FINAL REPORT

HVAC and Electrical Systems Review

Glencoe Village Hall
675 Village Court
Glencoe, IL 60022

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G/BA #P14-0121-00

September 12, 2014

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EXECUTIVE SUMMARY

The Village of Glencoe commissioned Grumman/Butkus Associates (G/BA) to evaluate the existing conditions at the Glencoe Village Hall and to provide recommendations for heating, ventilating and air conditioning (HVAC), electrical, and plumbing improvements. All major systems in the building were evaluated as part of the study. Issues considered in the analysis include redundancy, capacity, age, physical condition, and operating problems. General descriptions of the existing conditions, identified shortcomings, and recommended corrective actions, along with associated capital costs, have been provided.

The Glencoe Village Hall was originally constructed in 1956. The building contains two stories and a basement and houses several public services, including the Public Safety offices and finance department. There is also an equipment bay and garage for Public Safety vehicles.

G/BA reviewed all of the major systems in the building and evaluated each for anticipated life expectancy. A detailed accounting of all of the equipment is included in the Exhibits of this report. The two main air handling units are original to the building and are past their expected life. There are regular temperature control issues in the occupied areas of the building and the equipment does not operate efficiently. The steam boilers are about 20 years old and are in good working order, but they are nearing the end of their expected service life. The boilers are not as energy efficient as new condensing water boilers.

To address the temperature control issues, energy efficiency, and the need to replace aging infrastructure, G/BA evaluated two different HVAC options. Both options will provide improved temperature control and increased energy efficiency and are explained in more detail later in the report.

The first option is to install a new centralized system, similar to the existing equipment. Two new air handling units will be installed to provide conditioned air to spaces. The new units will be approximately 20,000 cfm each. A new air-cooled chiller that is approximately 150 tons should be installed outside to provide cooling and two new hot water boilers should be installed to provide heating. The new boilers will be approximately 2,000 MBH. Most of the existing ductwork should be reused which will limit the disruptions in the occupied areas. Some new ductwork will be installed along with variable air volume (VAV) terminal boxes. The VAV boxes are tied to the thermostat in the space, and they vary the amount of air provided to maintain the appropriate temperature in the space.

The second option is to install a distributed system. A smaller, approximately 7,500 cfm, air handing unit should be installed as part of the distributed system. The unit will provide fresh air to the building occupants. A small heating and cooling unit will be installed in each zone. The heating and cooling units can be mounted on the wall or above the ceiling. They are connected to refrigerant piping which is connected to condensing units located outside.

Outdoor equipment will be required for both HVAC options. The outdoor equipment for Option 1 and Option 2 have similar footprints. Four locations were considered for the outdoor equipment. These locations are detailed in the attached sketch MSK-7. It is recommended that the space to the east of the Public Safety vehicle garage driveway be utilized for the outdoor equipment. The capital cost includes the cost to place the equipment on east side of the Public Safety vehicle garage driveway. It is anticipated that the cost to place the equipment at the north end of the Public Safety vehicle garage driveway would be approximately $40,000 and the cost to install the equipment on the second floor roof would be approximately $100,000.

The Village Hall currently does not have any central control of the major equipment and systems. All of the equipment has local pneumatic controls. The pneumatic controls are failing which results in poor temperature control. There is currently no way to monitor the equipment remotely. As part of this upgrade, a new building automation system (BAS) should be installed. It is recommended that a new computer based, direct digital control (DDC) BAS be installed. The system should utilize a web-based, open source front end, so that future work is not constrained to a specific manufacturer. The web-based BAS will allow staff to remotely monitor the major systems. It will notify staff if any of the equipment has an issue, or if space temperatures are not being maintained. The BAS will also help the equipment operate more energy efficiently and will simplify building operation.

A new electrical service and new electrical equipment will be required with both options. The existing electrical service and equipment is original to the building and does not have the capacity to serve the new equipment. It is an ungrounded service, and this type of system is no longer installed in buildings due to personnel safety issues and increased maintenance.

G/BA estimated the cost for the upgrades based on previous project experience, vendor prices, and published cost data. The following costs are intended to help the Village of Glencoe to budget for the recommended improvements. Final pricing will be established after the design is complete.

Option 1	
General Construction	$50,000
HVAC Equipment	$1,366,000
BAS	$160,000
Outdoor Equipment Prep	$67,000
Electrical Equipment*	$255,600
Plumbing / Fire Protection	$32,000
Subtotal	**$1,930,600**
Design and Construction Contingency (20%)	$386,120
Total**	**$2,320,000**

Option 2	
General Construction	$50,000
HVAC Equipment	$1,250,000
BAS	$160,000
Outdoor Equipment Prep	$67,000
Electrical Equipment*	$255,600
Plumbing / Fire Protection	$32,000
Subtotal	**$1,814,600**
Design and Construction Contingency (20%)	$362,920
Total**	**$2,180,000**

Table 1: Order-of-Magnitude Opinion of Probable Cost

*Electrical equipment cost estimate does not include ComEd Fees

**Total does not include taxes, fees, or contractor overhead and profit.

INTRODUCTION

In March 2014, The Village of Glencoe commissioned G/BA to review the existing conditions of the Village Hall. The goal of the study is for G/BA to present equipment upgrade recommendations. Budget costs for the required improvements to the Village Hall are also presented.

Approach Methodology

The following tasks summarize activities and methodology performed by G/BA in execution of this study:

Information Gathering

G/BA started the project with a kick-off meeting. They met with representatives from the Village of Glencoe to discuss the project scope. The existing building and equipment conditions were discussed. G/BA reviewed recent modifications performed at the building. Staff provided a list of areas with specific temperature control issues. G/BA collected and scanned record drawings for the site.

G/BA performed several site visits to review the condition of the existing equipment, collect data, and review equipment operation. During the site visits, G/BA talked to building occupants to review specific temperature control issues and concerns.

Analysis

After the information gathering period, G/BA conducted an analysis of the existing conditions. G/BA met with the Village of Glencoe staff to review potential replacement options. Several options were presented and discussed during the meeting. Two upgrade options were selected for further development.

G/BA generated proposed areas of service. Staff reviewed the sketches and provided comments. The proposed areas of service were updated and used for equipment sizing and layouts. The proposed areas of service are provided in the Exhibit section (MSK-4 through MSK-6).

G/BA met with equipment vendors to gather detailed information about each of the two upgrade options. Sketches were generated to represent the mechanical and electrical improvements. Budget-level cost estimates were provided for each recommendation.

G/BA performed a rough load calculation to size the equipment for the study. The load calculation was based on the available information, and it will have to be revised during the final design. Equipment sizes described in this report are estimates used for equipment layouts and pricing. Final equipment sizing will be completed during final design.

EXISTING CONDITIONS

The Glencoe Village Hall was built in 1956. The building consists of two stories and a basement and is approximately 40,000 sq. ft. There is 26,500 sq. ft. of occupied space and about 7,800 sq. ft. of garage space, including the fire truck equipment garage on the first floor, the public safety vehicle garage, and the sally port in the basement. The rest of the area consists of mechanical spaces and stair wells. The building's first floor contains offices for the Village Administration, Public Safety, Finance, and Public Works departments. The second floor houses the Public Safety dorms and day room, the Village Council chambers, and the Family Services offices. The basement houses office space, storage, and a gun range along the south side of the building. There is a large mechanical space in the basement.

HVAC Systems

Heating for the building is provided by two low pressure steam boilers in the basement below the Public Safety equipment garage. They produce steam at 6 psi. The boilers are controlled manually and they do not have an automatic lead/lag control. If the operating boiler fails, the back-up boiler will not start automatically.

Basement

The main occupied portions of the basement are conditioned by a packaged roof top air conditioning unit located on the second floor roof. It was installed in 1994 and utilizes direct expansion (DX) cooling and a gas fired heater. The occupied office areas in the center of the basement are treated as a single zone with the thermostat located in the Roll Call Room. The spaces are generally well conditioned and there are no temperature control issues. There is a small server room in the basement that is served by two stand-alone DX cooling units. Both units operate under normal conditions.

The evidence locker, animal control office, and a storage room are located on the north side of the basement. These spaces are currently only heated. There are significant temperature and humidity issues in these areas. They are often hot and humid during the summer. The Public Safety vehicle garage is served by steam unit heaters and heating ventilating units.

The gun range on the south side of the basement is served by a standalone gun range air handling unit. The gun range air handling unit is in good condition, but it lacks sufficient controls. There are complaints that the gun range has temperature control issues and there are complaints of excessive air velocities when the gun range air handling unit is in operation.

First Floor

The first floor is served by a multi-zone unit, AHU-2, located in the basement. The multi-zone units generate hot and cold air at the unit. The hot and cold air is blended at the unit with pneumatically controlled dampers to serve the temperature demands of each individual zone. The pneumatic controls are failing which results in poor temperature control in the spaces. AHU-2 is original to the building. The multi-zone unit is constant volume, so it provides full airflow regardless of the current heating or cooling load in the building. Therefore, a significant amount of air is simultaneously heated and cooled resulting in poor energy efficiency. It has eight zones, a DX cooling coil, and a steam heating coil. The DX cooling coil utilizes a once-through domestic water system to reject heat. This type of system is no longer allowed by code. A once-through system uses clean domestic water and discharges it down the

drain, which is a very wasteful practice. The DX cooling equipment and AHU-2 are well past their useful life.

The space uses in the building have changed several times since the building was originally built. The ductwork has been recently modified, but it still does not match the space layout in all areas. The most recent ductwork modifications were completed between 2005 and 2010. Several different areas are treated as a single zone and in some cases area space temperatures are controlled by thermostats in different areas. This results in poor temperature control and complaints from occupants. Spaces are often over heated or over cooled. Occupants often use space heaters or space coolers to control the temperature of their space. Perimeter heat is provided by steam radiators located below each of the windows. The radiators have been retrofitted with local thermostatic control valves. Several of the radiators are blocked by desks and other office equipment. This causes occupants to have temperature complaints.

The 911 call center is served by a stand-alone DX cooling unit. The unit is 100% recirculation. It is less than 10 years old and is in good working condition.

Second Floor

The second floor is served by a multi-zone unit, AHU-1, located in the basement. This unit operates in the same manner as AHU-2 and is original to the building. It has five zones, a DX cooling coil, and a steam heating coil. The DX cooling coil utilizes once through domestic water for heat rejection. The zone dampers in AHU-1 are pneumatically controlled and are starting to fail. This results in temperature control issues in the occupied areas. The DX equipment and AHU-1 are well past their useful life. The ductwork generally matches the space uses. However, there are only five zones, so there is limited individual space temperature control. Perimeter heat is provided by steam radiators located below each of the windows. The radiators have been retrofitted with local thermostatic control valves.

Plumbing System

There is an older tank type electric domestic hot water heater. There is rust at the base of the tank. It appears to be nearing the end of its useful life.

Building Electric Systems

The main building electric service is located in the basement near the gun range exhaust unit. The main electrical service is a 400A, 480 volt, 3 phase ungrounded system. The ground fault alarm and indicator lights are installed on the main service. Ungrounded systems are no longer installed in buildings due to increased maintenance and personnel safety issues. The danger is most prevalent during maintenance or modifications to the system.

In addition to providing electrical service to the village hall, the main service also provides a 200A electrical feeder for the maintenance garage located across the street from the Village Hall. The existing main 400A switch is original 1956 equipment.

A 240kW/300kVA, 480Y/277V diesel emergency generator provides back-up power for the Village Hall and the maintenance garage. The emergency generator is in good condition and is not in need of replacement.

DEFICIENCIES

Based on the review of all major equipment and systems at the Glencoe Village Hall, most of the major systems are past their useful lives. The two major air handling units are original to the building. They are pneumatically controlled and have significant temperature control issues. They are multi-zone units that have very poor energy efficiency. This type of unit is no longer allowed by energy code, due to the simultaneous heating and cooling that occurs in the unit. The units have steam coils which are difficult to control. They have DX cooling coils which are inefficient and they use once through domestic water for heat rejection. Once-through domestic water cooling is no longer allowed by code. The areas served by these units have significant temperature control issues.

The low pressure steam boilers in the building are approximately 20 years old. They are currently in good operating condition. However, they are nearing the end of their expected useful life. Low pressure steam boilers generally have efficiencies between 80-85%. New high efficiency condensing hot water boilers have efficiencies between 92-96%. Hot water provides improved temperature control over steam.

The steam unit heaters and heating ventilating units are original to the building. They are past their useful life and most of them are no longer in good working order.

A detailed list of all major equipment and systems in included in the Exhibits section of this report. The equipment list includes the age, condition, and expected remaining life of each piece of equipment.

PROPOSED SYSTEMS

General Systems

Building Automation System

A new computer based, direct digital control (DDC) building automation system (BAS) will be installed. The BAS will allow public works staff to control all of the new systems from a central location. A Web based system can be installed, so the systems can be controlled from off site. New direct digital controls will be installed to replace pneumatic controls. There are several reasons to install a new BAS. New digital thermostats will allow public works staff to monitor and review existing space conditions from the BAS. The BAS will improve building operation and system efficiency. It will ensure that all of the systems work together. Building automation systems simplify building operation. Computerized controls and graphical displays let staff monitor equipment operation without physically observing each piece of equipment or system individually. The BAS can be programmed to alert staff if a piece of equipment fails or is operating outside of normal conditions. This results in reduced down time and disruptions to building occupants. The BAS can also automatically start redundant equipment. Improved energy efficiency operations can be implemented with a new BAS.

Equipment Garages

The fire equipment garage is currently heated by steam unit heaters. As part of the upgrade, gas fired IR radiant heaters should be installed in the garage. This type of heater is ideal for garages with high ceilings. They keep the space warm and operate efficiently. Due to the lower ceilings, unit heaters or heating ventilation units will work better in the Public Safety vehicle garage.

Domestic Hot Water

A new gas fired tank type domestic hot water heater should be installed to replace the existing electric domestic hot water heater. It should be installed where the existing hot water heater is located. The new unit will have similar capacity to the existing unit.

Miscellaneous

The evidence area, storage area, and animal control office in the basement are currently heated only. They have temperature and humidity issues, especially in the warmer months. As part of this project, these areas will be conditioned. The area in the basement served by the existing RTU will also be served by the new equipment under either option. The RTU should be demolished and the duct riser removed.

HVAC Options

The main focus of this report was to analyze the best options to replace the main HVAC equipment in the building. G/BA evaluated several options and decided to explore two options in greater detail. Option 1 is to install a centralized system similar to the existing system. The centralized system will utilize air handling units and an air-cooled chiller. The air handling units will utilize the existing ductwork. Option 2 is to install a distributed system. The distributed system will utilize individual heating and cooling units located at each zone. The individual heating and cooling units are connected to refrigerant piping that is connected to condensing units located outside.

G/BA performed a rough load calculation to size the equipment for the study. The load calculation was based on the information available and will be revised during the final design. Equipment sizes described in this report are estimates used for equipment layouts and pricing. Final equipment sizing will be completed during final design.

Outdoor equipment will be required for both HVAC options. The outdoor equipment for Option 1 and Option 2 have similar footprints. Four locations were considered for the outdoor equipment. These locations are detailed in the attached sketch MSK-7. It is recommended that the space to the east of the Public Safety vehicle garage driveway be utilized for the outdoor equipment. The capital cost includes the cost in place the equipment on east side of the Public Safety vehicle garage driveway.

The existing gun range air handling unit is still in good working order. However, there are some temperature and air velocity issues with the unit. It may be beneficial to replace the gun range air handling unit during the other HVAC improvements.

A detailed breakdown of the two options is included in the Exhibits section of this report. Phasing guidelines for both options are also included in the Exhibits section of the report.

HVAC Option 1 – Centralized System

This option proposes the installation of two new air handling units (AHUs), a new air-cooled chiller, and two condensing boilers to provide heating and cooling to the spaces. The centralized system will simplify maintenance. It will also require limited work in the occupied spaces.

The AHUs will be located in place of the existing units. They should be approximately 20,000 cfm each. The new units would be variable air volume (VAV), have chilled water coils, and utilize an outside air economizer. VAV systems are very energy efficient. They modulate the airflow based on the current load in the space. A VAV terminal unit with hot water reheat will be installed for each zone. The VAV terminal unit increases the airflow as the space temperature rises above the temperature setpoint. The VAV terminal unit must provide a minimum amount of fresh air to the space occupants. As the space temperature drops below the setpoint, the VAV terminal unit reduces the airflow until it reaches the minimum airflow. Then the hot water reheat coil modulates to maintain the space temperature. Because the airflow is reduced before the reheat coil is utilized, it minimizes the amount of simultaneous heating and cooling.

The ductwork in the basement and the risers will be demolished and replaced. New ductwork will be installed between the AHUs in the basement and the first and second floors. New VAV terminal units with reheat coils will be installed on the floors and connected to the existing branch ductwork. Most of the recently installed ductwork will be reused. All existing ductwork will be sealed and cleaned. Insulation to be repaired as required. Minor branch ductwork modifications will be made to improve individual zone controls. See the attached sketches for more detail. Hot water piping will be run to the new VAV boxes. See attached sketches (MSK-1 to MSK-3) for approximate new ductwork runs. VAV box locations are for diagrammatic purposes only.

A new 150 ton air-cooled chiller will be installed with variable speed pumps. The pump speed will modulated to maintain the current load. The pumps will slow down and use less energy when peak cooling is not required. The pumps will be located near the new AHUs. The air-cooled chiller will have two circuits for redundancy. The possible locations are depicted in the attached sketch MSK-7.

Figure 1: Typical Air-cooled Chiller

Two new 2,000 MBH condensing hot water boilers were selected due to their ease of maintenance and their high efficiency. The existing low pressure steam boilers have efficiency between 80% and 85%, while the new condensing hot water boilers will operate between 92% and 96%. Two boilers will be installed to provide full redundancy. They will be located in the basement where the existing boilers are located currently. Perimeter heat will be provided by a combination of overhead heating through the new VAV terminal units and the existing radiators. The steam radiators will be modified to use hot water. The existing piping should be re-used and should not require significant modifications. New control valves should be installed at the radiators. These modifications will de-rate the radiator capacity, so the VAV reheat coils will need to be sized to meet the peak heating load.

Figure 2: Typical Condensing Hot Water Boiler

HVAC Option 2 – Distributed System

A second option is to install a distributed system that provides individual heating and cooling units in each zone. This type of system provides individual temperature control for each zone. As spaces are modified, it is possible to add or remove heating and cooling units to maintain individual temperature control. If a distributed system is installed, we recommend installing a system with variable refrigerant flow (VRF). Individual heating and cooling cassettes are installed to provide conditioning in each zone. A thermostat will be installed in each zone to control the local cassette. All of the cassettes are connected to refrigerant piping that is connected to a condensing unit located outside. Refrigerant pipe will be installed through the ceiling of the occupied spaces.

A dedicated outside air system (DOAS) will be installed in the basement mechanical room. A DOAS is a small air handling unit that provides tempered outside air to the spaces to satisfy the fresh air requirements for the occupants. The DOAS will be approximately 7,500 cfm. It can be scheduled to reduce that airflow during periods of lower occupancy. Much of the existing ductwork can be reused to supply the outside air. Minor ductwork modifications will be required. The central piece of heat rejecting equipment can be installed in any of the locations described for the air-cooled chiller above. The possible locations are depicted in the attached sketch MSK-7.

A disadvantage of a distributed system is the amount of regular maintenance that is required. There are filters in each cassette that have to be changed on a regular basis. There is also a small amount of noise associated with the cassettes. It is minimal and similar to a fan in the space.

There are two types of cassettes that can be installed to serve each zone. One is a ducted type system. An advantage is that the equipment is hidden above the ceiling. The occupants see normal supply and return diffusers. They won't notice a difference between this type of system and a normal centralized system. A disadvantage is that additional ductwork modifications are required. Additional space above the ceiling is required for this type of cassette. A second option is to use non-ducted type of cassette. This may be a cheaper option due to the reduced ductwork modifications. The disadvantage to the ductless type cassette is that the system is located in the space. Occupants may not like the appearance of the equipment in the space.

Figure 3: Examples of Non-ducted Cassettes

Multiple cassettes may be required to serve larger zones. It is recommended that both ducted and non-ducted cassettes are utilized to serve the building. The ducted type should be used for larger zones and the non-ducted type should be used for smaller zones. At least one unit will be used in each of the zones outlined in the proposed areas of service in the attached sketches (MSK-4 to MSK-6).

With this type of system, the existing low pressure steam boilers can remain in operation to provide the perimeter heating. The existing steam radiators will be utilized with the local thermostatic control valves.

However, it is recommended that new condensing hot water boilers should be considered as part of this project. The existing steam boilers are nearing the end of their expected useful life and they will likely need to be replaced in the next five years. It may be more cost effective to install the new boilers along with the rest of the new HVAC equipment. The new condensing hot water boilers will utilize the modified radiators similar to the method described under the centralized system. If the new condensing hot water boilers are installed with the VRF system, the cassettes can be sized to account for the de-rated radiators.

Building Electric System

A new, grounded ComEd incoming service to accommodate the new mechanical equipment will be required. A new 800A, 480Y/277V, 3 phase, 4 wire, grounded main switchboard with metering is proposed. The new chiller and the new AHUs will be fed from this switchboard. The existing ungrounded system will remain serving the existing loads. As the existing loads are rewired to include ground wire, they can then be fed from the new switchboard.

See the attached electrical sketches, ESK-1 and ESK-2.

EQUIPMENT LIST AND COST BREAKDOWN

A breakout of required equipment is presented in this section. Capacities are estimates that will have to be refined during final design.

Option 1 – Centralized System

Option 1	
General Construction	$50,000
HVAC Equipment	$1,366,000
BAS	$160,000
Outdoor Equipment Prep	$67,000
Electrical Equipment*	$255,600
Plumbing / Fire Protection	$32,000
Subtotal	**$1,930,600**
Design and Construction Contingency (20%)	$386,120
Total**	**$2,320,000**

Table 2: Order-of-Magnitude Opinion of Probable Cost

1. General Construction $50,000
    a. Landscaping
    b. Site preparation
    c. General Contractor
    d. Ceiling modifications
2. HVAC Equipment $1,366,000
    a. Air-cooled chiller
        i. 150 tons
        ii. Associated chilled water pumps
    b. Two air handling units
        i. 20,000 cfm each
        ii. Approximately 27 VAV terminal boxes
    c. Two condensing hot water boilers
        i. 2,000 MBH each
        ii. Associated hot water pumps

d. Heating ventilating units and unit heaters

e. Gun range air handing unit

f. New ductwork

i. Existing ductwork demolition

g. Hot water piping

h. Chilled water piping

3. BAS $160,000

a. New controllers

b. New sensors

c. Programming

4. Outdoor Equipment Prep $67,000

a. Excavation

b. Concrete

c. Support Steel

d. Hoisting

5. Electrical Equipment $255,600

a. New transformers

b. New panels

c. Connections to new equipment

d. ComEd fees are not included

6. Plumbing / Fire Protection $32,000

a. Miscellaneous plumbing modifications

b. Miscellaneous fire protection modifications

7. Design and Construction Contingency $386,120

a. A 20% contingency is included to cover unknown costs

Option 2 – Distributed System

Option 2	
General Construction	$50,000
HVAC Equipment	$1,250,000
BAS	$160,000
Outdoor Equipment Prep	$67,000
Electrical Equipment*	$255,600
Plumbing / Fire Protection	$32,000
Subtotal	**$1,814,600**
Design and Construction Contingency (20%)	$362,920
Total**	**$2,180,000**

Table 3: Order-of-Magnitude Opinion of Probable Cost

1. General Construction $50,000
    a. Landscaping
    b. Site preparation
    c. General Contractor
    d. Ceiling modifications
2. HVAC Equipment $1,250,000
    a. Five VRV Condensing unit
        i. 26 tons each
        ii. Approximately 27 heating and cooling cassettes
    b. Dedicated outdoor air system
        i. 7,500 cfm each
    c. Condensing hot water boilers
        i. 2,000 MBH each
        ii. Associated hot water pumps
    d. Heating ventilating units and unit heaters
    e. Gun range air handing unit
    f. Ductwork modifications
        i. Existing ductwork demolition
    g. Hot water piping

h. Refrigerant piping

3. BAS $160,000
    a. New controllers
    b. New sensors
    c. Programming
4. Outdoor Equipment Prep $67,000
    a. Excavation
    b. Concrete
    c. Support Steel
    d. Hoisting
5. Electrical Equipment $255,600
    a. New transformers
    b. New panels
    c. Connections to new equipment
    d. ComEd fees are not included
6. Plumbing / Fire Protection $32,000
    a. Miscellaneous plumbing modifications
    b. Miscellaneous fire protection modifications
7. Design and Construction Contingency $386,120
    a. A 20% contingency is included to cover unknown costs

RENEWABLE ENERGY OPTIONS

Renewable energy options are good to consider when performing major renovations at a building. These types of systems can be used to reduce energy cost and improve overall energy efficiency. Unfortunately, most of these systems have a long payback, significant maintenance costs, and may cause disruptions to building occupants. Below, four types of renewable energy are described for consideration. The solar hot water heating has the quickest payback and the smallest disruption to building occupants of the renewable energy options.

Solar Hot Water Heaters

Solar collectors can be installed on the roof to heat water for domestic hot water uses. Water is circulated through the solar collectors and the domestic hot water tank. The domestic hot water tank usually has a natural gas burner as a backup to provide domestic hot water when the sun is not available. Solar hot water heater packages usually have a payback between 7 and 12 years.

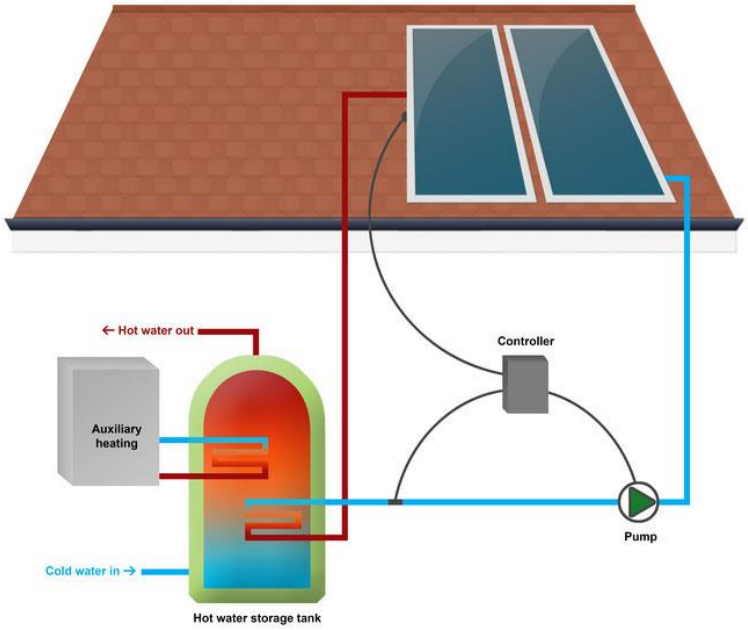

Figure 4: Diagram of Solar Hot Water System

Geo-thermal ground loop

A geo-thermal ground loop drills wells and places pipes underground to reject and collect heat. The temperature underground remains relatively constant throughout the year. This consistent temperature provides a very efficient operation of HVAC systems. There is a significant cost to the initial installation of the wells and underground pipes. The system also requires a large area of space to install the wells. The wells could be installed below the Wyman Green to the north of the village hall.

The geo-thermal ground loop can be used with either the centralized or distributed systems described above. The loop would replace the air-cooled chiller in the centralized option. If the distributed option is selected, water-source heat pumps will be installed instead of the VRF type system. The water-source heat pumps have similar ducted and non-ducted options.

The geo-thermal ground loop can be used for heating, but it is likely that new hot water boilers will still be needed for the peak heating loads. Due to the additional cost of the geo-thermal field, at approximately 2,000-3,000 per ton, geo-thermal ground loop systems usually have a payback of greater than 10 years.

Wind Turbines

Wind turbines can be installed to provide electricity that can be used in the building. Some utilities allow excess electricity to be sold back to the utility company. Wind turbines can produce electricity during the day and night. The building would still be connected to the utility to provide electricity when the wind is insufficient. Wind turbines generally have a payback of greater than 20 years.

Figure 5: Example of Wind Turbines

Solar Panels

Solar panels can be installed to provide electricity that can be used in the building. Some utilities allow excess electricity to be sold back to the utility company. Solar panels can only provide electricity during the daytime. They also take up a significant amount of roof area. The building would still be connected to the utility to provide electricity when the wind is insufficient. Solar panels generally have a payback of greater than 25 years.

Figure 6: Example of Solar Panels on a Roof

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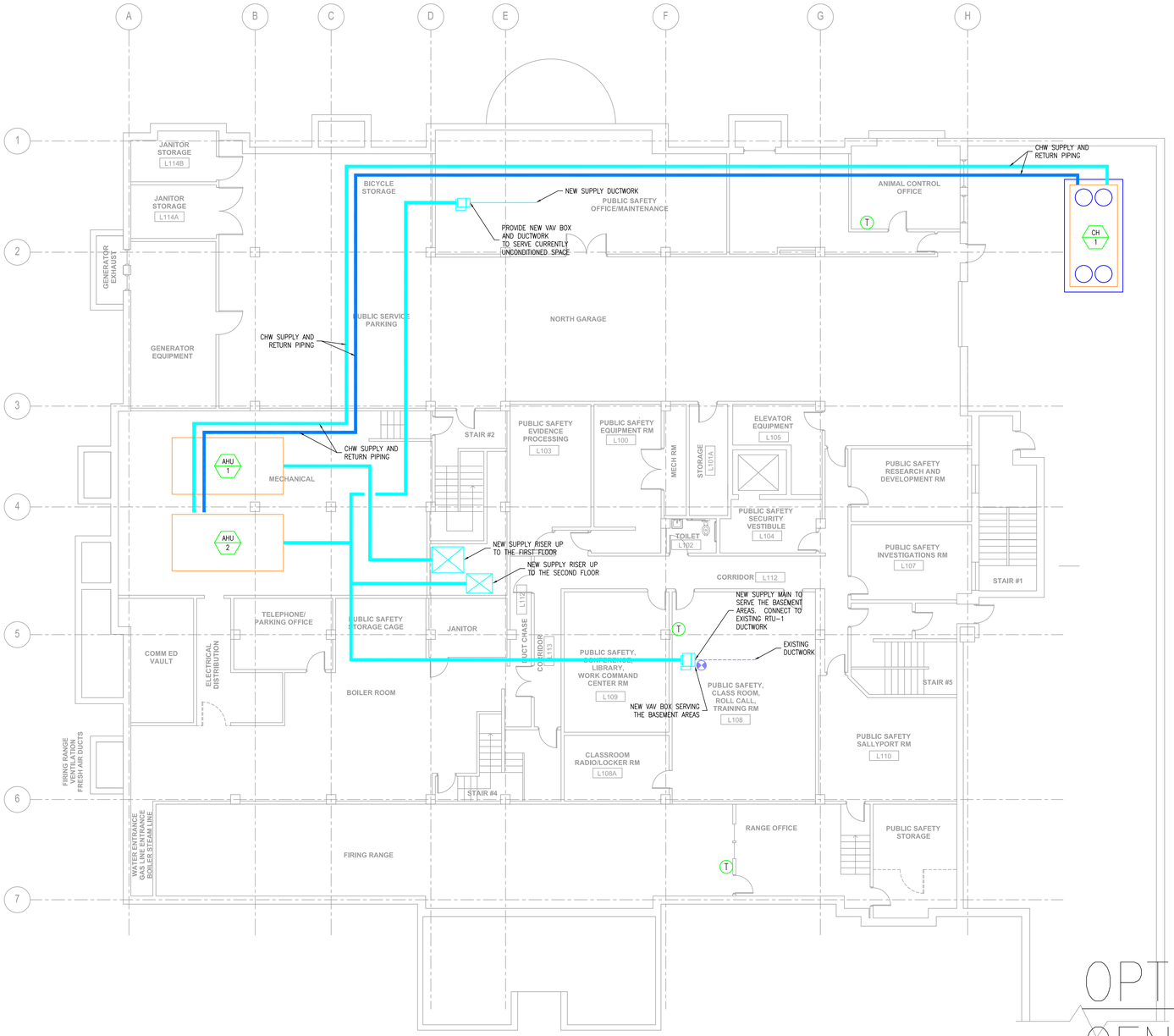
EXHIBIT 1 -
Mechanical Sketches
(MSK-1 to MSK-7)



OPTION 1
CENTRAL SYSTEM

1 MECHANICAL BASEMENT NEW WORK PLAN
1/8" = 1'-0"

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820 Davis St, Ste 300
Evanston, Illinois 60201 4446
847 328.3555 www.grummanbutkus.com

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MECHANICAL BASEMENT NEW WORK PLAN

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS
VILLAGE OF GLENCOE
675 VILLAGE COURT
GLENCOE, IL 60022

DATE	7/3/14
SCALE	
DRAWN	DSC
CHECKED	DSC
APPROVED	JET
JOB NO.	P14-012I-00

MSK-1

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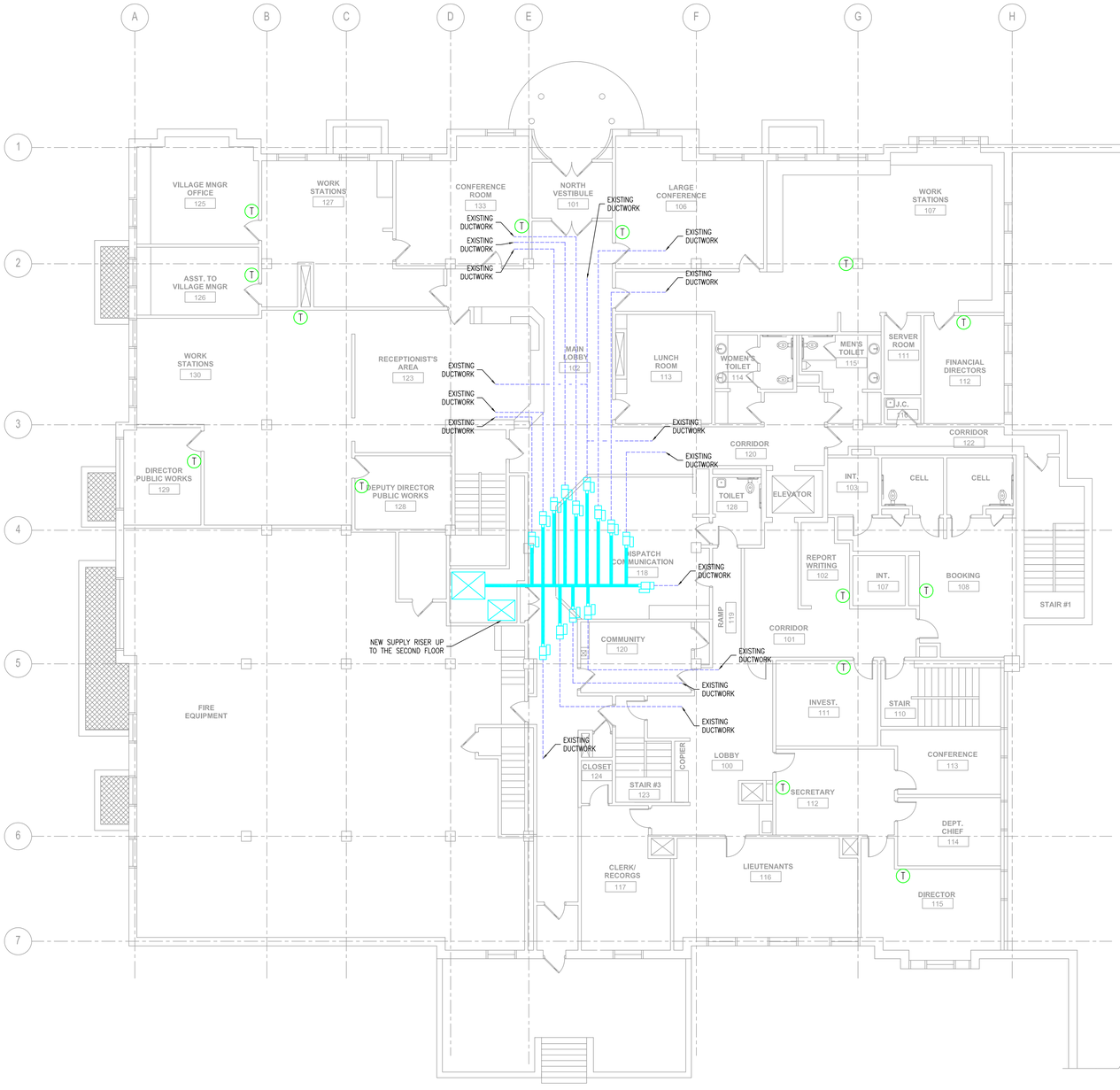

OPTION 1
CENTRAL SYSTEM

1 MECHANICAL FIRST FLOOR NEW WORK PLAN
1/8" = 1'-0"

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MECHANICAL PLAN

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS
VILLAGE OF GLENCOE
675 VILLAGE COURT
GLENCOE, IL 60022

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SCALE	
DRAWN	DSC
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MSK-2

DWG S. OWEN

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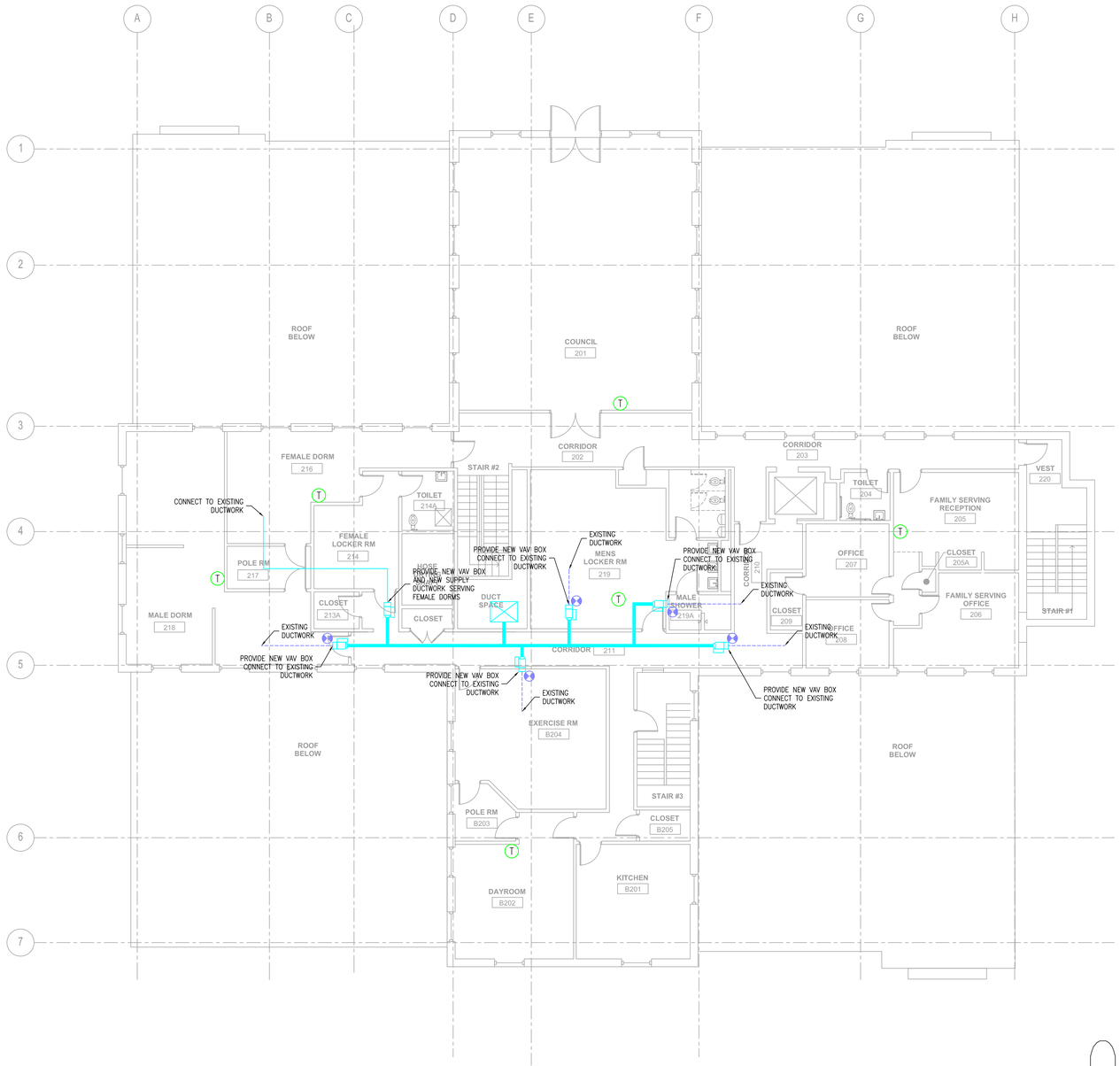

OPTION 1
CENTRAL SYSTEM

1 MECHANICAL SECOND FLOOR NEW WORK PLAN
1/8" = 1'-0"

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MECHANICAL PLAN

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS
VILLAGE OF GLENCOE
675 VILLAGE COURT
GLENCOE, IL 60022

DATE	7/3/14
SCALE	
DRAWN	DSC
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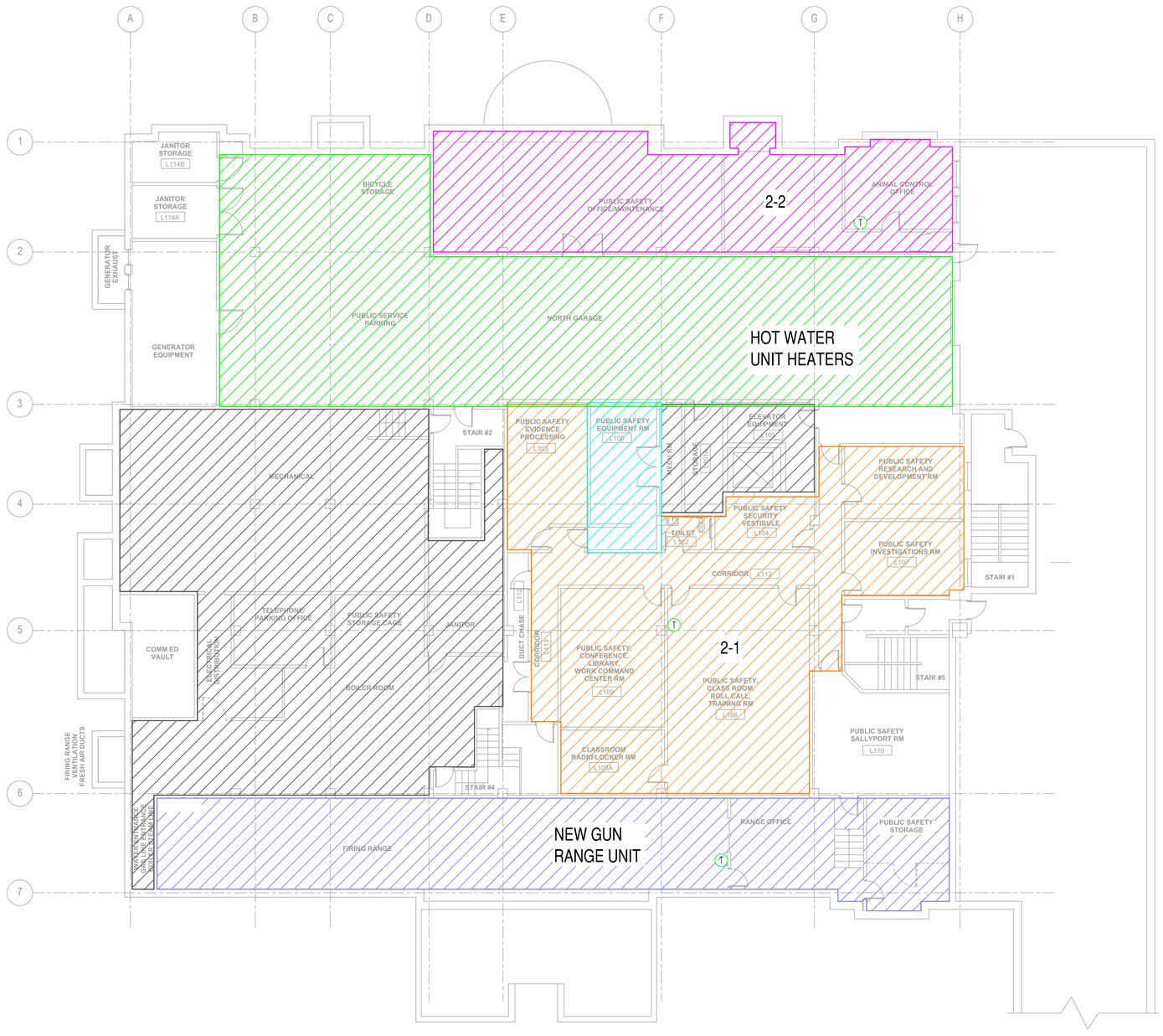
APPROVED	JET
JOB NO.	P14-0121-00

MSK-3



GENERAL NOTES

A. PROPOSED AREAS OF SERVICE.

B. FOR OPTION 1, CENTRALIZED SYSTEM, EACH ZONE WILL HAVE A DEDICATED VAV BOX WITH A REHEAT COIL.

C. FOR OPTION 2, DISTRIBUTED SYSTEM, EACH ZONE WILL HAVE A DUCTED OR NON-DUCTED TYPE HEATING/COOLING UNIT.

1 MECHANICAL BASEMENT PLAN PROPOSED AREAS OF SERVICE

1/8" = 1'-0"

N

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MECHANICAL BASEMENT PLAN PROPOSED AREAS OF SERVICE

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

VILLAGE OF GLENCOE
675 VILLAGE COURT
GLENCOE, IL 60022

DATE 7/3/14
SCALE
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CHECKED DSC
APPROVED JET
JOB NO. P14-0121-00

MSK-4

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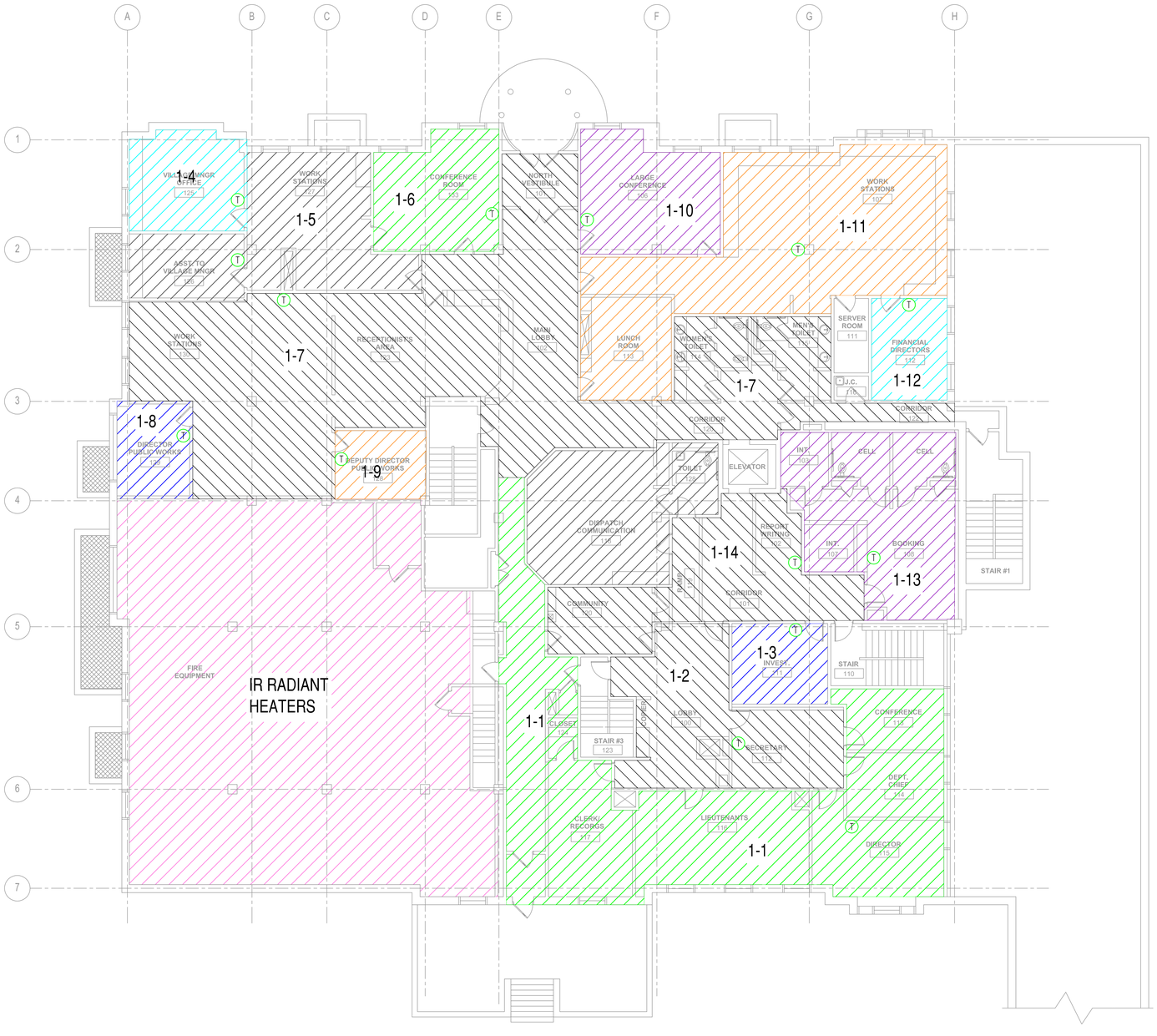
GENERAL NOTES

A. PROPOSED AREAS OF SERVICE.

B. FOR OPTION 1, CENTRALIZED SYSTEM, EACH ZONE WILL HAVE A DEDICATED VAV BOX WITH A REHEAT COIL.

C. FOR OPTION 2, DISTRIBUTED SYSTEM, EACH ZONE WILL HAVE A DUCTED OR NON-DUCTED TYPE HEATING/COOLING UNIT.



1 MECHANICAL FIRST FLOOR PLAN PROPOSED AREAS OF SERVICE

1/8" = 1'-0"

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MECHANICAL FIRST FLOOR PLAN PROPOSED AREAS OF SERVICE

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

VILLAGE OF GLENCOE
675 VILLAGE COURT
GLENCOE, IL 60022

DATE	7/3/14
SCALE	
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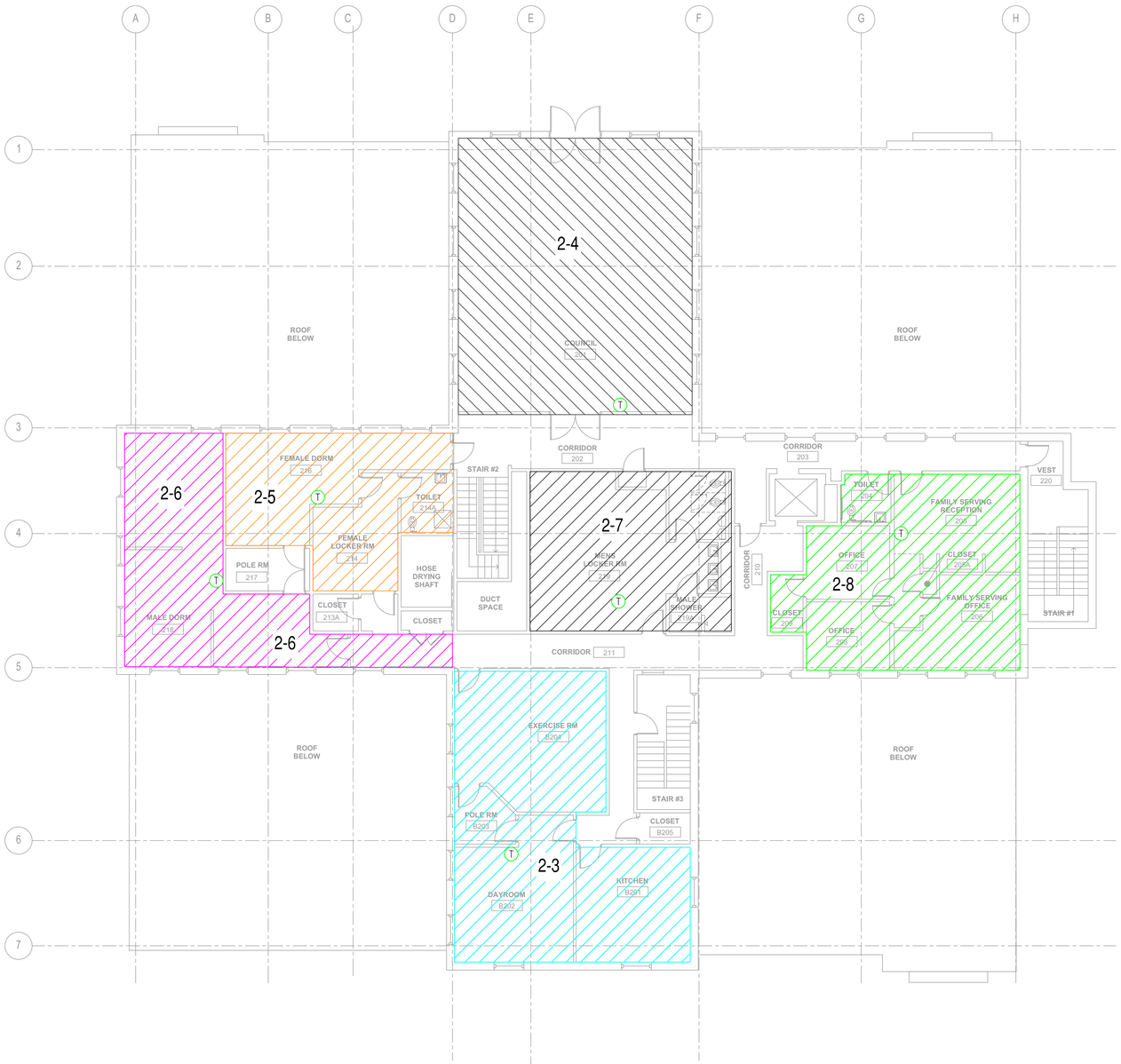
JOB NO.	P14-0721-00

MSK-5



GENERAL NOTES

A. PROPOSED AREAS OF SERVICE.

B. FOR OPTION 1, CENTRALIZED SYSTEM, EACH ZONE WILL HAVE A DEDICATED VAV BOX WITH A REHEAT COIL.

C. FOR OPTION 2, DISTRIBUTED SYSTEM, EACH ZONE WILL HAVE A DUCTED OR NON-DUCTED TYPE HEATING/COOLING UNIT.

1 MECHANICAL SECOND FLOOR PLAN PROPOSED AREAS OF SERVICE

1/8" = 1'-0"

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MECHANICAL SECOND FLOOR PLAN PROPOSED AREAS OF SERVICE

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

VILLAGE OF GLENCOE

675 VILLAGE COURT

GLENCOE, IL 60022

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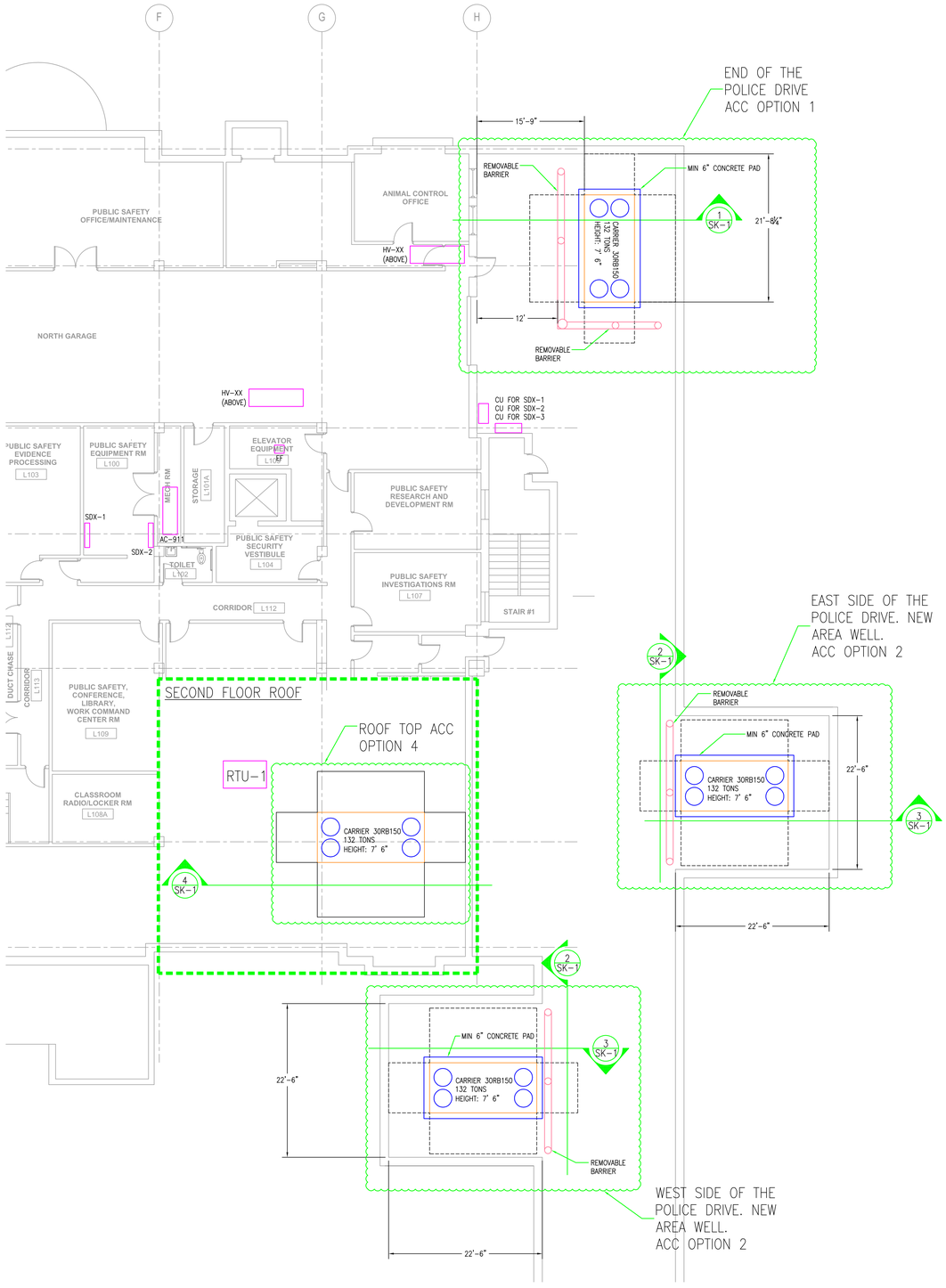
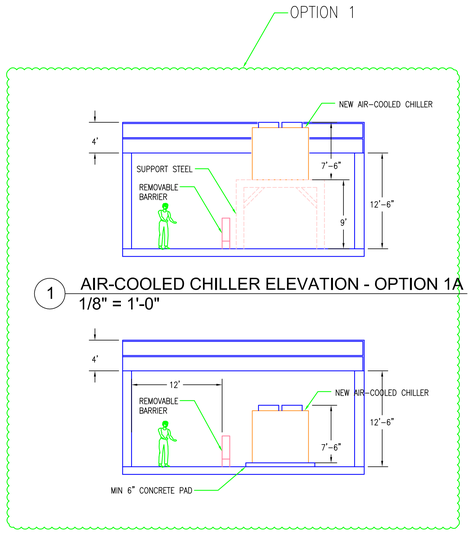
MSK-6

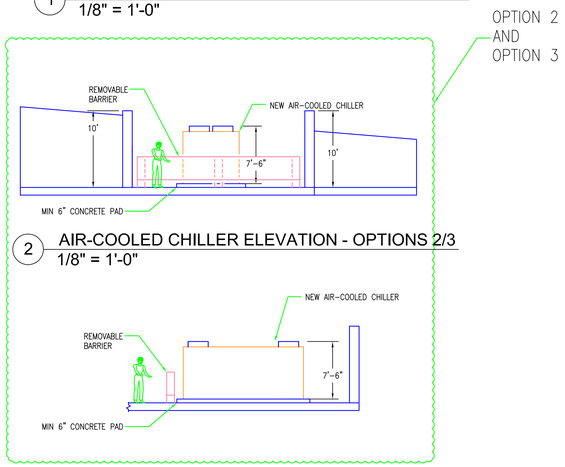


1 MECHANICAL BASEMENT PLAN - CHILLER LOCATIONS
1/8" = 1'-0"



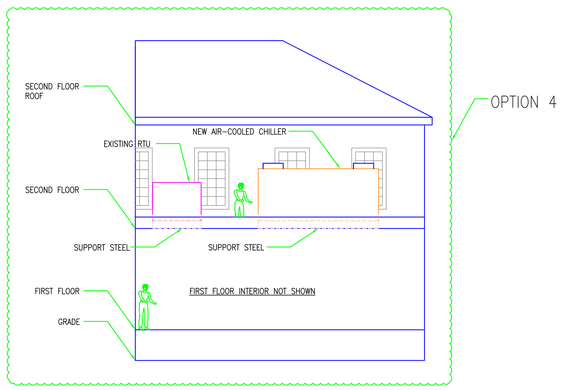
1 AIR-COOLED CHILLER ELEVATION - OPTION 1A
1/8" = 1'-0"

1 AIR-COOLED CHILLER ELEVATION - OPTION 1B
1/8" = 1'-0"



2 AIR-COOLED CHILLER ELEVATION - OPTIONS 2/3
1/8" = 1'-0"

3 AIR-COOLED CHILLER ELEVATION - OPTIONS 2/3
1/8" = 1'-0"



4 AIR-COOLED CHILLER ELEVATION - OPTION 4
1/8" = 1'-0"

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MECHANICAL ACC LAYOUT OPTIONS

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS
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675 VILLAGE COURT
GLENCOE, IL 60022

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APPROVED	JET
JOB NO.	P14-0121-00

MSK-7

EXHIBIT 2 -
Electrical Sketches
(ESK-1 and ESK-2)

1 ELECTRICAL BASEMENT NEW WORK PLAN
1/8" = 1'-0"

N

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ELECTRICAL BASEMENT NEW WORK PLAN

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS
VILLAGE OF GLENCOE
675 VILLAGE COURT
GLENCOE, IL 60022

DATE	6/5/14
SCALE	
DRAWN	SDG
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APPROVED	JET
JOB NO.	P14-0121-00

ESK-1

DWG. S. OWEN

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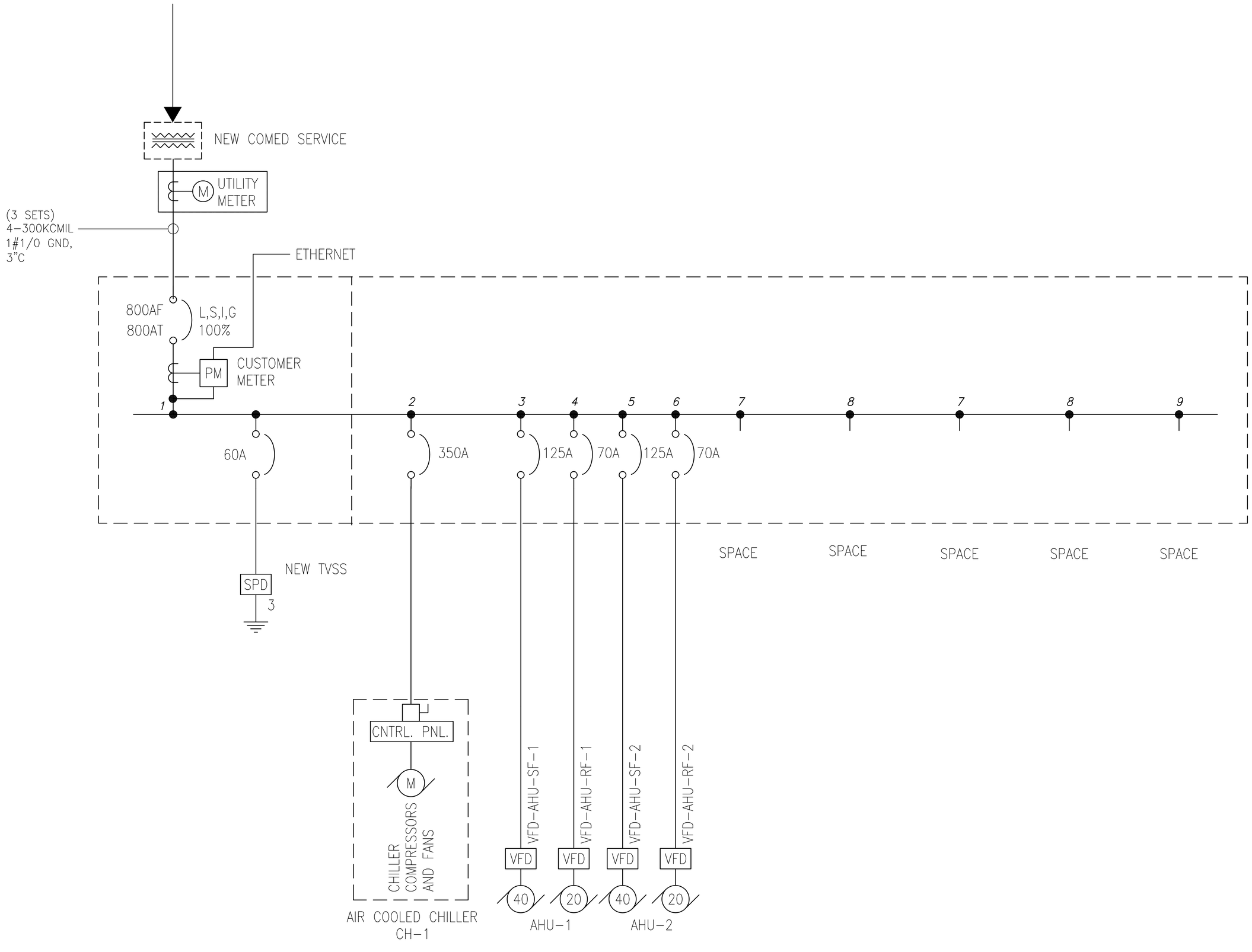

1 PROPOSED ELECTRICAL ONE LINE DIAGRAM
NO SCALE

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ELECTRICAL ONE LINE DIAGRAM

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS
VILLAGE OF GLENCOE
675 VILLAGE COURT
GLENCOE, IL 60022

DATE 6/5/14
SCALE
DRAWN SDG
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JOB NO. P14-0121-00

ESK-2

EXHIBIT 3 –
Village of Glencoe Existing Equipment Detail

Grumman/Butkus Associates
Energy Efficiency Consultants and Sustainable Design Engineers

820 Davis Street, Suite 300
Evanston, Illinois 60201 4446

Main 847-328-3555
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Item Number	Equipment Tag	Equipment Description	Location	Area of Service	Approx Age (2014)	Condition	Remaining Life	Pictures
1	AHU-1/ RE-1	Existing multi-zone unit. It has a DX cooling coil and a steam heating coil. There are 5 zones with pneumatic dampers that modulate to maintain space temperatures. This unit uses recirculated air and outside air. It had some economizer function.	Basement Mechanical Room	2nd floor	58 yrs	The unit is in poor condition and has significant operational issues	AHU-1 should be replaced in the next 1-3 years	
2	AHU-2/ RE-2	Existing multi-zone unit. It has a chilled water cooling coil and a steam heating coil. There are 9 zones with pneumatic dampers that modulate to maintain space temperatures. This unit uses recirculated air and outside air. It had some economizer function.	Basement Mechanical Room	1st floor	58 yrs	The unit is in poor condition and has significant operational issues	AHU-2 should be replaced in the next 1-3 years.	

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Item Number	Equipment Tag	Equipment Description	Location	Area of Service	Approx Age (2014)	Condition	Remaining Life	Pictures
3	RTU-1	Packaged roof-top unit. This unit has a DX cooling coil and gas fired heating coil. It is controlled by a single thermostat in the roll call room. This unit uses recirculated air and outside air. It has some economizer function. Only the cooling function is used.	1st floor roof	Basement Office areas	10 yrs	This unit maintains space temperatures well.	Normal life expectancy for a RTU is 15 years. This unit should be replaced when the main AHUs are replaced	
4	AC-911	This is a 100% recirculation unit. It has a DX cooling coil. It was installed to provide supplemental cooling for the 911 call center.	Basement Mechanical Closet	Supplemental cooling for the 911 call center	6 yrs	This unit functions well and provides sufficient cooling for the 911 call center.	This unit should continue to operate for the next 6 – 8 years.	

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Item Number	Equipment Tag	Equipment Description	Location	Area of Service	Approx Age (2014)	Condition	Remaining Life	Pictures
5	B-1/ B-2	These are, natural gas, low pressure steam boilers.	Basement Boiler Room	Building perimeter heat, AHU heating coils, HV units, and unit heats	20 yrs	The units are generally in good operating condition. They are not the most efficient type units.	The units should be considered for replacement in the next 5 years.	
6	Gun Range Exhaust	This is a dedicated exhaust system. It has built in filters and specifically designed to exhaust gun range fumes.	Basement Boiler Room	Gun Range	20 yrs	The unit is in good condition and operates normally. There are issues with the gun range air balance.	The unit should continue to operate for the next 10 – 15 years. The gun range air balance should be addressed when the AHUs are replaced.	

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Item Number	Equipment Tag	Equipment Description	Location	Area of Service	Approx Age (2014)	Condition	Remaining Life	Pictures
7	DHW-1	Electric hot water heater. It has an 80 gallon tank and a 27 kW heating element.	Basement Boiler Room	Building domestic hot water	10 yrs	The DHW heater is starting to rust at the base or the unit.	It should be replaced with a gas fired water heater in the next 1-3 years.	
8	Air Compressor	Simplex air compressor. It has an integral air dryer.	Basement MER	Temperature Control Pneumatics	5 yrs	The air compressor is in good condition and functions well.	It will continue to operate for the next 10 years. It will likely be removed when the major equipment is upgraded.	

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Item Number	Equipment Tag	Equipment Description	Location	Area of Service	Approx Age (2014)	Condition	Remaining Life	Pictures
9	SDX-1/ SDX-2	These are split DX wall mounted air conditioners. They have remote mounted condensers in the police car driveway.	Bsmt Public safety equipment Room	Bsmt Public safety equipment Room	3-7 yrs	These units operate together to cool the servers in the room. They function well and proved sufficient cooling to the space.	They should continue to operate for the next 7 - 10 years.	
10	SDX-3	This is a split DX wall mounted air conditioners. They have remote mounted condensers in the police car driveway.	1st Flr Server Room	1st Flr Server Room	< 5yrs	This unit cools the server room. It functions well and provides sufficient cooling for the space	It should continue to operate for the next 10 - 12 years.	
11	Misc HV Units	These units have steam heating coils. They use both recirculated air and outside air.	Various	Provide heating to various mechanical and garage spaces	58 yrs	These units are in poor condition. Some of them no longer function.	These units should be removed or replaced when the main AHUs are replaced	

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Item Number	Equipment Tag	Equipment Description	Location	Area of Service	Approx Age (2014)	Condition	Remaining Life	Pictures
12	Misc EFs	These units serve mechanical spaces and toilet exhausts.	Various	Various, Provide general and toilet exhaust for the building	Most are 58 yrs	These units appear to function well.	The older exhaust fans should be replaced when the main AHUs are replaced. Newer fans can remain.	
13	Misc Unit Heaters	The unit heaters have a steam coil and a small fan. They do not provide outside air.	Various	Provide heating to various garage spaces	58 yrs	These units are in poor condition. Some of them no longer function.	These units should be removed or replaced when the main AHUs are replaced	

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Item Number	Equipment Tag	Equipment Description	Location	Area of Service	Approx Age (2014)	Condition	Remaining Life	Pictures
14	GEN-1	This is a 300 kVA emergency generator.	Bsmt Police Car Garage	Entire Building	10 yrs	The generator is in good condition and is tested regularly.	This unit should continue to operate for the next 5-10 years.	
15	FE Vehicle Exhaust	Dedicated fire engine exhaust fan. This system is specifically designed for vehicle exhaust. The system has hoses that are connected directly to the tail pipes. This reduces the required exhaust airflows.	Fire engine garage	Fire engine garage	20 yrs	The system is in good condition and is similar to current design standards	It should continue to operate for the next 10 - 12 years.	Note: this is a similar system, not a picture from this faciltiy.

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EXHIBIT 4 –
Village of Glencoe
Options by Zone

Grumman/Butkus Associates
Energy Efficiency Consultants and Sustainable Design Engineers

820 Davis Street, Suite 300
Evanston, Illinois 60201 4446

Main 847-328-3555
www.grummanbutkus.com

Area	Current System	Option 1	Option 2
First floor occupied areas	AHU-2, a multi-zone unit with 9 zones.	A new central VAV AHU. The new unit can use the existing ductwork and serve the same 9 zones, or new zones can be added. Install a new air-cooled chiller and a boiler to serve the AHU and reheats.	A variable refrigerant based system. With individual heating and cooling units in the space. The units in the space and be a mix of ducted and non-ducted models. Condensing units will need to be located outside. Install a dedicated outside air system to provide ventilation to the occupied spaces.
Second floor occupied areas	AHU-1, a multi-zone unit with 5 zones.	A new central VAV AHU. The new unit can use the existing ductwork and serve the same 9 zones, or new zones can be added. Install a new air-cooled chiller and a boiler to serve the AHU and reheats.	A variable refrigerant based system. With individual heating and cooling units in the space. The units in the space and be a mix of ducted and non-ducted models. Condensing units will need to be located outside. Install a dedicated outside air system to provide ventilation to the occupied spaces.
Basement office, roll call, and library areas.	RTU-1 located on the 1st floor roof. This area is treated like a single zone. No modification is necessary in this space. Options are listed for reference. It is likely RTU-1 will need to be replaced in the next 5 years.	Add zones to the new AHUs. Break up the space to smaller zones. Only provide ventilation air and maintain space temperatures during occupied periods.	A variable refrigerant based system. With individual heating and cooling units in the space. Break up the space to smaller zones. Only provide ventilation air and maintain space temperatures during occupied periods.
911 command center	A small amount of ventilation air from AHU-2, and a small DX recirculation unit (AC-911) in the basement. No modification is necessary in this space. Options are listed for reference. It is likely AC-911 will need to be replaced in the next 5-10 years.	Add a zone to the new AHUs.	A variable refrigerant based system. With individual heating and cooling units in the space.
Server rooms, basement and first floor	Stand-alone split DX cooling units. No modification is necessary in this space. Options are listed for reference.		A variable refrigerant based system. With individual heating and cooling units in the space.

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Area	Current System	Option 1	Option 2
Fire truck garage	Steam unit heaters	IR gas fired heaters located at the perimeter of the space.	
Police car garage	Steam unit heaters and steam heating / ventilating units.	New hot water or steam unit heaters and supply air from the new AHUs.	
Basement evidence room	Partially conditioned Some heating from steam unit heaters.	Add a zone to the new AHUs.	A small dedicated system.
Animal control area and storage	Partially conditioned Some heating from steam unit heaters. Window A/C unit in the summer.	Add a zone to the new AHUs.	A small dedicated system.
Basement mechanical spaces	Steam heating / ventilating units.	New heating ventilating units and exhaust fans.	
Gun range	Some supply air from a steam heating / ventilating unit and a specialized gun range exhaust fan. The space has significant pressurization issues when the gun range exhaust fan is operating.	Modify existing gun range exhaust and outside air intakes to address the pressurization issues.	
Perimeter heat	Low pressure steam radiators are located under each window. Each radiator has a manual thermostatic control valve.	Use the hot water from the boiler in the existing radiators.	Use the hot water from the boiler in new radiant panels.

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EXHIBIT 5 –
Phasing Guidelines

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Energy Efficiency Consultants and Sustainable Design Engineers

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Main 847-328-3555
www.grummanbutkus.com

PHASING GUIDELINES

Below are general phasing outlines for the two upgrade options. During night and weekend shutdowns, spot coolers or heaters will be utilized in occupied areas.

Centralized Option

1. Install new electrical service and equipment
    a. Adjacent to existing service
2. Install new terminal boxes with new controls
    a. This will require minor night shutdowns of individual zones
    b. Most boxes will be located above hallways and other unoccupied areas
    c. **Con -** There may be open ceilings during occupied hours, but most work would be done at night
    d. Boxes will be installed but will not operate at first
3. Install new hot water piping above the ceiling
4. Install new boilers in basement mechanical room and tie into piping
5. Install new air-cooled chiller outside
6. Rent temporary packaged unit and locate outside the building
    a. **Con -** Rental will cost approximately $25,000
7. Replace duct risers and tie into temporary unit
    a. **Con -** Weekend shutdown
8. Demo existing AHUs
9. Install new AHUs in basement mechanical room and new controls
10. Tie into ductwork and piping
    a. **Con -** This will require a weekend shut down
11. Start up and Commissioning
12. Normal building operations

Distributed Option

1. Install outdoor condensing units
2. Install new refrigeration pipework above ceilings.
    a. This will mostly be done at night
    b. **Con -** This work will be above occupied areas

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3. Install new local conditioning units above ceiling and in room units
    a. This will mostly be done at night
    b. Install all controls
    c. Tie into refrigeration piping
    d. **Con -** There will be work in occupied areas
    e. **Con –** There will be minor shutdowns if above ceiling units are tied into existing ductwork
4. Install new dedicated outside air (DOAS) ductwork above ceilings
5. Demo existing AHUs and Install DOAS unit and exhaust fan in basement mechanical room
    a. **Cons -** There may be a period when no outside air is provided. Space conditioning will be provided by the new units in each space.
    b. Install all new controls
6. Start up and Commissioning
7. Normal building operations

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