Flood Athletic Center

Woong June Chung

Penn State University Mechanical Option

Thesis Advisor : DR. Willam Bahnfleth, P.E.

Project Background

- Richard T. Flood Jr., & Sally Elliot Flood Athletic Center
- Completed in December 2009
- Northwest Connecticut
- Area: 102,000 ft^2
- Replacement of Ice rink

Project Background

- Function of gymnasium
  - Basketball Court
  - Fitness Center
  - Wrestling Room
  - Ice Rink
  - Offices
  - Locker Room

Existing Mechanical System

- (4) Boilers 85% Efficiency
- (5) Hot Water Unit
- (26) Hot Water Heating Coil

- (9) Air Handling Units
- (2) Energy Recovery Ventilators

Existing Mechanical System

- (1) Ice Rink Ventilating and Dehumidifying Unit
  - With Desiccant Wheel Dehumidification System
    - 100% OA system
    - Prevent water condensation in ice rink

Proposed Mechanical System

- Objective of Proposed Mechanical System
  - Provide economic benefit to the owner
  - Reduce of energy consumption
  - Decrease emission of the system

Proposed Mechanical System

- CHP system
  - Feasibility Check
    - Spark Spread = Electricity rate – Gas rate
      = $11.29/MMBtu
    - System may be inefficient
      - Spark Spread was lower than $12/MMBtu
      - Building does not run 24/7

Proposed Mechanical System

- CHP system
  - Components
    - Prime Mover
    - Generator
    - Heat Recovery Unit

Proposed Mechanical System

- Selection of Prime Mover
  - High efficiency
  - Low start-up time

Proposed Mechanical System

- Estimation of annual cost and savings
  - BCHP Screening Tool
    - $21,563 / year

Proposed Mechanical System

- Emission
  - Reduction of NOx and SOx
    - NOx – 57.6% reduction
    - SOx – 99.1% reduction

Proposed Mechanical System

- Ground Heat Source System
  - Location
    - Plenty of ground to utilize as GSHP system
  - Soil
    - Stockbridge Loam
    - Thermal Conductivity = 1.15 Btu/(h*ft*F)

Proposed Mechanical System

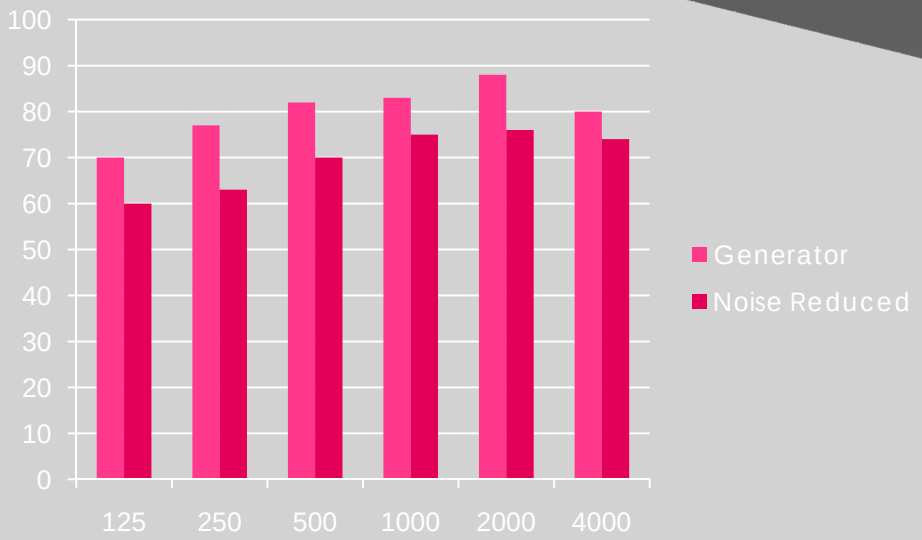
- Utilize underground temperature
  - Underground temperature is low on summer and high on winter
  - Run with 23.5% propylene glycol and 76.5% water
    - Lower the freezing point to 15^{o}F

Proposed Mechanical System

- 25 Bore holes
- Vertical Loop System
- Ground Loop Design
  - $4,900 / year

Acoustical Breadth

- Installation of All weather Acoustical tile
  - Acoustiblok reduces approximately 10 dB



Cost Estimation

- Combined Heat and Power System
  - Installation Cost = $1,676,211
  - Annual Savings = $21,563
  - Payback Period = **50years**

- Ground Source Heat Pump System
  - Installation Cost = $63,900
  - Annual Savings = $4,900
  - Payback Period = **13years**

Conclusion

- Recommendation
  - Inadequacy to install CHP system
  - GSHP is challenging
    - Owner can consider due to the function and religion of school
    - Acoustical tiles are recommended to install after the installation of GSHP system

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