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EXISTING MECHANICAL SYSTEMS REVIEW
for
MAPLEWOOD NURSING HOME
WESTMORELAND, NEW HAMPSHIRE

January 18, 2016

Introduction:

The following report is based on our October 2015 review of existing conditions at the Maplewood Nursing Home, study of original contract drawings and related discussions with facilities personnel.

Part 1 – Existing Heating, Ventilating and Air Conditioning Systems

Original (1976) Nursing Care Building:

Heating Plant

Two (2) fuel oil transfer pump sets supply #4 fuel oil from one (1) 12,000 gal, cathodically-protected steel underground storage tank. This tank and associated piping were installed in 2006 and meet current NHDES requirements. Heavy oil is initially pre-heated by two (2) steam x oil shell and tube heat exchangers located above the oil pump sets.

Two (2) Cleaver-Brooks CB600-250 steel fire-tube boilers (pictured) each rated at 10,461,000 Btuh gross output with 70.0 GPH #4 oil produce 25# (medium pressure) steam. Each boiler is equipped with 7.5 kW electric oil pre-heaters, LP gas ignition, 7.5 HP combustion blower motors and automatic controls that reduce steam pressure to 15# in mild weather per a night setback schedule. Boilers 1 and 2, installed during original construction in 1976 and last re-tubed (fire-side tube replacement) in 2000 and 1998 respectively, are in serviceable condition. With continued annual maintenance, proper steam system chemical treatment and periodic fire-tube replacement, boiler life is indefinite.

The steam system is protected from corrosion by an automatic chemical feed system that is managed by in-house personnel. Condensed steam is collected by one (1) duplex condensate pump set and then transferred to one (1) Industrial Steam 6JS5 boiler de-aerator/feed-water system. The condensate pump set is in serviceable condition and the feed-water system, while new in 2014, appears to be subject to over-filling and unintended blow-off. Steam traps are maintained annually. Steam humidifiers located in major air handling units throughout the original building have been deactivated.

Combustion air is supplied to by one (1) wall louver/pneumatically-operated damper intake assembly dedicated each boiler. The boiler room is ventilated by one (1) large propeller exhaust fan assembly located at the ceiling/roof level.

Two (2) shell and tube heat exchangers (pictured) convert steam to heating hot water. Two (2) 15 HP base-mounted, constant speed primary pumps then supply this hot water to heating terminals located throughout the original building. Heat exchangers are original and in serviceable condition. Heating pumps are newer and are fit with high efficiency motors.

Automatic temperature controls throughout the original and AL buildings are by Honeywell Corp. and consist of the original pneumatic system (including pneumatic control valves fin tube radiation in all resident rooms) and various updates that added direct digital (DDC) control (including control of existing pneumatic actuators) to the boiler room and major air handling systems. Compressed air is supplied to the pneumatic system by two (2) compressors, including a newer vertical unit, and a refrigerated air dryer. Honeywell Corp. continues to service and maintain building temperature controls under an annual maintenance contract.

Nursing Care Units

The three (3) upper floors in the original building each house twenty-four (24) semi-private resident rooms, two (2) private resident rooms, central nurse station, common dining/day room and utility rooms. Resident rooms are heated by baseboard fin tube radiation each with a pneumatic control valve and thermostat for individual heating temperature control. Resident rooms are not permanently air conditioned. The facilities department maintains approximately thirty (30) window air conditioning units for temporary use in critical rooms when necessary. Resident rooms are ventilated by exhaust from shared resident toilet rooms and make-up air (improperly) transferred from adjacent corridors.

Two (2) Venmar 9218 rooftop heat recovery units (pictured) collect exhaust air from resident toilet rooms (via original exhaust only system duct risers) and use it to pre-temper outside air for building makeup air. Make-up air then leaves HRU's and enters two (2) Trane Voyager packaged rooftop air conditioning units. Make-up air from RTU's (cooled to whatever extent possible by these conventional units) is then ducted (exposed) down the exterior of the building to a hot water heating coil (for final tempering) then a connection to the original duct system supplying fresh air to corridors on each level. These systems, installed in 2002, are typical of early attempts to implement energy recovery i.e. much better than the original energy-intensive systems but short of a complete system upgrade needed to meet current patient health standards.

Common resident dining/day rooms are heated and ventilated one (1) unit ventilator with supplemental heating from fin tube radiation. Unit ventilators and associated pressure relief units are original, employ face and bypass (constant hot water flow) controls that invariably cause overheating during mild weather and are past their expected service lives. Each of these rooms was retrofit with one (1) horizontal split air conditioning system fan coil unit located above ceiling. Air-cooled condensing (outdoor) units associated with these systems are either located on high or on

adjacent lower roofs.

Nurse's stations on each level are served by one (1) split system fan coil unit. Air-cooled condensing units (outdoor) units associated with these original systems appear to either have been removed or never installed.

Medication rooms are each served by a Panasonic ductless multi-split air conditioning system fan coil unit. These indoor units are served by one (1) common air cooled condensing (outdoor) unit located on the high roof. This system is fairly new.

Common core utility rooms are ventilated by the original central exhaust systems with make-up air (ducted or transferred) from the corridor outside air supply systems.

Commercial Kitchen

The cook line is served by the exhaust-only island hood system (pictured) that is ducted to an exhaust fan on the high roof. This system is equipped with an automatic fire suppression system. The commercial dishwasher is served by an integral entry/exit door condensate collection system that is ducted to an exhaust fan on the high roof. These systems are in serviceable condition. A large sidewall exhaust fan with exposed ductwork was added to supplement exhaust/heat relief from the dishwashing area. Make-up air is supplied by an original 100% outside air handling unit located over the food storage area. This unit includes a hot water heating coil and split system air conditioning coil with the associated air-cooled condensing (outdoor) unit on low roof above. Controls are pneumatic. Given very warm/humid conditions in the kitchen, mechanical cooling function of this system is either disabled or non-functional.

Commercial Laundry

The commercial laundry including LP gas-fired dryers and steam boosted washers is ventilated by a heat recovery system located outside on grade. This HRU system, installed in 2002, is intended to recover heat from laundry operations and supply pre-heated make-up air to the adjacent service corridor. This system replaced two (2) original 100% outside air make-up air handling units that previously served these areas. The facilities department is presently working on an energy improvement project to enclose dryers and permit the direct introduction of un-tempered make-up air.

A second heat recovery unit located on the roof above the boiler room was installed in 2002 to reclaim heat from commercial dryer exhaust and pre-heat outside air being introduced by an updated steam heat/split system cooling make-up air system (from 1998 AL contract). These systems were troublesome and have been taken out of service.

Staff Dining, Meeting Room/Chapel

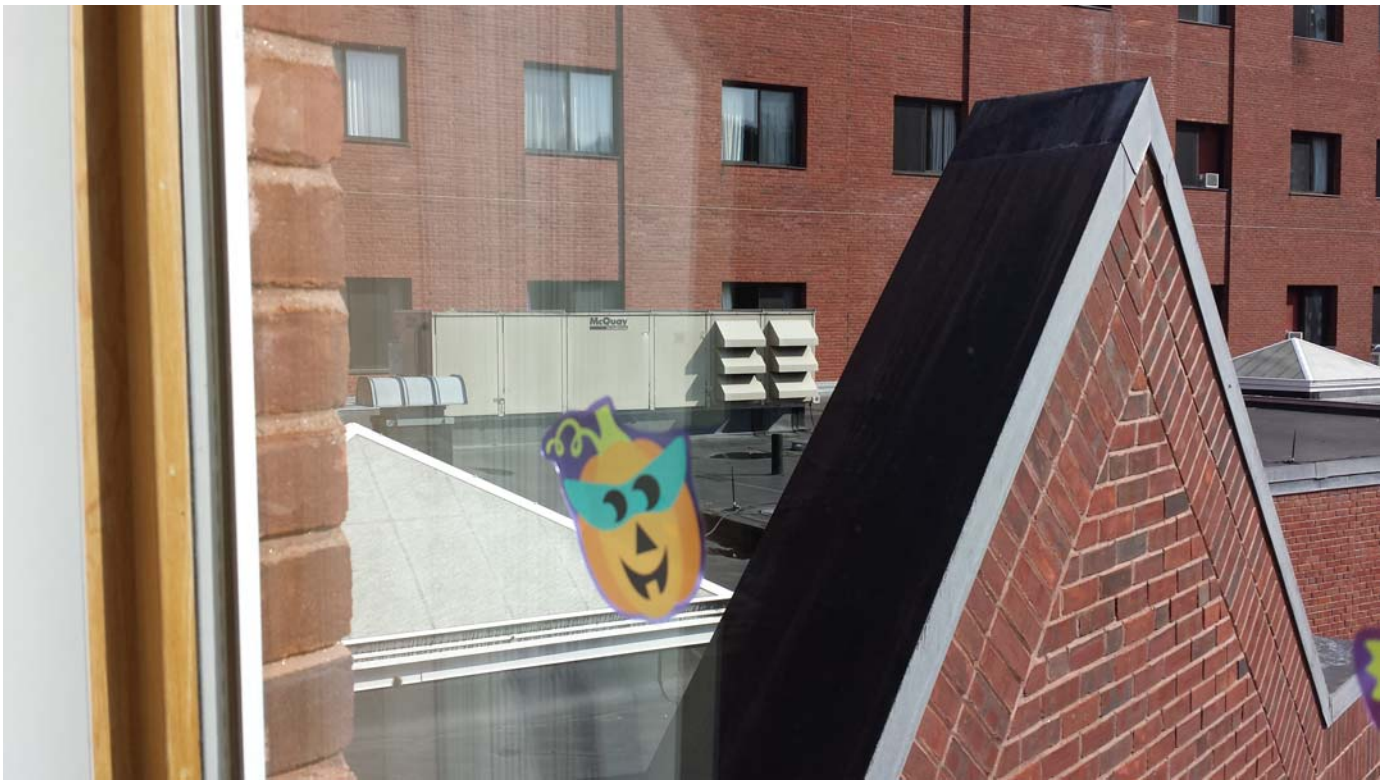
The Staff Dining room and Meeting/Chapel rooms are heated and ventilated by unit ventilators with supplemental heating from fin tube radiation. Unit ventilators and an associated pressure relief unit are original, employ face and bypass (constant hot water flow) controls that invariably cause overheating during mild weather, have very low intake louvers (requiring maintenance/snow removal) and are past their expected service lives. A window air conditioning unit (pictured) provides mechanical cooling in Staff Dining.

Salon, Medical Records, IT

The Salon, Medical Records, IT rooms and miscellaneous other offices/service spaces have been retrofit with ductless split air conditioning systems. Air-cooled condensing (outdoor) units associated with these Mitsubishi/Sanyo/Carrier systems are located on the low roof above these areas.

Activities, Physical Therapy

The first floor Activities, Crafts and Physical Therapy areas are heated, ventilated and air-conditioned by one (1) McQuay large commercial heating (hot water) and air conditioning unit located on the low roof above this area (pictured). Hot water fin tube radiation provides supplemental heating and some degree of individual control in perimeter offices. This system, installed in 1998 and serving a large area with diverse cooling needs, provides just one (1) zone of heating/cooling temperature control.



Administration Wing, Main Entrance

The administration offices, conference rooms and main entrance are heated, ventilated and air-conditioned by four (4) horizontal split system fan coil units. Hot water fin tube radiation provides supplemental heating and some degree of individual control in perimeter spaces. Air-cooled condensing (outdoor) units associated with these systems are located on the low roof above these areas (pictured on next page). These systems were part of renovations to the administration wing and replaced the original exhaust-only ventilation system.

Assisted Living (1998) Addition/Renovations

AL Mechanical Room

Medium pressure steam piped from the original boiler room supplies Two (2) shell and tube heat exchangers (pictured) convert steam to heating hot water. Two (2) 3 HP in-line, constant speed primary pumps then supply this hot water to heating terminals located throughout the addition. Heat exchangers, associated pumps and condensate set are original and in serviceable condition.

Hydrotherapy

The Hydrotherapy pool area is heated, ventilated, air-conditioned and de-humidified by one (1) Dectron split pool dehumidification system. The air-cooled condensing (outdoor) unit associated with this system is located on the low roof above administration. In-floor hot water radiant tubing provides supplemental heating in this space. These systems are in serviceable condition.

Ground Level Storage

The ground level Storage (future fit-up) and adjacent service area are heated by hot water propeller unit heaters. These spaces are ventilated by a sidewall propeller exhaust fan. Un-tempered make-up air is provided by a motorized damper-equipped louver intake assembly.

Ground Level Office, Conference

The ground level offices, a conference room and adjacent areas are heated, ventilated and air-conditioned by one (1) horizontal, central station heating, ventilating and split system air-conditioning unit located above ceiling. This bypass variable air volume (VAV) system provides two (2) zones of heating/cooling control. Hot water fin tube radiation provides supplemental heating and some degree of individual control in perimeter spaces. Air-cooled condensing (outdoor) units associated with these systems are located on the low roof above.

AL Resident Units

The two (2) upper floors in the assisted living addition each house ten (10) resident rooms. AL resident rooms are heated by baseboard fin tube radiation each with a pneumatic control valve and thermostat for individual heating temperature control. Resident rooms are ventilated via exhaust from adjacent private bathrooms. A duct system collects air from bathrooms on each level and rises to a central exhaust fan on the roof. Conditioned make-up air (with some cooling benefit) is supplied to each resident room and common corridors from one (1) horizontal, central station heating, ventilating and split system air-conditioning unit located above ceiling on each level. These systems have pneumatic controls and are equipped for outside air economizer ‘free’ cooling when outside air conditions are favorable.

AL Dining/Dayrooms

Dining/Dayrooms on each level are heated, ventilated and air-conditioned by one (1) horizontal, central station heating, ventilating and split system air-conditioning unit located above ceiling. These bypass variable air volume (VAV) systems each provide two (2) zones of heating/cooling control. Hot water fin tube radiation provides supplemental heating and some degree of individual control in perimeter spaces. Air-cooled condensing (outdoor) units associated with these systems are located on the low roof above. These systems have pneumatic controls and are equipped for outside air economizer ‘free’ cooling when outside air conditions are favorable.

Part 2 – Existing Plumbing Systems

Original (1976) Nursing Care Building:

Central Plant

Domestic cold water is supplied to the facility by a private water well system including a 250,000 gal gravity storage tank installed in 2008. Two (2) 25,000 gal underground storage tank that were part of the original water supply system have been drained and abandoned.

Domestic hot water for the original building is produced by two (2) Patterson Kelly 240181 indirect-fired steam to water heat exchangers (pictured). These units are original and in serviceable condition. Recently, one (1) State 200 gal. vertical storage tank and two stage mixing valves were installed to improve hot water temperature control. The tempered hot water system is recirculated.

Plumbing Infrastructure

Domestic cold and hot water piping throughout the original building is copper with soldered joints. Given the age of these systems, it is likely that solder used on fittings contained some amount of lead. Water piping systems, including many repaired or replaced valves are reported to be sound and functional.

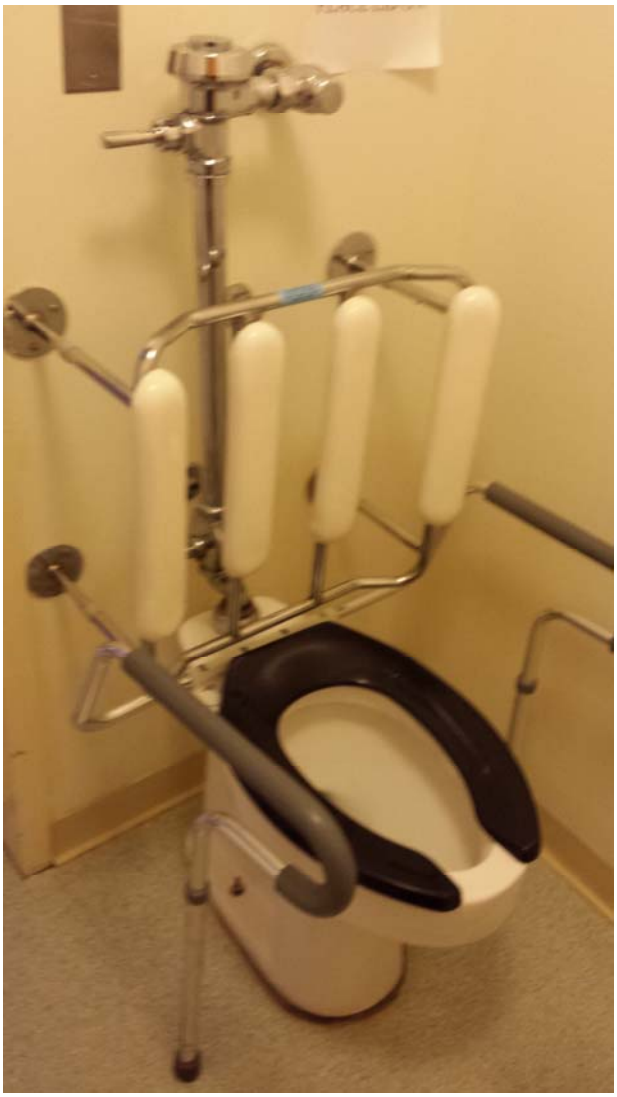
LP gas is supplied to boilers (for ignition only), the commercial kitchen and the laundry from four (4) 1000 gal aboveground storage tanks located behind the building. The LP gas piping system is reported to be sound and functional.
The sanitary waste and vent piping system serving the original building is bell and spigot cast iron.

Per review with the facilities department, many sections of the original aboveground network failed due to corrosion and/or blockage and have been replaced with sections of Sch. 40 PVC. It is very likely that significant portions of the underground sanitary network are equally deteriorated and also subject to failure.

The storm drainage piping system serving the original building is also bell and spigot cast iron. Per review with the facilities department, this system including associated roof drain assemblies is sound and functional.

Plumbing Fixtures

Plumbing fixtures and associated trim throughout the original building are a combination of original, out-of-date non-accessible fixtures that have been modified for handicap access where necessary (pictured) and more modern, accessible fixtures. Fixtures and trim have been well maintained and are in serviceable condition.



Assisted Living (1998) Addition/Renovations

AL Mechanical Room

Domestic cold water is supplied to the AL addition from the original boiler room.

Domestic hot water for the AL addition produced by two (2) Reco indirect-fired steam to water heat exchangers (pictured). These units are original and in serviceable condition. The tempered hot water system is recirculated.

Plumbing Infrastructure

Domestic hot and cold water systems, sanitary waste and vent systems and the storm drainage system serving the (1998) AL addition meet current material standards and are sound and functional.

Plumbing Fixtures

Plumbing fixtures and associated trim throughout the AL addition are modern and are handicap accessible where required. Fixtures and trim have been well maintained and are in very good, serviceable condition.

Part 3 – Existing Sprinkler System

The entire facility is protected by a wet-pipe automatic fire sprinkler system. Water is supplied to the system riser (pictured) from the 250,000 gal private gravity storage tank.

An electrically-driven fire pump located in the boiler room (pictured) boosts system pressure to required levels.

Part 4 – Additional Observations/Recommendations

1. Mechanical systems employed here generally follow the hospital-model of the original building. The physical plant including a medium pressure steam system is particularly maintenance-intensive. Also operating one (or both) 10 million Btuh steam boiler(s) and maintaining a live steam/condensate system year around results in very large standby heat losses and associated fuel consumption. That said, it, colloquially 'is what it is' and probably always will be given the very high cost of replacement.

2. The authors of an energy audit conducted in 2014 suggest that there may be some savings from de-energizing heavy oil pre-heaters and tuning boilers to fire on #2 (light) oil. Depending on relative (and constantly fluctuating) fuel costs, that may be worth investigating further.

3. The capacity/operation of the newly installed condensate de-aerator/feedwater system should be reviewed by a knowledgeable manufacturer's representative as soon as possible. Manually dumping condensate to prevent this unit from purging on high level wastes energy and continually introduces fresh, oxygenated make-up water into the steam system promoting corrosion.

4. Proper steam trap maintenance is critical to prevent live steam from passing through the system and being wasted to atmosphere through condensate receiver vents.

5. Constant (full) flow heating hot water systems serving the original building and AL addition are out of date and do not meet current energy code standards. Existing pumps should be retrofit with variable speed controls (and motors if/where needed) to automatically reduce system flow (and required pumping horsepower) during periods of light load. This would also require that 3-way control valves at all existing heating terminals be either modified or replaced to operate 2-way (i.e. open/closed, no bypass).

6. HVAC system penetrations through general construction throughout the original building should be reviewed to verify that opening protectives are either in place or a list for retrofit to maintain the fire and/or smoke rating of the building assemblies.

7. Current healthcare standards require that nursing care resident rooms be provided with a minimum of 2 air changes per hour of directly-introduced, conditioned outside air. Existing systems serving nursing care floors do not meet these standards and make-up air (with the potential for smoke) transfer from adjacent corridors is against the building code. Given available clearances above finished ceilings, it may be possible to re-configure the existing make-up air systems to supply fresh air directly into patient rooms.

8. Current healthcare standards also require that HVAC systems be able to maintain a maximum of 75F in patient rooms (effectively requiring air conditioning). Existing systems serving nursing care floors do not meet these standards. While it is our understanding that the existing building electrical infrastructure may be inadequate, retrofitting resident rooms with mechanical cooling using variable refrigerant flow (VRF) multi-split systems would be relatively straight forward.

9. Pneumatic automatic temperature controls located throughout this facility are maintenance-

intensive, error-prone (wasting energy) and effectively obsolete. Whenever/wherever possible, these controls (and associated devices) should be replaced with modern, electric/electronic controls.

10. The existing commercial cook line hood system is out of date. This system, which operates continuously up to fifteen (15) hours/day, seven days/week, should be retrofit with a dedicated, nominally tempered make-up air system and variable speed technology so that is operates much more efficiently. If/when this is done, the existing make-up air handling unit should be re-configured to reduce outside air intake (currently 100%) and greatly improve comfort conditioning within the kitchen.

11. Unless water chemistry is unusual, existing copper domestic hot and cold water systems fit with leaded solder generally remain in service.

12. All above and belowground sanitary waste and vent piping within the original building needs to be thoroughly surveyed to establish the true condition of this system. Without such a survey, pronouncing the system ‘failed’ and in need of complete replacement is premature. Meanwhile, every conceivable operational measure should be taken to protect and preserve the integrity of this piping network.