### 3.5 STEAM AND HOT WATER EXISTING SYSTEM

The boiler plant in the supply center consists of three natural gas-fired fire tube boilers. The two larger boilers, 200 BHP, service the building HVAC heating and domestic water heating loads. The third smaller boiler, 125 BHP, meets the kitchen equipment hot water demands. The boilers also incorporate flue gas recirculation to lower pollution levels. $NO_X$ levels are held to 30 parts per million due to this configuration.

A combination deaerator and condensate storage tank is used to provide feed water to the boilers. Three active feed water pumps operate continuously with feed water valves located on the boilers. The feed water valves are controlled by level sensors so that minimum water levels are met to avoid potential hazards.

As stated above, the steam boilers produce 40 psig steam to service kitchen equipment loads, such as dishwashers. However, hot water for HVAC heating is also produced by these boilers. Hot water is needed to serve fin tube radiators, VAV box reheat coils, and cabinet and horizontal unit heaters. The hot water is produced by conversion of low pressure steam in two (one duty, one standby) shell and tube heat exchangers. Two hot water pumps with VFDs distribute the hot water to the HVAC equipment.

## 4.0 ASHRAE STANDARDS APPLICATIONS

This section includes summaries of compliance evaluations for the existing mechanical systems at the supply center for ASHRAE Standard 62.1-2004 and ASHRAE Standard 90.1-2004.

### 4.1 ASHRAE STANDARD 62.1 VENTILATION REQUIREMENTS

ASHRAE Standard 62.1-2004 Table 6-1 provides minimum ventilation rates for breathing zones and governs the design outdoor air requirements of the Supply Center. Table 6-1 includes a list of occupancy categories and the required minimum outdoor air rates per person and per square foot for those spaces.

The Ventilation Rate Procedure uses a series of equations in conjunction with tables found in Standard 62.1 which calculate the amount of ventilation air required for each space based on the it's use, occupancy, and floor area. This procedure then calculates the amount of outdoor air required for each AHU to intake in order to ensure that each space receives at least the minimum amount of outdoor air. Ventilation rates calculated for a compliance check are summarized in Table 4-1 shown below. The table illustrates the amount of outdoor air each AHU is to intake in order to comply with the standard and the

amount of outdoor air each AHU is scheduled to intake according to the design documents provided by H.F. Lenz Company.

**Table 4-1 Ventilation Compliance Summary**

| AHU | ΣVOZ | MAX ZP | MIN OA REQ. (VOT CFM) | OA SUPPLIED (CFM) | COMPLIES WITH STD. 62.1 |
|---|---|---|---|---|---|
| 1 | 1124 | 0.1 | 1124 | 1150 | YES |
| 2 | 795 | 0.14 | 795 | 1150 | YES |
| 3 | 1957 | 0.53 | 3215 | 3640 | YES |
| 4 | 1817 | 0.52 | 3008 | 5585 | YES |
| 5 | 833 | 0.26 | 1041 | 3000 | YES |
| 6 | 1133 | 0.30 | 1416 | 13500 | YES |
| 7 | 549 | 0.29 | 686 | 3000 | YES |
| 8 | 335 | 0.09 | 335 | 7400 | YES |
| 9 | 943 | 0.38 | 1348 | 1000 | NO |
| 10 | 849 | 0.51 | 1414 | 1125 | NO |
| 11 | 354 | 0.23 | 394 | 1045 | YES |
| 12 | 497 | 0.19 | 552 | 1250 | YES |
| 13 | 896 | 0.25 | 996 | 3000 | YES |
| 14 | 582 | 0.18 | 647 | 800 | YES |

Table 4-1 indicates that two of the fourteen air handlers do not comply with ASHRAE Standard 62.1 – 2004. The reason for the non-compliance is that the occupancy type assumed for certain areas, such as boys and girls fitting rooms, are assumed retail spaces which differ from the original design. Table 6-1 in Standard 62.1 requires 7.5 cfm per person and 0.06 cfm per square foot of ventilation air supplied to these spaces. The original design of the supply center did not use any values on a per person basis. This proves that the original design calculations produced smaller amounts of ventilation air than what Standard 62.1 recommends.

There are significant over ventilation results that Table 4-1 illustrates. These AHUs are 100% outdoor air units for make-up when the kitchen and loading dock areas are in operation. The units must provide enough air to meet the thermal loads and to maintain space pressurization. The resulting actual outdoor air flow rate proves to over ventilate the spaces when compared to the value calculated using Standard 62.1.

### 4.2 ASHRAE STANDARD 90.1 COMPLIANCE SUMMARY

ASHRAE Standard 90.1-2004 provides minimum requirements for the design of energy efficient buildings. Section 5 of Standard 90.1 specifies requirements for

an energy efficient building envelope and is used as the basis for the calculations.

Standard 90.1 provides two methods for checking building envelope compliance, the Prescriptive Building Envelope Option and the Building Envelope Trade-Off Option. According to the standard, in order to use the Prescriptive Building Envelope Option the total vertical fenestration must not exceed 50% of the gross wall area. Also, the total skylight area can not surpass 5% of the total roof area. The supply center, however, contains vertical clear story windows not horizontal skylights. Therefore, the clearstory windows' areas are accounted for in the vertical fenestration calculation. Incase either of the two stipulations are not satisfied, the Building Envelope Trade-Off Option is used for determining envelope compliance.

**Table 4-2 Percent Vertical Fenestration Breakdown**

| TOTAL GLASS AREA ($FT^2$) | TOTAL WALL AREA ($FT^2$) | % TOTAL VERTICAL FENESTRATION |
|---|---|---|
| 2600 | 30,500 | 8.5% |

Table 4-2 illustrates that the total glass area for the supply center is less than 50% of the total wall area verifying the use of the Prescriptive Building Envelope Option for the Standard 90.1 compliance check.

The Milton Hershey School New Supply Center, located in Hershey, Pennsylvania, falls under the climate zone 5A according to Table B-1 in Appendix B of the Standard. Table 5.5-5 in the Standard is used to determine building envelope compliance and breaks down into three sections; residential, nonresidential, and semi-heated. The supply center falls under the nonresidential section. The portions of Table 5.5-5 examined are as follows:

- Roofs, Walls, and Floors
  - Compliance based on the assembly maximum U-value or insulation minimum R-value.

- Vertical Glazing % of Wall
  - Compliance based on the assembly maximum U-value for both fixed and operable windows.
  - Compliance based on the assembly maximum solar heat gain coefficient (SHGC) for either case of the glass facing the north or all directions.

Construction documents provided by H.F. Lenz Company and the architectural specification provided by Spillman Farmer Architects indicate the R-values used for wall and roof insulation. The two design documents also provide the U-value

for the windows as well as the solar heat gain coefficient which are both used in checking for fenestration compliance with Standard 90.1. Tables 4-3 and 4-4 compare the requirements for building envelope compliance dictated by Standard 90.1 to what is actually designed. As the tables indicate, the New Supply Center complies with ASHRAE Standard 90.1 for an energy efficient building envelope.

## Table 4-3 Building Envelope Compliance Summary

| | ROOF (INSULATION ENTIRELY ABOVE DECK) INSULATION MIN R-VALUE | | WALLS (METAL BUILDING) INSULATION MIN R-VALUE | | FLOORS (SLAB ON GRADE) UNHEATED |
|---|---|---|---|---|---|
| **Required (ASHRAE 2004)** | R-15 Continuous Insulation | | R-13 | | N/A |
| **Installed** | 3" Thick | R-18.5 Continuous Insulation | 6" Thick | R-19 | N/A |
| **Compliance** | **Complies** | | **Complies** | | **Complies** |

## Table 4-4 Fenestration Compliance Summary

| % VERTICAL GLAZING 0-10% | ASSEMBLY MAX U-VALUE (FIXED WINDOWS) | ASSEMBLY MAX SHGC (ALL ORIENTATIONS) | COMMENTS |
|---|---|---|---|
| **Required (ASHRAE 2004)** | 0.57 | 0.49 | Windows are double pane (1/4" thick glass each) insulating float glass with Low-e coating |
| **Installed** | 0.35 | 0.40 | |
| **Compliance** | **Complies** | **Complies** | |

The existing major mechanical equipment at the supply center all meet the minimum efficiency requirements outlined in Section 6 of Standard 90.1-2004. This includes the building's chillers, boilers, and cooling towers. Any new equipment analyzed in the mechanical systems redesign must comply with these same requirements.