ICM Tools & Techniques

How to keep a US Naval Destroyer warm...

By George R. Carey

I have had a lot of opportunities over the years to see some very interesting heating systems. Some of the systems were in million dollar mansions; others were in beautiful old churches. Some were in old run-down apartment buildings and others even in modern manufacturing facilities.

And they ran the gambit from modern multi-temperature hot water systems to hybrid alternative energy sources to old decrepit steam systems that time had long forgotten. But the other day, I was asked to help out with a steam system that was a first for me! I was invited to look at a heating plant that was using four small steam boilers. Unfortunately, in a short period of time (like 4-6 months) three of the four boilers were out of commission.

What's so unusual about that? During the course of a heating season, you can probably ask any number of boiler manufacturers' salesmen and they will tell you they have come across a system with multiple steam boilers that has failed at least once during the heating season (if not more!)

But did I mention that these boilers were installed on a Fletcher class destroyer that currently is in dry dock at the Boston National Historic Park? The name of the destroyer is USS Cassin Young (DD-793) and was a ship of the US Navy named for Captain Cassin Young (1894-1942) who was awarded the Medal of Honor for his heroism at Pearl Harbor and later killed in the Naval Battle of Guadalcanal.

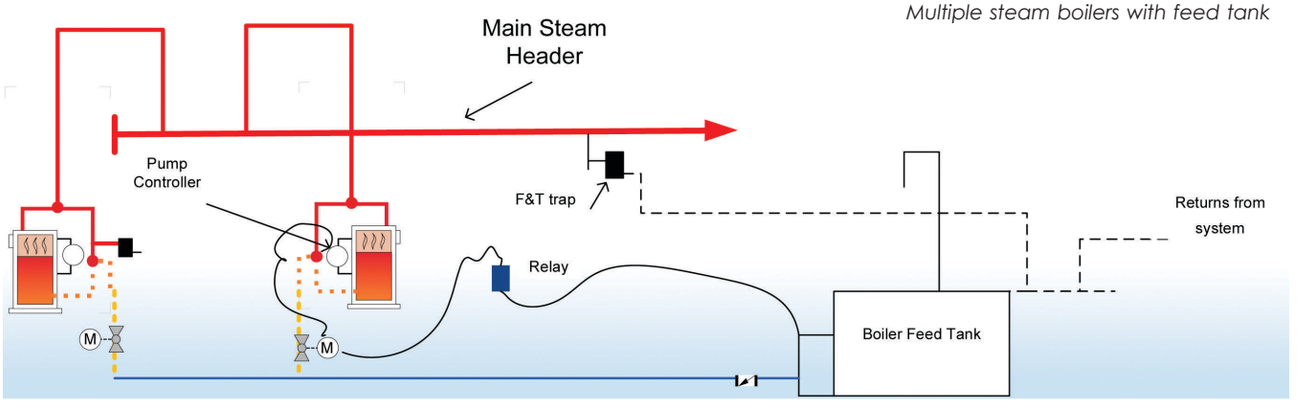
Cassin Young was launched September 12, 1943 by the Bethlehem Steel Corp. in San Pedro, California and commissioned on December 31, 1943. It is 376 feet long, 40 foot beam and displaces 2050 tons. It has five single five-inch/38 caliber guns, seven 10 x 20 mm Oerlikon cannons and six 10 x 40 mm Bofors AA guns as well as depth charges and torpedoes to make up its armament.

After serving in World War II, including the Battle of Leyte Gulf and the Battle of Okinawa, Cassin Young continued active service until 1960. She is preserved today as a memorial ship berthed at Boston Navy Yard across from the USS Constitution (Old Ironsides).

In doing a little research, I discovered there are only four remaining Fletcher class destroyers in the world preserved as these Museum ships. And here I was standing in the old "shower room converted to boiler room" of one of these. From what I was told by one of the Boston Historical National Park rangers, the Cassin Young was the last destroyer to be hit by a kamikaze plane in World War II in the Pacific Theater.

Back to the reason why I was there: four small oil fired steam boilers were installed and "designed" to provide steam to a main that was piped throughout the ship. Instead of standing radiation, the terminal units were several steam coils located in duct work and one big fan motor that moved the heated air

Multiple steam boilers with feed tank



throughout the ship. As I had mentioned, three of the four boilers failed within a very short time span and needed to be replaced right away. The ship, now in dry dock, has to be finished and placed back into the harbor at its berth for the upcoming tourist season. They need the heat to be back on and running reliably.

Unlike hot water applications with multiple boilers, steam applications can be VERY tricky, so you definitely do not want to take the same approach as you might with multiple water boilers.

The near-boiler piping in any steam application is critical, but especially so in a multiple steam boiler system. The best approach is to think of each boiler as if it were the only boiler in the system. Therefore each boiler should have a riser piped into its own header and equalizing line. The header collects all the steam and any water that has come out of the boiler through its riser(s). The steam, which is "lighter", will flow along the top of the header and enter into the vertical tee which leads to a common supply header; the heavier "wet" molecules are carried along the bottom portion of the header and into the equalizing line back to the boiler.

When piped this way, with the proper pipe sizes recommended by the manufacturer, each boiler will do a good job of delivering dry steam to the common supply header. If you pipe each boiler's riser into the common header without the benefit of its own header and equalizing line, you'll create wet steam, water hammer, water line problems with each boiler and a very unhappy customer who has to push the reset button on each of the boiler's manual reset low water cut-off control and who will wonder why they paid you all this money for their boiler plant that doesn't work!

It is very difficult to return condensate to a multiple boiler system without the use of a boiler feed pumping system. Each boiler is under different pressures even though they are all piped to a common header. That's because steam is dynamic, and is always moving, condensing and dropping in pressure. But some people, confusing steam with other gases like air and propane gas, believe that after you fill the system and pressurize it, the pressure will be the same throughout. It can't, so multiple boiler systems should employ a boiler feed system, including a pump controller installed on each boiler.

Once you decide on a boiler feed system, DON'T try to pipe one pump controller (such as a McDonnell & Miller 150MD) onto a common equalizing line. The reason: the pump controller doesn't know the level of the water in each boiler, only the level where it is actually located. Besides, when the pump moves water, where does the water want to go? Naturally, the water takes the path of least resistance, so it enters the boiler with the lowest pressure. But this is typically the "off" boiler, which doesn't need any water and subsequently, the "on" boiler, which has the greatest demand for water, gets little or no water.

The "on" boiler will then shut off on low water, and as the steam condenses, the boilers will equalize. This raises the water line in ALL the boilers, reducing the steam separating chamber within each boiler, and affecting the quality of steam being supplied to the system.

The best way to return condensate in a multiple boiler system is for each boiler to have its own pump controller piped onto each boiler. Each controller is wired back to either its own feed pump or its own motorized feed valve. If motorized valves are used, once the valve opens, its end switch makes contact, activating a common feed pump. Now the water can only enter the boiler that really needs more water. This maintains the proper water line in each boiler, improving the quality of steam and the efficiency of your multiple boiler system.

Finally, when each boiler is piped into a common header, there will be times when one or more will be "off" because of a light load on the system. Unfortunately, the steam doesn't know where it is supposed to go, so some of it enters the "off" boilers and condenses. Condensate accumulates and floods the "off" boilers. The easiest and most cost effective method for addressing this situation is to pipe "overflow" traps (usually ¾" F&T traps) into each boiler's equalizing line a couple of inches above the operating water level. Then, when the condensate starts to build up in an "off" boiler, it enters into the trap and drains into the boiler feed receiver.

Whenever you are faced with using multiple steam boilers to heat a building—or a Navy Destroyer—you have to "dot your i's and cross your t's" to make sure that new boiler plant will perform as advertised!

If you have any questions or comments, e-mail me at gcarey@fiainc.com or call me at FIA. 1-800-423-7187