Risk Management Guidance for Health and Safety under Extraordinary Incidents

Report Prepared by the ASHRAE Presidential Study Group on Health and Safety under Extraordinary Incidents

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1.0 INTRODUCTION

Since its founding in 1894, ASHRAE has pursued its mission of advancing the arts and sciences of HVAC&R for the public's benefit. For more than a century, its members have shared ideas, identified the need for research and written the industry's standards for testing and practice. The result of these efforts is that engineers have been better able to provide for safe and productive indoor environments, energy efficiently and cost effectively. Historically, these provisions have been achieved through compliance with reasonable safety and health requirements established by building codes and standards, which typically have not addressed the threats associated with extraordinary incidents beyond fire and natural disasters. But now, the public's expectations for the ability of buildings to keep occupants safe have been raised as a result of the extraordinary incidents that have occurred since September 11, 2001. Building owners and occupants may now be willing to redirect resources to enhance the performance of buildings to further reduce occupant risks associated with extraordinary incidents, while continuing to provide acceptable indoor environments, energy efficiently and cost-effectively, during normal conditions.

Extraordinary incidents, whether caused by war, terrorism, accident or natural disaster, focus attention on such basic, immediate, human needs as survival and safety and longer-term needs such as water, food and shelter. To reduce risks under such situations, ASHRAE recognizes that its expertise in HVAC&R, and its knowledge of building envelope insulation, fenestration, air infiltration, intake and exhaust air control, and filtration is critical in addressing occupant survival and safety. Advances in technology have also increased ASHRAE's responsibility for providing design, construction and operational information that integrates security, fire and smoke control, and indoor air quality with other building systems to enhance the safe operations of buildings. Recognizing this increased responsibility in providing guidance for enhanced building performance, the President of ASHRAE appointed a Study Group to provide initial guidance, through this report, on actions that should be taken to reduce the health and safety risks of occupants in buildings that might be subjected to extraordinary incidents.

It is important to point out that the problem of extraordinary incidents will impact other issues that are not addressed in this initial report. Noteworthy exclusions are structural integrity, emergency power integrity, security protection, water contamination and/or supply disruption, and transportation issues such as food refrigeration or vehicular ventilation. Also, some types of HVAC systems are not included here because of their small size (e.g., window or rooftop units and split systems that only handle small areas). Equally important items beyond the scope of this study are the destructive effects of conventional and nuclear blast, or incendiary devices. The principal area of this study is centered on buildings with larger HVAC and life-safety systems. However, this study is not based on any specific project, building, design/configuration or HVAC system design. Rather, it draws on the collective knowledge and experience of the Study Group.

The scope of this report pertains to public use and assembly buildings, including commercial, institutional, educational and residential facilities for more than four families. This report addresses many aspects of building performance that affect health and safety under extraordinary incidences in these buildings. These aspects include: egress; chemical, biological & radiological protection; fire protection; smoke removal or purging; filtration; maintenance of air quality; entrance paths for contaminants; and building envelopes. The fundamental parameters of risk/benefit cost, and level of protection were considered in the study, but the recommendations provided in this report are limited in extent and depth based on the time available to develop this report and on the current state of knowledge.

2.0 BACKGROUND AND LESSONS LEARNED

Since the Study Group began its work on 12 November 2001, many articles have been reviewed and the personal experiences of the members have been discussed through telephone conference calls, three scheduled meetings, and e-mail communications. From these deliberations several lessons have been learned from the catastrophic events of September 11th and the subsequent contamination of spaces and sickness and deaths attributed to the distribution of anthrax via the postal system. These lessons focused on methods of protection from intentional, but are also related to accidental and naturally occurring, extraordinary incidences. Lessons that apply to all buildings being considered in the scope of this study include:

- Buildings in the U.S. have important safety factors that have proven effective against some threats because of the quality of the standards of care practiced in the U.S., the enforcement of building codes and standards during design and construction, and because of the legal liability of designers, constructors and owners of these buildings.

- If protection against aerosol attacks launched from a source exterior to a building is to be accomplished, then the openings into the building that could allow airborne aerosols to enter must be capable of timely closure, located sufficiently remote from any launch site, or equipped with adequate filtration.

- If protection against aerosol attacks launched from a source interior to a building is to be accomplished, then the space in which the aerosol is released or present must be capable of timely isolation by the closure of all openings communicating with other spaces.

- Sensors, monitors, and other means of forewarning are not presently available or are not reliable for many contaminants. Therefore, strategies other than feedback control are relied upon, today.

- It is unlikely that areas of refuge are economically viable in many buildings. Therefore, a practical and commercially viable application of HVAC technology is the enhancement of building egress paths and the isolation of significant contamination to selected building volumes

- Enhanced filtration is a desirable, but not sufficient, control strategy to reduce occupant risk to airborne contaminant. A comprehensive strategy is needed which includes enhanced filtration coupled with building pressurization of the building interior relative to the outdoors; this, in turn, requires improved air tightness.

3.0 RECOMMENDATIONS FOR OWNERS AND MANAGERS OF EXISTING BUILDINGS

The recommendations under this section include steps that building owners and managers should and should not take to provide the maximum protection available, with what they already have to work with considering various levels of risk. It is not possible in preparing these recommendations to generalize for all building types, but the recommendations are as universally applicable as possible. Where the building owner or manager has need for more technical information, this should be obtained from a professional engineer, or other qualified practitioner, prior to proceeding, or at any point along the way where it is deemed necessary. Three preliminary recommendations have resulted from the lessons learned: 1) Understand the capabilities of your building and its systems; 2) assure that your building is performing as intended; and 3) do not make changes to building performance unless the consequences are understood.

3.1 Understand Your Building

The following list of major systems, components, and processes should be considered as safety issues associated with extraordinary incidences in most existing buildings:

- *Ventilation System Operation*
- *Filter Efficiency and Bypass*
- *Quantity of Outdoor Air*
- *Control Access to Air Handling Components*
- *Isolate Likely Entry Points*
- *Fire Protection and Life Safety*
- *Building Shell and Duct Tightness*
- *Areas of Refuge*
- *Preparedness Plan*
- *What Not to Do*

With this list in mind, the building plans and the building itself should be thoroughly inspected with appropriate records being constructed relating to each of the above, after which the following steps, as appropriate, taken.

3.2 Ventilation System Operation

In the event of an incident of chemical, biological or radiological contamination, no action should be taken regarding fan operation unless the effects of the consequential airflow patterns are thoroughly understood.

3.3 Filter Efficiency and Bypass

Verify that filter efficiency has been upgraded to the highest Minimum Efficiency Reporting Value (MERV) attainable under existing conditions of space and available airflow capacity.

MERV designation numbers are representative of the minimum efficiency curve resulting from the ASHRAE Standard 52.2-1999 Method of Test for particulate filters. Increasing the filter efficiency will increase the removal of airborne particulates from outdoor air supply and return air, thus reducing occupant exposure.

Verify that bypass of particulate contaminates around air filters has been minimized by ensuring that filter-to-filter rack and filter-to-filter seals are in place, and that there are not any air leaks in the air handling cabinet between the filter rack and supply fan.

Preventing bypass will help ensure that airborne particulates will be captured in the filter media.

3.4 Quantity of Outdoor Air

Verify that the quantity of outdoor air supplied to each zone within the building is in compliance with ASHRAE Standard 62-1999.

If all ventilation system components are working properly, the supply of outdoor air will help dilute any airborne contaminants inside the building.

3.5 Controlled Access to Air Handling Components

Public access to outdoor air intakes, air handling units, air ducts and plenums, motor controls, and mechanical equipment rooms should be prevented to minimize the intentional release of contaminants directly into the air supply systems.

Verify that air intakes are elevated as high as practical above ground level.

3.6 Isolate Likely Entry Points

Consideration should be given to reducing the entry of contaminants into occupied portions of the building from such vulnerable areas as mailrooms, loading docks, lobbies, and utility chases.

Physical and air pressure barriers can be employed to reduce the movement of contaminants from these contaminated spaces to other areas of the building. Examples of barriers include sealing unnecessary penetrations in walls, ceilings and floors; weatherstripping doors; and installing an exhaust system designed to exhaust more air from the room than is supplied by the space conditioning and ventilation system (i.e., operate the room at a pressure that is lower than the surrounding spaces).

3.7 Fire Protection and Life Safety

Life safety issues under many extraordinary conditions require alerting of occupants to danger, and providing safe egress. *Alerting occupants under terrorist attacks should follow similar procedures unless directed otherwise by responsible authority.*

Fire Detection Systems should be verified for proper shut down of ventilation fans in the affected zone, but not in the entire building.

Many installations rely on smoke detection in the return air duct to shut down fans. Pull stations and smoke detectors presently may not interface with fan shut down.

Verify that Emergency Egress Stairwells are pressurized relative to the adjacent fire zone. This may accomplished by keeping fans running in the remaining zones as people exit into the stairwells, or by stairwell fans that are controlled by the fire detection system.

For Fire Suppression, verify that fans are controlled as above to encompass the problem area to contain smoke, particulate matter, and gases.

For Smoke Evacuation, verify that fans can be energized to purge contaminants for the impacted zone, using 100% outdoor air and exhaust fans where installed.

For Standby Power: the ventilation fan systems should be included on standby power that support critical and life safety systems.

Verify that all fire protection and life safety systems receive highest priority within any automated building or energy management system.

3.9 Building Shell and Duct Tightness

Verify that the building shell and air ducts are as air tight as practical.

The purpose of this air tightness is to minimize unintended airflows that could diminish the effectiveness of building life and safety systems, and to reduce the infiltration of any outdoor airborne contaminants into the building.

3.10 Areas of Refuge

Where areas of refuge have been identified in existing buildings, verify that personnel guidance is clear, emergency facilities are available and functional, and training is effective for proper use during extraordinary incidences.

3.11 Preparedness Plan

Every building management team should have a preparedness plan to be followed in the event of an extraordinary incident.

A key member of the management team should be responsible for the plan which should be written, documented, and kept prominently in the building files.

3.12 What Not to Do

The following actions should not be taken unless under the written advice or direction of a professional engineer registered in the state in which the building is located.

- ❑ Do not close outdoor air intake dampers or otherwise block ventilation air paths.
- ❑ Do not change the designed airflow patterns or quantities.
- ❑ Do not modify the fire protection and life-safety systems without approval of the local fire marshal.

4.0 RECOMMENDATIONS FOR ASHRAE'S CONSIDERATION

The recommendations in this section include steps that ASHRAE should and should not take to continue its mission of advancing the arts and sciences of HVAC&R for the public's benefit, specifically in the development of risk management guidelines for health and safety under extraordinary incidents.

4.1 Recognize Increasing Responsibilities to Building Owners, Operators and Maintenance Providers

Proactively encourage those involved to see that all building service systems are thoroughly and verifiably commissioned to assure building performance.

Expand the scope of ASHRAE standards, handbooks, periodicals, programs and research, where applicable, to include owning and operating considerations and also to address maintenance issues.

Encourage involvement and participation in ASHRAE activities by building owners, operators, managers, and maintenance technicians.

Through the ASHRAE Learning Institute, develop program material and training curricula relevant to extraordinary incidents that will focus on methods needed by building owners, developers, operators, managers, and maintenance technicians.

Consider development of a new guideline or handbook chapter on "Management by Walk Around" (MBWA) to help building owners, developers, operators, managers and maintenance personnel assess needed improvements in building maintenance.

4.2 Recognize Increasing Responsibilities in Providing Guidance for Enhanced Building Performance

Encourage the Research Activities Committee (RAC) to allocate a percentage of the research projects each year to building safety under extraordinary incidents, and the Special Projects Committee to explore other sources of funding for research in this area.

Encourage owners, developers and designers to recognize that building codes are ***minimum*** *requirements and that, when their building project budget allows, or the level of risk requires it, design in "excess of code" is desirable and has demonstrated benefits against extraordinary incidents.*

Direct the Technical Committees and the Standards Project Committees to address the safety aspects of their specific areas of expertise, to an extent appropriate to the associated cost/benefit/risk relationships.

Consider development, of a standard or guideline for indoor air quality that addresses recommended levels (i.e., efficiency) of filtration to use in different applications.

Consider establishing a Study Group to explore methods of classifying buildings for "level of risk" considerations in design, based on statistical probability of risk and benefit.

Recognizing that many other building systems must interface with HVAC&R systems to enhance safety, ASHRAE should explore ways to reduce occupant risks under extraordinary incidents, while continuing to provide acceptable indoor environments, energy efficiency, and cost effectiveness.

4.3 Continuation of Study Group on Health and Safety under Extraordinary Incidents

The current Study Group should be continued and be authorized to expand or contract its charge as the "study" evolves.

The Study Group should be given an extended time line of January 2003 with a progress report on June 2002.

Issues like "likely" target are not readily resolvable and are most definitely not amenable to "statistical" analysis.

Finally the Study Group membership should be expanded to include more individuals with private world, hands on, practical backgrounds. The Study Group should be reinforced with people expert in pedestrian movement under duress, the expertise of electrical experts on reliable power, detection, alarm and communication, and someone skilled in lateral force resistant construction.

4.4 What Not to Do

It is further recommended that ASHRAE should NOT consider:

- Any changes in building codes to address issues of health and safety under extraordinary incidents.

- Requiring, or even recommending, that buildings be designed to enhance safety under extraordinary incidents **without** careful consideration of such parameters as initial and maintenance costs, energy consumption, indoor air quality, and site adaptability.