Steam Balancing: The First Step in Steam System Optimization

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What is steam balancing?

- Steam balance is always the first step in any steam system optimization and management program
  - Efficient way to gain knowledge
    - steam generation
    - distribution
    - end users
    - condensate-recovery systems
- Creating and maintaining a steam balance

WHAT IS STEAM BALANCING?

- Steam balance leads to setting a road map to use the steam system in the most efficient way
- Provides the understanding necessary to increase steam system thermal cycle efficiency
- Today's competitive business environment - every plant needs to achieve the highest steam thermal cycle efficiency possible

STEAM BALANCE

- A steam system in perfect balance has the end users (steam processes) achieving the correct volume of energy at the correct steam pressure/temperature with the proper steam quality

Perfect steam balance

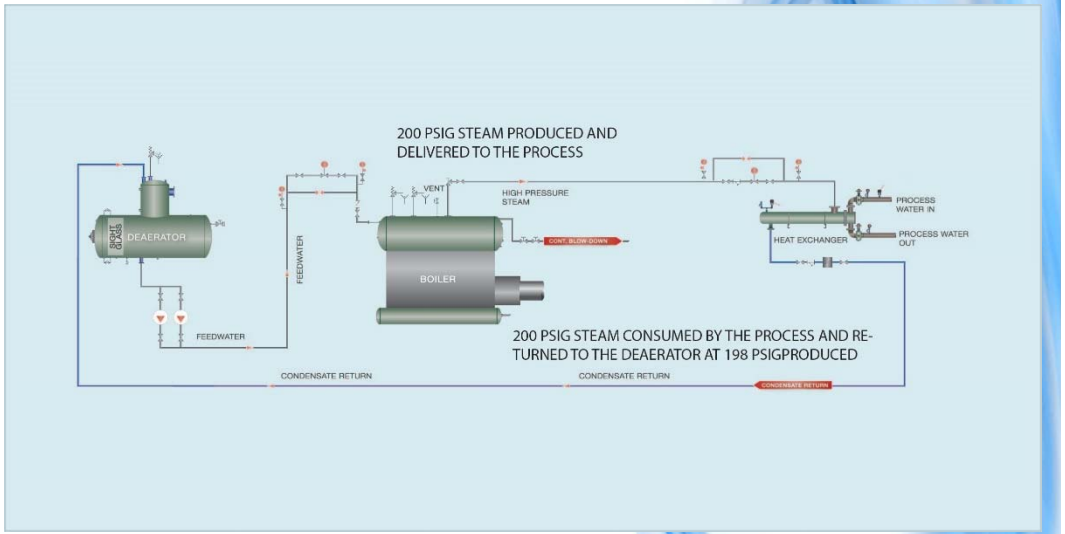
- Perfect steam balance has no energy losses
  - steam leakage
  - excessive low-pressure steam venting
  - flash steam venting
  - condensate loss, etc

STEAM BALANCE

- Establishing the correct steam balance can be very challenging because of all the different dynamics in a steam system
  - modulating steam loads
  - variable production times
  - unaccountable losses
  - insulation inefficiencies
  - turbine operation
  - etc.

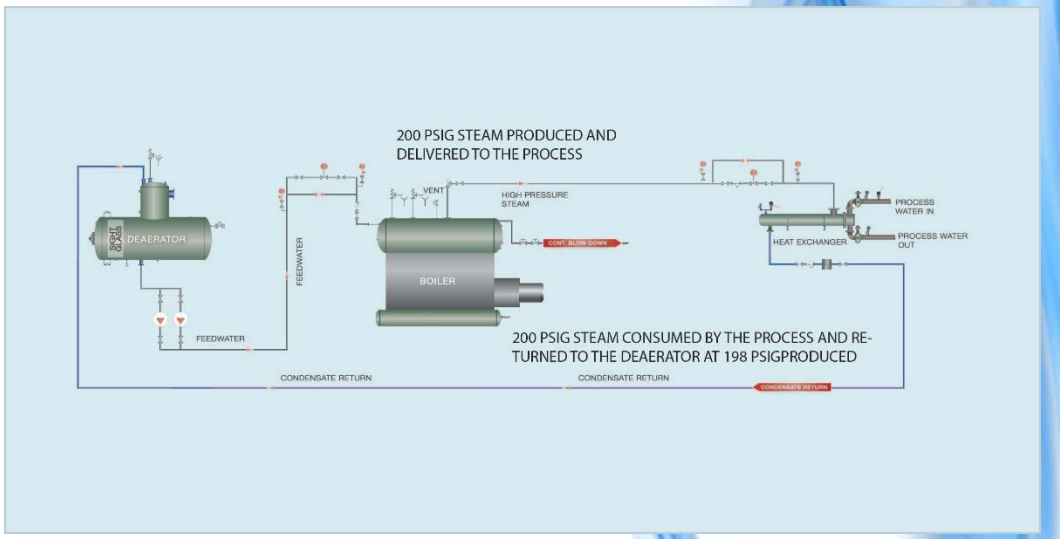
PERFECT STEAM BALANCE

- Advantages of a steam system in perfect balance are as follows:
  - higher sensible energy content in the condensate;
  - reduced flash steam, with no need for flash steam recovery, because the deaerator will consume the small percentage of flash steam



PERFECT STEAM BALANCE

- Advantages of a steam system in perfect balance are as follows:
  - smaller diameter condensate piping;
  - higher feedwater temperatures, thus a higher boiler efficiency; and
  - higher steam system thermal cycle efficiency

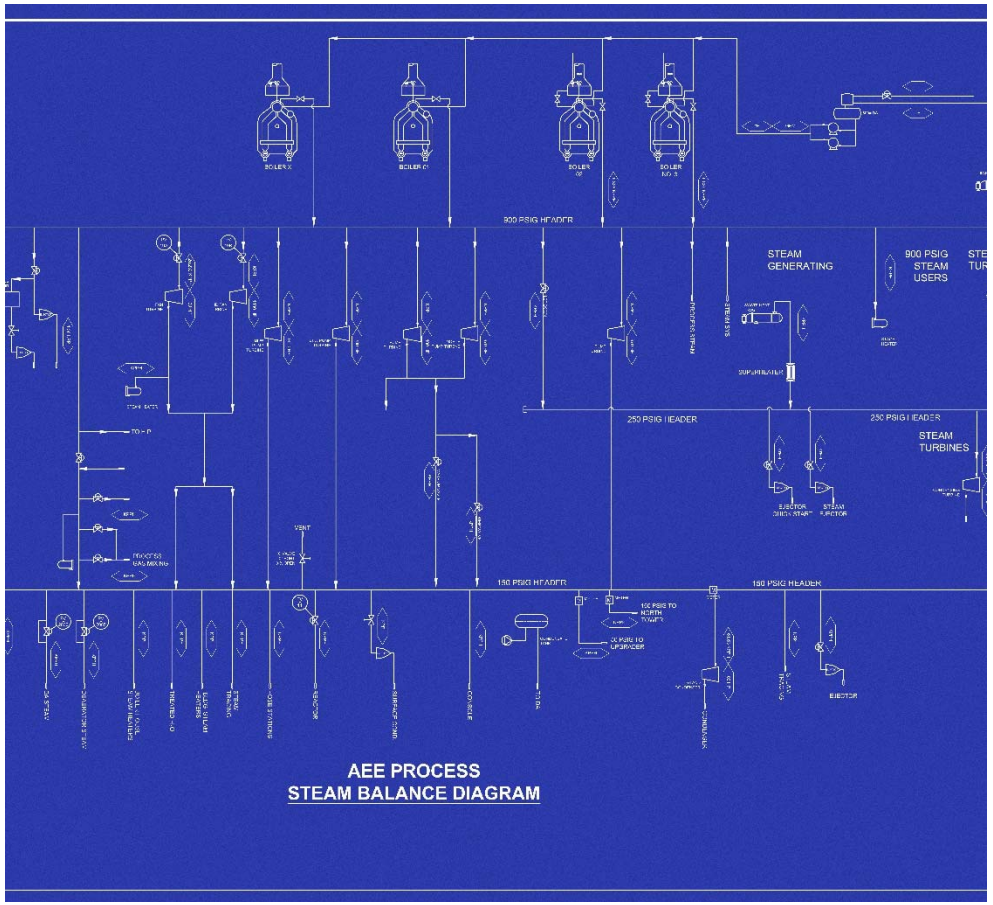


Perfect steam balance

- A perfect steam balance cannot exist for several reasons
  - Modulated steam pressures or flows to system processes
  - Dynamics of condensate drain devices
  - Condensate system's dynamics can also limit on how high a pressure the plant can maintain in the condensate return system

WHY STEAM BALANCES ARE NOT ACCOMPLISHED

- High percentage of time - fragmented
  - Boiler plant
  - End users
  - Steam distribution
  - Condensate recovery



STEAM BALANCE

- Difficult to establish a single or dual set of prints
  - CAD library might contain multiple different PID prints
    - Different owners of the plant
    - Different engineering directions on system designs and prints
    - Different engineering firms
  - All of the above could have used a different format
  - Plants sometimes do not keep their CAD prints up-to-date

ACCOMPLISHING A STEAM BALANCE

- Impossible to optimize a steam and condensate system without a steam balance
- Steam balance flow diagram
  - Aspen software
  - AutoCAD
  - Solid Works
  - Microsoft Visio

Implementing a steam balance

- Steam balance
  - Steam generation, distribution, end-user requirements, and condensate recovery can be an extremely challenging goal in any industrial steam plant operation
- Industrial plant can have several different steam-generating sources and a multitude of end users with varying steam pressure and steam flow demands
  - Steam turbine operation for electrical generation or drive units plays an important role in the balance
  - Steam pressure letdown valves (pressure-reducing valves) need to be minimized to ensure maximum steam flow to the steam turbine operation

Implementing a steam balance

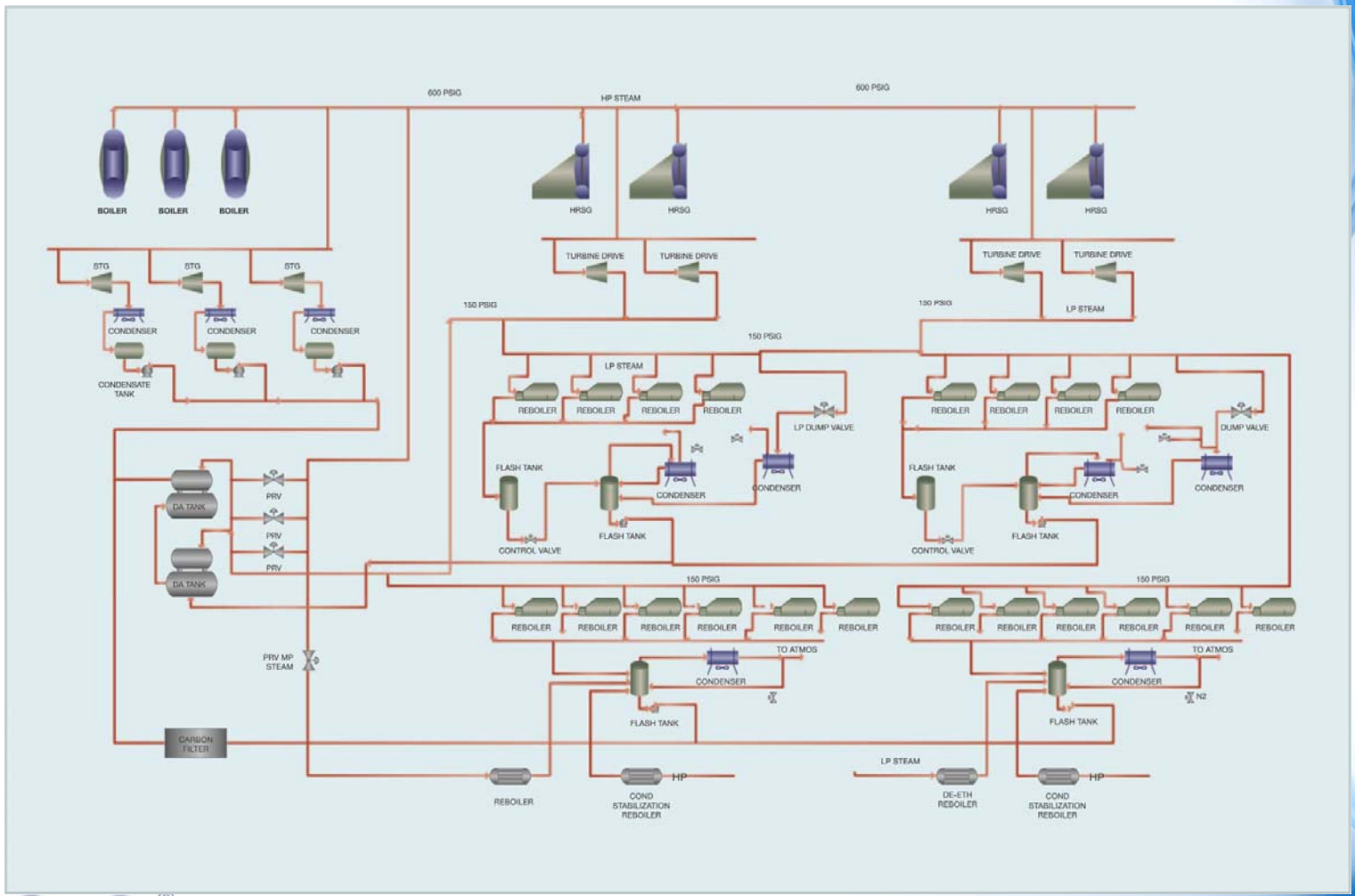
- Four types of condensate recovery systems are added into the balance
  - System dynamics get even more complex

- Steam balancing is a continuous program, not a one-time venture

IMPLEMENTING A STEAM BALANCE

- Steam balance will eliminate the waste:
  - Unusable low-pressure steam being vented to the atmosphere
  - Steam flow to the end users (steam turbines, heat exchangers, reboilers, etc.)
  - Discharging the condensate/flash steam to the steam cascade systems to successfully consume the flash steam
  - Low-pressure steam can be thermocompressed to medium steam pressure grids until a steam balance is achieved in the system

STEAM BALANCE EXAMPLE



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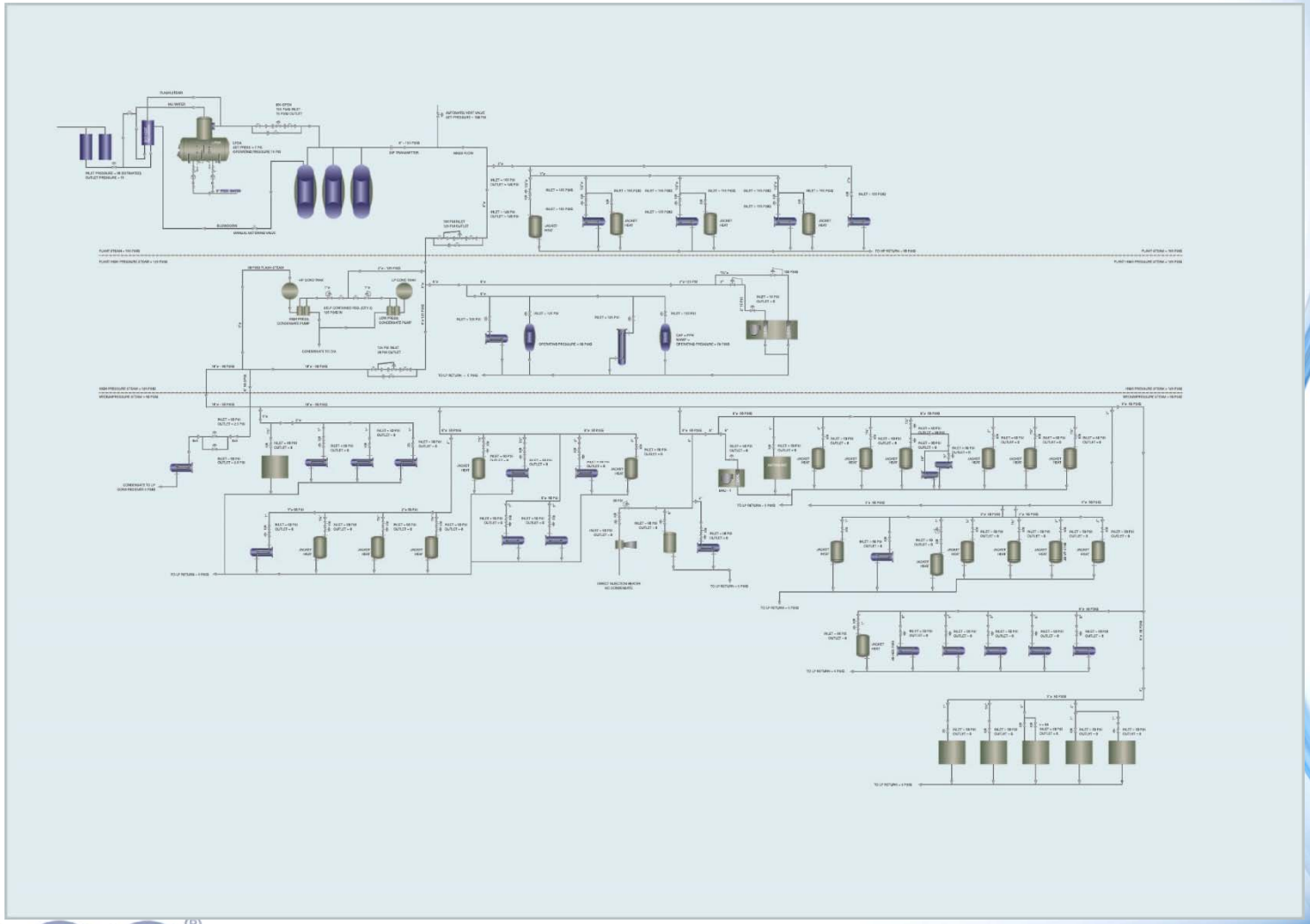

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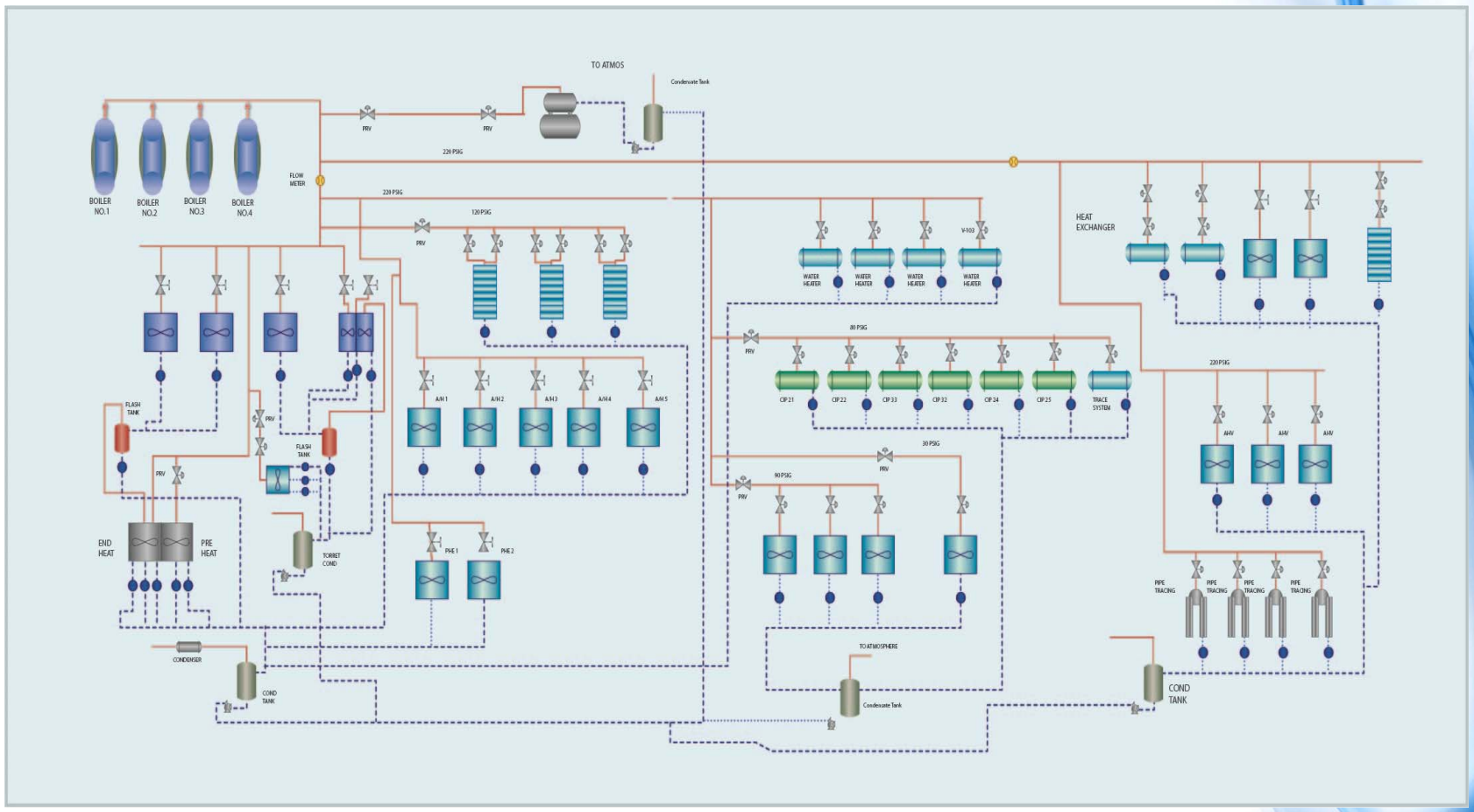
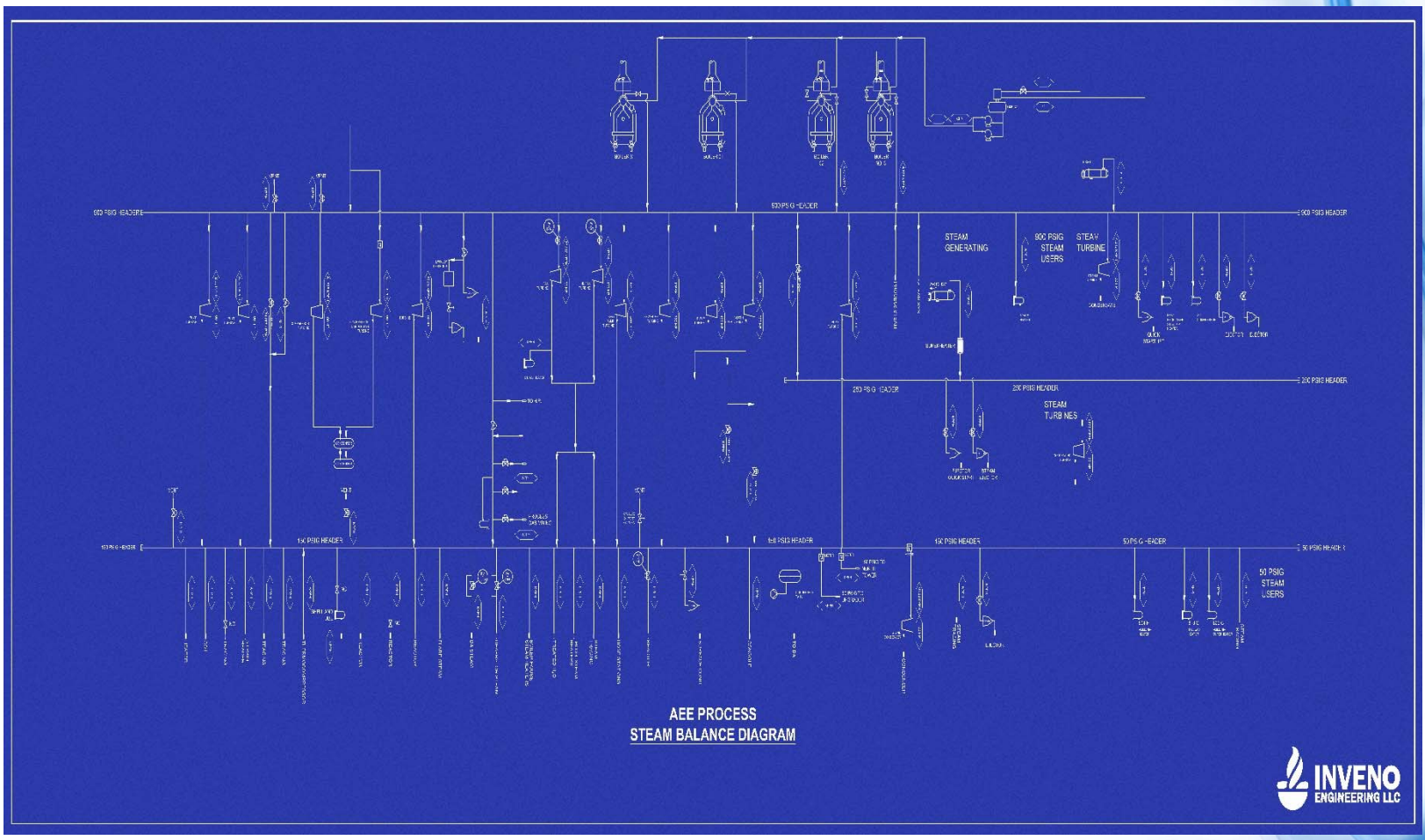


SEAM BALANCE EXAMPLE



WITH OUT A STEAM BALANCE

- Low steam system thermal cycle efficiency
- Energy losses
- Emissions
- Safety
- Process performance
- Low steam quality

End result of a steam balance

- a better understanding of the steam and condensate system,
- the ability to set a road map for changes that will improve the system,
- opportunities to improve energy efficiency,
- opportunities to reduce emissions, and
- opportunities to increase reliability.

THANK YOU

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