

January 9, 2007

via email: merle.miller @ state.vt.us

Dept. of Buildings and General Services  
2 Governor Aiken Ave., Drawer 33  
Montpelier, VT. 05633

Attention: Merle Miller

Dear Mr. Miller:

**SUBJECT:** 3<sup>rd</sup> *Draft*  
**Proposed First Round Detailed Diagnostic / Evaluation Scope**  
Emergency Response Proposal to Assist the Vermont Dept. of Buildings  
and General Services Regarding Indoor Air Quality/HVAC and Building  
Science Concerns Related to 200 Veterans Memorial Drive, Bennington,  
Vermont  
TBS # 682

### **BACKGROUND**

Per our authorized scope, we have completed a first review of the materials we received during our meeting in Montpelier on 11-29-06 and in subsequent communications from you. Additionally, we conducted a building walkthrough of representative areas and rooftops on 12-7-06, and have spoken with Dr. Austin Sumner. We also participated in a conference call with NIOSH, BGS, and VDH on 1-3-07, and with VDH and NIOSH on 1-8-07.

### **GENERAL SUMMARY OF OBSERVATIONS TO DATE**

Based on our history of working in buildings with IAQ concerns, our review of materials to date, and our building walkthrough we offer the following professional opinions:

- 1) **Possible Indicators of Building Failure Modes:** Based on our review of multiple reports, data recently collected by ATC (October 2006), and visual and olfactory observations on 12-7-06, there are multiple indicators of what we would regard as indicators of ongoing IAQ problems within the facility.

Problems, not with regard to exposures likely exceeding expected common office exposure guidelines, but lots of clues as to what might be some of the multi-factors or irritants driving the unresolved long history of complaints, health concerns, and thermal comfort issues.

2) **Visual and Olfactory Observations:** Based on our walkthrough to date we offer the following observations.

a. **Odors:** We experienced multiple odors during our tour. These include:

- i. Chemical VOC's: Some were strong and chemical in nature such as likely VOC from binding carbon black, iron filings, and proprietary polymer to paper (photocopying or laser printing),
- ii. Fuel Like: others were related to fuel oil smells,
- iii. Musty Smells: others were more traditional musty smells.

Based on the ACT Carbon Dioxide monitoring data in the October 2006 report (and other historical data) one would expect most spaces to be well ventilated (meeting ASHRAE Guidelines) and not experiencing significant obvious odors as we did during our tour.

Our olfactory observations would imply either currently failed or inadequate dilution ventilation on the day we were on site; significant identifiable odor sources that need to be removed or isolated and controlled to reduce further olfactory exposures, or a combination of the above.

Whatever the current situation, it is our recommendation that the sources of the odors need to be identified for elimination or better control than dilution is currently providing. Improved control approaches will be recommended in accordance with ASHRAE guidelines for source control. ASHRAE Std. 62 guidelines for general dilution are primarily based on the dilution of body odor, not identifiable point sources.

b. **Visual Observations of Stains:** We experienced multiple types of staining during our walkthrough. In all cases the source of the staining needs to be identified for permanent repairs or altering of building systems. These stains include:

- i. Water Damage On Ceilings: Ceiling staining was observed in some cases; current sources of moisture need to be identified for temporary management and subsequent permanent repair.
- ii. Water Damage On Floors: Effervescence on materials located indoors was observed in some exterior perimeter areas. Current sources of moisture need to be identified (some are obvious) for permanent repair.
- iii. Water Staining On Exterior Brick: Some staining on exterior brick was observed in multiple locations, this could be related to splash back, window drainage patterns, flashing details, or other building features. Given the history of musty complaints, it is important to determine if there is hidden water damage and mold amplification in any of these areas for permanent repair.
- iv. Suspect White Wall Staining: We observed some staining on exterior stud lines in some stairwells of the three story building. This staining or ghosting is typically related to Carbon (Soot) particle deposition or in rare cases mold growth.
- v. Suspect Ceiling Diffuser Staining: We observed signs of dark dirt accumulation on some ceiling diffusers. This is a possible indication of several situations that need to be evaluated for correction. These situations include possible dirt accumulation in ducts, possible inadequate floor cleaning, or possible fugitive Carbon Particles related to the boilers or some other exterior sources of soot.

#### **PROPOSED EVALUATIONS/ DIAGNOSTICS TESTING:**

Based on our experience in other occupied buildings with a history of unresolved health concerns, and our awareness of the technical published guidelines by NIOSH, OSHA, and US EPA, we offer the following specific evaluation and diagnostic approach to address the current situation to be implemented upon authorization to proceed. We recommend much of the work be conducted ASAP prior to vacancy of the premises.

General Statement: As stated in our proposal, we do not propose to duplicate evaluation work/testing that has been historically conducted in a comprehensive manner regarding environmental measurements. We do propose repeating some measurements in combination with new measurements to answer specific diagnostic questions. Any duplication of past measurement would also serve to validate most recent conditions within the facility.



Any intrusive disassembly work of wall cavities within the facility would be coordinated with contacts that are conveyed to us, and we would strongly prefer to do any intrusive disassembly walls during off hours or after vacancy has occurred.

Based on our expertise in building science, industrial hygiene, mechanical engineering, and building operations, we will formulate and offer an opinion regarding the conditions in the building that are prudent to correct based on the data available from others and our observations and analysis.

### **PROPOSED TIMELINE AND SPECIFIC DIAGNOSTIC TASK ITEMS**

1. Kick-off Meeting: Either before our beginning of the following tasks or the day before we are to start on site tasks, we propose a meeting with all stakeholders to present what we plan to do and why and to listen to any concerns we may not yet be planning to address.
2. Limited Particle Diagnostics: Based on our review to date and our walkthrough observations we propose that it is important to better understand the occupants current exposures to particles and the make-up of certain current deposited stains.
  - a. Indoor Deposited Soot Evaluation: We propose to collect deposits of soot from the boiler breaching at the barometric dampers and various appropriate surface in representative areas in the building for evaluation of composition via Microscopy and GCMS utilizing the laboratory services of Dr. Lori Streit, of Unified Engineering, Aurora, Illinois. She is very experience in the field and has successfully evaluated low levels of materials for us in several other cases.

Rational: This data will help us to understand the role the boilers have historically played in impacting the observed staining within the building.

Costs: We estimate initially 4 samples and a lab cost of **\$ 1,800.00** If addition sampling sites are requested by stakeholders the can be accommodated for an additional cost of \$1,800 per additional 4 samples.

- b. Indoor/Outdoor PM-10 Particle Measurements: Based on discussions with VDH and others we propose to collect both PM-10 and PM-2.5 samples of airborne dust in 2 locations indoors and two outdoors, moved around the facility (with item c. below), for three time periods spread out over a three week time period for a total of 24 samples. Additionally, we will run a dust trak monitor in four locations for comparison to the previous ATC data.



Rational: This data will help us to better understand the dust track data collected by ATC and how it compares to the BASE Data the health department has referenced. In most cases in the BASE data set in offices, the indoor levels were about ½ of the outdoor levels. This does not look to be the case in the ATC data if the outdoor levels are normally not elevated in the area. In a building with reasonably good air filters, as this one is reported to have, one would expect levels indoors to be lower than outdoors, unlike schools which are the opposite.

Costs: We estimate the 24 samples; with elemental analysis for 48 elements will cost \$ 2,400 for Teflon filters and analysis, \$ 8,640 for equipment use over a three to four week period. The equipment use fees will be able to be reduced by \$7,000 if the equipment is borrowed from NIOSH through a cooperative agreement.

- c. Continuous Laser Particle Counting: We propose to collect indoor and outdoor particle data with a size cut of 0.5 microns and 5.0 microns in 2 location moved around the facility for one week periods (with item b. above, for three time periods spread out over a three week time period.

Rational: This data will help us to better understand any relationship of combustion fumes or road dust size particles to the dust track data collected by ATC, and possible historic deposits of soot within the facility. We propose to collect this data with a temporary wind speed and direction unit, and temperature and humidity logger, set up on the lower level roof during the same time period. Weather data will also be available to compare to wind directions of local surrounding exterior sources and laser particle counts should this be of interest.

Costs: We estimate the three weeks of sampling, at total of 6 actual sites within the facility, will cost \$ 4,800 for equipment use, including the temporary weather station, over the three week period.

- d. Continuous Co-located Ventilation Assessment: We propose to collect Carbon Dioxide, Carbon Monoxide, Relative Humidity and Temperature data a the same sampling station as items b and c above, (two stations a week).

Rational: This data will help us to better understand any relationship between current ventilation rates, occupancy, and HVAC ventilation control operation during the particle sampling periods that are planned. During our walkthrough

some outdoor air supply system dampers were noted to be closed when we would expect them to be open.

Costs: We estimate the three weeks of sampling, at total of 6 actual sites within the facility, will cost \$ 3,800 for equipment use over the three week period.

3. Limited Pressure Field Diagnostics: Based on our review to date and our walkthrough observations we propose that it is important to better understand the current pressure fields within the facility.

- a. Indoor Zone Diagnostics and Continuous Logging of Selected Areas for Three Weeks: We propose to collect digital pressure measurements during an all day walkthrough at every door in the facility during normal occupancy and HVAC operation. Additionally, will items #2 b,c, and d above are conducted we propose to continuous log the pressure relationship between the boiler room and hallway, and hallway and outdoors.

Rational: This data will help us to understand the role the current air pressures have in moving air from one area to another and any possible interior impact the boilers may have on the indoor air quality, such that we can specify corrective action.

Costs: for equipment use for three weeks \$ 2,400.00

4. HVAC Detailed Hygiene Inspections. Conduct detailed inspections of all drain pans and duct liner in the immediate vicinity of any drain pan for signs of mold amplification, and inspect all air handlers and HRV's. Based on our current understanding of the drawings, we estimate the total number of equipment pieces to be observed to be in the range of 90 units. Current numbers appear to include 10 Rooftop AC units, 6 Energy Recovery units, and 75-80 heat pumps. There are no heat pumps reported to be in the ground floor area, however we observed a unit while on site. We do not know at this point what other discrepancies my exist.

Rational: Based on the long history of musty or mold smells reported we believe it is critical for TBS staff to inspect all HVAC units of hygiene conditions. Representative bulk samples can be taken if there areas of questionable growth. From this data we will determine any likely need for future duct camera inspections downstream of the air handlers.

Costs: Lab fees for analysis of suspect bulk samples will be budgeted at \$1,000 for up to 16 samples. Labor including photo documentation will be figured in the overall budgeting.

5. HVAC Detailed Control Observations. Conduct detailed observations of the basic control functions of all air handlers, HRV's, and heat pumps as applicable. As noted above, based on our current understanding of the drawings, we estimate the total number of equipment pieces to be observed to be in the range of 90 units.

Rational: During our walkthrough, dampers were noted in positions where they would not expect to be during the occupied period in the building. Based on the long history of thermal comfort and IAQ concerns we believe it is critical for TBS staff to look at all basic control functions. From this data we will determine any likely need for future repairs or replacement.

Costs: There are no Lab fees or equipment use charges. Labor including photo documentation as warranted will be figured in overall budgeting.

6. Settled Dust Evaluations: Collect representative settle dust samples for analysis.

Rational: Based on the history of concerns and reported historical neighboring historical sources, we feel it is prudent to collect a minimum of representative bulk samples of settled dust and evaluate it for:

1. Typical Allergens such as Dust Mite, Dog, and Cat Allergens
2. Optical Particle Morphology including fiberglass.
3. Unusual materials such as PCB's.

Costs: Further specific sample size and cost estimates need to be developed based on VDH and NIOSH input. We recommend a budget in the range of \$3,000.00 for laboratory analysis of multiple items.

7. Infrared Inspection With Blower Door Pressurization: Based on our walkthrough observations, review of information, and discussion with others, it is clear that cluster flies and their control have been a long term issue in this facility. We propose to conduct diagnostics to determine specific air leakages sites in the facility that are typically also insect entry sites.

Rational: It has been our experience that cluster fly problems are primarily a result of the existence of building shell air leakage sites. The integrated pest management approach to this situation is blockage of pathways for entry. IR with

building pressurization during the heating season is the fastest and most cost effective means of locating sites for sealing. This activity may also identify areas for possible intrusive disassembly for moisture diagnostics at a later date.

Cost: For infrared leakage site identification, (certified operator and camera) including TBS double blower door usage is estimated at **\$2,400.00.**

8. Tracer Testing. Conduct two types of tracer testing. The simplest test is to inject theatrical smoke into the sewer vent system to check for fugitive leaks or visual signs of roof vent re-entrainment into air intakes. The second test is to release very low levels of inert SF<sup>6</sup> (Sulfur Hexafluoride) into the boiler room under normal operating conditions (with the building vacant on a holiday or weekend). From this tracer gas study we will determine if materials originating within the boiler room readily find their way into the building and the predominant transport route.

Rational: Based on the long history of reported odors, these tracer tests will confirm if there are any sewer gas leaks and the predominant routes of boiler fume transport.

Costs: Equipment use fees for a portable Gas Chromatograph and related support equipment, and a theatrical smoke generator and blower will be budgeted at **\$1,000 for all equipment.** Labor including the tracer gas analysis and photo documentation of any sewer gas leads will be figured in overall budgeting.

9. Intrusive Disassembly of Walls or Duct Inspections. Conduct small intrusive disassembly areas of any suspect walls (Based on staining or Infrared Analysis) in the facility once it has been vacated. Investigation will be conducted with local negative air containment as warranted. The amount of areas is unknown. Currently we know of no areas where disassembly is clearly needed. Once the above eight analysis have been conducted, we could estimate a further scope and timeline. Conduct Duct Inspections via remote camera or other suitable techniques.

Rational: If obvious areas of microbial reservoirs are not located during the HVAC observations or other observations, limited intrusive disassembly of wall or duct inspections may provide answers regarding past reoccurring reports of musty odors.

Costs: Equipment use fees for establishment of temporary containment may be warranted. Fees for use of duct camera and

operator may be warranted. Scope and labor to be determined once a more detailed scope can be defined.

**ESTIMATED FEE AT COMPLETION OF THIS PHASE OF DIAGNOSTICS**

Based on the above tasks including labor to conduct each task and initial draft reporting so that the data can be discussed with the VDH and BGS. Based on approximately 90 pieces of HVAC equipment. **We estimate a total cost in the range of \$ 59,240** for this phase of work. This estimate includes \$31,240 for lab and equipment use fees. The total fee includes labor and travel expense for three intensive on-site periods over a four week period during January to February 2006, and initial data processing of all the material that will be generated. The above estimated cost for lab work and equipment use is approximately 300% in excess of any original estimates we may have envisioned for lab fees and equipment use for this diagnostic phase of work. *Savings of \$7,000 will be possible if NIOSH equipment is used.* This level of proposed testing and evaluation is because of the need to understand the magnitude and nature of the suspected fine particle exposure situation in the facility, and the route cause of historic musty smell concerns. Data will assist in the develop of specific items that will be necessary for adequate corrective action.

We have listed, for illustration purposes, our expected expenditures for each task:

Task # & Topic	Equipment Use And/or Lab Fee	Estimated Labor Site & Initial Analysis	Estimated Total Cost
1a Deposited Soot Eval.	\$ 1,800	\$ 2,400	\$ 4,200
b PM-10 and PM2.5	\$11,040	\$ 4,400	\$15,440
c Laser Particle Ct.	\$ 4,800	\$ 2,400	\$ 7,200
d Ventilation Co-located.	\$ 3,800	\$ 2,400	\$ 6,200
3 Pressure Fields& Logging	\$ 2,400	\$ 2,400	\$ 4,800
4 HVAC Hygiene	\$ 1,000	\$ 6,000	\$ 7,000
5 HVAC Controls	\$ 0	\$ 2,400	\$ 2,400
6 Settled Dust Eval.	\$ 3,000	\$ 1,600	\$ 4,600
7 Infrared & Press.	\$ 2,400	\$ 1,600	\$ 4,000
8 Tracer Testing	\$ 1,000	\$ 2,400	\$ 3,400
9 Intrusive D. or Duct In.	\$ ?	\$ ?TBD	\$ TBD

Travel for three partial weeks of on site activities to accomplish above tasks

Estimated at 1,000 miles at \$.40 = \$ 400

Overnight Motels \$ 900

Meals \$ 600

\$1,900

Total Above \$ 59, 240



## **CLIENT RESPONSIBILITIES DURING PROPOSED SERVICES**

In order to conduct the observations, measurements and analysis as outlined in this scope of work, we would need the following:

1. At some point, a detailed explanation of current HVAC control strategies and sequences of operation as the controls are being operated today, and specifically during proposed testing periods.
2. During all periods of on-site work, access to the facility with at least one person who is very familiar with the building and the HVAC control system, and has access to any keys needed for access to any area. Access to a small, heated and cooled, securable staging area (approximately 150 sf) during periods of on-site work to stage our equipment.
3. Availability of an individual with access to HVAC control during any on-site testing, and information regarding any trend logging that is available.
4. Authorization from the Owner (Client) for access to various appropriate areas, equipment rooms, and the roof, and assistance from the Client's representative during periods of on-site roof work, including access to any ladders necessary for access to above ceiling spaces for HVAC inspections.
5. Assistance with coordination with Stakeholders Team.

We appreciate the opportunity to be of service to you, and look forward to further assisting the Vermont Department of Buildings and General Services and Vermont Department of Health with the outlined diagnostics and upon approval development of specifications for resolution of this situation.

If there are any elements of this proposed scope that need clarification, please contact us in our Harrison, ME office at (207) 583-4571, ext. 11 or 14.

Sincerely,

TURNER BUILDING SCIENCE and DESIGN, LLC

William A. Turner, MS, P.E.  
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