Designing from scratch:

What's possible when a pellet boiler is planned into new building construction

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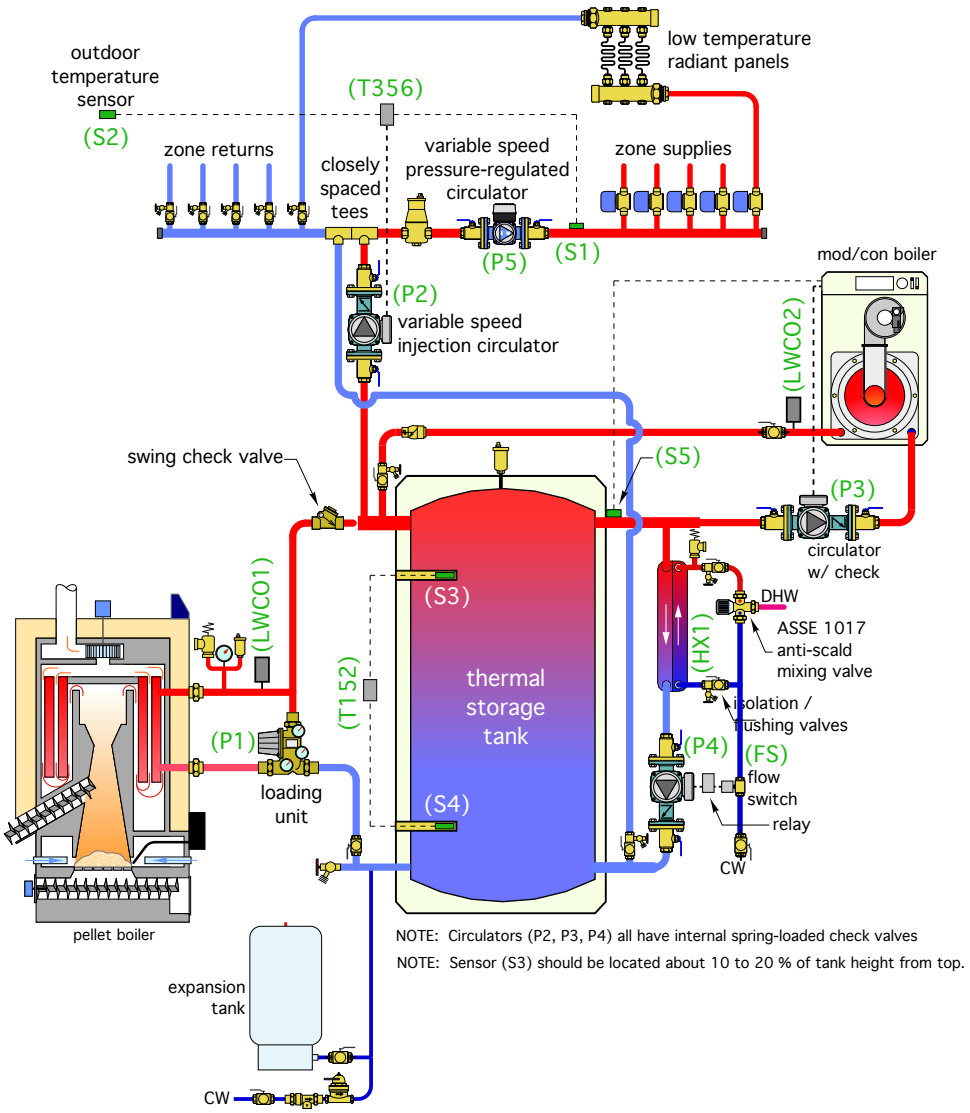
November 19, 2021
1:00 PM

Moderated by:

Sue Dougherty
Clean Heating & Cooling program
NYSERDA
sue.dougherty@nyserda.ny.gov

presented by:

John Siegenthaler, P.E.
Principal, Appropriate Designs
Holland Patent, NY
www.hydronicpros.com



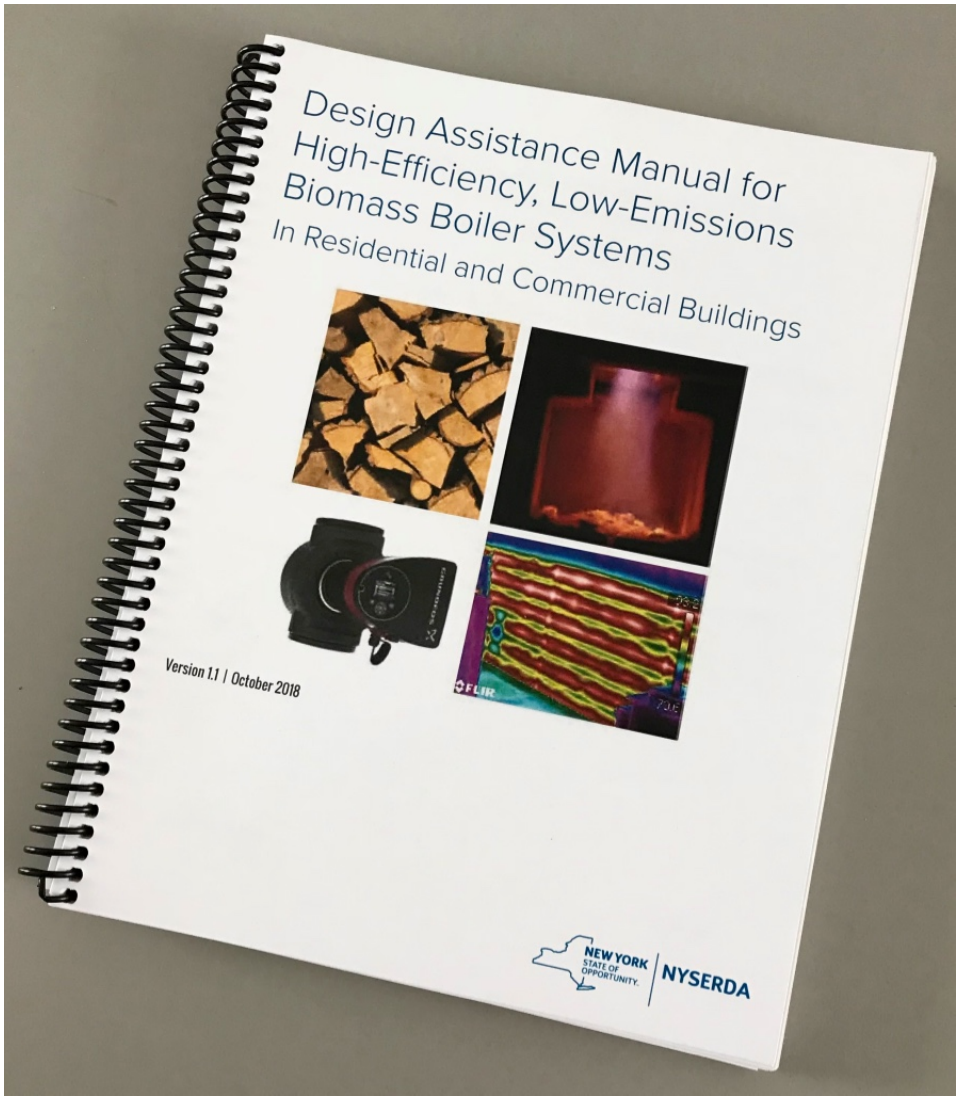
Designing from scratch:

Description: Many of the previous webinars have focused on adapting a pellet boiler into an existing hydronic heating system. This webinar describes an unfettered design development when a pellet boiler is incorporated into new construction. Details that leverage low temperature distribution systems, and optimal configuration of thermal storage for providing space heating and domestic hot water.

Learning Objectives:

- See overall system as collection of subsystems
- Understand the important of low temperature heat emitters
- See different heat emitter options
- Learn how to incorporate domestic water heating
- Learn how to leverage outdoor reset control.
- Learn how to keep the system as simple as possible.

Design Assistance Manual
for High Efficiency Low Emissions Biomass Boiler Systems



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It's available as a FREE downloadable PDF at:

https://www.nyserda.ny.gov/-/media/Files/EERP/Renewables/Biomass/Design-Assistance-Biomass-Boiler.pdf

What features are desirable in a new system?

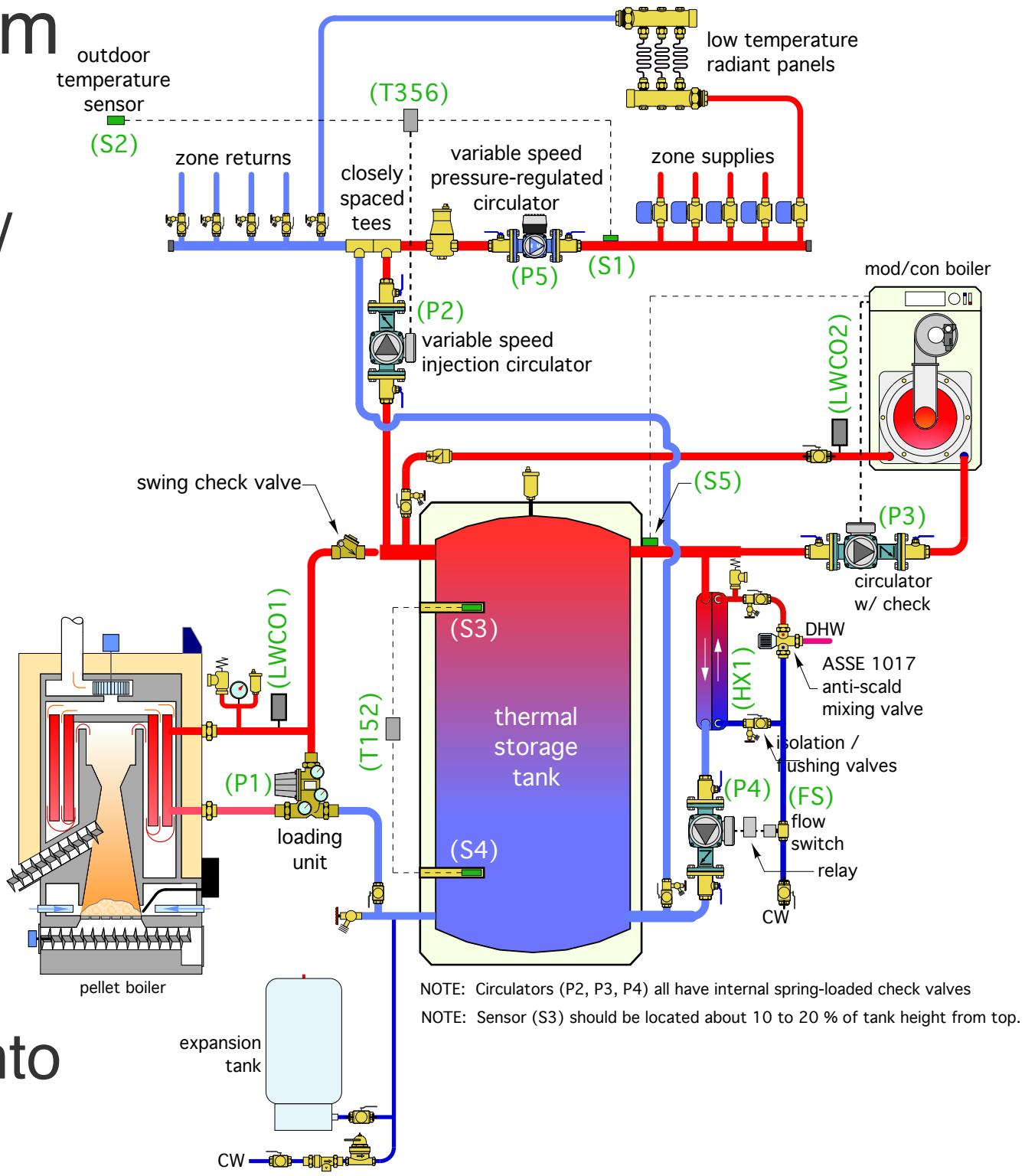
Context: Residential or light commercial system supplied by a pellet-fire boiler.

- Long burn cycles and long off-cycles
- High ΔT cycling range on thermal storage
- Ability to have several zones of heat distribution
- Providing as much thermal energy as possible from the pellet boiler
- Providing high efficiency automatic backup if pellet boiler is out of service
- Keeping piping and controls simple and repeatable
- Avoiding short cycling on auxiliary boiler
- Flexibility in auxiliary boiler fuel
- Minimizing mechanical room footprint

The overall system

- Multi-zone space / low temperature space heating
- Domestic water heating
- Fully automatic aux heating

We'll take it apart into sub-assembles



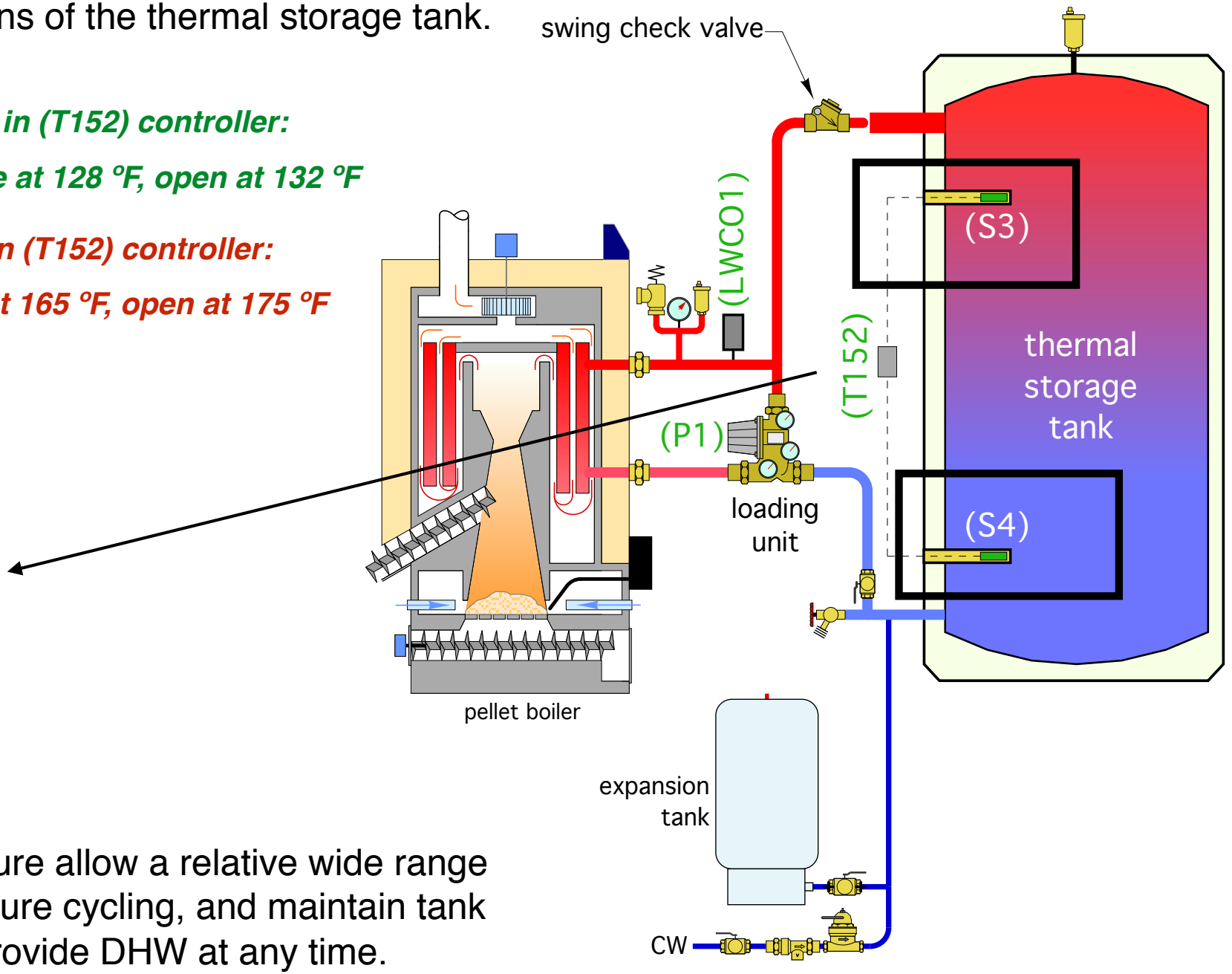
Pellet boiler operation: The pellet boiler Is turned on and off based solely on the temperatures in the upper and lower portions of the thermal storage tank.

Stage 1 contacts in (T152) controller:

contacts close at 128 ºF, open at 132 ºF

Stage 2 contacts in (T152) controller:

contact close at 165 ºF, open at 175 ºF

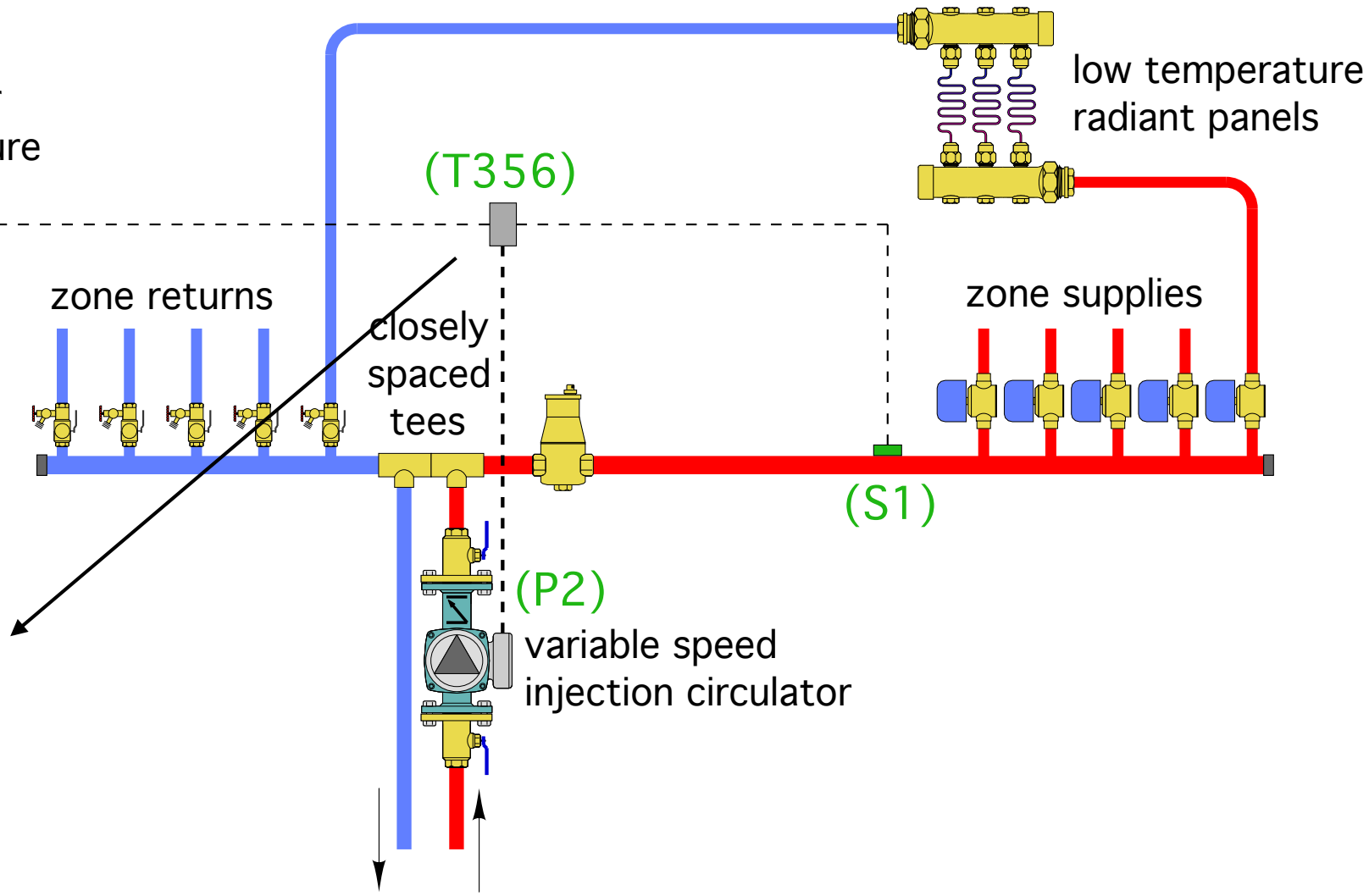


These temperature allow a relative wide range of tank temperature cycling, and maintain tank hot enough to provide DHW at any time.

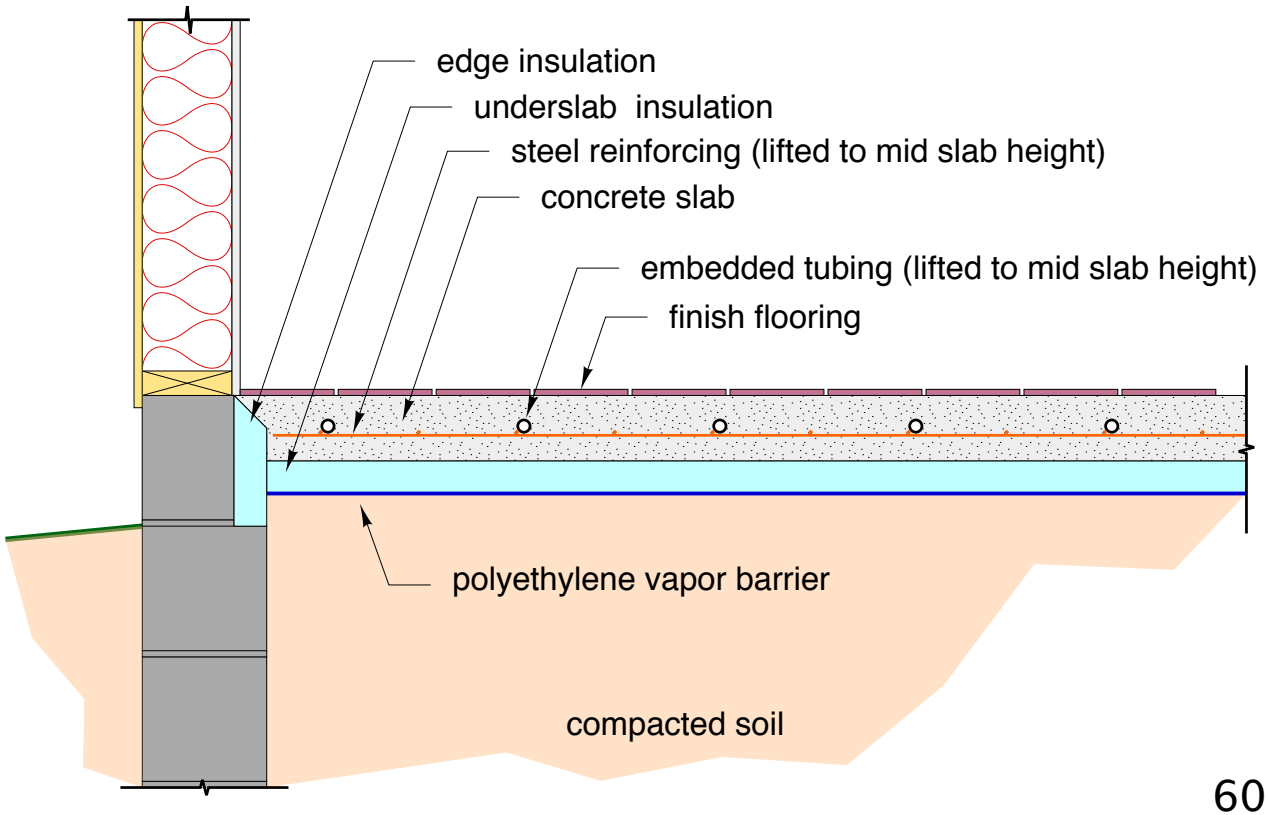
Distribution system: Multiple zone of low temperature radiant panel heating (floors, walls, ceilings).

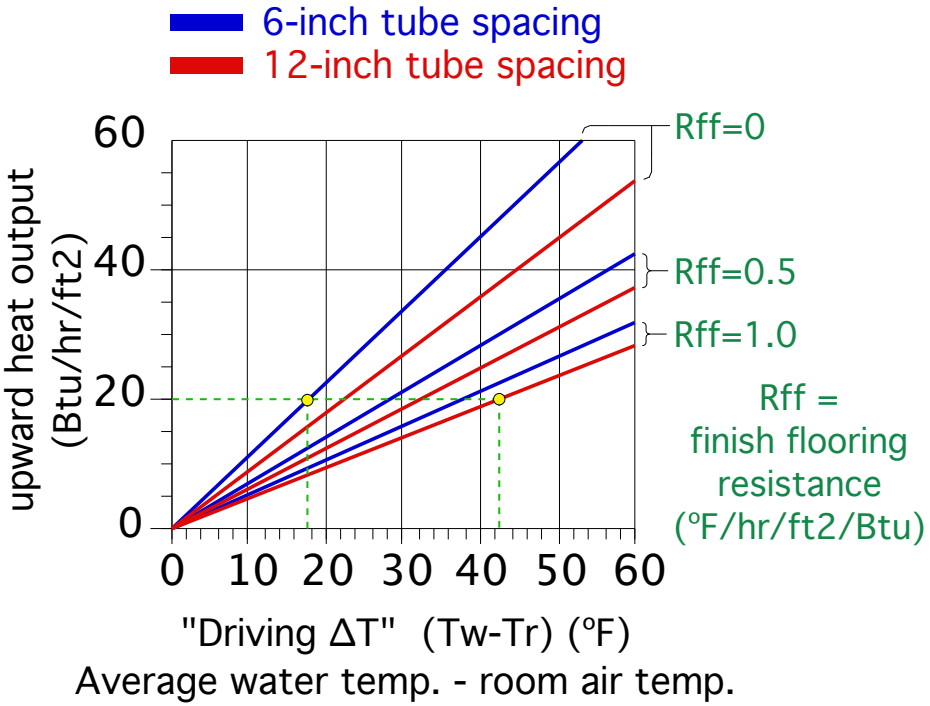
Supply water temperature regulated by a variable speed injection pump - operated by tekmar 356 controller - **allows for full outdoor reset control.**

Supply water temperature at design load conditions no higher than 120 ºF. Even lower if possible.

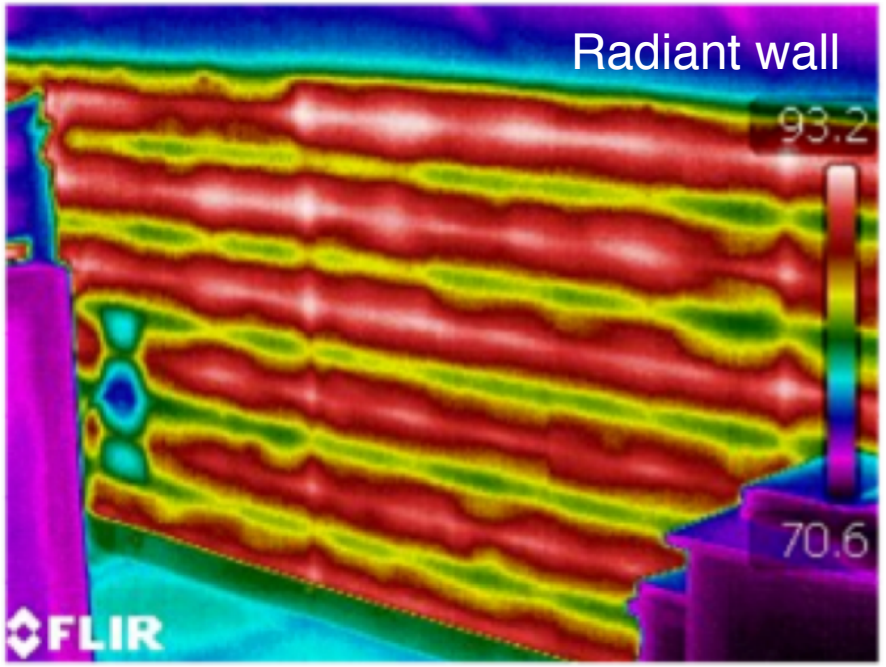


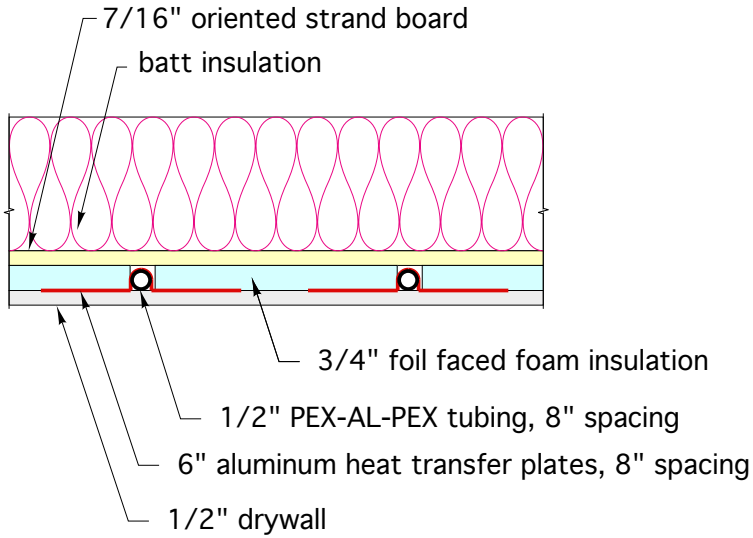
Distribution system: Examples of low temperature radiant panels

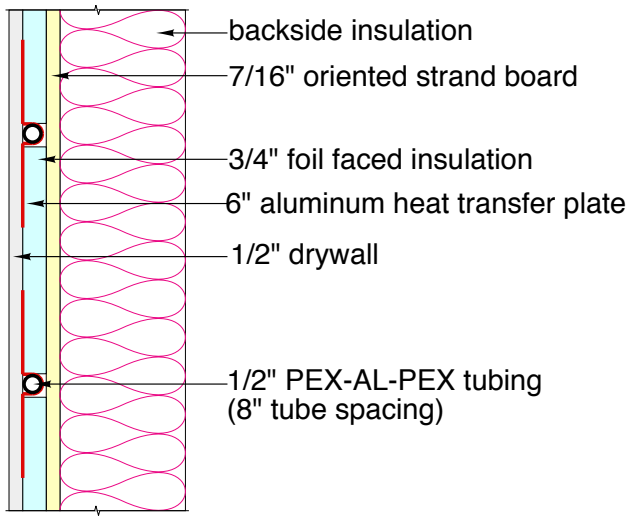




Distribution system: Examples of low temperature radiant panels







$$q = a \times (T_{wa} - T_{room})$$

where:

q = heat output of ceiling panel (Btu/hr/ft²)

a= 0.71 for ceiling applications, or 0.80 for wall applications

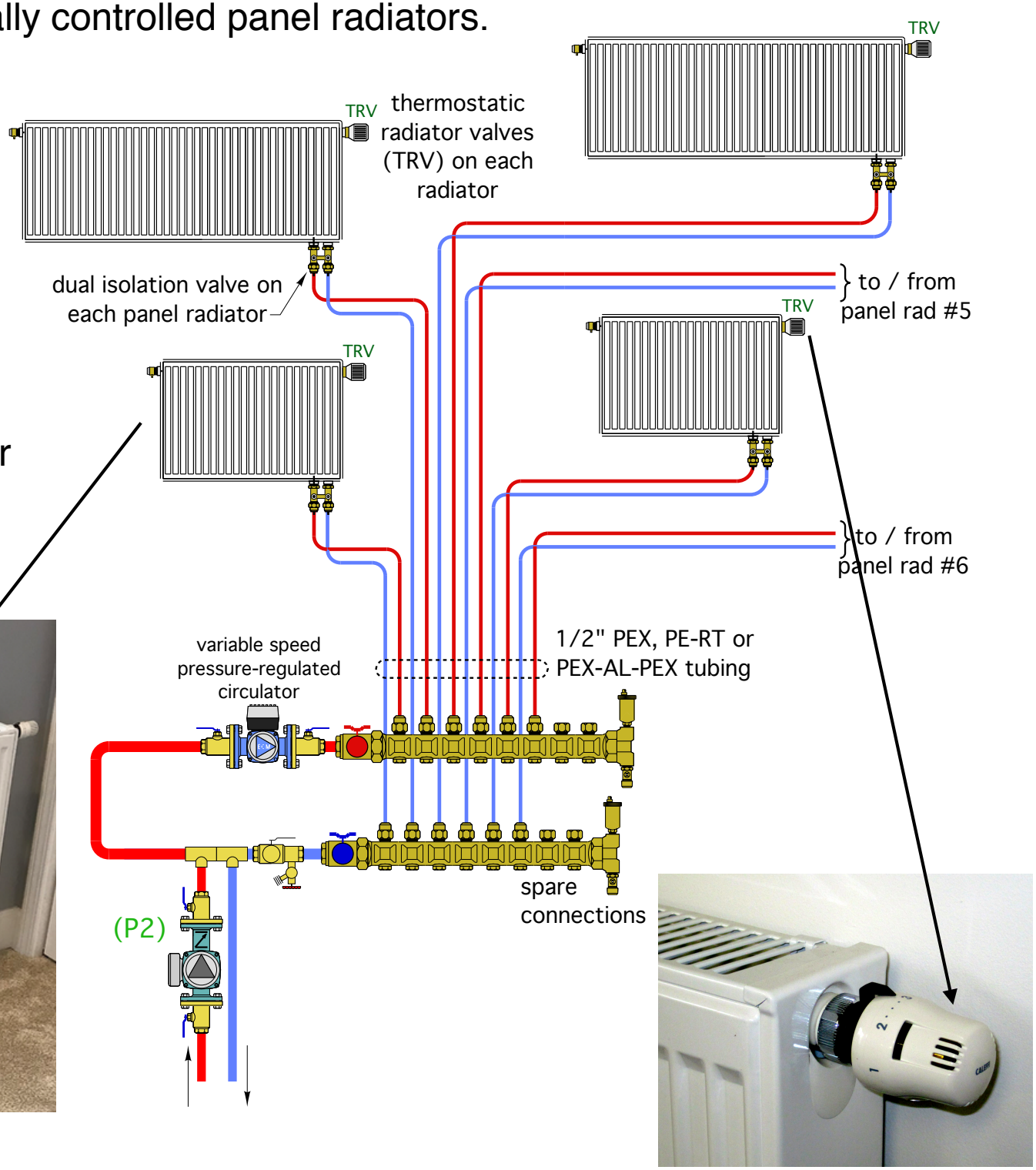
T_{wa} = average water temperature in panel (°F)

T_{room} = room air temperature (°F)

Distribution system: individually controlled panel radiators.

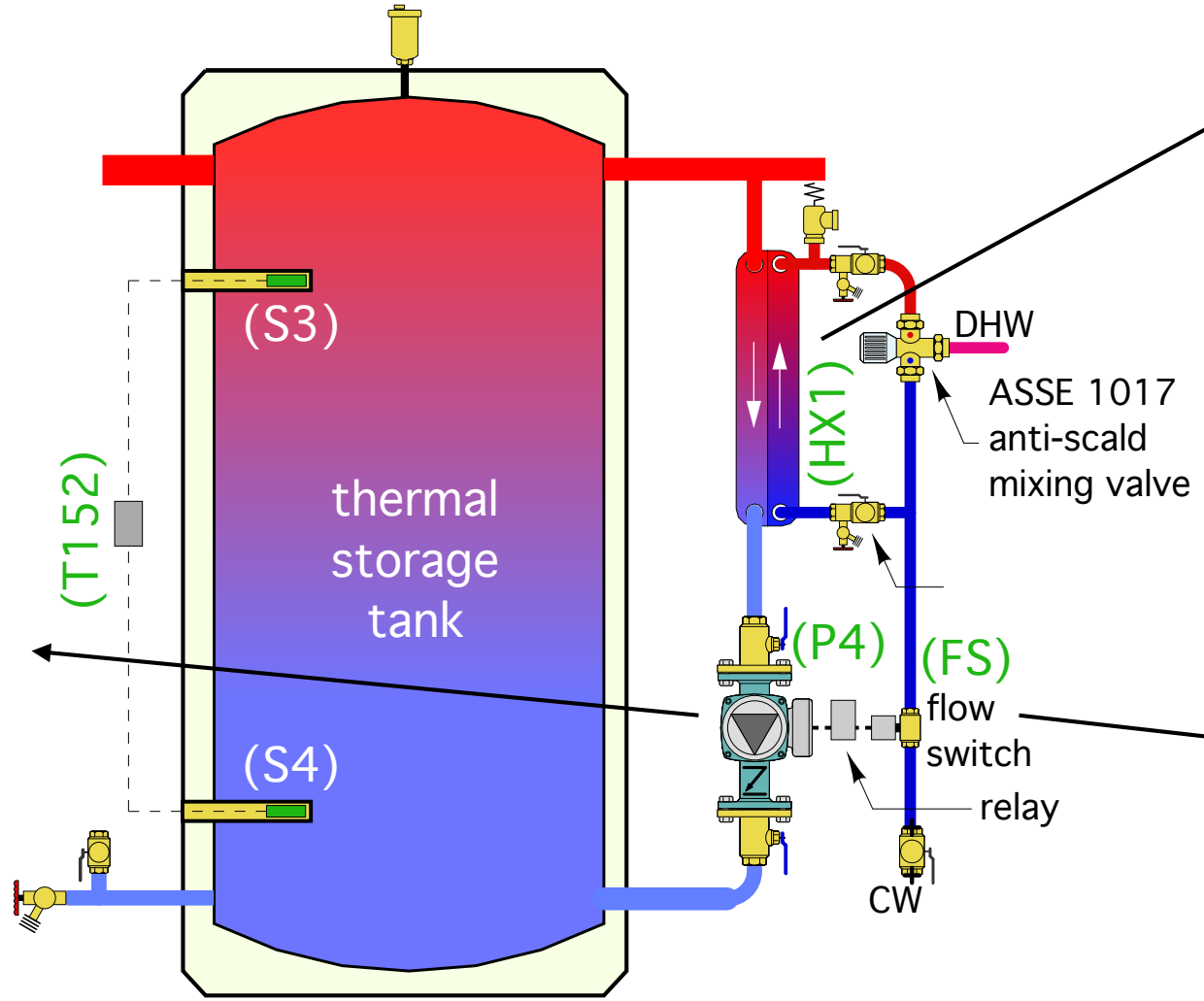
Supply water temperature regulated by a variable speed injection pump - operated by tekmar 356 controller - **allows for full outdoor reset control.**

Supply water temperature at design load conditions no higher than 120 ºF. Even lower if possible.



Domestic water heating subsystem:

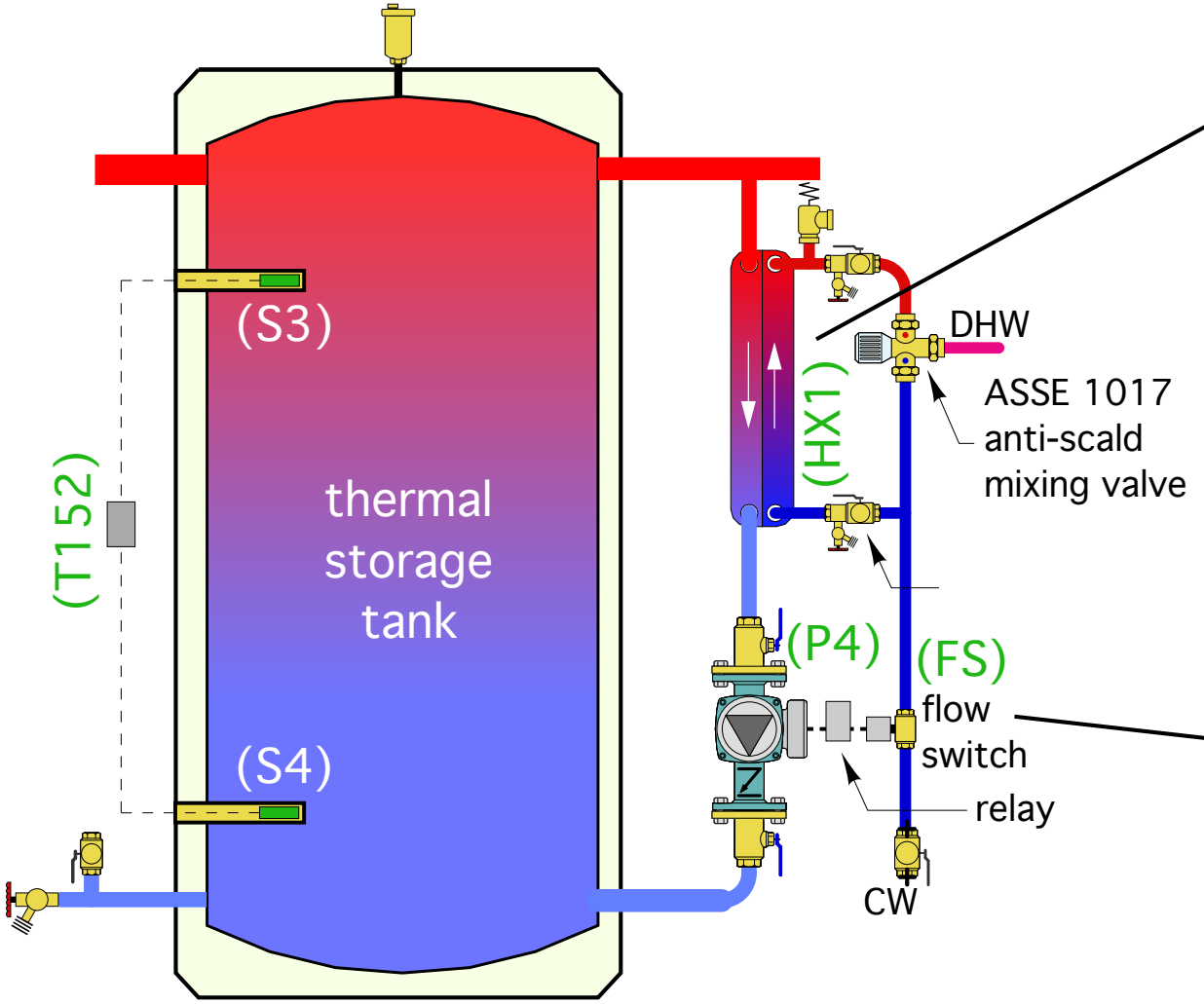
External brazed plate SS heat exchanger provides “on demand” domestic water heating using heat from thermal storage tank.



Domestic water heating subsystem:

Circulator between thermal storage tank and heat exchanger could even run continuously from - for example - 6AM to 11 PM

44 watt ECM circulator running 17 hour per day, using $0.13 electricity, costs about 10¢ per day

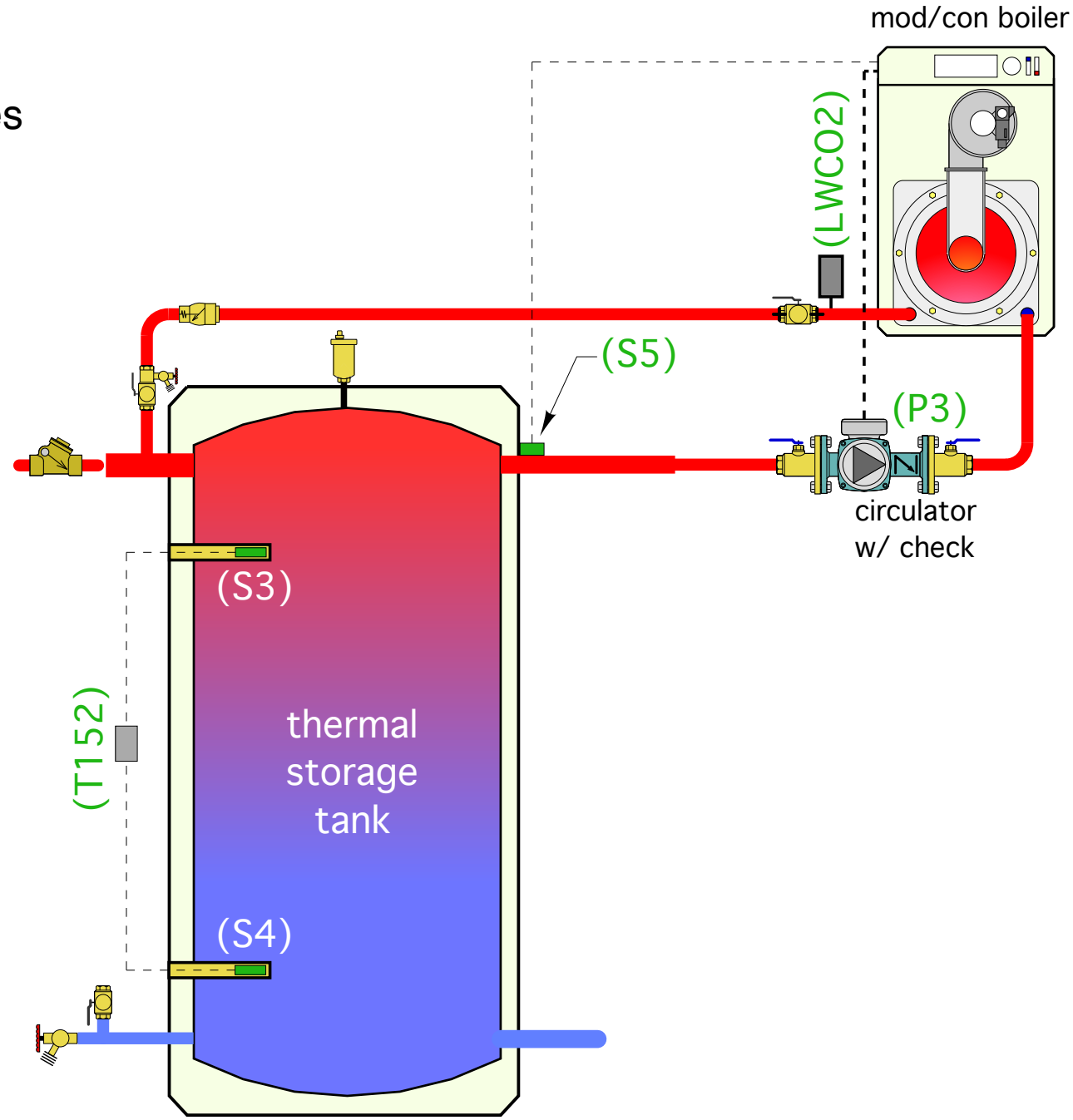


Auxiliary mod/con boiler subsystem:

Only heats upper portion of thermal storage tank -which serves as a buffer mass against a highly zoned distribution system.

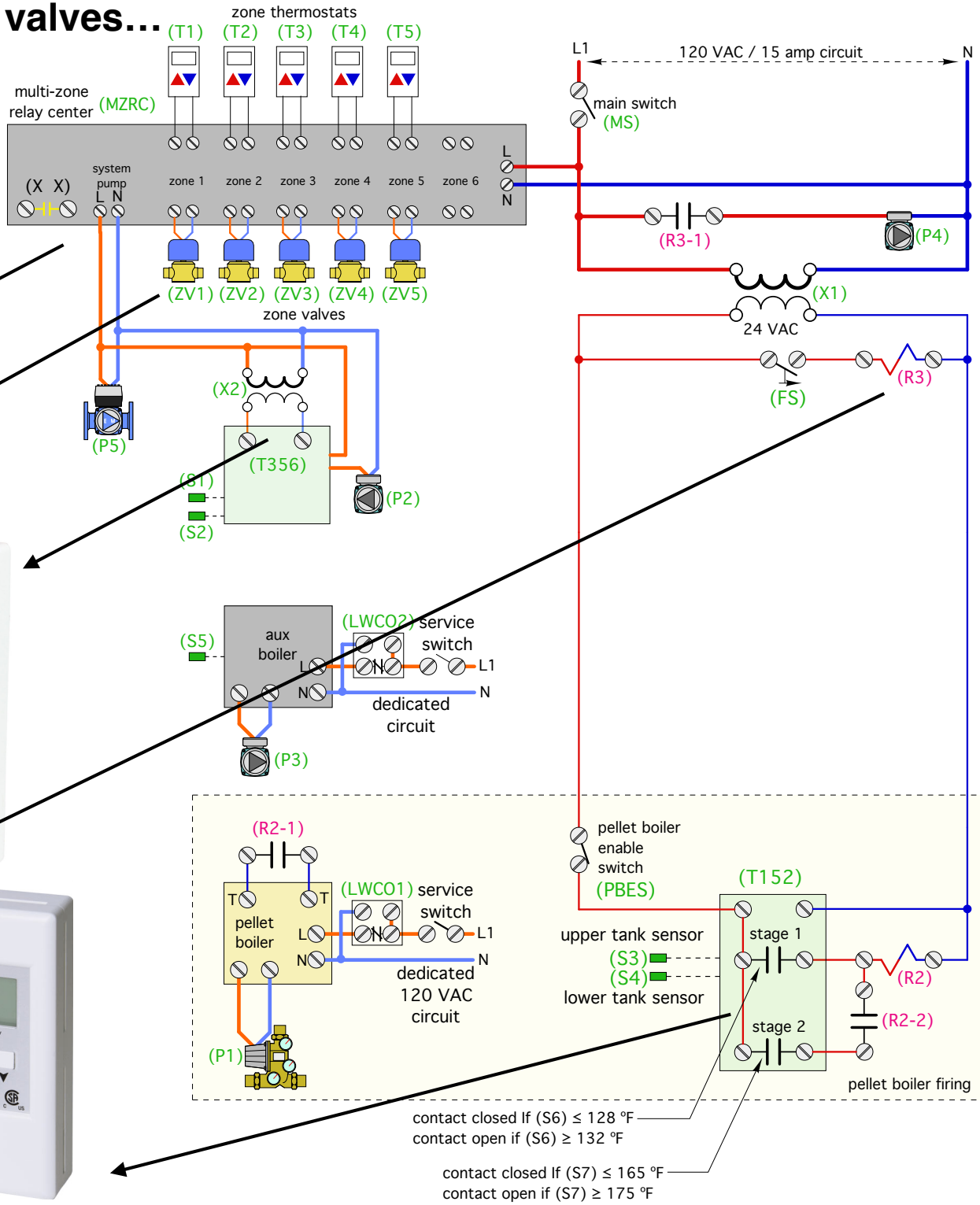
Can be used to heat domestic water in summer when pellet boiler is off.

Thermal mass of tank provides stability for domestic hot water supply.



Control wiring - assuming zone valves…

All “off-the-shelf” hardware



Control logic & possible settings

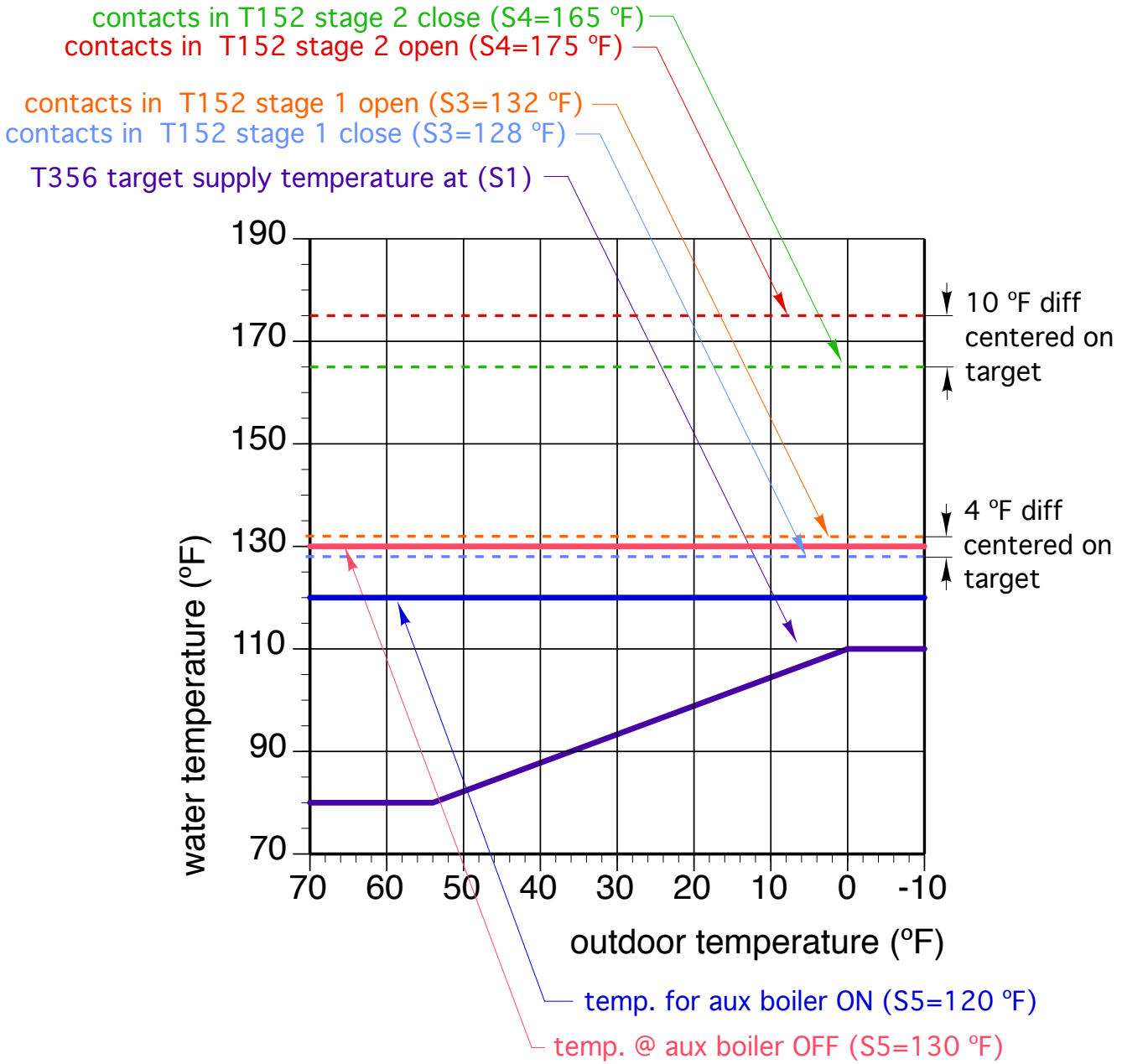
Pellet boiler and loading unit ON when upper tank sensor drops to or below 128 ºF

Pellet boiler and loading unit OFF when lower tank sensor increase to or above 175 ºF

Aux boiler ON when upper header temperature (S5) drops to or below 120 ºF

Aux boiler OFF when upper header temperature (S5) increases to or above 130 ºF

Distribution system operates on outdoor reset control with supply temperatures ranging from 80 to 110 ºF



This is the final RHNY webinar

There are PDF files of the past 22 webinars available for free downloading under the RHNY Training Opportunities section at:

https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY

Thank you for attending these trainings, both webinars and face-to-face, over the last several years…

We hope the information provided will better equip you to design and install high quality biomass heating systems

QUESTIONS?

Past Webinars and Trainings

September 9, 2021: Multiple pellet boiler systems. Presentation Slides [PDF]

July 1, 2021: Case study: A pellet boiler system for a highway garage. Presentation Slides [PDF]

June 17, 2021: Piping options for multiple thermal storage tanks. Presentation Slides [PDF]

April 22, 2021: Creating a summer / winter pellet boiler system. Presentation Slides [PDF]

March 18, 2021: Using external heat exchangers in biomass boiler systems with non-pressurized thermal storage. Presentation Slides [PDF]

February 18, 2021: Proper installation of temperature sensors in biomass boiler systems. Presentation Slides [PDF]

January 28, 2021: Why low temperature distribution systems improve biomass boiler performance. Presentation Slides [PDF]

November 12, 2020: Case study - Pellet boiler system for NYSDEC maintenance facility at Lake George. Presentation Slides [PDF]

October 29, 2020: Control concepts for hydronic systems using renewable energy heat sources (part 2). Presentation Slides [PDF]

September 17, 2020: Control concepts for hydronic systems using renewable energy heat sources (part 1). Presentation Slides [PDF]

August 20, 2020: Options for domestic water heating in biomass boiler systems. Presentation Slides [PDF]

April 16, 2020: Reducing Hydronic System Temperature for Improved Biomass Boiler Performance. Presentation Slides [PDF]

October 22, 2019: Introduction to the Fundamentals fo the Proper Commissioning Process. Presentation Slides [PDF]

May 14, 2019: Simplified Method for Controlling Heat Delivery From Biomass Boilers and Auxiliary Boilers. Presentation Slides [PDF]

March 7, 2019: Update on the Renewable Heat NY Program. Presentation Slides [PDF]

September 20, 2018: Situations to Avoid with Biomass Boilers. Presentation Slides [PDF]

May 10, 2018: Critical Measurements to Verify Operation of Biomass Boiler Systems. Presentation Slides [PDF]

February 20, 2018: Control Concepts for Cordwood Gasification and Pellet Boiler Systems. Presentation Slides [PDF]

November 16, 2017: Best practices for venting and chimneys on cordwood gasification and pellet boilers. Presentation Slides [PDF]

September 12, 2017: Integrating Thermal Storage with Biomass Boilers. Presentation Slides [PDF]

May 11, 2017: Replacing an outdoor wood furnace with a cordwood gasification boiler – design and installation considerations. Presentation Slides [PDF]