Application Guide

SmartPlate EV

Application Guide

Five Double Wall Models:

- SPDW-EV30
- SPDW-EV40
- SPDW-EV60
- SPDW-EV90
- SPDW-EV140

Heating and Hot Water Solutions

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TAG-0094_B • 5/11/2021

1. General

The SmartPlate EV is an instantaneous water heater that satisfies diversified domestic hot water demands and maintains accurate temperature control under varying loads without requiring domestic water storage. These objectives are achieved using digital controls with feed-forward sensing and a fast-acting electronic control valve.

The SmartPlate EV's control valve regulates the primary energy source (boiler water) in the proper proportion to satisfy the secondary (domestic water) load requirements. The SmartPlate transfers energy between the boiler water and domestic water using a brazed plate double wall heat exchanger. Because these plate heat exchangers are so efficient, they are capable of functioning effectively with as little as a 5°F approach temperature. This allows for a lower boiler water supply temperature and can increase condensing boiler system efficiency.

The availability of boiler water at the proper flow and at a reasonably stable temperature (±10°F) are key factors to the success of this design. The specifying engineer must consider what type of hydronic heating system and boilers the SmartPlate will interface with in order to optimize system performance and maximize boiler efficiency. Keep in mind that the boiler supply temperature to the SmartPlate must be at least 5°F above the desired domestic hot water setting; hence the boilers supply temperature cannot be reset below that point.

2. Purpose

The intent of this guide is to enable the specifying engineer applying SmartPlate to ensure acceptable temperature control at the heater and minimize boiler cycling, thus avoiding associated loss in system efficiency and physical wear and tear on the boiler.

3. Boiler Bypass Line

The SmartPlate EV has two boiler return connections: the boiler outlet and bypass line. The bypass line diverts excess boiler water back to the system or the boiler. This ensures that the water passing through the SmartPlate EV heat exchanger and leaving the boiler outlet is the lowest temperature possible. If using a dual inlet boiler, such as the Benchmark Platinum, this low temperature boiler water can be piped to the lower inlet of a dual inlet boiler for greater efficiencies. Such applications can have efficiency gains up to 6% depending on the upper to lower inlet flow rate ratios and return water temperature. For boilers with a single inlet, the bypass line may be piped with the boiler return line. In applications with multiple SmartPlates, a bypass may also be piped directly from the SmartPlate Supply header.

If using the SmartPlate EV's bypass line, consider the velocity limitations of the bypass line piping.

Other bypass line considerations:

- For plants with boiler water flow rates of up to 90 GPM, only one 2" bypass line is required.
- Multiple bypass lines may be manifolded together for plants with more than 90 GPM; bypass may be either:
  - One 2" line is required for every 90 GPM of flow from the boilers.
  - Or a single line from the SmartPlate EV's boiler water supply header with a balancing valve back to the upper inlet or to a buffer tank where only a single boiler inlet is used.

4. System Categories

Most hydronic heating systems fit into one of two general application categories:

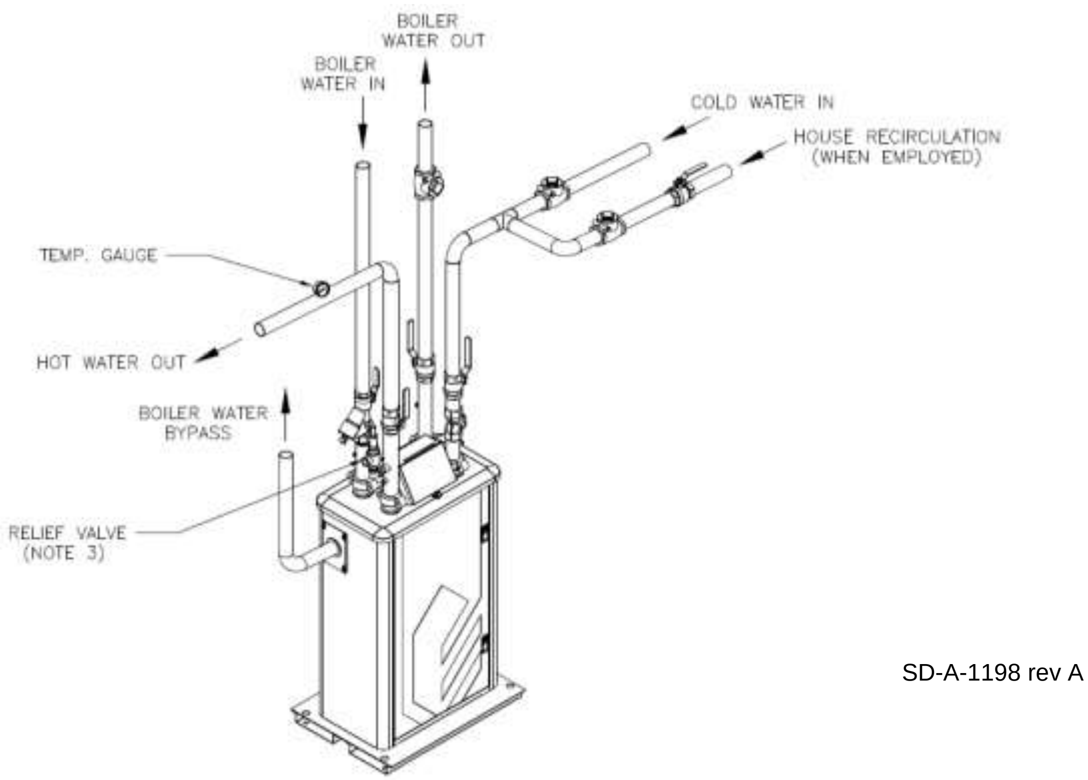
- Large volume systems with sufficient thermal mass and year-round loads to dampen out the peaks and valleys associated with domestic water heating loads.
- Small volume systems with insufficient thermal mass and/or seasonal loads that do not dampen out the peaks and valleys associated with domestic water heating loads.

If all SmartPlate EV(s) are installed in a 2-way valve configuration, a bypass line must be piped elsewhere in the system to prevent the possibility of deadheading a pump.

Systems in the second category can induce excessive boiler cycling while working to meet the domestic hot water demand. A properly designed system should not allow any single boiler to cycle more than 2-½ times per hour when domestic water heating is the only load, and cycle frequency should be much less during the heating season.

4.1 Large Volume Systems

To minimize boiler cycling, sufficient thermal mass must exist in the piping between the boiler and the SmartPlate EV, in each individual boiler, or in both. Sufficient boiler water flow at specified temperature must be provided for the SmartPlate EV to meet variable potable water load demand. The location of the SmartPlate EV heater relative to the boiler is also important; the required thermal mass must be between the boiler and the SmartPlate.

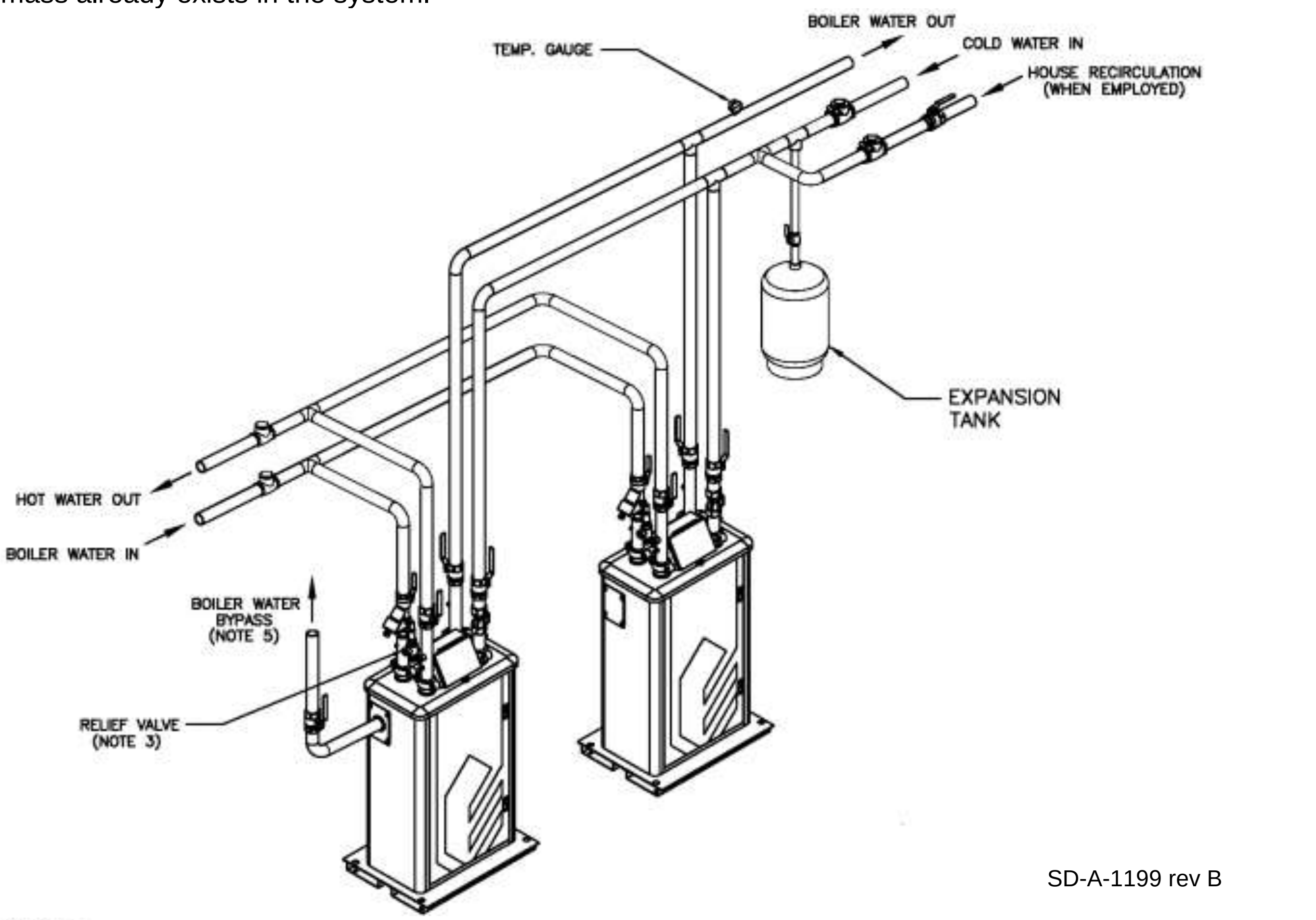


NOTES:
1. FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE HEATER, SEE DIMENSIONAL DRAWING AP–A–1055.
2. REDUCERS, ON THE WATER INLET SIDE, SHOULD BE LOCATED ADJACENT TO THE HEATER. EXPANSION FITTINGS, ON THE WATER INLET SIDE, SHOULD BE LOCATED AS FAR AS POSSIBLE FROM THE HEATER.
3. RELIEF VALVE DISCHARGE SHOULD BE PIPED TO THE NEAREST FLOOR DRAIN. WHEN NO FLOOR DRAIN IS AVAILABLE, THE RELIEF VALVE DISCHARGE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE THE FLOOR.

Figure 1: **Single SmartPlate EV Heater**

Large conventional boilers can contain anywhere from a few hundred to a few thousand gallons of water. In this scenario, the boiler and piping water volumes alone are typically (but not always) sufficient to ensure minimal boiler cycling and smooth operation of the SmartPlate EV. When this is the case, the SmartPlate EV could be installed without a buffer tank.

However, designers **should always** contact their local AERCO sales representative to perform the thermal buffer tank calculation discussed in the next section and confirm that sufficient thermal mass already exists in the system.



NOTES:

1. FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER DETAILS, SEE DIMENSIONAL DRAWING AP-A-1055.
2. REDUCERS, ON THE WATER INLET SIDE, SHOULD BE LOCATED ADJACENT TO THE HEATER. EXPANSION FITTINGS, ON THE WATER INLET SIDE, SHOULD BE LOCATED AS FAR AS POSSIBLE FROM THE HEATER.
3. RELIEF VALVE DISCHARGE SHOULD BE PIPED TO 6"–12" ABOVE THE NEAREST FLOOR DRAIN. WHEN NO FLOOR DRAIN IS AVAILABLE, THE RELIEF VALVE DISCHARGE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE THE FLOOR.
4. HEATERS SHOULD BE PIPED REVERSE RETURN OR BALANCING DEVICES ON THE OUTLETS SHOULD BE EMPLOYED.
5. ONE OR MULTIPLE BYPASS LINES MAY BE REQUIRED. BYPASS PIPING AND ISOLATION VALVE TO BE FIELD SUPPLIED. SEE APPLICATION GUIDE FOR REFERENCE.

Figure 2: **Multiple SmartPlate EV Heaters in Parallel**

Large conventional boilers are not designed to condense; hence they cannot tolerate return water temperatures below 140˚F. The average boiler return water temperature from the SmartPlate EV will be well below 140˚F due to the efficient design of the plate heat exchanger.

In order to protect a conventional boiler, the system designer must engineer a bypass line to ensure that the return water temperature to the non-condensing boiler never drops below 140˚F.

4.2 Small Volume Systems

Many of today's high efficiency systems incorporate small modular low-mass condensing boilers operating with temperature differentials of 40°F or greater.

This design reduces the volume of water in the system and requires the boilers to be capable of modulating quickly across a greater operating range to meet system load transitions. The higher the boiler turndown, the more effective it will be at transitioning to meet load requirements without cycling.

AERCO boilers, which feature some of the highest turndown ratios in the industry, are well suited for such applications. However, no boiler is capable of matching the speed and diversity of instantaneous domestic load demands without cycling and lowering overall system efficiency as a result of cycling.

In most cases, some thermal mass must be added as a buffer to dampen fast transitions and minimize boiler cycling, which occurs either during zero loads or during low load conditions in which the only load is generated by recirculation piping losses.

AERCO has provided your local sales representative with two sizing programs to calculate the thermal buffer tank volume required to reduce boiler cycling: one for use with AERCO boilers, and another for use with non-AERCO boilers.

The AERCO boiler buffer tank sizing program requires the following inputs:

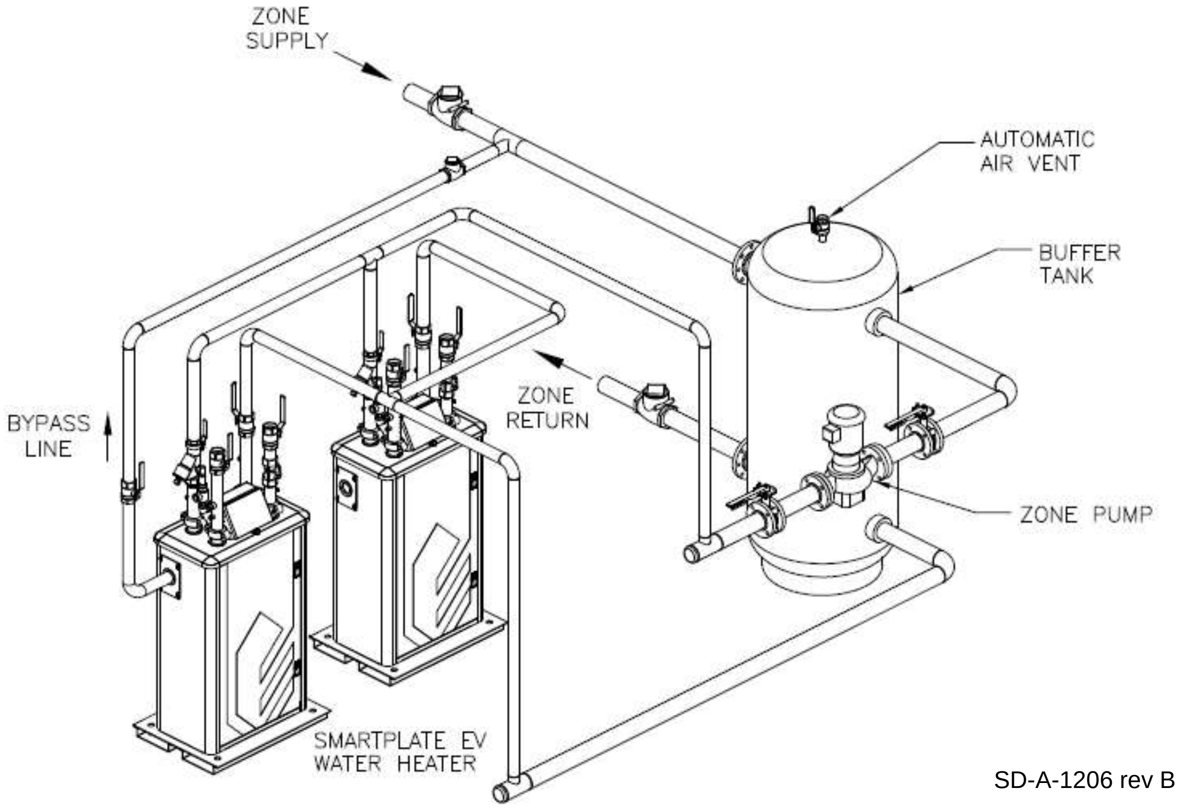
- AERCO boiler model number.
- Quantity of boilers.
- Boiler maximum supply temperature to SmartPlate EV.
- SmartPlate EV setpoint temperature.
- SmartPlate EV model number.
- Quantity of SmartPlates.
- Domestic hot water building design load.
- Building or application type. Choices include: elementary school, high school, hospital, hotel, laundry, process, office building, prison, residential apartment, restaurant, university building, and university dorm.
- Pipe diameter and length to calculate piping volume.
- Minimum flow per AERCO boiler.

The buffer tank should be vertical to promote natural stratification. Benchmarks can be installed with a two-port or a four-port buffer tank. For the two-port buffer tank, the boiler water return from the SmartPlates should be located in the lower quarter of the tank and the outlet to the boilers should be located in the upper quarter of the tank. Modulex boilers should be installed with a 4-port buffer tank. The hot water inlet from the Modulex boilers and outlet to the system loop should be located in the upper quarter of the tank, and the boiler water return from the system and to the boilers should be located in the lower quarter of the tank.

The non-AERCO boiler buffer tank sizing program will require the following inputs:

- Boiler model.
- Water volume contained in a single boiler.
- Quantity of boilers.
- Boiler primary loop flow rate.
- Boiler maximum supply temperature to SmartPlate EV.
- Boiler minimum input.
- Boiler maximum input.
- Boiler full fire efficiency.
- Boiler type. Choices include: condensing firetube, condensing cast aluminum, scotch marine, watertube, and other.
- SmartPlate EV setpoint temperature.
- SmartPlate EV model number.
- Quantity of SmartPlates.
- Domestic hot water building design load.
- Building or application type. Choices include: elementary school, high school, hospital, hotel, laundry, process, office building, prison, residential apartment, restaurant, university building, and university dorm.
- Pipe diameter and length (to calculate piping volume).
- Minimum flow per boiler - per the boiler manufacturer’s recommendation.

The SmartPlate system should be piped as a zone of the heating system utilizing non-AERCO low mass boilers, as shown in Figure 3, below.



NOTES:
1. REFER TO SMARTPLATE EV APPLICATIONS GUIDE FOR BUFFER TANK SIZING.
2. REFER TO SMARTPLATE EV INSTALLATION DRAWINGS FOR RECOMMENDED DOMESTIC PIPING INSTALLATION.
   SD–A–1198
   SD–A–1199
   SD–A–1200
   SD–A–1201
   SD–A–1202
   SD–A–1203
3. ONE OR MULTIPLE BYPASS LINES MAY BE REQUIRED. BYPASS PIPING AND ISOLATION VALVE TO BE FIELD SUPPLIED. SEE APPLICATION GUIDE FOR REFERENCE.

Figure 3: **4-Port Buffer Tank and SmartPlate Multiple Units with Boiler Side Buffer Tank as a Zone**
(This figure depicts boiler water piping only)

5. Building Recirculation

For best temperature control, a minimum flow rate though the SmartPlate EV is recommended. The suggested minimum flow rate is 6 GPM for the SmartPlate EV30, 40, and 60, and 10 GPM for the SmartPlate EV90 and 140. In most commercial applications, this will be accomplished with a building recirculation pump.

6. Combination Plant Piping

A space heating and domestic hot water combination system should be piped in one of three arrangements, depending on your system design requirements and the AERCO boiler specified.

- Figure 4 shows the SmartPlate EV heaters, piped with Benchmark Platinum boilers, as a separate zone from the space heating system. In this arrangement, the system pump supplies the space heating load and the DHW pump supplies the SmartPlates. A single boiler water setpoint is supplied to SmartPlate EV heaters and the space heating system.
- Figure 5 shows the SmartPlate EV heaters, piped with Benchmark Platinum boilers, as a separate zone from the space heating system. In this arrangement, the system pump supplies the space heating load and the DHW pump supplies the SmartPlates. A swing valve separates space heating boilers from the DHW boilers. The normally closed swing valve separates the DHW boiler from the space heating plant, thus allowing for each application to have a unique boiler water setpoint.
- Figure 6 shows the SmartPlate EV heaters, piped with Benchmark Platinum boilers, as a separate zone from the space heating system. In this arrangement, the system pump supplies the space heating load and the DHW pump supplies the SmartPlates. Two swing valves separate the DHW boiler from the space heating plant, thus allowing for each application to have a unique boiler water setpoint. In between the two swing valves is a swing boiler, which can switch between DHW and space heating plants if one plant requires additional capacity. The swing boiler is typically configured to normally support space heating and switchover to DHW during high domestic demands.
- Figure 7 shows the SmartPlate EV heaters, piped with Benchmark Platinum boilers, in a primary-secondary system. In this arrangement, each boiler has its own pump. Two swing valves separate the DHW boiler from the space heating plant, thus allowing for each application to have a unique boiler water setpoint. In between the two swing valves is a swing boiler that can switch between DHW and space heating plants if one plant requires additional capacity. The swing boiler is typically configured to normally support space heating and switch over to DHW during high domestic demands.

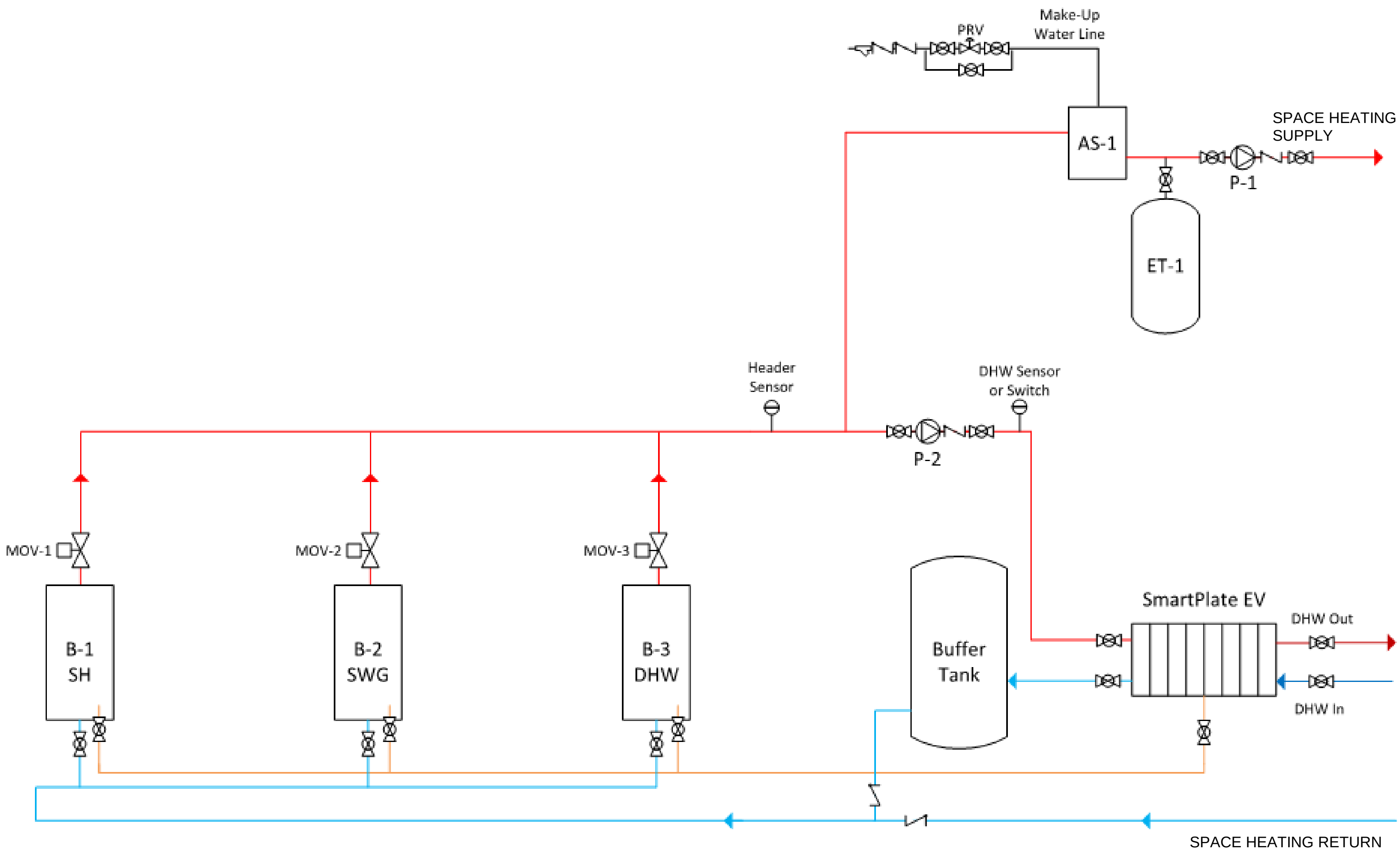


Figure 4: SmartPlate EV Heaters and Space Heating Zones, One Temperature Plant
(This figure depicts boiler water piping only)

	SWING VALVE 1	COMBINATION SYSTEM PUMP	B3 – DHW PRIORITY
Heating + DHW loads present	CLOSE	ON	CONSTANT SETPOINT
Heating load present (<100%); NO DHW	CLOSE	OFF	STANDBY
Heating load present (B1 & B2 = 100%); NO DHW	OPEN	OFF	HEATING MODE
Heating load present (B1 & B2 = 100%); DHW present	CLOSE	ON	CONSTANT SETPOINT

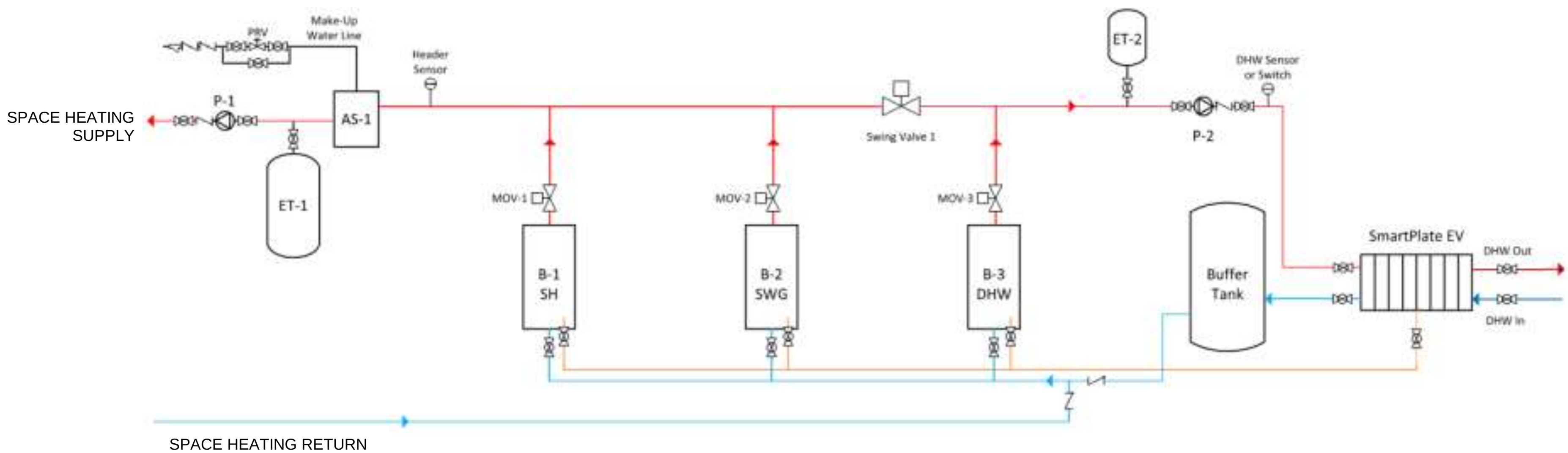


Figure 5: SmartPlate EV Heaters and Space Heating Zones, One Swing Valve Plant

(This figure depicts boiler water piping only)

	SWING VALVE 1	SWING VALVE 2	DHW PUMP	B2 - BLDG (SWING)	B3 - DHW
Heating + DHW loads present	CLOSE	OPEN	ON	HEATING MODE	CONSTANT SETPOINT
Heating load present (<100%); NO DHW	CLOSE	OPEN	OFF	HEATING MODE	STANDBY
Heating load present (B1 & B2 = 100%); NO DHW	OPEN	OPEN	OFF	HEATING MODE	HEATING MODE
Heating load present (B1 & B2 = 100%); DHW present	CLOSE	OPEN	ON	HEATING MODE	CONSTANT SETPOINT
Heating present; DHW present (B3 = 90%, >10 min.)	OPEN	CLOSE	ON	CONSTANT SETPOINT	CONSTANT SETPOINT

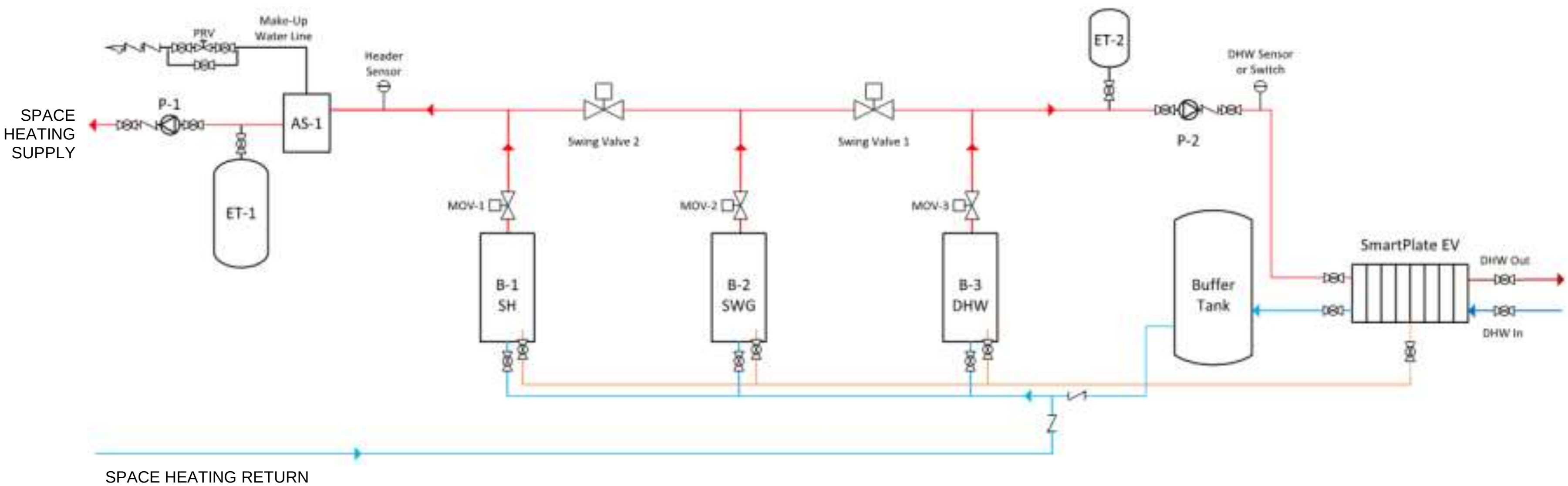


Figure 6: SmartPlate EV Heaters and Space Heating Zones, Two Swing Valve Plant

(This figure depicts boiler water piping only)

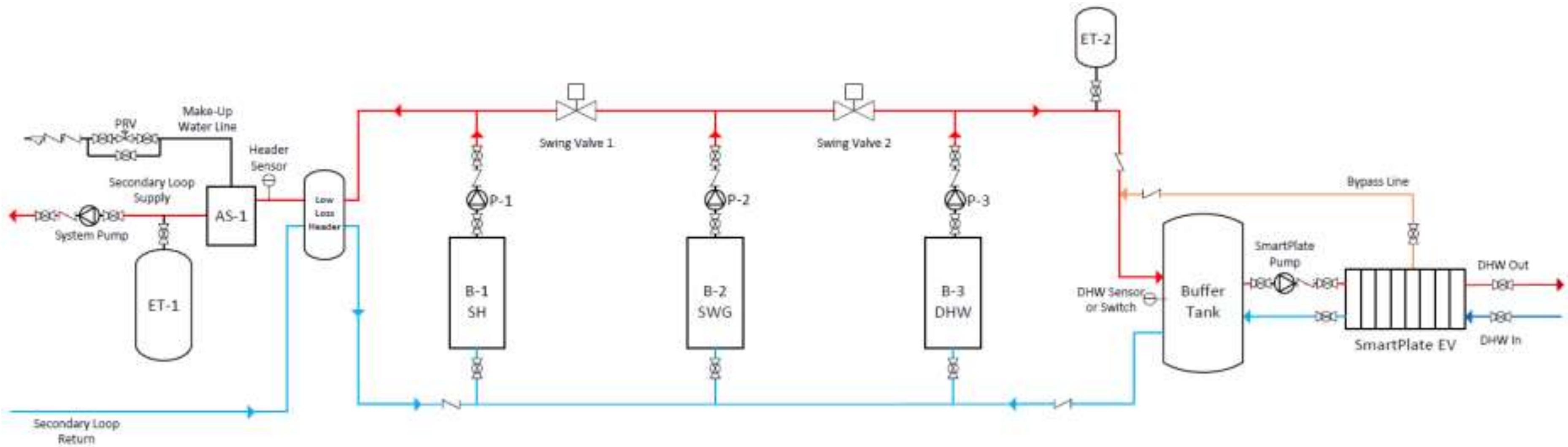


Figure 7: SmartPlate EV Heaters and Space Heating Zones, Two Swing Valve Plant, Primary-Secondary Piping

For certain applications that have a very large instantaneous demand for a short period of time followed by a period with little or no demand until the next cycle, it may be desirable to install a smaller sized (economical) SmartPlate with a storage tank.

For storage tank sizing, please consult your local AERCO representative.

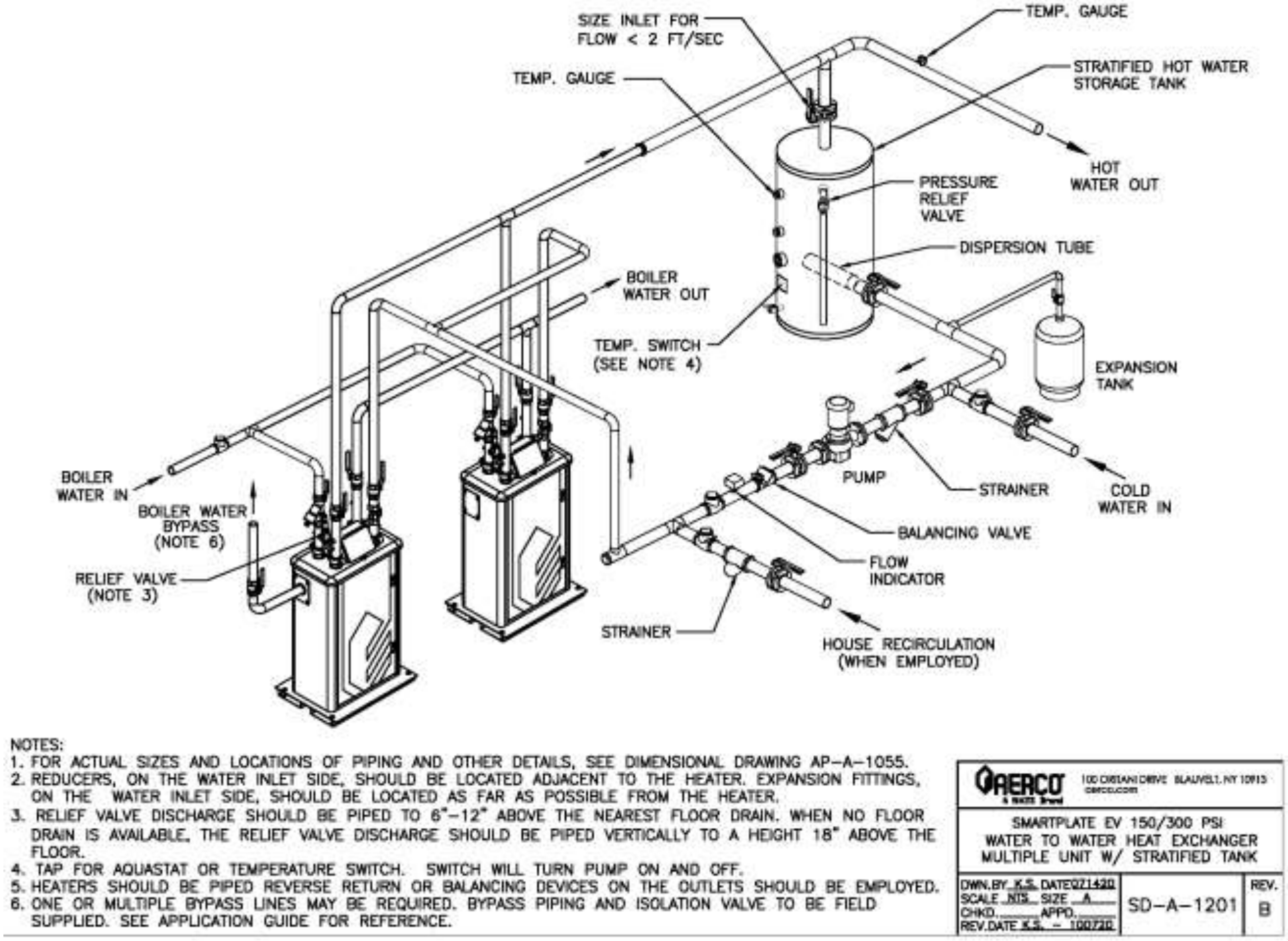


Figure 8: Two **SmartPlate Units with Stratified Storage Tank**

(This figure depicts domestic water piping only)

CHANGE LOG:		
Date	**Description**	**Changed By**
3/16/2021	**Rev A**: Initial Release	
5/11/2021	**Rev B:** Updated Figure 3, added new Figure 7.	Chris Blair