

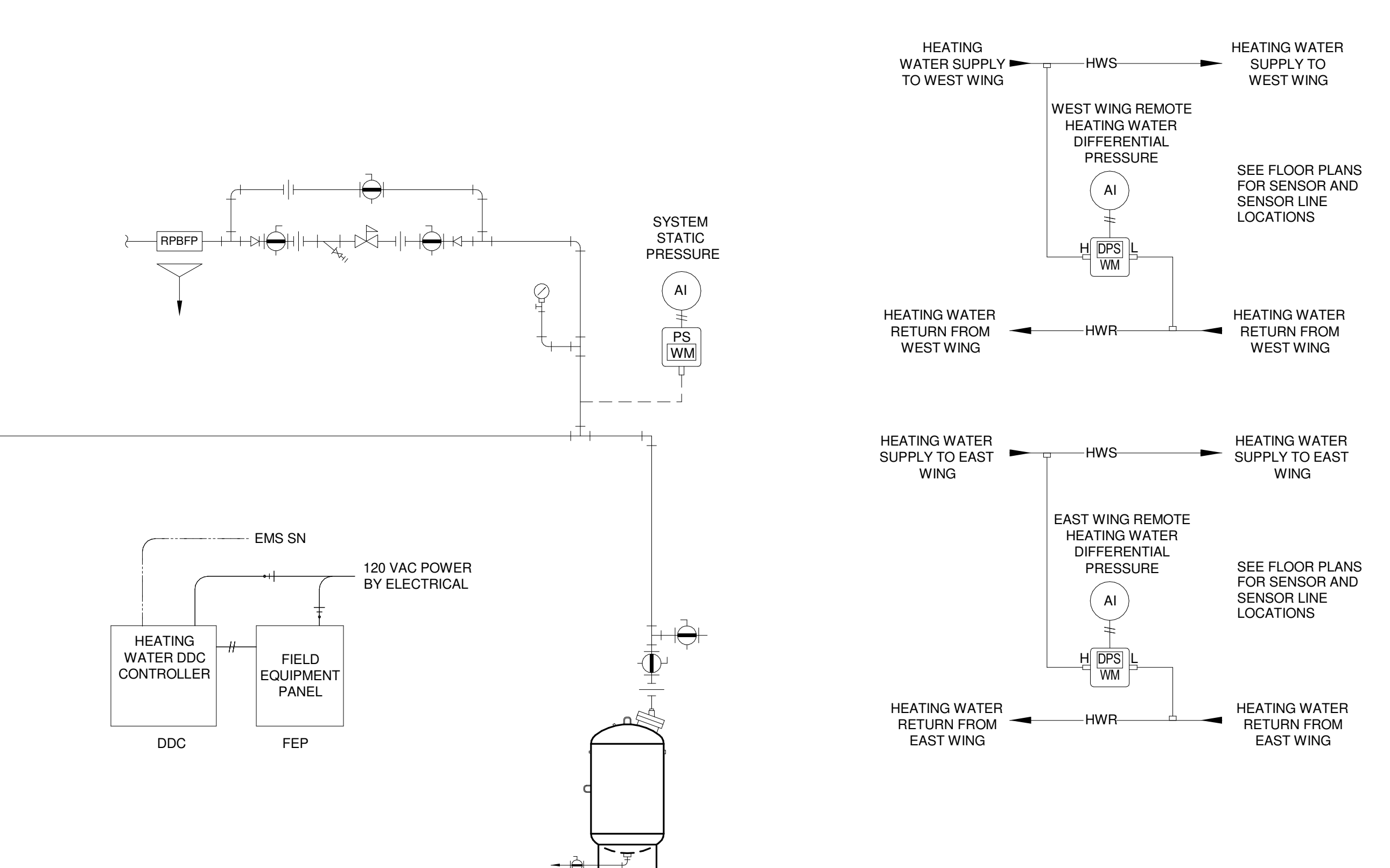
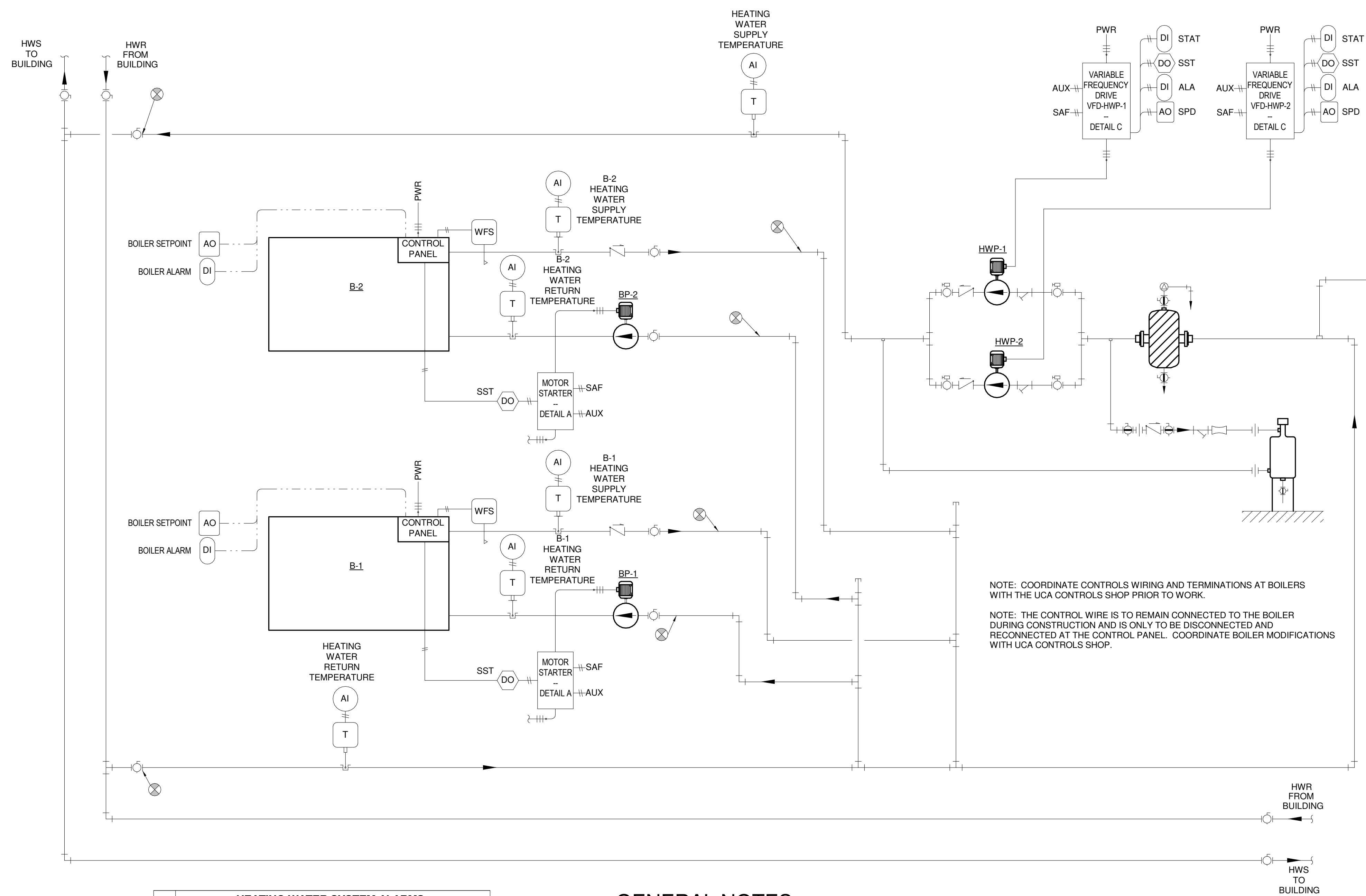
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**SEQUENCE OF OPERATION:**

- PRESSURE CONTROL:**
- MODULATE THE BUILDING ZONE PRESSURE SET POINTS BETWEEN A MAXIMUM SET POINT AND MINIMUM SET POINT AS REQUIRED TO MAINTAIN THE SECOND (ADJUSTABLE) MOST CRITICAL VALVE AT THE CRITICAL VALVE POSITION SET POINT. VALVES SHALL BE EXCLUDABLE FROM THE CRITICAL ZONE RESET CALCULATION FROM THE EQUIPMENT GRAPHIC AND FROM THE EQUIPMENT SUMMARY TABLE. THE HEATING WATER SECONDARY PUMP SPEED SHALL MODULATE TO MAINTAIN THE CRITICAL ZONE PRESSURE SET POINT. PUMPS SHALL BE STAGED ON AND OFF IN A LEAD LAG MANNER AND OPERATED IN PARALLEL TO A CONTROL SIGNAL WHEN ENABLED TOGETHER. PUMPS SHALL BE AUTOMATICALLY ROTATED FOR LEAD AND LAG POSITION ON A WEEKLY (ADJUSTABLE) BASIS BASED ON RUN TIME. IF A PUMP IS NOT AVAILABLE FOR OPERATION DUE TO ALARM, FAILURE, OR OPERATOR LOCKOUT, THE LAGGING PUMP OR PUMPS SHALL AUTOMATICALLY BE MOVED UP IN THE QUEUE AND ALLOWED TO OPERATE AND SHALL NOT BE LIMITED BY ANY STAGING PROCESS.
- TEMPERATURE CONTROL:**
- RESET THE PLANT HEATING WATER SUPPLY TEMPERATURE SET POINT LINEARLY BETWEEN THREE OUTSIDE AIR TEMPERATURE SET POINTS: 160F FOR A WINTER OUTSIDE AIR TEMPERATURE SET POINT (40F), 140F FOR A MID-SEASON OUTSIDE AIR TEMPERATURE SET POINT (60F), AND 120F FOR A SUMMER OUTSIDE AIR TEMPERATURE SET POINT (75F). EACH BOILER RESET TABLE SHALL BE OFFSET BY 2 DEGREES FROM THE PRECEDING BOILER SO THAT THE BOILERS WILL BE STAGED ON WHEN THE PRECEDING BOILER CAN NO LONGER MAKE SET POINT. CONTRACTOR TO FOLLOW THE EXISTING SEQUENCE TYPICAL TO SIMILAR HEATING WATER SYSTEMS ON CAMPUS.
  - THE BOILERS SHALL EACH HAVE A CONTROLLER CONFIGURED TO MAINTAIN A DISCHARGE TEMPERATURE SET POINT (NO MASTER BOILER CONTROLLER). THE BAS SHALL PROVIDE THE DISCHARGE TEMPERATURE SET POINT TO THE BOILER(S).
  - BOILERS SHALL BE AUTOMATICALLY ROTATED FOR LEAD AND LAG POSITION ON A WEEKLY BASIS BASED ON RUN TIME.
  - THE PRIMARY PUMP SHALL BE ENABLED WHEN ITS ASSOCIATED BOILER IS ENABLED AND SHALL MAINTAIN ANY MANUFACTURER REQUIRED DELAYS. DELAYS SHALL BE EITHER PROGRAMMED OR HARD WIRED WITH TIME DELAY RELAYS AS REQUIRED BY THE MANUFACTURER.
- LEAD LAG SCHEDULE:**
- PROVIDE A SCHEDULE FOR THE BOILERS THAT INDICATES ALL OF THE BOILERS AND THEIR CURRENT POSITION IN THE QUEUE.
  - PROVIDE A SCHEDULE FOR THE PUMPS THAT INDICATES ALL OF THE PUMPS, THEIR CURRENT POSITION IN THE QUEUE, RUN TIME, AND THE NUMBER OF STARTS.
- SET POINTS:** PROVIDE A SET POINTS TABLE FOR EASE OF OPERATOR ADJUSTMENT.
- ALARMS:** PROVIDE AN ALARMS TABLE WITH THE FOLLOWING ALARMS.
- LOW ZONE PRESSURE: ZONE DIFFERENTIAL PRESSURE < ZONE DIFFERENTIAL PRESSURE SET POINT - OFFSET (ADJUSTABLE)
  - HIGH ZONE PRESSURE: ZONE DIFFERENTIAL PRESSURE > ZONE DIFFERENTIAL PRESSURE SET POINT + OFFSET (ADJUSTABLE)
  - LOW SYSTEM PRESSURE: SYSTEM STATIC PRESSURE < SYSTEM STATIC PRESSURE SET POINT + OFFSET
  - BOILER ALARMS: PROVIDE ALL ALARMS AND WARNINGS COMMUNICATED FROM THE BOILER CONTROLLERS. A GENERAL ALARM IS NOT ACCEPTABLE.
  - VFD IN HAND.
  - VFD IN BYPASS.
  - VFD COMMAND.
  - HIGH CO: CO LEVEL EXCEEDS MAXIMUM SET POINT.
- MODES OF OPERATION:**
- BOILER**
- WHEN THE BOILER IS IN NORMAL MODE, THE ASSOCIATED PRIMARY PUMP SHALL BE ENABLED AND THE BOILER SHALL BE ALLOWED TO OPERATE TO SEQUENCE.
  - WHEN A BOILER IS IN MAINTENANCE MODE, THE ASSOCIATED PRIMARY PUMP SHALL BE DISABLED AND THE BOILER SHALL BE DISABLED. THE NEXT AVAILABLE BOILER SHALL TAKE ITS PLACE IN THE QUEUE.
  - ALARM MODE: WHEN THE BOILERS ARE NOT ALLOWED TO OPERATED DUE TO A FAULT, FAILURE TO PROVE, ETC, THE ASSOCIATED PRIMARY PUMPS SHALL BE DISABLED.
- SECONDARY PUMP**
- WHEN THE PUMP IS IN NORMAL MODE, THE PUMP SHALL OPERATED TO SEQUENCE.
  - WHEN THE PUMP IS IN MAINTENANCE MODE, THE PUMP SHALL BE DISABLED AND ANOTHER PUMP SHALL TAKE ITS PLACE IN THE QUEUE.
  - ALARM MODE: WHEN THE PUMP IS NOT ALLOWED TO OPERATED DUE TO A FAULT, FAILURE TO PROVE, ETC, THE PUMP SHALL BE DISABLED AND THE NEXT AVAILABLE PUMP SHALL TAKE ITS PLACE.
- TRENDING GROUPS**
- PROVIDE THE FOLLOWING TREND GROUPS FOR THE IDENTIFIED TRENDS:
- CRITICAL ZONE RESET: ZONE 1 AND ZONE 2 CRITICAL ZONE VALVE POSITIONS, ZONE PRESSURES, ZONE PRESSURE SET POINTS, AND THE PLANT DIFFERENTIAL PRESSURE.
  - TEMPERATURE CONTROL: BUILDING RETURN WATER TEMPERATURE, BOILER ENTERING WATER TEMPERATURES, BOILER LEAVING TEMPERATURES, PLANT SUPPLY WATER TEMPERATURE, BOILER FIRING RATES, BOILER TEMPERATURE SET POINT, PLANT TEMPERATURE SET POINT, PRIMARY PUMP STATUS.
  - SECONDARY PUMP CONTROL: ZONE PRESSURE AND PRESSURE SET POINTS, PLANT DIFFERENTIAL PRESSURE, SECONDARY PUMP SPEED COMMAND AND FEED BACK, CRITICAL VALVE POSITION.
  - SYSTEM PRESSURE.
  - TEMPERATURE: PLANT ENTERING AND LEAVING TEMPERATURES, ZONE ENTERING AND LEAVING TEMPERATURES.

| HEATING WATER SYSTEM ALARMS |                          |            |          |
|-----------------------------|--------------------------|------------|----------|
| #                           | DESCRIPTION              | ON GRAPHIC | IN TABLE |
| 1                           | LOW PLANT PRESSURE       | NO         | NO       |
| 2                           | HIGH PLANT PRESSURE      | NO         | NO       |
| 3                           | LOW ZONE PRESSURE        | YES        | NO       |
| 4                           | HIGH ZONE PRESSURE       | YES        | NO       |
| 5                           | HIGH DEMAND              | NO         | NO       |
| 6                           | OVER SUPPLY              | NO         | NO       |
| 7                           | LOW SYSTEM PRESSURE      | YES        | NO       |
| 8                           | BOILER ALARMS            | YES        | NO       |
| 9                           | VFD ALARMS               | NO         | NO       |
| 10                          | STARTER ALARMS           | NO         | NO       |
| 11                          | FLOW FAIL                | NO         | NO       |
| 12                          | LOW BOILER LEAVING TEMP  | NO         | NO       |
| 13                          | HIGH BOILER LEAVING TEMP | NO         | NO       |
| 14                          | LOW PLANT LEAVING TEMP   | NO         | NO       |
| 15                          | HIGH PLANT LEAVING TEMP  | NO         | NO       |
| 16                          | UNRELIABLE SENSOR        | NO         | NO       |
| 17                          | VFD IN HAND              | YES        | NO       |
| 18                          | VFD IN BYPASS            | YES        | NO       |
| 19                          | VFD COMMAND              | YES        | NO       |
| 20                          | HIGH CO                  | YES        | YES      |

**GENERAL NOTES:**

- CONTROL VALVES, FLOW METERS, THERMOWELLS AND TAPS ARE PROVIDED BY DIVISION 23 AND INSTALLED BY DIVISION 23 IN LOCATIONS INDICATED BY THE CONTROL DIAGRAMS AND AS SPECIFIED.
- ALL CONTROLLERS, ACTUATORS, SENSORS, SWITCHES, TUBING AND POINTS INDICATED ON THE PLANS ARE PROVIDED AND INSTALLED BY DIVISION 23 UNLESS OTHERWISE NOTED. CONTROL VALVES AND THERMOWELLS ARE PROVIDED BY DIVISION 23. TRANSFORMERS ARE PROVIDED BY DIVISION 23 AND INSTALLED BY DIVISION 26.
- ALL POINTS INDICATED ON THE CONTROL DIAGRAMS ARE NEW AND PROVIDED BY DIVISION 23 UNLESS INDICATED OTHERWISE.
- IF A COMPONENT IS DISABLED DUE TO MAINTENANCE SHUTDOWN, OVERRIDE OR A FAULT CONDITION, THE COMPONENT SHALL BE HIGHLIGHTED, OUTLINED, FLASH OR CHANGE COLORS.
- THIS GRAPHIC SHALL BE REPRESENTED ON THE BAS INCLUDING THE RESULTS OF AS-BUILT CONDITIONS. THE GRAPHIC IS TO BE POPULATED WITH LIVE VALUES. SETPOINTS SHALL BE ADJUSTABLE FROM THIS GRAPHIC AND LINKS SHALL BE PROVIDED TO TRENDING GROUPS. REFER TO SPECIFICATIONS FOR FURTHER GRAPHICAL REQUIREMENTS.
- ATC CONTRACTOR SHALL TUNE ALL LOOPS AND TABLES FOR SMOOTH, STABLE OPERATION. NUMBERS INDICATED IN THESE DIAGRAMS ARE FOR A STARTING POINT ONLY. THESE SEQUENCES REPRESENT THE BASIC FUNCTION OF THE CONTROLS SEQUENCE AND ARE NOT ALL INCLUSIVE. THE ATC CONTRACTOR IS STILL REQUIRED TO PROVIDE, DEFINE AND INDICATE ALL ALARMS, SETPOINTS AND FUNCTIONS REQUIRED TO ACHIEVE THE INTENT OF THE SEQUENCE AND MAINTAIN ALL EQUIPMENT MANUFACTURERS REQUIREMENTS. EQUIPMENT SHALL HAVE DEDICATED GRAPHICS PER SPECIFICATIONS. ALL POINTS SHALL BE INDICATED ON GRAPHICS.
- CONTROL VALVES SHALL BE SELECTED WITH PROPER AUTHORITY FOR THEIR GIVEN APPLICATION.
- UPDATE FACILITY GRAPHICS TO INCLUDE THIS BUILDING AND ASSOCIATED WORK.

**1 HEATING WATER CONTROL DIAGRAM**  
NOT TO SCALE

**UCA Housing Renovations - Phase 2 State Hall**

University of Central Arkansas  
Conway, Arkansas

SMA Project Number 1807

Date 05-10-2019

Phase Construction Drawings

UCA Project Number UCA-19-021

Contents

**CONTROLS - HVAC**

Sheet Number

**M6.5**