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Installation, Operation and Maintenance of Central Boiler Plants

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CHAPTER 1
GENERAL CONSIDERATIONS

SECTION I. INTRODUCTION

1-1. PURPOSE

The purpose of this course is to provide information and guidance on the installation, operation, and maintenance of Central Boiler Plant equipment. Efficient plant operation becomes more important with each increase in the cost of fuel and equipment. The Central Plant operator has an important job in achieving and maintaining maximum efficiency of plant operation. The information and guidance in this course should be reviewed as a first step toward achieving efficient plant operation.

1-2. CENTRAL BOILER PLANTS

The primary purpose of a Central Boiler Plant is to economically produce energy for distribution. This energy may be in the form of steam, hot water, or occasionally, compressed air or electric power. A distribution system is necessary to carry this energy to buildings, hospitals, kitchens, and laundries where it is used for heating, cooling, process, sterilization, and production of domestic hot water. Condensate or hot water is returned to the Central Boiler Plant where it is reheated in a boiler and returned to the distribution system for recycle.

a. 1ypes of Central Boiler Plants. Energy for heating or process use is generally produced in one of five forms:

Low Temperature Water	LTW (up to 250° F, less than 160 psig)
Medium Temperature Water	MTW (251° F, to 350° F)
High Temperature Water	BTW (351°F to 450° F)
Low Pressure Steam	LPS (up to 15 psig)
High Pressure Steam	BPS (above 15 psig)

The type of Central Boiler Plant built depends upon the requirements of the specific installation. For applications involving only space heating and domestic water, a low temperature water plant is generally sufficient. If steam is required for large process loads or electric generation, a steam plant must be constructed. For most other installations, an economic evaluation must be performed to compare the costs of a high temperature water system to those of a steam system. Such evaluation usually shows the high temperature water plant to be more economical. The following paragraphs provide a brief comparison of the major types of central heating plant systems.

b. Comparison of High Temperature Water and Steam. The major advantages of high and medium temperature water systems result from the closed-loop distribution system. The closed loop system recycles the unused energy in the water and results in very small system water losses. By comparison, steam distribution systems include condensate return systems with potentially significant energy and water losses due to steam flashing, defective traps, defective pressure reducing valves, pipe leaks, and unreturned process steam. The advantages of high and medium temperature water systems are further discussed in the following paragraphs.

(I) **Energy Losses from a Steam System.** Figures 1-1 and 1-2 illustrate the heat balance at a heat exchanger for 100 psig and 15 psig steam/condensate system, respectively. When 100 psig steam is supplied to a heat exchanger, the condensed water is at a temperature of 338° F and contains 26 percent of the energy originally supplied in the steam. When the condensate discharges from the trap, 13 percent of the water flashes to steam and the remaining condensate is at a temperature of 212° E When 15 psig steam is supplied, the condensed water contains 19 percent of the original energy at a temperature of 250° E When the condensate discharges from the trap, 4 percent of the water flashes to steam. The energy losses and makeup water requirements of the low-pressure system are thus lower, making the low-pressure system preferable if a steam system is used.

•**Pressure Reducing Valves and** Vent **Condensers.** The pressure reducing valve supplies the heat exchanger with low pressure steam, thus minimizing flash-losses. If a vent condenser is not supplied, the flash-off steam is lost. *H* a portion of the condensate is not returned to the central boiler plant for any reason, the portion of the energy remaining in the condensate is lost. For **example,** if a **100-psig** system has 20 percent condensate loss, 5.2 percent (.20 x .26 = .052) of the total energy produced is wasted. In addition, 20 percent treated make-up water is needed to keep the system operating. Procedures for monitoring and controlling condensate losses are further discussed in paragraph 3-2.

(2) **Heat Balance for a BTW** System. Figure 1-3 illustrates a heat balance for a high temperature water system at a heat exchanger. It is informative to compare the high temperature water system with 100 psig steam system. In both cases, 1125 lbs of water is heated from 50° F to 140° F by the heat exchanger. The high temperature

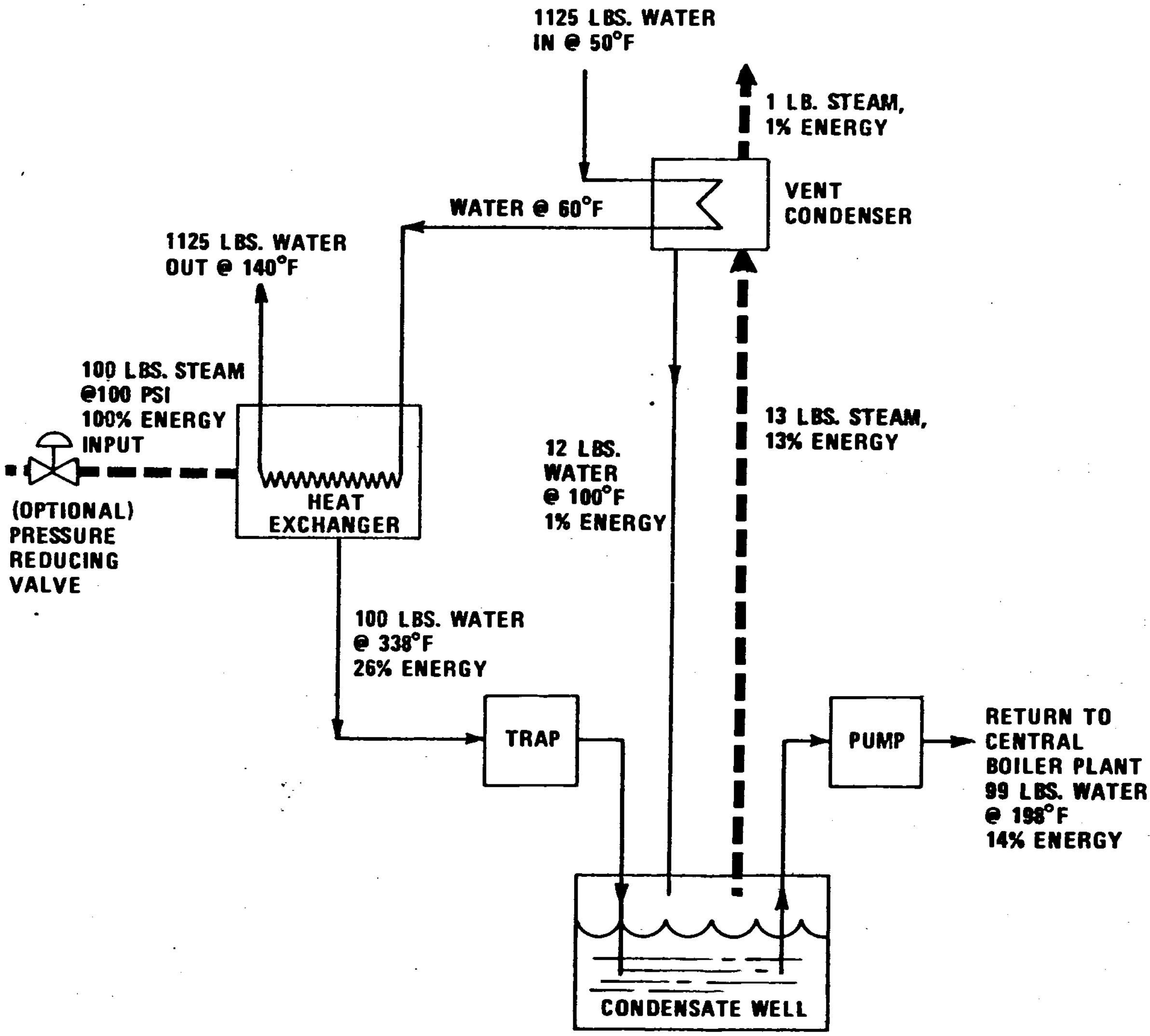

FIGURE 1–1. 100 PSI STEAM HEAT BALANCE

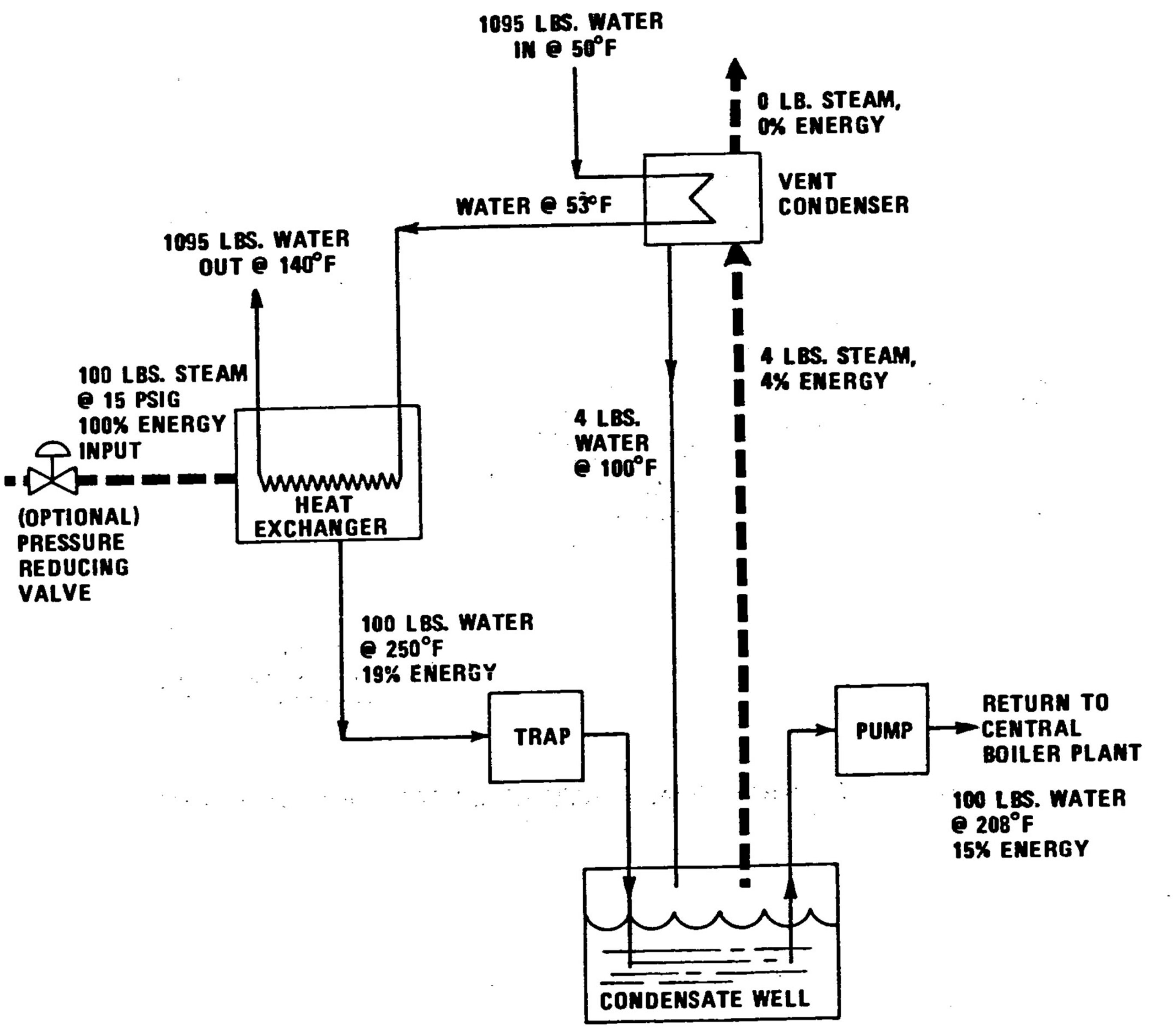

FIGURE 1–2. 15 PSI STEAM HEAT BALANCE

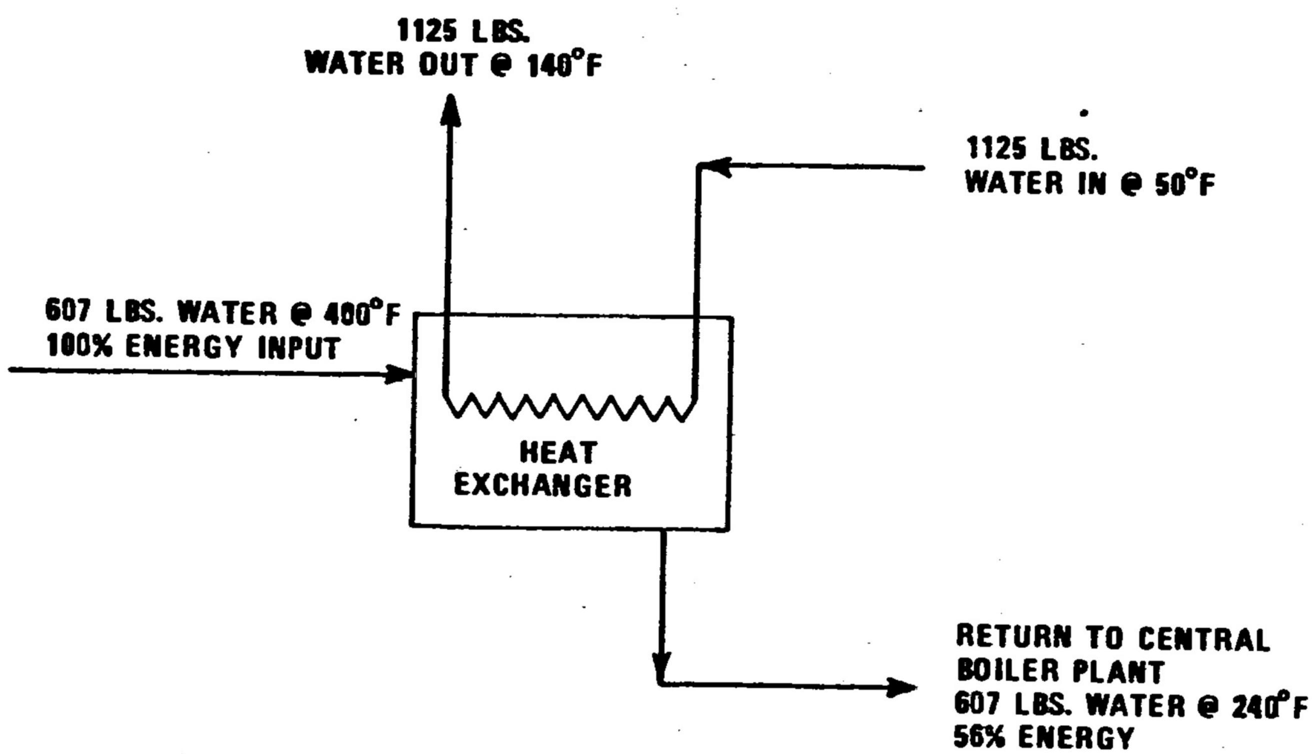

FIGURE 1–3. HIGH TEMPERATURE WATER HEAT BALANCE