**Mechanical Inspection – Heating & Ventilation**

**0821 Heating Equipment** – Boilers, circulation pumps, etc.

An oil fired hydronic boiler replaced the original boiler for the facility in 1982. An electric boiler was installed in parallel with the oil fired boiler in 1982 for reduced electric rate dual fuel operation. The facility currently uses the electric boiler for the majority of the time. Breeching is a single wall welded steel fabricated chimney assembly connected to the original masonry vertical chimney. The interior of vertical masonry chimney was not checked for deficiencies.

Heating water is distributed throughout building via two base mounted end suction hydronic pumps (P-101, P-102) to finned pipe heating units in classrooms, other occupied areas, and entries. Pipe mounted pump (P-103) circulates heating water to the main ventilation unit AHU-1 heating coil. Pipe mounted pump (P-104) supplies heating water from the existing boiler into the heating water loop. Pipe mounted pumps (P-5 and P-6) supply heating water to multipurpose room fan heating coils.

Pneumatic automatic control valves modulate, as controlled by room thermostats, the heating water flow to the heating units throughout the building.

Condition of heating equipment, boilers, is fair.
Condition of breeching is poor.
Conditions of all pumps are poor.

Boiler remaining life expectancy: 5-10 years
Breeching remaining life expectancy: 0-5 years
Pumps remaining life expectancy: 0-5 years
Automatic valves remaining life expectancy: 0-5 years
Deficiency
0821-1 Boiler Breeching Failure
Corrosion of boiler breeching ductwork has resulted in holes in duct. The openings allow boiler exhaust into the boiler room.

Deficiency category: RR

Remedy
Replace breeching ductwork with single wall, welded steel breeching, with minimum 2 inches mineral fiber insulation.

Estimated Construction Cost: $14,500
Deficiency
0821-2 Old Circulation Pumps
The circulation pumps for the heat system range from 15 to 30 years old. All the circulation pumps have exceeded their service life.

Deficiency category: RR, EM

Remedy
Replace all circulation pumps with dual lead/lag base mounted variable frequency drive pumps. Revise piping as required for elimination of multiple pumps. Install pressure sensors (4) in heating piping throughout building for control of pumping capacity. Connect controls to district wide DDC system.

Estimated Construction Cost: $101,400
Deficiency
0821-3 Boiler Thermal Shock Protection
Hydronic boiler lacks thermal shock protection. This protects the boiler from a sudden influx of cold water that could crack the boiler heating chamber.

Deficiency category: RR

Remedy
Install pipe mounted circulation pump on hydronic oil-fired boiler for thermal shock protection.

Estimated Construction Cost: $8,700
Deficiency
0821-4 Old Automatic Valves
The Automatic valves throughout the facility are 30 years old and have exceeded their service life. The valves do not function optimally, are prone to leaks, and need to be replaced. If possible this valve replacement should occur when the control system is upgraded to DDC, then utilize electronic valves instead of pneumatic. Otherwise, replace all valves with pneumatic type.

Deficiency category: RR

Remedy
Replace all automatic pneumatic valves throughout the facility (quantity 30). If possible this valve replacement should occur when the control system is upgraded to DDC to utilize electronic valves instead of pneumatic. Otherwise, replace all valves with pneumatic type. Replacement with DDC valves is included under section 0828-1.

Estimated Construction Cost: $34,800
0822 Heating Distribution – Pipes, fittings, valves, insulation, radiators, etc.

The original heating piping circulation system was constructed out of black steel piping and cast iron fittings. The heating piping system supplies heating water to finned pipe convectors located on the exterior wall of all rooms and to unit convectors in the entries. Most of the additions and remodel work retained the black steel material component but at least one location copper piping was found. No chemical pot feeder is installed on the heating piping system to add chemicals. Heating piping system is insulated with mineral fiber pipe insulation with cloth covers. Automatic air vents are installed at the high points of the system but many were reported to have failed.

Condition of the building heating piping system is fair.

Remaining life expectancy: 10+ years

Boiler room black steel piping system displays signs of leakage, corrosion, and failure of equipment and valves. The piping is partially insulated with mineral fiber pipe insulation with cloth covers.

Condition of the boiler room piping systems is poor and failing is several locations.

Remaining life expectancy: 0-5 years
Deficiency
0822-1 Boiler Room Piping Failure
The entire Boiler Room heating piping system is failing resulting in increased maintenance; shut downs of system, and replacement of parts.

Deficiency Category: RR

Remedy
Replace entire boiler room piping system with type L copper including insulated piping and fittings, valves, thermometers, and trim. Include chemical pot feeder with new piping system.

Estimated Construction Cost: $58,000
Deficiency
0822-2 Failed Rally Room Heating Units
The Rally Room unit ventilators are 31 years old and past their service life. Dampers do not operate. Control of heating is sporadic.

Deficiency Category: RR

Remedy
Replace two unit ventilators with two cabinet unit heaters controlled by room thermostats. Perform remedy in conjunction with 0823-1 for ventilation renovation for the room.

Estimated Construction Cost: $14,500
Deficiency
0822-3 Automatic Air Vents Failure
Air vents are increasingly failing creating the potential for increased air in the heat piping system, thus reducing efficiency.

Deficiency Category: RR

Remedy
Replace all air vents and half of their associated isolation valves. Estimated quantity, 20 total.

Estimated Construction Cost: $9,400
0823 Ventilation Equipment – Fans, make-up units, mixing boxes, etc.

In the 1982 renovation the main ventilation system, including fans and ductwork, was replaced with a single fan Trane system (AHU-1) with relief air fan (RF-1). AHU-1 and RF-1 were installed in a second floor classroom. Supply air ductwork was installed above the ceilings with main ductwork above the corridor and branch ductwork to the variable air volume (VAV) terminal boxes located in each classroom or similar occupied area. Supply is delivered to VAV boxes on all three floors of the school. The VAV boxes modulate their air flow depending on temperature in the room as controlled by the respective pneumatic room thermostat. Return air is pushed out of the occupied areas into the corridor ceiling return air plenum and returns to the Fan Room. The fan is a mixed air plenum with the return air and outside air mixing before entering AHU-1. If all of return air is not utilized then it relieves out the relief cap through the relief fan. The relief air penthouse was destroyed in a wind storm approximately 5 years ago and a wooden shelter was installed at that time for replacement. The relief air ductwork from the discharge of the relief fan RF-1 is not ducted to the relief cap but seems to have been dismantled or fallen apart. Currently the ductwork is open to the room negating any impact RF-1 may have on the system.

None of the classrooms were observed to have standard ventilation rates or code required amounts of outside air. All of the classrooms that were measured for flow rates were below design rates. Several VAV boxes were observed as being shut or ductwork not connected with little or no airflow being supplied. The VAV boxes are essentially first generation technology with no minimum setpoints of flow rate. So when the temperature set point is below set point in the room then the VAV box modulates to zero air flow with maximum air flow being supplied when the thermostat is calling for cooling. The IT office in the basement, far northwest, does not have any ventilation serving the space.

EF-1, installed in the 1982 renovation, exhausts air from the two basement toilet rooms and discharges the air out a roof cap. EF-1 is located above the ceiling of one of the basement toilet rooms. Approximately 2 years ago, a roof top exhaust fan was installed by maintenance staff to replace the above ceiling EF-2 that was installed in the 1983 renovation. EF-2 exhausts air from the main toilet rooms and adjacent toilet rooms. Toilet room in Classroom 109 is exhausted from a ceiling mounted exhaust fan EF-3 with discharge out a roof cap.

Rally room area is supplied ventilation from two unit ventilators (UV-1), located on the east and west exterior walls, with outside taken in from a louver in the wall and return air from the room. Supply air discharge is from the top of each unit. Mixing dampers are to mix the outside and return air to a setpoint and an integral heating coil heats the air for delivery. Both unit ventilators have reached their service life with the ventilation portion of the unit shut off due to lack of operation and excessive noise. Essentially the unit ventilators are acting as heating convectors supplying heat to the room passively.
**Mechanical Inspection – Heating & Ventilation**

The multipurpose area is ventilated and heated from two original Trane vertical single fan units SF-1 and SF-2 installed in 1973. Each unit heats half of the gym (SF-1 south area, SF-2 north area) with the temperature of the supply air modulated by a respective room thermostat. The fan units do not have access doors for cleaning. It was reported that the heating coils for the units may never have been cleaned due to the lack of access. It was also reported that in recent years the fan units are not supplying enough heating, to keep the gym above 60°F, during colder times of the year. Unit ventilator (UV-2) is located above the old stage area to supply heating and ventilation to the stage area. UV-2 has not operated for several years after finally failing after years of trouble from cracked (frozen) coils and improper operation.

The basement ventilation system serving the abandoned shooting range has been turned off. The range area underwent a major renovation in 1983 with a new ventilation system installed. Within 2-3 years the area was abandoned and the ventilation system was turned off.

The Emergency Generator Room was observed as hot and reportedly overheats continually. Maintenance personnel have installed a propeller fan to help with cooling.

Condition of the school AHU fan system is fair.
Condition of the school VAV room delivery system is poor.
Condition of the exhaust fan EF-1 is fair.
Condition of the exhaust fans EF-2 and EF-3 is poor.
Condition of the Rally Room unit ventilators is poor.
Condition of the Multipurpose Room Fan Units; SF-1 and SF-2 is poor.
Condition of Stage unit ventilator is poor.
Condition of the Range Ventilation System is fair.

School Fan System remaining life expectancy: 5-10 years
VAV boxes remaining life expectancy: 0 years
Exhaust fans EF-1 and EF-3 remaining life expectancy: 0-5 years
Exhaust fans EF-2 remaining life expectancy: 5-10 years
Rally Room UV’s remaining life expectancy: 0 years
Multipurpose Fan Unit System remaining life expectancy: 0-5 years
Multipurpose Stage UV remaining life expectancy: 0 years
**Deficiency**  
0823-1 Main AHU System  
The AHU is not being controlled correctly as a VAV system. AHU motor is not an energy efficient motor. The relief air discharge is not connected to the relief cap. Relief fan is not operating. VAV boxes are not operating correctly. Classrooms are not being supplied the code required amount of outside air (IMC Table 403.3). Overheating and stuffiness in classrooms is a common complaint and is a result of less than standard ventilation rates and poorly operating controls. A small classroom on second floor, Room 215, is not supplied any ventilation air as the room was intended to be storage.

**Deficiency category:** RR, C (IMC Table 403), E, F

**Remedy**  
Refurbish AHU with variable speed premium efficient motor. Refurbish relief air discharge ductwork. Replace all 32 VAV boxes with modern VAV terminal boxes. Replace relief air cap. Extend ventilation air with VAV box for Room 215. Install diverting vanes in unit to prevent stratification of outside air in order to prevent freezing of the heating coil. Clean AHU and all ductwork. Recommend extending ductwork to Rally room area to supply ventilation air from main system. Perform AHU upgrade in conjunction with control DDC upgrade.

**Estimated Construction Cost:** $181,100
Deficiency
0823-2 Multipurpose Room Fans
The Multipurpose Room fans are 31 years old and past their service life. They are no longer capable of maintaining sufficient heat the Multipurpose Room. The fan units are constructed in such a way that access for maintenance of the units is difficult.

Deficiency category: RR.

Remedy
Replace the two fan units with modern fans with premium efficient motors. Extend ductwork to supply old stage area. Perform fan unit upgrade in conjunction with DDC upgrade.

Estimated Construction Cost: $159,400. This cost does not include DDC upgrades.
Deficiency
0832-3 Exhaust Fans EF-1 & EF-3
Exhaust fans are 23 years old and past their service life. The exhaust flow has been diminished due to fans not being cleaned.

Deficiency category: RR.

Remedy
Replace EF-1 and EF-3.

Estimated Construction Cost: $7,200
Deficiency
0832-4 Basement IT Office Ventilation
The area does not have any ventilation as required by code.

Deficiency category:  C, IMC Table 403

Remedy
Extend ductwork to IT office area with new VAV terminal box.

Estimated Construction Cost:  $5,800
Deficiency
0823-5 Emergency Generator Room Ventilation
The Emergency Generator Room overheats. The propeller fan installed by school district maintenance staff is a temporary fix.

Deficiency Category: F

Remedy
Install a cabinet fan to exhaust air out of room controlled by electric room thermostat.

Estimated Construction Cost: $5,800
0824 Ventilation Distribution – Ducts, insulation, diffusers, dampers, etc.

The ductwork distribution is made of galvanized sheet metal. Interior of ductwork was observed to be dirty.

See 0823 for further discussion, deficiencies, and remedies.
0825 Cooling Systems – Cooling system equipment and distribution

A ductless split air conditioning system is located in the basement server room of the District Administration/Community Schools area. The condenser is located outside in a fenced area on the west playground.

Condition of the AC unit is fair.

AC unit remaining life expectancy: 10+ years

No deficiencies noted for this building system.
0828 Controls – Heating and ventilation controls

The building was fully converted to pneumatic controls in the 1982 renovation. During the late 1980’s a direct digital control system was installed in the fan room for partial DDC control. All room thermostats and automatic valves are pneumatically controlled.

Condition of the control system is poor and has reached its service life.

Control systems remaining life expectancy: 0-5 years
**Deficiency**
0828-1 Control System Upgrade
Pneumatic controls are antiquated and past their service life. The DDC system originally installed needs to an upgrade to a modern DDC system.

**Deficiency category:** RR, F

**Remedy**
Complete upgrade of pneumatic controls to facility wide direct digital controls compatible with district wide system.

**Estimated Construction Cost:** $435,000