Appendix N : Mechanical, Electrical and Plumbing Systems Report

STATE OF WYOMING

JOINT LEGISLATIVE AND EXECUTIVE TASK FORCE

DEPARTMENT OF ADMINISTRATION & INFORMATION
CONSTRUCTION MANAGEMENT

WYOMING STATE CAPITOL
REHABILITATION & RESTORATION

LEVEL I /LEVEL II

MECHANICAL, ELECTRICAL AND PLUMBING SYSTEMS REPORT

PREPARED BY

LORING CONSULTING ENGINEERS

FOR

HDR

IN ASSOCIATION WITH

PDP
Preservation Design Partnership, LLC

AND

P4 ARCHITECTS

24 FEBRUARY 2014

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Overview

Loring Consulting Engineers (LORING) visited the Wyoming State Capitol in April 2013 and October 2013 to observe the building's existing HVAC, Plumbing and Electrical systems in preparation for this report. All interior and exterior areas of the Capitol Building were observed as well as the main mechanical and electric rooms in the adjacent Connector Link and in the Herschler Building where equipment that serves the Capitol Building is located. Observations noted are based upon readily visible systems and equipment and existing documentation that was available. LORING toured the buildings with personnel from the Capitol's maintenance staff, and during these tours the staff shared their hands-on knowledge of the existing HVAC, Plumbing and Electrical systems with LORING.

EXISTING SYSTEMS

The existing HVAC, Plumbing and Electrical systems serving the Capitol Building are well-maintained and in working order but are beyond their expected useful service lives, which will result in on-going increased maintenance and reductions in operating efficiencies.

HVAC Systems - The existing HVAC systems for the Capitol consist principally of 4-pipe fan coil units which serve the majority of the spaces in the building. The fan coil units utilize chilled water from the central plant for cooling and low pressure steam for heating. These spaces have minimal mechanical ventilation and rely primarily on operable windows for ventilation. There are some all-air systems which serve interior offices and high occupancy spaces. These systems have chilled water coils for cooling and steam coils for heating. As detailed in existing HVAC zoning diagrams in this report, approximately 27% of the building is not directly served by HVAC systems.

The limitations of the existing HVAC systems include the following:

- The Rotunda space is not directly conditioned and relies on spill air from adjacent spaces for conditioning and ventilation.
- The use of operable windows does not allow for proper filtration of outdoor air resulting in reduced indoor air quality.
- The use of operable windows is highly unlikely during inclement weather or cold periods, resulting in under-ventilated spaces.
- The use of operable windows for ventilation can be a security concern.
- The use of steam as the final medium requires maintenance of traps, and there are leaking condensate lines.
- The current system requires maintenance of 170-plus fans associated with the 165 individual fan coil units and the air system located in the Basement and Attic MERS
- The HVAC system is past its useful life expectancy.

Plumbing Systems - The Capitol's domestic water service is fed from the main water service in the underground Connector Building. Hot water is served from the Capitol Complex's two main hot water heaters located in the Herschler Building. The existing water and drainage piping in the Capitol Building will not be adequeate to serve the proposed plumbing fixtures.

Electrical Systems - The Capitol derives electrical power from one (1) exterior pad-mounted utility transformer located at the northwest rear of the building that feeds a service switchboard located in the adjacent Connector Link. This feeds the Capitol via over two-dozen individual feeders. The feeders are routed through a large splice box located in the ceiling in the Capitol's north center basement corridor at the location of an old switchboard that was removed when the building link was constructed. The feeders are spliced to older feeders at the splice box to serve individual Capitol electric panels. Typical power distribution system feeders are installed in conduits, and panels are located throughout the building flush-mounted in corridors and in closets. The panels are a mix of newer and older vintage. Wiring is a mix of newer and old vintage, some reported by facilities personnel to be old, cloth-covered type. Many of the panels and equipment are beyond their expected useful life and were not intended to serve modern computer loads.

Proposed Systems - The primary objective of the new systems selection process is the generation of basic design concepts which will blend into the architectural design and the historic fabric of the structure and function in harmony with the programmatic aspects of the facility, and are consistent with the operational intent of the Owner. The major mechanical equipment centers, including the central equipment, electrical rooms, pump rooms and fan rooms will be located to permit ease of access for building personnel for the purpose of maintenance of equipment while limiting impacts on public spaces. Equipment and materials will be selected for long-term service life and to minimize maintenance. Equipment requiring regular maintenance will be located in accessible mechanical rooms.

Systems will be designed for flexibility and reliability with:

- Standardization of system sizes and configurations
- Use of factory fabricated systems to facilitate rapid installation
- Use of materials, systems and equipment which have long-term records of satisfactory operation.
- Use of systems which are basically energy conserving during all seasons of the year with provisions for free cooling, specifically designed for the dry climate in Cheyenne.

All systems will be designed to conform to the latest referenced International Building Codes, NFPA Codes, applicable Local Codes and regulations of the Authorities Having Jurisdiction. All systems will meet recognized standards for energy efficiency, maintenance and long term service life. While it is recognized that the systems do not need to meet the requirements of the International Energy Conservation Code due to the fact that the Capitol is listed on the Register of National Historic Landmarks, every effort will be made to meet the intent of this code where existing space conditions permit.

The following is a list of major recommendations arrived at through the analysis of various alternatives presented in this report:

1. A new central utility plant, located outside the footprint of the building, will house the required boiler plant, cooling system, electric service and emergency generators to satisfy the needs of the Capitol. This new plant will produce steam for heating purposes and chilled water for cooling purposes.
2. The HVAC systems for the Capitol will generally consist of multiple air handing units to serve common program area types in a given area of the building which will have similar hours of operation. Economizers will be used to reduce energy consumption via a free cooling cycle and limit the amount of mechanical cooling required throughout the year. The economizer cycle will take advantage of Cheyenne's dry and cool climate.
3. Basement level fan rooms will serve the Basement and First Floor spaces.
4. Attic level fan rooms will serve the Second and Third Floor spaces.
5. A smoke evacuation system will be provided to address the existing single building volume issue at the Rotunda; exhaust fans will be located in the attic.
6. A building management system will tie together all heating, ventilating and air conditioning functions required for remote supervision of the systems from a central location.
7. New plumbing systems will be provided to support new restrooms that will meet current requirements and standards.
8. The Capitol will be fully sprinklered, and a new, second, fire-water service will be provided to allow the sprinkler system to be fed from two separate sources.
9. A new electrical service will be provided for the Capitol with full generator back-up to allow for an orderly evacuation of the building and avoid interruption of operations, especially when the Legislature is in session. Life-safety loads, including emergency egress lighting and alarm systems, will be served via dedicated equipment and feeders in accordance with Code requirements. Existing manual capability to swap utility service feeders at the Capitol Complex by the power company will be maintained.
10. New electric distribution, circuiting, lighting, power and telecom / AV / security auxiliary systems will be provided throughout the Capitol, and a full-coverage addressable fire alarm system will be provided.

The report provides details on all of the above items and will be the basis of design for the Level III Scope of Work.

N.01.01 - Capitol Complex Existing HVAC Infrastructure

COOLING

The Capitol Complex is served by multiple chillers located in the Herschler Building and the Connector Link between the Herschler and Capitol buildings. Currently there are four (4) chillers totaling 1,330 tons of installed cooling capacity, which serve the following buildings via an underground distributed chilled water network:

1. Capitol
2. Herschler Building
3. Supreme Court Building
4. Barrett Building
5. Hathaway Building

The capacity and the location of the chillers are as noted below:

Chiller Name	Location	Cooling Capacity
Herschler -1	Herschler Basement	500 tons
Herschler – 2	Herschler Basement	250 tons
Herschler – IT	Herschler Basement	80 tons
Capitol	Connector between Herschler and the Capitol Building	500 tons

These chillers reject their heat via induced draft cooling towers located in the Plaza between the Capitol and Herschler buildings. There are two (2) sets of towers: one (1) for the Herschler chillers and one (1) for the Capitol chiller. Each cooling tower is rated for 1,400 tons of cooling. The Capitol cooling towers are winterized and incorporate a 300 ton plate and frame heat exchanger for free cooling. Facilities personnel reported that the total block load on the entire chiller plant is roughly 1,000 tons on a 90 degree F day (Design Cooling Day).

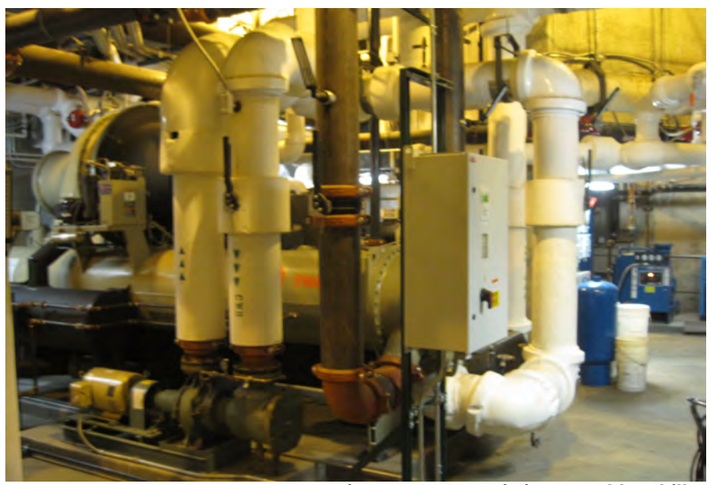
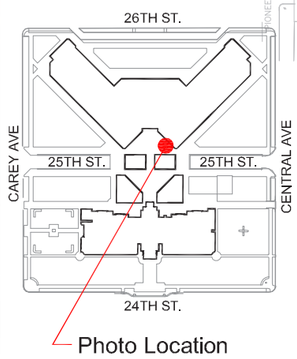
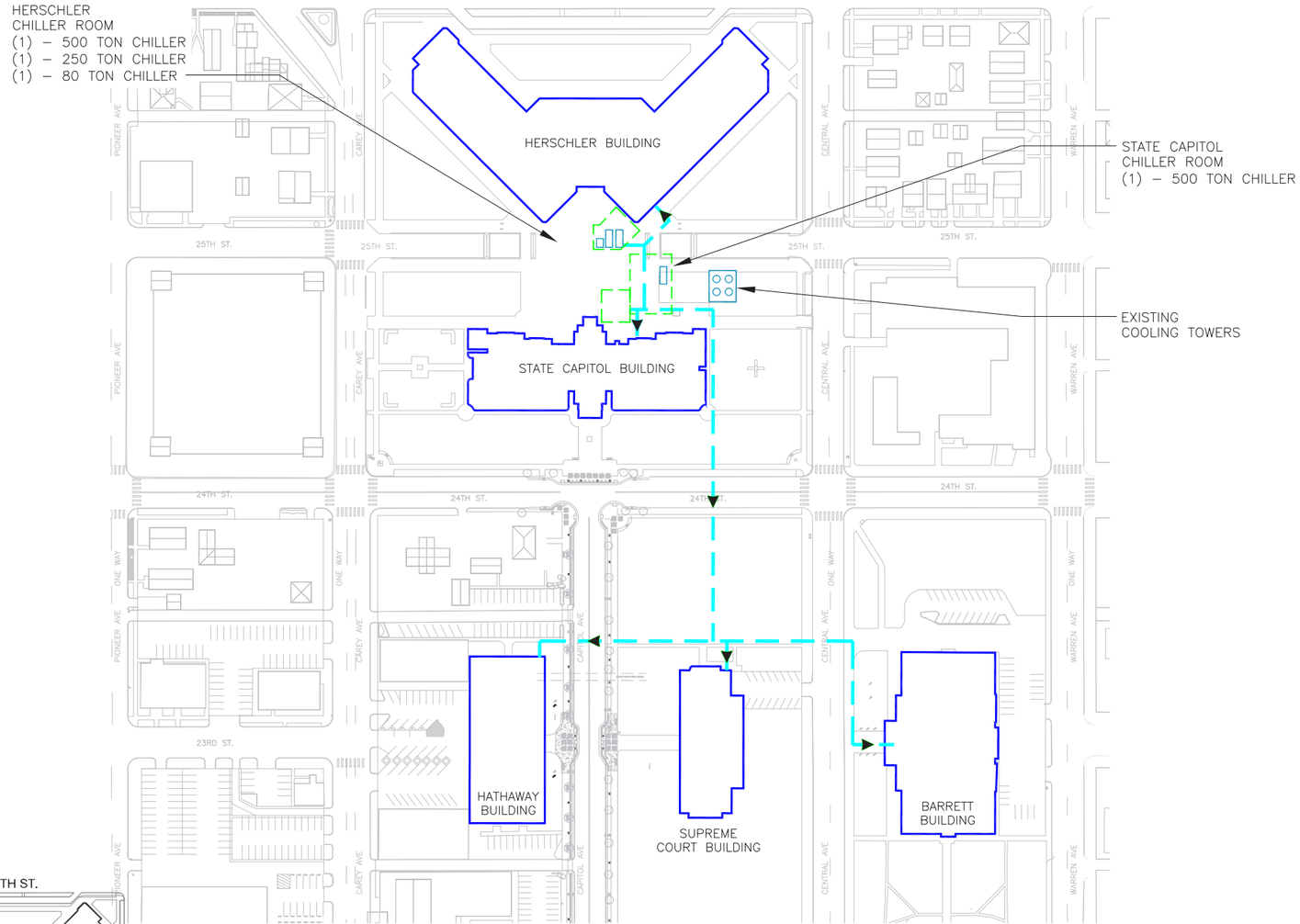


Figure N.01.02 - Existing Herschler Chiller





EXISTING CHILLED WATER NETWORK DIAGRAM

(NOT TO SCALE)

BUILDING OUTLINE
EXISTING CHILLED WATER DISTRIBUTION
OUTLINE OF MECHANICAL ROOM

Figure N.01.01 Existing Chilled Water Network

HEATING

The Capitol Complex is served by multiple high pressure steam boilers located in the Barrett and Herschler Buildings. These boilers produce approximately 75 PSIG steam and are interconnected via a piping network located in tunnels. Local pressure reducing stations lower the steam pressure to 5 PSIG for each building. Boilers are dual fuel - gas and oil fired. Currently there are five (5) boilers totaling 1,150 boiler horsepower (BHP), which serve the following Buildings:

1. Capitol
2. Herschler Building
3. Supreme Court Building
4. Barrett Building
5. Hathaway Building

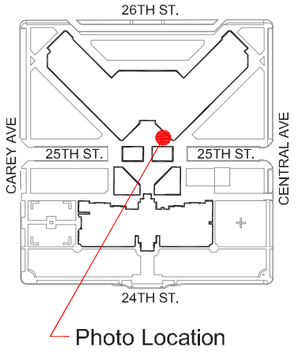
The capacity, location and usage of the boilers are as noted below:

Boiler Name	Equipment Location	Capacity	Usage
Barrett – 1	Barrett Building	250 BHP	Winter
Barrett – 2	Barrett Building	250 BHP	Winter
Barrett – 3	Barrett Building	250 BHP	Winter
Herschler – 1	Herschler Building	200 BHP	Summer
Herschler – 2	Herschler Building	200 BHP	Summer

NOTE: 1 BHP = 33,000 BTUH. 250 BHP boiler = 8,250,000 BTUH or 8.25 MMBTUH.

We understand that the three (3) Barrett boilers can accommodate heating loads down to -10 degree F outdoor temperature and that below this threshold, the Herschler boilers are brought on line to serve the Herschler and Capitol Buildings and the two (2) systems are isolated, with the Barrett boilers serving the Supreme Court, Barrett and Hathaway Buildings. An existing 12,000 gallon (size is from 1980 Herschler Building design drawings) fuel-oil storage tank is located in the grassy area east of the Herschler Building. The tank serves the Herschler Building's existing boilers and emergency generator.

Figure N.01.04 - Existing Herschler Boilers



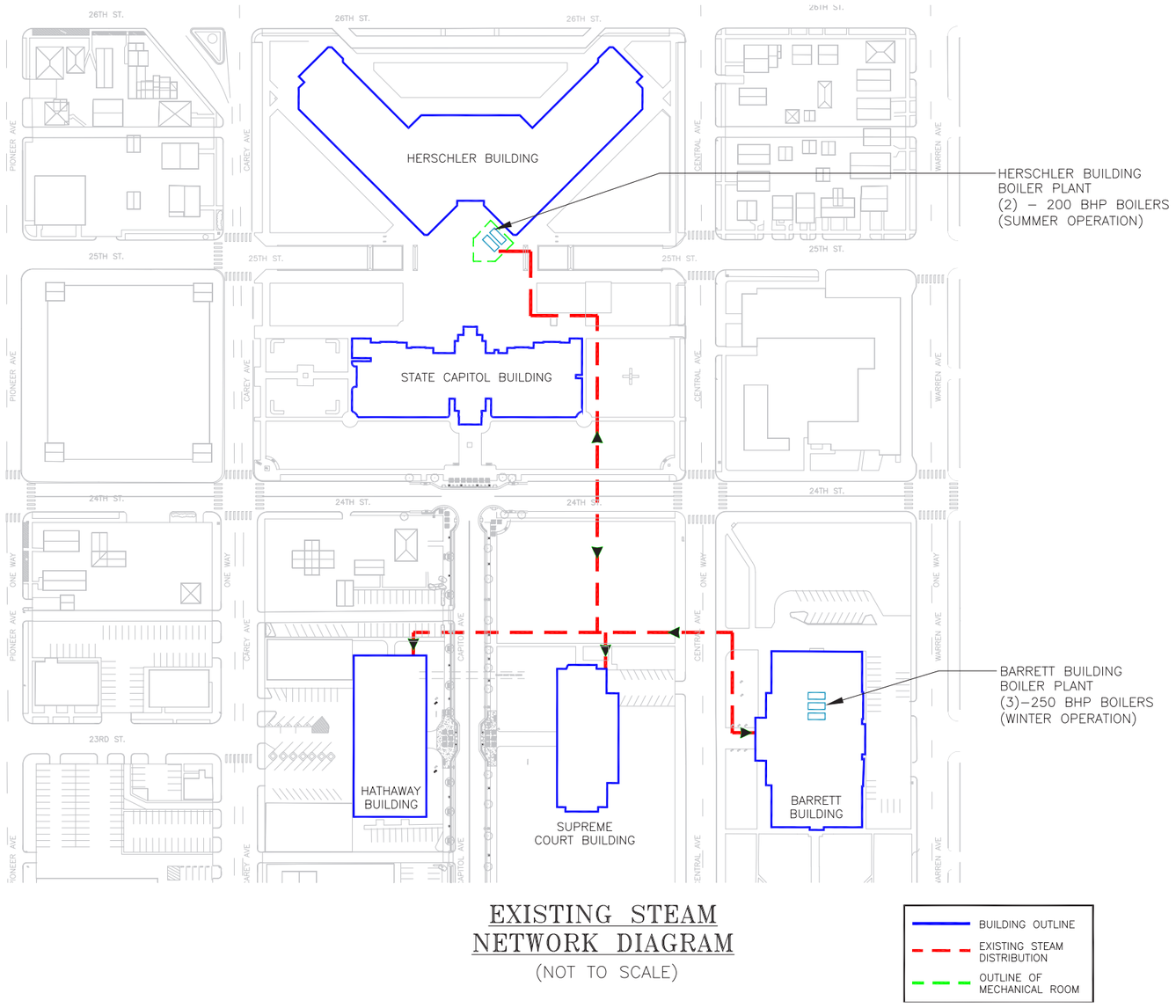
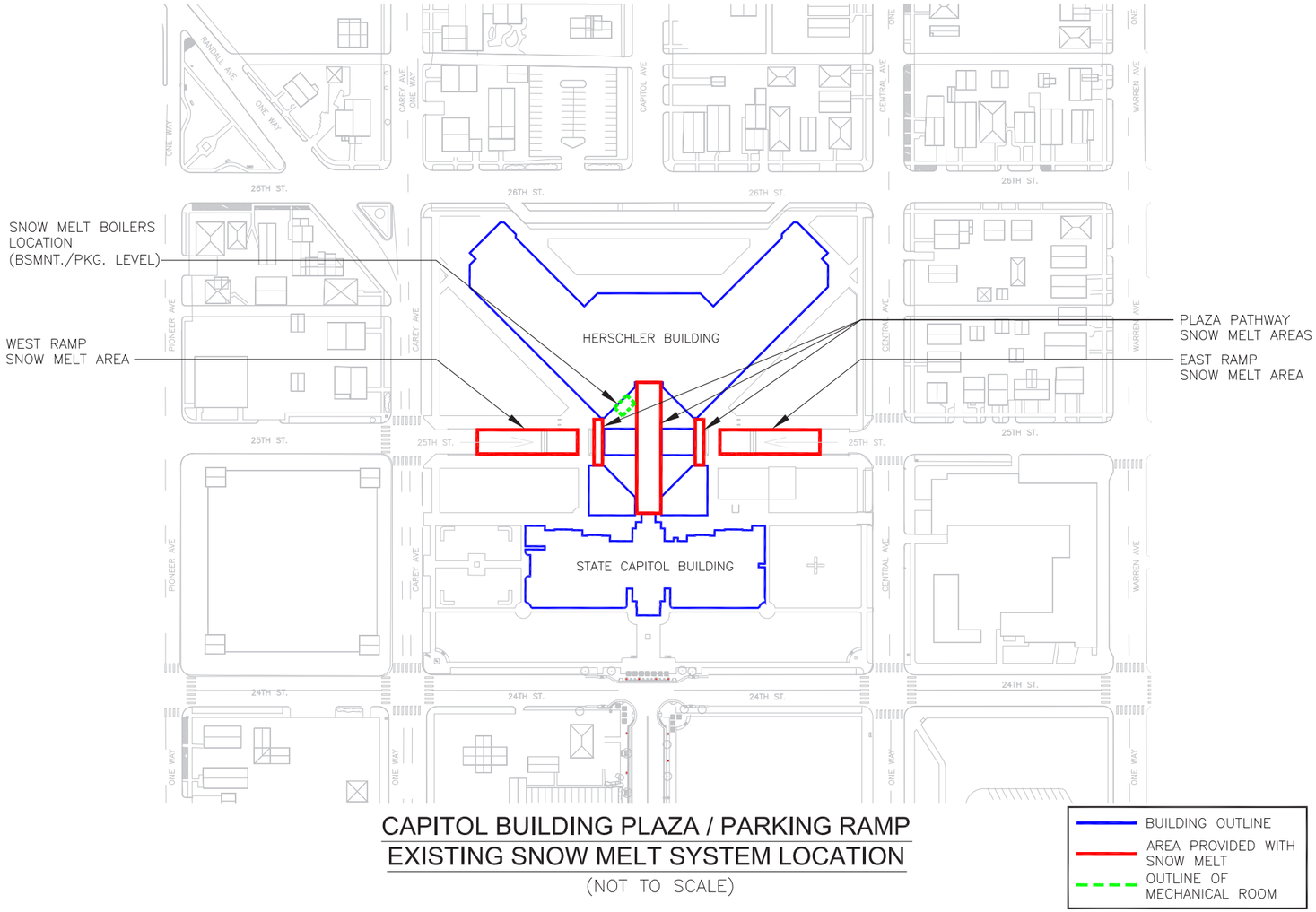


Figure N.01.03 - Existing Steam Network

The existing Plaza between the Capitol and Herschler Buildings is served by a snow melting system. The system consists of three (3) gas fired boilers located in the underground Parking Garage on the west side of the Plaza.

The snow melting system only serves portions of the Plaza between the Capitol and Herschler Buildings and the west and east Parking Garage ramps.



CAPITOL BUILDING PLAZA / PARKING RAMP
EXISTING SNOW MELT SYSTEM LOCATION
(NOT TO SCALE)

Figure N.01.04a- Existing Snow Melt System

N.01.02 Capitol Complex Existing Plumbing Infrastructure

A single 6" domestic cold water service enters the Connector Link between the Herschler and Capitol Buildings where it is protected by a backflow preventer and then splits into five (5) main branches, each with backflow prevention and pressure reducing valves. Incoming pressure was observed to be 125 psi (pounds per square inch). Reduced pressure to the Capitol was observed to be 75 psi.

The five main branches serve the following systems:

1. Herschler Building
2. Herschler Building cooling tower make-up water
3. Herschler Building irrigation
4. Capitol
5. 6" main routed in the Capitol Complex utility tunnel which serve the following:
    a. Capitol irrigation system
    b. Supreme Court Building and associated systems
    c. Barrett Building and associated systems
    d. Hathaway Building and associated systems.

Additional domestic water services and water meters in the Supreme Court, Barrett and Hathaway Buildings back feed into this system.

An existing reserve well and pump system is currently disconnected, but we understand that it is maintained as an emergency back-up for times of drought. The well is located beneath the underground Connector Link in Mechanical Room B7 and the associated well pump and buffer tanks located in the main water service room.

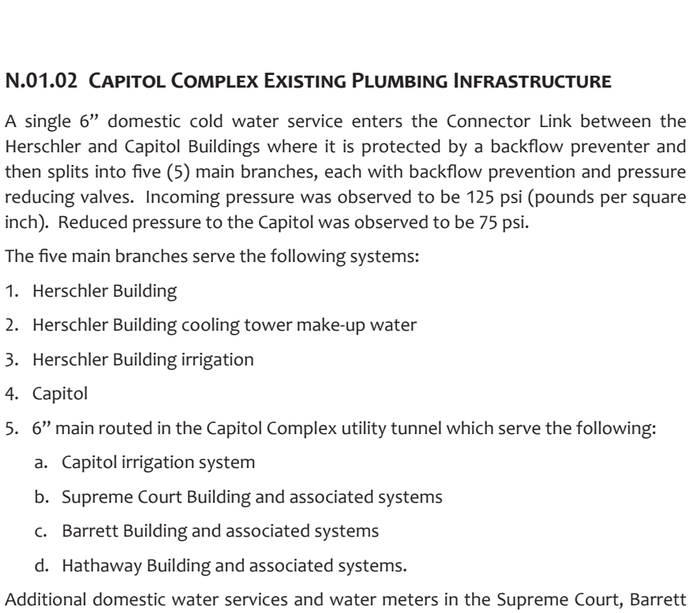


Figure N.01.06 - Existing 6" Domestic Water Service, BFP & Pressure Reducing Station, Underground Connector Bldg

Figure N.01.05 - Existing Plumbing Equipment

Figure N.01.07 - Existing Watertight Cover over Interior Well, Room B7

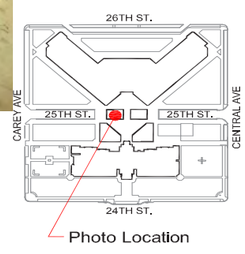


Figure N.01.08 - Existing Well Pump & Buffer Tanks, Water Svc Rm, Central Utility Plant

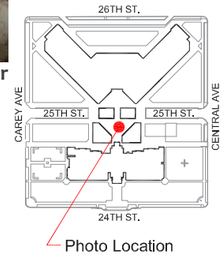


Figure N.01.09 - Existing Gas-Fired Domestic Hot Water Heater, Herschler Basement MER

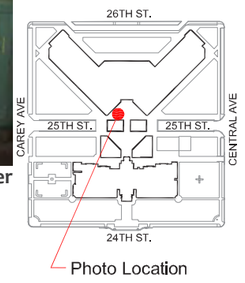
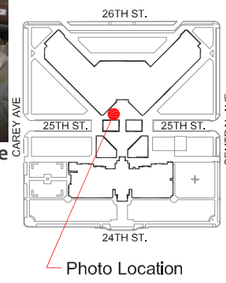


Figure N.01.10 - 10,000 Gal Solar Domestic Water Storage Tank, Herschler Basement MER



The Capitol Complex is served by two (2) hot water heaters located in the Herschler Building Boiler Room. The first is a gas-fired hot water heater with 500 gallons of storage, 919,400 Btuh input, 914 gal/hr recover; the second is a solar hot water heater with 10,000 gallons of storage. The gas-fired heater is dated to 1998, or is approximately 15 years old, which is well within its typical life expectancy of 20 years when maintained. The solar water heater is original to the building and is in working condition, however we understand that replacement parts are becoming difficult to find. These heaters also serve the following Buildings via a distributed domestic hot water network in the existing tunnel system:

1. Supreme Court Building
2. Hathaway Building

The Barrett Building is served by a separate hot water heater.

A common hot water circulation main brings hot water back to the Herschler Building; hot water circulation pumps at each building provide local circulation into this common system. Main recirculation pumps are located at Herschler; individual building pumps are located at each building; the Capitol circulator is located in the Main Water Service Room.

Twelve (12) storm mains exit the Capitol, each serving a single roof drain, as well as local area drains. Six (6) storm mains exit the building to the south, and are routed across the Capitol lawn to 24th Street at two (2) locations. These were replaced in approximately 1994 from the street connections back to the building. Six (6) storm mains exit the building to the north, and were replaced and combined with the Herschler Building storm water systems during the Herschler Building construction. Of these, three (3) are routed west to Carey Avenue, and three (3) are routed east to Central Avenue. For all of these systems, only those portions of the pipe outside of the footprint of the Capitol were replaced. Storm leader base elbows inside of the building and penetrations of the foundation walls were not replaced.

There is an indication of a subsurface / footing drainage system around the Capitol foundation on the Herschler Building construction drawings, but the extent and condition of this system is unknown.

Plaza surface drains installed during the Herschler Building project are routed into the Capitol storm water system below grade to the north-east and north-west.

N.01.03 - Capitol Complex Existing Electrical Infrastructure

The existing electric services for the Capitol Complex includes separate utility services for the Herschler Building and for the Capitol that are fed from exterior utility transformers located on grade in the Plaza area between the two buildings.

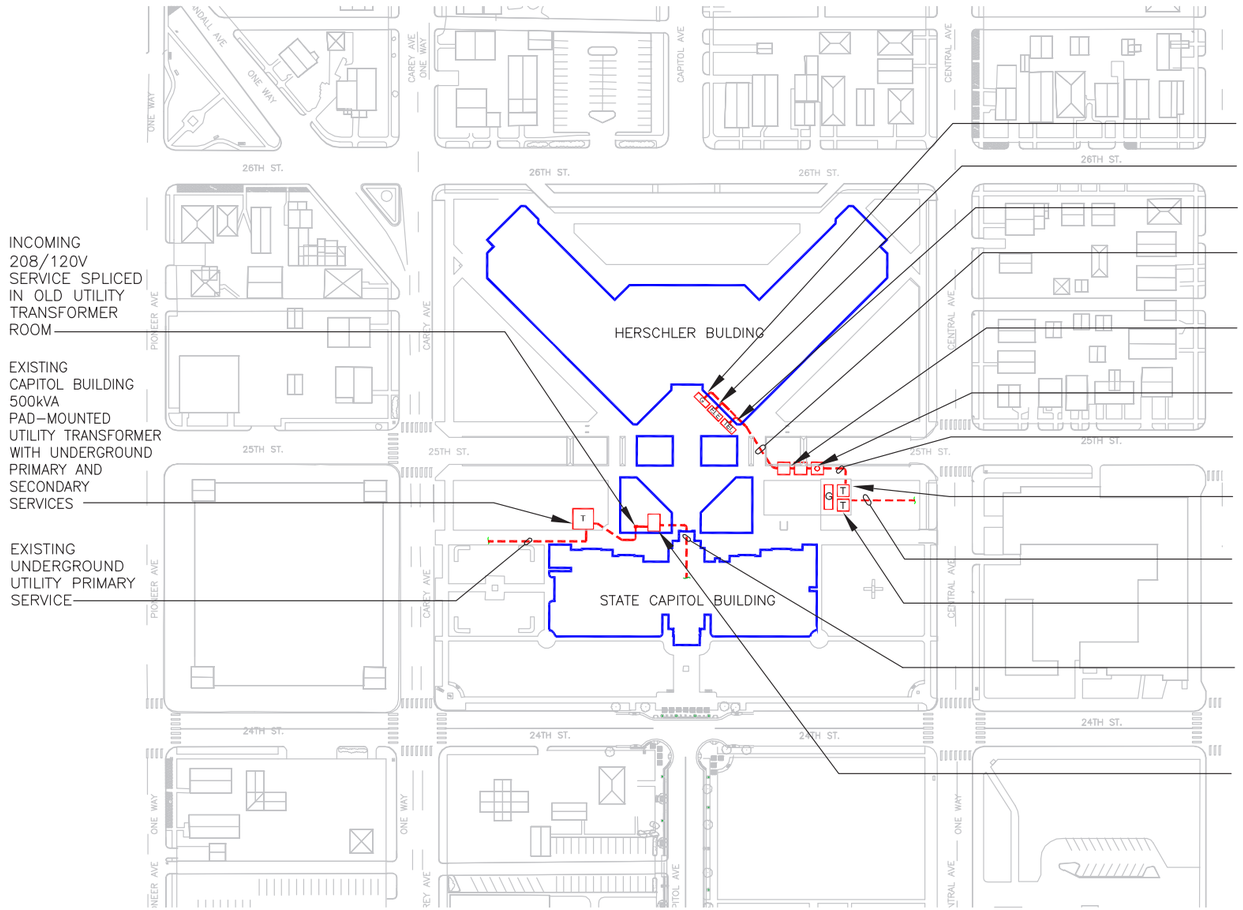
The Capitol's electric service includes one (1) 500 kVA transformer to the northwest. The transformer's secondary is rated 208/120V, 3-phase, 4-wire and feeds the Capitol's electrical loads via one (1) service switchboard located in a basement room on the west side of the Connector Link. Utility metering at 208/120V is provided at the service switchboard.

The Capitol is not served by an emergency power source or generator.

A utility company primary feeder is routed east-to-west between the Capitol and Herschler Buildings. This feeder allows the utility company to manually change the source of the Capitol and Herschler Buildings to two separate utility feeders.

The Herschler Buidling's electric service includes two (2) 2000 kVA transformers located in the southeast of the Plaza. The transformers' secondaries are rated 480/277V, 3-phase, 4-wire and feed the Herschler Building, including the Connector Link and Central Plant loads via two (2) service switchoards located in the existing VIP Parking Garage. Utility metering at 480/277V is provided at each of the two service switchboards.

Figure N.01.12 - Existing Capitol Bldg Utility Transformer



ELECTRICAL:
EXISTING SITE PLAN
(NOT TO SCALE)

BUILDING OUTLINE
ELECTRICAL FEEDER ROUTING

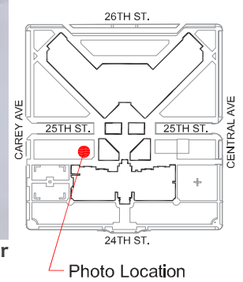


Figure N.01.11 Existing Electrical Equipment

N.02.01 Capitol Building Existing HVAC Systems

The existing HVAC systems for the Capitol consist principally of one-hundred-sixty-five (165) 4-pipe fan coil units which serve the majority of the spaces in the building. The fan coil units utilize chilled water from the central plant for cooling and low pressure steam for heating. These spaces have minimal mechanical ventilation and rely primarily on operable windows for ventilation.

All-air systems supply fan (sf) units, that serve interior offices and high occupancy spaces. These systems have chilled water coils for cooling and steam coils for heating. The following summarizes air handling systems in the building:

System #	Equipment Location	Area Served
SF-1	Basement East	House of Representatives Chamber
SF-2	Basement East	Basement & 1st Floor East Interior Zones
SF-3	Basement West	Senate Chamber
SF-4	Basement West	Basement & 1st Floor West Interior Zones
SF-5	Attic West	2nd Floor Senate Lobby
SF-6	Attic West	3rd Floor Senate Lobby and Press Room
SF-7	Attic East	2nd Floor House Lobby
SF-8	Attic East	3rd Floor House Lobby
SF-9	Attic	3rd Floor Conference Room and Press Room

The limitations of the existing systems include the following:

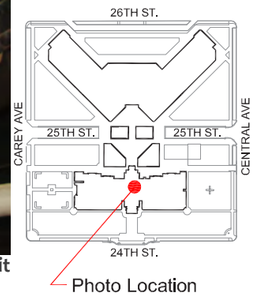
- Rotunda space is not directly conditioned and relies on spill air from adjacent spaces for conditioning and ventilation.
- The use of operable windows does not allow for proper filtration of outdoor air resulting in reduced indoor air quality.
- The use of operable windows is highly unlikely during inclement weather or cold periods, resulting in under-ventilated spaces.
- The use of operable windows for ventilation can be a security concern.
- The use of steam as the final medium requires maintenance of traps and there are leaking condensate lines.
- The current system requires maintenance of 170-plus fans associated with the 165 individual fan coil units and the air system located in the Basement and Attic MERS. The HVAC system is past its useful life expectancy.

System equipment service life expectancies (median service life) are based upon ASHRAE guidelines and existing equipment ages.

The following figures summarizes expected equipment life:

Equipment	Expected Life	Existing Equipment Age
Fan Coil Units	20 yrs.	35+ years
Ductwork	30 years	35+ years
Fans	20-25 years	35+ years
Coils- Water or Steam	20 years	35+ years

Figure N.02.01 - Existing Attic Air Handling Unit



The existing building management / HVAC controls system for the Capitol is by Honeywell and is tied into the State of Wyoming's existing Tridium front controls system.

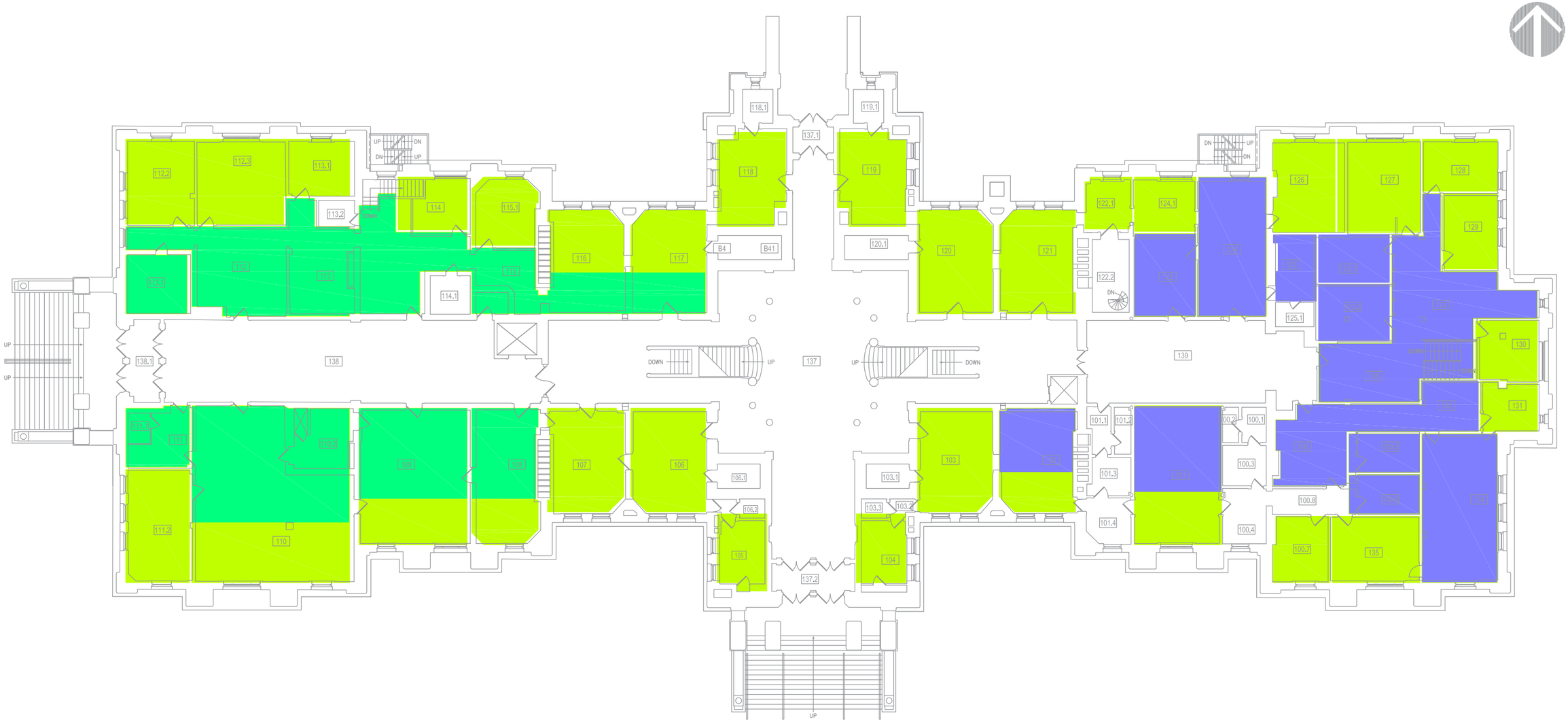
(NOMENCLATURE FOR EXISTING SYSTEMS)
AHU = AIR HANDLING UNIT
SF = SUPPLY FAN
N = NORTH
E = EAST
S = SOUTH
W = WEST
R = ROTUNDA

SERVED BY AHU-SF-1
SERVED BY AHU-SF-2
SERVED BY AHU-SF-3
SERVED BY AHU-SF-4
SERVED BY INDIVIDUAL FANCOIL UNITS
SERVED BY AHU-SF-5
SERVED BY AHU-SF-6
SERVED BY AHU-SF-7
SERVED BY AHU-SF-8
SERVED BY AHU-SF-9

CAPITOL BUILDING
BASEMENT
EXISTING HVAC ZONING CONCEPT

HDR PDP RLAM

NORTH



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AHU = AIR HANDLING UNIT
SF = SUPPLY FAN
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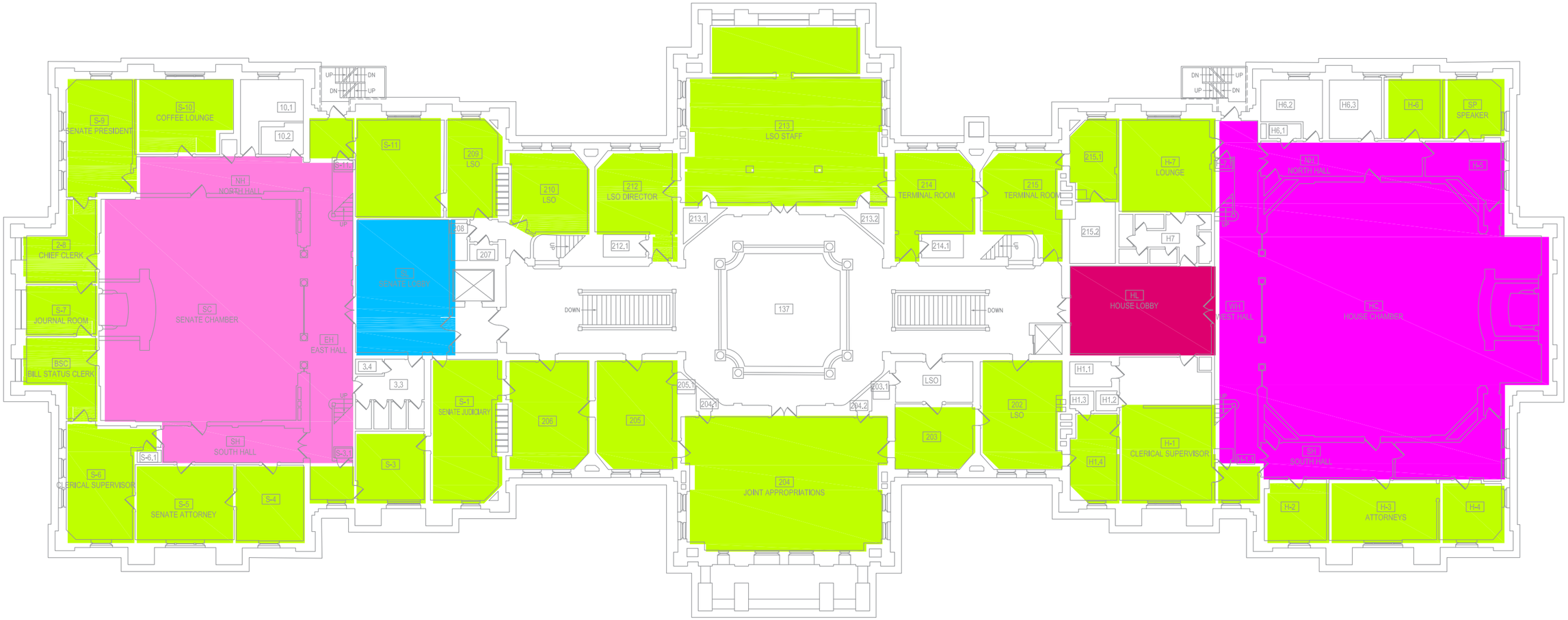
W = WEST
R = ROTUNDA

SERVED BY AHU–SF–1
SERVED BY AHU–SF–2
SERVED BY AHU–SF–3
SERVED BY AHU–SF–4
SERVED BY INDIVIDUAL FANCOIL UNITS
SERVED BY AHU–SF–5
SERVED BY AHU–SF–6
SERVED BY AHU–SF–7
SERVED BY AHU–SF–8
SERVED BY AHU–SF–9

CAPITOL BUILDING
FIRST FLOOR
EXISTING HVAC ZONING CONCEPT

HDR PDP P4 PLANNING

NORTH



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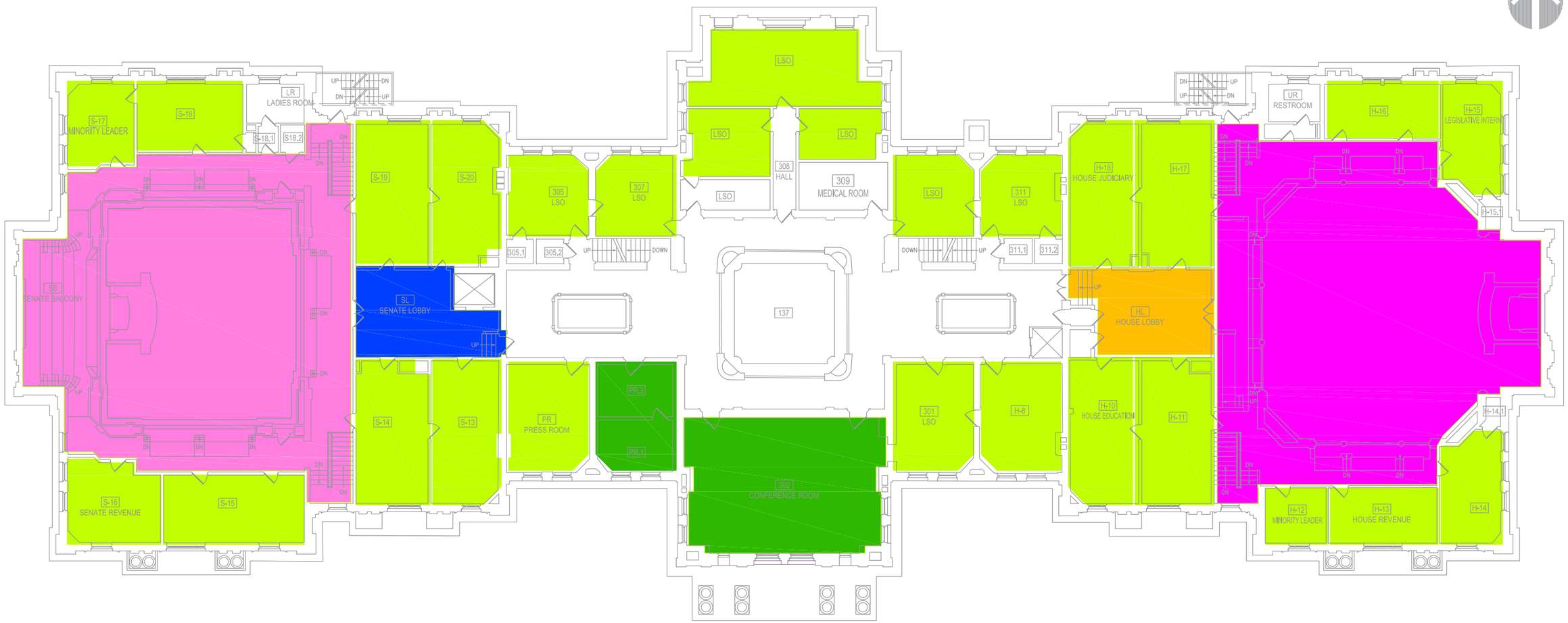
- SERVED BY AHU-SF-2
- SERVED BY AHU-SF-3
- SERVED BY AHU-SF-4
- SERVED BY INDIVIDUAL FANCOIL UNITS
- SERVED BY AHU-SF-5
- SERVED BY AHU-SF-6
- SERVED BY AHU-SF-7
- SERVED BY AHU-SF-8
- SERVED BY AHU-SF-9

CAPITOL BUILDING
SECOND FLOOR
EXISTING HVAC ZONING CONCEPT

HDR PDP FLAD

NORTH



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AHU = AIR HANDLING UNIT
SF = SUPPLY FAN
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E = EAST
S = SOUTH
W = WEST
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SERVED BY AHU-SF-1
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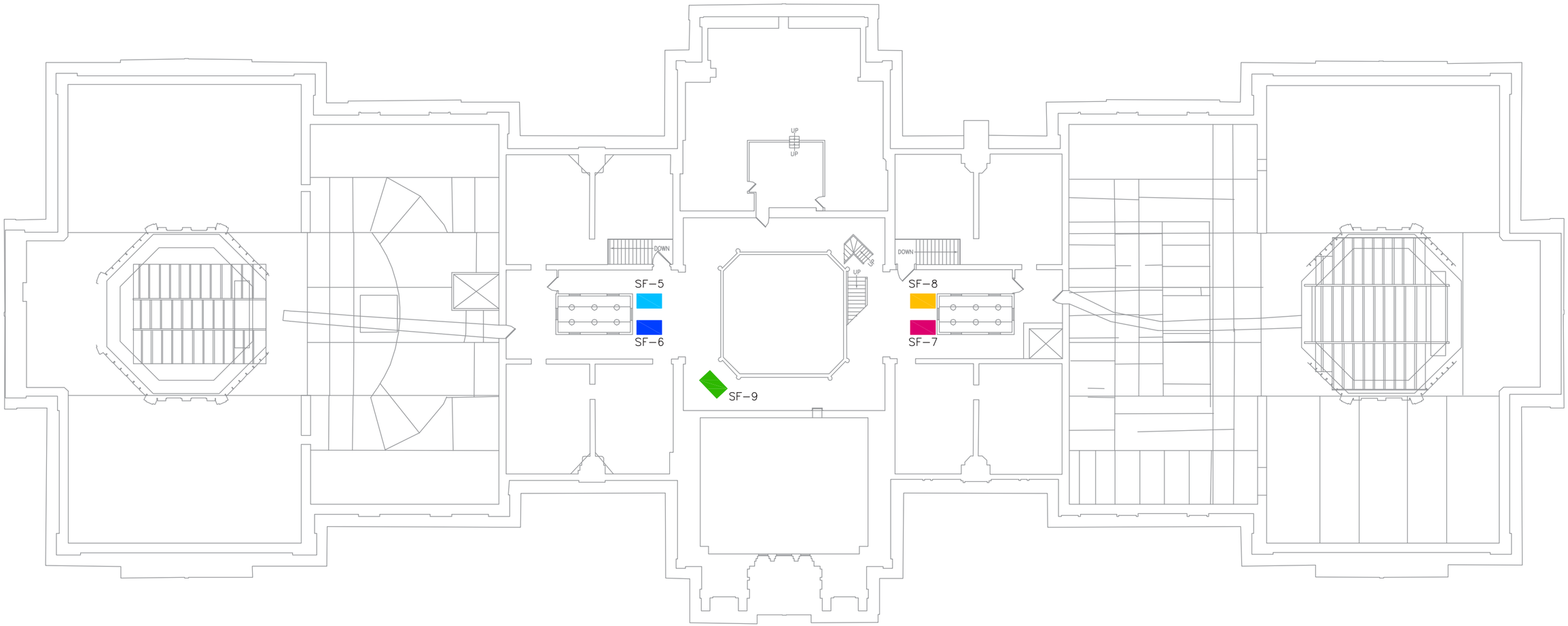
SERVED BY INDIVIDUAL FANCOIL UNITS
SERVED BY AHU-SF-5
SERVED BY AHU-SF-6
SERVED BY AHU-SF-7
SERVED BY AHU-SF-8
SERVED BY AHU-SF-9

CAPITOL BUILDING
THIRD FLOOR
EXISTING HVAC ZONING CONCEPT

HDR PDP RLAN

NORTH



SERVED BY AHU-SF-1
SERVED BY AHU-SF-2
SERVED BY AHU-SF-3
SERVED BY AHU-SF-4
SERVED BY INDIVIDUAL FANCOIL UNITS
SERVED BY AHU-SF-5
SERVED BY AHU-SF-6
SERVED BY AHU-SF-7
SERVED BY AHU-SF-8
SERVED BY AHU-SF-9

CAPITOL BUILDING
ATTIC FLOOR
EXISTING HVAC ZONING CONCEPT

HDR PDP

N.02.02 Capitol Building Existing Plumbing Systems

There is a dedicated water meter and pressure reducing station that follow the 2" Capitol branch off of the 6" main water service in the underground Connector Building and the associated dedicated backflow preventer that is described above. A 1-1/2" branch following this serves the Capitol cooling tower make-up with a dedicated submeter. This branch is unprotected by a backflow preventer, and could potentially back-feed into the Capitol drinking water system.

A separate 6" water service was added in approximately 1999, routed from 24th Street into the front of the Capitol to serve fire protection systems. This service is protected by a double check valve backflow preventer and can likely remain to serve the modified and expanded fire protection systems; ultimate adequacy will be determined by hydraulic calculations.

A single sanitary main exits the Capitol to the west towards Carey Avenue. We were given an approximate location for this service by maintenance staff, but there is no house trap and the pipe is buried underground. An exterior cleanout was reportedly added by the staff, but has subsequently become buried in the lawn. The main is reportedly original to the building, and there is no manhole in the street at its connection to the street main. Consideration should be given to replacing it during modifications to the Capitol.

Vent stacks extend up through the roof from existing toilet fixtures. These stacks currently extend between three and eight inches above the roof level. New vent terminations must extend a minimum of 12" above the roof level, and must be a minimum of 10' from any outside air intakes (or shall be a minimum of 2' higher than any such outside air intake).

Figure N.02.02 - Existing Capitol Bldg Water Service Branch with Meter & Pressure Reducing Station

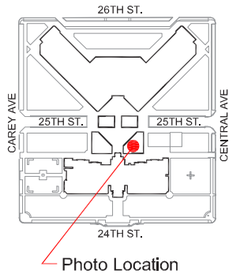
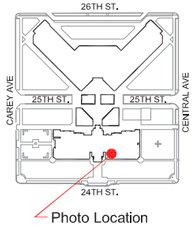
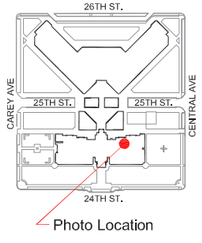
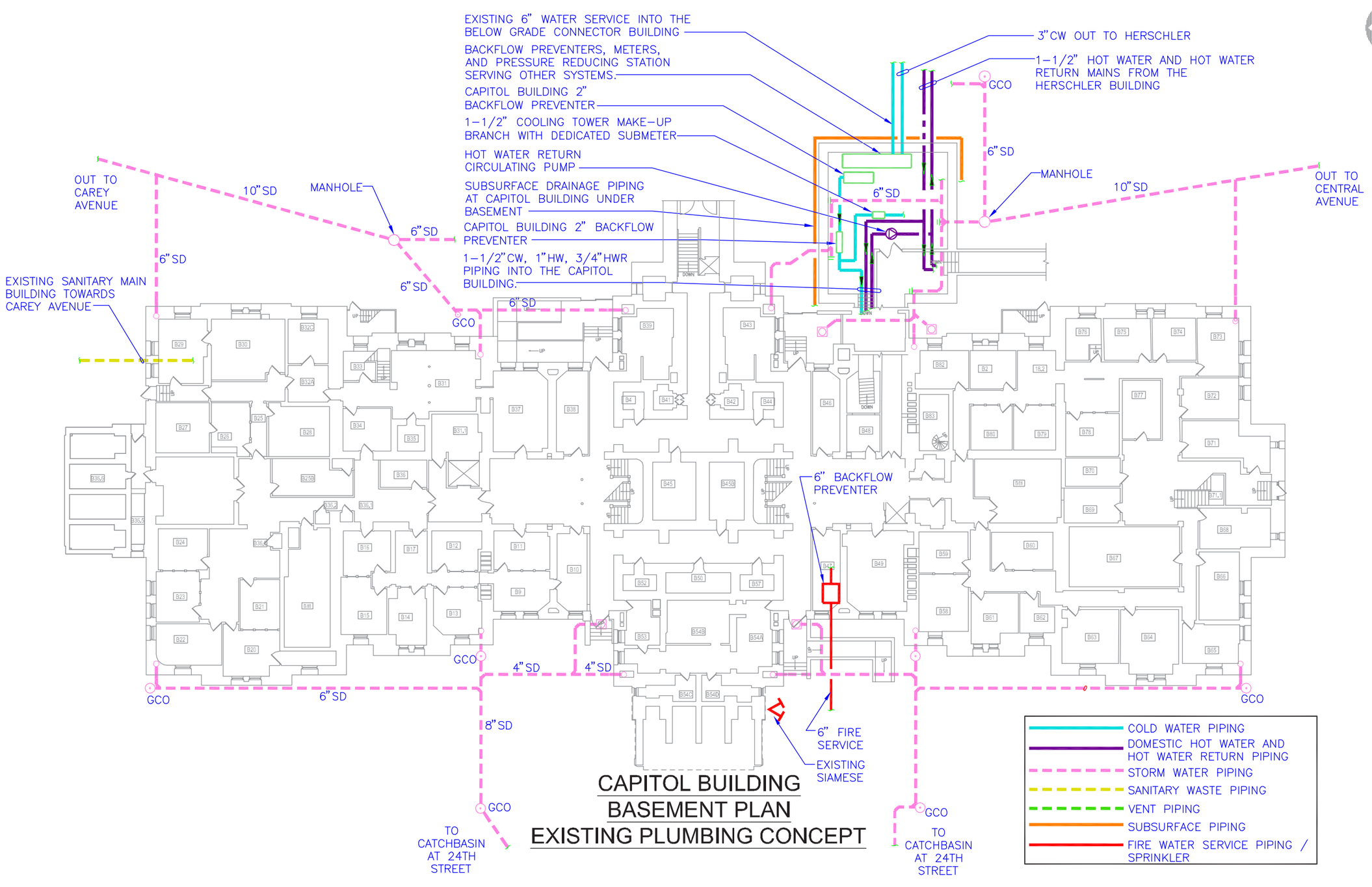


Figure N.02.03 - 6" Fire Protection Water Service with BFP, Capitol Bldg Basement

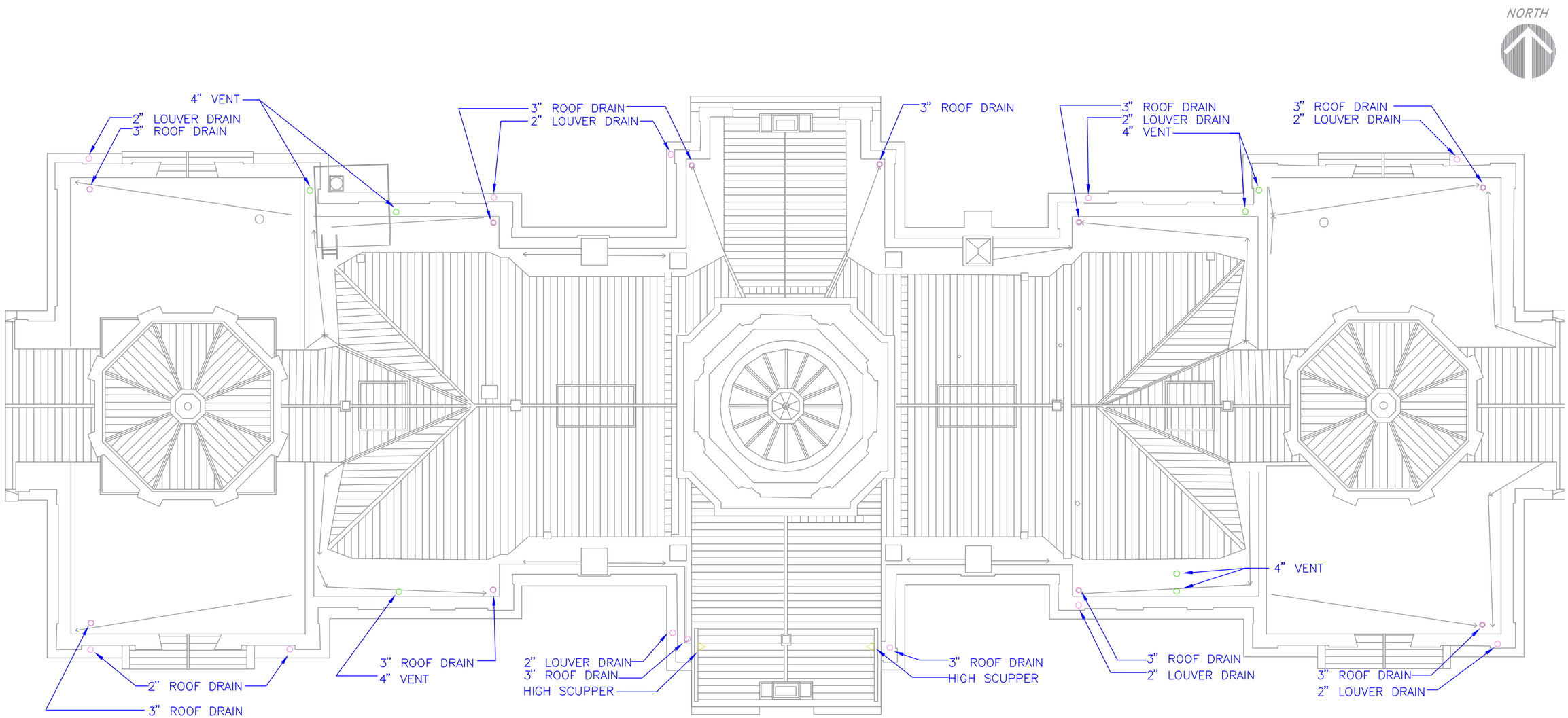
Figure N.02.04 - Existing Sanitary Vent Penetration of Roof







CAPITOL BUILDING
BASEMENT PLAN
EXISTING PLUMBING CONCEPT



LOUVER DRAINS ARE DOWN IN LOWER LEDGES AND LIKELY TIE DIRECTLY INTO VERTICAL LEADERS

COLD WATER PIPING
DOMESTIC HOT WATER AND HOT WATER RETURN PIPING
STORM WATER PIPING
SANITARY WASTE PIPING
VENT PIPING
SUBSURFACE PIPING
FIRE WATER SERVICE PIPING / SPRINKLER

CAPITOL BUILDING
ROOF PLAN
EXISTING PLUMBING CONCEPT

HDR PDP RLAM

N.02.03 Capitol Building Existing Electrical Systems

The Capitol derives electrical power from one (1) exterior 500 kVA pad-mounted utility transformer located at the northwest rear of the building. The utility transformer feeds one (1) 1,600A, 208/120V, 3-phase, 4-wire service switchboard located in the adjacent Connector Link in a dedicated main electrical room on the Basement level, west of the Connecting Corridor to the Capitol. The switchboard is fed by a single utility feeder and includes utility metering and two (2) overcurrent devices: (1) 400A that serves a chiller in the Connector Link and (1) 1,200A that serves an integral switchboard distribution section that serves all Capitol feeders. An existing "lightning protection" surge protection device is connected the the service switchboard.

The Capitol is not served by an emergency power service or generator.

Over two-dozen individual feeders from the main switchboard in the Connector Link are routed through the Connector Link in the Basement ceiling to serve the Capitol. The feeders are routed through a large splice box located in the ceiling in the Capitol's north center corridor at the location of an old switchboard that was removed when the building link was constructed; the feeders are spliced to older feeders at the splice box to serve individual Capitol electric panels.

Typical power distribution system feeders are installed in conduits and panels and are located throughout the building flush-mounted in corridors and in closets.

The panels are a mix of newer and older vintage. Wiring is a mix of newer and old vintage, some reported by facilities personnel to be old, cloth-covered type. Many of the panels and pieces of equipment are beyond their useful life expectancy.

Emergency Power:

There is no emergency power service in the building. Emergency lighting throughout the building is provided by the use of battery-powered fixtures and exit signs; a 5kW UPS inverter system that is located in the Attic provides emergency power to selected lighting in the two chambers via transfer relays at the dimming panels.

Lighting:

The typical existing lighting systems throughout the building are described in the "Lighting" report prepared by GSLD.

Fire Alarm:

The building is provided with a stand-alone conventional zoned fire alarm system ("Conventional" or "hardwired" fire alarm systems are zoned by groups of initiating devices and how they are wired. In modern "addressable" systems, every initiating device has a unique electrical address.) The fire alarm control panel is located in the Basement near the southeast handicap ramp. The fire alarm system is comprised of manual pull stations, audible horns and gongs (no visual strobe devices) and smoke detectors with door-holder devices at the Rotunda. The fire alarm system dials out to an independent central station.

Lightning Protection:

The existing building is not provided with an overall lightning protection system consisting of numerous lightning rods at the roof with multiple down-conductors to grade. However, a single "Lightning Preventer" device is mounted at the peak of the Dome; the device is connected to the ground via two (2) lightning protection down-conductors that are routed, concealed in PVC conduits, on opposite sides of the Dome through the Attic and down to the ground near the east and west elevators. Surge protection is provided on the Capitol's north switchboard (see Figure N.02.06).

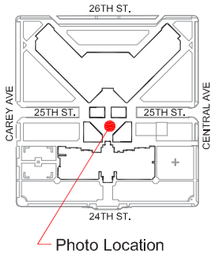


Figure N.02.05 - Capitol Bldg Service Switchboard, Connector Bldg

Figure N.02.06 - Caiptol Bldg Switchboard Surge Protector, Connector Bldg

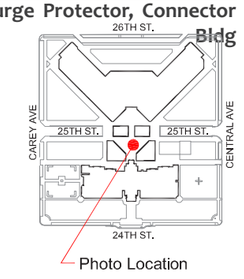
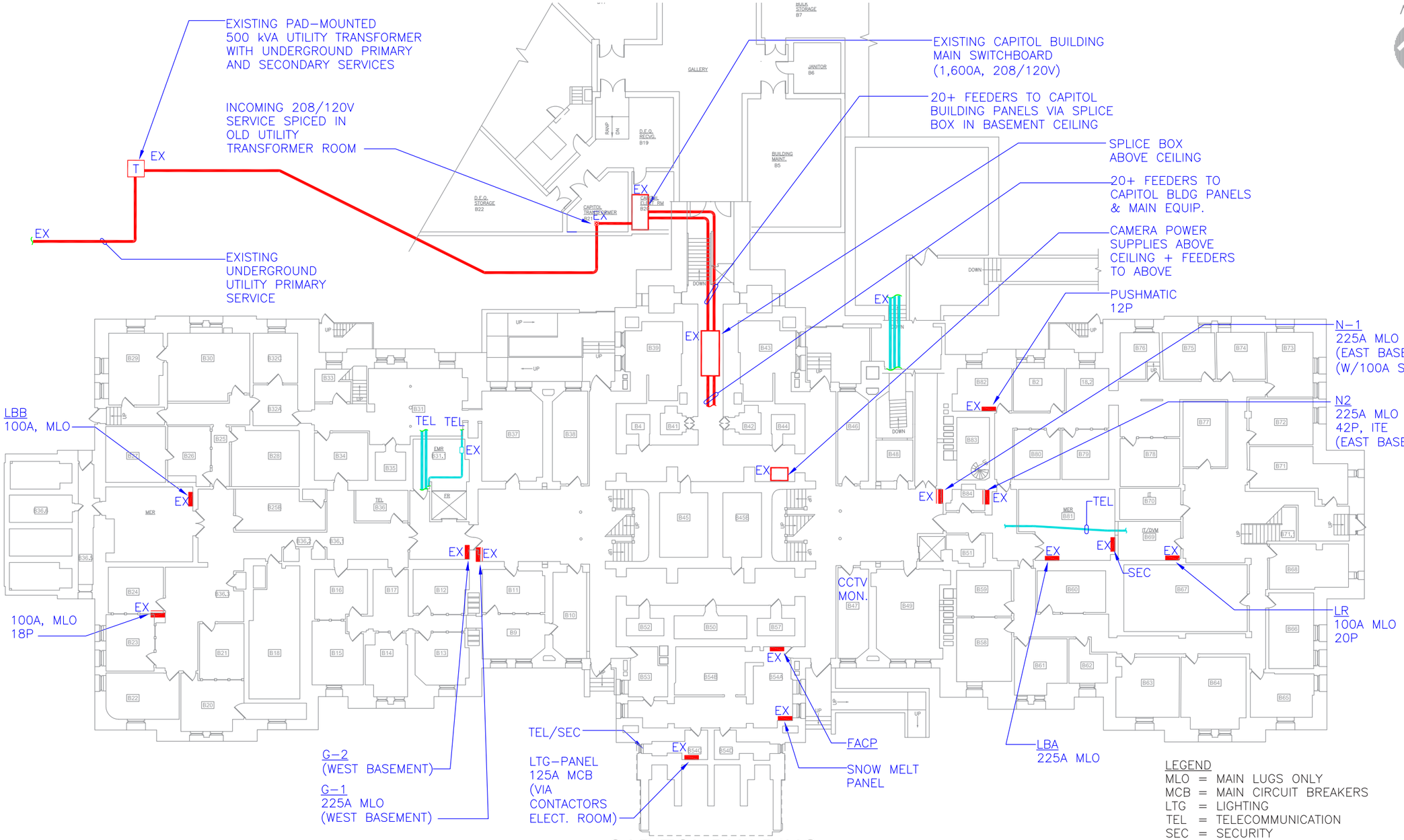


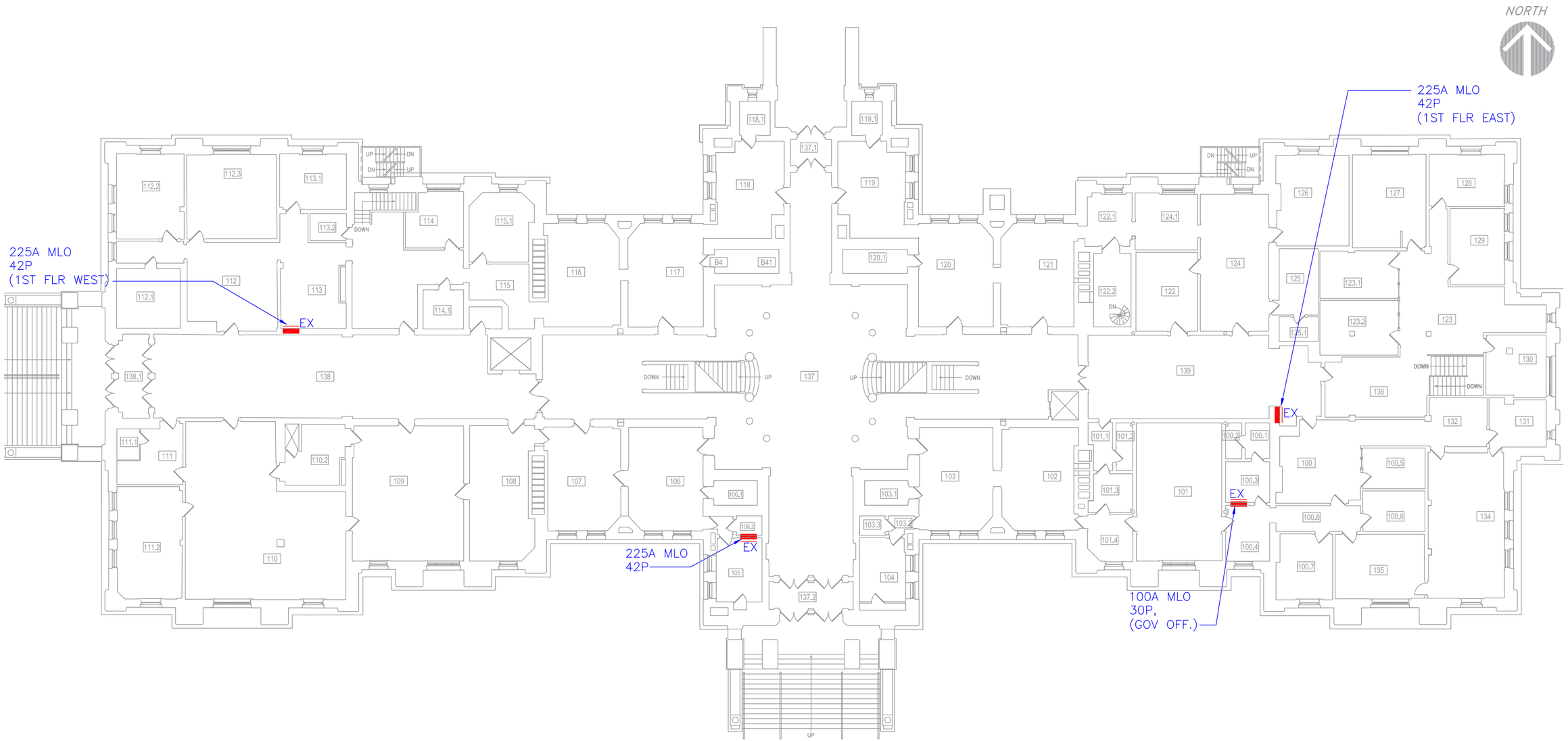
Figure N.02.07 - Existing Emergency Lighting UPS System (Attic)



CAPITOL BUILDING
BASEMENT
EXISTING ELECTRICAL PLAN

LEGEND
MLO = MAIN LUGS ONLY
MCB = MAIN CIRCUIT BREAKERS
LTG = LIGHTING
TEL = TELECOMMUNICATION
SEC = SECURITY
SUBF = SUBFEEDER
CCTV = CLOSED CIRCUIT TELEVISION
A = AMPS
EX = EXISTING
FACP = FIRE ALARM CONTROL PANEL

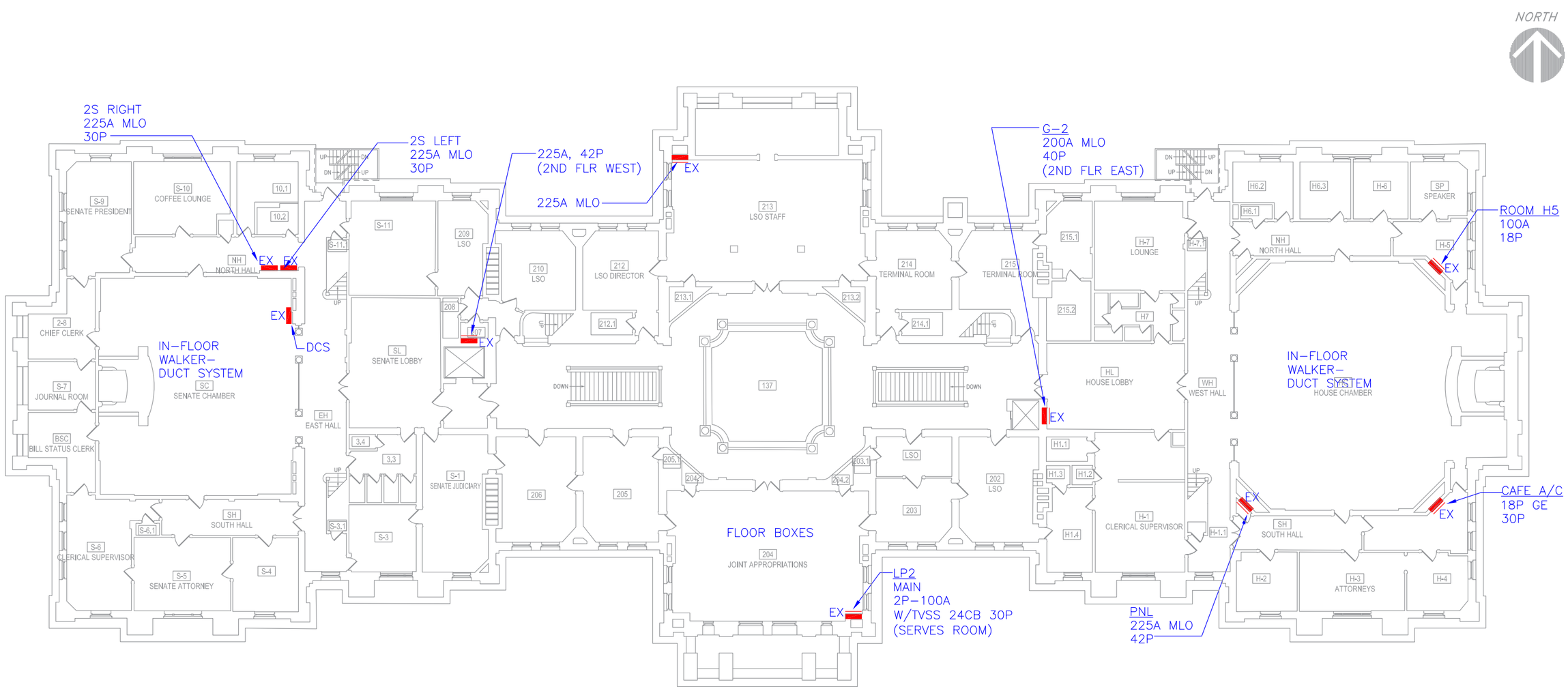
HDR PDP FM



CAPITOL BUILDING
FIRST FLOOR
EXISTING ELECTRICAL PLAN

LEGEND
MLO = MAIN LUGS ONLY
MCB = MAIN CIRCUIT BREAKERS
LTG = LIGHTING
TEL = TELECOMMUNICATION
SEC = SECURITY
SUBF = SUBFEEDER
CCTV = CLOSED CIRCUIT TELEVISION
A = AMPS
EX = EXISTING
FACP = FIRE ALARM CONTROL PANEL

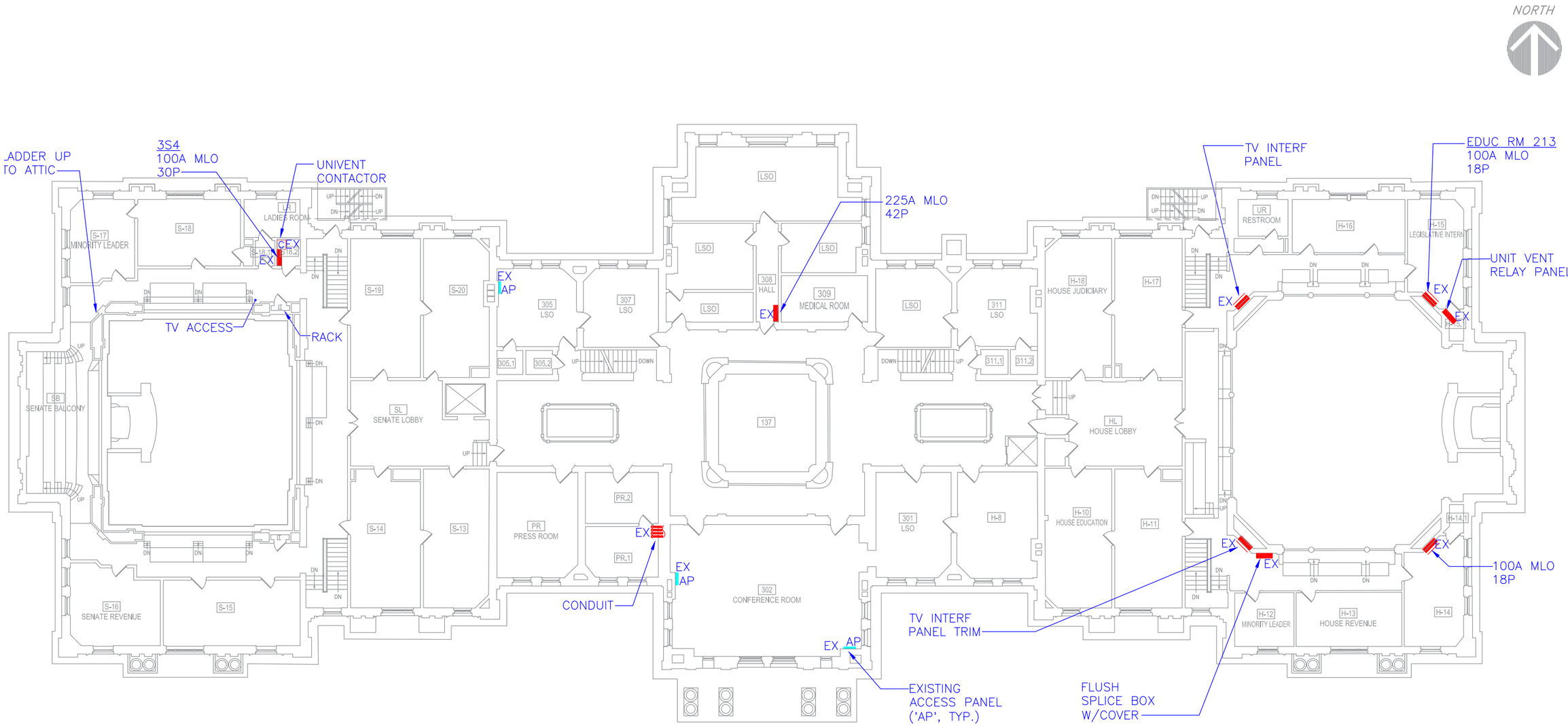
HDR PDP



CAPITOL BUILDING
SECOND FLOOR
EXISTING ELECTRICAL PLAN

LEGEND
MLO = MAIN LUGS ONLY
MCB = MAIN CIRCUIT BREAKERS
LTG = LIGHTING
TEL = TELECOMMUNICATION
SEC = SECURITY
SUBF = SUBFEEDER
CCTV = CLOSED CIRCUIT TELEVISION
A = AMPS
EX = EXISTING
FACP = FIRE ALARM CONTROL PANEL

HDR PDP RLM



CAPITOL BUILDING
THIRD FLOOR
EXISTING ELECTRICAL PLAN

LEGEND
MLO = MAIN LUGS ONLY
MCB = MAIN CIRCUIT BREAKERS
LTG = LIGHTING
TEL = TELECOMMUNICATION
SEC = SECURITY
SUBF = SUBFEEDER
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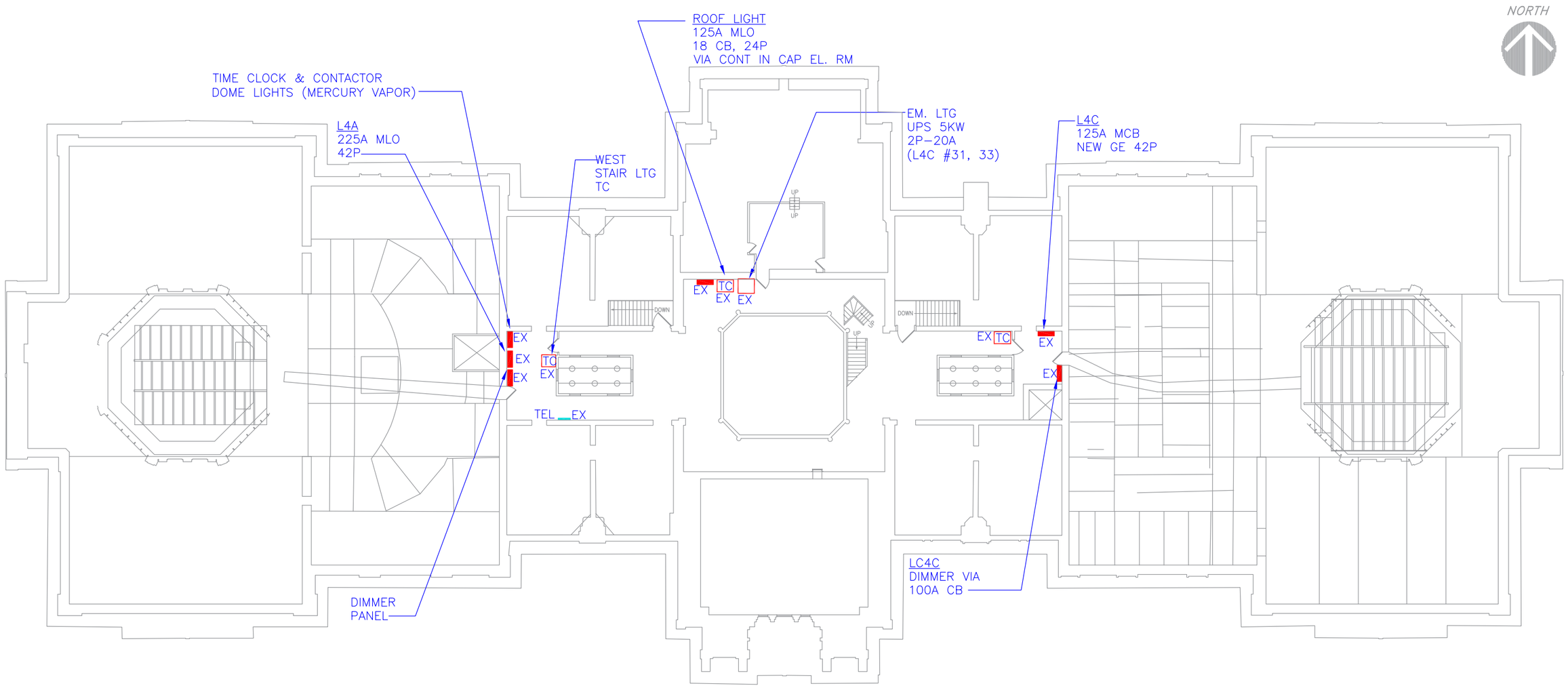
HDR PDP



LEGEND
MLO = MAIN LUGS ONLY
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LTG = LIGHTING
TEL = TELECOMMUNICATION
SEC = SECURITY
SUBF = SUBFEEDER
CCTV = CLOSED CIRCUIT TELEVISION
A = AMPS
EX = EXISTING
FACP = FIRE ALARM CONTROL PANEL

CAPITOL BUILDING
ATTIC PLAN
EXISTING ELECTRICAL PLAN

HDR PDP P4

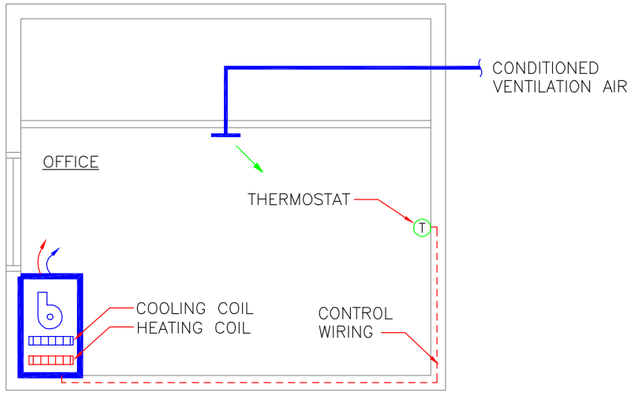


Figure N.03.01 - Typical Fan Coil Unit Arrangement

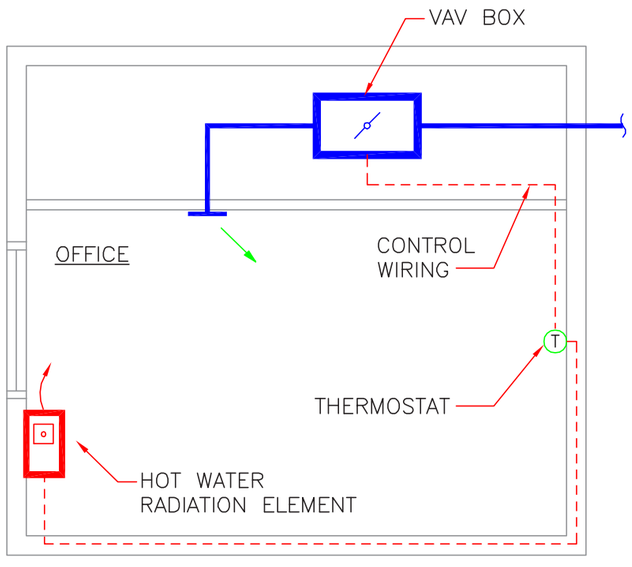


Figure N.03.02 - Typical All-Air System Arrangement

N.03.01 Capitol - Proposed HVAC Systems

General Design Intent:

The Central Plant will be utilized for heating and cooling generation. This plant will produce steam for heating purposes and chilled water for cooling purposes.

The HVAC systems for the Capitol will generally consist of multiple air handling units to serve common program area types in a given area of the building which will have similar hours of operation. Economizers located at the Central Plant will be used to reduce energy consumption via a free cooling cycle and limit the amount of mechanical cooling required throughout the year. The economizer cycle will take advantage of Cheyenne's dry and cool climate.

Ventilation:

Ventilation systems will be designed in accordance with the 2012 International Mechanical Code. Ventilation systems for the House Chamber (101 people) House Balcony (139 people), Senate Chamber (58 people) and Senate Balcony (206 people) will be based upon a normal occupancy. These limitations will avoid oversizing equipment for one-off events and will reduce overall system life cycle costs.

Heating System:

The Central Plant high pressure steam will serve the comfort heating and humidification requirements for the building. A new 2-stage 1/3, 2/3 parallel pressure reducing valve station will be provided to reduce the incoming steam pressure to roughly 10 psig. This low pressure steam will serve three (3) shell and tube hot water convertors for comfort heating and Domestic hot water storage type heaters.

The comfort heating system will consist of the following:

- One (1) steam to hot water converter to serve the pre-heat requirements for the air handling systems
- One (1) steam to hot water converter to serve the perimeter heating system and any reheat requirements
- One (1) common standby heat exchanger to serve both the pre-heat, perimeter and reheat requirements

The hot water system serving the preheat system will utilize propylene glycol for freeze protection purposes and will consist of two (2) variable speed primary hot water pumps that distribute 180 degree F water. A glycol storage tank with pre-mixing glycol solution and duplex fill pumps will be provided.

The hot water system serving the perimeter heating system will consist of two (2) variable speed primary hot water pumps. This system will have a variable temperature discharge setpoint based upon outdoor air temperature.

It is anticipated that a new hot water heat exchanger / pump room will be provided outside the footprint of the Capitol. This equipment will be located in the Connector Building and will require roughly 1200 square feet of space.

Chilled Water System:

The Central Plant chilled water will serve the comfort cooling requirement of the building. Secondary cooling distribution pumps will be located in the Cooling Plant. Chilled water will be available year round.

Air Distribution Systems:

Available Options

For a building with historical significance such as the Capitol, there are two main options for space conditioning:

Option 1 (Fan Coil Units):

Basement:

Office type spaces located in the east and west wing of the Basement will have local individual four pipe fan coil units with dedicated temperature controls and dedicated outdoor air handler systems. [*Figure N.03.01*]

Office type spaces located in the central parts of Basement will have all air-side systems that will provide individual temperature control via variable volume boxes and vary the air flow rate in accordance with the temperature requirements of the spaces. [*Figure N.03.02*]

Upper Floors:

High occupancy spaces, such as the House and Senate Chambers and the large Committee Rooms will have dedicated air handling units

Office type spaces will have all air-side systems that will provide individual temperature control via variable volume boxes and vary the air flow rate in accordance with the temperature requirements of the spaces

Option 2 (All-Air Systems):

Basement:

Office type spaces of Basement will have all air-side systems that will provide individual temperature control via variable volume boxes and vary the air flow rate in accordance with temperature requirements of the spaces. [*Figure N.03.02*]

Upper Floors:

Identical to Option 1, above.

Benefits of Both Option 1 and Option 2:

AHU's are an appropriate choice for high occupancy spaces such as Chambers, Committee Rooms and Conference Rooms as the required number of fan coil units would be excessive.

The benefits of Option 1 (AHU's and some fan-coil units) are:

1. Individual temperature control for each system.
2. Limited overhead ventilation ductwork sizes, especially for the Basement which has a low existing floor to floor height.

The benefits of Option 2 (all AHU's) are:

1. Energy efficiency – larger more efficient fans than in fan coil units
2. Ability to vary the flow rate and save energy with individual temperature control via variable volume boxes, which vary the air flow rate in accordance with cooling requirements of the space
3. Eliminates maintenance of multiple fans in the occupied spaces. Centralized maintenance is primarily limited to mechanical rooms
4. Noise producing equipment is easier to attenuate due to the fact that this equipment is physically remote from the occupied space
5. Distribution is primarily above ceilings or in trenches, therefore impacts to program space are reduced (fan coil units would take up significant wall space or other floor space)
6. Access to maintenance items in the occupied spaces is limited to terminal VAV boxes located above the ceilings or in trenches. Ceiling Access doors will be required in inaccessible ceilings

General Air Distribution Systems design

Local air handling systems will be designed to provide operational flexibility and to limit main duct sizes in the historic structure. Exhaust fans will be utilized in the systems to relieve excess building pressure and reduce overall air handling system fan horsepower. Multiple air handling systems will be required to meet the zoning requirements and work within existing structural limitations. This arrangement also offers the inherent benefits of allowing for independent operation of different spaces throughout the building and allowing for off-hours operation of distinct smaller zones throughout the building

In general, air handling units serving the Basement and First Floor will be located in the Basement and air handling units serving the Second through Third Floors will be located in the Attic. Proposed air handling zoning drawings are included herein.

Senate and House Chambers

Each of the Chambers will have dedicated air handling units. The intention of having dedicated air handling units is to serve the heating and cooling requirements. When the General Assembly is in session, the air handling units will operate at full speed. When not in session, the air handling units will operate at reduced speed with reduced ventilation rates.

Large Committee Rooms

Similarly, each of the Large Committee Rooms will have dedicated air handling units. The purpose of having a dedicated air is to serve the heating and cooling requirements independently of other rooms in the building.

Office Type Spaces

Office spaces on the lower floors will be connected to common air handling units based upon location in the building. The need for individual room or department control will be satisfied by a variable air volume (VAV) system (Option 1 and 2) or fan coil units (Option 2, only) in individual offices. Individual central VAV systems will be provided for the various zones of the office sector and will be located in the Basement and Attic.

All systems will be capable of providing 24-hour air conditioning and/or heating. Cooling will be performed by chilled water coils in the air handling units. Cooling will be provided by chilled water coils which use water side economizer operation in winter. Due to limited floor areas and the need to maximize program spaces, water side economizers will be used in lieu of airside economizers due to the associated larger shaft requirements for airside economizer. The use of waterside economizer allows for free cooling for a large number of hours throughout the year and takes advantage of the inherent dry and cool climate in Cheyenne. Refer to Appendix N1 for applicable design data for Cheyenne.

Critical spaces, such as the Main Telecommunications Room and A/V Rooms which require year-round cooling, will have dedicated air conditioning units.

Space heating will be provided as follows:

- Tempering outside air in the air handling units with hot water preheat coils.
- Hot water reheat coils downstream of the terminal variable and constant air volume boxes.
- Hot water perimeter finned tube radiation.

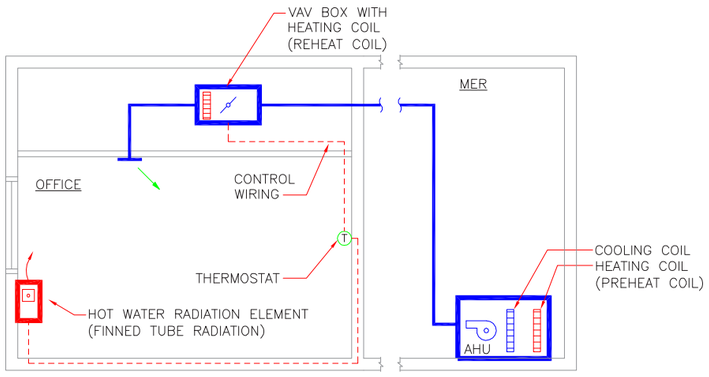


Figure N.03.03 - Typical Perimeter Zone Heat Arrangement

The air handling units will distribute air to the spaces via medium pressure and low pressure ductwork. Similar thermal zones that are connected to a common air handling unit will have individual thermostatic control via the use of pressure independent terminal VAV boxes.

Custom air handling units will consist of supply fan, cooling coil, access section, preheat coil, access section, humidifiers (where applicable), final filters and pre-filters. Custom air handling units will be selected with coil velocities to allow for future increased capacities. All custom air handling units will include external discharge attenuators on supply and return sections. Each custom air handling unit will be provided with minimum outdoor air as required to meet code. Heat recovery will be investigated for sensible heat recovery in winter for spaces that are continuously occupied.

Conference-type spaces will be provided with occupancy sensors to close off variable air volume (VAV) boxes during unoccupied periods to prevent overcooling. Additionally, Demand Controlled Ventilation (DCV) strategies will be incorporated in order to reduce outdoor air intake during reduced occupancies for all high occupancy type spaces.

The Attic and Dome spaces will be minimally heated and ventilated. Exact thermal requirements will be confirmed in a later phase pending further investigation. Requirements for mechanical dehumidification will be confirmed pending further analysis.

Ductwork located downstream of VAV boxes will be provided with an integral sound trap or acoustical lining.

Supply and return air ducts connecting the noise-sensitive spaces will be sized for low air flow velocities, to achieve low noise levels in accordance with noise criteria and sensibilities of program uses.

Filtration

Air filtration to control contaminants will be provided in the air handlers by means of 30% Atmospheric dust spot efficiency pre-filters and 85% final filters.

Atrium Smoke Control:

- Four (4) dedicated up-blast exhaust fans rated at 22,500 CFM each will be provided for atrium smoke control and interconnected to the fire alarm system.
- Requirements for natural or mechanical make-up air for the exhaust system will be confirmed as the design progresses. Schematic plans of proposed make-up air concepts are included in this section.

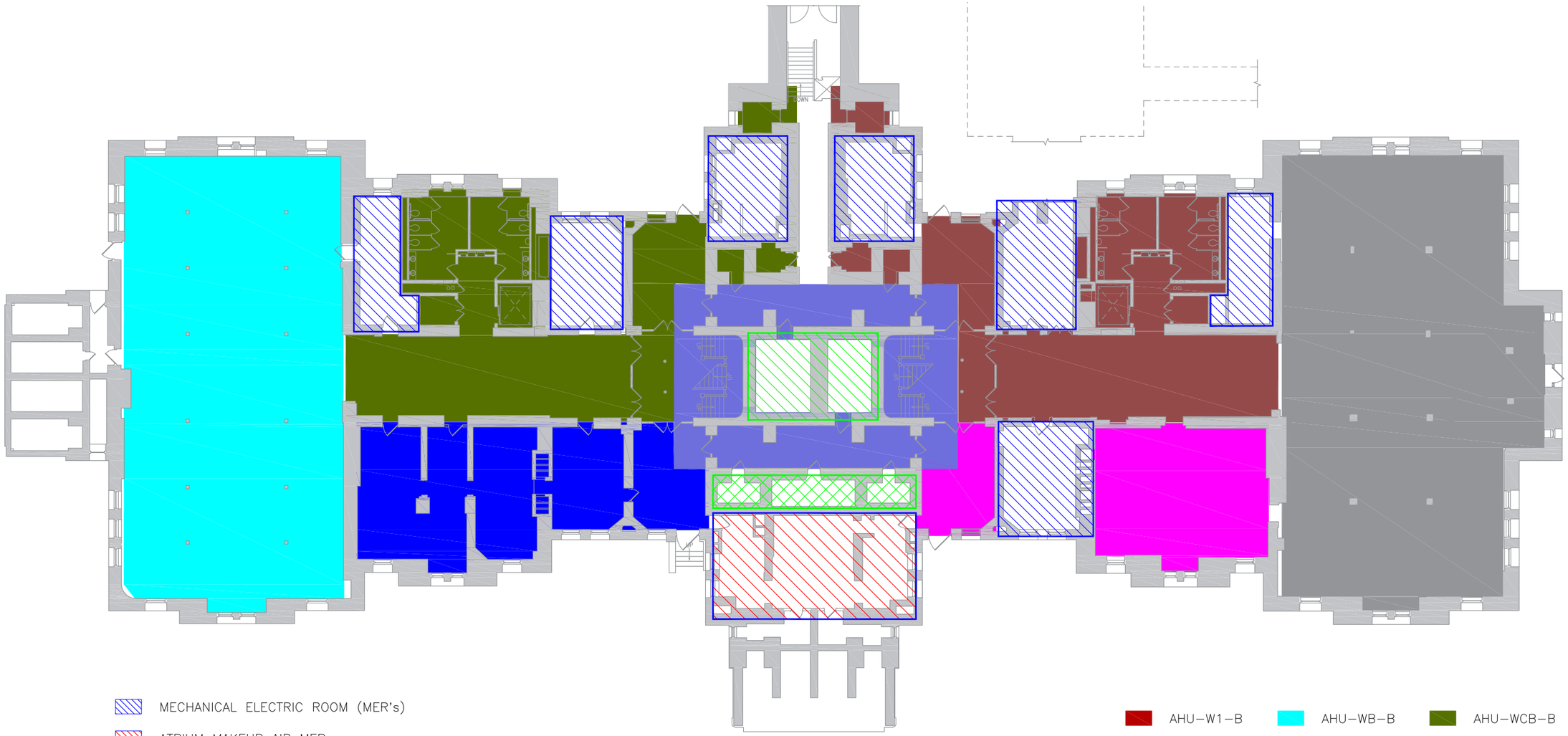
Leak Detection

There is an inherent concern with locating air handling equipment and associated piping in the Attic, due to the potential for pipe leaks. While no measure is foolproof, potential strategies for addressing this issue are outlined, in ascending order of protection below:

- Areas where AHU's will be located will have a new slab
- Each slab will be a "tub" construction with waterproofing (Kemper or equal) with curbs and drains
- Sensors will be located at key locations (water leak detectors)
- Shut-off valves
- Pipe-within-a-pipe (double wall)
- All systems will be accessible for repair
- Pipe-within-a-pipe (double wall) will be open-protocol so that they can interface with the existing statewide Tritium network system.

Building Automation System (BAS)

All systems will be provided with direct digital control (DDC) via a distributed network. All controls systems will be open-protocol so that they can interface with the existing statewide Tritium network system. The BAS will be capable of providing remote read out and operating via the existing statewide network.



MECHANICAL ELECTRIC ROOM (MER's)

ATRIUM MAKEUP AIR MER

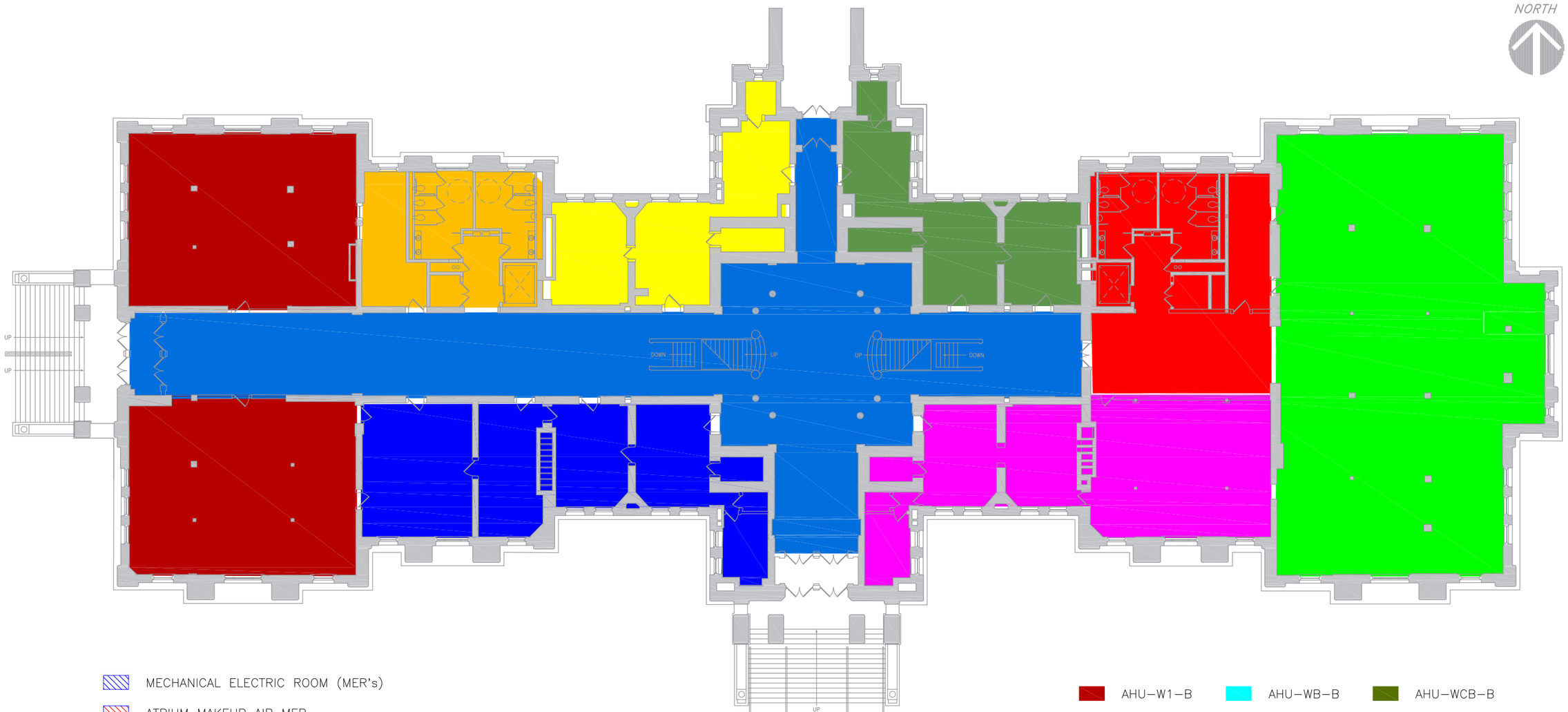
ELECTRICAL ROOMS

TELECOM / SECURITY ROOMS

(NOMENCLATURE FOR EXISTING SYSTEMS)
AHU = AIR HANDLING UNIT
SF = SUPPLY FAN
N = NORTH
E = EAST
S = SOUTH
W = WEST
R = ROTUNDA

AHU-W1-B
AHU-WB-B
AHU-WCB-B
AHU-N1-B
AHU-S1-B
AHU-ECB-B
AHU-N2-B
AHU-S2-B
AHU-N3-B
AHU-EB-B
AHU-N4-B
AHU-C-B
AHU-E1-B
AHU-R1-B

CAPITOL BUILDING
BASEMENT
PROPOSED HVAC ZONING CONCEPT



MECHANICAL ELECTRIC ROOM (MER's)

ATRIUM MAKEUP AIR MER

ELECTRICAL ROOMS

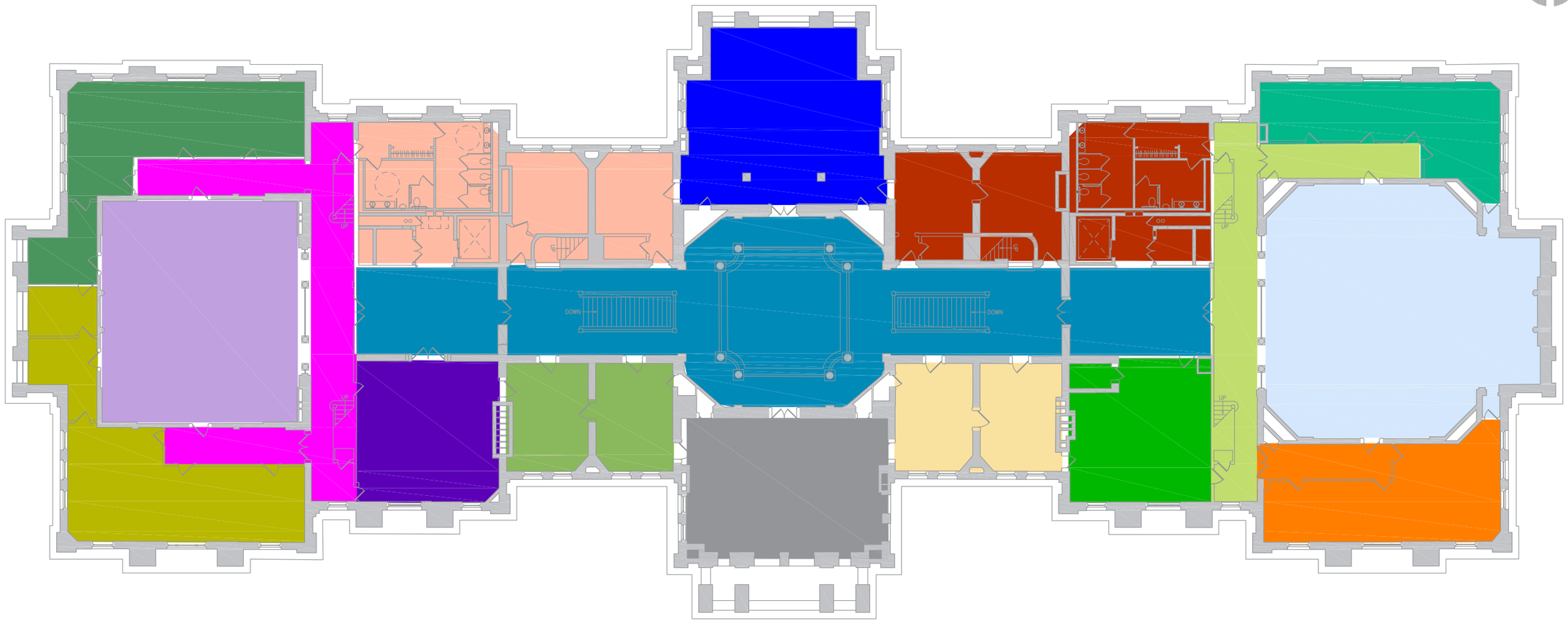
TELECOM / SECURITY ROOMS

(NOMENCLATURE FOR EXISTING SYSTEMS)
AHU = AIR HANDLING UNIT
SF = SUPPLY FAN
N = NORTH
E = EAST
S = SOUTH
W = WEST
R = ROTUNDA

AHU–W1–B
AHU–WB–B
AHU–WCB–B
AHU–N1–B
AHU–S1–B
AHU–ECB–B
AHU–N2–B
AHU–S2–B
AHU–N3–B
AHU–EB–B
AHU–N4–B
AHU–C–B
AHU–E1–B
AHU–R1–B

CAPITOL BUILDING
FIRST FLOOR
PROPOSED HVAC ZONING CONCEPT

NORTH



MECHANICAL ELECTRIC ROOM (MER's)

ATRIUM MAKEUP AIR MER

ELECTRICAL ROOMS

TELECOM / SECURITY ROOMS

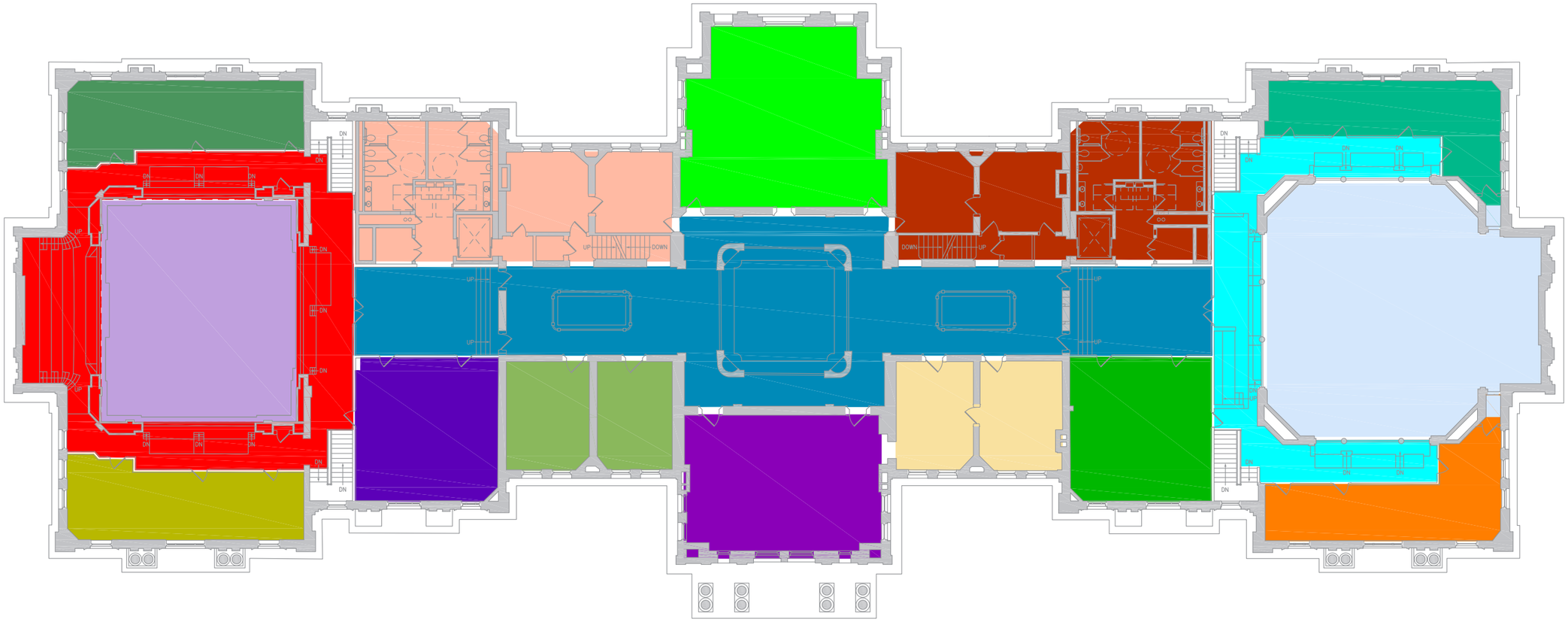
(NOMENCLATURE FOR EXISTING SYSTEMS)
AHU = AIR HANDLING UNIT
SF = SUPPLY FAN
N = NORTH
E = EAST
S = SOUTH
W = WEST
R = ROTUNDA

SENATE CHAMBERS
SENATE UPPER
AHU–SENATE–N–A
AHU–SENATE–S–A
HOUSE CHAMBERS
HOUSE UPPER
AHU–HOUSE–N–A
AHU–HOUSE–S–A
ROTUNDA
AHU–NW–A
AHU–NE–A
AHU–N–CENTER3–A
AHU–N–CENTER2–A
AHU–SE–A
AHU–SW–A
AHU–S–CENTER3–A
AHU–S–CENTER2–A
AHU–SENATE–BREAKOUT–A
AHU–HOUSE–BREAKOUT–
AHU–SENATE–LOBBY–A
AHU–HOUSE–LOBBY–A

CAPITOL BUILDING
SECOND FLOOR
PROPOSED HVAC ZONING CONCEPT

HDR PDP

NORTH



MECHANICAL ELECTRIC ROOM (MER's)

ATRIUM MAKEUP AIR MER

ELECTRICAL ROOMS

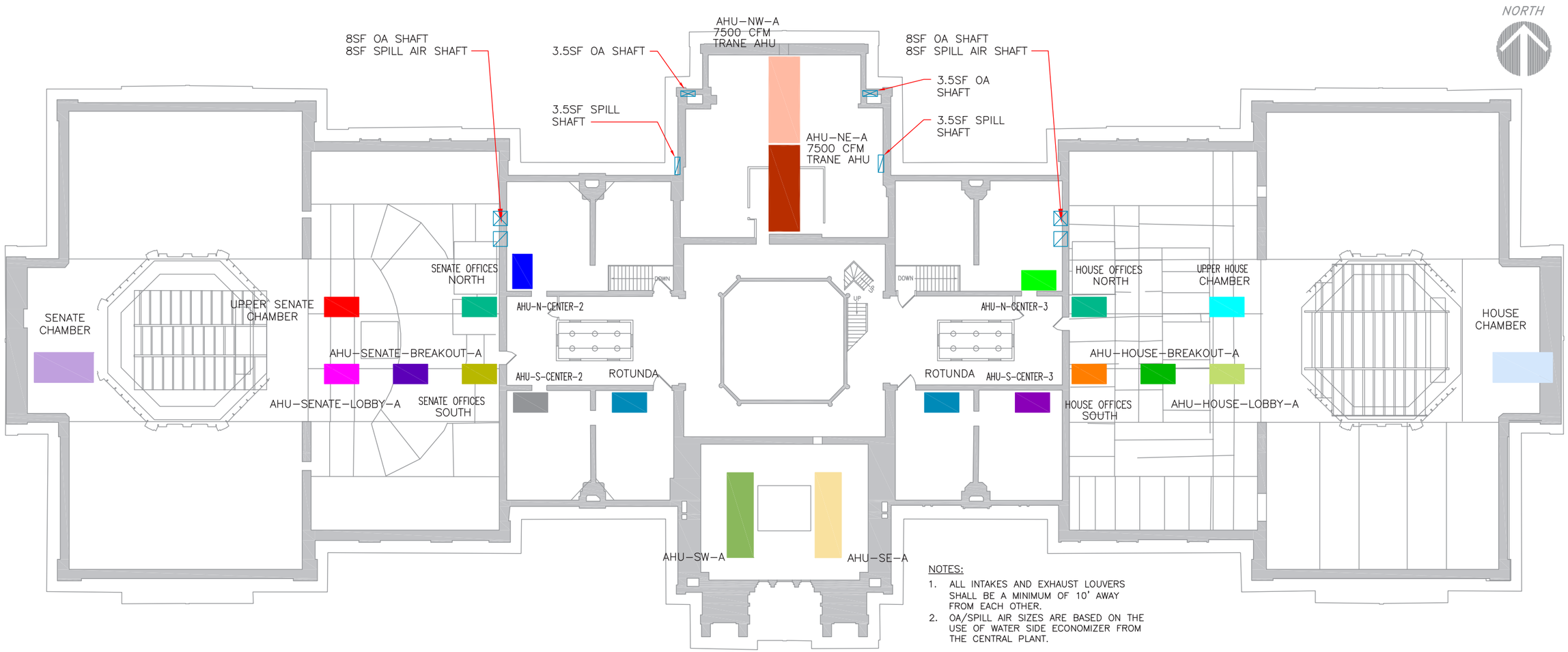
TELECOM / SECURITY ROOMS

(NOMENCLATURE FOR EXISTING SYSTEMS)
AHU = AIR HANDLING UNIT
SF = SUPPLY FAN
N = NORTH
E = EAST
S = SOUTH
W = WEST
R = ROTUNDA

SENATE CHAMBERS
SENATE UPPER
AHU–SENATE–N–A
AHU–SENATE–S–A
HOUSE CHAMBERS
HOUSE UPPER
AHU–HOUSE–N–A
AHU–HOUSE–S–A
ROTUNDA
AHU–NW–A
AHU–NE–A
AHU–N–CENTER3–A
AHU–N–CENTER2–A
AHU–SE–A
AHU–SW–A
AHU–S–CENTER3–A
AHU–S–CENTER2–A
AHU–SENATE–BREAKOUT–A
AHU–HOUSE–BREAKOUT–
AHU–SENATE–LOBBY–A
AHU–HOUSE–LOBBY–A

CAPITOL BUILDING
THIRD FLOOR
PROPOSED HVAC ZONING CONCEPT

HDR PDP FFA



NOTES:

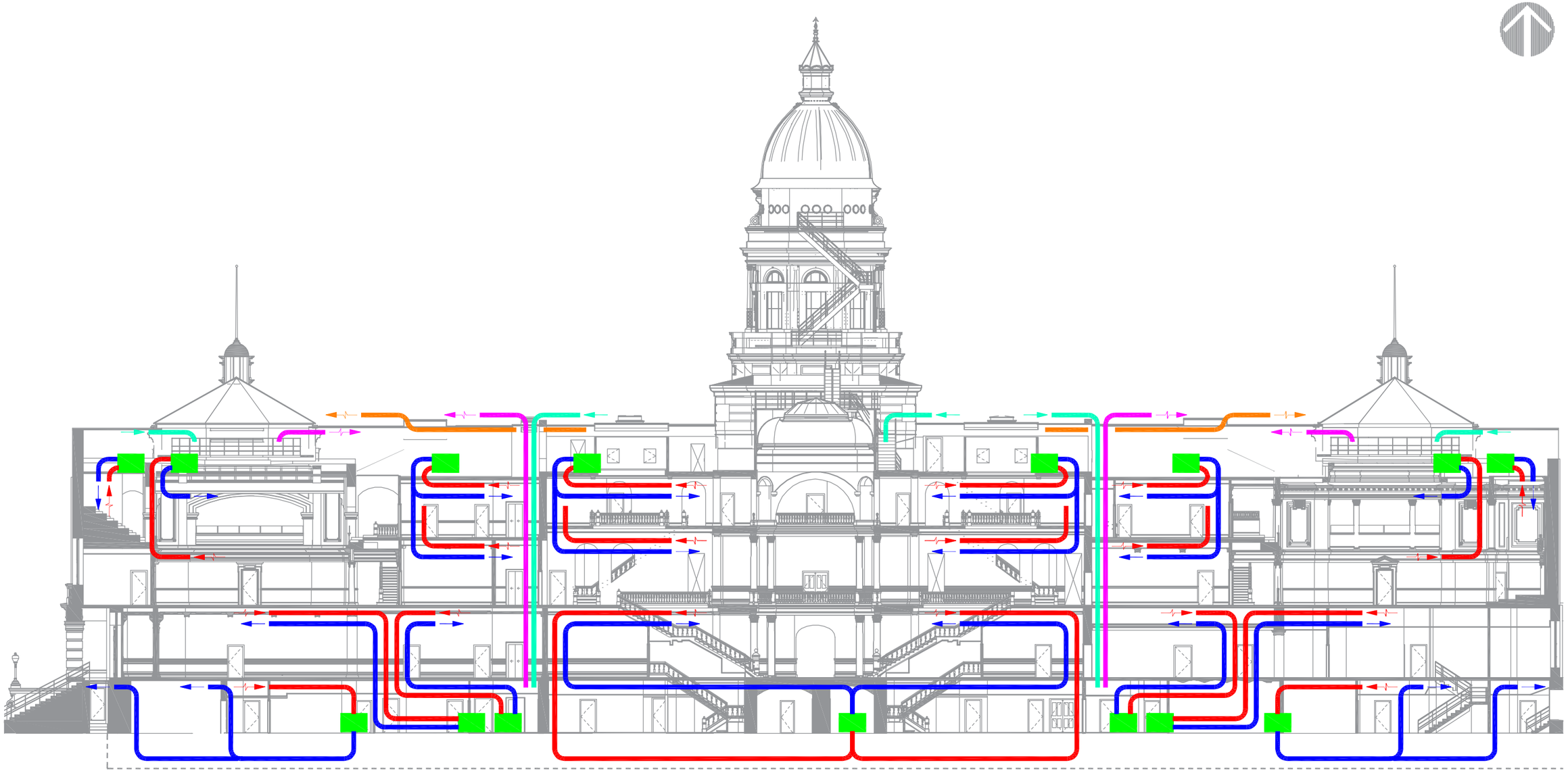
1. ALL INTAKES AND EXHAUST LOUVERS SHALL BE A MINIMUM OF 10' AWAY FROM EACH OTHER.
2. OA/SPILL AIR SIZES ARE BASED ON THE USE OF WATER SIDE ECONOMIZER FROM THE CENTRAL PLANT.

- SENATE CHAMBERS
- SENATE UPPER
- AHU-SENATE-N-A
- AHU-SENATE-S-A
- HOUSE CHAMBERS
- HOUSE UPPER
- AHU-HOUSE-N-A
- AHU-HOUSE-S-A
- ROTUNDA
- AHU-NW-A
- AHU-NE-A
- AHU-N-CENTER3-A
- AHU-N-CENTER2-A
- AHU-SE-A
- AHU-SW-A
- AHU-S-CENTER3-A
- AHU-S-CENTER2-A
- AHU-SENATE-BREAKOUT-A
- AHU-HOUSE-BREAKOUT-A
- AHU-SENATE-LOBBY-A
- AHU-HOUSE-LOBBY-A

CAPITOL BUILDING
ATTIC FLOOR
PROPOSED HVAC CONCEPT

HDR PDP

NORTH



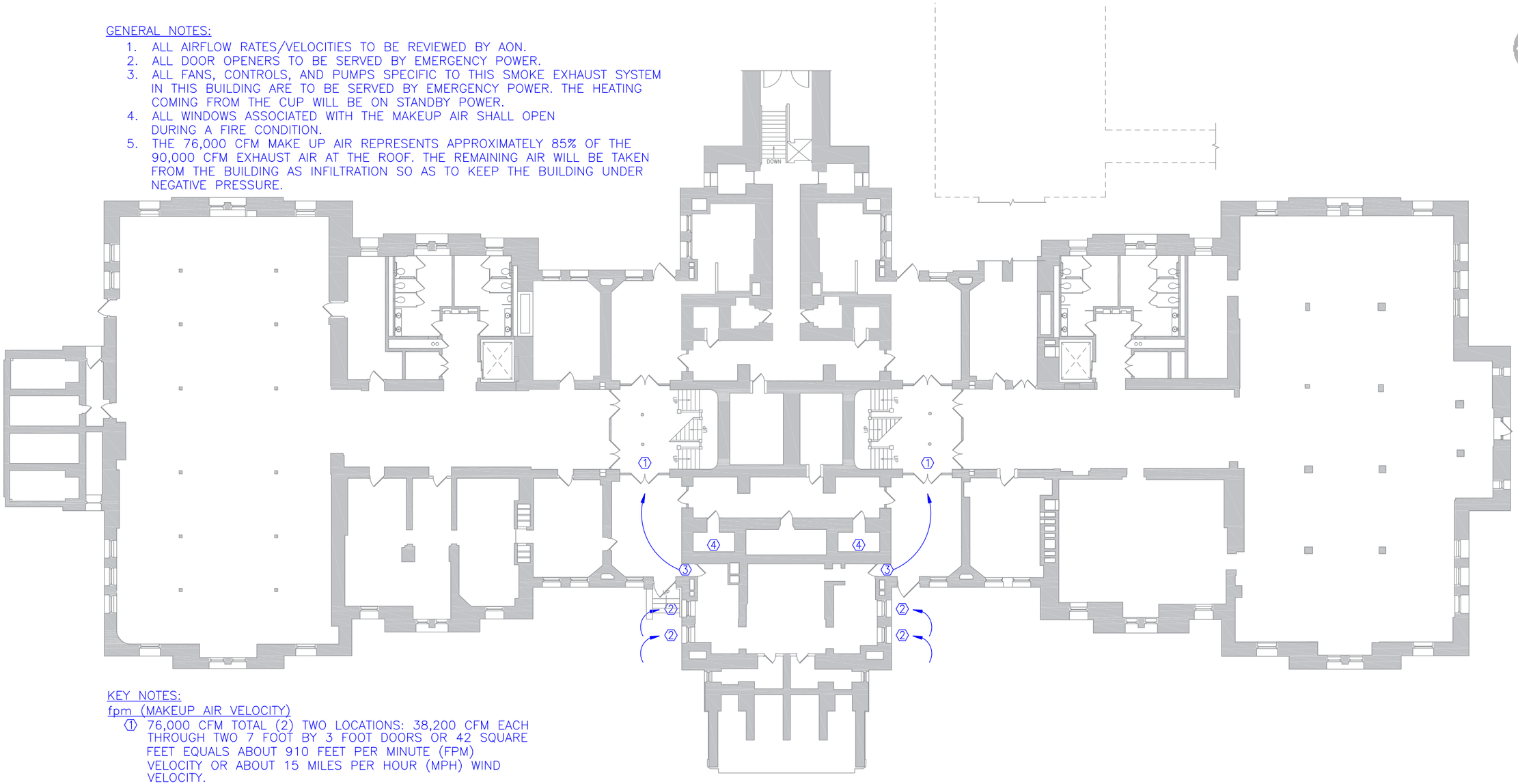
CAPITOL BUILDING
PROPOSED HVAC ZONING RISER CONCEPT

LEGEND
- SUPPLY AIR
- RETURN AIR
- OUTDOOR AIR INTAKE
- EXHAUST AIR
- ATRIUM EXHAUST
- UNDERGROUND TRENCH

GENERAL NOTES:

1. ALL AIRFLOW RATES/VELOCITIES TO BE REVIEWED BY AON.
2. ALL DOOR OPENERS TO BE SERVED BY EMERGENCY POWER.
3. ALL FANS, CONTROLS, AND PUMPS SPECIFIC TO THIS SMOKE EXHAUST SYSTEM IN THIS BUILDING ARE TO BE SERVED BY EMERGENCY POWER. THE HEATING COMING FROM THE CUP WILL BE ON STANDBY POWER.
4. ALL WINDOWS ASSOCIATED WITH THE MAKEUP AIR SHALL OPEN DURING A FIRE CONDITION.
5. THE 76,000 CFM MAKE UP AIR REPRESENTS APPROXIMATELY 85% OF THE 90,000 CFM EXHAUST AIR AT THE ROOF. THE REMAINING AIR WILL BE TAKEN FROM THE BUILDING AS INFILTRATION SO AS TO KEEP THE BUILDING UNDER NEGATIVE PRESSURE.

NORTH



KEY NOTES:

fpm (MAKEUP AIR VELOCITY)

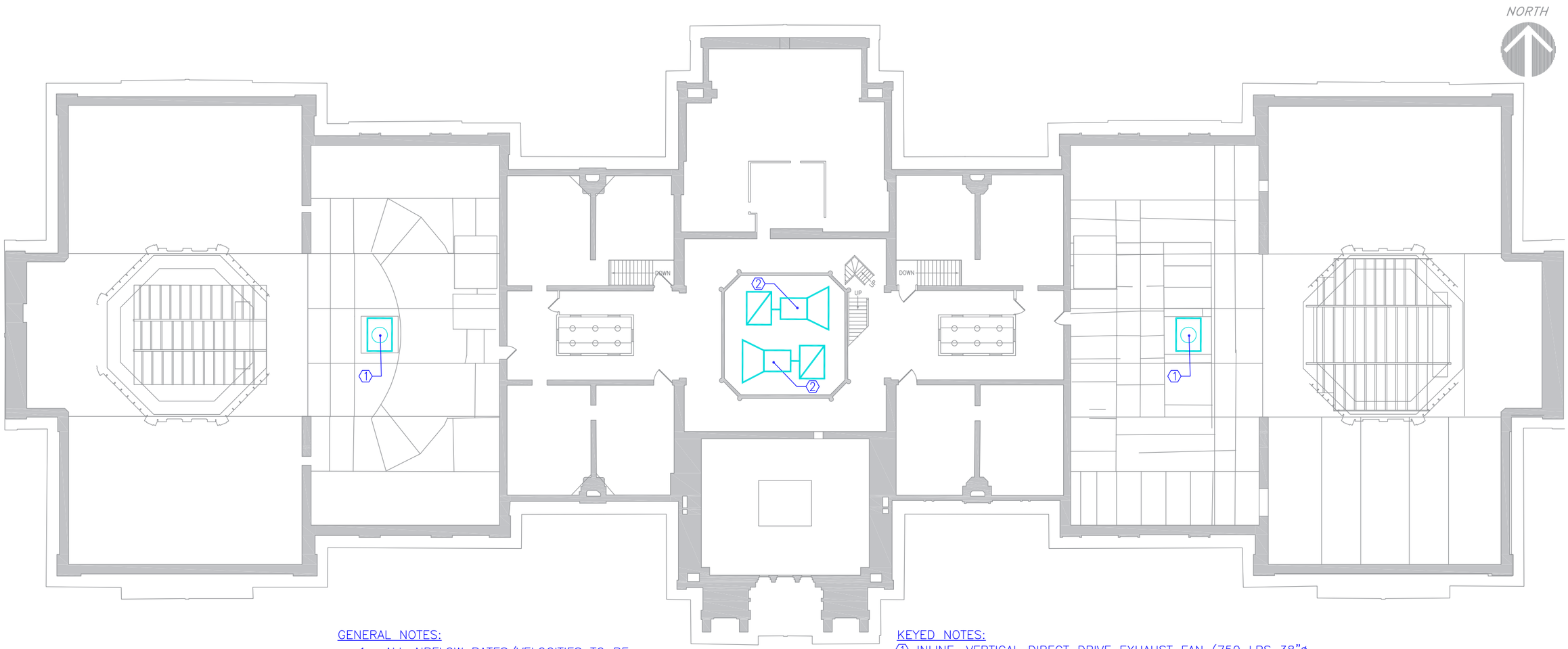
① 76,000 CFM TOTAL (2) TWO LOCATIONS: 38,200 CFM EACH THROUGH TWO 7 FOOT BY 3 FOOT DOORS OR 42 SQUARE FEET EQUALS ABOUT 910 FEET PER MINUTE (FPM) VELOCITY OR ABOUT 15 MILES PER HOUR (MPH) WIND VELOCITY.

② DEDICATED SMOKE EXHAUST MAKE UP AIR: (4) FOUR EXISTING 15 SF WINDOWS 76,400 CFM (FROM MAKEUP FAN) @ 60 SF = 1275 FPM

③ 21 SF OPENING @ 19,100 CFM = 910 FPM

④ NEW 21 SF OPENING IN WALL @ 19,100 CFM = 910 FPM

CAPITOL BUILDING
BASEMENT
SMOKE EXHAUST SYSTEM BASEMENT MAKEUP AIR



GENERAL NOTES:

1. ALL AIRFLOW RATES/VELOCITIES TO BE REVIEWED BY AON.

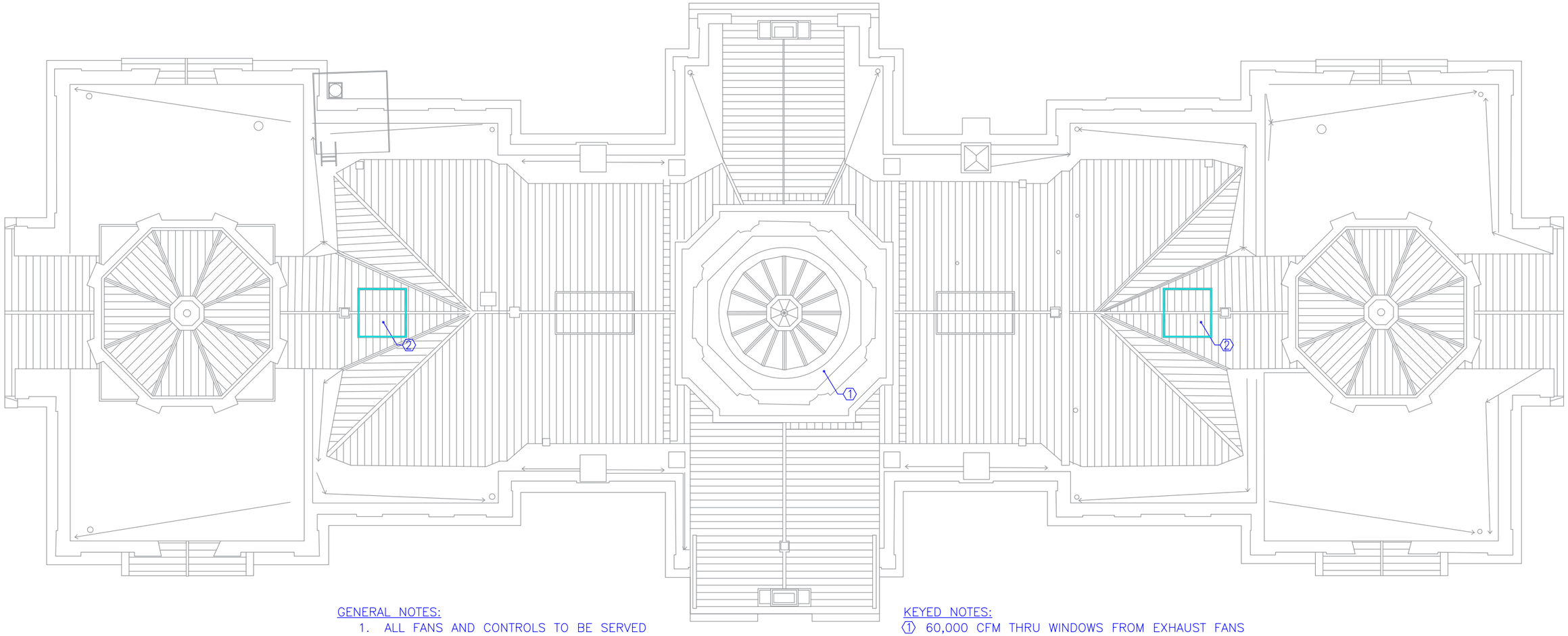
KEYED NOTES:

⟨1⟩ INLINE, VERTICAL DIRECT DRIVE EXHAUST FAN (750 LBS 38"ø 44" LONG), 15,000 CFM EACH (TYP. FOR 2) BLASTING UP INTO PLENUM BENEATH NEW LOUVERED "PENTHOUSE" OPENINGS WHICH ARE EXISTING IN THE ROOF (FORMER SKYLIGHTS), 18 INCH HIGH RELIEF LOUVER AT OPENING ALL FOUR SIDES.

⟨2⟩ INLINE DIRECT DRIVE EXHAUST FAN (2,000 LBS 55"ø 65" LONG), 30,000 CFM EACH (TYP. FOR 2)

CAPITOL BUILDING
ATTIC FLOOR
SMOKE EXHAUST SYSTEM ATTIC EXHAUST FAN LOCATIONS

NORTH



GENERAL NOTES:

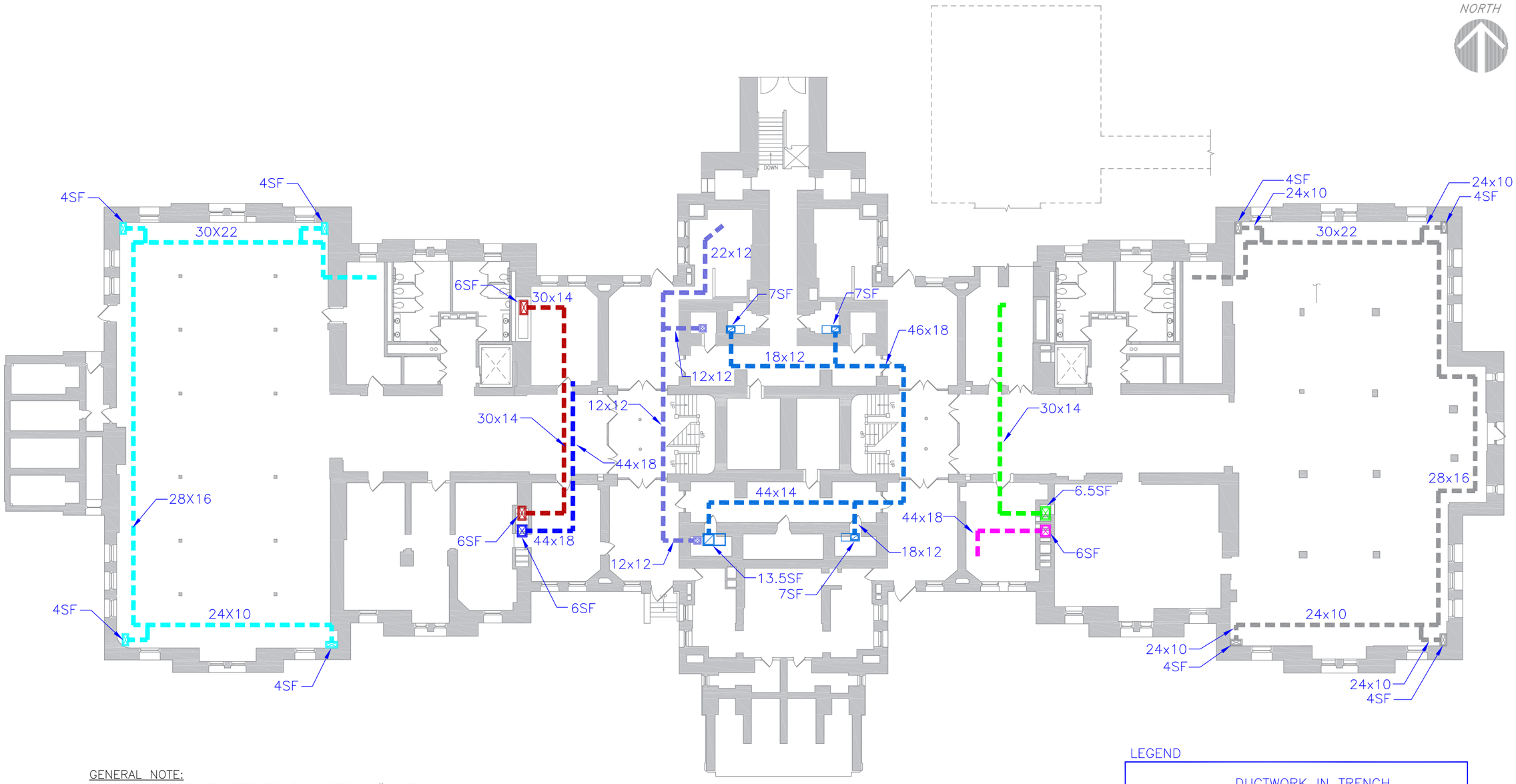
1. ALL FANS AND CONTROLS TO BE SERVED BY EMERGENCY POWER.

KEYED NOTES:

⟨1⟩ 60,000 CFM THRU WINDOWS FROM EXHAUST FANS WITH IN UPPER LEVEL OF THE ROTUNDA.

⟨2⟩ 15,000 CFM UP THROUGH EACH OF THE TWO OPENINGS. FORMER SKYLIGHTS TO BE CONVERTED TO LOUVER "PENTHOUSE" WITH 18 INCH HIGH RELIEF LOUVER AT ALL FOUR SIDES.

CAPITOL BUILDING
ROOF
SMOKE EXHAUST SYSTEM ROOF EXHAUST POINTS



GENERAL NOTE:

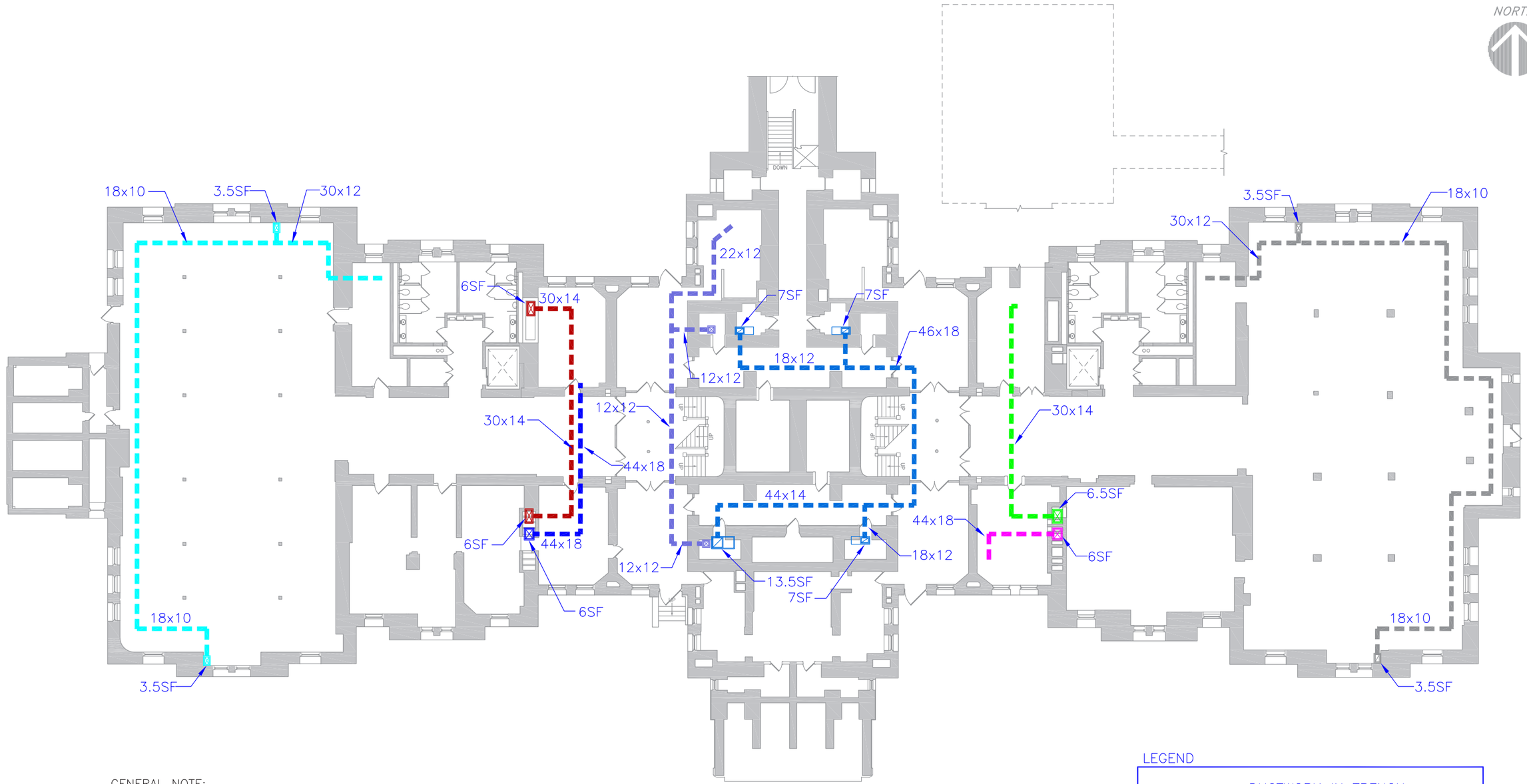
1. THE DIFFERENCES BETWEEN THIS OPTION #1 –FAN COIL UNITS AND OPTION #2 – ALL AIR OPTIONS IS THE SLIGHTLY SMALLER DUCTS REQUIRED AT THE FAR EAST AND WEST SECTION. THE CENTER AREA DUCTWORK REQUIREMENTS ARE IDENTICAL.

LEGEND

- L X W — DUCTWORK IN TRENCH (APPROXIMATE DIMENSIONS IN INCHES)
- OR — SHAFT UP FROM TRENCH (APPROXIMATE AREA IN SQ FT)

CAPITOL BUILDING
BASEMENT
PROPOSED HVAC TRENCHING PLAN: ALL AIR OPTION #1

HDR PDP RA



GENERAL NOTE:

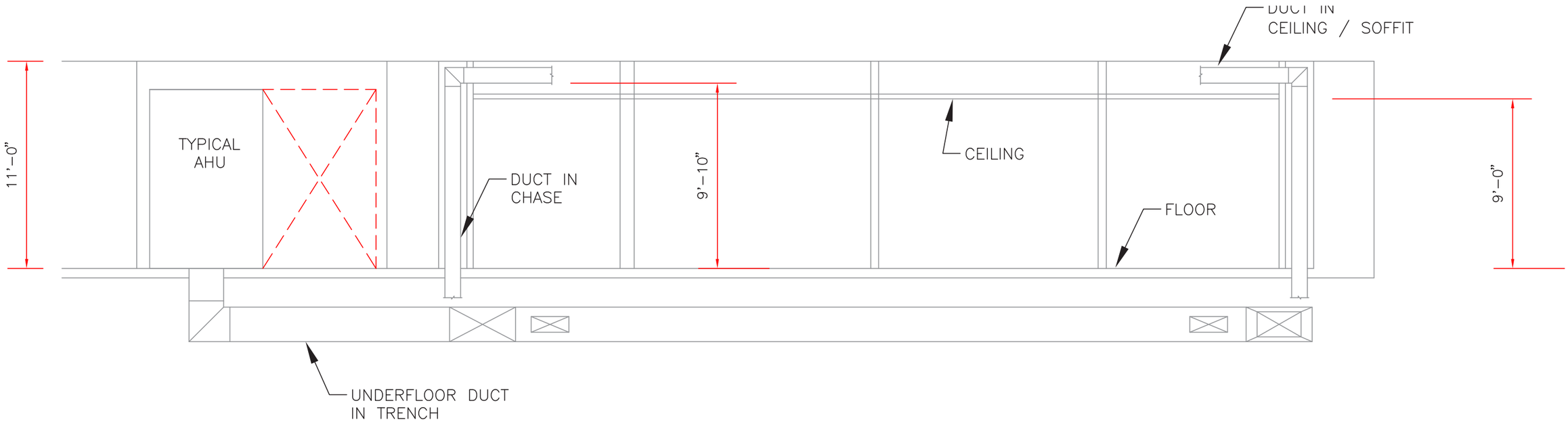
1. THE DIFFERENCES BETWEEN THIS OPTION #2 –ALL AIR OPTION AND OPTION #1 – FANCOIL UNITS IS THE SLIGHTLY LARGER DUCTS REQUIRED AT THE FAR EAST AND WEST SECTION. THE CENTER AREA DUCTWORK REQUIREMENTS ARE IDENTICAL.

LEGEND

- L X W — DUCTWORK IN TRENCH (APPROXIMATE DIMENSIONS IN INCHES)
- OR — SHAFT UP FROM TRENCH (APPROXIMATE AREA IN SQ FT)

CAPITOL BUILDING
BASEMENT
PROPOSED HVAC TRENCHING PLAN: FCU-OPTION #2

HDR PDP RA



CAPITOL BUILDING BASEMENT SECTION
PROPOSED DUCT / TRENCH CONCEPT

(NOT TO SCALE)

N.03.02 Capitol Building Proposed Plumbing Systems

The plumbing design intent is to provide new, code compliant toilet facilities distributed throughout the building in quantities and locations sufficient for the occupancy. This would principally consist of new centrally-located men's and women's public toilet rooms. New custodial fixtures would also be provided at central locations.

New domestic cold water, hot water, hot water return, sanitary, vent piping and distribution systems will be provided to new toilet rooms. Additionally, new floor drains will be provided in the vicinity of new HVAC units. Finally, existing roof drains will be replaced and existing storm leaders from the roof through the base offsets through the foundation wall below grade will be removed and replaced, as these systems have exceeded their expected useful life.

Sanitary Drainage System:

A complete sanitary drainage system will be provided for conveying soil and waste from fixtures and equipment, through vented fixtures, branches and stacks. Sanitary piping exiting the building will connect to the existing municipal system through a house trap. New sanitary mains will be distributed at the Basement level. Final routing shall be coordinated with mechanical piping and ductwork and final locations of plumbing fixtures.

The existing 6" sanitary main from the building to the street will be replaced, as it has exceeded its life expectancy. A new manhole shall be provided in the street at the new connection to the municipal sewer main.

Vent piping will be extended from fixtures, drains, equipment and stacks to termination above the roof.

Storm Drainage System:

The existing storm water leader system will be removed and replaced from the roof to the base offsets and out through the building foundation wall below grade. Existing roof leaders are 4" cast iron. Existing sizes will be reviewed against current code requirements, but the leaders will likely be upsized to 6" cast iron. Existing storm piping mains under the north and south lawns are 6" diameter.

As the roof will be replaced, new roof drain bodies will be provided at existing locations. Additional roof drains may be incorporated into the existing system pending review of roof pitch and drainage.

Code-required secondary roof drainage will be added.

HVAC Drainage System:

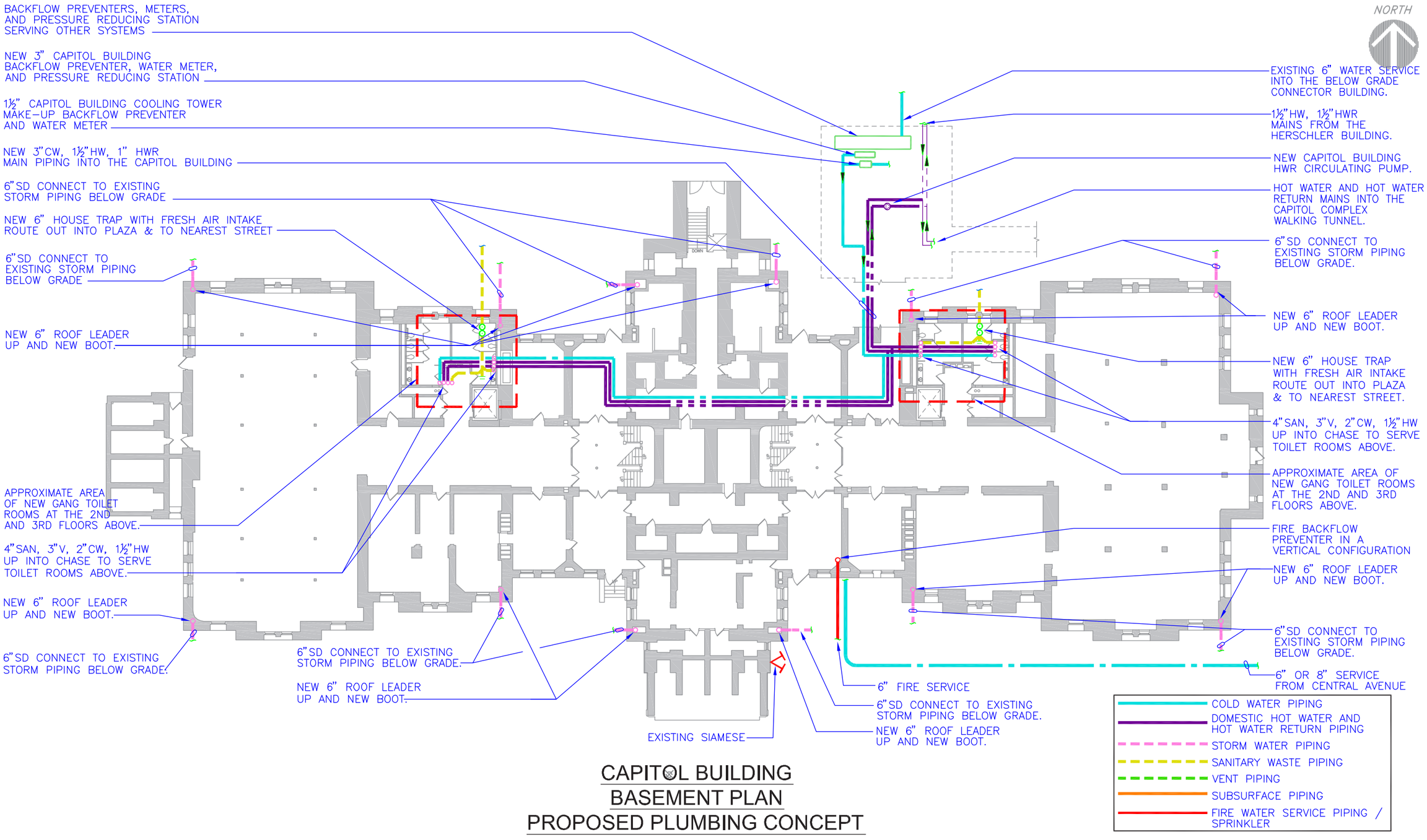
A system of drainage for attic mechanical rooms and drip pans will connect to new vertical drainage stacks down to indirect connections at building sanitary mains in the Basement. These indirect connections may consist of custodial mop sinks or dedicated floor funnel drains. All drainage will be sized to handle failure of Attic HVAC systems.

Water Supply and Distribution:

The existing 2" Capitol domestic cold water supply is too small for the new fixture load. A new, larger system will be supplied by a connection made to the existing 6" cold water service. A new water meter, backflow preventer, and pressure reducing station will be provided and sized to serve all new Capitol fixtures. The cold water piping will be extended to new fixtures in the Capitol, in the trench system at the Basement level and in vertical risers at the main core toilet rooms.

The domestic hot water system will be supplied by the hot water plant located at the Central Plant. New hot water piping will be extended to new fixtures in the Capitol. The hot water piping will be routed in parallel with the cold water piping. New connections to the central system will be made at the central plant or in the existing tunnel between the Capitol and Herschler Buildings.

The existing hot water return pump located in the underground Connector Link adjacent to the Capitol water meter will be removed and replaced, and hot water return piping will be extended to all new fixtures in the Capitol.



CAPITOL BUILDING
BASEMENT PLAN
PROPOSED PLUMBING CONCEPT

N.03.03 Capitol Building - Proposed Electrical Systems

General Design Intent:

The design intent is to replace the existing electrical systems in their entirety with normal and emergency utility services fed from the main equipment and generator located in the adjacent Capitol Complex, remote from the Capitol. The proposed electric service would include two utility services fed from separate grids that would feed a double-ended substation with automatic main-tie-main operation to allow continuous service even if one utility grid is down. Distribution voltage from the main substation will be 480/277V, 3-phase, 4-wire, which will result in smaller sized feeders and less voltage drop concerns than the existing 208/120V service.

Due to the critical nature of the Capitol operations, full generator back-up of the building is proposed. The building would be served via two automatic transfer switches (ATSs): one "normal / standby" ATS to serve all general building lighting, power and equipment loads and one "emergency" ATS to serve Code required life-safety loads (separation of life safety loads is required by Code).

The emergency system loads will be served from dedicated panelboards, feeders and circuits and will include the following:

- Emergency lighting and exit signs
- Fire Alarm System
- Elevators
- Elevator car lighting
- Smoke control fans and associated controls and pumps (includes systems for tempering smoke exhaust make-up air)
- Security System

The overall estimated demand for the Capitol is roughly 750kVA, or 1,200A at 480/277V (does not include central cooling and heating equipment). The double-end substation would include two (2) 750kVA transformers. A diesel driven emergency generator of approximately 600kW is proposed. Alternately, 1,500kVA double-end substation or 1,200kW generator would be provided to also serve one chiller for the Capitol.

Power:

The new electric service will consist of 480/277V "normal / standby" and "emergency" power feeders to the Capitol from service and emergency generator equipment located remotely from the Capitol in the Capitol Complex; options and required spaces for this equipment are addressed in the separate Herschler Building / Central Utilities report. The two "normal / standby" and "emergency" ATSs will be located remote from the Capitol, which will minimize the amount of equipment in the building and reduce the total number of conduits routed to the building than if the ATSs where located in the building. This is important due to space limitations in the existing building. The existing electrical systems within the building will be removed and replaced with new power distribution equipment, devices and wiring system that will be sized as required for the new loads.

Due to the general restrictions imposed by the layout of the existing building and the fact that the Rotunda splits the Building in half east-to-west, electrical distribution will be separated into east and west risers and closets with horizontal distribution in the Basement and Attic. Typical electrical and telecommunication closets in the east and west areas will alternate floor-to-floor, which will minimize the amount of space required on each floor.

Power will be distributed in conduit and wire feeders to distribution and branch-circuit panelboards, and to individual pieces of equipment as appropriate. Panelboards, in general, will be surface-mounted in electrical closets or mechanical spaces. Panelboards serving sensitive loads (communications, security, voting boards and other special electronics) will be electronic grade with integral surge suppression and filtering.

No central uninterruptible power system (UPS) is planned for this facility. Local UPS should be provided as part of equipment or systems having special power requirements, including telecommunication, security, audio-visual and other auxiliary systems, as deemed necessary.

Convenience, workstation and lighting power will be provided through conduit and wire branch circuits. In existing hollow construction areas, it may be necessary to use Type MC cable. In certain historically sensitive areas, it may be necessary to conceal Type MC cable within finished surfaces.

Lighting:

The lighting control system will consist of manual light switches, occupancy sensors and programmable and dimming lighting control systems. Lighting and lighting control system will be provided in accordance with requirements of the Energy Code. The final requirements will be determined by the lighting consultant, Architect and Owner and are addressed in the separate Lighting Design Report prepared by GSLD.

- LED exit signs will be provided per building code requirements.
- Infrared / ultra-sonic vacancy-type sensors will be provided in all offices and individual rooms.
- Combination photocell and programmable lighting control will be provided for all exterior lighting circuits.
- Switched emergency lighting circuits will be provided with emergency transfer relays.

Fire Alarm System:

A new addressable manual and automatic Fire Alarm System will be provided as required by the applicable Building Codes and NFPA.

The fire alarm system will be an addressable system consisting of horns, strobes, pull stations, smoke detectors, flow switch and tamper switch connections and other associated equipment. In Architectural Preservation Zone 1 areas where the aesthetics of the space would be disrupted by a conventional ceiling mounted smoke detector, a VESDA smoke detection system will be employed. The VESDA sampling tubes will be integrated within building elements to retain the desired appearance of the space; conventional discrete and beam-type smoke detectors will be used in less sensitive areas. Fire suppression systems will be by others and coordinated with the addressable fire alarm system.

Low Voltage Systems:

As part of the electrical contractor's work, the following will be provided for Telecommunication, Security, Cable TV, Audio/Visual and other Low Voltage Systems:

- Power for equipment and devices provided by other trades.
- Empty conduit systems as required.
- J-hooks for telecommunication system wiring running in accessible ceilings.

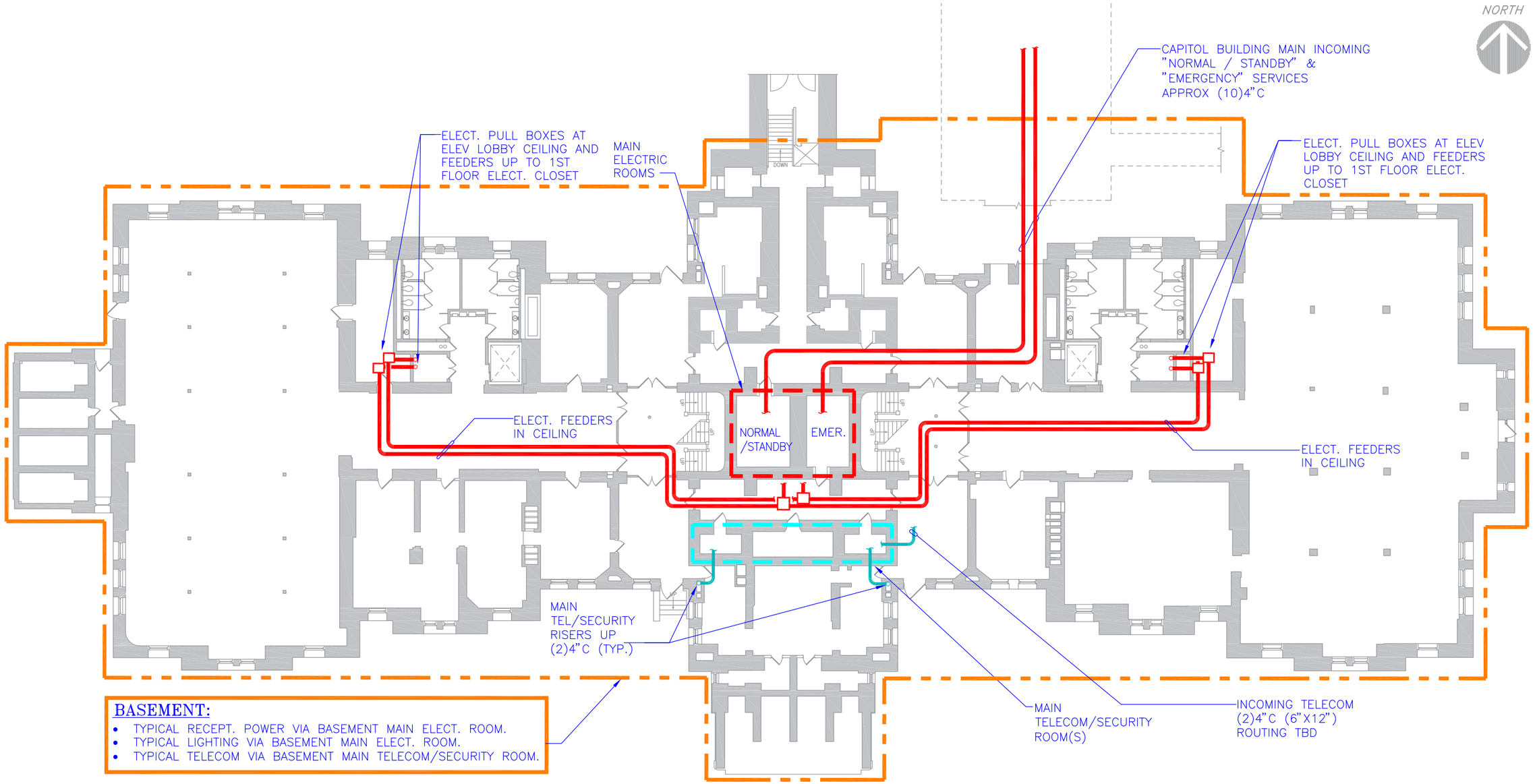
Specific requirements for the Low Voltage Systems (power requirements, locations of equipment and devices, conduit and raceway system sizes, quantities, etc.) will be determined by the respective systems consultants.

Lightning Protection:

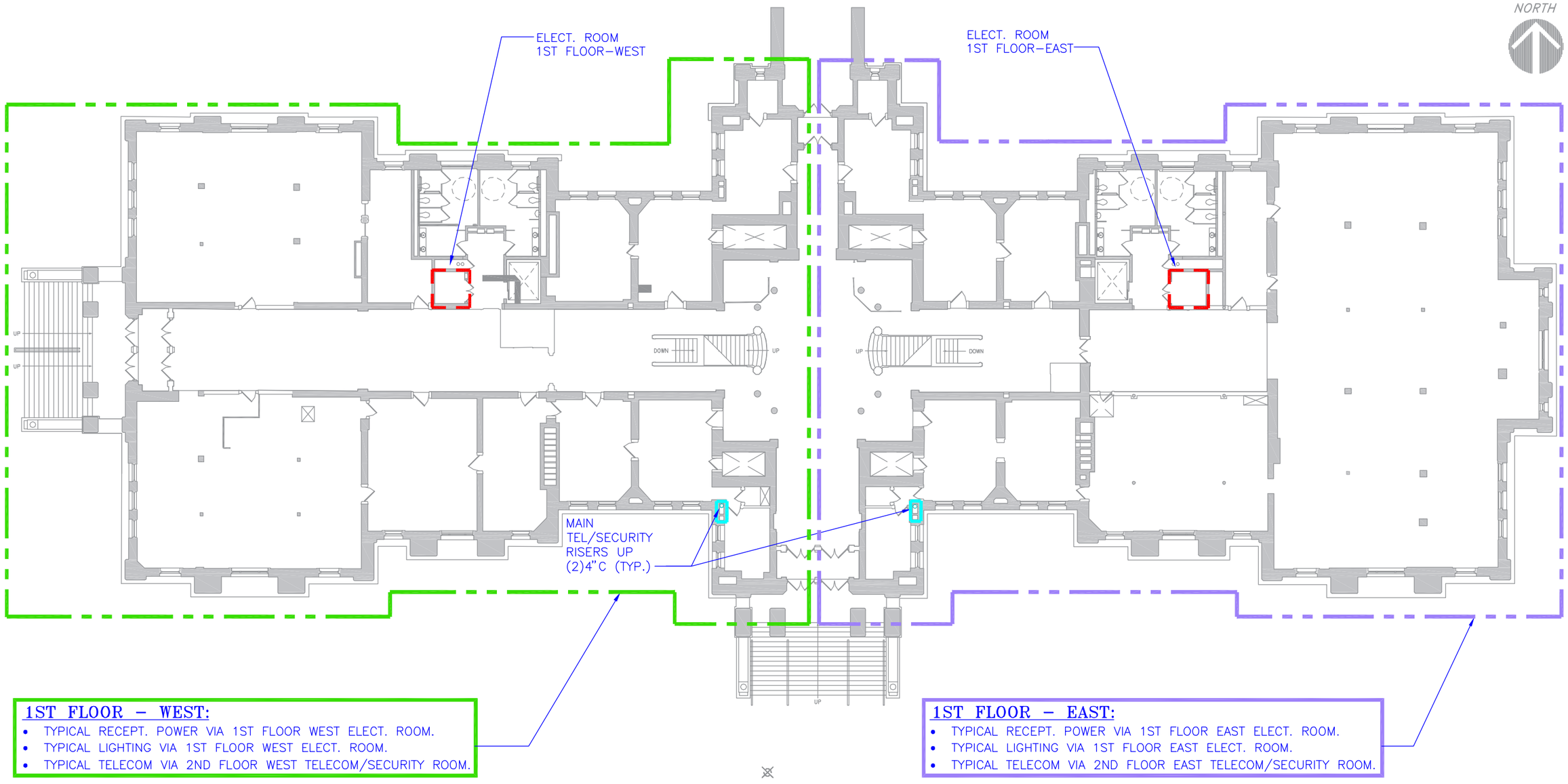
The existing "Lightning Preventer" system will be maintained to minimize the visual impact that a system of lightning rods and additional down conductors would have on the apperance / fabric of the building.

Telecommunication and Auxiliary System Pathways:

Typical horizontal cable pathways for telecommunication, security, A/V and voting systems will consist of J hooks and/or solid bottom cable trays where accessible for support of cabling; conduit pathways will be provided at inaccessible ceilings. Each typical telecommunication outlet will be a 2-gang box with a minimum 1" conduit routed to the pathway system or associated telecommunications closet. Large radius sweeps will be utilized at all conduit bends.

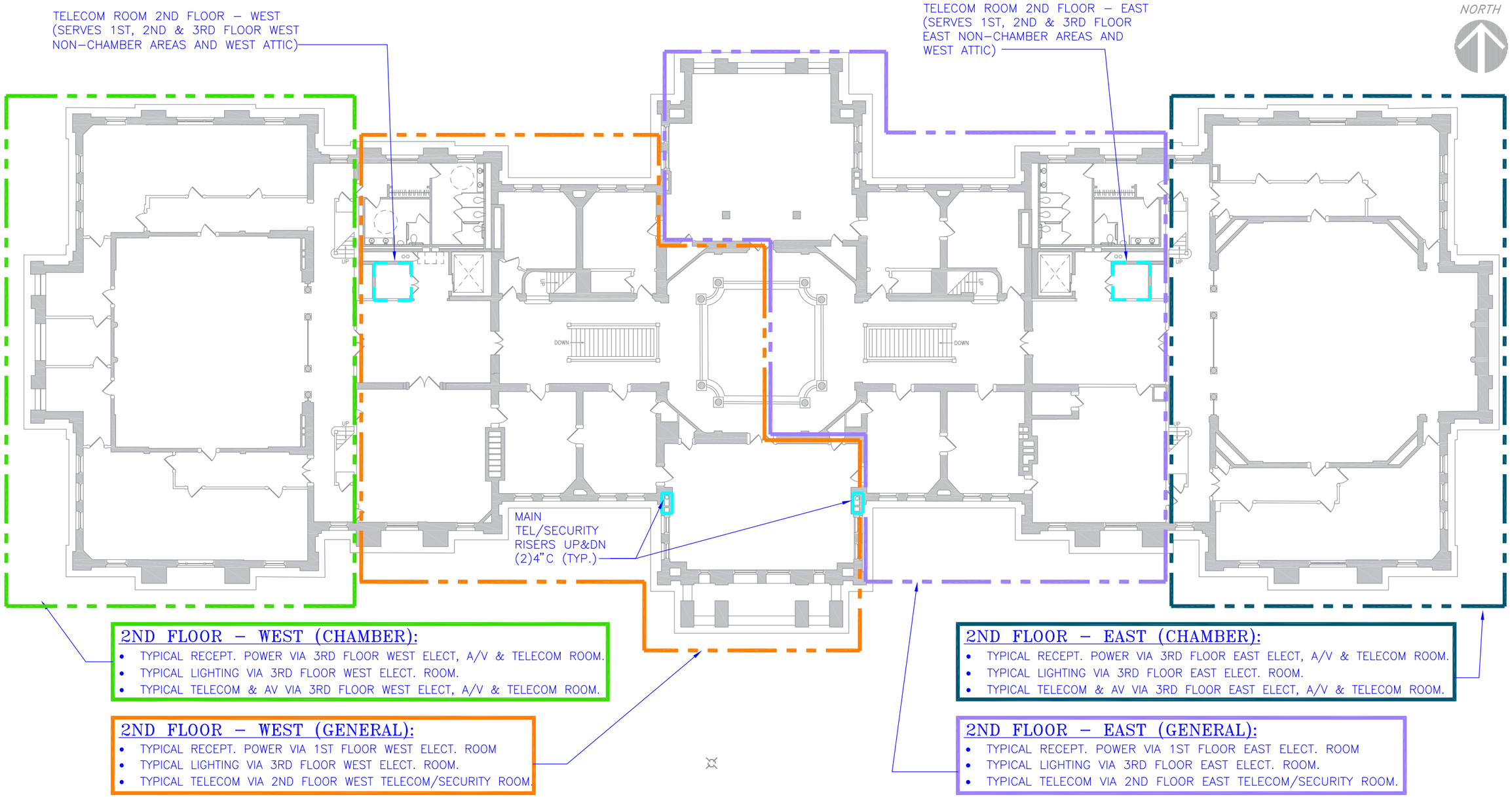


CAPITOL BUILDING
BASEMENT
PROPOSED ELECTRICAL PLAN



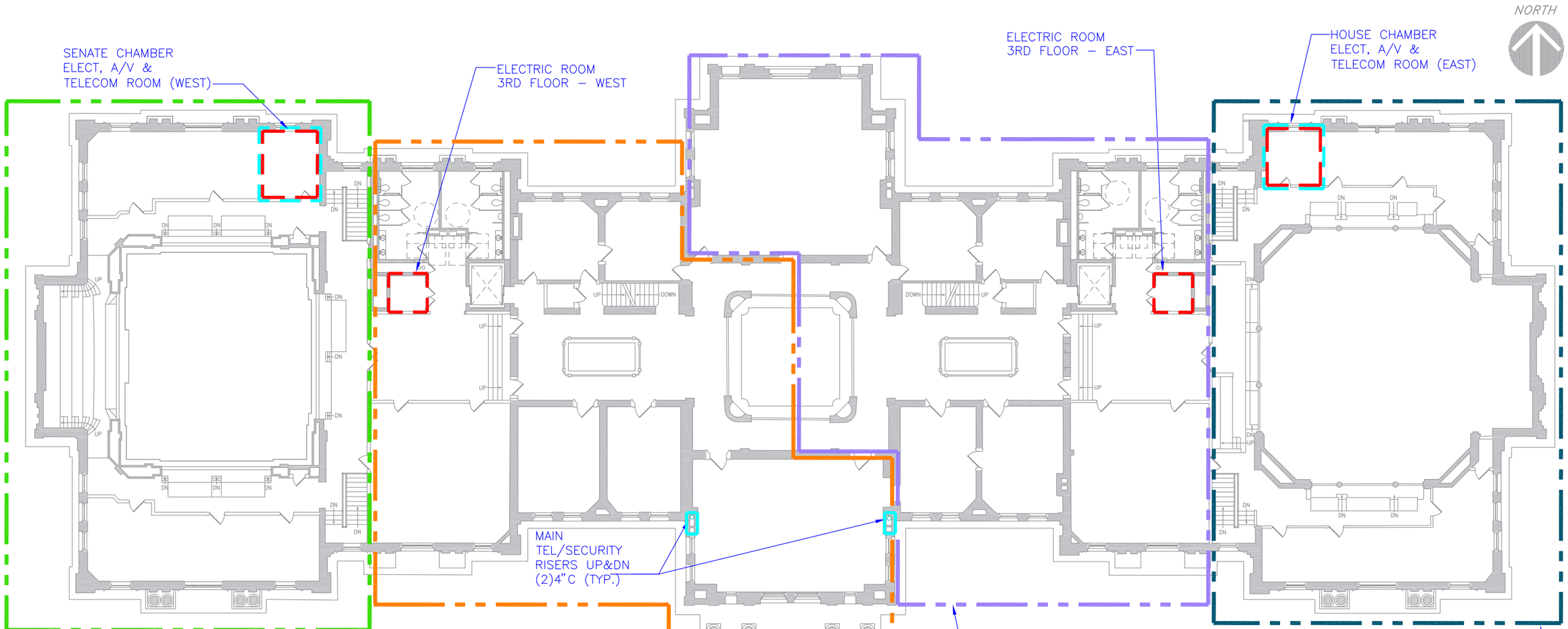
CAPITOL BUILDING
FIRST FLOOR
PROPOSED ELECTRICAL PLAN

HDR PDP



CAPITOL BUILDING
SECOND FLOOR
PROPOSED ELECTRICAL PLAN

HDR PDP RA



3RD FLOOR – WEST (CHAMBER):

- TYPICAL RECEPT. POWER VIA 3RD FLOOR WEST ELECT, A/V & TELECOM ROOM
- TYPICAL LIGHTING VIA 3RD FLOOR WEST ELECT. ROOM.
- TYPICAL TELECOM & AV VIA 3RD FLOOR WEST ELECT, A/V & TELECOM ROOM.

3RD FLOOR – WEST (GENERAL):

- TYPICAL RECEPT. POWER VIA 3RD FLOOR WEST ELECT. ROOM.
- TYPICAL LIGHTING VIA 3RD FLOOR WEST ELECT. ROOM.
- TYPICAL TELECOM VIA 2ND FLOOR WEST TELECOM/SECURITY ROOM.

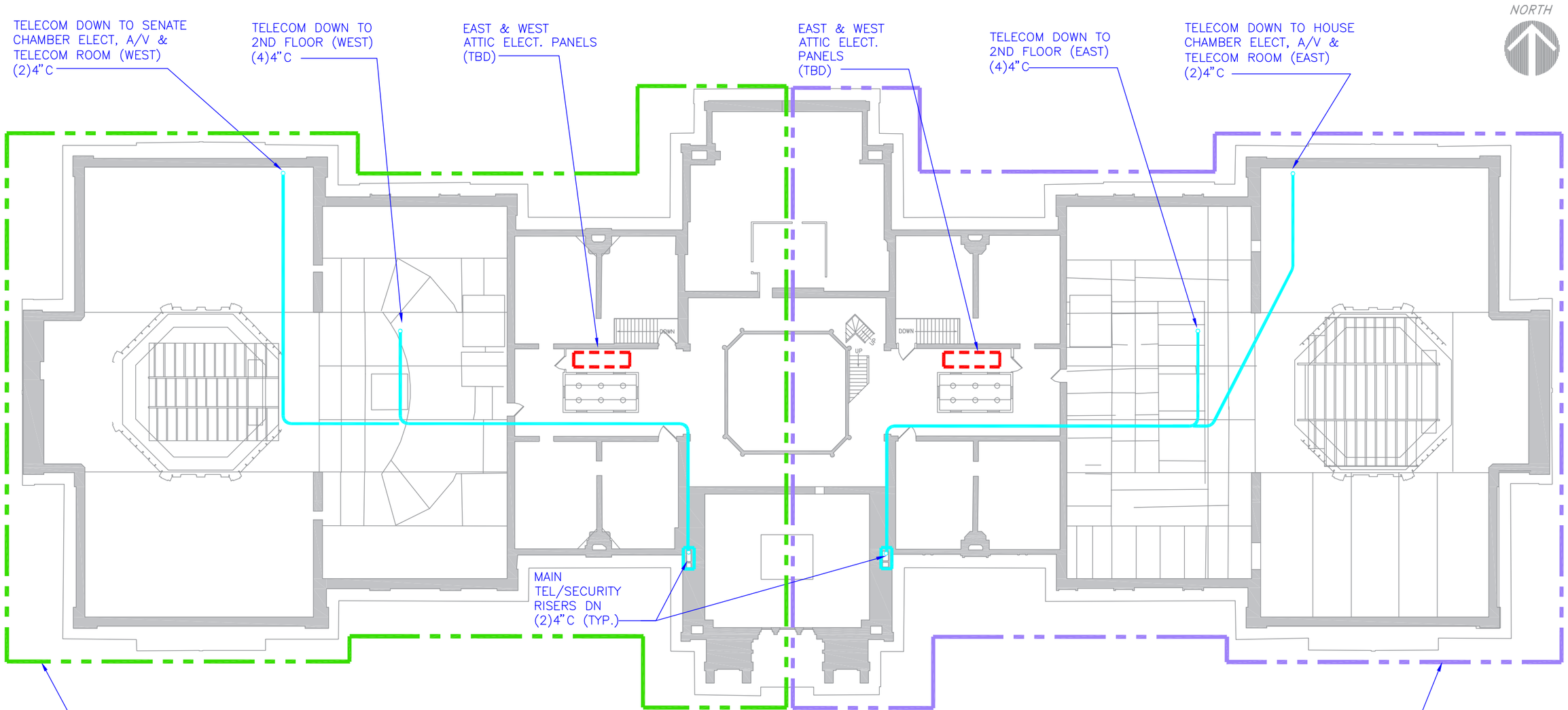
3RD FLOOR – EAST (CHAMBER):

- TYPICAL RECEPT. POWER VIA 3RD FLOOR EAST ELECT, A/V & TELECOM ROOM.
- TYPICAL LIGHTING VIA 3RD FLOOR EAST ELECT. ROOM.
- TYPICAL TELECOM & AV VIA 3RD FLOOR EAST ELECT, A/V & TELECOM ROOM.

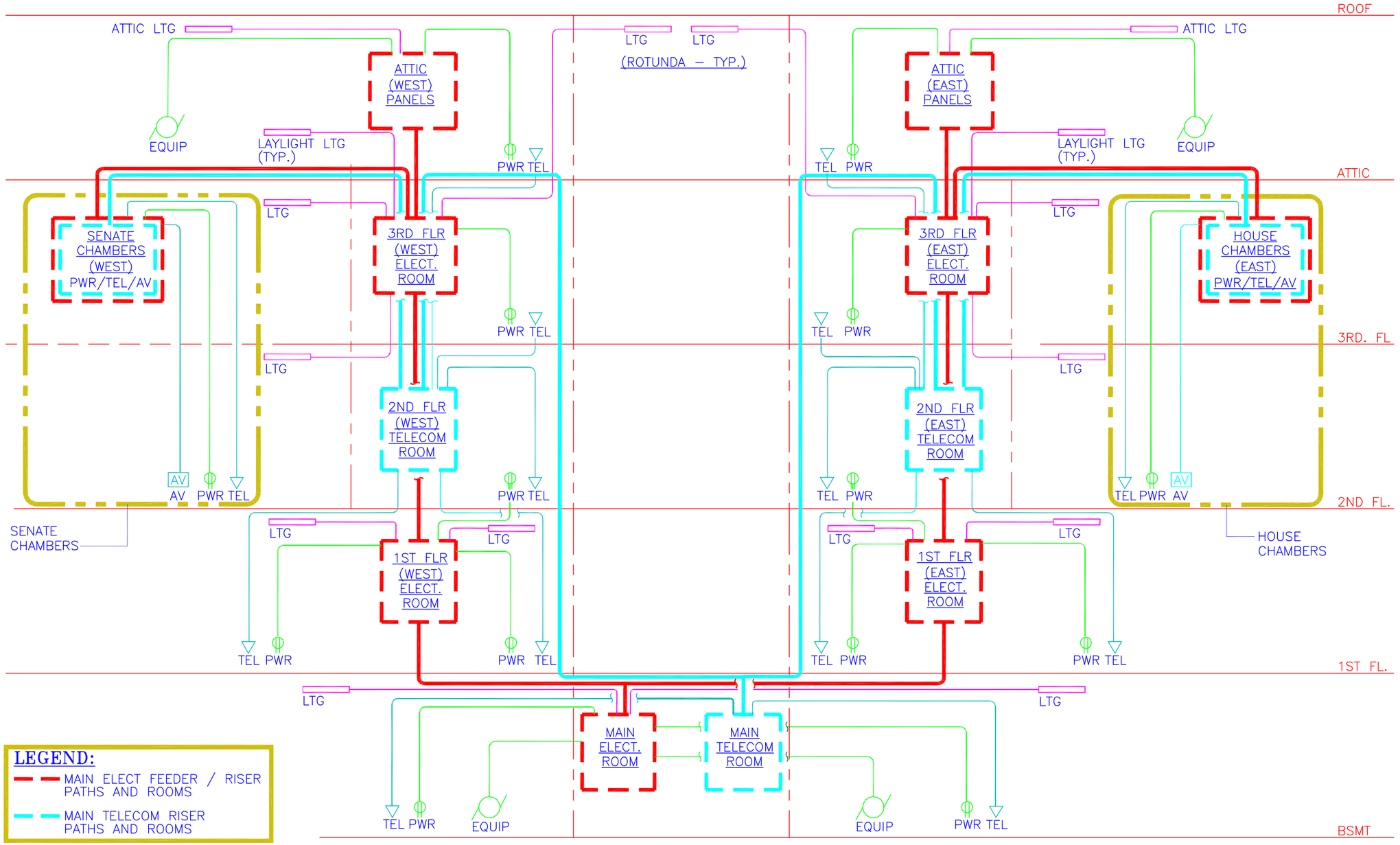
3RD FLOOR – EAST (GENERAL):

- TYPICAL RECEPT. POWER VIA 3RD FLOOR EAST ELECT. ROOM.
- TYPICAL LIGHTING VIA 3RD FLOOR EAST ELECT. ROOM.
- TYPICAL TELECOM VIA 2ND FLOOR EAST TELECOM/SECURITY ROOM.

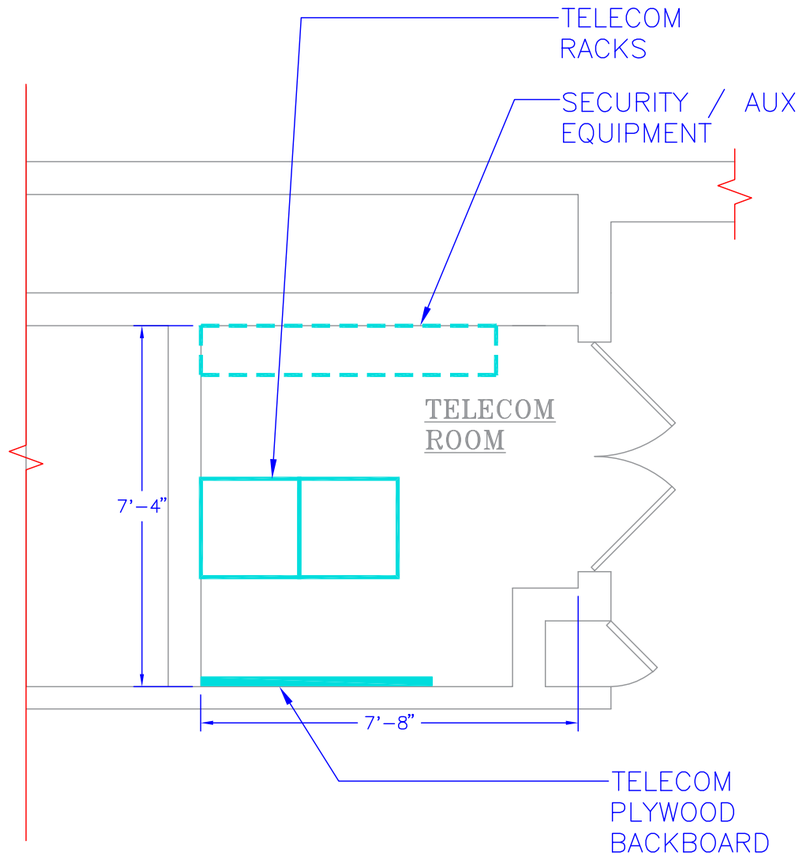
CAPITOL BUILDING
THIRD FLOOR
PROPOSED ELECTRICAL PLAN

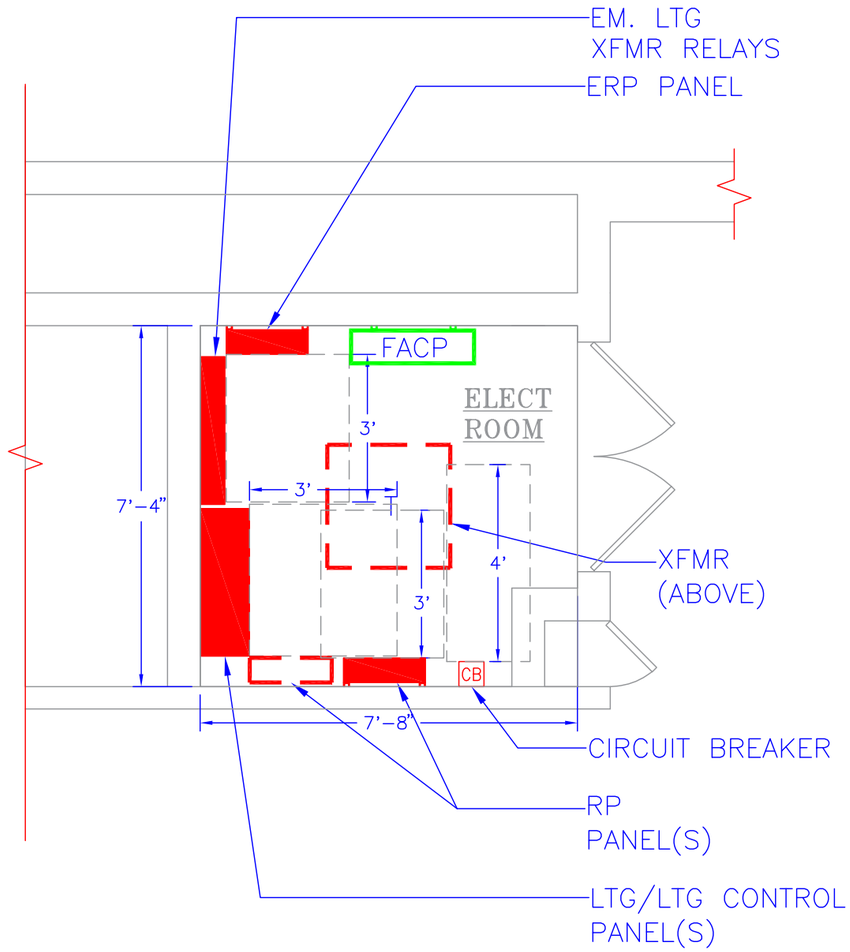


CAPITOL BUILDING
ATTIC PLAN
PROPOSED ELECTRICAL PLAN



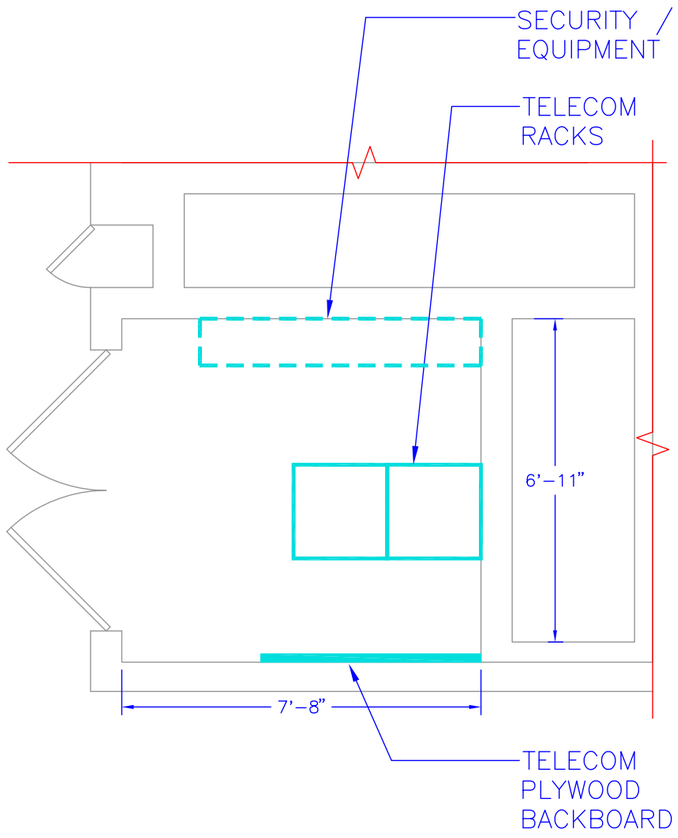
CAPITOL BUILDING
PROPOSED ELECT / TELECOM RISER AND CONNECTIVITY DIAGRAM

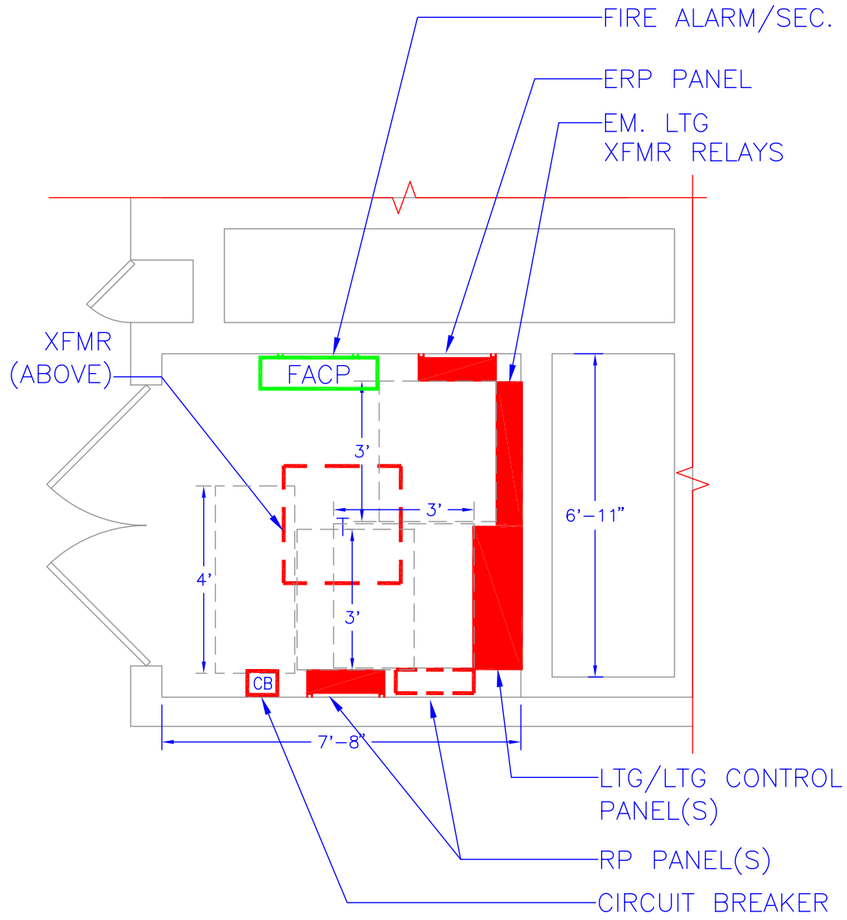




LEGEND
LTG = LIGHTING
RP = RECEPTACLE PANEL
FACP = FIRE ALARM CONTROL PANEL
ERP = EMERGENCY RECEPTACLE PANEL
XFMR= TRANSFORMER
AUX = AUXILIARY
EM = EMERGENCY

CAPITOL BUILDING
TYPICAL ELECT & TELECOM CLOSET (WEST)





LEGEND
LTG = LIGHTING
RP = RECEPTACLE PANEL
FACP = FIRE ALARM CONTROL PANEL
ERP = EMERGENCY RECEPTACLE PANEL
XFMR = TRANSFORMER
AUX = AUXILIARY
EM = EMERGENCY

CAPITOL BUILDING
TYPICAL ELECT & TELECOM CLOSET (EAST)

N.03.04 Commissioning of Mechanical and Electrical Systems

The fundamental objective of the commissioning process is to ensure that building systems are properly designed, integrated, installed and operational upon project completion and are in accordance with the State of Wyoming's project requirements. The commissioning process also ensures that the Operations Staff receives proper training and documentation for all systems. This process starts in the design phase and continues throughout the physical construction process and after occupancy of the finished building. The end result is proper integration and operation of all systems and reduced life cycle operating costs, from a thermal comfort, energy and maintenance perspective, for the building.

The commissioning procedure will be performed in accordance with ASHRAE Guideline 0-2005 – The Commissioning Process. A team of certified commissioning professionals will be required to complete this effort in conjunction with the Operations Staff, the design team and the installing contractors.

The systems to be part of the formal commissioning process may include:

- HVAC Systems
- Life Safety Systems
- Fire Alarm Systems
- Power and Lighting Systems and Controls
- Plumbing Systems
- Security Systems
- A/V Systems

Refer to list of Commissioning activities in Appendix N2.

N.04.01 Appendix N1 - Mechanical, Plumbing, and Electrical Summary Specifications

HVAC Summary Specifications

Design Criteria

Outside Design Conditions:

Location: Cheyenne, Wyoming

Latitude: 41°

Elevation: 6,100 ft.

Dry Bulb Temperature (Winter): -10°F

Dry Bulb Temperature (Summer): 87°F

Wet Bulb Temperature (Summer): 62°F

Inside Design Conditions:

Dry Bulb Temperature (Summer): 75°F (+/-2.0°F)

Dry Bulb Temperature (Winter): 72°F (+/-2.0°F)

Relative humidity (Summer): 50% (+/-10%)

Relative humidity (Winter): Not controlled*

*Select spaces will be provided with nominal 20% minimum relative humidity.

Building Construction (TBD):

Existing Wall Construction: U Value =.2 BTU/H°F-SF

Existing Roof Construction: U Value =.1 BTU/H°F-SF

Existing Windows: U Value = .6 BTU/H°F-SF

Shading Coefficient = .5

Exterior wall will remain as is and windows will be replaced.

The building construction U-Values have not been confirmed to date.

Occupancy:

Senate Chamber	58 people
Senate Balcony	206 people
House Chamber	280 people**
House Balcony	236 people**
Conference Rooms	1 person / 20 SF
Offices	1 person / 100 SF

**Occupancy indicated is based upon the State of the State address. Normal occupancy is 101 people for the House Chamber and 139 people for the House Balcony.

Miscellaneous Sensible Gains:

Chamber equipment:	2.0 watts/sf
Chamber lighting:	4.0 watts/sf
Office equipment:	1.5 watts/sf
Office and support area lighting:	1.0 watts/sf
Committee / Conference Room equipment:	1.5 watts/sf
Committee / Conference Room lighting:	1.3 watts/sf

Noise Criteria:

All systems equipment and ductwork will be designed and selected to meet or exceed critical noise and vibration criteria as outlined in the latest edition of the ASHRAE Handbook as determined for individual critical spaces.

Constant air volume systems and ductwork downstream of VAV units will have the ductwork distribution sized for low pressure drop 0.1 w.g./100 ft.

Variable air volume systems will have the ductwork distribution system sized for 0.2 w.g./100 ft. between air handling units and VAV/FPVAV boxes.

Ductwork located downstream of VAV boxes will be provided with an integral sound trap or acoustical lining.

Supply and return air ducts connecting noise-sensitive spaces will be sized for low air flow velocities.

Filtration:

Air filtration to control contaminants will be provided in the air handlers by means of 30% atmospheric dust spot efficiency pre-filters and 85% final filters.

A. Ductwork:

1. All ductwork, fittings, dampers, hangers, stiffeners, joints, etc. will conform to the requirements of the SMACNA HVAC Duct Construction Standards and ASHRAE Guide.
2. Ductwork will generally be fabricated of galvanized sheet steel.
3. Duct transitions will be fabricated with fittings with slopes not exceeding one in seven (maximum of 15°).
4. All elbows and branch duct take-off fittings will conform to SMACNA details.
5. All joints and seams will be sealed to SMACNA class 'A' for air tightness using UL approved duct sealants. VAV system ductwork, upstream of VAV boxes will be tested in accordance with SMACNA test methods for 4" w.g. (water gauge) design.
6. Ductwork for constant air volume systems and downstream of VAV boxes will be tested in accordance with SMACNA test methods for 2" w.g. design.
7. Volume control dampers will be provided at all branch take-offs and where required for balancing the system. Volume dampers will be of the opposed blade, multi-louver type.
8. Fire, smoke, and combination fire/smoke dampers will be provided where required by the Building Code and will be UL tested and certified. Duct access doors will be provided for access to the damper's motor and fusible link.
9. Air handling units will have duct smoke detectors monitored by the Fire Alarm System.

B. Motors for Mechanical Equipment:

1. All motors sized at ½ horsepower and larger will be 480V, three phase. All motors will be rated and tagged to operate at 460V with a service factor of 1.15.

C. Piping:

1. Chilled Water and Heating Hot Water.
   a. Pipes: Standard weight steel pipe, Schedule 40, ASTM, A-53, or soldered copper Type L up to 3".
   b. Fittings: Welded fittings for 2-1/2" and larger, Schedule 40 steel, screwed fittings for 2" and smaller.
   c. Valves:

Shut-off	2-1/2" and smaller	Ball valve with bronze body, screwed, 125# SWP.
Shut-off	3" and larger	High performance butterfly valve with flame cut carbon steel body, 150# flanges, forged carbon steel disk.
By-pass & Control	3" and smaller	Lubricated plug valve
By-pass & Control	3" and larger	Vee ball valve with carbon steel body, 300# flanges

All valves will have 150 psig shut-off capabilities.

D. HVAC Insulation:

Supply air ductwork and return air ductwork will be insulated in accordance with the requirements of the energy code. Insulation will meet the requirements of UL for flame spread and smoke developed (less than 25 and 50, respectively). Outdoor air intake ductwork in mechanical rooms will be 1" thick, 4# density, rigid insulation applied with metal pins and shields.

Pipe will be insulated as follows:

Chilled water, condenser water & hot water will be insulated with glass fiber insulation with vapor barrier and an average thermal conductivity of 0.22 BTU/in/ft2-°F.

E. Building Automation System

1. The Building Automation System (BAS) Contractor will provide and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified. The basis of design will be reviewed with the Operations Staff.
   a. Open communications system will be provided. System will be capable of utilizing standard protocols as follows, as well as be able to integrate third-party systems via equipment vendor protocols. System will be capable of BACnet communication according to ASHRAE standard SPC-135A/95.
   b. The BAS system will have provisions, including all software and hardware, for a remote monitoring and control station.
   c. The design of the BAS will network operator workstations and stand alone DDC Controllers (SAC). The network architecture will consist of three levels, a campus-wide (Management Level Network) Ethernet network based on TCP/IP protocol, high performance peer to peer building level network(s) and DDC Controller floor level local area networks with access totally transparent to the user when accessing data or developing control programs. All controllers will be standalone DDC (SAC) controllers. Loss of network communications will not stop/limit the control sequences. System architecture will have multiple password protected levels of access.

d. Communication Capability:

Automatic communications will be provided to allow DDC Controllers to communicate with the remote operator workstation. The locations of the remote operator workstations will be reviewed with the Operations Staff. Standard Internet Protocols will be used for communications.

e. Building Automation:

1. The building control systems will be comprised of the following sub-systems and functions at minimum:
   - DDC based control systems with electronic actuation for control valves and dampers
   - DDC based central Building Management System (BMS) connected to local stand alone DDC field panels
   - Central Fire Alarm System interface as required for implementing system shutdown and smoke control system
   - Security system interface
   - Emergency generator monitoring
   - Plumbing system monitoring for alarm conditions
   - High temperature alarms in the telecommunications room
2. The Energy management software of the BMS will contain the following energy conservation features:
   a. Start-stop programs
   b. Space temperature monitoring
   c. Economizer cycle control
   d. Electrical demand monitoring
   e. Fire Alarm system control interface
   f. Smoke exhaust
3. The variable air volume systems will be provided with air flow monitoring stations installed in the supply, return, exhaust and fresh air intake ductwork.
4. The DDC system will control the variable frequency drive of the supply fan based on the supply ductwork static pressure. The variable frequency drive of the return/exhaust air fan will be controlled to track the supply fan.
5. In addition, the DDC system will modulate the fresh air damper, spill air damper and the return air damper to maintain the minimum setting for the outside air intake.
6. All valves, dampers, etc. will use electronic modulating devices.
7. All low voltage signal and power wiring within MER's, outdoors, within walls and above inaccessible ceilings will be in EMT. All low voltage signal wiring above accessible ceilings will be plenum rated cable.

Plumbing Summary Specifications

1. **Plumbing Specialties:**
   a. Fixtures will be low flow type with electronic hard wired sensors.
   b. Roof and Floor Drains:

   New roof drains will be provided with cast iron dome strainers.

   Floor drains will be provided with trap primers.

   c. The inverts of new floor drains serving Basement level HVAC units will be assessed based on the final pipe/duct trench layout and the existing sanitary main inverts leaving the building, and local sump pumps will be provided as necessary to pump condensate and other clear-water discharge to the sanitary system. These small sump tanks will be coordinated with HVAC rooms and located within new pipe/duct trenches. They will consist of packaged five gallon fiberglass basins with simplex sump pumps.
   d. Cleanouts will be brass recessed fittings in floor, brass cover with three hold-down screws, cleanout plug recessed with slot in head. Cleanouts in walls will have a plug with protruding square head and a chrome plated cover with three screws (principally located at bathroom walls or at the base of all new storm leaders at the Basement level). All plugs will be bronze.
   e. Wall hydrant will be frost proof, vacuum breaker type with recessed brass valve box and trim. These items can be located where desired at the building perimeter.
   f. Water hammer arrestors will be bellows type with stainless steel body and bellows
2. **Piping Insulation:**
   a. Material: Pre-molded fiberglass with All Service Jacket; minimum 2 inch longitudinal laps and butt strips.
3. **Pipe Material:**

Sanitary and Storm Drainage

Service	Size	Material	Fittings	Notes
Sanitary and Storm Drainage	All	Service Weight Cast Iron	Drainage Pattern	
Domestic Water	All	Type"L" Copper	Soldered Copper	ASTM B88

Electrical Summary Specifications

1. **Switchboards and Distribution Panelboards**
   a. In general, switchboards and distribution panelboards of the circuit breaker type will be utilized to serve branch circuit panelboards, motors and three-phase equipment loads.
   b. Equipment ground buses bonded to enclosures will be provided for all distribution equipment.
2. **Branch Circuit Panelboards:**
   a. Branch circuit panelboards of the molded case circuit breaker type, rated 480/277V will be used to serve mechanical equipment; panelboards rated 208/120 volts will be utilized to serve all lighting and receptacle loads.
   b. Equipment ground buses bonded to enclosures will be provided for all branch circuit panelboards.
   c. Panelboards will be provided with minimum 15% spare circuit breakers (min. 3, 1P-20A) and 15% space (min. 6 poles.)
   d. Panelboards will be multi-section as required to serve the loads and provided with a minimum of 15% spare circuit breakers.
3. **Conduit Utilization:**
   a. General
      - Raceways in finished areas shall be concealed
      - Minimum conduit size shall be 3/4"
   b. Rigid galvanized steel conduits shall be provided where:
      - Conduits are exposed to the outdoors
      - Interior conduits are exposed below 10 feet AFF where subject to potential physical damage
      - Encased in concrete
      - Installed under floor slabs
      - At exposed fire alarm system risers
      - Required by code
   c. Electric Metallic Tubing (EMT) shall be provided:
      - Where it will not be subject to physical damage
      - At raceways for the low voltage system wiring (telecommunications, security, A/V, etc.)
      - For conduit within CMU voids for interior walls
      - As permitted by code, except as noted above

      EMT fittings will be insulated throat, steel with compression fittings.
   d. MI Cable shall be provided at:
      - Emergency feeders routed in unsprinklered areas (above hung ceilings)
      - General feeders and circuiting where necessary due to space and access restraints.
   e. Flexible metal conduits and armored cables shall be provided at:
      - Final connections to vibrating or rotating equipment. These shall be in liquid tight conduit, 18" maximum length.

      The use of BX cable shall be avoided.
4. Wiring Requirements
   a. Lighting and receptacle branch circuit wiring will be installed concealed and above suspended ceilings and walls in finished areas and exposed in mechanical spaces and other non-finished areas without suspended ceilings.
   b. Wiring will be copper with type "THHN" or type "XHHN" insulation rated at 600 volts, Wire sizes #10AWG and smaller will be solid, wire sizes #8AWG and larger will be stranded.
5. **Utilization Voltages and Branch Circuiting Criteria**

120V Lighting:	On a 1 pole, 20 ampere, 120 volt branch circuit, average 1200 watts
Convenience Receptacles:	On a 1 pole, 20 ampere, 120 volt branch circuit, typical receptacles, maximum 8 receptacles
Special Purpose Receptacles:	On a 120 or 208 volt appliance branch circuit, ampere rating as required
Motors 1/2 HP and larger	On a three-phase 480 volt circuit, ampere rating as required
Motors less than 1/2 HP	On a 1 pole, 15 ampere 120 volt branch circuit

6. Grounding
   a. Power system grounding will meet or exceed requirements of the National Code.
   b. Insulated equipment grounding conductors will be provided with all feeders and branch circuit wiring.
   c. All extraneous conducting metal work within the building shall be bonded.
   d. A dedicated grounding system will be provided to telecommunication closets.
   e. All panelboards and equipment will be provided with ground buses or lugs connected to equipment enclosures.
7. Wiring Devices:
   a. General wiring devices will be heavy duty specification grade. Standard switches will be 120/277 volt rocker type switches; standard duplex receptacles will be NEMA 5-20R.
8. Miscellaneous Electrical Provisions
   a. One (1) duplex receptacle will be provided in public corridors and lobbies with a maximum spacing of 50 ft. on centers and 25 ft. from corridor ends, maximum of two (2) receptacles per circuit.
   b. Minimum of one (1) duplex receptacle on emergency service will be provided in each electric and mechanical room.
   c. Rooftop GFI weatherproof receptacles will be provided as required by code.
   d. One (1) duplex GFI receptacle will be provided in each toilet room.
   e. All receptacles within 6 feet of sinks will be GFI protected.
   f. Heavy duty safety disconnect switches will be provided at all three-phase motors as required by code.
   g. Single-phase motors will be served via manual motor starter toggle type switches with thermal overloads unless otherwise required by the HVAC and/or plumbing system design documents.
   h. GFI receptacles and switched lighting fixtures will be provided in all elevator pits and elevator machine rooms.
   i. Special power requirements for specific equipment and systems will be provided as per respective manufacturer's requirements.

N.05.01 : Mechanical and Electrical Systems Commissioning Tasks

Major commissioning tasks per phase are outlined below:

Design Phase:

1. Review the project design and develop with the state of Wyoming an Owners Project Requirement (OPR) document which will be the guideline for the Commissioning Agent and the project team in implementing the commissioning process.
2. Develop a commissioning plan for the systems.
3. Develop commissioning specifications along with preliminary installation checklists and functional testing requirements.
4. Include a requirement for performance testing, Operations and Maintenance (O&M) training and O&M documentation in the construction documents.
5. Conduct commissioning design review and back-check at each the end of each design phase milestone.

Bid Phase:

1. Attend construction pre-bid meeting to respond to commissioning related questions.
2. Coordinate responses to commissioning related questions submitted by bidders.
3. Review the bid proposals in order to assure that the contractor fully understands the project scope of work and that he/she has included in their bid all materials and labor necessary to satisfactorily complete the commissioning aspects of the project.

Construction Phase:

1. Coordinate and direct the commissioning activities in a logical, sequential and efficient manner consistent with the OPR.
2. Review contractors schedule and verify commissioning activities are planned and given adequate time.
3. Review contractor submittals including shop drawings and catalog cuts for equipment being commissioned.
4. Review O&M manuals and equipment warranties for compliance with the OPR.
5. Plan and conduct commissioning meetings as required, coinciding with regularly scheduled bi-weekly construction progress meetings.
6. Perform site visits as necessary to observe component, equipment and systems installation.
7. Complete Installation Checklists.
8. Witness all functional and operational equipment and systems tests.
9. Review air balancing (TAB) reports for compliance with the OPR.
10. Oversee the training of the operations and maintenance personnel.
11. Provide bi-weekly progress reports of commissioning activities to include the status of:
    - Installation checklists
    - Functional testing
    - Performance testing
    - O&M training & documentation
    - Issues Log

Close Out Phase

1. Provide a final commissioning report.
2. The systems that can be part of the formal commissioning process include:
    - HVAC Systems
    - Life Safety Systems
    - Fire Alarm Systems
    - Lighting Systems and controls
    - Select plumbing systems