SETS®

Solar Electric Thermal Storage

Installation, operation and service instructions for SETS

Vaughn Water Heaters Controllers

ICC-SRCC™ Solar Heating and Cooling
Listing Number: SRCC-30004366, 30004367, 30004368

Exclusive Distributor
Sensible Technologies, Inc
4723 Tidewater Avenue • Oakland, CA 94601

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Delineation of tradesman responsibilities:

1. Plumber, plumbs per SETS drawing.
2. Electrician wires 240/1 a) to SETS control from house main panel from 20 amp disconnect, b) from SETS control to local disconnect adjacent to SETS tank, c) from local disconnect to SETS tank.
3. Solar contractor wires one leg from PV disconnect, 'L1', through SETS control's sensor loop on the way to the house main panel. Or supply extra length 'L1' wire in the house main panel to be able to loop through the SETS control and back again to the house main panel. SETS is the same for either a String Inverter system or a Micro Inverter system.
4. Energy Consultant must add a minimum of 2.8 KW capacity of solar panels to solar PV array to comply with OG300 solar fractions. If there are site circumstances which derate solar capacity, additional panels will be needed to make up the difference.

Solar Electric Thermal Storage, SETS®

Welcome to SETS energy storage systems, especially relevant to California's Title 24 code compliance requirements. SETS is a solar electric energy source that utilizes photovoltaic collectors to heat domestic hot water stored in a super insulated storage tank. SETS is used to supplement the primary domestic hot water. The SETS high net solar fraction assures the most cost effective and valuable compliance option credits for all 16 California climate zones. The SETS storage tank sets the bar on quality with an expected life of 30 years and is impervious to hard water and chloride water quality conditions that ordinarily shorten the life of typical water heaters.

The SETS manual is a supplement to the Vaughn Water Heater Manual. Installer must follow the Vaughn manual for maximum performance and warranty. An extended Lifetime warranty is available from Vaughn for the tank.

CAUTION: Incorrect installation, service or operation can damage the water heater and other property. Risks are (but not limited to) fire, electrical shock, flooding, and scalding. Only a trained licensed professional should install SETS and only in accordance with local regulations and codes. All wiring in SETS is to be in accordance with the National Electrical Code and/or local regulations.

How SETS Works

The SETS system is a Solar Electric Thermal Storage system. It preheats the primary domestic hot water heater. So, when someone opens a hot water tap or takes a shower, the cold water enters the SETS tank and simultaneously moves warm-to-hot water in the SETS tank to the primary water heater. During the day, energy is produced to heat the water until the tank reaches its set-point, or the capacity of the PV array is reached, or until the sun goes down. If the SETS tank is above 120˚F, the field installed tempering valve will keep the water from exceeding 120˚F. See drawing (SETS with gas tankless primary). A temperature gauge is to be installed at the blend point of the mixing valve to dial in appropriate domestic hot water.

The SETS system converts solar electricity to hot water. The SETS tank has a 3.8 KW element, so when the solar PV system has enough power for the SETS tank, the element is engaged. So the SETS system is only heating during daylight. SETS stores the hot water as a thermal battery. When the SETS tank temperature reaches customer selected setpoint, the water heater element turns off and all solar electricity is diverted to other uses, the grid, or is stored in electric batteries.

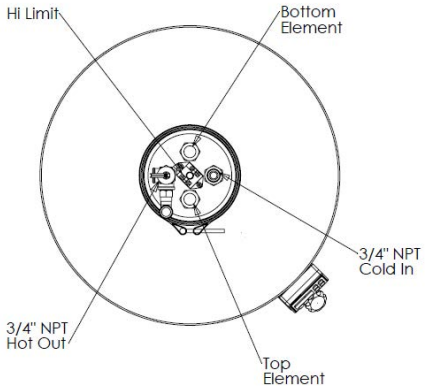
SRCC Values per Climate Zone

	String Inverter Systems			Microinverter Systems		
	Annual Solar Fraction (SF) - OG-300 Baseline			Annual Solar Fraction (SF) - OG-300 Baseline		
Location*	Electric Tank-Type	Gas Tank-Type	Gas Tankless	Electric Tank-Type	Gas Tank-Type	Gas Tankless
CCZ1	0.63	0.54	0.76	0.63	0.75	0.80
CCZ2	0.67	0.56	0.81	0.68	0.79	0.84
CCZ3	0.70	0.58	0.83	0.70	0.81	0.86
CCZ4	0.73	0.61	0.86	0.73	0.83	0.88
CCZ5	0.73	0.60	0.85	0.73	0.83	0.87
CCZ6	0.75	0.62	0.88	0.75	0.84	0.89
CCZ7	0.74	0.62	0.87	0.74	0.84	0.89
CCZ8	0.75	0.62	0.88	0.75	0.84	0.89
CCZ9	0.73	0.61	0.85	0.73	0.83	0.87
CCZ10	0.74	0.61	0.87	0.74	0.84	0.89
CCZ11	0.68	0.56	0.82	0.68	0.80	0.85
CCZ12	0.69	0.57	0.83	0.70	0.81	0.86
CCZ13	0.71	0.59	0.85	0.72	0.82	0.87
CCZ14	0.76	0.62	0.89	0.76	0.85	0.90
CCZ15	0.74	0.60	0.87	0.74	0.83	0.89
CCZ16	0.69	0.59	0.81	0.69	0.79	0.84

Product Description, Specifications, and Dimensional Information

SETS Components

SETS-55 (Vaughn Featherweight) tank
SETS Controller with Auto Transfer Switch
ESBE ¾" tempering valve with thermometer
SETS reserves the right to update the manual and components when necessary.



Storage Capacity (Gallons)	First Hour Rating (Gallons)	Continuous Recovery	Overall Dimensions		Connections		Shipping Weight (LBS)	Energy Factor (EF)	Standby Heat Loss
			Height	Diameter	Cold Water Inlet	Hoy Water Outlet			
55	55	13.6	49.5"	30"	3/4"	3/4"	95	.95	-0.3˚F/HR

SETS is supplied with a 3800-Watt bottom element. When the sun is shining, SETS has a rated 13.6 gallons per hour of continuous recovery heated at a 60˚F rise. Another way of calculating rise is if we have a 60˚F rise, the 55-gallon tank will be completely heated in 4 hours. The first hour rating at a 60˚F rise is 55 gallons. (This takes into account cold water mixing into the SETS tank.)

The SETS tank has a maximum working pressure of 150 psi and maximum working temperature of 200˚F. Recommended operating high limit temperature is 160˚F. The pressure temperature relief valve is set for 125 psi to accommodate other components in the domestic hot water system.

Since the SETS is a solar electric water heater, there is no combustion, there is no venting, there is no condensate, there is no natural or LP gas, and there are zero clearances to combustible materials

(service clearances are still in force). So, the tank can be installed on a garage floor or on blocks with ¾" solid plywood. Follow local codes regarding strapping.

Every water heater may eventually leak; whenever possible place water heater in an area that will not be damaged if there is a water leak. If the tank is located in an area where possible damage could occur, a drain pan must be installed with plumbing to the outside or drain per local codes.

Follow the "Featherweight" Vaughn electric water heater manual for placement and general guidelines (Pages 3-6), water heater check list (Page 7), service information (Page 9), maintenance (Page 13), tank wiring diagram (Page 14), tank control programming and operation (Page 17), troubleshooting (Page 24), parts list (Page 25), service assistance (Page 27) and warranty information (Page 28).

SETS Control:

SETS control box needs to be installed adjacent to the electrical main, where L1 and L2 from the main disconnect with 20 amp breaker connects to SETS control box, which also goes through a local disconnect adjacent to the SETS tank and powers the SETS tank .

The SETS control box is dimensionally 14" tall by 12" wide by 8" deep. It includes relays, sensor, prewired and a labeled terminal strip. It will also bear the UL label 508A.

Special note to PV Installer: L1 wire from PV disconnect box must pass through SETS control box and pass-through sensor loop inside SETS control on its way to the main control panel.

The SETS Control must never be set less than 16 amps.

Recommended optional components:

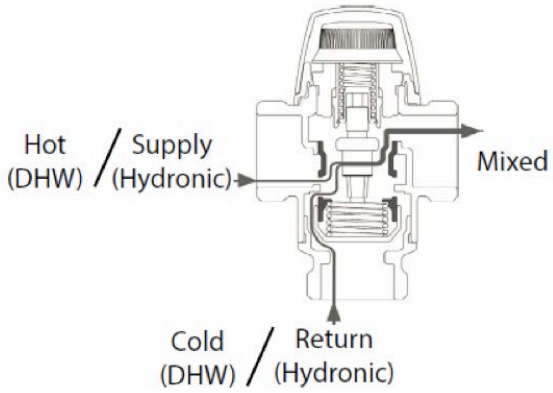
- AquaMotion domestic hot water recirculation pump.
- Elbi DXT-18, 5-gallon expansion tank. Good for the volume of the SETS tank plus up to an 80 gallon back up water heater.
- Temperature and pressure gauges, standard 3/4" ball valves and check valves. Larger sized valves or fitting connections are available upon request at additional cost .
- Plumber to supply all necessary tubing, fitting, pipe insulation (R-4) for a complete job.

ESBE
NO.1 IN HYDRONIC SYSTEM CONTROL

ESBE Tempering valve, VTA 3/4", FPT

Tempering valve, ESBE VTA 3/4", FPT. Install per SETS drawing(s). The tempering valve ships with a temperature gauge. When the domestic hot water system is fully functional, and a hot water fixture such as kitchen faucet is open to hot water, the final detail when commissioning the system is dialing in the tempering valve. Look at the temperature gauge on the outlet of the tempering valve. If the temperature is above 120˚F, remove the tempering valve's cap. This cap is tamper-resistant, but can be pried off to make adjustments. Remove the cap, and turn the knob clockwise to reduce the temperature. Watch the gauge as you do this until you get the desired temperature.

Flow Pattern:



Then replace knob back in the locked position and screw it back together. If you need higher temperatures, turn the knob on the counterclockwise side, until you get the desired temperature. You may need to set your primary water heater to a set point of 130˚F to allow this fine tuning to happen, particularly if the SETS tank is not up to temperature.

There is a manual bypass around the SETS tank should the SETS tank need servicing, such as cleaning or replacing the electric element (as found on page 11 section D), and by following the Maintenance portion of the Vaughn manual on page 12. To bypass the sets tank so the end user can maintain domestic hot water during SETS servicing, one must close the normally open valves located on the inlet and outlet of the water heater, and then open the normally closed bypass ball valve above the SETS tank so cold-water supply goes directly to the primary water heater.

The V-Grid that comes with the SETS package allows the local utility to remotely disable the primary electric source water heater during peak demand times to prevent brownouts. To obtain the listed solar fraction in a given California Climate zone, at least 2 KW capacity of photovoltaic modules (UL 1703) must be installed taking into account shading, panel orientation to south and panel pitch.

AquaMotion®

The AquaMotion AMH2K-7N for up to 200' recirc loop, or the AMH2K-RN for up to 600' recirculation loop.

Given the importance of water conservation, an "On Call" domestic hot water system should be a feature of most residential applications. For example, a 25' run of ¾" type L copper contains ½ gallon of water would have to be dumped before warm water arrives at a fixture if a AquaMotion recirc pump isn't used. When used, the AquaMotion AMH2K-RN "On Call" recirculation pump must be installed per drawing in the SETS manual. This allows the preheated water in the SETS to be moved to the primary heater every time the pump turns on. AMK-WB "On Call" wireless receiver. It plugs into a receptacle, and the AMH2K recirculation pump plugs into the AMK-WB receiver. WB wireless buttons or motions sensor to activate domestic hot water. When primary heater is a tankless water heater, the AMH2K-RN three speed pump is best, set to speed three. When the primary water heater is a tank type, speed one or two should be used.

When starting up the SETS system, leave the "On Call" pump unplugged for at least 24 hours after the solar PV system has been connected and is operational. This will allow the SETS tank to get up to

temperature, otherwise, the "On Call" will run continuously during initialization until the aquastat gets up to 105˚F or more to turn off the pump.

elbi

Elbi expansion tank

Install Elbi DTX18 as indicated on SETS drawing. The bottom of the DXT there is a Schrader valve. Set the DXT tank pressure to be at or slightly above the entering water pressure (with an air compressor or bicycle pump), before applying water pressure to tank. If you have applied water pressure to the plumbing side of the DXT, isolate the DXT and remove it from the plumbing line, then test the Schrader valve. Apply or let air out as necessary.

All modern homes have a check valve installed on the cold-water inlet to prevent back flow into the city water supply (#3 in Drawing), so per the UPC an expansion tank such as the Elbi DXT-18 five-gallon expansion tank must be installed on the cold-water inlet to the SETS tank. This size tank will take into account the volume of the SETS-55 and up to an 80-gallon primary water heater tank.

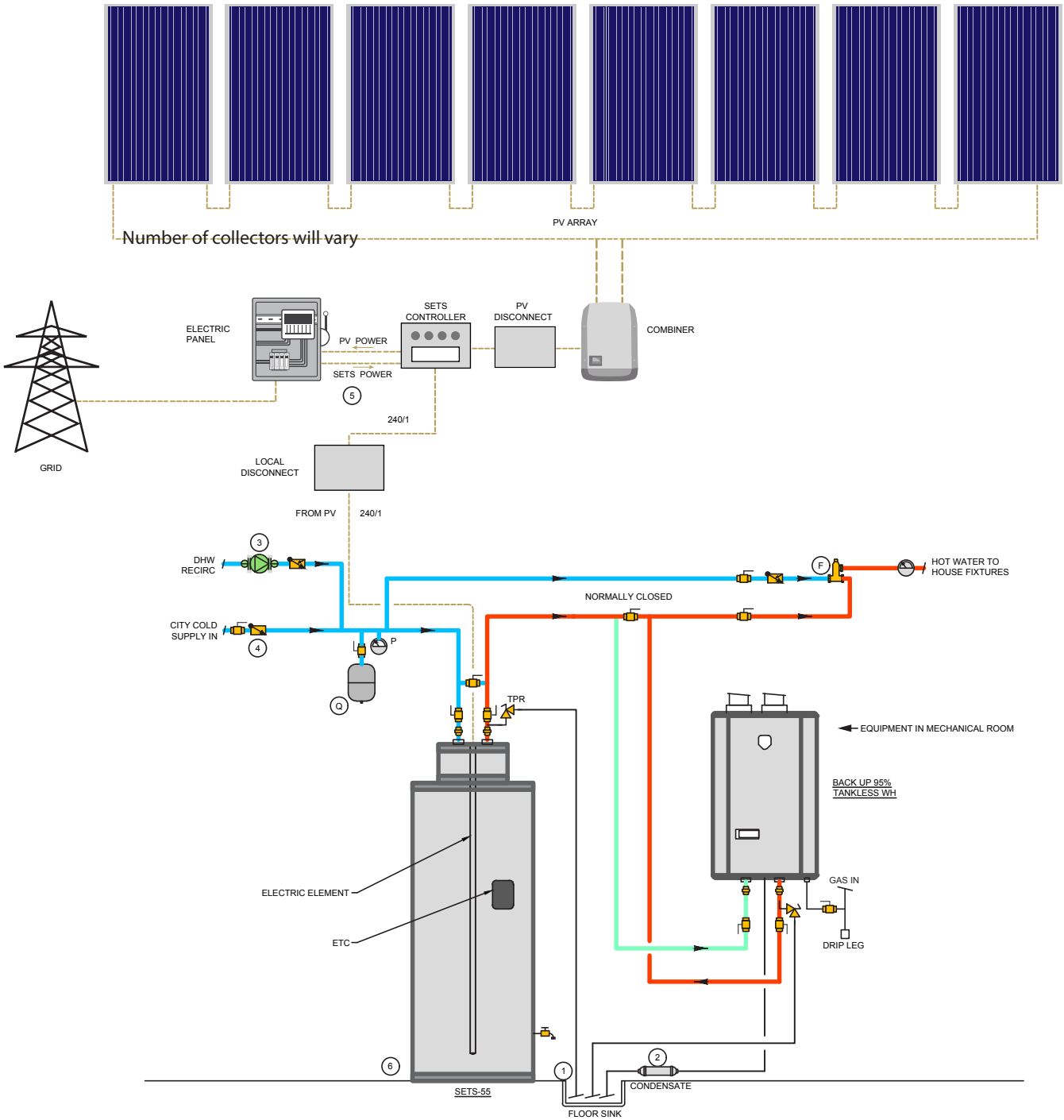
The SETS system plumbing is designed to have a three-valve bypass around the SETS tank and the primary water heater. Depending on time of year and hot water usage, it may be possible to run 100% SETS by manually bypassing the primary heater by closing the two normally open valves going to the primary water heater and opening the bypass valve. An automated bypass option is also available at additional cost.

LEGEND

- BALL VALVE
- PRESSURE GAUGE
- TEMPERATURE GAUGE
- THERMOSTATIC MIXING VALVE
- UNION
- HOSE BIB/DRAIN/ PURGE VALVE
- CHECK VALVE - SPRING
- TEMPERATURE PRESSURE RELIEF VALVE
- EXPANSION TANK

KEY NOTES

1. PROVIDE TEMPERATURE & PRESSURE RELIEF WITH DIRECT PIPING TO APPROVED LOCATION.
2. CONDENSATE REMOVAL PER CMC AND LOCAL CODES.. NEVER DRAIN CONDENSATE THAT HAS NOT BEEN NEUTRALIZED TO CAST IRON WASTE PIPING. PROVIDE CONDENSATE PUMP KIT JJM CBM-225 AVAILABLE FROM HEAT TRANSFER PRODUCTS WHERE CONDENSATE CANNOT BE DRAINED BY GRAVITY WITH PROPER SLOPE.
3. RECIRCULATION PUMP WITH DEMAND PER T-24 REQUIREMENTS, AQUAMOTION AMH2K-7N AND RECEIVER AND MOTION SENSOR OR EQUAL. COORDINATE WITH PLUMBING CONTRACTOR AND SIZE BASED ON PLUMBING DESIGN.
4. VERIFY WITH LOCAL AUTHORITY HAVING JURISDICTION FOR BACKFLOW PREVENTION REQUIREMENTS.
5. WIRE PV POWER L1 THROUGH LOOP IN SETS CONTROLLER. LOCAL DISCONNECT. SHOULD BE 20 AMP
6. PROVIDE DRAIN PAN UNDER EACH WATER HEATER



1 S.E.T.S. WITH BACKUP 95% GAS TANKLESS WATER HEATER

NOT TO SCALE

ICC-SRCC™ Solar Heating and Cooling
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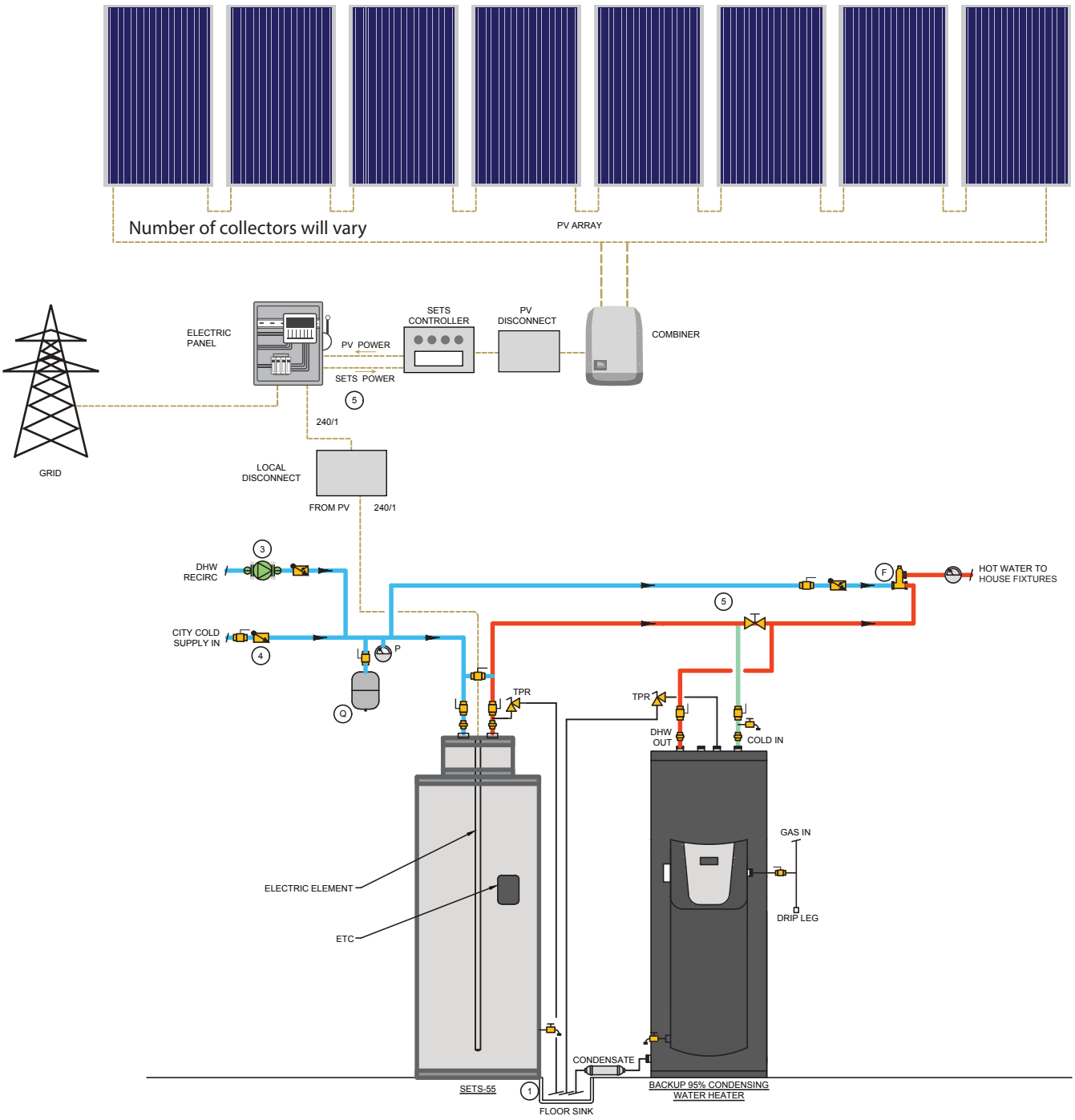
LEGEND

- BALL VALVE
- P — PRESSURE GAUGE
- TEMPERATURE GAUGE
- THERMOSTATIC MIXING VALVE
- UNION
- HOSE BIB/DRAIN/ PURGE VALVE
- CHECK VALVE - SPRING
- BYPASS VALVE
- TPR — TEMPERATURE PRESSURE RELIEF VALVE
- EXPANSION TANK

KEY NOTES

1. PROVIDE TEMPERATURE & PRESSURE RELIEF WITH DIRECT PIPING TO APPROVED LOCATION.
2. CONDENSATE REMOVAL PER CMC AND LOCAL CODES.. NEVER DRAIN CONDENSATE THAT HAS NOT BEEN NEUTRALIZED TO CAST IRON WASTE PIPING. PROVIDE CONDENSATE PUMP KIT JJM CBM-225 AVAILABLE FROM HEAT TRANSFER PRODUCTS WHERE CONDENSATE CANNOT BE DRAINED BY GRAVITY WITH PROPER SLOPE.
3. RECIRCULATION PUMP WITH DEMAND PER T-24 REQUIREMENTS, AQUAMOTION AMH2K-7N AND RECEIVER AND MOTION SENSOR OR EQUAL. COORDINATE WITH PLUMBING CONTRACTOR AND SIZE BASED ON PLUMBING DESIGN.
4. VERIFY WITH LOCAL AUTHORITY HAVING JURISDICTION FOR BACKFLOW PREVENTION REQUIREMENTS.
5. WIRE PV POWER L1 THROUGH LOOP IN SETS CONTROLLER. LOCAL DISCONNECT. SHOULD BE 20 AMP
6. PROVIDE DRAIN PAN UNDER EACH WATER HEATER



1 S.E.T.S. WITH BACKUP 95% CONDENSING WATER HEATER

NOT TO SCALE

ICC-SRCC™ Solar Heating and Cooling

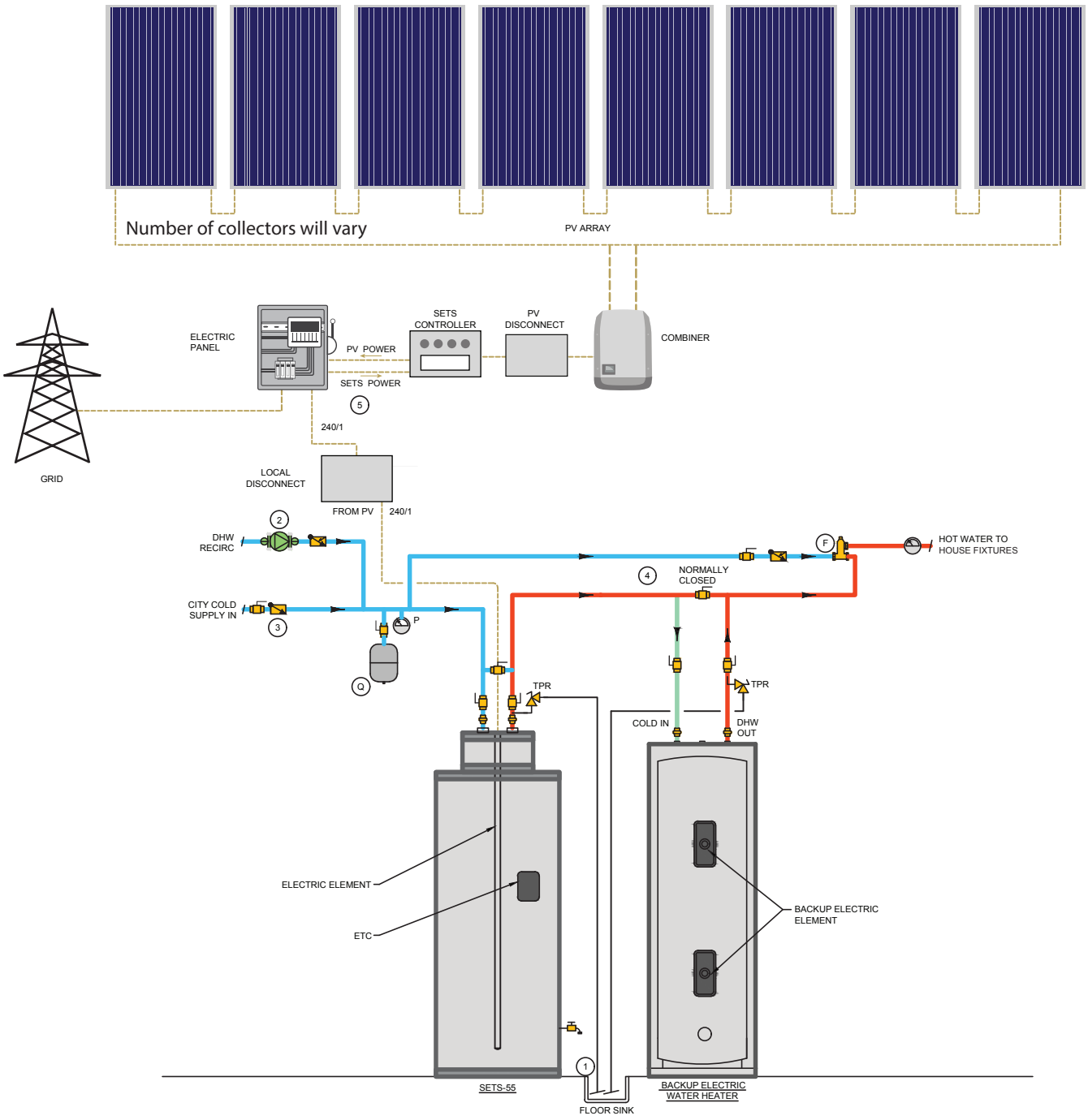
Listing Number: SRCC-30004366, 30004367, 30004368

LEGEND

- BALL VALVE
- PRESSURE GAUGE
- TEMPERATURE GAUGE
- THERMOSTATIC MIXING VALVE
- UNION
- HOSE BIB/DRAIN/ PURGE VALVE
- CHECK VALVE - SPRING
- BYPASS VALVE
- TEMPERATURE PRESSURE RELIEF VALVE
- EXPANSION TANK

KEY NOTES

1. PROVIDE TEMPERATURE & PRESSURE RELIEF WITH DIRECT PIPING TO APPROVED LOCATION.
2. ??????????? See this above recirc pump in diagrm
3. RECIRCULATION PUMP WITH DEMAND PER T-24 REQUIREMENTS, AQUAMOTION AMH2K-7N AND RECEIVER AND MOTION SENSOR OR EQUAL. COORDINATE WITH PLUMBING CONTRACTOR AND SIZE BASED ON PLUMBING DESIGN.
4. VERIFY WITH LOCAL AUTHORITY HAVING JURISDICTION FOR BACKFLOW PREVENTION REQUIREMENTS.
5. WIRE PV POWER L1 THROUGH LOOP IN SETS CONTROLLER. LOCAL DISCONNECT. SHOULD BE 20 AMP
6. PROVIDE DRAIN PAN UNDER EACH WATER HEATER



1 S.E.T.S. WITH BACKUP ELECTRIC WATER HEATER

NOT TO SCALE

ICC-SRCC™ Solar Heating and Cooling

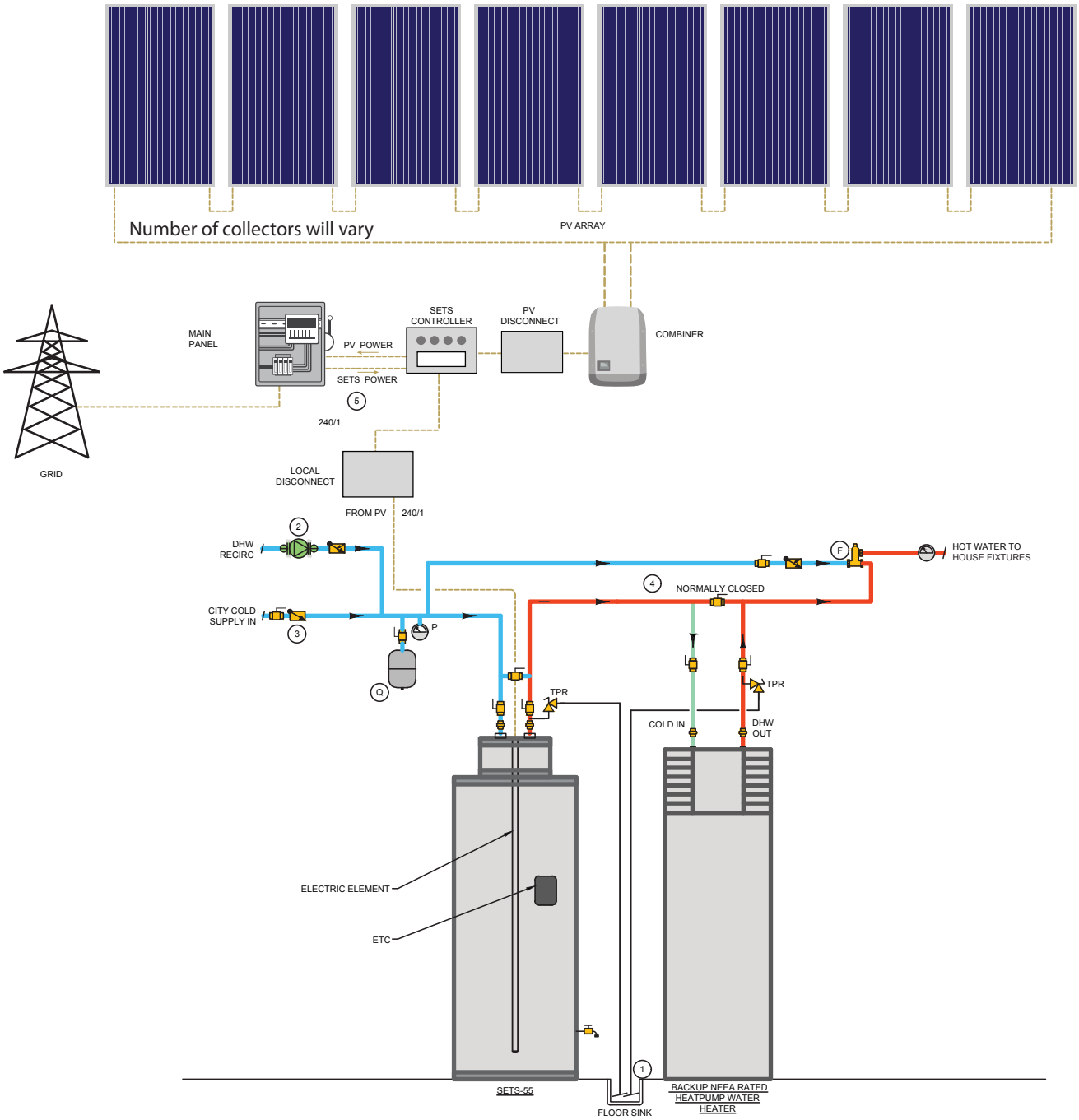
Listing Number: SRCC-30004366, 30004367, 30004368

LEGEND

- BALL VALVE
- PRESSURE GAUGE
- TEMPERATURE GAUGE
- THERMOSTATIC MIXING VALVE
- UNION
- HOSE BIB/DRAIN/ PURGE VALVE
- CHECK VALVE - SPRING
- TEMPERATURE PRESSURE RELIEF VALVE
- EXPANSION TANK

KEY NOTES

1. PROVIDE TEMPERATURE & PRESSURE RELIEF WITH DIRECT PIPING TO APPROVED LOCATION.
2. HEATPUMP CONDENSATE TO DRAIN
3. RECIRCULATION PUMP WITH DEMAND PER T-24 REQUIREMENTS, AQUAMOTION AMH2K-7N AND RECEIVER AND MOTION SENSOR OR EQUAL. COORDINATE WITH PLUMBING CONTRACTOR AND SIZE BASED ON PLUMBING DESIGN.
4. VERIFY WITH LOCAL AUTHORITY HAVING JURISDICTION FOR BACKFLOW PREVENTION REQUIREMENTS.
5. WIRE PV POWER L1 THROUGH LOOP IN SETS CONTROLLER. LOCAL DISCONNECT. SHOULD BE 20 AMP
6. PROVIDE DRAIN PAN UNDER EACH WATER HEATER



1 S.E.T.S. BACKUP NEEA RATED HEATPUMP WATER HEATER

NOT TO SCALE

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