THE UNIVERSITY OF UTAH

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Issued July 31, 2009 PN: 5K3-UU001

Mr. Earl Lewis, Project Manager
University of Utah
585 Komas Drive
Salt Lake City, UT 84108

Re: University of Utah Solicitation 9967
Data Center Improvements – Programming
Basis of Design

Dear Mr. Lewis:

HP Critical Facilities Services delivered by EYP MCF, Inc. (EYP) is pleased to provide the enclosed Basis of Design, which develops the space requirements and critical infrastructure needs for Data Center Tenant Improvements. The detail contained within this report is based on a week long meeting in Salt Lake City, UT, May 11-15, 2009, and subsequent meetings and phone discussions with University Facilities, interviews with University IT personnel and University designated Stakeholders.

EYP believes that we have accurately captured the Basis of Design, space requirements and equipment needs described to us as we have proceeded through the information gathering process. We would like to thank all of the personnel involved in this effort for their excellent cooperation and detailed information provided throughout the space planning and needs assessment. We especially thank you for the University's assistance in facilitating the discussion process, preparing meeting notes, and gathering information from various University of Utah user groups.

EYP greatly appreciates this opportunity to be of further assistance to you and the University of Utah in the development of the much needed Data Center Tenant Improvements. We are prepared to offer any additional support you deem appropriate in the detailed design and commissioning of this facility, and in the implementation of all the technologies to be installed in the Data Center. Should you or the University of Utah have any questions, please contact me at (310) 689-3522, or via email to cprawdzik@hp.com.

Respectfully submitted,

Charles Prawdzik, Jr., AIA
Principal and Project Manager
Utah Architect 7290049-0301

cc: Yigit Bulut, P.E.
Peter Gross, P.E., VP
Steve Carter

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

TABLE OF CONTENTS

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

1. Executive Summary

1.1. Background

This Basis of Design (BOD) sets forth the space requirements and critical infrastructure needs for the new University of Utah Data Center and provides detailed information, user preferences and requirements to be utilized for the design, facility engineering, construction, commissioning and operation of the facility. This document was prepared using information gathered during meetings with users and assessments to develop the spatial requirements for the Data Center and critical infrastructure requirements for the equipment supporting the Data Center's operations.

The team conducted this study through meetings, exchange of email, and telephone discussions with the University of Utah Facilities Management, Data Center operations personnel and designated University of Utah Data Center stakeholders. These discussions occurred over a three month period during which time, needs, preferences and requirements were discussed among the team members. Discussions were recorded with meeting minutes, and this BOD was prepared using these minutes as a guide. Drafts of the BOD were then circulated for coordination of content, review and correction.

The team's role in this process is to assist the University of Utah in identifying its needs and developing the requirements for the new Data Center; to convey these requirements to the Architect/Engineer and Contractor to insure that the new facility is designed, constructed, commissioned and delivered to meet the stated needs of the University of Utah.

1.2. Location of Data Center

The existing shell for the proposed Data Center Tenant Improvements is located at 875 West Temple Street, Salt Lake City, Utah. This existing shell will also provide basic facilitation and conveniences, for one or more other projects uses, on a short term occupancy, for storage, administrative support areas, restrooms, loading dock, parking, and building entrance, physical security, access and control.

1.3. Intent of this Basis of Design

This BOD is to provide the requirements for a single, new, Data Center Tenant Improvement to be located within the existing shell building, including various site improvements. The spatial requirements of this BOD assume the Data Center areas are physically located within the existing facility owned and controlled by the University of Utah. The BOD is prepared for a Data Center project Tenant Improvement (TI) interior to this controlled environment. This BOD is insufficient to establish requirements for a stand alone facility, and does not provide requirements for new construction on a "Greenfield" site.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

1.4. Data Center Continuous Occupancy

The Data Center shall be capable of continuous occupancy and continuous data processing operations for periods of unlimited duration, without interruptions for normal maintenance, utility outage, testing or repairs. Designer shall consider system design and selection of equipment to accommodate such operations permitting only scheduled shutdown for maintenance and repairs, not to exceed one period of 8 hours duration per calendar year and no more than a total of 24 hours of shutdown time, including the 8 hour shutdown per calendar year.

On site water and fuel storage shall be adequately sized to provide continuous service to required loads. Size of tanks shall take into consideration service level agreements for delivery of additional water and fuel to the site.

The Designer shall consider voluntary upgrades to building code minimum requirements to permit occupancy during times of emergencies and natural disasters. The prospective upgrades and estimated construction costs of such upgrades shall be presented to the University of Utah for consideration in design. The existing building structure and shell appears to meet Utah Essential Facility Requirements. No University personnel or users have expressed any absolute requirement for the facility to be designed to Utah Essential Facility Requirements or any requirement for the facility to be occupied during or immediately after an earthquake or natural disaster.

1.5. Data Center Facility Space Breakdown

The spatial requirements contained herein are based on the expressed needs of the users and operators. Equipment room floor areas are estimated and will vary based on the type of equipment and system(s) selected plus decisions made during detailed design to locate or select equipment specifically for indoor or outdoor use. These requirements will likely be modified as specific site, design, construction and equipment alternatives are evaluated.

Circulation space for access and egress to the Data Center Facility rooms and accessory uses are generally included and are assumed to be a part of the University of Utah Data Center facility space.

The following table summarizes the **Program Build** floor area, **Day 1 Need** floor area and **Final Need** floor area, in gross and net square feet as accepted by the University of Utah and detailed in **Section 3** of this BOD. By Agreement, the Program must identify the requirements and estimated costs on the basis of a floor area limited to the Southern building bay, South of the existing Building Firewall, regardless of need. The Day 1 Need and Final Need data center floor areas and critical IT electrical loads are determined by the Conceptual Master Plan effort, which has been completed concurrent with this Programming effort.

Net floor area is in *italics*. Gross floor area is normal font.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

1.6. Table: Data Center Facility Space Breakdown

Space Type	Program Build (*nsf*/gsf)	Day 1 Need (*nsf*/gsf)	Final Need (*nsf*/gsf)	Comments
University CORE	***11,000***	***11,000***	***16,000***	**Computer Room**
HPC	***5,000***	***5,000***	***9,000***	**Computer Room**
White space	*4,000*	*4,000*	*8,000*	Data Floor
HPC CORE	*1,000*	*1,000*	*1,000*	Dedicated space
COLO	***0***	***0***	***7,500***	**Computer Room**
Staging/Build	***1,000***	***1,750***	***2,750***	
CORE	*1,000**	*1,000*	*1,000*	* shared w/ HPC
HPC	*0*	*750*	*750*	
COLO	*0*	*0*	*1000*	
Network	*0**	*0**	*0**	* placed in (e) Dock, see below.
Data Center Operations Center	***250***	***250***	***250***	5 Operators w/ video wall
Infrastructure Support (MEP)	***4,800***	***4,800***	***9,750***	MEP/FP + IT
Mechanical, FP	*1,200*	*1,200*	*2,150*	FP&S gas
Electrical	*3,200*	*3,200*	*7,000*	UPS, Battery, Switchgear
Information Tech	*400*	*400*	*600*	MPOE, Meet-me, POP

Space Type	Program Build (nsf/gsf)	Day 1 Need (nsf/gsf)	Final Need (nsf/gsf)	Comments
Support, Office, Administration	***2,100***	***2,100***	***2,100***	
Security	*200*	*200*	*200*	With closet
Pre-Security	*400*	*400*	*400*	Entry, Lobby, Workroom
Conference	*400*	*400*	*400*	20 person min
Offices	*1,100*	*1,100*	*1,100*	8 Workstations, 3 private
New Corridor	**1,934**	**1,934**	**1,934**	
Net/Gross factor	**1,505**	**1,506**	**1,984**	
Program Area Totals	**27,589**	**28,340**	**51,268**	(Summation of **Bold Areas**)
Shared Area	**3,876**	**3,876**	**3,876**	
MPOE	149	149	149	
Break (B)	188	188	188	
Restrooms (RJ)	370	370	370	Existing, w/ Jan.
Loading Dock (Receiving)	1,719*	1,719*	1,719*	*Inc. 750 sf HPC Network Staging
Existing Corridor	1,450	1,450	1,450	Bulk Storage
DC Facility Total	**31,465**	**32,216**	**55,144**	(Summation of **Bold Areas**)

1.7. Data Center Facility Summary

The principal considerations for establishing the new University of Utah Data Center are as follows:

- The spatial and equipment requirements are based on current operational and head count projections. These projections were developed based on workload information provided by the University of Utah personnel that will occupy the new facility.

- The new Data Center may accommodate immediate move-in requirements, allow for foreseeable future expansion, and accommodate ancillary and infrastructure support space needs. The existing shell and site is of sufficient size and capacity to accommodate all current and future needs. The facility may be built out in one or more Phases, and the Phases of construction, may or may not align with the three floor area projections labeled Program Build, Day 1 Need, or Final Need.
- Security will be enhanced at the existing building and site. Site security must include both passive and active systems that will restrict and control personnel and vehicle access.
- The Data Center provides for enhanced availability of special critical operations and may provide a redundant location for backup and recovery of operations primarily located at other sites.

1.8. Report Format

The report that follows provides descriptions of the various systems and components that will make up the Data Center facility. Each section and subsection begins with a description of the system or component, and in some cases, provides alternative means of providing that system or component. Following these descriptions, the BOD development team may provide a specific **<u>Recommendation</u>** (bold underlined for emphasis) to the project. Where a specific recommendation is not noted, the information contained in the description of the system or component is to be considered the Recommendation.

1.9. Report Objective

The objective of this BOD is to provide the University of Utah with a comprehensive description of the needs and requirements for the proposed Data Center. The report will be used to prepare the Programming Phase budgets, and to obtain required University approvals. It is anticipated that this document will be incorporated by reference into the solicitation for the Design and Construction of the new Facility.

1.10. Implementation Timeline

No Phasing Plan and no Implementation Timeline has been prepared in connection with this Data Center TI project. A need date of October 2010 has been established as completion date of Phase 1 Construction and Commissioning. This objective is quite feasible if using fast track, design/build, turnkey, or similar accelerated construction delivery methods. However, there may be insufficient time remaining for traditional public contract, design, bid, construct, commission activities, especially if these services are separately procured by Utah.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

1.11. Construction Cost Budget

A Programming Phase construction cost estimate was prepared by Skanska USA Building Inc., for the **Program Build** floor area and MEP infrastructure requirements. This is a separate stand alone document submitted concurrent with this Report.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

2. Design Considerations

The Data Center is a critical facility for the State of Utah, and the operation of the University. Without a functioning reliable Data Center, the University of Utah's data processing, storage and network operations will be disrupted. In making modifications and improvements to the selected site, the following standards must be considered.

2.1. Site Specific requirements

As this is generally an interior tenant improvement project, location considerations will primarily effect mechanical equipment type selection, equipment sizing, and placement of outdoor equipment. Most interior improvements are otherwise unaffected by site environmental and location considerations. Many of the general requirements below are applicable to the Data Center Tenant improvements outdoor equipment, and site facilitations, such as parking and site access perimeter fencing and security.

2.1.a. Wind

Extreme wind conditions and resultant damage caused by high winds, reduced visibility, and blowing dust can result in power outages, closed roads, and damage to structures. The building structure and exterior equipment should be designed to resist maximum anticipated wind forces based on a 100 year period of recurrence. Construction of critical data processing areas shall be suitable to the exposure. Personnel entrances and loading docks should be adequately protected and designed to permit operation in high winds. The building structure should not be vulnerable to damage resulting from the collapse of structures such as masts, towers, antenna or stacks.

2.1.b. Flooding

Consideration must be given to the local 100 year flood plain. This consideration must not only address the isolation of the facility from flooding, but also the ability of critical personnel to access the facility. Based on preliminary review of FEMA flood maps, the site and surrounding streets are located above the 100 year flood plain. During detailed design, the Civil engineer is required to review, modify or adjust storm drains in the vicinity of the building. This work shall be performed using the latest flood maps and storm drainage plans available. The designer shall confirm that flood waters from 100 year floods shall not enter the building. In addition to this design requirement it is recommended that all data processing areas be surrounded by minimum 6 inch high curbs with bulkheads at openings to minimize standing or flood waters from entering all data processing areas. See section 2.3 of this Basis of Design for additional requirements.

Particular care should be exercised in establishing watertight seals to the roof and exterior wall intersections and whenever pipe or conduit penetrations are necessary. Installation of water detection devices should be provided for normally concealed under floor areas and above ceilings, where exposure to water cannot be avoided. For example, building roof

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

drains located above data processing areas should be relocated outside the area. If this is impractical, roof drains shall be double contained or provided with drip pans and leak detection.

2.1.c. Explosion

The exposure of the Facility from potential sources of explosions should be recognized and controlled. Fuel tanks, systems, pumps, day tanks and generators shall be located outdoors. Data processing areas shall not be located directly adjacent to boiler rooms, compressor rooms, hot water tanks, and uses handling or storing flammable or hazardous materials.

2.1.d. Traffic Protection

Data Processing areas shall be located in the building protected against severe external exposure to traffic impact and resultant fires, by blank, fire rated, reinforced exterior walls and doors, with parapets to protect the roof edge. Fresh air intakes shall not be located on street exposures to avoid the possible entrance of smoke and noxious or corrosive fumes. Highway barriers, traffic barricades and/or heavy bollards shall be considered along all street traffic exposures, especially at intersections, to avoid impact of vehicles into the building exterior walls.

2.1.e. Earthquake

Provide an earthquake resistant design for all Data Center structures and/or improvements. The Designer shall consider strengthening design of building components in areas housing the Data Center or its critical equipment that would result to minimize interior damage or accessibility of space immediately after a seismic event. However, upgrade to “essential facility requirements”, to permit continuous occupancy is not required.

2.1.f. Snow, Ice, Hail

The site is prone to heavy snow, ice and hail. Provide netting or hail guards to protect openings and outdoor equipment from damage caused by hail or heavy snow or ice. Design roofs and canopies for accumulated snow loads as required by local codes. Avoid roof drains that discharge water onto pavements that are used as walking surfaces, and reroute existing drains to storm lines to avoid ice accumulation around walking surfaces.

2.1.g. Utilities

The Data Center shall be planned to provide multiple and diverse paths for all utilities (power, communications, water and other mechanical services) and other site features, to support the availability requirements of the Project.

2.1.h. Acoustic Considerations

Noise generating equipment must not be located near occupied office areas, residential areas or other noise sensitive users. If adequate separation cannot be provided, acoustic protection shall be provided in the design.

2.1.i. Site Privacy Considerations

There shall be no exterior identification, signage, or features on site that may aid others in the surreptitious identification of operations within the Data Center.

2.1.j. Building Access, General Features

There must be adequate "on-grade" site area for development of the Data Center facility. Sufficient space must be available for Data Center supporting infrastructure equipment (i.e. generators, cooling towers, etc.) and limited parking. One separate entrance to the Data Center facility shall be provided. Data Center personnel and its visitors shall enter through this main Data Center building entrance.

2.2. Infrastructure Design Considerations

2.2.a. Redundancy

Reliable operation of the Data Center is dependent upon a properly designed, well constructed, and efficiently controlled environment. In order to achieve maximum uptime, it is important that redundancy be built into the facility and site infrastructure.

- **Redundancy** ---------The ability to maintain operation, in spite of a failure of a primary support source. It is providing backup in case of failure.

Just what level of redundancy (backup) is required? Numerous factors are used in making such determinations, but it generally becomes a cost/benefit issue. Combined with risk analysis from a historical perspective, the likelihood of failure is considered versus the cost of providing backup in the event of failure. For operations requiring continuous availability, the primary concern is that no single point of failure results in a total outage. It should be noted that all systems will eventually fail, and an understanding of the impact of each failure is important in establishing a reliable infrastructure and developing appropriate procedures to compensate for the failure.

It is critically important that the redundant systems are available when required. Consideration of standby equipment cannot be understated. Where financial considerations permit, the recommendation for standby systems is the preferred choice.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

2.2.b. Fault Tolerance

Reliability of critical facility electrical and mechanical systems and components is measured in terms of availability. If electrical service is lost, the critical operation is curtailed. Good design practice involves providing redundancy and bypass components to maintain service during disruption and maintenance. Since electrical and mechanical distribution systems consist of a chain of equipment and components; failure of any single item can result in an outage unless redundancy and/or bypass is provided.

A fault tolerant design eliminates single points of failure. A single point of failure is considered any single component, which in a failed condition will curtail the operation of the critical equipment. From the standpoint of electrical power distribution, it is any item that delivers power to the critical equipment or to the environmental support equipment that maintains the temperature and humidity control of the environment where critical equipment operates. Without power to the environmental support equipment, the computing hardware will be susceptible to thermal shutdown. On the mechanical side, it is any component that delivers or provides the cooling for the critical environment, including electrical distribution rooms and computer hardware.

To qualify as a single point of failure, the components will meet one of the following criteria:

- **Single Device** -------Where the failure of the device can completely disrupt the data processing operation
- **Single Route** ---------Where there is only one physical path existing between geographically diverse equipment
- **Colocated**---------------Where redundant or alternate components reside together
- **Common Site**--------Where natural or manmade events can render a site or location inhabitable or dysfunctional

2.2.c. Maintainability (Concurrently Maintainable)

Appropriate design and construction are essential to reliability. However, maintenance is equally important to ensure the redundant and/or standby equipment is available when required. Without downtime for maintenance and repair, the reliability of systems will be compromised. Maintenance downtime should be available without disruption of necessary services to the critical environment. In order to achieve this, redundancy is necessarily limited during the maintenance activity, which is one reason for providing redundancy. Even with redundancy of selective components, there remains some requirement for scheduled downtime of selective components for torquing electrical connections. This downtime can be scheduled to avoid complete outage, but must be recognized as necessary.

2.2.d. Facility Growth Strategy

An essential element of design is the ability of a facility to house and support its business functions as it grows or changes. Expansion of the Data Center Facility is required.

2.2.e. Reliability Definitions

One of the most common sources of confusion in the field is what constitutes a reliable system. All too often, reliability is in the eye of the beholder. What is acceptable to one person or company is inadequate to the next. There have been various attempts to establish an industry standard definition to describe the design concepts employed in achieving reliability. As corporate computing and Internet website hosting continues to mature into a major industry, competing companies with data centers of radically different infrastructure capabilities are all claiming to deliver "high availability." Additionally, terms such as "N", "N+1", and "2N" are sometimes used. With the explosive growth comes an increased demand for computer hardware reliability. Information technology customers expect reliability of "Five Nines," or 99.999%. This report approaches the objective of achieving high availability by using Tiers of Reliability, as developed by the Uptime Institute.

2.2.f. Tiers of Reliability

The tier classification system involves several definitions:

- **Fault Tolerant**------A site that can sustain at least one "unplanned" worst-case site infrastructure failure with no critical load impact
- **Concurrently Maintainable**- A site that is able to perform planned site infrastructure activity without shutting down critical load (fault tolerance level may be reduced during concurrent maintenance)

It is important to remember that a typical critical facility site is composed of at least twenty major mechanical, electrical, fire protection, security and other systems, each of which has additional subsystems and components. All of these must be concurrently maintainable and/or fault tolerant for the entire site to be considered concurrently maintainable and/or fault tolerant.

Some sites built with fault tolerant electrical concepts failed to incorporate the mechanical analogy, which involves dual mechanical systems. Such sites are classified Tier IV electrically, but only achieve a Tier II level mechanically. The following list summarizes the characteristics of each Tier.

- **Tier I** Single path for power and cooling distribution, no redundant components, 99.8% availability
- **Tier II** Single path for power and cooling distribution, redundant components, 99.9% availability

- **Tier III** Multiple power and cooling distribution paths, but only one path active, redundant components, concurrently maintainable, 99.96% availability
- **Tier IV** Multiple active power and cooling distribution paths, redundant components, fault tolerant, 99.99% availability

The availability numbers have been drawn from industry benchmarking conducted by The Uptime Institute and sites in the top 90th percentile (this means only 10% of all sites performed at this level). The quality of human-factors management is the most significant element separating top sites from all others.

Tier I Data Center – Basic A Tier I data center is susceptible to disruptions from both planned and unplanned activity. It has computer power distribution and cooling, but it may or may not have a raised floor, a UPS, or an engine generator. If it does have UPS or generators, they are single-module systems and have many single points of failure. The infrastructure should be completely shut down on an annual basis to perform preventive maintenance and repair work. Urgent situations may require more frequent shutdowns. Operation errors or spontaneous failures of site infrastructure components will cause a data center disruption.

Tier II Data Center - Redundant Components Tier II facilities with redundant components are slightly less susceptible to disruptions from both planned and unplanned activity than a basic data center. They have a raised floor, UPS, and engine generators, but their capacity design is "Need plus One" (N+1), which has a single-threaded distribution path throughout. Maintenance of the critical power path and other parts of the site infrastructure will require a processing shutdown.

Tier III Data Center - Concurrently Maintainable Tier III level capability allows for any planned site infrastructure activity without disrupting the computer hardware operation in any way. Planned activities include preventive and programmable maintenance, repair and replacement of components, addition or removal of capacity components, testing of components and systems, and more. For large sites using chilled water, this means two independent sets of pipes or an adequate number of segmentation valves which will allow for multiple paths to all critical equipment. Sufficient capacity and distribution must be available to simultaneously carry the load on one path while performing maintenance or testing on the other path. Unplanned activities such as errors in operation or spontaneous failures of facility infrastructure components will still cause a data center disruption. Tier III sites are often designed to be upgraded to Tier IV when the client's business case justifies the cost of additional protection.

Tier IV Data Center (Fault-Tolerant) Tier IV provides site infrastructure capacity and capability to permit any planned activity without disruption to the critical load. Fault-tolerant functionality also provides the ability of the site infrastructure to sustain at least one worst-case unplanned failure or event with no critical load impact. This requires simultaneously active distribution paths, typically in a System + System configuration. Electrically, this means two separate UPS systems in which each system has N+1 redundancy. Because of fire and electrical safety codes, there will still be downtime exposure due to fire alarms or people initiating an Emergency Power Off (EPO.) Tier IV implies that all computer hardware will have dual power inputs.

Recommendation: Based on our understanding of the reliability requirements for the Data Center and in consideration of the Tier classification system described above, all systems shall be **Redundant** and **Concurrently Maintainable.** However, **Fault Tolerant** systems are not required. The Designer shall evaluate these requirements at a system by system level and propose alternatives in the level of reliability, and shall propose options with cost estimates during preliminary design. The Designer shall analyze, evaluate and compare operational trade-offs, and costs for Tier II and Tier III systems during Preliminary Design, for the selected site. This will support The University of Utah's goals to a facility which is concurrently maintainable, and which eliminates single points of failure. To that end, all systems and components which will be required to maintain operational integrity 24x7x52 as well as to support the needs of personnel, must be redundant and must be housed within the footprint of the new facility. These issues are described in subsequent sections of this report, and are summarized as follows:

- The design will minimize the number of single points of failure in the engineering systems supporting the Data Center critical and essential loads. This shall be achieved by means of a dual path distribution topology to the critical and essential loads. The single point of failure shall be moved to as close to the load as economically practical.
- The mechanical and electrical system infrastructure shall be concurrently maintainable. This means that any component, sub-system, and system must be configured such that the critical load will receive filtered/conditioned UPS power and cooling at the rated load during all routine, scheduled maintenance.
- The electrical system infrastructure may be fault tolerant, where dual cord equipment is in use. This means that any fault or failure associated with a component, sub-system or system shall not have an impact to the continuous operation of the respective redundant component, sub-system or system.
- Sufficient space to meet short and long term data processing needs
- Modular power and cooling growth accommodations to meet short and long term data processing projections
- Redundant power including multiple utility sources, standby generators and UPS systems
- Static switch technologies within the power systems shall be considered during design, based on system design and use of single or dual corded loads.
- Redundant mechanical systems shall be considered during design. Systems shall include on-site water storage and wells, but not use of Central Plant systems for backup supply.
- Redundant communications entrances from diverse service providers

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

- Emergency accommodations for 24x7x52 operations personnel.

2.3. Raised Floor Design Considerations and Coordination

The requirements for under floor coordination within the Data Center are of the utmost importance. There is a strong temptation to put as much as possible under the access floor, but this must not be done without adequate planning. The typical systems, which are generally located within the raised floor areas, are:

- Mechanical chilled water supply and return piping
- Domestic water piping for the CRAH Units
- Drainage piping, condensate pans and lines, vent lines, and floor drains
- Communications wires and cable contained within a cable tray
- Electrical power feeds for equipment
- Smoke detectors under the raised floor
- Suppression gas nozzles and piping
- Water leak detection wires and system
- Curbs, bulkheads, or dams around the perimeter of raised floor areas to prevent water entry.

Since the area under the raised floor is primarily designed as a supply air plenum, the airflow characteristics of this plenum can be impacted by the location of each of the previously mentioned under floor systems. The perforated floor tiles in the raised floor system are utilized to allow airflow into the room. The perforated raised floor tiles must be positioned with minimal under floor obstructions. This will insure that the maximum amount of conditioned air will flow into the Data Center.

Recommendation: The following are the general recommendations for under floor systems, which should be considered during the design phase.

- At a minimum, raised floor systems designed as a supply air plenum are required in the Data Center spaces. Raised floor systems are also preferred but not required in other operating areas, such as the Data Center Operations Center (DCOC), for access and distribution of cable below the floor. Raised floor systems may also be provided in Support (M/E/IT/Security) spaces. Raised floor may be desirable and can be provided throughout the entire facility as determined by the A/E during the design phase. Providing raised floor systems throughout provides flexibility for future modifications, may avoid the need for ramps and stairs which will add to the gross floor area required, and facilitates alignment of walking surfaces and convenient routing of cables.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

- The data processing equipment and cabinets should be configured front-to-front and back-to-back, in a hot aisle, cold aisle arrangement. There should be a full row of access floor panels, both in front of and behind each equipment row, to allow accessibility to the under floor services.
- The CRAH units should be positioned in the Data Center to provide optimum airflow patterns, as well as to address Data Center redundancy concerns.
- The electrical power routing should have minimal impact or interference on any other under floor systems. Access to these cables is required for relocation of existing equipment, along with the installation of new power cables for future equipment. The power cabling shall preferably be located in the hot aisles and run parallel to the floor grid (not diagonally).
- Fiber and copper shall be in separate trays, preferably overhead, or copper overhead with fiber under the raised floor. Each tray branch (fiber, copper) should be located over the rear of the equipment cabinets or over the cool aisles, or in the warm aisles (if under floor) for input through the back of the cabinets. The communication cable trays should have minimal impact or interference on any under raised floor systems. The tray must be clear of the perforated access floor panels to maximize airflow inside the Data Center. Access to the communication cable tray will be required to install data cables for future equipment.
- Where power and communications cabling must cross, they must cross at 90° angles to each other, and should be separated vertically. By running power cables on the slab, and communications cables in tray suspended from the access floor pedestal system, vertical separation can be achieved.
- All mechanical piping valves, flanges, and serviceable connections for the CRAH units must be located in accessible aisle areas at the Data Center perimeter only, and not under the data processing equipment. The shutoff and isolation valves for the equipment and primary piping systems must also be able to operate freely through all positions. Fittings will need to be serviced periodically and should be fully accessible. Piping within the Data Center shall be kept to an absolute minimum, preferable only over the area normally occupied by the drip pans under the CRAH units.
- Suppression gas nozzles must be clear of any under floor obstructions to operate properly. Under floor smoke detectors must be located in an area subject to good airflow, not under or behind piping or cable tray. The Inert nozzles and smoke detectors should be located in designated aisles and not under equipment. Smoke detectors will need periodic service and need to be accessible.
- An access floor tile identification system should be implemented. In some cases, an alphanumeric coding system is attached to the walls (appliqués or painted) and aligned with access floor tiles. This system can then be used to easily pinpoint the location of under floor device such as a smoke detector or valves for the purpose of troubleshooting or maintenance.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

2.4. Electromagnetic Interference

Electromagnetic Interference (EMI), better known as "noise", is energy in the form of electric and magnetic fields that can interfere with the transmission of a signal. Electronic devices can act both as generators and receivers of this noise.

Successful transmission of data required that the signals not be adversely affected by electromagnetic interference. Since computer signal voltage levels are low, they can easily be influenced by noise. Depending on the site environment, computer equipment and cables may require additional external protection from noise.

Data processing equipment contains some degree of protection from EMI. The metal housing, the grounding scheme, the EMI filter, and shielded cable are all examples of this protection. Nevertheless, this protection is not always completely effective, so the facility design team incurs the responsibility of providing acceptable levels of protection at the installation site. Each discipline must consider the EMI generation potential of equipment being installed and take steps to mitigate the effect on the computer systems. This will involve cross-discipline coordination and is an essential feature of an integrated design.

2.5. Standby Operations – Sequence of Operations

2.5.a. Load Priority

The following Load Priority is **recommended**.

Table: Data Center Load Priority

The basic load priority for the Data Center is as follows (with 1 the most critical, 4 the least):

Load Center	Priority
Network Area	1
Data Center	2
Other Critical and Essential Loads	3
HPC designated non Critical Loads on conditioned power	4
Non-essential Site loads, other facilities & miscellaneous structures	5

2.5.b. Sequence of Operation

The following is a high level description of the 'Automatic' sequence of operation of the data center electrical system. There will also be manual modes of operation and other requirements, details of which will be furnished during the design phase. Further, under normal and utility failure modes of operation, all interconnecting ties shall remain open. The interconnecting ties will only be closed in certain maintenance modes.

The Designer shall consider an electrical distribution system capable of a 'Closed Transition' between the electrical utility supply and the standby system for maintenance purposes, and a return to utility after a utility failure, subject to discussions with the Utility service provider.

2.5.c. Normal Operating Conditions

Utility voltage is within acceptable limits. Generator mounted circuit breakers are closed. Generator distribution circuit breakers are open. Generator control switches are in automatic mode. No generator start signals are present.

2.5.d. Utility Failure

A utility failure signal will cause **ALL** diesel engine generators to start automatically. The main electrical utility circuit breakers are signaled to open. Distribution circuit breakers to load centers are signaled to open.

Once the first diesel engine generator has reached rated voltage and frequency, the generator breaker is signaled to close.

After the first unit is closed to the bus, the control of the remaining units is switched to the synchronizer in each generator paralleling control, which causes the diesel engine generators to synchronize with the system bus, and then close to it at the proper time.

The priority (Load Add) controls prevent overloading of the system bus by providing inhibit signals to prevent operation of selected loads on the system until sufficient generating capacity is available on the bus.

The standby system shall be equipped with a 'Load Shed and Load Add' scheme, which shall be programmed in accordance with the load priority scheme detailed above.

Once sufficient generator capacity has been established on the bus, the load center distribution circuit breakers will close sequentially according to their priority rating.

If a diesel engine generator fails to start after the over crank time delay, the unit will be shut down, and an alarm will sound. If a unit fails to synchronize after a predetermined time delay, an alarm will sound but the unit will continue to attempt to synchronize until signaled to stop by manual operation of the control switches on the diesel engine generator.

In the event that one diesel engine generator fails when the system is supplying emergency power, the failed diesel engine generator will be taken off-line by opening the pertinent generator breaker.

With a significant number of diesel engine generators off-line, the priority control will prevent the lowest priority loads from being added to the system without manual intervention. Bus overload monitoring shall protect the first priority loads in the event that the bus is inadvertently overloaded due to operator error.

If a bus overload occurs for any reason, a load shed signal will be generated to initiate load shedding in the system. If the bus does not return to proper frequency within a predetermined period of time, additional load shed signals will be generated.

If the total load on the bus falls below predetermined limits the controller will automatically shut down each diesel engine generator in an operator predetermined order.

On sensing that the available bus capacity is being approached, the standby unit will automatically be restarted (in the reverse order of which they were shut down) and paralleled with the bus to assume its proportional share of system load.

2.5.e. Return of Utility Power

When utility power supply has recovered to proper voltage conditions the system shall enable a time delay before initiating the retransfer sequence. On the completion of the retransfer time delay, the system will begin a retransfer process.

The diesel engine generators will then run unloaded for a cool down period and shut down.

If a "Utility Fail" start signal is received during the cool down period, the system will re-enter "Utility Fail Mode" as described above.

2.6. Mechanical Operations – Sequence of Operations

2.6.a. Load Priority

The Mechanical Load Priority is the same as the Standby (Basic) Load Priority.

2.6.b. Sequence of Operation

The following is a high level description of the "Automatic" sequence of operation of a chilled water system. There will also be manual "modes of operation" and other requirements, and details that will be furnished during the design phases of the project. For instance, under normal and failure modes of cooling operation, all interconnecting cooling systems shall remain in operation. Some interconnecting cooling systems will only be shutdown in maintenance modes that will not affect the reliability, security and conditions of the critical space.

The mechanical equipment cooling system shall be capable of "switchover modes" between operation and redundant systems for scheduled maintenance purposes, and return to normal operation after equipment cooling failure modes.

2.6.c. Normal Operating Conditions

Chilled water systems will operate to satisfy the Project demand. The sequence shall be further developed in the design phase as the mechanical system components are finalized.

2.6.d. Utility Failure

A utility failure will cause the chilled water plant and accessories to fail trip. All chilled water bypass valves will fail open and all Heat, Vent and Air Conditioning (HVAC) equipment supporting the non-critical and critical loads will be de-energized and fail trip.

Once power is restored though the emergency generators, all critical HVAC equipment will be energized.

With the continuous loss of utility power and continuous switchover to the emergency generators, the chillers will be cleared off through the Building Management System (BMS) and will be enabled to operate within the duration of power outage.

2.6.e. Return of Utility Power

When the utility power outage has recovered to its proper voltage demand conditions, the chillers and accessory equipment that are on the emergency generator bus will indicate to go to a pump down mode until shutdown. The BMS will indicate the chillers to order a subsequent re-start of the mechanical equipment under the normal sequence of operations without affecting the reliability and critical loads.

2.7. University Design Standards & Requirements

Unless this Basis of Design includes more stringent requirements, the below applicable construction industry standards and University Design Standards have the same force and effect as if bound or copied directly into this BOD to the extent referenced. Such standards are made a part of the BOD by reference. The Designer shall comply with standards in effect as of date of their Agreement unless otherwise indicated. Each entity engaged in design or construction on the Project should be familiar with industry standards and University of Utah standards applicable to its discipline or construction activity. Copies of applicable standards are not bound herein.

- University of Utah Design Standards as issued, updated and maintained by Campus Design & Construction, available at the internet portal: http://www.facilities.utah.edu
- Codes in use and adopted in the State of Utah are listed at the above internet site.
- Design criteria, including Snow, Wind, Seismic and Soils requirements are listed at the above internet site.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

3. Space, Occupancy and Capacity Requirements

3.1. General

As a prerequisite to defining the space plan, physical plant and infrastructure for the Data Center, the user's data processing requirements and personnel operations must be defined. The team has received projections of staffing and workspace needs, network and data processing equipment requirements and expectations for the operating environment from the University of Utah facilities and Data Center personnel and stakeholders. While it is recognized that these expectations may vary based on evolving technology, changing business needs, and physical security requirements, it is nonetheless important to prepare a facilities space plan in concert with this Basis of Design.

3.2. Space Planning and Growth

To project the space needs for the Data Center, requirements were received from users through a series of meetings and phone discussions. Space plans were prepared, reviewed and modified, and each area was tested to confirm that user equipment, support equipment and furnishings would fit within the floor areas provided, allowing sufficient space for equipment access, service, and egress. Floor area requirements at the time of move-in, day one, are spun together with gathered expectations for future growth, and tallied as the final expected area demand. Where noted, net square footage (nsf) shall indicate the balance of useable occupiable floor area aside from MEP infrastructure.

These space plans were then reviewed to confirm requirements for supporting critical power and cooling equipment. An initial selection of equipment was made, taking into consideration selecting equipment of the maximum anticipated footprint that may possibly be provided. An initial decision was made as to which equipment was to be located indoors, and is included in the programmed interior area, and which equipment is to be located outdoors, and is included in the programmed exterior yard area. The site, 875 W. Temple St. in Salt Lake City, is prone to harsh winter weather, often with snow, sleet, hail, and rain. Selected Data processing and infrastructure equipment types shall be tolerant of extreme temperature changes, sun exposure, seismic activity, and precipitation. The recommendations described below are based upon information received at the time of this report and may need to be revised, should substantial alterations of requirements or significant data processing growth occur.

Through interviews and phone calls with University of Utah facilities and IT personnel, Data Center growth projections and plans were collected. Future growth expectations are estimates based on historical user data against industry and technology trends. The Designer shall consider requirements for future growth of the Data Center during Preliminary Design.

3.3. Implementation Assumptions

The following assumptions are made for the implementation of the new Data Center facility space plan:

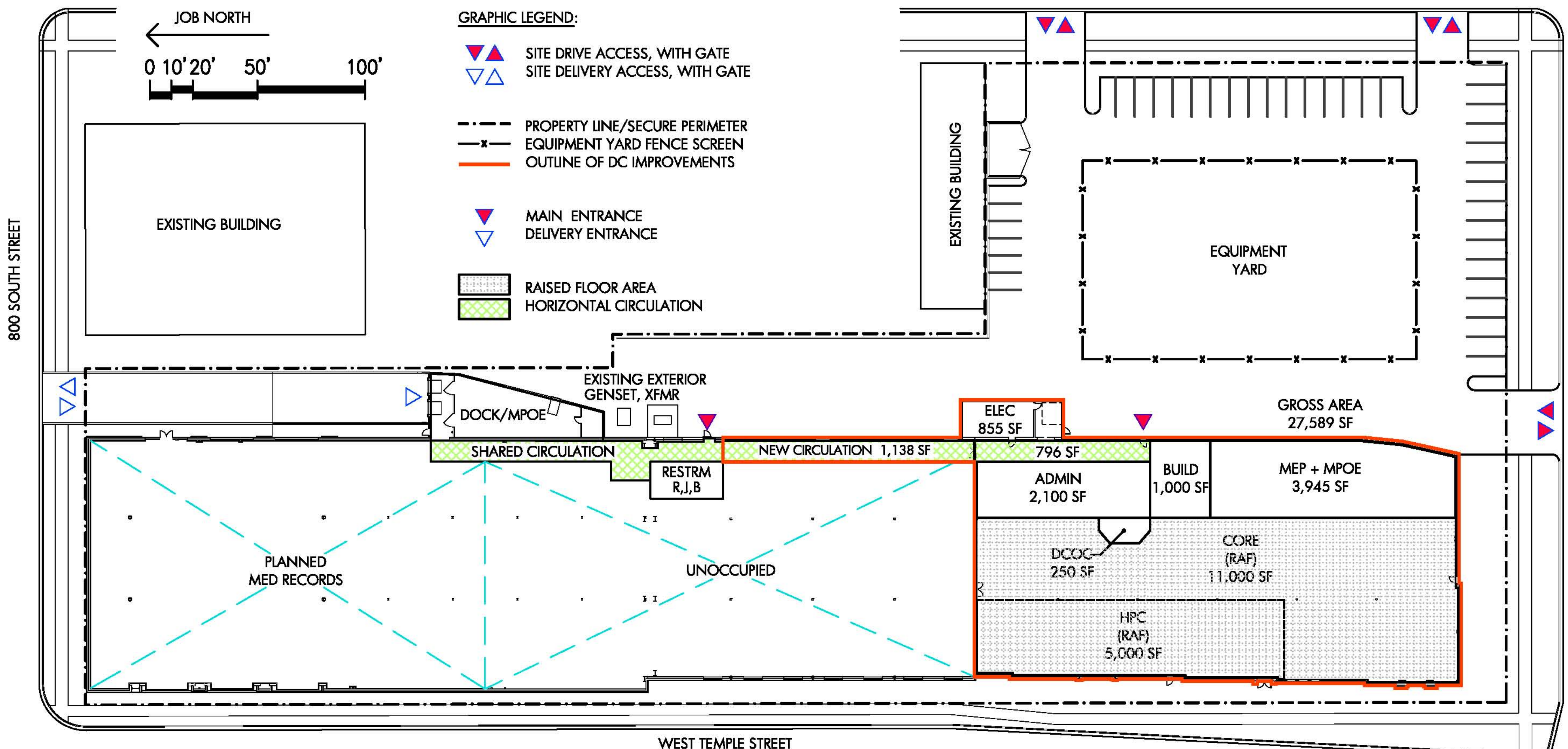
- The Project will be constructed per the recommended space requirements listed in this section, with all of the electrical and mechanical infrastructure equipment in place for the initial move-in environment.
- Data Processing loads on move-in may not be at 100% of available loads. The facility shall be fully functional, and shall be capable of energy efficient operation with data processing loads at 50% or more of available load. No energy efficiency measures are presumed if actual operating loads remain below 50% of available capacity for extended periods of time.
- Growth in space and an increase in critical infrastructure is currently expected. Expansion of these services might consist of providing space in the immediate vicinity for growth, converting other tenant space to new use, providing additional similar facilities at other sites, or future tenant improvement projects to expand this project at the selected location. These growth alternatives are beyond the scope of this Basis of Design, but shall be evaluated at commencement of Preliminary Design, based on needs expressed by the University of Utah at that time.

3.4. Space Concepts

The space concept diagrams for the Data Center indicate the major building components, occupied spaces, infrastructure equipment and required access, service and egress areas, and exterior equipment yards and site features and their relationships.

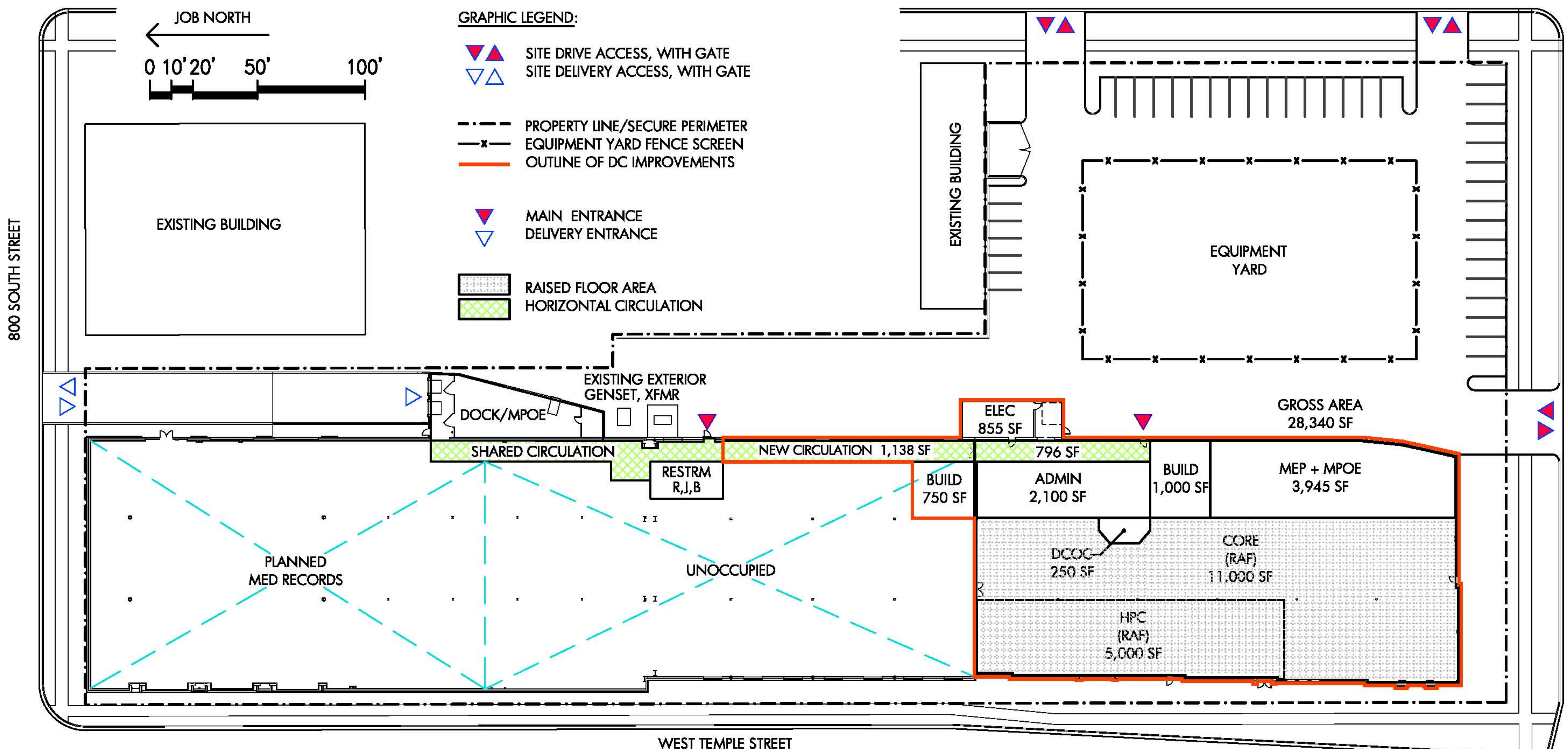
Diagrams are not to scale.

3.4.a. Figure: Data Center Facility Plan Diagram – Program Build



EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

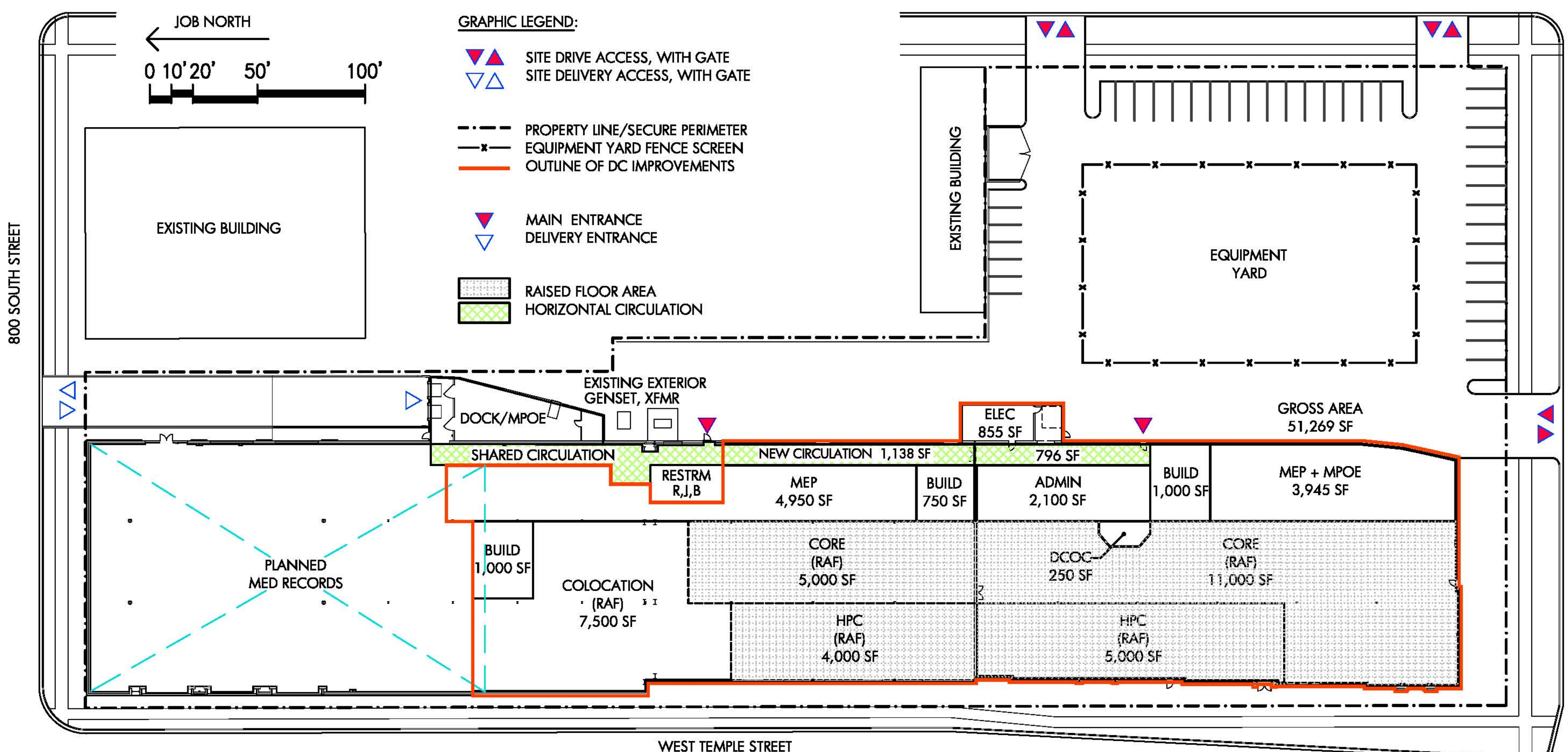
3.4.b. Figure: Data Center Facility Plan Diagram – Day 1 Need



THE UNIVERSITY OF UTAH

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

3.4.c. Figure: Data Center Facility Plan Diagram – Final Need



EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

3.4.d. Figure: University Enterprise Data Center Services (CORE) Plan Diagram

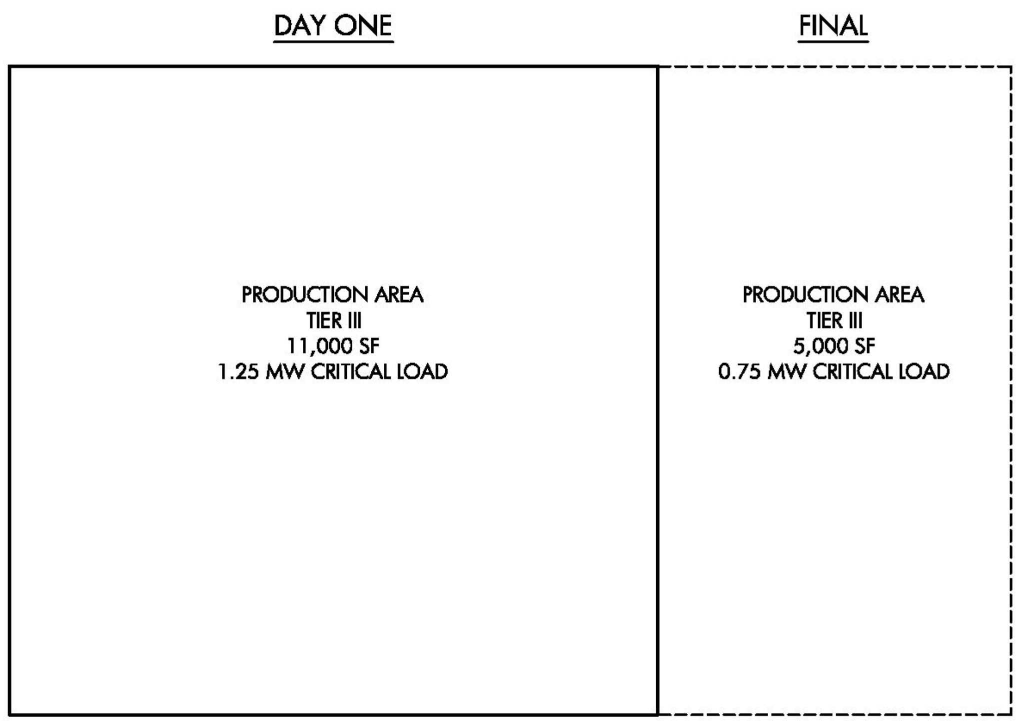


DIAGRAM NOTES:
1. 24-30" HIGH RAISED FLOOR HEIGHT

3.4.e. Figure: High Performance Computing (HPC) Plan Diagram

See Section 3.7C of this report for special requirements and additional details for HPC plan areas.

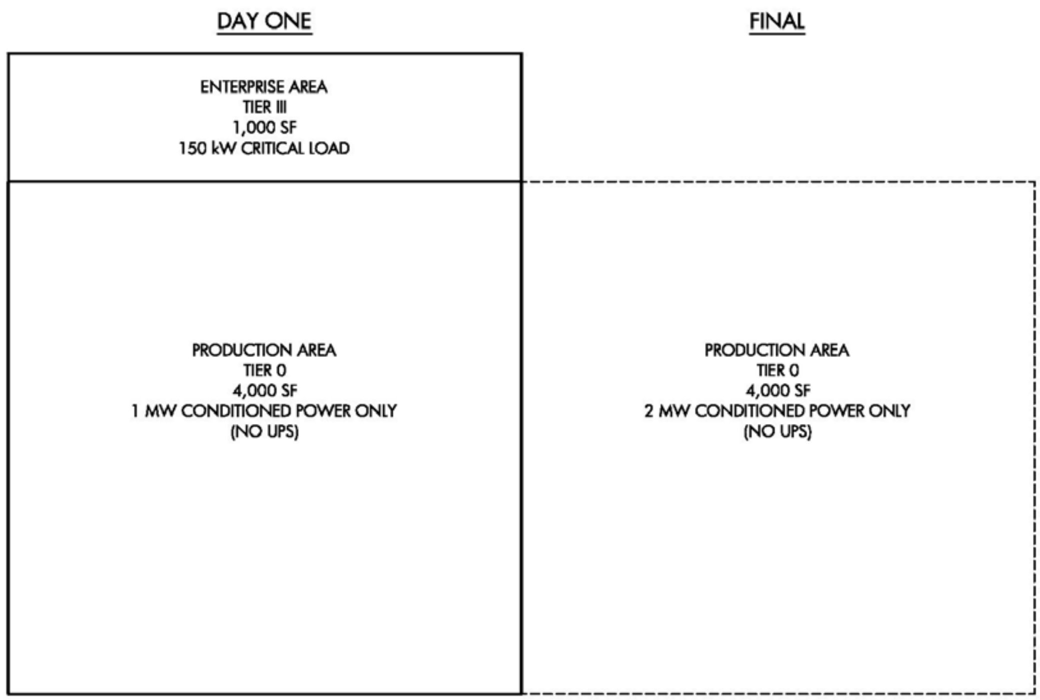


DIAGRAM NOTES:
1. PROVIDE SECONDARY COOLING FOR UP TO 20 kW/CABINET LIQUID COOLED IN PRODUCTION AREAS
2. 48" HIGH RAISED FLOOR HEIGHT DESIRED, 24" MINIMUM REQUIRED

3.4.f. Figure: Colocation (COLO) Plan Diagram

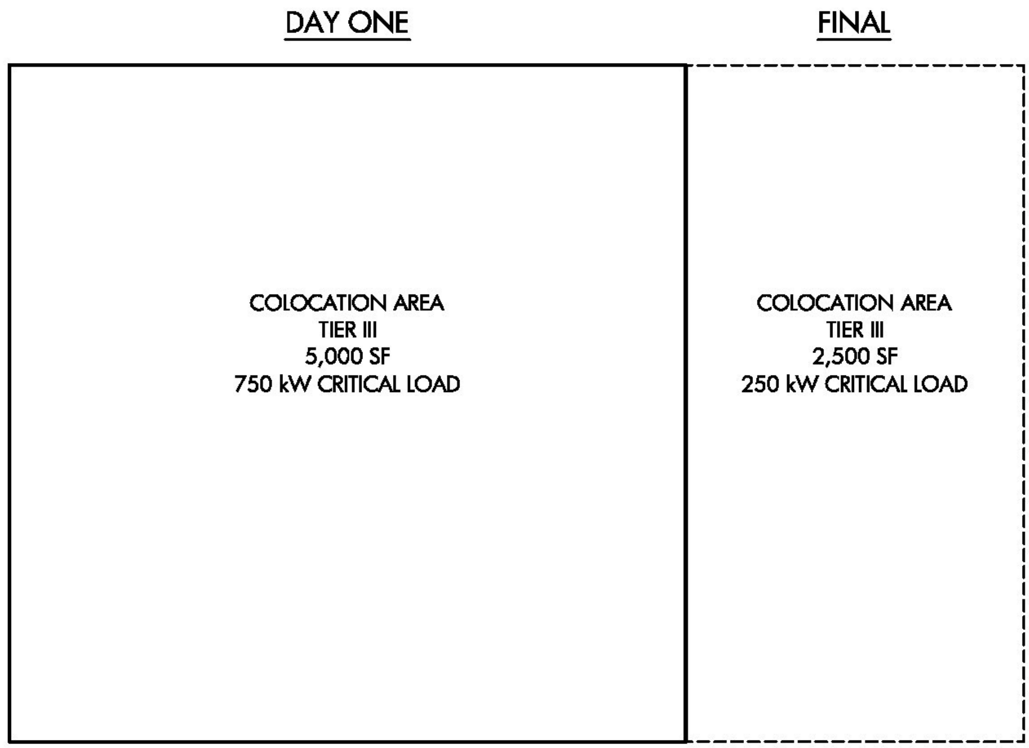


DIAGRAM NOTES:
1. 24-30" HIGH RAISED FLOOR HEIGHT

3.5. Adjacencies

Relationships between spaces are also indicated on the above Space Concept Diagrams. Occupant circulation and movement of materials will occur along common building corridors, which extend and provide access to the secure entrance lobby and loading dock. The corridor, lobby and dock spaces are considered building common area and the floor areas of these functions cannot be determined at this time and are not included in the facility area summary. The strongest adjacencies are noted below:

- Provide close but indirect access for movement of equipment from Receiving into the Data Center and Staging areas. This movement shall pass briefly through the common corridor. As this movement cannot occur through a mantrap, separate doors and vestibule are provided. Staging/Builds shall be immediately adjacent to served spaces.
- Access into Data Center and DCOC shall be controlled. Control shall consist of a mantrap for secure passage of individuals, and a small vestibule for two or more to access the controlled area.
- The Data Center requires direct adjacency to the Network room.
- The Fire Riser and Gas Suppression areas shall be located directly adjacent to the Data Center, to minimize distance to the areas served. The preferred location would be in an MEP compartmentalized space, near the Data Center.
- Indoor equipment rooms for Electrical, Mechanical, and IT, shall be located in close proximity or directly adjacent to the Data Center, to minimize distances, transmission losses, installation costs, and provide for security of pathways through controlled spaces.
- Security equipment will be housed within the Data Center, within wall mounted cabinets, or racks placed within the room.
- Main Entry Lobby requires direct adjacency to the Security Office and Pre-Security office and restroom.

3.6. Space Programming

Space Programming defines the project needs of the User. Programming includes cataloging the spaces and equipment needed, and functional relationships. This includes defining the facility functional needs: interior and exterior functional requirements including space sizes, contents, activities and relationships. This Basis of Design serves not only as a Space Program and a source of information about this facility, but is also used as a basis for project budgeting and funding.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

The detailed program information that follows below establishes quality and scope. Quality is often defined abstractly in the project goals and more specifically in the project program. Scope is clearly defined and incorporates the following factors:

- The definition of the space, its users and the purpose of the user
- The functions and operations performed within the space
- The assigned square feet, net usable and/or estimated gross
- Special factors or unique requirements for the space

3.7. Preferred Space Organization

The Space Concept provided is for a ground floor level plan, directly accessible from grade. All ground floor areas are desired (in lieu of equipment mezzanines), so they are at the same level, minimizing use of steps or ramps to access elevated floors. The Designer shall review efficiencies, first between isolated user areas of the overall Data Center and the common circulation pathways, second between Data Center user areas. Program areas for stairs, ramps, and/or lifts are not included. It is **Recommended** that raised floor areas be constructed above the existing structural slab. Special applications or unusual heavy IT equipment may require depressed slabs and/or reconstructed slabs to accommodate unique load, reaction forces or seismic considerations.

3.7.a. Data Center

For the purpose of this Section's criteria establishment, Data Center shall refer to the collection of three (3) main compartmentalized user data spaces: Enterprise CORE (CORE), High Performance Computing (HPC), and Colocation (COLO). Raised Floor areas include all production servers and network devices for both critical and back office applications. Equipment layout shall be provided by Users during the Conceptual Design phase, and the Space Concept suggested above shall be modified to suit space configuration and proportions desired, within the physical and structural construction requirements of the secured Data Center. Where indicated, the minimum net useable floor area is required for user occupancy at Day One, with capability to meet the Final, or Future need for each space through occupation of provided space or adjacent expansion to arrive at a final but cohesive area for each user space.

Data Center user areas may include tributary spaces with immediate access such as IT Storage, dedicated infrastructure serving a unique user raised floor space, or user dedicated personnel support spaces. Access to Data Center computer rooms shall be mantrap secured. Although individual controlled access with dedicated mantraps to each of the three user spaces is preferred, the Designer shall consider efficiencies of circulation space requirements, especially in areas of different raised finished floor elevations, against the goals of operations security and fire/life safety codes. The estimated gross area includes space for critical mechanical and electrical equipment which serves this space.

Data Center Day One and Final floor plan configurations shall be inclusive of the tributary and/or ancillary dedicated Data Center areas.

Commonalities between the Data Center user areas are listed immediately below; unique characteristics of the CORE, HPC, and COLO areas follow.

- Bounding vertical perimeters of the Data Center user areas shall be continuous from top of floor slab to under roof framing or hardened overhead structure. Data Center with tributary spaces shall be of minimum one hour net working time fire resistance according to UL.
- Data Center door and frame assembly shall comply with UL608, listed and labeled for burglary resistance; the same classification as Data Center walls. Assembly shall be fire rated in compliance with UL 155, for the same fire protection rating as Data Center walls. Provide a minimum clear opening size 40 inches wide by 96 inches high.
- Provide physical protection (man bars on openings in excess of 96 square inches) for air vents, ducts, conduits and pipes, between the Data Center and Data Center support space, and between the Data Center support space and University of Utah controlled space outside the program area.
- Raised access flooring, providing air distribution plenums with minimized obstructions, is desired. A detailed tile flow analysis by the Designer for at least the three main Data Center user areas is required if the RAF area is less than the heights noted in the subsequent sections.
- 10 ft – 0 inch minimum clear height is required, or higher as spaces permit. Designer shall confirm the Need for ceilings (plenums) to enhance mechanical cooling system efficiencies.
- 24 inch minimum clear space between the tops of cabinets and the underside of Data Center ceilings or structural lids.
- No fire protection of openings is required between Data Center and Data Center tributary non-equipment support spaces. Each of the three Data Center areas shall be considered as one room, excluding mantraps for fire separation purposes. Fire protection of openings is required between Data Center equipment support spaces and other program areas or University of Utah controlled spaces.
- There is no US agency Classified document storage in open or closed containers required for this Project. Protection is for University of Utah and collocation tenant records and equipment.
- There is no production print center requirement for the Data Center.
- There are no TEMPEST or Technical Surveillance Countermeasure (TSCM) equipment or requirements for this Project.

- Rooms shall be equipped with leak detection atop the structural floor, particularly in areas of liquid filled equipment or risers, as noted elsewhere in this BOD.
- Designer to consider use of vision panels along common corridor in lieu of visitor access to Data Center environments.

University Enterprise Data Center Services (CORE)

University of Utah controlled room, with identified organizations including OIT, ACS, UEN, Hospital.

- Shall be a single, open plan, data center area, with space having access/egress aisles and from 10-25 server cabinets per row, without cages or internal separations.
- A 24 inch height raised access floor is **Recommended** and provides the minimum free area required to properly cool data center spaces operating at loads up to 150 w/sf. A 30 inch height raised access floor (RAF) height is preferred, if it can be accommodated and cost justified.
- Systems shall be designed with expectancies for zero downtime and concurrent maintainability, Uptime Institute Tier III.
- Conventional medium load density, hot aisle/cold aisle space with cabinets and racks filled with servers and network gear. No high density, proprietary, air or liquid cube racks will be provided.
- 2N PDU distribution within room.
- Estimated power consumption averages 6.0 kW per server or network cabinet.
- N+1 CRAH distribution within room. The preferred arrangement is for half the CRAH units on two opposing. Air distribution is preferred to be parallel to server rows, which is the same direction that cables and conduits are predominately routed.
- Lockable IT asset storage, local to this room.

■ Hospital

Meet HIPPA construction, security requirements.

Provide PBX.

Minimum 2 Cabinets for Ancillary Systems (business and clinical).

Hospital expects growth up to two (2) times Day 1 after 5 years of occupancy.

Identified Hospital sub-tenants:

- **CPOE**: Cabling isolation requirement; large growth
- **Health Services**:

- **Epic**: Highest growth rate of Hospital sub-tenants
- **Financial**: Perspective sub-tenant

■ **Operations, Help Desk, User Support**

Lights out data storage; staff usage of Office spaces.

Minimum 2 cabinets for Ancillary Systems (business and clinical)

High Performance Computing – HPC

University of Utah controlled space focused on maximum infrastructure systems adaptation to innovative power and cooling technologies. Designer shall consider capabilities of space to be reconfigured to support changes such as delivered voltage, added cooling systems, varied data storage enclosures, and alternative distributions to user equipment.

HPC has about 15kW as today's average load for racks. The HPC racks range (today) from around 12kW to 20kW (air-cooled), depending on density within the rack. The racks range in density from 32 to 66 nodes per rack (128 to 256 computational cores). The future rack power requirements will be higher (above 20kW).

The 48" height raised floor is not an absolute requirement from HPC. HPC has an interest in trying to find the sweet spot to meet cooling requirements for their load, plus meet growing requirements. HPC is looking for a harmonious match of raised floor to existing and future cooling. The floor must also accommodate the liquid cooling to the rack requirements in addition to possible power distribution below the floor.

Growth strategies shall be considerate of nested space, Enterprise CORE, and their stated differences.

- Data Center shall be a single, open plan, data center area, with space having access/egress aisles and from 10 to 25 server cabinets per row, without cages or internal separations.
- A 24 inch height raised access floor is **Recommended** and provides the minimum free area required to properly cool data center spaces operating at loads up to 150 w/sf. A 48 inch height raised access floor (RAF) height is preferred by Users, and can accommodate loads beyond 300 w/sf., as this height can better accommodate supplemental cooling systems, valves and piping located below the floor. There are substantial seismic requirements and high implementation costs for providing 48 inch height throughout the data center. The HPC occupants have no current application or equipment which absolutely requires 48 inch height, or is operating at loads in the range of 300 w/sf. The University requests that Contractor provide base price construction cost estimates using 24 inch height raised floor, and provide additive alternate pricing for 48 inch height raised floor in HPC area only.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

- Systems shall be designed with expectancies for minimized downtime and concurrent maintainability; Uptime Institute: Mechanical / Electrical Tier 0, with conditioned power only.
- Estimated power consumption range, 1 MW Day One; up to 4 – 6 MW Final.
- 2N distribution within room is required.
- Three phase 480 volt distribution to each rack is required.
- Provision to accommodate future DC power to each rack is required.
- N topology chilled water piping loop with connectivity for rack cooling systems. During Design, Designer shall ensure adaptability to possible Hot Aisle air containment.
- Cabinet monitoring of airflow, humidity, and power.
- Lockable IT asset storage, local to this room.

■ **Enterprise CORE**

Dedicated, non-demised space within HPC.

- 150 kW Critical load Day One and Final
- Systems shall be designed with expectancies for zero downtime and concurrent maintainability, Uptime Institute Tier III.

Colocation – COLO

Rentable white space with potential Tenants: University of Utah subsidiaries and affiliates, state agencies

- Data Center shall be a single, open plan, data center area, with space having access/egress aisles and from 10 to 25 server cabinets per row, with lockable data storage cabinets and/or cages.
- Raised floor and/or ceiling panels in circulation aisles to be secured.
- Minimum 24 to 30 inch height raised access floor (RAF) is required.
- Systems shall be designed with expectancies for zero downtime and concurrent maintainability; Uptime Institute: Mechanical/Electrical Tier III.
- DC plant.
- 2N PDU distribution within room.
- Estimated power consumption averages 6 kW per cabinet.
- Lockable IT asset storage, local to this room.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

3.7.b. Staging/Build

Three separate Build Rooms are desired, one each for the three main data center areas. Powered and conditioned spaces with connectivity for User and/or vendor builds/decommissions are required. Spaces shall have storage, some lockable, for assets and/or limited quantities of tape media. Burn in and testing of equipment or built-up racks or cabinets will not be performed in the Build Rooms. Raised floor and data center cooling loads are not required for these rooms.

Designer shall review Security requirements for each space with Users and Facilities during Design. Provide sheet vinyl finished floors, suspended ceilings and painted gypsum board walls for all rooms except where special requirements are noted below.

University CORE

Potential space Users: MED, ACS, OIT; dedicated floor areas will be required for each User. Provide UPS power to support one cabinet/rack, and phone, space for desk and chair. Vendor service access is required, Designer to incorporate security requirements during Design.

COLO

No additional requirements

HPC

6 kW of UPS power required Day One and Final. Provide phone, space for desk and chair.

NOTE: that in Table 1.5 Data Center Facility Space Breakdown, the Program Build floor area may be insufficient to accommodate all Staging/Build Rooms on the South side of the existing building Firewall. This table shows that University Core and HPC may have to share one Build Room during this initial phase of the Project. It is preferred that there be separate rooms, if these rooms can be accommodated South of the existing Firewall. If not, it is recommended that only one shared Build Room be constructed in the first phase of construction, with the balance of rooms provided in a subsequent phase.

3.7.c. Data Center Operations Center (DCOC)

This room is the central point of Data Center operations. The space environment shall be a small room theatrical arrangement, consisting of two “U” or “U + L” space work consoles with seating for five personnel. Each work console shall support two under table servers and two monitors and one laptop. All consoles seats shall face or turn toward one video wall. Floor shall be level and seats arranged to facilitate viewing of the video wall from each seat. Space shall be single story in height, with “borrowed light” windows to the data center areas where possible. Space is preferred to have raised access flooring for under floor air distribution and cable management, but this is not an absolute requirement. The use of suspended acoustical ceiling(s) shall be determined during the Design phase.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

- Provide console seating for five operators with three monitors each. Each console shall have functional capacity for two desktop and one laptop PC. Consoles shall have drawer storage for personnel use. Consoles shall have under table top acoustic enclosures to reduce PC cabinet fan noise.
- Provide space for one table top combination print/copy/fax machine with limited paper storage. No other file or storage cabinets are required.
- The video wall in the front of the room shall consist of two displays, each capable of displaying 1 to 4 video and PC feeds. These screens display data center operational functions, system health statistics as well as security, Project and plant status displays. The plan layout provided is based on providing two side by side video monitors, of approximately 40 inch size.
- Provide NRC 45 sound attenuation and acoustic environment in the room.
- “Borrowed Light” windows, if provided shall be sound attenuated to match the room attenuation, and shall have black-out curtains or blinds.

3.7.d. Mantraps (M/T)

Access into Data Center main lobby shall be through a single person, secure mantrap, with vestibule. Floors shall be level. Space shall be single story in height, without windows or openings to outside. Space is preferred to have raised access flooring for convenience and to avoid the necessity of stairs or ramps, but this is not an absolute requirement.

- Mantrap shall be Tomsed Corp, Model TAP-100 or approved equal. See Physical Security, **Section 10** of this BOD, for additional requirements.
- A vestibule is required between the Mantraps and areas served to transition from single person to two or more persons with equipment access. The mantraps accommodate single person access control. However, doors into controlled areas require two persons to open, when bringing equipment into the room. The vestibule also accommodates the single swinging egress door required by codes.

3.7.e. Network

IT Data Center telecommunications equipment located on the data center floor.

- Raised access floor (RAF) is required.
- 10 ft – 0 inch minimum clear height is required, or higher as spaces permit. Designer shall confirm the Need for ceilings (plenums) to enhance mechanical cooling system efficiencies.
- DC plant.
- Remote monitoring and control capability to equipment, support infrastructure.

- This space shall accommodate a need for lockable assets and tape storage.

MPOE

Two (2) spaces at opposite ends of Data Center facility requested

Meet-me Room

A Meet-me Room is required for the Co-location data center area only. This can be a small room or caged area located on the data center raised floor or in the vicinity of the Co-location data processing area. The detailed requirements for this room can be developed in consultation with the carrier's using this room.

3.7.f. Equipment Rooms

Provide space for Equipment, in rooms, areas or closets, as required by good design practice, local codes, and other **Sections** of this BOD for the below equipment.

- Mechanical Equipment
- Electrical Equipment
- Information Technology Equipment
- Sprinkler Riser(s)
- Supplemental Gas Suppression Tanks

The Data Center's equipment rooms are sized based on the assumption that one standby power generation system and one chilled water system are provided for all three Data Center areas. All generators and cooling towers are assumed to be located outside and this yard area is separately estimated in size. Gas suppression tanks are assumed to be located in the data centers on the raised floor. Battery rooms are sized to assume use of flooded wet cell batteries. The space required for Equipment Rooms may vary substantially from the estimated floor areas provided in Table 1.6 if the above assumptions are not retained during detailed design.

Security Equipment

Security equipment for the Data Center will be housed within the Enterprise CORE area of the Data Center. See Physical Security, **Section 10**, for a description of equipment.

3.7.g. Accessory Spaces (Office, Administration)

For the purpose of this Section, spaces shall be within the secured interior perimeter, unless noted as Pre-Secure.

Unless a directive of this BOD, spaces shall be finished according to the University of Utah Construction Standards.

Main Entry Lobby

Pre-Secure Data Center entrance for all personnel (visitor, employees, vendors, etc.)

- Exterior wall loaded, conditioned vestibule with in-floor snow melt removal drainage requested.
- Provide minimum seating (chairs) for two (2).
- Direct access to lockable storage (closet requested) for Visitor supplies.

Visitor Office

Compartmentalized Pre-Secure workspace for temporary use.

- Work table with minimum seating (chairs) for four (4).

Security Office

Custom millwork: cabinets, countertop; two (2) levels of above-counter monitors; seating for two (2) operators

Work table with additional seating for two (2); dry-erase board

Space shall not be provided with redundant Break amenities (microwave, refrigerator, etc.)

Direct access to lockable storage (closet requested) for Security supplies.

Facility Manager's Office

Desk, chair, dry-erase board.

Conference

Provide minimum NRC 45 sound attenuation and acoustic environment in the room.

Twenty (20) Person conference table and seating with dry-erase boards around three walls.

Provide for a center of room, suspended, ceiling mounted projector with a motor operated, ceiling suspended projection screen.

Offices, Workstations

Designer shall reconfirm Operative Control of these spaces during Conceptual Design. Consider lockable office storage containers and shared office workspace, with goal of minimizing this provision. Users with identified needs:

- **HPC**: Eight (8) shared workstations (cubicles)

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Break

- Adequate facilitation is provided by a different project.

Restroom

- Adequate facilitation is provided by a different project.

Janitor

- Adequate facilitation is provided by a different project.

Loading Dock

An existing, two position, loading dock is provided by a different project.

Two (2) existing interior overhead coiling doors at north of Facility; motorized and with chains; two (2) interior dock levelers.

Storage

A storage room shall be sized during Design to accommodate operations and overstock needs; configured to facilitate access to and within space from Receiving, considering the loading dock is shared with a different project. Circulation through Facility common areas shall be considerate of hardened flooring and vertical surfaces to approximately 40 – 48 inches above the finished floor. Designer shall ensure door leaf faces in the direction of travel to and within these spaces are also impact protected.

Spaces shall be configured to include University of Utah preferred rack/cabinet storage solutions to maximize operations' efficiencies.

- **Facility**

Provide lockable hard-walled or caged space with immediate access from within the loading dock for temporary holding of receivables.

- **IT Bulk**

General Data Center telecommunication assets common to all improved raised floor environments.

- **Tape Vault**

Enclosed, One hour Fire Rated, Secure storage area for racks of computer tapes, approximately 100 sq ft in area.

3.7.h. Exterior

Roof

Permanent access to the roof is provided by a different project.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Bike Storage

Consider providing covered, illuminated, not conditioned bike storage. Provide drive lane impact protection and lockers. Quantity of stalls to be determined during design.

Equipment Yards

Provide screened equipment yards with equipment gates and mandoors. Provide sufficient height and visual screening of contained equipment. Provide physical security protection at top of screen to minimize access over the top of the screen.

4. Civil

4.1. Site Development and Site Work

Minor Site Development and Site Work is necessary for this Data Center Tenant Improvement project, primarily enhancing site security and housing Data Center MEP infrastructure equipment. The selected site, 875 W. Temple St., is a former commercial parcel within the University's controlled campus perimeter. The selected lot is bounded on three (3) sides by public two-way streets and partially on the fourth lot edge. The remainder of the fourth (northeast) property edge abuts two (2) private commercial lots, separated from the Data Center site by a chain link fence with barb wire.

This section includes only those specific program requirements for the Site as a result of the Data Center occupancy.

See **Section 5**, of this BOD, for additional Site Erection Considerations.

4.2. Site Perimeter

The Project lot perimeter shall be fenced. Site approach shall be to protected openings, sliders for vehicles and motorcycles, gates for personnel and bicycles. Designer shall consider vehicular impact to site improvements from outside and within site perimeter, and mitigate with impact protective barriers.

Designer shall consider future locations for manned perimeter posts and if desired by the University of Utah, shall incorporate necessary empty conduits and capped piping for possible guard shack installation(s).

4.3. Parking and Paving

Provide sufficient parking spaces for all staff and additional visitor parking spaces minimum, or greater number as required by local requirements. Size and type of spaces, i.e. standard, compact, visitor, accessible, commuter, van, etc. shall comply with University of Utah standard and local requirements. Do not segregate, reserve, or identify specific parking spaces or locations for the Data Center.

Parking shall not be loaded along the exterior of the Data Center building.

Parking shall not include wheelstops; paving subject to snow removal shall not have abrupt changes in elevation. Plow vehicles are not required to park on-site.

4.4. Loading and Truck access

Data Center deliveries may arrive by common carrier or corporate vehicles. No overnight truck parking is required. The loading dock shall accommodate deliveries from grade by small, single-unit truck, up to tractor and semi-trailer, dock high secure delivery. The existing site secure delivery consists of exterior truck parking (2 stalls) that includes weather canopy, mechanical dock levelers, truck restraint, sight-proof dock seals, bumpers, and industrial grade overhead coiling doors. Data Center drive lane to the Loading Dock shall be gated.

Improvements to loading dock are planned in a different project.

4.5. Building Perimeter

Superfluous legacy paving improvements that no longer serve the ingress or egress of the Data Center building shall be returned to match the adjacent areas. In the case of landscaping, irrigation shall be extended to maintain plantings or low-water maintenance native vegetation shall be selected to reduce environmental impact. These areas shall be identified during design.

4.6. Walks, Building Entrances

Designer shall consider covering active entrance doorways and grade walks that abut the Data Center exterior wall.

4.7. Storm Drainage

Existing roof storm drainage to grade shall be reviewed by the Designer to verify integrity of buried structural systems. In lieu of grade-top discharge, consider extending downspout to underground drain loop or another acceptable location away from the Building's immediate exterior perimeter.

No ponding on site is permitted.

Designer shall work with the University of Utah and AHJ to develop an approved Spill Control and Containment plan for the site (ie: Fuel Oil). Grade level drains in the area of hazardous chemical storage or refill shall ideally be segregated from storm water collection piping and discharge systems.

4.8. Hardscape and Landscape

Provide for one, six bicycle capacity, lockable, enclosed, storage unit.

Newly planted or modified landscape shall be returned to a sustainable indigenous type.

5. Structural

5.1. General

The structural standards contained within this section are to be used in conjunction with the local, state, and national codes and laws applicable to the work being conducted. The structural standards are not intended to replace or overwrite the applicable codes and laws. In the event of conflict between the structural standards and the codes and laws, the more stringent of the two must be used without sacrificing the intent of the law and/or code.

The design shall provide a structure that will support the loads that occur from the weight of materials, occupancy, environmental effects, and other sources. Based on the requirements of the code established as applicable for the design of the Project, the following specifications and standards will be followed in the design of the permanent structural elements of the Project.

- **ASCE-7**: American Society of Civil Engineers, "Minimum Design Loads for Buildings and Other Structures"
- **Factory Mutual System**: Loss Prevention Data for Architects and Engineers
- **Concrete** (ACI-318): American Concrete Institute Code of Standard Practice for Pre-cast Concrete
- **Structural Steel** (AISC): American Institute of Steel Construction, Specification for Structural Steel Building – Allowable Stress Design and Plastic Design
- **Masonry** (ACI-530/ASCE-5): Building Code Requirements for Masonry Structures
- **ANSI**: American National Standards Institute
- **Network Equipment Building Systems** (NEBS): Telcordia Technologies GRE-63-CORE (formerly Bellcore GR-63)

5.2. Design Criteria

5.2.a. Live Loads

The floor live loads are those type of gravity-induced loads intended to provide for the requirements of the use and occupancy of the building, and do not include dead load, construction load, or environmental loads such as wind, snow, rain, earthquake or flood.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Table: Occupancy Loading

Occupancy Group	Design Live Loads (PSF)	Notes
Data Center, DCOC, IT Support Spaces	150	Where expansion into adjacent Level Office/Support spaces can accommodate future Growth
Support Spaces (MEP + IT)	250	If selected, Electrical wet-cell batteries shall increase immediate area's loading 2x.
Office, Administration	50	Where subdividing partitions are to be used, an additional +20 PSF partition load will be used to allow for random placement of demising drywall partitions
Corridors (Service)	150	Rolling and overhead suspended loads.
Other Floor Areas	80 (+ Partition)	Only applied to elevated floors above grade, minor structures

The Minimum Roof Live Load shall be 30 PSF. Capacities of the existing building roofs have been enhanced. Environmental loads should be calculated in conformance with code-established parameters. The variables to be considered in calculating these loads are the shape of the roof, the exposure factor, the importance factor, and the environmental load. At roof areas, adjacent to vertical projections, such as parapets and other walls, changes in roof elevation, etc., the wind load should be increased above the "flat roof" value in conformance with code-established parameters to account for the additional exposure.

All roof top equipment should be supported on dunnage, a separate steel framed structure approximately two feet above the roof. This dunnage should be supported directly to the building columns below, thus minimizing penetrations through the roof. Their weight and the weight of the equipment they support, including lateral forces induced by wind and seismic activity, should be accounted for in the comprehensive structural design of the building. Specific areas should be identified and designed for appropriate loading to allow for movement of mechanical equipment components across the roof.

Live Load Reduction is a code-allowed mechanism for reducing the code-mandated minimum design live load for a given structural member in inverse proportion to the area supported by that member. It is based on a statistical evaluation of the probability of loaded areas being required to support the full design live load. For code-mandated live loads of 100 PSF or less and for live loads that are not minimums mandated by code, the design live load for members having support area of 400 square feet or more may be reduced in accordance with the code-established equation. No reduction shall be taken for live loading on roofs, storage areas, or defined equipment allocations. In addition to the uniform live load allowance, code requires specific concentrated live load capacity. These must be addressed in the design.

5.2.b. Dead Loads

The dead loads are those types of gravity-induced loads intended to provide for the nominally permanent requirements of the building, such as structure, construction materials and fixed equipment.

Table: Dead Loads

In addition to the above uniform loads, the routing of large pipes, conduits and bus ducts must be specifically identified and the support points and anticipated loads accommodated, as described in the Table that follows:

Suspended Element	Design Dead Load (PSF)
Ceilings/Finishes	
Acoustical Tile	3 PSF
Plaster	12 PSF
Drywall	8 PSF
Mechanical/Electrical/Plumbing/Fire Protection	
Above Mechanical Spaces, Penthouses, Service Corridors	30 PSF
Above all other Occupancy Groups	10 PSF

All raised access floor assemblies (RAF) shall meet or exceed industry mark ANSI 1250.

A minimum eight (8") inch reinforced first level concrete slab thickness need be considered for drilled in equipment anchorage after initial facility occupancy.

Wind produces forces on every exterior component of a building and on interior components of "open" structures. These loads are transferred to and resisted by the basic structural system. The wind loads should be developed by code-established parameters. The variables to be considered in calculation these loads are the component shape, the area of exposure, its orientation to wind direction, its height above grade, and the code-established wind speed for the site, the exposure category and the importance factor.

Seismic events (earthquakes) cause loads due to the inherent inertia of a structure – the ground by which the structure is supported moves and the tendency of the structure is not to move. The level/type of "response" of different elements to any seismic motion generates different design load levels. Seismic loads should be calculated in conformance with code-established parameters.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Project specific variables to be considered in the calculating of seismic loads, which can be established at this time are the level of seismicity of the site, the Seismic Hazard Group, the Seismic Performance Category, and the Site (soil) Coefficient.

Loads applied to the building's below grade elements must address soil and ground water conditions reported in the geotechnical report.

Building structures, structural elements, and building components move in response to applied loads. Movement limiting design criteria are established in order to minimize the degradation of materials applied or attached to the structure and/or to control the perception of movement by occupants or sensitive equipment. These criteria also form the basis for detailing other systems' connections to the structure.

5.2.c. Deflection Control

Deflection is generally considered the downward movement of structural framing members under the influence of applied gravity loads. Structural elements will be designed within the following deflection control limits:

Table: Deflection Control Limits

Framing Element	Load Type	Span	Notes
Typical Floor Member	Live	Span/360	Spandrel deflection must be controlled within detailing requirements of the exterior cladding
Floor member Supporting Glass	Superimposed	Span/480	
Floor member Supporting Masonry	Superimposed	Span/600	
Typical Roof Member	Live	Span/240	Spandrel deflection must be controlled within detailing requirements of the exterior cladding
Elevator Supports	Live	Span/1666	

Selfweight Deflection is the construction-related deflection of the structure due to its own weight. The design must specify that construction procedures be followed such that the "move-in" levelness of the floors is no less than ¼" in 10'-0" distance from a column.

Drift is generally considered lateral movement of the building frame due to wind or seismic lateral loading. The interstory (between any two floors) and total drift of the structural frame will be designed within the drift control limits of height/400. Drift will also be controlled within detailing limits of building expansion joints.

Structural systems and components may be subjected to deterioration dependent on the type and severity of exposure. Some of the "normal" durability/maintenance requirements have been previously defined. For typical material finishes, see BOD **Section 6**, **Architectural**.

The location of the columns should accommodate efficient arrangement of computer hardware. Data Center columns are spaced approximately 37 ft – 0 inches on center, dividing the existing structure into three north-south long rectangular bays.

If multi-story construction is used, floor slabs over the Data Center and critical infrastructure rooms shall be made watertight to prevent leakage between floors.

5.3. Seismic Considerations

5.3.a. General

Recommendation: The basic goal of seismic design is to counteract lateral forces generated by ground movement during earthquakes. The intensity of these forces are determined by the site's location in a specific seismic zone, as set forth by building codes, as well as its closeness to the seismic source. Additionally, critical facilities, such as the Data Center, are recommended to withstand an additional 50% of these forces.

It is of primary importance to investigate the underlying geology of the site. Rigid materials, such as hard rock and hard granular materials will withstand shaking better than soft materials, such as lake sediments, which may be entirely unsuitable if they are prone to liquefaction (of soils). The shape of a building is crucial to how it will perform during an earthquake. The ideal aspects of a building form are simplicity, regularity and symmetry in both elevation and plan. These properties all contribute to more predictable and evenly distributed forces in a structure, whereas irregularities are likely to create force concentrations resulting in parts of the building shaking differently. To this end, disparities of stiffness, caused by architectural features are to be avoided. Also, buildings which are tall in comparison to their plan area will generate high overturning moments.

Ductile behavior, which allows a structure to undergo large plastic deformations with little decrease in strength, is an important factor in resisting seismic loads. Steel frame construction is ideal for ductile response. In general, ductility in concrete is increased by the addition of reinforcing steel. Additional reinforcing steel is required to be added to contain the concrete and prevent structural failure from seismic shaking forces.

5.3.b. Other Seismic Considerations

Equipment with a ratio of height-to-base width dimensions greater than 2 to 2.5, and with the center of gravity located in the upper half of the equipment, is top-heavy and is subject to overturning during earthquakes. This equipment will require special bracing and/or special attachment to a wall, other equipment, or the subfloor. This includes hardware, network and communications racks, tape racks, raised floor system, and air conditioning units. Floor stands, available from the manufacturer, are recommended for the air conditioning units on the computer room floor. These stands also help isolate the raised floor from vibration created by the unit. Where possible, racks subject to overturning forces should be placed near walls, fastened to structural members, fastened to the concrete floor or fastened to each other.

Access floor openings under equipment need to be protected to prevent the equipment from sliding into the openings. These cable holes should be the minimum required size and lined with seismic moldings to prevent equipment casters or levelers from sliding into them.

Suspended ceilings and light fixtures should be seismically braced directly to the structure above. The suspended ceiling should be braced by means of a compression strut tied to the structure above, according to building codes.

Sprinkler and gaseous fire suppression piping in the Data Center should be braced to resist lateral loads that would be experienced during an earthquake.

5.3.c. Seismically Rated Data Processing Cabinets

The structural requirements for enhancing data processing equipment to manage seismic loading is primarily a function of the earthquake zone, height of the structure in which the equipment is installed, the type of structure and the method of attachment to the structure. The equipment's weight, size and relative location will describe how well the equipment tolerates a seismic event.

Movement of installed equipment is not permissible in the Data Center. This motion could cause undue stress and strain on the telecom cables, power cables or conduit interconnections, and pipe fittings, which could lead to failure in the equipment. Seismic design criterion and the University of Utah necessitate that data processing equipment shall remain functional following the event of an earthquake. Even though it is acceptable for the Data Center equipment to sustain some minor (repairable) secondary physical damage, the equipment must remain operational.

One method of resisting movement during an earthquake is to structurally enhance or stiffen the data processing cabinets. Seismically braced (frame) cabinet systems are readily available for data processing cabinets rated for the most active seismic areas (UBC Zone 4 – Seismic Standards, equivalent), and certified by an independent seismic testing laboratory.

Telcordia Technologies GR-63-CORE denotes earthquake simulation testing in accordance with seismic activity levels in the highest-risk areas of the United States. Project cabinet enclosure components used in these areas should be evaluated in line with (NEBS) Section 4.4.1.1. The code driven (UBC, IBC) seismic specifications are analytical calculations performed by a structural engineer and do not necessarily test the enclosure itself, but rather how the enclosure frame is secured (with concrete bolts and brackets) to the structure. The Telcordia test replicates an actual seismic event with the doors and side panels attached to assure that the electronic equipment within the enclosure is safe and secure. The test assures that all enclosure components perform their required function correctly. Telcordia GR-63-CORE seismic Zone 4 Standard requires that each frame, doors, side panels, be capable of withstanding significant seismic shocks in both the essential and non-essential structural environments.

For many seismic enclosure manufacturers, meeting Telcordia Standards often requires more robust design practices, such as reinforced enclosure frames, side panels and lock mechanisms, than the code required structural requirements. Due to all of the structural enhancements, the cost of a seismically rated cabinet is roughly 2 to 3 times the cost of a standard frame cabinet.

5.3.d. Equipment Isolation Bases

Utilizing Data Processing Equipment Isolation Base (IsoBase) is another method of handling the vibration and displacement, which is normally generated during an earthquake or seismic activity. The theory of operation for an IsoBase system is to control, in some cases dampen, the acceleration and displacement on the equipment through the process of "decoupling of the equipment" from the relative ground motions which are sometimes present during an earthquake condition.

This individually isolated base platform system for data processing equipment is a diametrically opposed system in comparison to Zone 4 seismic bracing and cabinet reinforcement. The isolation system provides "Ball-N-Cone" technology, which allows controlled movements to dissipate the energy. In a typical non-isolated building when a substantial seismic condition occurs, the entire building structure will move.

One solution to this problem is to enhance or stiffen the data processing cabinets to allow them to accept more input energy. However, this enhanced, reinforced cabinet can actually impose more shock and vibration into the sensitive components within the data processing equipment such as drive heads, which can cause them to fail. A properly designed IsoBase system can offset these effects through decoupling the motion of the ground with the top of the platform. The damaging low frequency seismic vibrations are filtered away from the cabinet before they can damage the equipment. These IsoBase systems are designed to accommodate many different size cabinets and to retrofit many existing data processing cabinets.

5.4. Site Erection Considerations, Tolerances

Construction of Data Centers within an existing structure presents unique challenges during Design and Construction. Adequate must be considered between existing structural masonry or spray applied concrete and finish materials and partitions. For modular construction components, removal and replacement of existing structure may be required.

6. Architectural

6.1. General

Together with local, state, and federal codes, laws, and authorities having jurisdiction (AHJ), the architectural standards contained within this section are to be applied by the architect/engineer during the design phases.

Based on the applicable requirements, the following standards will be followed in the design of the architectural elements of the Project.

- **NFPA** (75): National Fire Protection Agency Construction Standard for Raised Floor Data Storage Environments
- **ASHRAE**: American Society of Heating Refrigeration and Air Conditioning Engineers
- **SMACNA**: Architectural Sheet Metal
- **NRCA**: National Roofing Contractors Association
- **OSHA**: Occupational Safety and Health Administration
- **ANSI**: Elevator Code
- **UL**: Underwriter's Laboratories

6.2. Base Building Design Criteria

Facility envelope air leakage and thermal transmittance shall comply with ASHRAE Standard 90.

Protect all exposed exterior concrete surfaces with a minimum five (5) year warranted, colored finish (with ultraviolet light protection coating).

Seal all joints between exterior concrete panel construction with continuous sealants over backer rods.

6.3. Accessibility (ADA)

Provide fully accessible accommodations in conformance with Federal, State and Local laws and regulations. Accessible construction requirements in restricted personnel areas, such as the critical electrical or mechanical spaces, may be limited to "Entry" only, in accordance with the AHJ.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

6.4. Roof System

Roofs shall be Underwriters Laboratories (UL) Class "A" rated. Manufacturer and installer shall provide a minimum twenty (20) year warranty.

Fully redundant primary and secondary drainage systems shall be provided in accordance with local AHJ. Design considerations shall include monthly Mean levels of precipitation as well as hourly maximized "flash" occurrences. Geotechnical backfill beneath discharge locations from roof to grade shall be designed to prevent moisture from entering the building at or below grade. Internally, vertical drains will not pass through critical equipment or operations spaces. Storm water drainage shall be tied into the master campus storm water piping loop.

Metal flashings, gutters, scuppers and other exterior sheet metals shall be of formed stainless steel, copper, or terne coated stainless steel. Use of galvanized, zinc coated metals or other naturally oxidizing materials are discouraged.

As required in the governing mechanical code, rooftop access must be provided to all structures. The preferred method of access is by exterior ship's ladders, broken into two (2) runs – grade to low roof, low roof to high roof. Where provided, coordinate the required roof opening size with the smallest shipping split of regularly maintainable rooftop equipment (often mechanical). Roof access opening components shall be insulated.

Provide a 'laydown' area for engineer supplies next to each rooftop access location. Walkpads shall connect from each access point to and around all maintainable rooftop equipment, drains, and other miscellaneous rooftop sensors and devices.

Flash and seal all rooftop penetrations, compliant with the roofing manufacturer's warranty. Provide continuous flashing and counterflashing within facility parapet walls. Penetrations above critical spaces are not permitted. See BOD **Section 7**, **Mechanical**, for information on Leak Detection.

OSHA guidelines for safe personnel activity atop roofs shall be outlined for Owner during the detail design phase.

Architectural roof screens shall be provided around all visible equipment, in conjunction with local codes. Coordinate with antenna providers to avoid obstructions and interferences.

Any added loads shall be included in the Structural roof design. All permanent rooftop equipment shall be supported interstitially from beneath the finished roof surface.

Steel members (dunnage) exposed to the exterior will be either galvanized (minor members) or painted for protection against environmental corrosive effects

6.5. Environmental Controls

6.5.a. Waterproofing Control

The following are **recommendations** for controlling the entry of unwanted moisture through the building foundation system:

- Waterproof all walls and floors subject to hydrostatic pressure, below the water table, or subject to immersion in water
- Dampproof all similar surfaces subject to condensation, moisture from soils or frequent contact with water, including all slabs and walls below raised floor areas

Coordinate with civil engineer for waterproofing control methods and site-specific geotechnical evaluations.

6.5.b. Vapor Control

The following shall be provided for controlling the passage of unwanted moisture between spaces within the facility:

- Provide vapor retarders to resist the diffusion of water vapor through building elements and to prevent water vapor migration and condensation in exterior walls and roofs.
- Vapor retarders shall also be installed to isolate each electronic data processing space from other spaces. Provide vapor or smoke seals at all openings and penetrations to also prevent smoke migration into these rooms.
- Vapor retarders shall also be installed between interior spaces with different temperature and humidity requirements.

6.5.c. Contaminant Control

The following cleanliness considerations shall be followed during the construction and occupancy of the Facility:

- Operating, computing, and equipment areas shall be designed to be relatively dust free.
- Surfaces and finishes shall provide an environment free from the accumulation or generation of dust (debris), static electricity, and mutations such as "zink whiskers".
- Exterior windows shall be fixed glass. Doors and exterior opening shall be restricted to minimize dirt and dust infiltration. There shall be no broken or damaged glazing by Day One occupancy of the Data Center.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

- All exterior openings shall be sealed with weatherstripping. Environmentally controlled gasketing, compliant with assembly ratings, shall be considered for all trafficked interior doorways.
- Access to dust sensitive areas shall be through vestibules, foyers, corridors, or other buffer areas.

6.6. Thermal Insulation

Provide thermal insulation between the interior and exterior of the Facility in all locations above and below grade. Provide thermal insulation between interior spaces that expect different occupied temperature requirements. Provide insulation around wet areas (MEP, restrooms, etc.). The following shall be characteristics of Project insulation:

- Insulation shall be moisture resistant.
- Loose fill insulation shall not be used. Insulation shall be covered or sealed to prevent the shedding of fibers.

6.7. Fire Rating

Full height (slab to slab) physical compartmentalization and separation with fire resistive elements shall be provided to minimize loss of high valued equipment.

6.8. Firestopping

Provide firestopping materials in and around all penetrations in fire rated assemblies.

Use cementitious type fireproofing with a non-shedding non-dust producing finished surface, preventing the shedding of fibers in a covered or sealed 'hard' coat; loose materials shall not be used.

6.9. Acoustics and Noise Control

Provide acoustic evaluation and analysis for all areas with high sound levels and rooms where intelligible speech is important.

In areas identified for audible recordings, it will be necessary to consult an Acoustics Consultant during the design process.

Provide acoustic materials and or enclosures to isolate generators, chillers, CRAH units, and other high sound producing equipment.

For outdoor equipment, noise control shall be designed to comply with local codes and noise ordinances

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

6.10. Interior Finishes

Flame spread shall be Class 25 with a smoke rating of less than 50.

All data processing area interior finishes shall be non-shedding, anti-static, non-dusting, and non-outgassing materials, complying with the guidelines of NFPA 75.

The use of plaster is discouraged.

Painting and coating systems shall be "professional line" systems from recognized manufacturers.

Unless specifically addressed herein, finish materials shall comply with the University of Utah Standards.

Use of galvanized finishes shall be limited so as not to cause the growth of "zink whiskers".

Provide control joints in all finished surfaces per manufacturer's and industry standards.

Provide fire rated control joints at fire rated assemblies.

6.11. Walls/Partitions

Data Center and the demising partitions of the Pre-Secure area perimeter shall be reinforced in the inside with 9 gage expanded metal spot welded every 6 inches to steel studs, 16 gage or greater, permanently attached to true floor and true ceilings.

Typical interior partition design shall accommodate a lateral load of 5 PSF at a deflection of L/240, minimum.

Wire mesh partitions (cages) shall extend through raised flooring surfaces to substrate and through overhead ceilings. Brace above, below, and laterally to adjacent gypsum or similar partitions.

Finishes shall be smooth, painted, gypsum wallboard.

Provide bumper rails, corner guards, hardboard wainscot protection, and/or bollards where finishes are subject to impact damage.

Moisture resistant, or "greenboard" type, backer board shall be used in areas exposed to moisture.

6.12. Doors, Windows, and Hardware

Doors shall have substantial resistance to unauthorized entry.

Doors that serve exclusively as exits should not be operable from the non-exit side.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Vision panels shall be considered only at door locations indicated elsewhere in this BOD.

Opening components exposed to the exterior or moisture prone conditions shall be of corrosion resistant materials.

All metal frames shall be welded and ground smooth; knock-down frames are not permitted. All metal frames in concrete openings shall be grout filled.

Project Hardware shall be described as the following:

- Heavy duty type; hinges heavy duty ball-bearing.
- Fire rated doors shall have closers and shall be self-latching or self-locking.
- Astragals on all pairs of doors, and automatic door bottoms on all doors.
- Panic devices shall not be used on exit doors from high security areas unless required by code, due to occupant load; those used shall be concealed type with lateral latching.
- Strike plates and keepers on all latch and lock functions.
- Plated or provided with permanent finish; paint grade is not recommended.
- Rain drips over all exterior door openings.

6.13. Flooring

Carpet shall be low, level loop, direct glued with urethane backing. Carpet shall be manufactured both for use as carpet tile and as sheet goods.

Vinyl tile, laminated plastic, resinous coating and other hard surface flooring shall be commercial grade, static dissipative (ESD type).

All exposed concrete interior surfaces shall be sealed to minimize dust, including concealed surfaces beneath RAF systems.

6.13.a. Raised Access Floors (RAF)

Floor loading shall be ANSI 1250 minimum; ANSI 1500 or greater at ramps, as required to support Project equipment weights. Construction of raised access floor (RAF) systems in data processing environments shall comply with the recommendations of NFPA 75, and the following:

- RAF assemblies to fit 'air-tight' when installed.
- Only non-combustible materials shall be used.
- Provide operable adjustable dampers for air control.

- Provide custom designed structural support systems for support of floor grating and superimposed loads.
- RAF assembly panels shall be two (2) foot square, with pedestals beneath each corner (two feet apart). Trim shall be integral and not applied.
- Access floor assemblies shall be a minimum of twenty-four (24) inches deep; thirty-six (36) inches is preferred and required where underfloor supply design requires such depth. Custom design and fabrication may be required for plenums over 36 inches, and should be seismically evaluated during Design.
- Stringers shall be bolted, four (4) foot lengths, installed in a herringbone pattern.
- Provide finish 'grommets' at all floor panel penetrations.
- Ramps, rails, stairs, riser, fascia, etc. shall be provided by the same manufacturer as the RAF assembly.

6.14. Ceilings

Suspended acoustical lay-in ceiling systems and panels shall be provided in all personnel and critical data processing environments, as listed in BOD **Section 3**. Suspended painted gypsum ceilings shall be furnished in Facility wet areas. Exposed overhead surfaces shall be unfinished.

In data processing spaces, ceilings shall be clean-room rated, mylar faced, with all edges secured against spalling. Provide hold-down clips in these spaces, especially where suppression gas discharge may dislodge ceiling tiles.

Suspension systems shall be aluminum or stainless steel.

Finish all ceiling system openings or penetrations with escutcheons, grommets, etc.

Provide access doors at all hard ceilings. Access doors shall be provided to all concealed services in all hard finished surfaces.

6.15. Specialty Millwork, Furniture, Accessories

Modular systems furnishings shall be provided in accordance with the University of Utah Furniture Standard.

Specialty furnishings, consoles, tables, etc. are described elsewhere in this BOD, particularly **Sections 3** and **10**.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

6.16. Lifts, Cranes (Hoists)

Vertical transportation or lifting devices, including those designed to carry freight, shall be automatic with push button controls for each call station.

Provide emergency phone service and security intercom service within each lift cab and/or at the level landings of each lift stop.

Consider the use of wheelchair platform lifts where access or egress is required, but limited due to physical constraints.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7. Mechanical

7.1Table: Mechanical Load Summary

	Program Build			Final Need		
Space Type	(kW)	(Tons)	(600 Ton Chillers) N+1	(kW)	(Tons)	(600 Ton Chillers) N+1
University CORE	1,250	355		2,000	569	
HPC*	1,150	327		2,000	569	
COLO	0	0		1,150	327	
IT SubTotal	2,400	682		5,150	1,465	
Other Loads	288	107		773	220	
Total	2,688	789	2*	5,923	1,685	4

* N+1 600 ton chillers exclude HPC load

7.1. Design Parameters

Codes & Standards:

- International Mechanical Code
- International Plumbing Code
- International Fire Code
- International Energy Conservation Code
- **ASHRAE**: American Society of Heating Refrigeration and Air Conditioning Engineers
- **ASME**: American Society of Mechanical Engineers
- **NFPA**: National Fire Protection Agency
- **UL**: Underwriter's Laboratory

Additional authorities having jurisdiction:

- University of Utah Mechanical Design Standards

7.2. Design Conditions

Cooling and heating load calculations shall be based upon ASHRAE statistical data for climatic conditions in Salt Lake City. Equipment shall be sized for temperature extremes and for an altitude of 4,226 feet above sea level.

- High outdoor design temperature = 107° F
- Low outdoor design temperature = 2° F

7.2.a. Table: Indoor Design Conditions

Space	Temperature (F)	Relative Humidity (RH)
Data Center	75° ± 2°	45% + 10% / - 5%
UPS	75° ± 2°	25% min - 55% max
Battery	77° ± 2°	25% min - 55% max
Substation	75° ± 2°	25% min - 55% max
Switchgear	75° ± 2°	25% min - 55% max
Office	75° ± 2°	25% min - 55% max
DCOC	75° ± 2°	25% min - 55% max
Storage	75° ± 5°	25% min - 55% max
MPOE, IT	75° ± 5°	25% min - 55% max
Staging	75° ± 5°	25% min - 55% max
Corridor	75° ± 2°	25% min - 55% max

7.3. System Overview

The University of Utah building at 875 South Temple is a former Coca Cola bottling plant that had been prepared to house telecommunications equipment by the former owner, MCI. In its present state, the building is a cleaned-up shell with seismic upgrades, water service risers, electrical service and empty conduits for communications cable entry. There is an existing small generator. There is no existing mechanical equipment in the building or on the site.

The new data center will be a roughly equal combination of a highly sustainable, Tier 3 Enterprise Core area and a high performance computing (HPC) area which needs no mechanical sustainability. Power densities range from 150 Watts per square foot for the core area to 250 Watts per square foot in HPC. HPC also utilizes individual high density cabinets which will be cooled by rack cooling systems.

There are a number of options for mechanical system design for the new data center. These run a range from the more conventional but less efficient to the more efficient newer, more sustainable technologies. Because the requirements for this facility mandate both a highly reliable area and a less reliable area for the data center, efficiency is the only variable.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Because space inside the building is limited, the mechanical plant will be placed adjacent to the building, in an existing parking lot. Air handling equipment will be either raised floor mounted CRAH units or central station rooftop units with overhead ducting.

The Salt Lake City area climate is well suited to outdoor air economizer and to evaporative cooling and these are among the options to save energy in cooling the facility.

7.4. Data Center Cooling Options

Option 1 – Program Build. Chilled water system comprised of:

- Centrifugal chillers
- cooling towers
- chilled water & condenser water pumps
- Tier 3 piping system to building
- Raised floor mounted CRAH units with humidifiers
- Liquid cooled cabinets

Option 2 – Sustainable Design Option. Chilled water system comprised of:

- Centrifugal chillers
- cooling towers
- chilled water & condenser water pumps
- Waterside economizer heat exchanger system
- Tier 3 piping system to building
- Raised floor mounted CRAH units with humidifiers
- Liquid cooled cabinets

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Option 3 – Sustainable Design Option. Chilled water system comprised of:

- Centrifugal chillers
- cooling towers
- chilled water & condenser water pumps
- Tier 3 piping system to building
- Rooftop mounted air handlers
- Outdoor air economizer
- Suspended ceiling with hot aisle containment. (No raised floor)
- Liquid cooled cabinets
- Humidification

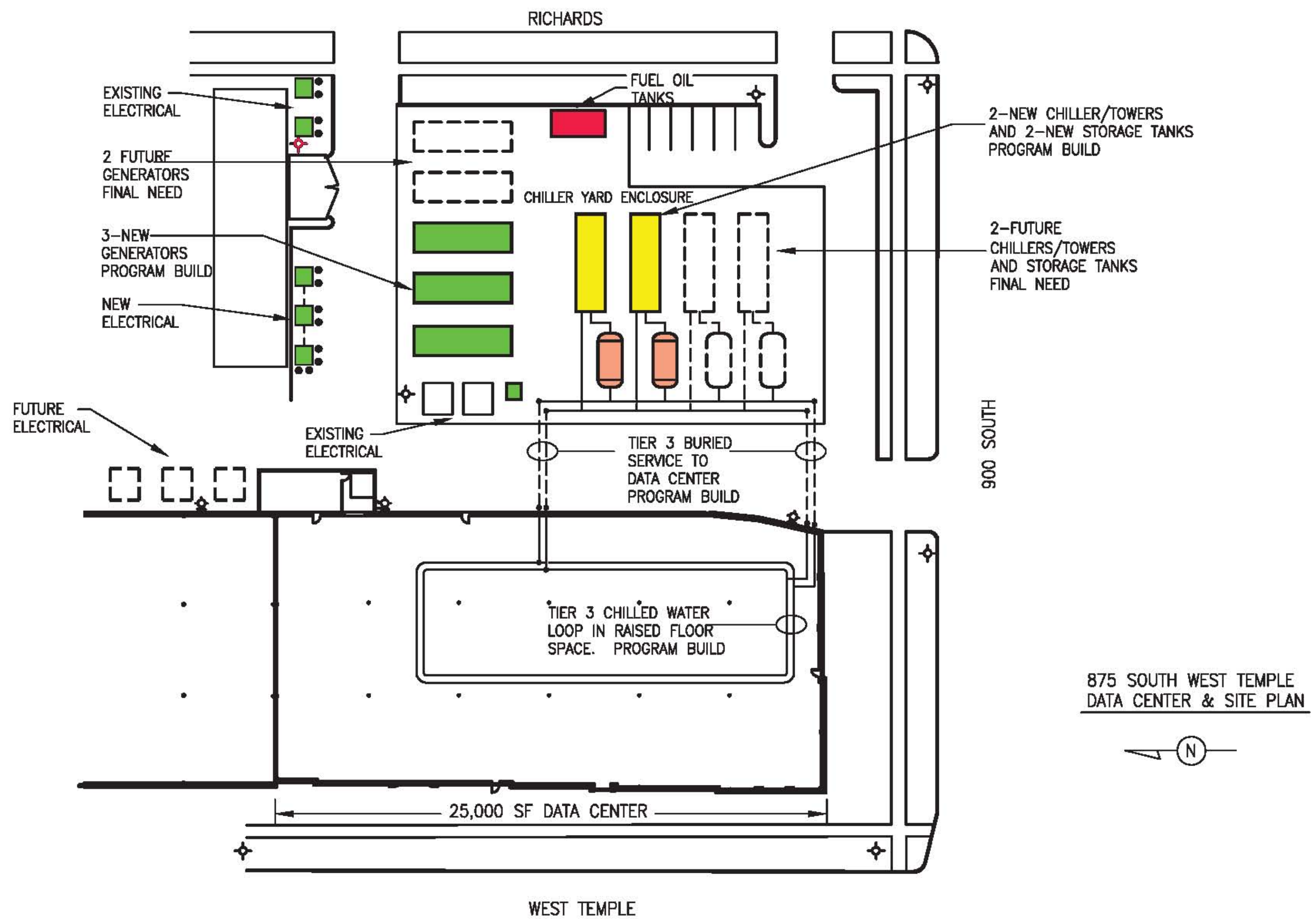
Option 4 - Sustainable Design Option. Chilled water system plus evaporative cooling system comprised of:

- Centrifugal chillers
- cooling towers
- chilled water & condenser water pumps
- Tier 3 piping system to building
- Rooftop mounted air handlers
- Outdoor air economizer with evaporative cooling & humidifying pads
- Suspended ceiling with hot aisle containment. (No raised floor)
- Liquid cooled cabinets

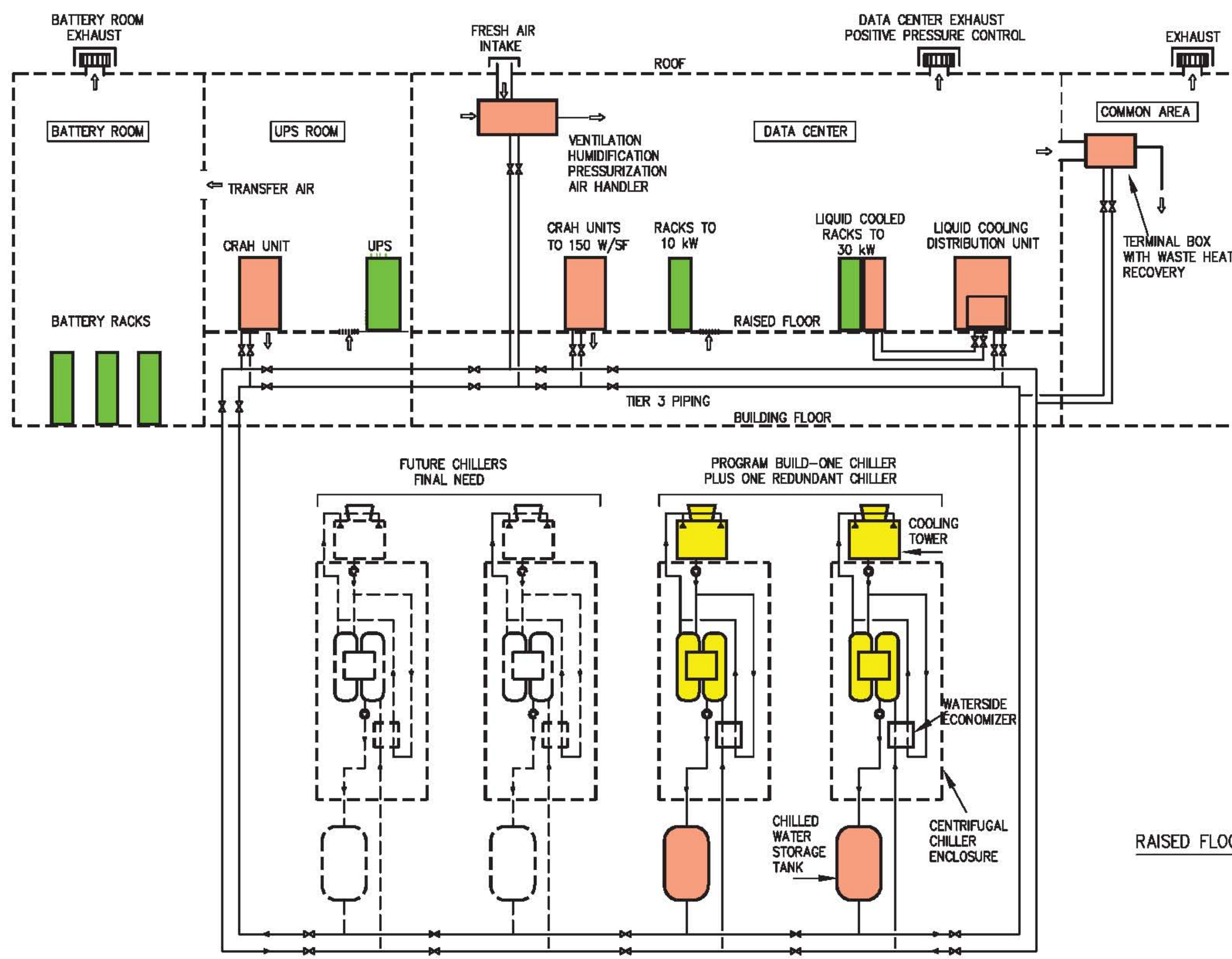
EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7.5. Figures:

7.5.a. ...Mechanical/Electrical Site Plan



7.5.b. …Raised Floor Cooling Diagram – Program Build

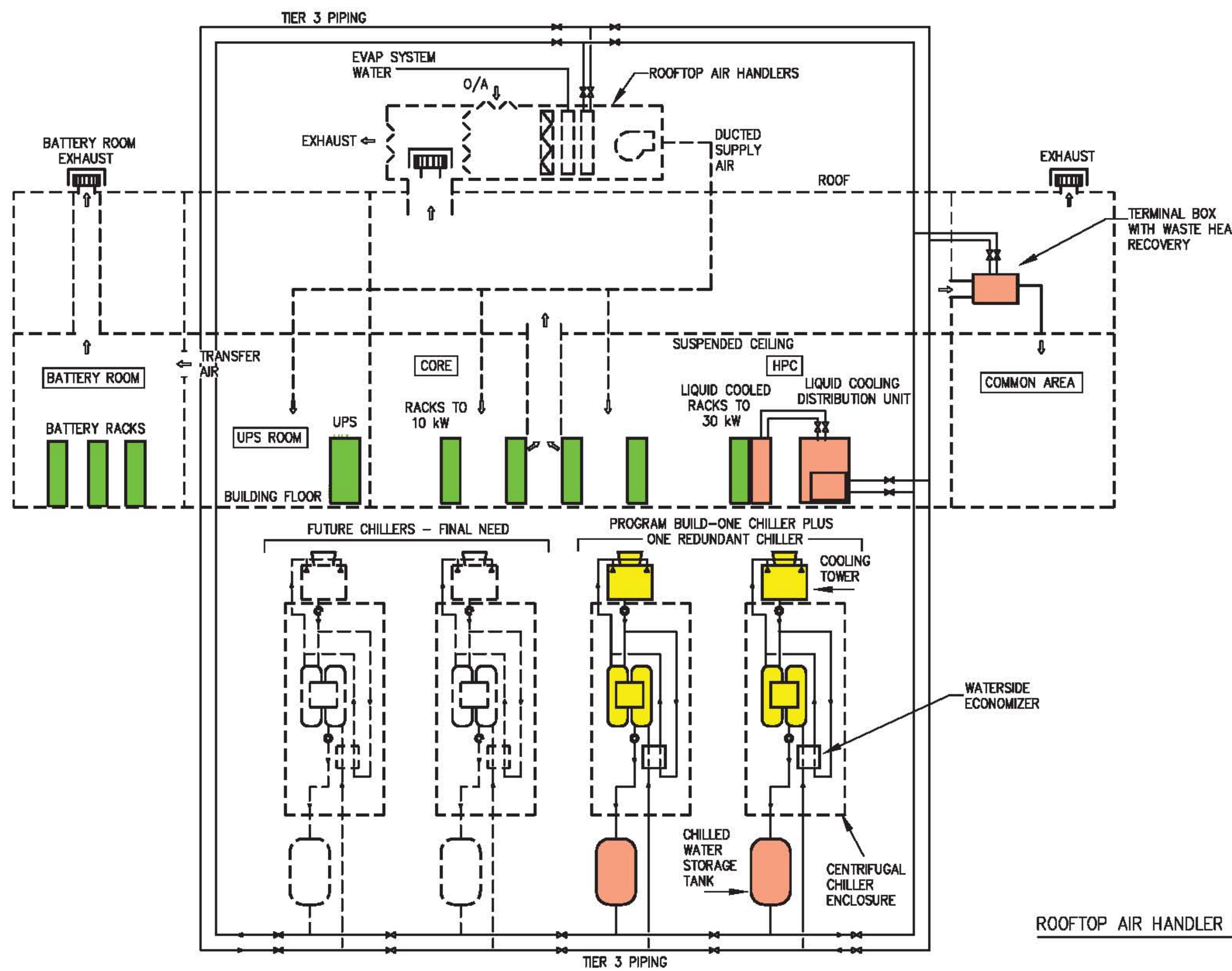


RAISED FLOOR COOLING DIAGRAM

THE UNIVERSITY OF UTAH

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7.5.c. Rooftop Air Handlers Cooling Diagram - Sustainable Design Option

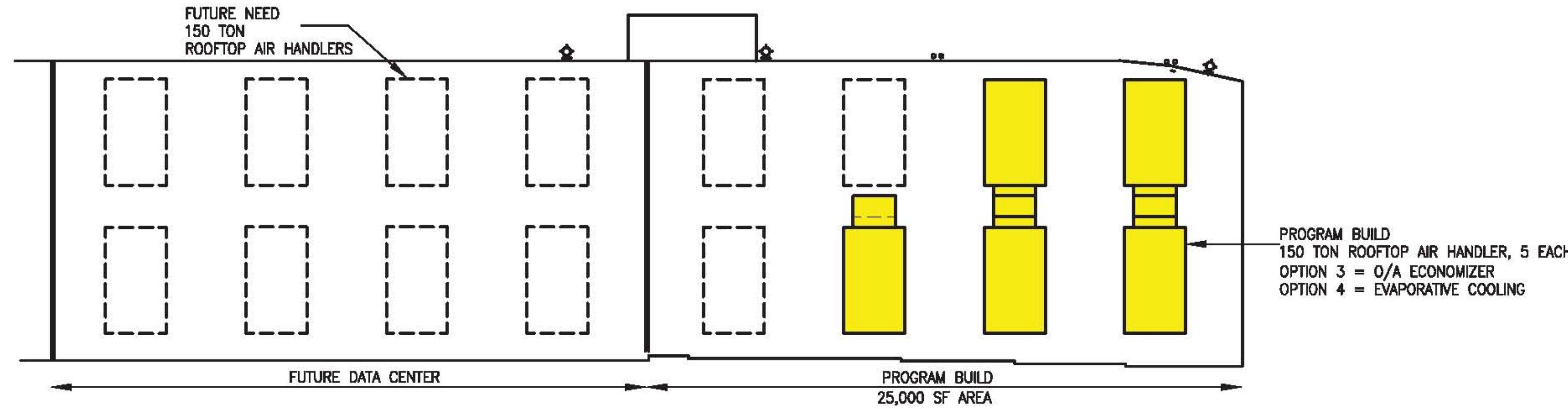


ROOFTOP AIR HANDLER COOLING DIAGRAM

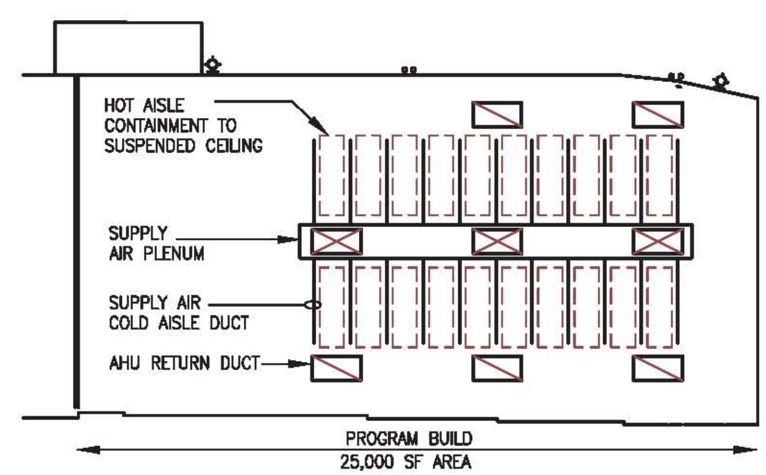
THE UNIVERSITY OF UTAH

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7.5.d. Mechanical Roof & Ceiling Plan – Sustainable Design Option



DATA CENTER ROOF PLAN

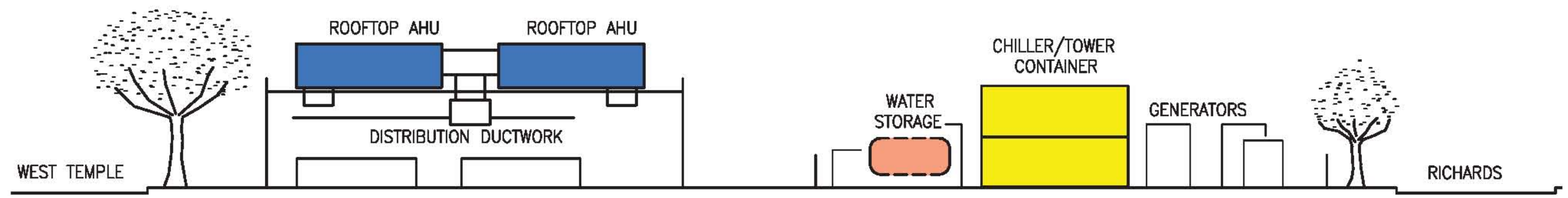


DATA CENTER CEILING PLAN

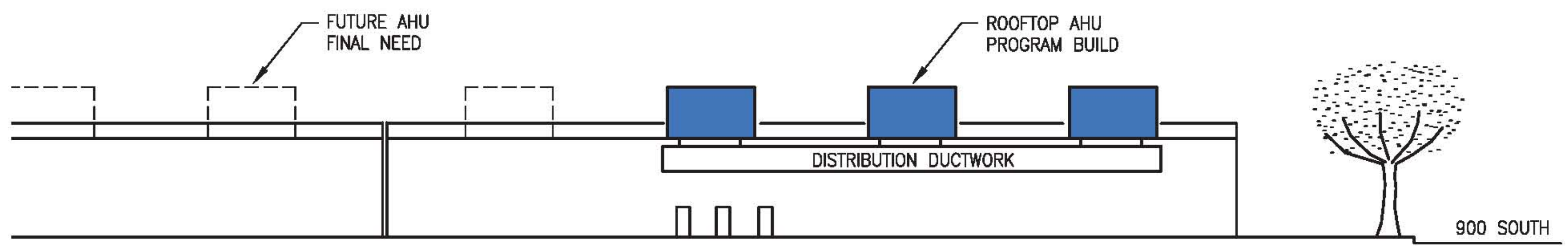
DATA CENTER COOLING SHOWING ROOFTOP AIR HANDLERS FOR:
OPTION 3 – OUTDOOR AIR ECONOMIZER
OPTION 4 – EVAPORATIVE COOLING WITH OUTDOOR AIR

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7.5.e. Mechanical Building Sections – Sustainable Design Option



DATA CENTER SECTION LOOKING NORTH



DATA CENTER SECTION LOOKING EAST

DATA CENTER SECTIONS
OPTIONS 3 & 4 AIR HANDLERS SHOWN ON ROOF

7.5.f. Base Cooling Load

There are two (2) potential means of cooling the Data Center for base loads:

1. A raised floor may be employed with down-flow CRAH units delivering cooling air. For the base loaded area no special row encapsulation will be required. Recommended raised floor height is 24 inches plus 6 inches for accommodation of raceways & piping.

2. Or, rooftop air handlers may be employed to supply cooling air through overhead ductwork. This design allows outdoor air economizer and saves data floor space but presents possible problems in filtration needs, maintenance, roof penetrations and low ambient temperature exposure. The raised floor may be eliminated or a low RAF may be employed for cabling.

7.5.g. Supplemental, High Density Cooling

For supplemental cooling, liquid cooling systems are available that provide up to 30 kW per cabinet, dew point control, and isolation from the main chilled water system. A high density refrigerant based cooling system is also available from Liebert. All of the high density systems employ dedicated heat exchange modules and pumps to isolate their systems and provide the pressures necessary to operate them.

7.5.h. Chilled Water Plant

The magnitude of the data center IT load and the nature of the proposed cooling delivery systems dictate the use of chilled water as a cooling distribution medium. With limited interior floor space, the chiller plant will be placed in an exterior location. The parking lot to the East of the building's Southern end is the only location available for this purpose. There are two (2) types of water chillers which can be used to provide refrigeration for the heat load.

1. Air cooled, screw type chillers. These units typically use around 1.4 kW of electrical power per ton of cooling and are relatively inefficient compared to centrifugal chillers. Screw type chillers are also prohibited by the University design standards.

2. Centrifugal chillers and associated cooling towers & pumps use around 0.6 kW per ton of cooling. These are indoor units and will need enclosures for this project. Modular systems are available that combine a chiller, chilled water pump, condenser water pump, cooling tower and piping in a single, compact enclosure. For this project, modules of 600 ton chillers (2,100 kW) are recommended. The program limit cooling capacity will require one chiller plus one additional chiller for N+1 redundancy for the Enterprise Core area. The final IT build-out will require three chillers plus one redundant unit for a total of four.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7.5.i. Thermal Stand-by Systems

For high Watt density data centers the IT spaces can suffer dramatic heat gains if cooling is lost for a few minutes. This is the duration of chiller re-start time in a utility power outage when emergency generators start and assume the mechanical loads. For chiller shutdown periods, a chilled water storage tank can sustain cooling water supply while the chillers restart. For this project in-line horizontal tanks are recommended for each chiller. These are relatively small pressure tanks that are essentially an enlarged section of pipe. When generator power restarts the chilled water pumps the storage maintains cooling water supply while the chillers restart & assume load. The chilled water storage tanks shall also provide emergency cooling tower make-up water through the waterside economizer into the tower basin while chilled water bypasses the tank.

7.5.j. Tier Classification

The University has specified a Tier III mechanical system:

- Chiller, pump, tower line-up: N+1
- Feed piping to data center: Dual supply & return loop system fed off both sides of the chiller manifolds with manifold isolation valving for each chiller module. A portion of the data center feed loops will be buried to allow a roadway between the data center and the chiller yard.
- Distribution piping in data center: Loop system with main line isolation valving on each side of equipment branch piping.
- High Performance Computing areas will have conventional raised floor cooling and Tier 2 piping systems.
- Data Floor Air Handlers: N+20%
- Support Air Handlers: N+1
- Liquid Cooling Distribution Units: Internally 2N

7.5.k. Data Center Piping & Ductwork

All piping & ductwork shall be designed to the University's mechanical design standards and to energy code requirements. Ductwork shall be oversized to reduce pressure losses. Velocities shall be maintained under 1,500 FPM.

7.5.l. Leak Detection and Heat Trace Systems

Leak Detection. The data center sub-raised floor spaces and equipment drip pans and sumps shall have leak detection systems of continuous cable and spot devices. Leak detection equipment shall be microprocessor based multichannel systems which can be integrated into the BMS. Cable detectors shall indicate the location of the leak in a digital readout

Heat Trace. All outdoor water, hydronic piping and condensate piping shall be heat traced.

7.5.m. Comfort Conditioning Systems

Comfort conditioning systems shall be designed to the University's mechanical design standards and to energy code requirements.

7.5.n. Energy Savings 'Green' Design

Air Economizer. Airside economizers are possible with rooftop mounted air handlers. Other locations for outdoor air economizers are not possible considering the building wall construction and City architectural requirements.

Waterside Economizers. Plate and frame heat exchangers for cooling tower water economizers may be provided as a package with the chiller/tower packages.

Control Optimization. The digital control system will run routines which develop the lowest energy use for the combination of operating parameters which exist at a given time and which are consistent with critical facility constraints.

Waste Heat Utilization. Warm air from the from the data center ceiling space shall be utilized as a heat source for parallel terminal box operation in common & support areas.

7.5.o. BMS (Building Management System)

A building management system shall be provided for the data center and all its systems. The mechanical systems shall be operated by distributed digital controls. An EPMS shall be provided for the electrical systems. The University has standardized its control systems around Johnson Controls and Staefa. This project will require JCI or Staefa controls. The University Systems Operations Shop shall coordinate controls work and may do some or all of the installation to integrate the data center BMS into the existing campus system.

7.5.p. Natural Gas

A two (2) inch natural gas line is stubbed up on the exterior of the building West side. This service is planned for use in the North end of the building. No natural gas is planned for the Data Center. Natural gas lines shall not penetrate data center walls or traverse any part of the data center interior.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7.5.q. Water Systems

The building presently has two stubbed water risers on the West side of the building. A 6" diameter riser enters the data center portion. Domestic water and fire system water shall be brought separately into the building.

7.6. Chiller Plant

Centrifugal chillers, chilled water pumps, condenser water pumps, waterside economizer heat exchanger, cooling towers and controls shall be provided in modular, pre-piped containers which may be run in parallel to form a chiller plant with common chilled water supply & return manifolds. Each container line-up shall provide the specified cooling capacity at Salt Lake City elevation and weather conditions. Each module shall contain water conditioning equipment for both the chilled water system and the condenser water system. Chillers and all associated equipment shall be sized for Salt Lake City elevation and for a glycol concentration adequate for burst protection at the lowest recorded ambient temperature.

7.6.a. Chilled Water Pumps

Each chiller module shall have a primary chilled water pump. Pumping shall be a variable primary flow system complete with all piping, instrumentation, controls and programming to operate each chiller line-up separately or in parallel.

7.6.b. Cooling Towers

Cooling towers shall be induced draft, cross-flow type, mounted on top of the chiller container module. A condenser water pump, instrumentation & controls shall be provided inside the container. The tower fan motors shall be variable speed drive. Towers shall be sized for use also as a waterside economizer.

7.6.c. Chilled Water Storage

Approximately 10 minutes of chilled water storage, at maximum heat loads, will be available in horizontal tanks located at each chiller discharge pipe. The tanks shall be ASME 150 psi rated and mounted on concrete saddles above grade. The tanks shall also provide tower make-up water by separate pumping through the economizer. The storage tank shall incorporate a line size bypass and control valves to isolate the tank while operating the chiller.

7.6.d. Economizer

Each chiller module may contain a plate and frame heat exchanger, piping, instrumentation and controls to form an indirect waterside economizer using tower water.

7.6.e. Water Treatment

A traditional chemical treatment system shall be utilized for both the open and closed loop systems for the Facility.

A self contained, side-stream filtering system shall be provided at the condenser water system. A pot feeder system shall be provided on the closed loop chilled water system.

A water meter shall be provided for the condenser water make-up system.

A pumped side-stream micron filter shall be provided on the chilled water loop.

7.6.f. Refrigerant Detection System

Provide a refrigerant detection system for the chiller modules. The system will consist of a control panel, detectors and piping. The control panel will be located outside the container.

During an alarm condition, the refrigerant detection system will shut down the equipment contained in the container and activate the high speed setting of the exhaust fan.

Warning signage, audible visual alarms will be provided inside and outside of the container. The alarm shall be connected to the Building Management System (BMS).

7.7. Computer Room Air Handling Units (CRAHs)

7.7.a. General

Modular computer room grade, air handling units (CRAH) will be provided to serve the critical areas. Each CRAH unit will be furnished with a chilled water-cooling coil, down flow configuration (if on raised floor), variable speed blower, micro-processor controller, integral automatic dual disconnect switches with transfer switch and indicator lights for power source, seismic zone floor stand (zone determined by site requirements) and 30% efficient filters. The CRAH units will not contain reheat coils and humidifiers. The electrical feeders to the CRAH units will be derived from diverse panels. The CRAH units will be selected for full sensible cooling.

One redundant CRAH unit will be provided for every four operating units. The CRAH units shall be controlled by supply air temperature sensor.

Liquid cooling modules will be employed for cabinets in excess of 10 kW heat production. These will be supplied with dedicated chilled water from cooling distribution units which exchange heat with the plant chilled water system.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

7.7.b. Physical Security

Chilled water and drain piping serving the CRAH units will be located below the equipment space raised floor, in a looped configuration.

A continuous leak detection system will be installed in the Equipment Space, and will be connected to a leak detection panel. Leak detection cable will be installed on the slab, under the chilled water piping and CRAHs. The alarm will be connected to the BMS.

7.7.c. Data Center and other White Space Areas

The CRAH supply air for data center base load cooling will be distributed into the raised floor plenum and pass through perforated air floor panels located to serve the computer equipment. Perforated air panels shall meet structural requirements described elsewhere in the BOD. A CFD analysis shall be provided to determine the appropriate cooling capacity for perforated panels.

Cold Aisle/Hot Aisle methodology will be followed with CRAHs perpendicular to the rows of computer hardware racks. Redundant wall mounted temperature and humidity sensors shall be provided in each area. All sensors shall be monitored by the BMS.

7.8. Ventilation, Humidification and Pressurization Air Handling System

The Data Center shall be provided with a dedicated air handler for ventilation, humidification and pressurization. The air handler shall be suspended in the ceiling space above the Data Center support area. The air handler shall be sized for two (2) times required ventilation and shall have a chilled water coil, evaporative pads and an economizer to blend return air for tempering low ambient outdoor air. The fan shall be driven by a variable speed drive. Provide a complete controls package to maintain room pressure, ventilation and humidity. Ductwork shall connect outdoor air intake and exhaust to rooftop penthouses. Supply ductwork shall serve all areas in the Data Center and support spaces.

7.9. Evaporative Air Handling Units (if employed)

Evaporative cooling for the data center shall be provided by rooftop air handling units. The units shall contain chilled water coils, evaporative pads, supply and return/exhaust fans, filters (prefilters & 85% filters), air blenders and 100% outdoor air economizer. Fans shall be driven by variable speed drives. The rooftop units shall be low profile and develop face area through width. The units shall be custom built. Provide a complete controls package.

7.10. Support Spaces

7.10.a. Data Center Operations Center (DCOC)

The rooms will be conditioned by overhead ductwork and dedicated air handlers in an N+1 arrangement. The air handlers will be chilled water cooling and use data center heat recovery air for space heating.

7.10.b. Electrical Rooms (UPS, Substation, etc.)

The rooms will be conditioned using down flow CRAH units in a N+1 arrangement. The units will deliver air parallel to the equipment. The electric feeds for the units will be from diverse power sources.

7.10.c. Battery Rooms

The Battery Rooms will be air conditioned utilizing transfer air from the UPS room. The battery rooms will be exhausted continuously by a common exhaust system with high and low inlets in each battery room. Two exhaust fans will serve the battery rooms for an N+1 configuration. One fan will run continuously to provide 1.0 cfm/sf and the second fan will start in the event the lead fan fails or if high levels of hydrogen are detected. The amount of pressurized exhaust air ductwork will be minimized.

A wall mounted temperature sensor will be provided in every battery room and will be monitored by the BMS.

A hydrogen leak detection system will be provided for each battery room to detect high levels of hydrogen. The control panel will be located outside the corresponding battery room.

An emergency shower and eye wash station will be provided in each battery room. Water flow detection will be provided for shower and eye wash stations.

Warning signage, audible and visual alarms will be provided inside and outside of each battery room. Alarms will be connected to the BMS.

7.11. Fuel Oil System

The fuel oil storage system will be sized for a minimum storage capacity of 72 hours of full load run time. The Designer shall provide a cost benefit analysis of installing above ground tanks, below ground tanks, tanks integral to the generator, etc. UL listed double wall steel fuel oil storage tanks will be provided.

A remote fill system will be provided, so the fuel oil delivery truck does not have to enter the actual facility.

Each tank will have two fuel oil pumps to serve the generators. The pumps will operate on a lead/lag sequence and alternate after each pump run. Each pump will have the capacity to deliver enough fuel to supply all generators running at full load connected to its tanks.

Each generator will be served by its own double wall day tank (subject to local Fire Marshall approval). Each day tank will be sized to provide a minimum of two (2) hours of operation at full load in the event of a catastrophic fuel pump/AST failure.

The AST's will have a tank gauging and monitoring system that will report to the building management system. Day tank gauge and monitoring will be accomplished through the individual day tank control panels. All alarms will be reported to the BMS. The monitoring system shall provide alarms for:

- High level
- Low Level
- Water level at bottom of tank
- Fuel Leak (Main tanks, underground double wall piping, and piping trench)
- Continuous statistical leak detection

Fuel oil controls and control panels will be provided for each day tank. Each panel will be Programmable Logic Controller (PLC) and fed from two (2) separate and diverse electrical feeds for redundancy.

A fuel polishing system will be provided for each above ground storage tank (AST).

Parallel "Racor" fuel oil filters shall be provided at each generator to allow for quick change-out without shutting the system down.

The fuel oil piping system will be flushed out prior to activating.

7.12. Plumbing

7.12.a. General

Design of domestic and process water systems shall be according to the requirements of all authorities having jurisdiction, including local plumbing codes.

7.12.b. Domestic Water Service

Domestic water service is existing on the West side of the building. Reduced pressure backflow preventers shall be provided for main supply and branch piping to serve plumbing fixtures. A single, metered, mechanical make-up cold water branch will be provided for process water with a backflow preventer.

7.12.c. Domestic Water Treatment

Water serving humidifiers shall be treated by deionized (DI) water cartridges to avoid build-up of minerals in the humidification equipment.

Water service for the Project will be provided with a packaged water softening system (if required) with final size determined by the Designer after analyzing the water quality report.

7.12.d. Domestic Water Heating

Independent electric water heaters shall be provided to serve the battery room emergency showers/eye wash stations. The emergency shower/eyewash stations will be supplied through a tempered water blending station.

7.12.e. Sanitary Drainage System

Provide a sanitary drain to receive discharge from all mechanical equipment. New drains for the chiller plant and condensate lines shall tie in to an existing 8" underground sewer on the building's East side. Provide copper lines for pumped condensate inside the building.

7.12.f. Liquid Leak Detection System

Liquid leak detection will be provided utilizing a continuous cable type leak detection sensor and required accessories shall be installed under the chilled water piping and around the CRAH drip pans under the raised floor.

The leak detection system panel shall consist of main control panel and an annunciation panel.

The leak detection system shall communicate with the BMS system.

Provide power from the UPS system in accordance with system design requirements.

7.12.g. Plumbing Fixtures

Acid resistant sinks shall be provided in batteries rooms.

Non-freeze hose bibbs shall be provided along walls in all Project exterior equipment yards.

Sanitary fixtures shall have manual controls, not automatic.

7.12.h. Drainage Receptors

Floor drains shall be located in Fire Protection Rooms.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

8. Fire Protection, Detection, and Alarm

8.1. Fire Protection

8.1.a. General

The building shall be protected throughout by an automatic fire sprinkler system, designed and installed in accordance with all codes and authorities having jurisdiction, including the Owner's insurance underwriter's requirements.

Data center fire protection will use clean agent gas as the first line of defense. A dry pipe pre-action sprinkler system will also be installed. Common areas shall be protected by a wet sprinkler system.

Protection, detection, and alarm systems will be on one common zone for all Project areas. The Designer shall evaluate zoning Project areas by space function.

Fire extinguishers will be provided throughout all Project spaces in accordance with the Owner's insurance underwriter's requirements and authorities having jurisdiction (AHJ). The Designer shall determine type, considering issues such as code, contents requiring protection, frequency of provision, etc. Public spaces, including COLO, shall be provided with cabinet-type housings; secure spaces can utilize exposed wall mounted extinguishers.

An electric or diesel operated motor-driven fire pump shall be provided if deemed necessary by inadequate available pressure. The Designer shall perform a cost comparison and list the pros and cons of each type of system.

The backflow preventer will be inside the building, meet applicable codes, and will be UL listed (Underwriters Laboratories).

- Schedule 10 piping is **NOT** permitted for use on the Project.

8.1.b. Suppression Systems – Pre-action System

The Project will be protected with double interlock pre-action sprinkler systems. Manual releases for these systems will be dual action valves so as to prevent accidental actuation.

Galvanized pipe will be used in the pre-action systems to prevent scale buildup and related pipe decay that can hinder sprinklers from functioning.

8.1.c. Suppression Systems – Clean Agent

A clean agent suppression system shall be provided throughout all data processing Project areas. This shall include coverage above and below raised floors. It is preferred that agent containers shall be located outside the spaces being protected.

A manual valve will be included at the clean agent tanks to deactivate the system during maintenance periods. An alarm will be activated during this condition.

Preferred inert gas system types are FM-200, Inergen and/or Saffire, in that order.

8.2. Fire Detection

8.2.a. Detection Systems – Air Sampling Smoke Detection (ASSD)

All Project Data Processing areas will utilize ASSD detection systems. The ASSD units, at high alarm level, will stop air movement below the raised floor and release the suppression system.

Cross-zoned ASSD units will be utilized to activate the clean agent systems in the event of a fire.

Preferred air sampling detection system manufacturers are HSSD and VESDA.

8.2.b. Detection Systems – Conventional Detectors

Cross-zoned Conventional smoke detectors shall be used throughout all Project Non-Data Processing areas.

8.3. Fire Alarm

An addressable alarm system with multi-vendor compatibility, multi-site interconnectivity and web access will be provided to monitor all Project areas. Suppression systems will be activated by conventional detectors or spot detectors, or the air sampling system. Detectors will be connected to associated sprinkler release system panels, providing activation in the event of a fire. The fire alarm control panel will monitor the suppression release panels.

The Project fire detection and alarm systems will provide gateways and connections to monitoring systems (BMS, Security, etc.).

The ASSD system will be on a network loop and will utilize an ASSD compatible Fire Alarm Control Panel. An addressable smoke detection and alarm system will be provided throughout Project areas.

Abort stations shall be located inside Project room exits and at the building (main) security desk. Project room abort stations shall be accompanied by a phone.

THE UNIVERSITY OF UTAH

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

9. Electrical

9.1. a Table: Electrical Load Summary and Redundancy

Electrical Load Summary				
	Program Build		Final Need	
Space Type	(kW)	Qty	(kW)	Qty
HPC (Flywheel)	1000		2000	
HPC (UPS add to Core)	150		150	
Core	1250		2000	
Colo	0		1750	
Total IT load	2400		5900	
PUE	1.75		1.75	
Facility Load	4200		10325	
# of 2500 kva Transformers		2		5
PUE	1.75		1.75	
Core + HPC(core) + Colo	1400		3900	
sub total Gen Load	2450		6825	
HPC Mech Load - est.	500		1000	
Total Gen Load	2950		7825	
# of 2000kW Gensets (N+1)		3		5
Core + HPC (Core) + Colo	1400		3900	
# of 675kW UPS modules (N+1)		3		8
PDU for Core + Colo # of 225kva PDUs (N) – (4 RPPs in each PDU) =		6		19
PDU for HPC on UPS – 4 RPPs in PDU =		1		1
HPC	1000		2000	
# of 1200kva Flywheel UPS (N)		1		2
# of 225kva PDUs (N) – (4 RPPs in each PDU)		5		10

9.1.b Table: Electrical Redundancy

Basis of Design - Description	Units	Program Build	Final Need
Service (see notes on dual utility feeders)	Selection	N	N
Standby Generator (for Enterprise)	Selection	N+1	N+1
Exterior Sound Attenuated Enclosure	Yes/No	Yes	Yes
Sub-Base Fuel, Day Tank or Above Ground Convault	Type	Sub-Base Fuel Tank	Day/Above Ground Convault
Diesel Fuel Backup	Hours	24	24
Load Bank	Yes/No	Yes	Yes
Generator Distribution (for HPC)	Selection	None	None
Flywheel (for HPC)	Selection	N	N
UPS Topology (for Enterprise)	Selection	N+1	N+1
Battery Time (for UPS)	Minutes	15	15
Battery Type (for UPS)	VRLA/Flooded Wet Cell	Flooded Wet Cell	Flooded Wet Cell
Mechanical Equipment on UPS	Yes/No	No	No
Mechanical Controls on UPS	Yes/No	Yes	Yes
ASTS	Selection	No	No
PDU	Selection	N	N
RPP	Selection	N	N
Aspiration Smoke Detection at Ceiling	Yes/No	Yes	Yes
Aspiration Smoke Detection at CRAH	Yes/No	Yes	Yes

9.2. General

All electrical systems will conform to all applicable building codes and regulations including the National Electrical Code (NEC), local codes and OSHA. Systems shall be designed and constructed to meet standards of ANSI, ASTM, AEIC, CBM, ETL, IESNA, IPCEA, NEMA, NFPA, NEA UL and University of Utah (UU) Electrical Design Standards.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

9.3. Overview

The University of Utah building at 875 South Temple has the following existing electrical components. A 2500kva 12kV/480 volt pad mounted transformer connected to a 4000 amp, 480 volt 3 phase 4 wire UL 891 Main Switchboard. This board subfeeds 480 volt and 120 volt panel(s) – which supplies nominal house power and interior/exterior lighting. A second un-energized 2500kva pad mounted transformer is located outside the main building. A 25 kVA generator located adjacent to the un-energized transformer is slated for the proposed Records Project at the north end of the building. Numerous underground conduit stub-ups are located in the existing electrical room(s), the end points of these conduits are not documented. A basic fire alarm system is located in the south electrical room.

Electrical infrastructure will consist of exterior and interior equipment components. Outdoor infrastructure will include incoming Rocky Mountain Power (RMP) electrical utility feeders at 12.47 kV with Disconnects and Primary Metering Cabinets to step down 12.47kV-480V transformers: Automatic Transfer Switches (ATS), standby power generation equipment consisting of standby diesel generators with underground duct bank system, permanent load bank and temporary generator pad.

Interior infrastructure will include main switchgear(s) for distribution and utilization. Critical power support for the Enterprise and Colo spaces will be by static double conversion UPS with battery backup. Critical power support for the HPC (High Density Computing) will be by flywheel UPS and conventional UPS system. Raised floor power distribution will be provided by PDU (power distribution units) and RPPs (remote power panels).

All electrical feeders will be installed overhead. All conduits will be installed in surface in infrastructure rooms such as electrical room, battery room, cable/MDF/MPOE, data floor.

9.4. Electrical System Load Criteria

The following vary from Day One to the Final installation; refer to Electrical Load Summary Table

- Building core area load density
- Data Center critical load on two utility sources
- Data Center critical load on UPS/Generator

9.5. General Design Criteria

The facility is a continuously operating data center (24/7/365).

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

The electrical design will follow guideline from TIA-942 (Telecommunications Industry Association) Tier level system. The electrical design selected is Tier 3 for Enterprise and Colo and Tier 1 electrical for HPC. The UPS configuration provides N+1 redundancy.

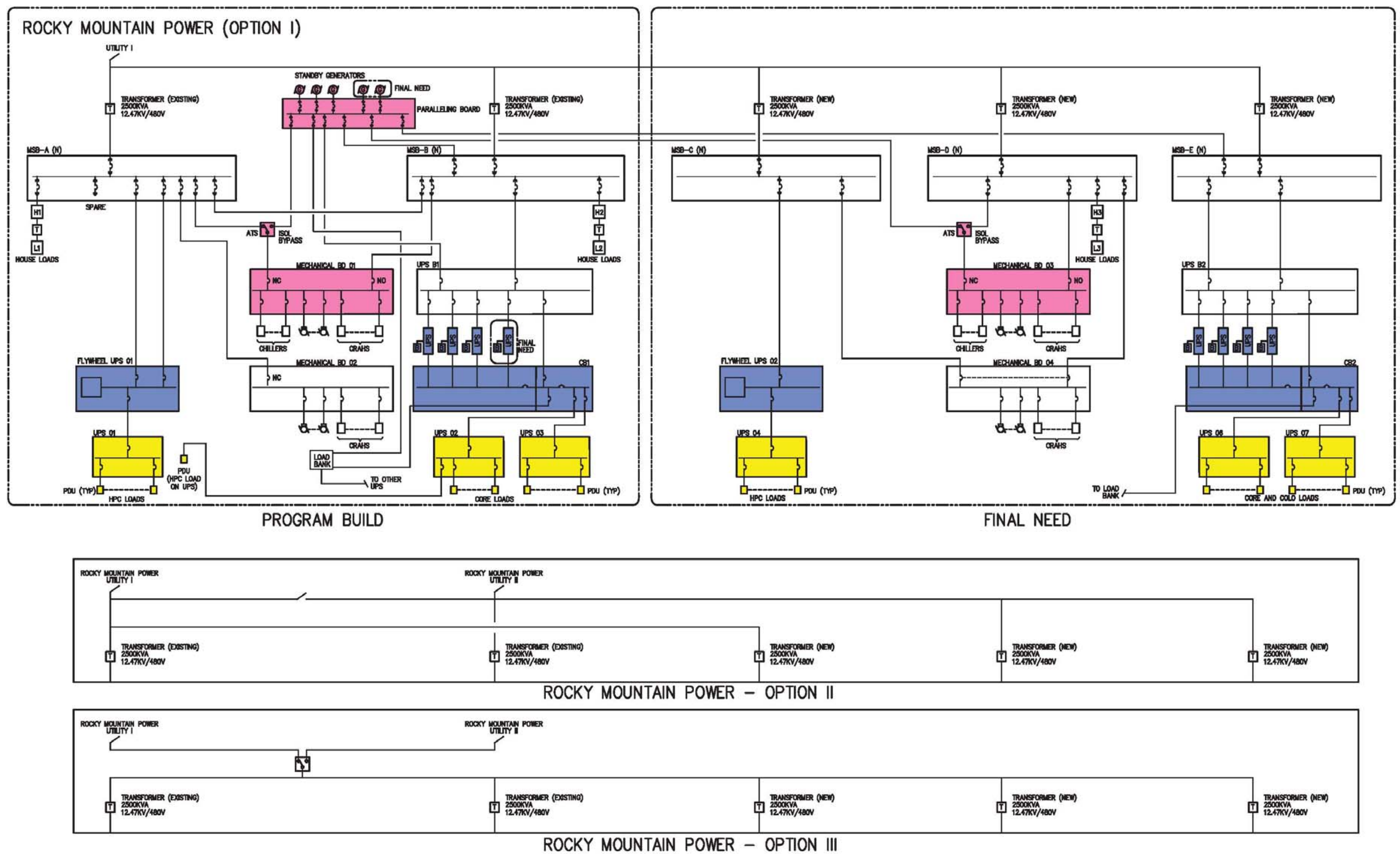
The PDU units serving the data floor shall be provided with UPS power source backed by generator power source.

The paralleled UPS modules are backed with a 15 minute-rated flooded wet cell batteries.

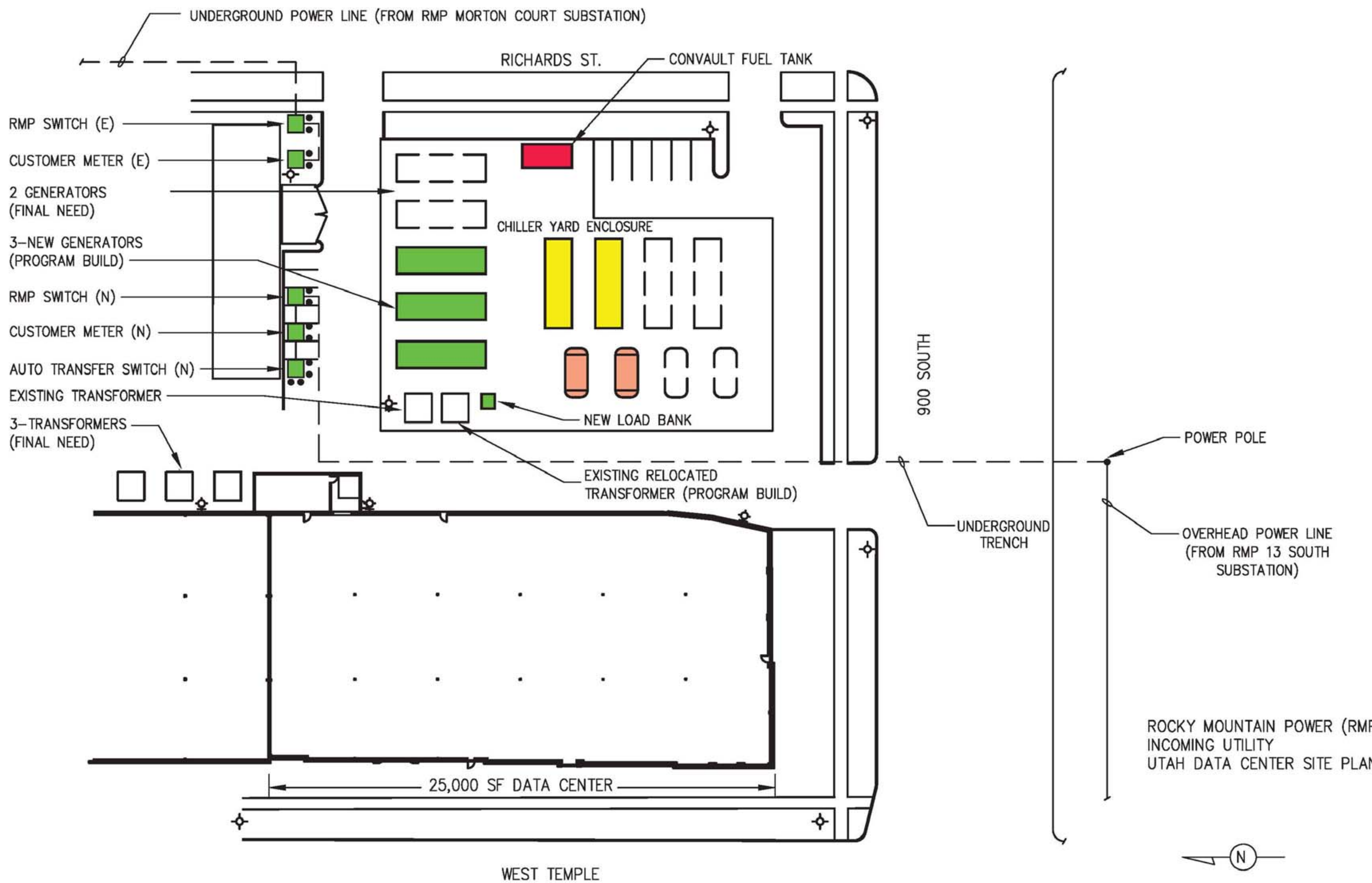
THE UNIVERSITY OF UTAH

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

9.6. Figure: Electrical Single Line Diagram



9.7. Figure: Electrical Site Plan



THE UNIVERSITY OF UTAH

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

9.8. Power Service

Electrical power service will be provided to the site by Rocky Mountain Power (RMP) electric utility distribution.

The service voltage to the site will be 12.47 kV. The existing connection is from RMP Morton Court Substation (SS) located .8 miles NE of site. This site has 1MW of power immediately available for the UU Data Center. 2 to 4 MW of power can be made available in time of proposed UU DC construction (6 to 18 months). Additional MW capacity can be made available by application. There are RMP plans in place to double the MW capacity for Morton Court SS from 30MVA to 58MVA.

The Primary Metering Cabinet (PMC) and low voltage feed to overhead to legacy Candy Building was reviewed. Ownership of the 600 amp switch/CMC will be confirmed at next phase.

Two other substations have been identified as possible second source to the site. 13 South SS and Snarr SS are located respectively 1.2 miles and 1.0 mile from the site. The feed from both substations can be routed underground through W 900 S Street to the site. See site plan for routing. Each SS require the same amount of time to add sufficient capacity for future data center expansion.

Morton Court #11 138kV is considered more reliable that the older 46kV 13 South SS and Snarr Substation.

RMP sent the following history of reliability. Morton Court #11 has tripped 4 times in the last two years (all trip and reclose, no extended outage). Snarr SS has tripped 7 times in the last two years. 13th South SS has tripped 7 times in the last two years.

RMP sees their power reliability improving as their planned upgrades are implemented.

138kV feed to the site with UU owning the substation was discussed. Cost of high voltage work is prohibitive compared to RMP owning the HV equipment.

RMP is flexible in providing a single service/dual service to an ATS or two separate services. See Electrical Single Line diagram for the 3 options.

RMP recommends confirmation with the City officials for all new power work.

New power application process and time lines are spelled out in the RMP web site.

RMP will entertain Cogeneration and Solar alternative – not a likely alternative for UU at this time.

Cost for power is roughly 5 cents per Kwh depending on the rate schedule.

9.8.a. Electrical Service and Site Distribution

Utility service consists of 12.47 kV utility feeders terminated at fused disconnects. University of Utah standard is high voltage load break SF-6 gas switches. The switches are upstream of the step down 12.47 kV-480V 2500 kVA transformer.

The output of the transformers land respectively on Main Switchgears located inside the building. During normal operation each transformer will feed its own load; tie breakers will be normally opened.

A breaker will be provided for temporary generator(s) connection. Proper interlock will be implemented to prevent paralleling temporary generator with permanent generator or utility.

All exterior feeders will be routed underground and encased in concrete. Underground pre-cast manholes provided as needed.

Transfers between utility and on-site standby generators will be open transition. The transfer will be automatic upon lost of power from utility. The retransfer from generator to utility will be automatic with adjustable timer. It will be possible to override the timer if required.

PLC to be used for control and interlock of breakers.

9.8.b. Main Service Switchgear

The 4000A ampere rated main distribution with UL-1558 switchgear will consist of metal enclosed, draw out, power circuit breakers. The switchgear associated with the UPS loads shall be 3-phase, 3-wire, continuous rated and appropriate interrupting capacity. All of the breakers shall be 100% rated, the main and tie breakers shall be electrically operated.

All breakers shall be equipped with solid state trip units with adjustable long time, short time pick up and delay and adjustable instantaneous trip settings.

9.9. Emergency Power System

Code required emergency power for egress lighting and exit signs will be supplied by stand-by generator and UL Listed 90-minute integral to light fixture battery backup.

The fire alarm system will be provided with an integral battery backup power supply as defined by NFPA 72 and will not rely on the standby generator system for backup power.

9.10. Standby Power System

The standby power system will provide standby power to the data center (Core and Colo loads). The system will be classified as an Optional Standby System, as defined by the National Electrical Code Article 702.

The standby power system will consist of diesel engine generators operating at 480V nominal. The complete system is N+1.

The generators are connected to a paralleling board.

The outdoor weatherproof sound attenuation enclosure system shall be designed to limit generator noise emissions to the Code required levels permitted by the applicable jurisdiction at the property lines. Acoustical treatment will be provided on the air intakes and air discharge of the generators.

Building loads on a failed utility will be transferred to generator power.

Failure of a utility feeder is defined as an abnormal voltage and/or frequency deviations on an incoming utility feeder.

Site acceptance testing of the standby generator system will include a full capacity heat run of the system with resistive load banks for a period of not less than 8 hours to validate the performance of the installation and all associated systems.

9.11. Uninterruptible Power System (UPS) – Enterprise, Colo & HPC

The UPS systems for the Enterprise and Colo spaces are arranged in N+1 configuration to deliver power on the 480-volt input of 225 kVA power distribution units (PDU).

A PDU sub fed off the Enterprise and Colo critical UPS output system will be provided for HPC loads requiring conventional UPS (not flywheel) backup.

The overall configuration consists of static UPS systems with modules rated at 750-kVA/675-kW. See Summary Table for quantities of UPS systems and modules.

The system will include a 100% continuous duty rated static bypass switch. A load bus synchronism circuit will be provided to keep the UPS inverter bus of each system in synchronism upon loss of power to the static bypass input and battery operation.

Planned maintenance activities on the UPS systems will utilize the dedicated engine generators and the maintenance bypass substation feeder to support or backup the critical load thus maintaining the redundant active power paths to the critical load.

Each module shall be provided with a 15-minute minimum full capacity dedicated battery string. The battery shall be C&D XT Plus or equivalent. Batteries shall be 100% rated at full capacity at the time of site acceptance testing. The batteries and installation will be certified in accordance with IEEE 450.

The UPS vendor shall provide an electrolyte containment and neutralization system for the batteries.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

A battery monitoring system shall be provided to monitor not less than each battery jar and shall be capable of remote monitoring and integration with the electrical power monitoring system.

9.12. Flywheel UPS Systems for HPC spaces

Flywheel UPS systems matching the UU existing installation have been requested by UU for the HPC spaces. Depending on configuration and loading from 25% to 100%, Flywheels can provide from 14 to 100 seconds of backup time. Typically UPS systems are backed up by standby generators. It has been determined through discussions with UU that reaching the end-time of Flywheel backup power does not impact HPC operations as much as the Utility power hits. No generator backup will be required for the flywheel UPS systems serving the HPC loads.

While the relative initial installed cost of flywheels UPSs are higher than conventional static UPS systems, the cost of ownership after 10 years becomes less due to the differences in operation, maintenance and energy costs.

A 480 volt Flywheel system (Caterpillar 1200S) in N configuration will provide backup power to the HPC critical load. The flywheel system shall be a single freestanding unit equipped with bypass, input/output breakers, 100% rated static switches, controls and inverter built to UL 1778 standards. Energy storage will be provided by flywheel component(s) – a four flywheel unit will provide 27 seconds at 100% load and 100 seconds at 25% load.

9.13. Power Distribution Unit (PDUs)

Computer room power distribution units shall be single 225-kVA-transformer type. The transformer shall be high-efficiency, copper windings, and UL K-20 minimum rated.

Each PDU transformer shall include a common 200% rated neutral and single neutral-ground bond and shall be so listed.

Each PDU shall be provided with 225 ampere distribution feeder circuit breakers fed off the main PDU output bus.

Remote Panels shall be located on the computer room raised floor with the server equipment. Each panel will be 208V/120V, 3phase 4wires, 225 ampere, 42 pole position branch circuit panelboards

At end of each cabinet row (1) one panel from PDU A and (1) one panel form PDU B will be installed.

Steel floor stands will be provided for the PDU equipment.

Smart Cabinet Strips with Power monitoring feature shall be provided to monitor the current for each branch circuit and will be connected to a central monitoring system.

9.14. Emergency Power Off (EPO) System

The Emergency Power Off (EPO) system [Installation of EPO system to be confirmed] will be fully documented, easily testable without causing a data center shutdown, fault tolerant and designed to inhibit false trips due to human error.

The EPO system will be well labeled, recessed, and covered with protective transparent covers. The electric power shut off operation will require two separate and distinct actions. First, an "enable" and then, a "power off" action will be required to shut-off or activate the EPO system.

The EPO system control panel will be readily accessible and easily maintainable. EPO control panels shall utilize fire alarm control panels that utilize standard components and technology and are capable of supervising EPO wiring.

9.15. Power to Mechanical and House Loads

A complete 480Y/277V and 208Y/120V power distribution system consisting of UL 891 distribution panels, branch circuit panel boards and feeders shall be provided to connect and electrically operate all the mechanical, plumbing, water heaters, air compressors, roll up door controllers and other miscellaneous building loads in accordance with the requirements of NEC and applicable local amendments.

Automatic transfer switches (ATS) shall be continuous duty, complete with bypass/isolation constructed to UL1008 standards.

The following utilization voltages shall be applicable for various loads:

- Lighting: 480Y/277V, 3 phase, 4wire
- Receptacles: 208Y/120V, 3phase, 4wire
- HVAC: 480V, 3 phase, 3 wire and 120V, 1 phase, 3 wire
- Motors ½ HP and larger: 480V, 3 phase, 3 wire
- Motors less than ½ HP: 120V, 1 phase, 3 wire

The mechanical control systems will be powered-up by UPS power.

9.16. Electrical Power Monitoring Systems (EPMS)

Complete electrical systems monitoring system (EPMS) provided to monitor all critical and non-critical electrical systems and equipment.

System to operate on a dedicated communications network with redundant power feeds from electrically separated UPS power sources with web based connectivity to remote sites.

Provide connectivity to critical breaker monitoring systems meters and trip units including electrical metering and thermal metering of critical switchgear and breakers.

Provide full integration to all electrical equipment such as, generators, UPS, PDUs, smart cabinet strip, transformers, switchgears, MCC, etc.

The EPMS will report critical alarm and conditions to the BMS.

9.17. Lighting

Illuminance levels - IES Standards as a guideline with adjustments as required for compliance with local energy codes and University of Utah Lighting Design Standards.

Lighting systems will utilize T8 fluorescent lamps and electronic ballasts. Occupancy sensors will be utilized to automatically turn lights off when areas are unoccupied.

All interior fluorescent lighting fixtures will utilize energy efficient, high power factor electronic ballasts.

The finished areas of the building will be illuminated utilizing 2 foot by 4 foot, two lamps recessed fluorescent luminaires.

The battery rooms will be illuminated with suspended fluorescent enclosed and gasketed damp location luminaires located along aisles.

Exterior yards will be illuminated with HID area luminaires. Minimum illuminance will be continuously provided for security purposes. Supplemental illumination will also be provided for servicing of equipment.

Building exterior pathways, roadways, and parking areas will be illuminated utilizing building mounted HID luminaires to levels appropriate for personnel safety and video surveillance.

9.17.a. Lighting Levels

Zone (room) foot candle design criteria:

Average Maintained Foot Candles at work surfaces:

- 50 Offices with paper work intensive tasks
- 42 Computed oriented offices and general purpose computer workstation
- 30 Conference
- 20 Restrooms, mechanical and electrical rooms

Minimum Maintained Foot-candle:

- 10 Corridors, passageways, stairways, store rooms

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

9.18. Grounding System

Grounding will be designed in accordance with NEC and IEEE standards.

An embedded building ground loop system consisting of minimum 500 kcmil bare copper cable and ground rods located outside the Project perimeter shall be provided. The ground loop shall be bonded to building steel and main cold-water pipe. All buried ground loop system connections shall be made through the exothermic welding process.

The ground rods shall be ¾" diameter copper clad steel rods at least 10 feet long and spaced not more than 40 feet on-center.

A #2/0 bare copper conductor shall be installed along the Data Center computer room perimeter, bonded to the raised floor stringer system in 4 foot intervals. The copper conductors will extend 4 feet in each direction, creating a 4 foot copper grid under the raised floor; becoming the signal reference (SRG) grid in raised floor areas. Copper conductors shall be bonded to the raised floor using mechanical fasteners listed for the application.

All grounding connections and fittings shall be UL listed for the purpose.

Pre-drilled copper grounding bus bars shall be provided in all electrical room(s) and below raised floor for grounding connections. The grounding bus bars shall be bonded to the perimeter ground loop.

All the metal conduit, cable trays, metal piping, equipment enclosures, PDUs, RPPs, and ductwork located in the computer equipment areas and in spaces below raised floors shall be connected to the ground bus and the raised floor bolted stringer system.

All substation transformer neutrals, general power transformer neutrals and UPS system neutrals shall be grounded per code. The grounding electrode conductors shall be sized according to the NEC.

A backbone grounding system shall be provided for the IT (telecommunications) room. The backbone grounding system shall be bonded to the electrical grounding system at the service entrance.

A separate green grounding conductor shall be provided with each feeder and branch circuit conduit run.

9.19. Lighting Protection System

A lightning protection system shall be provided in accordance with NFPA Standard 780. The system shall be built by a licensed lightning protection contractor and provided with a UL Master "C" label.

The down conductors from the lightning protection system shall be connected to ground rods provided with the building ground loop system.

Roof mounted air terminals shall be provided with adequate identification and protection to prevent damage to themselves and others.

The lighting protection down conductors shall be bonded to the building ground loop.

Surge Protective Devices will be distributed at multiple levels of the medium and low voltage distribution systems so as to attenuate traveling surges. Surge arresters and TVSS performance criteria will be specified by the Designer for competitive bidding.

9.20. Security

The engineering design will accommodate and incorporate conduit/power to University of Utah standards for the security infrastructure required.

Conduit for camera locations:

- Coverage outside doors, especially the main Data Center Building entrance
- Loading and unloading areas
- Parking areas
- Data center doors
- Circulation (corridors, halls)
- Egress only doors - these doors to have audible alarm and notify security
- Cameras on roof to pan roof.

9.21. Raceways

All raceways shall be sized in accordance with NEC requirements.

All raceways shall be installed parallel and perpendicular to walls, beams and columns.

Concealed conduits shall be installed in Electrical Metallic Tubing (EMT) or Intermediate Metallic Tubing (IMC) unless subject to damage or required otherwise by code.

Conduits exposed to physical damage or installed exterior to building shall be Heavy Wall Rigid Galvanized Steel Conduit (RGSC).

All conduits installed under floor slab or directly buried in ground shall be rigid schedule 80 PVC.

The underground conduits shall be installed 36 inches below grade or below the frost line, whichever is greater.

All branch circuits and feeders supplying any vibrating type equipment (transformers, motors, etc.) shall be installed in flexible metal or liquid tight flexible metal conduit.

The minimum sized conduit for power and lighting circuits shall be ¾ inch.

Telecom raceways shall be coordinated for point of termination and routing throughout the Project areas.

The three hour rated walls of the Temple Street Data Center will require sleeves and seismic connections for all conduits. Consideration of location of support spaces relative to raised floor space needs to be factored into final design.

9.22. Conductors

The 600V conductors shall be copper type THHN/THWN.

The 15 kV conductors shall be copper, type EPR, MV 105, 133% insulation, copper tape shield, PVC jacket.

Conductors for lighting and power circuits will be #12AWG minimum.

Conductor for control circuits will be #14 AWG minimum.

Solid or stranded conductors will be provided in wire sizes #10AWG and smaller.

Stranded conductors will be provided in wire sizes larger than #10AWG.

Stranded conductors will be provided for all connections to motors, transformers and other vibrating equipment.

The UPS/battery DC feeders shall be type DLO.

All the lugs shall be of copper and compression type, two-hole.

All conductors shall be color-coded.

All conductors shall be installed in raceways.

9.23. Receptacles

All receptacles (convenience, GFCI, etc.) shall be minimum NEMA 5-20R, and shall include type circuit labels.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

9.24. Study Criteria

9.24.a. Short Circuit

A Short Circuit Study is required for all circuit breakers and fuses in the Project's critical power system down to the computer room rack level. The intent is that the individual devices are selected to isolate a fault at the lowest level. This type of study determines the magnitude of current available at various points of the electrical distribution system when a fault occurs.

The study provides the information necessary to determine if the circuit breakers and fuses are capable of interrupting a fault, as well as the means of determining whether or not the bus sections of the switchgear are supported adequately to withstand the forces generated from the fault currents.

This study provides the maximum current available to operate an electrical protective device (i.e., Molded Case Circuit Breaker, Low Voltage Power Circuit Breaker, Relays, Fuses, etc.).

9.24.b. Coordination

A Coordination Study is required to determine the proper selection and settings for overcurrent protection devices.

When a fault occurs, it is desirable to interrupt and remove only that portion of the electrical system where the fault is located, leaving the remaining system intact.

This study is required for a coordinated electrical system, from the critical power level down to the Computer Room rack level.

9.24.c. Arc Flash

An Arc Flash Study is required to determine the amount of current that could flow at any point in an electrical system, and the timing required for the nearest circuit protective device to clear a fault.

When an arc occurs, electric current flows between two or more separated energized conducting surfaces. Some arcs are caused by human error, including dropped tools, accidental contact with electrical systems, and improper working procedures. Another common cause of an arc is insulation failure. Other arcs are caused by a build-up of dust, impurities, or corrosion on insulating surfaces that provide a path for the current.

This study is used to determine the required level of personal protective equipment required while servicing components of the electrical distribution system.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

9.25. Testing

A NETA certified electrical testing agency shall be retained to perform testing of electrical systems and equipment. The testing agency shall be independent of the electrical contractor or the supplier of any material or equipment on the project.

Testing shall include but is not limited to the following:

- Inspection and testing of all electrical equipment in accordance with NETA standards.
- Primary current injection testing and calibration of all circuit breakers 100 amperes and larger.
- Thermal scanning of all terminations under load and thermal scanning of all batteries during site acceptance testing.
- Calibration of all meters, instruments. And protective relays.
- Inspection and testing of the grounding system.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

10. Physical Security

10.1. General

Project physical security shall consist of controlled access, intrusion detection, and CCTV. This system shall also be the redundant (secondary) monitoring location for the Project's BMS environmental components (refer to **Section 12** of this BOD). These systems shall be stand alone whether this configuration of spaces is in an existing building.

Monitoring of the alarms shall be at the Project's security office, and Regional facility (another University of Utah Site or third party monitoring service).

During Design, the physical security system shall be reviewed by University of Utah Security and Data Center Facilities.

The Controlled Access System (CAS) shall be made up of the corporate managed system with a department managed partition on the system. This system (CAS) shall consist of proximity card reader technology using corporate issued cards and department issued key fobs. High security areas require corporate installed card readers and biometric hand geometry readers at the perimeter of the high security space. Department issued key fobs and pin numbers shall be used once inside the secured perimeter for specified access points rooms that require additional security.

The intrusion detection system shall consist of the fence monitoring system and flush mounted door position switches, flush mounted triple biased door position switches, tamper switches, dual technology motion detectors (interior), and vibration detectors.

The CCTV system shall consist of digital video recorders, fixed cameras, pan/tilt/zoom cameras, switchers and local workstations.

All control components (access control, BMS, DVR, etc.) must be in tamper resistant, lockable cabinets inside the Data Center CORE.

10.2. Security Objectives

Design Objective

- To provide a manageable and usable comprehensive security system for University of Utah Security.
- To establish a secure site in advance of commencing with Project improvements.

Functional Objectives

- To provide controlled access at the perimeter of the building, between public and staff space and between staff space and higher security staff space.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

- To provide intrusion detection at the perimeter of the building, between public and staff space and between staff space and higher security staff space.
- To provide video surveillance of the site, controlled access doors, perimeter doors, equipment yards, areas and selected rooms.

10.2.a. Space Classifications

Public Space: Location where visitors, vendors and repair technicians sign in to the building. This is a minimal security space that requires public/staff security separations.

Interior Space: General office area that is separated from public space and high security staff space.

Restricted Space (High Security Area): Area requiring security that is higher than the University standard for the building.

10.2.b. Site Access

All points of site access shall be controlled. Means of approach for Design consideration:

- Vehicular
- Bicycle
- Pedestrian

10.2.c. Exterior Signage

Designer shall work with AHJ to provide the minimum – conceal Data Center location.

10.2.d. Building Entrances

Data Center building entrances shall be minimized. The interiors of Project associated controlled access building entrances shall be monitored by the CCTV system. University of Utah Security shall include CCTV coverage of the entrances' exteriors based on higher risk at the doorway.

10.2.e. Exterior Equipment Yards

The University of Utah will enhance site security. A minimum of 2 foot candles in yards is required for CCTV camera video surveillance. See BOD **Section 9** for additional Lighting requirements.

10.2.f. Fencing and Gates

Shall be extended to secure the perimeter of the site. Gates shall be provided for vehicles, bicycles, and pedestrians at the site perimeter. Site perimeter entrances shall be provide

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

for controlled access, similar to building entrances and shall be monitored by the CCTV system.

10.2.g. Concealed Areas

Inside the secure parcel perimeter, all accessible areas shall be monitored.

10.2.h. Exterior Lighting

Provide a minimum of 2 foot candles along the building perimeter and in equipment yards at grade, equipment, facades, doorways, etc., supporting CCTV camera video surveillance.

10.2.i. Hub Points

Shall include, but not be limited to, points of Project connection, often existing, generally outside Project secured perimeters, that integrate Project systems with existing site infrastructure. At a minimum, controlled access entrances into these spaces shall be monitored by the CCTV system.

10.2.j. Equipment Cabinet Security

All support equipment cabinets in the secured and unsecured spaces shall be provided with tamper switches. All support equipment junction boxes that are located in the unsecured space shall be provided with security screws.

Project tamper resistant cabinet screws (hardware) shall be:

- Pinhead Hex
- Pinhead Torx

10.3. Alarm Systems

All building exterior perimeter openings shall have flush door position switches installed that indicate an opening is forced open, left ajar or is in a secured position. For high security areas, door position switches shall be flush mounted, triple biased or high security type.

Each exterior perimeter opening used to access the building shall be protected by door position switches that are normally open; and are the type of switch that will activate when the door is opened.

The security system shall be capable of arming the rooms by a time zone or manually at monitoring locations. The monitoring locations shall **NOT** have the capability to disarm the rooms remotely.

Each high security door shall have latch bolt monitoring to confirm that the door is locked.

Emergency exits shall be alarmed exit-only doors with no exterior hardware. These exits shall have a local annunciation alarm for intrusion or unauthorized exit.

All alarmed openings shall be CCTV monitored. CCTV feeds shall register on the central GUI screen and be recorded.

Loading dock doors, roof hatches and other points requiring extended open periods shall require operator intervention to override door ajar alarms. A message shall remain on the screen, notifying the operator that the door ajar alarm has been overridden. The override shall automatically time out after a University of Utah Security definable time not to exceed sixty (60) minutes.

Hard key override of the card reader system shall produce an intrusion alarm.

Loading dock, garage and overhead doors shall be equipped with contacts and audible alarms that sound when doors are opened after being secured and are being monitored.

Doors leading to roofs, penthouses and exterior to equipment yards, structures, gates, Data Centers or manholes shall be equipped with alarm contacts and high security locking devices and shall be monitored by CCTV.

All security breaches shall initiate a 65 dBA Piezo Annunciator at the Project's security monitoring location, and forward the incident's location identification to the security monitor.

Opening intrusion detection shall consist of the following:

- Latch bolt monitoring (i.e.: Door closed, latch bolt in place = engaged)
- Flush mounted door position switches - triple biased or high security

Arm/disarm card readers shall be separate from the entrance/exit card readers for local control of room intrusion detection points.

Motion detectors shall be located as follows:

- Below raised floors
- Above raised floors and below ceilings
- Above suspended ceilings

Motion detectors will be dual tech type (PIR and Microwave) to minimize false alarms.

Vibration sensors shall be located as follows:

- On Data Center walls
- On Data Center (structural) ceiling

- Below raised floors (on the wall where it is not continuous from slab to slab)

10.4. Controlled Access System (CAS)

10.4.a. General

The controlled access system shall be a dedicated stand-alone security system with connections to the on-site security office, an off-site security office and the University of Utah monitoring location.

Controlled access system shall be capable of the following recognitions:

- Reading standard corporate proximity card containing the corporate identifier and the unique card number.
- Reading department key fob containing the department identifier and the unique card number.
- Utilizing standard biometric hand geometry readers.

The CAS system shall operate on its own communications network that is separate from the building's LAN. When communicating to Campus Security or a third party monitoring station, CAS will share the campus WAN or POTS network infrastructure. There will be no CAS interface to the general building system network or the human resources systems. The CAS system controller shall not default to facility code mode with a loss of power or a break in communications link.

The CAS shall be Windows based and managed "off the shelf" software. The CAS software package options shall include advanced alarm graphics, CCTV interface, digital photo imaging and/or guard tour software.

Complete access control and alarm monitoring workstations or operator software only (for existing workstations) will be provided as follows. Workstation terminals will all be capable of displaying digital photo images.

- One in the existing local security monitoring room for alarm monitoring
- Software only in the DCOC for administration purposes

Locations for controlled access shall include, but not be limited to the following:

- Site perimeter gates
- Selected building perimeter doors (determined during Design)
- Doors separating public from staff areas
- Doors separating staff areas from high security areas

Access control will be provided at designated building lobby entrance doors, for use after hours, and at designated employee entrances accessed 24 hours a day. Opening selection will be determined during the Design phase.

Alarm monitoring using door position switches shall be provided at the following locations:

- Site perimeter gates.
- Selected building perimeter doors (determined during Design)
- All access controlled doors
- Emergency egress doors
- Support spaces (MEP)
- Telecommunications and security equipment locations
- Roof doors, access hatches, smoke vents

Electrified locking hardware shall be equivalent to or exceed requirements of ANSI grade 1, and should be installed by the door hardware installer. Project hardware will be included in the scope of the security system design.

All electronically controlled doors shall have automatic door closers.

Tamper switches shall be provided at the following locations:

- On equipment cabinets in secure and non-secure areas
- For all junction and pull boxes that are outside high security areas
- Tamper resistant screws shall be used on all junction and pull boxes inside and outside high security areas.

The preferred manufacturer for the University of Utah CAS shall be determined during Design.

10.4.b. Biometric Authentication

Biometric readers will be of the Hand Geometry type. Readers shall integrate into the University of Utah controlled access system as another reader on the system.

All locations with the biometric hand geometry units shall also have a University of Utah card reader located adjacent to it. This card reader will be used to verify the identity of the person at the reader, shortening the hand print comparison search time.

The preferred manufacturer for the hand geometry unit is Recognition Systems.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

10.4.c. Card Access

A card reader will read the applied card. The system will proceed to unlock the door and momentarily deactivate the door mounted position switch, providing alarm-free entry. The door will close and lock behind the cardholder and the door position switch will reactivate.

A card reader with combined intrusion detection and electrified hardware fully integrated into the alarm system shall control entry doors. The system will include a card reader on both doorway sides and intrusion detection on the door. In some locations, biometric, pins and/or two (2) staff members will be required by the system.

Card in/out is required for the use/activation of the system's anti pass back feature.

The entrances to all equipment rooms shall be equipped with card readers.

The preferred manufacturer for the corporate card readers, cards, and key fobs is HID, Proximity type, with University of Utah Security's proprietary coding. Proximity technology shall be used for access cards and card readers. Proximity card readers with a pin pad shall be provided on entrances and exits of high security areas such as the Data Centers and DCOC.

10.4.d. Arm/Disarm Card Readers

Disarming the intrusion detection alarms in the DCOC and Data Center shall require a valid department key fob read by one (1) staff member. Arming the alarms shall be accomplished through one of the following:

- Valid department key fob read from one (1) staff member
- A preset time associated with a time zone for the room
- Manually from the remote monitoring locations

The preset time zone arming of the rooms shall be aborted if there is someone in the room. The system shall use the ant pass back feature to determine if someone is in the room, and try to arm in 30 minute intervals.

Disarming the intrusion detection alarms in support areas shall require a valid corporate proximity card read by one (1) staff member. Arming the alarms shall require the following:

- A valid corporate proximity card read from one (1) staff member
- A preset time associated with a time zone or manually from the remote monitoring locations

The preset time zone arming of the rooms shall be aborted if there is someone in the room. The system shall use the anti pass back feature to determine if someone is in the room, and try to arm in 30 minute intervals.

10.4.e. Anti Pass Back

Anti pass back shall be used to track when staff members leave rooms and to shunt door alarms when exiting rooms. Failure to read one's card when exiting shall send an alarm to the security monitoring locations and shall render the card useless until that staff member gets their card reset by the security department.

10.5. Digital Closed Circuit Television (DCCTV)

CCTV shall be installed in spaces noted elsewhere in this Section.

Exterior CCTV camera coverage shall include site perimeter fencing, vehicle and pedestrian entry and exit points, parking areas, loading dock, equipment yards, guardhouses, manholes, vent and Data Center covers, and pole mounted utilities.

Exterior CCTV camera coverage of building features shall include roofs, antenna, entrances, lobbies, exits, docks, exterior vents, louvers and windows, ramps and stairs.

CCTV camera equipment installations shall require:

- All cameras be mounted out of reach to deter vandalism
- All cameras use of feed through camera mounts to protect cabling
- All cameras are hardwired to a power supply. All power supplies shall be hardwired to their power source. Plug-in transformers or power supplies are **NOT** acceptable.

General interior CCTV camera coverage shall include reception desk, staff entrances, and vestibules, and inside all access/egress points. Cameras shall be located outside of perimeter exits that University of Utah Security deems a higher security risk. All cameras shall be positioned to show the faces of people that are leaving the perimeter exit.

Data Center, DCOC, MT and IT Equipment Support Space CCTV camera coverage shall include, but not be limited to all occupied spaces, aisles and rows of managed spaces, and stand-alone cabinets and equipment. Consider providing camera coverage from both ends of aisles and both sides of equipment. Controls, equipment faces and maintenance access and rows of equipment shall be viewed.

Cameras shall be ceiling wall and pole mounted as required for coverage. Fixed cameras are preferred. Cameras shall be pan/tilt/zoom (PTZ) where needed to follow moving persons or vehicles, especially in locations where personnel identification is desirable. All PTZ cameras shall be capable of being remotely viewed, panned, tilted or zoomed by security personnel. All PTZ cameras shall have a pre-programmed default sector of coverage. Only one PTZ camera will be allowed to deviate from its default sector at a time. Sixty (60) seconds of inactivity at the controller shall activate automatic return of the camera to the default sector.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Monitors and Digital Video Recorders (DVRs) shall be provided as components of the CCTV System.

Monitors shall sequence a single view or simultaneously display four views. Monitors shall be 20" minimum for four images or larger monitors that can display nine views at the same time.

All CCTV control and recording equipment shall be secured in the University CORE computer room.

All CCTV images shall be digitally recorded and displayed in real time at the Project's monitoring desks. The regional monitoring facility shall receive an alarm with a link to the camera. The operator will make the decision to click the link to call-up images in real time.

A remote monitoring capability at a regional and global location shall be provided to allow remote monitoring of the CCTV System.

Locate a camera at the exit of a space showing phones and EPO's.

The Digital Video Recording (DVR) system recording is triggered by the DVR's internal video motion detection (VMD) or alarm point triggers. Each camera shall be capable of individually adjusting its VMD settings, but must record 30 seconds of pre-alarm and 60 seconds of post-alarm video.

10.6. Architectural Features

10.6.a. Walls and Partitions

Perimeter walls and room partitions shall extend from slab to slab.

Where perimeter walls of spaces are on raised floors, they shall extend beneath the raised floors. If the perimeter walls are not continuous front slab to slab, vibration detectors shall be required on the interrupted wall sections below raised floors.

10.6.b. Windows

Building windows on the perimeter of the public areas shall be protected. Protection provisions shall be determined during the Design phase with the help of University of Utah Security. Intrusion detection measures may include glazing security films, motion detection enabled CCTV camera monitoring, or other site specific solutions. Window position switches shall be added to operable windows. This requirement does not apply to the existing false exterior perimeter windows.

10.6.c. Doors

Perimeter and high security doors shall be protected with flush mounted door position switches and latch bolt monitoring. Where access control is required, doors shall be equipped with electrified hardware.

Hinges for doors in all high security spaces, their related support spaces and perimeters shall be security hinges or shall be spot welded to prevent the removal of hinge pins. Doors throughout other parts of the Project and/or building shall have security hinges where required.

10.6.d. Opening Protection

All door, window, penetrations, miscellaneous openings, etc., associated with the Project, shall be protected at a level commensurate with space security levels.

Where spaces shall employ "burglar bars" to secure an oversized opening, an inspection door with corresponding locks and tamper switches shall be provided for each opening on the secured space side.

10.7. Design Criteria

In addition to the requirements listed elsewhere in this BOD, notably **Section 3**, the following criteria shall be met.

10.7.a. Table: Security Design Criteria

Space	Security Requirements
Building Main Entrance to Lobby	A valid department issued key fob and pin is required to open the Building Main Entrance door. A valid key fob read and pin from one (1) staff member is required. Provide door opening intrusion detection consisting of the following: door position switch, latch bolt monitoring (i.e.: door closed, latch bolt in place = engaged). Motion detectors shall be located in the Lobby. Adjustable motion detector mounts (gimbals, swivels, etc.) are NOT permitted. Provide an arm/disarm card reader located in the Lobby to disarm intrusion detection and room motion detectors. The need for a manual override on the Building Entrance door shall be determined during the Design phase. Provide fixed cameras viewing entrance to the Lobby and exit from

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Space	Security Requirements
	the Building. Provide duress alarms in the Lobby.
Data Center Lobby Mantrap (DC MT)	Card in/out shall be required for mantrap entry/exit. University of Utah issued access card and biometric hand geometry will be required to enter the mantrap. With the anti pass back feature programmed and activated, a valid access card read will be required to exit the Data Center MT. Provide a fixed camera viewing the entry side of the Data Center MT. Provide duress alarms.
Typical Data Center Entrance	A valid department issued key fob and pin is required to open the Data Center door. A valid key fob read and pin from one (1) staff member is required. Provide door opening intrusion detection consisting of the following: door position switch, latch bolt monitoring (i.e.: door closed, latch bolt in place = engaged). Provide vibration detection on the outside skin (sides and ceiling) of the Data Center enclosure. Detectors shall be located 8'-0" to 10'-0" on-center. If perimeter walls do not extend continuously from slab to slab, vibration detectors are required on wall sections below raised floors. Motion detectors shall be located along the perimeter of the Data Center and IT Equipment Support Space below raised floors and in these spaces (above raised floors). Adjustable motion detector mounts (gimbals, swivels, etc.) are NOT permitted. Provide an arm/disarm card reader located in the Data Center to disarm vibration detectors and room motion detectors. Motion detectors below the raised floor shall remain active. The need for a manual override on the Data Center door shall be determined during the Design phase. Provide a fixed camera viewing exit from the Data Center, showing the EPO and phone. Provide fixed cameras for general equipment aisle views (1 per aisle) inside the Data Center computer room. Provide duress alarms.

Space	Security Requirements
DC ENTERPRISE CORE	Same as above
DC HPC	Same as above
DC COLO	Same as above
Data Center Operations Center (DCOC)	A valid corporate issued access card shall be required for DCOC entry. A corporate access card read from 1 (1) staff members is required. With the anti pass back feature programmed and activated, a valid access card read will be required to exit the DCOC. Provide door opening intrusion detection consisting of the following: door position switch, latch bolt monitoring (i.e.: door closed, latch bolt in place = engaged). Provide vibration detection on outside skin (sides and ceiling) of the DCOC enclosure. Detectors shall be located 8'-0" to 10'-0" on-center. If perimeter walls do not extend continuously from slab to slab, vibration detectors are required on wall sections below raised floors. Motion detectors shall be located along the perimeter of the DCOC below raised floors, inside DCOC spaces (above raised floors and below ceilings) and above suspended ceilings. Adjustable motion detector mounts (gimbals, swivels, etc.) are NOT permitted. Provide an arm/disarm card reader in the DCOC to disarm the vibration detectors and room motion detectors. Motion detectors below raised floors and above suspended ceilings shall remain active. Provide a fixed camera viewing the DCOC entrance and exit, showing the phone. Provide fixed cameras for general views of the DCOC spaces. Provide duress alarms.
Support Spaces (Mechanical, Electrical, etc.)	University of Utah issued access card and biometric hand geometry shall be required to enter these spaces. Provide door opening intrusion detection consisting of the following: door position switch, latch bolt monitoring (i.e.: door closed, latch bolt in place = engaged). Motion detectors shall be located along the perimeter of the

Space	Security Requirements
	support spaces, below raised floors, inside these spaces (above raised floors and below ceilings) and above suspended ceilings. Adjustable motion detector mounts (gimbals, swivels, etc.) are NOT permitted. Provide arm/disarm card readers in the each support space to arm/disarm space motion detectors. Any motion detectors below raised floors and above suspended ceilings shall remain active. Provide a fixed camera, in each space, viewing space exits and phones. Provide fixed cameras for general views of each space.
Equipment Yards	Yard perimeter intrusion detection shall be a fence alarm system. Enclosed equipment shall have door position switches on enclosure doors and tamper switches on panels. Provide CCTV cameras, viewing Yards in their entirety, that are programmable with video motion detection for alarm call-up.
Perimeter Enclosure and Gates	Perimeter Enclosure intrusion detection shall be a fence alarm system. Gates shall be full panel, swinging or sliding security gates and shall have door position switches and tamper switches. Provide CCTV cameras, viewing perimeters in their entirety, that are programmable with video motion detection for alarm call-up.

10.7.b. Exterior Equipment Intrusion Detection Criteria

Generator Enclosure intrusion detection shall consist of the following:

- Door position switches on all operable doors
- Tamper switches on all removable panels
- Exterior detection system mounted on fences

Fuel oil intrusion detection will include the following on sump manholes and fill port/fill station lids:

- Explosion proof door position switches
- Special locking bolts

Cooling tower intrusion detection shall consist of the following:

- Exterior detection system mounted on fences

All door position and tamper switches shall be the normally open types. Where available, they shall have integrated resistor packs for line supervision. If integrated resistor packs are not available, a separate resistor pack shall be used.

All motion detectors and acoustical glass break detectors shall have a separate resistor pack for line supervision.

10.8. Sequences of Operation (SOPs)

10.8.a. Building Entrance Lobby Mantrap (Data Center MT)

Entry into the Data Center MT and then the Data Center shall require the following:

- A valid University of Utah proximity card read and a valid hand scan by two (2) staff members to enter the mantrap
- A valid department key fob read and a valid pin from one (1) staff members to open the Data Center door
- If opening an Equipment Support Space door is necessary, a valid University of Utah proximity card read by one (1) staff members is required

Although the doors will be fail secure and allow free egress, exit from the Buildingr and Mantrap shall require the following:

- A valid University of Utah proximity card read at the mantrap door.

10.9. Security Operation Procedures

University of Utah Security developed and implemented the Procedures.

The physical security devices and equipment listed in this **Section** of the BOD are only part of the equation for securing the spaces of this Project. The basic architecture of the building along with what University of Utah Security shall defined operational procedures are required. The following is a list of operational procedures that have been identified for this Project:

- Anti Pass back
- Response to Alarms
- Response to Attempted Access by Unauthorized Staff
- Visitor/Vendor Escort

- Verification of the staff in the room if the automatic time zone arming does not take place
- Operator Override of Door Ajar Alarms
- Arming/Disarming secure areas

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

11. Communications

11.1. General

This Section of the Basis of Design (BOD) will provide the criteria requirements for the network architecture as it pertains to the required core, distribution, and access layers of the network and the requirements for all other IT technologies, such as LAN/WAN/SAN, Mid-range systems, Open Systems (Wintel, UNIX), Storage systems, Backup systems, and Telephony.

This document will provide the criteria requirements for the network infrastructure as it pertains to all physical cabling systems and components that will be deployed throughout the data processing areas of the Project.

11.1.a. Objectives

Coordinate Project issues affected by Technology planning, including MEP support, space planning, redundancies, workflow analysis, procedures, and equipment planning.

Emerging Technology. Technology is dynamic in a data processing environment. Project technology planning will anticipate and accommodate emerging technology trends in critical facilities.

11.1.b. Assumptions

The Technology Systems scope encompasses all typical technology infrastructure and architecture systems and components usually deployed within critical data center facilities.

Technologies should be equal or exceed what is currently deployed throughout University of Utah's existing Data Center Environments.

IT systems are dynamic, continually changing. **The Designer shall validate the contents of this BOD Section against the latest Univeristy of Utah Data Center Wiring Standards and industry innovations, and shall reconfirm requirements for move-in and/or future occupancy.** Flexibility, scalability and future-proofing are resultss of successful IT planning and design efforts.

Proposed technology infrastructure/architecture systems and/or components should be commercially available beyond move-in.

Technology systems will be physically and logically secured. The public will NOT have access to the Project site.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

11.2. Table: Codes and Standards

Reference	Description
(x)E C	(Site) Electrical Code
NFPA 70-2005	National Electric Code
BICSI TDMM	Telecommunications Distribution Methods Manual
BICSI NDRM	Network Design Reference Manual
ANSI/TIA/EIA	American National Standards Institute / Telecommunications Industry Association / Electronics Industries Alliance
ANSI/TIA/EIA 568 B	Commercial Building Telecommunications
ANSI/TIA/EIA 569	Commercial Building Standard for Telecommunications Pathways and Spaces
ANSI/TIA/EIA 606	Administration Standard for Telecommunications Infrastructure of Commercial Buildings
UL 60950	Safety of Information Technology Equipment
UL 1950	Standard for Safety of Information Technology Equipment
UL 1459	Standard for Safety of Telephone Equipment
IEEE 802.1	Telecommunications and Information Exchange between systems – common specifications
IEEE 802.3	Telecommunications and Information Exchange between systems – access method and physical layer specifications
IEEE 802.11	Telecommunications and Information Exchange between systems – wireless LAN
IEEE 802.15	Telecommunications and Information Exchange between systems – wireless personal area networks
IEEE 802.16	Telecommunications and Information Exchange between systems – air interface for wireless broadband

11.2.a. Definitions

- **Technology Infrastructure**: Structured cabling to support identified Technology systems. Cabling infrastructure shall consist of all backbone fiber and copper cabling, plus Cat-6a UTP horizontal cabling. Other components include patch-panels, copper/fiber patch-cords, faceplates, jacks, horizontal/vertical cable management systems, cable tray systems, 2-post racks, and 4-post racks/cabinets.
- **Technology Architecture**: Network Switches, Routers, Firewalls, Intrusion Detection Devices, VPN Appliances, Access-Servers, Load-balancers, etc.
- **Data Communications**: Network Electronics: Hubs, routers, and switches for the LAN. Includes access switch layer, boundary switch layer, and core switch layer to support the Project.
- **Telephone System**: PBX based system with trunk service from local Telco and/or existing client systems. May be Voice over Internet Protocol (VoIP).
- **Audio/Visual**: Broad category consisting of video conferencing, projectors, screens, speakers, and associated cabling and equipment.
- **Master Clock**: A single source where all associated clocks receive the same synchronized time signal. May be an electrical or IT based system.
- **Wireless Data**: Network interface to access layer LAN switch using wireless radio frequency. Can include PDAs, PCs, and other devices.
- **Cable Management System**: Software and methodology based system utilizing construction documents to manage adds, moves, and changes post move-in.
- **Cable Support System**: System of raceways consisting of cable trays, conduits, bridal rings, and communication rooms used to support the cabling infrastructure.

11.2.b. Cabling Infrastructure

Infrastructure shall follow industry standard codes & guidelines (NEC, TIA/EIA, etc).

Structured cabling will support all Project technology systems.

Cabling infrastructure will be generic, supporting multi-product, multi-vendor environments. Designer shall explore cabling integration for cost & operational savings.

IT will be designed, managed, and operated as a utility.

The quantity of ports that are active will depend on need at move-in.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

11.3. Design

11.3.a. Scope

Project IT designs for support of information technology systems are generally based on Electronic Industries Association and Telecommunications Industry Association (EIA/TIA) guidelines. Computer room design shall incorporate the following concepts of information technology systems and facility IT design:

- Information technologies transport signals. This scope includes all information conveying low voltage systems, such as voice and/or data systems with associated electronics (i.e. network hardware, computing devices, tape backup systems, disk storage systems, etc).
- Technology infrastructure shall support other Project systems, such as BMS, power monitoring, etc.
- Project IT systems shall accommodate existing or newly proposed University of Utah controlled facilities.

11.3.b. Enabling Projects

Modifications to any commissioned site that impacts existing configurations, support systems (power, cooling, etc.), or operations are considered "enabling projects". The following lists related possible projects:

- Modifying existing MDF/IDF equipment areas
- Modifying existing Telco/NetPop equipment areas
- Modifying existing Mechanical/Electrical (support) spaces and/or systems
- Modifying existing Data Center spaces
- Modifying existing IT/Network systems, applications
- Modifying existing technology infrastructures (backbone/horizontal cabling systems)

11.4. Space Characteristics

11.4.a. General

The information technology infrastructure will consist of cabling and space to terminate cabling and house equipment. The cabling will follow the tenants of a structured cabling system to provide a vendor-neutral network transport.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Levels of Project IT resiliency, availability, and continuance shall be commensurate with University of Utah requirements to mitigate business, technology and facility risks and/or operational models.

Deploy IDFs within the Project areas to provide an aggregation point for all horizontal cabling from server cabinets. The IDF shall be racks (not physically segregated) within the Data Center.

Existing building equipment rooms shall be provisioned with equipment racks, plywood backerboards for panel & punch-down block mounting, accessible grounding, UPS power, static free flooring, no ceilings, cable tray systems, and 24x7x52 cooling.

The following are specific criteria/requirements for areas of the Secure Hosting Environment. Refer to **Sections 3, 10** and **13** of this BOD for additional capacities, securities, and shieldings not listed herein.

11.4.b. "White Space"

Raised floor data processing space to be equipped with backbone and horizontal cabling infrastructure systems/components for a practical and workable set of technology solutions.

Clear height (top of finished floor to under ceiling or structure) shall be a minimum of ten (10) feet.

Purpose: To house IT/Network technology systems. This space shall be engineered and configured similar to a typical data center "white space".

Cabling: Infrastructure will consist of backbone fiber and horizontal Cat-6a UTP cabling systems within and between racks, as well as between racks and the MDF line-up row.

Equipment: Network core, distribution- and access-layer systems required to provide network communications services within the white space; IT server systems deployed in data cabinets; required tape backup and/or disk storage systems; panels, cable terminations

NO wireless network access points shall be installed inside the white space.

Shielding: Prevent ingress/egress of wireless transmissions.

11.4.c. Data Center Operations Center (DCOC)

Provide a network switch in the DCOC for network connectivity. Inner duct shall be placed between the DCOC and the white space.

Purpose: To provide raised floor operations space for approximately five (5) University of Utah personnell.

Location: Adjacent to the data center.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Cabling: Provide one (1) fiber-optic inner duct and cable between the MDF and the DCOC, connected to one (1) Ethernet switch in the DCOC for network tie-in; five (5) Cat-6a jacks/faceplates-terminating voice UTP cables.

Equipment: Ethernet switch & telephone sets (details, quantities to be determined during Design)

11.4.d. Other Spaces, Criteria

All technology spaces should be equipped with a grounding bar and/or grounding system to properly provide grounding paths for cable trays, cabinets, racks, etc.

The following may be included in the Project areas:

Communications Rooms (typical)

Minimum **recommended** size for any communications room is 8-foot by 10-foot.

Room door should be a minimum of 7 feet high by 3 feet wide, 4 foot wide **recommended**, with an outward swinging door activated by key fob and/or card read.

Recommended flooring over sealed concrete slabs shall be static dissipative (ESD) vinyl tile.

Cover all wall surfaces on the inside of the space with (nearly) full-height, painted ¾ inch fire retardant (finished grade) plywood.

Staging/Build Area

Will consist of Racks/Cabinets adjacent to the white space, providing a location to build, test, burn-in equipment. Designer to coordinate cabling and equipment needs with University of Utah (details, quantities to be determined during Design).

Multiple Points of Presence (POPs)

White space shall NOT include Multiple Points of Presence (POPs) spaces/areas/room that terminate service provider cabling. Provide two (2) 4 inch conduits in the white space, each terminating at opposite ends of the white space for direct cabling paths in/out of the white space to POPs.

Meet-me Room/Location

Will consist of Racks/Cabinets adjacent to or within the white space, providing a location to interconnect collocation tenants with each other's networks. Designer to coordinate cabling and equipment needs with University of Utah (details, quantities to be determined during Design).

Network Core Area (MDF)

Will consist of Racks/Cabinets in the white space, providing network layer-2/3 switch/router/firewall equipment. The MDF will be the aggregation point for all Distribution switches deployed throughout the white space. The MDF shall serve as the centralized copper/fiber cross-connect point for all LAN, WAN and SAN services, and the termination point for all copper/fiber tie-cabling to other existing building technology spaces.

There will be one (1) MDF line-up equipment row in the white space, serving as the core for all technology infrastructure/architecture systems.

All backbone riser cables (copper and/or fiber) will be "trunked" back to the MDF core/s.

IDF

Deploy (multiple) IDF racks/cabinets throughout the Data Center, serving as network infrastructure/architecture aggregation points. Quantities, locations, configurations, etc. shall be in line with University of Utah Standards and technology systems.

Network Distribution Areas

Will consist of Racks/Cabinets in the white space, providing the aggregation point for all network access layer switching systems and/or horizontal fiber/copper cabling systems used in the . The network distribution switches will be connected to the core network switches at the MDF via "trunked" fiber-optic cabling consisting of 50um/125 multimode fiber cabling. Complete network distribution details will be determined by the Designer and University of Utah during Design.

Network Access Areas

Will consist of Racks/Cabinets in the white space, serving various computing systems (i.e. servers, mainframes, etc). The access layer switches can be located within server cabinets and/or in network distribution cabinets/racks. Complete network access details will be determined by the Designer and University of Utah during Design.

SAN Frame

Shall provide a centralized cross-connect point for all SAN connectivity in the white space. This cabling will consist of 9um/125 single mode fiber optic cabling. SAN cabling, details will be determined by the Designer and University of Utah during Design.

Distributed Servers

Will be installed in Racks/Cabinets that accommodate 1U/2U rack-mount server systems and/or blade server systems. The racks/cabinets will be configured in line-up rows that do not exceed ten (10) continuous racks without a space break. University of Utah will provide specific rack/stack methodologies and plans that outline specific server densities for each cabinet/rack and/or each server line-up aisle in the . Each server rack/cabinet within the

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Data Center shall be supported by a rack and/or series of racks, consisting of multiple racks/cabinets, path-panels, and switching hardware, formulating an IDF inside the white space.

Server Line-up Rows/Cabinets

Design considerations for the rows/cabinets are as follows. University of Utah shall provide final requirements during Design.

Each server cabinet shall consist of two (2) 24-port Cat-6a patch-panels, configured as A and B panels that will provide two (2) distinct and separate paths back to network PODS and/or Distribution areas. This design requires 48 Cat-6a horizontal cables to supply each server rack/cabinet with 10/100/1000 Ethernet network connectivity across all cabinet-installed IT systems.

- Each server cabinet shall consist of two (2) 6-strand/12-strand multimode fiber cables. This design provides each server cabinet with two (2) 48-port 10/100/1000 Ethernet access layer switches. This eliminates large volumes of horizontal cabling between the server cabinets and Network PODS and provides for optical trunking paths between the access layer switches and POD distribution switches. This design shall provide 10/100/1000 Ethernet network connectivity to all cabinet bound IT systems.

Tape Systems

University of Utah IT "Backup" personnel will provide specific requirements for the Tape Backup system cabling infrastructure.

Storage Systems

University of Utah IT "Storage" personnel will provide specific requirements for the Storage system cabling infrastructure.

Room and Grid Identification

University of Utah IT and/or Facilities team will orient and label grids throughout Project white spaces. It is **recommended** that an alphanumeric grid be referenced by Design teams' construction documentation.

11.4.e. Space Relations

Installing cabling and IT/Network equipment should not disrupt surrounding spaces, systems, and/or occupants.

Refer to BOD **Section 10, Physical Security**, for protection criteria not discussed herein.

The IT Designer shall verify all cross-referenced information technology system and component data with other Project Design efforts during Preliminary Design.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Consideration must be given to building access and circulation for equipment handling. Opening sizes shall be considerate of the largest shipping splits, horizontal circulation (corridors, ramps, motion enabled walks, etc.) should be finished with durable floor finishes and/or wall mounted impact protection (bumpers, rails, cornerguards, etc.). Vertical circulation (stairs, ramps, lifts, elevators, etc.) shall be evaluated for cab size, loading capacities, availabilities, etc.).

11.5. Systems Design

11.5.a. Assumptions

All technology infrastructure distribution systems will follow the tenets of a highly structured cabling system.

A horizontal pathway will be provided between all server cabinets and the Network Pods, MDF line-up rows, and/or all equipment communications rooms. A horizontal pathway will be provided between workstation areas located within the DCOC, Mechanical/Electrical, and Staging Area spaces to the appropriate MDF line-up row, other existing data center spaces, or other existing equipment rooms.

A horizontal pathway facility may consist of several components including cable tray, inner ducts, conduits, under and/or overhead support systems, raised floor, ceilings and perimeter systems.

A backbone cabling system will be provided between the IDF and MDF cabinets in the . The backbone cabling systems will consist of fiber-optic cabling to provide network pathways between the network core and distribution network hardware systems.

The MDF line-up row in the will serve as the network core for the and will be the centralized point where all network distribution and access layer switching is aggregated. The MDF line-up row will also serve as centralized cross-connect point for all technology infrastructure systems deployed within the .

The MDF line-up row will consist of other copper and/or fiber-optic backbone tie cabling that may be installed into other equipment rooms and/or existing site white spaces.

There will be two (2) 4-inch conduits installed into the that will serve as the primary pathways for all cabling traversing from outside, into the . These two (2) conduits should be located on opposite ends of the for adequate levels of pathway redundancy. These conduits should be installed at the slab level underneath raised floors.

The technology design for the Project should provide infrastructure that meets "fault-tolerant" design guidelines for continuance, reliability and recoverability for all IT/Network systems, applications, and components.

All technology equipment (e.g. switches, servers, firewalls, etc.) will be provided by University of Utah. All backbone and related equipment (racks, power strips, patch

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

panels, etc.) will be provided by installation contractor. Designer to coordinate with University of Utah.

11.6. Cabling System Infrastructure

11.6.a. Main Point of Entry (MPOE)

It is **recommended** to place the building entrance facility within a server room and/or communications room.

A second building entrance facility for redundancy is required.

Locate the building entrance facility along the interior side of a perimeter wall.

5 cabinets and 2 racks in each MPOE.

A minimum of two 4-inch conduits from a designated manhole should penetrate from below the finished raised floor.

Conduits should terminate in a minimum 48-inch high by 48-inch wide by 12-inch deep NEMA rated enclosure equipped with a double-hinged lockable door secured to the interior side of a perimeter wall.

Extend a minimum of two (2) 4-inch conduits from the enclosures to the .

A building ground should be installed within all enclosures.

11.6.b. Risers

Minimum schedule of 4-inch conduits to be installed within a typical building between the building entrance facility communication rooms is as follows:

Number of Rooms	Number of Conduits	Number of Communication Outlets Supported
Up to 2	2	1 to 50
3	3	51 to 200
4	4	201 to 350
5	5	351 to 500

All conduits entering from overhead or below slab should penetrate 3-inches, adjacent to a wall and be fitted with a protective plastic bushing on both conduit ends.

All directional changes in conduit runs should be gradual. A minimum 36” sweep is required for all 90-degree turns. The total aggregate of directional changes should not exceed 270-degrees. A pull box should be installed if this requirement cannot be met.

11.6.c. Horizontal Pathway

Minimum ¾" conduit from the communications outlet should be attached to a cable tray with a protective bushing installed at both ends. 1" conduit is preferred.

Cable tray should be a minimum of 4-inches deep by 24-inches wide, NEMA class 12a, constructed of aluminum.

Cable tray should be grounded per National Electric Code.

Cable tray should terminate at a 5-inch radius drop-out located 3 inches below the finished ceiling and against a wall in the communication or server room.

Cable tray support hardware should be installed at a maximum of 8 foot intervals allowing support of up to 113 pounds per linear foot.

Locate cable tray in corridors wherever possible in order to avoid furniture and work areas so that access to the cable tray is unencumbered.

Locate cable tray below all other items above, ceilings, ducts, piping, supports, etc.

11.6.d. Distribution System

University of Utah will negotiate with the appropriate telecom carriers to procure sufficient fiber optic connectivity to the Data Center site.

University of Utah will deploy fiber-optic inner-duct systems between other required technology areas within any proposed Data Center site (i.e. existing data centers, equipment rooms, etc). The technology design intent assumes all chosen Telco carriers will enter the conduit system via client-provided conduits so that each Telco can extend their services to the appropriate Demarcation points within the and/or any other designated client technology spaces (data centers, equipment rooms, etc).

Cabling among the technology spaces will be achieved and/or supported via a combination of under floor cable trays, overhead ladder racks, fiber raceway systems, and 4-inch conduits.

The cable distribution system should allow for reasonable flexibility – within technically viable bounds – to accommodate moves, adds, and changes and provide adequate level of path separation, continuance and recoverability.

11.7. Design and Installation Considerations

11.7.a. Layout/Provisioning

Consider the use of conduits and/or inner ducts. Provide a minimum of two 4-inch EMT conduits in and out of the .

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

Conduits should contain a pull-string for installing future information technology media.

Provide as a baseline standard 19-inch racks for all network equipment and/or terminations.

Provide as a baseline standard 48U, 28"x 48" cabinets for housing IT equipment within the white space.

Provide a means for vertical and/or horizontal cable management for all racks and cabinets deployed within the data center space.

Consider ladder rack for any required riser cabling management (if required).

Provide cable tray for all backbone and horizontal wiring located. There should be two (2) cable tray systems installed to accommodate copper and fiber-optic cabling so that copper and fiber cabling are completely separated. Use ladder and/or basket for supporting copper horizontal UTP cabling and fiber raceway for supporting all fiber-optic backbone cabling systems.

Provide pull boxes in the conduit systems for easy installation of information technology media and to maintain any required bend radiuses.

Locate racks/cabinets so that equipment can be easily installed and serviced both from the front and back of the racks/cabinets.

Provide at least 4-feet of space between the fronts of the cabinets (cold isle) and 4-feet of space between the backs of the cabinets (hot isle).

Supply storage shall not occur within the .

Provide at least one (1) telephone in close proximity to the server line-up rows within the .

11.8. System Architecture

11.8.a. Definition

The Technology Architecture consists of the required IT and Network systems/applications that enable end-to-end signal processing activities throughout the Data Center. "Technology Architecture" does not encompass the technology infrastructure systems and components, as that deals specifically in the areas of physical cabling infrastructure items (i.e. cabling, patch-panels, patch-cords, connectors, jacks, faceplates, racks, etc).

Technology Infrastructure will refer to all IT/Network systems that will be deployed throughout the Project white space.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

11.9. LAN (Local Area Network)

The Local Area Network (LAN) deployed in the will consist of core, distribution and access-layer hardware that will make up the backbone network architecture within the raised floor white space. Each designated area (Core, HPC, HPC Enterprise Core and Colo) has it's own unique "white space" (refer to section 11.4.b) for LAN design considerations.

LAN design shall occur during Design, with University of Utah.

The LAN architecture in the (s) will consist of the following:

- LAN Core
- LAN Distribution
- LAN Access

The Local Area Network (LAN) will consist of the following design criteria:

- Consists of core, distribution, and access layer switches to support data, video, wireless, and/or telephony.
- 10 GB in the core with 100% IT ports engineered as 1GB.
- Chassis, Power, and Supervisor Engine redundancy is assumed.
- Provide adequate Firewalls, Intrusion Detection Devices, and Remote Access systems are anticipated.
- The LAN should be deployed as an extension of the overall client backbone network architecture.
- Ethernet switch port counts should be based on cabling infrastructure port count requirements within the . Assume that 80% of LAN ports are active at move-in.
- Mesh architecture minimizing and/or mitigating all single points of failure.
- Dual paths over diverse geographical routes for LAN connectivity.
- VPNs will be utilized at the access layer for segmenting specific systems/applications.
- Backbone network connections shall consist of fiber optic cabling with dual paths.
- Horizontal IT connections shall consist of Category-6 UTP cabling deployed as separate A and B systems (patch-panels) within each server cabinet. The exact cabling counts have not been finalized and are to be coordinated/verified with University of Utah.

11.9.a. LAN Core Layer

The LAN core should consist of two (2) enterprise switches that are both equipped with dual power supplies and supervisor engine modules.

The LAN core should be deployed at the MDF line-up row in the and will represent the "core" for all network connectivity in and out of the white space. All high-level switching/routing functions will occur at this layer with simplified layer-2 switching and/or layer-3 routing tables. This network core area will provide for the aggregation point for all distribution and access layer network connectivity within the white space, as well as the aggregation for all WAN connections in and out of the .

11.9.b. LAN Distribution Layer

The LAN distribution layer will provide for intermediate layer-2 and/or layer-3 area between the core and all access network switching systems deployed throughout the . For connectivity to the core, this will consist of dual fiber-optic paths deployed either as layer-2 trunks and/or layer-3 routed connections. Final network design will occur during Design with assistance from University of Utah.

Since the connections to the core are anticipated to be layer-3, there should be no requirements for spanning VLANs between the core and distribution network layers. VLANs would be managed and/or distributed between access-layer switch hardware and the distribution switches.

It is anticipated that the network distribution switches will be located at IDFs that are deployed in close proximity to the server line-up rows, or deployed within or at the ends of the server cabinet line-up rows. It is anticipated that the network distribution switches will be deployed within the server line-up rows. If this is the case, all access-layer switches deployed within the server cabinets would be aggregated back to the distribution switches deployed within each server line-up row.

11.9.c. LAN Access Layer

The LAN access layer will provide the network connections/ports for all IT systems deployed throughout the white space. It is anticipated that access switches will be deployed in one of two design models:

- (Scenario-1): Access-layer switches deployed in each server cabinet with each switch "trunked" back to the distribution switches via fiber-optic cabling. All Cat-6a UTP cabling would be cross-connected within each server cabinets with no requirements for UTP cabling leaving any of the server cabinets.

- (Scenario-2): Access-layer switches deployed at the ends and/or within the server line-up rows. This would require that all Cat-6a UTP cabling installed within each server cabinet be ran to wherever the access switches are deployed (i.e. ends of server line-up rows and/or within the server line-up rows). This design would require additional amounts of UTP cabling than scenario-1, which would also require larger and more robust copper cable support systems.

It is anticipated that all traffic between the access and distribution layer switches will consist of layer-3, with the access switches configured to manage VLANs and perform layer-3 routing within a single switching platform. It is important to extend layer-3 routing capabilities to the network edge in order to provide higher-end routing functionality for even higher service delivery models.

Connectivity between the access and distribution network layers should consist of dual optical paths with each consisting of multi-Gigabit connections. The access layer should always be deployed in pairs in order to provide for path redundancy and high levels of availability and continuance.

11.10. Telephony

The telephone system/s deployed at the proposed Data Center site could consist of legacy-type circuit-switched PBX systems, or the systems could consist of more modern VoIP systems.

Since telephony technologies are continuously evolving and with the advancements of VoIP technologies and systems, it should be anticipated that any telephone systems deployed at the proposed Data Center sites should be capable of delivering basic telephone services within the hybrid PBX/VoIP spectrum. If the systems deployed are not 100% VoIP, they should consist of hybrid systems that offer both legacy circuit-switched types of telephone services as well as current VoIP capabilities and/or a roadmap for migrating to VoIP.

11.10.a. Voice over IP

It is anticipated that there will not be a dedicated VoIP communications system deployed at the . However, there are requirements for telephone sets within some of the work areas and it is anticipated that these will consist of whatever is available and/or deployed within the rest of the site.

Figure: Typical VoIP Network Configuration

The use of Voice-over IP with in the proposed sites could lower the cost of cabling required to service the facility, but it will increase the cost of the network components.

Even thought current plans call for not deploying a dedicated VoIP system in the , the local area network should be engineered to anticipate and/or accommodate an IP Telephony implementation within the proposed data center facilities.

The basic requirements include:

- Provide Power over Ethernet from the network access and/or distribution switching systems to provide power the VoIP telephone sets. This prevents the client users from having to deploy separate power supplies wherever VoIP telephone sets are deployed within the facility.
- Provide network switches capable of Layer-2 and/or layer-3 policy-based Quality of Service (QoS).

11.10.b. Telephony Design Criteria

The Telephone system for the Data Center location should be capable of delivering both circuit-switched and/or VoIP telephony services.

IP enabled PBX switch, modules, cabinets, processors, and servers located in data center space.

Telephony features specifications should include voicemail, E911, unified messaging, and basic PBX-type features/functionality.

PBX switch will include redundant processor and battery back-up

Any required trunk lines delivered by the local Telco would most likely consist of digital trunks.

Alternate System Scenarios

Analog PBX with trunk lines from Telco
POTs lines from the local serving Telco with Analog telephone sets.

11.11. Technology Infrastructure

11.11.a. Definition

The Technology Infrastructure deployed within the Data Center consists of all cabling infrastructure systems and components that enable end-to-end signal processing activities throughout the .

It should be understood that this area only addresses the physical cabling infrastructure systems and components required providing the physical cabling/network paths throughout the white space and does not speak to the required IT and/or network systems/applications required to transport data across the physical cabling medium.

11.11.b. Technology Design Intent

The Technology Infrastructure deployed within the Data Center should be consistent with typical, industry-standards and best-practices for planning, designing, and constructing critical technology infrastructures deployed within today's high-profile data center operations.

11.11.c. Cabling Infrastructure Systems / Components

Racks

Cabinets

MDF Line-up Row/s (Network)

MDF Line-up Row/s (SAN)

Network Pods / IDF Racks

SAN Pods / IDF Racks

Network Backbone Cabling (Fiber/Multimode)

Network Horizontal Cabling (Copper/Cat-6a UTP)

SAN Backbone Cabling (Fiber/Multimode/Singlemode)

SAN Horizontal Cabling (Fiber)

Patch-Panels

Patch-Cords

Cable Management (Horizontal/Vertical)

11.11.d. Technology Infrastructure Support Systems

Cable Tray System (Copper)

Cable Raceway System (Fiber)

11.11.e. Power Infrastructure / Systems

UPS

PDUs

Power Distribution Panels

Power Whips

Rack/Cabinet Power Strips

11.11.f. Technology Spaces

LAN Core Layer

LAN Distribution Layer

LAN Access Layer

WAN Core

WAN Firewalls / Content Management / VPN Appliances / Remote Access Systems

SAN Core

SAN Distribution

Network Monitoring Systems

Application Monitoring Systems

Mid-Range Systems (Unix)

Servers (Wintel)

Servers (UNIX)

SAN Network Line-Up Row/s

SAN Network Pods/IDFs

Storage Systems (Disks)

Tape systems (Libraries)

11.12. Cable Plant Distribution Model

University of Utah's cable plant design will follow an industry-standards model.

All fiber optic and/or copper cabling feeds to the will traverse via 4-inch conduits placed underneath the raised floor within the white space. There may be other conduits and/or cables installed that traverse between the space and any existing client data centers and/or equipment rooms. The exact cabling infrastructure design will be somewhat dependent on the overall site itself as to whether it is deployed within an existing facility and/or data center.

As for the support spaces (i.e. DCOC, Mechanical/Electrical, and Staging Area), cabling will be installed to accommodate the specific requirements of each support space. Voice cabling will traverse between the support spaces and the existing corporate equipment rooms, unless the site is a new stand-alone facility. Data cabling will traverse between the support spaces and the existing corporate equipment, with the exception of the DCOC space where a dedicated fiber run and switch will be deployed.

All backbone cabling within the white space and/or between the DCOC and existing data center/corporate equipment room will consist of fiber-optic, multimode, 50/125um cabling. There may be requirements for additional SAN fiber cabling and there could be requirements for both singlemode and multimode fiber-optic cabling to support that network and/or devices. All backbone cabling for network and/or SAN should consist of dual and separate pathways.

All horizontal cabling deployed within the white space should consist of category-6 UTP copper cabling and should be terminated onto category-6, 8-pin RJ-45 jacks and/or category-6 path-panels. Horizontal cabling terminated into the server cabinets will consist of A & B path-panels in order to provide diverse and redundant network connections for all servers deployed throughout the white space. This horizontal cabling will be terminated at IDF and/or NetPop cabinets on the opposite end.

11.13. Cable Support

Cable trays and/or raceways installed to support all low voltage cabling.

Horizontal copper cabling shall be supported by a cable tray system (ladder and/or basket)

Fiber backbone cabling shall be supported by "raceway" system (i.e. ADC and/or Panduit).

If the cable tray system is installed underneath the raised floor, this system should be extended to the operational support spaces (i.e. DCOC, Mechanical/Electrical, Staging Area) to accommodate cabling requirements for those areas. If the cable tray is installed overhead, it is also anticipated that some levels of cable tray will also be installed over the support space offices. For the overhead system, the use of J-hooks to support cabling as it leaves the overhead tray system may be required.

Outside cabling shall be supported by a system of two (2) 4" conduits, 4" conduit sleeves, and/or inner duct.

Cable tray and/or raceways shall be grounded per code.

Alternate System Scenarios:

Horizontal cabling infrastructure for operational support areas installed completely in conduit/s.

Multi-layered ladder/basket system to support copper UTP, fiber, and electrical/grounding cabling systems.

Coordinate cable tray types and installation requirements (overhead vs. underneath the raised floor)

Coordinate separate support systems for horizontal UTP and fiber backbone cabling.

Coordinate installation methodologies for separating copper and fiber cabling, cable tray and/or raceway locations with floor plans.

11.14. Communications Pathways

The technology Design team will design the communication pathways according to the following criteria. Cable trays will be provided throughout the Project for cable routing. This cable tray will be shared with the various low voltage systems, including security, BMS/BAS, and CATV cabling as part of the structured cabling system. In general, cable tray systems will be deployed overhead within the Secured Hosting Environment to provide adequate support all cabling systems and to minimize the impact on facility operation when future moves, additions, and changes occur.

Cable tray will be sized according to capacity and projected expansion and is expected to include 24", 18", and 12" tray, depending on cable density in a particular area. Cable tray located in hallways will be "ladder-style" tray with side rails approximately 4" in height.

Dual-gang boxes with single gang mud rings will be provided at each communications outlet location. From each communications outlet location, a minimum of 1” conduit will run up the wall and terminate at the ceiling, where the cable will then be supported via J-hooks (cabling supports) back to the closest cable tray (typically located in a hallway, as indicated above).

No length of conduit shall exceed 150-feet when used for communications cabling and shall not contain more than two 90-degree bends without a pull box. In addition to this requirement, a provision will be made that all conduit bends must accommodate future fiber optic installations. A maximum of 40% fill will be maintained on any conduit run to ensure that future expansion space is maintained.

Communication rooms will be vertically stacked directly above each other. Each communication room will be connected with sleeves between each floor in order to run backbone fiber optic, copper, and coaxial cable through the facility. Conduits will be run directly between communication rooms and cabling will not be exposed in sleeves unless the cabling terminates on the floor.

11.15. Racks / Cabinets

There will be two (2) distinct types of racks deployed within the for Network racks and Server racks as follows:

Network Rack – Synaptix (Electrorack), 45U, 24-inches wide, 46-inches deep, and 88-inches in height.

Server Rack – Synaptix (Electrorack), 47U, 24-inches wide, 47.25 inches deep, and 88.87 inches in height.

The MDF line-up row will be made up of the network racks, with the server cabinet line-up rows being made up of the server racks.

The network racks will be utilized to house the network switch core hardware, as well as other associated network routers and devices. These racks will also house fiber-optic backbone cabling that traverses to the IDFs and/or NetPops deployed throughout the white space.

The server racks will be utilized to house all server hardware, as well as horizontal Cat-6a UTP cabling, patch-panels, and patch-cords.

All racks will be securely bolted to the raised floor tiles with at least 4-feet of distance between the fronts/backs of the racks and any walls and/or other equipment. See Structural, **Section 5** of the BOD for more rack anchorage information. There should also be at least three (3) feet of space at the ends of the rack line-up rows.

There will be either an overhead or under-the-floor cable support system installed within the white space, but the tray system will not be directly mounted and/or supported by the racks.

All racks must be grounded according to ANSI TIA/EIA and/or BICSI specifications utilizing a Telecommunications Grounding Bar (TGB) installed within the white space.

11.16. Voice Backbone Cables and Terminations

If VoIP is not deployed as the communications system, then there will be requirements for typical voice cabling systems. This cabling infrastructure would consist of dedicated Cat-6a UTP cabling to the wall outlets and jacks and would be terminated onto 100-type connecting blocks and/or Category-6E UTP patch-panels. There would also be requirements for backbone voice tie-cabling installed to the existing equipment rooms and/or data center consisting of at least Category-3, multi-paired cabling (100-pair).

11.17. Data Backbone Cables and Terminations

The data transport backbone cabling within the white space will consist mostly of 50-micron multi-mode fiber, but there could be requirements for single-mode fiber optic cabling to support specific SAN services. Each fiber optic cable will originate in the white space and will then be routed to each IDF within the space. There will be other fiber cables that traverse between the MDF and some support spaces, as well as between support spaces and existing data center/corporate equipment room.

The multi-mode fiber connectors will be SC-type connectors.

11.18. Grounding and Bonding

The space shall be equipped with a Telecommunications Bonding Backbone (TBB). This grounding backbone shall be used to ground all communications cable shields, equipment racks, cabinets, raceways, and other associated hardware that has the potential for acting as a current-carrying conductor. The TBB shall be installed independent of each building's electrical and building ground. A 3/0-gauge cable shall be installed for the TBB. All connection points shall use a 6-gauge cable conductor.

All racks, cabinets and cable tray systems should be properly grounded to the provided TBB.

The building containing the should be equipped with a telecommunications main grounding bus (TMGB). All TBBs should be directly connected to the TMGB. The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building's electrical system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

11.19. Outside Plant Infrastructure and Site Planning

Any required outside plant cabling shall be installed through a dedicated duct bank system (banks of conduits used for pathway purposes), s ("manholes"), and cabling (fiber optic and/or copper). Entrance facilities for the proposed space shall consist of two (2) 4-inch conduits that provide direct pathways in and out of the proposed white space for each site.

There should be two redundant service entrance pathways into the client's facility from multiple service providers in order to provide for the highest levels of reliability, availability, and continuance. These redundant pathways will enter the building(s) at different points. It is anticipated that the University will provide dual, high-sped optical communications paths into the new facility. The Telco architecture can consist of SONET-Ring and/or DWDM in order to provide provisioned services in and out of the client's facility.

11.20. Cabling Design Criteria

The cabling infrastructure system shall provide voice and data communication transport to support voice, video, data, and other specialty systems in the .

Cable infrastructure will consist of wired systems only. Wireless deployments within the space are prohibited.

Cable infrastructure will be leveraged to provide signal transport for a number of traditional stand-alone systems.

Cable infrastructure shall provide signal transport for the following systems:

Data
Voice
Building Automation System
Security systems
Alarm systems

Devices connected to IT ports shall generate signals for transport over the LAN equipment via the cable infrastructure.

Horizontal data cable channels

Cabinets equipped with Cat-6a, High Density 24-port, Patch-Panels and High Density 24-port Fiber Patch Panels.

Fiber Optic Backbone

MDF to each IDF/NetPod - (2) 24 strand multi-mode fiber optic cable
DCOC to MDF - (1) 24 strand multi-mode fiber optic cable

Copper Backbone

(N/A)

Copper Patch Panels

Sufficient to terminate all horizontal Cat-6a UTP cabling plus 20% spare capacity.

Fiber Optic Patch Panels

Sufficient to terminate all riser fiber optic cable per IDF plus 25% spare capacity

MDF will be connected to existing data center spaces via fiber optic cables over two diverse routes/paths.

11.21. Data Center Technology Architecture

11.21.a. Definition

The Technology Architecture consists of the IT and Network systems/applications that enable end-to-end signal processing activities throughout the data center. It should be understood that this area does not encompass the technology infrastructure systems and components, as that deals specifically in the areas of physical cabling infrastructure items (i.e. cabling, patch-panels, patch-cords, connectors, jacks, faceplates, racks, etc).

11.21.b. LAN Network Architecture

Network Core-layer switch hardware

Network Distribution-layer switch hardware

Network Access-layer switch Hardware

Load-Balancing Systems

Content Switching Systems

Firewalls

Intrusion Detection Systems (IDS)

VPN Appliances / Systems

Remote Access Systems

*LAN equipment provided by University. Designer to coordinate with University of Utah.

11.21.c. IT Architecture

Mainframe Systems

Mid-Range Systems

Servers (Wintel)

Servers (UNIX)

Storage Systems (Disks)

Tape Systems (Libraries)

*IT Architecture equipment provided by University. Designer to coordinate with University of Utah.

11.21.d. SAN Architecture

SAN Core-layer switch hardware

SAN Distribution-layer switch hardware

SAN Access-layer switch hardware

*SAN equipment provided by University. Designer to coordinate with University of Utah.

11.21.e. WAN (Wide Area Network)

WAN Core Network layer

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

CSU/DSU Racks

*WAN equipment, circuits and planning will be performed and provided by University. Designer to coordinate with University of Utah for provisioning of cabinets for Carriers.

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

12. Building Management System (BMS)

12.1. General

The Project Building Management System will be a DDC (direct digital control) system utilizing an Ethernet network with redundant servers and dual power feeds. See BOD, **Section 9**, **Electrical**, for power requirements. The system shall be an expandable, integrated, centralized BMS, with monitoring and control functions.

Direct Digital Control (DDC) products shall transport alarms to a network (alarm) system.

Alarm surveillance shall include personnel safety (ie: fire, smoke, explosive gas, physical security, etc.), equipment conditions (incoming/outgoing service levels, efficiencies, etc.), environmental conditions (temperature, humidity, precipitation, lighting, etc.).

The Designer shall verify Project BMS system requirements according to University of Utah Standards (see BOD **Section 2**) and/or University of Utah identified representatives, during and following Preliminary Design, commiserate with Project (other BOD) System selections and designs.

12.2. Objectives

Provide a system to monitor and control all power and environmental systems throughout the Project; a system that shall be made inclusive of all required points, alarms, and activations; that shall be capable of fully integrating with all other Project systems, in or beyond the Project site location, in line with predetermined criteria as well as adapting to changes in the Project location.

12.3. System Design Criteria

The system shall be capable of automatically stabilizing environments according to predefined parameters. The system shall be capable of paging operations personnel, using internet based "thin-client" operator interfacing. Algorithms, start/stop commands, statuses or any other value or binary point shall **NOT** be broadcast across the Network to initiate a System operation. A possible exception to this may be an "outside air" broadcast.

The System shall employ a distributed technology, such that each complex mechanical system component (ie: chillers, cooling towers, CRAHs, etc.) will have a dedicated processor.

Each DDC controller will contain its own memory, processor, real time clock, and control programs for stand alone operation if the DDC network is not functional.

There will be a dedicated chiller manager controller that will monitor the load, chiller, tower and pump statuses and any other local condition pertinent to the performance of the mechanical plant. The chiller manager controller for the mechanical plant will have a

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

redundant manager controller in the opposite plant. All information communicated between individual system controllers and chiller managers shall be hard wired. Redundant manager controllers shall perform the same functions as the lead manager controller.

There shall be dedicated software in the BMS for advanced event management features and real time event logging.

All System control wiring will be routed in EMT conduit.

Provide separate alarm systems for each Project component and/or in each Project space. The contents of relayed alarm information to different monitoring stations/levels shall be determined during Design. Alarm detail levels may differ from the University of Utah monitoring location hierarchy (ie: local alarm relay may be more detailed than regional, remote alarm relay).

12.3.a. Monitoring Points

The Designer shall evaluate the following minimum **recommended** list of systems and/or points (against pre-determined statuses, shown other than Normal) for Project integration:

- Security system (trouble, intrusion, failure)
- Perimeter building door (open)
- Building alarm system (failure)
- Building control system (failure)
- PLC (trouble, failure)
- Fire/smoke detection system (trouble, alarm, failure)
- Fire pump operation (pressure, failure)
- Cooling system (failure)
- Air handler fan failure
- Control air system (low pressure, failure)
- Chilled water temperature (high)
- Loss of chilled water flow
- Domestic water (low pressure, failure, leak)
- Sump pump (high, failure)
- Sewage pump (high, failure)

- Boiler (failure)
- Conduit/cable bank (Data Center) moisture, gas levels (high)
- Utility AC power (failure)
- Switchgear battery plant (failure)
- Surge arrester (failure)
- UPS (failure)
- UPS critical-to-battery (failure)
- UPS critical-to-standby power (failure)
- UPS major synchronization (failure)
- UPS major chargers (failure)
- UPS major (failure)
- PDU (failure)
- Standby engine operation (failure)
- Standby engine minor (failure)
- Standby engine start system (failure)
- AC power transfer (failure)
- Fuel tank (low, failure, leak)
- Day tank (low, failure, leak)

Minimum list of **recommended** equipment system data (operational) points includes:

- Chillers, cooling towers, pumps, air handling units, CRAHs
- Generator room ventilation and exhaust systems

Minimum list of **recommended** equipment system data (summary) points includes:

- UPS, battery monitors, generators, transfer switches, transformers, circuit breakers, power quality monitors, EPO
- Liquid detection, gas monitoring
- Fire alarm and detection
- Fire suppression

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

12.3.b. Area Specific Alarms

The Designer shall evaluate the following minimum **recommended** group of Project Space-specific alarms (against pre-determined statuses, shown other than Normal) for BMS integration:

- Temperature (low, high, rate of change)
- Humidity (low, high)
- Security (trouble, intrusion)

EYP Mission Critical Facilities, Inc.
An HP company
11845 W. Olympic Blvd., Suite 850w
Los Angeles, CA 90064
www.hp.com/go/eypmcf

13. Digital Media

13.1. General

Provide a video display wall in the Data Center Operations Center (DCOC). The wall shall consist of flat wall mounted theatre screen or motorized screens to display technology, using multiple ceiling mounted front projection monitors mounted below the ceiling. Alternately, provide 3 or four flat panel video monitors. System shall be visible within standard ergonomic viewing cones, from all workstations in the room.

Provide a projection system in the Conference Room.

13.2. Design

System design shall include video wall and sound system, with digital data and voice connections to local network within the DCOC. Monitors and projection systems shall NOT be visible to security CCTV cameras

Conference Room:

- A/V systems shall not be mounted in conference room table
- In lieu of front projection system: plasma, LED, Laser, or HDTV
- Lighting shall be separately dimmable at dry erase board, projection screen, and over conference room table
- Sound Taping equipment to include speakers, microphones

13.3. Video Systems

Front Projector and screens preferred for Conference Room and DCOC.

13.4. Sound System

Provide a two channel, sound system with wall mounted speakers and control module. System shall project digital music or voice from local network or laptop.

************* END OF REPORT *************