COOK PHYSICAL SCIENCE BUILDING RENOVATIONS

Engineering & Architectural Services

CONCEPT DESIGN

MAY 11, 2012

BVH Project No. 21-11-199
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1. General
1. General

Over the past 40 years, which has encompassed the design and construction of the Cook Building, physical and educational demands of higher learning have evolved to a point as to significantly alter the learning environment necessary to support present day Chemistry and Physics programs. Program comments that must be addressed in any modernization timetable include:

- Physical and space needs
- Ventilation and exhaust rates
- Temperature and humidity control
- Vibration limitations
- Emergency power and system redundancies
- Building Code and FM Global compliant systems

Any renovation to the Cook Building must provide significant improvements to these systems in order to be safe and cost effective. Air quality, energy consumption, maintenance costs, ADA compliance, safety and redundancy in these program changes are critical investments for the future.

BVH Integrated Services, Inc. was commissioned to perform an evaluation and concept design for the renovation of the Cook Physical Science Building which would consist of the replacement of all Mechanical/Electrical/Plumbing (MEP) systems and a limited architectural evaluation and replacement as required. The intent of this project is to evaluate the condition and capacity of existing MEP systems, which will help to aid in identifying the relevant issues and relative costs associated with proposed replacement and also to assist in the preparation of a long range capital plan for the various facility infrastructure upgrades.
SCOPE OF WORK & DESIGN REQUIREMENTS:

- **Building Exhaust Systems**: Replacement of existing fume hoods, exhaust ductwork, and fans with a variable air volume system including energy recovery. Subsequent program planning added a significant amount (fifty) of fume hoods to the building program.
- **Building Make-Up Air Systems**: Temperature and humidity control of all spaces, heating and cooling energy recovery.
- **Plumbing**: Survey existing systems and provide evaluation and design improvements of domestic and laboratory water including hot, cold, and recirculation systems, DI and RO water distribution, emergency showers and tempered water, laboratory waste, roof drains, natural gas distribution, and code and conservation-compliant laboratory and bathroom fixtures.
- **Chilled Water**: Extension of central chilled water infrastructure from UVM Vault MH2 to point of use. Physical shell space for chilled water storage or on-site chilled water generation at Cook to offset the ton-hours required to cool the facility to be evaluated.
- **Fire Protection Systems**: Design of a code-compliant and FM Global-compliant fire protection system.
- **Fire Detection System**: Evaluation, modifications, and improvements to existing fire detection systems.
- **Building Management System**: University standards for an integrated Building Management System with requirements for interfacing with the campus control networks.
- **Electrical Systems**: Survey and evaluation of all existing systems, lighting upgrade, lighting control systems, emergency power distribution, emergency generators, clean power distribution, security and building access systems, and specialized grounding systems. Upgrade of all power distribution based on age, condition, and space requirements.
- **Structural**: Modifications to support all systems renovations.
- **Architectural**: Architectural modifications to support all systems renovations. Subsequent program planning added significant architectural modifications to the building program.
- **Civil**: Modifications to support all systems renovations.
- **Building Envelope**: Evaluation and improvements to exterior walls, existing roofing systems, windows, entry doors, and insulation systems. Select areas of the building were designated for destructive testing in order to evaluate existing building conditions.
- **Specialized Programs**: Chemical storage areas, accommodations for specialized equipment and research throughout the building.
- **Elevators**: Evaluation, assessment, and improvements for code compliance.
The information contained in this report was developed as a result of our field observations and discussions with facilities staff. We thank Mr. Todd Merchant, Senior Construction Administrator, Mr. David Blatchly, Administrative Facilities Professional and Mr. Clay Warren, Facilities Trades Supervisor, for their assistance and cooperation in helping us to become familiar with the various facilities.

The Cook Physical Science Building is a five story 110,709-SF building. The departments of Chemistry and Physics are located in the facility. Classrooms and research are located in the building along with laboratories, which are located throughout each floor. The Cook Building is also home to the 11,497-SF Angell Lecture Center. Both buildings were designed in 1969.

Evaluations are contained below indicating opinion of probable budget and a relative phasing priority.
2. Executive Summary
2. Executive Summary

Several site visits and review of the existing conditions at the Cook Physical Science Building, concludes that although MEP systems are operational they are beyond their useful life expectancies. In addition, the application of the HVAC air delivery system is neither on par with present academic nor modern science research design. A basis of future design was developed for the various building components as a result of code, building envelope and required MEP improvement analysis and is summarized below.

The recommendation to satisfy the proposal scope is to renovate the building in a phased manner to allow occupancy during this process. Modular trailers are to be provided to accommodate the areas under renovation. This construction phasing process is assumed to take place over a 62-month period and will be identified as the Base Concept. A variation on the Base Concept is to complete the construction phasing process over a more compact 36-month period and to be identified as Alternate Concept No. 1.

As the analysis of the Base Concept and the Alternate Concept No. 1 progressed, it became apparent that there would be merit in providing a cost comparison to the Base and Alternate No. 1 Concepts verses constructing a brand new standalone Chemistry building followed by the renovation of the Cook Building into a general classroom building. This will be identified as the Alternate No. 2 Concept. This Alternate No. 2 Concept consists of a 75,000-SF freestanding building to house the Chemistry curriculum as defined during our Architectural space programming exercise for the Cook Building.

The Alternate No. 2 Concept has some attractive considerations such as providing a new and modern chemistry building to the campus. Also, a new building construction period of 18 months and a two-phase renovation approach taking a total of 18 months for the Cook Building. This alternate would eliminate the need for modular trailers to provide swing space during the Cook Building renovation construction phasing.

Please see the Conceptual Estimate section of this Volume for cost information.

HVAC Systems (Base and Alternate No. 1 Concepts)

- Remove all existing HVAC equipment such as steam heating supply and return piping, laboratory exhaust ductwork, supply ductwork, exhaust fans, unit ventilators, and temperature controls.
• 800 tons of chilled water to be provided from the campus distribution system. All delivery systems such as pumps to have redundancy.
• Steam to be provided from the campus distribution system. All delivery systems such as PRV stations and heat exchangers to have redundancy.
• Laboratory area and fume hood exhaust shall be via dedicated room exhaust ductwork and air valves to a central redundant roof-mounted laboratory fan exhaust systems.
• Humidification will be provided by utilizing clean steam generators.
• The building shall be served via three new custom variable air volume air-handling units with redundant fans, located in new architectural enclosures outside the building entrances at the north and south ends of the building and one located on the fourth floor roof to serve the central area of the building.
• Angell to have its two existing air handlers replaced with new.
• A steam-to-water heat exchanger system will be used to generate heating hot water for use in, reheat coils, radiant heating panel, fin tube radiation, fan coil units and unit heaters.
• Steam and condensate piping from the south end mechanical room shall extend to the north end custom air handling unit locations and to the new roof mounted air handling unit.
• Hot water heating distribution piping, originating from the south end mechanical room, shall connect to new room terminal air equipment.
• Redundant chilled water circulation pumps shall be provided.
• The north and south end custom air handling unit air distribution shall be via new utility chases installed on the exterior of the building from the lower level to the roof. The central custom air handling unit air distribution shall be via interior constructed distribution shafts.
• Provide energy recovery from the laboratory exhaust to the air handlers.
• The automatic temperature control system will be direct digital control (DDC) and will be compatible with the campus building automation system.

There is a program requirement to evaluate how to offset the cooling ton-hours for this building as supplied by the campus chilled water system, or in other words, provide an evaluation to shed this building off of the campus chilled water system on a cooling peak design day. The following HVAC cooling design measures were evaluated as optional alternates to the Base Design Concept.

• Optional Cooling Alternate A: Provide two (2) 400-ton standalone air-cooled chillers with interconnection to the campus chilled water piping.
• Optional Cooling Alternate B: Provide 800-ton equivalent of peak ice storage output. This requires two (2) 300-ton water-cooled chillers. Heat of rejection to the campus condenser water loop at night when making ice. Use ice during the day with interconnection to campus chilled water and condenser water piping.

• Optional Cooling Alternate C: Provide 400-ton equivalent of peak ice storage output. This requires two (2) 200-ton air-cooled chillers. No heat of rejection to the campus condenser water loop. Make ice at night. Use the chiller and ice during the day with interconnection to campus chilled water piping.

Fire Protection Systems (Base and Alternate No. 1 Concepts)
- A new fire service into the building.
- Provide a new electric fire pump.
- Provide sprinkler system throughout the building and new standpipes.
- Angell to have soffits constructed in the ceiling of the lecture halls to accommodate the new sprinklers.

Plumbing Systems (Base and Alternate No. 1 Concepts)
- Remove entire existing plumbing systems, fixtures, piping (water, gas, soil, vent, storm, etc.), supports, drains, water heaters, etc: within existing building renovated areas.
- Provide all new plumbing fixtures such as: roof drains, floor drains, sinks, lavs, water closets, urinals, and laboratory fixtures.
- Provide all new potable and non-potable water piping.
- Provide all new high efficiency domestic and laboratory hot water systems.
- Provide new natural gas system throughout the building.
- New chemical acid resistant piping where required to existing site neutralization tank.
- Provide new laboratory vacuum, laboratory compressed air and pure water (R.O.) system throughout.

Electrical Systems (Base and Alternate No. 1 Concepts)
- Remove all existing electrical equipment such as: panelboards and feeders, bus duct, emergency and standby distribution, branch circuits, wiring devices and switches, lighting, fire alarm and telecommunication equipment.
- For the base HVAC system, provide a 1200A normal electrical main distribution switchboard fed from the pad mounted transformer.
- For the Cooling Alternates A, B or C HVAC systems provide a 1600A normal electrical main distribution switchboard fed from the pad mounted transformer.
- Provide a new 500 KW standby generator with new emergency and standby distribution.
- Provide normal and generator power to the transfer switch feeding the fire pump controller.
- Provide two new electrical distribution rooms on each floor.
EXECUTIVE SUMMARY

- Provide a panelboard within each large lab room connected individually to its respective distribution panelboard.
- Replace all panelboards and transformers with new electrical equipment in the Angell Lecture Hall Building.
- Maintain elevators and reconnect to new electrical distribution.
- Provide energy efficient fluorescent lighting.
- Replace all lighting within the Angell Lecture Hall Building.
- Provide emergency lighting in all means of egress, toilet rooms, and on the exterior of the building.
- Provide LED type exit and directional signs within means of egress.
- Control all lighting within the labs and offices via occupancy sensors and via local switches that provide manual on/off with positive automatic off operations of the lighting.
- Control all lighting within the corridors connected to both normal and emergency circuits via occupancy sensors. The system will allow the lighting connected to the emergency circuits to be switched off when the building is unoccupied.
- Control all lighting within the exit stairwells connected to the normal circuits via occupancy sensors. Lighting connected to the emergency circuits to be on 24/7.
- Provide an addressable, voice, fire alarm control system.
- Provide smoke detectors where required.
- Provide new telecommunication system including: data racks, telephone terminal boards, raceways, cable trays, wiring, boxes, jacks, etc.
- Provide a security system consisting of card readers, power supplies, boxes, raceway, and wiring. Provide card readers located at entrances to building, mechanical rooms, and access to the roof.

Civil (Base and Alternate No. 1 Concepts)
- Relocate existing underground utilities as required to accommodate new MEP spaces.
- Provide new site utilities (water, fire, storm, sanitary, chilled water, steam, and telecommunication).
- Provide site services to accommodate the temporary modular trailers.
- Limited surface improvements.
Architectural (Base and Alternate No. 1 Concepts)

- A building envelope analysis was performed and determined that there is significant masonry cracking and the issue is advanced. There is a structural concern that the deteriorated masonry presents a fall hazard potential. Temporary protection measures should be taken.
- Improve exterior architecture by removing and replace the building’s skin in its entirety (roof, brick veneer, and glazing and entry systems) through a phased approach to provide the renovated building with a high performing weather/thermal/air/vapor/envelope
- Replace glazed curtain wall.
- Provide composite metal panels to enclose new mechanical space.
- Replace all building entrances and terrace doors.
- Replace exterior expansion joints.
- Improve code deficiencies in stair towers and elevators.
- Modify interior partitioning and chases to accommodate MEP requirements and program.
- Assume replacement of existing doors and hardware and reuse of existing frames.
- Provide all new locks and latch sets for all program space doors.
- Improve the room finishes.
- All restrooms in both buildings are to be completely renovated.
- New fire extinguishers.
BASE AND ALTERNATE NO. 1 HEATING / COOLING CONCEPT
EXECUTIVE SUMMARY

BASE AND ALTERNATE NO. 1 FUME HOOD EXHAUST CONCEPT
EXECUTIVE SUMMARY

BASE AND ALTERNATE NO. 1
HEATING / COOLING AND FUME HOOD
EXHAUST CONCEPT COMBINED
Cook Physical Science Building Renovations
University of Vermont
MEP Design Engineering

EXECUTIVE SUMMARY

BASE CONCEPT: HVAC SYSTEM
- 800 TONS FROM CAMPUS UTILITIES
- NO CHILLER OR COOLING TOWER
- CONNECTED TO CAMPUS CHILLED WATER PIPING
- STEAM FROM CAMPUS UTILITIES

CAMPUS COOLING TOWER
CUSTOM AIR HANDLER
RECEIVING + FIRE PUMP ROOM
BUNKER MECHANICAL ROOM

SOUTH END OF BUILDING FRONT SIDE
EXECUTIVE SUMMARY

Cook Physical Science Building Renovations
University of Vermont
MEP Design Engineering

BASE CONCEPT OPTIONAL COOLING
ALTERNATE A
- STANDALONE 800 TONS
- 2-400 TON AIR COOLED CHILLERS
- STEAM FROM CAMPUS UTILITIES
- INTERCONNECTION TO CAMPUS CHILLED WATER LOOP

SOUTH END OF BUILDING FRONT SIDE

CAMPUS COOLING TOWER

2-400 TON AIR COOLED CHILLERS
CUSTOM AIR HANDLER
RECEIVING + FIRE PUMP ROOM
BURIED MECHANICAL ROOM
EXECUTIVE SUMMARY

Cook Physical Science Building Renovations
University of Vermont

MEP Design Engineering

BASE CONCEPT OPTIONAL COOLING
- ALTERNATE B
  - 300 TON ICE STORAGE
- 2 – 300 TON WATER COOLED CHILLERS
- CONDENSER WATER CONNECTION TO CENTRAL PLANT
- STEAM FROM CAMPUS UTILITIES
- INTERCONNECTION TO CAMPUS CHILLED WATER LOOP

SOUTH END OF BUILDING FRONT SIDE
CUSTOM AIR HANDLER
RECEIVING + FIRE PUMP ROOM
BURIED MECHANICAL ROOM
CAMPUS COOLING TOWERS
ABOVE GRADE CHILLER ROOM

800 TON EQUIVALENT OF PEAK ICE STORAGE BURIED WITH 3 EXPOSED 30 TANKS (8FT X 100 FT EACH)
EXECUTIVE SUMMARY

Cook Physical Science Building Renovations
University of Vermont
MEP Design Engineering

Section 2

NOTE: CONCEPTUAL DESIGN
ALTERNATE C
- 400 TONS OF ICE STORAGE
- 2-200 TON AIR COOLED CHILLERS
- STEAM FROM CAMPUS UTILITIES
- INTERCONNECTION TO CAMPUS CHILLED WATER LOOP

BASE CONCEPT OPTIONAL COOLING

2-200 TON AIR COOLED CHILLERS

400 TON EQUIVALENT OF PEAK ICE STORAGE BURIED WITH 3 "EXPOSED, 21 TANKS
(DIA. x 10' HT EACH)
### EXECUTIVE SUMMARY

**Cook Physical Science Building Renovations**  
University of Vermont

**MEP Design Engineering**  

[Diagram Image]

**ARCHITECTURAL SPACE PROGRAMMING**  
(BASE AND ALTERNATE NO. 1)

1. REQUESTED OFFICE SPACE FOR 7 FACULTY, 84 GRADUATE STUDENTS, AND 7 POSTDOCTORAL FELLOWS WAS CALCULATED AS FOLLOWS: 98% OF THE REQUESTED PROGRAM AREA IS BEING PLACED IS USED.

2. IN AREAS WHERE REQUESTED PROGRAM SQUARE FOOTAGE IS NOT SPECIFIED BY UVM, THE SQUARE FOOTAGE OF THE ROOM INTO WHICH A REQUESTED PROGRAM HAS BEEN PLACED WILL BE USED.

3. ONE (1) CLASSROOM IN ANGELL HALL WILL BE CONVERTED TO RESTROOMS; THIS CLASSROOM PROGRAM SPACE HAS NOT BEEN RELOCATED.

**NOTES:**

- A CLASSROOM THAT IS DESIGNATED FOR PROGRAM SQUARE FOOTAGE IS NOT IMPACTED BY ANY SQUARE FOOTAGE OF THE FUTURE EINCH CONSTRUCTION.

- PROGRAM SPACE HAS NOT BEEN INCLUDED.

- A CLASSROOM PROGRAM SPACE HAS NOT BEEN INCLUDED.

**RP101**
### EXECUTIVE SUMMARY

**Cook Physical Science Building Renovations**

**University of Vermont**

May 2012

**MEP Design Engineering**

Section 2

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<th>AREA</th>
<th>REQUESTED USE</th>
<th>EXISTING USE</th>
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<th>AREA</th>
<th>REQUESTED USE</th>
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**ARCHITECTURAL SPACE PROGRAMMING**

(BASE AND ALTERNATE NO. 1)
CONSTRUCTION PHASING PLAN
(Base and Alternate No. 1)
## COOK Physical Science Building
### Preliminary Phasing Schedule - Alternate Concept #2
#### New Chemistry followed by Renovation

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<td>2</td>
<td>New Chem. Bldg. Construction</td>
<td>1 mo</td>
<td>Mon 5/10/13</td>
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<td>Muir Chemistry Department</td>
<td>48 days</td>
<td>Mon 6/6/14</td>
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<td>Cook Renovations</td>
<td>268 days</td>
<td>Mon 8/4/14</td>
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<tr>
<td>5</td>
<td>Phase A</td>
<td>0 mo</td>
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<tr>
<td>6</td>
<td>Phase B</td>
<td>9 mo</td>
<td>Mon 11/3/15</td>
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### EXECUTIVE SUMMARY

*Cook Physical Science Building Renovations*
*University of Vermont*
*MEP Design Engineering*

May 2012

*MEP Design Engineering*
3. Conceptual Estimate
3. Conceptual Estimate

The Conceptual Cost Estimates were prepared by Vermeulen Cost Consultants and are based on discussions with the design team, documentation prepared by the design team, review of existing conditions, phasing requirements and market conditions. The estimates use today’s dollars and have been escalated at 1% per quarter to the midpoint of construction. The Base Estimate uses a 62 month construction schedule that includes four phases for the interior renovations and three phases for the exterior renovations. Each interior phase is based on a vertical renovation that requires approximately 27,000 square feet of temporary modular buildings to accommodate the displaced classrooms, labs and offices and assumes that the temporary modular buildings are to remain in place for the full duration of construction, 62 months for the Base Concept and 36 months for Alternate Concept No. 1.

The Base and Alternate No. 1 Conceptual Estimates include:

- The removal and replacement of the exterior façade, windows and doors for Cook Science Building and Angell Lecture Center.
- Replacement of all MEP Systems for Cook Science Building and Angell Lecture Center including full cooling and humidity control throughout the buildings.
- Minimal architectural renovation of all interior spaces that do not have a change in program requirements.
- More substantial architectural renovation of all interior spaces that require significant program modifications (i.e. additional hoods).
- Replacement of most existing fume hoods and the addition of approximately 50 new fume hoods to accommodate program requirements.
- An addition at the North and South end of the building to accommodate the additional MEP space requirements which shall allow occupancy of the building during the phased construction.
- Connection to the campus steam and chilled water system.

The Conceptual Estimate for Alternate No. 1 that has been prepared reduces the construction time period to 36 months and maintains the full scope of the Base Estimate and Phasing. This estimate reduces the overall cost of the project by reducing the general conditions costs, reducing the escalation and reducing the lease cost of the temporary modular buildings.
The Conceptual Estimate for Alternate No. 2 that has been prepared consists of a 75,000-SF freestanding building to house the Chemistry curriculum as defined during our Architectural space programming exercise for the Cook Building. The estimate also includes the renovation of the Cook Building into a general classroom building.

Conceptual Budget Estimates

- Base Concept (62-Month Phased Construction) - $53,346,173
- Additional Premium for Optional Cooling Alternates (Applicable to both Base and Alternate No. 1 Concepts)
  - Optional Cooling Alternate A - $1,630,800
  - Optional Cooling Alternate B - $4,241,213
  - Optional Cooling Alternate C - $2,650,050
- Alternate Concept No. 1 (36-Month Phase Construction) - $49,514,628
- Alternate Concept No. 2 (New Chemistry Building with Cook Renovation) - $67,541,000
Conceptual Budget

Base Concept

62 Month Phased Construction

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<td>Additions</td>
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<td>Interior Finishes</td>
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<td>Fittings and Equipment</td>
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<td>Modular Classroom</td>
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Total: $53,346,173

CONCEPTUAL ESTIMATE

May 2012

MEP Design Engineering

Section 3
### Conceptual Budget

**Alternate Concept #1**

**36 Month Phased Construction**

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<td>Building Enclosure</td>
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<td>Modular Classroom</td>
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<td><strong>Total</strong></td>
<td><strong>$49,514,628</strong></td>
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![Pie chart showing budget distribution]
**Conceptual Budget**

**Alternate Concept #2**

**New Chemistry Building with Cook Renovation**

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<thead>
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<th>Description</th>
<th>Cost</th>
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<tr>
<td>New 75,000 s.f. Chemistry Building ($477/s.f.)</td>
<td>$35,775,000</td>
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<tr>
<td>Renovation of Cook for General Classroom ($260/s.f.)</td>
<td>$31,766,000</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$67,541,000</strong></td>
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4. Use and Reliance Restriction
4. Use and Reliance Restriction

BVH Integrated Services, Inc. (BVH) has produced this document under an agreement between BVH and the University of Vermont. All terms and conditions of that agreement are included within this document by reference. Other than to the University of Vermont, BVH disclaims any obligations to any other person with respect to any material presented in this document, and no person may rely upon this document without advance and express written consent from BVH, and such person’s written agreement is to be bound by the limitations, qualifications, terms, conditions, and indemnities to BVH set forth in that agreement. BVH specifically states that its review of the property in question is subject to monetary restraints and scope limitations. Given those limitations and conditions, it has made what in its opinion, is a reasonable investigation. It has also relied upon interviews and documents with the understanding that our independent verification of their factual content was undertaken to the best of our abilities. The materials presented in this document are “to BVH’s knowledge” where such phrase means to BVH’s actual knowledge of the subject matter after such inquiry as BVH considered reasonable in light of the qualifications and limitations upon the scope of work.

The extent of the physical observation for the production of this report has been limited by Contract to walk-around visual inspections of the property, random operation of equipment, interviews and destructive testing of the envelope. Assumptions regarding the overall condition of the properties have been developed based upon observation of representative areas of the building. As such, the development of conceptual methods and associated costs for the correction of identified deficiencies is based upon the overview observations.