Report of Indoor Air Quality Investigation for 2nd Floor Geology Building

Executive Summary:
Complaints from two occupants of the Geology building about the quality of the air in their offices have been investigated repeatedly over the past four years.

There have been incidents of note.
- Several were related to the building being occupied while under construction including construction debris dust and sewer gas.
- One incident was due to the departmental barbeque activity near to below grade air intake.

To date we have found no indication of any harmful exposures at or above the regulatory limits for chemical exposures to employees.

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BACKGROUND

Complaints regarding the quality of the air on the second floor of Geology have been reported intermittently to Environmental Health & Safety (EH&S) over the past four years. One of the employees in suite 2258 submitted an injury claim recently and a tenured faculty member resigned citing poor indoor air quality as the cause.

Please review figures 1, 2, 3, 4 and 5 for the location of the Geology building at UCR, the 2nd floor plan for Geology and the floor plan highlighted with the locations of the two persons referenced above as well as pictures of the rooms 2460C and 2258E respectively.

OBSERVATIONS, TESTING RESULTS AND CORRECTIVE ACTIONS

EH&S and Physical Plant responded to above indoor air quality complaints and following is a summary of our observations, testing results and corrective actions taken by both EH&S and Physical Plant. As the initial complaints were from one occupant of the suite at 2258 Geology, the narrative focuses on this situation first:

- May 19, 2008 – Louise DeHayes reported that unknown debris dropped from the air supply vent and fell in the office suite. EH&S and Physical Plant responded and investigated the complaint. During the weekend prior to this event the building ventilation system (HVAC) was shut down to allow the construction contractor to connect the new HVAC ductwork to the existing HVAC ductwork. Some construction debris migrated into the existing building ductwork during this process. When the building HVAC system restarted, the debris blew out of the HVAC vent. Although the dust level in the office suite was far below OSHA permissible exposure level for nuisance dust, which is 5 mg/m³, three work orders (08W040870, 08W040871, 08W041005) were created and Physical Plant installed woven filter medias above the supply air grills for the office area to mitigate nuisance dust concern. In addition, Physical Plant performed visual inspection of the ductwork and diffuser and no debris buildup was observed.

- Between June 2009 and November 2010 – EH&S received several phone calls regarding either natural gas smell or unidentified smell in the Geology 2258 office suite. Each time EH&S responded to the complaint and surveyed the office suite and surrounding area with a four gas meter equipped with hydrogen sulfide, carbon monoxide, oxygen, combustible gases sensors and a photoionization detector (PID). These reading were consistently normal with the oxygen levels at 20.9%, hydrogen sulfide and carbon monoxide concentrations were both below 1 ppm (the detection limit), and combustible gases concentrations were below 1%. Except for one instance in which sewer gas smell was detected once at the first floor near the elevator area, no odors in the office area were detected by EH&S. During the same period of time, Laurie Graham reported sewer gas odor from other areas in Geology building to Physical Plant and Physical Plant Plumbing Shop responded to these events. However, Physical Plant employees had experience similar to EH&S – the apparent sewer gas odor dissipated quickly and was not
detected when Physical Plant employees arrived the scene. The Physical Plant employees were not able to identify a source for the reported odors.

- **February 4, 2011** – Professor Chris Amrhein reported that smoke entered into his office Room 2460C in Geology building through supply air vent and smoke inhalation made him sick. EH&S arrived the scene within 5 minutes after receiving the complaint. At this time the Earth Science department was grilling hotdogs and hamburgers at the courtyard near air intake of Air Handler Unit 1 which provides outside air to many rooms including 2460C. It is possible for the smoke from the grill to migrate into the air intake and eventually enter 2460C; however, at the time EH&S arrived, there was no visible smoke in the building and barbeque odor was detected by the responders on the first floor. EH&S responders interviewed several building occupants whose offices were adjacent to Room 2460C. They smelled the barbeque earlier, but did not see any smoke in their office. EH&S recommended Earth Science to set the barbeque grill further away from the air intake for future events. Figure 7 illustrates the current location of this activity.

- **April 29 2011** – Melody Powell reported to EH&S that the odor in the building made her sick. She also informed EH&S that Laurie Graham found several uncapped sewer pipes in the basement. EH&S requested Physical Plant to assist with the issue. Physical Plant Plumbing Shop found that two pipes in room 1323 were cut during Geology Renovation project and these pipes were never plugged. Physical Plant sealed these pipes. However, sewer gas smell in the subbasement was reported to Physical Plant couple weeks later by other building occupants. Physical plant plumbing shop surveyed the whole basement and subbasement areas again and found additional uncapped 2” sewer line and sealed the line.

- **November 2011** – Melody Powell emailed EH&S and asked whether the sewer system was connected to the HVAC system. EH&S contacted Melody and informed her that these two systems were independent systems and HVAC system was not the source of sewer gas. EH&S also followed up with Physical Plant Plumbing Shop and found multiple surveys for the uncapped sewer lines were conducted by their employees since the problem was reported. All uncapped sewers lines identified during these surveys were capped. At the same period of time, some dry sink drain traps problems were reported in Geology building by other employees. Dry traps were identified as the source of sewer gas smell in the building for these events. Physical Plant repaired a trap primer and poured water down several dry sink traps to mitigate the problem.

- **April 2, 2012** – Melody Powell requested an air filter to be installed at the supply air vent in her office. She believed some unidentified materials released from the supply air vent made her sick. A small portable fan in her office helped to relieve her symptom. EH&S discussed her concern with her and identified that the HVAC system was an unlikely source of her health problem and the portable fan was unlikely to have any effect to reduce exposure. She requested information for a portable HEPA filter air cleaning unit to help relieve her symptom. HEPA filter air cleaning unit information from Consumer Report was emailed to her as a reference. During a follow-up site visit, Melody Powell indicated she would purchase a smaller HEPA filter unit other than what was recommended by Consumer Report. She also expressed her concern of air contamination migrating from the adjacent lab spaces to her office. EH&S surveyed these lab spaces with the device referenced to earlier. The detected conditions were normal with oxygen concentrations were 20.9%, hydrogen sulfide and carbon monoxide concentrations were below 1 ppm, combustible gases concentrations were below 1% and volatile organic compound concentrations were below 1 ppm. All chemical containers in these labs were capped and no smell was detected in these areas. In addition, EH&S evaluated the relative hallway/lab air pressures for these areas with a smoke tube. All labs, except 2268 and 2278, had negative pressure compared with the hallway. A Work order (12 12W009413) was created.
April 8, 2012. Physical Plant personnel surveyed the basement area on April 8, 2012 and found no additional sources of the sewer gas odor reported.

April 12, 2012- Professor Chris Amrhein reported an odor he described as an organic vapor, entered his office through supply air vent which he associated with adverse physical reactions he described. He also reported that this toxin came from the air supply register but it only occurred in his office, but not any of the adjacent offices. EH&S inspected room 2460C and measured the air quality in his office using the previously mentioned four gas meter with PID. Volatile organic compound, carbon monoxide, and hydrogen sulfide concentrations were below 1 ppm (detection limit). The oxygen concentration was 20.9% and combustible gases concentration was below 1% (detection limit). No odor was detected in the office by the responding EH&S staff. EH&S also interviewed several building occupants whose offices were adjacent to Room 2460C and none of them reported smelling chemicals emitting from the air supply vents during period of time in question. EH&S staff also measured the relative room pressure for laboratory space near Room 2460C. All of the labs near 2460C had room air pressures which were negative with respect to the hallway.

April 17, 2012 – Professor Chris Amrhein expressed concern that the chemicals inside room 1510 Geology were contaminating the air supplied to his office. EH&S staff inspected 1510 and found that all chemicals containers were closed without apparent external contamination, no odor was detected and the air concentration of organic compounds, carbon monoxide, hydrogen sulfide and oxygen as measured with the previously mentioned four gas meter and PID. The air handler unit 2 which is located on the rooftop of Room 1510 supplies air to south wing of the second floor, not 2460C which is located in the North wing of the second floor (and supplied through the air intake in the courtyard on the opposite side of the building.

April 24, 2012. Climate Control personnel adjusted the room pressures for two labs, 2268 & 2278, which EH&S found were not previously negative with respect to the hallway.

DISCUSSION AND CONCLUSION

1. The air supply for the building is ‘single pass’ or 100% outside air and the ductwork is clean. It is highly unlikely that contaminations other than what naturally exist in the outdoor air will be delivered through the vent to any office. Figure 6 illustrates the location of the supply air intakes and building distributions.

2. In a review of the mechanical plans for the Geology Building, EH&S and A&E staff confirmed that all offices inside Suite 2460, included 2460C, shared the same air supply which matches field observations. As all of the air for the rooms around 2460C is supplied from the same source, it is reasonable that anything which affected 2460C through the air supply system would also affect each of the adjacent rooms.

3. All laboratory spaces near Room 2460C were found to have negative air pressure as compared with the hallway so the likelihood for any chemical vapors to migrate from the laboratory space through the hall into 2460C is extremely small.

4. Sewer gas is a complex mixture of toxic and non-toxic gases that can be present at varying levels depending upon the source. It is formed during the decay of household and industrial waste. The most toxic components of sewer gas include hydrogen sulfide and ammonia. Sewer gas also contains methane, carbon dioxide, sulfur dioxide, and nitrous oxides. In addition, chlorine bleaches, industrial solvents, and gasoline can be occasionally present in sewage treatment systems.

5. There is no evidence of overexposure to sewer gas, but if there were, the principle hazards are:
   a. Hydrogen sulfide poisoning. Exposure to low levels of hydrogen sulfide causes irritation of the eyes and respiratory tract. Other symptoms include nervousness, dizziness, nausea,
headache, and drowsiness. This gas smells like rotten eggs, even at extremely low concentrations. Exposure to high concentrations can interfere with the sense of smell, making this warning signal unreliable. At extremely high levels, hydrogen sulfide can cause immediate loss of consciousness and death.

b. **Asphyxiation.** High concentrations of methane in enclosed areas can lead to suffocation as large amounts of methane will decrease the amount of oxygen in the air. The effects of oxygen deficiency include headache, nausea, dizziness and unconsciousness. At very low oxygen concentrations (<12%), unconsciousness and death may occur very quickly and without warning. Sewer gas diffuses and mixes with indoor air, and will be most concentrated where it is entering the home. It can accumulate in basements.

c. **Explosion and fire.** Methane and hydrogen sulfide are flammable and under the right conditions can be explosive.

6. During our onsite assessment, hydrogen sulfide concentrations were always below 1 ppm. The Cal/OSHA 8-hour average Permissible Exposure Limit\(^{iv}\) for hydrogen sulfide is 10 ppm. An average employee will not experience adverse health effect if the employee was exposed to hydrogen sulfide 8 hour a day and 40 hours a week at the permissible exposure level. The maximum measured concentrations to which our employees have been exposed were more than 10 times lower. The risk of adverse health effects from hydrogen sulfide exposure in the building is very low; however as the odor threshold for this distinctive rotten egg smell is 0.008 ppm it is easily detected at concentrations much lower than when it becomes hazardous. As such it is a nuisance to the building occupant and the odor needs to be address. Because the smell is transient, it is hard to locate the source or sources and both timely reporting and rapid response is very important.

7. The oxygen concentrations in the normal range. There was no sign of any oxygen depletion.

8. Combustible gas and volatile organic compounds were not found at hazardous levels in the area; therefore the risk for fire and explosion is very low.

9. While the EH&S records indicate there are 68 chemicals stored or used in room 2268 and no chemicals in 2278; monitoring the air in the labs showed normal atmosphere with no measureable air contaminants from these locations. It is highly unlikely the lab air that migrated to the office suite would cause adverse health effects. Because the all labs were designed to have a negative pressure, EH&S placed a work order to change the air pressure in these labs simply to make sure all lab spaces met design guidelines.

**Summary**

There is no evidence that the air quality inside Geology is significantly different from the air outside the building. We identified transient events, such as barbecue emissions in the courtyard and truck exhaust at the loading dock along with recurring, persistent nuisance of odors from the sewer system. The dry traps and open sewer lines that seem to be a result of the remodeling activity were addressed as they were reported and the sources identified. This source appears to have been resolved. Beyond these we found no evidence for any exposures. All together we found no evidence of any airborne contaminant that would likely significantly contribute to any adverse health effects.
Figure 1. Location of Geology at UCR

Figure 2. Geology 2\textsuperscript{nd} Floor Plan
Figure 3. Geology office location of persons identified

Figure 4. Pictures of 2460C Geology
Figure 5. Picture of 2258E Geology

Figure 6. Locations and distribution of Geology Air Supply Sources
Figure 7. Location of the Earth Science Barbeque and the Air Handler Unit 1

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1 The specifications for the instrument used can be found at: [http://www.raesystems.com/sites/default/files/downloads/FeedsEnclosure-EntryRAE.pdf](http://www.raesystems.com/sites/default/files/downloads/FeedsEnclosure-EntryRAE.pdf)
2 As investigated through a visual inspection by the Climate Control Shop Personnel, provided as a personal communication to EH&S.
4 For context: [http://www.dir.ca.gov/Title8/5155.html](http://www.dir.ca.gov/Title8/5155.html) for limits: [http://www.dir.ca.gov/Title8/ac1.pdf](http://www.dir.ca.gov/Title8/ac1.pdf)