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September 3, 2004

Mr. Rem Alley, Architect
Alley Associates
P.O. Box 2317
Las Cruces, NM 88004

New Chaparral High School
Heating, Ventilating and Air Conditioning Systems

Dear Mr. Alley:

Attached you will find a brief report discussing the various Heating, Ventilating and Air Conditioning Systems considered for the new High School in Chaparral, New Mexico. This letter report presents basic system descriptions and comparisons along with our recommendation of the Fan Coil system for the project.

Please review the material and do not hesitate to call if you have any questions or comments.

Sincerely,

Robert H. Beasley, P.E.

Mr. David Boyd, GISD

/attachments

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INTRODUCTION

This report is provided for the evaluation and recommendation of the heating, ventilating and air conditioning (HVAC) system for the New Chaparral High School in Chaparral, New Mexico. The report is the result of the initial meeting with Mr. Rem Alley (Alley & Associates Architects) and Gadsden School District staff on August 17, 2004. This study is prepared by RBM Engineering, Inc. for Alley & Associates Architects.

This report shall consider four system types that might be applied for the facility. Advantages and disadvantages are discussed for each system with basic cost comparisons provided for each. Two important issues regarding these systems were stressed by everyone during the initial meeting. The system must be able to be phased in such a way to minimize disruption during future construction phases and the equipment must be maintainable, reliable and familiar to the District's maintenance staff.

A very basic comparison of operation and maintenance costs are discussed but no detailed system energy or life cycle cost analysis has been performed for these systems.

PROPOSED SYSTEMS

The New Chaparral High School is initially planned as a 150,000 square foot facility consisting of classroom wings, cafeteria/kitchen, library and administrative areas. Future construction phases shall add locker rooms, gymnasium and more

classroom facilities, which may eventually reach a total area of 300,000 square feet.

The following systems are considered for this school

1 Packaged rooftop air conditioning units for each classroom.

2. Water Source Heat Pump System – Conventional with Cooling towers and boilers. Individual heat pumps serving each classroom or area.

3. Ground Coupled Water Source Heat Pump System. Individual heat pumps serving each classroom or area. Similar to systems at Santa Teresa Middle School and the two new Elementary Schools.

4. Four pipe fan coil system for each classroom utilizing central air cooled chillers and gas fired boilers. Similar to new additions at Santa Teresa High School.

Packaged Rooftop Air Conditioning Units

This system would provide a roof mounted packaged air conditioning unit for each classroom and office area. The air conditioning unit would be provided with an outside air economizer to minimize electrical consumption during the cooling season. Natural gas would provide room heating through the rooftop unit.

Advantages:

1. Will provide individual room temperature and humidity control.
2. Failure of one unit affects only one room and not others.
3. Construction phasing for future additions would not impact existing facilities since units would be added as classrooms and areas are added.
4. Lowest first cost option.

Disadvantages:

1. Each unit would contain compressor system requiring refrigerant maintenance and management.
2. Utility costs would be higher than the other systems considered.
3. Although maintenance costs are comparable to other systems, these units have a shorter life expectancy than the other equipment and would require replacement sooner.
4. Numerous roof penetrations on the building due to the installation of so many units.
5. Significant electrical distribution system requirements throughout the building.
6. Higher installed capacities and power requirements due to "nominal" ratings of equipment.

Estimated Construction Cost (Initial 150,000 sq.ft. phase) $1,000,000

WATER SOURCE HEAT PUMP SYSTEM – CONVENTIONAL COOLING TOWERS & BOILERS

An individual heat pump air conditioning unit would be located within the ceiling space to each classroom or area. These units are water cooled by a circulating water loop connected to central cooling towers to reject heat or boilers to add heat to the loop depending on building loads.

Advantages

1. Energy efficient since equipment is water cooled and loop can transfer heat throughout the building.
2. Equipment within the building is similar to the Ground coupled units currently in use at other school sites.
3. Allows individual room or area control and operation.
4. Failure of one unit affects only one room and not others.
5. Ability to match building loads better avoiding installation of more capacity to handle peak loads.

6. System could expand with future construction phases adding new units for added spaces and incremental capacity at the central plant (towers and boilers).

Disadvantages:

1. Higher maintenance costs than fan coil or ground coupled heat pump systems.
2. Significant electrical distribution system requirements throughout the building.
3. Cooling Towers require high levels of maintenance in this climate with associated maintenance expenses.

Estimated Construction Cost (Initial 150,000 sq.ft. phase) $1,600,000

GROUND COUPLED WATER SOURCE HEAT PUMP SYSTEM

Similar to the conventional water source heat pumps except the earth is used as the heat transfer source for the circulating loop replacing the boiler and cooling tower. This system would be similar to the air conditioning system currently in use at the two new elementary schools.

Advantages:

1. Most energy efficient of the systems being considered.
2. Allows individual room or area control and operation.
3. Failure of one unit affects only one room and not others.
4. Ability to match building loads better avoiding installation of more capacity to handle peak loads.

Disadvantages:

1. Requires surrounding land to install the well fields to transfer heat to the earth.
2. Higher maintenance costs when compared to the fan coil system.
3. Significant electrical distribution system requirements throughout the building.

4. System could expand with future construction phases adding new units for added spaces. Well fields would also require expansion and would require the destruction of existing playing fields and landscaped areas to increase system capacities.

Estimated Construction Cost (Initial 150,000 sq.ft. phase) $2,500,000

FOUR PIPE FAN COIL SYSTEM

An individual fan coil unit consisting of a supply fan, heating coil, cooling coil and filter section would be provided for each room. These would be located in the ceiling space with chilled and heating water piped to each unit from central chillers and boilers. Chillers would be air cooled and boilers would be natural gas fired. This system would be similar to the system for the new additions at Santa Teresa High School.

Advantages:

1. Fan coil units are simple to maintain and repair.
2. Refrigerants are concentrated at central plant simplifying management and maintenance.
3. Operating costs better than packaged rooftops and not quite as good as water source heat pump systems.
4. Good room temperature and humidity control.
5. System could expand with future construction phases adding new units for added spaces and incremental capacity at the central plant.

Disadvantages:

1. Chiller/compressor failure would impact more widespread areas.
2. Chillers require more skilled maintenance or service.

Estimated Construction Cost (Initial 150,000 sq. ft. phase) $1,800,000

COMPARATIVE SUMMARY

Installed Costs:
(Least expensive to most expensive)

1. Packaged Rooftop Units.
2. Conventional water source heat pumps.
3. Four pipe fan coil system.
4. Ground coupled water source heat pumps.

Maintenance Costs:
(Least expensive to most expensive)

1. Four pipe fan coil system.
2. Packaged rooftop units. (Replacement costs need to be considered)
3. Ground coupled water source heat pumps.
4. Conventional water source heat pumps.

Operating Costs or Energy Use:
(Least expensive to most expensive)

1. Ground Coupled water source heat pumps.
2. Conventional water source heat pumps.
3. Four pipe fan coil system.
4. Packaged rooftop units.

RECOMMENDATION

We recommend the Four Pipe fan coil system with central air cooled chillers and boilers for this facility. The fan coil system provides a quality system for all areas of the school allowing each space to have individual control and operation while larger equipment would be centralized for maintenance and service. This system can expand for future phases of construction with minimal disruption of the

existing building areas and occupants and surrounding fields and landscaped areas. The system equipment has longer expected life cycles than the other systems considered.

Packaged rooftop units would be the most energy consumptive over the life of the system and this equipment would have a shorter life expectancy compared to equipment in the other systems. Roof areas would be cluttered and more prone to leaks.

The water source heat pump systems would have higher initial installation costs and slightly higher maintenance costs. It would be expected that the ground coupled heat pump system would have the lowest operating cost of all systems considered. However, due to the size of the school with its future additions and resulting air conditioning loads, the required well field area would be enormous. If the school reached a total building area of 300,000 square feet, the well field could be as large as 625,000 square feet. This equates to 15 acres of land required for the well field. There may not be enough open land and the well field would occupy every available playfield area. Future expansion would require digging up existing playfields to increase the well field for the next expansion. This seems impractical for a new occupied High School.