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Safe Quantity of Open Medical Gas Storage in a Smoke Compartment

NFPA 99 (2018) allows medical gases to be stored outside of a storage enclosure if the volume is less than or equal to 300 ft^3 in a healthcare facility smoke compartment. Medical gases are required for various operations such as surgeries, calibration of medical equipment, and breathing support for patients. Hence, storing enough volume of medical gases in healthcare facilities is critical.

These gases, however, may pose a serious threat to occupants if they are not stored or handled properly. For example, failure of oxygen cylinders can create an oxygen enriched atmosphere (OEA), where materials that may not burn in normal oxygen concentrations have a higher probability of ignition in this atmosphere. Therefore, regulating the number of the medical gas cylinders that can be stored outside a storage enclosure can reduce this fire risk. In this context, the current study identifies the hazards associated with medical gas storage in healthcare facilities and provides a quantitative analysis on the risks associated with medical gas releases in healthcare facilities.

Project Goal & Approach

This project aimed to determine the safe quantity of open medical gas storage in a smoke compartment through a literature review and hazard assessment. This project specifically focused on providing scientific justification for the requirement in NFPA 99 that limits the quantity of medical gases stored outside of a smoke compartment to 300 ft^3.

Final report is available here.

Research by:

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Summary Observations

Statistics on the medical gas industry provide evidence of increasing demand for medical gases and a decreasing trend for fire incidents in health care facilities in the US. Based on the statistics, it is not clear that medical gas volume and associated fire risk are closely related.

The oxygen concentration of 23.5 Vol % is considered an Oxygen Enriched Atmosphere (OEA) in which fire risk is deemed to increase significantly. Quantitative analysis on oxygen concentration for various oxygen release amounts was conducted for an average patient room (320 ft^2 large and 9 ft high) with the ventilation of eight-air changes per hour. It is shown that an entire release of three fully charged E-sized oxygen cylinders is required to reach 23.5 Vol %, after which it would take approximately 30 minutes for the oxygen concentration to get back to nominal values. With a more probable scenario of a single-cylinder failure, OEA is not formed.

In addition, the number of people exposed to fire in hospitals seems to be decreasing, for reasons such as floor plans moving from multiple occupancy rooms to single-patient rooms and the increase of smoke compartments sizes, which ultimately reduces fire risk. Despite relatively low fire concerns associated with medical gas storage, the current study recommends a wide range of surveys to be conducted to better understand the typical storage location of medical gases up to 300 ft^3, from which other fire concerns such as fuel load, the number of occupants likely to be exposed to fire, if any, and potential ignition sources around the medical gas storage could be further assessed.