GENERAL NOTES:

1. BUILDING AUTOMATION SYSTEM (BAS) INSTALLER SHALL FURNISH AND INSTALL A DIRECT DIGITAL CONTROL BAS THAT CONNECTS TO THE EXISTING BAS FRONT-END. THE SAME BAS MANUFACTURER SHALL BE USED THROUGHOUT A PARTICULAR BUILDING; MIXED SYSTEMS IN THE SAME FACILITY ARE NOT ACCEPTABLE. THE BAS SHALL UTILIZE ELECTRONIC SENSING, MICROPROCESSOR-BASED DIGITAL CONTROL, AND ELECTRONIC ACTUATION OF DAMPERS, VALVES AND DEVICES TO PERFORM CONTROL SEQUENCES AND OTHER SPECIFIED FUNCTIONS. REFER ALSO TO CONTROL DRAWINGS, SEQUENCES OF OPERATION, AND POINT LISTS IN CONTRACT DOCUMENTS.

2. ALL MATERIALS SHALL BE NEW, THE BEST OF THEIR RESPECTIVE KINDS WITHOUT IMPERFECTIONS OR BLEMISHES AND SHALL NOT BE DAMAGED IN ANY WAY, AND SHALL CONSIST OF THE MANUFACTURER'S LATEST PROVEN TECHNOLOGY AT THE TIME OF EQUIPMENT SUBMITTAL. USED EQUIPMENT SHALL NOT BE USED IN ANY WAY FOR THE PERMANENT INSTALLATION EXCEPT WHERE DRAWINGS OR SPECS SPECIFICALLY ALLOW EXISTING MATERIALS TO REMAIN IN PLACE.

3. THE SYSTEM MUST BE FULLY BACNET (ASHRAE 135-LATEST EDITION) COMPLIANT AT THE TIME OF INSTALLATION. THE SYSTEM MUST USE BACNET AS THE NATIVE COMMUNICATION PROTOCOL BETWEEN THE BAS DEVICES AND UNIVERSITY NETWORK SERVERS.

4. THE FOLLOWING ARE THE ONLY ACCEPTABLE MANUFACTURERS FOR BUILDING AUTOMATION SYSTEM EQUIPMENT: AUTOMATED LOGIC CORPORATION (WEBCTRL), JOHNSON CONTROLS, INC. (METASYS).

5. ALL CONTROLS WORK SHALL BE INSTALLED BY THE BAS INSTALLER, UNLESS SPECIFIED OTHERWISE. ALL EQUIPMENT SHALL BE DIRECTLY CONTROLLED BY THE BAS IN LIEU OF THIRD-PARTY OR FACTORY CONTROLS, UNLESS APPROVED BY UVA AUTOMATION SERVICES.

6. THE INSTALLATION OF ALL EQUIPMENT SHALL BE IN STRICT ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND INSTALLATION GUIDELINES.

7. CRITICAL SAFETY INTERLOCKS, SUCH AS FREEZESTATS, HIGH LIMIT PROTECTORS, END SWITCHES ETC., SHALL BE DIRECTLY CONNECTED, THROUGH WIRE, SO AS NOT TO DEPEND ON ANY DIGITAL CONTROL SYSTEM "SEQUENCE OF OPERATION" TO PERFORM THEIR SAFETY FUNCTION. CONTACTS SHALL BE PROVIDED SO THE SAFETY CAN BE MONITORED BY THE BAS. FREEZESTATS AND STATIC PRESSURE SWITCH CONTACTS SHALL BE MECHANICALLY LATCHING AND ONLY RESET MANUALLY. SEE FIG. 9 : SAFETY CIRCUIT REQUIREMENTS FOR MORE INFORMATION.

8. LAMINATED CONTROL DRAWINGS INCLUDING NETWORK RISER DIAGRAM, SYSTEM CONTROL SCHEMATICS, SEQUENCES OF OPERATION AND PANEL TERMINATION DRAWINGS, SHALL BE PROVIDED IN EACH PANEL FOR THE EQUIPMENT SERVED BY THAT PANEL. TERMINAL UNIT DRAWINGS SHALL BE LOCATED IN THE CENTRAL PLANT EQUIPMENT PANEL OR MECHANICAL ROOM PANEL. THE DRAWINGS SHALL ACCURATELY RECORD THE ACTUAL CONTROLLER PROGRAMMING AND SETTINGS AT THE TIME OF BUILDING TURNOVER.

9. ELECTRONIC COPIES, INCLUDING EDITABLE AUTOCAD OR VISIO FILES, OF THE RECORD DRAWINGS SHALL BE PROVIDED TO UVA AUTOMATION SERVICES AND SHALL INCLUDE COPIES OF THE ABOVE NOTED DRAWINGS, PROJECT SUBMITTALS AS WELL AS INDIVIDUAL FLOOR PLANS WITH CONTROLLER LOCATIONS WITH ALL INTERCONNECTING ROUTING WIRING, SPACE SENSORS, LAN WIRING, POWER WIRING, AND LOW VOLTAGE POWER WIRING.

10. THE CONTROLS INSTALLER SHALL PROVIDE THE UNIVERSITY WITH ALL PRODUCT LINE TECHNICAL MANUALS AND TECHNICAL BULLETINS, TO INCLUDE NEW AND UPGRADED PRODUCTS, BY THE SAME DISTRIBUTION CHANNEL AS TO DEALERS OR BRANCHES THROUGHOUT THE WARRANTY PERIOD OF THE PROJECT.

11. BAS SHALL NOT BE UTILIZED FOR ANY ACTIVE SMOKE CONTROL SYSTEMS (UUKL/UL864).

12. THE UNIVERSITY RESERVES THE RIGHT TO MAKE CHANGES TO THE BAS DURING THE WARRANTY PERIOD. SUCH CHANGES DO NOT CONSTITUTE A WAIVER OF WARRANTY. THE INSTALLER SHALL WARRANTY PARTS AND INSTALLATION WORK REGARDLESS OF ANY SUCH CHANGES MADE BY THE UNIVERSITY, UNLESS THE INSTALLER PROVIDES CLEAR AND INDISPUTABLE EVIDENCE THAT A SPECIFIC PROBLEM IS THE RESULT OF SUCH CHANGES TO THE BAS. ANY DISAGREEMENT BETWEEN THE UNIVERSITY AND THE INSTALLER ON SUCH MATTERS SHALL BE SUBJECT TO RESOLUTION THROUGH THE CONTRACT 'DISPUTES' CLAUSE.

13. BILLING METERS WILL BE OWNER FURNISHED CONTRACTOR INSTALLED. ALL BILLING METERS WILL BE CONNECTED TO THE EXISTING SCHNEIDER ELECTRIC POWER MONITORING EXPERT (PME) SOFTWARE.

1 CONTROL WIRING STANDARDS

GENERAL NOTES:

1. ALL CONTROL WIRING SHALL BE STRANDED, PLENUM-RATED AND SHIELDED CABLE.

2. ALL CONTROL WIRING SHALL FOLLOW THE GENERAL CONVENTIONS LAID OUT IN THE CONTROL WIRING STANDARDS TABLE BELOW. BASIS OF DESIGN IS CONNECT AIR (PART NUMBERS LISTED). EQUIVALENT PRODUCTS FROM ALTERNATIVE MANUFACTURERS MAY BE USED, PROVIDED THEIR SPECIFICATIONS MEET OR EXCEED THE BASIS OF DESIGN.

3. ALL CONTROL WIRING SHALL BE LABELLED AT EACH JUNCTION AND TERMINATION. SEE CONTROL WIRING STANDARDS TABLE FOR LABELING CONVENTIONS. ALL JUNCTION BOXES HOUSING BAS WIRING MUST BE LABELLED.

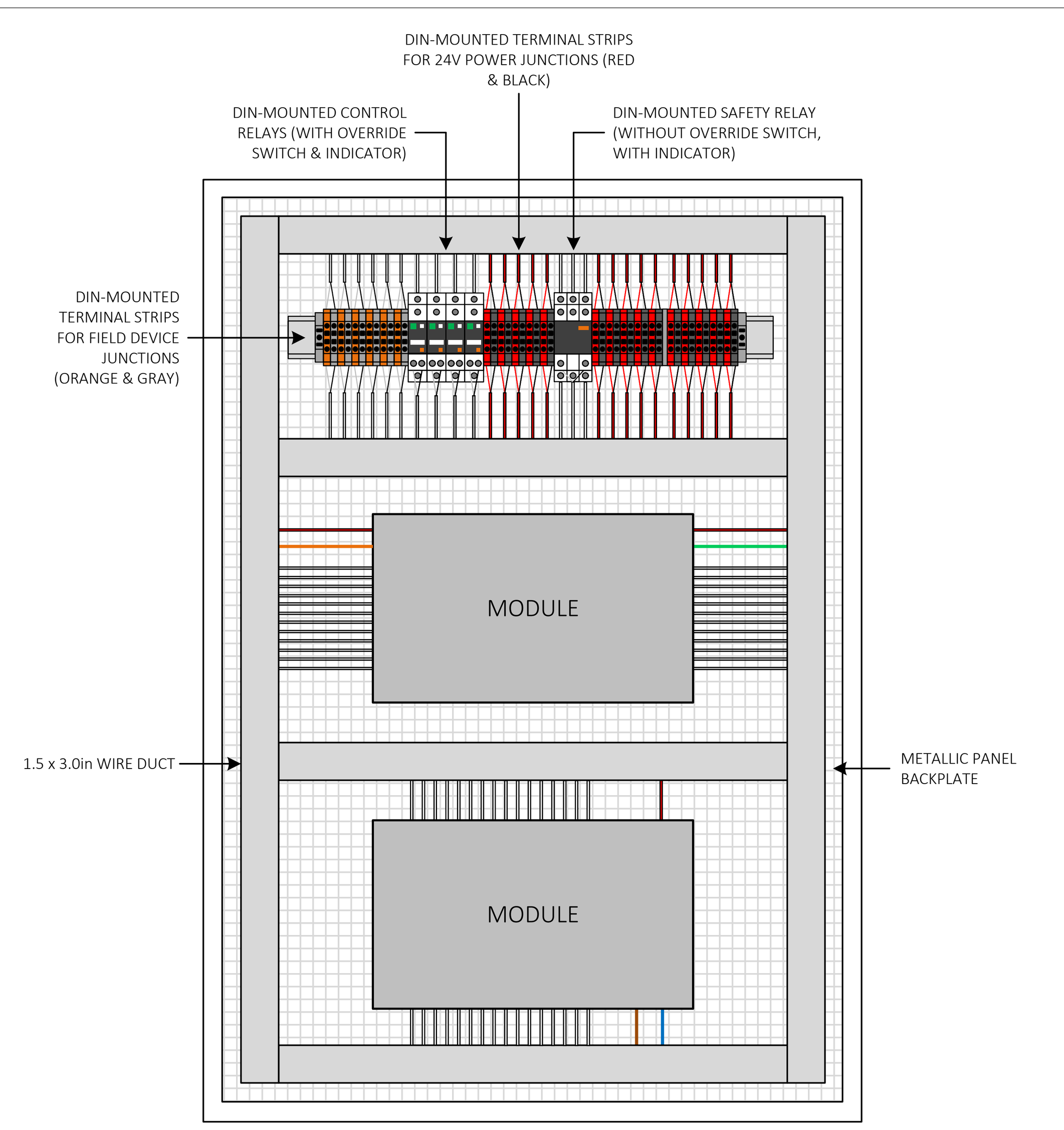
4. THE TERM "CONTROL WIRING" IS TO INCLUDE THE PROVISION OF WIRE, CONDUIT, AND MISCELLANEOUS MATERIALS REQUIRED FOR MOUNTING AND CONNECTING ELECTRIC OR ELECTRONIC CONTROL DEVICES IN PILOT CIRCUITS OF CONTACTORS, STARTERS, RELAYS, ETC., AND WIRING FOR VALVE AND DAMPER ACTUATORS AND METERS.

5. WIRE TERMINATIONS AND JOINTS SHALL BE MADE VIA SCREW TERMINALS. DOUBLE STACKING OF CONNECTIONS MUST BE APPROVED IN WRITING BY THE UVA AUTOMATION SERVICES DEPARTMENT. WIRE NUTS ARE NOT ACCEPTABLE. A WIRE CONNECTOR WITH A CLAMPING MECHANISM MAY BE USED WITHIN 36 INCHES OF AN END DEVICE AND WHERE THE END DEVICE IS NOT AVAILABLE WITH SCREW TERMINALS FOR TERMINATING FIELD WIRING. BASIS OF DESIGN IS WAGO 222 SERIES CONNECTORS.

6. ALL CONTROL WIRING IN MECHANICAL, ELECTRICAL, TELEPHONE, AND SIMILAR ROOMS SHALL BE INSTALLED IN CONDUIT. ALL OTHER WIRING SHALL BE INSTALLED NEATLY AND INCONSPICUOUSLY ABOVE CEILINGS, ANCHORED TO THE PERMANENT BUILDING STRUCTURE, WITH SUPPORTS NO MORE THAN 6 FEET APART. CONTROL WIRING EXPOSED TO OUTDOOR AIR MUST BE INSTALLED IN SEALED RIGID CONDUIT.

CONTROL WIRING STANDARDS

APPLICATION	TYPE	JACKET	CONDUCTORS	CONNECT AIR P/N	LABELING CONVENTION	
EIA-485/ARC156 NETWORKS	LOW-CAP SHIELDED 22AWG x 2	GREEN	WHITE : NET+ BLACK : NET- SHIELD : GND	ARC156	INDICATE THE NETWORK ADDRESS AND EQUIPMENT NAME (IF APP) OF THE NEXT DOWNSTREAM NODE *ex. "to CM01 : AHU-1"*	to CM01 : AHU1 / GREEN / WHITE : NET+ / BLACK : NET- / SHIELD : SHIELD
LOW VOLTAGE POWER	SHIELDED 18AWG x 2	WHITE *with* RED STRIPE	RED : 24V+ BLACK : 24V- shield : not used	W181P-2040K2WRDR	INDICATE THE SOURCE TRANSFORMER, VOLTAGE AND CURRENT TYPE *ex. "TX1 : 24VAC"*	TX1 : 24VAC / WHITE w/RED STRIPE / BLACK : 24- / COM / RED : 24+ / HOT / shield (not used)
ANALOG & DIGITAL I/O SIGNAL	SHIELDED 18AWG x 2	WHITE	WHITE : SIGNAL BLACK : SIGNAL shield : not used	W181P-2040RIB	INDICATE THE I/O NUMBER AND POINT NAME ACRONYM *ex. "AI1 : DA-T"*	AI1 : DA-T / WHITE / WHITE : SIG+ / BLACK : SIG- / COM / shield (not used)
NETWORKED SENSORS & THERMOSTAT	SHIELDED 22AWG x 4	ORANGE	WHITE : Rnet+ BLACK : Rnet - RED : 12V+ GREEN : GND shield : not used	W181P-2040RIB	INDICATE THE NAME OF THE EQUIPMENT SERVED AND THE TYPE AND ADDRESS OF THE NETWORK SENSOR (IF APP) *ex. "VAV-1 : STAT01"*	VAV-1 : STAT01 / ORANGE / WHITE : Rnet+ / BLACK : Rnet - / RED : 12V+ / GREEN : GND / shield (not used)
FC BUS or N2	SHIELDED 22AWG x 3	BLUE	BLUE : + BLACK : - WHITE : COM SHIELD : SHLD	W223C-2144FCBJC	INDICATE THE NETWORK ADDRESS AND EQUIPMENT NAME (IF APP) OF THE NEXT DOWNSTREAM NODE *ex. "to [module type]01 : AHU-1"*	to FEC04 : AHU-1 / BLUE / BLUE : + / BLACK : - / WHITE : COM / SHIELD : SHLD
SC or SA BUS	SHIELDED 22AWG x 4	BROWN	BLUE : + BLACK : - WHITE : COM RED : SA PWR shield : not used	W222P-2147BNRJC	INDICATE THE NAME OF THE EQUIPMENT SERVED AND THE TYPE AND ADDRESS OF THE NETWORK SENSOR (IF APP) *ex. "VAV-1 : STAT200"*	VAV-1 : STAT200 / BROWN / BLUE : + / BLACK : - / WHITE : COM / RED : SA PWR / shield (not used)



120/24V CONTROL TRANSFORMERS MOUNTED IN ISOLATED ADJACENT ENCLOSURE

2 CONTROL PANEL LAYOUT CONVENTIONS

1. ALL LINE VOLTAGE WIRING AND CONNECTIONS MUST BE ISOLATED IN SEPARATE ENCLOSURES. LINE VOLTAGE DEVICES AND EXPOSED LINE VOLTAGE CIRCUITRY IS PROHIBITED INSIDE CONTROL CABINETS. SEE FIG.7 - POWER WIRING, FOR FURTHER DETAIL.

2. CONTROL WIRING SHALL BE NEATLY ROUTED AND TERMINATED WITHOUT EXCESSIVE CABLE LENGTH. WHEREVER POSSIBLE, CONTROL WIRING SHOULD BE CONCEALED BY WIRE DUCT (SEE SCHEMATIC ABOVE).

3. ALL FIELD DEVICE JUNCTIONS SHALL BE MADE IN A NEATLY CONFIGURED DIN-MOUNTED TERMINAL STRIP. TERMINAL STRIP COMPONENTS MUST FOLLOW UVA STANDARD COLOR CODING.

4. CONTROL RELAYS SHALL BE DIN-MOUNTED AND PROVIDED WITH A VISUAL STATUS INDICATOR AND OVERRIDE SWITCH. BASIS OF DESIGN IS MAGNECRAFT 78X SERIES.

7. RELAYS PERTAINING TO SAFETY CIRCUITS SHALL OMIT OVERRIDE SWITCHES (SEE FIG.9 : SAFETY CIRCUIT REQUIREMENTS FOR MORE DETAIL).

3 BAS RECORD DOCUMENTS

1. BAS RECORD DOCUMENTS SHALL CLEARLY CONVEY THE PHYSICAL DESIGN OF THE SYSTEM, NETWORK, MATERIALS AND DEVICES TO BE USED THEREIN.

2. EACH UNIQUE TYPE OF EQUIPMENT SHALL HAVE AN EQUIPMENT SCHEMATIC SHOWING HARDWARE LAYOUT, A MODULE OR PANEL DETAIL SHOWING LAYOUT AND CONNECTION, A BILL OF MATERIALS AND A CONCISE WRITTEN SEQUENCE DESCRIBING EACH MODE OF OPERATION.

3. A NETWORK DIAGRAM SHALL BE PROVIDED FOR EACH PROJECT, INDICATING THE PHYSICAL LAYOUT, INCLUDING THE ROUTING OF NETWORK WIRE, AS WELL AS THE LOCATION OF EACH NODE AND THE EQUIPMENT IT SERVES. THIS DIAGRAM SHOULD INCLUDE ALL BAS MODULES, AS WELL AS ANY NETWORK DEVICES SUCH AS GATEWAYS, ROUTERS AND THIRD-PARTY INTERFACES. NETWORKED SENSORS SHALL ALSO BE SHOWN.

4. RECORD DOCUMENTS SHALL INCLUDE EQUIPMENT SCHEDULES DETAILING THE SPECIFICATION AND APPLICATION OF CONTROL VALVES, CONTROL DAMPERS AND ANY OTHER EQUIPMENT PROVIDED BY THE BAS CONTRACTOR.

5. ALL RECORD DOCUMENTS ARE SUBJECT TO THE APPROVAL OF THE PROJECT ENGINEER OF RECORD, UVA AUTOMATION SERVICES AND THE UNIVERSITY BUILDING OFFICIAL.

4 BAS POWER REQUIREMENTS

1. ALL CONTROL PANELS SHALL BE SERVED BY DEDICATED POWER CIRCUITS FROM THE SAME SOURCE AND SERVICE LEVEL PROVIDED TO THE EQUIPMENT CONTROLLED. THE CONTROL PANEL SHALL BE LABELED WITH THE ELECTRICAL PANEL NAME AND CIRCUIT SOURCE.

2. CENTRAL/DISTRIBUTED LOW VOLTAGE POWER IS PROHIBITED. LINE VOLTAGE SHALL BE PROVIDED TO EACH CONTROL PANEL AND/OR TERMINAL UNIT AND SHALL BE FURNISHED AND INSTALLED BY THE ELECTRICAL CONTRACTOR. THE CONTROLS CONTRACTOR SHALL PROVIDE LOW VOLTAGE TRANSFORMERS AT EACH CONTROL PANEL TO STEP DOWN THE LINE VOLTAGE TO 24V FOR USE WITHIN THAT PANEL ONLY. EACH CONNECTION TO LINE VOLTAGE SHALL INCLUDE A DISCONNECT TO FULLY ISOLATE THE TRANSFORMER FROM THE POWER SOURCE.

3. BAS INSTALLER SHALL FURNISH AND INSTALL ANY POWER SUPPLY SURGE PROTECTION, FILTERS, ETC. AS NECESSARY FOR PROPER OPERATION AND PROTECTION OF ALL CONTROLLERS. ALL CONTROL EQUIPMENT MUST BE TOLERANT OF VARIATIONS 10% ABOVE OR BELOW SCHEDULED NOMINAL VOLTAGE WITH NO IMPACT ON HARDWARE, SOFTWARE, COMMUNICATIONS OR DATA STORAGE.

4. FOR EQUIPMENT ON EMERGENCY OR STANDBY POWER, THE BAS CONTROLLER SERVING THAT EQUIPMENT SHALL BE PROVIDED WITH AN EXTERNAL UNINTERRUPTABLE POWER SUPPLY (UPS). A UPS SHALL BE PROVIDED FOR EACH CONTROLLER REQUIRED TO MAINTAIN COMMUNICATION BETWEEN THE EQUIPMENT CONTROLLER AND THE BAS SERVER. THE UPS SHALL BE CONFIGURED TO PROVIDE UNINTERRUPTED SERVICE TO THE CONTROLLERS DURING TRANSITION TO/FROM NORMAL AND EMERGENCY/STANDBY POWER. THE UPS SHALL HAVE A LOW BATTERY ALARM MONITORED WHILE FUNCTIONING ON NORMAL POWER AND WIRED TO THE BAS FOR NOTIFICATION. THE UPS SHALL PASS POWER THROUGH TO THE CONTROLLER IF THE UPS BATTERY FAILS.

5. AN INTEGRATED FULL-BUILDING UPS MAY BE USED IN PLACE OF INDIVIDUAL UPS'S FOR BAS EQUIPMENT.

6. PURSUANT TO ELECTRICAL SAFETY STANDARDS, NO LINE VOLTAGE TERMINATIONS OR JOINTS MAY BE EXPOSED TO AN OCCUPIABLE SPACE, INCLUDING CONTROL CABINETS. ALL CONNECTIONS INVOLVING VOLTAGES >24VAC MUST BE MADE IN DEDICATED ENCLOSURES SEPARATE FROM CONTROLLER CABINETS.

5 CONTROL VALVE REQUIREMENTS

1. CONTROL VALVES SHALL BE PRESSURE-INDEPENDENT (PICV) TYPE. MECHANICAL AND/OR ELECTRONIC (EPIV) PRESSURE-INDEPENDENT FUNCTIONALITY IS ACCEPTABLE.

2. VALVES SERVING EQUIPMENT WITH SAFETY CIRCUITS MUST BE FAILSAFE. HOT WATER VALVES SHALL FAIL OPEN AND CHILLED WATER VALVES SHALL FAIL CLOSED.

3. TERMINAL EQUIPMENT NOT CONNECTED TO SAFETY CIRCUITS MAY USE FAIL-IN-PLACE (FIP) ACTUATORS.

4. EQUIPMENT USING ONLY CONDENSATE/WATER DETECTION DEVICES FOR SAFETY MAY USE FAIL-IN-PLACE (FIP) ACTUATORS, PROVIDED THE CONTROL LOGIC COMMANDS THE VALVES CLOSED UPON DETECTION OF WATER.

5. ACCEPTABLE CONTROL VALVE MANUFACTURERS INCLUDE: BELIMO & FLOW CONTROL INDUSTRIES (FCI).

6 SAFETY CIRCUIT REQUIREMENTS

1. SAFETY CIRCUITS SHALL BE USED IN ANY APPLICATION WHERE DAMAGE MAY OCCUR DUE TO EQUIPMENT MALFUNCTION INCLUDING, BUT NOT LIMITED TO:
   - STATIC SWITCHES BETWEEN FANS AND DAMPERS
   - CONDENSATE OVERFLOW/LEAK DETECTION SWITCHES
   - DUCT SMOKE DETECTORS (AS REQUIRED BY VA CODE)
   - FREEZESTATS FOR ALL EQUIPMENT CONNECTED TO OUTSIDE AIR

2. SAFETY CIRCUITS SHALL BE HARDWIRED, NORMALLY-CLOSED, LOW-VOLTAGE (24VAC) SERIES CIRCUITS NOT DEPENDENT ON CONTROL LOGIC OR SOLID-STATE ELECTRONICS FOR OPERATION.

3. ALL SENSING DEVICES CONNECTED TO SAFETY CIRCUITS SHALL HAVE TWO SETS OF ISOLATED CONTACTS (DPDT). A NORMALLY CLOSED (NC) SET SHALL BE PROVIDED FOR THE HARDWIRED SAFETY CIRCUIT. A NORMALLY OPEN (NO) SET SHALL BE PROVIDED FOR MONITORING BY THE BAS.

4. SAFETY CIRCUITS SHALL INTERRUPT THE BAS CONTROL SIGNAL AND SEND ALL DEVICES TO FAILSAFE POSITIONS TO SECURE THE CONNECTED EQUIPMENT.

5. SAFETY CIRCUITS SHALL BE NON-OVERRIDABLE. RELAYS & DEVICES WITH MANUAL SWITCHES ARE PROHIBITED, INCLUDING ALL "SAFETY INTERFACE BOARDS" THAT COMBINE DIGITAL MULTIPLE INPUTS TO ONE OUTPUT, SUCH AS THE RIBMNLB-XXX AND SIMILAR DEVICES.

7 VIVARIUM LABORATORY TEMPERATURE AND HUMIDITY SENSOR REQUIREMENTS

1. A NIST-TRACEABLE TEMPERATURE AND HUMIDITY SENSOR WITH A NEMA TYPE 2 OR HIGHER ENCLOSURE AND WALL-MOUNTED DISPLAY, AS REQUIRED BY THE SPACE APPLICATION, SHALL BE PROVIDED FOR EACH SPACE, AS SPECIFIED BY THE UNIVERSITY.

2. IF THE SENSOR IS LOCATED INSIDE ANIMAL ROOMS, IT SHALL HAVE A WATERPROOF ENCLOSURE SUITABLE FOR PERIODIC WASH DOWN.

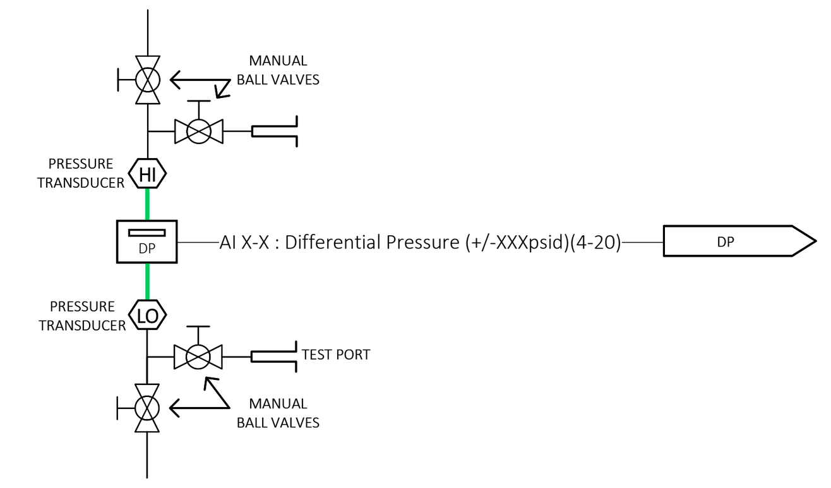
3. THE SENSORS FOR THESE DISPLAYS SHALL BE THE CONTROLLING SENSORS AND SHOULD BE SUITABLE FOR HIGH HUMIDITY ENVIRONMENTS WITH QUICK RECOVERY FOR SATURATION EVENTS, EQUIVALENT TO VAISALA HMT130.

8 THIRD-PARTY INTEGRATION

1. THE BAS INSTALLER SHALL BE RESPONSIBLE FOR DIRECTLY CONNECTING AND CONTROLLING ALL EQUIPMENT AND ASSOCIATED SYSTEMS WITH THE BUILDING AUTOMATION SYSTEM. EQUIPMENT MANUFACTURER PROVIDED CONTROL OF EQUIPMENT (AKA "PACKAGED CONTROLS") IS NOT ACCEPTABLE UNLESS PRE-APPROVED BY UVA AUTOMATION SERVICES.

2. ALL THIRD-PARTY INTEGRATION, INCLUDING THAT WHICH IS INTENDED FOR MONITORING-ONLY, SHALL BE ACCOMPLISHED VIA SERIAL EIA485 BACNET MS/TP CONNECTION. INTEGRATION UTILIZING ALTERNATIVE MEDIA (IP, EIA232, ETC) OR PROTOCOLS (MODBUS, LON, ETC) MUST BE PRE-APPROVED BY UVA AUTOMATION SERVICES

3. WHERE A THIRD-PARTY INTERFACE IS APPROVED FOR THE EQUIPMENT CONTROL AND SEQUENCING, THE INTERFACE SHALL BE NATIVE BACNET AS PROVIDED BY THE MANUFACTURER AND SHALL BE WIRED TO THE BAS ON AN MS/TP COMMUNICATION TRUNK LOCAL TO THE BUILDING CONTROL NETWORK. ALL CONTROL AND MONITORING POINTS SHALL BE MADE AVAILABLE TO THE BAS WITH READ AND WRITE AUTHORIZATION AS APPLICABLE.



9 HYDRONIC DIFFERENTIAL PRESSURE TRANSMITTER REQUIREMENTS

1. HYDRONIC DIFFERENTIAL PRESSURE TRANSMITTERS SHALL BE THE REMOTE TRANSDUCER TYPE (NOT INTEGRATED/MANIFOLD TYPE) AND SHALL INCLUDE LCD DISPLAYS.

2. EACH TRANSDUCER LOCATION SHALL INCLUDE ALL NECESSARY HARDWARE TO ISOLATE, BLEED AND TEST THE INDIVIDUAL SENSOR (SEE SCHEMATIC).

3. USE OF SOFT TUBING (COPPER, POLY, ETC.) AND/OR MANIFOLDS IS PROHIBITED.

10 STANDARD ALARMING

1. ALARM SETTINGS MUST BE COORDINATED WITH AUTOMATION SERVICES, SYSTEMS CONTROL AND THE SPACE USER/ZONE MAINTENANCE. THE TABLE BELOW IS A GENERAL GUIDELINE.

2. TEXT SHALL BE ADDED TO THE ALARM MESSAGE BLOCK WHEN CREATING ALARMS TO PROVIDE THE OPERATORS AND MAINTENANCE PERSONNEL WITH ADDITIONAL INFORMATION. MESSAGES SHALL FOLLOW THE BELOW FORMAT:

Building Number.System.Point Identification.ALARM

Example: "0228.AHU-01.SA-T.ALARM"

3. CRITICAL ALARM POINTS WILL REQUIRE A SPECIFIC MESSAGE TO BE PROVIDED AND THIS MESSAGE SHALL BE COORDINATED WITH SYSTEMS CONTROL CENTER.

5. UPON SYSTEM TURNOVER TO THE UVA PRODUCTION ENVIRONMENT, SYSTEM SHALL BE FREE OF ANY NUISANCE AND ERRONEUS ALARMS.

6. ALARMS SHALL BE ENABLED IN A SYSTEMATIC FASHION, ALLOWING TIME FOR OBSERVATION AND DEBUGGING PRIOR TO WIDE-SCALE DEPLOYMENT.

7. ALARMS SHALL INDICATE ABNORMAL CONDITIONS REQUIRING OPERATOR INTERVENTION. ALARMS SHOULD NOT OCCUR UNLESS THERE IS A DEFICIENCY PREVENTING THE SYSTEM FROM FUNCTIONING AS SPECIFIED.

8. ALARMS SHALL BE ACTIONABLE, NOT SIMPLY INFORMATIONAL.

9. ALARMS SHALL NOT BE REDUNDANT AND/OR CASCADING.

10. ALARMS SHALL BE CONFIGURED WITH ADEQUATE HYSTERESIS AND/OR DEBUNKING MEASURES TO PREVENT SHORT-CYCLING AND/OR CONDITIONAL CYCLING.

DEFAULT ALARM PARAMETERS

ALARM TYPE	BACNET PRIORITY	DELAY
UTILITIES (CHW, HW, STEAM, GENERATOR, ETC.)	1	60sec
PATIENT CARE AREA (OR, ISOLATION ROOM, ED, ETC)	3	300sec
PHARMACY (ROOM TEMP, FREEZERS, FRIDGES, ETC)	5	300sec
MEDICAL GASES	7	300sec
VIVARIUM CRITICAL	14	300sec
BSL-3 FACILITY	15	30sec
OTHER FREEZERS, COLD ROOMS, INCUBATORS, FRIDGES...	18	60sec
RESEARCH & LAB SPACES	20	300sec
IT INFRASTRUCTURE (SERVERS, SWITCHES, ETC.)	40	600sec
FREEZESTATS	60	30sec
SYSTEM CRITICAL NETWORK DEVICE	106	60sec
METERING	110	900sec
ENERGY/SUSTAINABILITY	112	900sec
HVAC GENERAL	148	18,000sec
NORMAL	200	18,000sec
AUTOMATIC (RESERVED FOR EMAIL NOTIFICATION FILTERS)	225-240	18,000sec

11 ROOM PRESSURIZATION

1. WHERE A ROOM REQUIRES ACTIVE PRESSURIZATION CONTROL, THE AIR SUPPLY AND EXHAUST SHALL BE CONTROLLED DIRECTLY BY THE BAS.

2. IF A FUME HOOD IS REQUIRED, THE FUME HOOD SHALL BE CONTROLLED BY A STAND-ALONE ORIGINAL EQUIPMENT MANUFACTURER (OEM) CONTROLLER WITH THE POINTS LISTED IN THIS DETAIL PROVIDED TO THE BAS VIA BACNET MS/TP OR HARDWIRED, AS NOTED BELOW:

1. SUPPLY AIR FLOW (SA-F)
2. SUPPLY AIR FLOW SETPOINT (SA-F-STPT)
3. SUPPLY DAMPER OUTPUT/POSITION (SA-D-O)
4. REHEAT VALVE OUTPUT/POSITION (RH-V-O)
5. SUPPLY AIR TEMPERATURE (SA-T)
6. ZONE TEMPERATURE (ZN-T)
7. ZONE HUMIDITY (ZN-RH)
8. GENERAL EXHAUST AIRFLOW (GEX-F)
9. GENERAL EXHAUST AIRFLOW SETPOINT (GEX-F-STPT)
10. GENERAL EXHAUST DAMPER OUTPUT/POSITION (GEX-D-O)
11. FUME HOOD EXHAUST AIRFLOW (HOOD-F)
12. FUME HOOD EXHAUST AIRFLOW SETPOINT (HOOD-F-STPT)
13x. ALL FUME HOOD ALARMS (FACE VELOCITY, SASH POSITION, ETC.)

12 WEBCTRL DATABASE CONVENTIONS AND ARCHITECTURE

1. THE WEBCTRL DATABASE SHALL FOLLOW THE CONVENTIONS AND ARCHITECTURE OUTLINED IN THE "UVA WEBCTRL DATABASE STRUCTURE AND NAMING STANDARDS" DOCUMENT, AS OUTLINED BELOW:

Geo Tree:
a. Area Display Name: [Building Number] – [Building Name](PRN Additional Descriptors)
Example: 2150 – Bond House (Brandon UCH)
b. Area Reference Name: #[building number]_[building_name]
Example: #2150_bond_house
i. Equipment Display Name: [Equipment Name] : [Area Served/Room Number]
Example: FC-12H : C200
ii. Equipment Reference Name: #[equipment name]_[area served]_[building number]
Example: #fc-12h_c200_2150

Net Tree:
a. Gateway Display Name: [Device Model][Building Number][***Gateway Suffix***] – [Building Name] (BACnet Network)(IP)
Note: For "Gateway Suffix" use consecutive letters to identify multiple gateways in a single building; "A" for first gateway, "B" for second gateway, etc.
If there is only one gateway in a building, simply use "A".
Example: G5CE2150A – Bond House (11100)(10.182.3.129)
b. Gateway Reference Name: #[device model][building number][*gateway suffix*]_[building name]
Example: #g5ce2150a_bond_house
i. Network Display Name: [Network Descriptor] [Network Type] (Network Number)
*Example: 1st Floor ***Subnet**** *(11101)*
****Note****: *For standard ARCnet, you may use "Main" and "Subnet" descriptors. For TPI networks, use full descriptors, such as "BACnet MS/TP"*
ii. Network Reference Name: #[network type]_[network number]_[building number]
Example: #arcnet_11101_2150
1. Router Display Name: [Primary Network MAC Address] – [Device Model] : [Name of Secondary Network]
Example: CM01 – AAR : 1st Floor Subnet
2. Router Reference Name: #[primary network number]_[primary network mac address]_[building number]
Example: 11100_cm01_2150
a. Controller Display Name: [MAC Address] – [Device Model] : [Area/Equipment Served]
Example: CM01 – ME812u : OAU-1
b. Controller Reference Name: #[network number]_[MAC address]_[building number]
Example: #11101_cm01_2150

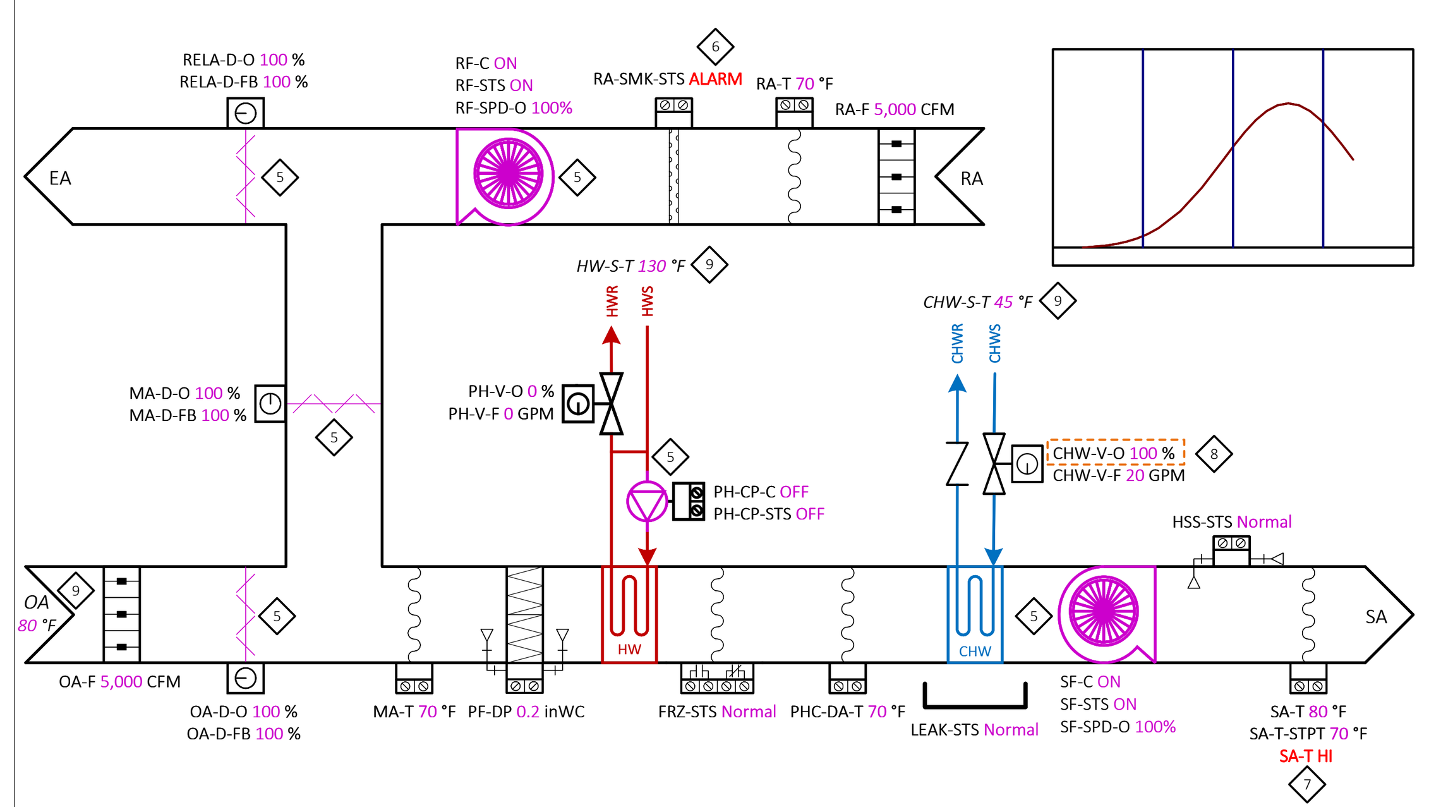
13 USER INTERFACE GRAPHICS

1. DYNAMIC SYSTEM GRAPHICS ARE REQUIRED FOR ALL BUILDING AUTOMATION SYSTEMS. GRAPHICS SHALL CONSIST OF THREE LEVELS: EQUIPMENT, AREA AND SUMMARY.

2. ALL GRAPHICS SHALL HYPERLINK TO THE REPRESENTED SPACE OR EQUIPMENT.

3. ALL GRAPHICS SHALL DISPLAY THE OUTSIDE AIR TEMPERATURE AND HUMIDITY.

EQUIPMENT GRAPHICS



1. EQUIPMENT-LEVEL GRAPHICS SHALL BE SCHEMATICALLY ACCURATE REPRESENTATIONS OF THE EQUIPMENT BEING CONTROLLED. ALL ASSOCIATED POINTS AND VALUES SHALL BE REPRESENTED.

2. POINT NAMES SHALL BE CLEARLY LABELLED AND FOLLOW THE UVA STANDARD NAMING CONVENTION (PAGE 2 OF THIS DOCUMENT).

3. ENGINEERING UNITS SHALL BE DISPLAYED FOR ALL ANALOG VALUES.

4. EQUIPMENT GRAPHICS SHALL CONTAIN A TREND GRAPH SHOWING KEY PERFORMANCE INDICATORS.

5. DYNAMIC EQUIPMENT COMPONENTS SHALL ANIMATE TO REFLECT STATUS AND/OR POSITION (FIGURE 1 MAGENTA).

6. SAFETY SYSTEMS SHALL INCLUDE TEXT DIFFERENTIATING NORMAL AND ALARM STATES. THE TEXT SHALL DYNAMICALLY CHANGE COLOR TO RED WHEN IN ALARM.

7. ALARM TEXT SHALL BE HIDDEN WHEN IN NORMAL STATE. WHEN IN ALARM STATE, ALARM TEXT SHALL BE DESCRIPTIVE OF THE ALARM CONDITION AND BE BOLD AND RED TO DRAW OPERATOR ATTENTION.

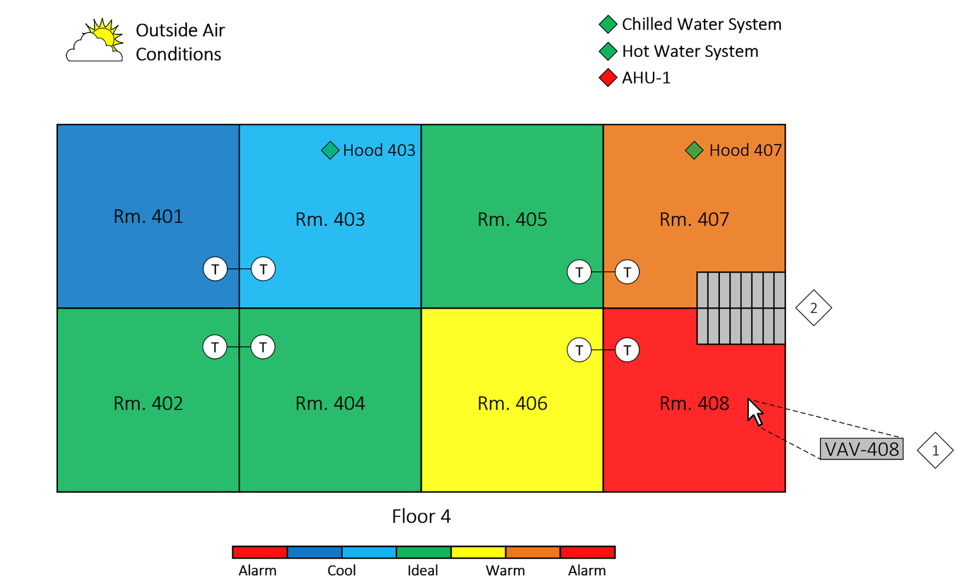
8. POINTS WHICH ARE OVERRIDDEN/LOCKED SHALL BE CLEARLY INDICATED.

9. PARENT SYSTEMS SHALL DISPLAY THE VALUE OF THE SUPPLIED MEDIUM AND HYPERLINK TO THE RELEVANT PROGRAM.

10. COMPONENTS LOCATED REMOTELY FROM THE EQUIPMENT SHALL INDICATE THEIR GEOGRAPHIC WHEREABOUTS.

11. EQUIPMENT SETPOINTS AND MODES OF OPERATION SHALL BE CONTROLLABLE VIA EDITABLE INTERFACES.

AREA GRAPHICS



1. INDIVIDUAL AREA GRAPHICS SHALL BE PROVIDED FOR ALL FLOORS AND/OR SECTORS. THESE GRAPHICS SHALL BE ACCURATE REPRESENTATIONS OF THE GEOGRAPHIC FLOOR PLANS, CLEARLY DIFFERENTIATING EACH SPACE.

2. AREA GRAPHICS SHALL DYNAMICALLY UPDATE TO DEPICT THE STATUS OF THE SPACES BEING SERVED.

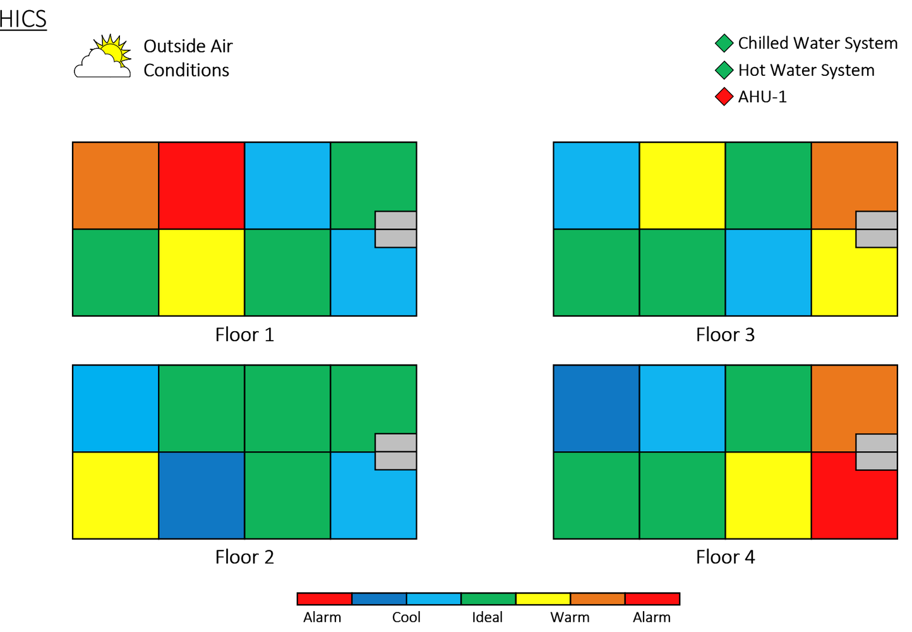
3. SPACE TEMPERATURES SHALL BE DISPLAYED EITHER THERMOGRAPHICALLY (DYNAMIC COLORATION) OR NUMERICALLY. THERMOGRAPHS ARE PREFERRED.

4. UNCONDITIONED SPACES SHALL BE CLEARLY INDICATED BY NEUTRAL FILL.

5. SENSOR LOCATIONS SHALL BE INDICATED AND HYPERLINK TO THEIR ASSOCIATED PROGRAMS.

6. EACH SPACE SHALL DISPLAY THE ROOM NAME/NUMBER AND SHOW THE EQUIPMENT TAG FOR ITS TERMINAL UNIT WHEN THE MOUSE IS HOVERED OVER THE SPACE OR LINK.

SUMMARY GRAPHICS



1. A BUILDING-LEVEL SUMMARY GRAPHIC SHALL BE PROVIDED THAT COMBINES ALL INDIVIDUAL AREA GRAPHICS ON ONE SCREE. THE KEY FUNCTIONS OF EACH AREA GRAPHIC SHALL BE RETAINED IN THE SUMMARY. EACH AREA ON THE SUMMARY PAGE SHALL LINK TO THE MORE DETAILED AREA GRAPHIC.

2. THE SUMMARY GRAPHIC SHALL INCLUDE LINKS AND STATUS INDICATORS FOR EACH PIECE OF CENTRAL EQUIPMENT (E.G. AIR HANDLERS, HYDRONIC SYSTEMS, ETC), CRITICAL BUILDING EQUIPMENT (EMERGENCY POWER SYSTEMS, ELEVATOR ALARMS, ETC.) AND ANY OTHER CRITICAL MONITORING POINTS (FREEZER/REFRIGERATOR MONITORING, VIVARIUM AREAS, ETC.)

14 BAS NETWORKING AND CYBERSECURITY

1. THE MAIN UNIVERSITY BACNET IP NETWORK IS 2400. ALL BACNET IP DEVICES RESIDING ON THE MAIN UNIVERSITY SYSTEM SHALL BE ASSIGNED TO NETWORK NUMBER 2400.

2. ALL BACNET NETWORK NUMBERS AND IP ADDRESSES MUST BE REQUESTED AND COORDINATED THROUGH AUTOMATION SERVICES.

3. BACNET BROADCAST MANAGEMENT DEVICES (BBMD'S) ARE CONFIGURED MANUALLY BY THE UNIVERSITY. AUTOMATIC BBMD MANAGEMENT SHALL BE DISABLED. WHEN A NEW NETWORK CONTROLLER IS CONNECTED TO UNIVERSITY SYSTEMS, THE BAS INSTALLER MUST COORDINATE WITH AUTOMATION SERVICES TO CONFIGURE ANY NECESSARY BBMD'S.

4. THE NETWORK TREE ON THE CONTROL SYSTEM SHALL USE THE FOLLOWING CONVENTION FOR THE TOP-LEVEL NETWORK CONTROLLERS/GATEWAYS: [DEVICE TYPE][BUILDING NUMBER][A,B,C]-[IP ADDRESS][(BACNET ADDRESS/ LOCATION)]. EXAMPLE: LGR0001A – 10.182.55.55 (2410199/RM020) OR NAE0002A – 10.182.55.55 (1410199/RM020). SEE "UVA WEBCTRL DATABASE STRUCTURE AND NAMING STANDARDS" DOCUMENT FOR MORE DETAIL.

5. NETWORK ACCESS/DROP REQUESTS ASSOCIATED WITH THE BAS SHALL BE REQUESTED VIA AUTOMATION SERVICES.

6. ALL DEFAULT/ GENERIC USER ACCOUNTS AND PASSWORDS SHALL BE CHANGED AND COORDINATED WITH AUTOMATION SERVICES PRIOR TO PLACING ANY CONTROLLER ONLINE IN THE PRODUCTION ENVIRONMENT.

BACNET DEVICE ADDRESSING:
1. BACNET CONTROLLERS SHALL HAVE UNIQUE ADDRESSES THROUGHOUT THE SYSTEM.

2. BACNET ADDRESSES SHALL USE THE FOLLOWING FORMAT: PPNNNXX
"PP" IS THE ALLOCATED ADDRESS SPACE
"PPNNN" IS THE BACNET NETWORK NUMBER THE CONTROLLER RESIDES ON (AS ASSIGNED BY AUTOMATION SERVICES)
"XX" IS THE ADDRESS FOR THE INDIVIDUAL DEVICE

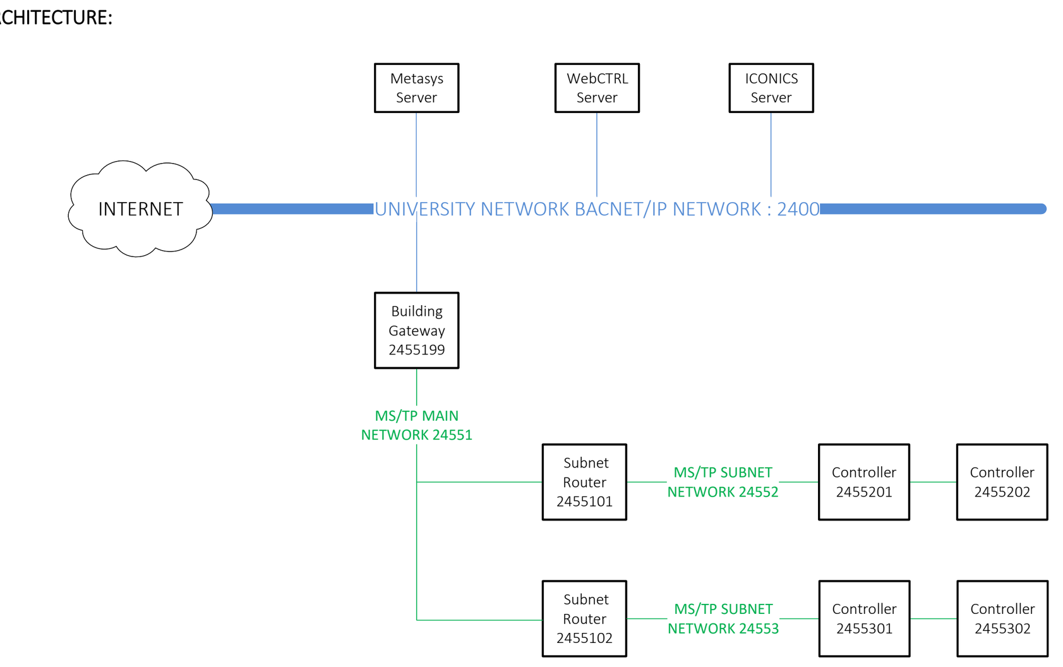
3. NO INDIVIDUAL BACNET NETWORK MAY HAVE MORE THAN 99 INDIVIDUAL DEVICES RESIDING ON IT. IN THE EVENT ADDITIONAL DEVICES ARE REQUIRED, ADDITIONAL NETWORKS MUST BE REQUESTED.

4. TO AVOID DUPLICATE ADDRESSES, PARENT BUILDING ROUTERS/GATEWAYS SHALL USE THEIR CHILD MS/TP NETWORK NUMBER AS THE BASIS OF THEIR DEVICE ID, NOT 2400.

DESIGNATED NETWORK AND DEVICE ADDRESS RANGES

BACNET RANGE	ALLOCATION:
12001-19999	DEVICES WITH INSTANCE ID LIMITATIONS (APPROVAL REQUIRED)
11000-11999 1100000-1199999	UVA METERING
12000-12999 1200000-1299999	JCI CONSTRUCTION PROJECTS
14000-14999 1400000-1499999	UVA AUTOMATION SERVICES INTERNAL
2400-2499 2400000-2499999	ALC CONSTRUCTION PROJECTS

EXAMPLE BAS NETWORK ARCHITECTURE:



UVA BUILDING AUTOMATION SYSTEM STANDARDS
FM Automation Services: Will Muncaster, 434.906.9117
REV : 6.1 | ISSUED : 7/11/2023 | DRAWN BY: WTM, WGS
UNIVERSITY of VIRGINIA
Automation Services

15 POINT NAMING CONVENTIONS

1.ALL POINT NAMES, INCLUDING DISPLAY NAMES, REFERENCE NAMES, AND BACNET OBJECT NAMES, SHALL USE A COMBINATION OF THE UVA STANDARD ABBREVIATIONS WITH A DASH (-) SEPARATING THE ABBREVIATIONS. FOR EXAMPLE, A SUPPLY AIR TEMPERATURE SENSOR WOULD BE INDICATED AS SA-T (SEE THE "BAS POINT NAME CONVENTION" REFERENCE DOCUMENT FOR ADDITIONAL INFORMATION ABOUT THE POINT NAMING STANDARDS, WHICH IS AVAILABLE UPON REQUEST FROM UVA AUTOMATION SERVICES). ALL FULLY QUALIFIED OBJECT NAME, WHERE APPLICABLE, SHALL INCLUDE THE RESPECTIVE BUILDING NUMBER, CONTROLLER IDENTIFICATION, AND APPROPRIATE POINT ABBREVIATION SEPARATED BY A PERIOD. FOR EXAMPLE, "0001.VAV-01.SA-T" WOULD REPRESENT A SUPPLY AIR TEMPERATURE ASSOCIATED WITH VARIABLE AIR VOLUME CONTROLLER NUMBER 01 IN BUILDING NUMBER 0001.

2. THE DETAILS/DESCRIPTION FIELD, WHERE APPLICABLE, SHALL CONTAIN FLOOR, ROOM, AND ASSOCIATED COOLING/HEATING SOURCE IN THAT ORDER. FOR EXAMPLE, ROOM ZONE TEMPERATURE - "FLR 3 : RM 321 : AHU-06" THIS WOULD INDICATE THE LOCATION OF THE POINT AND ITS RESPECTIVE HEATING/COOLING SOURCE, WHICH IS AIR HANDLER 06.

3. WHEN POINTS ARE OBSERVED AT A SYSTEM LEVEL, A FULLY-QUALIFIED REFERENCE NAME SHALL BE USED, INCLUDING BUILDING NUMBER, EQUIPMENT NAME AND POINT DESCRIPTORS. EX. 0221.AHU1.SA-T

4. ALL POINTS SHALL CONTAIN A PREFIX DESCRIBING THE SYSTEM THEY SERVICE (CHWS, HWS, AHU, EF, ETC). HOWEVER, THE PREFIX MAY BE DROPPED WHEN THE POINTS ARE OBSERVED AT THE EQUIPMENT LEVEL UNDERNEATH A SYSTEM HEADER.

5. IF A SPECIFIC POINT IS NOT LISTED IN THIS DOCUMENT, BEST JUDGEMENT SHALL BE USED TO IMPLEMENT AN ACRONYM THAT IS GENERALLY REPRESENTATIVE OF THE INDUSTRY STANDARD DESCRIPTION. DUPLICATE ACRONYMS SHOULD BE AVOIDED. HOWEVER, DUPLICATES ARE ACCEPTABLE IN INSTANCES WHERE CONTEXT IS DEFINED AND THE NON-DUPLICATE ALTERNATIVE WOULD BE UNCLEAR.

GENERAL

Acronym	Description
AVG	Average
C	Command (Binary Output)
EFF	Effective
ELV	Elevator
ENA	Enable
FB	Feedback
H2O	Water
MAX	Maximum
MIN	Minimum
O	Output (Analog Output)
OCC	Occupancy
OCCS	Occupancy Sensor
OVR	Override
SPD	Speed
STPT	Setpoint
STPT	Setpoint
STS	Status
SW	Switch
UNOCC	Unoccupied
WIN	Window Switch
ZN	Zone

WATER-SIDE

Acronym	Description
BLDG	Building
BLR	Boiler
BRDG	Bridge
BYP	Bypass
CBCHW	Chilled Beam Chilled Water
CHLR	Chiller
CHW	Chilled Water
CRW	Condensate Recovery Water
CW	Condenser Water
DOM	Domestic (Prefix - assign temp after)
DP	Differential Pressure
DTW	Dual-Temp (legacy only)
EOL	End-of-Line
F	Flow
GLY	Glycol
HRC	Heat Recovery
HX	Heat Exchanger
IRR	Irrigation
LTHW	Low Temperature Hot Water
LVL	Level
MTHW	Medium Temperature Hot Water
MU	Make-up
P	Pump (Used as suffix with system descriptor and pump number, example HWP1)
P	Guage Pressure (must be hyphenated, for example HW-P)
PCHW	Process Chilled Water
PRI	Primary
R	Return
RADHW	Radiant Loop Hot Water
RWH	Rain Water Harvesting
S	Supply
SEC	Secondary
SMHW	Snow Melt Hot Water
STM	Steam
STRNR	Strainer
SUMP	Sump
T	Temperature
TCHW	Tempered Chilled Water
TER	Tertiary
THW	Tempered Hot Water
TK	Tank
V	Valve

AIR-SIDE

Acronym	Description
AHU	Air Handling Unit (w/Return Air)
BCU	Blower Coil Unit
BSP	Building Static Pressure
BYP	Bypass
C	Coil (Suffix Only, used in conjuction with coil descriptor, PHC/CHWC/RHC/RARC)
CHB	Chilled Beam
CHW	Chilled Water
CO2	Carbon Dioxide
COND	Condensate
CP	Coil/Circulation Pump
D	Damper
DA	Discharge Air (Coil or Terminal Equipment)
DDSP	Down Duct Static Pressure
DOAS	Dedicated Outside Air System
DP	Differential Pressure
DSW	Dessicant Wheel
DWPT	Dew Point
DX	Direct Expansion (Refrigerant)
EA	Exhaust Air
ECON	Economizer (only for physically linked dampers - legacy only)
EF	Exhaust Fan
ER	Energy Recovery
ERU	Energy Recovery Unit
ERV	Energy Recovery Ventilator
ERW	Energy Recovery Wheel
F	Flow
FACE	Face (legacy only)
FCU	Fan Coil Unit
FF	Final Filter
FILT	Filter
FN	Fan (If Single-Fan System)
FPIU	Fan-Powered Induction Unit
FPVAV	Fan-Powered VAV
FRZ	Freezestat
FTR	Radiator
GEX	General Exhaust Air
H	Humidity
HD/CD	Hot Deck/Cold Deck (legacy only)
HOOD	Hood Air
HSS	High Static Switch
HUM	Humidifier
HW	Hot Water
LEAK	Water/Leak Detector
LSS	Low Static Switch
MAU	Make-up Air Unit
OA	Outside Air
OVF	Overflow
PAN	Pan
PF	Pre-Filter
PH	Preheat
PM25	Particulate Matter 2.5
RA	Return Air
RAR	Runaround
RELA	Relief Air
RF	Return Fan
RH	Reheat
RH	Relative Humidity
RLF	Relief Fan
ROPE	Rope Leak Detection Sensor
SA	Supply Air (Pre-terminal, Parent Equipment)
SEW	Sensible Energy Wheel
SF	Supply Fan
SMK	Smoke
SP	Static Pressure
SUMP	Sump
T	Temperature
TEW	Total Energy Wheel
UH	Unit Heater
VAV	Variable Air Volume Box (add prefix for air source, where necessary)
VEL	Velocity
VOC	Volatile Organic Compound
VP	Velocity Pressure
ZD	Zone Damper