shall not issue addenda to contractors.

d. Special Tests & Inspections

The A/E will specify any special tests and inspections for electrical systems which are not governed by, or for which special needs exceed State adopted codes.

e. Drawing Requirements

1) Electrical drawings shall be prepared at a scale appropriate to the project size, but not less than 1/8th scale for building floor plans. See Design Process for more information.

2) Drawings shall include a complete layout of all electrical systems, including device locations. All parts of the system shall be completely detailed on the drawings.

3) Each device shall have its circuit number shown on the drawings. All panel schedules shall be shown on the drawings.

4) After project completion, system maintenance, future alterations, and future additions to the project will rely on the A/E's drawings as a basis for system maintenance and design modifications. Therefore, as project electrical drawings are prepared, the A/E will need to consider the future usefulness of the drawings as an aid to ongoing maintenance of the electrical system, and as an aid in the design of alterations or additions to the system.

(12) Labeling & ID Tags

a. General Requirements

1) The A/E shall include the information provided below in project electrical specifications and drawings, requiring the Contractor to provide and install appropriate labels and tags throughout the project's electrical system.

2) The purpose of the labels and tags is to provide clear indications of the function of each item, the loads served, routing information, etc., for primary and secondary elements comprising the electrical system.

b. Permanently Engraved Lamicoid Nameplates

1) Specify permanently engraved nameplates, labels, or ID tags for a master nameplate, also for manholes, distribution equipment, devices, etc., identified in 3) below.

2) Lamicoid nameplates shall be three-ply plastic, 1/16 inch thick. Letters shall be formed by engraving into the outer colored ply, exposing the white or black center-ply. Lettering shall be a minimum of 5/8 inch high, except for MV cable (see below).

LAMICOID NAMEPLATE COLORS		
NAMEPLATE	**OUTER PLY**	**CENTER PLY (Lettering Color)**
Master Nameplate	Black	White
Normal Power	Black	White
Emergency Power	Red	White
UPS Power	Blue	White
Medium Voltage	Yellow	Black

3) Provide permanently engraved nameplate labels / tags for the master nameplate, for each manhole, duct bank, all distribution equipment, devices, etc., listed below as well as all other similar equipment. Other electrical sections in this supplement may have additional labeling requirements.

Each label shall include the arc flash hazard class based upon NFPA 70 E, where applicable.

a) Master Nameplate

Provide a permanently engraved lamicoid master nameplate at the main distribution location affixed with double sided adhesive tape covering the back of the nameplate, to identify the project, the engineer and the installation date.

b) Duct Bank Identification Nameplates

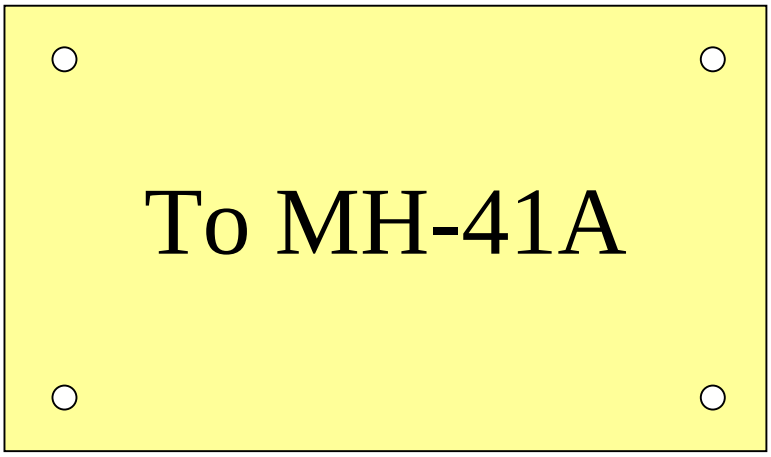
(*i*) Permanently engraved lamicoid nameplate labels must be placed adjacent to each entering / leaving duct at the duct banks in the man hole.

(*ii*) Labels are to be 3” x 5” yellow with black engraved letters.

(*iii*) Labels are to include a ¼” hole in each corner. Each label shall be affixed to the wall using plastic anchors and screws.

(*iv*) Lettering shall indicate the conduit’s next destination point or last departure point (*e.g.*, To MH #123, From Pad #123, To Vault #123).

(*v*) Example **duct bank identification nameplate**:



c) MV Cable

(*i*) Feeder identification tags shall be attached to each feeder near entrance or exit points inside manholes, vaults or pad locations; at any switch section the feeder connects to; and, inside the primary compartment of each transformer.

(*ii*) Lamicoid tags shall be 2 ½” x 2 ½” x 1/16”, diamond orientation (not a square), and shall be yellow with black engraved letters.

(*iii*) Lettering shall be 3/8” high, centered, and shall indicate the substation and feeder number (*i.e.*, F-71 [*indicating substation 7, feeder #1*]; or, RB F-10-2 [*indicating the Red Butte Substation, Substation 10, feeder #2*]).

(*iv*) Lamicoid tags shall be attached to phase B using a black weather resistant zip tie. Tags are to include a ¼” hole in the top corner to allow attachment by means of the zip tie.

(*v*) Tags shall be located where lettering will be readily visible. The zip tie attachment must not be pulled too tight, allowing for minor adjustment by maintenance personnel.

d) MV "Switch Cabinet" Identification Nameplates

(*i*) Permanently engraved lamicoid nameplate labels shall identify each switch cabinet.

(*ii*) Labels are to be 3" x 5" yellow background with black engraved letters.

(*iii*) Each label shall be affixed to the cabinet with double sided adhesive tape covering the back of the nameplate.

(*iv*) Each nameplate shall include the pad number, switch number, the building name and number served by the switch, and voltage.

(*v*) Example **MV <u>switch cabinet</u> identification nameplate** follows on the next page:

Pad 350
MV Switch SW-A
Bldg. 350 USB
12,470 V

e) MV "Switch" Identification Nameplate

(*i*) A permanently engraved lamicoid nameplate label shall:

Identify the device the switch will operate; or,

Identify the destination manhole, vault, or pad number; the switch number; and, section it serves; or,

Identify the destination switch and the section the feeder serves.

(*ii*) Labels are to be 3” x 5” yellow background with black engraved letters.

(*iii*) Each label shall be affixed to the switch with double sided adhesive tape covering the back of the tag.

(*iv*) Example **MV <u>switch</u> identification nameplate**:

To MH - 942
Switch SW-A
Section #4

f) Distribution Transformer Identification Nameplates

(*i*) Permanently engraved lamicoid nameplate labels shall identify each transformer and its location.

(*ii*) Labels are to be 3” x 5” yellow background with black engraved letters.

(*iii*) Each label shall be affixed to the cabinet exterior with double sided adhesive tape covering the back of the nameplate.

(*iv*) Each nameplate shall designate the pad number (same as the building number), transformer number, primary and secondary voltages, KVA rating, and the building name / number served by the transformer.

(*v*) Example **transformer identification nameplate**:

Pad 350
Transformer #1
12470:480/277
750 KVA
Bldg.350 USB

g) Step Down Transformer Identification Nameplate

(*i*) A permanently engraved lamicoid nameplate label shall identify each transformer.

(*ii*) The nameplate shall be 3" x 5" with yellow background and black engraved letters.

(*iii*) Each label shall be affixed to the cabinet with double sided adhesive tape covering the back of the nameplate.

(*iv*) The nameplate shall designate the transformer, electrical source feeding the transformer, load supplied, size (kVA), and the primary and secondary voltages (*i.e.*, Transformer T-1, Source PH1-1, 3, 5; Load PL1, 150kVA, 480:208/120).

h) Manhole Identification Nameplates

(*i*) Manhole identification nameplates will be supplied to the Contractor by the Facility Operations Electric Shop through the University Project Manager.

(*ii*) A manhole identification nameplate is required for each manhole, installed at existing and new manholes associated with the project.

(*iii*) The nameplate shall be mounted on the north side of the concrete ring as you enter the manhole, and shall be easily visible both from ground level outside and from the floor level inside the manhole. This standard will be followed for all manholes on campus, and provides a means for convenient orientation by

observing the nameplate in a known location, either while entering or when established inside the manhole.

(*iv*) The nameplate shall be affixed to the concrete ring using plastic anchors and screws.

i) Switchboards, Distribution Boards, and Panel boards

(*i*) Permanently engraved lamicoid labels are required for each switchboard, distribution board, and panel board, as described below.

(*ii*) For normal power, labels are to have a black background with white engraved letters.

For emergency power, labels are to have a red background with white letters.

(*iii*) Each label shall be affixed to the cabinet in a readily visible location with double sided adhesive tape covering the back of the nameplate.

(*iv*) Conductors shall be color coded by phase with colored tape. See E. Conductors / (9), and G. Medium Voltage / (1) / a. / 8) for color coding requirements.

(*v*) Switchboard Label

The switchboard label shall include the switchboard name, electrical source feeding the switchboard, voltage, size (amps), number of phases, number of wires, and AIC rating (*i.e.*, MDP1, Transformer-1, 480V, 3P, 4W, 65kAIC). If the switchboard contains a main building disconnect, this shall be included on the label, (*i.e.*, Main Building Disconnect 1 of 2).

(*vi*) Switchboard Breaker and Spare Space Labels

Switchboard breaker and spare space labels shall be installed to clearly identify each switchboard breaker and spare/space. Each label shall include the breaker number and the load served (*i.e.*, MDP1-1, Panel PH1). For spare/space, the label shall indicate “spare” as well as the size in amps and phase (*i.e.*, Spare, 200A, 3P or Space, 400A max, 3P).

(*vii*) Panel board Labels

Panel board labels shall be mounted inside the door for flush panels, and on the outside face of the door for surface panels. The label shall include the panel name, source feeding panel, voltage, size (Amps), number of phases, number of wires, AIC rating, and the arc flash hazard class based upon NFPA 70E (*i.e.*, PH1, MDP1-1, 277/480V, 225A, 3P, 5W, 42kAIC, Arc Flash Class __).

Use the labeling scheme for panel boards provided on the following page:

PANELBOARD LABELING SCHEME

Level	UPS / Emergency Power	Voltage Level	Panel Sequence
0 (Level 0 / Basement	U (UPS)	H (277 / 480 V)	1
1 (Level 1)	E1 (Emergency Life Safety – Connected to ATS-1)	L (120 / 208 V)	2
2 (Level 2)	E2 (Critical Emergency – Connected to ATS-2)		3
3 (Level 3)	E3 (Optional Emergency – Connected to ATS-3)		4
etc.	etc.	etc.	etc.

Examples: *(a)* 2E1L1 – Level 2, Emergency Life Safety Power, 277/48120/208V0V, 1st panel on level 2

(b) 0UL6 – Level 0, UPS Power, 120/208V, 6th panel on level 0

(c) 1H2 – Level 1, 277/480V, 2nd panel on level 1

(d) 3L11 – Level 3, 120/280V, 11th panel on level 3

j) Motor Control Centers (MCC), Motor Controllers

(*i*) Permanently engraved 3" x 5" lamicoid labels are required to identify the MCC and each controller.

(*ii*) For normal power, labels are to have a black background with white engraved letters.

For emergency power, labels are to have a red background with white letters.

(*iii*) Each label shall be affixed to the cabinet in a readily visible location with double sided

adhesive tape covering the back of the nameplate.

(*iv*) MCC labels shall identify the MCC, source feeding the MCC, voltage, size (amps), number of phases, number of wires, and AIC rating (*i.e.*, MCC#1, MDP1-2, 600A, 3P, 4W, 42kAIC).

Where applicable, the label shall also include the load served and the breaker size (*i.e.*, EF-1, 125A).

For spare / space, the label shall indicate the size in amps and phase (*i.e.*, Spare, 200A, 3P or Space, 400A max, 3P).

k) Variable Frequency Drives (VFD)

(*i*) Permanently engraved 3" x 5" lamicoid labels are required to identify the equipment controlled, electrical source feeding the controller, voltage, number of phases, disconnect and fuse sizes in amps where applicable, and equipment horse power (*i.e.*, AHU-1, PH1-1,3,5, 480V, 3P, 200A/150A fuse, 75HP).

(*ii*) Additionally, require a second label on the VFD cabinet specifying which control signal is used.

(*iii*) For normal power, labels are to have a black background with white engraved letters.

For emergency power, labels are to have a red background with white letters.

(*iv*) Each label shall be affixed to the cabinet in a readily visible location with double sided adhesive tape covering the back of the nameplate.

l) Fire Alarm Control Panels (FACP), Fire Alarm Notification Appliance Circuit Panels (NAC), and Other Fire Alarm Panels / Cabinets

(*i*) Permanently engraved 3" x 5" lamicoid labels are required to identify each panel. Require labels for each fire alarm control, notification appliance (NAC), power supply, transponder, and speaker system panel.

(*ii*) For normal power, labels are to have a black background with white engraved letters.

For emergency power, labels are to have a red background with white letters.

(*iii*) Each label shall be affixed to the cabinet in a readily visible location with double sided adhesive tape covering the back of the nameplate.

(*iv*) Each label is to include the panel name and the source feeding the panel (*i.e.*, FACP, PL1-1 or NAC-1, PL1-3).

m) Additionally provide permanently engraved lamicoid nameplate labels / tags for the following, as well as all other similar electrical devices and equipment.

(*i*) UPS and Surge Protection Devices

(*ii*) Safety Disconnects

(*iii*) Generators

(*iv*) Automatic Transfer Switches

(*v*) Paralleling Switchgears

(*vi*) Electrical Contactors and Relays

(*vii*) Lighting Control Panels, Lighting Contactor Panels, Dimming Panels

(*viii*) Timeclocks

(*ix*) Security Panels

(*x*) Power Supplies

c. Self-Adhesive Labels

1) Specify self-adhesive labels for the devices and equipment identified in 4) below, as well as all other similar devices and equipment.

2) Self-adhesive labels shall have black lettering with a clear (see through) background, and a self-adhesive sticky back.

3) Each label shall identify the applicable circuit number feeding the device. The label shall also display “EMERGENCY” or “UPS” as applicable next to the circuit number for devices fed from Emergency or UPS power. For example, a receptacle fed from circuit 2 in panel 1P1 would read “1P1-2” on the label.

4) Require the Contractor to apply self-adhesive labels to the following devices and equipment, and all similar equipment.

a) Thermal Switches and Manual Starters

b) Power Outlet Receptacles

c) Light Switches

d) Wall Mounted Occupancy Sensors

e) Wall Mounted Time Switches

f) Dimming Switches and Wall Mount Dimming Controllers

g) Fire Alarm Initiation Devices (Smoke Detectors, Heat Detectors, Pull Stations, etc.) and Fire Alarm Notification Devices (Horns, Strobes, etc.).

(*i*) Require self-adhesive labels for all initiation and notification devices.

(*ii*) Each initiation device label shall indicate the addressable node, the addressable loop number, device type (S=sensor, M=monitor), and device number (*i.e.*, N1-L1S001, N1-L2M001).

(*iii*) Each notification device label shall indicate the device type (S=speaker, L=strobe), the circuit number, and the device number (*i.e.*, S1-1 or L1-2).

d. Handwritten Labeling

1) Specify legible handwritten labeling for all junction boxes containing power and fire alarm wiring.

2) Require the Contractor to use a permanent chisel tip black marker, and write the required information in a neat and clearly legible manner clearly visible from the floor.

3) Label each junction box with the applicable circuit number(s) for the cables contained within.

e. Word Processor Generated Branch Panel Schedules

1) Specify typewritten branch panel schedules incased in clear, transparent covers for each branch panel.

2) Require the Contractor to label every breaker or available space.

3) Actual room designations (room name and room number) assigned by the University must be used. Instruct the Contractor to verify room designations. Room identifiers on project drawings may be different than final room assignments.

4) When the project requires changes in, or additions to existing panels, distribution boards, etc., provide new schedules and labeling to accurately reflect the changes.

(12) Contractor Responsibilities

a. Foreman

The Contractor shall be required to provide competent supervision for all electrical work throughout the duration of the project. The same foreman shall remain on the project from the beginning to completion unless a change is authorized by both the A/E and University Project Manager.

b. Permits

1) The A/E shall coordinate with the University Project Manager for projects where special permits are required, and request additions to the University's boiler-plate when these are to become the responsibility of the Contractor.

2) Shut-down and digging permits are the Contractor's responsibility, and specific requirements are described in the Supplemental General Conditions for University of Utah Projects.

c. Shop Drawings

1) Require the Contractor to review shop drawings prior to delivery to the A/E. Shop drawing submittals are to be complete, approved, and signed by the Contractor before delivering to the A/E.

2) The A/E shall receive the Contractor's shop drawings and review them for conformance, and determine their acceptability.

3) The A/E shall forward the shop drawings with its recommendations to Facilities Management through the University Project Manager, who will distribute them to the appropriate Facility Operations shops for University review and comment.

4) University approval of the shop drawings is required prior to the Contractor's release of the order.

d. Workmanship

The A/E shall expect professional workmanship of the Contractor. Specify that all workmen shall be qualified and licensed for the work they perform. Substandard workmanship shall not be allowed. Any workmanship or installation deemed to be substandard by the A/E and University Project Manager will be required to be redone until acceptable.

e. Inspection of Repaired Damage, Replaced Work

In addition to the requirements of Article 9 of the General Conditions, repair or replacement of defective or nonconforming Work shall be inspected by the Facility Operations Electric Shop prior to being accepted.

f. Housekeeping and Cleanup

A reasonable level of housekeeping and cleanup shall be required throughout the duration of the project. At the conclusion of the project, require the Contractor to restore all areas and equipment to an "as-new" condition.

(13) Display As-Builts and One-Line Diagrams

a. The electrical engineer's design of the electrical systems for new buildings, major additions or renovations shall include a requirement for a set of completed and University approved as-built electrical drawings (including a copy of the electrical one line diagrams), framed and permanently mounted in the electrical distribution room, vault or other suitable location selected by the A/E and Facilities Management.

b. The A/E and Contractor shall coordinate with the University Project Manager and Electric Shop to determine the mounting location and size of the sheets required to be clearly readable.

c. These drawings shall be framed between 2 sheets of 1/8" Plexiglas.

ADDED:

J. Communications and Security Wiring Systems Serving University of Utah Buildings

(1) Introduction

a. Designer Qualifications

The University expects a high quality, standards-based communications infrastructure on campus. The design of communications infrastructure for new or remodeled facilities shall be engineered by a qualified Registered Communications Distribution Designer (RCDD) actively affiliated with the Building Industry Consulting Services International (BICSI) organization. Further, engineering designs must meet all

applicable Federal, State, and local codes and standards, and must be designed in accordance with this Design Manual and University of Utah Supplement.

b. Communications Entrance

The design for new buildings will include a communications service entrance and provisions for running communications conductors to various parts of the building. The scope of these provisions will be determined in consultation with Facilities Management through the University Project Manager. The communications service entrance will interconnect the building with the University underground communications duct system. The communications service entrance will include a minimum of six 4" ducts into the building. The service entrance ducts shall be run without bends. Where this is not possible specific approval of Facilities Management electrical engineer(s) through the University Project Manager will be required.

c. CAD Layering

Telecommunications wiring, conduit, and raceways are to be layered separately from electrical layers.

d. Installation by UIT

In an effort to maintain a consistent structured wiring system throughout campus, University Information Technology department (UIT) is the only entity on campus authorized to install new communication cabling, both inside and between buildings. Therefore, the designer is to notify contractors that the University of Utah installs their own telecommunications wiring in new and remodeled spaces. Project specifications are to require the Contractor to coordinate the work with the University, thereby properly sequencing the installation of the wiring with the rest of the construction work. Wiring must be completed prior to the installation of drop ceiling grid.

e. Penetrations of Fire Rated Partitions

The University has experienced problems in many buildings where the installation of communications wiring resulted in penetrations of fire rated partitions, which were left untreated. The designer is to refer to 3.3 Architectural H (1) University of Utah Supplement.

f. Total Raceways

It shall not be acceptable to run low voltage wiring as a free air system. All low voltage wiring systems shall be run in conduit in walls up to a raceway system. The raceway system can be specified as J-hooks, cable tray, conduit, or any other approved cable management system.

(2) Cable Tray

Where appropriate cable tray shall be provided to facilitate the installation of communication cable in University buildings. Where provided, cable tray shall be installed in such a manner that free and unobstructed access is provided at all times after completion of construction.

(3) Communications Duct Banks

a. General

Duct banks will be provided to house underground communication cables. See Detail Drawing COM-3. Duct banks will be concrete encased round bore plastic duct. Typically the duct size should be 4 inches. Spare ducts will be provided in duct bank installations in consideration of the future needs of the campus communications system. Duct banks will have a minimum slope of 4 inches per 100 ft. Seal around all cables entering manhole with Virginia KMP Presstite Permagum. Provide plastic plugs in both ends of all unused ducts and seal with silicon sealant. Concrete encasement will be a minimum of three inches between ducts and between ducts and earth. The top of the concrete encasement will be a minimum of 3 ft. below finished grade. Care shall be taken during installation to insure no debris gets into the line. After completion a mandrel not less than 12 inches long and approximately 1-1/2 inches diameter less than the duct diameter will be pulled through each duct to insure that no debris has collected in the duct. Mandrel pulls shall be witnessed by the A/E and University Project Manager. The A/E should inspect duct bank construction before concrete is poured. Provide polypropylene pull rope in each unused duct.

b. Rigid Galvanized Steel

Where duct banks enter manholes, buildings or vaults, a 10 ft. length of rigid galvanized steel conduit will be used for each duct. All elbows and offsets in duct runs will be made of rigid galvanized steel.

c. Maximum Bend Radius

All communications ducts must be installed in such a manner as to be free of bends, twists, turns etc.. Absolutely no 90, 45, 30 degree bends shall be allowed. A maximum bend radius of 5 degrees shall be allowed. Any other bend necessary shall require approval of Facilities Management electrical engineer(s) and the Campus Utility Services Electronics Shop (upon request to the University Project Manager). Any bends required greater than 5 degrees shall be rigid steel. The A/E shall provide elevation drawings that show elevation differences.

(4) Telecommunications Service Entrance and Termination

a General Information

"Telecommunications service entrance" on campus is defined as the means by which connections for Local Exchange Carrier's, Campus Distribution, Interexchange Common Carrier, etc. will enter and terminate in campus buildings. Entrance conduit begins at the communications manhole nearest the structure and ends when terminated in the equipment room for that structure [see *(5) Equipment Rooms (ER)* below].

b. Types of Entrances

1) The acceptable means of service entrance on campus is an underground conduit system. All entrance conduit must be four inch (4") PVC conduit, encased in concrete, and buried at a minimum of twenty four (24) inches below grade. The actual number of conduits designed for any campus structure will be determined by the University Project Manager and University Information Technology (UIT) project coordinator during the design phase of the project.

2) On each new building, and where approved for each remodel, include a two inch (2") roof mounted galvanized rigid conduit with weather-head in the system design. The new conduit is to extend two feet (2') above the finished roof. The base is to be sufficiently secured to support future electronic equipment which may be attached to the conduit. The designer shall coordinate with the A/E for a location: *a)* which is reasonably close to (preferably directly over) a telecommunications room; *b)* which is near a roof access for maintenance and service; and, *c)* which would have walkway approach protection to limit the possibility of roof damage. If possible, this roof conduit should be located directly over the top floor telecommunications room. Extend conduit into the building either to the telecommunications room or to the nearest communications cable tray. Review the design with the University Project Manager and UIT project coordinator for approval at the design development submittal review or prior to completion of the bidding documents.

c. Bends

Bends in service entrance conduit are generally considered unacceptable. However, should bends be unavoidable, they shall be reviewed for approval by Facilities Management and UIT prior to installation; and, they will be long, sweeping bends with a radius not less than ten times the internal diameter of the conduit. There shall be no more than the equivalent of two quarter bends (180^{o} total) between pull points. All bends and sweeps are to be in rigid conduit.

d. Preventing Shearing

In order to prevent shearing of conduits, each entrance conduit is required to have 10 feet of rigid steel conduit leaving and entering any structure including buildings, manholes, etc. Ends of metallic conduit must be reamed and bushed.

e. Manholes

1) Communication manholes will be provided for the underground communications distribution system.

2) Manholes used for communications will not be used for the distribution or termination of any electrical cables.

3) Communication Manhole Fabrication Requirements

a) Communications manholes will have a minimum of 96 square feet of floor area (unless pre-approved by UIT) with a minimum 8’ ceiling height; and, are to be reinforced concrete, either poured in place or pre-cast; and, must be suitable for H20 highway loading.

b) Covers will be clearly marked “COMMUNICATIONS”.

c) Manholes must be equipped with bonding inserts and struts for racking. Include cast-in provisions for cable supports (equal to Super Strut Series No. C300).

d) Include pulling eyes cast into each wall of the manhole. Pulling eyes shall be at least 2.2 centimeters in diameter.

e) Manholes must include a sump of at least one (1) cubic yard of crushed rock with a three (3’) foot diameter.

4) Required manhole accessories shall include, but not be limited to:

a) Manhole cover and seat shall be in accordance with Detail Drawing COM-4.

b) Require a minimum of two ground rods for each manhole, each shall be 3/4" x 10', copper clad steel, and each ground shall extend below the manhole at opposite corners of the manhole floor.

c) Require complete water proofing of the manhole, entrance structure, and all openings.

d) Require bell end entrances for all conduits. Specify threaded metallic type Emerson O.Z. Gedney Bell End Entrances (or equal). Require the Contractor to seal all conduit entrances.

e) Require a demountable stainless steel ladder affixed at both top and bottom, but removable from below by the worker if desired.

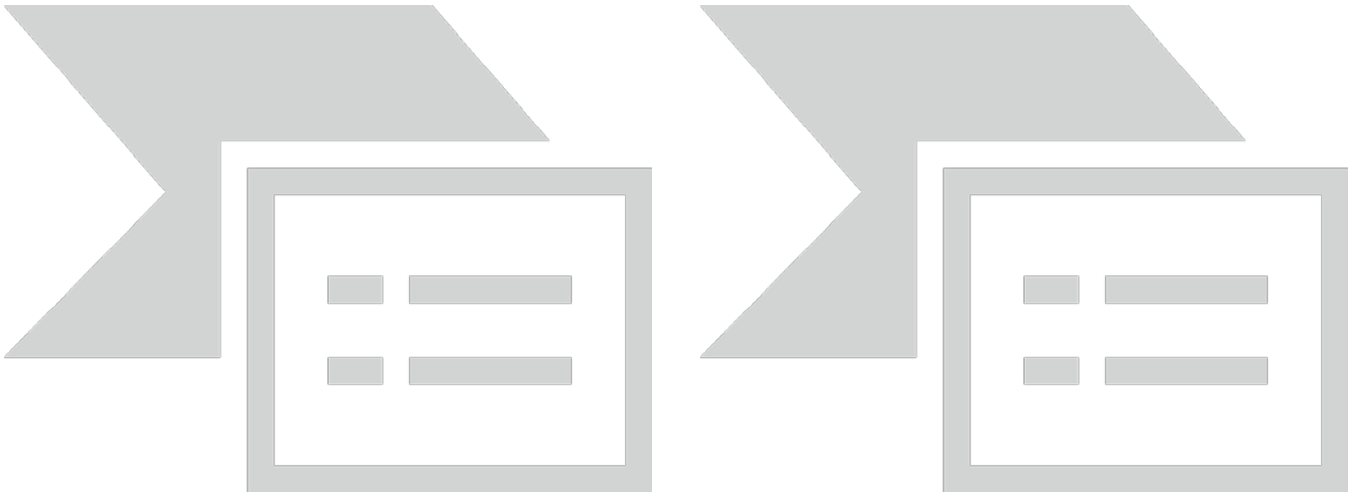
(*i*) The ladder system, including all hardware, is to be submitted for review and approval before purchase and installation.

(*ii*) The ladder top shall be hooked to the side of the manhole.

(*iii*) Each bottom rail shall be drilled to receive a security pin which locks the ladder to angle flanges anchored to the concrete manhole floor. Specify both the pin and its associated pin lock to be attached to the ladder rail by stainless steel chain to prevent misplacing the pin locking devices (the required security chain is not shown in the picture below). This assembly will provide a safe entry descent, and enable workers to unpin the bottom rails and unhook the ladder top when additional workspace is desired while working in the manhole.

(*iv*) All hardware shall be specified stainless steel.

(*v*) The following pictures indicate the approved attachments, except for the required *pin*-to-*pin lock*-to-*ladder rail* stainless steel chains (one for each ladder rail) described above.



5) Spacing of manholes will be carefully considered to allow reasonable pulling tensions for cable pulls between manholes. Spacing between manholes shall not exceed 400 feet.

6) The University of Utah requires all communications manholes to be fitted with a secure access system. Coordinate with the University Project Manager and UIT for current approved details regarding manhole security and access systems. The only approved secure access system is manufactured by the University Metal Shop, with a lock provided by the University Key Shop. When manholes are included in the design, coordinate with the University Project Manager to either *a*) cover the cost by internal work order, or *b*) notify Facilities Management Business Services that an allowance of $1,000 is required on the Bid Response Form when bidding documents are being prepared. The work order amount or bid allowance shall be $1,000 for each manhole.

f. Terminating Conduit Inside a Building

Service entrance conduits should enter the communications room without bends. If the conduits enter the building below the finished floor, this is best accomplished by creating a trench for the conduits to enter. The trench must be a minimum of three (3) feet wide to allow the bending of cable inside the trench. The trench must be fitted with a steel grate to cover the entire span of the trench. Knockouts in the grate, for cable entrance and exit, must be provided. The grate must be capable of withstanding weight in excess of 1,000 pounds. If conduits enter from the ceiling, they should terminate four inches (4") below the finished ceiling. It is imperative that slope and grade be considered in the design and installation of entrance conduits, ensuring that conduits inside the building are not lower than the conduits leaving the manhole, thus creating drainage problems.

g. Redundant Entrance Provision

All new buildings shall be equipped with dual entrance facilities, originating from separate manhole structures. All standards that apply to the primary entrance facility apply to the redundant facility. Any deviation from this standard must be approved by both the University Project Manager and University Information Technology (UIT) project coordinator.

h. Fill

All conduit must be concrete encased.

(5) Equipment Rooms (ER)

a. Definition

1) Equipment Rooms (or "ER") provide secure space and maintain suitable operating environments for large communications and/or computer equipment. Equipment Rooms are generally considered to serve a building, where Telecommunications

Rooms [or "TR" – see (6) below] generally serve only one floor of a building. *Any or all functions of a Telecommunications Room may be provided by an Equipment Room.*

2) The Equipment Room is typically the point of demarcation ("dmarc") for the following services:

a) Local Exchange Carrier (Qwest)
b) Fiber Optic Network
c) Building Maintenance Systems
d) Security Systems

b. Considerations for Design

1) When designing Equipment Rooms, consider incorporating building information systems other than traditional voice and data communications systems (*e.g.* CATV distribution systems, alarm / security systems, and audio/paging systems). In most instances, the Equipment Room may also serve as the entrance facility for the building communication.

2) The design of a new Equipment Room should begin with an assessment that considers each of the factors listed below. The information gathered from this assessment must be considered by the designer at all stages of the project design, along with guidelines and requirements of applicable local, state, federal standards, this Design Manual and the University of Utah Supplement.

a) Customer Requirements
b) Telecommunications Pathway Locations
c) Service Provider (Local Exchange Carrier [LEC]) Requirements
d) Environment/Facility Conditions and Resources

c. Locating the Equipment Room

1) The location of the main Equipment Room can have significant impact on all other aspects of communications systems distribution design. Location selection is to include consideration of spaces immediately adjacent to the Equipment Room (beside, below, and above). In general, the main Equipment Room should be located near the building center to minimize cable distance.

2) Design of Equipment Rooms must take in to consideration:

a) Services to be terminated
b) Access and proximity to distribution cable pathways

c) Building facilities and access to the Equipment Room

d) Local Exchange Carrier (LEC) requirements

e) Proximity to electrical service and EMI sources

f) Space required for equipment

g) Provisions for future expansion

3) Do not locate Equipment Rooms in places that are subject to the following conditions:

a) Water infiltration

b) Steam infiltration

c) Humidity from nearby water or steam

d) Heat (*e.g.*, direct sunlight)

e) Any other corrosive atmospheric or environmental conditions

4) Shared use of Equipment Room space with other building facilities must be avoided. Locations which are unsatisfactory for Equipment Rooms include space in or adjacent to:

a) Electrical Closets

b) Boiler Rooms

c) Washrooms

d) Janitor Closets

e) Storage Rooms

f) and any space that contains:

(*i*) Sources of excessive EMI

(*ii*) Hydraulic equipment or other heavy machinery that may cause excessive vibration

(*iii*) Steam pipes

(*iv*) Drains

(*v*) Clean-outs

5) Avoid locations that are below the water level unless preventive measures against water infiltration are employed. The room must be free of plumbing and electrical utilities that are not directly required to support the Equipment Room function. A

floor drain is required if there is any risk of water entering the facility.

d. Working Clearances

NEC Section 110-16 requires three (3) feet of clear working space around equipment with exposed live parts. This applies to communication Equipment Rooms.

e. Conduit Accessibility

It is essential that clear, unobstructed access to cable trays and conduits be provided within the Equipment Room. Entrance conduit and distribution conduit/cable trays should enter and exit on the same wall. If this is not possible, a cable tray inside the room should be provided for distribution from wall to wall.

f. Electrical Systems

Power for telecommunications equipment in Equipment Rooms should be supplied by feeders dedicated only to supplying that equipment (NEC Article 215). Quadplex power receptacles with separate 20 amp feeders and isolated grounds, should be mounted on every wall in the Equipment Room, spacing should be on six foot (6') centers, and located eighty four inches (84") above the finished floor. Other power requirements (*e.g.* fluorescent lighting, motors, air conditioning equipment, etc.) should be supplied by a separate feeder, conduit, and branch panel.

g. Dimensions

Determination of "adequate size" for the Equipment Room depends upon what services are to be terminated there. Input from UIT personnel, LAN support groups, Electronics Shop, HVAC and UCard personnel should be considered. Minimum size for an Equipment Room is ten by 15 feet. (10' x 15') The actual size of the Equipment Room will be determined during the design phase of the project when more information, pertinent to the size and application of the building, is available.

h. Space Allocation & Layout

1) The layout of major communications equipment in the main Equipment Room must facilitate the effective routing of power and communications cabling. The main Equipment Room must provide adequate space for:

a) All planned equipment

b) Access to equipment for maintenance and administration

c) Future growth

2) In addition to space for communications and security system requirements, an Equipment Room may also include space requirements for environmental control equipment, power distribution/conditioners, and UPS systems.

i. Determining Size of Equipment Rooms (Based on Area Served)

1) When specific equipment that may be used in an Equipment Room is not yet known, the following criteria may be used to determine the minimum size of the Equipment Room.

a) Divide the amount of useable floor space (building area used by occupants during normal daily activity, including hallways, copier rooms, etc.) by 100 $ft.^2$ (or smaller if average work area size is less) to determine the number of individual work areas; or, count the number of individual work areas (offices, conference rooms, cubicles, etc.).

b) Multiply the number of work areas to be served by 0.75 $ft.^2$ to determine the minimum Equipment Room size.

2) If there are fewer than 200 work areas, the Equipment Room must be no less than 150 ft^2. In special use buildings (hospitals, hotels, etc.) Equipment Room sizes may vary. Refer to ANSI/EIA/TIA-569-B.

j. Fire Protection / Fire Rating / Fire Suppression

All ER spaces shall be designed with pre-action fire suppression systems (the space remains water free until both heat and smoke detectors are activated). Fire alarms should be installed in accordance with this Design Manual and University of Utah Supplement. Portable fire extinguishers should be located in the room as close to the entrance as possible. A minimum of a 2 hour fire rating should be provided with a fire sprinkling system exterior to the room.

k. Environmental Considerations

Environmental considerations should be determined prior to design; however, assume that air conditioning will be a year-round requirement and should be capable of maintaining a maximum temperature of 75 degrees F and a relative humidity of 30% to 50%.

l. Floor Requirements

Equipment Room spaces are generally considered to be computer rooms. Design these rooms with raised floors, 18 inches clearance (minimum), to ensure maximum flexibility of power and communication cabling.

m. Loading Requirements

1) The floor rating under distributed loading must be greater than 12 Kpa (250 lb/ft.^{2}).

2) The floor loading under concentrated loading must be greater than 4.4 M (1,000 lbs) in areas that will support communications equipment, racks, and cabinets.

n. Ceiling Requirements

The recommended height of the finished ceiling to the finished floor in an Equipment Room is sufficient height to allow 8 ft. 6 in. clear space below light fixtures. Any ceiling protrusions (ventilation, sprinklers, etc.) must be located with a minimum clearance height of 8 ft. 6 in. The ceiling finish must minimize the introduction of dust, and be light colored to enhance room lighting.

o. Lighting Requirements

Equipment Rooms shall be designed with adequate and uniform lighting that provides a minimum equivalence of 540 lux (50 footcandles) when measured 3 ft. above the finished floor. Locate lighting fixtures a minimum of 8 ft. 6 in. above the finished floor. Locate light switches near the entrance(s) to the Equipment Room. Power for lighting should not come from the same circuits as power for the communications equipment. Provide emergency lighting as required by applicable building codes.

p. Security Design Considerations

Provide adequate clear wall space to accommodate the required number of CCure iStar security control panels as determined by UCard. Provide an adequate quantity of power outlets to serve the iStar panels.

q. Cable Management

Cable management, either overhead or under the floor, must be given careful consideration during design. As a minimum, all communication spaces shall be designed with cable trays installed at a height of one hundred eight inches (108") above the finished floor, with minimum dimensions of (4”d x 12”w) and which wraps the entire room. Considerations for additional cable trays and/or raised floor will require consultation with the University Project Manager, the UIT project coordinator, and the tenants of the proposed building or space.

r. HVAC Requirements

Telecommunications equipment requires full time operation of heating, ventilating, and air conditioning in the room to meet the criteria shown below. If the building’s HVAC system cannot provide continuous

service to satisfy the ER room's environmental requirements, consult with the University Project Manager and UIT project coordinator to consider an independent HVAC system. If approved, each ER space would be designed with an independent cooling system capable of operation when other chiller and ventilation systems may be interrupted (*e.g.* fire alarm tests, maintenance, season off-times for cooling or heating, etc.). The system should be designed with a high performance cooling system utilizing positive pressure techniques.

Temperature Range	64 degrees to 75 degrees F
Humidity Range	30 percent to 55 percent relative
Heat Dissipation	750 to 5,000 BTUs per hour per cabinet (number of cabinets to be determined through consultation with Facilities Management through the University Project Manager).

s. Electromagnetic Interference (EMI)

Because EMI causes severe problems with electronic equipment, telecommunications rooms must not be shared with electrical feeders, branch circuits of noisy equipment or transformers.

t. Un-Interruptible Power Systems (UPS)

A building UPS system shall be installed and connected to all communication spaces; and, should be equipped with access to building emergency generator power to protect critical voice and data systems. The sizing of the UPS will depend on the size and use of the building which is to be determined during the design phases with the assistance of UIT and the building occupants' IT staff.

u. Telecommunications Grounding and Bonding

1) A proper grounding and bonding infrastructure is essential for the reliable operations of today's sensitive telecommunications equipment and systems.

2) The building telecommunications grounding and bonding should follow ANSI-J-STD-607-A. This standard is intended to augment (not replace) the requirements specified in the NEC.

3) The grounding and bonding infrastructure originates at the electrical power service entrance and extends throughout the building. Predrilled copper grounding bus bars are to be installed in all TR's and ER's.

4) Whenever two or more telecommunications bonding backbones (TBB) are used within a multistory building, they are to be bonded together with a grounding equalizer (GE) at the top floor and every third floor in between.

5) The size of wire used in the telecommunications bonding backbone is distance driven. See Drawing Detail COM-2.

Telecommunications Bonding Backbone length (ft)	**Telecommunications Bonding Backbone (AWG)**
1 – 13 feet	6 AWG
14 – 20 feet	4 AWG
21 – 26 feet	3 AWG
27 – 33 feet	2 AWG
34 – 41 feet	1 AWG
42 -52 feet	1/0 AWG
53 – 66 feet	2/0 AWG

(6) Telecommunication Rooms ("TR")

a. Telecommunication Rooms

Telecommunications Rooms differ from Equipment Rooms and entrance facilities in that they are generally considered to be "floor-serving" (as opposed to "building-serving") spaces that provide a connection point between backbone and horizontal distribution pathways. Requirements for the design of ERs found in this document, specifically power/UPS, HVAC, fire alarm / suppression, security, cable management, and electrical systems also apply to TR design.

b. General

1) Telecommunication Rooms are "floor-serving" spaces for:

a) Voice equipment (e.g. KSU's, etc.)
b) Data equipment (routers, concentrators, etc.)
c) Cable terminations (both horizontal and backbone)
d) Fiber optic terminations (both horizontal and backbone)
e) Cross-connect wiring

c. Size

TRs vary in size depending on their function and the size of the floor area they serve. Typically size requirements are based on distributing

telecommunications service to one individual work area per 100 feet^2 of occupied work space. While the actual size of Telecommunications Rooms will depend on the application of the building and therefore will require input from various entities during the design phase of the project, minimum Telecommunications Room sizes are shown in the table below:

IF THE SERVING AREA IS....	THEN THE TR MUST BE AT LEAST....
Below 740 meters^2 (8,000 feet^2)	3.0 meters x 3.0 meters (10 feet x 10 feet)
Larger than 740 meters^2 (8,000 feet^2)	3.0 meters x 3.6 meters (10 feet x 12 feet)

d. Working Clearances

NEC Section 110-16 requires three (3) feet of clear working space around equipment with exposed live parts. This applies to Telecommunication Rooms.

e. Conduit Accessibility

It is essential that clear, unobstructed access to cable tray and conduits be provided within the Telecommunication Room. When possible entrance conduit and distribution conduit/cable tray should enter and exit on the same wall, if this is not possible cable tray inside the room should be provided for distribution from wall to wall.

f. Electrical Systems

Power for telecommunications equipment in Telecommunications Room should be supplied by feeders dedicated only to supplying that equipment (NEC Article 215). Quadplex power receptacles with separate 20 amp feeders and isolated grounds, should be mounted on every wall in the Telecommunications Room, spacing should be on six (6) foot centers, located eighty four inches (84") above the finished floor. Other power requirements (*e.g.* fluorescent lighting, motors, air conditioning equipment) should be supplied by a separate feeder, conduit, and branch panel. Refer to (5) u. above for grounding requirements.

g. Lighting

Telecommunication Rooms should have adequate and uniform lighting. Design room lighting to maintain an intensity of 50 foot candles (LM/ft^2) at 3 feet above floor level. Coordinate light fixture positions with the equipment layout, especially overhead cable trays, to ensure the light is not obstructed.

h. HVAC Requirements

Telecommunications equipment requires full time operation of heating, ventilating, and air conditioning systems. If the building's HVAC system cannot ensure continuous operation (including weekends, holidays, off-

season, maintenance, etc.), coordinate with the University's Project Manager and UIT to consider stand alone systems with independent controls. Typical room requirements are as follows:

Temperature Range	64 degrees to 75 degrees F
Humidity Range	30 percent to 55 percent relative
Heat Dissipation	750 to 5,000 BTUs per hour per cabinet (number of cabinets to be determined through consultation with Facilities Management through the University Project Manager).

i. Structural Guidelines

1) Telecommunications Room walls should extend from the finished floor to the structural ceiling (*e.g.* the slab).

2) If ceilings must be installed they must be a minimum of 2.6 meters high to provide space over the equipment frames for cables and suspended racks.

j. Fire Alarm

A fire alarm should be installed in all Telecommunications Rooms. A portable fire extinguisher should be made available inside all Telecommunications Rooms.

k. Locating Telecommunication Room

1) It is imperative that TRs be located so as to minimize cable lengths for both horizontal and vertical cable runs.

2) Vertical Distribution

When designing TRs for vertical distribution it is preferable to "stack" TRs so that the Telecommunication Room on level one is located directly below the Telecommunications Room on level two, etc. TRs should be connected to one another via four (4), four (4") inch conduits. Conduits should penetrate the floor in the TR on the far left corner of the TR, and extend no less than two inches (2") above the finished floor.

3) Horizontal Distribution

Telecommunication Rooms must be located so as to maintain a distance no greater than ninety (90) meters (cable length) from the furthest termination point (communication outlet) being served by that TR. Ensure that conduits and cable trays feeding the Telecommunication Room terminate *completely inside* the TR.

(7) Communications Distribution Systems (Pathways & Spaces)

a. Definition

Communications pathways and spaces are facilities used to distribute and support cable and connecting hardware between Equipment Rooms; and, between Equipment Rooms and the work area outlet. These spaces may include conduit, cable tray, open air plenums, cellular floor duct, etc.

b. Backbone Communication Pathways

Backbone communication pathways may consist of shafts, conduits, raceways, and floor penetrations (*i.e.* sleeves or slots) which provide routing space for communication cables.

c. Sleeves & Slots

1) Vertically aligned TRs with connecting sleeves or slots are the most common type of backbone pathway.

2) Position cable sleeves or slots adjacent to a wall, which can support backbone cables. Sleeves or slots must not obstruct wall terminating space. All sleeves and slots must be constructed in accordance with the National Electrical Code (NEC) and local fire codes, and must have curb, a minimum 2 inches high from the finished floor.

3) Design sleeves with a 4 in. diameter, unless a smaller size is required by the structural engineer.

4) The following table provides general guidelines for determining the number of 4 in. sleeves required, based on ANSI/EIA/TIA-569.

TOTAL SQUARE FEET	QTY- OF SLEEVES
Up to 50,000	3
50,000 to 100,000	4
100,000 to 300,000	5-8
300,000 to 500,000	9-12

5) The following table provides general guidelines for determining the sizes of slots required, based on ANSI/EIAITIA-569.

TOTAL SQUARE FEET	SIZE OF SLOT
Up to 250,000	6" x 9"
250,000 to 500,000	15" x 46"
500,000 to 1,000,000	23" x 51"

1,000,000 to 2,000,000	38" x 61"

d. Open Shafts

Open shafts should only be used where large quantities of cables are required. Backbone cables should never be located in elevator shafts.

e. Conduit / Enclosed Metallic Raceways

1) Conduit or enclosed raceways may be used to run cables "point to point" where intermediate splicing is not required, or where physical protection or enhanced security is required.

2) The following table indicates the "conduit fill ratio" based on area and the minimum bend radius. Apply these fill percentages to straight runs with nominal offsets equivalent to no more than two 90º bends.

Conduit			**Area of Conduit**			**Minimum Bend Radius**
Trade Size (in.)	Internal Diameter	Area= .79D ^{2} Total 100%	Maximum Occupancy A (1 Cable) 53% Fill	Maximum Occupancy B (2 Cables) 31% Fill	Maximum Occupancy C (3 or more) 40% Fill	10X Conduit Diameter
¾	0.82	0.53	0.28"	0.16"	0.21"	8
1	1.05	0.87	0.46"	0.27"	0.35"	11
1 ¼	1.30	1.51	0.80"	0.47"	0.60"	14
1 ½	1.61	2.05	1.09"	0.64"	0.82"	16
2	2.07	3.39	1.80"	1.05"	1.36"	21
2 ½	2.47	4.82	2.56"	1.49"	1.93'	25
3	3.07	7.45	3.95"	2.31"	2.98"	31
3 ½	3.55	9.96	5.28"	3.09"	3.98"	36
4	4.03	12.83	6.80"	3.98"	5.13"	40
5	5.05	20.15	10.68"	6.25"	8.06"	50
6	6.07	29.11	15.43"	9.02"	11.64"	60

f. Horizontal Communication Pathways

1) Horizontal distribution systems (or horizontal pathways & spaces) consist of structures that conceal, protect, and support horizontal cables between the communications workstation

outlet and the horizontal cross-connect in the serving Telecommunications Room.

2) Horizontal communications pathways are used to distribute and support horizontal cable and connecting hardware between the workstation outlet and the Telecommunications Room. These pathways & spaces are the "container" for the horizontal cabling.

3) It is the responsibility of the designer to review all proposed horizontal distribution systems with the UIT project coordinator to ensure that the systems design:

a) Makes optimum use of the ability of the horizontal cabling system to accommodate change,

b) Is as unconstrained as possible by vendor-dependence,

c) Complies with ANSI/NFPA 70 (ref. 7.1), this Design Manual and University of Utah Supplement, Local, State, and Federal Codes, and,

d) Complies with ANSI/EIA-TIA-569 (Ref. 7.20).

g. Design Considerations

1) Horizontal distribution systems must be designed to accommodate diverse user applications including:

a) Voice Communications

b) Data Communications

c) Local Area Networks (LANs)

d) Wireless Applications

2) The designer shall also consider any other building information systems (*e.g.* CATV, building alarms / security, audio PA systems, etc.), which may require area/space in the horizontal distribution system, and shall allow for these systems accordingly.

3) An effective design of a building's horizontal distribution system should meet the following criteria:

a) All applicable local, state, and federal, codes.

b) All applicable BICSI, ANSI, NFPA, EIA/TIA, UL, NEC, IEEE, ASTM, BOCA, FCC, SBC, ISO, and State adopted codes.

c) Provide flexible cable distribution to workstation locations

d) Facilitate ongoing maintenance

e) Easily accommodate future changes in equipment and services

f) Minimize occupant disruption when horizontal pathways and spaces are accessed.

g) A minimum of three cable runs per individual workstation.

4) The horizontal distribution system must be designed to handle all types of communications cabling (i.e., UTP, STP, Coax, and Fiber Optic). When determining the type and size of the cable pathway, consider the quantity and size of the cables that the pathway is intended to house, and allow for growth of the area served over the planning cycle.

5) When designing the horizontal distribution system it is important to consider adds, moves, and changes, and minimal disruption to immediate occupants.

h. Number of Cable Runs per Work Area

The pathway design should allow for a minimum of three cable runs per individual work area.

i. Electromagnetic Interference (EMI)

1) Because EMI causes severe problems with electronic equipment, telecommunications, and data communications, avoidance of all potential sources or electromagnetic interference must be a primary consideration when designing a horizontal distribution system. To avoid electromagnetic interference, all distribution pathways should provide clearances of at least:

a) Four ft. (4’ or 1.2 m) from large motors and/or transformers

b) One ft. (1’ or 0.3 m) from conduit and cables used for electrical power distribution

c) Five in. (5” or 12 cm) from fluorescent lighting

2) Horizontal distribution pathways should cross perpendicular to fluorescent lighting and electrical power cables or conduits.

3) For additional clearance requirements, see ANSI/EIA-TIA-569 and ANSI/NFPA 70.

j. Grounding & Bonding

Horizontal pathways must be grounded and bonded in accordance with the requirements specified in ANSI J-STD-607-A, except where other codes or local authorities impose more stringent requirements.

k. Fire-Stopping

1) Install removable fire pillows.

2) All horizontal pathways that penetrate fire-rated barriers must be sealed in accordance with applicable codes. Provide smoke rated protection as required for smoke rated wall and floor penetrations.

l. Administration of Horizontal Distribution Systems

Utilize standard methods and procedures for labeling and managing horizontal pathways. Locate markings so that they are clearly visible after installation, and easily distinguishable from any markings that appear on individual components. For details on guidelines and requirements for the administration of horizontal pathways and spaces, see BICSI TDM Manual Chapter 4 and ANSI/TIA/EIA-606.

m. Types of Horizontal Distribution Systems

1) Many types of horizontal distribution systems are acceptable for installation at the University of Utah. Many buildings may require two or more of the following systems to meet all distribution needs. Acceptable types of horizontal pathways are:

a) Unlimited access (raised floors).

b) Ceiling zones and grids

c) Cellular floors.

d) Conduit

e) Underfloor ducts (one-level or two-level)

f) Cable tray

n. Sizing of Horizontal Pathways

1) The size requirements for horizontal distribution pathways depend on the following:

a) Usable floor space served by the pathway.

b) Maximum occupant density (*i.e.*, floor space required per individual work area).

c) Cable type and diameter.

d) Pathway capacity (requires that the fill factor be taken into account).

Trade Size	Cable Outside Diameter Inches									
Inches	**0.13**	**0.18**	**0.22**	**0.24**	**0.29**	**0.31**	**0.37**	**0.53**	**0.62**	**0.70**
½	1	1	0	0	0	0	0	0	0	0
¾	6	5	4	3	2	2	1	0	0	0
1	8	8	7	6	3	3	2	1	0	0
1 ¼	16	14	12	10	6	4	3	1	1	1
1 ½	20	18	16	15	7	6	4	2	1	1
2	30	26	22	20	14	12	7	4	3	2
2 ½	45	40	36	30	17	14	12	6	3	3
3	70	60	50	40	20	20	17	7	6	6
3 ½	-	-	-	-	-	-	22	12	7	6
4	-	-	-	-	-	-	30	14	12	7

2) The usable floor space (also referred to as "office space") is generally considered to be the building area used by the occupants for their normal daily work functions. For design purposes, this space should include hallways. All other common areas in the building should be disregarded.

3) The occupant density or floor space allocation per office or individual work area for the University of Utah is 100 ft^2 of usable floor space.

4) Cable Density

Design for pathway capacity to accommodate a minimum of three horizontal cable runs per workstation location.

5) Cable Diameter

For planning purposes use the following table to determine the minimum amount of Horizontal Pathway Distribution capacity.

Horizontal Cable Type	Typical Outside Diameter
Four-Pair Category 5, 100-ohm UTP	0.25 to 0.28 inches
Two-Pair Shielded Twisted Pair, 150-ohm STP	0.31 to 0.43 inches
Duplex 62.5/125pm Optical Fiber Cable	0.11 to 0.18 inches

6) Conduit Capacity

Adequate planning should allow for a minimum of 1 inch conduits to each workstation location. Maximum conduit fill capacities shall not be exceeded in accordance with ANSI/NFPA 70, Chapter 9.

o. General Conduit Distribution

A horizontal conduit system consists of conduits radiating from the Telecommunications Room to the work station outlets in the floor, walls, ceilings, and columns of a building.

p. Suitable Conduit

1) The following types of conduit are deemed suitable for building installation at the University of Utah:

a) Flexible Metal Tubing - (limitations apply, obtain specifications and direction from the UIT project coordinator)

b) Rigid metal conduit (typical two (2), 3/4 inch conduits to each workstation location for horizontal distribution)

q. Conduit Runs

1) Conduit runs should be designed for the most direct route, parallel to building lines, with no more than two (2), 90 degrees bends between pull points or pull boxes. Design each run with a maximum horizontal cable run of ninety (90) meters (295 ft.). Continuous sections shall not be longer than thirty (30) meters without pull points or pull boxes installed.

2) It is recommended that conduit runs be kept to no more than 45 meters (150 ft.) in total length including sections through pull boxes.

r. Conduit Quantity and Size

1) A minimum of two (2), 3/4 inch metal conduits shall be installed from the Telecommunications Room and terminated to each four square workstation outlet.

2) Include in the design, the installation of one ¾" metal conduit from the Telecommunications Room to termination at each wireless access point.

s. Conduit Bend Radii

The radius of a conduit bend must be at least 6 to 10 times the diameter of the conduit. Conduits designated for Futureflex tubing must be installed with a minimum bend radius of 12 times the diameter of the conduit.

t. Conduit Entering Telecommunications Rooms

Horizontal distribution conduits entering a Telecommunications Room should terminate near the corners and allow for proper cable racking. If conduits are entering through the floor, they must terminate four inches (4") above the finished floor. If conduits are entering through a wall, the conduits must be reamed and bushed, and terminated as close as possible to the terminating rack or wall.

u. Completing Conduit Installation

1) Upon completion of Horizontal Distribution Conduit, the conduits will be:

a) Left clean, dry and unobstructed

b) Capped for protection

c) Labeled for easy identification

2) All conduits will be equipped with a contiguous length of plastic or nylon pull string with a minimum rating of 200 lbs. (90 Kg) or a 12 AWG wire.

v. General Cable Tray Systems

Cable tray systems are used primarily as main corridor distribution apparatus. Cable tray systems should be designed as equipped to support only telecommunications and data communications cable. Shared systems with power are not acceptable under the guidelines listed in avoiding EMI.

w. Suitable Cable Tray Systems

1) The following cable tray systems are acceptable for installation at the University:

a) Channel

b) Ladder

c) Solid Bottom

d) Trough

e) Wire Mesh (basket), dual hung with no center support

x. Cable Tray Runs

Cable tray systems should be installed with a minimum number of bends installed, if more than three 15 degree turns are installed in a contiguous length, then de-rate the effective capacity of the cable tray by twenty five (25) percent. Delineations in a level cable tray installation are often unavoidable, however these delineations should be kept at a minimum with each delineation not exceeding 30 degrees and 24 inches offset. The total delineation for the tray span should not exceed 180 degrees.

y. Cable Tray Size and Capacity

Cable tray size and capacity will be determined by the amount and type of cable installed, the static load capacity of the tray, and the length of the support span. Cable tray systems should be designed to accommodate 100 percent future growth.

z. Cable Tray Installation Clearance

1) Cable tray systems are to be installed with as much clearance as possible from other building facilities, and installed in the lowest position below all other building facilities but above the ceiling grid, in accordance with ANSI/NFPA standards and meeting the following criteria:

a) 8 in. clearance from obstructions on both sides.

b) 8 in. clearance from obstructions to the top.

2) Installation of cable tray pulley systems installed in a solid ceiling environment should provide access points at 20 ft. on-center, and at any directional deviation greater than 15 degrees and/or 90 degree turns.

aa. Cable Tray Entering Telecommunications Rooms

Cable tray entering a Telecommunications Room should wrap around the room and allow for proper cable racking.

bb. Completing Cable Tray Installation

1) Upon completion of horizontal cable trays, the trays shall be inspected by the designer to verify that the trays are:

a) Free and clear of all obstructions and debris

b) Free of burrs, sharp edges, and projections

c) Labeled for easy identification

d) Identified as "Telecommunications Cable Tray Only"

cc. Other Types Of Horizontal Distributions Systems

1) The university has identified other types of acceptable horizontal distribution systems that may be installed. These include, but are not limited to:

a) Unlimited access (raised floors).

b) Ceiling Zones and Grids

c) Cellular Floors.

d) Conduit

e) Underfloor ducts (one-level or two-level)

2) Due to the individuality, complexity, and the broad scope of requirements for these systems. The University Information Technology (UIT) will review each of these specified systems on a 'case-by–case' basis.

dd. Outlet Boxes, General

Telecommunications outlet boxes installed in dry-wall, plaster, or concrete block wall shall be single gang plaster (mud) rings. Wall phones and wireless connections shall use single gang plaster (mud) rings.

ee. Mounting Outlet Boxes, Office Environment

1) Outlet boxes installed in an office environment must be specified to meet the following criteria:

a) At least 4 in^2 by 2-1/8 in. deep

b) Mounted at least 18 inches above the finished floor or even with adjacent electrical duplex services

c) Outlet boxes shall not be placed back to back

ff. Mounting Outlet Boxes, Above Counters

1) Outlet boxes installed above a counter will meet the following criteria:

a) Counter with Backsplash
At least 6 inches above the top of the counter to the center of the outlet.

b) Counter without a Backsplash
At least 12 inches above the top of the counter to the center of the outlet.

gg. Mounting Outlet Boxes, Wireless

1) At least 4 in^2 by 2-1/8 in. deep

2) Mounted at 10 inches below the finished ceiling

3) Outlet boxes shall not be placed back to back

4) Distance between units determined by the project designer

hh. Elevator Phone

Elevator phones on campus are installed and maintained by UIT.

ii. Communication Connection

Include in specifications that the Contractor will be responsible for the installation of the traveling cable from the elevator panel to the Car Operating Panel ("COP"). A minimum of four (4) 18 gauge wires will be provided in the traveling cable for the purpose of communication services transport. The communication wires will extend from the COP to the access panel opening that is provided for the communication device.

jj. Conduit

1) Include in the Design

The Contractor must provide a home run 3/4 inch conduit extending from the top of the elevator panel and extending to the nearest Telecommunication Room (TR or ER). UIT will provide the necessary cable to connect the emergency line to the elevator panel.

kk. Communication Device

1) The elevator communication device (phone panel) will be a standard design and configuration per drawing Detail COM-1. The 'back-box' is required per the drawing. The University UIT Department will furnish and install the device. The approved device for elevator installation is Ramtel Corporation Model RR833. The unit is a stainless steel, brushed finish panel which meets ADA requirements. The minimum required opening that must be provided for the approved device is 9 1/4" H x 6-5/8" W with a minimum 4 inch clearance for the back of the device.

2) The elevator car is to be factory prepared for this device; or, the Contractor shall prepare the car to receive the device per Detail COM-1. Note that the device must be mounted at a height which positions the activation button no higher than 48-3/4" above the finished floor.

ll. Emergency Service Line

1) The telephone line that is used in the elevators is a standard Centrex line that automatically rings to Public Safety.

2) It is the responsibility of the University Project Manager to order the line for the elevator and to notify Public Safety that a new elevator phone is being added to their system.

(8) Security Systems

a. Access Control and Intrusion Detection

1) System

a) The Access Control and Intrusion Detection system is the Software House C*Cure system which includes a microprocessor based and managed access control system, with options for intrusion detection, and personal protection (duress) security and specifies sensors, detection devices, signal equipment, system controls, and displays. Each system installed will utilize either the iSTAR Pro or iSTAR Edge Controllers, or designated dialer.

b) The system shall tie into the existing C*Cure access control system currently installed on the University Campus.

c) The system shall have access controlled doors as well as perimeter doors and hatches monitored with door position switches.

d) The system shall interface with the fire alarm system and in the event of an alarm, shall unlock all controlled doors designated for emergency egress.

e) Any card access component of this system shall be an extension of the existing campus-wide C*Cure access control system utilized by the University of Utah for all their facilities, with all existing functions available and be completely compatible with the then current version of the CCure system installed.

f) Duress alarm: Performed by indicated hard wired stationary duress alarm button locations and remote wireless receivers that are triggered by portable transmitters.

g) Alarm Annunciation: In addition to the audible signal sounds and visual text indication on the system keypad, video images from associated cameras in the area may,

at the election of Facilities Central Services, be called up immediately and automatically to an assigned workstation for viewing. No additional operations for video call up by the control officers shall be necessary. Provide all licensing as required for CCure system and video system to perform automatic video camera call up via event programming in CCure.

h) Battery backup for all components in security system shall be capable of operating for a minimum of 8 hours in the event of a power failure.

i) Security contractor shall interface ADA openers where security access control is installed to allow for proper ADA access/egress as per building code.

2) Testing

The campus Facilities Central Services Office will perform final system testing. Contractor must provide notification to Project Manager that system is complete and ready. Project Manager will schedule the final testing with the University Facilities Central Services.

3) Warranty

Specify two year warranty to repair or replace components of access control and intrusion detection devices and equipment that fails in materials or workmanship. Warranty should be started upon completion of final walk through and sign off with University Facilities Central Services.

4) Equipment

a) Equipment specified for the C*Cure system will be required to use the approved University Parts list. The Parts list can be found in the University Forms at (Insert Link Here)

Any deviation will require a Project Variance Request in accordance with Design Process section 1.4

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b) Surge Protection
Comply with minimum requirements of UL Standard 1449, "Transient Voltage Surge Suppressors," for each component using solid-state devices and having a line voltage power source connection or an exterior underground signal connection.

c) Controllers

Provide at the locations identified, a complete and C*Cure System including but not limited to the following equipment:

i. iSTAR Pro or iSTAR Edge controller
iSTAR Pro controllers can be purchased and installed as either an 8 door package or a 16 door package. The Altronix Power Supply AL300ULX can be used for powering 2 iSTAR Pro controllers when they are installed in the same room.

ii. For a list of approved parts for the 16 and 8 Reader Front End Package Equipment refer to the University Parts list. The Parts list can be found in the University Forms at (Insert Link Here)

iii. I-class Card Readers

iv. Relay Output Contact

v. Motion Detectors

vi. Request to Exit Devices

vii. Door Contacts

viii. Power Supplies and Transformers

d) Magnetic Door Locks

Magnetic door locks shall not be used within alarm and access systems at the University

e) Power Supplies

i. Provide power supplies as per manufacturers written recommendations with total number of powered devices for each power supply restricted to only consuming 75 percent of the power supplies rated amperage. Provide separate power supplies for system controllers (As per manufacturer), card readers (12VDC, 5 A), and locks (24 VDC, 7 A).

ii. 120 V 60 Hz from locked disconnect device. System components are
supplied with power through separate power supplies. Provide all required power supplies and associated transformers as specified by the manufacturer and required for the installation.

iii. Power Source Transfer: When normal power is interrupted, system is automatically switched to backup supply without degradation of critical system function or loss of signals or status data. Whenever possible, the system should be tied to the building's emergency power.

iv. To ensure adequate power, installer must calculate the total power requirements of the iSTAR Pro controller and related hardware. If the maximum power consumption exceeds the output of the iSTAR Pro power supply, an additional power supply must be connected to the system.

f) Card Access System Hardware

i. The access control panel (iSTAR Pro and/or iSTAR Edge controller) shall be provided and wired with back-up battery power for a minimum of eight hours operation upon loss of AC power.

ii. The access control panel shall have provisions for relay suppressor kits for each relay used, to protect the access control panel from collapsing electrical fields.

iii. Card readers shall be HID Prox-Pro and HID Mini-Prox readers matching the readers currently installed on campus for door control. The access control panel shall support card readers using Wiegand, Proximity and Biometrics technologies.

g) Door and Window Switches

i. Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of [two] [three] encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields. Position switches on doors shall be magnetic reed switch type and shall be per manufacturers recommendations for the type of door installed on. Provide concealed door frame types

ii. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.

iii. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounting magnet and floor-mounting switch unit.

iv. Remote Test: Simulate movement of actuating magnet from centralstation control unit.

h) Exit Request Devices

i. Passive Infrared (PIR) Devices: Detect request to exit by monitoring infrared energy emitted within the door exit zone. Units are sensitive to the infrared wavelengths emitted by the human body and are insensitive to general area thermal variations.

ii. On door types (see drawing schedules) that do not show motion detectors being used, the request to exit function will be handled by the switched exit hardware devices. It shall be the responsibility of the security contractor to coordinate with the hardware contractor in wiring of power transfer hinges and switched exit devices. The only doors that do not require any exit request are doors with a reader on both sides.

i) Acoustic Type, Glass-Break Sensors

i. Sensor Element: Microprocessor-based, digital device to detect breakage of plate, laminate, tempered, and wired glass while rejecting common causes of false alarms. Detection pattern shall be at least a 20-foot (6-m) range.

ii. Hookup Cable: Factory installed, not less than 72 inches (1830 mm).

iii. Activation Indicator: LED that lights on sensor housing when responding to vibrations, remaining on until manually reset at sensor controller or at central-station control unit.

iv. Controller: Integral with sensor housing or in a separate assembly, locally adjustable by control under housing cover.

v. Glass-Break Simulator: A device to induce frequencies into protected glass pane that simulate breaking glass without causing damage to glass.

j) Photoelectric Sensors

i. Sensitivity: Detect standard-intruder movement within sensor's detection patterns at any speed of less than 7.5 fps (2.3 m/s) though the beam. Allow installation of multiple sensors within same protected zone that will not interfere with each other.

ii. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.

iii. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard intruder movement within sensor's detection patterns, causing an alarm.

k) Microwave Pir Dual technology Motion Sensors

i. Single unit combining a sensor that detects changes in microwave signals and a PIR sensor that detects changes in ambient level of infrared emissions caused by standard-intruder movement within detection pattern.

ii. An alarm is transmitted when either sensor detects a standard intruder within a period of three to eight seconds from when the other sensor detects a standard intruder.

iii. Minimum Detection Pattern: A room 30 by 30 feet.

iv. PIR Sensor Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1 deg C) or less, and standard intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across 2 adjacent segments of detector's field of view.

v. Microwave Sensor Sensitivity: Adjustable, able to detect standard intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s). Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.

vi. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test enabling switch under sensor housing cover.

vii. Remote Test: When initiated by central-station control unit, start a test sequence for each detector element that simulates standard intruder movement within sensor's detection patterns, causing an alarm.

l) Wire and Cable

i. Provide both TPS (Twisted pair Shielded) and TP (Twisted Pair), with the appropriate number of pairs. Provide Cat 5e UTP for emergency telephone signal wiring.

ii. Cable for Low-Voltage Control and Signal Circuits: shall be shielded twisted-pair cable with drain.

iii. HID Card Reader-Weigand-Composite cable part number CSC #702790

1. 1-22/6 conductor overall shield (Reader)
2. 1-18/4 conductor (Lock Power)
3. 1-22/2 conductor (Door Contact)
4. 1-22/4 conductor (Request to Exit)

iv. RM Style Card Reader-RS485-CSC #112102
1. 1-18/2 pair individually shielded

v. Inside Card Reader on IN/OUT Door-Weigand-CSC #110253
1. 1-22/6 conductor overall shield

vi. Alarm Door Contact-CSC #110105
1. 1-22/2 conductor

vii. Duress/Panic Button-CSC #110105

1. 1-22/2 conductor

viii. RM input/output Modules-RS485-CSC #112102
1. 1-18/2 pair individually shielded

5) Installation Requirements

a) Wiring

i. Install all wiring in raceways

ii. ¾ inch minimum conduit is required

iii. Multiple home runs may be contained in a single conduit of appropriate size.

iv. Conceal raceways except in unfinished indoor spaces.

v. Conduit fill shall not exceed 40%.

vi. Wiring shall be neat and workmanlike.

vii. Cables shall be individually labeled.

viii. Cable Central Services using spools, guides, supports and other devices.

ix. Cable shielding and grounding SHALL be utilized in panels and enclosures.

x. Shield grounding SHALL be at the panel and NOT at the device (to avoid ground loops)

xi. Cable routing within the enclosure or panel shall be neat and workmanlike.

xii. Number of terminated conductors shall be in accordance with manufacturers' recommendations and/or requirements.

xiii. Un-terminated conductors shall be electrically isolated and secured within the enclosure or panel.

xiv. Appropriate splices, taps or terminations shall be in an approved junction box.

xv. External device power supplies shall be installed in Facilities Central Services approved locations.

6) Naming and Programming

a) Convention:

i. Use the official University of Utah campus building numbers, and the University designated room numbers.

ii. Descriptive abbreviations should be used as most CCure program display boxes are limited in size.

b) iSTARs:

i. Building Number: iSTAR Number L# Door# Room Description Ex: 0003:03 L1 0166 Northwest Comm Rm
0079:02 L2 2000D L2 Data Closet 0525:19 L4 East Comm Rm by Elevator.

ii. A more complete description of the iSTAR's location, access requirements (card access, key number, how to find the room where the iSTAR is located, etc.) should be entered in the description section of the configuration identification screen.

1. Ex.; Located on level one, room 1001, (or across from elevator) using key RT2674 or access card.

iii. Programming

1. Leave time zone box blank.

2. Tamper, AC power fail and Low Battery inputs should all be defined and properly working.

3. An event should be defined for controller communication failure.

c) iSTAR Clusters:

i. Naming: Building Number: iSTAR L#
Ex: 0003:03 L1 Cluster
0079:02 L2 Cluster
0525:19 L4 Cluster

d) Reader, Input & Output Device:

i. Naming; Building Number:iSTAR number, (IZ, PH, EX, etc) – if included in intrusion zone, pharmacy, exterior door, etc. : (input/output type) (DC, REX, DL, ML, GB, DUR, MOT) Room number, L#, which board

it is controlled by (ACM, I8 or RM) and which port or relay it is wired to on the board to which it is attached.

1. Ex: 0851:01 1125 Lab Reception 1-R6 (reader 6 on ACM 1 of iSTAR 1)0043:01 (IZ):MOT Safe Rm 1-I7 (motion sensor within intrusion zone) 0086:04 DC L1 DSL/TACC RM-4-I1 (door switch monitor on RM board number 4)
0512:01 DC L1 E101 Conf Rm I8:1-I4 (door switch monitor on I8 board number1)

ii. Programming:

1. Input and output state changes should not be sent to the Monitoring Station and should only be sent to the Journal if it is part of an intrusion zone, panic button or other life safety or high level security feature; i.e. freezers.

2. Readers should have the continuously active box checked.

3. Reverse sense of input should only be used in exceptional situations and then only temporarily.

4. No unused inputs, outputs, readers, doors or any other element should be defined in the system.

5.After complete installation, no input supervision errors, open loops, or line faults should be reporting in the Monitoring Station.

f) Door:

i. Naming: Building Number: iSTAR number (Door type) – IZ (intrusion zone), EX (exterior door), PH (pharmacy) University assigned room number (if known) Floor (if applicable): Description

1. Ex: 0019:03 0490 Atmos Comp/Vis 0575:01 (EX) L1 North Entry :13 3C354 Vascular Surgery Back Dr

ii. A more complete description of the door can be entered in the description section of the configuration identification screen.

g) Camera:

i. Naming: Building Number View Description (IP Address) Camera Model Number

1. Ex: 0086 Loading Dock (10.0.86.5) Axi P3346

*Facilities Central Services is generally responsible for programming the following:

h) Event:

i. Naming: Building Number : iSTAR number, (type) – (intrusion zone, duress, etc) : Event Description

1.Ex: 0026:01 (DU) Rm 106 Duress Evt 0032:01 Unlock Usher Rm Evt 0179:01 (IZ): Arm Event Group Evt

ii.A more detailed description should be entered if the cause of the event or required action to the event needs to be displayed on the General Activity Monitor screen.

i) Clearance:

i. Naming: Building Number – Partition name if other than default, Description, (type) – (IZ-intrusion zone, PH-pharmacy, etc.), time range (D-D 0000-0000)

1. Ex: 0093 Natatorium Men's Pool Entry Clr 0179 Ext Ent M-F 0800-1700 Clr

ii. The type and/or location of the doors in the clearance should be clear.

j) Schedule:

i. Naming: Building Number: iSTAR number (if applicable for event activation) – Description, time range (D-D 0000-0000)

1. Ex: 0053:01 Disability Center Unlock M-F 0800-1700 Scd 0722:02 Shop Area Force Arm M-S 2200 Scd 0086 Custodial Day M-F 0600-1500 Scd

2. Since there is no place for a detailed description, the time specification name should supply as much information in as an abbreviated form as possible.

ii.Programming:

1.The time zone box must be left blank when defining a time specification.

k) Groups:

i. Naming: Building Number: Floor (if applicable): Description

1. Ex: 0512 Ext Door Grp for door group 0556 Patient ElevGrp for elevator group 0865 EvtGrp for event group 0064 InputGrp for input group 0035 OutputGrp for output group

2. There is a description box that can be used to clarify particular group information if necessary

7) Grounding

a) Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and system pre-testing, testing, adjustment, and programming.

b) Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

c) Pre-testing: Align and adjust the system and perform pre-testing of all components, wiring, and functions to verify conformance with specified requirements. Correct deficiencies by replacing malfunctioning or damaged items with new items. Retest until satisfactory performance and conditions are achieved.

d) Testing: Provide at least 10 days' notice of acceptance test performance schedule.

e) Operational Tests: Perform operational system tests to verify conformance with specifications. Test all modes of system operation and intrusion detection. Methodically test for false alarms in each zone of space intrusion devices by simulating activities outside indicated detection patterns.

f) Installer Start-up Responsibility: The Installer shall initiate system operation. The Installer shall provide competent start-up personnel until the system is fully functional. Upon reoccurring technical problems, the Installer shall supply factory direct Manufacturer's support in the form of factory technical representation and/or diagnostic equipment until the resolution of those defined problems.

g) Final testing must be observed by a representative of the campus Facilities Central Services Office. Complete security system must be approved and accepted by Facilities Central Services.

b. Video Surveillance Systems

1) General

a) The contractor or sub-contractor installing the video system must be qualified and trained to OnSSI standards and Axis certified.

b) Video Central Services systems shall integrate with the Software House CCURE 9000 software. The IP video surveillance control and Central Services system shall handle an unlimited number of cameras and alerts through a desktop-based or mobile video client.

c) The contractor or sub-contractor installing the video system must be qualified and trained to OnSSI standards and Axis certified.

2) Warranty

a) Manufacturers standard form in which manufacturer and Installer agree to repair or replace components of video surveillance devices and equipment that fails in materials or workmanship within specified warranty period which is two years from date of final walkthrough and sign-off by Facilities Central Services.

3) Equipment

a)Video Surveillance Wire/Cable
The primary cabling is Ethernet cabling, either Cat 5 or Cat 6. Cat 6 cable shall be used for any new or replacement cable installations. Additional cable may be required for the environmental controls of outdoor housings or additional power requirements for PTZ (Pan-Tilt- Zoom) cameras. However, as cameras have continued to evolve, the additional power required for these (Power-Over-Ethernet) standard. Any deviation shall require approval from Facilities Central Services prior to installation of substitute cabling.

i. Ethernet extenders may be used in rare circumstances to provide reliable connectivity. Use of extenders must be approved by Facilities Central Services during the design process.

b) Video Surveillance Equipment

The University of Utah has standardized on the Axis product line for video surveillance. Common Axis camera models used by the university are listed. Other camera models may be required for specific surveillance purposes, but must still contain the remote focus feature. However, any substitution or deviation from Axis camera products, or these specific Axis models, must be approved by Facilities Central Services prior to installation.

i. Legacy analog camera conversion: existing camera installations can be converted to the Ocularis OnSSI system with the addition of conversion hardware. While replacement of analog cameras with newer high-definition models is preferred, the following hardware must be used in situations where analog camera images are determined to be sufficient.

c) OnSSI Video Software and Hardware

i. Facilities Central Services maintains the centrally managed servers the Ocularis Surveillance system as well as the appropriate server(s) for the cameras at various locations throughout the campus. Installations/conversions of fewer than 8 cameras will record to existing Ocularis servers. Installations/conversions of 9 or more cameras will require an additional recording server which will be supplied and maintained by Facilities Central Services. Cost of these servers is covered within monthly camera fees already billed to the departments.

ii. Video Monitoring Workstations require a minimum of:

1. CPU : Intel core i7 (similar or better)

2. RAM: 8GB

3. Operating System: Microsoft Windows 7 Professional 64- bit.

4. Graphics Adapter: PCI-Express, 1GB RAM w/dual DVI outputs 35 simultaneous Video Channels – 1GB

5. Software: Microsoft .NET 3.5 Framework and DirectX 9.0 or newer.

iii. Switches: All IP camera installations must be connected to a campus standard PoE rated switch.

d) Raceways, Electrical Boxes, and Fittings shall be per the University Standards found in 3.5 Electrical.

4) Installation

a) Install video surveillance systems and components where indicated, in accordance to NFPA 70, with equipment manufacturer's written instructions, in compliance with National Electrical Code, and with recognized industry practices, to ensure that video surveillance system complies with requirements and serves intended purposes.

b) Wiring Method: Install all wiring only in raceways, 3/4" minimum, or cable trays. Multiple home runs may be contained in a single conduit of appropriate size. Conceal raceways except in unfinished indoor spaces. Conduit fill shall not exceed 40%.

c) Wiring within enclosures: Label, bundle, wrap, and train the conductors to terminal points with 6-inches of slack minimum, 12-inches of slack maximum. Provide and use cable Central Services hardware and distribution spools. Wire shielding, where used, should remain un-cut as much as possible.

d) Number of Conductors: As recommended by system manufacturer for functions indicated.

e) Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.

f) Tighten connections to comply with tightening torques specified in UL Standard 486A.

g) Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so media are identified and coordinated with system wiring diagrams.

h) Install power supplies and other auxiliary components for camera devices at the locations pre-approved by Facilities Central Services.

5) Grounding

A. Ensure that any power supplies are properly connected to an earth ground near the AC input wiring.

B. For devices appropriate for cable shield grounding, ensure that any shield wires are grounded at the power supply end of the cable to the ground referenced above.

C. Do NOT connect the shield to ground at the far end cabled device. (This will avoid the potential for “ground loops”.)

D. When disconnecting wiring, disconnect ground wires last (to provide maximum protection to the equipment and personnel.)

End of 3.5 Electrical