Utility Steam Generation Plant Design

Project Description

Lotte Biologics is a South Korean Contract Development and Manufacturing Organization (CDMO). Lotte Biologics specializes in manufacturing large quantities of biologics medicines, which are typically related to the immune system and are delivered via IV or syringe. Once manufactured, these medicines are distributed to large pharmaceutical companies for sale. In 2020, Lotte Biologics purchased a manufacturing plant from Bristol-Myers Squibb in Syracuse, NY, making the facility the only U.S. manufacturing plant owned by the company. Currently, the facility is outfitted with a 3 – 800 bhp boiler steam plant. It acts as a heat source for the HVAC systems on campus, providing comfort heating during the cold winter months. In addition, the steam plant is a crucial process utility, supplying steam required to sterilize bioreactors and water used in IV bags. While serving a crucial role in the facility's operation, the current plant is 80 years old, and significantly oversized for its current purpose. Both factors cause significant operational inefficiencies and lead the plant to draw more power and produce additional emissions. Our group has been tasked with the development of an appropriately sized new design, which meets current and future facility demands in a highly efficient manner. Furthermore, there is a strong emphasis on highly innovative and sustainable design, leading the client to serve as an example of environmentally conscious industry in the State of New York

Possible Solutions

Include multiple process flow diagrams that represent our current design concepts

- Pre-heat feed water before boiler by geo-thermal or solar energy.
- Recycle energy from the waste
- Separate boilers into two specific demands, use hydronic system for HVAC demand

Deliverables

- 60% Basis of Design
- Risk Assessment and Analysis
- Cost and Incentive Analysis
- Piping and Instrumentation Diagrams

Design Options

Decentralization

Table 3. Calculated Site Steam Loads (2019 IPS Report) *revised

Building	Heating Load (Btu./Hr.)	Comfort Demand (Lbs./Hr.)	Process Demand (Lbs./Hr.)	Percent Comfort Demand	Percent Process Demand	Percent Total Demand
B15		160		0.81%	0%	0.49%
B32	5,494,808	6,181		31.24%	0%	18.5%
B33	155,400	175		0.88%	0%	0.53%
B42	99,912	113		0.57%	0%	0.34%
B58	11,697,200	13,158	13,000	66.5%	100%	79.78%
Total Stm. Demand		19,787	13,000			

Description

Given the data from the feasibility report provided to us by Lotte, we propose the idea of creating a decentralized system to provide steam to the campus. As seen in the table above, building B58 takes the entirety of the process demand, which accounts for roughly one third of the total demand. Due to this we believe a boiler can be placed in B58 to provide the process demand load to the building, while all the comfort demand would be met by a 2-- boiler plant housed in its own location.

Figure M-1. Partial Arial Site Plan

Pros

- ✓ Reduce Risk
- ✓ Smaller load leading to better sustainability
- ✓ Specialized design for just B58 could give us the ability to create something more desirable for process steam application
- ✓ 179D Energy Efficient Commercial Building Tax Deduction: $2.50 - $5.00 /ft^2 for energy-saving new construction or retrofit projects. Minimum eligibility requirement is 25% energy savings.

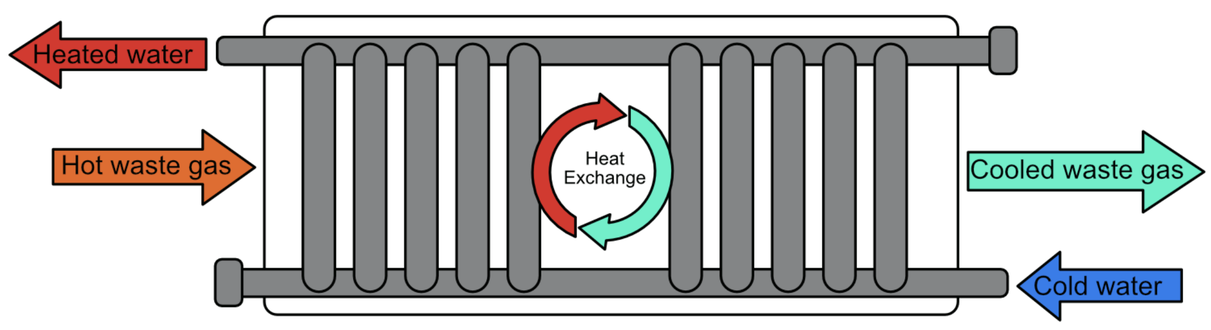
Cons

- X Rise of construction cost and longer construction time
- X Potential rise of overall cost dependent on incentives used
- X Require more maintenance throughout operational period on top of original steam plant maintenance
- X Require more permits due to construction on multiple builds

Energy Recovery

Description

Through the processes of deaerating, combustion, and HVAC, waste gas or steam will be generated. There is potential to recycle this wasted energy via. economizer or heat exchanger.

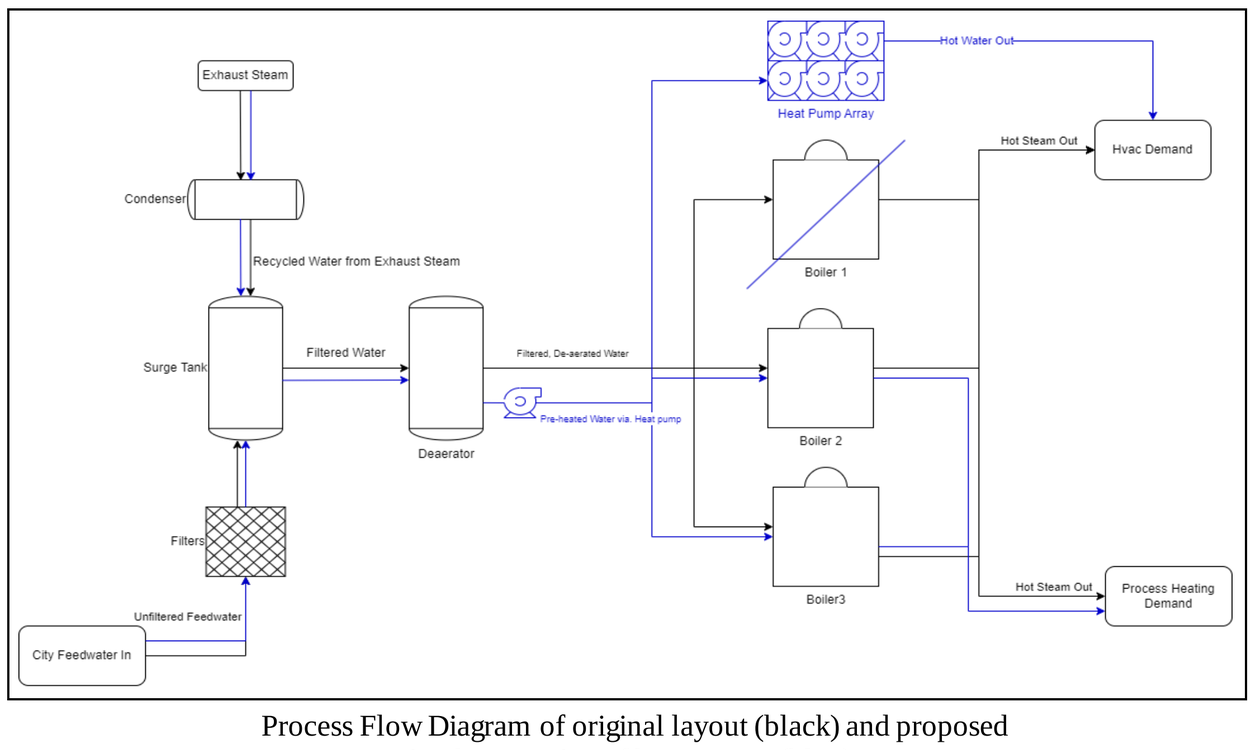


Advantages

- ✓ Improve boiler's efficiency
- ✓ Reduce excess heat loss
- ✓ Reduce fuel costs
- ✓ Promote sustainability and improve air quality

Heat Pumps

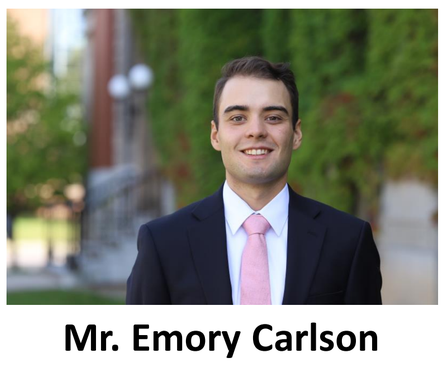
- Heat pumps are a highly efficient mechanism for heating fluids via. electricity
- Incorporating heat pumps in our design could reduce or eliminate fossil fuel usage, and cut down emissions
- Alternative energy sources could be used to supplement power to heat pumps (solar, wind, etc.) either onsite or offsite
- Current steam-based HVAC heating system can be replaced with a hydronic system powered by industrial heat pump array



Process Flow Diagram of original layout (black) and proposed implementation of heat pumps (blue).

- Alongside solar, heat pumps are highly incentivized at state and federal level: qualify for 179D tax deduction via. Inflation Reduction Act (IRA), and directly incentivized by NYS Clean Heat Program
- 2 applicable categories of heat pumps: air source, and ground source heat pumps (geothermal)
- Ground source heat pumps are more expensive to purchase and install, but are more stable in performance than air-source heat pumps and heavily subsidized (see table)

Faculty Mentor: Prof. Ben Akih Kumgeh



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