- **Standard Number:** 1910.134 ; 1910.134(d)(2)(i)(A) ; 1910.134(d)(2)(i)(B) ; 1910.134(d)(2)(iii)

April 2, 2007

Mr. William Costello
Vice President
FirePASS Corporation
1 Collins Drive
Carneys Point, NJ 08069

Dear Mr. Costello:

Thank you for your January 8, 2007 letter to the Occupational Safety and Health Administration's (OSHA's) Directorate of Enforcement Programs regarding the Respiratory Protection Standard, 29 CFR 1910.134. This letter constitutes OSHA's interpretation only of the requirements discussed and may not be applicable to any question not delineated within your original correspondence.

In your letter you ask OSHA to revise the Respiratory Protection Standard to state that an atmosphere containing a partial pressure of oxygen at or above 100 mm of mercury is safe for employees when employers demonstrate that, under all foreseeable conditions, they can maintain the partial pressure of oxygen at or above 100 mm of mercury. Although most of your letter argues for the use of "partial pressures of oxygen" to describe atmospheric oxygen concentrations, the expression "percent oxygen" was purposely chosen during the rulemaking for the Respiratory Protection Standard. Oxygen meters used to assess hazardous conditions by safety personnel in both general industry and construction are calibrated in percent oxygen, and employers and employees are familiar with, and prefer, this terminology. This same terminology has been used in the Confined Space Standard, 29 CFR 1910.146, since 1993.

Paragraph (d)(2)(iii) of the Respiratory Protection Standard considers any atmosphere with an oxygen level below 19.5 percent to be oxygen-deficient and immediately dangerous to life or health. To ensure that employees have a reliable source of air with an oxygen content of at least 19.5 percent, paragraphs (d)(2)(i)(A) and (d)(2)(i)(B) of the Respiratory Protection Standard require employers working under oxygen-deficient conditions to provide their employees with a self-contained breathing apparatus or a combination full-facepiece pressure-demand supplied-

air respirator with auxiliary self-contained air supply. In the preamble to the final Respiratory Protection Standard, OSHA discussed extensively its rationale for requiring that employees breathe air consisting of at least 19.5 percent oxygen. The following excerpt, taken from the preamble, explains the basis for this requirement:

> Human beings must breathe oxygen . . . to survive, and begin to suffer adverse health effects when the oxygen level of their breathing air drops below [19.5 percent oxygen]. Below 19.5 percent oxygen . . . , air is considered oxygen-deficient. At concentrations of 16 to 19.5 percent, workers engaged in any form of exertion can rapidly become symptomatic as their tissues fail to obtain the oxygen necessary to function properly (Rom, W., *Environmental and Occupational Medicine*, 2nd ed.; Little, Brown; Boston, 1992). Increased breathing rates, accelerated heartbeat, and impaired thinking or coordination occur more quickly in an oxygen-deficient environment. Even a momentary loss of coordination may be devastating to a worker if it occurs while the worker is performing a potentially dangerous activity, such as climbing a ladder. Concentrations of 12 to 16 percent oxygen cause tachypnea (increased breathing rates), tachycardia (accelerated heartbeat), and impaired attention, thinking, and coordination (e.g., Ex. 25-4), even in people who are resting.
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> At oxygen levels of 10 to 14 percent, faulty judgment, intermittent respiration, and exhaustion can be expected even with minimal exertion (Exs. 25-4 and 150). Breathing air containing 6 to 10 percent oxygen results in nausea, vomiting, lethargic movements, and perhaps unconsciousness. Breathing air containing less than 6 percent oxygen produces convulsions, then apnea (cessation of breathing), followed by cardiac standstill. These symptoms occur immediately. Even if a worker survives the hypoxic insult, organs may show evidence of hypoxic damage, which may be irreversible (Exs. 25-4 and 150; also reported in Rom, W. [see reference in previous paragraph]).

(*Federal Register*, Vol. 63, p. 1159.) The rulemaking record for the Respiratory Protection Standard clearly justifies adopting the requirement that air breathed by employees must have an oxygen content of at least 19.5 percent. A lesser concentration of oxygen in employees' breathing air could endanger them physiologically and diminish their ability to cope with other hazards that may be present in the workplace. The rulemaking record also demonstrates that any workplace atmosphere controlled at or near your recommended minimal oxygen level of 100 mm of mercury at sea level (equivalent to about 13 percent oxygen at sea level) is not safe and healthful for all employees. Exposing employees to partial pressures of oxygen that approach 100 mm of mercury at sea level leaves them with no margin of safety from potentially debilitating effects, which could appear suddenly and without warning.

OSHA recognizes that, at higher altitudes, oxygen in air has a partial pressure that is less than the partial pressure of oxygen in air at sea level; accordingly, the Respiratory Protection Standard makes allowances for employees who work at altitude. OSHA made these allowances based on record evidence showing that such employees usually are acclimated to the reduced oxygen partial pressures and, as a result, will not experience the physiological dysfunction and performance impairments seen in non-acclimated employees. Nevertheless, when the oxygen concentration at altitude becomes oxygen-deficient, paragraph (d)(2)(iii) of the Respiratory Protection Standard requires employers to provide a supplied-air respirator that delivers at least 19.5 percent oxygen to the employee. In the preamble to the final Respiratory Protection Standard, the Agency explained this requirement as follows:

> OSHA's experience confirms the record evidence that most work at higher altitudes is performed by fully acclimated workers (Exs. 54-6, 54-208). These provisions will allow acclimated workers to continue to perform their work without oxygen-supplying respirators, at any altitude up to 14,000 feet altitude, as long as the ambient oxygen content remains above 19.5% and the employee has no medical condition that would require the use of supplemental oxygen.

(*Federal Register*, Vol. 63, p. 1203.) Therefore, in addition to the protection afforded to them by altitude acclimation, OSHA's Respiratory Protection Standard ensures that employees working under oxygen-deficient conditions at altitude will have an adequate and reliable breathing supply consisting of 19.5 percent oxygen, an oxygen content that will provide the employees exposed to these conditions with a substantial margin of safety.

In conclusion, OSHA would not consider any environments with your suggested oxygen partial pressure of 100 mm of mercury (~13 percent oxygen at sea level) to be safe for all employees. For those employees that can tolerate such levels, a work environment with only 13 percent oxygen provides no margin of safety from the potentially debilitating effects resulting from exposure to low oxygen levels, which could suddenly appear without warning. Accordingly, the Agency will not propose or adopt a revision to the Respiratory Protection Standard that would allow employees to work in such environments, even when the employer can demonstrate that, under all foreseeable conditions, the partial pressure of oxygen can be maintained at 100 mm of mercury.

In several telephone conversations we have had with you since we received your letter, you mentioned studies that purportedly demonstrate the safety of hypoxic environments in the workplace. We would be interested in reviewing any authoritative studies or information that specifically support your claims regarding the safety of such systems.

Thank you for your interest in occupational safety and health. We hope you find this information helpful. OSHA requirements are set by statute, standards, and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov. If you have any further questions, please feel free to contact the Office of General Health Enforcement at (202) 693-2190.

Sincerely,

Richard E. Fairfax,Director
Directorate of Enforcement Programs

UNITED STATES
DEPARTMENT OF LABOR

Occupational Safety & Health Administration
200 Constitution Ave NW
Washington, DC 20210
800-321-6742 (OSHA)
TTY
www.OSHA.gov

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