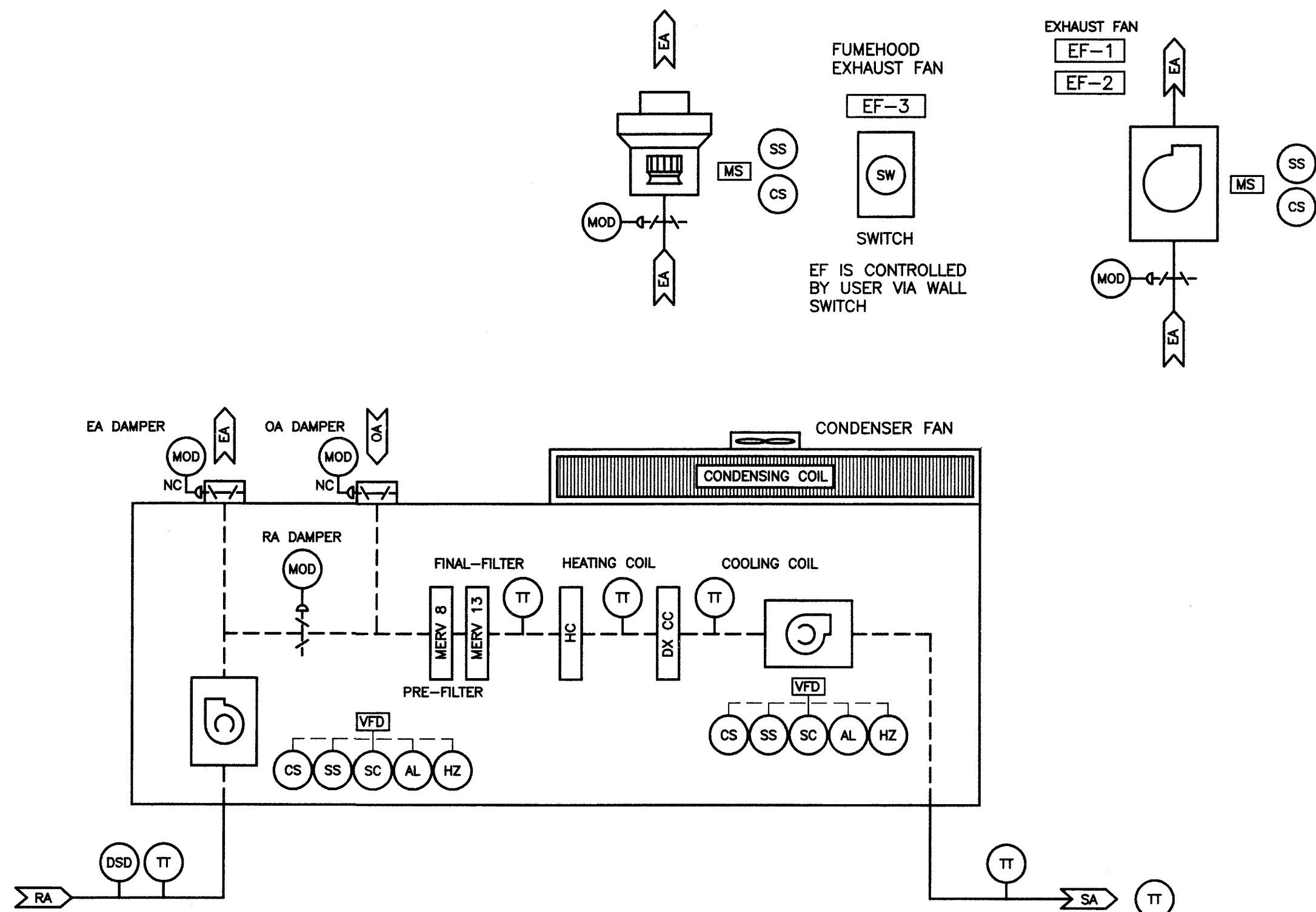


**3 DOMESTIC WATER PIPING AND CONTROL DIAGRAM**  
SCALE: NONE



**4 ROOFTOP AIR HANDLING UNIT AIRFLOW AND CONTROL DIAGRAM (RTU)**  
SCALE: NONE

**SEQUENCE OF OPERATION: DWH-1**

- A. GENERAL:
1. THE SYSTEM PROVIDES DOMESTIC HOT WATER FOR THE BUILDING.
  2. EQUIPMENT CONSISTS OF ONE GAS WATER HEATER DWH-1 AND DOMESTIC WATER CIRCULATION PUMP. HOT WATER IS GENERATED TO 115° F FOR BUILDING DURING COMMISSIONING AND BALANCING, COORDINATE WITH OWNER TO FINALIZE TEMPERATURE SUPPLY TO BUILDING.
- B. SYSTEM CONTROL:
1. THE SYSTEM IS ENABLED 24/7.
  2. DDC SYSTEM SHALL MONITOR STATUS OF PUMPS THROUGH THE CURRENT SENSING RELAYS.
  3. DDC SYSTEM SHALL ENABLE/DISABLE THE DOMESTIC WATER HEATER.
  4. FACTORY CONTROLS FOR THE WATER HEATERS SHALL STAGE THE BURNER TO MAINTAIN A TANK TEMPERATURE OF 115F.
  5. DDC SYSTEM SHALL MONITOR TEMPERATURE IN THE DISCHARGE LINE OF THE TANK AND THE RETURN TEMPERATURE IN THE HWC SYSTEM.
- C. ALARMS: THE DDC SYSTEM SHALL MONITOR THE FOLLOW POINTS AND GENERATE AN ALARM FOR EACH.
1. GENERAL ALARM SIGNAL FROM THE DWH FACTORY CONTROL PANELS.
  2. ALARM WHEN THE TEMPERATURE OF THE DISCHARGE LINE FROM THE TANK FALLS BELOW 105F OR RISES ABOVE 125F.
  3. ALARM IF TEMPERATURE SUPPLY TO BUILDING RISES ABOVE 130F. THIS SETPOINT SHALL BE ADJUSTABLE THROUGH THE DDC SYSTEM.

TS TEMPERATURE SENSOR - ROOF  
HS HUMIDITY SENSOR - ROOF

**1 OUTSIDE AIR AND HUMIDITY SENSING**  
SCALE: NONE

LIGHTING DRY CONTACTS → TO DDC

**2 LIGHTING CONTROLS**  
SCALE: NONE

**SEQUENCE OF OPERATION: RTU-1, 2, 3, 4, 5, 6**

- A. GENERAL:
1. SYSTEM IS SINGLE ZONE VARIABLE VOLUME.
  2. SYSTEMS PROVIDES HEATING, COOLING, AND VENTILATION.
  3. SYSTEMS HAS GAS HEATING COIL AND DX COOLING COIL.
  4. THE DDC SYSTEM GENERATES AN ALARM UPON FAILURE OF ANY DEVICE.
  5. PROVIDE VALVE AND DAMPER POSITION FEEDBACK TO DDC SYSTEM FOR ALL VALVES AND DAMPERS.
  6. ALL SETPOINTS ARE ADJUSTABLE THROUGH THE DDC SYSTEM.
- B. SYSTEM START/STOP:
1. PROGRAMMED SCHEDULING: SYSTEM IS STARTED AND STOPPED BASED UPON PROGRAMMED OCCUPIED AND UNOCCUPIED TIMES, WITH WEEKDAY, WEEKEND AND HOLIDAY SCHEDULES. INITIAL SCHEDULE CALLS FOR OCCUPIED OPERATION FROM 6 AM TO 6 PM (ADJ.).
  2. DDC SYSTEM SHALL PROVIDE START/STOP CONTROL. DDC SYSTEM SHALL MONITOR THE FOLLOWING INPUTS: STATUS AND ALARMS.
  3. OPTIMUM START: THE UNIT SHALL USE AN OPTIMUM START ALGORITHM FOR MORNING START-UP. THIS ALGORITHM SHALL MINIMIZE THE UNOCCUPIED START-UP PERIOD WHILE STILL ACHIEVING COMFORT CONDITIONS BY THE START OF SCHEDULED OCCUPIED PERIOD.
  4. NORMAL SHUTDOWN: DAMPERS SHALL BE IN THE FOLLOWING POSITIONS WHEN UNIT IS OFF FOR ANY REASON:
    - a. OUTDOOR AIR DAMPER: CLOSED.
    - b. RETURN AIR DAMPER: OPEN.
    - c. EXHAUST AIR DAMPER (AHU): CLOSED.
    - d. EXHAUST AIR DAMPER (EF): CLOSED.
  4. SAFETY SHUTDOWN:
    - a. FIRE ALARM: A HARD-WIRED DUCT SMOKE DETECTOR (FURNISHED BY DIVISION 26, INSTALLED BY DIVISION 23. POWERED BY DIVISION 26) LOCATED IN THE MAIN RETURN AIR DUCTWORK SHUTS DOWN THE AIR HANDLING UNIT UPON DETECTION OF SMOKE AND ENERGIZES AN ALARM AT THE DDC SYSTEM. DDC SHALL RESTART SYSTEM UPON RECEIPT OF AN "ALL CLEAR" SIGNAL FROM THE FIRE ALARM SYSTEM. WIRING FOR HARD-WIRE SHUT DOWN SHALL BE PROVIDED BY DIVISION 23.
- C. ALARMS:
1. AN ALARM SHALL BE GENERATED UPON THE FAILURE OF ANY COMPONENT.
- D. TEMPERATURE AND FAN SPEED CONTROL:
1. THE SUPPLY FAN SPEED, ECONOMIZER DAMPERS, GAS HEATING COIL AND DX COOLING COIL BE CONTROLLED IN SEQUENCE TO MAINTAIN ZONE TEMPERATURE.
  2. THE SUPPLY FAN AIRFLOW SHALL OPERATION BETWEEN MAXIMUM AND MINIMUM SUPPLY AIRFLOW AS DEFINED IN THE AIR HANDLING UNIT SCHEDULE.
    - a. WHEN ZONE TEMPERATURE DROPS BELOW SETPOINT, THE AIRFLOW SHALL DECREASE TO MINIMUM AIRFLOW AND THE GAS HEATING COIL SHALL FIRE TO MAINTAIN TEMPERATURE.
    - b. WHEN ZONE TEMPERATURE RISES ABOVE SETPOINT THE AIRFLOW

**SEQUENCE OF OPERATION:**

- A. GENERAL:
1. THE CONTROLLER SHALL MONITOR THE OUTSIDE AIR TEMPERATURE AND HUMIDITY AND CALCULATE THE OUTSIDE AIR ENTHALPY ON A CONTINUAL BASIS. THESE VALUES SHALL BE MADE AVAILABLE TO THE SYSTEM AT ALL TIMES.
  2. OUTSIDE AIR SHALL BE AVERAGED WITH THE CAPABILITY OF REMOVING SENSOR FROM CALCULATION/DISPLAY.
  3. ALL HISTORY TEMPERATURE SHALL BE VIEWABLE THROUGH THE GRAPHIC.
- B. TRENDDING:
1. HISTORY: THE CONTROLLER SHALL MONITOR AND RECORD THE HIGH AND LOW TEMPERATURE READINGS FOR THE OUTSIDE AIR. THE READINGS SHALL BE RECORDED ON A DAILY, MONTH-TO-DATE, AND YEAR-TO-DATE BASIS.
- C. ALARMS: THE DDC SYSTEM SHALL MONITOR THE FOLLOWING POINTS AND GENERATE ALARMS AS FOLLOWS:
1. SENSOR FAILURE: SENSOR READING INDICATES SHORTED OR DISCONNECTED SENSORS. IN THE EVENT OF A SENSOR FAILURE

**SEQUENCE OF OPERATION: LIGHTING CONTROLS**

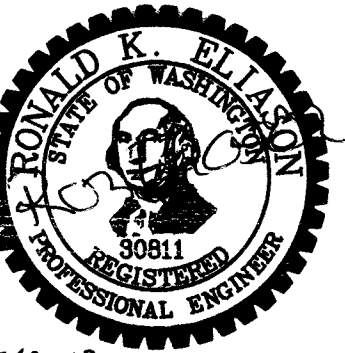
- A. GENERAL:
1. THE DDC SYSTEM SHALL CONTROL EXTERIOR LIGHTING THROUGH DRY CONTACTS. PROVIDE REQUIRED CABLING TO MAKE CONNECTIONS.
  2. DDC SYSTEM SHALL CONTROL 6 EXTERIOR LIGHTING ZONES THROUGH DRY CONTACTS. EACH ZONE SHALL BE CONTROLLED SEPARATELY THROUGH THE GRAPHIC AND SHALL BE CONTROLLED VIA SCHEDULE WHICH SHALL BE ADJUSTABLE. REFER TO ELECTRICAL DRAWINGS.
- B. ALARMS: THE DDC SYSTEM SHALL MONITOR GENERATE ALARMS AS DEFINED IN THE LIGHTING CONTROL SEQUENCE OF OPERATION ON THE ELECTRICAL DRAWINGS.

- SHALL INCREASE UP TO THE MAXIMUM AIRFLOW TO SATISFY ZONE TEMPERATURE SETPOINT. IF THE AIRFLOW IS AT THE MAXIMUM OPERATING CONDITION FOR MORE THAN 10 MIN, THEN THE DX COOLING COIL SHALL ACTIVATE TO SATISFY ZONE TEMPERATURE.
- c. TEMPERATURE SETPOINTS SHALL BE AS FOLLOWS:
- HEATING: 60 °F
  - COOLING: 75 °F
3. DURING UNOCCUPIED OPERATION, FANS SHALL BE COMMANDED OFF UNLESS THE SPACE TEMPERATURE SENSOR FALLS OUTSIDE UNOCCUPIED TEMPERATURE SETPOINTS AS FOLLOWS:
- a. HEATING: 60 °F
  - a. COOLING: 85 °F
4. EXHAUST FAN: FAN SHALL OPERATE TO MAINTAIN BUILDING PRESSURE AS SENSED BY BUILDING PRESSURE SENSOR. INITIAL SETPOINT SHALL BE +0.02 IN WG. CONFIRM SETPOINT DURING COMMISSIONING.
6. ECONOMIZER DAMPER CONTROL
- a. GENERAL OPERATION: UPON STARTUP OF THE AIR HANDLING SYSTEM THE ECONOMIZER DAMPERS SHALL BE RAMPED SLOWLY INTO OPERATION. THE OUTSIDE AIR DAMPER SHALL OPEN TO THE MINIMUM POSITION AS COORDINATED WITH THE TESTING, ADJUSTING AND BALANCING CONTRACTOR WHENEVER THE SUPPLY FAN STATUS IS ACTIVE, THE RETURN AIR DAMPER SHALL REMAIN OPEN AND THE EXHAUST AIR DAMPER SHALL REMAIN CLOSED. AFTER THE SUPPLY FAN HAS STARTED AND RUN FOR MORE THAN 5 MINUTES (300 SECONDS, ADJUSTABLE) THE RETURN AND EXHAUST AIR DAMPERS SHALL BE ALLOWED TO OPERATE. THE ECONOMIZER DAMPERS SHALL MODULATE IN SEQUENCE TO MAINTAIN THE DISCHARGE AIR TEMPERATURE AT SETPOINT. THE DISCHARGE AIR TEMPERATURE SETPOINT SHALL BE MAINTAINED BY MODULATING THE OUTSIDE AIR DAMPER AND EXHAUST AIR DAMPER OPEN WHILE MODULATING THE RETURN AIR DAMPER CLOSED WHENEVER THE OUTSIDE AIR TEMPERATURES ARE BELOW THE RETURN AIR TEMPERATURE. THE OPPOSITE WILL OCCUR TO INCREASE THE DISCHARGE AIR TEMPERATURE; THE EXHAUST AIR AND OUTSIDE AIR DAMPER WILL MODULATE CLOSED TO THE MINIMUM POSITION AND THE RETURN AIR DAMPER SHALL MODULATE OPEN. WHEN THE OUTSIDE AIR TEMPERATURE IS HIGHER THAN RETURN AIR TEMPERATURE BY 2 DEG F THE OUTSIDE AIR DAMPER AND EXHAUST AIR DAMPER WILL MODULATE TO MAINTAIN MINIMUM OUTSIDE AIR VOLUME AS DESCRIBED BELOW, AND THE RETURN AIR DAMPER WILL OPEN FOR FULL RECIRCULATION WITH MINIMUM OUTSIDE AIR.

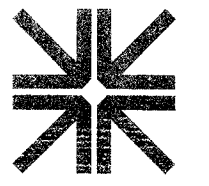
- E. MINIMUM OUTDOOR AIR: SYSTEM SHALL BE BALANCED TO MINIMUM AIRFLOW AS INDICATED IN THE AIR HANDLING UNIT SCHEDULE.
- E. EXHAUST DAMPER: THE DDC SHALL SYSTEM SHALL MODULATE THE EXHAUST (RELIEF) DAMPER IN SEQUENCE WITH THE OA AND RA DAMPERS SO THAT THE DAMPER IS AT MINIMUM POSITION WHEN THE OA DAMPER IS AT MINIMUM POSITION AND FULL OPEN WHEN THE OA DAMPER IS FULL OPEN.

**CONTROLS LEGEND:**

- NO NORMALLY OPEN  
NC NORMAL CLOSED
- MS MOTOR STARTER
- VFD VARIABLE FREQUENCY DRIVE
- AI ANALOG INPUT  
AO ANALOG OUTPUT  
AL ALARM  
AMP AMPERAGE  
AFS AIRFLOW MEASURING STATION  
CO2 CARBON DIOXIDE SENSOR  
CS CURRENT SENSOR  
CV CONTROL VALVE  
DI DIGITAL INPUT  
DO DIGITAL OUTPUT  
DPT DIFFERENTIAL PRESSURE TRANSMITTER  
DPV DIFFERENTIAL PRESSURE VALVE  
DSD DUCT SMOKE DETECTOR  
E/D ENABLE/DISABLE  
FL FLOAT SWITCH  
FS FLOW SWITCH  
FT FLOAT TRANSMITTER  
FZ FREEZE/STAT  
GFR GAS FLOW RATE  
HLPS HIGH LIMIT PRESSURE SWITCH  
HS HUMIDITY SENSOR  
HZ VFD HERTZ  
KW VFD KILOWATTS  
LLPS LOW LIMIT PRESSURE SWITCH  
MOD MOTOR OPERATED DAMPER  
pH pH LEVEL PROBE  
PS PRESSURE SWITCH  
S SENSOR  
SA SETPOINT ADJUST  
SC SPEED CONTROL  
SS START/STOP  
ST STATUS  
SPS STATIC PRESSURE SENSOR  
SW SWITCH  
TCV TEMPERATURE CONTROL VALVE  
TS TEMPERATURE SENSOR  
TT TEMPERATURE TRANSMITTER  
WM WATER METER  
% VFD PERCENTAGE



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**PIPING AND CONTROL DIAGRAMS**

SHEET

**M10.01**