NEW YORK CITY
SCHOOL CONSTRUCTION AUTHORITY

ARCHITECTURE & ENGINEERING DEPARTMENT

2005-2009 FIVE YEAR CAPITAL PLAN
PROGRAM CATEGORIES
HVAC

AGENDA

LOCATION: Boardroom

DATE: Thursday – Nov.4, 2004

PRESENTERS: Bill Benson, Gary Krishnan

CONTENTS:

HVAC CATEGORIES OF THE FIVE YEAR CAPITAL PLAN

- **Climate Control**
- **Heating Plant Upgrade**
  - **Gas Service: See P&D**
  - **Heating**
  - **Heating Plant**
  - **Ventilation**
  - **Air Conditioning**
- **Kitchen**

- **Piping**
  - **Cold and Hot Water: See P&D**
  - **Sanitary: See P&D**
  - **Storm: See P&D**
  - **Sprinkler: under HVAC discipline**
- **Toilet Rooms**

NON-HVAC CATEGORIES OF THE FIVE YEAR CAPITAL PLAN THAT INCLUDE HVAC WORK

- **Room Conversions**
- **Upgrades to Auditorium, Gymnasium, Libraries, Science Labs**
- **Roofs/Windows**

GENERAL COMMENTS

PNEUMATIC TESTING METHODOLOGY

CLIMATE CONTROL/HEATING/VENTILATION PROJECT GUIDELINES

1987 ASHRAE SYSTEMS & EQUIPMENT HANDBOOK: EQUIPMENT SERVICE LIFE

RELATED DESIGN REQUIREMENTS

SAMPLE SCOPE REPORT FOR PS 180M

<u>DISCUSSION:</u>

HVAC CATEGORIES OF THE FIVE YEAR CAPITAL PLAN

Page 9 shows a page taken from the 2005-2009 Five-Year Capital Plan (PS180 in Manhattan for example), and illustrates how the categories are organized.

- **Climate Control**

  See the Climate Control/Heating/Ventilation Project Guidelines that address the items that should be considered when investigating repairs/replacements to the "Climate Control" system. See the Pneumatic Testing Methodology that defines the testing of the backbone pneumatic system.

- **Heating Plant Upgrade – Gas Service**

  The "Gas Service" category covers the possible upgrade of the gas service (both firm and interruptible lines) which may be required for a new boiler plant or burner conversion from #4 or #6 fuel oil to dual fuel #2 oil/gas burners. The P&D discipline will address these issues.

- **Heating Plant Upgrade - Heating**

  The "Heating" category would include the hydronic or steam distribution piping and terminal systems (i.e. without the central boiler systems). See the Climate Control/Heating/Ventilation Project Guidelines which cover the items that should be considered when investigating repairs/replacement to the "Heating" category.

- **Heating Plant Upgrade – Heating Plant**

  The "Heating Plant" category covers the boilers themselves, i.e. the central systems (and does not include the distribution piping and terminal systems). See attached scope report for PS180M which includes the items to consider when evaluating the central "Heating Plant". Additionally refer to related HVAC Design Requirements 6.2.9, 6.2.13, 6.2.14, 6.2.15, 6.2.16, 6.2.18, and 6.2.19.

  Note that burner replacement and boiler replacement projects are to have the system run 24/7 as detailed in HVAC Design Requirement 6.2.19 and burner Specification Sections 15592 and 15593.

  The scope and design documents shall call for a new chimney liner if the tightness of the existing chimney is questionable. The breeching (existing to remain or new as required) and chimney (existing if it appeared in satisfactory condition or with new liner) shall undergo a smoke test after the Heating Plant Upgrade construction work is completed. Scope and Design documents shall highlight the necessity of this smoke test and shall highlight the Contractor's responsibilities as described below. The smoke test shall be performed in accordance with the NYCDOB Code 27-868. The Authority shall witness all smoke tests. The smoke tests shall be

performed when the school is not occupied. The boiler shall be isolated from the tests. The Contractor shall be responsible for inserting temporary plugs (plates, caps, etc.) in all openings, connecting a blower and providing instrumentation (static pressure taps, etc.). The Authority's Controlled Inspector shall provide smoke machines, smoke bombs, or other equivalent methods to fill the chimney and breeching with a thick penetrating smoke. As the smoke appears at the stack opening on the roof, such opening shall be tightly closed and a pressure equivalent to one-half inch column of water measured at the base of the stack, shall be applied. Test shall be applied for a length of time sufficient to permit inspection of the chimney and breeching. If the test shows any evidence of leakage or other defects, such defects shall be corrected and the test shall be repeated until the results are satisfactory.

Where an existing #6 or #4 directly buried tank is to be abandoned (such as in burner conversion or new boiler projects), the soil surrounding the existing buried tank shall be tested. Coordinate with the SCA's IEH group to initiate soil testing during the scoping phase. See General Comments, page 8.

- **Heating Plant Upgrade - Ventilation**

The "Ventilation" category covers repairs/replacement required to existing air handling units, return fans and exhaust fans. See the Climate Control/Heating/Ventilation Project Guidelines which cover the items that should be considered when investigating the "Ventilation" systems. See the Pneumatic Testing Methodology that defines the testing of the backbone pneumatic system.

Repairs/replacement to the air handlers for the Public Assembly (PA) spaces are handled differently for each school depending upon which specific categories have been funded and if the school in question has a separate perimeter heating system for the PA spaces. If the PA space has a perimeter heating system in addition to an air handling system, and only the "Climate Control" category is funded, only repairs/replacement to the perimeter heating system (and not the air handlers) should be addressed. If this same PA space has a separate "Ventilation" category, then repairs/replacement to the existing air handling unit should be addressed.

If the PA space only has an air handling system and does not have a separate perimeter heating system, then repairs/replacement to the air handling units should be addressed under the "Climate Control" category, even without the existence of funding set aside for a separate "Ventilation" category. This is due to the fact that the PA space is relying on the air handler to ventilate <u>and</u> heat the space, and not to merely ventilate the space (as would be the case when a separate perimeter heating system exists).

A testing firm shall test the existing air handling units and fans and verify that they have the ability to provide the required air flow rates. Architect/Engineer of Record shall engage a testing firm to initiate the tests during the scoping phase only if there is a concern that the existing units (which have not exceeded their useful service life) are not delivering the required quantities of air. See General Comments, page 8.

- **Heating Plant Upgrade – Air Conditioning**

  The "Heating Plant Upgrade" also includes an "Air Conditioning" category for some particular schools. The Capital Plan has lumped "Air Conditioning" under the "Heating Plant Upgrade" category. This category addresses repairs/replacement required to existing (not new) air conditioning systems (central chillers, distribution piping, chilled water coils in air handling units, chilled water coils in unit ventilators etc.). Special Reso A funding (not under the CIP program) would have to be set aside if a school in question is to have new air conditioning added to a particular space within the school (like the Auditorium). Reference HVAC Design Requirements 6.2.11 and 6.2.12 provided on pages 24-26.

- **Kitchen Areas and Conversions**

  This program consists of three major elements:

  - **Installation of range hood Ansul fire suppression systems**
  - **Replacement of Walk-In Units**
  - **Replacement of Kitchen Equipment.**

  Range hood Ansul fire suppression systems include heat sensors that trigger automatic distribution of chemical fire suppression material once a specified temperature has been reached. Walk-in refrigerators and freezers that are 20 years old typically have reached a state of deterioration that may require replacement. In addition, utility carts, scales, ovens, reach-in refrigerators, reach-in freezers, and hot plates may have passed their useful life and require replacement. In addition, conveyor belt systems must be removed in that they do not hold foods at a safe constant temperature throughout the meal service as required by the NYC Health Code. Although funding has not been listed in the 5 year plan for any of the 5 boroughs, work may be identified under special funding for a particular school to perform the Kitchen conversions and upgrades.

- **Piping - Sprinkler**

HVAC Design Requirement 6.3 defines the Fire Protection Design Requirements.

Wet pipe automatic sprinkler systems shall be provided in the following selected areas of a school when undergoing substantial CIP alterations:

- **Workshops**
- **Storage Areas For Combustible Materials**
- **Refuse Disposal Areas**
- **Cooling Towers**
- **Central Book Storeroom**
- **Central Shop Storeroom**
- **Computer Rooms**
- **Custodian's Supply Storeroom**
- **Custodian's Workshop**
- **Duplicating Room**
- **Refuse Collection**
- **Engineer's Closet**
- **Furniture Storeroom**
- **Receiving--General Supply Room**
- **Woodworking Shop and Storeroom**
- **Ceramics Shop and Storeroom**
- **Library Stacks**
- **Graphics Arts and Storeroom**
- **Home Economics and Storerooms**
- **Kitchen Storeroom**
- **Walk-in Garbage Refrigerator**
- **Storerooms exceeding 150 Sq. Ft.**
- **Paint Storage**
- **Spray Booths**
- **Auditorium--stage[See Note 1], wardrobe areas, dressing rooms, property and stage storerooms, proscenium arch and deluge curtain[See Note 1].**

Note 1:

The Building Code of New York City differentiates between Occupancy Group F-1a and F-1b spaces as follows:

27-255(a) Occupancy group F-1a. Includes buildings and spaces in which scenery and scenic elements are used.

27-255(b) Occupancy group F-1b. Includes buildings and spaces in which scenery and scenic elements are <u>not</u> used.

A deluge sprinkler system driven by a heat detection system is only required for F-1a stages. F-1b stages shall be supplied with a wet pipe sprinkler system.

Automatic sprinklers shall <u>not</u> be installed in elevator machine rooms, elevator hoistways, elevator machinery spaces and electrical closets.

<u>Only</u> New Building, Additions & Major Modernizations shall be provided with wet pipe automatic sprinklers throughout except those areas specifically exempted by the NYC Building Code such as boiler rooms, electrical service room, stairways, toilets, etc.

An alarm valve shall be installed on the main service and flow switches shall be installed on upper floor branches. System shall produce a waterflow alarm and be capable of indicating floor where sprinkler was activated.

- **Toilet Rooms**

  The Five Year Capital Plan indicates that many schools have funding set aside for work in the Toilets. Some schools will reopen previously closed Toilets or repair antiquated or rundown Toilets. Toilet exhaust ductwork and Toilet exhaust fans should be evaluated.

NON-HVAC CATEGORIES OF THE FIVE YEAR CAPITAL PLAN THAT INCLUDE HVAC WORK

- **Room Conversions**

- **Upgrades to Auditorium, Gymnasium, Libraries, Science Labs**

  Above related GC work may require the removal and reinstallation of existing (or replacement with new) thermostats, diffusers, grilles, registers, VAV boxes, radiators, convectors, etc.

- **Roofs/Windows**

  Roof work may require the removal and reinstallation of existing (or replacement with new) rooftop exhaust fans, air handling units, air cooled condensers, packaged rooftop unit chillers, etc. If units need to be replaced, access needs to be made. Window replacements may involve window air conditioners or be related to unit ventilators.

- **Electrical**

  All mechanical equipment changes must be coordinated with the electrical service.

GENERAL COMMENTS

- **Only <u>required</u> diagnostic testing shall be initiated during the scoping phase of a project. If the test can not be completed within the scoping phase allotted time, the test shall be completed during the design phase. The Architect/Engineer of Record shall use their judgment and assume that the items being tested require replacement or can be salvaged on a case by case basis. Scope estimate shall reflect these assumptions. Design documents shall reflect actual testing results. The scheduled scope completion date for a given project shall not be compromised if the required diagnostic testing initiated during the scoping phase is not completed by the scheduled scope completion date.**

- **The 2003 BCAS introduced life-cycle ratings because building systems are difficult to assess based on visual inspection. Under this methodology, the projected useful life for various systems was established and those exceeding their projected useful life were automatically rated a 4 or 5 (5 being the worse case condition). For example, all heating plants over 40 years old were rated a 4 or 5 automatically, even if there was no apparent deficiency. The Architect/Engineer of Record shall perform diagnostic testing on those systems which may still be salvaged despite their age. <u>Only systems where there is a reasonable chance of being salvaged are to be tested.</u> Testing is recommended if there is no clear cut evidence or facts to support a decision one way or the other. If the equipment can provide an additional 10 years of service, it may remain in place. Testing is a reimbursable expense to the Contract. <u>Where justified</u>:**

  - **Pressure test the backbone pneumatic tubing (See Pneumatic Testing Methodology)**
  - **Ultrasonically test boilers to determine if the basic boiler is salvageable before doing repairs on the ancillary systems**
  - **Employ the services of a metallurgist to analyze pipe samples and perform boiler investigations, etc.**
  - **Have a testing firm test the existing air handlers and fans (Traverse duct and measure velocities so the flow can be computed and take ammeter readings. Actual fan performance can then be compared against fan characteristic curves).**
  - **Coordinate with SCA's IEH group to test the soil surrounding a directly buried oil tank**

- **The Five Year Capital Plan must be consulted for the particular school in question to determine which specific sub-categories have allocated funding.**

- **All recommendations must be fully supported based on detailed findings. Statements such as "…the system is old and requires replacement" are not adequate.**

- **Design Managers and Senior Construction Specialists should review the Scope Reports for conformity to all of the guidelines presented herein and reject those reports that do not conform PRIOR to sending to the in-house technical reviewers. This will save time, as scope reviews usually get turned around in a week.**

- **Any life safety and hazardous conditions observed shall be reported immediately.**

New York City Department of Education
Five-Year Capital Plan
Fiscal Years 2005 - 2009
School Based Program
Borough of Manhattan

Region	District	School	Project #	Program Category	FY	Total
10	03	P.S. 180 - Manhattan				
			DSF0000407317	***State of Good Repair - Building Upgrade - Climate Control*** CLIMATE CONTROL	2005	313,772
			DSF0000407321	***State of Good Repair - Building Upgrade - Flood Elimination*** PUMPS	2005	85,007
			DSF0000407319	***State of Good Repair - Building Upgrade - Lighting Fixtures*** LIGHTING FIXTURE - FLUORESCENT LIGHTING FIXTURE - HID LIGHTING FIXTURE - INCANDESCENT	2005	849,181
			DSF0000407318	***State of Good Repair - Building Upgrade - Low-Voltage Electrical Systems*** FIRE ALARM SYSTEM PUBLIC ADDRESS SYSTEM	2005	798,232
			DSF0000407323	***State of Good Repair - System Replacements - Electrical Systems*** MOTOR STARTER/CONTACTOR SWITCHBOARD:MOLDED CASE CIRCUIT BREAKER	2005	1,105,275
			DSF0000407324	***State of Good Repair - System Replacements - Heating Plant Upgrade*** GAS SERVICE HEATING HEATING PLANT VENTILATION	2005	2,210,554
				P.S. 180 - Manhattan Total:		$5,362,021
10	03	P.S. 191 - Manhattan				
			DSF0000407428	***State of Good Repair - Building Upgrade - Flood Elimination*** PUMPS	2005	50,951

* Building scheduled for an Exterior Mod

M40

TOTAL P.01

PNEUMATIC TESTING METHODOLOGY

The purpose of the following tests (to be initiated during the scoping phase of a project) is to determine if the existing (possibly salvageable) pneumatic system should be repaired, or if the pneumatic system should be abandoned/demolished and replaced with a DDC system. Note that should the decision be made to replace the existing pneumatic system with a DDC system, a networked Building Management System (BMS) with a school operating console is <u>not</u> to be provided. The DDC system only entails installing a local electronic thermostat and control valve system.

No backbone testing shall be performed if a correctly functioning compressor (existing compressor or a replacement one used for the test with the thermostats, control valves, etc. installed) does not cycle more than 50% of the time. This generally indicates that the system is functioning. New installations of completely new components would require a compressor that would not cycle more than 33-1/3% of the time, but, there is more acceptable leakage for an older system. Should a correctly functioning compressor cycle more than 50% of the time, testing shall be done as per the following procedure. (This testing must be initiated during the scoping phase).

(If the existing system has not functioned for several years and appears to be non-salvageable, testing shall not be done. A DDC system shall be specified in this case. The following testing procedure shall only be done on pneumatic systems that appear salvageable.)

A. Pressure Test For Existing Lines:

The overall goal is to obtain a pneumatic system that properly pressurizes the thermostats and does not run the compressor with a greater than 50% duty cycle.

The pneumatic air distribution system consists of two components including (i) the main air header, one riser to each floor from the header and individual floor mains and MER main air piping, hereinafter referred to as the "backbone" system; and, (ii) branch air lines from room thermostats and fan system controllers to control valves and damper motors, hereinafter referred to as the "branch" system. The backbone system and branch system are collectively called the "distribution" system.

There are two types of thermostats used including single temperature systems and dual temperature systems. Single temperature systems are installed for heating only systems as part of Climate Control renovations to existing schools. Dual temperature systems are installed when central air conditioning is being added to schools and on new wings on existing schools. Single temperature systems and dual temperature systems shall undergo a pressure test on the backbone system utilizing a test pressure equal to the maximum operating pressure.

Pressure Test Procedure

Backbone Tests:

Step 1. Isolate the existing compressor and storage tank from the distribution system by closing the isolation valve and run the existing compressor to determine if it is capable of pressurizing the tank, usually to 60 or 80 psi. If the existing compressor can't achieve tank pressure, then a backbone test will have to be conducted using a replacement compressor with the same capacity. It is also an indication that the existing compressor requires replacement.

Step 2. Pressurize the distribution system by running the compressor for one hour and monitor minutes of operation and minutes of off time. If the duty cycle does not exceed 50%, and a pressure equal to the operating pressure has been measured and verified at the furthest thermostat in each distribution zone, then the backbone and branch tubing will be deemed acceptable and will not require repair. The pneumatic control system will be deemed salvageable at this point. No further testing will be required. If the duty cycle exceeds 50% then go to Step 3 to determine if the pressure leak is in the backbone system.

Step 3. This step will isolate the backbone from the branch system by removing existing pneumatic room thermostats and capping each main air supply at each room thermostat. Also, if blower systems exist and are being used, cut and cap the main air supply to each duct thermostat and other air consuming devices such as receiver controllers and temperature sensors. Before testing the backbone, the tester should attempt to find and repair backbone leaks that can be easily identified and repaired in the basement or other exposed existing backbone air piping, if any. The isolated backbone will now be pressurized using the compressor to determine if the duty cycle of the compressor would be 50% or less including backbone leakage and including the air consumption from the room thermostats and other air consuming loads. The Engineer of Record will have to add SCIM consumption of all thermostats and other air consuming loads to the measured backbone leakage rate and analytically determine if one would get a less than or equal to 50% compressor duty cycle.

If it is analytically determined that the compressor would run at more than a 50% duty cycle while making up the backbone leakage plus simultaneously making up the SCIM of the connected equipment, then the backbone will be deemed to have failed the test. The existing pneumatic system shall be abandoned/demolished and replaced with a DDC system. Engineer of Record should define what parts of the existing pneumatic system are to be demolished in the scope report (example, existing compressor, PRV station and exposed tubing with associated pneumatic thermostats and pneumatic control valves). Concealed pneumatic tubing would typically be abandoned in place.

If it is analytically determined that the compressor would experience a duty cycle less than or equal to 50%, and the operating pressure has been measured and verified at

the furthest thermostat, then the backbone shall be deemed acceptable. It may then be concluded that the leaks are in the branch system. This branch system is to be scoped to be replaced, since testing is expensive compared to the branch system replacement costs.

By starting the testing procedure early, it can hopefully be completed prior to the end of scoping. If it can't be completed, assume replacement with the DDC electronic system and avoid working on that portion of the project until testing is complete.

B. Installation Standards for the Replacement of the Branch System:

The scope report estimate shall include the costs associated with the replacement of all of the branch lines if the backbone system was deemed acceptable during the testing process.

Horizontal concealed branch tubing running within or behind walls shall be replaced with surface mounted softshell copper tubing installed in surface mounted conduit 10 feet above finished floor in classrooms, offices, gyms, playrooms, cafeteria's and other occupied rooms. If the 10ft elevation is not possible, the horizontal tubing encased in surface mounted conduit may be installed lower, but in no case less than 7'AFF. Vertical drops may be installed lower than 7ft. AFF for drops to thermostats and control valves. All such vertical drops shall be encased in surface mounted conduit.

CLIMATE CONTROL/HEATING/VENTILATION PROJECT GUIDELINES

Following is a suggested / recommended list of guidelines to be followed to optimize the work at schools with tight budgets and at the same time obtain satisfactory results.

1. **Scope of project**:

Climate control projects, in general and as a minimum, should deal with comfort issues in occupied spaces in a school building during winter. Problems associated with heating of a space, such as running wild, no heat, banging noise, etc., should be addressed. Thermostats, traps, control valves and pneumatic control system comprising compressors, dryers, PRV station, backbone and branch tubing together form the main scope. This scope is understood to cover leaking heating coils, control valves, thermostats, ductstats, damper controls, traps and strainers associated with all Air Handling Units supplying conditioned air to the spaces, including replacement of motors, belts, freezestats, etc. AHUs for Public spaces, such as, Auditorium or Gymnasium may need special attention if the main source of heating for the spaces is by AHUs (i.e. - absence of perimeter heating). In this case any problems in those systems may also need to be included in the scope and brought to attention of the Manager; replacement of a motor / drive may not need filing with D.O.B.

Unit Ventilators: functioning / condition of these units should be noted; these units are not expected to be replaced, though, if they are functioning as UVs, they may need cleaning / servicing of fans and dampers, controls, etc.

Pneumatic controls for occupied spaces and self-contained thermostatic valves for radiators in corridors, stairways, toilets, etc., is the preferred arrangement. Unit heaters / cabinet heaters are controlled by electrical thermostat and are also equipped aquastat and F & T traps on the return line.

The temperature of condensate returns from the system indicate general condition of the traps; returns above 190 ^{0} F, indicate possible required trap replacements; returns above 200 ^{0} F may require a detailed investigation to identify the location of a possible cross connection between steam and return piping without traps, etc. Supply riser connections taken from steam mains in basement with proper pitching do not need to be trapped as long as the ends of mains are dripped and trapped.

Any replacements of items, say within the past five (5) years, by D.O.E. Central shops or by C.I.P projects, should be given due consideration in developing a scope.

2. **Custodial / School staff interview**:

A discussion with school Custodial staff is the first step to assess the functioning of the existing system with associated problems, if any. Occasionally interviewing of classroom teachers as to comfort levels may elicit some useful information. The information gathered should be recorded and it becomes an important basis for scoping. In addition, the BCAS reports can provide some useful information.

3. **Survey / Observation:**

There is no better way than to observe the system than in operation; this may not be possible all the time. A walk through the school is absolutely necessary to assess the extent of work necessary. If more than 25 % of system temperature system components – traps, thermostats, etc. - are not functional, then replacing all the traps, thermostats, etc., seem to be appropriate. Check to see if rebuild kits are available for the thermostats and traps. This should only be investigated if the traps are within 15 years of age. Check to see if the pneumatic valve itself may remain in place by merely replacing the valve operator.

4. **Review of drawings in Alchemy**:

Information regarding existing system - gravity return, wet return, vacuum system, one- / two-pipe system - etc., might be available in the files. But most of the systems might have been converted to vacuum / two-pipe return system over a period of time. Depending on the system that exists, an appropriate scope of work should be developed. The present standard is vacuum return system for the returns from radiators / convectors. Note that conversion from one-pipe / wet return / gravity system, etc., to two pipe vacuum return system require related additional changes to system components (such as the removal of thermostatic traps at the radiators if converting to a vacuum system), which should all be effected for proper functioning of the system.

5. **Pneumatic system:**

The pneumatic system has been found to suffer from various defects - leaks, moisture, oil and clogged tubing, insufficient air pressure at the control components, etc., - which could affect the proper operation of the controls. The Engineer should observe the system – compressors, dryers, etc., – in operation and based on information gathered and provided by Custodian should decide whether detailed testing of the backbone system is warranted during scope and design or could be required at the time of construction. The pneumatic system should be blown-out and thoroughly cleaned, using chemicals, if necessary.

6. Unit Ventilators:

Based on the existing usage of the UVs, scoping is suggested. If there are fresh air intake openings, then the fans, motors, filters, damper & damper controls should be checked and restored to operating condition. In most schools, the openings in walls / windows have been blocked / or not used in the way there were designed; in such instances, if pneumatic control valves exist, then they may need replacement. Addition of pneumatic control valves now, may not be feasible or may not be necessary. If the heat from the unit is significant and affects the comfort level, then addition of pneumatic control valves may need to be considered.

7. General recommendations:

Refer to the following list of recommendations for developing design documents for climate control/heating/ventilation projects. Feasibility, budget constraints and other limitations may also dictate the extent to which some of the recommendations can be implemented. A sincere effort to provide a satisfactory temperature control and heating system for the schools is the goal.

a. Pneumatic and thermostatic control valves must be sized to suit the flow, the steam pressure at inlet, pressure drop, CV of valve, etc., wherever feasible; control valves must be at least one pipe size less than connected piping; provide eccentric reducers; ¾” valve should be fine in most cases.
b. Control valves installed in gym, corridors, stairwells, toilets, etc., should be provided with pipe mounted integral guards of the type supplied by Brooklyn Guard, Inc.
c. Individual control / trapping of radiators, where multiple radiators exist in a space, is preferred. If the radiators are piped in series presently, modify piping to provide a gate and control valve for each radiator for isolation and better control. Provide new supply branch piping to and condensate return piping from each radiator if room exists for new piping.
d. Select / size pneumatic control valve models so that they can fit within the convector enclosures, if any.
e. Re-configured spaces may require additional thermostats or relocation of thermostats; check for such conditions, while surveying a project.
f. Steam supply risers: there is no need to provide new F & T traps on existing risers if the take off from mains is properly pitched and end of the mains are trapped. Remove and replace existing traps and strainers.
g. There is no need to provide pneumatic control valves on risers; the existing ones, if any, may have been provided for zone control, which is obsolete now that each individual space is provided with control.
h. Unit heaters: no need to provide control valves; replace F & T trap; check for existence / proper functioning of aquastat on condensate return pipe and electric thermostat to control fan. Reference spec section 15836.
i. Near radiators / convectors, provide copper tubing in steel braids to prevent tubing damage / vandalism.

j. Pneumatic controls, if they exist in spaces such as corridors, may be left in place, if they can be repaired; no need to change to self-contained thermostatic valves.
k. Removal and re-installation / replacement of riser casings: this may be required in connection with asbestos abatement or modification of the run out piping near radiators. Review and include in specifications, as required.
l. Check with Custodian / Fireman on any existing problems, such as leaking radiators, cold class rooms, knocking problems, leaking / frozen heating coils at air handling units and radiators without protective shield, etc.
m. Any corroded, leaking condensate piping (most likely in basement), observed or brought to attention by Custodian should be included for replacement. Also, any buried condensate return piping should be replaced, preferably above ground, or located in trenches with removable covers.
n. Inoperative, fresh air intake pneumatic damper actuators may fall within the scope of this project; check with Custodian and include as needed.
o. Indicate sizes of all valves, traps, heating coils, etc.
p. A schematic plan of the building showing various spaces is recommended in addition to equipment schedule.
q. Checkout existence of thermostats in rooms which might have been re-configured / modified.
r. Flush the system, discarding all condensate to get rid of debris and scale from the system before replacement of traps and valves.
s. Recommend phasing to work on all radiator traps / control valves served by a riser at the same time, to avoid the problem of debris in the new installation.
t. Note <u>adding</u> (compared to replacing one) freezestat at the end of pre-heat coils requires related electrical work to de-energize fan and sound an alarm on the local control panel. Refer to spec section 15985.
u. Observe / Check with Custodian and record the condensate return temperature before renovation so that this can be compared after the project is completed.
v. Indicate on plan, particularly, for thermostats shown in public spaces, what equipment they control – such as Re-heat Coil – A (Gym blower), etc.
w. Any work on existing fans, motors, pulleys, belts, etc. shall explicitly state that fan RPM / performance – design CFM, s.p., etc., - will continue to be same as existing. Any new motors shall be properly sized and provided with soft starting device, particularly when changing from flat belts to V-belt operation, to avoid any operational problems.
x. Check with Plant Managers / Custodians regarding salvaging items of their interest – such as thermostats, motors, etc., - that are in fairly good condition.
y. When the projects are completed, it is expected that the condensate return temperatures are within acceptable range – 160 – 180 ^{0} F; to this end, effort should be made to identify any cross connections between steam supply and return piping without trapping and take corrective steps, particularly, when the existing system is not a vacuum return system.
z. All piping changes – particularly in corridors, toilets, etc., - should be ADA compliant; i.e. should not project out into aisles and become a trip hazard.
aa. Have an asbestos survey performed and include asbestos abatement in the specifications.

8. Equipment access:

Access / door openings to deliver duplex compressor unit to the desired location should be investigated and identified on plan. If field assembly is contemplated, it should be stated in the drawings.

9. Scoping:

Scope should be developed and submitted to the Manager for review based on information collected as described in paragraphs 1 through 8, with estimated cost for the project.

10. Design implementation:

The Engineer -of - Record should be able to justify the final design with survey reports / facts / feasibility studies, etc., during QC review meeting.

11. Cost Estimate:

Provide as accurate a cost estimate as possible for every project, for proper evaluation and budgeting at scoping and after the final design is completed.

12. Salvageable items:

Contact Plant Manager / Custodian to check whether they will be interested in salvaging items that have determined to be removed – compressors, motors, thermostats, etc. Indicate a list of items for Contractor to deliver to Custodian.

13. Phasing during construction:

Note, that functioning of the school is not to be disrupted on any account; discuss with Principal / P.O. and have a phasing plan developed for the project. The phasing plan becomes part of bidding document for the Contractor to follow; it also affects project duration, cost, etc.
It is recommended that all traps and control valves of radiators served by a riser be replaced at the same time before the steam / condensate is allowed to flow back to prevent debris / scales obstructing the passages again.

14. Bid documents - allowances:

Provide allowances for site related unknowns – such as total number of traps, branch tubing lengths, etc., - that cannot be exactly quantified at design stage. The allowance should specify a $ amount.

15. Specifications / drawings:

The specifications and drawings for a project should include project specific scope / information even though the final documents could be common to more than one school and many details may be common. The drawings should include as a minimum; schematic plans of the spaces and a schedule of components planned for replacement. The details shown on drawings should be appropriate for the specific project.

16. Testing after installation:

Testing and calibration of the system after installation of new equipment should be accompanied by a report.

17. As-built information:

Provide as-built drawings for information and record.

The guidelines have been developed based on experience gained from previous projects. The Engineer is expected to exercise his professional judgment and should bring unusual issues or findings to the attention of management.

1987 ASHRAE SYSTEMS & EQUIPMENT HANDBOOK: EQUIPMENT SERVICE LIFE

Table 5 Equipment Service Life[a]

Equipment Item	Median Years	Equipment Item	Median Years	Equipment Item	Median Years
Air conditioners		Air terminals		Air-cooled condensers	20
Window unit	10	Diffusers, grilles, and registers	27	Evaporative condensers	20
Residential single or split package	15	Induction and fan-coil units	20	Insulation	
Commercial through-the-wall	15	VAV and double-duct boxes	20	Molded	20
Water-cooled package	15	Air washers	17	Blanket	24
Heat pumps		Duct work	30	Pumps	
Residential air-to-air	15[b]	Dampers	20	Base-mounted	20
Commercial air-to-air	15	Fans		Pipe-mounted	10
Commercial water-to-air	19	Centrifugal	25	Sump and well	10
Roof-top air conditioners		Axial	20	Condensate	15
Single-zone	15	Propeller	15	Reciprocating engines	20
Multizone	15	Ventilating roof-mounted	20	Steam turbines	30
Boilers, hot water (steam)		Coils		Electric motors	18
Steel water-tube	24 (30)	DX, water, or steam	20	Motor starters	17
Steel fire-tube	25 (25)	Electric	15	Electric transformers	30
Cast iron	35 (30)	Heat Exchangers		Controls	
Electric	15	Shell-and-tube	24	Pneumatic	20
Burners	21	Reciprocating compressors	20	Electric	16
Furnaces		Package chillers		Electronic	15
Gas- or oil-fired	18	Reciprocating	20	Valve actuators	
Unit heaters		Centrifugal	23	Hydraulic	15
Gas or electric	13	Absorption	23	Pneumatic	20
Hot water or steam	20	Cooling towers		Self-contained	10
Radiant heaters		Galvanized metal	20		
Electric	10	Wood	20		
Hot water or steam	25	Ceramic	34		

[a] Obtained from a nation-wide survey conducted by ASHRAE TC 1.8 (Akalin 1978). Data changed by TC 1.8 in 1986.
[b] See Lovvorn and Hiller (1985) and Easton Consultants (1986) for further information.

The above ASHRAE Systems & Equipment Handbook table shows the median service life in years and is based on a nation-wide survey conducted by Technical Committee 1.8 in 1978 and updated in 1986. The above table may be used as a <u>guideline only</u> as it represents the median service life. A given piece of equipment may not have reached its particular service life based on its maintenance history and duty cycle. The equipment in each school shall be individually evaluated during the scoping process.

RELATED DESIGN REQUIREMENTS

- 6.2.9 Heating and Cooling Design Parameters (Load Calculations)
- 6.2.10 Smoke Purge Systems Layout
- 6.2.11 Air Conditioning Existing School Buildings
- 6.2.12 Unit Ventilators (Existing School Buildings Only)
- 6.2.13 Arrangement and Sizing of Equipment
- 6.2.14 Fuel Oil Storage Tanks
- 6.2.15 Cleaning and Inspection Requirements for Boilers and Chimneys
- 6.2.16 Fuel Burning Equipment
- 6.2.17 Gas and Carbon Monoxide Leak Detection and Alarm Systems
- 6.2.18 Venting of Oil and Gas Fired Steam and Hot Water Boilers and Emergency Generators
- 6.2.19 Boiler Burner Safety Considerations
- 6.2.20 Building Management Control System/Direct Digital Control BMS/DDC
- 6.2.21 Emergency Generator Fuel Tank
- 6.2.23 Ventilation Requirements for the Compressor Room of the Kitchen Walk-In Units
- 6.2.24 Kitchen Storeroom HVAC Requirements

- 6.2.26 Seismic Design Criteria (Retrofit Work on Existing Buildings Subject to the Requirements of LL17/1995 Applying to Approvals After Feb.21,1995)
- 6.2.28 HVAC Design Requirements for Special Spaces
- 6.2.29 Compliance With New York State Energy Conservation Construction Code (NYSECCC)
- 6.2.30 Refrigeration Leak Detection and Ventilation System

6.2.9 Heating and Cooling Design Parameters (Load Calculations)

Description/Design Approach:

Heating and Cooling Systems shall be designed using the following criteria:

1. Heating

   a. Fresh air requirements per occupant**;** 15 cubic feet/minute (CFM).

   b. No. of occupants based on NYC Building Code maximum occupancy per net floor area of occupied space (NYCBC Subchapter 6 Table 6-2).

   c. Inside ambient design parameters:

      72° F DB

   d. Outside ambient design parameters:

      13° F DB (Based on Wind at 15 MPH)

   e. Heating load to include:

      (1) Transmission losses through exterior envelope.

      (2) Ventilation outside air intake load, based on number of occupants in a given space plus the building pressurization.

      (3) Miscellaneous transmission losses through basement floor.

      (4) Infiltration losses with 15 mph wind (include the effects of positive pressurization)

2. Cooling

   a. Fresh air requirements per occupant**;** 15 cubic feet/minute (CFM)

   b. No. of occupants based on NYC Building Code maximum occupancy per net floor area of occupied space (NYCBC Subchapter 6 Table 6-2).

   c. Inside ambient design parameters:

      78° F DB, 50% RH (with the exception of spaces served by constant volume air conditioners with DX evaporators and air cooled condensers where the minimum relative humidity shall be 60% in accordance with the New York State Energy Conservation Construction Code).

d. Outside ambient design parameters:

89° F DB, 73° F WB; Cooling Tower (if used) @ 78° F WB

e. Cooling load to include:

1) Transmission and Solar heat gain through exterior envelope.

(2) Ventilation outside air intake load plus building pressurization.

(3) Sensible and latent heat gain per space based on DoED program occupancy requirements.

(4) Interior heat gains (i.e. lights, equipment, etc.)

(5) Infiltration losses with 15 mph wind (include the effects of positive pressurization)

6.2.10 Smoke Purge Systems Layout

Description/Design Approach:

A. Designers shall refer to and comply with the requirements of the NYC Building Code Paragraph 27-777.01(b) for rules pertaining to the function, capacity and operation of building Smoke Purge Systems.

B. A dedicated smoke purge system (i.e. one that purges the non-assembly spaces through the corridors) is preferred to one that is integrated with the HVAC units for the non-assembly spaces. This dedicated smoke purge system allows the usage of non-purgeable fusible link fire dampers in the non-purge HVAC duct systems for the non-assembly spaces. The smoke purge system shall be sized to exhaust six (6) air changes per hour (or 1 cfm per sq.ft. of floor area whichever is greater) one floor at a time. The purging of a given floor may be accomplished by zones. Public assembly spaces may be purged separately and independently from each other and from classroom/office spaces in order to downsize the dedicated purge ductwork and dedicated purge exhaust fan. If the Public Assembly spaces are separately purged, they may be purged by using the return fans of the Public Assembly air handler or air conditioning unit or by using separate Public Assembly purge fans.

C. The fire dampers and combination fire-smoke dampers necessary for operation of the purge system shall be provided with a manual override feature, which shall be activated by the NYC Fire Department at the smoke purge panel.

D. The Building Code of New York City differentiates between Occupancy Group F-1a and F-1b spaces as follows:

27-255(a) Occupancy group F-1a. Includes buildings and spaces in which scenery and scenic elements are used.

27-255(b) Occupancy group F-1b. Includes buildings and spaces in which scenery and scenic elements are <u>not</u> used.

A stage smoke purge system shall only be provided for F-1a stages. F-1b stages need not be provided with stage smoke purge system. Reference 27-546(b)(8). Verify F-1a stages with Architect prior to design.

6.2.11 Air Conditioning Existing School Buildings

Description/Design Approach:

The existing building steam and/or hot water heating systems and associated radiators/convectors shall continue to serve without modification unless an upgrade to these systems is included as part of the scope of work to add air-conditioning to the building.

Many existing school buildings contain operable ventilation systems, or central ventilation systems that could be re-activated. In some school buildings, these existing ventilation systems serve only auditoriums, gymnasiums, cafeterias etc., but in other school buildings, these systems serve general classrooms as well.

These existing ventilation systems often run on 100% outside air and as such, will be inefficient to operate in an air-conditioning mode. Determine during the early survey of the building if there are practical methods for adding return air capabilities to the existing air supply apparatus. Investigate if the existing exhaust stacks can be re-used for this purpose without eliminating any required exhaust functions. Further, investigate the condition of the existing ductwork, insulation, for the presence of asbestos and the need to install fire dampers before deciding to reuse these existing ventilation systems to provide air conditioning to this existing school building. Report the findings and recommendations during the first design review meeting where a final determination will be made jointly.

In any building where such existing ventilation systems are operational or easily reactivated and where there is agreement that these systems can be upgraded more easily than installing totally new systems, install new DX cooling coils; drain pans; air filter racks etc. into each existing air supply apparatus to be re-used for air-conditioning. Install roof mounted air-cooled condensing unit and split refrigeration piping. Note that normally these existing ventilation systems are oversized and as such, warmer air-conditioning air supply temperatures can be utilized, often negating the need to add insulation to the existing ductwork. Where the existing ventilation system serves more than one area (such as multiple classrooms), install variable air volume boxes controlled from new local room digital thermostat. Install supply duct static pressure sensor, variable frequency drives or inlet vanes on supply and return fan.

For classrooms not presently served by an existing central ventilation system or where it is deemed too expensive or impractical to re-activate such existing systems, install classroom type self-contained, DX acoustically lined unit ventilator(s) of sufficient capacity to accommodate the cooling load and the required ventilation. Unit ventilators shall be provided with steam coils to temper the outside air intake. It is assumed here that the existing terminal heating system is to remain and that this existing terminal heating system will handle the space heating loads. Mount units from the ceiling or where that is not practicable; mount units on the floor. Connect outside air ventilation connection on each unit ventilator to a modified double hung window sash fitted out with a new storm proof aluminum louver. Investigate the possibility of optionally providing new masonry openings (with associated loose lintels) in order to bring in outside air.

For existing perimeter heated auditoriums, gymnasiums, cafeterias etc. not presently served by a central ventilation system or where the existing ventilation system has been judged too expensive or impractical to reactivate, install new single zone constant volume rooftop packaged air-conditioning units. Rooftop units shall be provided with steam coils to temper the outside air intake. Each such air supply unit shall be connected to an outside air intake louver for code-required ventilation.

Investigate the need to upgrade the existing building electrical service to accommodate the new refrigeration/air conditioning apparatus.

6.2.12 Unit Ventilators (Existing School Buildings Only)

Description/Design Approach:

Existing Classrooms, Offices and similarly sized exterior rooms shall be provided with acoustically lined unit ventilators for ventilation capability if it is determined that providing a new central system is not a cost effective option. If the existing unit ventilators are of the two-pipe, hot/chilled water dual temperature type and require repair/replacement, they shall be repaired/replaced in kind. If the existing building has a functioning central heating and ventilation system (without air conditioning) together with a functioning perimeter heating system, and air conditioning is to be added, cooling only self-contained DX coil type unit ventilators shall be provided. If a new perimeter heating system is required and air conditioning is also to be added, self-contained DX coil type unit ventilators equipped with steam coils shall be provided. All self-contained unit ventilators are to be equipped with integral compressors and air-cooled condensers. Connect outside air ventilation connection on each unit ventilator to a modified double hung window sash fitted with a new storm proof aluminum louver. Investigate the possibility of optionally providing new masonry openings (with associated loose lintels) in order to bring in outside air.

Large corridors, large lobbies, assembly areas, cafeterias, and other large interior or exterior rooms shall be provided with a central ducted ventilation system.

Unit ventilator fans shall be sized to satisfy the sensible cooling/summer load using a combination of fresh air and recirculated air. Fresh air component shall be a minimum of 15 CFM per occupant.

6.2.13 Arrangement and Sizing of Equipment

Description/Design Approach:

Rooftop gas fired air conditioning units shall be provided for all spaces according to Article 6.2.0. For Capital Improvement Projects and projects where the classroom heating load exceeds 400 BTUs per hour per linear foot, boilers shall be provided. Architect/Engineer shall provide documentation including load calculations to substantiate the design if the 400 BTUH/LF criteria is exceeded.

The heating loads and cooling loads shall be calculated as per Article 6.2.9.

Heating Capacity:

VAV rooftop unit serving the classrooms shall be sized to have a capacity 10% to 20 % beyond the ventilation load. Electric heaters in the fan powered VAV boxes in the classrooms shall be sized to have a capacity 10% to 20% beyond the classroom transmission and infiltration losses. Constant volume rooftop units serving the Public Assembly spaces shall be sized to have a capacity 10% to 20% beyond the Public Assembly load (transmission plus infiltration plus ventilation). The 10% to 20% reserve capacity shall cover the duct losses and pickup loads from the night setback condition.

Boilers shall be provided with a reserve capacity equal to that as defined in the Engineering Criteria for Fuel Oil Burning Equipment of the NYC Department of Environmental Protection Bureau of Air Resources, July, 1973. Reserve capacity shall be 25% to account for piping losses and pickup.

Firetube boilers (Scotch Marine or firebox) or flexible bent tube watertube boilers shall be provided. Two boilers each sized for 75% of building total connected load, consistent with B.A.R. requirements for pick-up and piping factors, shall be provided. However, three boilers each sized for 40% of building total connected load, consistent with B.A.R. requirements for pick-up and piping factors, shall be provided if the two boiler design yields a boiler capacity which exceeds 300 BHP.

Cooling Capacity:

All rooftop units shall have a cooling capacity 10% to 20% beyond the cooling loads. The 10% to 20% reserve capacity shall cover the duct losses and pulldown loads from the night setback condition.

6.2.14 Fuel Oil Storage Tanks

Description/Design Approach:

For Dual Fuel Burner Systems Utilizing Interruptible Gas, oil storage tank for Number 2 heating oil shall be sized for 10 hours per day, 10-day operation; not less than 5,000 gallon nor more than 10,000 gallon storage capacity.

For Single Fuel Source Systems, oil storage tanks for Number 2 heating oil shall be sized as follows:

Schools Less Than 110,000 SF………...Two (2) ea. 7,500 gallon tanks

Schools Greater Than Or Equal To
110,000 SF But Less Than
Or Equal To 130,000 SF………………. Two (2) ea. 10,000 gallon tanks

Schools Greater Than 130,000 SF……..Two (2) ea. 15,000 gallon tanks

Fuel oil tanks shall not be buried but shall be located inside the building in a tank chamber.

6.2.15 Cleaning and Inspection Requirements for Boilers and Chimneys

Description/Design Approach:

Contract specifications for boiler and burner replacement projects shall set forth cleaning and inspection requirements for boiler, boiler breeching and chimney.

No boiler/burner (or vent from a gas appliance) shall be connected to an unlined chimney or to a chimney having a damaged lining. Contract specifications shall set forth lining installation and repair requirements, as appropriate.

Contract specifications for burner replacement projects shall include soot cleaning of boiler firetubes.

6.2.16 Fuel Burning Equipment

Description/Design Approach:

New boiler plants and burner conversions from # 6 or # 4 fuel oil, and fuel oil tank replacement projects shall be designed with dual fuel burners. The dual fuel burners shall be designed for interruptible natural gas as the primary fuel and No. 2 fuel oil as the backup fuel.

Designers shall coordinate with the local utility to determine gas service connection fee by first submitting a standard gas load letter.

New burners shall be dual fuel capable but use #2 oil only if the Authority does not approve of the gas service installation due to excessive connection fee. The gas train shall not be installed on boilers operating only on #2 fuel oil.

The scope of work involving repairs to the existing #6 or #4 oil burners shall be identified by the designer for subsequent submittal to and corrective action by the DoED Central Repair Shops. Repair of the existing #6 or #4 oil burners, shall not proceed beyond the scope phase. Only burner conversions from #6 or #4 fuel oil to dual fuel or single fuel #2 oil fired burners shall proceed into the design phase.

6.2.17 Gas and Carbon Monoxide Leak Detection and Alarm Systems

Description/Design Approach:

See Revised Design Requirement 6.2.17 Rev. 1, dated 1/20/05.

6.2.18 Venting of Oil and Gas Fired Steam and Hot Water Boilers and Emergency Generators

Description/Design Approach:

The venting of interruptible gas fired boiler plants (No. 2 heating oil backup) and No. 2 oil only firing plants shall be in accordance with the requirements of the Bureau of Air Resources (B.A.R.), the Department of Environmental Conservation (DEC) and the Building Code of New York City.

Double wall insulated metal vents shall not be used for boiler breeching/stack. Double wall insulated metal vents (in lieu of insulated schedule 40 black steel pipe) may only be used downstream of emergency generator silencer. All venting upstream of emergency generator silencer shall be insulated schedule 40 black steel pipe.

Single wall boiler breeching shall be 12 gauge, black steel with 1-1/2" calcium silicate insulation. Longitudinal seams shall be welded. Each breeching section shall have 1-1/2” X 1-1/2” X 3/16” steel angles for the purpose of bolting the sections together.

10-gauge stainless steel liner shall be provided on existing masonry chimneys and in the new non-combustible chase enclosures from the boiler room to the roof. New stacks shall be insulated with 3-1/2" calcium silicate.

The venting of gas-fired appliances is governed by the requirements of NFPA-54 as modified by the Building Code of New York City.

Stack systems extending through any story above the boiler room require a minimum 2-hour rated non-combustible chase enclosure from the boiler room to the roof and a penetration assembly or roof support assembly at the roof level. Rooms containing boilers or other equipment of similar or greater explosion hazard shall not be located within 50 feet of any Place of Assembly, unless separated from such Place of Assembly by minimum three (3) hour construction. In this event, chimney enclosure shall also be minimum three (3) hour fire rated.

6.2.19 Boiler Burner Safety Considerations

Description/Design Approach:

1. Each boiler shall have its own oil burner pump. The oil transfer pump shall not be used as a burner pump.

2. Provide one (1) 2 way direct acting normally closed fuel oil safety solenoid shut-off valve, one (1) 2 way normally closed fuel oil hydramotor safety shut-off valve with one (1) FM proof of closure switch similar to ASCO/General Controls HOV1A safety shut-off valve and one (1) normally open recirculation valve in burner oil piping layout. Provide Y-type strainer in burner oil piping upstream of the two (2) safety shut-off valves. Provide in line check valve in burner oil piping downstream of both fuel oil safety shut-off valves. Recirculation valve shall open when safety valves are closed. Hydramotor safety shut-off valve shall be installed downstream of the safety solenoid shut-off valve (closest to the burner). Provide two tee fittings between the solenoid oil safety valve and hydramotor oil safety valve. Branch leg of the first tee fitting shall be equipped with a test port that can be used to verify that the upstream solenoid safety valve has properly closed. Branch leg of the second tee fitting shall be equipped with a relief valve that in turn connects to the oil return lines.

3. Provide a low-pressure oil recirculation loop from transfer pump to oil storage tank. Branch takeoffs from this loop shall convey oil to suction side of the burner oil pumps. Oil discharged from relief valves and from the recirculation valve(s), upstream of the safety shut-off valves, shall be returned to the loop. Transfer oil pumps shall be sized in excess of heating plant maximum fuel consumption requirements to ensure that oil return flow to tank is maintained for all operating conditions. Each burner booster pump is nominally sized by the burner manufacturer to draw 1.5 times the burner oil consumption rate. The transfer pumps are to be sized at 1.5 times the cumulative draw of all booster pumps. Overall sizing factor for the transfer oil pump is 2.25 times the cumulative burner consumption. All burner oil consumption rates are based on providing the boiler nameplate horsepower using the manufacturer's stack loss.

4. Boiler/burner testing and start-up shall be witnessed by SCA including FID personnel. Firetube boilers shall have the Burner Management System (Flame Safeguard System) programmed to provide for a minimum of four air changes during the pre-purge period. Flexible bent tube watertube boilers shall be programmed to provide for a minimum of

eight air changes during the pre-purge period. The sequential draft damper shall be proven to be 100 % opened (with end switch) prior to the forced draft fan operation, i.e. prior to and during the pre-purge period. For forced draft fan operation only, the sequential draft damper shall also be proven to be 100% open prior to ignition (light-off). Pointer shall be provided at indicated damper position.

During burner idle periods (between load cycles) the sequential draft damper shall be at the "safe-closed" position (70^o closed out of a possible 90^o travel.)

The post purge cycle shall be for a minimum 15-second duration. A safety shutdown shall have the sequential draft damper at proven 100% opened position. Smoke alarm shutdown shall be wired into the safe shutdown circuit.

5. For existing buildings equipped with pneumatic space thermostats, the cut-in and cut-out operating steam header pressure controls shall control boiler operation during the day. For after-hours operation, a space thermostat shall be installed in the coldest space of the building where pipes could freeze. This space thermostat shall control boiler operation after hours and be set at nominally 55 ^{0}F. An outside temperature thermostat shall determine the duration time that the boilers shall operate. The header limit pressure control shall always be functional. Alternate control sequences to control the night setback temperatures include using a steam header pressure sensor or condensate return temperature aquastat in lieu of the space thermostat in the coldest room.

   New steam boilers and new hot water boilers shall be equipped with a night setback system and shall utilize digital electronic thermostats throughout the building. A 55 ^{0}F night setback temperature shall be maintained after hours.

   An emergency dial-up modem shall be set up to page the school Custodian and Department of Education Central Repair Shops in the event that the boilers go into a safe shut down mode during the after hours operation.

6. Contractor shall arrange for the training of school firemen and other custodial personnel. Training shall consist of hands-on instruction and classroom instruction and shall be conducted by qualified representatives of the equipment manufacturers. The Contractor shall videotape all training. Not less than 40 hours of supervised training shall be provided. Contractor shall also prepare a detailed, coordinated step-by-step maintenance manual covering this new equipment.

7. Gas Meter Room, if provided, shall have explosion-proof exhaust fan, light fixtures, switches, relays and accessories.

8. All burner assemblies shall be fitted with anti-drip nozzles, or equivalent devices, to prevent oil dripping into furnace following closure of the main shut-off and safety shut-off valves.

9. A gas and carbon monoxide leak detection and alarm system shall be provided as

detailed in Article 6.2.17.

10. Provide 100 mesh strainer baskets in strainers serving burner oil pumps, strainer serving transfer oil pumps, and strainers serving burner safety shut-off valves. Oil tank and oil piping shall be thoroughly cleaned, flushed, tested, etc., before being placed in operation.

11. Each burner oil pump shall be interlocked with fuel valve circuit to shut-off when burner shut-off valves close.

12. Each burner shall be arranged for dual fuel operation with interruptible gas as the main fuel and No. 2 fuel oil as backup if the gas utility hook up charges have been approved by the SCA. The burners shall be single fuel #2 oil if the SCA determines that the gas hook up charges are excessive. Adjust burner and controls so that combustion efficiency is maintained automatically at a minimum of 84% over the entire range of modulation when operating on either gas or No. 2 oil.

13. Fuel oil transfer pumps shall be wired to burner panel so that when boiler is operating on oil, the transfer pump shall start automatically. Transfer pumps shall be automatically locked out when boiler is operating on gas.

14. Provide gas safety shut-off valves on both the firm and interruptible gas mains located in the gas meter room (if provided) as shown on attached drawing.

15. Contractor shall register, file applications and obtain all related permits, certifications, and approvals required and pay all fees required by all agencies including but not limited to:

    a. Plumbing Inspection – sign off (DOB/FID)
    b. Certificate of Approval for Fuel Oil Burner Installation –(DOB/FID)
    c. Fuel Oil Storage Inspection/Tests/Permit – (DOB/Fire Department)
    d. Bureau of Electrical Controls (DOB/BEC)
    e. Environmental Protection Agency (Federal)
    f. Stationary Combustion Installation – Application/Permit New York State Department of Environmental Conservation (D.E.C.)
    g. Application for Certificate of Operation of Fuel Burning Equipment, Air Resources (B.A.R.) Tests, Inspection and Certificate of Operation – NYC Department of Environmental Protection (DEP)
    h. Hydrostatic Test of Boilers (900A) and Form 276, Equipment Use Permit – (DOB Boiler Division)
    i. Coordination, inspection and approval by the Natural Gas Utility Company
    j. Compliance with New York State D.E.C. 6 N.Y.C.R.R. Part 612, 613 and 614 with regard to fuel oil piping and storage systems

16. Contractor shall perform all tests and provide advance notice to the SCA to facilitate witnessing by SCA FID.

17. If ceiling height in boiler room precludes the installation of the 180-degree bend as shown in the Oil Piping Schematic, then a manufacturer approved back pressure regulator may be used. The fuel oil return piping from each burner oil pump shall connect directly back to the fuel oil return header as shown on the attached Oil Piping Schematic. The burner oil pump fuel oil return lines must connect downstream of the back pressure regulator to guard against the condition of the back pressure regulator being erroneously closed.

18. Per NYCBC 27-830, both the fuel oil fill and fuel oil vent lines must be located a minimum of 2 foot laterally from any building opening.

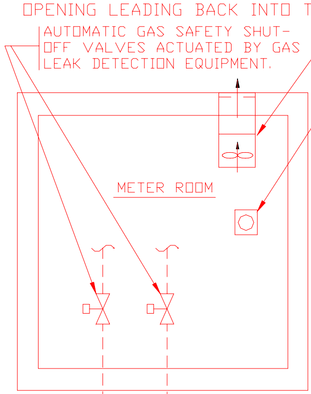
19. A normally open vent valve shall also be installed between the two safety shut off pilot valves ONLY for burners with fuel input OVER 12,500,000 BTUH (nominally 300 boiler horsepower). This pilot line normally open vent valve must be piped separately and directly to the outside. The pilot line normally open vent valve piping shall not be combined with the interruptible line normally open vent valve piping.

Relevant Conceptual Sketches:

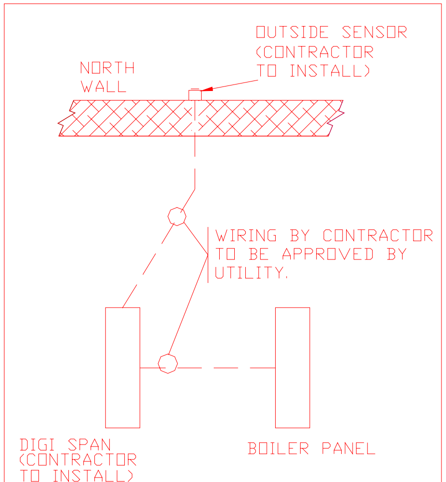
1. Gas Piping Schematic
2. Oil Piping Schematic

NOTES:

1. REGULATORS WITH INTEGRAL CONTROL REQUIRE AT LEAST FIVE (5) PIPE DIAMETERS OF STRAIGHT PIPE ON THE OUTLET SIDE UNINTERRUPTED WITH FITTINGS, ELBOWS, ETC. FOR PROPER REGULATION AND PERFORMANCE.
2. GAS VENTS FROM ONE BOILER SHALL NOT BE MANIFOLDED TO GAS VENTS FROM OTHER BOILERS.
3. NORMALLY OPEN VENT VALVE MUST BE PIPED SEPARATELY AND DIRECTLY TO THE OUTSIDE.
4. VENT PIPING FROM PILOT SYSTEM (FIRM GAS) AND MAIN BURNER SYSTEM (INTERRUPTIBLE GAS) CANNOT BE COMBINED.
5. GAS VENTS FROM GAS PRESSURE REGULATOR AND HIGH & LOW GAS PRESSURE SWITCHES CAN BE MANIFOLDED.
6. ALL GAS VENTS SHALL BE EQUIPPED WITH A UTILITY APPROVED WEATEHERPROOF VENT CAP. VENTS SHALL TERMINATE AT LEAST 10' LATERALLY FROM ANY BUILDING OPENINGS, WINDOW, DOOR OR VENTILATION AIR INTAKE DUCT. VENTS SHALL TERMINATE A MINIMUM OF 10' ABOVE GRADE. IF THE ABOVE IS NOT POSSIBLE DUE TO THE LOCATION OF EXISTING WINDOWS, THEN VENTS SHALL TERMINATE A MINIMUM OF 18" ABOVE THE PARAPET. VENTS SHALL TERMINATE AT LEAST 10' AWAY FROM ANY CHIMNEY. VENTS SHALL NOT BE ROUTED ON THE FRONT FACADE OF THE BUILDING.
7. VENT OUTLETS SHALL NOT BE LOCATED UNDER A WINDOW, OVERHANG, PROJECTION OR ANY OPENING LEADING BACK INTO THE BUILDING.

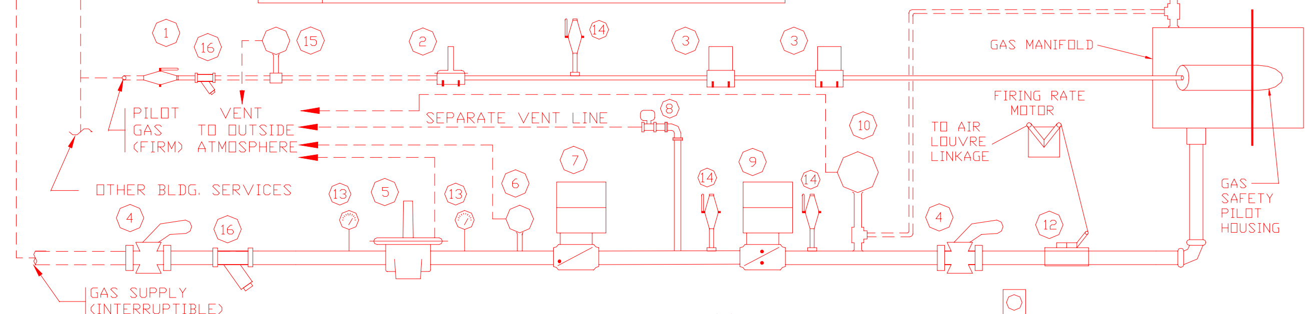


ITEM	DESCRIPTION
16	STRAINER
15	PILOT LOW GAS PRESS. SW
14	TEST COCK WITH PLUG
13	PRESSURE GAUGE
12	BUTTERFLY GAS VALVE
11	MANUAL TEST LEAK VALVE
10	HIGH GAS PRESSURE SWITCH
9	SAFETY SHUTOFF GAS VALVE W/PROOF OF CLOSURE
8	NORMALLY OPEN VENT VALVE
7	2nd SAFETY SHUTOFF GAS VALVE
6	LOW GAS PRESSURE SWITCH
5	GAS PRESSURE REGULATOR
4	MANUAL GAS SHUTOFF VALVE
3	SAFETY SHUTOFF PILOT VALVE
2	PILOT GAS PRESSURE REGULATOR
1	PILOT SHUTOFF COCK



AUTOMATIC CHANGE-OVER GAS/OIL

NOTE: DIGI SPAN & SENSOR TO COMPLY WITH UTILITY CO. REQUIREMENTS.

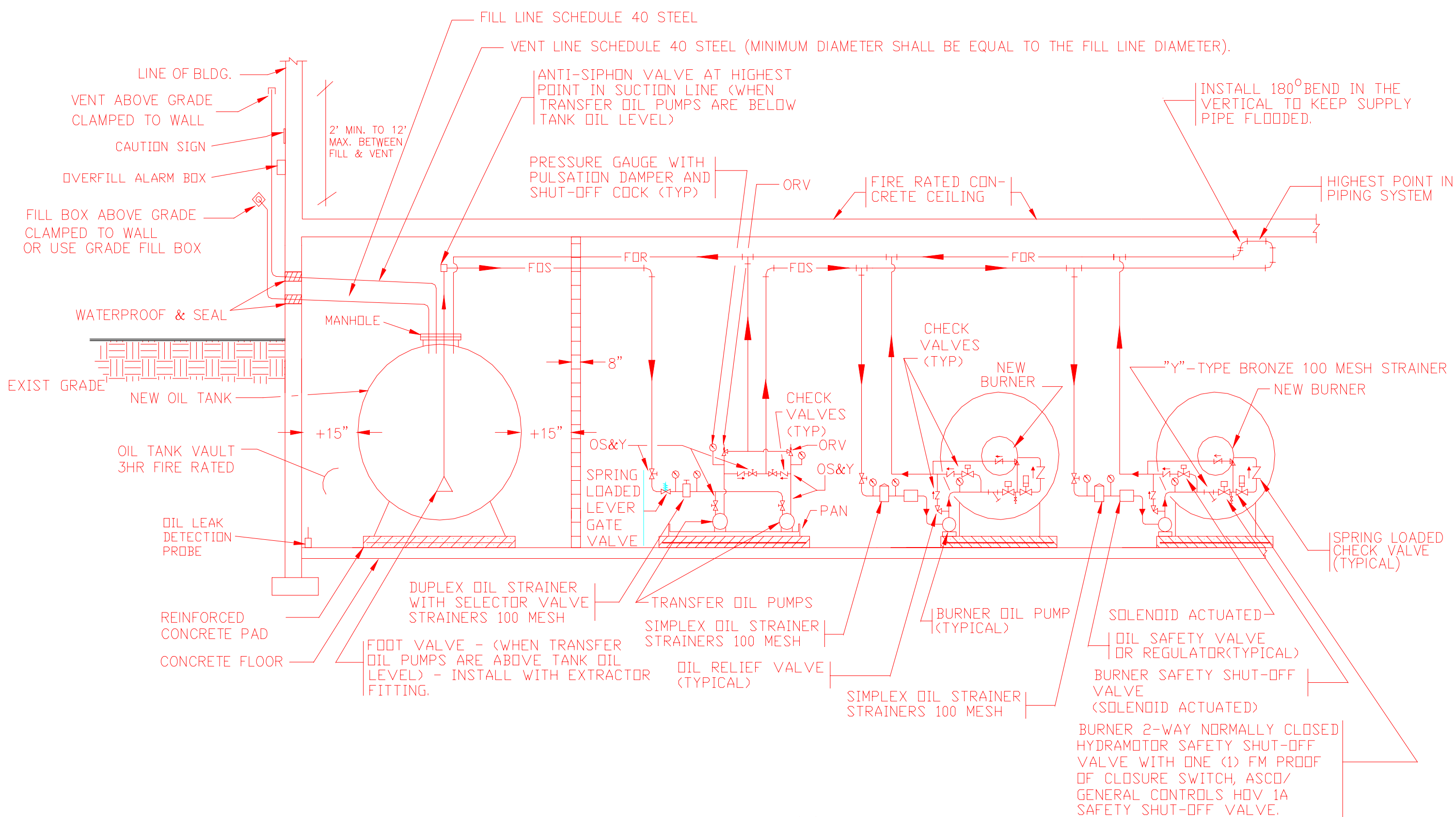


GAS PIPING SCHEMATIC

(PIPING LAYOUTS TYPICAL. ALTERNATE ARRANGEMENTS ARE SUBJECT TO SCA APPROVAL)

ATTACHMENT TO H.V.A.C DS 2.7

REVISED 12-29-00



OIL PIPING SCHEMATIC

(PIPING LAYOUT IS TYPICAL. ALTERNATE ARRANGEMENTS ARE SUBJECT TO SCA APPROVAL. ALTERNATE ARRANGEMENTS MUST INCLUDE AT EACH BURNER ONE (1) 2-WAY NORMALLY CLOSED HYDRAMOTOR SAFETY SHUT-OFF VALVE WITH ONE (1) FM PROOF OF CLOSURE SWITCH, ASCO/GENERAL CONTROLS HOV 1A SAFETY SHUT-OFF VALVE.)

ATTACHMENT TO H.V.A.C DS 2.7

REVISED XX-XX-03

6.2.20 Building Management Control System/Direct Digital Control BMS/DDC

Description/Design Approach:

Case A: New Schools, Capital Improvement Projects with building- wide new central systems and new terminal units (eg. long term Leased Building projects):

Provide BMS/DDC system with a connection to the Central Host Control Station at the Bureau of Supplies (BOS) building at 44-46 Vernon Blvd., Long Island City, NY.

Case B: Capital Improvement Projects with some new central systems and associated new terminal units (eg. Noise Abatement projects with new chiller with new unit ventilators where existing boiler system is to remain):

Provide BMS/DDC system for the new equipment only without a connection to the Central Host Control Station at the Bureau of Supplies (BOS) building at 44-46 Vernon Blvd., Long Island City, NY.

Case C: Capital Improvement Projects where existing central systems and existing terminal units are to remain and where new control systems are required (eg. Climate Control projects):

The existing pneumatic system shall be analyzed to determine if it is salvageable/repairable. It is acceptable to provide a direct digital control (DDC) system in those cases where there is a cost benefit as compared to salvaging/repairing the existing pneumatic system. The DDC system shall consist of stand - alone controllers and shall not be connected to a BMS network. There shall be no connection to the Central Host Control Station at the Bureau of Supplies (BOS) building at 44-46 Vernon Blvd., Long Island City, NY.

In all of the above cases, the digital control systems shall utilize the LONTALK protocol. DDC only control systems of Case C shall have the ability to be hooked up to a BMS network in the future. It shall be possible for Case B BMS/DDC systems without a connection to the Central Host Control Station to make a future connection to the central system.

The Authority's Design Manager shall be consulted to verify the nature of the new control system for existing buildings.

The BMS network operating system shall be the LONWORKS Network System (LNS). All controllers that drive the valves, dampers, etc. shall be LONMARK* certified. LONMARK* certified controllers shall be interchangeable.

Each Public Assembly space shall be equipped with carbon dioxide sensors that will reduce the amount of outside ventilation air supplied to the space if the space becomes unoccupied. The

VAV rooftop air conditioning units for the non-assembly spaces shall be controlled by humidity sensors that maintain 55 +/- 2% relative humidity during occupied periods and 65 +/- 2% relative humidity during unoccupied periods. The constant volume rooftop air conditioning units for the Public Assembly spaces shall be controlled by humidity sensors that maintain 60 +/- 2% relative humidity during occupied periods (in accordance with the New York State Energy Conservation Construction Code) and 65 +/- 2% relative humidity during unoccupied periods.

Control system shall utilize night setback settings. Winter temperature setpoints shall be reset to 55 degF from the 72 degF day setting.

Morning start up cycles shall close the outside air intake dampers during the winter morning pick up period. Summer morning cycles shall purge the building with dry cooler outside ambient air before the initiation of the air-conditioning cycle.

The School Construction Authority shall use the services of a Facility Management Systems Integrator (FMSI) for projects equipped with a BMS/DDC network system as noted in Case A and Case B[**] whose responsibilities shall be to:

1. Evaluate the control submissions made by the HVAC contractor's proposed Temperature Control System Contractor. FMSI shall prepare a report for submission to the Architect/Engineer of Record if the proposed Temperature Control System Contractor submission is rejected by the FMSI.

2. Oversee the installation of the field level controls by the Temperature Control System Contractor.

3. Oversee the commissioning of the field level controls as installed and commissioned by the Temperature Control System Contractor.

4. Provide the Graphic User Interface (GUI) front-end hardware and software and provide schematic control graphics according to SCA Standard Details.

5. Turn over all software routines, operation manuals and access codes.

6. Provide 40 hours of training for the Custodial staff in the operation of the control system.

7. Connect the project school to the Department of Education Centralized Host Control Station located at the Department of Education Bureau of Supplies building (as noted in Case A).

* LONWORKS controllers are acceptable in those cases where the LONMARK controllers do not operate according to the Sequence of Operations as defined in Specification Section 15985.

** Case C projects provided with only a DDC system (not BMS/DDC system) shall not require the services of the Facility Management Systems Integrator.

Architect/Engineer of Record shall edit all associated project specification sections as required to be consistent with the above.

6.2.21 Emergency Generator Fuel Tank

Description/Design Approach:

New Construction projects and designated Major Modernization projects shall be provided with 275-gallon diesel oil storage tanks that are integral with the electric generator. The new generator/storage tank assemblies shall be located outdoors within close proximity to the Electrical Service Room, in a suitable enclosure.

Existing basement mounted 275-gallon No. 2 diesel oil storage tanks and diesel oil transfer pumps (which pump up to higher floor level day tanks/generators) shall be repaired/replaced in kind for Capital Improvement projects.

6.2.23 Ventilation Requirements for the Compressor Room of the Kitchen Walk-In Units

Description/Design Approach:

The Compressor Room (if any) for the Kitchen Walk-in Refrigeration Equipment shall be provided with a ventilation system to control the room temperature. The ventilation system shall be designed to mechanically exhaust at least 1100 CFM per remote condensing unit horsepower. In Kitchens, where the Compressor Room is located in the central area of the Kitchen, the ventilation system shall include but not be limited to exhaust ductwork, exhaust louver on an exterior wall or goose neck on roof, motorized backdraft damper, exhaust fan and adjustable control thermostat. Makeup air for the Compressor Room shall not be drawn from the Kitchen. Makeup air must be available 24/7 and shall be drawn from the ambient.

The preferred alternate (other than the Compressor Room location) is to locate the air-cooled condensing units on a slab on grade or roof mounted in a secured (caged) location. A secondary preferred alternate (other than the Compressor Room location) is to locate the air-cooled condensing units for the walk-in units above the walk-in units themselves at the ceiling level. This ceiling space in turn must be ventilated.

6.2.24 Kitchen Storeroom HVAC Requirements

Description/Design Approach:

A temperature of between 50^0 F - 70^0 F shall be maintained inside the food storage rooms by using an electrical heat pump system with the outdoor unit located next to the walk-ins air cooled condensing units, if the walk-ins condensing units are mounted outside in a caged (secured) location. If not, the electric heat pump outdoor unit shall be in a separately secured location.

6.2.26 Seismic Design Criteria

Description/Design Approach:

New School Buildings and Additions and retrofit work on Existing Buildings (subject to the requirements of LL17/1995 applying to approvals after Feb. 21, 1995) shall be designed for seismic effects as per latest NYC Building Code.

New Buildings, Additions, and Existing Buildings subject to the requirements of LL17/1995 are considered as occupancy category I – "Essential Facility" for seismic design.

Generic seismic restraint details shall be shown on the contract drawing bid set. A note shall be added stating, "Details are shown to illustrate the scope of work. Contractor's registered professional engineer shall be responsible for seismic restraint locations and all details and shall reflect same in the signed/sealed shop drawings".

Seismic restraints shall be provided for the following HVAC items in New Buildings, Additions or Existing Buildings subject to the requirements of LL17/1995. Any of the listed items in an Existing Building constructed prior to the effective date of LL17/1995 that are integrated with life safety systems in the Addition, shall also meet the seismic requirements.

1. All fuel oil and diesel oil piping 1" diameter and larger

2. Sprinkler system piping as required by NFPA 13-1989 as modified by Reference Standard RS17-2 of the Building Code of the City of New York

3. Ductwork:

   a) All rectangular ductwork with cross sectional area over six (6) square feet where there is more than 12" from the bottom of the slab or structural member to the top of the duct for any portion of the duct run.

   b) All round ducts with diameters of 28" or larger where there is more than 12" from the bottom of the slab or structural member to the top of the duct for any portion of the duct run.

   c) Restrain flat oval ducts the same as rectangular ducts of the same nominal size.

   d) All smoke purge exhaust ducts, emergency generator vents, and Gas Meter Room exhaust ducts shall be restrained regardless of size and distance to above slab or structural member.

4. All HVAC piping (other than fuel oil piping, diesel oil piping, and sprinkler piping) 2-1/2" diameter and larger (1-1/4" and larger in boiler and mechanical rooms) where there is more than 12" from the bottom of slab or structural member to the top of the pipe for any portion of the pipe run.

5. Any new floor or roof-mounted equipment that exceeds 400 pounds in weight shall be seismically restrained. New floor or roof-mounted equipment that is not part of a life safety system, is not related to hazardous systems and weighs less than 400 pounds, need not be seismically restrained.

6. All new wall-mounted or suspended equipment shall be seismically restrained. Suspended fans, VAV boxes, suspended fan coil units that weigh less than 50 pounds, independently supported with a minimum of four hanger rods, and which are rigidly connected to ductwork (which in turn must be seismically braced) need not be restrained.

Seismic restraints shall be provided for the following equipment. (Equipment exclusions based on size or distance from above slab or structural member do not apply. Equipment exclusions based on weight, as defined above, do apply.)

Restraints shall be provided for the following (but not limited to):

AC Unit Chillers	Fans	Tanks
VAV Boxes	Air Compressors	Air Handling Units
Heat Exchangers	Unit Heaters	Air Separators
Condensers	Boilers	Cooling Towers
Pumps	Cabinet Heaters	Rooftop Units
Unit Ventilators	Gravity Ventilators	

All restraining devices shall have a pre-approval number from California Office of Statewide Health Planning & Development for the State of California (OSHPD), or other recognized government agency showing maximum restraint ratings. Local NYC accelerations are to be used when computing seismic inertia forces even though OSHPD of California provides pre-approval number. OSHPD only certifies that the restraint under consideration can survive the imposed loads (calculated with NYC accelerations). Pre-approvals based on independent testing are preferred to pre-approvals based on calculations. Where pre-approved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to seismic restraint designs must be stamped by Contractor's Registered Professional Engineer with at least five years of seismic design experience in New York State.

All attachments of hangers and bracing shall be positive attachments that shall be cast in place anchors, drill in wedge anchors, or a welded or bolted connection to structure. Stud wedge anchors and female wedge anchors shall have an evaluation report number from ICBO (International Conference of Building Officials) verifying their allowable loads. Double-sided beam clamps are preferred. Single-sided beam clamps are not acceptable unless they are equipped with a safety hook or strap. Note that single-sided beam clamps for bracing, with or without safety straps or hooks are not acceptable on sprinkler piping per NFPA13.

The following note is to be included on the drawings in relation to mechanical HVAC items:

"For all items that are required to have seismic supports or restraints, seismic plans and seismic restraint calculations shall be prepared, sealed, and submitted by a Professional Engineer licensed in the State of New York engaged by the Contractor. The Engineer shall provide installation supervision of all seismic supports and restraints. The Contractor's Registered Professional Engineer shall submit signed and sealed affidavit stating that the installation is in full compliance with the signed/sealed shop drawings."

6.2.28 HVAC Design Requirements for Special Spaces

Description/Design Approach:

Telecom Rooms shall be provided with ductless split heat pump system that shall maintain 65 ^{0} F space temperature 24 hours a day, 7 days a week.

Electrical Distribution Rooms (EDR) and Elevator Rooms shall be provided with a ductless split heat pump system or split air-conditioning system that shall maintain the space temperatures (24 hours a day, 7 days a week) in accordance with the equipment manufacturer's requirements. Solid-state elevator controllers typically require an air-conditioned environment. If EDR does not require split heat pump or split air-conditioning system, provide a thermostatically controlled exhaust fan to guard against excessive space temperatures.

Provide electric unit heater in the Water Meter Room and Crawl Spaces to maintain a minimum 50 ^{0} F space temperature.

Sloping top convectors shall be used in Janitor's Closets that are located at the perimeter of the building or mounted on the top floor or building slab. If gas fired rooftop air-conditioning units are used as the source of heat for the building, all convectors shall be of the electric resistance type. If boilers are used as the source of heat, convectors shall be either steam or hot water type consistent with the type of boilers used. Provide exhaust airflow of 5 minutes per change in Janitors' Closets.

Entrance Vestibules shall be provided with floor mounted recessed cabinet heaters (i.e. fan-coil units). Ceiling hung cabinet heaters may be used in Entrance Vestibules if floor space is limited. If gas fired rooftop air-conditioning units are used as the source of heat for the building, all cabinet heaters shall be of the electric resistance type. Where boilers are used, cabinet heaters shall be either steam or hot water type consistent with the type of boilers used.

Main Entrance: In addition to the floor cabinet heaters defined above, provide door air curtains controlled by door-operated switches that have an adjustable time delay. If gas fired rooftop air-conditioning units are used as the source of heat for the building, all door air curtains shall be of the electric resistance type. If boilers are used, door air curtains shall be either steam or hot water type consistent with the type of boilers used.

Science Labs and Prep Rooms shall be equipped with fixed fume hoods and portable fume hoods. Science Demonstration and Science Lecture Rooms shall be equipped with only portable fume hoods. The portable hoods are allowed to be ductless.

Acid Storage Rooms shall be exhausted 24 hours a day, 7 days a week. Makeup air for the Acid Storage Room exhaust fan may be drawn from the adjacent spaces by infiltration.

6.2.29 Compliance With New York State Energy Conservation Construction Code (NYSECCC)

Description/Design Approach:

<u>Applicability:</u>

Reference Article 101.4.2 of the New York State Energy Conservation Construction Code, (NYSECCC)

1. New Buildings

2. Newly-conditioned spaces that were previously unconditioned

3. New construction in existing buildings

4. Substantial Alterations to existing spaces and buildings: Code shall only apply to that portion of a building subsystem that it replaces; provided that 50% or more of such building subsystem is replaced, within any consecutive twelve month period. See the NYSECCC for exceptions.

5. Additions

<u>Compliance:</u>

HVAC systems shall comply with either Chapter 7 of the 2002 NYSECCC which in turn refers to complying with ASHRAE 90.1-1999, “Energy Standard for Buildings Except Low-Rise Residential Buildings”, or, Chapter 8 of the NYSECCC. The New York State Energy Conservation Construction Code requires minimum equipment performance, minimization of distribution losses, optimization of controls, and the ability to take advantage of “free cooling”, i.e. the usage of an economizer.

The following are the requirements of the NYSECCC that shall be complied with (including but not limited to):

1. HVAC equipment efficiencies and functioning shall comply with Section 803 of the NYSECCC.

2. Systems >3000 cfm shall automatically close outside air intake and spill exhaust dampers during periods of non-use.

3. Air or water economizers are required on systems with cooling capacity > 65,000 BTU/H unless the following energy efficiency ratios (EER) are met:

90,000 to 134,999 BTU/H total cooling capacity	11.4 EER
135,000 to 759,999 BTU/H total cooling capacity	10.9 EER
760,000 BTU/H or more total cooling capacity	10.5 EER

4. Two-Pipe Dual Temperature Change Over Systems shall have:

   a) 15^{0}F dead band between heating and cooling
   b) Controls to allow operation in one mode greater than or equal to 4 hours before changing over to the other mode
   c) Heating and Cooling supply temperatures at changeover point to be no more than 30^{0}F apart.

5. Part load controls for systems greater than or equal to 600,000 BTU/H:

   a) Shall use automatic resets for supply water temperature by 25% of design supply - to-return temperature differences or
   b) Reduce system pump flow by 50% of design flow using:
      1. Multiple staged pumps or
      2. Adjustable speed drives and
      3. Control valves with modulation or step down capabilities

6. Heat Rejection Equipment Fan Speed Control (for fan motors greater than or equal to 7-1/2 HP) shall:

   a) Have capability to operate fan at two-thirds of full speed or less, and
   b) Have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device

7. Systems serving multiple zones shall be variable air volume (See NYSECCC for exceptions).

8. Controls are required to reduce the primary air to each space before reheating, recooling and mixing.

9. Individual VAV system fan motors greater than or equal to 25 HP shall:

   a) Be driven by mechanical or electrical variable speed drives, or
   b) Be a vane-axial fan with variable pitch blades, or
   c) Have controls or devices resulting in a fan motor demand less than or equal to 50% of the design wattage at 50% of design airflow

10. For ductwork, seal and securely fasten all joints, longitudinal and transverse seams, and connections with welds, mastic-plus-embedded-fabric system, gaskets, mastics, or approved tapes. Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at static pressures less than 2" w.g. pressure classification.

11. Ducts > 3" w.g. shall be leak tested.

When plans or specifications bear the seal and signature of a licensed professional, such licensed professional shall also include a written statement that to the best of his/her knowledge, belief, and professional judgment, such plans or specifications comply with the New York State Energy Conservation Construction Code. Compliance with specific provisions of the code shall be determined through use of computer software, worksheets, compliance manuals and other similar materials when they have met the intent of the New York State Energy Conservation Construction Code. Such approved compliance methodologies and materials shall include, but not be limited to, the New York Commercial Energy Code software materials developed by the US DOE (with allowance for HVAC tradeoffs) and other building energy modeling software approved by the Secretary of New York State. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in sufficient detail pertinent data and features of the building, equipment and systems as governed by the New York State Energy Conservation Construction Code including, but not limited to, design criteria, exterior envelope component materials, U-factors of the envelope systems, U-factors of fenestration products, R-values of insulating materials, size and type of apparatus and equipment, equipment and systems controls and other pertinent data to indicate conformance with the requirements of the New York State Energy Conservation Construction Code.

6.2.30 Refrigeration Leak Detection and Ventilation System

Description/Design Approach:

Refrigeration (chiller) Machinery Rooms shall contain a refrigerant detector with an audible and visual alarm. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The alarm shall be actuated at a value not greater than the corresponding TLV-TWA as defined in Table M1103.1 of the Mechanical Code of New York State. The mechanical ventilation system shall exhaust air from the refrigeration machinery room (at a volumetric rate as defined in ASHRAE Standard 15, Safety Code for Mechanical Refrigeration) upon activation of the required refrigerant detector. Exhaust registers or outlets capable of exhausting the amount required shall be located near the floor unless a lighter than air refrigerant is used. When a lighter than air refrigerant is used, the exhaust registers or outlets shall be located near the ceiling. Alarm signal shall be sent to the BMS/DDC system if it is provided.