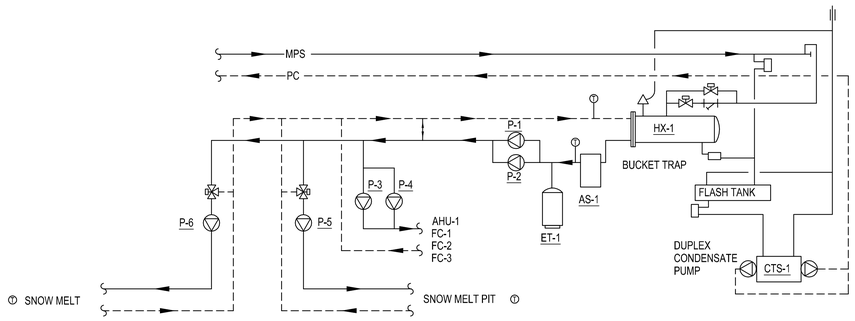



GLYCOL (HEATING) WATER SYSTEM CONTROL SEQUENCE

GENERAL:
THE HEATING SYSTEM SHALL BE A PRIMARY HEATING WATER (50% PG) SYSTEM USING 30# MPS FROM BLDG 70, CONVERTOR AND SUBLOOP PUMPS. IT SERVES THE SIDEWALK SNOWMELT, SNOW DUMP PIT, AHU-1 AND FCUs. ALL PUMPS ARE CONSTANT SPEED. REFER TO SECTION 230831 FOR SIDEWALK SNOWMELT (P-6, 3-WAY VALVE) AND SNOW DUMP PIT (P-5, 3-WAY VALVE) SYSTEMS AND SEQUENCES. CONDENSATE PUMP CP-1/2 IS SELF-CONTAINED.

CONVERTOR (HX-1):
CONVERTOR CONTROL SHALL BE ENABLED WHEN OUTDOOR AIR TEMPERATURE DROPS BELOW 60°F (ADJ.). 1/3-2/3 CONTROL VALVES SHALL MODULATE TO MAINTAIN GLYCOL HEATING WATER SUPPLY TEMPERATURE SETPOINT PER THE FOLLOWING RESET SCHEDULE:

| OUTDOOR AIR TEMPERATURE | SUPPLY WATER TEMPERATURE |
|---|---|
| 0 °F (ADJ.) | 180 °F (ADJ.) |
| 60 °F (ADJ.) | 120 °F (ADJ.) |

PUMPS (P-1 & P-2):

EACH GLYCOL WATER PUMP SHALL HAVE A HAND-OFF-AUTO (H-O-A) SWITCH MOUNTED ON THE STARTER. PUMPS SHALL RUN WHEN IN THE "HAND" POSITION, STOP WHEN IN THE "OFF" POSITION, AND BE CONTROLLED THROUGH DDC WHEN IN THE "AUTO" POSITION. THE LEAD PUMP SHALL BE ON WHEN OUTDOOR AIR TEMPERATURE DROPS BELOW 60°F (ADJ.). IF LEAD PUMP GOES INTO ALARM, THE LAG PUMP SHALL BE ENABLED AND THE LEAD PUMP SHALL BE LOCKED OUT UNTIL MANUALLY RESET BY OPERATOR. LEAD-LAG PUMP SHALL ROTATE ON A MONTHLY BASIS. AN ALARM SHALL BE SENT FROM THE PUMP TO THE DDC IF A PUMP IS ENABLED AND THE CORRESPONDING CURRENT SENSOR DOES NOT INDICATE FLOW.

PUMPS (P-3 & P-4):
EACH GLYCOL WATER PUMP SHALL HAVE A HAND-OFF-AUTO (H-O-A) SWITCH MOUNTED ON THE STARTER. PUMPS SHALL RUN WHEN IN THE "HAND" POSITION, STOP WHEN IN THE "OFF" POSITION, AND BE CONTROLLED THROUGH DDC WHEN IN THE "AUTO" POSITION. THE LEAD PUMP SHALL BE ON WHEN OUTDOOR AIR TEMPERATURE DROPS BELOW 60°F (ADJ.). IF LEAD PUMP GOES INTO ALARM, THE LAG PUMP SHALL BE ENABLED AND THE LEAD PUMP SHALL BE LOCKED OUT UNTIL MANUALLY RESET BY OPERATOR. LEAD-LAG PUMP SHALL ROTATE ON A MONTHLY BASIS. AN ALARM SHALL BE SENT FROM THE PUMP TO THE DDC IF A PUMP IS ENABLED AND THE CORRESPONDING CURRENT SENSOR DOES NOT INDICATE FLOW.

PUMPS (P-5): SIDEWALK SNOW MELT
REFER TO SECTION 23 83 01 FOR SNOW MELT SYSTEM CONTROL.

PUMPS (P-6): SNOW MELT PIT
REFER TO SECTION 23 83 01 FOR SNOW MELT SYSTEM CONTROL.

GENERAL SEQUENCE OF OPERATIONS

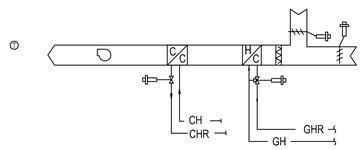
1. ALL NEW CONTROLLERS, DEVICES AND COMPONENTS SHALL BE ACCESSIBLE USING A WEB BROWSER INTERFACE AND SHALL COMMUNICATE EXCLUSIVELY USING THE ASHRAE STANDARD 135 BACNET COMMUNICATIONS PROTOCOL WITHOUT THE USE OF GATEWAYS.

2. NEW DDC SYSTEM SHALL BE 100% COMPATIBLE WITH THE EXISTING JCI METASYS SYSTEM. THE CONTROLS SHALL BE ELECTRONIC, NO PNEUMATIC CONTROLS ARE ALLOWED. ASSOCIATED SOFTWARE AND GRAPHICAL INTERFACE SHALL BE DESIGNED AND PROGRAMMED INTO THE FRONT-END SYSTEM.

3. ALL THE POINTS IN THE SEQUENCE CONTROL SHALL BE MONITORED. REFER TO SECTION 23 09 23 FOR ADDITIONAL DDCS INFORMATION.

LEGEND

| | |
|---|---|
| AD-AIR DAMPER | HL-HIGH LEVEL ALARM |
| B-BOILER | P-PUMP |
| CC-COOLING COIL | RF-RETURN FAN |
| CS-CURRENT SENSOR | RH-RELATIVE HUMIDITY SENSOR |
| DA-DAMPER ACTUATOR | SP-STATIC PRESSURE SENSOR |
| DPS-DIFFERENTIAL PRESSURE SWITCH | SF-SUPPLY FAN |
| DPT-DIFFERENTIAL PRESSURE SENSOR | SMK-DUCT SMOKE DETECTOR |
| EF-EXHAUST FAN | TS-TEMPERATURE SENSOR |
| FS-FLOW SENSOR | TSL-FREEZSTAT |
| HC-HEATING COIL | VA-VALVE ACTUATOR |
| DO-DIGITAL OUTPUT | VAV-VARIABLE AIR VOLUME |
| DI-DIGITAL INPUT | VFD-VARIABLE FREQUENCY DRIVE |
| AI-ANALOG INPUT | |
| AO-ANALOG OUTPUT | |
| DS-DIGITAL SOFTWARE POINT | |
| AS-ANALOG SOFTWARE POINT | |




FCU-1, 2, 3, AHU-1 SEQUENCE OF OPERATIONS

GENERAL:

EACH UNIT INCLUDES A CONSTANT SPEED SUPPLY FAN, HEATING AND COOLING COILS. SUPPLY FAN SHALL HAVE HAND-OFF-AUTO SWITCH MOUNTED AT THE STARTER. SUPPLY FAN SHALL RUN WHEN IN "HAND" POSITION; STOP WHEN IN "OFF" POSITION; BE CONTROLLED THROUGH DDC WHEN IN "AUTO" POSITION. WHEN IN "AUTO" MODE, SUPPLY FAN SHALL RUN CONTINUOUSLY, AND OUTDOOR AIR DAMPER SHALL FULLY OPEN. A DDC ALARM SHALL OCCUR IF THE SUPPLY FAN FAILS TO PROVE FLOW AFTER A DELAYED TIME FROM THE DDC START SIGNAL.

SCHEDULE: SPACES SHALL BE CONSIDERED OCCUPIED 24 HOURS PER DAY, YEAR ROUND (SCHEDULE ADJ.).

OCCUPIED: FAN SHALL RUN AND OUTDOOR AIR DAMPER SHALL MAINTAIN MINIMUM POSITION. HEATING COIL CONTROL VALVE SHALL MODULATE TO MAINTAIN SPACE TEMPERATURE SETPOINT OF 65°F (ADJ.). COOLING COIL CONTROL VALVE SHALL MODULATE TO MAINTAIN SPACE TEMPERATURE SETPOINT OF 75°F (ADJ.). ALL CONTROL VALVES SHALL BE CLOSED TO COIL FLOW BETWEEN THESE SETPOINTS. WHEN OUTDOOR AIR TEMPERATURE IS BELOW 70°F (ADJ.), OUTDOOR AIR DAMPER SHALL BE ENABLED TO MODULATE BEYOND MINIMUM POSITION TO AS THE FIRST STAGE OF COOLING.

## CONTROL SYSTEMS POINT LIST

| SYSTEM | POINT NAME | TYPE | ALARM | TREND | SCHEDULE | SEQUENCE | NOTES | SYSTEM | POINT NAME | TYPE | ALARM | TREND | SCHEDULE | SEQUENCE | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AHU-1 | SUPPLY FAN START/STOP | DO | Y | Y | Y | Y | | HX-1 | HEATING CONTROL ENABLE | DS | Y | Y | Y | Y | |
| AHU-1 | SUPPLY FAN STATUS | DI | Y | Y | Y | Y | | HX-1 | 1/3-2/3 STEAM VALVES CONTROL | AO | Y | Y | Y | Y | |
| AHU-1 | STAIRWELL SPACE TEMPERATURE | AI | Y | Y | Y | Y | | HX-1 | GH SUPPLY TEMPERATURE | AI | Y | Y | Y | Y | |
| AHU-1 | COOLING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | HX-1 | GH RETURN TEMPERATURE | AI | Y | Y | Y | Y | |
| AHU-1 | COOLING COIL VALVE POSITION | AS | Y | Y | Y | Y | | CP-1 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| AHU-1 | HEATING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | CP-2 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| AHU-1 | HEATING COIL VALVE POSITION | AS | Y | Y | Y | Y | | CP-1/2 | CONDENSATE RECEIVER HIGH LIMIT | DI | Y | Y | Y | Y | |
| AHU-1 | MIXED AIR DAMPER CONTROL | AO | Y | Y | Y | Y | | P-1 | PUMP START/STOP | DO | Y | Y | Y | Y | |
| AHU-1 | MIXED AIR DAMPER POSITION | AS | Y | Y | Y | Y | | P-1 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| FCU-1 | SUPPLY FAN START/STOP | DO | Y | Y | Y | Y | | P-2 | PUMP START/STOP | DO | Y | Y | Y | Y | |
| FCU-1 | SUPPLY FAN STATUS | DI | Y | Y | Y | Y | | P-2 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| FCU-1 | ELEV. EQ. ROOM SPACE TEMP | AI | Y | Y | Y | Y | | P-3 | PUMP START/STOP | DO | Y | Y | Y | Y | |
| FCU-1 | COOLING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | P-3 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| FCU-1 | COOLING COIL VALVE POSITION | AS | Y | Y | Y | Y | | P-4 | PUMP START/STOP | DO | Y | Y | Y | Y | |
| FCU-1 | HEATING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | P-4 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| FCU-1 | HEATING COIL VALVE POSITION | AS | Y | Y | Y | Y | | P-5 | PUMP START/STOP | DO | Y | Y | Y | Y | |
| FCU-1 | MIXED AIR DAMPER CONTROL | AO | Y | Y | Y | Y | | P-5 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| FCU-1 | MIXED AIR DAMPER POSITION | AS | Y | Y | Y | Y | | P-6 | PUMP START/STOP | DO | Y | Y | Y | Y | |
| FCU-2 | SUPPLY FAN START/STOP | DO | Y | Y | Y | Y | | P-6 | PUMP RUN STATUS | DI | Y | Y | Y | Y | |
| FCU-2 | SUPPLY FAN STATUS | DI | Y | Y | Y | Y | | SIDEWALK | SNOWMELTING SYSTEM ENABLE | DS | Y | Y | Y | Y | |
| FCU-2 | COMM. ROOM SPACE TEMPERATURE | AI | Y | Y | Y | Y | | MELT PIT | SNOWMELTING SYSTEM ENABLE | DS | Y | Y | Y | Y | |
| FCU-2 | COOLING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | SIDEWALK | SIDEWALK TEMPERATURE | AI | Y | Y | Y | Y | |
| FCU-2 | COOLING COIL VALVE POSITION | AS | Y | Y | Y | Y | | SIDEWALK | SIDEWALK MOISTURE SENSOR | AI | Y | Y | Y | Y | |
| FCU-2 | HEATING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | SIDEWALK | GH RETURN TEMPERATURE | AI | Y | Y | Y | Y | |
| FCU-2 | HEATING COIL VALVE POSITION | AS | Y | Y | Y | Y | | MELT PIT | MELT PIT SLAB TEMPERATURE | AI | Y | Y | Y | Y | |
| FCU-2 | MIXED AIR DAMPER CONTROL | AO | Y | Y | Y | Y | | MELT PIT | MELT PIT MOISTURE SENSOR | AI | Y | Y | Y | Y | |
| FCU-2 | MIXED AIR DAMPER POSITION | AS | Y | Y | Y | Y | | MELT PIT | GH RETURN TEMPERATURE | AI | Y | Y | Y | Y | |
| FCU-3 | SUPPLY FAN START/STOP | DO | Y | Y | Y | Y | | SIDEWALK | HEATING VALVE CONTROL | AO | Y | Y | Y | Y | |
| FCU-3 | SUPPLY FAN STATUS | DI | Y | Y | Y | Y | | MELT PIT | HEATING VALVE CONTROL | AO | Y | Y | Y | Y | |
| FCU-3 | WAITING AREA SPACE TEMPERATURE | AI | Y | Y | Y | Y | | SIDEWALK | HEATING VALVE POSITION | AO | Y | Y | Y | Y | |
| FCU-3 | COOLING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | MELT PIT | HEATING VALVE POSITION | AO | Y | Y | Y | Y | |
| FCU-3 | COOLING COIL VALVE POSITION | AS | Y | Y | Y | Y | | ALL | OUTDOOR AIR TEMPERATURE | AS | Y | Y | Y | Y | |
| FCU-3 | HEATING COIL VALVE CONTROL | AO | Y | Y | Y | Y | | | | | | | | | |
| FCU-3 | HEATING COIL VALVE POSITION | AS | Y | Y | Y | Y | | | | | | | | | |
| FCU-3 | MIXED AIR DAMPER CONTROL | AO | Y | Y | Y | Y | | | | | | | | | |
| FCU-3 | MIXED AIR DAMPER POSITION | AS | Y | Y | Y | Y | | | | | | | | | |

CONSTRUCTION DOCUMENTS

| Revisions: | Date |
|---|---|
| | |

CONSULTANTS:

SIGNAGE
SIGNIA DESIGN
2395 UNIVERSITY AVENUE W., SUITE 316
SAINT PAUL, MN 55114
PHONE: 651-209-6254

LANDSCAPE
ANDERSON ENGINEERING
13605 1ST AVENUE NORTH, SUITE 100
PLYMOUTH, MN 55441
PHONE: 763-412-4000

ARCHITECTS/ENGINEERS:

LEO A DALY
PLANNING ARCHITECTURE ENGINEERING INTERIORS
EST. 1915

730 Second Avenue South, Suite 1100
Minneapolis, MN 55402-2455 USA
Tel 612-338-8741 Fax 612-338-4840
Project #023-10131-000

Project #023-10131-000

Drawing Title: MECHANICAL CONTROLS DIAGRAM

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am duly Licensed Professional Engineer under the laws of the State of Minnesota
Signature:

Printed Name: BRIAN L. BENSON
Date: 02-24-2012
License: 20397

Project Title
CONSTRUCT PARKING RAMP DESIGN

Location 1 VETERANS DRIVE MINNEAPOLIS, MN 55417

Date 02-24-2012 | Checked BLB | Drawn ALH

Project Number 618-820

Building Number 78

Drawing Number MH-701

Drawing 094 of 116

Office of Construction and Facilities Management

Department of Veterans Affairs

VA FORM 08-6231