8/13/2020

Study for Certification of Deferred Maintenance Project

NORTH·SHORE COMMUNITY COLLEGE

North Shore Community College
Math & Science Building HVAC Replacement Project Study
1 Ferncroft Road, Danvers, MA 01923

State Project #, Phase: NSC 1956-FT**1**
CAMIS 'J' #: J203721
Agency Project #:

Prepared For:
North Shore Community College
1 Ferncroft Rd, Danvers, MA 01923

Division of Capital Asset Management and Maintenance (DCAMM)
One Ashburton Place, 15th floor
Boston, MA 02108

DIVISION OF CAPITAL ASSET MANAGEMENT & MAINTENANCE

The Commonwealth of Massachusetts

Prepared By:
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Template 04/19

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Acknowledgements

We would like to acknowledge the efforts of the following individuals and firms for the contributions toward the preparation of this study:

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Table of Contents

Section 1 – Study Summary

The Need

North Shore Community College (NSCC) asked Goldman Reindorf Architects, Inc. (GRA) and its team to produce this study because of problems associated with the aging heating, ventilation and air conditioning (HVAC) equipment and inefficient air distribution systems in the Math & Science Building on the Danvers Campus. The three fundamental needs include:

1) An assessment of the existing equipment systems and determination of which systems are at the end of their useful life cycle and how best to replace these systems.
2) Examine how to reconfigure the air distribution ductwork systems to properly ventilate, heat and cool the existing building for occupant comfort, health, and safety.
3) Review structural integrity of existing and proposed roof loads

The Findings

GRA has engaged WSP Engineers, Inc. (WSP) for the preparation of this Study to investigate modernizing the heating, cooling and ventilation systems for the Math and Science Building. In General, most of the existing mechanical equipment and systems are at or near the end of their useful life cycle and much of the air distribution does not circulate air flow properly resulting in uncomfortable hot and cold spots throughout the building. See WSP HVAC Replacement Study Report in Appendix D for detailed information on the existing and proposed HVAC systems. Seacoast Structural Engineers have evaluated the structural integrity of the existing roof and with proposed equipment loads and has provided the structural scope of work provided, see Appendix D and Appendix F. GRA has included the architectural scope of work associated with the above and as required by code, see below and Appendix F. Unfortunately, the available budget is not adequate to address all the deficiencies present in the buildings mechanical systems, and two of the three options are above the available budget. The Covid-19 state shutdown may provide for scheduling opportunities, depending on when the state fully reopens, but during normal hours of operation construction scheduling will be challenging as the building is typically used all year and the computer server room is in operation 24/7 and cannot be taken offline.

The Recommendation

The team has provided three (3) options for renovating the existing HVAC systems. Each option provides for a phased replacement of the equipment and systems for the continuation of use during the work, see WSP HVAC Replacement Study Report, Appendix D, and cost estimates. The consensus solution, Option Three, replaces existing rooftop mounted equipment with new only at units in immediate need of replacement and meets the current NSCC budget. Structural reinforcement and minimal architectural finish and accessibility scope are also included.

☒ *I acknowledge that the information provided by the House Doctor in this Study has been reviewed and approved by the User Agency for accuracy including investigation of existing conditions, applicability of building code and accessibility regulations, estimated construction cost, and schedule for design and construction.*

Signature of Agency Point of Contact: _____ 8/17/20

Rick Reney, Assistant Vice President - Facilities Operations & Services

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Section 2 – Existing Conditions Investigation

Goldman Reindorf Architects, in collaboration with WSP Engineers, Inc. investigated the existing conditions of the North Shore Community College located at 1 Ferncroft Rd Danvers, MA. 01923. The team performed an investigation of the problem and existing conditions including a site visit and review of the existing mechanical equipment, and conditions throughout the building. GRA, serving as the primary consultant to the North Shore Community College, has compiled and analyzed the results of this investigation to determine possible options and a recommendation for remediation.

Basic Building Data

Year of original construction	Math And Sciences Building 1985
Year(s) of recent renovations	1992
Building occupancy type	B
Building square footage	100,800SF
Building use/occupancy	Use Group B: Office, Post Secondary Educational and Assembly spaces
Current CAMIS Value	$37,736,198.28
CAMIS 'J' Number	J203721
CAMIS Site Code and/or Building Number	Math & Science Building: 526NSC0200

Investigation Findings

The existing Math & Science Building facility is a two story 100,000 sf structure built as a warehouse in 1985 and converted to teaching labs and classrooms around 1990. The building houses science labs, classrooms, offices, network server computer room and other campus support services with multiple mechanical systems providing heating, cooling, and ventilation. Current HVAC equipment is approximately 20 to 30 years old, and most are at or near the end of their useful life. The team visited the project site and reviewed the existing equipment throughout the facility. An earlier study by BVH from May 2012 was also reviewed, which evaluated the existing HVAC systems and provided recommendations for individual equipment replacements. WSP found much of the equipment is in disrepair while other equipment has parts in need of immediate replacement, see Section One of WSP HVAC Replacement Study Report, and Seacoast Structural Engineers LLC Structural Evaluation Dated 5/26/2020 in Appendix D.

Accessibility

The existing building has an accessible entrance, toilet rooms, telephones and single level wheelchair accessible drinking fountain that protrudes into the corridor. Curb ramps and sidewalks leading to the building are in fair condition. The existing accessible entrance door is compliant except that the opening force exceeds 15 pounds. The existing parking includes seven accessible parking spaces that are less than 200' from the accessible entrance but the parking lacks the required signage and painted markings for the van-designated accessible parking space. See also Section 3 and GRA drawing T-1 in Appendix F.

Section 3 – Code and Regulations Summary

The following is a **summary** of the essential requirements of the code review conducted for this project, describing the evaluation of the existing building in accordance with 780 CMR 34.00 (2015 International Existing Building Code with amendments) and the code compliance approach associated with the proposed work:

Introduction and Project Description

The work primarily encompasses HVAC with associated hot and cold water and gas piping, electrical and minor accessibility improvements. The consensus solution, Option Three, replaces some existing rooftop mounted equipment with new and includes structural steel frame reinforcement. All work will occur on the existing roof or within the existing building envelope, no additions will be built. All new work will meet the code for new construction.

Applicable Codes

Building Code 780 CMR 34.00 (2015)	☒ Applicable	☐ Not Applicable
Fire Protection	☒ Applicable	☐ Not Applicable
Plumbing	☒ Applicable	☐ Not Applicable
Electrical	☒ Applicable	☐ Not Applicable
Mechanical	☒ Applicable	☐ Not Applicable
Elevator	☐ Applicable	☒ Not Applicable
Hazardous Materials	☒ Applicable	☐ Not Applicable
Energy	☒ Applicable	☐ Not Applicable
Accessibility	☒ Applicable	☐ Not Applicable
Historic Preservation	☐ Applicable	☒ Not Applicable

Code Analysis

See attached WSP Report in Appendix D. The following Codes are applicable:

MA Building Code 780 CMR Chapter 34 (2015 International Existing Building Code with amendments)

Fire Protection 780 CMR Chapter 9 (2015 International Existing Building Code with amendments; NFPA 72, 2017 Edition)

Plumbing 248 CMR

Electrical 527 CMR 12.00
See WSP study report, Appendix D for summary of Mechanical and Electrical systems.

Mechanical Code 780 CMR Chapter 28 (2015 International Existing Building Code with amendments)
See WSP study report, Appendix D for summary of Mechanical and Electrical systems.

Hazardous Materials 310 CMR 30.000
NSCC informed the design team that no hazardous materials have been found during the previous construction projects, however, costs for testing have been included with the project budget.

Energy Conservation Code 780 CMR Chapter 13 (2015 International Existing Building Code with amendments) See WSP study report, Appendix D

Accessibility 521 CMR, 2010 ADA Standards, 28 CFR Part 35.151

Architectural Access Board (AAB) and ADA Title II Summary

North Shore Community College Math and Science Building is owned by the Commonwealth of Massachusetts and is required to meet the accessibility requirements of both the Architectural Access Board (AAB), Section 3.00 of 521CMR, 2006 Edition; Title II of the Americans with Disabilities Act (ADA), 28 CFR Part 35 as amended; and the 2010 ADA Standards for Accessible Design. When the state and federal regulations differ, the regulation that provides the greater level of accessibility must be followed.

The ADA is a civil rights law, not a building code. Title II requires more accessibility than the AAB when a project includes alterations to a program space, sometimes including an accessible path of travel (including access to toilets) from site arrival to the program space.

The Rules and Regulations of the Architectural Access Board 521CMR are enforced by local and state building inspectors, but interpretations are made, and variances granted, only by the Architectural Access Board.

Accessibility Scope of Work according to AAB

This project has the following scope of accessibility work that must be included in the cost estimate:

A. The estimated construction cost for this project (plus work performed over the last three years) exceeds $100,000 and is less than 30% of this year's CAMIS value, see calculations in MAAB Scoping Form in Appendix A. The building must have at least one fully accessible entrance, one fully accessible single user toilet room or fully accessible multi-user toilet rooms for men and women, and an accessible hi-lo drinking fountain or one high and one low. If public telephones exist, one must be fully accessible.
    1. Some of these elements are not in full compliance with the MAAB or the ADA Standards. The following work must be included in this project, see sheet T-1, Appendix F:
        - To achieve an unrestricted accessible building entrance, Replace or adjust the existing door closer at the entrance labeled 'D'.
        - Install compliant parking signage and markings for van accessible parking space.
        - To achieve accessible high and low drinking fountains, complete the following work: On first floor replace existing drinking fountain with new accessible high and low drinking fountains with flanking half height wing walls for cane detection.

- An accessible public telephone exists.
- Any element that has accessibility requirements and is touched by this project also must be made compliant.

MAAB Variances

GRA is not aware of any current variances for the building and does not anticipate the need to seek variances for compliance.

Accessibility Scope of work according to ADA Title II Compliance

1. The project scope does NOT include alterations to any primary function areas in the building so does not trigger accessibility upgrades greater than those required by the MAAB analysis above. The anticipated cost of making the program area and the related route accessible is $23,862 and is included in the cost estimate in Appendix C. This cost does not exceed 20% of the Estimated Construction Cost; therefore, the scope must be addressed as part of this project.

Section 4 – Options and Proposed Solution

Analysis of Potential Solutions

Each option provides for a phased replacement of the equipment and systems to meet the Schools schedule and operating needs. All options must include replacement of the boilers and cooling plant, terminal equipment and address the ventilation and air distribution issues outlined above and as per the WSP report. All options will also include minor accessibility work outlined in Section #3 above and shown Appendix F. The new work must be coordinated with upcoming renovations. New controls will also be part of the project and equipment serving computer service spaces must have redundant systems. The HVAC renovation goals as described in the WSP HVAC Replacement Study Report in Appendix D which includes the following: 1. Analyze renovation to HVAC systems serving the existing building to replace current HVAC equipment and controls, 2. Recommend new HVAC systems serving replacement of dedicated ventilation in labs including fume hoods, 3. Recommend new HVAC system with future expandability to include planned lab renovations. As detailed in the WSP HVAC Replacement Study Report the three options as are as follows:

OPTION 1: Replace equipment in kind - Update Boilers - Update Pumps - Update Chiller & Cooling Tower - Update RTU and Update controls. As the existing RTUs will be replaced in kind, roof modifications will be minimal, but will involve flashing and some structural framing reinforcement, see drawings A-3 Roof Plan and S1.3 Roof Framing Modifications in Appendix F. Ideally the existing RTUs can remain in operation to serve areas that must remain in operation. See also architectural scope included in all options below. These units must be serviced at roof level. Work for areas that must remain in operation will have to accomplished off hours which will increase costs. These units must be serviced at roof level. This Option addresses all existing equipment problems and system deficiencies but does not meet the current budget.

Option 1 Construction cost Estimate	$4,583,166
Accessibility Construction cost Estimate	$24,363
Total Construction cost Estimate	**$4,607,529**
Escalation Allowance	$103,121
Escalated Estimated Construction Cost:	**$4,710,650**
Const C.O. Contingency 10%	$471,065
Total Estimated Construction Cost:	**$5,181,715**
Other Project Costs (Soft costs)	
Designer fees: Architectural, Engineering	$376,852
Other Related fees: Testing, permitting, etc	$15,000
Advertising and Printing	$4,711
Owner furnished products/ equipment	$0
Total Project Soft Costs:	**$396,563**
TOTAL PROJECT COSTS	**$5,578,278**

OPTION 2: Replace existing RTUs with RTUs having DX cooling and gas heating, Replace UV and FCU with RTU having DX cooling and gas heating; Smaller Boiler than Option 1, and no chiller plant will be required. The new RTUs added to the roof will require additional structural framing reinforcement, see drawings A-3 Roof Plan and S1.3 Roof Framing Modifications in Appendix F. Ideally the existing RTUs can remain in operation to serve areas that must remain in operation. See also architectural scope included in all options below. These units must also be serviced at roof level. This Option also addresses all existing equipment problems with a superior system, but it is the most expensive option does not meet the NSCC budget.

Option 2 Construction cost Estimate	$6,079,633
Accessibility Construction cost Estimate	$24,363
Total Construction cost Estimate	**$6,103,996**
Escalation Allowance	$136,792
Escalated Estimated Construction Cost:	**$6,240,788**
Const C.O. Contingency 10%	$624,079
Total Estimated Construction Cost:	**$6,864,867**
Other Project Costs (Soft costs)	
Designer fees: Architectural, Engineering	$499,263
Other Related fees: Testing, permitting, etc	$15,000
Advertising and Printing	$6,241
Owner furnished products/ equipment	$0
Total Project Soft Costs:	**$520,504**
TOTAL PROJECT COSTS	**$7,385,371**

ARCHITECTURAL WORK SCOPE INCLUDED IN OPTIONS ONE AND TWO:

HEATING UNIT REPLACEMENT: Where existing hot water heating elements are comprised of cabinet unit heaters (CUH), unit heaters (UH) and fin tube radiation (FTR) will be removed or replaced in kind as called for in WSP HVAC Report in Appendix D, patch existing wall finishes at each location, see drawings A-1 and A-2 in Appendix F.

FCU REPLACEMENT: Where existing interior fan coil units, (FCU, mostly ceiling mounted) will be removed and/or replaced in kind as called for in WSP HVAC Report in Appendix D. Most units and structure are exposed, but painted finishes will require patching and paint touch up, some areas will require removal & reinstallation of existing ACT ceiling, see drawings A1 and A2 in Appendix F.

LECTURE HALL DUCTWORK SCOPE: To improve airflow new vertical ductwork is to be installed from the existing at the ceiling down to new supplies near the lower floor. An approximately 16" wide by 15' high opening in the existing gypsum wall board will be cut and patched for the installation of vertical ducts between the studs in the existing chase.

ARCHITECTURAL WORK SCOPE INCLUDED IN ALL OPTIONS:

ACCESSIBILITY IMPROVEMENTS: To meet MAAB requirements: To achieve an accessible building entrance, Replace or door hardware at the entrance labeled 'D', also install compliant parking signage and markings for van accessible parking space, see sheet T-1, in Appendix F. On first floor replace existing drinking fountain with new accessible high and low drinking fountains with flanking half height wing walls for cane detection.

DATA CENTER CEILING SCOPE: All options must address the condensation issue being experienced during the summer months at the ceiling of the computer Room 102A Data Center. According to NSCC staff, during warm, humid weather condensation develops at the data center ceiling where unconditioned space exists below the roof deck. The recommended solution is to provide a thermal separation between the data center and equipment and the air above the ceiling. The following scope is proposed: Demolish the existing ceiling, verify that equipment is insulated and install a new moisture resistant 2x4 ACT ceiling with vapor resistant panels and gaskets to provide hermetic sealing between the panels and suspension grid. Install 6" layer of mineral wool batt insulation above the new finish ceiling. The existing fire protection, lighting, electrical and fire alarm devices, split system Liebert computer room air conditioning units and the underfloor ductwork distribution will all remain.

STRUCTURAL SCOPE: Seacoast Structural Engineers have evaluated the structural integrity of existing roof structure and reviewed proposed roof equipment, see Appendix D, and has provided a schematic structural reinforcement design for the proposed new rooftop equipment, see roof framing drawing in Appendix F.

Preferred Solution and Scope of Work

OPTION 3:

The consensus solution, OPTION 3, is a scaled down version of Option One and replaces only the oldest and most problematic existing rooftop mounted units and heating units to meet the schools budget requirements. This approach incurs the smallest disruption of building use as existing ductwork and piping can remain with most work, including structural reinforcement, being accomplished from the roof level.

The scope is as follows: Replace equipment in kind - Update Boilers - Update Pumps - Update Chiller & Cooling Tower (Phase One) - Update RTUs and associated controls (Phase Two), see WSP HVAC Replacement Study Report in Appendix D. As the existing RTUs will be replaced in kind, roof modifications will be minimal, and will involve some structural framing reinforcement, see drawings A-3 Roof Plan and S1.3 Roof Framing Modifications. Work for areas that must remain in operation will be accomplished off hours which will increase costs, per the attached cost estimate. These units must be serviced at roof level. All new work will meet the code for new construction. See also GRA drawings in Appendix F.

Option 3 Construction cost Estimate	$2,560,985
Accessibility Construction cost Estimate	$24,297
Total Construction cost Estimate	**$2,585,282**
Escalation Allowance	$64,632
Escalated Estimated Construction Cost:	**$2,649,914**
Const C.O. Contingency 10%	$264,991
Total Estimated Construction Cost:	**$2,914,905**
Other Project Costs (Soft costs)	
Designer fees: Architectural, Engineering	$185,494
Other Related fees: Testing, permitting, etc	$12,000
Advertising and Printing	$2,650
Commissioning	$90,720
Total Project Soft Costs:	**$290,864**
TOTAL PROJECT COSTS	**$3,205,769**

Section 5 – Cost Estimate Summary - Option #3

Study Costs

1.	Total Consultant Study Fees:	$88,800
2.	Total Consultant Reimbursable not included in study fee:	$ 0
	Total study cost	**$88,800**

Design and Construction Cost Estimate (prepared by: CHA Consulting Inc)

See Construction Cost Estimate dated 6/11/2020 in Appendix C

Identify cost estimator's assumptions and exclusions

A.	**Estimated Construction Cost (ECC) based on this Study**	**$2,585,282**
1.	ECC date (*mo/yr*):	8/12/2020
2.	Projected construction midpoint (*mo/yr*):	12/13/2021
3.	Months elapsed from ECC date to construction midpoint:	11
4.	Cost escalation rate (*3% per year x ECC*):	$64,632
5.	Escalated Estimated Construction Cost (*ECC x Escalation Rate*):	$2,649,914
B.	**Change Order Contingency (*10% of Escalated ECC*)**	$264,991
C.	**Final Designer's Fee**	
1.	Fee Rate (*%*) per Inspector General's guideline:	7%
2.	Designer's Fee (*Escalated ECC x Fee Rate*)	$185,494
D.	**Other Designer Related Expenses not included in design fee** *(e.g. permitting fees, testing, etc.)*	$12,000
E.	**Advertising and Printing** *(0.1% of Escalated ECC)*	$2,650
F.	**Construction Administration/Resident Engineer:**	
1.	Period of time (*weeks*):	0
2.	Rate *($/week)*:	$_0
3.	Reimbursable expenses:	$_0
4.	Resident Engineer costs:	$_0
5.	Commissioning	$90,720
G.	**Furnishings and/or Equipment**	$_0
TOTAL PROJECT COST (TPC)		**$3,294,569**

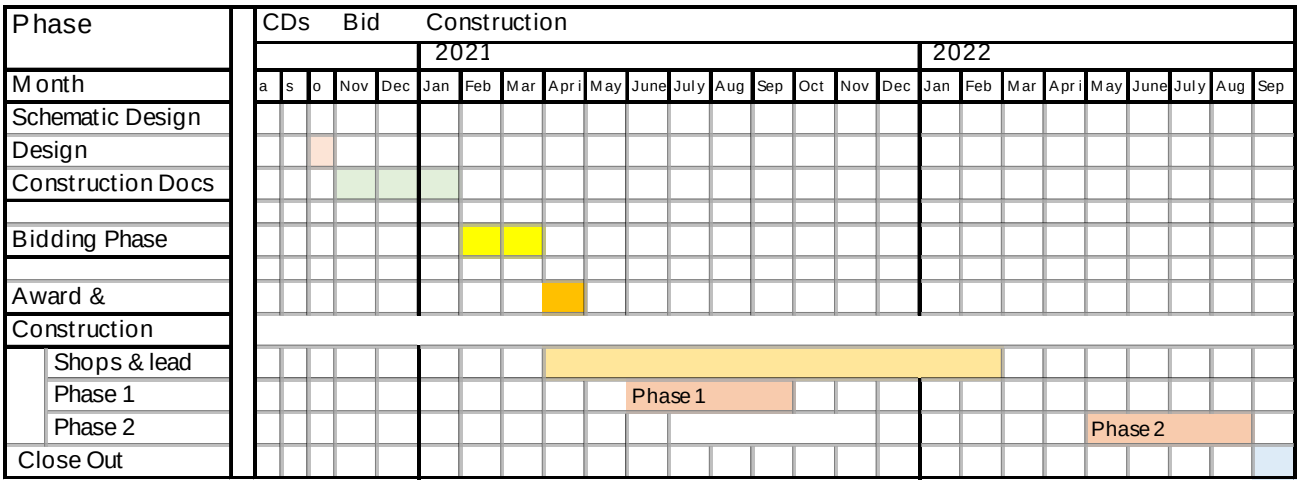
Section 6 – Proposed Schedule

Once the Study document is certified, the project is funded, and funds have been encumbered, the schedule proposed below is anticipated to provide reasonable timeframes for project completion:

Design Development	3	Three Weeks
DD Review	1	One Week
90% Construction Documents	5	five Weeks
90% CD Review	2	Three Week
100% Construction Documents	2	Two Weeks
Bid Period	9	Nine Weeks
Award Contract	2	Two Weeks
Construction Duration	64	Sixty-four Weeks
Total	88	Eighty-Eight Weeks

Scheduling Considerations

Normally the building is in use all year and according to NSCC, no swing space opportunities exist on campus to move occupants out temporarily. Also, the computer server room is in operation 24/7 serving the whole campus and cannot be taken offline even during the recent shutdown. The Covid-19 related state shutdown will affect the project schedule. In the event of a prolonged shutdown, lead times for some equipment may increase but may provide for schedule acceleration if the building is not yet fully occupied. The above is based on a normal schedule assuming the state has reopened. In that case the building will be fully occupied during construction and the work must proceed in two phases and during off hours to provide that spaces are available during the work. The shop drawing/submittal process should begin immediately after the award of the contract. Five weeks are estimated for shop drawings and 16 weeks for fabrication for an estimated total of 20 to 23 weeks for this phase. The phasing strategy requires that two RTUs be installed per weekend, with other supporting work happening concurrently for a total of 14 weeks of installation. With the assumption that this study will be finished, reviewed, and approved by DCAMM in a timely manner, the contract for the projected is expected to be awarded by 4/12/2021. The below timeline assumes that each phase will be separated by full school sessions, but this could be condensed if additional Covid-19 responses reduce the building occupancy.



Section 7 – Appendices

Appendix A: Accessibility Scoping

- **DCAMM Scoping Form for MAAB Compliance**

Appendix B: DCAMM Outline Specification for the Scope of Work

Appendix C: Full Cost Estimate

- **Schematic Cost Estimator Dated 8/12/2020 by CHA Consulting Inc**

Appendix D: Code Reports and Testing Reports

- **WSP Engineers, Inc. Math & Science Building HVAC Replacement Study Report Dated 6/10/2020**
- **Seacoast Structural Engineers LLC Structural Evaluation Dated 5/26/2020**

Appendix E: Existing Conditions Photos

Appendix F: Project Drawings

Seacoast Structural Engineers LLC Drawing
Roof Framing Modification Plan S1.3

GRA Drawings
T-1 Site / First Floor / Accessibility Review
A-1 First Floor Plan
A-2 Second Floor Plan
A-3 Roof Plan

Appendix A: Accessibility Scoping

- **DCAMM Scoping Form for MAAB Compliance**

DCAMM Scoping Form for MAAB Compliance 2019
Building Repairs, Alterations, and Renovations version 1.5

DCAMM requires that all DCAMM-funded projects be in full compliance with state and federal accessibility laws and regulations, including the Rules and Regulations of the Massachusetts Architectural Access Board (521 CMR), Title II of the Americans with Disabilities Act (ADA), as amended, the 2010 ADA Standards for Accessible Design and other legislation and executive orders that may apply to upholding the rights of citizens with disabilities to equal access to programs, services, and activities of the Commonwealth, including employment.

This form is intended to help facility managers and design consultants during the Study Phase to determine the scope of MAAB requirements for a project. This form should be filled out as early as possible and incorporated into the Study document in the Code Review section. Completing this form does not relieve the designer and user agency of its obligations to provide equal access to persons with disabilities to programs, services, and activities. For technical assistance related to Title II ADA compliance contact the Statewide Accessibility Initiative (SAI) through Chris Becker at 857-204-1206 or email christopher.becker@mass.gov
This material is available in alternative formats. Please request from Christopher Becker at 857-204-1206 or christopher.becker@mass.gov, Monday through Friday 9:00am to 5:00pm.

Form completed by:	John Gately	**Date:**	10-Jun-2020
DCAMM project #:		**CAMIS "J" #:**	J203721
Project name:	NSCC Danvers Campus HVAC Renovations		
Building name:	Math and Sciences Building	**Site name:**	NSCC Danvers Campus
Study consultant:	Goldman Reindorf Architects		
Anticipated date of building permit:	1-Oct-2020		

1. **Describe the scope of work:**

The project comprises multi-phased HVAC improvements that replaces the existing rooftop mounted equipment with new air handler units within the existing building in new equipment mezzanines and mechanical rooms. All work will occur with the existing building envelope, no additions will be built. All new work will meet the code for new construction. The existing building has an accessible entrance, toilet rooms, telephones a new high low wheelchair accessible drinking fountain with wing walls for cane protection will replace existing. Curb ramps and sidewalks leading to the building are in fair condition. The existing accessible entrance door will be made compliant by the installation of new closers.

2. **Does the scope of work include a change of use from private space (ex. single family house) to public space (ex. administrative offices)?** If yes, describe the situation, complete the rest of the form, and contact the Statewide Accessibility Initiative (SAI) for technical assistance.

☐ Yes

☑ No

3. **Is the building connected by doors or corridors to another building?** If yes, describe the situation, complete the rest of the form, and contact the SAI for technical assistance.

☐ Yes

☑ No

ADVISORY - Definition of Building per 521 CMR Section 5: *Before proceeding with this form, please be aware that the definition of building per IBC or 780 CMR differs from the definition per 521 CMR. This form does not ask you to define the building in terms of 521CMR. However, please be aware that the scoping result may change depending on the information provided in Question #3 above. The SAI will provide technical assistance if Question #3 is answered affirmatively.*

4. **Enter the Estimated Construction Cost (ECC) including possible change orders and/or contingencies:** $2,830,761 Box A

5. **Enter the current CAMIS Value in Box B.**
Search the tab "2019 CAMIS Values" at the bottom of this worksheet. $37,736,198 Box B

CAMIS ID #:	526NSC0200	CAMIS Building Name:	Math And Sciences Building

6. **30% of the current CAMIS Value is:** **$11,320,859** Box C

7. **Enter the total cost of any permitted work occurring 36 months prior to the anticipated date of building permit using the lines below.** Box D

Anticipated date of building permit for current project:	1-Oct-2020

Description of permitted work occurring 36 months prior…	Date of Building Permit	Construction Cost (plus change orders)

8. **The total cost of ECC plus permitted work occurring 36 months prior is:** **$2,830,761** Box E

9. **Is the work being performed limited to ONLY the following categories of work? (check all that apply)**

- [x] Electrical
- [x] Roof repair/ replacement
- [x] Mechanical/ HVAC
- [ ] Window repair/ replacement
- [ ] Plumbing, not including fixtures
- [ ] Exterior envelope repairs
- [ ] Automatic sprinklers, but not alarm system
- [ ] Site utilities
- [ ] Abatement of hazardous materials

10. Does the work being performed include any of the following components or elements? (check all that apply) *Work done on these facility elements must be in compliance with accessibility regulations. For example, paving of walkways may require making the slope of the walkway accessible; installing low flow toilets may require additional accessibility upgrades; upgrading fire alarm systems may require changes to pull box locations.*

- ☐ Roadways/ curb cuts
- ☐ Parking
- ☐ Walkways/ steps
- ☐ Building entries
- ☐ Ramps
- ☐ Stairs
- ☐ Elevators/ lifts
- ☐ Doors
- ☐ Showers
- ☐ Drinking fountains
- ☐ Fire alarm system
- ☐ Toilet rooms / plumbing fixtures
- ☐ Program spaces
- ☐ Unique spaces per 521CMR:

Retail Establishments, Transient Lodging Facilities, Educational Facilities, Medical Care Facilities, Detention Facilities, Transportation Terminals, Recreation

List any additional work items that do not fit into the categories in #9 or #10 above:

11. Is the total ECC plus work performed over time (Box E) greater than $100,000?

- ☑ Yes → Go to #12 below
- ☐ No → Go to #13 below

$2,830,761	Box E

12. Is ECC plus work performed over time (Box E) greater than the 30% CAMIS value (Box C)?

- ☐ Yes → Go to #15 and check item C.
- ☑ No → Go to #13 below

$2,830,761	Box E
$11,320,859	Box C

13. Does the entire scope of work fit into the categories listed in #9 above?

- ☑ Yes → Go to #14 below
- ☐ No → Go to #15 and check item B.

14. Is the total cost of ECC plus work performed over time (Box E) less than $500,000?

- ☐ Yes → Go to #15 and check item A.
- ☑ No → Go to #15 and check item B.

$2,830,761	Box E

15. SCOPING RESULT. The following accessibility requirement(s) apply as a result of this scoping analysis:

A. ☐ All elements in the scope of work must comply with 521CMR. Additional compliance with 521CMR is not required.

ACTION → Save a copy for this file for your record. Send an electronic copy of the Excel file to christopher.becker@mass.gov.

B. ☑ All elements in the scope of work must comply with 521CMR. In addition, the following elements are required to comply with 521CMR requirements:

- ***Accessible entrance,*** *including approach walk, stairs, ramps, entry platform, entry doors, thresholds, hardware, maneuvering space and signage.*
- ***Accessible toilet room(s),*** *either a men's room and a women's room* ***or*** *one* single user toilet, and signage. *(Two may be required by 248 CMR)*
- ***Accessible drinking fountain,*** *if a drinking fountain is provided in the building. A high and an accessible low drinking fountain will be required; a compliant accessible combination unit is preferred.*
- ***Accessible telephone*** *, if a public pay telephone is provided. A TTY may be required.*

ACTION → Save a copy for this file for your record. Send an electronic copy of the Excel file to christopher.becker@state.ma.us.

ACTION → Complete the "DCAMM Accessibility Checklist for MAAB Triggered Buildings" to determine if all the above are provided and compliant. Find this form at https://www.mass.gov/service-details/compliance-tools-developed-by-the-statewide-accessibility-initiative. When the checklist is complete or if you have questions about completing the checklist, contact Chris Becker at 857-204-1206 or email christopher.becker@mass.gov.

C. ☐ The entire building, including work performed, must comply with 521CMR.

ACTION → Save a copy for this file for your record. Send an electronic copy of the Excel file to christopher.becker@mass.gov.

ACTION → Complete a "Statewide Accessibility Initiative Intake Form". Contact Chris Becker at 857-204-1206 or email christopher.becker@mass.gov. The SAI will coordinate with you on initiating a full accessibility audit of the building.

ADVISORY - MAAB Variances: *Occasionally in renovation and repair projects, an element cannot be made fully accessible. In this case a variance must be requested from the MAAB. It is incumbent on the applicant to demonstrate with drawings and cost estimates that bringing the element into full compliance is impracticable – **either** "technically unfeasible" **or** " results in excessive and unreasonable costs without any substantial benefit to persons with disabilities". DCAMM should be notified is an MAAB variance request is planned. The DCAMM Statewise Accessibility Initiative may be able to assist designers and user agencies with preparing variance requests. For technical assistance, contact the Initiative through Chris Becker at 857-204-1206 or email christopher.becker@mass.gov .*

Appendix B: DCAMM Outline Specification for the Scope of Work

DIVISION 02 — EXISTING CONDITIONS
Section 02 41 19 Selective Demolition

DIVISION 05 - METALS
05 01 00 Miscellaneous Metals (Filed Sub-Bid)
05 50 00 Metal Fabrications (Part Of Section 05 01 00)

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES
06 10 00 Rough Carpentry

DIVISION 07 — THERMAL AND MOISTURE PROTECTION
Section 07 59 00 Cutting and Patching Roofing
Section 07 72 00 Roof Accessories
Section 07 81 00 Applied Fireproofing
Section 07 84 00 Firestopping
Section 07 92 00 Joint Sealants

DIVISION 08 — OPENINGS
Section 08 71 00 Door Hardware

DIVISION 09 - FINISHES
09 21 10 Gypsum Board Assemblies
09 50 00 Acoustical Tile (Filed Sub-Bid)
09 51 00 Acoustical Ceilings (Part Of Section 09 50 00)
09 90 00 Painting (Filed Sub-Bid)
09 90 01 Painting And Coating (Part Of Section 09 90 00)

DIVISION 23 — HEATING, VENTILATING AND AIR CONDITIONING
Section 23 00 01 * Mechanical Filed Subcontractor Bid Required
(* Filed Sub-Bid Required)
Section 23 01 00 * Basic Mechanical Requirements
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 12 00 * Mechanical Demolition
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 14 00 * Supports and Anchors
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 26 00 * Piping Insulation
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 29 00 * Ductwork Insulation
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 53 50 * Refrigeration Piping and Specialties
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 53 60 * Mini-Split Air Conditioning Systems
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 89 00 * Ductwork
(* Filed Sub-Bid Required as part of Section 23 00 01)
Section 23 93 60 * Air Outlets and Inlets
(* Filed Sub-Bid Required as part of Section 23 00 01)

DIVISION 26 — ELECTRICAL

Section 26 00 01 Electrical

(* Filed Sub-Bid Required)

Section 26 01 00 * Basic Electrical Requirements
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 06 00 * Grounding and Bonding
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 07 00 * Supporting Devices
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 07 50 * Electrical Identification
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 08 00 * Electrical Testing
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 09 10 * Electrical Demolition
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 12 00 * Conductors and Cables
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 13 00 * Raceways
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 13 70 * Outlet Boxes and Enclosures
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 14 00 * Wiring Devices
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 15 00 * Electrical Connections
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 41 00 * Enclosed Switches and Circuit Breakers
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 41 10 * Circuit Breakers in Existing Installations
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 71 00 * Fire Alarm System
(* Filed Sub-Bid Required as part of Section 26 00 01)

Section 26 71 20 * Elevator Lobby and Stairway Communication System
(* Filed Sub-Bid Required as part of Section 26 00 01)

Appendix C: Full Cost Estimate

- **Schematic Cost Estimate Dated 8/12/2020 by CHA Consulting Inc**

North Shore Community College
Math & Science Building HVAC Renovation
Danvers, MA

August 12, 2020

Schematic Cost Estimate

Architect:
Goldman Reindorf Architects, Inc.
427 Watertown Street
Newton, MA 02458
(617) 467-3119

Cost Estimator:
CHA Consulting Inc
1 Faneuil Hall Marketplace
South Market Bldg, Suite 4195
Boston, MA 02109
(617) 451-2717

INTRODUCTION

Project Description:

Math & Science Building HVAC Phases Renovation at North Shore Community College Danvers campus including the whole building following program changes;

- HVAC Option 1: Replace equipment in kind on a one-to-one basis. Replace existing ceiling in isolated location
- HVAC Option 2: Provide rooftop air handling with DX cooling and gas Heating. Replace existing ceiling in isolated location
- HVAC Option 3: Provide new boilers and cooling tower, replace failing rooftop air handling units and provide new DDC control system and integration of new equipment to BMS

Project Particulars:

Schematic Design Drawings dated March 2, 2020 from Goldman Reindorf Architects Inc.
"Math & Science Building" HVAC Replacement Study dated February, 2020 prepared by WSP
Detailed quantity takeoffs where possible from design package documents
CHA Companies, Inc. experience with similar projects of this nature
Design intent and scope review discussions with Goldman Reindorf Architects Inc. and their Design Team

Project Assumptions:

Project will only be bid by DCAMM certified Contractors
The project will be constructed under a single prime contract in accordance with the requirements of Massachusetts General Laws Chapter 149, including Filed Sub-Bids
Bona fide bid returns from no less than three pre-qualified Filed sub-contractors for each filed Sub-bid
Our costs assume that there will be at least three subcontractors submitting unrestricted bids in each trade bid category
Direct trade unit rates include escalation to mid-point of construction duration and prevailing wage labor rates. These unit rates continue to be updated during the design period
Operation during off -hours, RTU replacement will be phase to allow continuous classroom occupancy
No occupancy of project zone during construction
Temporary electrical and water site utility connections will be available. General Conditions value includes utility connections and consumption costs
Noise and vibration disturbances are anticipated and will be minimized or avoided during normal business hours
Subcontractor's markups are included in each unit rate. These markups cover field and home office overhead and subcontractor's profit
General Conditions covers supervision, general facilities to support Project, and site office overheads that are not attributable to the direct trade costs
Anticipated start of construction Summer 2021

Construction Cost Estimate Exclusions:

Work beyond the boundary of the site
Hazardous materials survey and report
Architectural/Engineering; Designer and other professional fees, testing, printing, surveying
Owner's administration; legal fees, advertising, permitting, Owner's insurance, administration, interest expense
Project costs; utility company back charges prior to construction, construction of swing space and temporary facilities, program related phasing, relocation
Owner's site representation and project administration
Owner furnished and installed products; residential appliances, computer networking, desks, chairs, furnishings, equipment, artwork, loose case goods and other similar items
Third Party testing and commissioning

OPTIONS MAIN SUMMARY

ELEMENT	TOTAL	TOTAL/SF
Option 1: Replace equipment in kind on a one-to-one basis	$4,780,131	$47.80
Option 2: Provide rooftop air handling with DX cooling and gas Heating	$6,340,665	$63.41
Option 3: Option 3 scope reduced to meet the budget available	$2,625,010	$26.25
Accessibility Costs	$24,904	$0.25

HVAC OPTIONS SUMMARY

ELEMENT		OPTION 1		OPTION 2		OPTION 3			
						Phase 1		Phase 2	
		TOTAL	COST/SF	TOTAL	COST/SF	TOTAL	COST/SF	TOTAL	COST/SF
02-EXISTING CONDITIONS		$84,726	$0.85	$84,726	$0.85	$27,960	$0.28	$56,766	$0.57
03-CONCRETE		$2,500	$0.03	$2,500	$0.03	$1,000	$0.01	$1,500	$0.02
05-METALS		$42,665	$0.43	$58,555	$0.59	$8,584	$0.09	$17,301	$0.17
06-WOODS, PLASTICS, AND COMPOSITES		$750	$0.01	$4,500	$0.05	$750	$0.01	$17,301	$0.17
07-THERMAL AND MOISTURE PROTECTION		$66,340	$0.66	$78,436	$0.78	$21,817	$0.22	$44,523	$0.45
09-FINISHES		$105,580	$1.06	$199,821	$2.00	$31,655	$0.32	$64,115	$0.64
23 00 00 HVAC		$2,587,187	$25.87	$3,574,760	$35.75	$401,125	$4.01	$817,444	$8.17
26-ELECTRICAL		$454,430	$4.54	$432,890	$4.33	$107,062	$1.07	$217,368	$2.17
Premium for Phasing	10.00%	$334,418	$3.34	$443,619	$4.44	$59,995	$0.60	$123,632	$1.24
Premium for Off-Hours	4.00%	$133,767	$1.34	$177,448	$1.77	$23,998	$0.24	$49,453	$0.49
Direct Trade Details Subtotal		**$3,812,362**	**$38.12**	**$5,057,254**	**$50.57**	**$683,946**	**$6.84**	**$1,409,402**	**$14.09**
Design and Pricing Contingency	8.00%	$304,989	$3.05	$404,580	$4.05	$54,716	$0.55	$112,752	$1.13
Trade Cost Subtotal		**$4,117,351**	**$41.17**	**$5,461,834**	**$54.62**	**$738,662**	**$7.39**	**$1,522,155**	**$15.22**
Burdens and Markups									
General Conditions and Project Requirements	10.00%	$411,800	$4.12	$546,200	$5.46	$73,900	$0.74	$152,300	$1.52
General Liability Insurance	1.10%	$49,900	$0.50	$66,100	$0.66	$9,000	$0.09	$18,500	$0.19
Performance and Payment Bonds	1.10%	$45,291	$0.45	$60,080	$0.60	$8,125	$0.08	$16,744	$0.17
Permit	0.50%	$23,200	$0.23	$30,700	$0.31	$4,200	$0.04	$8,600	$0.09
General Contractor's Fee	3.00%	$16,000	$0.16	$21,100	$0.21	$2,900	$0.03	$5,900	$0.06
Estimated Construction Cost Total		**$4,663,542**	**$46.64**	**$6,186,014**	**$61.86**	**$836,787**	**$8.37**	**$1,724,198**	**$17.24**
Escalation Allowance To The Start Of Construction Summer 2021	2.50%	$116,589	$1.17	$154,650	$1.55	$20,920	$0.21	$43,105	$0.43
Estimated Construction Cost Total at Bid Opening		**$4,780,131**	**$47.80**	**$6,340,665**	**$63.41**	**$857,707**	**$8.58**	**$1,767,303**	**$17.67**

HVAC OPTION DIRECT TRADE COST DETAILS

	ELEMENT	UNIT	UNIT RATE	OPTION 1		OPTION 2		OPTION 3			
								Phase 1		Phase 2	
				QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
10	**02-EXISTING CONDITIONS**										
11											
12	Demo existing ceiling; in isolation location	SF	$2.00	**16,573**	$33,146	**16,573**	$33,146	**5,469**	$10,938	**11,104**	$22,208
13	Miscellaneous demolition other than detailed above	MHR	$85.00	**294**	$24,990	**294**	$24,990	**97**	$8,247	**197**	$16,743
14	Cart and disposal of all demolition materials	LS	$11,590.00	**1**	$11,590	**1**	$11,590	**1**	$3,825	**1**	$7,765
15	Protect existing elements to remain	AL	$15,000.00	**1**	$15,000	**1**	$15,000	**1**	$4,950	**1**	$10,050
16	*Contaminated Material Removal*										
17	Hazardous materials	AL		**1**	N.I.C.	**1**	N.I.C.	**1**	N.I.C.	**1**	N.I.C.
18	**02-Existing Conditions Total**				**$84,726**		**$84,726**		**$27,960**		**$56,766**
19											
20											
21	**03-CONCRETE**										
22											
23	Equipment pads; boiler and pump	LS	$2,500.00	**1**	$2,500	**1**	$2,500	**1**	$1,000	**1**	$1,500
24	**03-Concrete Total**				**$2,500**		**$2,500**		**$1,000**		**$1,500**
25											
26											
27	**05-METALS**										
28											
29	Lift rental and Lift operator crews for roof dunnage install	WEEK	$4,195.00	**7**	$29,365	**7**	$29,365	**1**	$4,195	**2**	$8,390
30	Roof dunnage steel	LF	$70.00	**190**	$13,300	**417**	$29,190	**63**	$4,389	**127**	$8,911
31	**05-Metals Total**				**$42,665**		**$58,555**		**$8,584**		**$17,301**
32											
33											
34	**06-WOODS, PLASTICS, AND COMPOSITES**										
35											
36	*Rough Carpentry*										
37	RUT opening	EA	$750.00	**1**	$750	**6**	$4,500	**1**	$750		
38	**06-Woods, Plastics, And Composites Total**				**$750**		**$4,500**		**$750**		**$0**
39											
40											
41	**07-THERMAL AND MOISTURE PROTECTION**										
42											
43	*Roofing and Flashing*										
44	Remove and replace with new roofing at data center	SF	$25.00	**630**	$15,750	**630**	$15,750	**208**	$5,198	**422**	$10,553
45	Patch existing roof after replace RTU; isolated location	SF	$17.50	**808**	$14,140	**808**	$14,140	**267**	$4,666	**541**	$9,474
46	Miscellaneous sealants at roof	LOC	$250.00	**10**	$2,500	**10**	$2,500	**3**	$750	**7**	$1,750
47	New roof curb and flashing	LF	$54.00			**224**	$12,096				
48	New roof flashing at existing curbing	LF	$25.00	**358**	$8,950	**358**	$8,950	**118**	$2,954	**240**	$5,997
49	*Joint Sealants*										
50	Caulking and sealants; allow	SF	$0.25	**100,000**	$25,000	**100,000**	$25,000	**33,000**	$8,250	**67,000**	$16,750
51	**07-Thermal And Moisture Protection Total**				**$66,340**		**$78,436**		**$21,817**		**$44,523**
52											
53											

HVAC OPTION DIRECT TRADE COST DETAILS

	ELEMENT	UNIT	UNIT RATE	OPTION 1		OPTION 2		OPTION 3			
								Phase 1		Phase 2	
				QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
54	**09-FINISHES**										
55											
56	*Acoustical Ceilings*										
57	2x2 ACT office ceiling	SF	$6.50	**2,400**	$15,600	**3,200**	$20,800	**594**	$3,861	**1,206**	$7,839
58	C1; Temporarily remove and reinstall of ACT ceiling for mechanical works	SF	$5.25	**3,600**	$18,900	**4,200**	$22,050	**825**	$4,331	**1,675**	$8,794
59	New ACT material only; assume 15% of ceiling area	SF	$2.25	**540**	$1,215	**680**	$1,530	**158**	$356	**322**	$724
60	New 2x4 vapor retardant computer ceiling w/ 6" Wood batt insulation	SF	$8.50	**780**	$6,630	**780**	$6,630	**257**	$2,188	**523**	$4,442
61	*Painting and Coating*										
62	Patch wall finish and paint after replace existing cabinet unit heater	SF	$3.00	**3,112**	$9,336	**3,112**	$9,336	**1,027**	$3,081	**2,085**	$6,255
63	C2; Touch up painted exposed structure where damage by mechanical	SF	$1.75	**20,600**	$36,050	**20,600**	$36,050	**6,798**	$11,897	**13,802**	$24,154
64	GWB walls; prep and paint	SF	$1.75	**1,456**	$2,549	**44,528**	$77,925	**481**	$841	**976**	$1,708
65	Door	LEAF	$150.00	**2**	$300	**70**	$10,500	**1**	$150	**1**	$150
66	Miscellaneous interior painting	GFA	$0.15	**100,000**	$15,000	**100,000**	$15,000	**33,000**	$4,950	**67,000**	$10,050
67	**09-Finishes Total**				**$105,580**		**$199,821**		**$31,655**		**$64,115**
68											
69											
70	**21,22,23-MECHANICAL**										
71											
72	**23 00 00 HVAC**										
73	Crane rental and crane operator crews for roof HVAC install	WEEK	$14,500.00	**7**	$101,500	**7**	$101,500			**3**	$43,500
74											
75	*Demolition:*			*$18,625*		*$83,500*		*$21,125*		*$18,375*	
76	B-1 (3563 MBH Boiler)	MHR	$125.00	**5**	$625	**5**	$625	**5**	$625		
77	Chiller Unit and Distribution	LS	$55,000.00			**1**	$55,000				
78	Cooling tower	LS	$20,000.00					**1**	$20,000		
79	Pumps	MHR	$125.00	**11**	$1,375	**11**	$1,375	**4**	$500		
80	Rooftop units	MHR	$125.00	**60**	$7,500	**100**	$12,500			**60**	$7,500
81	Unit ventilators	MHR	$125.00	**16**	$2,000	**16**	$2,000			**10**	$1,250
82	Supply fans to provide make up air	MHR	$125.00	**16**	$2,000	**16**	$2,000			**8**	$1,000
83	4 Pipe fan coil units	MHR	$125.00	**1**	$125					**29**	$3,625
84	Misc. demo				$5,000		$10,000				$5,000
85	*Heating Plant:*			*$138,000*		*$138,000*		*$116,000*			
86	B-1 & B-2 (4000 MBH Gas-Fired Hot Water Boilers)	EA	$36,000.00	**2**	$72,000	**2**	$72,000	**2**	$72,000		
87	P-1 & P-1A (640 GPM Rated Hot Water Boiler Pumps)	EA	$12,000.00	**2**	$24,000	**2**	$24,000	**2**	$24,000		
88	P-2 & P-2A, P-3 & P-3A (Secondary Hot Water Pumps)	EA	$8,000.00	**4**	$32,000	**4**	$32,000				
89	Glycol system	AL	$10,000.00	**1**	$10,000	**1**	$10,000	**1**	$10,000		
90	Controls & Instrumentation	EA	$5,000.00					**2**	$10,000		
91	*Cooling Plant:*			*$388,000*		*$288,000*		*$250,000*			
92	P-4 & P-4A (275 GPM Rated Chilled Water Pumps)	EA	$8,000.00	**2**	$16,000	**2**	$16,000				
93	Glycol System, Antifreeze	AL	$12,000.00	**1**	$12,000	**1**	$12,000				
94	120 Ton Cooling Tower	TON	$2,000.00	**120**	$240,000	**120**	$240,000	**120**	$240,000		
95	P-5 & P-5A (360 GPM Rated Hot Water Boiler Pumps)	EA	$10,000.00	**2**	$20,000	**2**	$20,000				
96	Piping				$100,000		$50,000				
97	Controls & Instrumentation	EA	$5,000.00					**2**	$10,000		

HVAC OPTION DIRECT TRADE COST DETAILS

	ELEMENT	UNIT	UNIT RATE	OPTION 1		OPTION 2		OPTION 3			
								Phase 1		Phase 2	
				QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
98	*Space Heating & Cooling:*			*$23,000*		*$234,250*					
99	4 Pipe Fan Coil Units	EA	$4,000.00	**2**	$8,000	**47**	$188,000				
100	Unit heaters	AL	$2,500.00	**6**	$15,000	**6**	$15,000				
101	Fin-tube radiation	LF	$250.00			**125**	$31,250				
102	*Ventilation and Distribution:*			*$1,848,062*		*$2,609,510*		*$1,750*		*$732,819*	
103	Rooftop Units:										
104	*Zone 0 (Arcade, Corridors):*									**462,134**	
105	RTU-2	CFM	$15.00	**12,000**	$180,000					**12,000**	$180,000
106	VAV Terminal Units	EA	$2,500.00	**10**	$25,000						
107	Fin-Tube radiation	LF	$175.00	**125**	$21,875						
108	15210 of Clean, Rebalance ductwork	LBS	$3.00	**13,689**	$41,067					**13,689**	$41,067
109	Controls & Instrumentation	EA	$5,000.00							**2**	$10,000
110	RTU-3	CFM	$15.00							**12,000**	$180,000
111	15210 of Clean, Rebalance ductwork	LBS	$3.00							**13,689**	$41,067
112	Controls & Instrumentation	EA	$5,000.00							**2**	$10,000
113	Option 2	LS	$941,900.00			**1**	$941,900				
114	RTU-11	CFM	$15.00			**12,200**	$183,000				
115	6,100 sf of laboratory space ductwork	LBS	$17.00			**5,490**	$93,330				
116	Fan powered hot water VAV terminal units	EA	$2,500.00			**4**	$10,000				
117	Controls and Instrumentation	LS	$25,000.00			**1**	$25,000				
118	*Zone 1:*										
119	4 Pipe Fan Coil Units	EA	$4,000.00	**1**	$4,000						
120	3055SF Sheet Metal Ductwork (Rebalance, Clean)	LBS	$5.00	**2,750**	$13,748						
121	Controls & Instrumentation	LS	$20,000.00	**1**	$20,000						
122	*Zone 2:*										
123	4 Pipe Fan Coil Units	EA	$4,000.00	**16**	$64,000						
124	3055SF Sheet Metal Ductwork (Rebalance, Clean)	LBS	$5.00	**2,750**	$13,748						
125	Controls & Instrumentation	LS	$20,000.00	**1**	$20,000						
126	RTU-15	CFM	$15.00			**8,000**	$120,000				
127	Sheet metal ductwork	LBS	$14.00			**2,295**	$32,130				
128	VAV terminal units	EA	$2,000.00			**3**	$6,000				
129	Fin tube perimeter heating	LF	$175.00			**115**	$20,125				
130	Controls and Instrumentation	LS	$25,000.00			**1**	$25,000				
131	*Zone 4:*										
132	RTU-07	CFM	$15.00	**6,400**	$96,000						
133	Fan Powered VAV Terminal Units	EA	$3,000.00	**3**	$9,000						
134	4120 SF, Rebalance ductwork	LBS	$12.00	**8,253**	$99,036						
135	Controls & Instrumentation	LS	$10,000.00	**1**	$10,000						
136	*Zone 6:*										
137	RTU-08	CFM	$15.00	**6,400**	$96,000						
138	Fan Powered VAV Terminal Units	EA	$3,000.00	**3**	$9,000						
139	Heat filters, misc. construction associated w/clean room	SF	$5.00	**1,000**	$5,000						
140	2105 SF, Rebalance ductwork	LBS	$13.00	**1,895**	$24,629						
141	Controls & Instrumentation	LS	$15,000.00	**1**	$15,000						

HVAC OPTION DIRECT TRADE COST DETAILS

	ELEMENT	UNIT	UNIT RATE	OPTION 1		OPTION 2		OPTION 3			
								Phase 1		Phase 2	
				QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
142	*Zone 7:*										
143	RTU-11	CFM	$16.00	**14,400**	$230,400						
144	Fan Powered VAV Terminal Units	EA	$3,000.00	**10**	$30,000						
145	4 Pipe Fan Coil Units	EA	$4,000.00	**1**	$4,000						
146	Fin-Tube radiation	LF	$175.00	**125**	$21,875						
147	9500 SF, Rebalance ductwork	LBS	$12.00	**8,253**	$99,036						
148	Controls & Instrumentation	LS	$35,000.00	**1**	$35,000						
149	*Zone 9:*										
150	4 Pipe Fan Coil Units	EA	$4,000.00	**2**	$8,000						
151	Sheet Metal Ductwork	LS	$5,000.00	**1**	$5,000						
152	Controls & Instrumentation	LS	$5,000.00	**1**	$5,000						
153	*Zone 10 & 13:*										
154	RTU-1	CFM	$15.00	**10,400**	ETR						
155	VAV Terminal Units	EA	$2,500.00	**7**	$17,500						
156	Sheet Metal Ductwork	LS	$5,000.00	1	$5,000						
157	Controls & Instrumentation	LS	$10,000.00	**1**	$10,000						
158	*Zone 11:*										
159	4 Pipe Fan Coil Units	EA	$4,000.00	**15**	$60,000						
160	2880 SF Sheet Metal Ductwork (Rebalance, Clean)	LBS	$3.00	**2,592**	$7,776						
161	Controls & Instrumentation	LS	$10,000.00	**1**	$10,000						
162	RTU-16	CFM	$15.00			**8,000**	$120,000				
163	Sheet metal ductwork	LBS	$14.00			**2,295**	$32,130				
164	VAV terminal units	EA	$2,000.00			**3**	$6,000				
165	Fin tube perimeter heating	LF	$175.00			**115**	$20,125				
166	Controls and Instrumentation	LS	$25,000.00			**1**	$25,000				
167	*Zone 12:*										
168	RTU-9	CFM	$15.00	**10,400**	ETR						
169	RTU-10	CFM	$15.00	**5,000**	$75,000					**5,000**	$75,000
170	VAV Terminal Units	EA	$2,500.00	**7**	$17,500						
171	Sheet Metal Ductwork	LS	$5,000.00	**1**	$5,000						
172	Controls & Instrumentation	LS	$10,000.00	**1**	$10,000					**1**	$10,000
173	*Zone 13 & Zone 1:*										
174	RTU-12	CFM	$15.00			**10,000**	$150,000				
175	Sheet metal ductwork	LBS	$14.00			**8,640**	$120,960				
176	VAV terminal units	EA	$2,000.00			**6**	$12,000				
177	Fin tube perimeter heating	LF	$175.00			**115**	$20,125				
178	Controls and Instrumentation	LS	$40,000.00			**1**	$40,000				
179	*Zone 15:*										
180	4 Pipe Fan Coil Units	EA	$4,000.00	**2**	$8,000						
181	2000 SF Sheet Metal Ductwork (Rebalance, Clean)	LBS	$3.00	**1,800**	$5,400						
182	Controls & Instrumentation	LS	$10,000.00	**1**	$10,000						
183	RTU-13	CFM	$15.00			**8,000**	$120,000				
184	Sheet metal ductwork	LBS	$14.00			**1,798**	$25,175				
185	VAV terminal units	EA	$2,000.00			**3**	$6,000				

HVAC OPTION DIRECT TRADE COST DETAILS

	ELEMENT	UNIT	UNIT RATE	OPTION 1		OPTION 2		OPTION 3 Phase 1		OPTION 3 Phase 2	
				QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
186	Fin tube perimeter heating	LF	$175.00			**115**	$20,125				
187	Controls and Instrumentation	LS	$25,000.00			**1**	$25,000				
188	*Zone 16:*										
189	4 Pipe Fan Coil Units	EA	$4,000.00	**10**	$40,000						
190	3855 SF Sheet Metal Ductwork (Rebalance, Clean)	LBS	$3.00	**3,470**	$10,409						
191	Controls & Instrumentation	LS	$20,000.00	**1**	$20,000						
192	RTU-14	CFM	$15.00			**10,000**	$150,000				
193	Sheet metal ductwork	LBS	$15.00			**2,349**	$35,235				
194	VAV terminal units	EA	$2,000.00			**3**	$6,000				
195	Controls and Instrumentation	LS	$25,000.00			**1**	$25,000				
196	*Zone 17 & Zone 5 (Health Professions Classroom):*										
197	RTU-6	CFM	$15.00	**3,000**	$45,000					**3,000**	$45,000
198	1165 SF of Health Professions Space, Rebalance/Modify ductwork	LBS	$10.00	**1,058**	$10,575					**1,058**	$10,575
199	Controls & Instrumentation	LS	$5,000.00	**1**	$5,000					**1**	$5,000
200	*Zone 17 & Zone 5 (Lecture Hall):*										
201	RTU-5	CFM	$15.00	**6,400**	$96,000					**6,400**	$96,000
202	2,140 SF of Lecture Hall Space, Rebalance ductwork	LBS	$5.00	**1,922**	$9,610					**1,922**	$9,610
203	Controls & Instrumentation	LS	$5,000.00	**1**	$5,000					**1**	$5,000
204	Insulated galvanized steel ductwork	GSF	$1.50	**53,820**	$80,730						
205	Insulated galvanized steel ductwork	GSF	$4.50							**2,500**	$11,250
206	Supply fans to provide make up air	CFM	$5.00	**13,830**	$69,150	**13,830**	$69,150				
207	Radiant heating panel	LF	$250.00			**500**	$125,000				
208	Misc. heating & cooling				$10,000				$1,750		$3,250
209	*Miscellaneous:*										
210	Coordination & management				$10,000		$10,000		$1,750		$3,250
211	Hydraulic calculations / Shop dwgs				$10,000		$10,000		$1,750		$3,250
212	Coring, sleeves & fire stopping				$30,000		$30,000		$5,250		$9,750
213	Fees & permits				$20,000		$20,000		$3,500		$6,500
214	**23 00 00 HVAC Total**				**$2,587,187**		**$3,574,760**		**$401,125**		**$817,444**
215											
216											
217	**26-ELECTRICAL**										
218											
219	**26 00 00 Electrical**										
220	Demo and make safe for HVAC replacement	GSF	$0.75	**100,000**	$75,000	**100,000**	$75,000				
221	Demo and make safe for HVAC replacement	GSF	$0.45					**33,000**	$14,850	**67,000**	$30,150
222	New power wiring and connections for new HVAC equipment	GSF	$2.50	**100,000**	$250,000	**100,000**	$250,000				
223	New power wiring and connections for new HVAC equipment	GSF	$1.50					**33,000**	$49,500	**67,000**	$100,500
224	Supplemental electrical work for Option # 1										
225	400A, 480/277V 3 phase, 4 wire equipment panel	EA	$7,800.00	**1**	$7,800	**1**	$7,800	**1**	$2,574	**1**	$5,226
226	Retrofit switchboard/breakers for new chiller	LS	$10,920.00	**1**	$10,920			**1**	$3,604	**1**	$7,316
227	Retrofit switchboard/breakers for new cooling tower	LS	$10,620.00	**1**	$10,620			**1**	$3,505	**1**	$7,115
228	New 800A breaker in extg switchboard	LS	$3,940.00	**1**	$3,940	**1**	$3,940	**1**	$1,300	**1**	$2,640
229	New 800A MDP2 panel	EA	$7,400.00	**1**	$7,400	**1**	$7,400	**1**	$2,442	**1**	$4,958

HVAC OPTION DIRECT TRADE COST DETAILS

	ELEMENT	UNIT	UNIT RATE	OPTION 1		OPTION 2		OPTION 3			
								Phase 1		Phase 2	
				QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
230	Feeders for panels	LS	$33,750.00	**1**	$33,750	**1**	$33,750	**1**	$11,138	**1**	$22,613
231	Permits and fees	LS	$30,000.00	**1**	$30,000	**1**	$30,000	**1**	$9,900	**1**	$20,100
232	Temporary power	LS	$25,000.00	**1**	$25,000	**1**	$25,000	**1**	$8,250	**1**	$16,750
233	Phasing, logistics and coordination's	GSF	$1.10	**100,000**	Main Summary	**100,000**	Main Summary	**33,000**	Main Summary	**67,000**	Main Summary
234	**26 00 00 Electrical Total**				**$454,430**		**$432,890**		**$107,062**		**$217,368**
235											
236											
237											

ACCESSIBILITY SUMMARY

ELEMENT		TOTAL	COST/SF
08-OPENINGS		$2,350	$0.02
09-FINISHES		$1,000	$0.01
22 00 00 PLUMBING		$6,800	$0.07
32-EXTERIOR IMPROVEMENTS		$7,120	$0.07
Premium for Off-Hours and Phasing	10.00%	$1,727	$0.02
Premium for Off-Hours	4.00%	$691	$0.01
Direct Trade Details Subtotal		**$19,688**	**$0.20**
Design and Pricing Contingency	8.00%	$1,575	$0.02
Trade Cost Subtotal		**$21,263**	**$0.21**
Burdens and Markups			
General Conditions and Project Requirements	10.00%	$2,200	$0.02
General Liability Insurance	1.10%	$300	$0.00
Performance and Payment Bonds	1.10%	$234	$0.00
Permit	0.50%	$200	$0.00
General Contractor's Fee	3.00%	$100	$0.00
Estimated Construction Cost Total		**$24,297**	**$0.24**
Escalation Allowance To The Start Of Construction Summer 2021	2.50%	$607	$0.01
Estimated Construction Cost Total at Bid Opening		**$24,904**	**$0.25**

ACCESSIBILITY DIRECT TRADE COST DETAILS

	ELEMENT	QUANTITY	UNIT	UNIT RATE	COST
8	**08-OPENINGS**				
9					
10	Provide door closer hardware for accessible entrance	**1**	SET	$2,350.00	$2,350
11	**08-Openings Total**				**$2,350**
12					
13					
14	**09-FINISHES**				
15					
16	*Gypsum Board Partitions*				
17	GWB wing walls at Drinking fountain	**40**	SF	$25.00	$1,000
18	**09-Finishes Total**				**$1,000**
19					
20					
21	**21,22,23-MECHANICAL**				
22					
23	**22 00 00 Plumbing**				
24	Drinking fountain, connect to extg piping, remove & replace	**1**	LS	$6,800.00	$6,800
25	**22 00 00 Plumbing Total**				**$6,800**
26					
27					
28	**32-EXTERIOR IMPROVEMENTS**				
29					
30	*Site Improvements*				
31	Provide new parking for van accessible parking	**6**	EA	$120.00	$720
32	Misc. pavement marking	**1**	AL	$500.00	$500
33	Provide new H/C parking signage	**2**	EA	$450.00	$900
34	Misc. site improvement other than above	**1**	AL	$5,000.00	$5,000
35	**Site Improvements Total**				**$7,120**
36					
37					

Appendix D: Code Reports and Testing Reports

- **WSP Engineers, Inc. Math & Science Building HVAC Replacement Study Report Dated 6/10/2020**
- **Seacoast Structural Engineers LLC Structural Evaluation Dated 5/26/2020**

NSCC DANVERS CAMPUS

“Math & Science Building” HVAC Replacement Study

Project No. B1912307.000

June 10, 2020

Prepared For: Jamieson Wicks

NSCC Danvers campus

“Math & Science Building” HVAC Replacement Study

Table of Contents

1. Executive Summary

A. North Shore Community College (NSCC) is seeking to replace the aging heating, ventilation and air conditioning (HVAC) equipment and systems in the Math & Science Building on the Danvers Campus. WSP has been commissioned to provide a study (report) detailing recommendations for removals and replacements of HVAC equipment and systems. The recommendations are to consider planned renovations for expanding the science classrooms located on the 2nd floor.

B. To perform the study WSP visited the project site and reviewed the existing equipment throughout the facility. WSP read through an earlier study performed by BVH from May 2012[1], which evaluated the existing HVAC systems and provided recommendations for individual equipment replacements. WSP learned from NSCC personnel that specific equipment has been replaced – the replaced equipment is noted in the report. Some of the equipment noted in the BVH report had certain components replaced to maintain operation for a few more years – this equipment is noted to be replaced in the report.

C. WSP has provided three (3) options for the replacements of existing HVAC equipment. Each option provides for a phased replacement of the equipment and systems as fits budgetary constraints and timelines. Option one provides for direct system replacement and for fan coil units (FCU) to replace the existing unit ventilators (UV). Option two replaces the FCU and UV in the classrooms and offices with rooftop air handling unit (RTU) having self-contained cooling systems and gas heating; existing RTU being replaced maintain their hydronic heating. Option 3 provides a scaled-down version of Option 1 to replace only equipment in immediate need of replacement; areas considered for planned renovations are not included in Option 3 in an effort to reduce construction costs.

2. Project Description

A. The existing Math & Science Building facility is a two story 100,000 sf structure built as a warehouse in 1985 and converted to teaching labs and classrooms around 1990. The building houses science labs, classrooms, offices, network server computer room and other campus support services with multiple mechanical systems providing heating, cooling, and ventilation. Current HVAC equipment is approximately 20 to 30 years old, and most are at or near the end of their useful life.

B. The HVAC renovation goals are as follows:

1. Analyze renovation to HVAC systems serving the existing building to replace current HVAC equipment and controls.
2. Recommend new HVAC systems serving replacement of dedicated ventilation in labs including fume hoods.
3. Recommend new HVAC system with future expandability to include planned lab renovations.

BVH integrated services HVAC SYSTEM EVALUATION North Shore Community College Danvers, MA May 2012 (BVH Report) Page 1

3. HVAC

Section 1 - Existing Conditions Assessment

A. Heating Plant:

1. The building is heated by six modular gas-fired hot water boilers each rated at 300 MBH input. A gas-fired water tube boiler, rated at 2.766 MMBTU, provides supplemental heating hot water during extreme cold temperatures[2]. Hot water is distributed through a primary-secondary hot water piping system configuration. Separate pump sets (P-1 & P-1A and P-2 & P-2A) provide primary pumping at the modular boilers and at the supplemental heating boiler, respectively. A glycol – water mixture is provided for freeze protection for all hot water distribution. One pump of each set serves as standby. A third set of primary pumps, P-3 & P-3A, sends hot water back to the boilers. Secondary pumping (with one pump as standby) includes pumps sets to:

    a. Distribute a 40% Propylene Glycol-water mixture to hot water coils inside the building (Pumps P-4 & P-4A) at 4-pipe fan coil units.
    b. Distribute a 40% Propylene Glycol-water mixture through a shell and tube heat exchanger HX-1 to heat up 40% Ethylene Glycol-water mixture (Pumps P-5 & P-5A).
    c. Distribute 40% Ethylene Glycol-water mixture to heating coils at the rooftop units (P-6 & P-6A).

2. The boilers and pumps appear to have been well maintained but show signs of age. The end of the 25-year life expectancy of the boilers and pumps is near and the equipment do not match energy efficiency of new heating apparatus and distribution pumps. Markings on the Smith boiler indicate that gaskets between the cast iron sections were replaced in November of 2007.

B. Cooling Plant:

1. The building is mainly cooled by a 120-ton Multistack water-cooled modular chiller located on the ground floor. Building heat is rejected to atmosphere through a 110-ton Baltimore Air Coil cross-flow type cooling tower situated at grade outside the mechanical room. A set of condenser water pumps, CTP-1 & CTP-1A, circulates cooling water between the chiller and outdoor cooling tower. Chilled water is circulated to equipment (unit ventilators and fan coil units) inside the through pumps P-3 and P-4. Only one condenser pump and one chilled water pump operate at one time, the others serves as standby. The chilled water pumps are fitted with 10 HP and 15 HP motors respectively and variable frequency drives (VFD). Condenser water pumps are constant flow with 7-1/2 HP and 10 HP motors respectively.

    a. The chiller, replaced in 2013, is in good to fair condition. The cooling tower was not replaced with the chiller and is in poor condition.

    b. Reports of comfort issues, specifically in open areas, were received by WSP during walk throughs and communications with staff.

BVH Report

2. NSCC operating personnel report that on peak heating days they utilize the Smith boiler and the modular boilers to maintain temperature the building.

2. Specific areas of the building receive cooling from direct expansion air-cooled rooftop air handling units. Refer to ventilation paragraphs below.

C. Terminal Equipment:

1. Cabinet fan coil units (FCU) and unit ventilators (UV) provide heating, ventilation and cooling for classrooms, laboratories and offices. Units located on the second floor are floor mounted cabinets positioned against the perimeter walls of the respective space while those on the first floor are horizontal type suspended above the classroom or office floor. The FCU and UV have passed their expected longevity.

D. Ventilation:

1. Ventilation of the building is accomplished using a combination of rooftop air handling units and supply air fans to introduce fresh air into the facility and exhaust fans to remove harmful laboratory vapors. These systems also provide a general exchange of air (refer to Appendix 2 for a listing of RTU and fans).

   a. The rooftop air handling units (RTU) have air-cooled factory packaged direct expansion (DX) refrigeration sections operating on refrigerant R-22 for interior cooling, hot water heating coils, filter sections, air mixing sections, supply fans and unit controls. The units vary in cooling capacity from 7-1/2 Tons (RTU-7) to 36 Tons (RTU-3) serving classrooms, office, open spaces, laboratories, and are generally zoned by area or specific room function. One unit, RTU-4, is abandoned in place. The RTU, although in reasonable condition for their age, have reached the end of their expected life and utilize an environmentally unfriendly refrigerant that is no longer produced.

      (1) Supply air ductwork from the various RTU is largely distributed at the roof level. The RTU with rooftop distribution include RTU-2, RTU-3, RTU-5, RTU-6 and RTU-7. Roof supports are provided for support of the ductwork. Ductwork extends down through roof curbs to short runs of supply duct within the respective spaces where duct mounted hot water heating coils provided temperature control. It is noted that by running ductwork on the roof maximum headroom is maintained in the exposed occupied spaces of the 2nd floor.

   b. Supply air fans (SF) distribute untempered outdoor air for ventilation to classrooms, laboratories and offices ducted directly to the intakes of suspended or floor mounted fan coil units (FCU); the ductwork is uninsulated where exposed to view. The SF are generally in fair condition but at the end of the normal life expectancy.

   c. SF, fitted with duct mounted hot water heating coils, provide tempered outside air directly to fume hoods in Science Storage room, Chemistry Lab and Biotechnology Lab. The SF are also generally in fair condition but at the end of their normal life expectancy.

   d. Return and Exhaust fans, labeled as NF and EF, provide return air from the space to their respective RTU and/or removing contaminants from laboratory fume hoods, biosafety cabinets and autoclave. NF's are provided to support ventilation of offices, classrooms and for other area specific exhaust duties including toilet exhaust, dark room exhaust and elevator machine room exhaust. A majority of these fans are in fair condition but at the end of their normal life expectancy.

      (1) Similar to the supply ductwork from the RTU, all return air ductwork rises to the roof through roof curbs where the utility type NF fans direct the air back to the RTU. Roof supports are provided for support of the ductwork.

E. Data Center

1. The 1st floor Data Center is presently served by RTU-10 for ventilation and cooling through an underfloor duct distribution system. A supplemental system consisting of five (5) in-room air-cooled ceiling mounted DX Liebert computer room air conditioning units coupled with five (5) roof-mounted air cooled condensers was installed to provide wintertime cooling of the Data Center when RTU-10 is not operational.

2. The Data Center is provided with a raised floor under which the RTU-10 ductwork runs. The room is fitted with a 2'x2' acoustic tile ceiling (ATC) above which is a large unconditioned space extending to the roof. NSCC extended complaints of condensation developing above the ceiling and dripping into the room. A quick review of the ceiling shows that the ATC is a basic acoustic tile without a vapor barrier and the supports have no gasketing to prevent vapor migration. A number of tiles are broken or chipped at the corners and entire tiles are missing in places.

Section 2 - Recommendations for System Replacements

A. Option 1: Replace equipment in kind on a one-to-one basis. This option will allow for direct replacements of most equipment without significant modifications to surrounding building components. One-to-one equipment and component replacements include the following:

1. Heating Plant:

   a. The modular boilers and separate Smith boiler will be removed and replaced with two modulating gas-fired hot water boilers, B-1 & B-2. The boilers will be sized at 3,000 MBH input each to provide an output of 2,500 MBF (approximately 75% of building heating load) and will generate 180°F hot water. The boilers will be staged for energy efficient operation utilizing hot water reset programming and provide 75% boiler redundancy in case of failure of any one boiler. A 40% inhibitive propylene glycol-water mixture will be used in the heating system to ensure freeze protection at all hot water coils of ventilation equipment. Replacement of the existing boilers with the new boilers will also free up floor space in the mechanical room.

   b. The existing sets of primary hot water pumps serving the boilers, P-1 & P-1A and P-2 & P-2A, and primary loop pumps P-3 & P-3A will be removed and replaced with a single set of primary hot water loop pumps rated for 640 GPM, P-1 & P-1A. The primary pumps will be base-mounted end-suction style providing variable flow in the primary loop as temperature requires.

   c. Secondary pump sets P-4 & P-4A and P-6 & P-6A will be replaced in kind to distribute the propylene-water mixture to hot water coils in the 4-pipe FCU and heating coils at the rooftop units, respectively. The inhibitive propylene glycol-water mixture will replace the existing ethylene glycol-water mixture in the P-6 & P-6A distribution piping eliminating the shell and tube heat exchanger HX-1. The new secondary hot water pumps will be relabeled as P-2 & P-2A and P-3 & P-3A, respectively, and be variable flow operation.

   d. The use of the 180°F propylene glycol-water maintains existing heating coil area requirements.

   e. The heating plant will be fitted with DDC controls and integrated into the new building management system (BMS).

   f. Off-season replacement of the boilers and pumps maintains use of the school building with minimal disruption of the ventilation systems.

2. Cooling Plant:

a. The existing 120-ton modular chiller is in fair to good condition and will be retained.

(1) Existing chilled water pumps P-3 and P-4 will be removed and replaced with new pumps, labeled as P-4 & P-4A, rated for 275 GPM at 80 FT total dynamic head (TDH) and supplied with VFD. One pump will be standby. Pumps will distribute chilled water through the existing chilled water piping system to 4-pipe FCU.

(2) Anti-freeze protection e.g. propylene glycol in the chilled water system will not be required as the distribution piping is contained within the building interior.

b. The existing cooling tower will be removed and replaced with a new 120-ton counterflow cooling tower CT-1 equipped with a fan VFD The new tower will be equal to Marley model NC8401.

(1) Existing condenser water pumps CTP-1 and CTP-1A will be removed and replaced with new vertical inline pumps, labeled as P-5 & P-5A, rated for 360 GPM at 40 FT TDH. Pump will have VFD for balancing (and code compliance). Pumps will have constant flow with one pump standby.

c. The existing modular chiller and new cooling tower and pumps associated with the cooling plant will be fitted with DDC controls and integrated into the new building management system (BMS).

3. Space Heating and Cooling

a. Existing interior fan coil units, (FCU) will be removed and replaced in kind with new 4-pipe FCU's to provide heating and cooling to the occupied spaces. Existing supply and return air ductwork, hot water supply and return, chilled water supply and return piping and condensate drain piping will be modified as necessary to accommodate any variations in FCU casing dimensions.

b. Existing perimeter hot water heating elements comprised of cabinet unit heaters (CUH), unit heaters (UH) and fin tube radiation (FTR) will be replaced in kind.

c. The new equipment will be fitted with DDC controls and integrated into the new building management system (BMS).

4. Ventilation

a. Without the proposed new second floor programing rooftop units RTU-2, RTU-3, RTU-4, RTU-5, RTU-6, RTU-7 and RTU-10 will be removed and replaced in kind with units having the same heating and cooling capacities. RTU-1, RTU-8 and RTU-9 are recently replaced and will be retained for continued use. The RTU will include a supply fan section, factory packaged DX cooling, hot gas reheat coil, hot water heating coil (duct mounted inside 2nd floor ceiling), filter section having MERV 7 and MERV 13 filtration, mixing and intake sections. Units will have factory packaged controls for stand-alone unit operation. The hot gas reheat coil uses the energy consumed in cooling to reheat the supply air without additional energy consumption; the hot gas reheat coils temper the supply air to prevent excessively cold air being distributed to the occupied spaces and causing occupant discomfort. RTU-4, designated for use at 2nd floor archive storage area and 1st floor storage rooms is currently not in operation but will be replaced. Existing supply and return air will be internally cleaned.

(1) RTU-1 ductwork distribution will be modified and updated to accommodate various changes in internal programming within Zone 10 and Zone 13[3]. VAV

[3] Refer to appendix for existing zones

terminal units will be provided for local zone control in the various offices, meeting rooms and break rooms. VAV terminals will be fitted with hot water reheat coils and 3'-0" long sound attenuators. Much of the existing supply and return air ductwork will be reused. VAV terminal control will interlock with perimeter heating.

(2) RTU-3 ductwork distribution will remain at the roof level. Unit will provide single zone VAV supply air and be interlocked with perimeter heating elements.

(3) RTU-5 ductwork distribution will remain at the roof level Serving Lecture Hall 119. Unit will provide single zone VAV supply air. Ductwork distribution serving the lecture hall will be modified to drop in wall chases to deliver air to either side of the lower level. Air will be returned to the rooftop unit through the existing sidewall registers at the rear of the space at the 2nd level.

b. To accommodate the 2nd Floor laboratory modifications and expansion the following RTU will be modified:

(1) RTU-2: Ductwork extending across the roof serving 1st floor& 2nd floor circulation will largely remain unchanged. Chases shared with RTU-6 distribution to 1st floor spaces will remain or be repositioned to accommodate the revised 2nd floor circulation only. Distribution to and at the 1st floor circulation will remain unchanged. RTU-2 will remain constant volume air supply.

(2) RTU-6: Serving Health Professionals Classroom 117 on the 1st floor and Science Storage 218 on the 2nd floor will be reduced in capacity to serve 1st floor rooms, only. Ductwork distribution to the 1st floor will continue to extend from the RTU-6 discharge to roof curbs down through shared chases with RTU-2.

- The new energy efficient factory packaged, constant volume RTU-6 is estimated to be of 7.5-ton nominal capacity to serve the 1st floor spaces.

(3) The proposed biology suite on the second floor will be served from a new custom rooftop VAV air handling unit serving Biology Lab 217, Biotech Lab 215, Classroom 214 and offices 213 and 216. Distribution will extend across the common corridor to provide heating, ventilation and air conditioning in Prep Area 232 (RTU-11).

- The new custom unit, RTU-11, will have a supply air capacity of 4,000 cfm, a cooling capacity of 25 tons and be located on new structural dunnage above Anatomy & Physiology 216. It is anticipated that the new combined 5,000 square foot lab spaces will be teaching facilities but some exhaust is anticipated. RTU-11 will have unit components as identified in paragraph "a" above. Ductwork will distribute at the roof level to maximize headroom within the occupied spaces.
- UV serving existing Room 219, Biology Lab 221, and Biology Labs 215 & 217 and associated piping will be removed to accommodate the new VAV air distribution system. Ventilation air ducted from the 1st floor will be removed and floor filled in.

- VAV terminals associated with RTU-11 will be fan-powered type with parallel flow and discharge hot water heating coils to provide nighttime space heating and permit RTU nighttime shutdown for energy conservation during unoccupied hours. VAV terminals will be fitted with sound attenuating units at their inlets and discharges for noise control in the occupied spaces.
- Supply and return air ductwork installed on the roof will be insulated and provided with weather protection to match or exceed existing exterior ductwork insulation.

(4) RTU-7: Serving Chemistry Lab 220 will be replaced with a custom rooftop air handling unit to serve Biotech Lab 219, Biotech Prep 220 and Micro Lab 221. The unit will be variable volume to serve the combined 3,200 square foot lab spaces.

- The new custom unit, RTU-7, will have a supply air capacity of 5,200 cfm, a cooling capacity of 20 tons and have the unit components as identified in paragraph "a" above in lieu of being a factory packaged unit. Ductwork will distribute at the roof level to maximize headroom within the occupied spaces.
- UV serving existing Room 219 and Biology Lab 221 and associated piping will be removed to accommodate the new VAV air distribution system. Ventilation air ducted from the 1st floor will be removed and floor filled in.
- VAV terminals associated with RTU-7 will be fan-powered type with parallel flow and discharge hot water heating coils to provide nighttime space heating and permit RTU nighttime shutdown for energy conservation during unoccupied hours. VAV terminals will be fitted with sound attenuating units at their inlets and discharges for noise control in the occupied spaces.
- Supply and return air ductwork installed on the roof will be insulated and provided with weather protection to match or exceed existing exterior ductwork insulation.

(5) RTU-8: Serving 223A and 223B will be replaced with a custom rooftop air handling unit to serve Micro Prep 222 and Clean Room 223. The new RTU-8 will have components as per paragraph "a" above.

- Hot water heating will be utilized and existing gas will be disconnected.
- The custom RTU-8 will be two zone VAV to serve the combined 1,000 square foot lab spaces with an air delivery capacity of 3,000 cfm and cooling capacity of 15 tons.
- VAV terminals will be supplied with discharge hot water reheat coils and sound attenuation.
- Fan powered HEPA filters will be installed in the suspended ceiling of Clean Room 223 to provide the require air exchange per hour.
- The number of HEPA filter modules and RTU-8 airflow will be determined upon classification of clean room space.
- RTU-8 will operate 24 hours a day and 7 days per week to maintain required clean room space conditions.

- Any supply and return air ductwork installed on the roof will be insulated and provided with weather protection to match or exceed existing exterior ductwork insulation.

(6) RTU-9: Providing backup air conditioning to the Data Center 102A is in fair to good condition and will be retained in operation. DDC Controls will be extended from the building's head end and integrated into the BMS.

(7) RTU-10: Serving Computer Room 102 will be replaced in kind. DDC Controls will be extended from the building's head end and the RTU integrated into the BMS.

(8) Rooftop units may be replaced in stages and in their present locations. Curb adaptors will allow the units to be mounted on their present roof curbs with requiring roof modifications. RTU may be replaced during off hours (weekends) allowing the school weekday schedules to be maintained. Data Center ventilation unit RTU-10 may also be replaced during off hours with a slight hindrance on indoor air quality (due to the ventilation system being temporary offline).

(9) Sound attenuators will be installed in the existing supply and return air ductwork to mitigate sound transmissions through the ductwork to the occupied spaces.

c. Supply fans connecting to return air ductwork of FCU will be replaced in kind. Connecting ductwork, presently uninsulated, will be removed and replaced with internally lined ductwork, which will provide for quieter air distribution from the rooftop fans, prevent condensation developing on the exterior of the ducts and allow painting of ductwork exposed to view in the occupied spaces. Duct mounted hot water coils having two-way modulating control valves will be provided to temper the outside air in the heating season to help offset possibilities of freezing air entering the FCU.

d. Supply fans providing makeup air to the fume hoods will be replaced in kind. Duct mounted hot water heating coils will remain but the associated piping and be modified to remove three-way hot water control valves and install two-way hot water control valves.

e. Return air fans associated with RTU-2 and RTU-3 will be replaced in kind but with variable speed operation to track the supply fans of the respective RTU.

f. All new or modified supply and return air ductwork installed at the roof level will be insulated and wrapped with weather protection similar to the existing roof-mounted ductwork.

g. All new and existing RTU will be fitted with DDC controls and integrated into the BMS.

5. Controls: The existing compressor and pneumatic control system will be replaced with a direct digital control (DDC) system. New controls will be web based BacNet. This replacement may be done in stages removing the compressor once the final system utilizing pneumatic controls is replaced. The head end for the new controls will be installed with the first phase of the renovation to enable integration of equipment as it is installed in subsequent phases.

6. Data Center

a. Split system Liebert computer room air conditioning units and the underfloor ductwork distribution all remain with Option 1.

(1) A new ceiling is installed to address the condensation issues being experienced in the summer months. The ceiling panels have a mylar finish

and gaskets provide hermetic sealing between the panels and suspension grid. A 6" layer of batte insulation provides thermal separation of Data Center and open ceiling above.

B. Option 2: Provide Rooftop Air Handling Units with DX Cooling and Gas Heating (RTU)

1. Heating Plant: This option will transfer most of the gas distribution for heating from the boilers to the rooftop air handling units. Two gas-fired hot water boilers of 1,000 MBH nominal capacity will be provided to circulate hot water to perimeter heating elements and duct mounted reheat coils and reheat coils of VAV terminals; the boilers will alternate production of hot water and provide approximately 70% redundancy in case one boiler should fail.

   a. Primary variable volume pumping will distribute the 180°F, 40% glycol-water mixture from two vertical inline pumps rated for 100 GPM. One pump is standby.
   b. Existing primary and secondary hot water piping within and around the boiler and mechanical room will be removed. New 3" hot water supply and return piping will be installed and connect to the existing hot water distribution at the 2nd floor.
   c. Existing perimeter hot water heating elements comprised of cabinet unit heaters (CUH), unit heaters (UH) and fin tube radiation (FTR) will be replaced in kind.

2. Chiller Plant: Existing chiller and chilled water pumps are removed. Chilled water piping distribution at the 1st and 2nd floor ceilings will be removed as it is not required for this option.

3. Ventilation: Existing rooftop units RTU 2, 3, 5, 6, 7, and 10 will be replaced and RTU-11 will be added as per Option 1. As with Option 1, RTU-1, RTU-8 and RTU-9 will be retained. Pursuit of the science expansion requires upgraded rooftop units RTU-7, RTU-8 and RTU-11 as detailed in Option 1.

   a. New VAV RTU will be provided to replace existing UV and FCU in classrooms and offices as follows:

      (1) RTU-12: Serving half of Zone 13 and Classrooms 109 & 110 on the 1st floor and classrooms of Zone 1 on the 2nd floor. Unit will be 25-ton nominal capacity with a supply airflow of 10,000 cfm heated, cooled and dehumidified air. Rooftop supply air distribution will utilize existing curbed roof openings and additional curbed openings. VAV terminals serving spaces without an exterior exposure will have hot water reheat coils and 3'-0" sound attenuators. For occupied spaces having an exterior exposure parallel flow fan powered VAV terminals will be provided each having discharge hot water heating coil and inlet and discharge sound attenuators.

      (2) RTU-13: Serving Funeral services in 114 and 115 and a computer classroom in 116 for Corporate and Community Education of Zone 15. Unit will be 12-ton nominal capacity with a supply airflow of 4,800 cfm heated, cooled and dehumidified air. VAV terminals will have hot water reheat coils and 3'-0" sound attenuators. Supply air ductwork will extend along the roof from the unit discharge to existing openings with roof curbs replacing supply air fans.

      (3) RTU-14: Serving Aestetics Lab 123, Media Services 124, Campus Police 124C-124Hin Zone 16; ductwork will be extended to serve Computer Lab 121 in Zone 11. Unit will be 15-ton nominal capacity with a supply airflow of 6,000 cfm heated, cooled and dehumidified air. VAV terminals will have hot water reheat coils and 3'-0" sound attenuators. Supply air ductwork will extend along the roof from the unit discharge to existing openings with roof curbs replacing supply air fans with additional curbed openings as necessary.

(4) RTU-15: Serving offices and conference rooms of Zone 2 on the 2nd floor southeast corner of the building. Unit will be 20-ton nominal capacity with a supply airflow of 8,000 cfm heated, cooled and dehumidified air replacing the console style FCU. VAV terminals will have hot water reheat coils and 3'-0" sound attenuators. Supply air ductwork will extend along the roof from the unit discharge to existing openings with roof curbs replacing supply air fans with additional curbed openings as necessary. Perimeter FTR will be installed to offset skin heat loss and provide for unoccupied space heating.

(5) RTU-16: Serving offices and conference rooms of Zone 11 on the 1st floor southeast corner of the building. Unit will be 20-ton nominal capacity with a supply airflow of 8,000 cfm heated, cooled and dehumidified air. VAV terminals will have hot water reheat coils and 3'-0" sound attenuators. Supply air ductwork will extend along the roof from the unit discharge to existing openings with roof curbs replacing supply air fans with additional curbed openings as necessary. Perimeter FTR will be installed to offset skin heat loss and provide unoccupied space heating.

b. Supply fans providing makeup air to laboratory fume hoods will be replaced as per Option 1.

c. All new or modified supply and return air ductwork installed at the roof level will be insulated and wrapped with weather protection similar to the existing roof-mounted ductwork.

d. All new and existing RTU and interior heating equipment will be fitted with DDC controls and integrated into the BMS.

C. Option 3: Provide a cut down version of Option 1 with the scope as follows:

1. Heating Plant: Hot water boilers are replaced as per Option 1. The primary pumps are replaced but the secondary pumps are maintained and reused.

2. Chiller Plant: The existing chiller, chilled water pumps and condenser water pumps are maintained and reused. The cooling tower will be replaced as per Option 1.

3. Operating Controls: The head end for the new DDC Controls will be installed in the Boiler Room. The new and existing heating and cooling equipment will be fitted with DDC controls and integrated into the BMS.

4. RTU-2 and RTU-3 are replaced as are RTU-5, RTU-6, and RTU-10. The new RTU and existing units RTU-1 and RTU-9 will be fitted with DDC controls and integrated into the BMS control system.

D. The following matrix summarizes the advantages and disadvantages for each of the three system options being considered for the project.

System Type	Initial Cost	Operating Cost	Maintenance Requirements	Acoustics	Space Requirements
OPTION 1 Replace equipment in kind - Update Boilers - Update Pumps - Update Chiller & Cooling Tower - Update RTU - Update controls	Low – This option maintains existing piping and ductwork distributions and simplifies scheduling and phasing of updating equipment would be the most flexible. This option will provide the most flexibility.	Low – New energy efficient boilers, chiller, cooling tower with fan VFD and pumps with VFD will save energy over existing outdated equipment. Energy efficient RTU with VAV operation will reduce energy consumption versus existing RTU.	Option 1 maintains the existing maintenance schedule of lubrications, belt changes and checking of glycol levels but reduces extended service time due to new equipment installations. Requires glycol in hot water system	Updated equipment will provide a decrease in noise levels on the interior of the building; precautions to be taken to combat noise dissipation from rooftop equipment to the 2nd floor occupied spaces. All compressor noise located inside mechanical room at chiller	Reduces boiler and pump footprint, maintains chiller plant and rooftop unit space requirements.
OPTION 2 Replace existing RTU with RTU having DX cooling and gas heating, Replace UV and FCU with RTU having DX cooling and gas heating; Smaller Boiler (than Option 1) No chiller plant	Medium – Added costs for removal of chilled water piping and ductwork modifications at UV and FCU and added RTU; Added costs for gas piping to RTUs	Lowest – RTUs will be efficient with VAV operation; except for one unit (RTU-8) RTUs may be deactivated during unoccupied hours	A majority of maintenance will be at the roof level with the new RTUs. Indoor maintenance remains for heating hot water systems. Hot water system maintains glycol additive for freeze protection	Updated rooftop equipment will provide a decrease in noise levels on the interior of the building; precautions to be taken to combat noise dissipation from rooftop equipment to the 2nd floor occupied spaces.	Reduces boiler and pump footprint Deletes chiller plant Consumes more rooftop space than existing system
OPTION 3 Reduced version of Option 1	Lowest – This Option replaces the bare minimum of equipment while providing a state-of-the-art control system,	Low – New energy efficient boilers and cooling tower with fan VFD will save energy. Energy efficient RTU will reduce energy	Option 3 maintains the existing maintenance schedule of lubrications, belt changes and checking of glycol levels but reduces extended service time due to new equipment installations. Requires glycol in hot water system	Updated equipment will provide a decrease in noise levels on the interior of the building; precautions to be taken to combat noise dissipation from rooftop equipment to the	Reduces boiler footprint, maintains chiller plant and rooftop unit space requirements.

		consumption versus existing RTU.		2nd floor occupied spaces. All compressor noise located inside mechanical room at chiller	

Section 3 - Design Criteria

A. Codes and Standards

1. The HVAC systems shall be designed in compliance with:

   a. The HVAC systems shall be designed in compliance with the Massachusetts State Building Code 9th Edition, 2015 International Mechanical Code.
   b. Applicable ASHRAE Standards
   c. 2015 International Mechanical Code
   d. 2015 International Energy Conservation Code
   e. NFPA Standard 101 - Life Safety Code
   f. NFPA Standard 30 - Flammable Liquid Storage
   g. NFPA Standard 45 - Laboratories Using Chemicals
   h. NFPA Standard 90A - Standard for the Installation of Air Conditioning and Ventilating Systems
   i. SMACNA Standards

B. Design Criteria and Design Conditions

1. The building HVAC systems shall be capable of the maintaining the following design conditions.

   a. Outdoor Design Conditions:

Summer	Winter
91°F db/73°F wb	7°F db

   b. Indoor Design Conditions:

   (1) The room temperature set points are as follows:

Space	Summer	Winter
Occupied	75°F DB/ Max 55%RH (no humidity control)	72°F DB

   c. Ventilation Rates:

Space	Ventilation Rates
Offices/Conference Rooms	5 cfm/person + 0.06 cfm/sq. ft.
Classrooms	7.5 cfm/person + 0.06 cfm/sq. ft.
Laboratories	10 cfm/person + 0.18 cfm/sq. ft.

Storage Rooms	0.06 cfm/sq.ft.
Corridors	0.06 cfm/sq. ft.
All Other Spaces	Minimum rate to meet IMC 2015

d. Noise Criteria (±2) (To be confirmed by the acoustical consultant):

Space	Noise Criteria
Classrooms/Conference Rooms	NC 30-35
Offices	NC 35-40
Auditorium	NC-25
All Other Occupied Spaces	NC 40-45

e. Electric Load Densities for Cooling (to be confirmed with lighting and IT design):

Space	Lighting	Equipment	Total
Offices	0.7 Watts per useable sq. ft.	1.0 Watts per sq. ft.	1.7 Watts per sq. ft.
Classrooms	0.7 Watts per useable sq. ft.	1.0 Watts per sq. ft.	1.7 Watts per sq. ft.
Auditorium	TBD	TBD	
All other spaces	0.7 Watts per useable sq. ft.	TBD	TBD

f. Filtration:

(1) All air-handling units shall be provided with 30% efficient MERV 8 prefilters and 85% efficient MERV 13 final filters.

4. Electrical

Section 1 - Existing Conditions Assessments

A. The Math & Science Building was originally constructed in 1985 as a warehouse and converted to labs, science classrooms around 1990. The facility is a two story 100,000 sf structure that houses classrooms, offices, computer room, teaching laboratories and support spaces.

B. The building is served from Town of Danvers utility pad mounted 500KVA transformer located outdoors near the buildings loading dock area.

C. The pad mount transformer serves a 3000A rated, 480/277V., 3 phase, 4 wire Switchboard. The Switchboard serves the entire building distribution system including the Chiller #1, 480/277volt mezzanine panelboards serving mechanical equipment and miscellaneous power. The Switchboard is located on the first floor in the main electrical room 129B. The Switchboard observed was manufactured by General Electric (GE) AV-LINE series. (See Photo #1).

D. The Switchboard and electrical distribution equipment observed appears to be mostly original equipment to the building, approximately 30-35 years old and approaching their serviceable life expectancy. The switchboard and electrical distribution equipment appear to be in good working condition and of GE manufacture.

E. Service Equipment Labeling per NEC 2017 110.16 (B) with Arc-Flash Hazard Warning labels for the electrical equipment were provided on equipment and does not meet current code. (See Photo #2)

F. Distribution panel DPM 800amp 480/277volt 3 phase 4 wire is directly fed from the Switchboard and is serving RTU-3 located on roof. Panel DPM located in the main electrical room across from the Switchboard.

G. Panelboard PPA rated 480volt 3 phase, 3 wire and is located in the boiler room 129C adjacent to the main electrical room and is serving panel RPA via dry type transformer and pumps P1 through P5A, SA-2, RTF-3, ACU-4 unit located on the roof which was labeled RTU-4. The pumps P3 and P4 were fed via VFD's manufactured by ABB which appear to be recently installed. (See Photo #3)

H. Panelboard RPB rated 60amp 120/208volt 1 phase 3 wire and is serving the boilers #1 thru boiler #6. The panel RPB is in the boiler room fed via panel RPA.

I. The motor control center (MCC) MCC-PPC rated 600amp 480volt 3 phase 4 wire observed is in the mechanical room 129A on the first floor. The MCC is serving pumps P1 through P6A, vacuum pump and the air compressors. The MCC observed was manufactured by Westinghouse, Series 2100. The MCC is approximately 35 years old and beyond its serviceable life expectancy but appears to be in good condition. (See Photo #4)

J. The motor control center (MCC) MCC-PPD rated 600amp 480volt 3 phase 4 wire observed is in the mezzanine electrical room 224A on the second floor. The MCC is serving fans NF-3, NF-4, NF-12 thru NF-16, SA-4 thru SA-6. The MCC observed was manufactured by Westinghouse, Series 2100. The MCC is approximately 35years old and beyond its serviceable life expectancy but appears to

be in good condition. (See Photo #5)

K. Panelboards CRPH, DPCR and PPB are rated 225amp MLO 480/277volt 3 phase 4 wire located in the mezzanine electrical room 224A the panels are fed from directly from the Switchboard. Panel CRPH is serving units SA-1, SA-5, RTU-6, RTU-7 and miscellaneous power. (See Photo #6)

L. Panelboards CRPL and RPB1 are 120/208volt 3 phase 4 wire located in the mezzanine electrical room 224A. Panel CRPL is rated 100amps and is serving the lab fume hood fans NF-2 thru NF-5, NF-19, NF-21, RAF-5. Panel RPB1 is serving RF-5, RF-8 and miscellaneous power.

M. Computer Room Emergency Power

1. The roof mounted natural gas generator is rated 125kW/156kVA.,480/277V.,3 phase and was manufactured by Cummins Onan. The generator mounted circuit breaker services a Cummins automatic transfer switch (ATS) located in electric room 102B on first floor. The generator and ATS appear to have been recently installed within the last 10 years and were observed to be in good working condition. (See Photo's #7 & #8)
2. The automatic transfer switch (ATS) is feeding optional standby power panelboard EHP rated 200amp, 480/277volt.,3 phase 4 wire serving the computer room UPS, inverters, panel RPT, computer room AC (RTU-9), ACU-1 thru ACU-4 and ACCU #1 thru ACCU #4 This panel was manufactured by Cutler Hammer and appears to be have been installed recently.

N. Existing Fire Alarm System

1. The main fire alarm control panel (FACP) observed appears to have been recently installed. The fire alarm control panel and power supplies are in the main electrical room 129B on the first floor. The fire alarm system was manufactured by FCI E3 series. (See Photo's #9)
2. The fire alarm A/V devices observed appear to meet NFPA 72 and ADA requirements.
3. The fire alarm system booster panels and amplifier cabinets are also located in the mezzanine electrical room 224A on the second floor.

Section 2 - Proposed Demolition

A. Disconnect and make safe all the existing electrical power connections serving mechanical equipment being demolished and removed with all associated service disconnects, conduits, boxes and feeders back to the existing electrical distribution panelboards. Refer to the mechanical system options for the phasing of work.

B. Remove all mechanical equipment unit wiring devices, lights, switches, controls, outlets, boxes, raceways with all branch circuit wiring back to source. The intent is to provide a complete demolition of the electrical systems associated with removal of the HVAC equipment based on the three options provided under the mechanical section.

C. Maintain existing power which passes through the renovated areas and serves equipment to remain.

D. Mechanical equipment served from the existing motor control center's (MCC's) shall be removed with all associated wiring back to MCC's. Remove the existing starters and label cubicle circuit breakers as spare. Refer to the mechanical section of report for the exact scope of existing

equipment to be removed and/or replaced.

Section 3 - Recommendations for system replacement

A. Option 1: Provide power to support the existing equipment being replaced in kind one-to-one.

1. Utilize existing spare 400-Amp 3 pole circuit breaker in switchboard to serve a new 400A, 480/277V 3 phase, 4 wire equipment panel to be located in the boiler room serving the new pumps via VFD's.
2. The existing Chiller is to remain with all the associated electrical connections and feeder from the Switchboard.
3. Provide a new 50Amp, 120/208volt 3 phase, 4 wire 18 pole sub-panel "RPB" with (12) 20A-1P circuit breakers to replace existing panel RPB to serve the new boilers and controls. New sub-panel RPB shall be fed from existing panel RPA.
4. Remove the existing 50Amp 3 Pole breaker serving cooling tower (CT) in panel PPA and provide new breaker sized to serve new cooling tower via VFD.
5. Retrofit and modify existing switchboard replacing spare circuit breakers with new 800 Amp Frame/Trip breaker to serve the new 800A 480/277V, 3 phase, 4 wire equipment panel MDP2 to be in the mezzanine electrical room serving new RTU's and fans via VFD's. Provide connection kit, breaker covers, black door covers and extend bus as required.

B. Option 2: Provide power to support new chilled water pumps and roof top units (RTU's)

1. Serve new hot water boilers from existing panel RPB 120/208 Volt, 3 phase, 4 wire utilize breakers made spare by removal of boilers.
2. The new roof top units (RTU's) shall be served from the new 800A, 480/277V, 3 Phase, 4 wire equipment panel MDP2 located in the mezzanine electrical room.
3. Retrofit and modify existing switchboard to allow for installation of the new circuit breakers (1) 400A and (1) 800A to serve the new equipment panels as noted above.

C. Option 3: Provide power to support new indoor air handling units (AHU's) and hot water boilers.

1. The existing Chiller is to remain with all the associated electrical connections and feeder from the Switchboard.
2. Remove the existing 50Amp 3 Pole breaker serving cooling tower (CT) in panel PPA and provide new breaker sized to serve new cooling tower via VFD.
3. Provide a new 50Amp, 120/208volt 3 phase, 4 wire 18 pole sub-panel "RPB" with (12) 20A-1P circuit breakers to replace existing panel RPB to serve the new boilers and controls. New sub-panel RPB shall be fed from existing panel RPA.

D. Electrical Service

1. Obtain one year of utility load readings with peak demands for buildings electrical service. In the event these meter readings are unavailable, perform meter readings on the main switchboard for a period of no less than 30 days.

E. Fire Alarm

1. Provide new duct smoke detectors, fire/smoke dampers as required for the new mechanical equipment design. Provide all duct and area smoke detectors, control modules, monitor modules and relays as required with wiring loop connection to the existing fire alarm system.

2. Provide reprogramming of the existing FCI E3 series fire alarm control panel (FACP) and annunciators to pick up all new addressable points associated with the new mechanical equipment design.

Section 4 - Design Criteria

A. Electrical systems will comply with the applicable codes and standards established for the project.

1. The electrical system will be designed in accordance with the following local and national codes and standards as well as local authority requirements.

a. American National Standard Institute (ANSI)
b. American with Disabilities Act (ADA)
c. National Electric Code (NEC)
d. National Electric Safety Code (NESC)
e. National Fire Protection Association (NFPA)
f. National Electrical Manufacturers Association (NEMA)
g. Massachusetts State Building Code 9TH Edition (MSBC)
h. Massachusetts Fire Prevention Regulations (MFPR)
i. Massachusetts Electrical Code (MEC)

B. Power distribution system components including panelboards, feeders, and other equipment, will generally be sized for present load and future allowance of 25%.

Section 5 - Outline Specifications

A. Perform work and provide materials as indicated on the drawings for complete and fully operational electrical and low voltage systems for the area of renovation.

B. Obtain and pay for all permits required for electrical and fire alarm work. This includes all municipal permits.

C. All equipment and materials shall be tested, approved and listed by underwriters laboratories (UL). Where equipment and/or material is not UL listed, listing by a nationally recognized testing laboratory (NRTL) will be acceptable where approved by all Authorities Having Jurisdiction (AHJ). For all equipment that needs on site test and approval by UL, associated costs shall be included in this contract.

D. In addition to manufacturer's warranties, all equipment shall include complete materials and labor warranties from the installer for 1 year from the date of substantial completion, unless warranties of greater duration are specified.

E. In general, the work of this section shall include, but not be limited to:

1. Panelboards – branch circuit.
2. Raceway systems.
3. Wireways.
4. Outlets and pull boxes.
5. Wires and cables.
6. Disconnect switches.
7. Enclosed circuit breakers.
8. Power and alarm wiring including connections for heating, ventilating, and air conditioning system motors and equipment. All starters and line voltage thermostats will be furnished for installation (wiring, connecting, and mounting) under this section.
9. Power, control, and alarm wiring, including connections for the plumbing and fire protection systems equipment, shall be provided under this section.
10. Devices and device plates.
11. Relays.
12. Fire Alarm
13. Protection of existing and new work.
14. Record drawings and documentation.
15. Seismic supports, supplementary steel and channels.
16. Operation and maintenance instructions and manuals for this section's work.
17. Nameplates, labels, and tags.
18. Testing and certifications.
19. Fireproofing of penetrations and openings.
20. Access panels and doors.
21. Coordination with manufacturers, other trades, general contractor, and owner. Include costs associated with adjustments and changes resulting from coordination.
22. Training.
23. MDO plywood backboards for starters, equipment, etc.
24. Temporary power and lighting and fire alarm for complete project requirements as per, MEC, NFPA 72 and OSHA requirements.
25. Seals.

F. Products

1. Raceways and Fittings

a. Conduits shall be rigid galvanized steel (RGS), or electrical metallic tubing (EMT). Conduits shall be as manufactured by Allied, Wheatland Tube Company, or approved equal.

b. Fittings for RGS shall be threaded malleable iron. Hubs shall be self-insulated and shall be self-locking weatherproof type.

c. Fittings for EMT shall be galvanized steel compression type or galvanized steel set screw type. Die-cast is not allowed. Setscrew fittings for EMT of trade size greater than 2 inches shall include minimum of (4) set screws for couplings and minimum of (2) setscrews for connectors.

d. Raceways for connections to motors and other equipment subject to vibration shall be galvanized spiral wrapped flexible metallic conduit utilizing fittings for flexible metallic conduits. Flexible conduits shall not exceed 36 inches in length. Provide liquid-tight type at damp and wet locations.

e. Conduit expansion fittings shall be threaded, hot-dipped galvanized malleable iron with internal bonding assembly by OZ Gedney or approved equal.

f. Provide water-tight gland sealing assemblies with pressure bushing for penetrations to the exterior.

g. Wireways shall be galvanized sheet steel with hinged and screw covers. Interiors shall be smooth and free of sharp edges and burrs. Wireways shall be sized for conductors to be installed within and the bend radii of those conductors. Wireways for fire alarm shall be provided without factory knockout locations. Wireways shall be manufactured by square d or approved equal.

h. All fire alarm fittings and box covers shall be painted red.

i. Minimum raceway (RGS, EMT, etc.) trade size is ¾ inches.

j. Minimum raceway size for fire alarm as follows:

(1) 2 inch vertical risers between floors.
(2) 1 inch horizontal circuit installations.
(3) ¾ inch final installation from box above to end-use device.

2. 600 Volt Insulation Wire and Cable

a. Provide annealed copper wire and cable with insulation rated for 600V and 90°C of sizes specified and as manufactured by Essex, Southwire, or approved equal.

b. Wire and cable shall have copper conductors. All conductors shall be stranded, soft drawn, annealed with 98% conductivity and insulated for 600 volts. Conductors shall be color coded as specified.

c. Fire-protective signaling wiring shall be in accordance with the electrical code, (Article 760), fire prevention systems for building fire alarm systems, and as indicated. All wires for the local fire alarm system shall be color-coded and the size and type as required by the NEC.

d. Metal clad (MC) cable shall be a multi-conductor assembly with insulated copper conductors and galvanized steel armor. Minimum conductor size is #12 AWG and equipment grounding conductor shall be full size and insulated (green). Conductors for MC cables that are #12 AWG or #10 AWG may be either stranded or solid. MC cables shall be manufactured by AFC.

3. Outlet, Pull and Junction Boxes

a. Boxes, and fittings for general use, flush mounted in concrete work and walls in normally dry locations, shall be manufactured by Steel City, Appleton, Raco, or approved equal. Boxes and fittings for normally wet locations, or surface or pendant mounted in all locations, shall be of the proper cast metal type and shall be manufactured by Crouse-Hinds, Appleton, Red Dot, Russell and Stoll, or approved equal.

b. Outlet boxes shall, in general, be as follows:

(1) Shall be 4” square minimum with plaster ring extension sized for devices specified.

(2) Exposed, surface, and pendant mounted outlet boxes, or outlet boxes installed in normally wet locations, shall be of the cast metal type with threaded hubs.

(3) Recessed outlet boxes for dry locations shall be of the pressed sheet steel, zinc coated type.

(4) Surface mounted boxes on existing concrete block walls shall be Wiremold type (for dry locations only) or cast boxes without knock-outs, suitable for painting. Device plates shall not overlap boxes. Surface boxes for fire alarm devices shall be red with sufficient size so that devices do not overlap boxes. Surface mounted boxes for fire alarm devices shall be of proper size and a specific model that is a product of the fire alarm system manufacturer for that device, unless fire alarm system manufacturer does not produce a box for that specific device. In that case, surface mounted boxes for fire alarm shall be cast type without knockouts (threaded hubs only).

(5) Shall not be less than 1-1/2” deep. Outlet boxes for telecommunications work shall be as indicated.

(6) Ceiling and bracket outlet boxes shall not be less than 4". Flush or recessed fixtures shall be provided with separate outlet boxes where required by the fixture terminal temperature requirements.

c. Pull and junction boxes shall be as follows:

(1) Pull and junction boxes less than 6" x 6" shall be as specified for outlet boxes.

(2) Pull and junction boxes shall be constructed of code gauge galvanized sheet metal and not less than the minimum size required by the electrical code and other applicable specification "standards" and shall be furnished with screw fastened covers. Boxes exceeding 48" in any direction shall be properly reinforced

(3) Pull and junction boxes to be installed in normally wet location areas shall be of the cast type with threaded hub and gasketed cover plate.

4. Distribution Panels:

a. Distribution panelboards shall be Square D, I-Line or Eaton-Cutler Hammer type PRL5P Series.

b. Panelboards shall be of the dead-front type suitable for 480/277V or 120/208V, three phase, four-wire operation and shall have a short circuit current rating to match existing.

c. Panelboard cabinets shall be fabricated from code gauge galvanized sheet steel and furnished with either flush or surface trim. Trims shall be fitted with hinged doors having combination lock and latch, with all locks keyed alike and heavy duty, continuous, section vertical hinging to box section for access to wiring gutters in addition to trim door.

d. Where indicated, distribution panelboard shall include a main circuit breaker. Main circuit breaker the main circuit breaker shall be a 100 percent rated device.

e. Interiors shall have copper bus bars with mains arranged for a grounded solid-neutral system with lugs only in the mains or main breakers as indicated. Panelboard shall be suitable for use with 75°C conductor ampacities.

f. Neutral bus shall be insulated from the panel enclosure, except provide bonded neutral only for service entrance equipment. Panelboards shall have a separate equipment ground bus and terminal strip. Provide separate, isolated, and insulated ground bus where indicated.

g. Circuit breakers shall be rack mounted, molded case, thermal magnetic type and shall be single, double, and three-pole circuit breakers with interrupting ratings indicated on the drawings. The design of the structure shall be such that the units may be removed without disturbing adjacent sections, bus structure, or insulation. Circuit breakers shall be labeled for use with 75°C conductor ampacities. Circuit breakers used for switching shall be type "SWD". Circuit breakers for HVAC equipment and any other equipment with multiple motors shall be type "HACR".

h. Two and three-pole breakers shall be common trip type so that an overload on one pole will trip all poles simultaneously. No handle bar ties will be allowed on multi-pole circuit breakers to accomplish either manual or automatic tripping. All circuit breakers with trip sizes larger than 100 ampere rating shall have interchangeable trips.

i. All circuit breakers rated 125 ampere to 600 ampere feeding motors shall have adjustable magnetic trip units with a range 500% to 1000% (10 percent tolerance) of trip unit rating.

j. All circuit breakers shall be fully rated for the AIC rating as indicated or higher rating. Series rated circuit breakers are not allowed.

k. Each distribution panelboard shall include a microprocessor based electronic customer metering package to include scrolling function, programming ability, remote monitoring capacity and liquid crystal displays for values as follows:

(1) Amperes each phase;
(2) Voltage each phase to phase and each phase to ground
(3) Watts or kw (each phase and total)
(4) VARS or KVAR (each phase and total)
(5) Volt-amperes or kVA (each phase and total)
(6) Kilowatt hours
(7) Kilowatt hours demand
(8) Peak demand
(9) Historical peak demand
(10) Frequency
(11) THD

5. Branch Circuit Panelboards

a. Branch circuit panelboards shall be as manufactured by Square D, Eaton Cutler-Hammer or GE.

b. Panelboards shall be of the dead-front type suitable for 480/277V or 120/208V, three phase, four-wire operation and shall have a short circuit current rating to match existing.

c. Panelboard cabinets shall be fabricated from code gauge galvanized sheet steel and furnished with either flush or surface trim as indicated on drawings. Trims shall be fitted with hinged doors having combination lock and latch, with all locks keyed alike and heavy duty, continuous, vertical section hinging to box section for access to wiring gutters in addition to trim door. A directory holder with a clear plastic or glass plate and metal frame shall be mounted on the inside of each door. A neatly typed directory properly identifying each circuit shall be provided in the holder.

d. Interiors shall have copper bus bars with mains arranged for a grounded solid-neutral system with lugs only in the mains or main breakers as indicated. Panelboard shall be suitable for use with 75°C conductor ampacities. All bus bars (phases, neutral, equipment grounding and IC) shall be of copper.

e. Neutral bus shall be insulated from the panel enclosure, except provide bonded neutral only for service entrance equipment. Panelboards shall have a separate equipment ground bus and terminal strip. Provide separate, isolated, and insulated ground bus where indicated.

f. Circuit breakers shall be molded case, thermal magnetic type with bolted connections to the bus and shall be single, double, and three-pole circuit breakers with interrupting ratings indicated on the drawings. Circuit breakers shall be labeled for use with 75°C conductor ampacities. Circuit breakers used for switching shall be type "SWD". Circuit breakers for HVAC equipment and any other equipment with multiple motors shall be type "HACR".

g. Two and three-pole breakers shall be common trip type so that an overload on one pole will trip all poles simultaneously. No handle bar ties will be allowed on multi-pole circuit breakers to accomplish either manual or automatic tripping. All circuit breakers with trip sizes larger than 100 ampere rating shall have interchangeable trips.

h. All circuit breakers rated 125 ampere to 600 ampere feeding motors shall have adjustable magnetic trip units with a range 500% to 1000% (10 percent tolerance) of trip unit rating.

I. All circuit breakers shall be fully rated for AIC indicated or higher rating. Series rated circuit breakers are not allowed.

i. Quantity of total poles scheduled shall not include main circuit breaker (MCB). MCB shall not be installed in branch circuit breaker locations in the panelboards.

6. Dry Type Transformers

a. All dry type transformers shall be in a NEMA type heavy gauge sheet steel enclosure finished with gray enamel paint and installed in a dry location. All dry type transformers shall be provided with internal vibration isolators, numbered terminal lugs extended to the cable compartment for external connections, and nameplate indicating all NEMA standard nomenclature relative to the transformer. All floor mounted ventilated type transformers shall be provided with adequate free areas under them for the circulation of air.

b. Transformer winding shall be of 98% conductivity copper. Transformer shall comply with the Department of Energy (DOE) 2016 energy efficiency ratings.

c. The maximum permissible dB level at all dry type transformers shall be proportional to the transformer's kVA rating and shall be in conformance with the latest NEMA and ANSI standards.

d. All dry type transformers shall be of the ventilated type, class "h" insulation. The transformers shall utilize a 220°C insulation system and have an average winding temperature rise not to exceed 80°C rise by resistance above a 40°C ambient. Transformer surface temperature rise shall not exceed 65°C.

e. Minimum impedance levels, unless higher minimum impedance levels specified shall be 2 percent for transformers up to and including 45 kVA and 4 percent for transformers of kVA rating greater than 45.

f. Transformers shall be three phase 208V Input voltage and 480V Output voltage to service the new Chillers.

7. Disconnect Switches

a. Disconnect switches shall be manufactured by Square D, Eaton-Cutler Hammer or GE.

b. Disconnect switches shall be horsepower rated, heavy duty of the fusible or non-fusible type as indicated and equipped with an external lever or handle for manual operation. Each unit shall be enclosed in a code-gauge, sheet steel cabinet with hinged door and catches and suitable for surface mounting as indicated on the drawings. Provide NEMA 1 enclosures for indoor use and NEMA 4X for outdoor applications and all other wet areas. Disconnect switches shall include arc containing shields.

8. Wiring Devices

a. Wiring devices shall be made by single manufacturer; Hubbell, Cooper, Leviton, or Pass and Seymour. Catalog numbers indicated shall be those of Hubbell.

b. Bodies shall be of thermoplastic compound, with faces of nylon supported by mounting yoke having plaster ears and shall be NEMA WD-1 heavy duty "commercial specification grade. All devices shall be the grounding type and shall be connected to metal mounting yoke. A terminal shall be provided for the ground wire on all devices.

c. Wiring devices color shall be of color as selected by Architect.

d. All receptacles unless specifically indicated otherwise shall be as follows:

(1) Receptacles shall be side wired with two screws per terminal. Provide receptacles tested to UL 498, NEMA WD-1 heavy duty, federal spec WC596 and 2008 compliant “tamper resistant and weather resistant” where applicable. Receptacles on individual branch circuits shall match the ampacities of the circuit.

(2) Convenience receptacles - duplex 20 ampere, 125 volts, 1 phase, 3 wire, u-slot grounded type BR20 series or approved equal.

(3) Ground fault interrupter type ‘GFCI”- duplex 20 ampere, 125 volts, 1 phase, 3 wire U-slot grounded type. Ground fault test function shall sense a ground fault and activate the LED in a ground fault condition. Red LED “flashing” indicates device has lost capability to provide ground fault protection. No power to face of receptacle where reverse wired. Receptacles shall be GF20 series or approved equal.

(4) Weatherproof ground fault interrupter type ‘GFCI”, duplex 20 ampere, 125 volts, 1 phase, 3 wire U-slot grounded type. Ground fault test function shall sense a ground fault and activate the LED in a ground fault condition. Red LED “flashing” indicates device has lost capability to provide ground fault protection. No power to face of receptacle where reverse wired. Receptacles shall be GFTR20 series or approved equal.

9. Toggle Switches:

a. Toggle switches shall be of the totally enclosed, flush tumbler type of suitable capacity for the intended load and shall be "specification grade". Provide listed switches tested to UL 20, and federal spec WS896E where applicable.

b. Toggle switch bodies shall be NEMA WD-1 heavy-duty thermoplastic compound, quiet indicating type with screw type terminals. Provide grounding terminal.

c. General lighting switches shall be 20 ampere, 120/277 volts AC, #1221 series, or approved equal.

10. Device Plates

a. Wiring device plates shall be of the same manufacturer as the wiring devices for the project. Plates shall be brushed stainless steel.

b. Outdoor devices shall have wet location listing for “in-use” weatherproof covers as manufactured by Hubbell Inc., TayMac, or approved equal.

11. Lighting

a. LED lighting shall be provided as specified by the lighting designer or architect.

12. Identification

a. All equipment and devices shall be properly identified by means of permanent, clear, and concise nameplates, tags, signs, or directories mechanically fastened or engraved on the item to be identified. Properly applied epoxy or super glue adhesive may be accepted for device plates only, with prior written approval of the architect. Embossed adhesive labels are not acceptable for any identification required by the drawings or specifications except for lighting wall switches and 125 volt, 20 ampere receptacles.

b. Provide mechanically fastened three ply black phenolic nameplates with ¼" high engraved white letters on the following equipment. Wording of the nameplates shall be in conformance with the respective schedules and notes on the drawings.

(1) Panelboards, fire alarm, and telephone terminal cabinets: nameplates shall be provided on the exterior of each panel and terminal cabinet door identifying same.

(2) Relays shall clearly identify the coil circuits and/or monitored circuits and all circuits controlled. Control stations shall clearly identify the power circuit and all circuits and equipment controls.

(3) Nameplates shall be provided for each remote operating station, motor controller, control panel, disconnect switch, mechanical interlock unit, equipment, starter, relay, pilot light, and control device identifying the units controlled or protected and the circuit(s) serving them.

(4) Provide a second nameplate at each panelboard, designating the upstream equipment feeding the equipment circuit numbers and the location of the upstream equipment that feeds this equipment.

(5) Color-code junction boxes, raceway, and conductors as indicated in this specification.

(6) The covers of boxes, fittings, and enclosures shall be marked by means of fluorescent paint so they will be readily identified as a component of the following systems:

- Fire alarm – red.

(7) All electrical power and fire alarm conductors and cables and cables shall be color-coded and shall include fire resistive circuit tags (made with label makers).

(8) All fire alarm notification devices shall include an adhesive label listing the circuits for each device at that unit.

13. Fire Alarm System

a. All signaling devices shall be synchronized.

b. Visible signaling shall be ADA compliant strobes.

c. All new fire alarm devices shall be compatible with existing FCI E3 Series system.

14. Seals

a. Water seals shall be OZ Gednay or approved equal.

b. Fire seals shall be 3M or approved equal.

c. Provide environmental seals where raceways are installed through areas of widely different temperatures.

15. Testing and Inspection

a. Provide labor, installation, supervision, test equipment, material, power supplies, devices, etc. required to perform the work indicated.

b. Test and inspect all parts of the work provided under this section and as required by manufacturers, codes, standards, or authorities having jurisdiction. Conduct all tests and inspections to the complete satisfaction of the architect and all authorities. Do not cover work prior to testing or inspection. Testing shall be completed prior to substantial completion.

c. Prior to the date of substantial completion and acceptance demonstrations, furnish the architect with certificates of testing and inspection for all systems furnished or installed under this section. Certifications shall include the approval of all authorities having jurisdiction, manufacturers and a letter from the installer stating conformance with all requirements of the contract documents.

d. All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than the values recommended by the manufacturers.

e. Test all circuits for proper neutral and grounding connections.

f. Failure or defects in workmanship or materials revealed by tests or inspection shall be corrected promptly and retested. Defective material shall be replaced at no additional expense to the owner.

g. Verify and correct as necessary the following: voltages, tap settings, trip settings, and phasing on all equipment and devices furnished and/or installed and all existing distribution equipment utilized on this project. Secondary voltages shall be tested at the bus in the main switchboard, at panelboards, and at such other locations on the distribution systems as necessary. Secondary voltages shall be tested under no-load and full-load conditions.

h. Measure minimum and maximum voltages and voltage between phase wires and neutral, and immediately deliver a report on all voltage measurements to the architect.

i. The equipment grounding shall be checked to insure continuity of the ground return path.

j. Provide a written report on all testing and device settings. Include a copy in the operation and maintenance manual.

k. Provide third party testing and commissioning of all major electrical equipment including the new panelboards.

l. Provide Infra-Red testing of the existing switchboard and 480volt distribution equipment panels.

5. Appendix 1-5

See following attachment.

NSCC Danvers campus

“Math & Science Building” HVAC Replacement Study – Appendix

Table of Contents

1. Appendix 1 - Existing Conditions

Listing of Existing Equipment

A. Heating Plant:

1. The existing hot water boiler plant consists of six Slant-Fin Galaxy Model# GG-375HEC gas-fired modular hot water boilers, 304 MBH each, labeled B-1 thru B-6 (Photo H1) and one H.B Smith Model# 28A-14 (Photo H2) gas-fired 2766 MBH water tube boiler B-7 located in Boiler Room 129C.

2. Two 7-1/2 HP pumps (P-4 & P-4A) provide glycol hot water (40% Propylene) in the heating season to the hot water coils inside the building. One pump serves as standby.

3. Two 1-1/2 HP pumps (P-5 & P-5A) serve the heat exchanger (HX-1) in the same mechanical room. One pump serves as standby.

4. Two 5 HP pumps (P-6 & P-6A) provide glycol hot water (40% Ethylene) in the heating season from HX-1 to the existing rooftop units. One pump serves as standby.

B. Cooling Plant:

1. The existing building cooling system consists of one 120-ton Multistack (Model# MS-C1H2W2AA) modular chiller (CH-1) located in the Boiler Room 129C.

2. Heat rejection from CH-1 to one 110-ton, Baltimore Air Coil cooling tower.

3. Two chilled water pumps (P-3 & P-4) provided with 10 HP and 15 HP motors respectively and variable frequency drives (VFD). One pump serves as standby.

4. Two condenser water pumps (CTP-1 & CTP-2) provided with 7-1/2 HP and 10 HP motors respectively. One pump serves as standby.

5. 5” chilled water piping from the existing CH-1 serves existing chilled water coils throughout the building in the cooling season.

C. Air Side Systems:

1. Existing rooftop units (RTU):

a. RTU-1: Daikin McQuay (Model# RPS026DLW) VAV rooftop unit with 26 ton DX cooling, hot water heating coil, outside air and return air mixing box, air-side economizer, filter section, supply and return fan. Unit charged with R-410A refrigerant. The supply air from this unit discharges into a common supply air plenum, which is then ducted to VAV terminal units serve the first-floor office area 104, 105 and 106. Plenum return air is ducted to this unit. Unit appears to be in good condition.

b. RTU-2: Trane Intellipak (Model# SLHFC30) single zone rooftop unit with 30 ton DX cooling, hot water heating coil, outside air and return air mixing box, air-side economizer, filter section, supply fan and a roof mounted return fan (NF-10). Unit charged with R-22 refrigerant. Unit serves the Arcade 111A, Corridors 119A,-B,-C & 131 on the first floor and Corridors 208C, 219A,-B,-C on the second floor.

c. RTU-3: Daikin McQuay (Model# RPS036DLW) single zone rooftop unit with 36 ton DX cooling and hot water heating coil, outside air and return air mixing box, air-side economizer, filter section, supply fan and a roof mounted return fan (NF-9). Unit charged with R-22 refrigerant and is at or near the end of its life. Unit serves the Cafeteria 111 and Bookstore 113 on the first floor and Student Lounge 212 on the second floor.

d. RTU-4: Abandoned in place.

e. RTU-5: Daikin McQuay (Model# CUR160ETSC) single zone rooftop unit with 16 ton DX cooling and hot water heating coil, outside air and return air mixing box, air-side economizer, filter section, supply fan. Unit charged with R-22 refrigerant and is at or near the end of its life. Unit serves the Lecture Hall 119.

f. RTU-6: Daikin McQuay (Model# CUR075GW02) single zone rooftop unit with 7-1/2 ton DX cooling and hot water heating coil, outside air and return air mixing box, air-side economizer, filter section, supply fan. Unit charged with R-22 refrigerant and is at or near the end of its life. Unit serves the Radiology Lab 117, Dark Room 117B, X-Ray Room 117C and Storage rooms 117A,-D &118A,-B on the first floor and Science Storage 218 and Office 218A on the second floor.

g. RTU-7: Daikin McQuay (Model# CUR075GW02) single zone rooftop unit with 7-1/2 ton DX cooling and hot water heating coil, outside air and return air mixing box, air-side economizer, filter section, supply fan. Unit charged with R-22 refrigerant and is at or near the end of its life. Unit serves the Chemistry Physics Lab 220 on the second floor.

h. RTU-8: Carrier (Model# 48HJE008) single zone rooftop unit with 7-1/2 ton DX cooling and 150 mbh gas-fired heating (AFUE 82%), outside air and return air mixing box, filter section and supply fan. Unit charged with R-22 refrigerant and is at or near the end of its life. Unit serves the Office 223A,-B on the second floor.

i. RTU-9: American Standard (Model# TCD241C4) single zone rooftop unit with 20 ton DX cooling only, filter section and supply fan. Unit charged with R-22 refrigerant. Unit serves the Data Center rooms 102A,-C on the first floor as a back up unit.

j. RTU-10: Carrier (Model# 48HJE014) single zone rooftop unit with 12-1/2 ton DX cooling and 250 mbh gas-fired heating (AFUE 80%), outside air and return air mixing box, filter section, supply fan. Unit charged with R-22 refrigerant and is at or near the end of its life. Unit serves the Computer Room 102 on the first floor.

k. Data Center room 102A served by five Liebert computer room DX air conditioning units. Air cooled condenser units (ACCU-1 thru ACCU-5) located on the roof. The units are in very good condition and will be remain.

2. Existing outdoor air supply fans (SA) provide unconditioned ventilation air distributed by non-insulated ductwork to the existing fan coil units and unit ventilators and consist of the following:

   a. SA-1: Loren Cook (Model# ASPT) rooftop ventilator and supplies 2110 cfm unconditioned outdoor air. The unit is in fair condition.

   b. SA-2: Loren Cook (Model# ASPT) rooftop ventilator and supplies 2640 cfm unconditioned outdoor air. The unit is in fair condition.

   c. SA-3: Loren Cook (Model# ASPT) rooftop ventilator and supplies 2900 cfm unconditioned outdoor air. The unit is in very good condition (installed 2014).

   d. SA-7: Loren Cook (Model# ASPT) rooftop ventilator and supplies 910 cfm unconditioned outdoor air. The unit is in fair condition.

   e. SA-8: Loren Cook (Model# ASPT) rooftop ventilator and supplies 1100 cfm unconditioned outdoor air. The unit is in fair condition.

3. Existing makeup air fans (SA) serve to the lab fume hoods:

   a. SA-4: Loren Cook (Model# ASPT) rooftop ventilator and rated for 980 cfm. Supply air from the unit is ducted with hot water heating coil to the fume hood in Science Storage 218. The unit is in fair condition.

   b. SA-5: Loren Cook (Model# ASPT) rooftop ventilator rated for 1,845 cfm. Supply air from the unit is ducted with hot water heating coil to three fume hoods in Chemistry 220. The unit is in fair condition.

   c. SA-6: Loren Cook (Model# ASPT) rooftop ventilator rated for 1,345 cfm. Supply air from the unit is ducted with hot water heating coil to the 8 feet hood in Biotechnology 215. The unit is in fair condition.

4. Existing exhaust fans (NF) serve to the lab fume hoods and biosafety cabinets:

   a. NF-12: This exhaust fan provides 1395 cfm exhaust air to the fume hood in Science Storage 218. The unit is in fair condition.

   b. NF-13, -14 & -15: These exhaust fans provide 875 cfm each exhaust air to the three fume hoods in Chemistry 220. These units are in poor condition.

   c. NF-16: This exhaust fan provides 1920 cfm exhaust air to 8 feet hood in Biotechnology 215. The unit is in fair condition.

   d. NF-20A, -20B & -20C: These exhaust fans provide 62 cfm each exhaust air to the three biosafety cabinets in Science Storage 218. These units are in poor condition.

   e. NF-20D: This exhaust fan provides 62 cfm exhaust air to the biosafety cabinet in Chemistry 220. The unit is in poor condition.

   f. Autoclave exhaust fan is located on the roof provides exhaust air to autoclave in Science Storage 218. This fan is in poor condition.

5. Existing general exhaust fans (NF) serve to the offices and classrooms:

   a. NF-1: 1210 cfm

   b. NF-2: 680 cfm

   c. NF-3: 680 cfm

   d. NF-4: 690 cfm

   e. NF-5: 1160 cfm

   f. NF-6: 1380 cfm

   g. NF-7: 840 cfm

   h. NF-8: 680 cfm

   i. NF-17: 1940 cfm

   j. NF-23: 120 cfm

6. Existing toilet and miscellaneous exhaust fans (NF):

   a. NF-11: This exhaust fan provides 250 cfm exhaust air for the Dark Room 117B.

   b. NF-18: This exhaust fan provides 1800 cfm exhaust air for the Toilets 107A,-B on the first floor and Toilets 207A,-B on the second floor.

   c. NF-19: This exhaust fan provides 450 cfm exhaust air for the Toilets 222A,-B on the second floor.

   d. NF-21: This exhaust fan provides 285 cfm exhaust air for the Toilets 126A,-B on the first floor.

   e. NF-22: This exhaust fan provides 240 cfm exhaust air for the Storage room 108 on the first floor.

   f. NF-24: This exhaust fan provides 500 cfm exhaust air for the Elevator Machine room 107E on the first floor.

   g. EF-1_VB: This exhaust fan (Loren Cook Model 150 ACRUH) provides 500 cfm exhaust air for the Boiler Room 129C on the first floor. The unit is in very good condition (installed 2013).

   h. EF-1_MSB: This exhaust fan (Loren Cook Model 100 ACEH) provides 300 cfm exhaust air. The unit is in very good condition (installed 2013).

   i. EF-NSCC: This exhaust fan (Loren Cook Model 100 ACEH) provides 300 cfm exhaust air. The unit is in very good condition (installed 2018).

   j. RF-5: This exhaust fan serves to the Locker Rm 124A&B and Waiting Area 124C.

k. Boiler room combustion air intake fan (Greenheck Model PBS-36) and Boiler room gravity relief (Greenheck Model GRS-36) are located on the roof. These fans are in poor condition.

2. Appendix 2 - Phasing

A. PROPOSED ZONES FOR CONSTRUCTION PHASING

1. Zone 0: Corridor 129, Boiler Room 129C, Main Electric Room 129B, Mechanical Room 129A, Stair 1, IS Workshop, 1st floor common areas including Cafeteria 111, Arcade 111A and Corridors 119A, 119B and 119C and 2nd floor common circulation areas.

2. Zone 1: 2nd floor classrooms and offices Copier 207, Classroom 208, Classroom 209, Office 210 and Classroom 211.

3. Zone 2: Offices 201, 201A, 201B 201C, Corridors 201F, 202A and 206B, Conference 201, Offices 203 & 203A, 204& 204A, 205 & 205A and 206 & 206A.

4. Zone 3: Elevator Lobby 207, Men's 207A, Women's 207B and Janitor 207C.

5. Zone 4: Classroom 219, Chemistry 220 and Biology 221.

6. Zone 5: Stair No. 20, Stair No. 21 and Lecture Hall 119 (at 2nd floor).

7. Zone 6: Women's 222A, Men's 222B, Adult Learning 223A and Adult Learning 223B (223 - Potential Clean Rm)

8. Zone 7: Rooms 128L, 128M, 128N, 128O and 128P.

9. Zone 8: 224 - Maintenance Staff Brkrm, Utility 224A, Storage 225 and Archive 225A.

10. Zone 9: Bookstore 113, Office 113A and Storage 113B.

11. Zone 10: Offices 104, 104A, 104B, 104C, Tutor 105, Offices 105A, 105B, 105C, 105D and Storage 105E.

12. Zone 11: Reception 101, Offices 101A, 101B, 101C, 101D, 101E, 101F, 101G, 101H, 101I, 101J, 101K and 101L and Computer Lab 121.

13. Zone 12: Computer Rooms, Data Processing and Phone Room 102B.

14. Zone 13: 106B - Meting Room, 106C - Corp & Comm Ed, 106D - Priv Office, 108 - Corp & Comm Ed.

15. Zone 14: Central Services 128A, Office 129B, Loading 128 and 128E and Storage 128D and F.

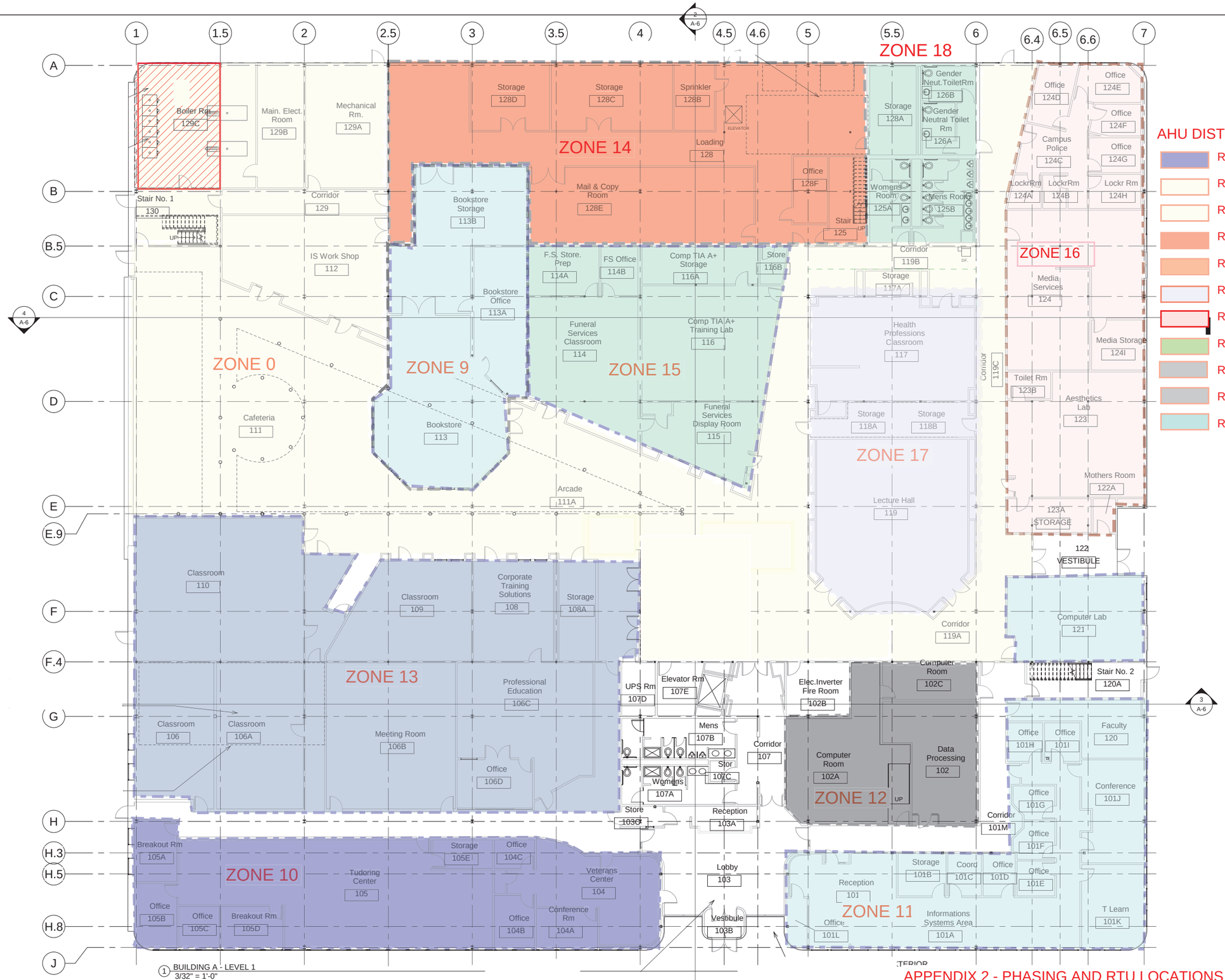
16. Zone 15: 114 - Funeral Services, 115 - Funeral Services, 116 - Computer Classroom for Corp & Comm Ed, 114A - Fun Srvcs Storage and 114B – Office.

17. Zone 16: 123 - Aesthetics Lab, 124 - Media Services, 124C -124H - Campus Police.

18. Zone 17: 117 - Health Classroom, 117A.

19. Zone 18: 1st floor men's and Women's, Women's Fac. 126A, Men's Fac. 126B Storage 128C.

B. Refer to the following plans for zone and rooftop unit (RTU) locations for Option 1, Option 2 and Option 3.



AHU DISTRIBUTION

- RTU-1 (NEW CONTROLS)
- RTU-2 (NEW RTU & CONTROLS)
- RTU-3 (NEW RTU & CONTROLS)
- RTU-4 (NEW RTU & CONTROLS)
- RTU-5 (NEW RTU & CONTROLS)
- RTU-6 (NEW RTU & CONTROLS)
- RTU-7 (NEW RTU & CONTROLS)
- RTU-8 (NEW RTU & CONTROLS)
- RTU-9 (NEW CONTROLS)
- RTU-10 (NEW RTU & CONTROLS)
- RTU-11 (NEW RTU & CONTROLS)

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NORTH SHORE COMMUNITY COLLEGE MATH & SCIENCE BUILDING HVAC RENOVATION

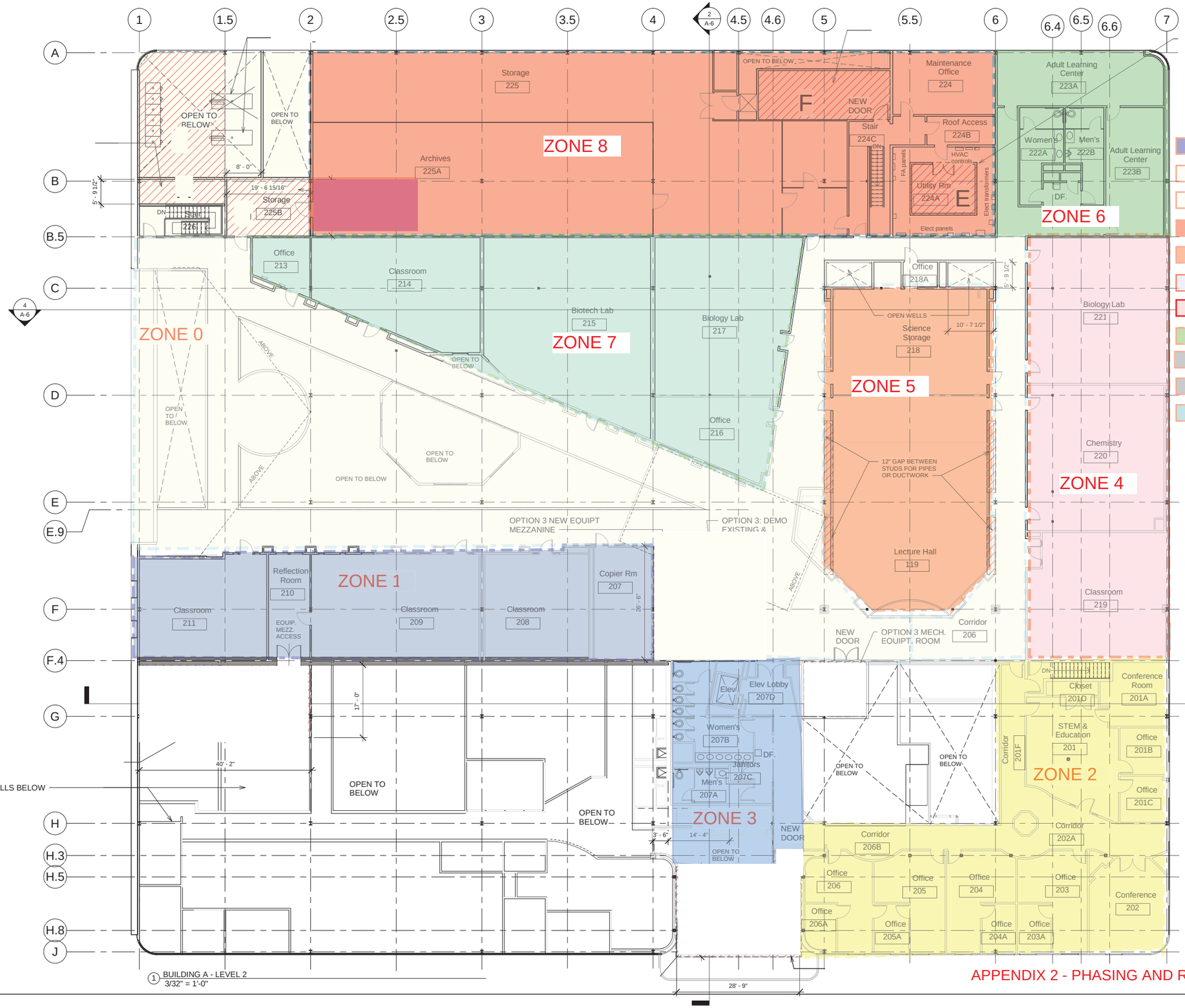
No.	Description	Date

Project number 2000.1
Date 2 Febuary, 2020

1ST FLOOR PLAN
(OPTION 1)

A-1

APPENDIX 2 - PHASING AND RTU LOCATIONS



AHU DISTRIBUTION

- RTU-1 (NEW CONTROLS)
- RTU-2 (NEW RTU & CONTROLS)
- RTU-3 (NEW RTU & CONTROLS)
- RTU-4 (NEW RTU & CONTROLS)
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- RTU-11 (NEW RTU & CONTROLS)

APPENDIX 2 - PHASING AND RTU LOCATIONS

LOCUS PLAN NOT TO SCALE

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Consultant

NORTH SHORE COMMUNITY COLLEGE MATH & SCIENCE BUILDING HVAC RENOVATION

No.	Description	Date

Project number 2000.1
Date 2 Febuary, 2020

2ND FLOOR PLAN
(OPTION 1)

A-2

MOUNT RTU-11 ON STRUCTURAL DUNNAGE- TOP OF DUNNAGE AT 4'-0" ABOVE ROOF

RTU-11

RTU-4

RTU-3

RTU-2

RTU-1

RTU-6

RTU-5

RTU-8

RTU-7

RTU-9

RTU-10

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SKYLIGHT

1 BUILDING A - EXISTING ROOF PLAN
3/32" = 1'-0"

AHU DISTRIBUTION

- RTU-1 (NEW CONTROLS)
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- RTU-10 (NEW RTU & CONTROLS)
- RTU-11 (NEW RTU & CONTROLS)

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No.	Description	Date

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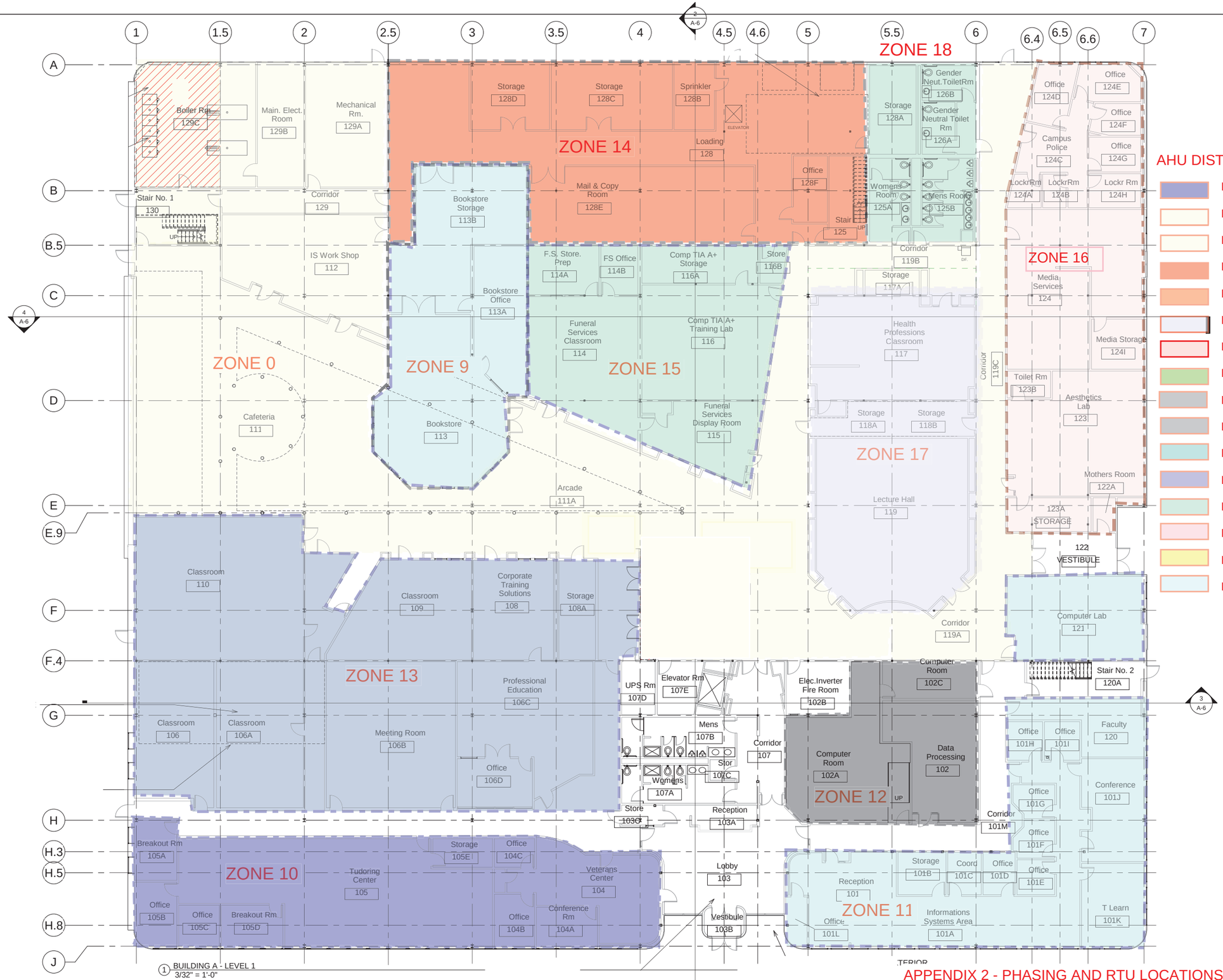
ROOF PLAN
(OPTION 1)

A-3

APPENDIX 2 - PHASING AND RTU LOCATIONS



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- RTU-15 (NEW RTU & CONTROLS)
- RTU-16 (NEW RTU & CONTROLS)

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APPENDIX 2 - PHASING AND RTU LOCATIONS

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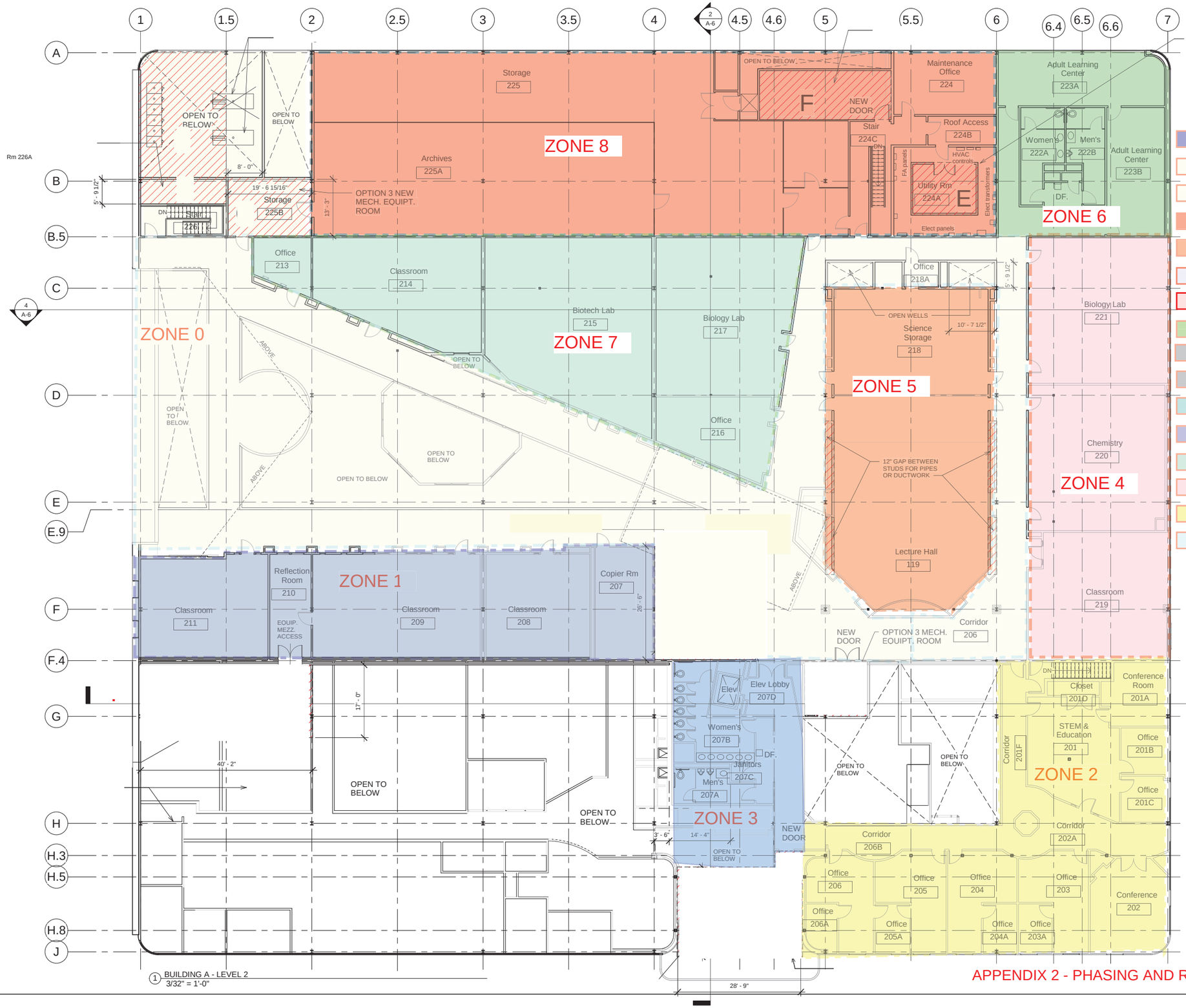
No.	Description	Date

Project number 2000.1
Date 2 Febuary, 2020

1ST FLOOR PLAN
(OPTION 2)

A-1



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APPENDIX 2 - PHASING AND RTU LOCATIONS

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COLLEGE MATH & SCIENCE
BUILDING HVAC RENOVATION

No.	Description	Date

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2ND FLOOR PLAN
(OPTION 2)

A-2

MOUNT RTU-11 ON STRUCTURAL DUNNAGE- TOP OF DUNNAGE AT 4'-0" ABOVE ROOF

RTU-11
RTU-4
RTU-13
RTU-3
RTU-2
RTU-12
RTU-1
RTU-16
RTU-9
RTU-10
RTU-6
RTU-5
RTU-8
RTU-14
RTU-7
RTU-15
SKYLIGHT

NOTE:
MOUNT RTU-12 - RTU-16, INCLUSIVE, ON VIBRATION ISOLATION ROOF CURB.

1 BUILDING A - EXISTING ROOF PLAN
3/32" = 1'-0"

AHU DISTRIBUTION

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PLAN NOT TO SCALE

NORTH SHORE COMMUNITY COLLEGE MATH & SCIENCE BUILDING HVAC RENOVATION

No.	Description	Date

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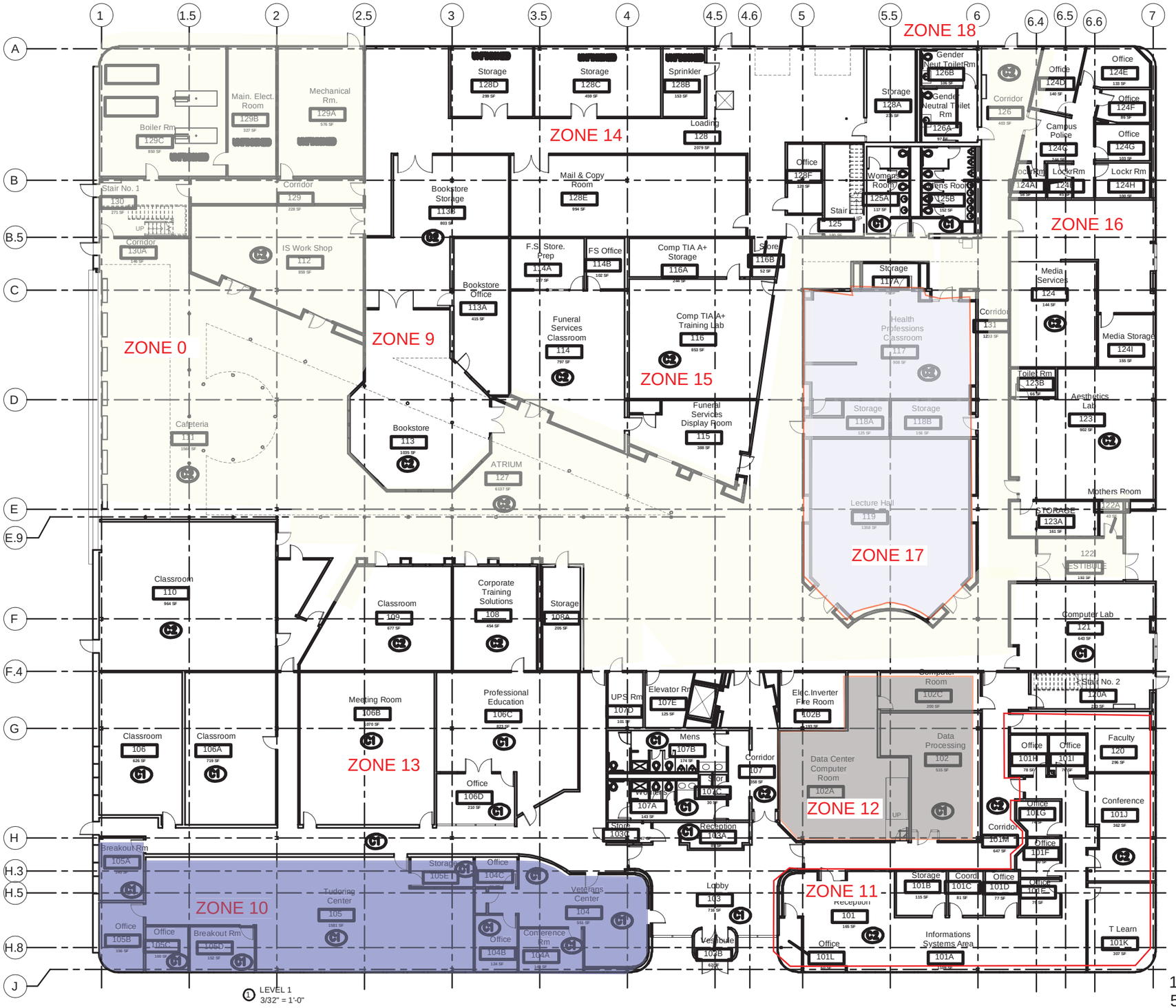
ROOF PLAN
(OPTION 2)

A-3

APPENDIX 2 - PHASING AND RTU LOCATIONS



1 LEVEL 1
3/32" = 1'-0"

1st FLOOR
50,482 SF

AHU DISTRIBUTION

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ARCHITECT:

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CONSULTANT:

LOCUS PLAN NOT TO SCALE

NORTH SHORE COMMUNITY COLLEGE DANVERS

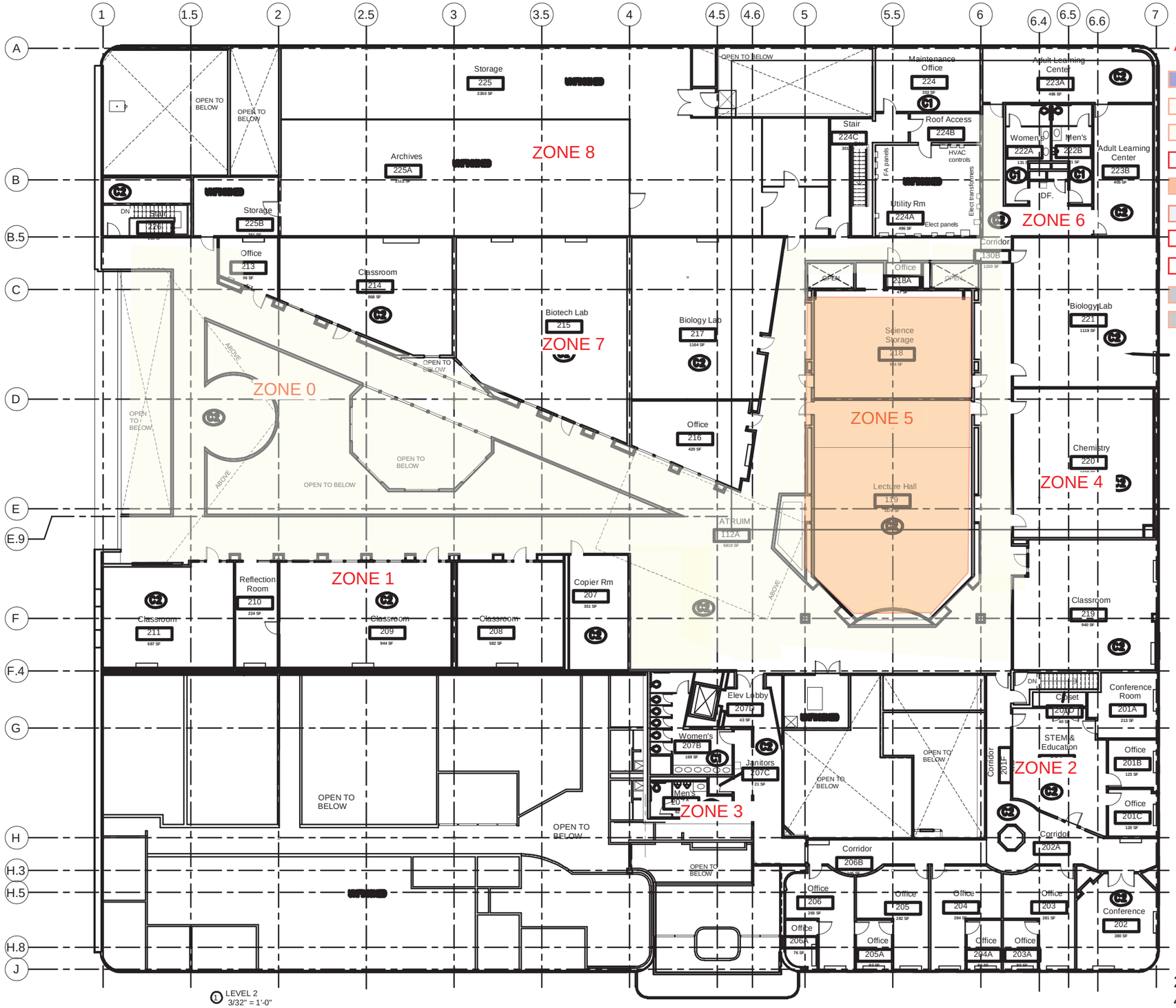
No.	Description	Date

Project number
Date
Plot Stamp

1ST FLOOR PLAN
(OPTION 3)

A-1

APPENDIX 2 - PHASING AND RTU LOCATIONS



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2ND FLOOR
41,602 SF

CHITECT:

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NSULTANT:

LOCUS PLAN NOT TO SCALE

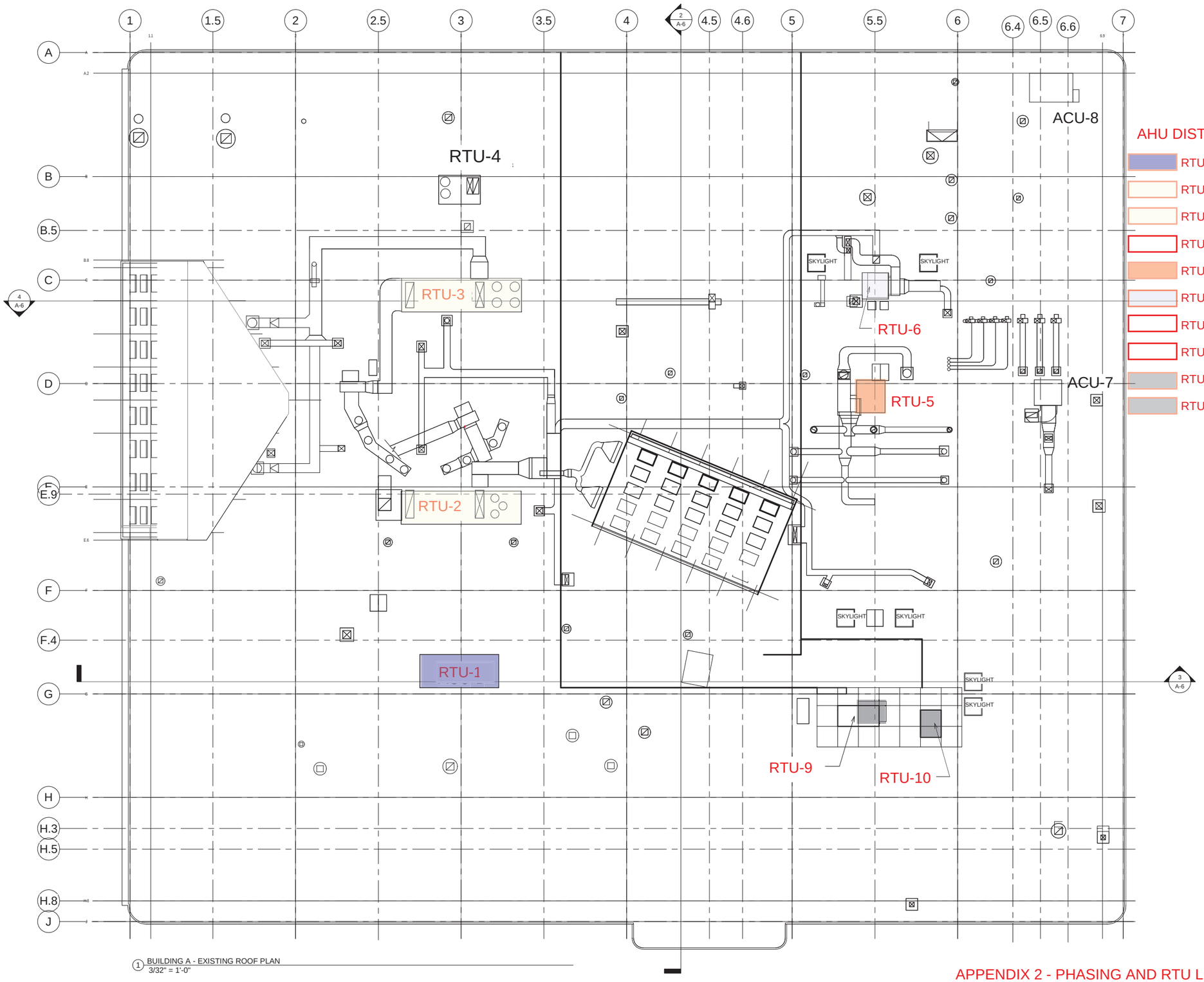
NORTH SHORE COMMUNITY COLLEGE DANVERS

No.	Description	Date

Project number
Date
Plot Stamp

2ND FLOOR PLAN
(OPTION 3)

A-2



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APPENDIX 2 - PHASING AND RTU LOCATIONS

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NORTH SHORE COMMUNITY COLLEGE MATH & SCIENCE BUILDING HVAC RENOVATION

No.	Description	Date

Project number 2000.1
Date 2 Febuary, 2020

ROOF PLAN
(OPTION 3)

A-3

3. Appendix 3 - HVAC Photos

Photo H1 - Boilers B-1 thru

Photo H2 - Boiler B-7

Photo H3 - Boiler Pump P-1 and P-1A

Photo H4 – Chilled water Pumps

Photo H5 Autoclave Fan

Photo H6 Cabinet Exhaust Fans NF-2

Photo H7 Cabinet Exhaust Ductwork

Photo H8 Chimneys and Boiler fans

Photo H8 Classroom General Exhaust Air Grilles

Photo H9

Classroom Ventilator Unit and outdoor Air Ductwork

Photo H10 Classroom Ventilator

Photo H11 Common Area Return Air Grilles

Photo H12 Cooling Tower Pumps

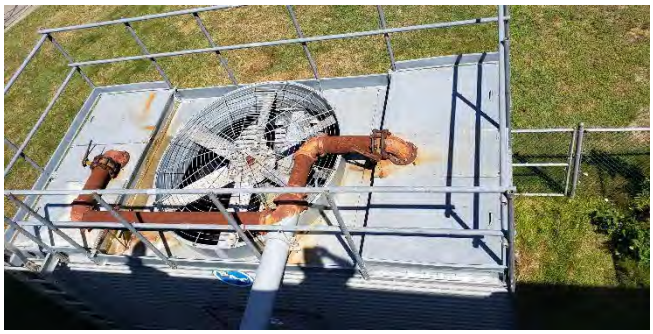


Photo H13 Cooling Tower

Photo H14 Exhaust Air Fan Typical – NFs

Photo H15 Exhaust Air Fan Typical

Photo H16 Exhaust Fan NF-3

Photo H17 Exhaust RF-5

Photo H18 Fan Coil Units

Photo H19 Fume Hood Fans NF-13

Photo H20 General Exhaust Air Grills in Office Area

Photo H21 Liebert ACCUs 2

Photo H22 RTU-1

Photo H23 RTU-2

Photo H24 RTU-3

Photo H25 RTU-4

Photo H26 RTU-5

Photo H27 RTU-6

Photo H28 RTU-7

Photo H29 RTU-8

Photo H30 RTU-9

Photo H31 RTU-10

Photo H32 Supply Air Fan Typical -SFs

4. Appendix 4 - Electrical Photos

Photo E1: Switchboard – Rm 129B

Photo E2: Switchboard – Rm 129B

Photo E3: Motor Control Center MCC-PPD

Photo 3: Panel PPA – Rm 129C

Photo E4 Mezzanine Electrical Rm 224A D EHP

Photo E5: Optional Standby ATS serving panel

Photo E6: Computer Room Generator

Photo E7: Fire Alarm Control Panel – Rm 129B

5. Appendix 5 - Proposed Equipment

A. Option 1 Heating and Cooling Equipment

B. Option 2 heating Equipment

C. Rooftop air handling Units (RTU)

Option 1 Heating

CREST CONDENSING BOILER

ENERGY STAR 0751-2001

AHRI CERTIFIED

ASME H

CSD-1 CERTIFIED

DESIGN CERTIFIED

DESIGNED ★ ENGINEERED ★ ASSEMBLED USA

Codes & Registrations

- ANSI Z21.13/CSA Certified
- ASME Certified, "H" Stamp / National Board
- California Code Compliant
- Canadian Registration Number (CRN)
- CSD1 / Factory Mutual / GE Gap Compliant
- South Coast Air Quality Management District Qualified & Energy Star Rated (FB 0751-2001)

Smart Touch™ Features

CON·X·US Remote Connect

SMART TOUCH Touchscreen Operating Control

Full-Color 8" Touchscreen LCD Display

Built-in Cascading Sequencer for up to 8 Boilers
- › Built-in Redundancy
- › Cascade Multiple Sized Boilers
- › Lead/Lag Cascade
- › Efficiency Optimized Cascade

Front-End Loading Capability with Copper-Fin II® and Power-Fin® Boilers

Building Management System Integration with 0-10 VDC Input

BACnet MSTP Communications

Outdoor Reset Control with Outdoor Air Sensor

Password Security

Domestic Hot Water Prioritization
- › DHW tank piped with priority in the boiler loop
- › DHW tank piped as a zone in the system with the pumps controlled by the Smart System
- › DHW Modulation Limiting
- › Separately Adjustable SH/DHW Switching Times

Low Water Flow Safety Control & Indication

Inlet & Outlet Temperature Readout

Freeze Protection

Service Reminder

Time Clock

Data Logging
- › Hours Running, Space Heating
- › Hours Running, Domestic Hot Water
- › Hours Running, Modulation Rate
- › Ignition Attempts
- › Last 10 Lockouts

Programmable System Efficiency Optimizers
- › Night Setback
- › Anti-Cycling
- › Outdoor Air Reset Curve
- › Ramp Delay
- › Boost Temperature & Time
- › Modulation Factor Control

Three Pump Control
- › System Pump
- › Boiler Pump
- › Domestic Hot Water Pump

High-Voltage Terminal Strip
- › 120V/1PH/60Hz Power Supply (FB 0751-2001)
- › 208V/3PH/60Hz Power Supply (FB 2501-3501)
- › 480V/3PH/60Hz Power Supply (FB 4001-6001)
- › System Pump, Boiler Pump and DHW Pump Power

Low-Voltage Terminal Strip
- › 24 VAC Auxiliary Device Relay
- › Auxiliary Proving Switch Contacts
- › Alarm on Any Failure Contacts
- › Runtime Contacts
- › DHW Thermostat Contacts
- › Unit Enable/Disable Contacts
- › System Sensor Contacts
- › DHW Tank Sensor Contacts
- › Outdoor Air Sensor Contacts
- › Cascade Contacts
- › 0-10 VDC BMS External Control Contact
- › 0-10 VDC Variable Speed Boiler Pump Control Contact

Standard Features

- Proof of Closure Valve (FB 6001)
- Modulating Burner with up to 25:1 Turndown
- Direct-Spark Ignition
- Low NOx Operation
- Sealed Combustion
- Air Inlet Filter
- Low Gas Pressure Operation
- **Vertical and Horizontal Direct Venting**
  - › Direct Vent up to 100 Feet
  - › PVC, CPVC, Polypropylene or AL29-4C (FB 0751-4001)
  - › AL29-4C (FB 0751-6001)
- ASME "H" Stamped Heat Exchanger
- 316L Stainless Steel Fire Tubes
- 160 psi Working Pressure
- On/Off Switch
- Adjustable High Limit with Manual Reset
- Low Water Cutoff with Manual Reset & Test
- High & Low Gas Pressure Switches w/Manual Reset
- Low Air Pressure Switches
- Condensate Trap w/Blocked Drain Switch
- Drain Valve
- System Sensor
- Outdoor Air Sensor
- Inlet & Outlet Temperature Sensors
- High-Voltage Terminal Strip
- Low-Voltage Terminal Strip
- Downstream Gas Test Cocks
- 50 psi ASME Relief Valve
- Temperature & Pressure Gauge
- Zero Clearances to Combustible Materials
- High Altitude Models Available
- 10-Year Limited Warranty (See Warranty for Details)
- 1-Year Warranty on Parts (See Warranty for Details)

Optional Equipment

- ☐ Alarm on Any Failure
- ASME Relief Valve Option:
  ☐ 75 psi ☐ 100 psi ☐ 125 psi ☐ 150 psi
- ☐ BMS Gateway - BACnet IP or LonWorks
- ☐ Condensate Neutralization Kit
- ☐ Common Vent Kits Damper
- ☐ Modbus Communication
- ☐ Motorized Isolation Valve
- ☐ O_2 Feedback
- ☐ Variable Speed Boiler Pump
- ☐ Wireless Outdoor Temperature Sensor

Electrical Transformer Options (Shipped Loose):
- › FB 0751-2001
  - ☐ 208V/3PH/60Hz → 120V/1PH/60Hz
  - ☐ 480V/3PH/60Hz → 120V/1PH/60Hz
  - ☐ 600V/3PH/60Hz → 120V/1PH/60Hz
- › FB 2501-3501
  - ☐ 480V/3PH/60Hz → 208V/3PH/60Hz
  - ☐ 600V/3PH/60Hz → 208V/3PH/60Hz
- › FB 4001-6001
  - ☐ 208V/3PH/60Hz → 480V/3PH/60Hz
  - ☐ 600V/3PH/60Hz → 480V/3PH/60Hz

Lochinvar® HIGH EFFICIENCY BOILERS & WATER HEATERS

Lochinvar, LLC
300 Maddox Simpson Parkway
Lebanon, Tennessee 37090
P: 615.889.8900 / F: 615.547.1000
Lochinvar.com

02/20—Printed in U.S.A.

CREST COMMERCIAL CONDENSING BOILER

Submittal Sheet

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

MODELS FB 0751 - FB 6001

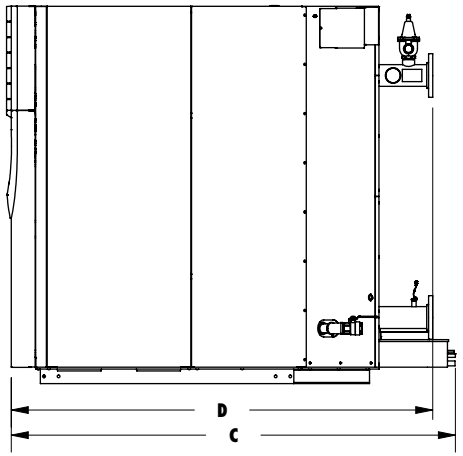
AHRI CERTIFIED™ www.ahridirectory.org

FBN-Sub-11

Job Name: _____ Location: _____ Contractor: _____ Type Gas: _____

Engineer: _____ Model #: _____ Agent/Wholesaler: _____ Equipment Tag(s): _____

SIDE



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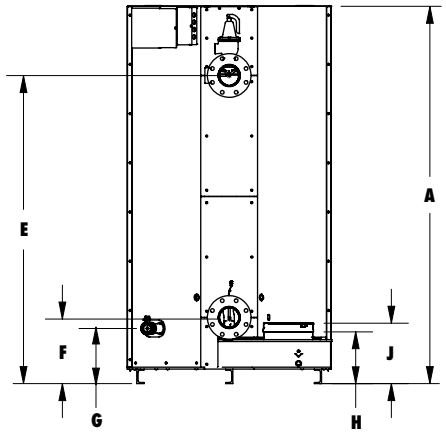

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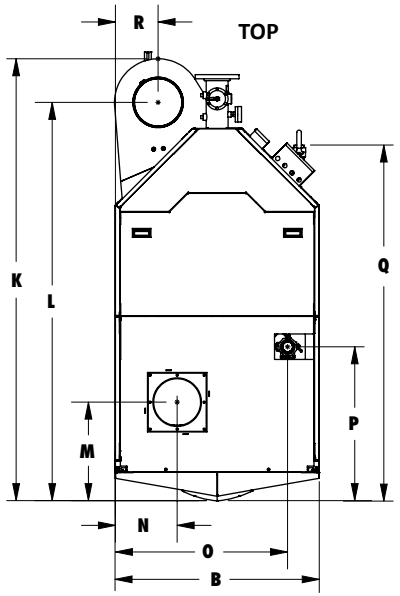


JOB NOTES:

Option 1 Heating

Notes:

* *Insert "N" for natural gas, "L" for LP gas models and "D" for dual fuel.*

- *Indoor installation only.*
- *Low NOx Operation.*
- *Lochinvar should be consulted before selecting a boiler for installations having unusual piping and pickup requirements, such as intermittent system operation, extensive piping systems, etc.*
- *The ratings have been determined under the provisions governing forced draft burners.*
- *The Net AHRI water ratings shown are based on a piping and pickup allowance of 1.15.*

Model Number	Input MBH Min	Input MBH Max	Thermal %	Gross Output MBH	Net AHRI Rating MBH	Turn-down	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	Gas Conn.	Water Inlet / Outlet	Air Intake	Vent Size	Oper. Weight (with water)	Ship. Weight (lbs.)
FB*0751	50	750	96.2%	722	628	15:1	78″	30″	55-1/2″	57-5/8″	66-1/8″	11-7/8″	11-3/8″	11-1/4″	12-1/2″	55″	51″	13″	8-3/4″	26-3/4″	23-3/4″	49-1/2″	7-3/8″	1-1/4″	3″	6″	6″	1,768	1,560
FB*1001	50	999	96.2%	961	836	20:1	78″	30″	56-1/2″	57-5/8″	66-1/8″	11-7/8″	11-3/8″	11-1/4″	12-1/2″	56″	51″	13″	8-3/4″	26-3/4″	23-1/8″	49-1/2″	6-1/2″	1-1/4″	3″	6″	6″	1,838	1,596
FB*1251	62.5	1,250	96.2%	1,203	1,046	20:1	78″	30″	56-1/2″	57-3/4″	66-1/8″	11-7/8″	11-3/8″	11-1/4″	12-1/2″	56″	51-3/8″	13″	8-3/4″	26-3/4″	21-5/8″	49-1/2″	6-1/2″	1-1/2″	3″	6″	8″	1,975	1,648
FB*1501	60	1,500	96.2%	1,443	1,255	25:1	78″	30″	67-3/4″	68″	65-3/8″	12-3/8″	11-3/8″	11-1/4″	12-1/2″	67-1/4″	62-3/8″	15-7/8″	9″	26-7/8″	27-7/8″	59-1/4″	5-1/8″	1-1/2″	4″	8″	8″	2,307	1,961
FB*1751	70	1,750	96.2%	1,684	1,464	25:1	78″	30″	66-1/4″	68″	65-3/8″	12-3/8″	11-3/8″	11-1/4″	12-1/2″	65-3/4″	61-1/2″	15-7/8″	9″	27″	27-1/8″	58-3/4″	5-1/8″	1-1/2″	4″	8″	8″	2,458	2,017
FB*2001	80	1,999	96.2%	1,923	1,672	25:1	78″	30″	66-1/2″	68″	65-3/8″	12-3/8″	11-3/8″	11-1/4″	12-1/2″	66″	61-1/2″	15-7/8″	9″	27″	26-3/4″	58-3/4″	5-1/8″	1-1/2″	4″	8″	8″	2,570	2,087
FB*2501	125	2,500	96%	2,400	2,087	20:1	77-3/4″	35″	83-3/4″	83-3/4″	63-3/4″	13-1/2″	11-1/4″	10-1/2″	12-1/4″	83-1/4″	76-1/4″	19-3/4″	9-1/4″	28-3/4″	32″	71″	7-1/4″	2″	4″	8″	9″	3,600	2,577
FB*3001	150	3,000	96%	2,883	2,507	20:1	77-3/4″	35″	83-3/4″	83-3/4″	63-3/4″	13-1/2″	11-1/4″	10-1/2″	12-1/4″	83-1/4″	76-1/4″	19-3/4″	9-1/4″	28-3/4″	32″	71″	7-1/4″	2″	4″	10″	10″	3,900	2,881
FB*3501	175	3,500	96%	3,364	2,925	20:1	77-3/4″	42″	91-1/2″	86-3/4″	63-1/2″	13-1/4″	11-1/2″	10-3/4″	12-1/2″	91″	82″	20-1/4″	12-3/4″	35-1/2″	31-3/4″	73-1/4″	8-3/4″	2″	4″	10″	10″	4,600	3,218
FB*4001	333.3	3,999	96%	3,843	3,342	12:1	77-3/4″	45-1/2″	103-1/2″	99″	63-1/2″	13-3/4″	11-1/2″	10-3/4″	12-1/2″	103″	94″	24-3/4″	13-1/2″	39-1/2″	42-1/4″	85-1/4″	10-1/2″	2-1/2″	4″	12″	12″	5,200	3,805
FB*5001	499.9	4,999	96%	4,804	4,177	10:1	77-3/4″	46-1/2″	102-1/4″	99-1/2″	63-1/2″	15″	11-1/2″	10-3/4″	12-1/2″	101-3/4″	92-1/2″	22″	14″	39-3/4″	39-1/2″	84″	9″	2-1/2″	6″	14″	14″	5,900	4,101
FB*6001	600	6,000	96%	5,766	5,014	10:1	77-3/4″	50″	102-3/4″	99-3/4″	63-1/4″	14-3/4″	11-1/2″	10-3/4″	12-1/2″	102-1/2″	93-1/4″	20″	15-3/4″	43-1/2″	36-1/2″	83-3/4″	9-1/4″	3″	6″	14″	14″	6,900	4,711

Information subject to change without notice. Dimensions shown are approximate and should not be used for construction purposes.

Bell & Gossett
a xylem brand

Submittal

OPTION 1 PRIMARY HOT WATER PUMPS P-1, P-1A

Job/Project:		**Representative:**	
ESP-Systemwize: WIZE-1D9CBA	**Created On: 02/23/2020**	**Phone:**	
Location/Tag:		**Email:**	
Engineer:		**Submitted By:**	**Date:**
Contractor:		**Approved By:**	**Date:**

Base Mounted End Suction Pump

Series: e-1510

Model: 5BD

Features & Design

- ANSI/OSHA Coupling Guard
- Center Drop Out Spacer Coupling
- Fabricated Heavy Duty Baseplate
- Internally Self-Flushing Mechanical Seal

*The Bell & Gossett Series e-1510 is available in 26 sizes and a variety of configuration options that enable customization and flexibility to fit a broad range of operating conditions.

http://bellgossett.com/pumps-circulators/end-suction-pumps/e-1510/

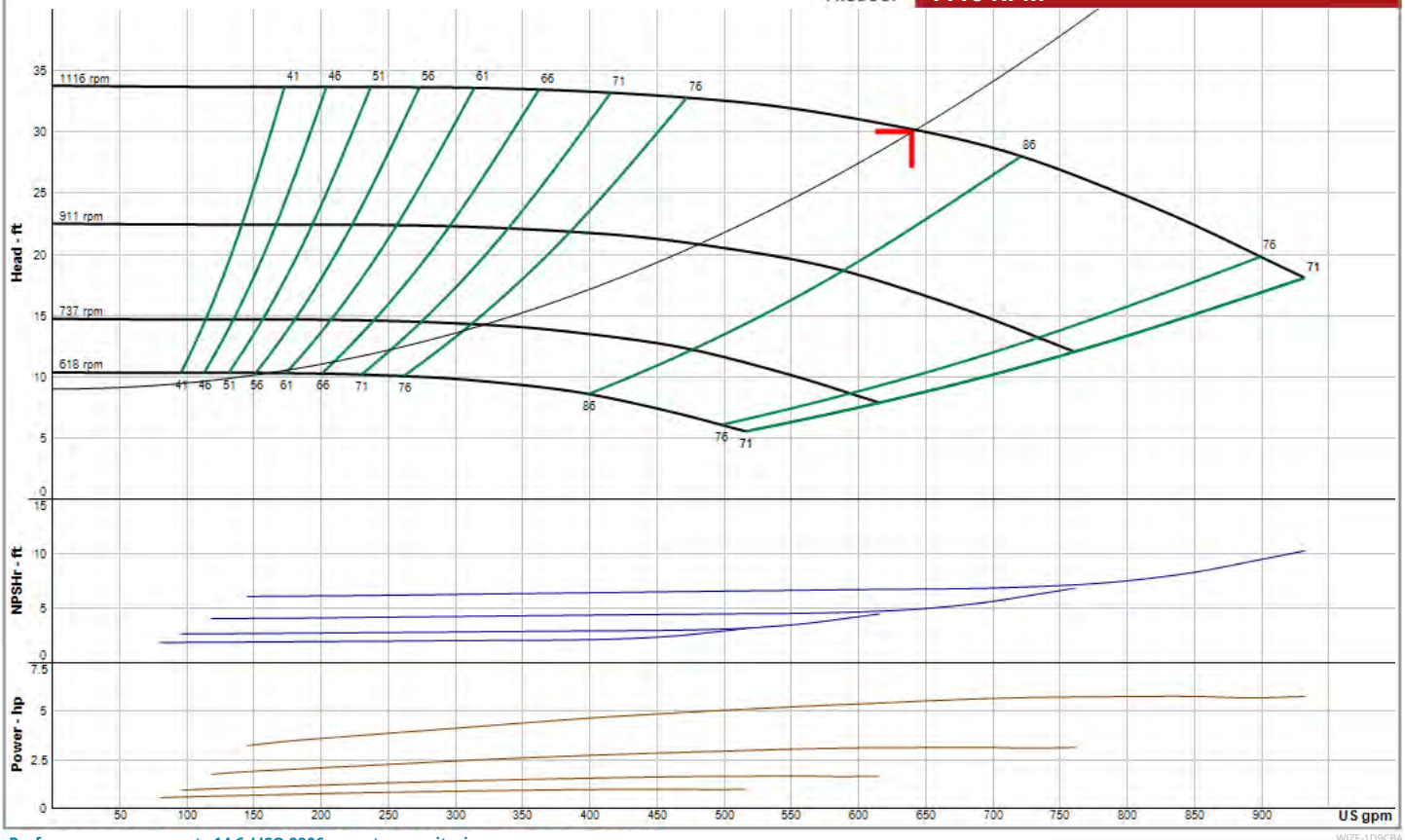
Pump Selection Summary

Duty Point Flow	640 US gpm
Duty Point Head	30 ft
Control Head	9 ft
Duty Point Pump Efficiency	84.6 %
Part Load Efficiency Value (PLEV)	76.5 %
Impeller Diameter	9.5 in
Motor Power	7.5 hp
Duty Point Power	5.49 bhp
Motor Speed	1200 rpm
RPM @ Duty Point	1116 rpm
NPSHr	6.8 ft
Minimum Shutoff Head	33.8 ft
Minimum Flow at RPM	144 US gpm
Flow @ BEP	721 US gpm
Fluid Temperature	200 °F
Fluid Type	Water
Weight *(approx. - consult rep for exact)*	645 lbs
Pump Floor Space Calculation	7.1 ft²

Performance Curve

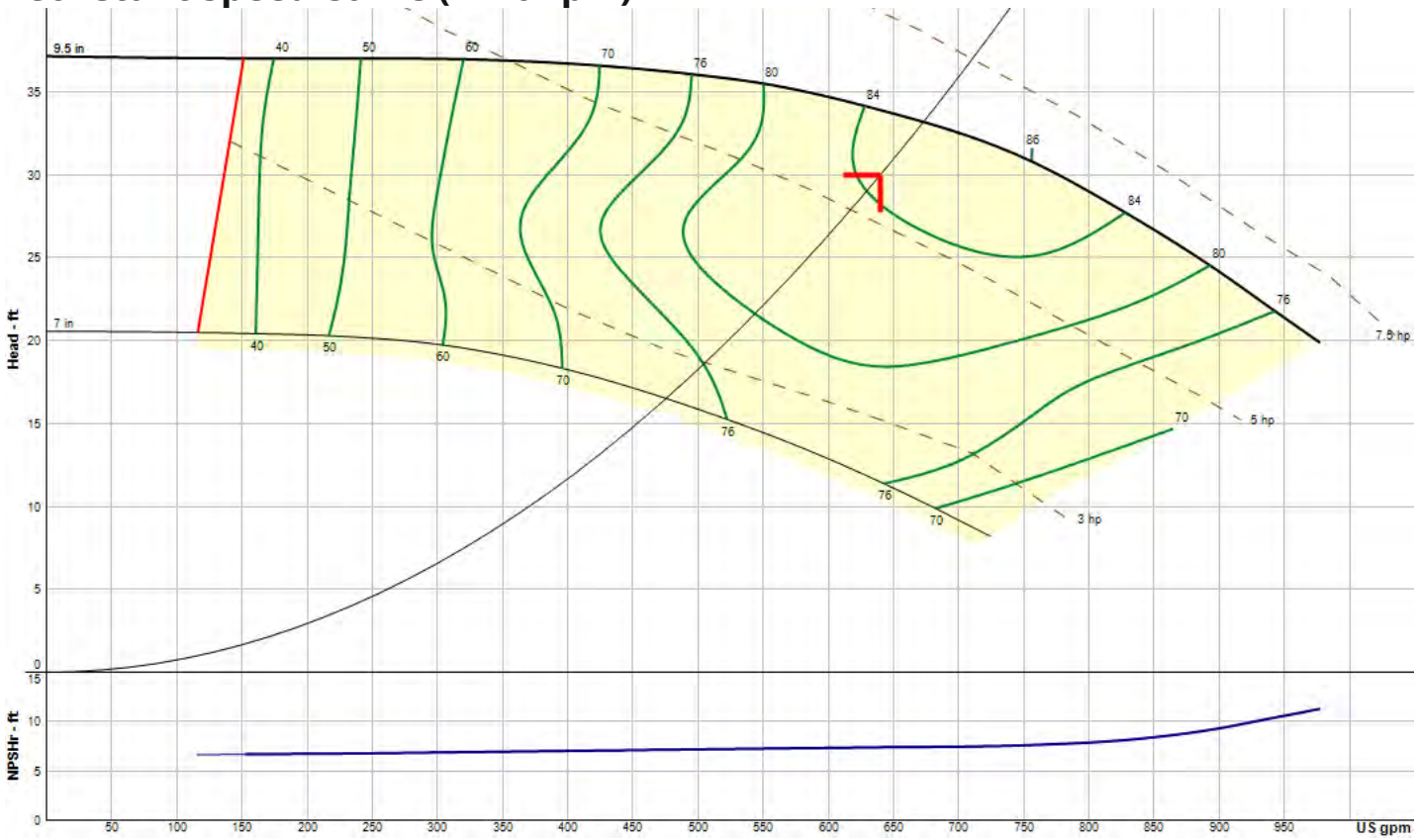
PREMIUM EFFICIENCY PRODUCT

e-1510
5BD
1116 RPM



Performance curve meets 14.6 / ISO 9906 acceptance criteria

Constant Speed Curve (1170 rpm)

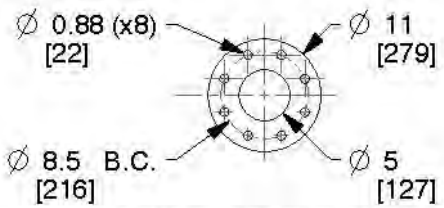


Operating Point

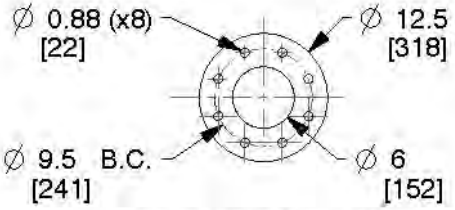
Flow: 640 US gpm **Head:** 30 ft **Speed:** 1116 **Efficiency:** 84.6% **Point BHP:** 5.49 **End Of Curve:** 68.7%

Maximum Duty Point (at rated motor speed)

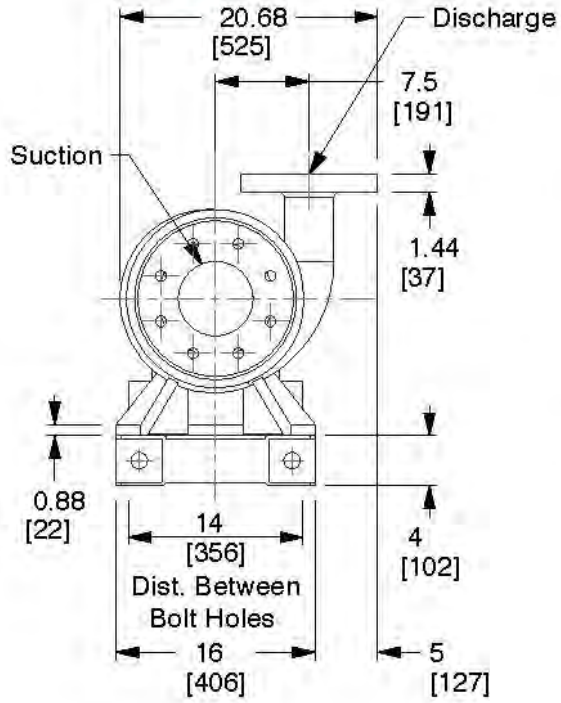
Flow: 671 US gpm **Head:** 33 ft **Speed:** 1170 **Efficiency:** 84.7% **Point BHP:** 6.33 **NOL Flow:** 893 US gpm **Runout Flow:** 977 US gpm **NOL (BHP):** 6.65

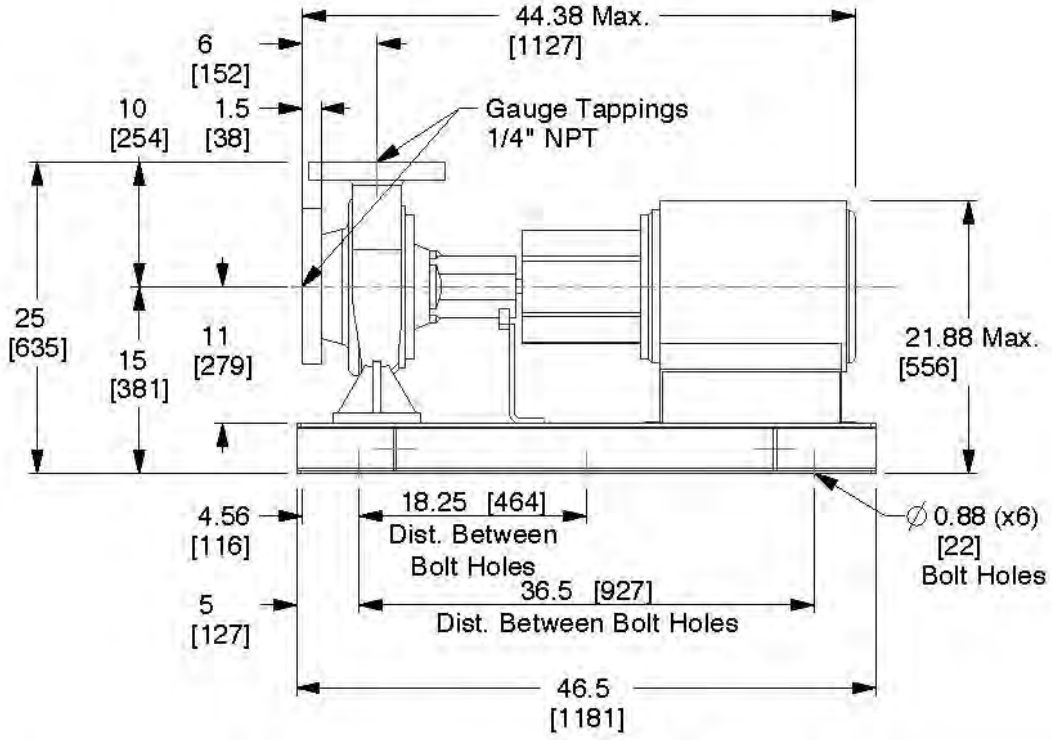


5" DISCHARGE FLANGE
ANSI 125#



6" SUCTION FLANGE
ANSI 125#





Bell & Gossett
a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change

Not to be used for construction unless certified

BG-E1510-5BD-SS-254T-S

Series e-1510 Centrifugal Pumps - Base Mounted

Seal Type: Standard Seal | Motor Frame: 254T | Frame Type: S | Flange: ANSI 125#

Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-880.26C

Bell & Gossett
a xylem brand

Submittal

OPTION 1 SECONDARY HOT WATER PUMPS P-2, P-2A
(Perimeter Heating)

Job/Project:	**Representative:**	
ESP-Systemwize: WIZE-76789D **Created On: 02/24/2020**	**Phone:**	
Location/Tag:	**Email:**	
Engineer:	**Submitted By:**	**Date:**
Contractor:	**Approved By:**	**Date:**

Close Coupled In-Line Centrifugal Pump

Series: e-80
Model: 4x4x9.5B

Features & Design

- Best in Class Hydraulic Performance
- Low Operating and Maintenance Cost
- Horizontal or Vertical Installation

The Series e-80 is a highly efficient, heavy duty, close coupled pump designed for horizontal or vertical in-line mounting. The e-80 is available in stainless steel fitted construction, with flows up to 2500 GPM, heads to 380 feet.

http://bellgossett.com/pumps-circulators/in-line-pumps/series-e-80/

Pump Selection Summary

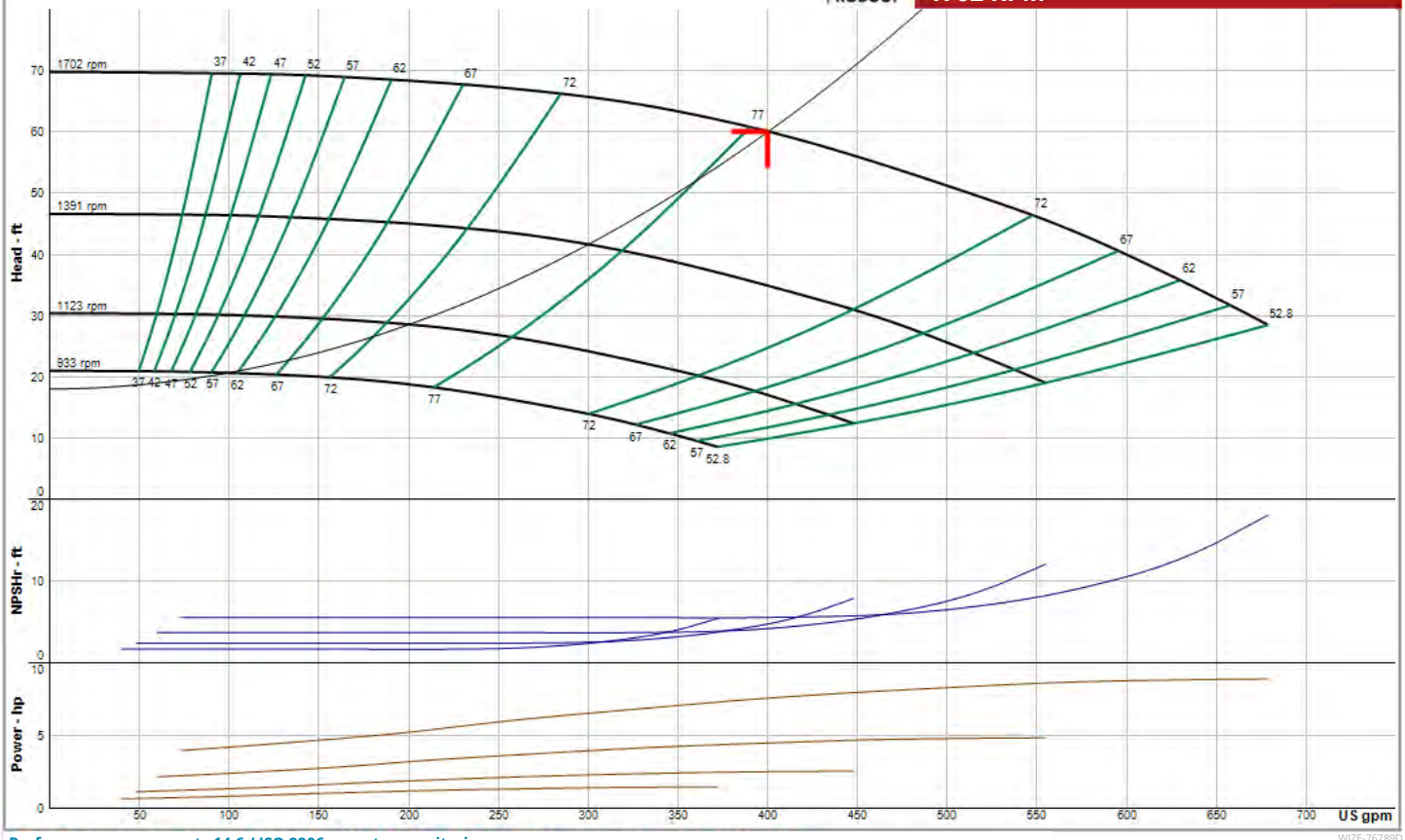
Duty Point Flow	400 US gpm
Duty Point Head	60 ft
Control Head	18 ft
Duty Point Pump Efficiency	76.7 %
Part Load Efficiency Value (PLEV)	72.6 %
Impeller Diameter	8.625 in
Motor Power	10 hp
Duty Point Power	7.57 bhp
Motor Speed	1800 rpm
RPM @ Duty Point	1702 rpm
NPSHr	5.6 ft
Minimum Shutoff Head	69.8 ft
Minimum Flow at RPM	78 US gpm
Flow @ BEP	390 US gpm
Fluid Temperature	200 °F
Fluid Type	Water
Weight *(approx. - consult rep for exact)*	415 lbs
Pump Floor Space Calculation	3.92 ft²

Performance Curve

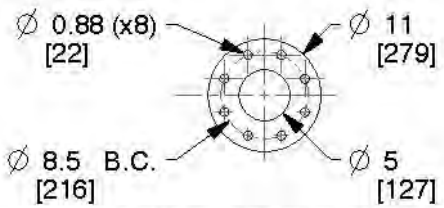
Energy Efficiency Ratings:
Pump & Motor PEIcl: 0.95 ERcl: 5
Pump, Motor & Drive: PEIvl: 0.47 ERvl: 53

PREMIUM EFFICIENCY PRODUCT

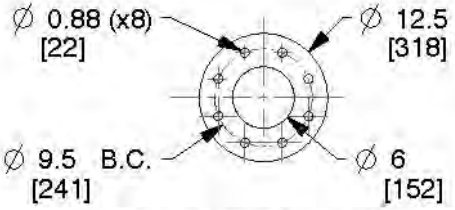
e-80
4x4x9.5B
1702 RPM



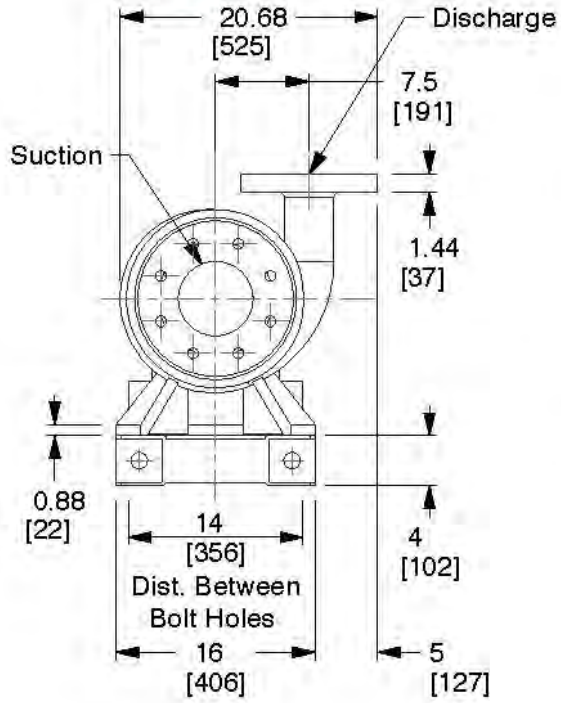
Performance curve meets 14.6 / ISO 9906 acceptance criteria

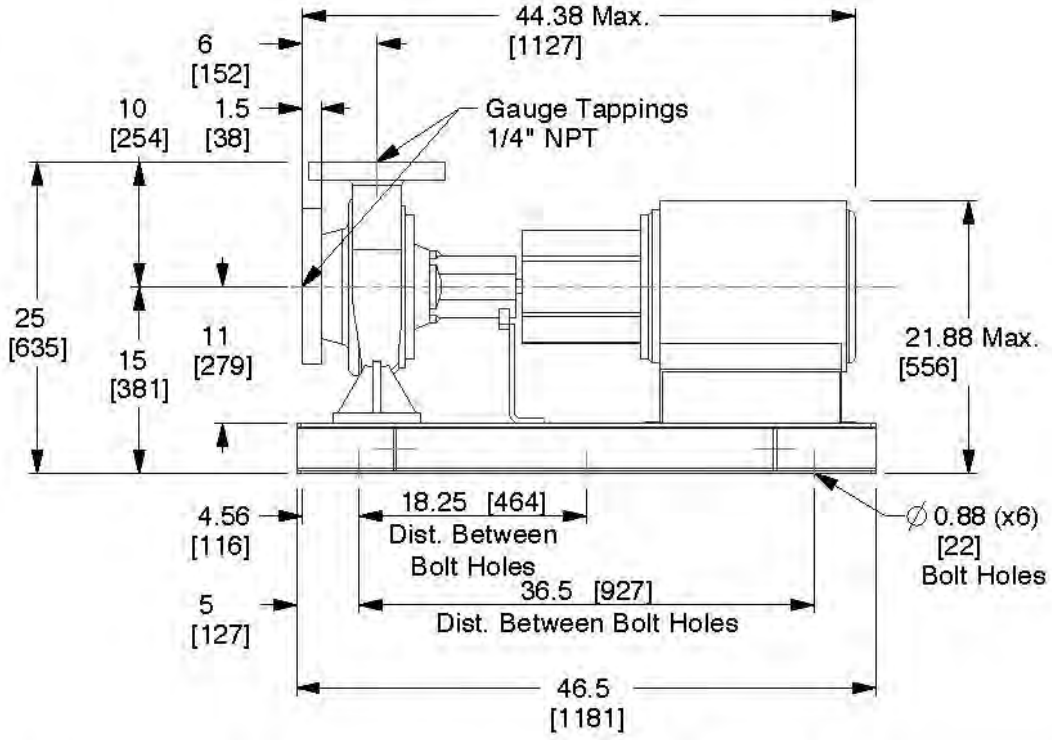


5" DISCHARGE FLANGE
ANSI 125#



6" SUCTION FLANGE
ANSI 125#





Bell & Gossett
a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change

Not to be used for construction unless certified

BG-E1510-5BD-SS-254T-S

Series e-1510 Centrifugal Pumps - Base Mounted

Seal Type: Standard Seal | Motor Frame: 254T | Frame Type: S | Flange: ANSI 125#

Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-880.26C

Bell & Gossett
a xylem brand

Submittal

OPTION 1 SECONDARY HOT WATER PUMPS P-2, P-2A
(Perimeter Heating)

Job/Project:	**Representative:**	
ESP-Systemwize: WIZE-76789D **Created On: 02/24/2020**	**Phone:**	
Location/Tag:	**Email:**	
Engineer:	**Submitted By:**	**Date:**
Contractor:	**Approved By:**	**Date:**

Close Coupled In-Line Centrifugal Pump

Series: e-80
Model: 4x4x9.5B

Features & Design

- Best in Class Hydraulic Performance
- Low Operating and Maintenance Cost
- Horizontal or Vertical Installation

The Series e-80 is a highly efficient, heavy duty, close coupled pump designed for horizontal or vertical in-line mounting. The e-80 is available in stainless steel fitted construction, with flows up to 2500 GPM, heads to 380 feet.

http://bellgossett.com/pumps-circulators/in-line-pumps/series-e-80/

Pump Selection Summary

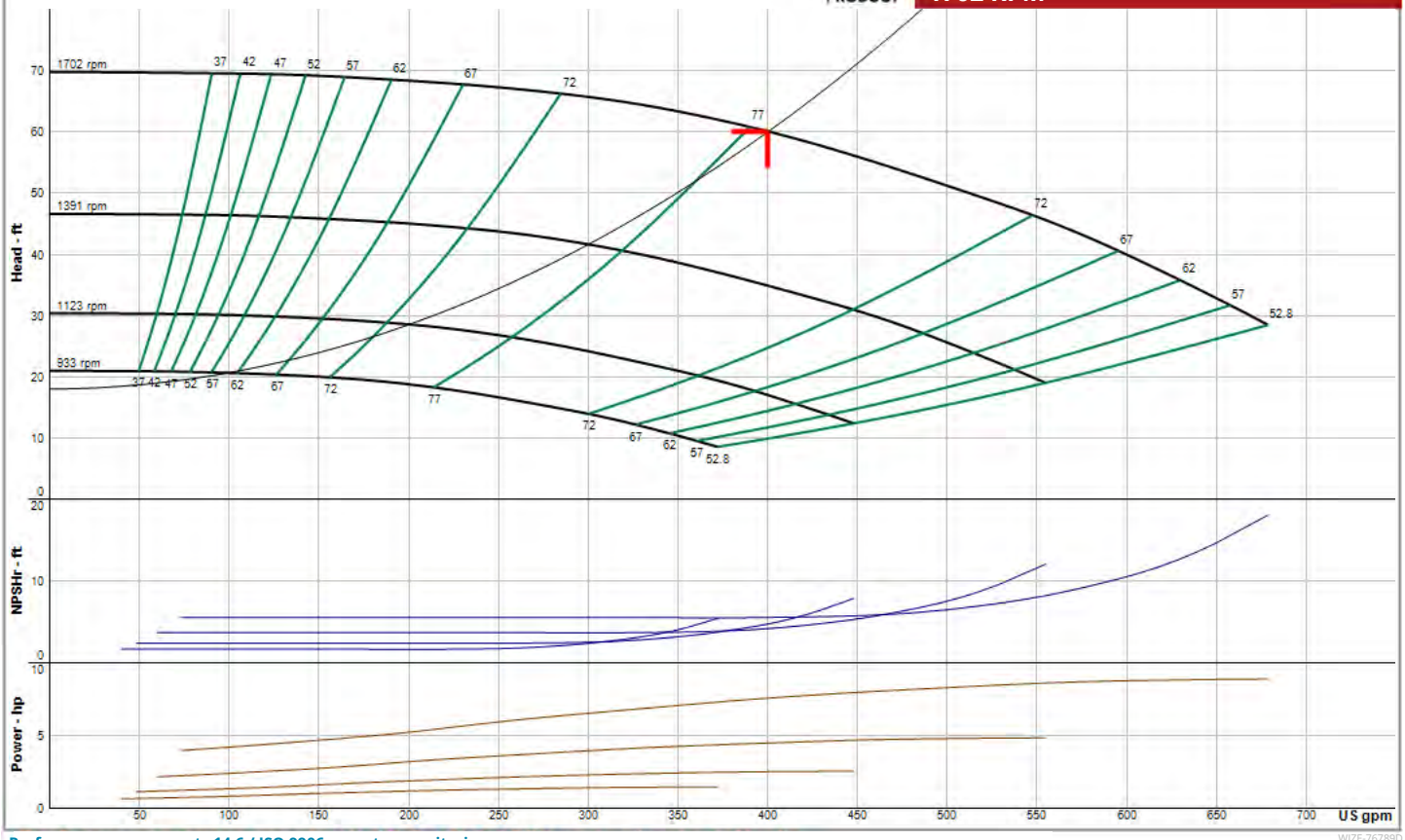
Duty Point Flow	400 US gpm
Duty Point Head	60 ft
Control Head	18 ft
Duty Point Pump Efficiency	76.7 %
Part Load Efficiency Value (PLEV)	72.6 %
Impeller Diameter	8.625 in
Motor Power	10 hp
Duty Point Power	7.57 bhp
Motor Speed	1800 rpm
RPM @ Duty Point	1702 rpm
NPSHr	5.6 ft
Minimum Shutoff Head	69.8 ft
Minimum Flow at RPM	78 US gpm
Flow @ BEP	390 US gpm
Fluid Temperature	200 °F
Fluid Type	Water
Weight *(approx. - consult rep for exact)*	415 lbs
Pump Floor Space Calculation	3.92 ft²

Performance Curve

Energy Efficiency Ratings:
Pump & Motor PEIcl: 0.95 ERcl: 5
Pump, Motor & Drive: PEIvl: 0.47 ERvl: 53

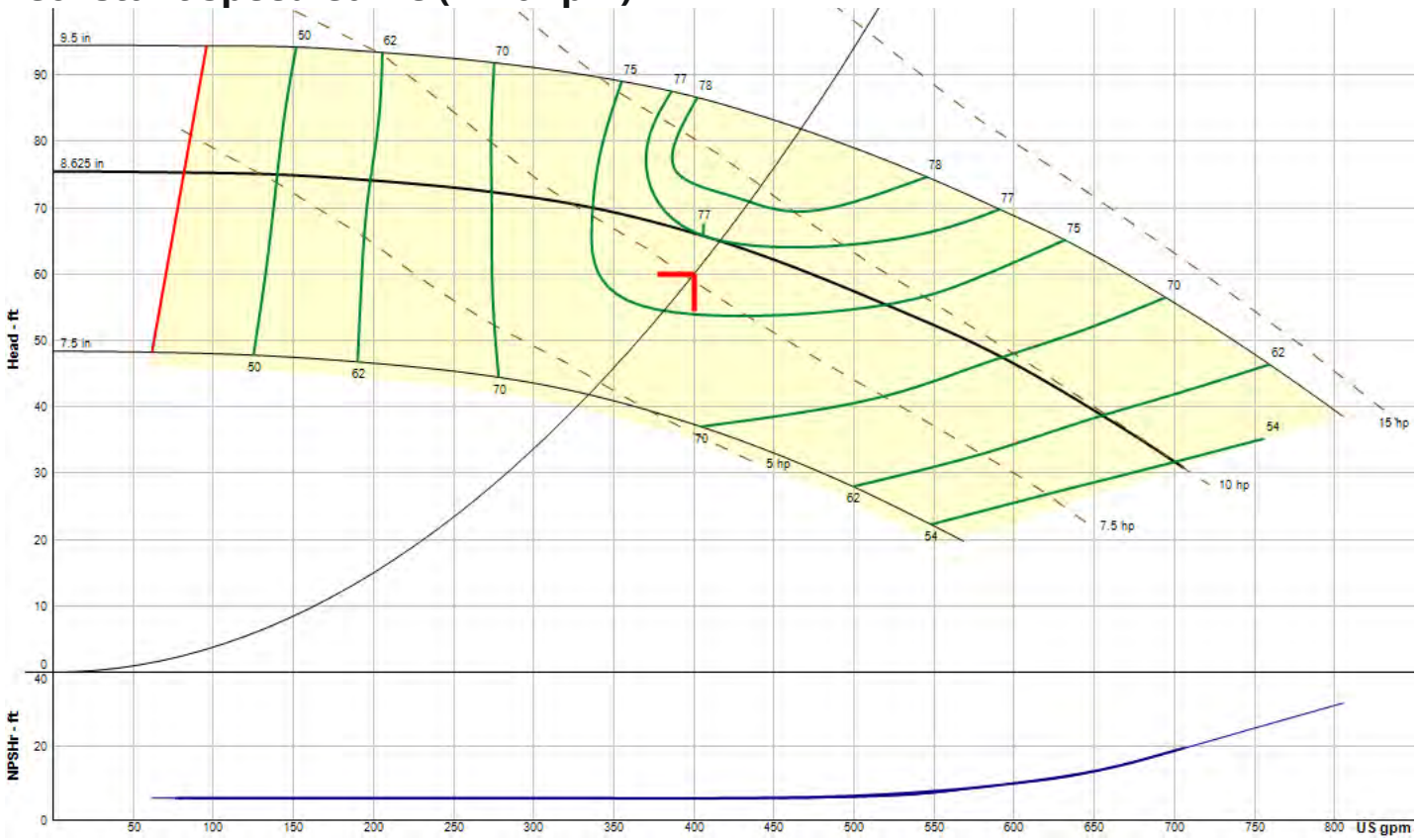
PREMIUM EFFICIENCY PRODUCT

e-80
4x4x9.5B
1702 RPM



Performance curve meets 14.6 / ISO 9906 acceptance criteria

Constant Speed Curve (1770 rpm)

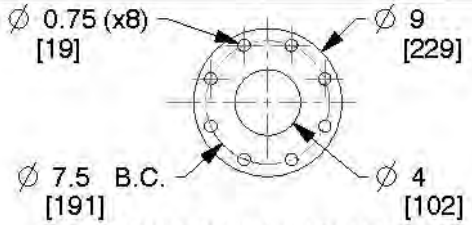


Operating Point

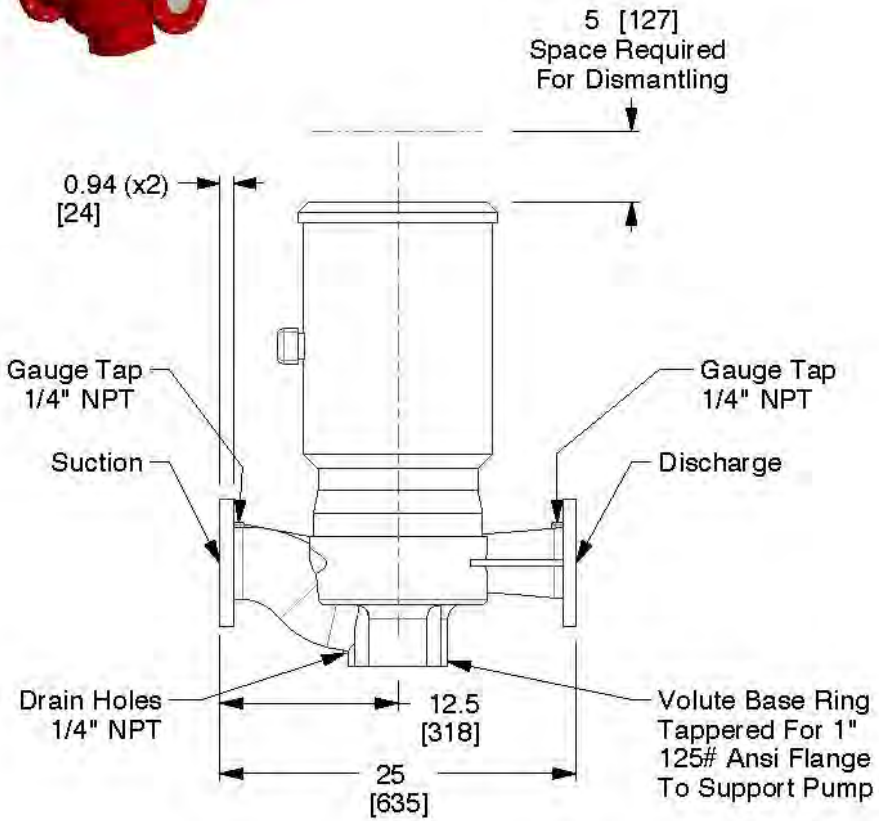
Flow: 400 US gpm **Head:** 60 ft **Speed:** 1702 **Efficiency:** 76.7% **Point BHP:** 7.57 **End Of Curve:** 58.9%

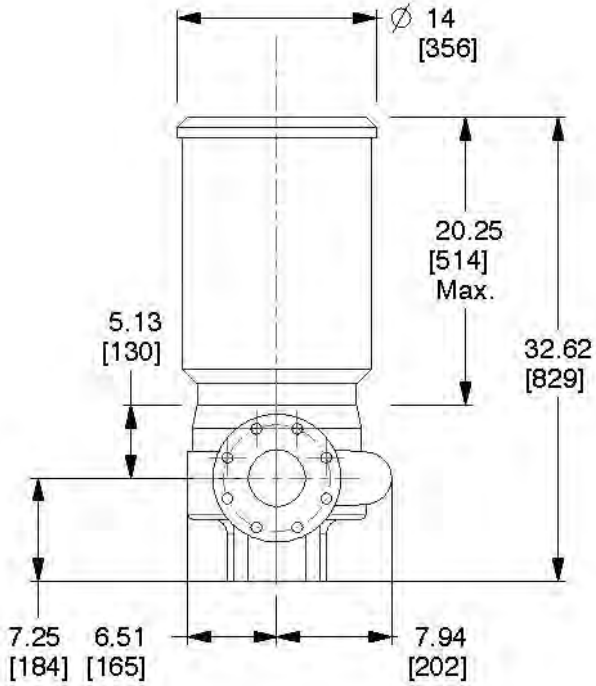
Maximum Duty Point (at rated motor speed)

Flow: 416 US gpm **Head:** 64.9 ft **Speed:** 1770 **Efficiency:** 76.9% **Point BHP:** 8.51 **NOL Flow:** 706 US gpm **Runout Flow:** 706 US gpm **NOL (BHP):** 10



4" SUCTION & DISCHARGE FLANGE DETAILS ANSI 125#





Bell & Gossett
a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change

Not to be used for construction unless certified

BG-E80-4x4x9.5B-SS215JM-1-IN

Series e-80 Close Coupled In-Line Centrifugal Pump

Motor Frame:215JM | Flange:ANSI 125#

Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-139.20A

Bell & Gossett
a xylem brand

OPTION 1 PRIMARY HOT WATER PUMPS P-3, P-3A
(Heating of Ventilation Air)

Submittal

Job/Project:	**Representative:**	
ESP-Systemwize: WIZE-787680 **Created On: 02/24/2020**	**Phone:**	
Location/Tag:	**Email:**	
Engineer:	**Submitted By:**	**Date:**
Contractor:	**Approved By:**	**Date:**

Close Coupled In-Line Centrifugal Pump

Series: e-80

Model: 3x3x9.5C

Features & Design

- Best in Class Hydraulic Performance
- Low Operating and Maintenance Cost
- Horizontal or Vertical Installation

The Series e-80 is a highly efficient, heavy duty, close coupled pump designed for horizontal or vertical in-line mounting. The e-80 is available in stainless steel fitted construction, with flows up to 2500 GPM, heads to 380 feet.

http://bellgossett.com/pumps-circulators/in-line-pumps/series-e-80/

Pump Selection Summary

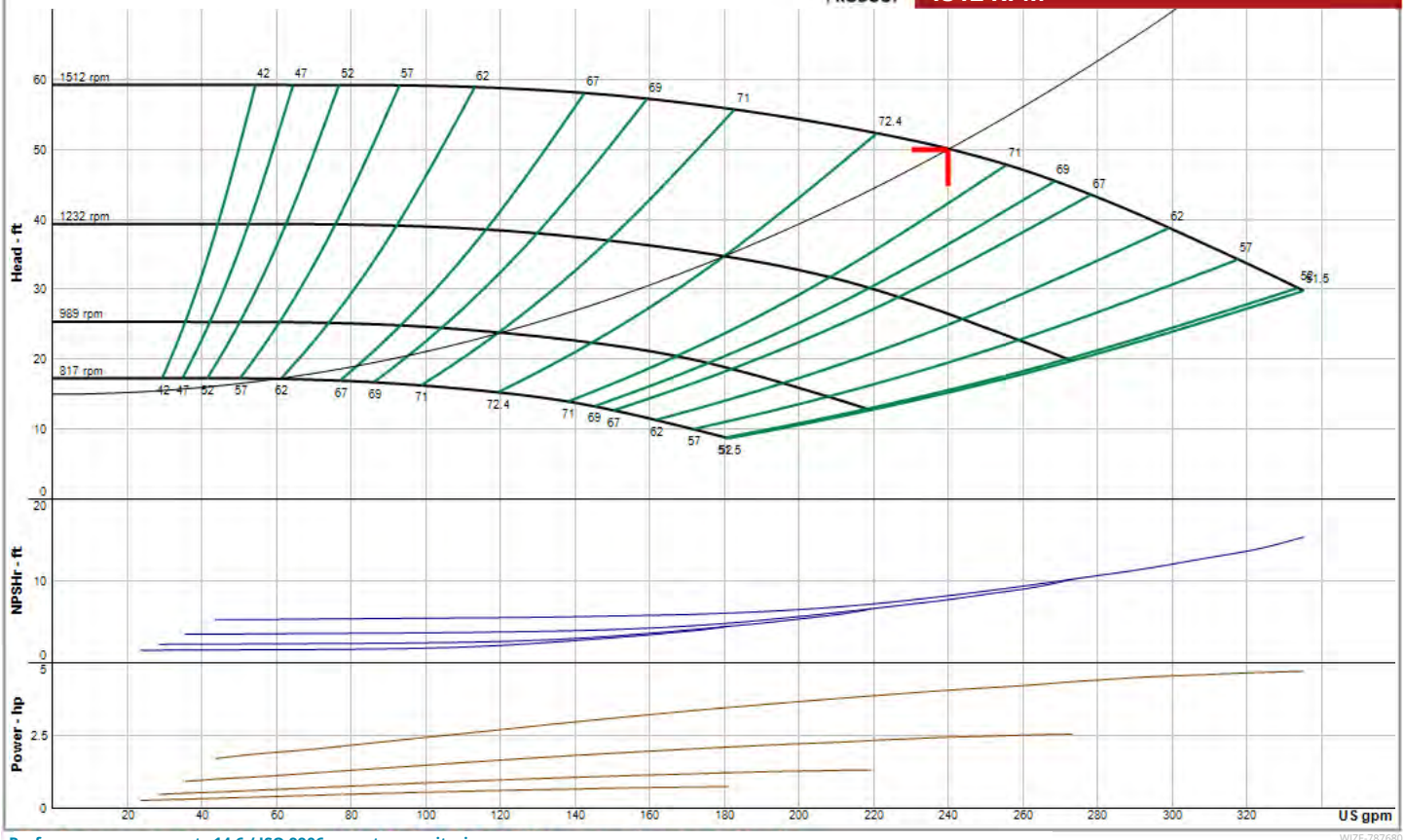
Duty Point Flow	240 US gpm
Duty Point Head	50 ft
Control Head	15 ft
Duty Point Pump Efficiency	71.4 %
Part Load Efficiency Value (PLEV)	70.2 %
Impeller Diameter	8.875 in
Motor Power	7.5 hp
Duty Point Power	4.06 bhp
Motor Speed	1800 rpm
RPM @ Duty Point	1512 rpm
NPSHr	8.23 ft
Minimum Shutoff Head	59.2 ft
Minimum Flow at RPM	44.2 US gpm
Flow @ BEP	221 US gpm
Fluid Temperature	200 °F
Fluid Type	Water
Weight *(approx. - consult rep for exact)*	300 lbs
Pump Floor Space Calculation	3.22 ft²

Performance Curve

Energy Efficiency Ratings:
Pump & Motor PEIcl: 0.94 ERcl: 6
Pump, Motor & Drive: PEIvl: 0.47 ERvl: 53

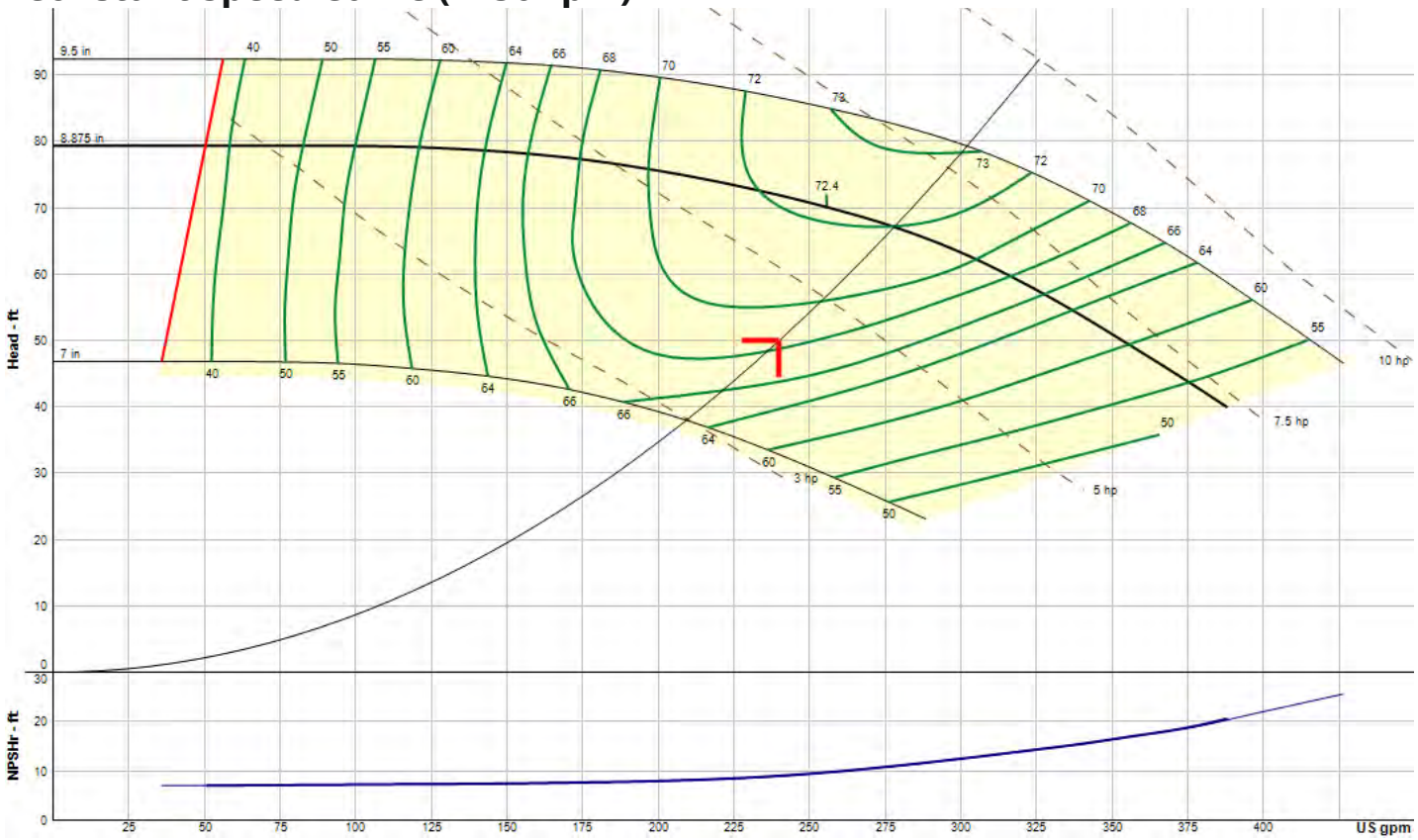
PREMIUM EFFICIENCY PRODUCT

e-80
3x3x9.5C
1512 RPM



Performance curve meets 14.6 / ISO 9906 acceptance criteria

Constant Speed Curve (1750 rpm)

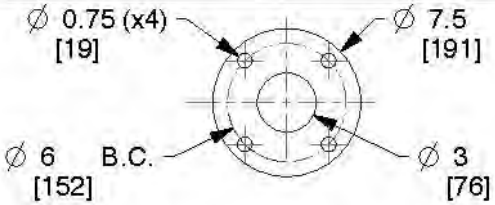


Operating Point

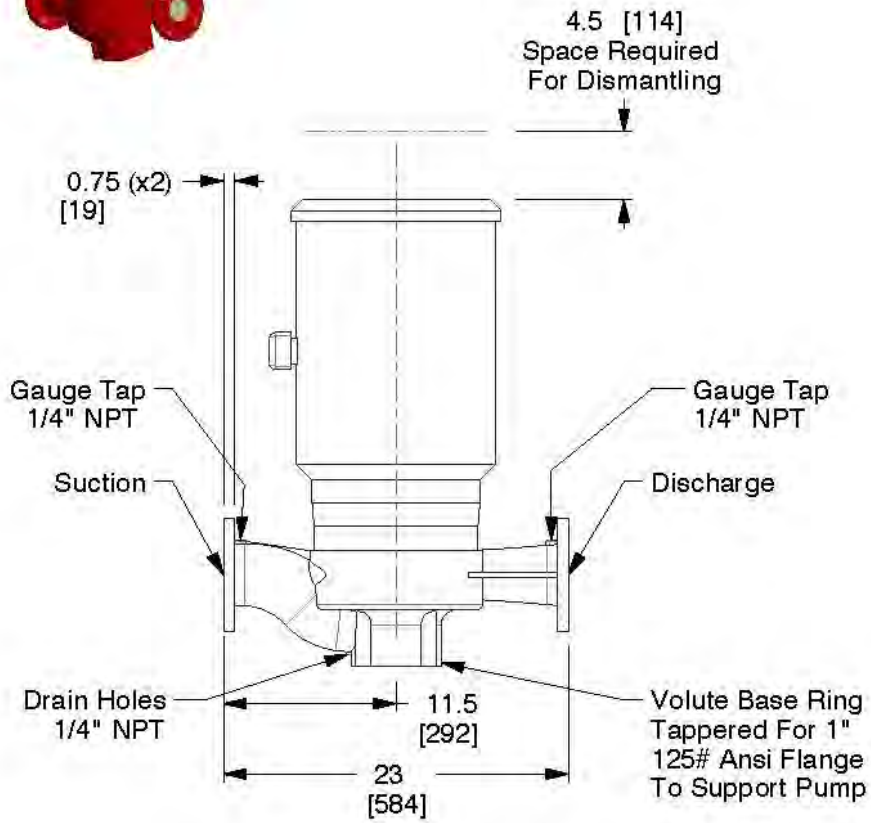
Flow: 240 US gpm **Head:** 50.1 ft **Speed:** 1512 **Efficiency:** 71.4% **Point BHP:** 4.06 **End Of Curve:** 71.7%

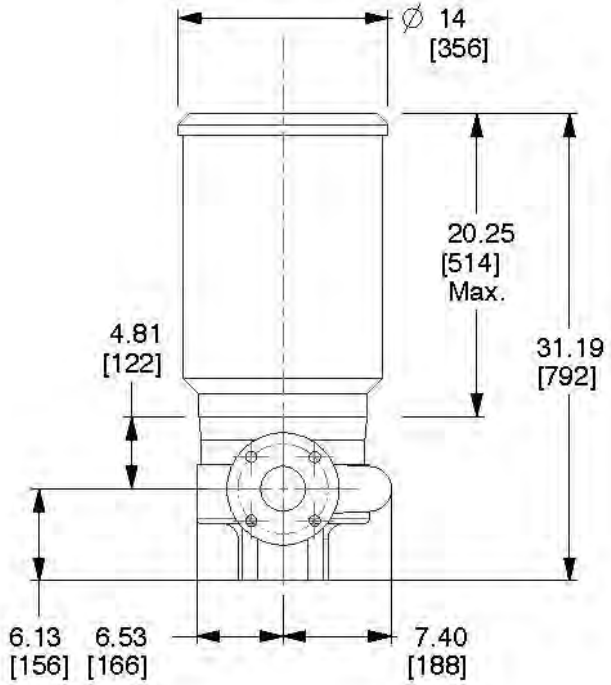
Maximum Duty Point (at rated motor speed)

Flow: 278 US gpm **Head:** 67.1 ft **Speed:** 1750 **Efficiency:** 72% **Point BHP:** 6.3 **NOL Flow:** 388 US gpm **Runout Flow:** 388 US gpm **NOL (BHP):** 7.31



3" SUCTION & DISCHARGE FLANGE DETAILS ANSI 125#





Bell & Gossett
a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change

Not to be used for construction unless certified

BG-E80-3x3x9.5C-SS213JM-1-IN

Series e-80 Close Coupled In-Line Centrifugal Pump

Motor Frame:213JM | Flange:ANSI 125#

Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-139.14A

Bell & Gossett
a xylem brand

Submittal

OPTION 1 CHILLED WATER PUMPS P-4, P-4A

Job/Project:		**Representative:**	
ESP-Systemwize: WIZE-38CCB9	**Created On:** 02/23/2020	**Phone:**	
Location/Tag:		**Email:**	
Engineer:		**Submitted By:**	**Date:**
Contractor:		**Approved By:**	**Date:**

Base Mounted End Suction Pump

Series: e-1510

Model: 2.5BB

Features & Design

- ANSI/OSHA Coupling Guard
- Center Drop Out Spacer Coupling
- Fabricated Heavy Duty Baseplate
- Internally Self-Flushing Mechanical Seal

*The Bell & Gossett Series e-1510 is available in 26 sizes and a variety of configuration options that enable customization and flexibility to fit a broad range of operating conditions.

http://bellgossett.com/pumps-circulators/end-suction-pumps/e-1510/

Pump Selection Summary

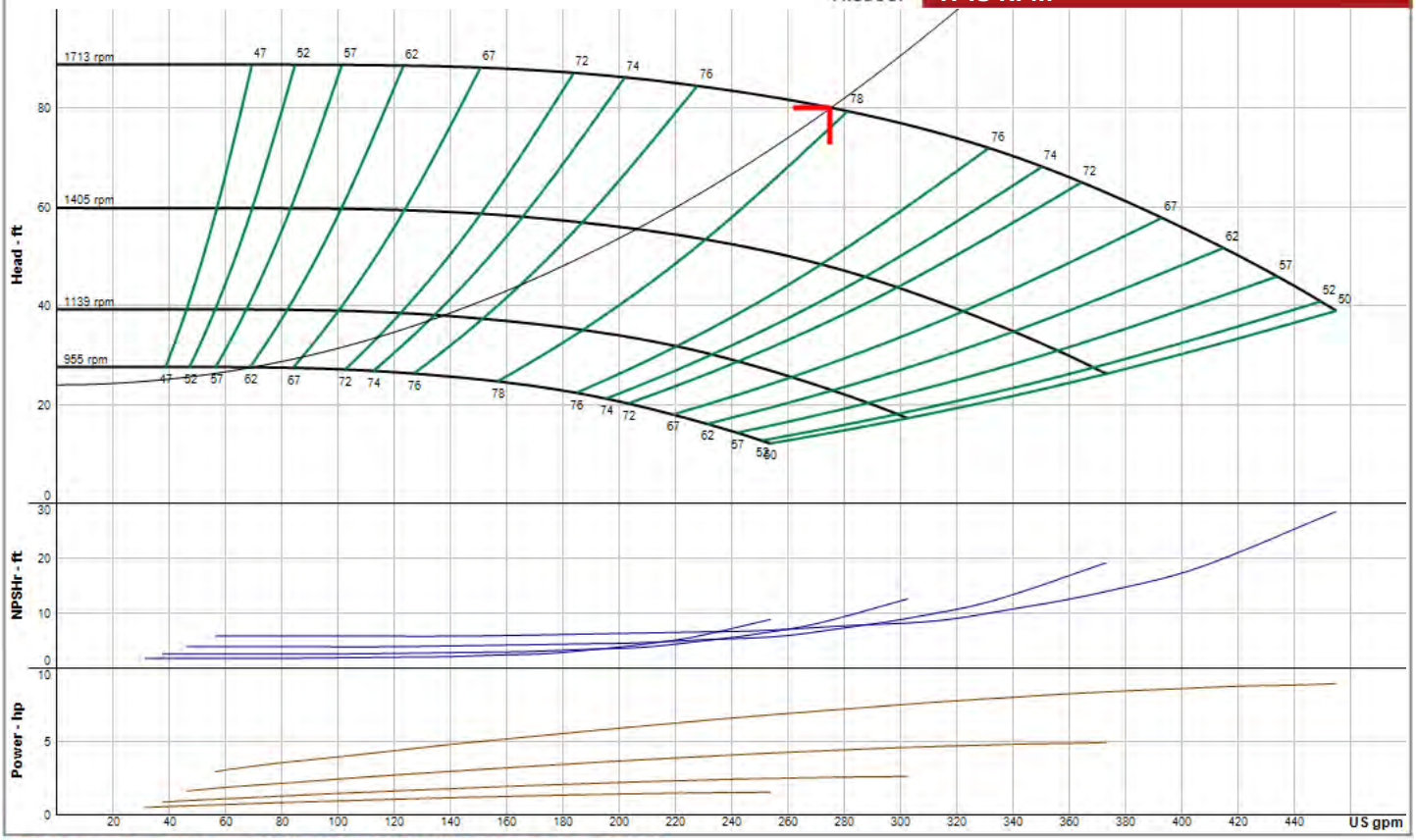
Duty Point Flow	275 US gpm
Duty Point Head	80 ft
Control Head	24 ft
Duty Point Pump Efficiency	77.6 %
Part Load Efficiency Value (PLEV)	73.7 %
Impeller Diameter	9.5 in
Motor Power	10 hp
Duty Point Power	7.14 bhp
Motor Speed	1800 rpm
RPM @ Duty Point	1713 rpm
NPSHr	7.59 ft
Minimum Shutoff Head	88.9 ft
Minimum Flow at RPM	56.2 US gpm
Flow @ BEP	281 US gpm
Fluid Temperature	60 °F
Fluid Type	Water
Weight *(approx. - consult rep for exact)*	388 lbs
Pump Floor Space Calculation	4.35 ft²

Performance Curve

Energy Efficiency Ratings:
Pump & Motor PEIcl: 0.89 ERcl: 11
Pump, Motor & Drive: PEIvl: 0.45 ERvl: 55

PREMIUM EFFICIENCY PRODUCT

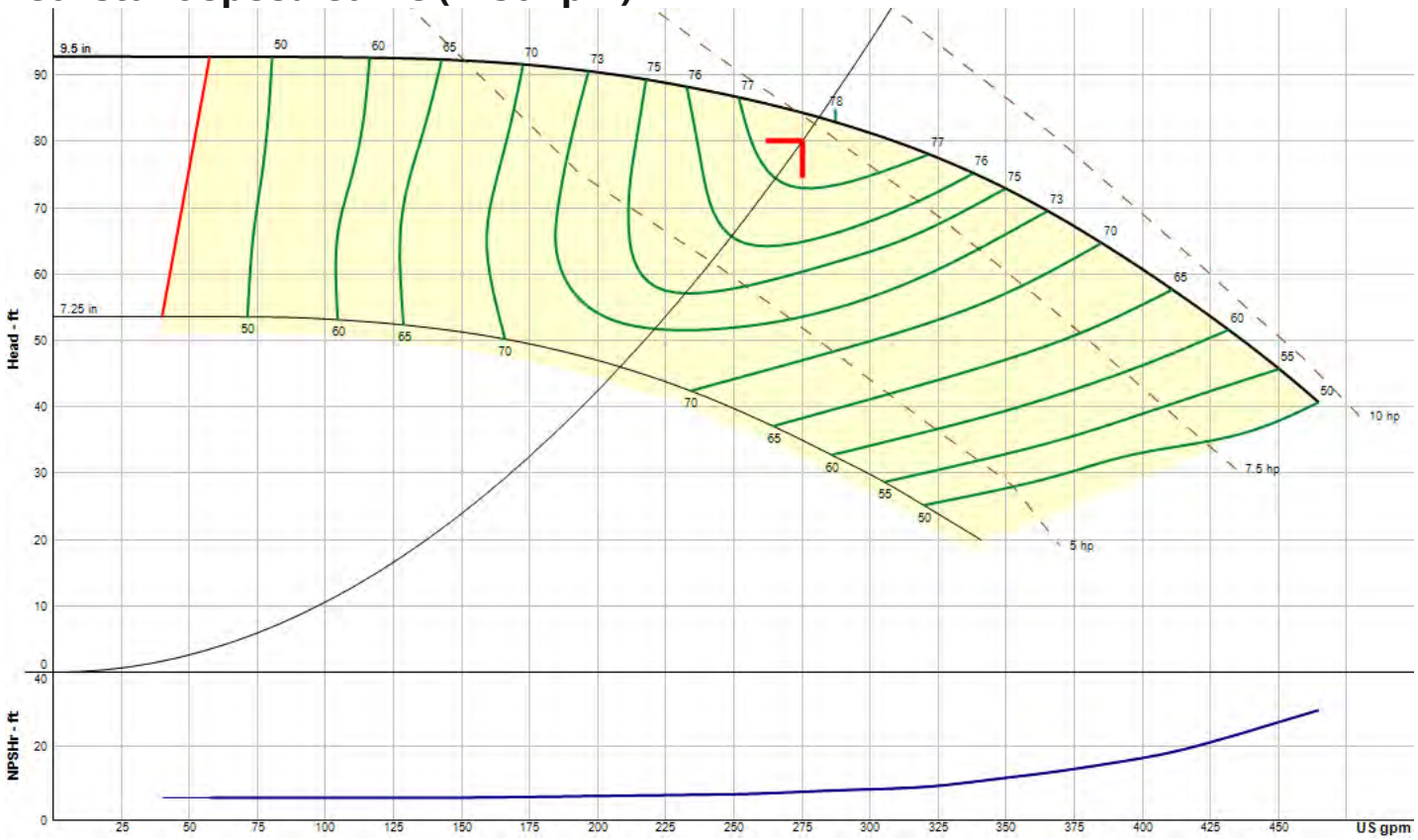
e-1510
2.5BB
1713 RPM



Performance curve meets 14.6 / ISO 9906 acceptance criteria

WIZE-38CCB9

Constant Speed Curve (1750 rpm)

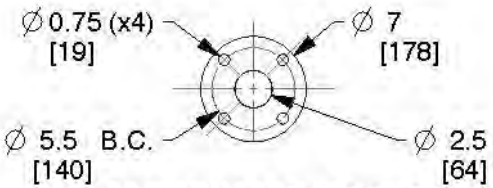


Operating Point

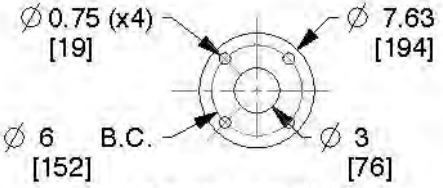
Flow: 275 US gpm **Head:** 80.1 ft **Speed:** 1713 **Efficiency:** 77.6% **Point BHP:** 7.14 **End Of Curve:** 60.5%

Maximum Duty Point (at rated motor speed)

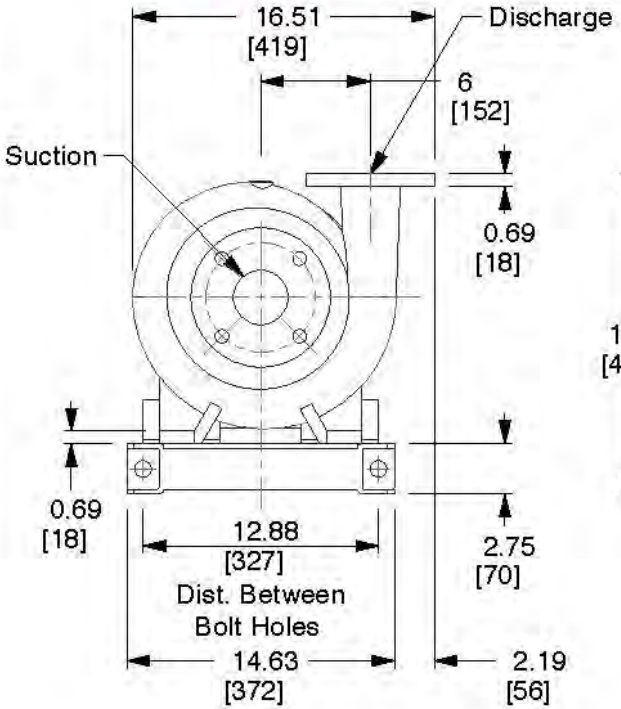
Flow: 281 US gpm **Head:** 83.6 ft **Speed:** 1750 **Efficiency:** 77.8% **Point BHP:** 7.62 **NOL Flow:** 465 US gpm **Runout Flow:** 465 US gpm **NOL (BHP):** 9.55

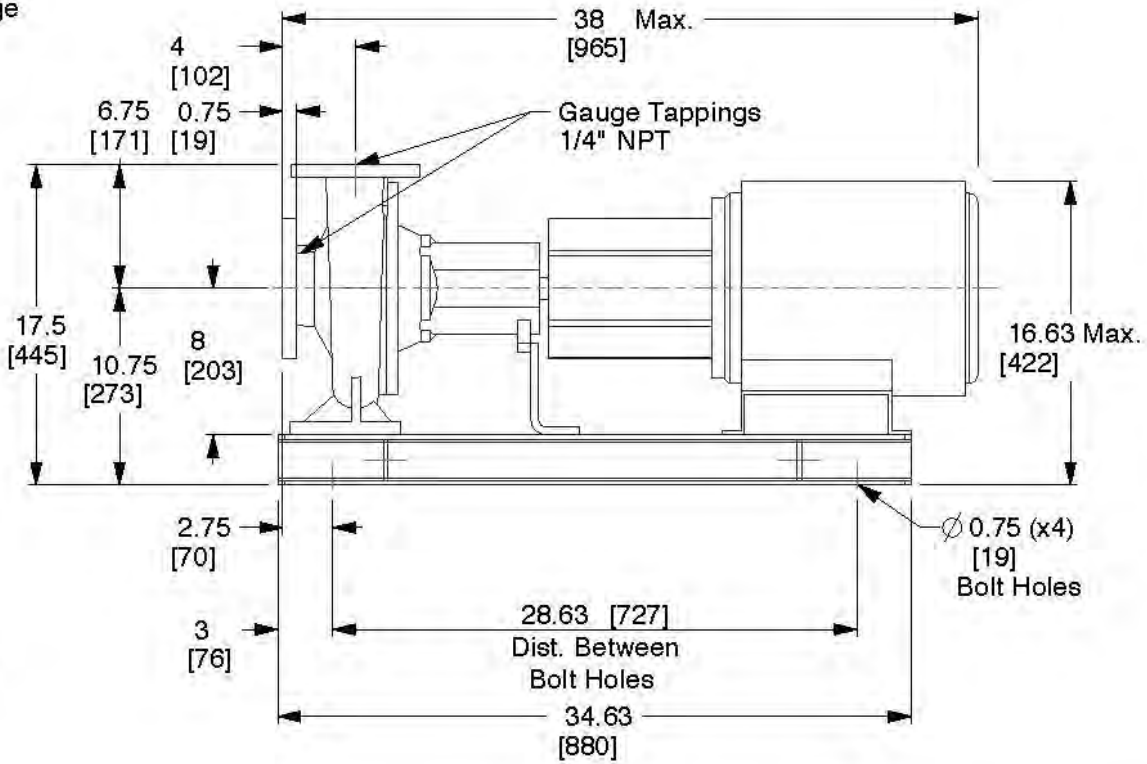


2.5" DISCHARGE FLANGE
ANSI 125#



3" SUCTION FLANGE
ANSI 125#





Bell & Gossett
a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change
Not to be used for construction unless certified

BG-E1510-2P5BB-SS-215T-S

Series e-1510 Centrifugal Pumps - Base Mounted

Seal Type: Standard Seal | Motor Frame: 215T | Frame Type: S | Flange: ANSI 125#

Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-880.20A

Bell & Gossett
a xylem brand

Submittal

OPTION 1 CONDENSER WATER PUMPS P-5, P-5A

Job/Project:		**Representative:**	
ESP-Systemwize: WIZE-EC0D96	**Created On:** 02/23/2020	**Phone:**	
Location/Tag:		**Email:**	
Engineer:		**Submitted By:**	**Date:**
Contractor:		**Approved By:**	**Date:**

Base Mounted End Suction Pump

Series: e-1510

Model: 3EB

Features & Design

- ANSI/OSHA Coupling Guard
- Center Drop Out Spacer Coupling
- Fabricated Heavy Duty Baseplate
- Internally Self-Flushing Mechanical Seal

*The Bell & Gossett Series e-1510 is available in 26 sizes and a variety of configuration options that enable customization and flexibility to fit a broad range of operating conditions.

http://bellgossett.com/pumps-circulators/end-suction-pumps/e-1510/

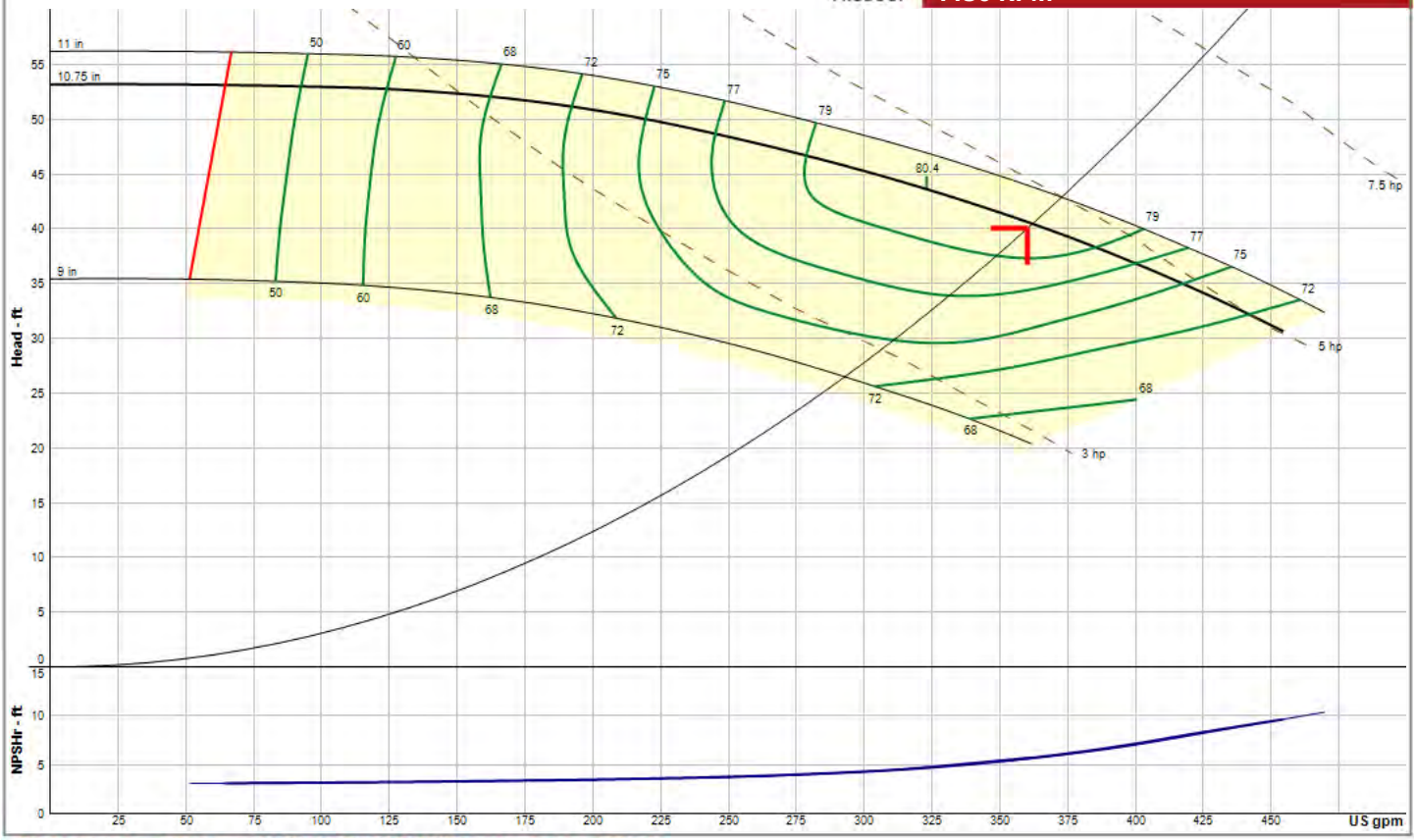
Pump Selection Summary

Duty Point Flow	360 US gpm
Duty Point Head	40 ft
Control Head	0 ft
Duty Point Pump Efficiency	79.5 %
Part Load Efficiency Value (PLEV)	0.0 %
Impeller Diameter	10.75 in
Motor Power	7.5 hp
Duty Point Power	4.58 bhp
Motor Speed	1200 rpm
RPM @ Duty Point	1150 rpm
NPSHr	5.83 ft
Minimum Shutoff Head	53.2 ft
Minimum Flow at RPM	64.6 US gpm
Flow @ BEP	323 US gpm
Fluid Temperature	95 °F
Fluid Type	Water
Weight *(approx. - consult rep for exact)*	530 lbs
Pump Floor Space Calculation	5.92 ft²

Performance Curve

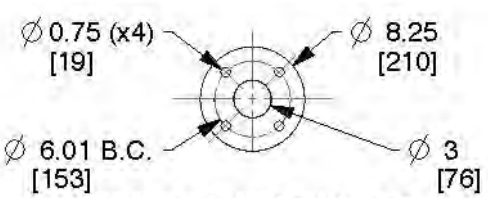
PREMIUM EFFICIENCY PRODUCT

e-1510
3EB
1150 RPM

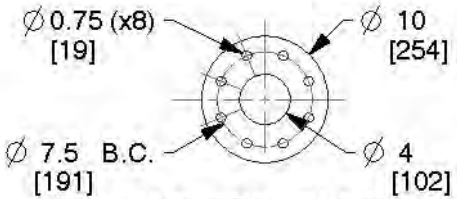


Performance curve meets 14.6 / ISO 9906 acceptance criteria

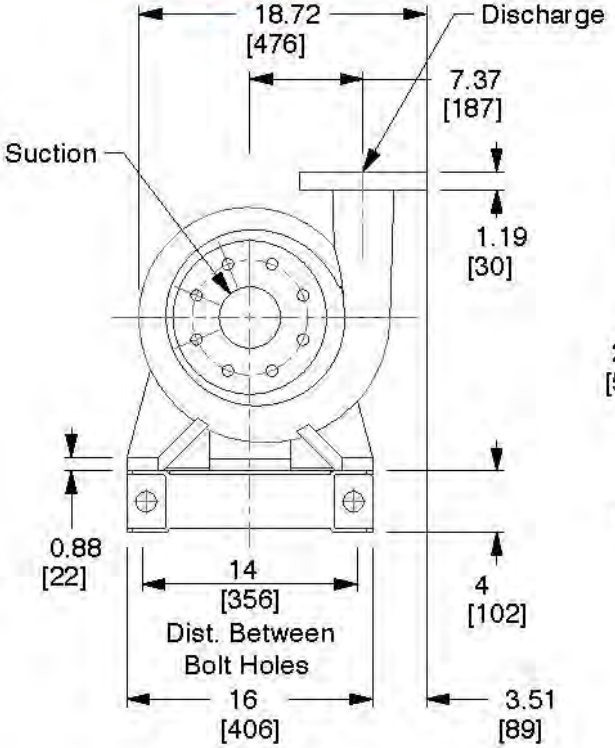
WIZE-EC0D96

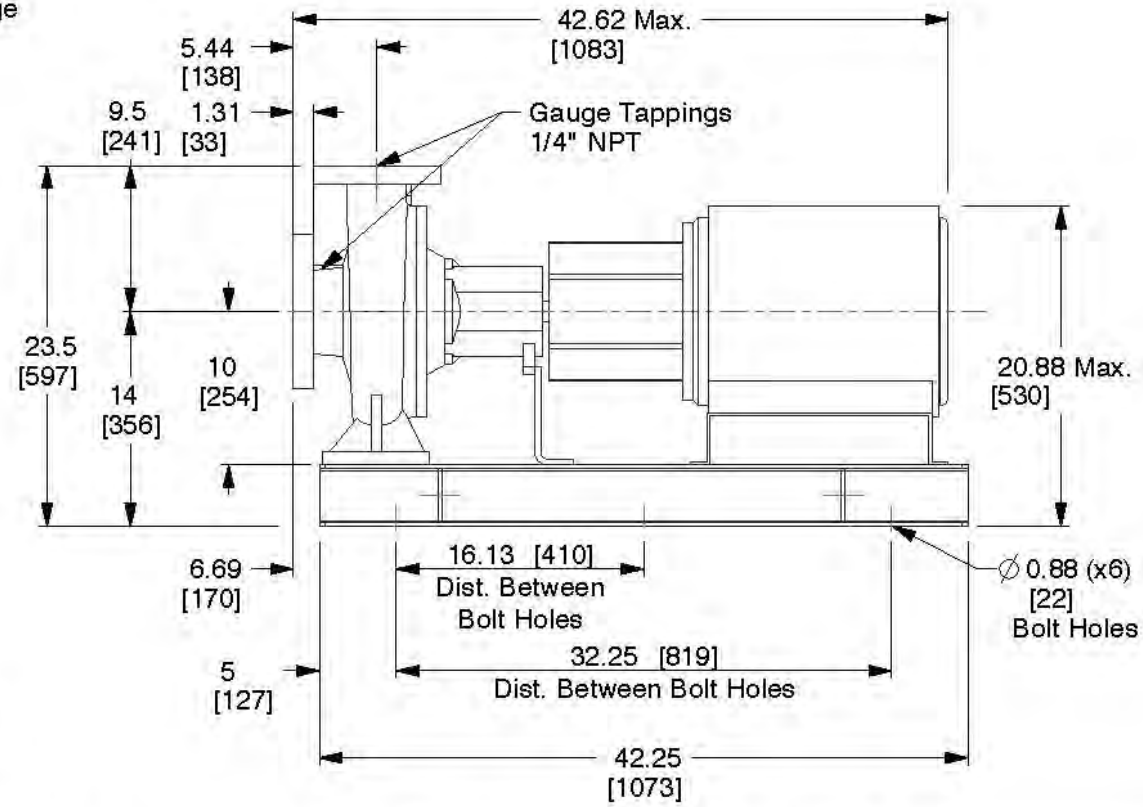


3" DISCHARGE FLANGE
ANSI 125#



4" SUCTION FLANGE
ANSI 125#





Bell & Gossett
a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change
Not to be used for construction unless certified

BG-E1510-3EB-SS-254T-S

Series e-1510 Centrifugal Pumps - Base Mounted

Seal Type: Standard Seal | Motor Frame: 254T | Frame Type: S | Flange: ANSI 125#

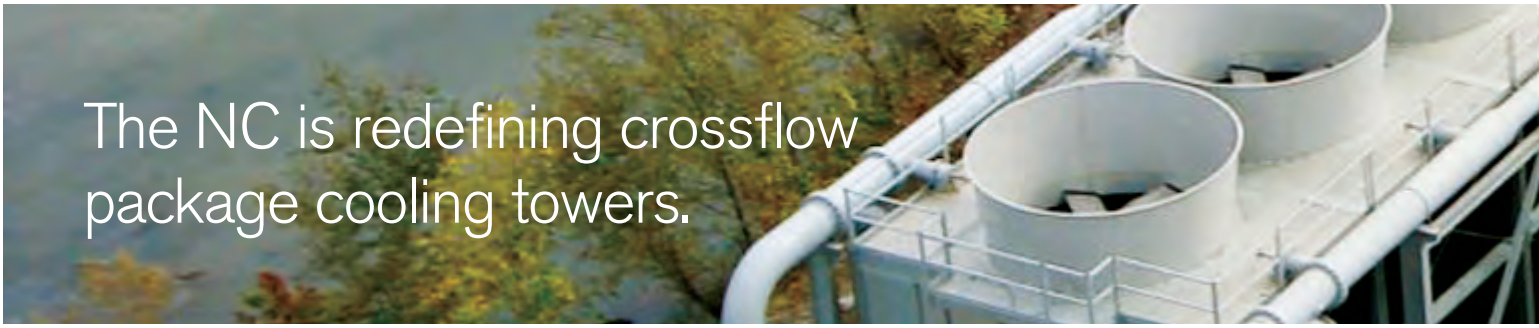
Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-880.32B

COOLING TOWER FOR OPTION 1

NC® steel cooling tower

MORE CAPACITY. MORE VALUE.

MARLEY®

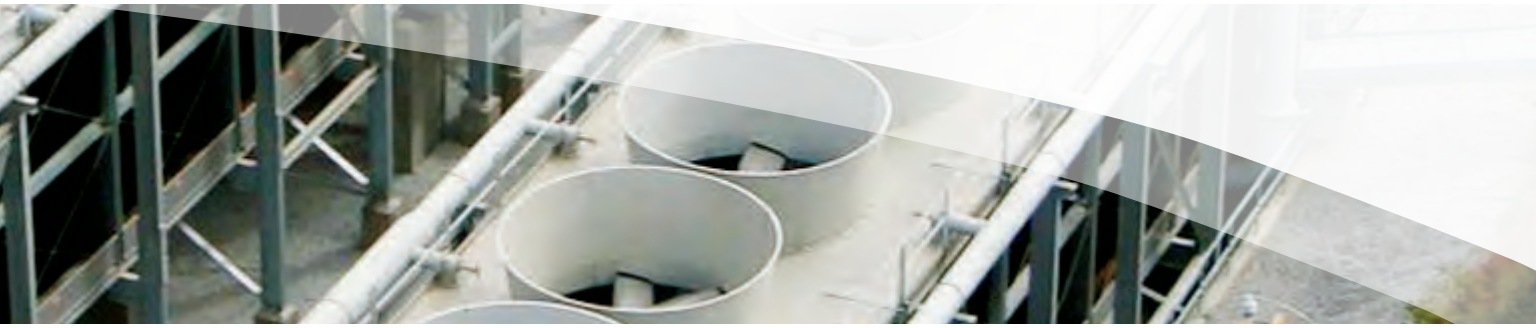


The NC is redefining crossflow package cooling towers.

SEE INCREASED VALUE FROM THE VERY BEGINNING.

- Lower shipping costs and global availability. Affordable performance – delivered when you need it, wherever you need it.
- Ease of installation. 90 years in the business have taught us to streamline the installation process and to anticipate the installation needs for numerous applications.

- The System 5 Geareducer requires no oil changes for a full five years – the lowest maintenance requirements in the industry.
- SofTork MC Coupling absorbs excessive shock loads at start-up – forgives minor misalignment between the motor and Geareducer. Specifically designed for VFD applications and cooling towers.
- The standard low-sound, high-efficiency axial fan has adjustable-pitch fan blades to permit maximum utilization of rated horsepower – allowing field adjustments to optimize performance.
- Easy fit guardrail and safety cage option for quick, hassle-free field installation.



INDUSTRY-LEADING FEATURES AND OPTIONS OF THE MARLEY NC.

- Improved efficiency and increased capacity: At its largest capacity, the Marley NC has the ability to deliver more tons of cooling than any other package cooling tower on the market, as high as 2189 tons in a single unit.
- Drift rates as low as .0005% of design flow rate are available on many standard models – the exclusive patented MarKey® drift eliminator achieves the lowest drift rates of any standard crossflow configuration.
- Optional belt drive – the choice is yours. Choose the belt drive system for all models up to 60 hp.
- Largest selection of options and accessories. Select and customize your NC with the most optional features of any factory-assembled cooling tower.
- The most CTI-certified low-sound options, with low-sound fans standard on all NC models.

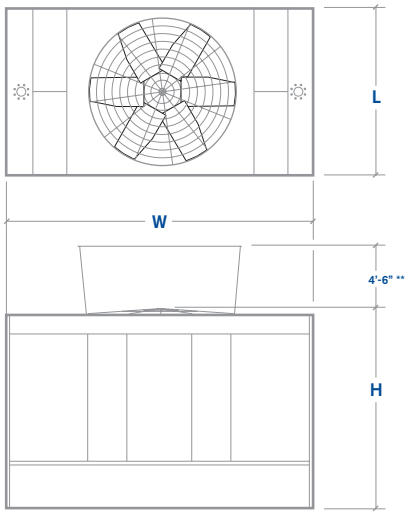
The perfect fit makes all the difference.

See how the best gets even better. There's a Marley NC that's ideal for your application.

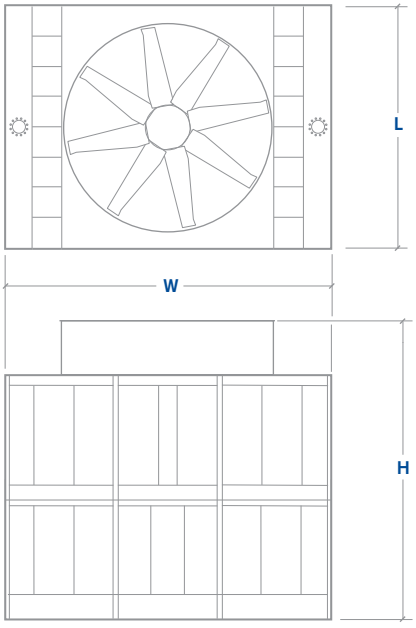
Models	Tons	L	W	H
NC8401	101–198	6'-6"	12'-10"	10'-2"
NC8402	156–308	8'-5"	14'-2"	10'-3"**
NC8403	196–489	8'-5"	18'-2"	11'-11"**
NC8405	242–591	9'-11"	19'-11"	12'-0"**
NC8407	320–736	11'-11"	21'-0"	12'-0" **
NC8409	417–865	13'-11"	22'-5"	12'-0" **
NC8410*	498–966	11'-11"	22'-5"	16'-0" **
NC8411*	546–1032	11'-11"	22'-5"	18'-10" **
NC8412*	693–1240	13'-11"	22'-5"	18'-10" **
NC8413*	598–1214	11'-11"	22'-5"	22'-7" **
NC8414*	761–1455	13'-11"	22'-5"	22'-7" **
NC8422	1311–2189	22'-5"	29'-6"	27'-1"

*Two-story modular cells

**Velocity recovery fan cylinders required on some models in this box size



NC8401 - NC8414



NC8422

Option 2 Heating

0751-2001

Codes & Registrations

ANSI Z21.13/CSA Certified

ASME Certified, "H" Stamp / National Board

California Code Compliant

Canadian Registration Number (CRN)

CSD1 / Factory Mutual / GE Gap Compliant

South Coast Air Quality Management District Qualified & Energy Star Rated (FB 0751-2001)

A

M

CERTIFIED

Smart Touch™ Features

CON·X·US Remote Connect

SMART TOUCH Touchscreen Operating Control

Full-Color 8" Touchscreen LCD Display

Built-in Cascading Sequencer for up to 8 Boilers
- › Built-in Redundancy
- › Cascade Multiple Sized Boilers
- › Lead/Lag Cascade
- › Efficiency Optimized Cascade

Front-End Loading Capability with Copper-Fin II® and Power-Fin® Boilers

Building Management System Integration with 0-10 VDC Input

BACnet MSTP Communications

Outdoor Reset Control with Outdoor Air Sensor

Password Security

Domestic Hot Water Prioritization
- › DHW tank piped with priority in the boiler loop
- › DHW tank piped as a zone in the system with the pumps controlled by the Smart System
- › DHW Modulation Limiting
- › Separately Adjustable SH/DHW Switching Times

Low Water Flow Safety Control & Indication

Inlet & Outlet Temperature Readout

Freeze Protection

Service Reminder

Time Clock

Data Logging
- › Hours Running, Space Heating
- › Hours Running, Domestic Hot Water
- › Hours Running, Modulation Rate
- › Ignition Attempts
- › Last 10 Lockouts

Programmable System Efficiency Optimizers
- › Night Setback
- › Anti-Cycling
- › Outdoor Air Reset Curve
- › Ramp Delay
- › Boost Temperature & Time
- › Modulation Factor Control

Three Pump Control
- › System Pump
- › Boiler Pump
- › Domestic Hot Water Pump

High-Voltage Terminal Strip
- › 120V/1PH/60Hz Power Supply (FB 0751-2001)
- › 208V/3PH/60Hz Power Supply (FB 2501-3501)
- › 480V/3PH/60Hz Power Supply (FB 4001-6001)
- › System Pump, Boiler Pump and DHW Pump Power

Low-Voltage Terminal Strip
- › 24 VAC Auxiliary Device Relay
- › Auxiliary Proving Switch Contacts
- › Alarm on Any Failure Contacts
- › Runtime Contacts
- › DHW Thermostat Contacts
- › Unit Enable/Disable Contacts
- › System Sensor Contacts
- › DHW Tank Sensor Contacts
- › Outdoor Air Sensor Contacts
- › Cascade Contacts
- › 0-10 VDC BMS External Control Contact
- › 0-10 VDC Variable Speed Boiler Pump Control Contact

Standard Features

Proof of Closure Valve (FB 6001)

Modulating Burner with up to 25:1 Turndown

Direct-Spark Ignition

Low NOx Operation

Sealed Combustion

Air Inlet Filter

Low Gas Pressure Operation

Vertical and Horizontal Direct Venting
- › Direct Vent up to 100 Feet
- › PVC, CPVC, Polypropylene or AL29-4C (FB 0751-4001)
- › AL29-4C (FB 0751-6001)

ASME "H" Stamped Heat Exchanger

316L Stainless Steel Fire Tubes

160 psi Working Pressure

On/Off Switch

Adjustable High Limit with Manual Reset

Low Water Cutoff with Manual Reset & Test

High & Low Gas Pressure Switches w/Manual Reset

Low Air Pressure Switches

Condensate Trap w/Blocked Drain Switch

Drain Valve

System Sensor

Outdoor Air Sensor

Inlet & Outlet Temperature Sensors

High-Voltage Terminal Strip

Low-Voltage Terminal Strip

Downstream Gas Test Cocks

50 psi ASME Relief Valve

Temperature & Pressure Gauge

Zero Clearances to Combustible Materials

High Altitude Models Available

10-Year Limited Warranty (See Warranty for Details)

1-Year Warranty on Parts (See Warranty for Details)

Optional Equipment

Alarm on Any Failure

ASME Relief Valve Option:
75 psi 100 psi 125 psi 150 psi

BMS Gateway - BACnet IP or LonWorks

Condensate Neutralization Kit

Common Vent Kits Damper

Modbus Communication

Motorized Isolation Valve

O_2 Feedback

Variable Speed Boiler Pump

Wireless Outdoor Temperature Sensor

Electrical Transformer Options (Shipped Loose):
- › FB 0751-2001
  - 208V/3PH/60Hz → 120V/1PH/60Hz
  - 480V/3PH/60Hz → 120V/1PH/60Hz
  - 600V/3PH/60Hz → 120V/1PH/60Hz
- › FB 2501-3501
  - 480V/3PH/60Hz → 208V/3PH/60Hz
  - 600V/3PH/60Hz → 208V/3PH/60Hz
- › FB 4001-6001
  - 208V/3PH/60Hz → 480V/3PH/60Hz
  - 600V/3PH/60Hz → 480V/3PH/60Hz

Lochinvar, LLC
300 Maddox Simpson Parkway
Lebanon, Tennessee 37090
P: 615.889.8900 / F: 615.547.1000

Lochinvar.com

HI

02/20—Printed in U.S.A.

CREST COMMERCIAL CONDENSING BOILER

Submittal Sheet

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

MODELS FB 0751 - FB 6001

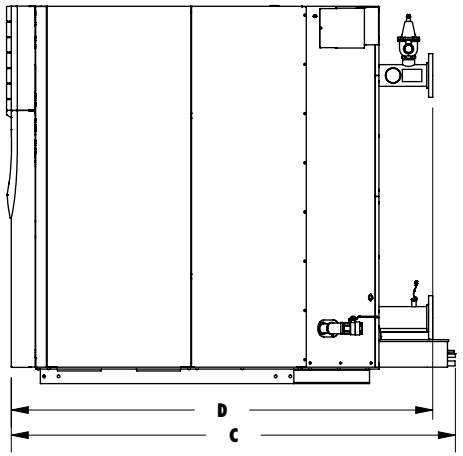
AHRI CERTIFIED™ www.ahridirectory.org

FBN-Sub-11

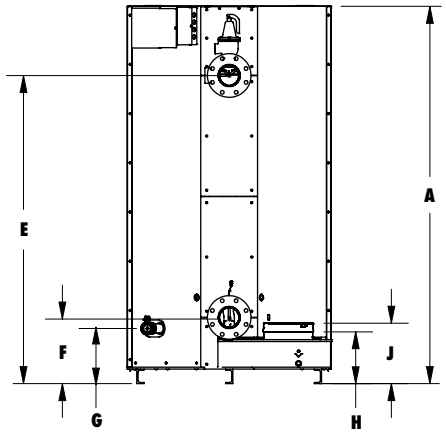
Job Name: _____ Location: _____ Contractor: _____ Type Gas: _____

Engineer: _____ Model #: _____ Agent/Wholesaler: _____ Equipment Tag(s): _____

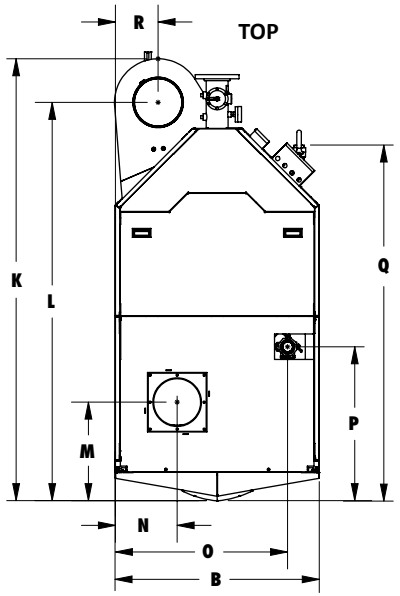
SIDE



BACK



TOP



JOB NOTES:

Notes:

* *Insert "N" for natural gas, "L" for LP gas models and "D" for dual fuel.*

- *Indoor installation only.*
- *Low NOx Operation.*
- *Lochinvar should be consulted before selecting a boiler for installations having unusual piping and pickup requirements, such as intermittent system operation, extensive piping systems, etc.*
- *The ratings have been determined under the provisions governing forced draft burners.*
- *The Net AHRI water ratings shown are based on a piping and pickup allowance of 1.15.*

Model Number	Input MBH		Thermal %	Gross Output MBH	Net AHRI Rating MBH	Turn-down	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	Gas Conn.	Water Inlet / Outlet	Air Intake	Vent Size	Oper. Weight (with water)	Ship. Weight (lbs.)
	Min	Max																											
FB*0751	50	750	96.2%	722	628	15:1	78″	30″	55-1/2″	57-5/8″	66-1/8″	11-7/8″	11-3/8″	11-1/4″	12-1/2″	55″	51″	13″	8-3/4″	26-3/4″	23-3/4″	49-1/2″	7-3/8″	1-1/4″	3″	6″	6″	1,768	1,560
FB*1001	50	999	96.2%	961	836	20:1	78″	30″	56-1/2″	57-5/8″	66-1/8″	11-7/8″	11-3/8″	11-1/4″	12-1/2″	56″	51″	13″	8-3/4″	26-3/4″	23-1/8″	49-1/2″	6-1/2″	1-1/4″	3″	6″	6″	1,838	1,596
FB*1251	62.5	1,250	96.2%	1,203	1,046	20:1	78″	30″	56-1/2″	57-3/4″	66-1/8″	11-7/8″	11-3/8″	11-1/4″	12-1/2″	56″	51-3/8″	13″	8-3/4″	26-3/4″	21-5/8″	49-1/2″	6-1/2″	1-1/2″	3″	6″	8″	1,975	1,648
FB*1501	60	1,500	96.2%	1,443	1,255	25:1	78″	30″	67-3/4″	68″	65-3/8″	12-3/8″	11-3/8″	11-1/4″	12-1/2″	67-1/4″	62-3/8″	15-7/8″	9″	26-7/8″	27-7/8″	59-1/4″	5-1/8″	1-1/2″	4″	8″	8″	2,307	1,961
FB*1751	70	1,750	96.2%	1,684	1,464	25:1	78″	30″	66-1/4″	68″	65-3/8″	12-3/8″	11-3/8″	11-1/4″	12-1/2″	65-3/4″	61-1/2″	15-7/8″	9″	27″	27-1/8″	58-3/4″	5-1/8″	1-1/2″	4″	8″	8″	2,458	2,017
FB*2001	80	1,999	96.2%	1,923	1,672	25:1	78″	30″	66-1/2″	68″	65-3/8″	12-3/8″	11-3/8″	11-1/4″	12-1/2″	66″	61-1/2″	15-7/8″	9″	27″	26-3/4″	58-3/4″	5-1/8″	1-1/2″	4″	8″	8″	2,570	2,087
FB*2501	125	2,500	96%	2,400	2,087	20:1	77-3/4″	35″	83-3/4″	83-3/4″	63-3/4″	13-1/2″	11-1/4″	10-1/2″	12-1/4″	83-1/4″	76-1/4″	19-3/4″	9-1/4″	28-3/4″	32″	71″	7-1/4″	2″	4″	8″	9″	3,600	2,577
FB*3001	150	3,000	96%	2,883	2,507	20:1	77-3/4″	35″	83-3/4″	83-3/4″	63-3/4″	13-1/2″	11-1/4″	10-1/2″	12-1/4″	83-1/4″	76-1/4″	19-3/4″	9-1/4″	28-3/4″	32″	71″	7-1/4″	2″	4″	10″	10″	3,900	2,881
FB*3501	175	3,500	96%	3,364	2,925	20:1	77-3/4″	42″	91-1/2″	86-3/4″	63-1/2″	13-1/4″	11-1/2″	10-3/4″	12-1/2″	91″	82″	20-1/4″	12-3/4″	35-1/2″	31-3/4″	73-1/4″	8-3/4″	2″	4″	10″	10″	4,600	3,218
FB*4001	333.3	3,999	96%	3,843	3,342	12:1	77-3/4″	45-1/2″	103-1/2″	99″	63-1/2″	13-3/4″	11-1/2″	10-3/4″	12-1/2″	103″	94″	24-3/4″	13-1/2″	39-1/2″	42-1/4″	85-1/4″	10-1/2″	2-1/2″	4″	12″	12″	5,200	3,805
FB*5001	499.9	4,999	96%	4,804	4,177	10:1	77-3/4″	46-1/2″	102-1/4″	99-1/2″	63-1/2″	15″	11-1/2″	10-3/4″	12-1/2″	101-3/4″	92-1/2″	22″	14″	39-3/4″	39-1/2″	84″	9″	2-1/2″	6″	14″	14″	5,900	4,101
FB*6001	600	6,000	96%	5,766	5,014	10:1	77-3/4″	50″	102-3/4″	99-3/4″	63-1/4″	14-3/4″	11-1/2″	10-3/4″	12-1/2″	102-1/2″	93-1/4″	20″	15-3/4″	43-1/2″	36-1/2″	83-3/4″	9-1/4″	3″	6″	14″	14″	6,900	4,711

Information subject to change without notice. Dimensions shown are approximate and should not be used for construction purposes.

OPTION 2 PRIMARY HOT WATER PUMPS P-1, P-1A

Bell & Gossett
a xylem brand

Submittal

Job/Project:	**Representative: FIA**	
ESP-Systemwize: WIZE-4B4B3D **Created On: 06/10/2020**	**Phone: (781) 938-8900**	
Location/Tag:	**Email: custsrv@fiainc.com**	
Engineer:	**Submitted By:**	**Date:**
Contractor:	**Approved By:**	**Date:**

Small Close Coupled In-Line Centrifugal Pump

Series: e-90

Model: 1.25AAB

Features & Design

- Designed to be mounted in the piping
- Installed wither horizontally or vertically
- Bolted Flange Connections
- Internally Self-Flushing Mechanical Seal

*The Bell & Gossett Series e-90 is available in 116 standard pre-configured designs and can be built-to-order in bronze fitted or all bronze construction. The e-90 pump offers proven hydraulic performance which provides an efficiency improvement of 2%-18% at BEP.

http://bellgossett.com/pumps-circulators/in-line-pumps/e-90/

Pump Selection Summary

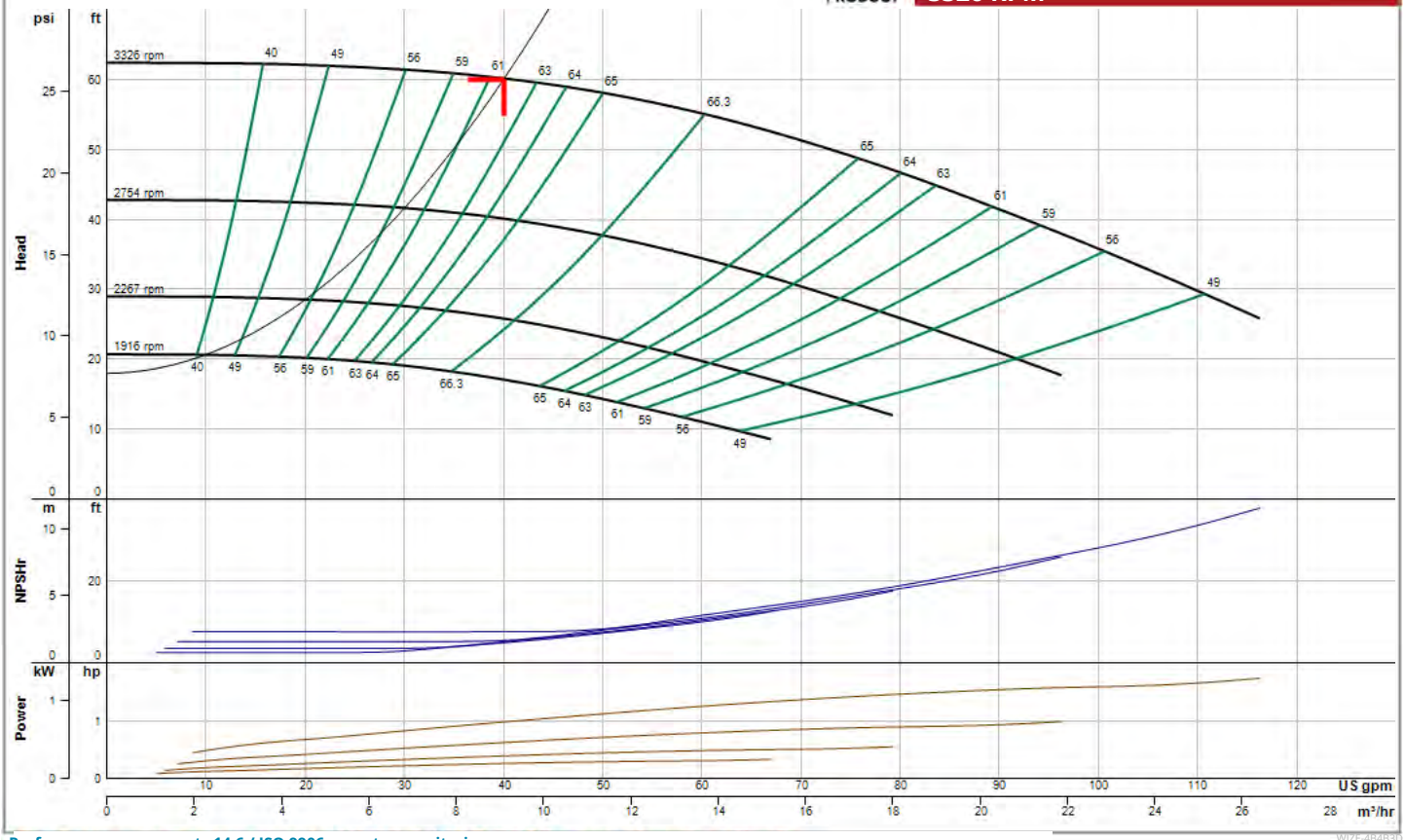
Duty Point Flow	40 US gpm
Duty Point Head	60 ft
Control Head	18 ft
Duty Point Pump Efficiency	61.2 %
Part Load Efficiency Value (PLEV)	54.6 %
Impeller Diameter	4.125 in
Motor Power	2 hp
Duty Point Power	0.976 bhp
Motor Speed	3600 rpm
RPM @ Duty Point	3326 rpm
NPSHr	7.78 ft
Minimum Shutoff Head	62.4 ft
Minimum Flow at RPM	9.05 US gpm
Flow @ BEP	60.3 US gpm
Fluid Temperature	180 °F
Fluid Type	40% Propylene glycol
Weight *(approx. - consult rep for exact)*	65 lbs
Pump Floor Space Calculation	0.43 ft²

Performance Curve

Energy Efficiency Ratings:
Pump & Motor PEIcl: 0.83 ERcl: 17
Pump, Motor & Drive: PEIvl: 0.46 ERvl: 54

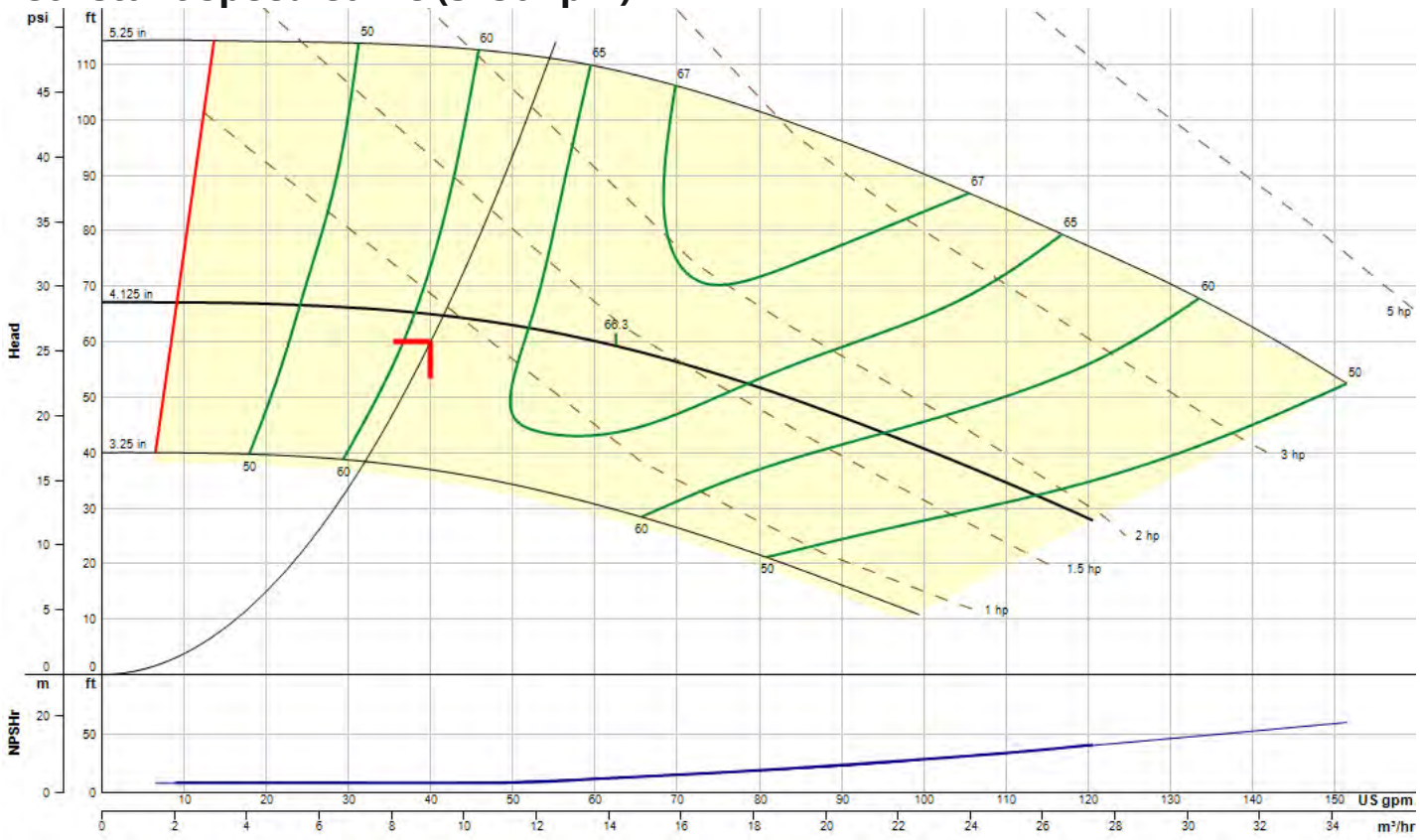
PREMIUM EFFICIENCY PRODUCT

e-90
1.25AAB
3326 RPM



Performance curve meets 14.6 / ISO 9906 acceptance criteria

Constant Speed Curve (3450 rpm)

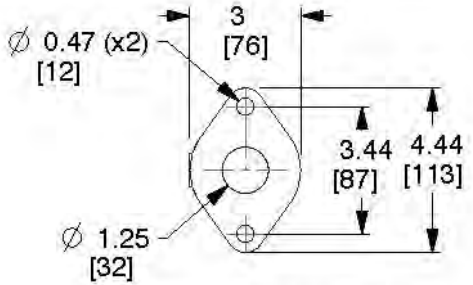


Operating Point

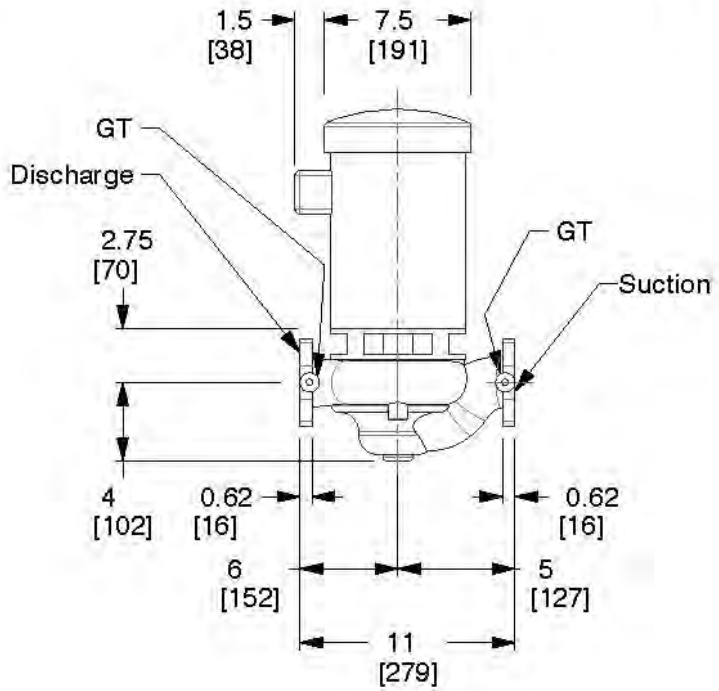
Flow: 40 US gpm **Head:** 60 ft **Speed:** 3326 **Efficiency:** 61.2% **Point BHP:** 0.976 **End Of Curve:** 34.4%

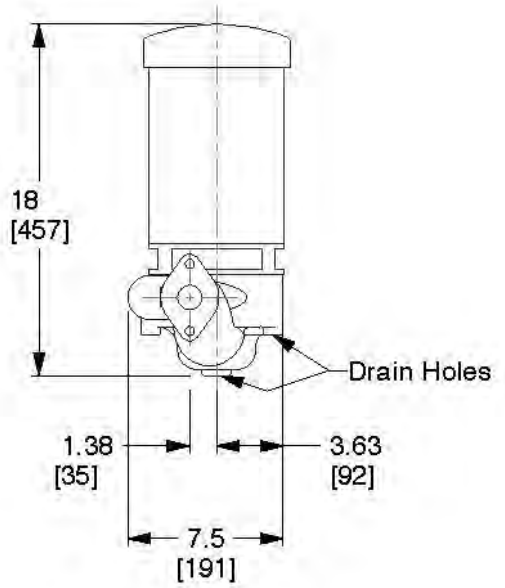
Maximum Duty Point (at rated motor speed)

Flow: 41.5 US gpm **Head:** 64.6 ft **Speed:** 3450 **Efficiency:** 61.2% **Point BHP:** 1.09 **NOL Flow:** 121 US gpm **Runout Flow:** 121 US gpm **NOL (BHP):** 1.93



SUCTION & DISCHARGE FLANGE DETAILS ANSI 125#





Bell & Gossett
a xylem brand
8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change

Not to be used for construction unless certified

BG-E90-125AAB-200-3450-1

Series e-90 Centrifugal Pumps In-Line Mounted-Close Coupled

Motor Hp : 2 | Motor Speed : 3450 | Phase : 1 | Flange : ANSI 125#

Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-146.1

Standard Materials of Construction *contact your local rep for configuration

Construction:	Bronze Fitted	All Bronze
Volute	Cast Iron ASTM A159	Cast Bronze ASTM B584
Impeller:	ASTM B584	ASTM B584
Shaft	Stainless Steel	Stainless Steel
Bracket	Cast Iron ASTM #A159	CF8 Stainless ASTM #A351
Companion Flange	1", 11/4", 11/2" - Steel SAE1006 2", 3" - Cast Iron ASTM #A159	1", 11/4", 11/2" - Bronze ASTM #36 2", 3" - Cast Bronze ASTM #B584

Pump Options *contact your local rep to configure

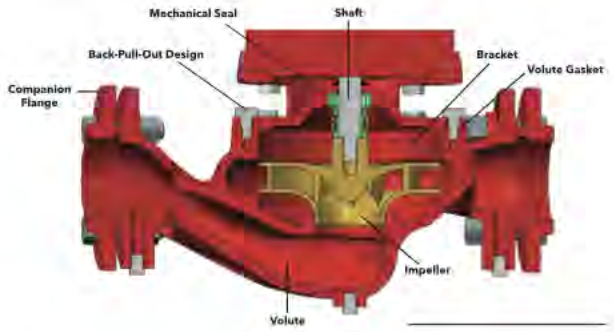
TEFC enclosures for non-ECM motors	Single and Three Phase motors
Available as a Header pump for boiler recirculation	ECM Permanent Magnet Smart Motor Option
FKM and EPR seals	

Standard Mechanical Seal Assembly

Elastomer:	EPR
Spring	Stainless Steel
Seat Insert	Silicon-Carbide
Seal Ring	Carbon
Seal Housing	Stainless Steel

Maximum Operating Tolerances

Max Working Pressure (standard)	175 psi (12 bar)
Max fluid Temperature	250°F



xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue, Morton Grove, IL 60053
Phone: (847)966-3700 Fax: (847)965-8379
www.bellgossett.com

Product Catalog

OPTION 1 -RTU-6

Packaged Rooftop Air Conditioners
Precedent™ Cooling and Gas/Electric

3 to 10 Tons - 60 Hz

January 2020

RT-PRC023AT-EN

Table 8. General data — 6 to 7.5 tons — high efficiency

	6 Tons Single Compressor T/YHC072E/F3,4,W	6 Tons Dual Compressor T/YHC074F3,4	7.5 Tons T/YHC092F3,4,W
Cooling Performance[a]			
Gross Cooling Capacity	72,000	73,000	92,000
EER[b]	12.6	13.1	12.6
Nominal cfm/AHRI Rated cfm	2,400/2,100	2,400/2,100	3,000/2,625
AHRI Net Cooling Capacity	68,000	71,000	89,000
IEER[c]	14.5	15.5[d]	14.5[e]
System Power (kW)	5.37	5.42	7.06
Compressor			
Number/Type	1/Scroll	2/Scroll	2/Scroll
Sound			
Outdoor Sound Rating (dB)[f]	89	89	88
Outdoor Coil			
Type	Microchannel	Microchannel	Microchannel
Configuration	Full Face	Face-Split	Face-Split
Tube Size (in.)	0.71	1	1
Face Area (sq. ft.)	20.77	20.77	20.77
Rows/FPI (Fins per inch)	1/23	1/20	1/20
Indoor Coil			
Type	Lanced	Lanced	Lanced
Configuration	Full Face	Intertwined	Intertwined
Tube Size (in.)	0.3125	0.3125	0.3125
Face Area (sq. ft.)	12.36	12.36	12.36
Rows/FPI (Fins per inch)	4/16	4/16	4/16
Refrigerant Control	Thermal Expansion Valve	Thermal Expansion Valve	Thermal Expansion Valve
Drain Connection No./Size (in.)	1¾ NPT	1¾ NPT	1¾ NPT
Outdoor Fan			
Type	Propeller	Propeller	Propeller
No. Used/Diameter (in.)	1/26	1/26	1/26
Drive Type/No. Speeds	Direct/1	Direct/1	Direct/1
CFM	5900	5750	6800
Motor HP	0.7	0.7	0.75
Motor RPM	1100	1100	1100
Indoor Fan			
Type	FC Centrifugal	BC Plenum	BC Plenum
No. Used/Diameter (in.)/Width (in.)	1/15x15	1/23.0315x6.14	1/23.0315x6.14
Drive Type/No. Speeds[g] /RPM	Belt/Variable/1,750	Direct/Variable	Direct/Variable
Motor HP (Standard/Oversized)	1.0/2.0	2.75/—	2.75/—
Motor Frame Size (Standard/Oversized)	56/56	—/—	—/—
Filters[h]			
Type Furnished	Throwaway	Throwaway	Throwaway
Number Size Recommended	(4) 20x25x2	(4) 20x25x2	(4) 20x25x2
Optional Hot Gas Reheat Coil			
Tube Size (in.) OD	—	—	0.3125
Face Area (sq. ft.)	—	—	8.652
Rows/FPI (Fins per inch)	—	—	1/16
Refrigerant Charge[i]			
Standard	7.7	5.8/4.1	5.5/4.2
Optional Hot Gas Reheat Coil	—	—	6.2/4.3
Heating Performance (Gas/ Electric Only)[j]			
Heating Input			

Table 8. General data — 6 to 7.5 tons — high efficiency (continued)

	6 Tons Single Compressor T/YHC072E/F3,4,W	6 Tons Dual Compressor T/YHC074F3,4	7.5 Tons T/YHC092F3,4,W
Low Heat Input (Btu)	80,000	80,000	120,000
Mid Heat Input (Btu)	120,000	120,000	150,000/105,000
High Heat Input (Btu)	150,000/105,000	150,000/105,000	200,000/140,000
Heating Output			
Low Heat Output (Btu)	64,000	64,800	96,000
Mid Heat Output (Btu)	96,000	97,200	120,000/84,000
High Heat Output (Btu)	120,000/84,000	121,500/85,050	160,000/112,000
Steady State Efficiency %			
Low Heat Input (Btu)	80	81	80
Mid Heat Input (Btu)	80	81	80
High Heat Input (Btu)	80	81	80
No. Burners			
Low Heat Output (Btu)	3	3	3
Mid Heat Output (Btu)	3	3	3
High Heat Output (Btu)	4	4	4
No. Stages			
Low Heat Input (Btu)	1	1	1
Mid Heat Input (Btu)	1	1	2
High Heat Input (Btu)	2	2	2
Gas Supply Line Pressure			
Natural (minimum/maximum)	4.5/14.0	4.5/14.0	4.5/14.0
LP (minimum/maximum)	11.0/14.0	11.0/14.0	11.0/14.0
Gas Connection Pipe Size (in.)			
Low Heat	1/2	1/2	1/2
Mid Heat	1/2	1/2	3/4
High Heat	3/4	3/4	3/4

Note: 575V (W voltage) is only available as YHC. No THC models available with 575V (W voltage).

(a) Cooling performance is rated at 95°F ambient, 80°F entering dry bulb, 67°F entering wet bulb. Gross capacity does not include the effect of fan motor heat. AHRI capacity is net and includes the effect of fan motor heat. Units are suitable for operation to ±20% of nominal cfm. Units are certified in accordance with the Unitary Air-Conditioner Equipment certification program, which is based on AHRI Standard 340/360.

(b) EER is rated at AHRI conditions and in accordance with DOE test procedures.

(c) Integrated Efficiency Ratio (IEER) is rated in accordance with AHRI Standard 340/360. The IEER rating requires that the unit efficiency be determined at 100%, 75%, 50% and 25% load (net capacity) at the specified in AHRI Standard.

(d) 16.0 IEER for multi-speed, SZVAV, and MZVAV.

(e) 15.0 IEER for multi-speed, SZVAV, and MZVAV 208-230/460V.

(f) Outdoor sound rating shown is tested in accordance with AHRI Standard 270. For additional information reference the outdoor sound power level data in the performance section.

(g) For multispeed direct drive rpm T/YHC values, reference the direct drive, evaporator fan performance data. This note only applicable to T/YHC074F3,4,W and T/YHC092F3,4,W.

(h) Optional 2" MERV 8 and MERV 13 filters also available.

(i) Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.

(j) Heating performance limit settings and rating data were established and approved under laboratory test conditions using American National Standards Institute standards. Ratings shown are for elevations up to 2000 feet. For elevations above 2000 feet, ratings should be reduced at the rate of 4% for each 1000 feet above sea level. Applicable to gas/electric units only.

Table 8. General data — 6 to 7.5 tons — high efficiency (continued)

	6 Tons Single Compressor T/YHC072E/F3,4,W	6 Tons Dual Compressor T/YHC074F3,4	7.5 Tons T/YHC092F3,4,W
Low Heat Input (Btu)	80,000	80,000	120,000
Mid Heat Input (Btu)	120,000	120,000	150,000/105,000
High Heat Input (Btu)	150,000/105,000	150,000/105,000	200,000/140,000
Heating Output			
Low Heat Output (Btu)	64,000	64,800	96,000
Mid Heat Output (Btu)	96,000	97,200	120,000/84,000
High Heat Output (Btu)	120,000/84,000	121,500/85,050	160,000/112,000
Steady State Efficiency %			
Low Heat Input (Btu)	80	81	80
Mid Heat Input (Btu)	80	81	80
High Heat Input (Btu)	80	81	80
No. Burners			
Low Heat Output (Btu)	3	3	3
Mid Heat Output (Btu)	3	3	3
High Heat Output (Btu)	4	4	4
No. Stages			
Low Heat Input (Btu)	1	1	1
Mid Heat Input (Btu)	1	1	2
High Heat Input (Btu)	2	2	2
Gas Supply Line Pressure			
Natural (minimum/maximum)	4.5/14.0	4.5/14.0	4.5/14.0
LP (minimum/maximum)	11.0/14.0	11.0/14.0	11.0/14.0
Gas Connection Pipe Size (in.)			
Low Heat	1/2	1/2	1/2
Mid Heat	1/2	1/2	3/4
High Heat	3/4	3/4	3/4

Note: 575V (W voltage) is only available as YHC. No THC models available with 575V (W voltage).

(a) Cooling performance is rated at 95°F ambient, 80°F entering dry bulb, 67°F entering wet bulb. Gross capacity does not include the effect of fan motor heat. AHRI capacity is net and includes the effect of fan motor heat. Units are suitable for operation to ±20% of nominal cfm. Units are certified in accordance with the Unitary Air-Conditioner Equipment certification program, which is based on AHRI Standard 340/360.

(b) EER is rated at AHRI conditions and in accordance with DOE test procedures.

(c) Integrated Efficiency Ratio (IEER) is rated in accordance with AHRI Standard 340/360. The IEER rating requires that the unit efficiency be determined at 100%, 75%, 50% and 25% load (net capacity) at the specified in AHRI Standard.

(d) 16.0 IEER for multi-speed, SZVAV, and MZVAV.

(e) 15.0 IEER for multi-speed, SZVAV, and MZVAV 208-230/460V.

(f) Outdoor sound rating shown is tested in accordance with AHRI Standard 270. For additional information reference the outdoor sound power level data in the performance section.

(g) For multispeed direct drive rpm T/YHC values, reference the direct drive, evaporator fan performance data. This note only applicable to T/YHC074F3,4,W and T/YHC092F3,4,W.

(h) Optional 2" MERV 8 and MERV 13 filters also available.

(i) Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.

(j) Heating performance limit settings and rating data were established and approved under laboratory test conditions using American National Standards Institute standards. Ratings shown are for elevations up to 2000 feet. For elevations above 2000 feet, ratings should be reduced at the rate of 4% for each 1000 feet above sea level. Applicable to gas/electric units only.

Figure 23. Cooling and gas/electric — 7.5 (dual compressor) to 10 tons standard efficiency, 6 to 8.5 tons high efficiency

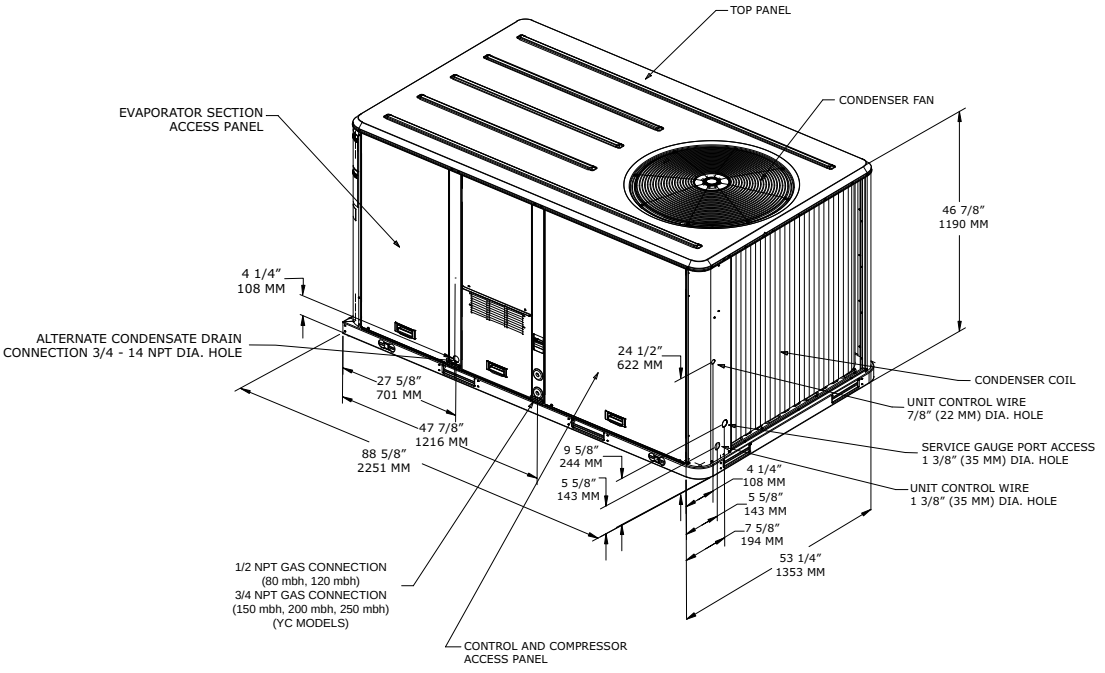


Figure 24. Cooling and gas/electric — 7.5 (dual compressor) to 10 tons standard efficiency, 6 to 8.5 tons high efficiency — power exhaust

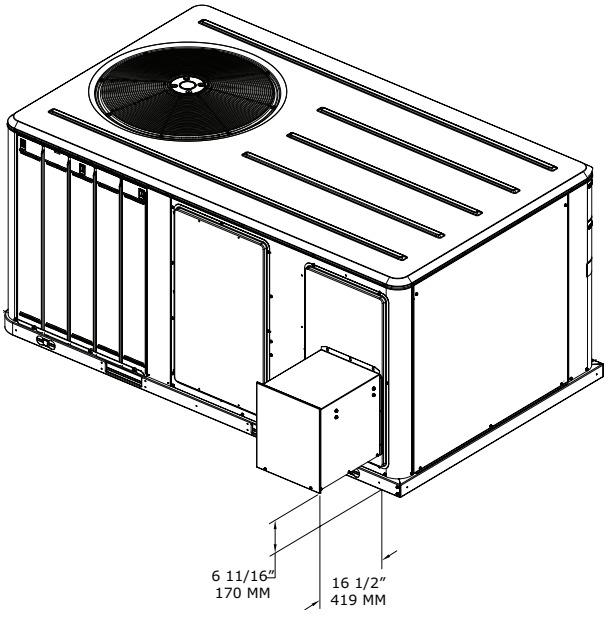


Table 174. Maximum unit & corner weights (lbs) and center of gravity dimensions (in.) — gas/electric models (continued)

Tons	Unit Model No.	Maximum Model Weights[a]		Corner Weights[b]				Center of Gravity (in.)	
		Shipping	Net	A	B	C	D	Length	Width
3	YHC036E	607	532	165	137	95	134	31	19
4	YHC048E	858	763	238	200	148	176	40	23
4	YHC048F	806	711	226	199	144	143	44	22
5	YHC060E	917	822	261	218	156	187	40	22
5	YHC060F	850	755	239	214	152	151	44	21
6	YHC072E	1025	927	296	198	205	228	41	24
6	YHC072F	965	822	250	245	174	153	47	21
6	YHC074F	1114	1016	334	231	248	202	41	23
7.5	YHC092F	1124	1026	340	233	249	204	41	23
8.5	YHC102F	1133	1035	341	236	253	205	49	23
10	YHC120F	1453	1259	356	371	289	242	54	27

[a] Weights are approximate.
[b] Corner weights are given for information only.

Table 175. Factory installed options (fiops)/accessory net weights (lbs)

Accessory	T/YSC036G-060G T/YHC036E Net Weight	T/YHC048E-060E T/YHC048F-060F Net Weight	T/YSC072H-102H T/YHC072E/F Net Weight	T/YSC120H T/YHC074F-102F Net Weight	T/YHC120F Net Weight
	3 to 5 Tons	4 to 5 Tons	6 to 8.5 Tons	6,7.5,8.5,10 Tons	10 Tons
Barometric Relief	7	10	10	10	10
Belt Drive Option (3 phase only)	31	31	—	—	—
Coil Guards	12	20	20	20	30
Economizer	26	36	36	36	36
Electric Heaters[a]	15	30	30	44	50
Hinged Doors	10	12	12	12	12
Low Leak Economizer	70	91	91	91	91
Manual Outside Air Damper	16	26	26	26	26
Motorized Outside Air Damper	20	30	30	30	30
Novar Control	8	8	8	8	8
Oversized Motor	5	8	8	—	—
Powered Convenience Outlet	38	38	38	38	50
Powered Exhaust	40	40	80	80	80
Reheat Coil	12(b)	14	15	20(c)	30
Roof Curb	61	78	78	78	89
Smoke Detector, Supply	5	5	5	5	5
Smoke Detector, Return	7	7	7	7	7
Stainless Steel Heat Exchanger[b]	4	6	6	6	6
Through-the-Base Electrical	8	13	13	13	13
Through-the-Base Gas	5	5	5	5	5
Unit Mounted Circuit Breaker	5	5	5	5	5
Unit Mounted Disconnect	5	5	5	5	5

Notes:
1. Weights for options not listed are <5 lbs.
2. Net weight should be added to unit weight when ordering factory-installed accessories.

[a] Applicable to cooling units only.
[b] Applicable to gas/electric units only.

Product Catalog

OPTION 1 - RTU-7
RTU-8
RTU-11

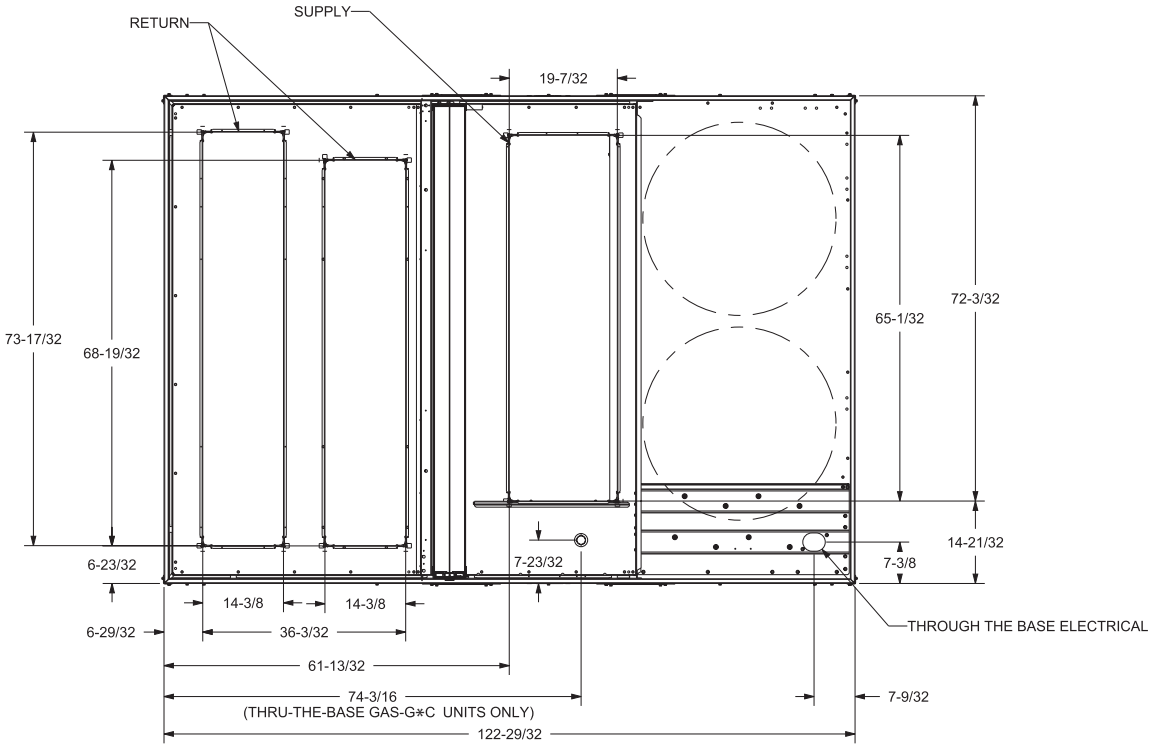
Packaged Rooftop Air Conditioners
Foundation™ Cooling and Gas/Electric
15 to 25 Tons, 60 Hz

June 2019

RT-PRC060K-EN

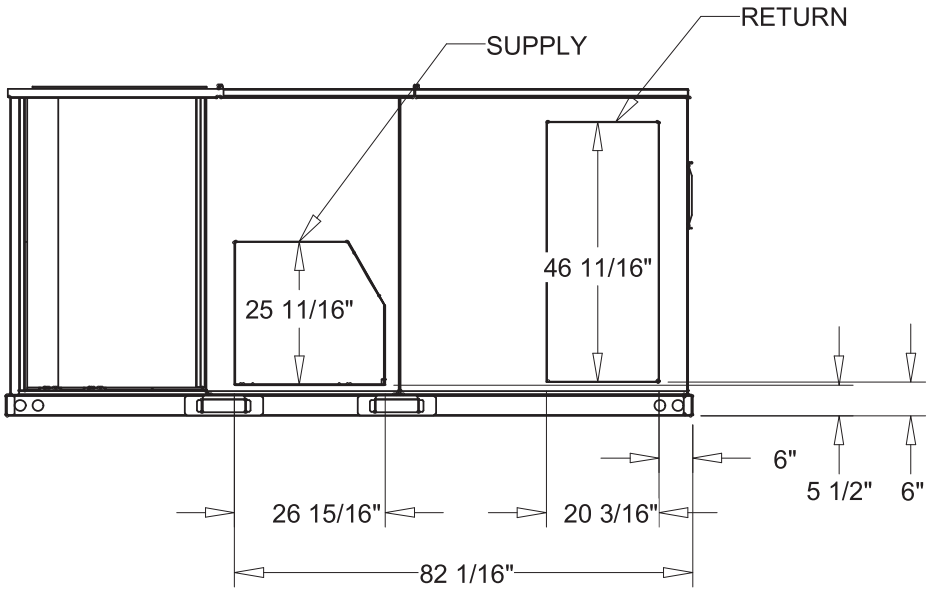
Dimensional Data

Figure 3. Cooling with optional electrical heat and gas/electric units — plan view — 15–25 tons



NOTES:
1. THRU-THE-BASE GAS AND ELECTRICAL PROVISIONS ARE STANDARD ON ALL UNITS.
2. VERIFY WEIGHT, CONNECTIONS, AND ALL OTHER DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSULATION.

Figure 4. Cooling with optional electrical heat and gas/electric units — back view (horizontal configuration) — 15–25 tons



Weights

Table 43. Maximum unit & corner weights (lb) and center of gravity dimensions (in.) cooling with optional electric heat units only

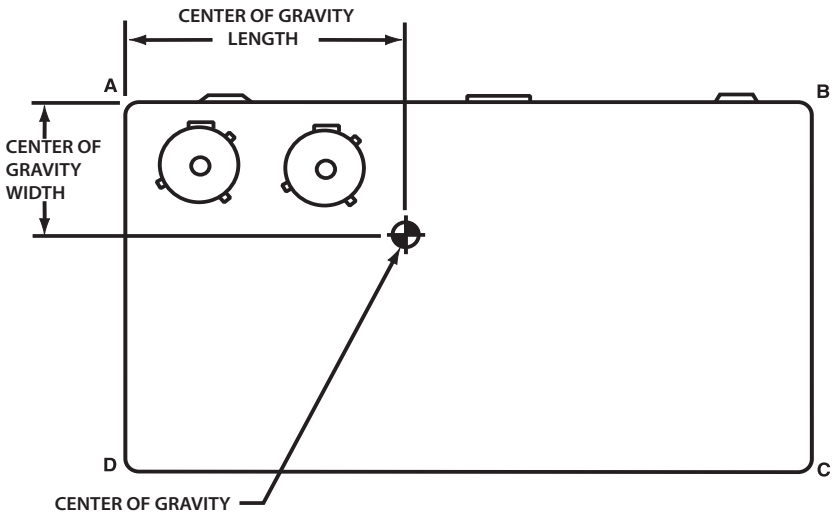
Tons	Unit Model No.	Weights (lb)[a], [b]		Corner Weights[c]				Center of Gravity (in.)	
		Shipping	Net	A	B	C	D	Length	Width
15	EBC180A	2146	1826	621	475	365	365	55.6	36.9
17½	EBC210A	2155	1835	624	477	367	367	55.4	36.8
20	EBC240A	2180	1860	632	484	372	372	55.5	37.0
25	EBC300A	2206	1886	641	490	377	377	54.6	36.2

(a) Weights are approximate. Horizontal and downflow unit and corner weights may vary slightly.
(b) Weights do not include additional factory or field installed options/accessories. For option/accessory additional weights, reference Table 45, p. 57 to be added to unit weights.
(c) Corner weights are given for information only. 15–25 ton models must be supported continuously by a curb or equivalent frame support.

Table 44. Maximum unit & corner weights (lb) and center of gravity dimensions (in.) gas/electric heat units only

Tons	Unit Model No.	Weights (lb)[a],[b]		Corner Weights[c]				Center of Gravity (in.)	
		Shipping	Net	A	B	C	D	Length	Width
RTU-7 RTU-8 15	GBC180A	2310	1990	632	505	396	457	55.6	36.9
17½	GBC210A	2319	1999	637	506	395	460	55.4	36.8
20	GBC240A	2344	2024	643	512	403	466	55.5	37.0
RTU-11 25	GBC300A	2370	2050	668	521	391	470	54.6	36.2

(a) Weights are approximate. Horizontal and downflow unit and corner weights may vary slightly.
(b) Weights do not include additional factory or field installed options/accessories. For option/accessory additional weights, reference Table 45, p. 57 to be added to unit weights.
(c) Corner weights are given for information only. 15–25 ton models must be supported continuously by a curb or equivalent frame support.



Product Catalog

OPTION 2 -RTU-6

Packaged Rooftop Air Conditioners
Precedent™ Cooling and Gas/Electric

3 to 10 Tons - 60 Hz

January 2020

RT-PRC023AT-EN

Table 8. General data — 6 to 7.5 tons — high efficiency

	6 Tons Single Compressor T/YHC072E/F3,4,W	6 Tons Dual Compressor T/YHC074F3,4	7.5 Tons T/YHC092F3,4,W
Cooling Performance[a]			
Gross Cooling Capacity	72,000	73,000	92,000
EER[b]	12.6	13.1	12.6
Nominal cfm/AHRI Rated cfm	2,400/2,100	2,400/2,100	3,000/2,625
AHRI Net Cooling Capacity	68,000	71,000	89,000
IEER[c]	14.5	15.5[d]	14.5[e]
System Power (kW)	5.37	5.42	7.06
Compressor			
Number/Type	1/Scroll	2/Scroll	2/Scroll
Sound			
Outdoor Sound Rating (dB)[f]	89	89	88
Outdoor Coil			
Type	Microchannel	Microchannel	Microchannel
Configuration	Full Face	Face-Split	Face-Split
Tube Size (in.)	0.71	1	1
Face Area (sq. ft.)	20.77	20.77	20.77
Rows/FPI (Fins per inch)	1/23	1/20	1/20
Indoor Coil			
Type	Lanced	Lanced	Lanced
Configuration	Full Face	Intertwined	Intertwined
Tube Size (in.)	0.3125	0.3125	0.3125
Face Area (sq. ft.)	12.36	12.36	12.36
Rows/FPI (Fins per inch)	4/16	4/16	4/16
Refrigerant Control	Thermal Expansion Valve	Thermal Expansion Valve	Thermal Expansion Valve
Drain Connection No./Size (in.)	1¾ NPT	1¾ NPT	1¾ NPT
Outdoor Fan			
Type	Propeller	Propeller	Propeller
No. Used/Diameter (in.)	1/26	1/26	1/26
Drive Type/No. Speeds	Direct/1	Direct/1	Direct/1
CFM	5900	5750	6800
Motor HP	0.7	0.7	0.75
Motor RPM	1100	1100	1100
Indoor Fan			
Type	FC Centrifugal	BC Plenum	BC Plenum
No. Used/Diameter (in.)/Width (in.)	1/15x15	1/23.0315x6.14	1/23.0315x6.14
Drive Type/No. Speeds[g] /RPM	Belt/Variable/1,750	Direct/Variable	Direct/Variable
Motor HP (Standard/Oversized)	1.0/2.0	2.75/—	2.75/—
Motor Frame Size (Standard/Oversized)	56/56	—/—	—/—
Filters[h]			
Type Furnished	Throwaway	Throwaway	Throwaway
Number Size Recommended	(4) 20x25x2	(4) 20x25x2	(4) 20x25x2
Optional Hot Gas Reheat Coil			
Tube Size (in.) OD	—	—	0.3125
Face Area (sq. ft.)	—	—	8.652
Rows/FPI (Fins per inch)	—	—	1/16
Refrigerant Charge[i]			
Standard	7.7	5.8/4.1	5.5/4.2
Optional Hot Gas Reheat Coil	—	—	6.2/4.3
Heating Performance (Gas/ Electric Only)[j]			
Heating Input			

Table 8. General data — 6 to 7.5 tons — high efficiency (continued)

	6 Tons Single Compressor T/YHC072E/F3,4,W	6 Tons Dual Compressor T/YHC074F3,4	7.5 Tons T/YHC092F3,4,W
Low Heat Input (Btu)	80,000	80,000	120,000
Mid Heat Input (Btu)	120,000	120,000	150,000/105,000
High Heat Input (Btu)	150,000/105,000	150,000/105,000	200,000/140,000
Heating Output			
Low Heat Output (Btu)	64,000	64,800	96,000
Mid Heat Output (Btu)	96,000	97,200	120,000/84,000
High Heat Output (Btu)	120,000/84,000	121,500/85,050	160,000/112,000
Steady State Efficiency %			
Low Heat Input (Btu)	80	81	80
Mid Heat Input (Btu)	80	81	80
High Heat Input (Btu)	80	81	80
No. Burners			
Low Heat Output (Btu)	3	3	3
Mid Heat Output (Btu)	3	3	3
High Heat Output (Btu)	4	4	4
No. Stages			
Low Heat Input (Btu)	1	1	1
Mid Heat Input (Btu)	1	1	2
High Heat Input (Btu)	2	2	2
Gas Supply Line Pressure			
Natural (minimum/maximum)	4.5/14.0	4.5/14.0	4.5/14.0
LP (minimum/maximum)	11.0/14.0	11.0/14.0	11.0/14.0
Gas Connection Pipe Size (in.)			
Low Heat	1/2	1/2	1/2
Mid Heat	1/2	1/2	3/4
High Heat	3/4	3/4	3/4

Note: 575V (W voltage) is only available as YHC. No THC models available with 575V (W voltage).

(a) Cooling performance is rated at 95°F ambient, 80°F entering dry bulb, 67°F entering wet bulb. Gross capacity does not include the effect of fan motor heat. AHRI capacity is net and includes the effect of fan motor heat. Units are suitable for operation to ±20% of nominal cfm. Units are certified in accordance with the Unitary Air-Conditioner Equipment certification program, which is based on AHRI Standard 340/360.

(b) EER is rated at AHRI conditions and in accordance with DOE test procedures.

(c) Integrated Efficiency Ratio (IEER) is rated in accordance with AHRI Standard 340/360. The IEER rating requires that the unit efficiency be determined at 100%, 75%, 50% and 25% load (net capacity) at the specified in AHRI Standard.

(d) 16.0 IEER for multi-speed, SZVAV, and MZVAV.

(e) 15.0 IEER for multi-speed, SZVAV, and MZVAV 208-230/460V.

(f) Outdoor sound rating shown is tested in accordance with AHRI Standard 270. For additional information reference the outdoor sound power level data in the performance section.

(g) For multispeed direct drive rpm T/YHC values, reference the direct drive, evaporator fan performance data. This note only applicable to T/YHC074F3,4,W and T/YHC092F3,4,W.

(h) Optional 2" MERV 8 and MERV 13 filters also available.

(i) Refrigerant charge is an approximate value. For a more precise value, see unit nameplate and service instructions.

(j) Heating performance limit settings and rating data were established and approved under laboratory test conditions using American National Standards Institute standards. Ratings shown are for elevations up to 2000 feet. For elevations above 2000 feet, ratings should be reduced at the rate of 4% for each 1000 feet above sea level. Applicable to gas/electric units only.

Figure 23. Cooling and gas/electric — 7.5 (dual compressor) to 10 tons standard efficiency, 6 to 8.5 tons high efficiency

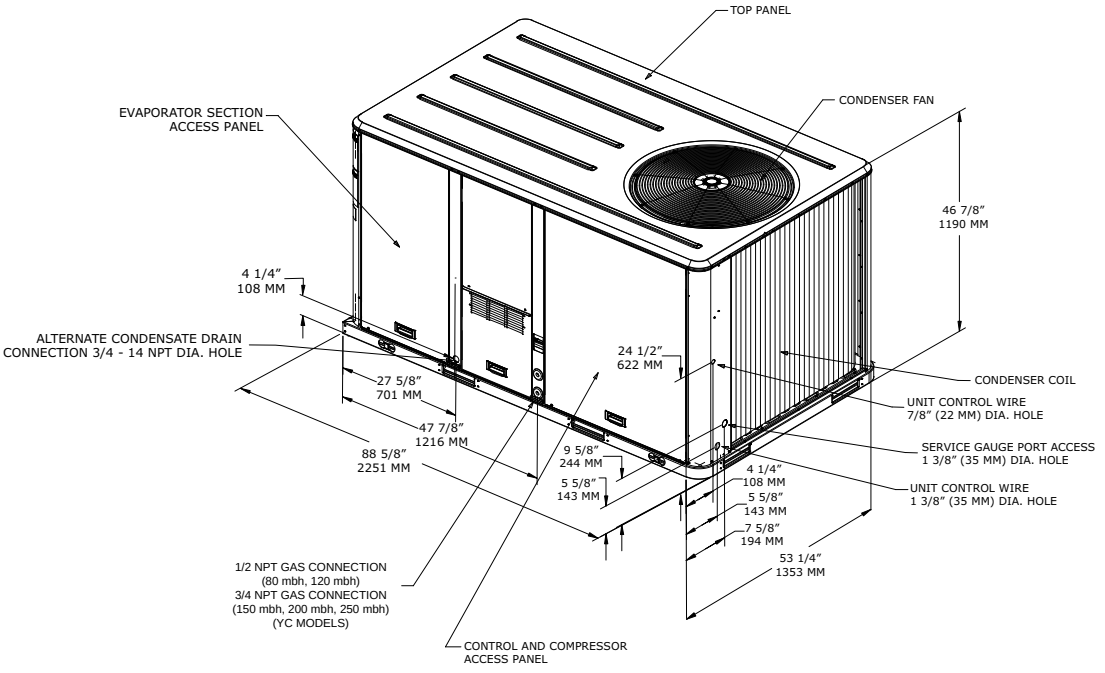


Figure 24. Cooling and gas/electric — 7.5 (dual compressor) to 10 tons standard efficiency, 6 to 8.5 tons high efficiency — power exhaust

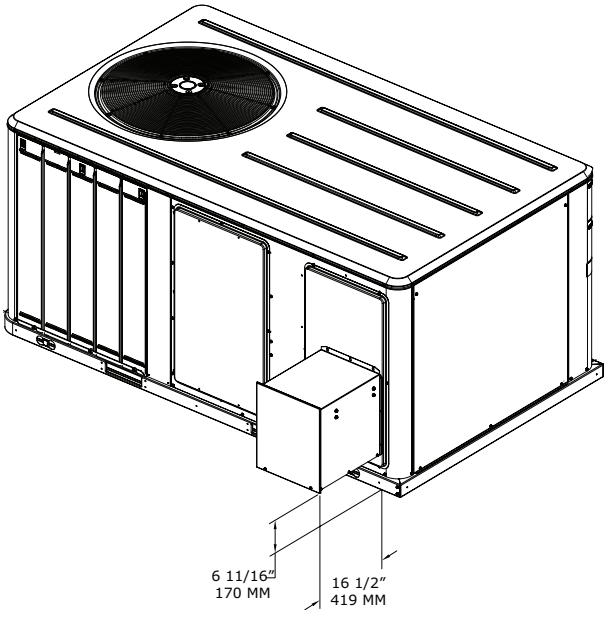


Table 174. Maximum unit & corner weights (lbs) and center of gravity dimensions (in.) — gas/electric models (continued)

Tons	Unit Model No.	Maximum Model Weights[a]		Corner Weights[b]				Center of Gravity (in.)	
		Shipping	Net	A	B	C	D	Length	Width
3	YHC036E	607	532	165	137	95	134	31	19
4	YHC048E	858	763	238	200	148	176	40	23
4	YHC048F	806	711	226	199	144	143	44	22
5	YHC060E	917	822	261	218	156	187	40	22
5	YHC060F	850	755	239	214	152	151	44	21
6	YHC072E	1025	927	296	198	205	228	41	24
6	YHC072F	965	822	250	245	174	153	47	21
6	YHC074F	1114	1016	334	231	248	202	41	23
7.5	YHC092F	1124	1026	340	233	249	204	41	23
8.5	YHC102F	1133	1035	341	236	253	205	49	23
10	YHC120F	1453	1259	356	371	289	242	54	27

[a] Weights are approximate.
[b] Corner weights are given for information only.

Table 175. Factory installed options (fiops)/accessory net weights (lbs)

Accessory	T/YSC036G-060G T/YHC036E Net Weight	T/YHC048E-060E T/YHC048F-060F Net Weight	T/YSC072H-102H T/YHC072E/F Net Weight	T/YSC120H T/YHC074F-102F Net Weight	T/YHC120F Net Weight
	3 to 5 Tons	4 to 5 Tons	6 to 8.5 Tons	6,7.5,8.5,10 Tons	10 Tons
Barometric Relief	7	10	10	10	10
Belt Drive Option (3 phase only)	31	31	—	—	—
Coil Guards	12	20	20	20	30
Economizer	26	36	36	36	36
Electric Heaters[a]	15	30	30	44	50
Hinged Doors	10	12	12	12	12
Low Leak Economizer	70	91	91	91	91
Manual Outside Air Damper	16	26	26	26	26
Motorized Outside Air Damper	20	30	30	30	30
Novar Control	8	8	8	8	8
Oversized Motor	5	8	8	—	—
Powered Convenience Outlet	38	38	38	38	50
Powered Exhaust	40	40	80	80	80
Reheat Coil	12(b)	14	15	20(c)	30
Roof Curb	61	78	78	78	89
Smoke Detector, Supply	5	5	5	5	5
Smoke Detector, Return	7	7	7	7	7
Stainless Steel Heat Exchanger[b]	4	6	6	6	6
Through-the-Base Electrical	8	13	13	13	13
Through-the-Base Gas	5	5	5	5	5
Unit Mounted Circuit Breaker	5	5	5	5	5
Unit Mounted Disconnect	5	5	5	5	5

Notes:
1. Weights for options not listed are <5 lbs.
2. Net weight should be added to unit weight when ordering factory-installed accessories.

[a] Applicable to cooling units only.
[b] Applicable to gas/electric units only.

Product Catalog

OPTION 2 - RTU-7
RTU-8
RTU-11
RTU-12
RTU-13
RTU-14
RTU-15
RTU-16

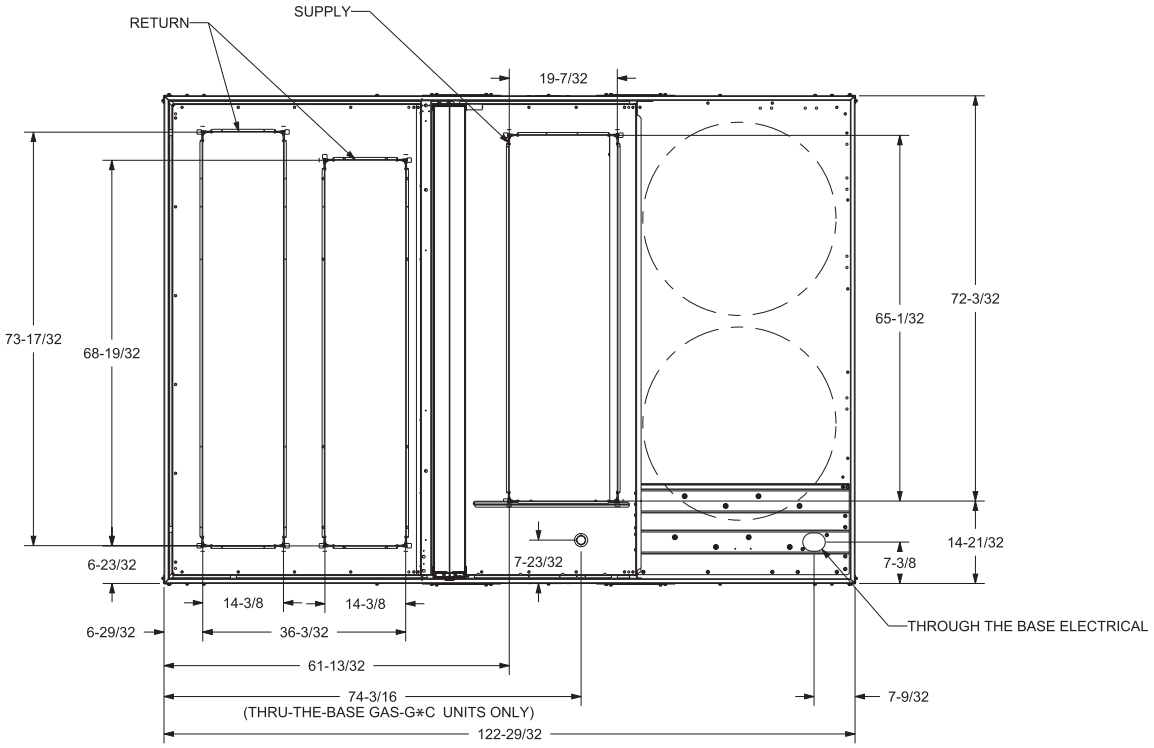
Packaged Rooftop Air Conditioners
Foundation™ Cooling and Gas/Electric
15 to 25 Tons, 60 Hz

June 2019

RT-PRC060K-EN

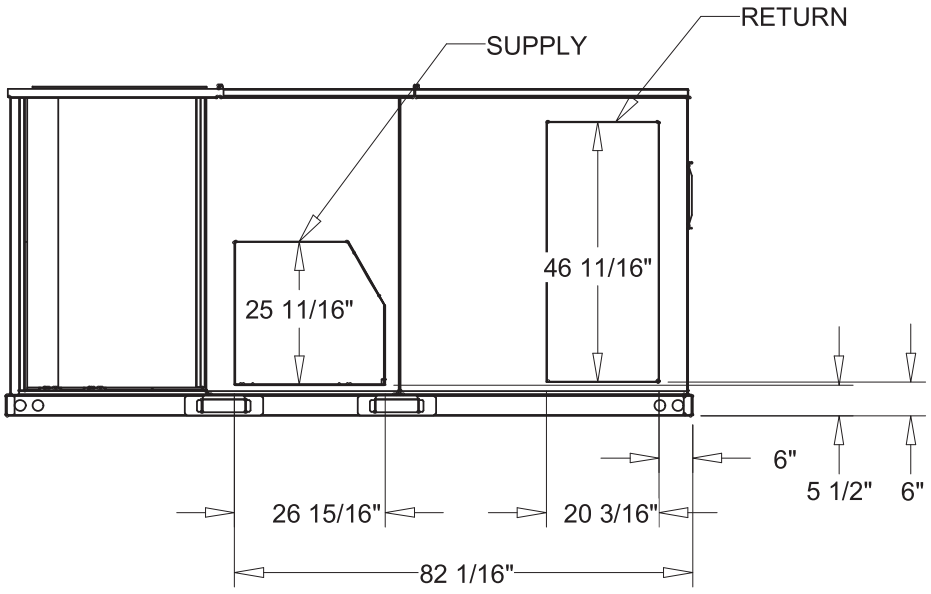
Dimensional Data

Figure 3. Cooling with optional electrical heat and gas/electric units — plan view — 15–25 tons



NOTES:
1. THRU-THE-BASE GAS AND ELECTRICAL PROVISIONS ARE STANDARD ON ALL UNITS.
2. VERIFY WEIGHT, CONNECTIONS, AND ALL OTHER DIMENSION WITH INSTALLER DOCUMENTS BEFORE INSULATION.

Figure 4. Cooling with optional electrical heat and gas/electric units — back view (horizontal configuration) — 15–25 tons



WSP
88 Black Falcon Avenue, Suite 210
Boston, MA 02210
617 210 1600
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SEACOAST STRUCTURAL ENGINEERS LLC
PAUL F. KIRBY, PE
5 Dogtown Road, Exeter, NH 03833
C 603-583-2453

May 26, 2020

John Gately
Architect
Goldman Reindorf Architects
427 Watertown Street
Newton, MA 02458

Re: North Shore Community College
Math & Science Building Roof Evaluation
Danvers, MA

Dear Mr. Gately:

The purpose of this letter is to present our structural review of the existing roof and floor structures to support new mechanical equipment. The project consists of structural engineering for the HVAC renovations described in the GRA North Shore Community College (NSCC) Math & Science Building Draft Study, Danvers, MA and as follows:

Schematic Structural Review

- Review available existing roof and floor framing plans to determine the pertinent building structural capacities and other information.
- Analyze the existing structural framing in the area of the proposed mechanical equipment to determine if framing modifications are required for support.
- Generate a narrative to be included in the final schematic study providing the results of our roof analysis with recommendations for reinforcement for support of mechanical units.

Our review was based on information provided by your office via the NSCC Facilities Department and the project mechanical engineer, WSP of Boston MA. The schematic review of the existing roof and floor was required based on concerns about locating new rooftop mechanical units on the existing roof framing. The NSCC Facilities Department noted that they have spent significant efforts removing roof snow, particularly in the winter of 2015 to reduce the structural weight of the long span framing and at the existing rooftop units.

Three options for the HVAC system renovation are being considered. Each option entails replacement of existing rooftop mechanical units which are nearing their useful life with new mechanical units. The following was provided for our review:

- Study for Certification of Deferred Maintenance Project; North Shore Community College Danvers Math & Science Building HVAC Study by GRA dated 1/20/2020 (Draft)
- North Shore Community College Math & Science Building HVAC Renovation drawings by GRA dated January 2020

- Renovations to the Varian Building North Shore Community College Danvers Campus Package No.1 – DCAM drawings by Perry-Dean-Rogers & Partners Architects dated July 1992.
- Various drawings from the original construction drawings for the Varian Danvers Facility by Symmes, Maini & McKee Associates Inc.
- Mechanical equipment product data for proposed rooftop equipment by WSP.

Existing Roof Structure

The existing facility was designed by Symmes Maini McKee Associates in 1984 as a one-story steel framed warehouse manufacturing facility. The structure consists of structural steel wide flange beams and columns with 30" deep steel joists. The building was renovated in 1992 to convert the facility to the NSCC Danvers educational facility. The renovations entailed roof modifications for new skylight structures and mechanical units. Most of the rooftop mechanical units were supported by new steel wide flange steel framing that was installed to replace some of the 30" deep steel joists. Upon review of the renovations drawings it appeared that the design engineers did not feel that the 30" steel joists were capable of supporting the additional weight of the mechanical units due to the joist spans of 40 feet and therefore replaced the joists under the new mechanical units with wide flange structural steel framing.

Roof Evaluation

The draft study referenced above considered three options for the renovation of the HVAC systems. All Options propose new rooftop mechanical units. An option that proposed replacement of all the rooftop equipment with new air handling equipment within the building envelope and supported on new steel framed and concrete mezzanines was not pursued due high cost. Our analysis focuses on the support of the new rooftop equipment. The following is a summary of the equipment weights provided by the project mechanical engineer:

Unit No.	Option No.	Unit Weight (LBS)
RTU--1	1 & 2	7,700
RTU--2	1, 2 & 3	7,700
RTU--3	1, 2 & 3	8,000
RTU--4	1 & 2	1,007
RTU--5	1, 2 & 3	2,319
RTU--6	1 & 3	700
RTU--7	1	2,310
RTU--8	1	2,310
RTU-9	ETR	2,344
RTU-10	1, 2 & 3	2,310
RTU-11	1 & 2	Unknown
RTU-12	2	2,370
RTU-13	2	2,310
RTU-14	2	2,310
RTU-15	2	2,319
RTU-16	2	2,319

We have reviewed the existing framing as renovated by the 1992 drawings. The 30” deep steel joist spanning 40 feet to the wide flange steel girders are truss elements and can be subject to significant deflection under roof snow, roof dead load, unit loads and snow drift. Snow drift loads are created when a roof projection such as a mechanical unit provides a vertical surface which wind can blow the roof snow against the unit. These loads combined together would overload the steel joists. This is likely the reason why the joists were replaced with wide flange steel beams to support the mechanical units for the 1992 renovation. Wide flange steel beam are less susceptible to deflection.

We have reviewed the ability of the existing framing to support snow loads and snow drift against the proposed mechanical units. The existing steel joists were of primary concern. Significant deflection from snow and snow drifting along with the roof dead load could cause ponding which would result in additional weight from snow, ice and other precipitation. Our analysis shows that the wide flange steel framing is capable of supporting the mechanical units without significant reinforcing. The capacity of these beams should be further reviewed during the final design based on the selected equipment. Based on our analysis indicates that the existing joists are adequate to support the imposed roof loads including snow and snow drifting. We have also evaluated the joists that will partially support RTU-8 and RTU-14. The imposed loads of the roof dead load, snow and snow drift and the tributary unit load are within the allowable capacity and acceptable deflection of the existing framing.

We recommend positioning the mechanical units at the locations of the steel wide flange beams. The attached drawing S1.3 shows the proposed locations of the mechanical units on the existing framing. The plan also proposes supplemental steel angle frames beneath the perimeter of the unit curbs and at the deck penetrations. Where the mechanical units land on the existing 30” steel joists, steel angle cross-bracing is also specified.

This concludes our review and evaluation for the roof and floor structures to support the options for the hvac equipment replacement. I look forward to assisting you on design of the building improvements. Please call me if you have any question

Very truly yours,
Seacoast Structural Engineers

Paul F. Kirby, P.E.

Appendix E: Existing Conditions Photos

Appendix E: Existing Conditions Photos

Photo-1 From Roof Hatch Looking West

Photo-2 Roof Looking Looking West

Photo-3 Roof Looking North

Photo-4 Roof Looking East

Photo-5 Roof Looking South

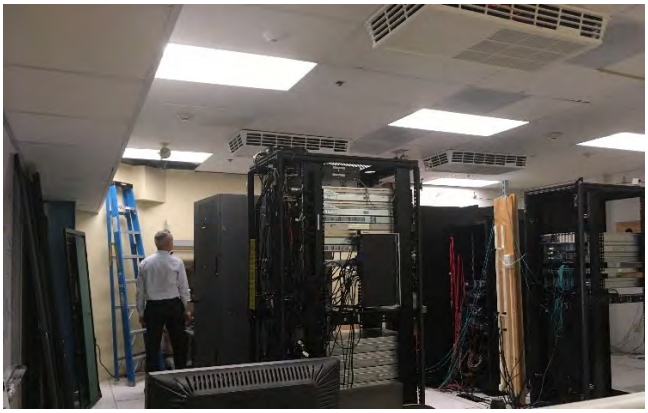


Photo-6 Data Center Ceiling

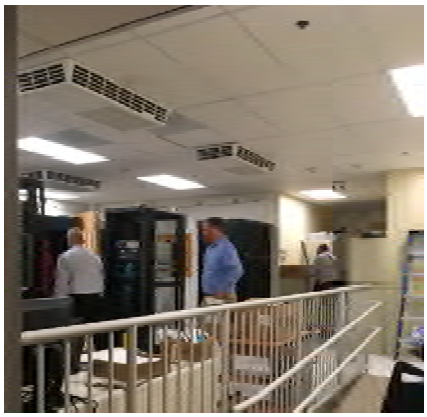


Photo-7 Data Center Ceiling

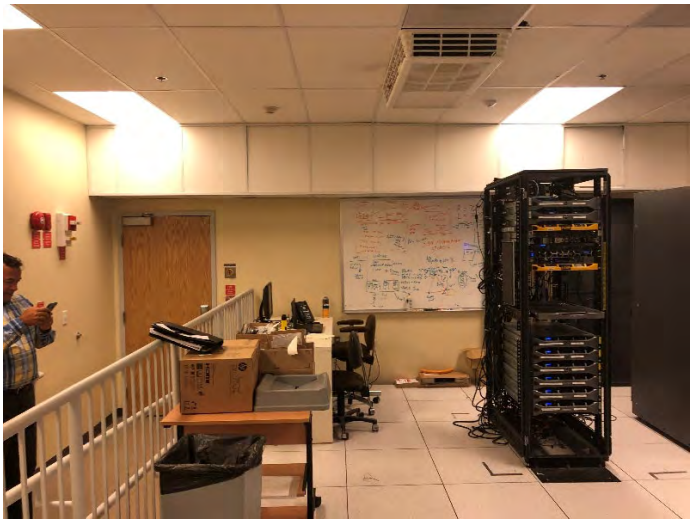


Photo-8 Data Center Ceiling

Photo-9 Data Center Store Rm

Photo-10 Typical CUH

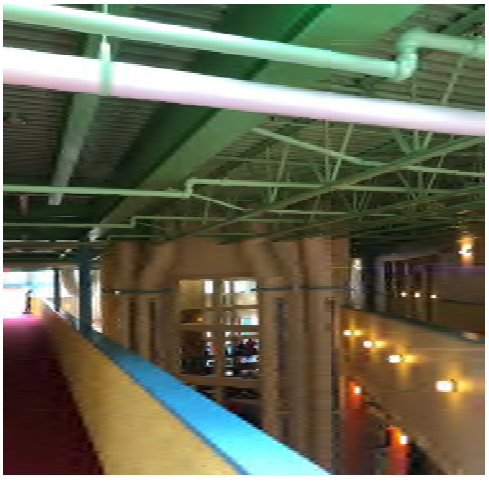


Photo-11 Atrium Space at Bookstore

Photo-11 Atrium Space at Cafeteria

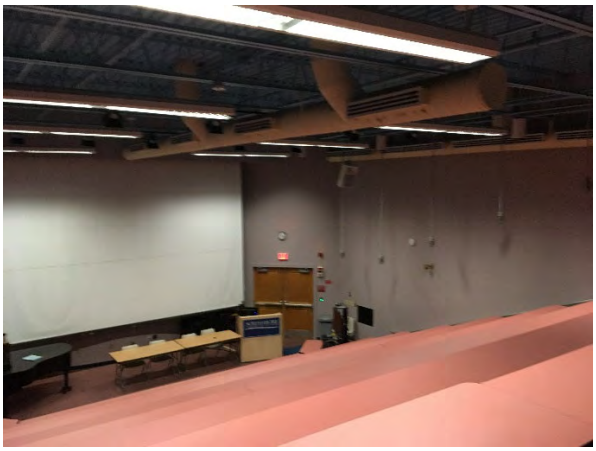


Photo-12 Lecture Hall

Photo-13 First Floor Drinking Fountain

Photo-14 Parking at Accessible Enrty

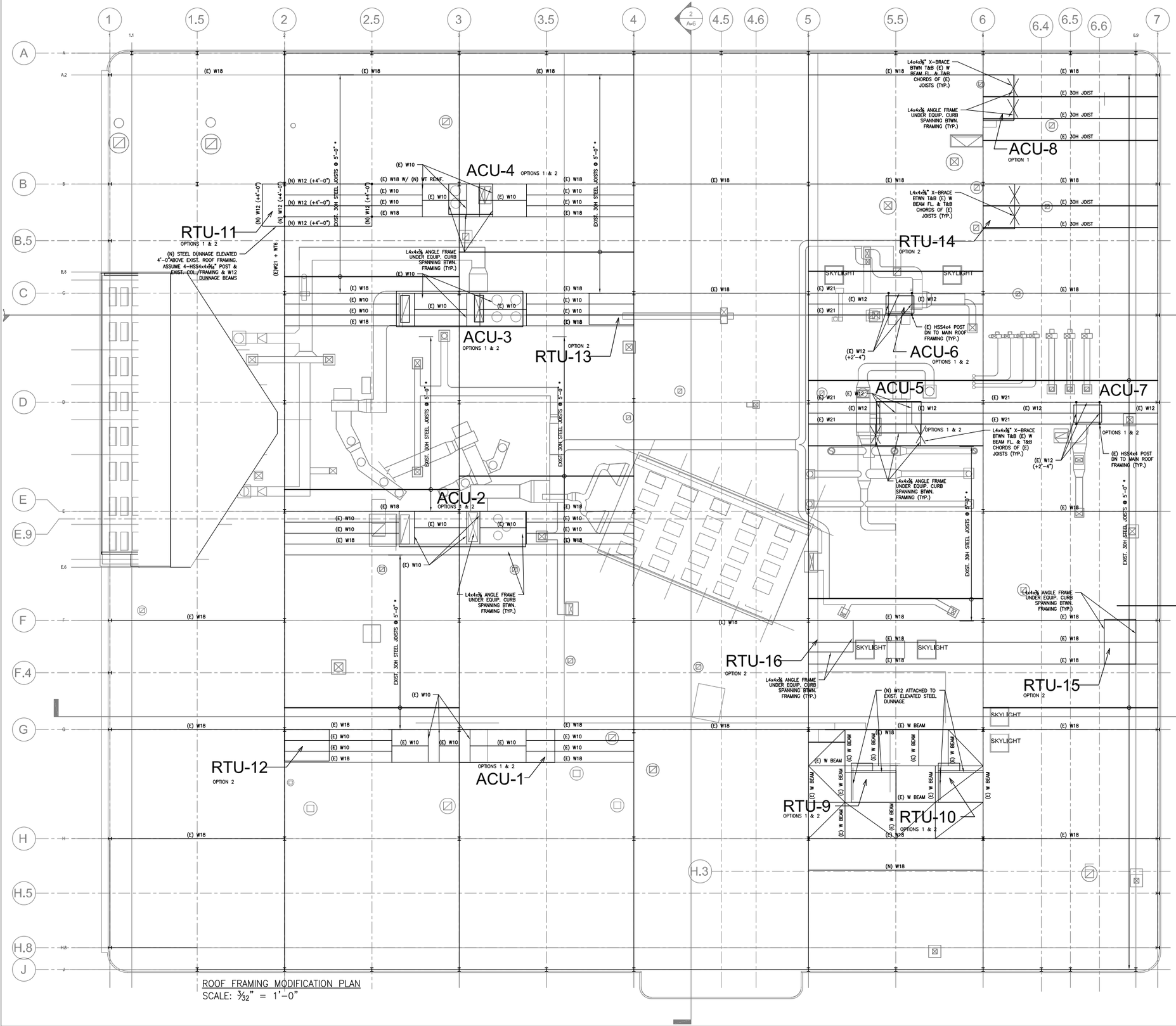
Photo-15 Accessible Toilet Room

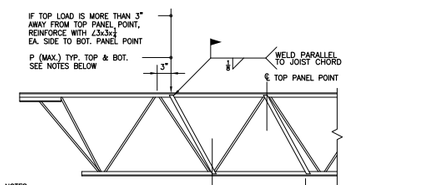
Photo-16 Accessible Toilet Room

Appendix F:

Seacoast Structural Engineers LLC Drawing
Roof Framing Modification Plan S1.3

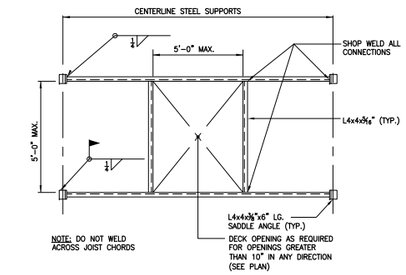
GRA Drawings
T-1 Site / First Floor / Accessibility Review
A-1 First Floor Plan
A-2 Second Floor Plan
A-3 Roof Plan





NOTES:
1. TRAPEZE HANGERS ARE TO BE USED TO SUPPORT PIPING. JOISTS SHALL BE SIZED FOR HUNG LOAD.
2. HANGING LOADS: JOISTS SHALL BE DESIGNED TO SUPPORT THE FOLLOWING HANGING LOADS FROM EITHER THE TOP OR BOTTOM CHORD PANEL POINTS. THESE LOADS ARE PART OF THE TOTAL DESIGN LOADS:
   A. JOISTS SHALL BE DESIGNED FOR A 10 PSF HANGING LOAD CONSISTING OF A SERIES OF CONCENTRATED LOADS NOT EXCEEDING 250 POUNDS EACH.

1 TYPICAL JOIST HANGING LOAD DETAIL
N.T.S.



2 TYPICAL OPENING IN DECK & UNDER MECH. EQUIP CURBS
N.T.S.

REV.	DESCRIPTION	DATE

Seacoast Structural Engineers
5 Dogtown Road
Exeter, NH 03833
(603) 583-2453

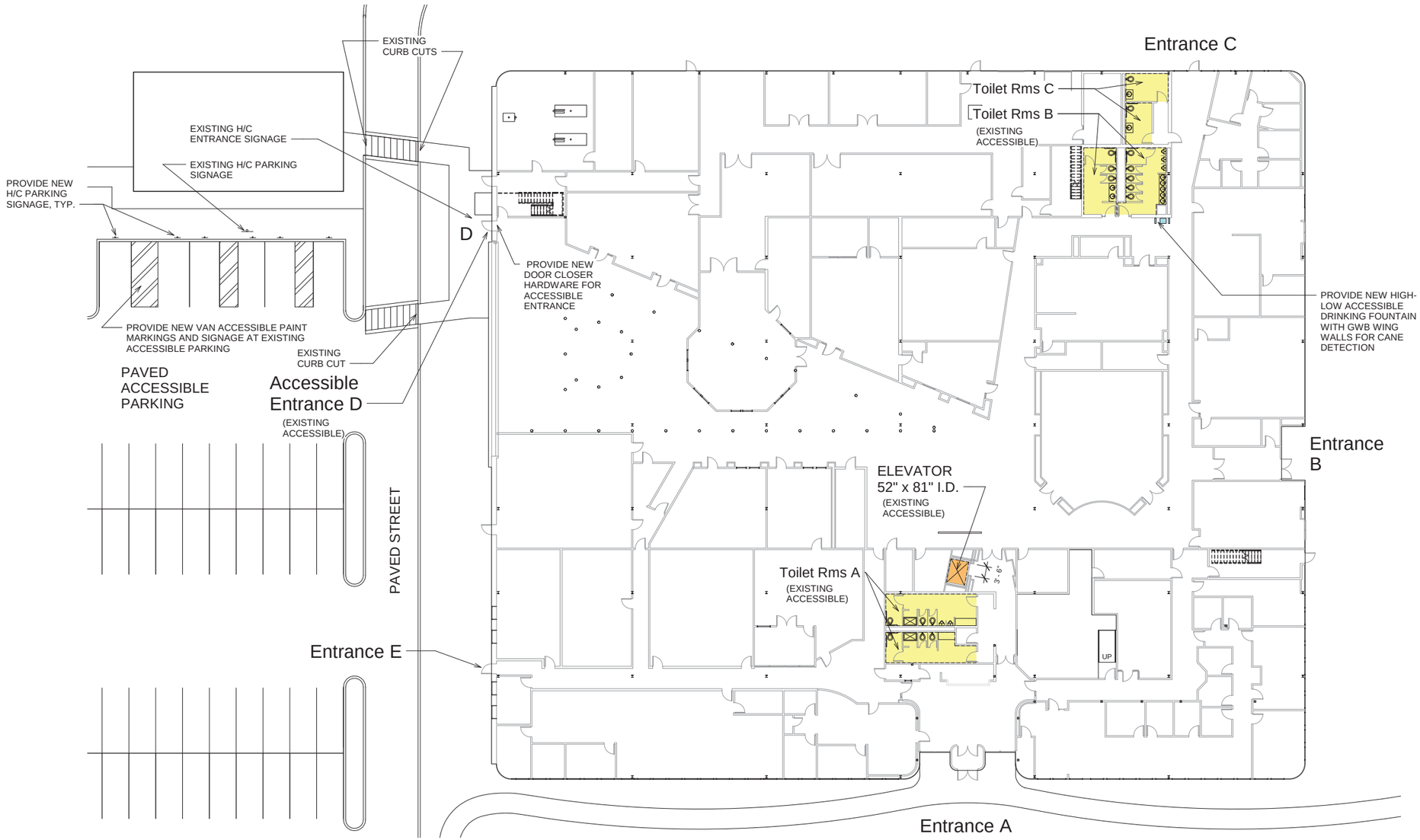
CLIENT: GRA
427 WATERTOWN STREET
NEWTON, MA 02458

PROJECT: NORTH SHORE COMMUNITY COLLEGE - DANVERS
MATH & SCIENCE BLDG. HVAC RENOVATION
DANVERS MA

ISSUE STATUS: SCHEMATIC DESIGN
02/26/2020

SHEET TITLE: SCHEMATIC ROOF FRAMING MODIFICATION PLAN

Drawn By:	PFK
Designed:	PFK
Checked By:	PFK
Approved:	JG
Job Number:	004-20
Date:	02/26/2020
Scale:	AS NOTED
SHEET No.	S1.3



1 EXISTING SITE / LEVEL 1
1/16" = 1'-0"

Sheet List		
Sheet Number	Sheet Name	Sheet Issue Date
A-1	1ST FLOOR PLAN	6/5/2020
A-2	2ND FLOOR PLAN	6/5/2020
A-3	ROOF PLAN	6/5/2020
T-1	SITE PLAN - FIRST FLOOR ACCESSIBILITY	6/5/2020

NORTH·SHORE COMMUNITY COLLEGE

ARCHITECT:
GR|A
427 Watertown St. Newton, MA 02458
www.grarchitects.com

CONSULTANT:

LOCUS PLAN NOT TO SCALE

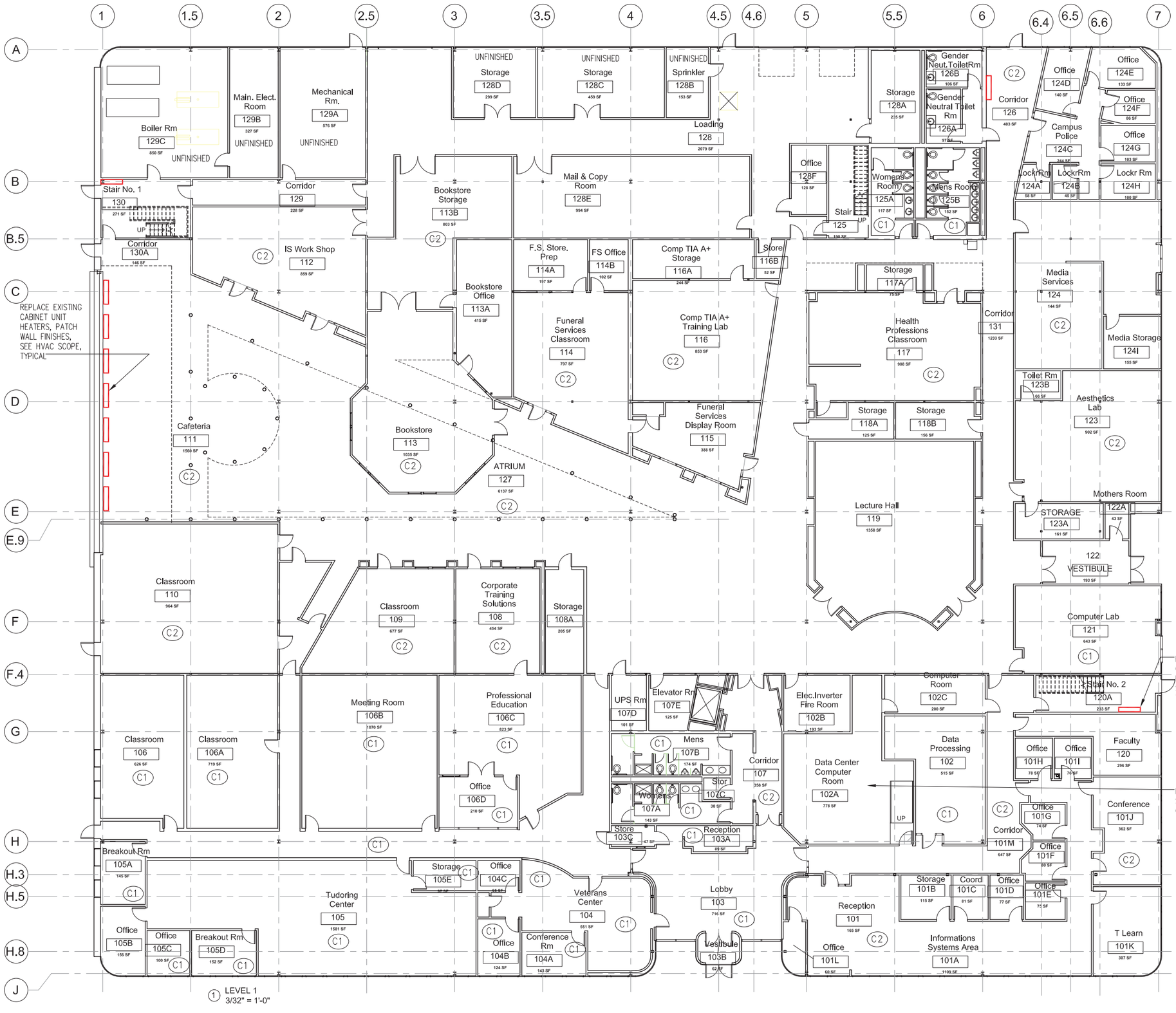
NORTH SHORE COMMUNITY COLLEGE MATH & SCIENCE BUILDING HVAC RENOVATION

No.	Description	Date

Project number 2000.1
Date 5 JUNE, 2020
Plot Stamp 6/11/2020 7:05:26 PM

SITE PLAN - FIRST FLOOR ACCESSIBILITY

T-1



1 LEVEL 1
3/32" = 1'-0"

1st FLOOR
50,482 SF

GENERAL NOTES - LEGEND:

C1 TEMPORARILY REMOVE PORTION OF ACT CEILING AT MECHANICAL WORK ABOVE REPAIR/REPLACE DAMAGED TILES. TOUCH UP PAINTED GWB WALLS WHERE DAMAGED BY MECHANICAL WORK ABOVE

C2 TOUCH UP PAINTED EXPOSED STRUCTURE WHERE DAMAGED BY MECHANICAL WORK. TOUCH UP PAINTED GWB WALLS WHERE DAMAGED BY MECHANICAL WORK ABOVE

REPLACE EXISTING CABINET UNIT HEATERS, SEE HVAC SCOPE, PATCH WALL FINISHES, TYPICAL

DATA CENTER ROOM: DEMO EXISTING FINISH CEILING AND INSTALL NEW 2X4 ACT CEILING WITH PANELS WITH MYLAR FINISH AND GASKETS TO PROVIDE HERMETIC SEAL BETWEEN PANELS AND SUSPENSION GRID. INSTALL 6" LAYER OF MINERAL WOOL BATT INSULATION ABOVE THE NEW FINISH CEILING.

EXISTING CEILING MOUNTED ELECTRICAL, F.A. & LIGHTING TO REMAIN, PATCH & PAINT ALL DAMAGED EXISTING WALLS

NORTH SHORE COMMUNITY COLLEGE

ARCHITECT:

GRA

427 Watertown St. Newton, MA 02458
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CONSULTANT:

LOCUS PLAN NOT TO SC

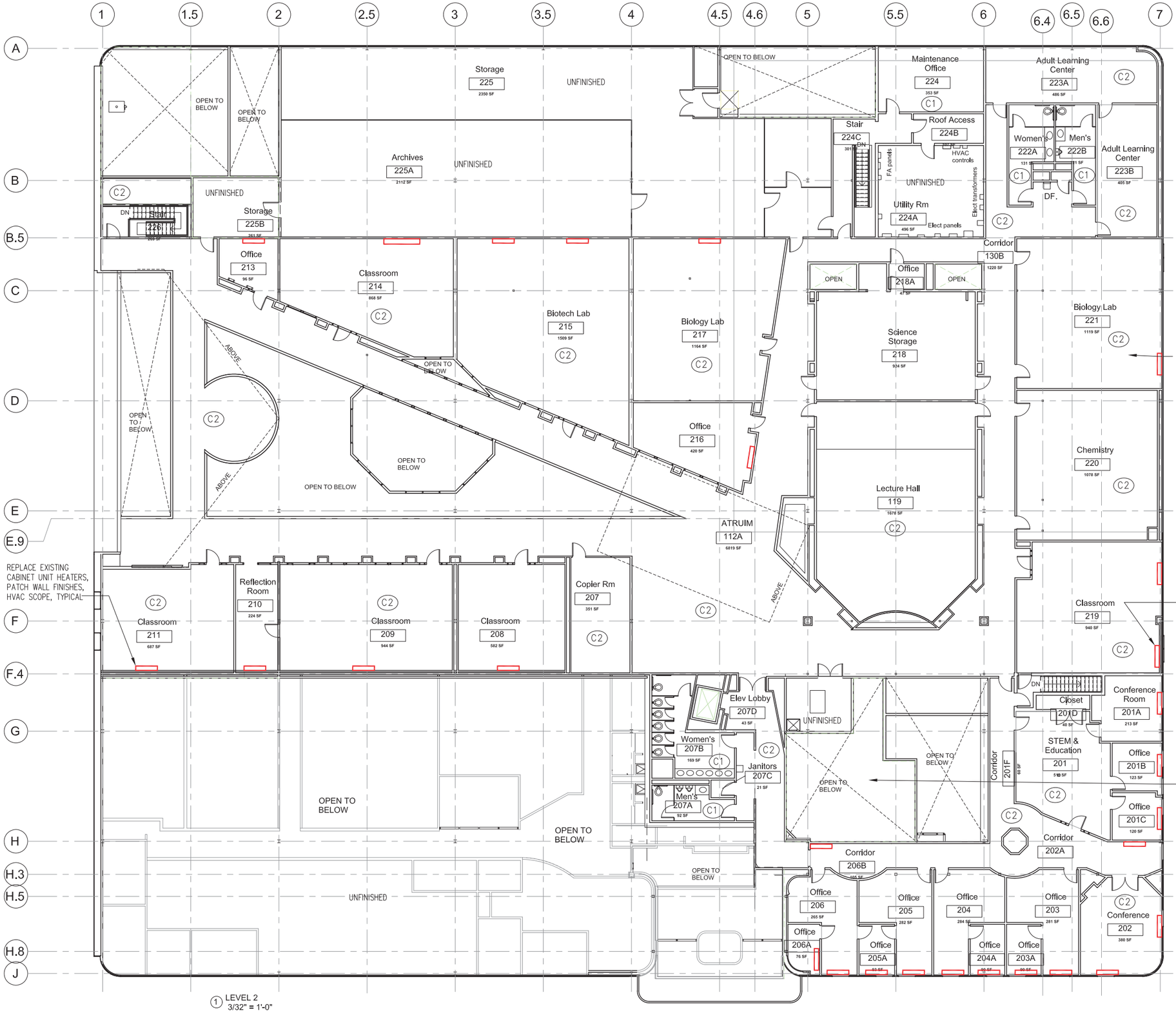
NORTH SHORE COMMUNIT
COLLEGE DANVERS

No.	Description	Date

Project number
Date
Plot Stamp

1ST FLOOR PLAN

A-1



1 LEVEL 2
3/32" = 1'-0"

2ND FLOOR
41,602 SF

GENERAL NOTES - LEGEND:

C1 TEMPORARILY REMOVE PORTION OF ACT CEILING AT MECHANICAL WORK ABOVE REPAIR/REPLACE DAMAGED TILES. TOUCH UP PAINTED GWB WALLS WHERE DAMAGED BY MECHANICAL WORK ABOVE

C2 TOUCH UP PAINTED EXPOSED STRUCTURE WHERE DAMAGED BY MECHANICAL WORK. TOUCH UP PAINTED GWB WALLS WHERE DAMAGED BY MECHANICAL WORK ABOVE

REPLACE EXISTING CABINET UNIT HEATERS, SEE HVAC SCOPE, PATCH WALL FINISHES, TYPICAL

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CONSULTANT:

LOCUS PLAN NOT TO SC

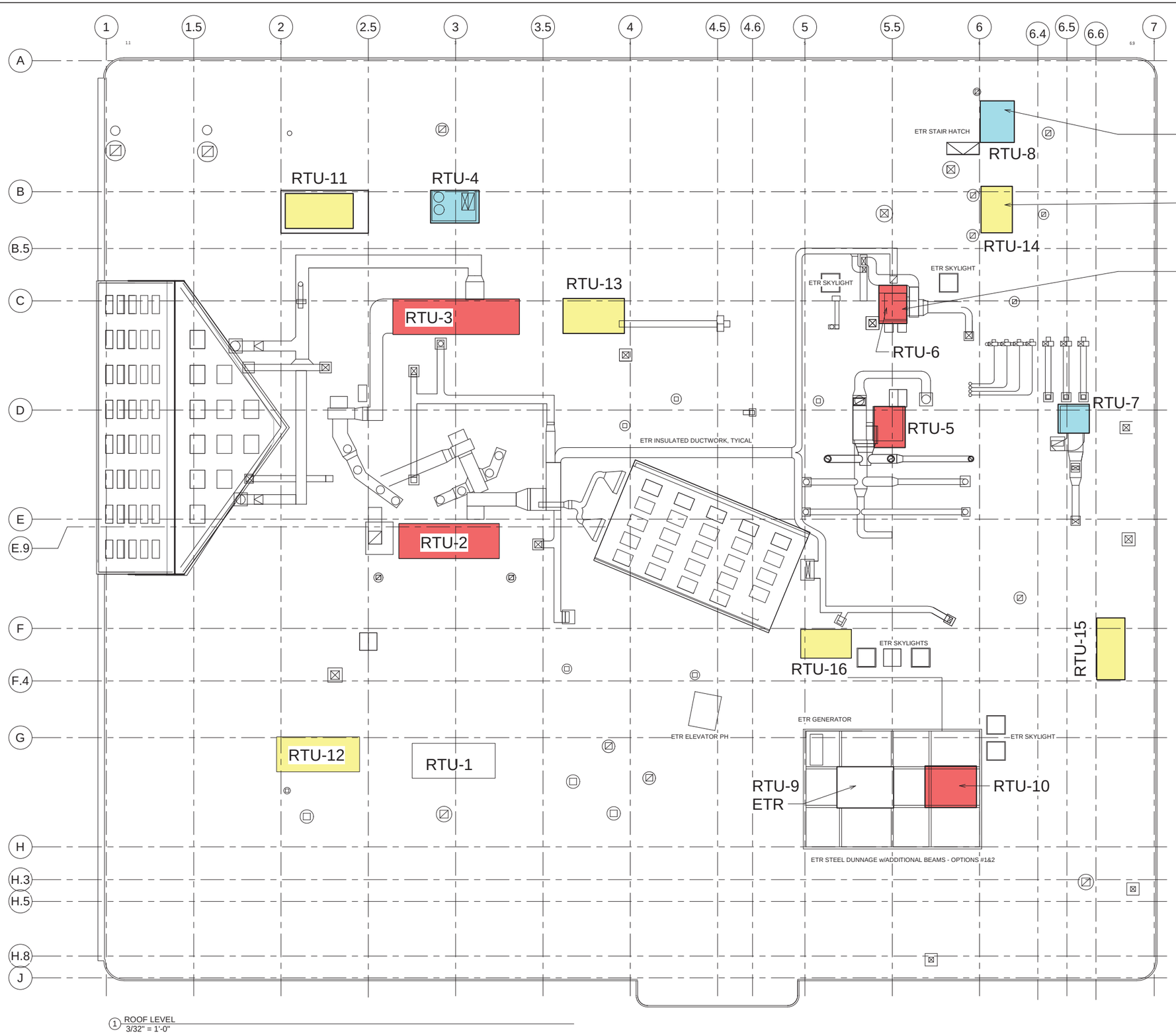
NORTH SHORE COMMUNIT
COLLEGE DANVERS

No.	Description	Date

Project number
Date
Plot Stamp

2ND FLOOR PLAN

A-2



1 ROOF LEVEL
3/32" = 1'-0"

REPLACE EXISTING ROOFTOP MECH. UNITS - OPTIONS # 2 & 3

RTU-11 THRU 16 ADDITIONAL OPTION# 2 ROOFTOP MECH. UNIT

REPLACE EXISTING ROOFTOP MECH. UNITS - OPTIONS #1 & 2

WORK SCOPE NOTES:

RTU SCOPE LEGEND

OPTION# 1 +

OPTION# 2 + +

OPTION# 3

ROOFING SCOPE:
PATCH BITUMINOUS BUILT-UP ROOFING AND INSTALL NEW FLASHING AT ALL NEW RTUs

PROVIDE FLASHING PENETRATIONS AND ROOF REPAIR AT NEW STEEL DUNNAGE - OPTION #2

SEE STRUCTURAL DRAWINGS FOR ROOF FRAMING MODIFICATIONS AT NEW RTUS

NORTH·SHORE COMMUNITY COLLEGE

ARCHITECT:
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CONSULTANT:

LOCUS PLAN NOT TO SCALE

NORTH SHORE COMMUNITY COLLEGE MATH & SCIENCE BUILDING HVAC RENOVATION

No.	Description	Date

Project number 2000.1
Date 5 JUNE, 2020
Plot Stamp 6/11/2020 7:05:25 PM

ROOF PLAN

A-3