Duke | Facilities Management
Utilities & Engineering Services

Steam Heating System

DU-101-PP

STEAM HEATING SYSTEM

Purpose

- The purpose of the Operations and Maintenance Training Program is to train Operations and Maintenance Technicians in the operation of the Duke University Chiller and Steam Systems

Objectives

- Trainees will demonstrate knowledge of
  - Steam Heating System Components
  - Steam Heating System Components Operation
  - Steam Heating System Configuration
  - Steam Heating System Controls and Instrumentation

OVERVIEW

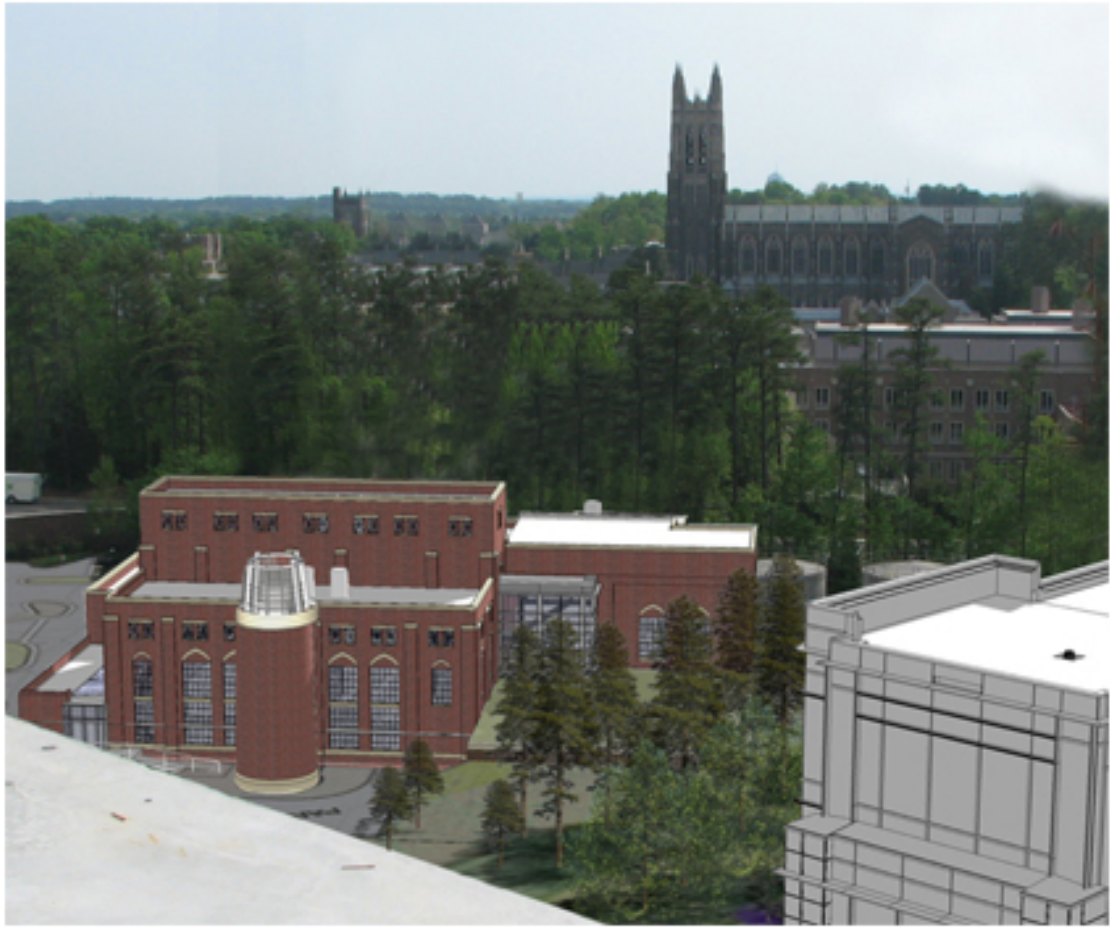
- East Campus and West Campus Steam Plants supply high pressure steam to heat Campus and Medical Center facilities
- Steam is delivered through the Underground Steam and Condensate Distribution System
  - Steam piping is routed through tunnels and manholes (steam vaults)
  - Drip leg stations remove condensate from the steam
  - Strainers remove dirt and particulates from condensate
  - Steam traps remove air and CO_2 from condensate
- In each building a Pressure Reduction Valve (PRV) Station reduces steam pressure to meet requirements of the building heating system

- **COMPONENTS**
- High Pressure Steam Headers
- Underground Steam and Condensate Delivery System
  - Utility Tunnels
  - Steam Vaults
  - Drip Leg Stations
  - Steam Traps
  - Steam Pit Entries
- Medium Pressure and Low Pressure Systems
  - PRV Stations

STEAM HEATING SYSTEM

- **HIGH PRESURE STEAM HEADERS**
- Located
  - West Campus Steam Plant
  - East Campus Steam Plant
- Regulate steam from online boilers for underground steam distribution

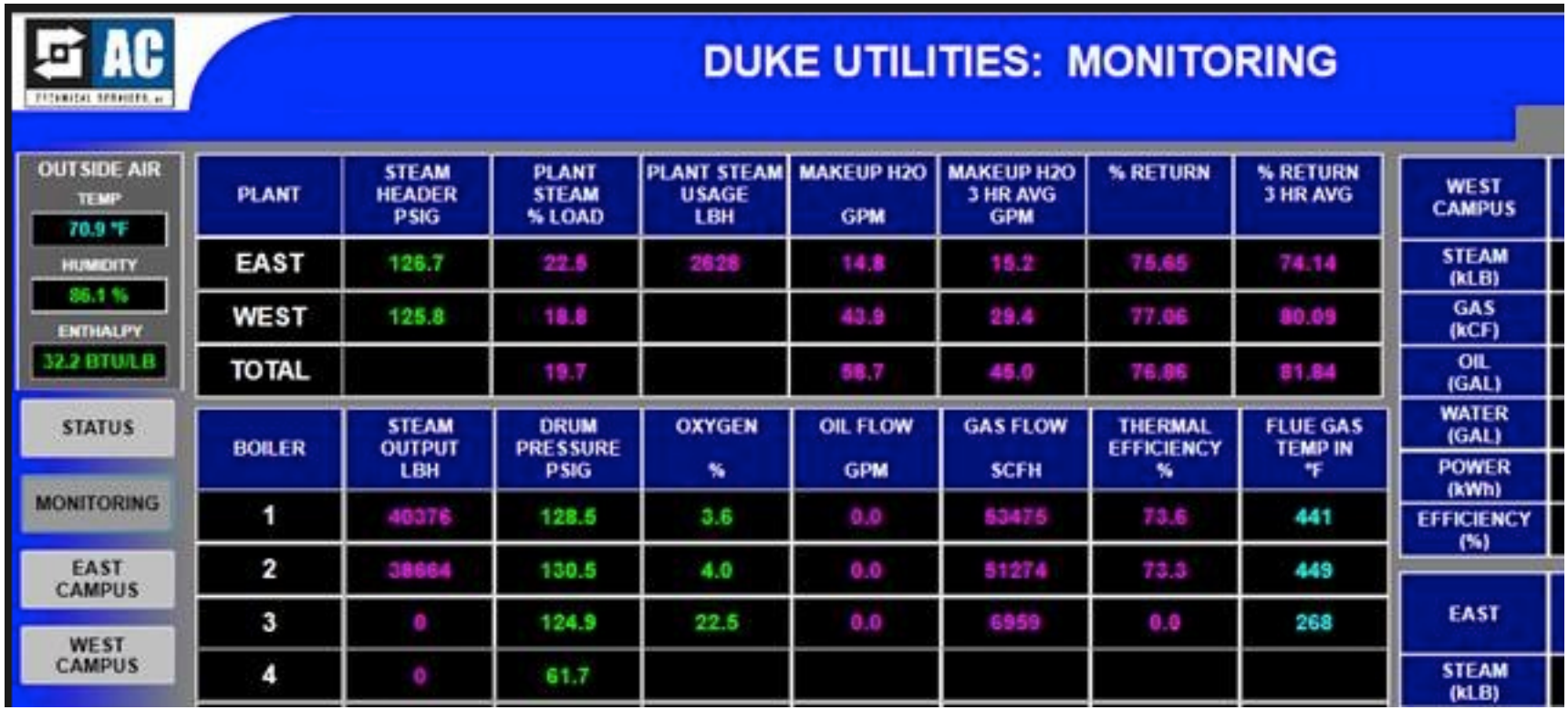
✦ WEST CAMPUS STEAM PLANT



✦ EAST CAMPUS STEAM PLANT

- **HIGH PRESSURE STEAM HEADER**
- HPS Header receives steam from all online boilers

- **HIGH PRESSURE STEAM HEADER**
- Sensors at the HPS Header send data on the steam to the Control Room



- **QUESTION**
- Where are HPS Headers located?
  - East Campus and West Campus Steam Plants
  - All steam and chiller plants
  - Campus and Medical Center buildings
  - Chiller Plants 1 and 2

STEAM HEATING SYSTEM Q&A

- **Answer**
- East Campus and West Campus Steam Plants

- **QUESTION**
- What is the nominal pressure of steam leaving the HPS Header?
  - 75 psig
  - Less than 16 psig
  - 125 psig
  - 170 psig

STEAM HEATING SYSTEM Q&A

- **ANSWER**
- 125 psig

- **QUESTION**
- Which boilers in a Steam Plant supply the High Pressure Steam Header?
  - All boilers all the time
  - Each boiler has its own HPS Header
  - All boilers that are on line

STEAM HEATING SYSTEM Q&A

- **ANSWER**
- 125 psig

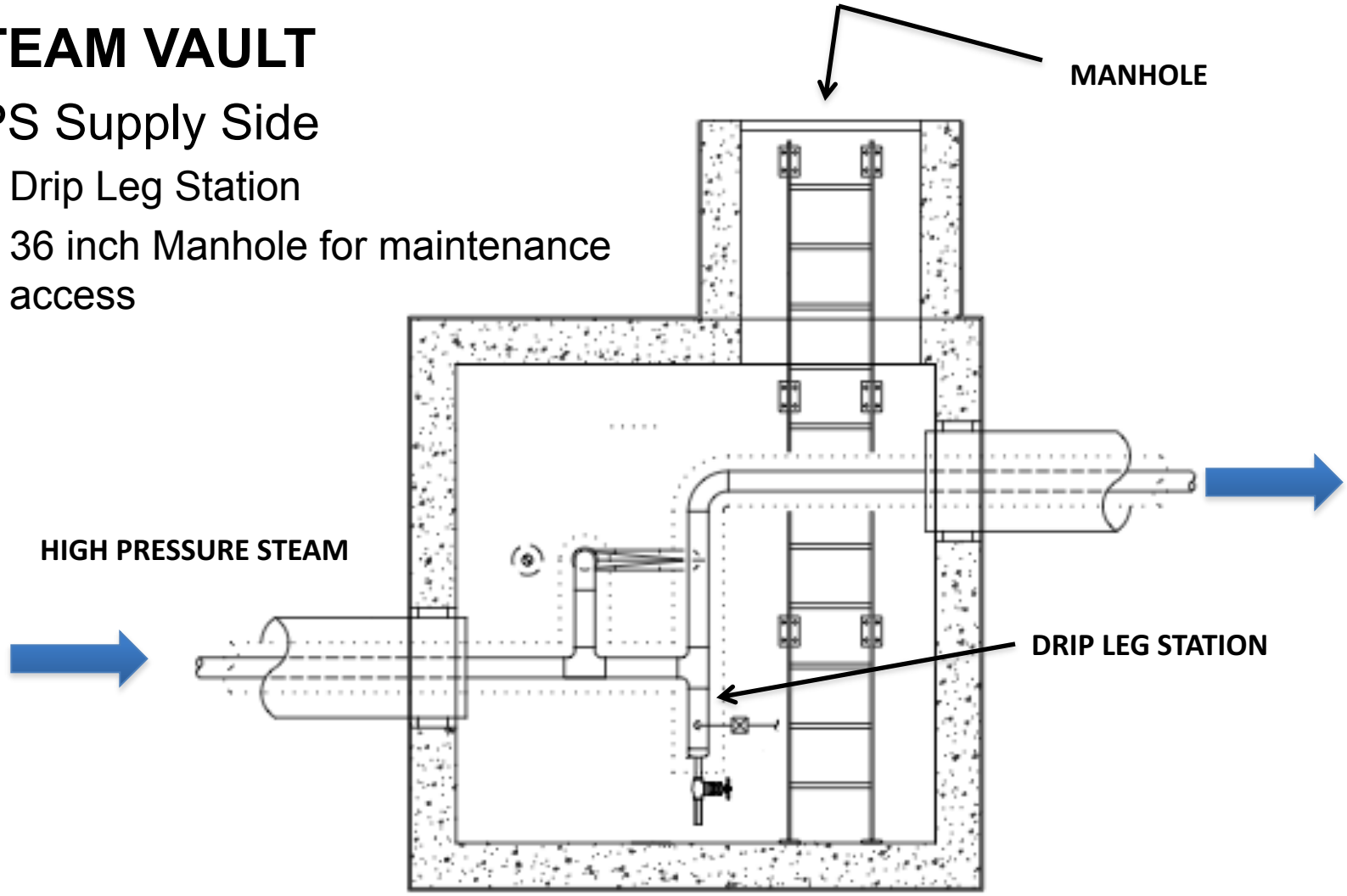
- STEAM VAULT
- Steam vaults are underground maintenance

STEAM HEATING SYSTEM COMPONENTS

- **STEAM VAULT**
- HPS Supply
  - 36 inch Manhole provides access for maintenance
  - Drip Leg Station drains condensate and cleans steam
- Condensate Return
  - 24 inch Manhole provides access for maintenance of condensate return piping
  - Sump and pump provide return of condensate drained from the supply steam
- Junction
  - HPS supply and condensate return from various lines can come together in a steam vault

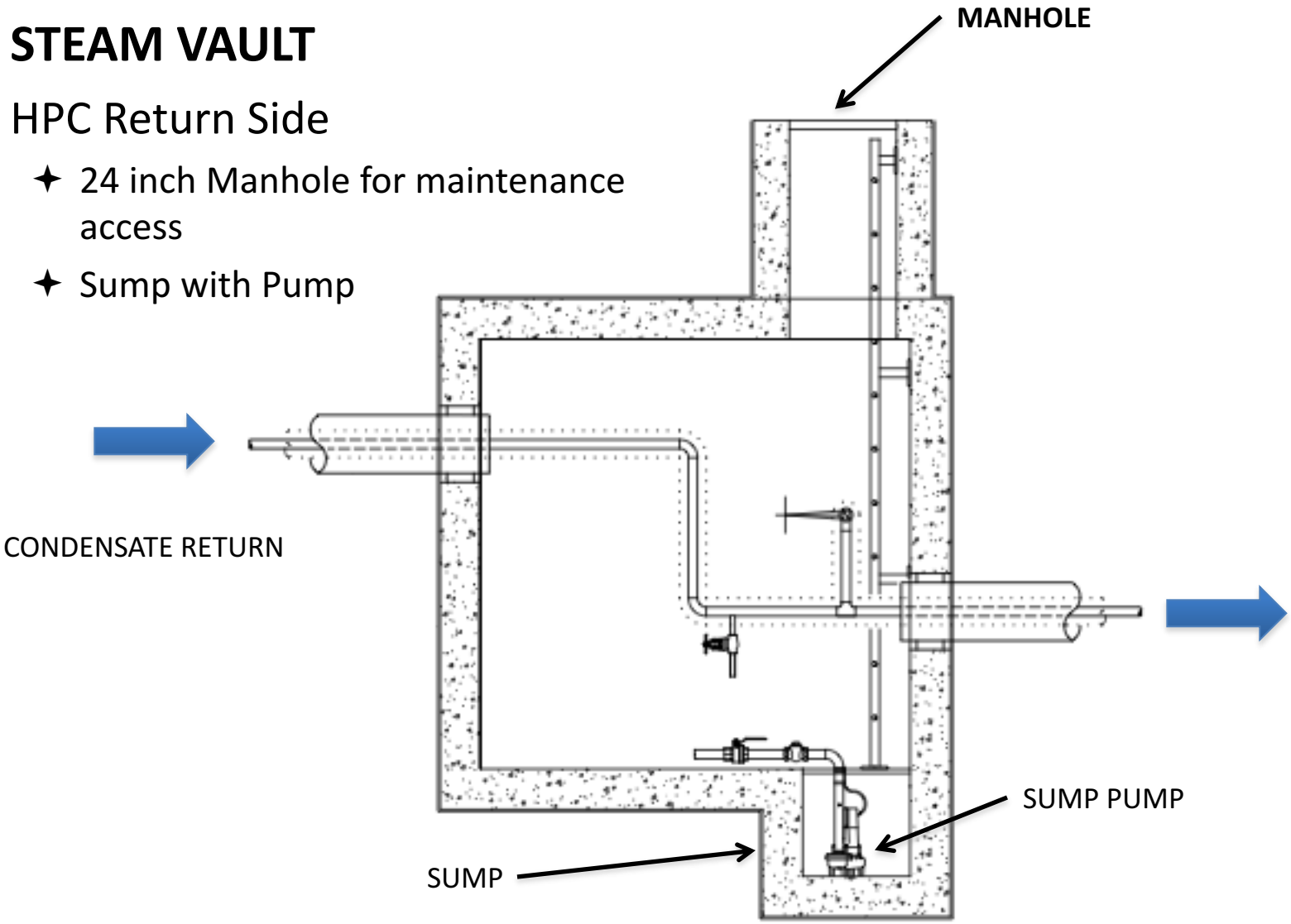
STEAM HEATING STATION

- **STEAM VAULT**
- HPS Supply Side
  - Drip Leg Station
  - 36 inch Manhole for maintenance access



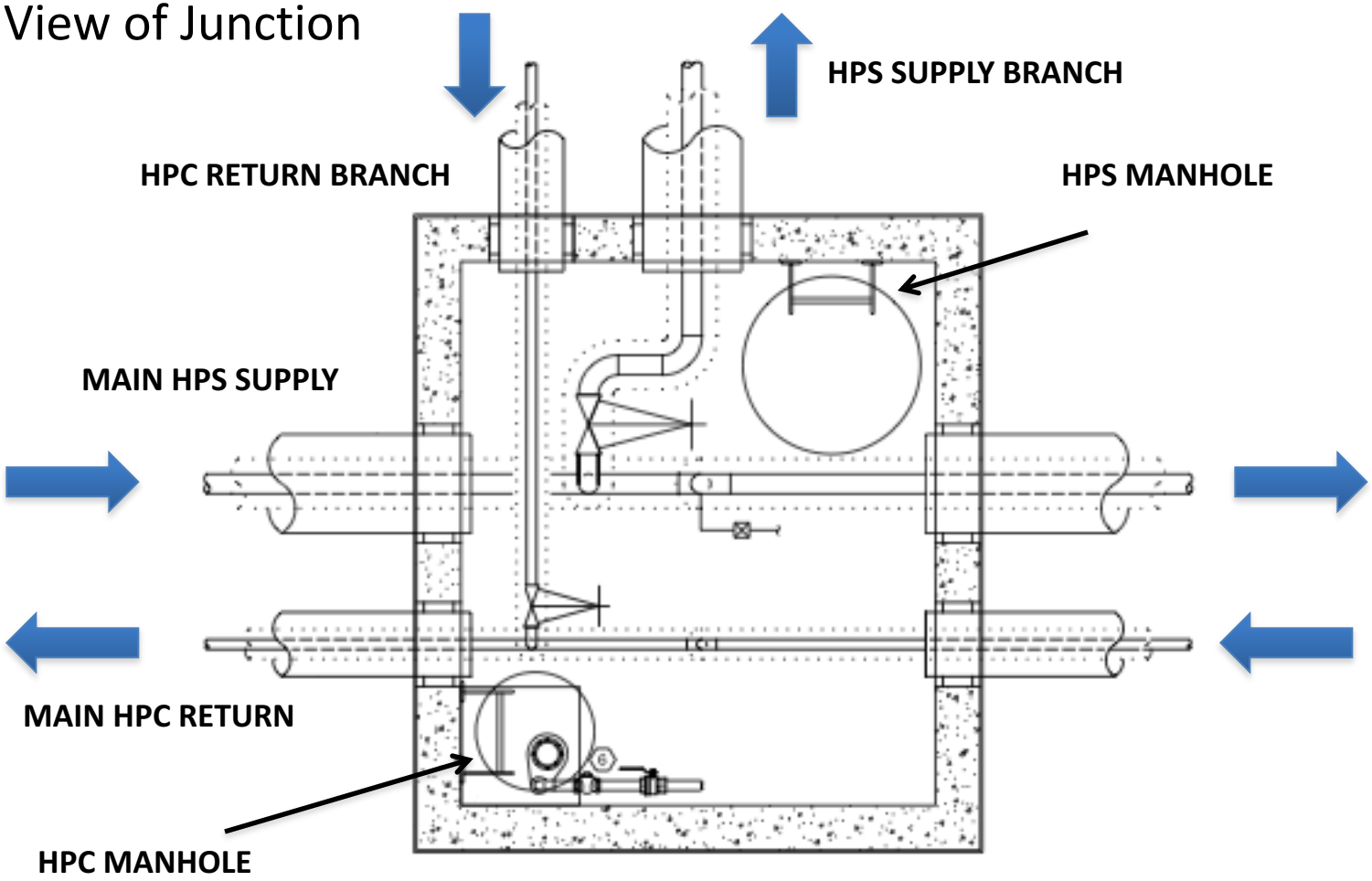
STEAM VAULT

- HPC Return Side
  - 24 inch Manhole for maintenance access
  - Sump with Pump

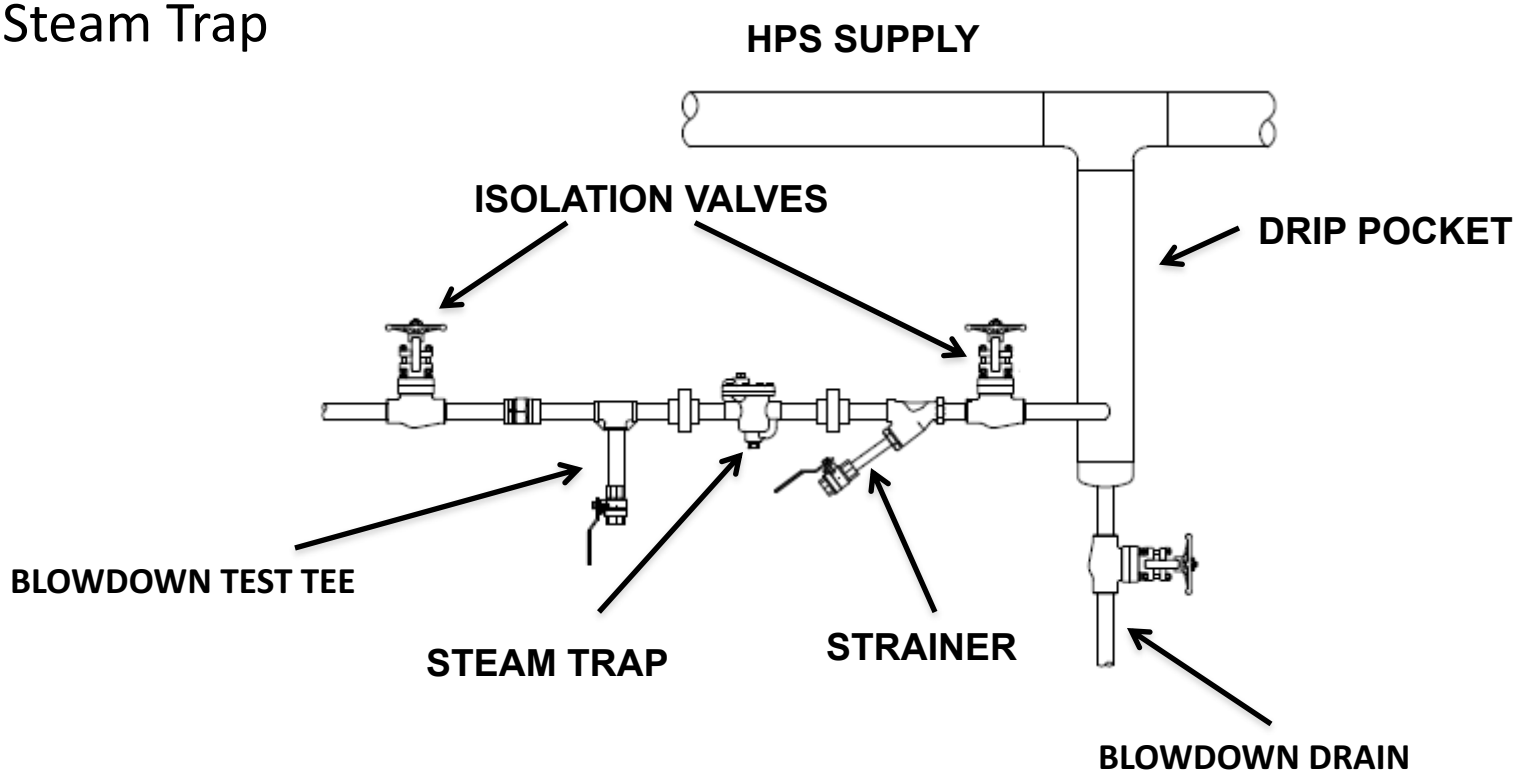


STEAM HEATING SYSTEM COMPONENTS

- **STEAM VAULT**
- Top View of Junction

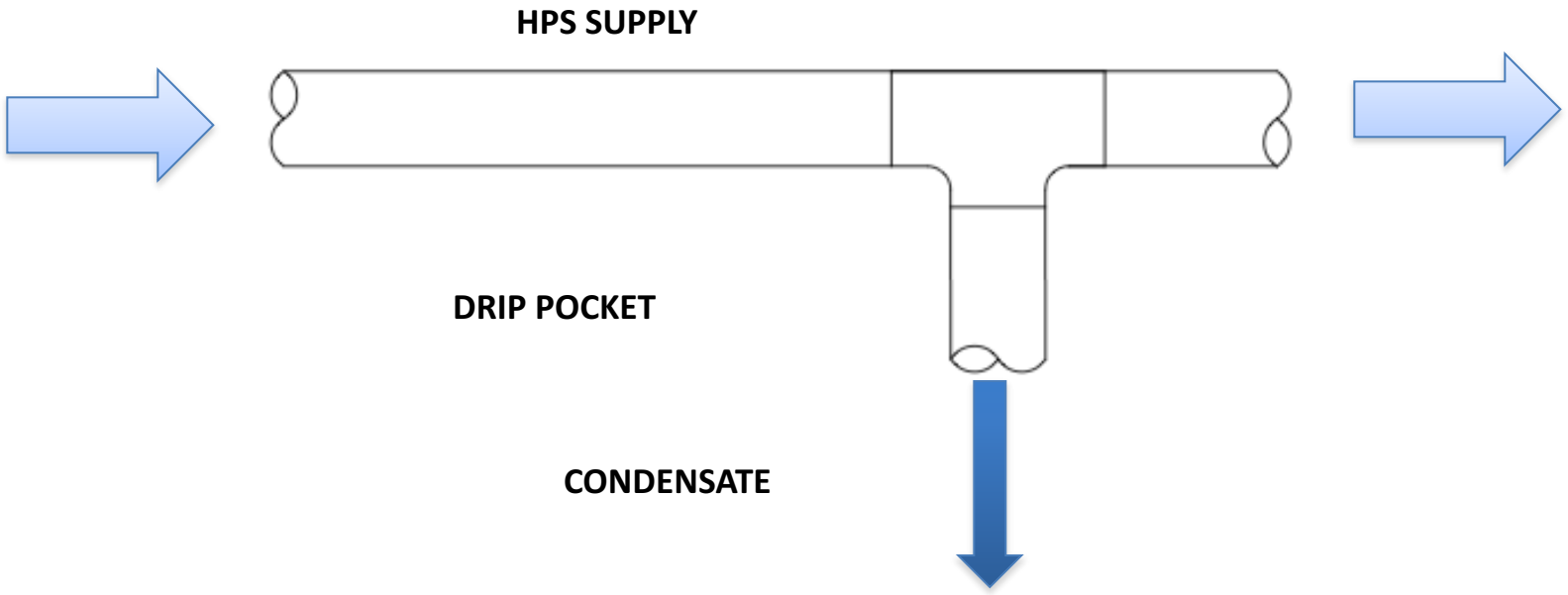


- **STEAM VAULT DRIP LEG STATION**
- Drip Pocket
- Strainer
- Steam Trap



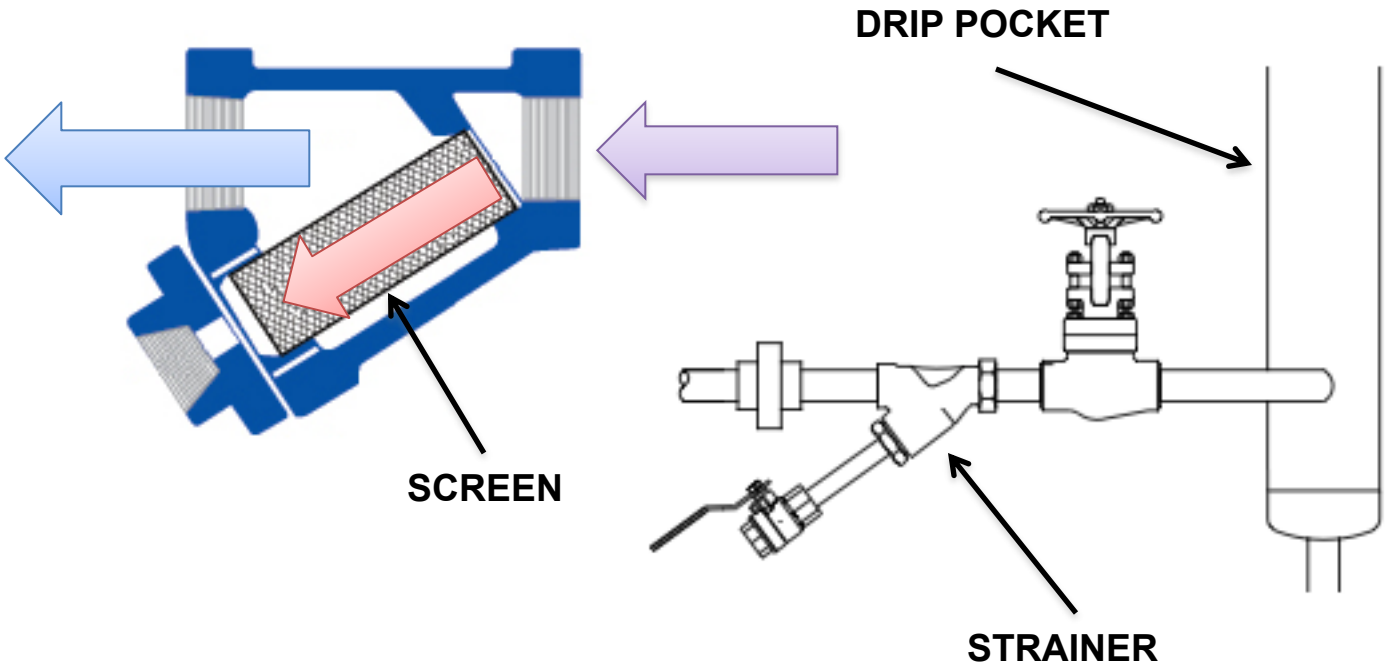
✦ STEAM VAULT DRIP LEG STATION

- ✦ Drip Pocket
  - Condensate forming as steam cools can cause water hammer, erosion of pipe, and pipe and equipment failure
  - Condensate drops out of the stream as steam passes over the drip pocket.



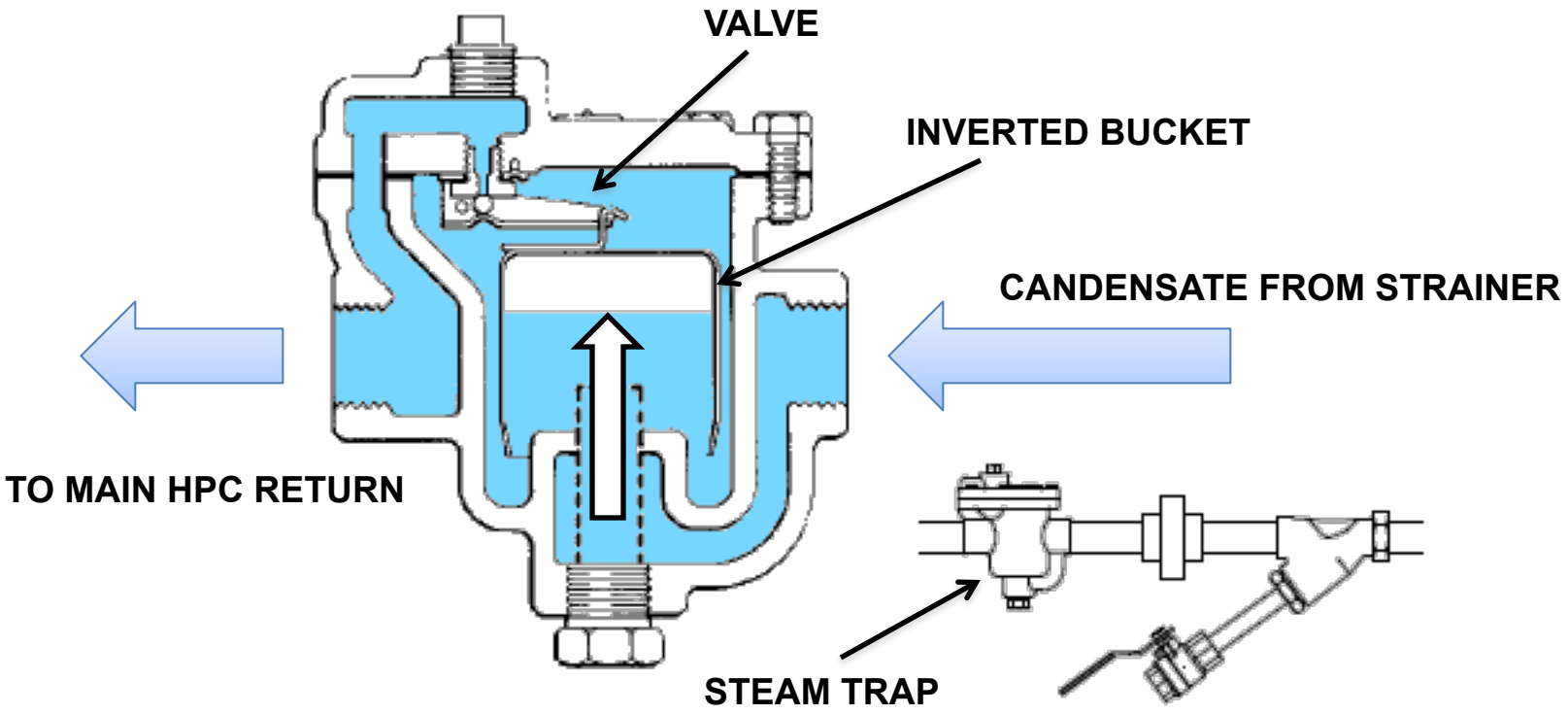
STEAM VAULT DRIP LEG STATION

- Strainer
  - Condensate from the drip pocket passes through the strainer
  - Fine mesh screen collects dirt and particulates



STEAM VAULT DRIP LEG STATION

- Stream Trap
  - Air and CO_2 separate from the condensate and collect in the inverted bucket
  - When the inverted bucket becomes buoyant, it rises, triggers the valve above the bucket, and the gases vent out the top of the Steam Trap

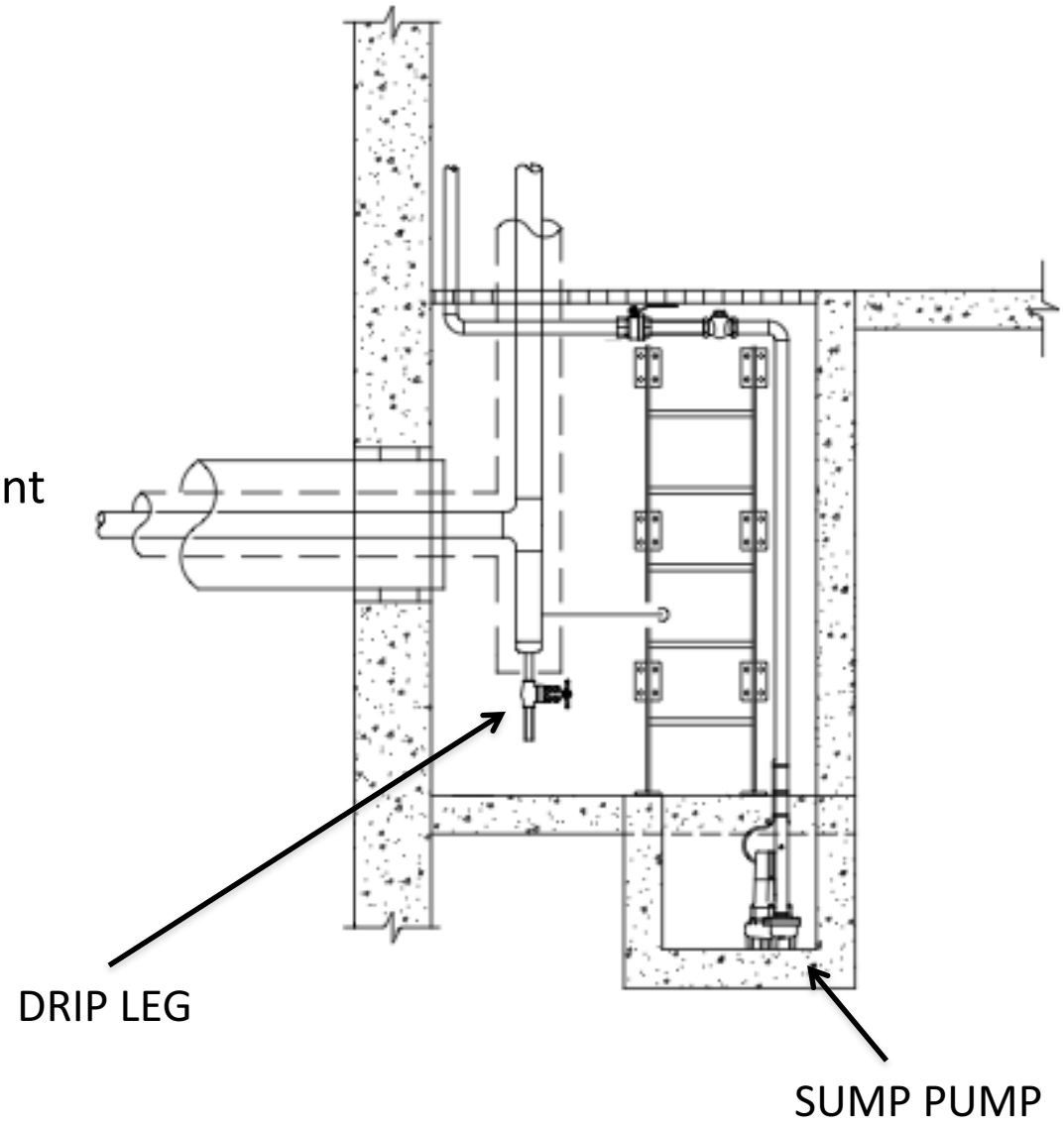


STEAM HEATING PLANT

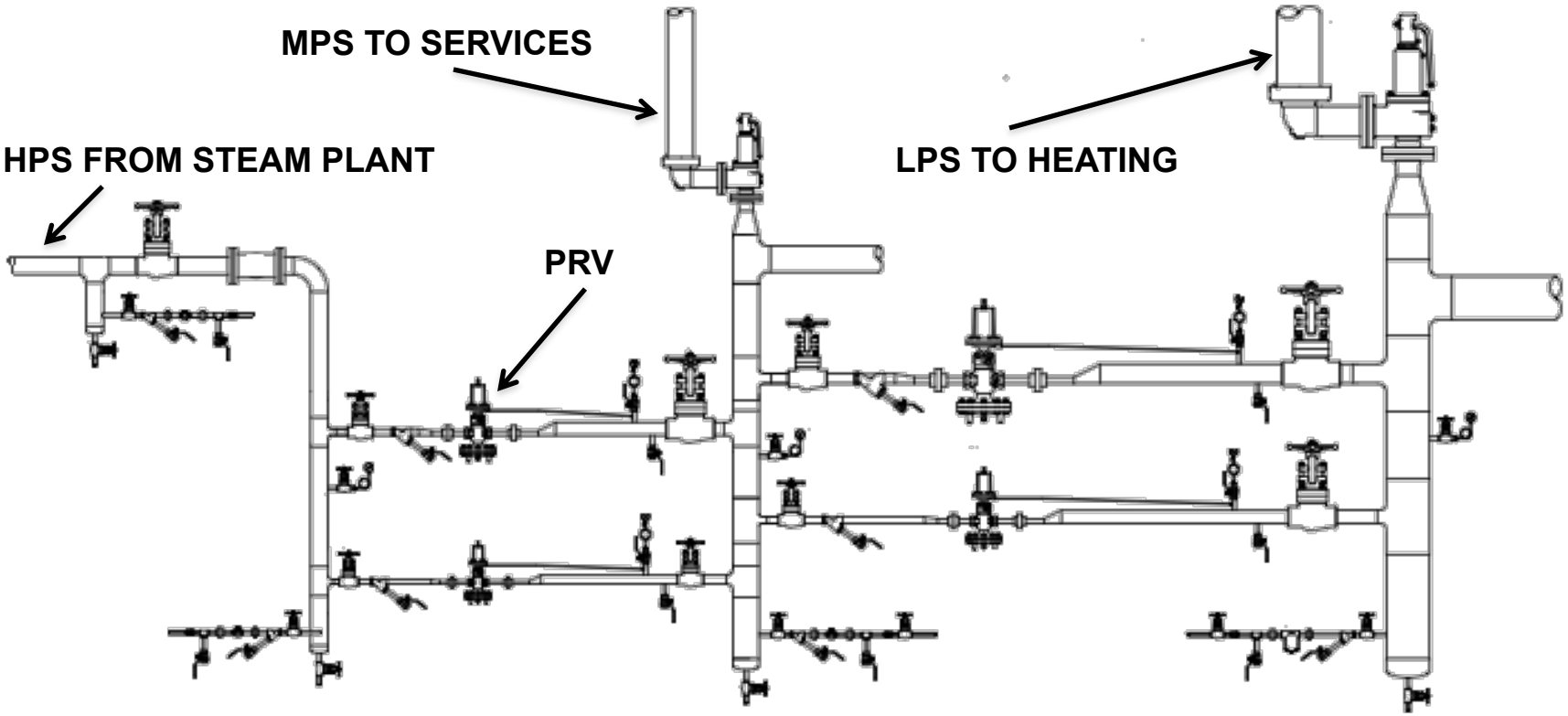
- QUESTION

Steam Heating System Components

- **STEAM PIT ENTRY**
- Entry point for Buildings
- Maintenance Access
- Drip Leg removes condensate
- Sump Pump returns condensate to Steam Plant

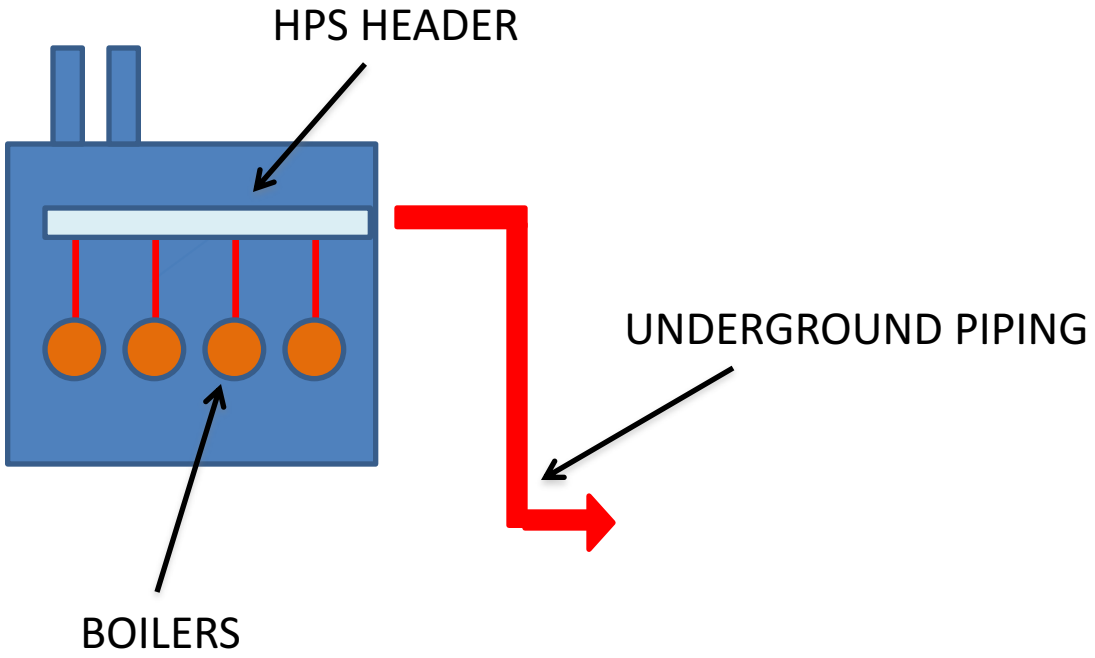


- **PRV Station**
- Reduce pressure for buildings in two stages
  - Low Pressure Steam (LPS) for heating
  - Medium Pressure Steam (MPS) for services



HPS HEADERS, EAST AND WEST STEAM PLANTS

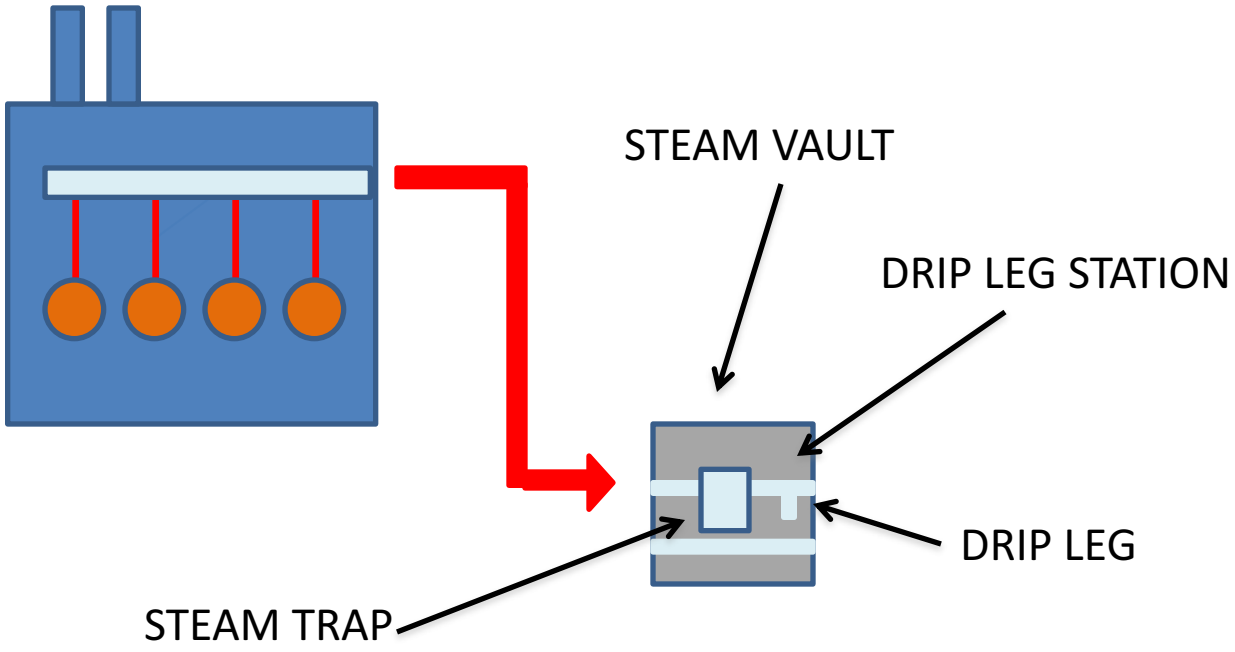
- Steam from boilers is regulated in HPS Header
- Header supplies HPS to Underground Steam and Condensate System
- Steam pressure exiting plant is 125 psig



STEAM HEATING SYSTEM PROCESS FLOW

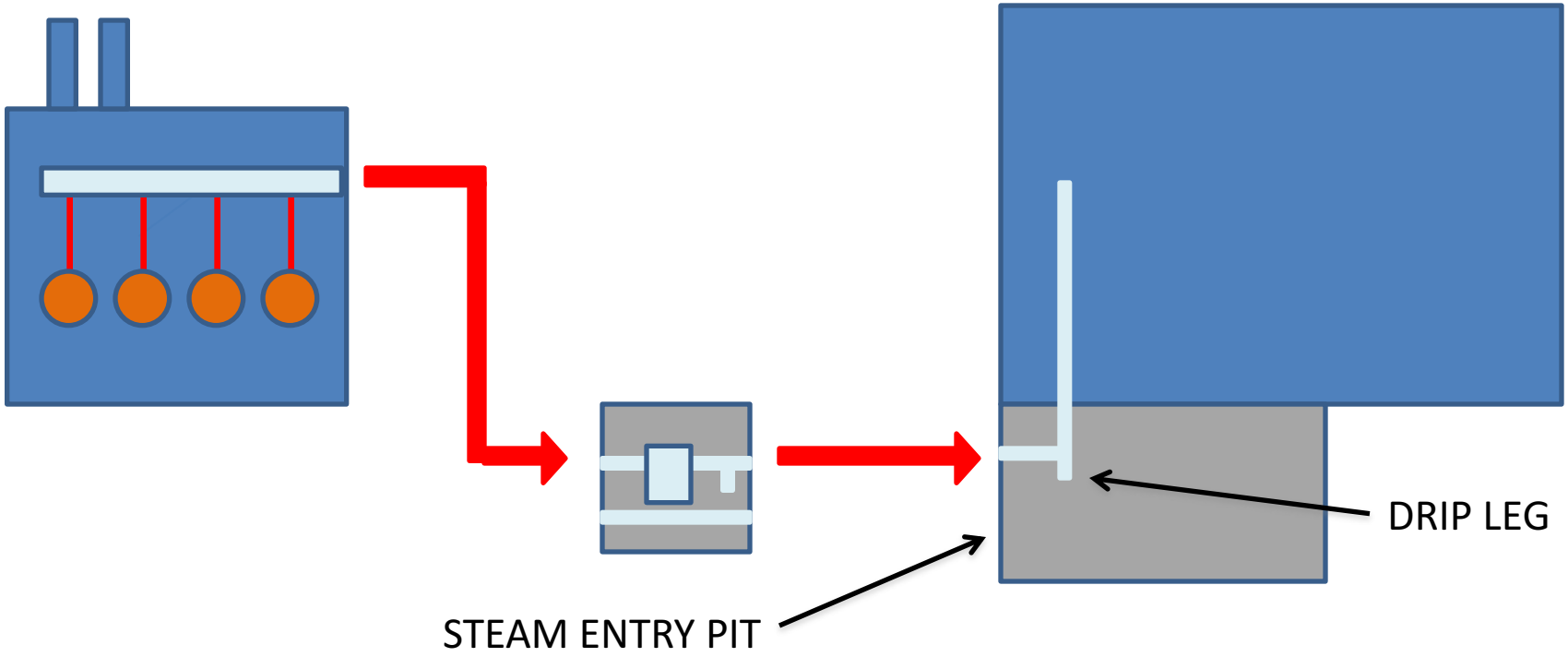
STEAM VAULT

- HPS steam enters Drip Leg Station
- Steam Trap removes air, CO2, dirt
- Drip Leg removes condensate



STEAM ENTRY PIT

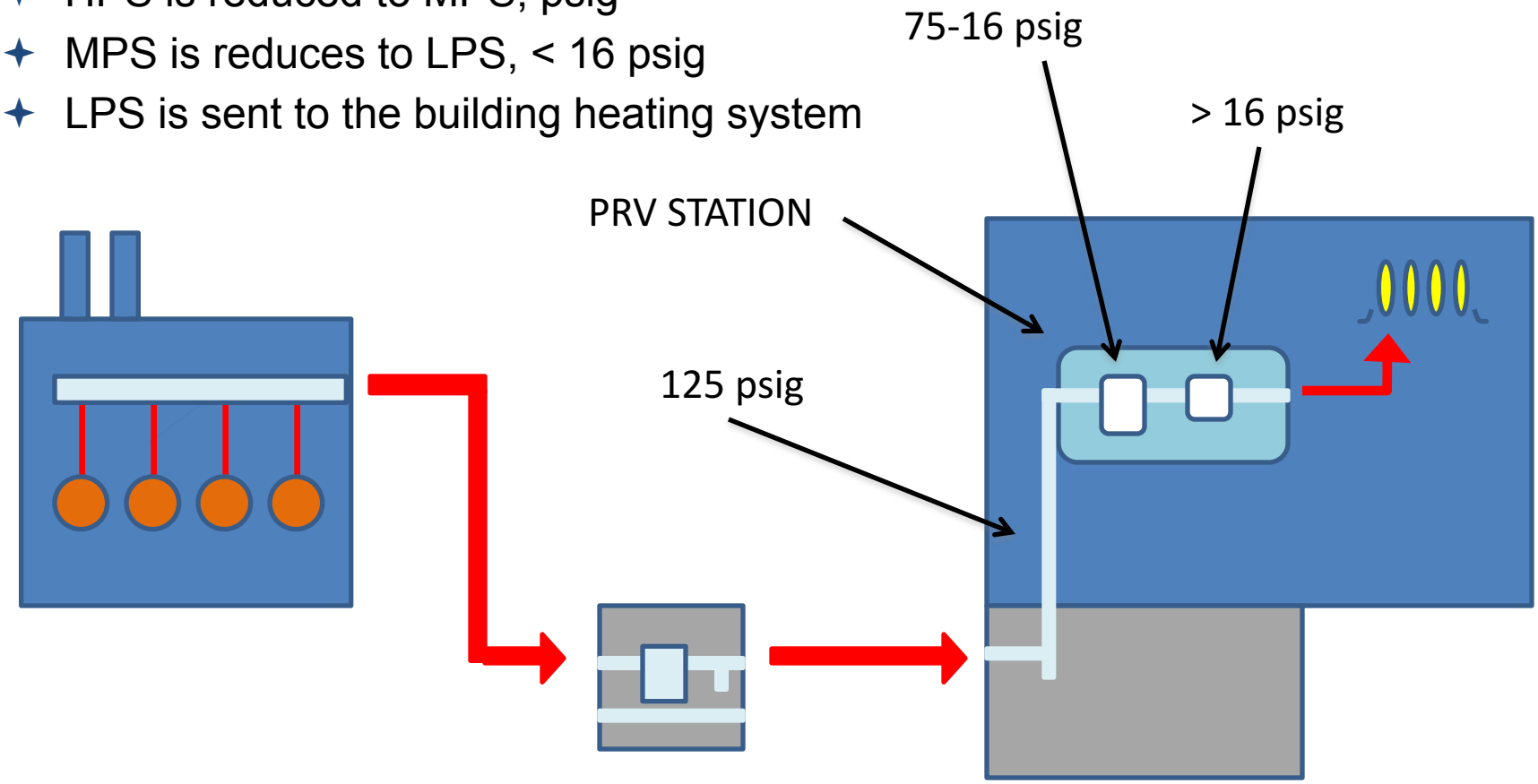
- HPS enters Campus and Medical Center buildings at Steam Entry Pit
- Drip Leg removes condensate



STEAM HEATING SYSTEM PROCESS FLOW

PRV STATION

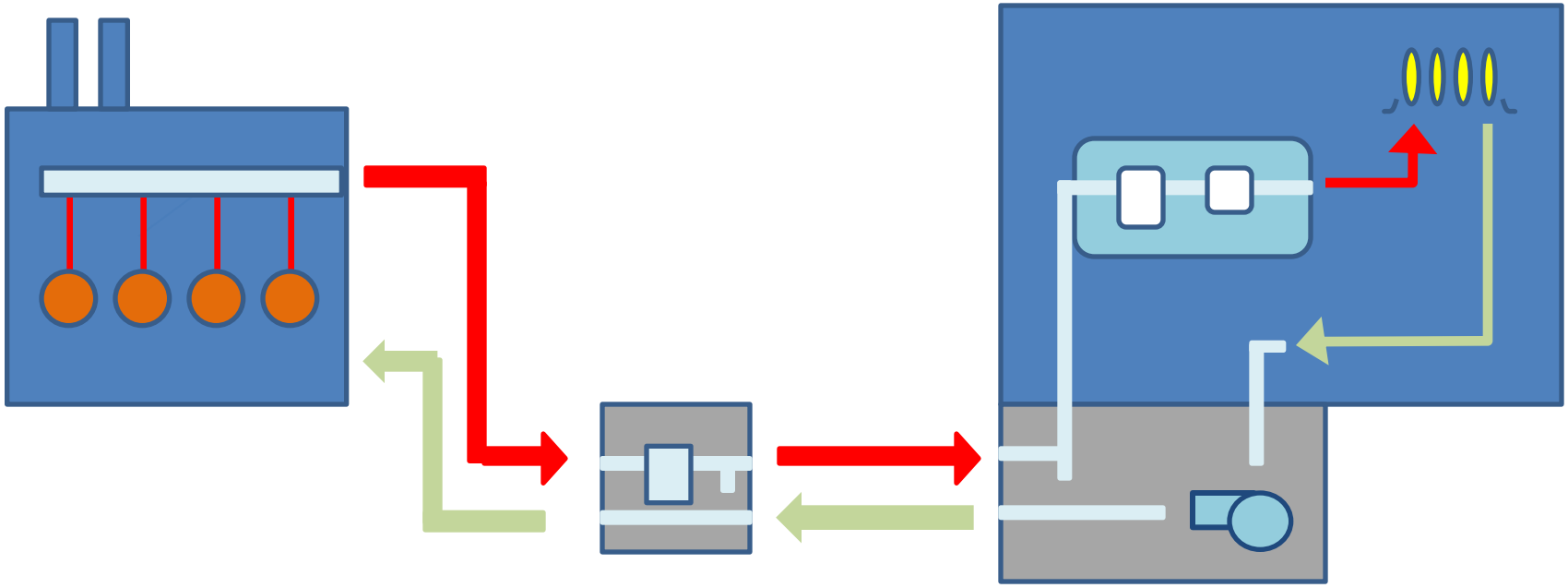
- HPS is reduced to MPS, psig
- MPS is reduces to LPS, < 16 psig
- LPS is sent to the building heating system



STEAM HEATING SYSTEM PROCESS FLOW

STEAM ENTRY PIT

- Condensate from heat heating goes to the Condensate Pump
- Condensate is returned to the Steam Plant



STEAM HEATING SYSTEM PROCESS FLOW