Town of Creston **March 24, 2018**

Fire Hall

200 10th Avenue North

Creston, BC

V0B1G4

Attention: Michael Moore Fire Chief

SUMMARY OF SITE ASSESSMENT

A request was made by you with regards to an assessment of the existing fire hall. The intent was to conduct a preliminary review of the existing building with regards to the potential for worker exposure and to assess the adequacy of the existing ventilation system in mitigating worker exposure to contaminants from truck emissions and from decontamination processes to remove contaminants derived from firefighting events.

A preliminary assessment of the fire hall was conducted on the 6th of March. The initial review consisted of a general site walk through of the existing building followed by an assessment of the ventilation systems and controls that are presently in place.

The fire hall is partitioned into two separate areas, a truck bay and an office, work activity area. Each area has its own ventilation supply. The issues found during the walk through and preliminary assessment will be highlighted into the office/work area and the truck bays.

OFFICE/WORK AREA

Duct Cleaning: All the make-up air vents supplying air to the training room, fire chief and deputy fire chief's offices were dirty. The return vent in the training room was also quite dirty which suggests the ducting throughout is dirty. Fine dusts will settle when the system is off and will reenter into the space when it reactivates. Any moisture entering the system will increase the risk of mould growth. Staff do not believe the ducting has been cleaned since it was installed. The entrainment of fine dusts can affect some people. Commercial ventilation systems should be cleaned at a minimum every 10 years.

Supply air: General ventilation supply in office environments normally involve introducing supply air to working areas. The make-up air system supplies the training room, the fire chief's office and the assistant fire chief's office. Other work areas do not receive any supply air. Normal ventilation systems should be supplying air to work areas which would include the admin area and kitchen. Air supply should be balanced throughout and have a minimum flowrate in accordance with standards.

Return air: The only return air I could find to the office ventilation system is located in the training room. Normal returns tend to draw from all work areas to ensure adequate air mix and movement.

Cleaning room: The cleaning room has an exhaust fan positioned high above on the wall. When staff clean their firefighting equipment any contaminant release from the cleaning process would still enter

the workers breathing zone before it eventually exhausts through the exhaust fan. Contaminant control normally requires capture at the source in the form of a slot hood that draws contaminants away during cleaning. Any cleaning of turnout gear through the washing machine and dryer would also need to have dedicated ventilation.

Cleaning room location: There is a concern that contaminated turnout gear brought down the hall from the truck bay to the cleaning room will contaminate the office space as they pass through to the cleaning room. Ideally the cleaning room should be directly off from the truck bay area to prevent any potential contamination from occurring in the office space. The only way to ensure what exposures to both particulate and gaseous emissions are from this activity would be to measure the airborne concentrations. Better exhaust ventilation to remove any contaminants away from the breathing zone is needed.

Recirculated air: It was not apparent if the supply air to the office/work area is drawing air from outside. If there is no fresh air supply, then air contaminants would increase. Normal engineering ventilation principles utilize a minimum 10% fresh air mixed with recirculated air.

Temperature demand: The existing system does not supply any air to the office/working area when the temperature set point is met. This means that air is not entering any work area which can result in accumulation of CO_2, contaminant releases and body odours.

Negative pressure: The office ventilation system is pulling air into the unit more than it is putting back into the office. This will create a slight negative pressure which may cause contaminants to enter into the office area from the truck bay. Ideal is to be in a slight positive pressure.

TRUCK BAY AREA

Turnout gear storage: All turnout gear is stored in the truck bays. Any emissions from truck operations can adhere on this safety equipment. Any contaminants on turnout gear can off gas. There are guidelines from NFPA that recommend a dedicated vented room for this equipment.

CO sensor location: The carbon monoxide sensor is located in the southwest corner wall of the truck bay. The location may not be ideal for quantifying CO concentrations representative of the whole truck bay area since the location is close to a truck bay door. Relocation of the sensor back nearer to the office area may aid in reflecting a better exposure profile. Consideration should be made to source out the availability of a NOx (nitrogen dioxide/nitric oxide) sensor since CO and NOx are both contaminants of concern to staff.

Calibration of sensor: The CO monitor has not been calibrated for some time. It is not certain that the readings are a true representation of the concentrations at the sensor head. Calibration in accordance with manufacturer's specification is required along with monthly bump checks or monthly calibrations to confirm the sensor is operational.

Ventilation system: The existing ventilation system in use in the truck bay consists of two wall exhaust fans (one in north wall west side and one on south wall east side) and one wall supply fan (on north wall east side). The fans are activated once the bay doors are opened or if the sensor reaches a set point. Measurements of the exhaust and supply air indicates a slight positive pressure (10,200 cfm vs 9240 cfm) of the bay is occurring once the fans are activated. Ideally the system should be in a slight negative

pressure to minimize any migration into the office area. There is a sign to activate the fans prior to vehicle start up, but this is not a foolproof method. Preference is to open the bay doors first which will activate the fans, then turn on the vehicles.

Ventilation effectiveness: Measurements of air movement at various locations indicate dead zones where minimal to no air movement is taking place. Albeit these readings were taken with all trucks in the bays with doors closed and doors open, it does indicate that the location of the exhaust fans in relation to the makeup air fans is not ideal in flushing out contaminants. Preference is to have the exhaust fans located on one wall with the makeup air located on the opposite wall. This will create a better laminar flow movement than present but it is still not ideal. Good engineering principles recommend capture at the source followed by general exhaust ventilation if local exhaust capture is not totally effective. At present there is one exhaust fan on the same wall as the makeup air fan. There is a high potential for short circuiting (exhaust air reentering into the makeup air fan) since prevailing winds are normally west to east, hence exhausted air will move east towards the makeup air fan.

Tempered makeup air: In the truck bays there are two furnaces located in the mezzanine that recirculate truck bay air to maintain temperature in this space. This is not ideal. Tempered make-up air should come directly from the make-up air supply. Secondly, recirculating this air through the furnace has the potential for leakage up in the mezzanine area which is directly above the office working area.

Door seals to office: One of the preventative measures to minimize contaminant from entering the office work area is to ensure effective seals of the common doors between these two spaces. Regular checks on the systems is needed to minimize migration of contaminants.

Worker exposure to contaminants: WorksafeBC has 8 hour, 15 minute and ceiling limit allowable exposure limits for many contaminants. During vehicle startup and actual fire response situations, the contaminants staff are routinely exposed to would include carbon monoxide, carbon dioxide, nitrogen dioxide, nitric oxide, diesel smoke, combustion breakdown products and the cleaning products. Since the existing setup has generated concerns from staff regarding contaminant exposures it would be prudent to quantify what their exposures would be.

Regards,

Richard Forget MSc (A), CIH, CRSP
Director
Western Canada Safety Services Ltd.

INTRODUCTION

A preliminary review of the exiting fire hall was conducted on the 6th of March. The intent was to assess the existing controls for effectiveness, review cleaning methods and to identify any potential deficiencies with recommendations.

A walk through was conducted initially to see how the building was utilized. The building is separated into two functional units, one being truck storage and the other being used for office and working operations. The truck bay is broken into three zones for vehicle storage. There are three bay doors accessing the west. The southeast area of the bay door has stairs to access the mezzanine. At the northeast side of the truck bay is a room that opens into the truck bay. This is the tool room. The mezzanine is used for storage and for containment of the furnaces that supply heat to the truck bays and the ventilation system that supplies air to the office and working area. The mezzanine is above the office and working area.

The office and working area consists of a large training room in the southeast corner, a kitchen to the west that opens to the training room and to the administration area. The public can enter into the admin area which incorporates the open office area. The open office area has individual rooms for the fire chief and the assistant fire chief which exits into the open office area. At the north end of the open office is a hallway. The west end of the hallway opens through doors to the truck bay. At the north side of the hallway is the tool room followed by the SCBA maintenance room, the cleaning room, the men's and women's washroom, a storage room and at the east end the compressor room/electrical room. The cleaning room is used after all firefighting events to clean all SCBA equipment. The turnout gear is cleaned using the washing machines and dryers.

The building construction is primarily wood laminate construction (south wall and west wall) with the north and east walls a combination of wood laminate and concrete. Concrete is primarily where the building is below the exterior grade. The roof is flat tar and gravel. North of the building is another building that is in close proximity and at a higher level to the fire hall. As you progress east, the same building has a raised parking lot which is level with the roof of the fire hall. There is a narrow space between the fire hall wall and the retaining wall of the adjacent parking lot. The makeup supply fan is located in this narrow space on the north wall east end of the fire hall. The truck bay exhaust fans are located in the northwest corner of the north wall and the southeast corner of the south wall. The building was originally purposed as a grocery store and had been modified to accommodate a fire hall. The truck bay ceiling is just high enough to accommodate the largest vehicles.

All ventilation supply and exhaust air flows were measured using a Kanomax thermoanemometer (excluding the washroom exhaust fans and the cleaning room exhaust fan).

Training room

The training room has five make up air supply vents located on the east and south side of the ceiling. There is one return vent positioned at the northwest side of the ceiling. The location of these vents should allow reasonably good air flow mixing in this room. All supply and return vents are connected to the Lennox ventilation unit via aluminum flex ducting. It was noted that every supply vent and the return vent had dirt accumulation on the face. This is usually as a result of inadequate cleaning of the ducting and ventilation unit system. When asked, no one could remember when the system was cleaned. They did mention that the filters for the ventilation system were on a scheduled replacement by local town staff. Most furnace or ventilation filters usually have a lower MERV rating. This will capture much of the particulate that passes through the system. However it does not capture all particulate.

Much of the fines will pass through the filter and get recirculated or caught in the ducting or system surfaces. When the system shuts down any fines within the ducting and system itself will settle only to be entrained on startup. As this progresses throughout the years, dust and dirt will accumulate. Ventilation specifications for commercial systems normally require duct and system cleaning every 10 years or even earlier depending on whether there is a lot of external dust entering the space. No chemical storage or handling was noted in this space.

The ventilation system supplying the office work area does not appear to have any external air supply. This should be confirmed. Good engineering principles for acceptable indoor air quality recommends a minimum 10% fresh air to be mixed with the existing recirculated air and pumped back into the working space. If no external fresh air supply is entering the system, then one may see a gradual increase in the concentrations of CO_2 which is an indicator of fresh air quality. One hundred percent recirculation will also increase odour levels which includes body odour, cooking odour, contaminants, cleaning product use, etc.

The Lennox unit was observed to be set on temperature demand mode. This mode only allows air to be circulated when the temperature is below a prescribed temperature level. When the temperature is met, no air movement occurs. This would be in contravention of proper ventilation requirements for good indoor air quality. The fans should be operated in continuous mode.

The existing make up air and return to the Lennox is not well balanced. From an initial review of the space there appears to be only one return to the Lennox unit. Measurements indicate air return at 964 cfm. Supply air into the training room was measured at 554 cfm. There were only two other supply vents found in the office working area which were in the fire chief's office and the deputy fire chief's office. Combined the supply to the office working area is ~650 cfm. The difference would place the space under slight negative pressure which will increase the migration of contaminants into this area. Preference is to maintain a slight positive pressure to mitigate the ingress of contaminants from the truck bay.

Kitchen

The kitchen area is adjacent and to the west of the training room. It is used regularly by staff. There is no makeup air or return air system in this room. Auxiliary heat is via an electric baseboard heater. The room is also open to the admin area. Normal ventilation designs for commercial operations will have supply air into each user space with either a mechanical return or a passive ventilation return to the ventilation unit. Any air movement to this space will be when the entry doors are opened or when someone walks through the space. The kitchen does use consumer products.

Administration area

This area has a front space for the public to access and three open office design workstations for firemen to use. There is no general makeup air or returns in this space. Auxiliary heat is via 2 electric heaters. Good indoor air quality protocol recommends having makeup air supply into this space at a minimum of 20 cfm per person with an effective return to the ventilation unit.

Fire chief and assistant fire chief's office

These offices each have a supply vent but no passive return outside of having the door opened. The air volumes entering these rooms are not well balanced and adjustments need to be made to ensure adequate supply to both rooms. The fire chief is receiving ~2.5 cfm while the assistant fire chief receives ~92 cfm. Ideally there should be a mechanical return in the admin area, and in each room. Barring this modification, a passive system would require either returns in the offices or louvered openings in the

doors when the door is kept closed. Low volumes in the fire chief's room would result in increased CO_2 levels. It was noted that the makeup air vents were dirty which indicates accumulation of dust and dirt in the ventilation system. Periodic cleaning of the system will help minimize this.

SCBA maintenance room
The room is not equipped with any makeup air or returns. It would be appropriate for a well-designed commercial system to have these in the space. If cleaners or any other chemical based products are used, it would be necessary to have exhaust ventilation to aid in removal of any contaminant release. Citroclean, Manorapid and lens cleaner are products used.

Cleaning room
In the cleaning room all SCBA's are sprayed down with Econoclean during decontamination. There are wash basins designed for this work. Above the work area at approximately 8-10 feet from the floor is a wall fan that I assume is activated when this work activity is performed. Smoke tubes were utilized to see what the airflow to the exhaust fan was like. There was gradual air flow to the exhaust fan but is was very slow. The fan cover was quite dirty suggesting this system has not been cleaned. If the fan is not periodically cleaned one will find dust and dirt accumulation on the fan blades. This will slow down the fan speed and hence it's rated capacity. Eventually the fan motor will fail due to the extra load.

The location of the exhaust fan is not ideal in capturing any contaminant release from the cleaning operation. Good engineering principles indicate that pulling contaminants away from the workers breathing zone is preferable. This would entail using a slot hood at the back of the washing station to move contaminants away while they are being cleaned. The AIHA Ventilation manual has useful information on proper slot hood design.

The location of the cleaning room is a bit problematic in that potentially contaminated gear must pass through the truck bay doors into the office work area hallway into the cleaning room. Some contaminants found from incomplete combustion during a fire event will likely have toxic chemicals in both vapour and aerosol phases adhered to the surface of the turnout gear and SCBA gear. This movement through the office working space may release this material which would affect staff in this area. Preference is for this material to be cleaned and properly vented in a room adjacent to the truck bay so that dirty contaminated gear does not enter the office work area.

Men's and Women's washrooms
Both washrooms are equipped with an exhaust fan according to code. Both fan faces were dirty which suggests that they need proper cleaning. Outside of the exhaust fan, there is no supply air to these locations. It would be appropriate to measure the airflows to see if it meets code requirements for ventilation exhaust.

Office supply storage
The office supply storage room does not have ventilation and if no chemicals are stored or used in the space it would not need ventilation. Ensure that no chemicals are stored in this space. It was noted that there was an opening in a brick chimney in this room. The opening will passively introduce air into the space but sealing of the chimney to prevent ingress of animals or birds would be advised. There is a hallway closet storing cleaner, consumer and WHMIS products such as Econoclean. There is always a concern from a spill and the need to ventilate a space.

Compressor room
This room has the compressor and the cascade breathable air storage cylinders. There are also numerous fire extinguishers located on the floor and some oil. This room does not have supply or return air. It was quite cool in this space. On a safety note, the main electrical panel had material stored within 1 metre to the panel. There must be a minimum 1 metre clearance from the panel to have safe access without obstructions. This room should have ventilation in the form of general exhaust in case one of the extinguishers is inadvertently released. If this is being performed (service and recharge) then there should be a dedicated station with its own ventilation system.

TRUCK BAYS
Main bay area
The truck bays are used to store all fire trucks and emergency response vehicles. There are three bays within this open space with dedicated bay doors for each bay. On the north and south side of the truck bay is where the firefighter turnout gear is stored. This is not the ideal location for storage of turnout gear. NFPA codes do reference the need for a ventilated space for turnout gear storage. Storage in the bay area does affect contamination of the turnout gear whenever the response vehicles are activated. Diesel exhaust particulate, vapours and gases can and will adhere to this equipment. Whenever such gear is used in a fire situation it is assumed that they are washed, dried and hung up. Even so contaminants can adhere to the gear and will off gas and release into the space. A dedicated vented space is needed for turnout gear. Some contaminants such as polycyclic aromatic hydrocarbons may be present which pose a risk to worker health.

Gas cans are stored at the front of the truck bay area. Due to the volume a flammable storage cabinet would be appropriate.

Under the make-up air supply is the fire hose dryer unit. There is a potential for contaminant release during this process which would result in release into the truck bay space. Venting to the outside should be confirmed.

CO sensor
The carbon monoxide sensor is located on the southwest corner of the truck bay at around 5 feet up from the floor near the bay door. The location of the sensor may not be the best location to give a true representation of the contaminant level. It may be more appropriate to relocate it nearer to the office working area. Once doors are opened the CO levels should dissipate at a quicker rate nearer to the bay doors versus the back area where the offices are located.

In discussion with staff it is not likely that the sensor has been calibrated for some time. Calibrations must be performed in accordance with manufacturer's specifications. A minimum annual calibration is required. This would entail performing a zero and a span gas check. This is necessary to ensure the sensor is reading linearly. If feasible the sensor should be either calibrated or bump checked monthly. These sensors are electrochemical and will eventually fail and it is imperative that calibration and bump testing be done to catch this failure.

The CO sensor has three fan modes, off, automatic and manual. The automatic mode should be verified that it will activate the fans when it hits a prescribed concentration. This set point should be conservative and be set at the 8 hour permissible exposure limit of 25 ppm. It would be necessary to see if the fan set at the off mode can be activated by a CO concentration that exceeds 25 ppm. I was advised

that staff will manually turn on the fan before the doors are opened and before the vehicles are started. I was also advised that once the bay doors are opened, the fans will activate.

NOx

Another contaminant common to diesel exhaust that should be considered for continuous measurement is NOx (nitric oxide (NO) and nitrogen dioxide (NO_2)). NO has an 8 hour permissible exposure limit of 25 ppm. NO_2 has a ceiling limit of 1 ppm which means no exposure should exceed this level. Depending on the service arrangement for the diesel engines, the engine size and the pollution controls for each vehicle, one can have widely different emissions. This should be measured with a wall mounted sensor for this contaminant along with CO. A survey using portable units should be utilized throughout the space during times when equipment is moved out and returned to quantify exposure profiles.

General exhaust and makeup air

The truck bay has two exhaust wall fans in the truck bay located at the north wall west side and in the south wall east side. Combined these fans exhaust at a rate of approximately 9250 cfm. The make-up air fan supplies the bay with approximately 10,200 cfm of supply air directly from the outside. It is located on the north wall east side. The prevailing winds tend to come from west to east. The supply is slightly pressurizing the space prior to the doors opening. This will enhance the migration of contaminants into the office working area. For this type of ventilation system it is better to have the room under slight negative pressure.

There is a building on the north side of the fire hall which is at a higher elevation to the fire hall. As one moves towards the east side of the building, there is a raised parking lot with a retaining wall approximately 1 metre from the fire hall's north wall at the same height up to the roof of the fire hall. With prevailing winds moving from west to east any contaminants exhausted from the NW exhaust fan has the potential to be entrained back into the fire hall truck bay by the supply exhaust fan since there is a restricted space which would tend to direct air down this narrow space where the supply fan is located. Preference is to capture contaminants at the source versus general capture. The use of breakaway local exhaust ventilation systems should be considered along with general exhaust ventilation.

To be effective, the exhaust fans should be located on one wall with supply air entering from the opposite wall. This will increase laminar movement of air towards the exhaust fans. Better design would have tempered makeup air entering at distributed spaces from the opposite walls. Smoke tube and ventilation checks were taken while the fans were operational to assess air flow throughout the space. This was done with all vehicles in the bays with bay doors closed and with several bay doors open. Airflows were quite varied anywhere from no air movement to ~40 fpm. With doors opened airflow nearer the doors increased. Smoke tube assessments confirmed that there were various dead zone throughout the space. Airflow measurements should also be performed when the service trucks have left.

Tempered air

At present the air entering the space comes directly from the outside. During low winter temperatures, the system may not stay operational due to freezing potentials. There are two furnaces located in the mezzanine that supplies heat to the truck bay. This system is a recirculating one, pulling air from the truck bay, heating it and returning the heated air to the truck bay. The system has some flaws in that any leakage at the furnace will be released into the mezzanine which is above the working area. These

contaminants can then migrate into the working area. Also the means to heat the space is not uniform. Heat is directed from the back area of the truck bay into the bay space. Tempered make-up air is the preferred replacement for supply air.

It is believed that the furnace filters are replaced on a scheduled basis.

Janitor room
The janitor room is located in the southeast corner of the truck bay. Various cleaning products are stored in this space. The space had a noticeable odour on entry. There was no general exhaust or makeup air to this space. This is needed to contend with any spillage or chemical off gassing.

Tool room
The tool room is used for mechanical repairs. Again this room is not equipped with either general exhaust ventilation or makeup air. There are various consumer products in this room such as ABC dry chemicals, WD 40, Wasp B Gone, etc. Any time chemicals are used ventilation should be utilized.

Air movement
The exhaust and makeup wall fans were activated to assess the effectiveness of the existing design. The primary makeup fan is located on the north wall east side and is supplying approximately 10,200 cfm of outdoor air when operating. The two exhaust fans are located on the north wall west side and on the south wall east side and they exhaust approximately 4,500 and 4750 cfm respectively. Smoke tube tests were performed at various locations inside of the truck bay with all trucks inside and the doors closed and with two of the three doors open. It was noted that there were many locations within the truck bay where it was observed that virtually no air movement was occurring. With the two bay doors open the air movement increased near the doors but was quite limited further back. I was informed that the prevailing winds are from west to east. As the doors are opened the prevailing winds would migrate into the bay area which would aid in dilution. One concern is with the northwest exhaust fan. With the raised elevation of the adjacent building the exhausted contaminated air would follow the contours of the building and funnel through between the north wall and the retaining parking lot wall of the adjacent building and is most likely to re-entrain back into the truck bay. Retesting this space when the trucks are removed or for simulation of the regular trucks that are used would be recommended to assess airflow.

General concerns

Staff have raised concerns over potential health issues with handling contaminated turnout gear through the hallway into the cleaning room as well as potential exposures from diesel exhaust. The only way to ascertain what the level of contaminant exposure would be to measure contaminant release. Contaminants of concern would include carbon monoxide, carbon dioxide, nitrogen dioxide, nitric oxide and elemental carbon (basic component in diesel exhaust). The elemental carbon should be looked at to see what other toxic chemicals have adhered to the particle. The gaseous contaminants and particulate matter should be measured in the office working area and in the truck bay for the duration of a working day. Ideally it would be prudent to measure during and after a fire fighting event but this cannot be scheduled. The gaseous and particulate component analysis would give a good assessment of exposure during a normal work day where trucks are started, driven out, checked and returned. One sample is not a true representation of staff exposure so multiple measurements are recommended to obtain a better statistical picture of the true exposure.

Regulations of concern
WorksafeBC regulations that apply to this situation are numerous. A list of the primary regulations pertaining to ventilation, indoor air quality, PPE and design are noted below:

4.72 Design and operation

(1) An employer must ensure that a ventilation system for the supply and distribution of air and removal of indoor air contaminants is designed, constructed and operated in accordance with

(a) established engineering principles, and
(b) *ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality*.

(2) An adequate supply of outdoor air must be provided to the workplace in accordance with Table 2 of *ASHRAE Standard 62-1989*.

4.74 Distribution

Outdoor air must be effectively distributed throughout the workplace.

4.75 Balancing

The ventilation system must be balanced to

(a) ensure that each space within the building receives an adequate allotment of outdoor air, and
(b) accommodate the actual or the normally anticipated occupancy of each space.

4.76 Ventilation openings

(1) A ventilation system must not be obstructed by material or equipment placed in front of the ventilation air intakes or discharge points.
(2) Outdoor air intakes must be located so that outdoor air entering the ventilation system does not contain any contaminant in a concentration greater than normal outdoor ambient air in that locality.

4.77 Discharged air

A ventilation system that discharges air from the work area must be designed to minimize the likelihood of exposing any worker at a workplace, including an adjacent workplace

(a) to an air contaminant in a concentration which exceeds either 10% of its applicable exposure limit in Part 5 (Chemical Agents and Biological Agents), or an acceptable ambient air quality standard established by an authority having jurisdiction over environmental air standards, whichever is greater, and
(b) where practicable, to an objectionable odour.

4.78 Preventive maintenance

(1) To maintain acceptable air quality, the employer, or if the employer is not responsible for maintenance of the ventilation system, the owner of the ventilation system must establish an effective preventive maintenance program for the ventilation system.

(2) Preventive maintenance must include

(a) regular inspections
(i) of all critical components of the ventilation system, such as dampers, fans, belts, baffles, ductwork, diffusers and control systems, and
(ii) for conditions which would promote the growth of micro-organisms, such as water leaks or stagnant water pools,
(b) correction of any deficiencies found during the inspections carried out under paragraph (a),
(c) repair or replacement of malfunctioning and consumable components, such as filters and belts, and the cleaning of air distribution systems, ducts and dampers when necessary to correct an indoor air quality deficiency,
(d) adequate treatment of open water systems associated with ventilation equipment such as cooling towers and humidifiers, to control biological growth, and
(e) maintenance of combustion sources, such as furnaces, space heaters and water heaters to assure proper burning and exhausting of waste gases so that recirculation of gases to the workplace will not occur.

4.79 Investigation

(1) The employer must ensure that the indoor air quality is investigated when

(a) complaints are reported,
(b) occupancy in the space changes substantially, or
(c) renovations involving significant changes to the ventilation system occur.

(2) An air quality investigation must include

(a) assessment of the ventilation rate, unless the indoor carbon dioxide level is less than 650 ppm above ambient outdoor levels,
(b) inspection of the ventilation system as required in section 4.78(2),
(c) sampling for airborne contaminants suspected to be present in concentrations associated with the reported complaints, and
(d) a record of the complaint, the findings of the investigation, and any actions taken.

5.33 Permitted quantities

Except for the quantity reasonably needed for immediate use, or that is present for display or sale in public areas of a mercantile facility, the quantity of combustible and flammable liquids stored outside an

approved storage cabinet, storage room or storage area in any fire compartment (2 hour fire separation) of a building must not exceed

(a) in closed containers, 600 litres (132 imp gal) of liquids having a flash point below 93.3°C (200°F) of which not more than 100 litres (22 imp gal) may be liquids having a flash point below 22.8°C (73°F) and a boiling point below 37.8°C (100°F),

5.48 Exposure limits

Except as otherwise determined by the Board, the employer must ensure that no worker is exposed to a substance that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

5.53 Workplace monitoring

(1) If a worker is or may be exposed to a hazardous substance, the employer must ensure that

(a) a walkthrough survey is conducted to assess the potential for overexposure taking into account all routes of exposure, including inhalation, ingestion, and skin contact, and
(b) reassessment is conducted when there is a change in work conditions which may increase the exposure, such as a change in production rate, process or equipment.

(2) If the walkthrough survey required by subsection (1) reveals that a worker may be at risk of overexposure to an airborne contaminant, the employer must ensure that air sampling is conducted to assess the potential for overexposure.

(3) Additional workplace monitoring to reliably determine worker exposure is required if

(a) the assessment under subsection (2) reveals that a worker may be exposed to an air contaminant in excess of 50% of its exposure limit, or
(b) measurement is not possible at 50% of the applicable exposure limit.

(4) Workplace exposure monitoring and assessment must be conducted using occupational hygiene methods acceptable to the Board.

(5) The results of workplace exposure monitoring and assessment, or a summary of the results, must be provided to workers at their request without undue delay.

5.61 Engineering principles

A ventilation system for controlling airborne contaminants in the workplace must be designed, installed and maintained using established engineering principles.

Note: A useful guide is *Industrial Ventilation — A Manual of Recommended Practice* published by the American Conference of Governmental Industrial Hygienists.

5.64 Controlling air contaminants

(1) If ventilation is used as an engineering control, an air contaminant must be controlled at the source by an effective local exhaust ventilation system.
(2) If local exhaust ventilation is not practicable, general (dilution) ventilation, or a combination of general and local exhaust ventilation must be used.

5.66 Ventilation openings

A ventilation system must not be obstructed by material or equipment placed in front of the ventilation openings.

5.67 Effectiveness

(1) An exhaust ventilation system used to control air contaminants in the workplace must remain in operation until the work process is completed and the air contaminants generated have been removed so as not to be a hazard to workers.
(2) An exhaust ventilation system used to control air contaminants in the workplace must be regularly inspected and monitored to ensure that it remains effective.

5.68 Failure warning

If failure of an exhaust ventilation system would result in a hazard that is not readily apparent to affected workers, the system must be equipped with a device or other means to warn those workers in the event of system failure.

5.69 Makeup air

(1) An adequate supply of makeup air must be provided as necessary to

(a) maintain the effectiveness of an exhaust ventilation system, or
(b) prevent an air contaminant being drawn into the work space from another work area.

(2) A makeup air supply must not expose a worker to uncomfortable temperatures or drafts.

5.70 Discharged air

(2) A ventilation system that discharges air from the work area must be designed to minimize the likelihood of exposing any worker at a workplace, including an adjacent workplace,

(a) to an air contaminant in a concentration which exceeds either 10% of its applicable exposure limit in this Part or an acceptable ambient air quality standard established by an authority having jurisdiction over environmental air standards, whichever is greater, and

(b) if practicable, to an objectionable odour.

8.5 Program

If personal protective equipment is required to protect against a chemical exposure or an oxygen deficient atmosphere the employer must implement an effective protective equipment program at the workplace which includes

(a) a statement of purpose and responsibilities,

(b) written procedures for selection, use, inspection, cleaning, maintenance and storage of protective equipment, when required,
(c) instruction and training in the correct use and maintenance of the equipment,
(d) for respirators, medical assessment of respirator wearers, when required,
(e) documentation when required, and
(f) program review.

31.11 Maintenance

(2) Procedures for cleaning and drying protective clothing must be in accordance with the manufacturer's instructions.

31.32 Vehicle exhaust in fire halls

Unless air monitoring shows that levels of vehicle exhaust gas components are below the exposure limits established under section 5.48, effective local venting for the exhaust gases must be provided in vehicle areas in fire halls.

PICTURES OF FIREHALL ISSUES

Figure 1: Picture showing make-up air vents east side

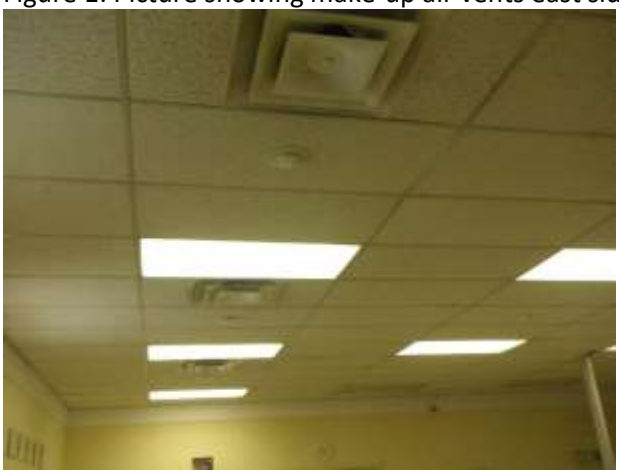

Figure 2: Picture showing make-up vents south side training room

Figure 3: Picture showing return vent in training room

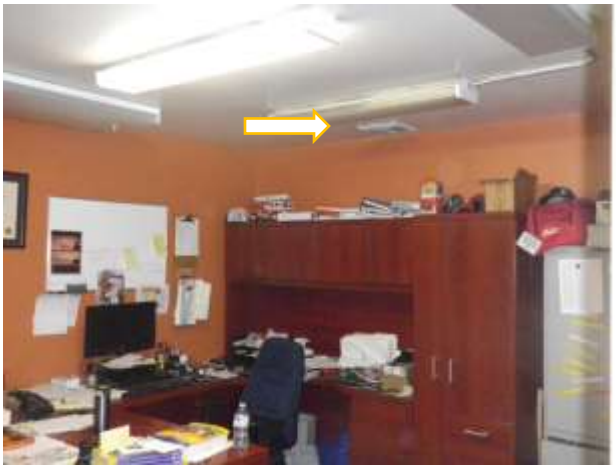

Figure 4: Assistant fire chief office. Note make-up air vent

Figure 5: Fire chief's office. Note make-up air vent.

Figure 6: Make up supply fan for truck bay. Note fire hose dryer under fan.

Figure 7: Picture of turnout gear storage in truck bay east side

Figure 8: Picture showing exhaust location on truck

Figure 9: Picture showing vertical exhaust stack and tempered furnace vent

Figure 10: Picture showing turnout gear storage and vertical exhaust stack

Figure 11: Picture of North wall west exhaust fan

Figure 12: Picture of furnace vents in truck bay recirculating air for heating

Figure 13: Picture of furnace for truck bay in mezzanine.

Figure 14: Picture of Lennox office unit.

Figure 15: South wall exhaust fan

Figure 16: Front of fire hall. Note raised adjacent building

Figure 17: Narrow space between north wall of fire hall and adjacent building

Figure 18: Picture of NW exhaust fan showing narrow space to next building

Figure 19: Picture showing narrow space and supply vent on north wall

Figure 20: Picture of flat roof of fire hall.