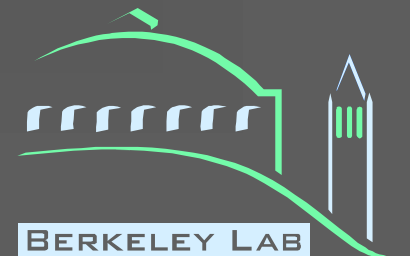


Assessment & Mitigation of Building Vulnerability to Biological & Chemical Agents

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Vulnerability Assessments

- A building vulnerability assessment is used to identify physical and administrative factors which may increase the likelihood or severity of a chemical, radiological or biological release



(either intentional or accidental)

Threat Assessment

- The level of vulnerability reduction needed is related to the threat level a facility faces. Factors which can increase threat levels include:
 - Nature of operations
 - Number of occupants
 - Historic or symbolic importance
 - Proximity to a high threat facility
 - Type and quantity of hazardous materials used
 - Proximity to a facility using large quantities of hazardous materials



Law enforcement can help facilities assess threat

Reduce the likelihood of an event

- Reduce access to facilities
- Reduce access to information
- Improve awareness of occupants
 - Although you cannot prevent people from getting access and information, making it difficult increases the chance of detection during the planning stages



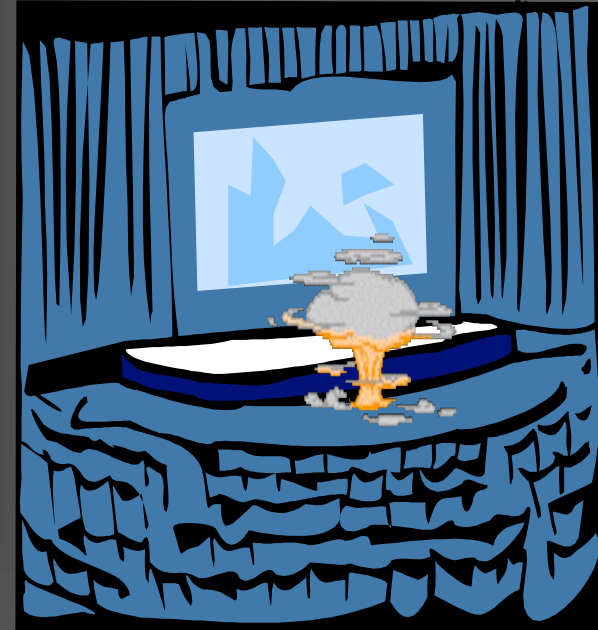
Reduce the severity of an event

- Emergency response planning
- HVAC design and operation
- Occupant training
 - Preplanning can significantly reduce the consequences for both indoor and outdoor releases



General Principles: Indoor Release

- HVAC system will spread contamination to areas sharing return air
- A well balanced HVAC system may inhibit spread to zones not sharing return air



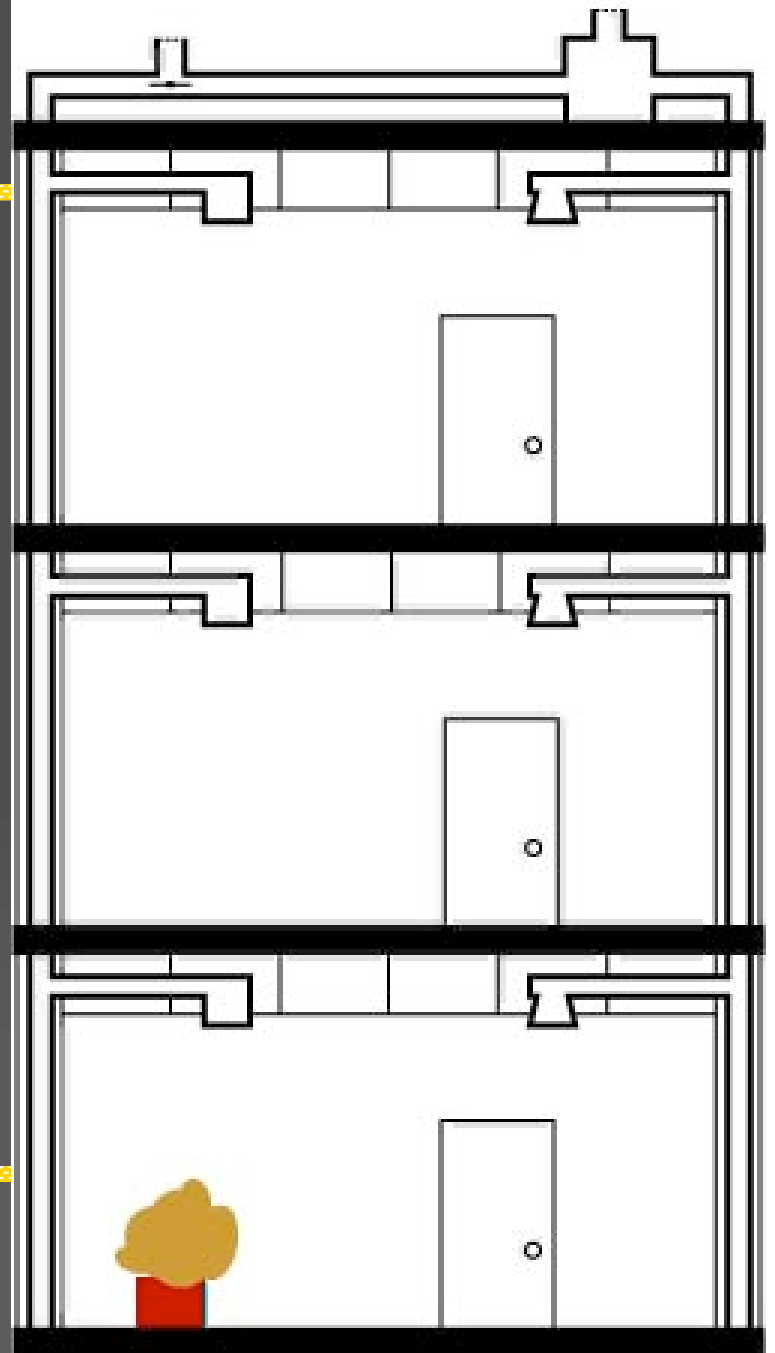
Indoor Releases

- Increasing air exchange will dilute indoor concentrations
- Exhaust plume could be hazardous to people outdoors



Indoor Transport

- Rate of Spread by HVAC
 - HVAC design
 - Ducted vs. plenum return
 - % outdoor air
 - Number of zones
 - Separation of zones



General Principles: Outdoor Release

- In most urban areas, occupants will need to shelter inside buildings
- Reducing air exchange with outdoors will decrease indoor concentrations
- Interior rooms with improved sealing can provide additional protection
- Occupants should leave buildings once the plume has passed



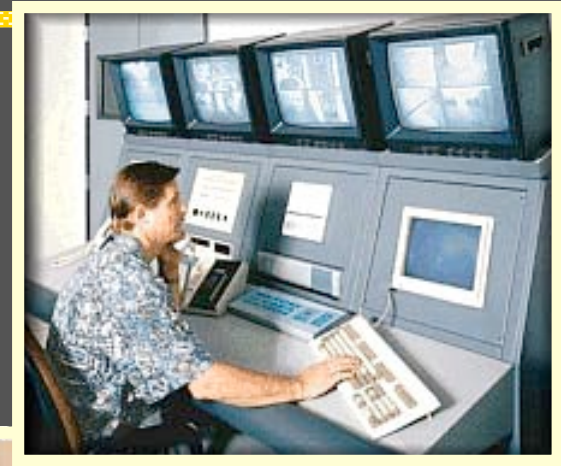
CB agents \neq Fire

- For outdoor releases, occupants will typically need to stay indoors, not evacuate
- Indoor releases may or may not rise through building like smoke
- Many gaseous chemical agents are heavier than air and may 'pool' on the floor
- Unlikely to affect power and other systems, if not explosive



Reduce Access to Information

- Terrorists typically spend months to years planning for a major event
- At each step, you need to make it difficult for them to obtain the needed information
- Requiring 'unusual activity' to obtain information increases the probability of detection



Restrict Physical Access

- Building
- Rooftop
- HVAC equipment
- Storage areas
- Mailrooms and Delivery Areas
 - Restrict unauthorized deliveries
- HVAC intakes and returns

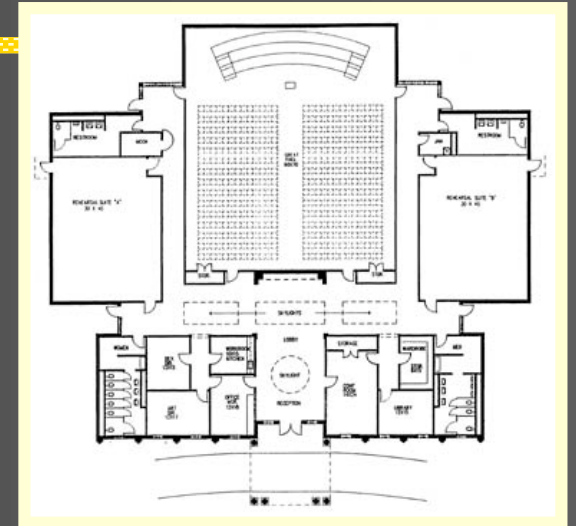


Need to make sure that controls are not bypassed

Restrict Access to Plans

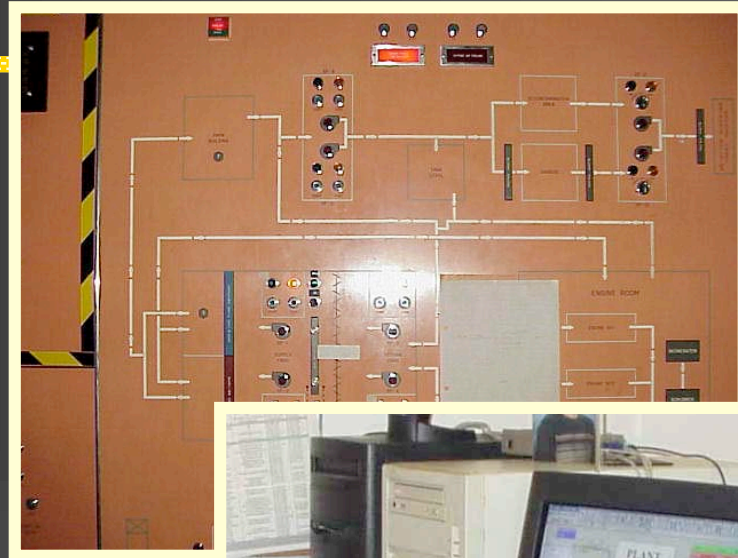
- Building drawings and plans
- HVAC system details
- Emergency response plans
- Material handling procedures

Access to any information which could be helpful for planning an attack should be restricted, all copies should be controlled



Restrict Access to HVAC Controls

- Access to controls yields information about HVAC operations
- Manipulation of HVAC controls can be used to increase the severity of an attack



HVAC Control Security

- Local access
 - Locked doors, passwords, user lists, user logs
- Remote access
 - Passwords, restrict users, only accessible by specific computers, watch out for backdoors
- Password management
 - Require regular changes, structural requirements (minimum size, characters)



Reduce the Severity of an Event

- Two main modification types
 - System modifications –
 - in place at all times
 - can reduce effectiveness of an attack, even before it is detected
 - Response modifications –
 - improve the ability to detect
 - reduce occupant exposure
 - Improve emergency response



System Modifications

- Improved particle filtration
 - Reduce indoor concentrations of biological, radiological, and particulate chemicals
 - Ineffective against gases
 - May increase pressure drop and energy costs (but might not)
 - Reduce bypass to maximize filtration



Chemical Filtration

- The type of filter depends on the chemical
 - Expensive to buy and maintain
 - Potentially large pressure drop (energy costs)
 - Activated carbon effective against most chemicals, but not all
 - Special filters may be used against specific hazards, like nearby chemical manufacturing



Chemical filtration is typically warranted only in cases of high risk

Air Exchange Reduction

- Reducing uncontrolled air exchange increases the effectiveness of sheltering
 - Seal leaks around windows, doors, and other access points
 - Use blower door and other testing to identify other leaks
 - Test dampers and other ventilation points periodically to assure proper operation



These measures may also reduce energy consumption

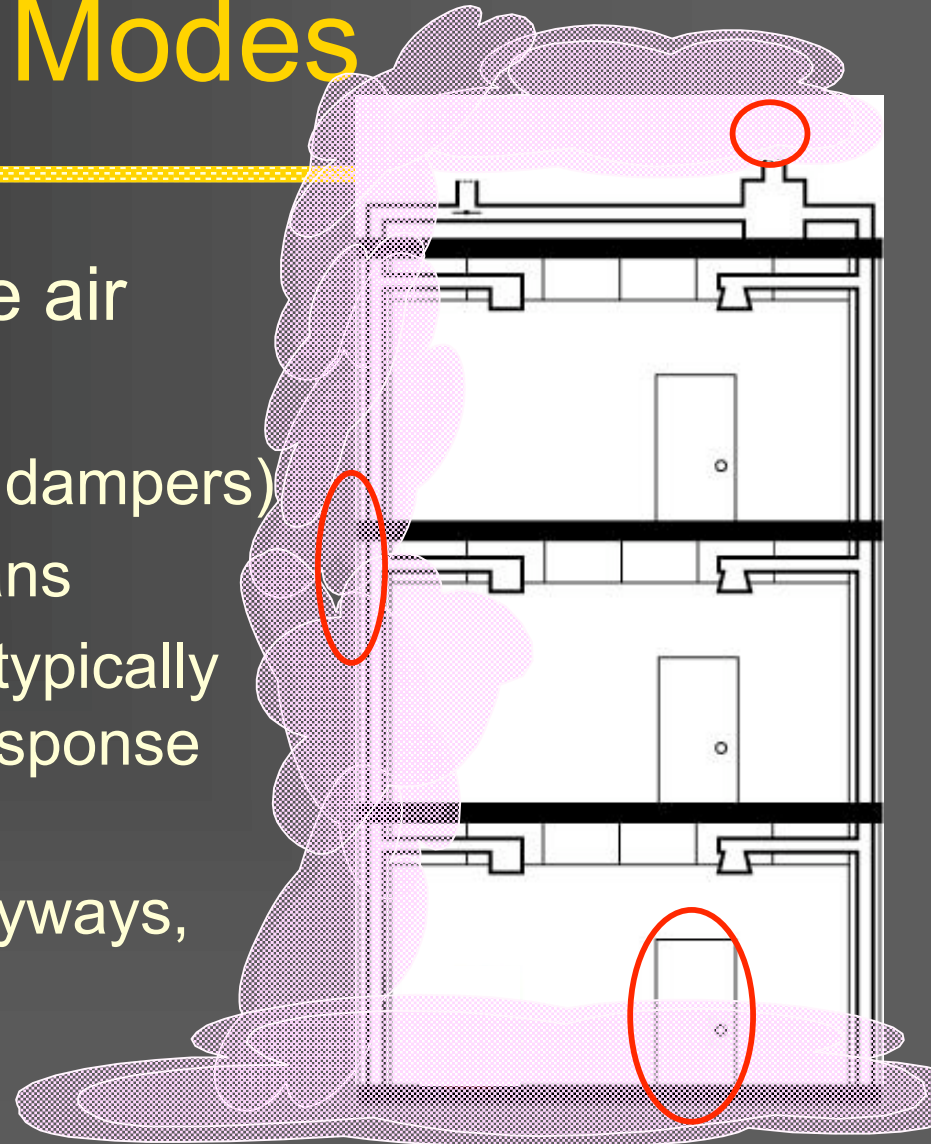
Response Modifications

- Detection (sensors, cameras, etc)
- HVAC Operation and Control
 - General building
 - Shelter-in-place
 - Material handling
public access areas
- Emergency Response Planning
 - Evacuation
 - Sheltering



HVAC Response Modes

- Outdoor release – reduce air exchange
 - Turn off HVAC (and close dampers)
 - Turn off local ventilation fans
 - Close operable windows (typically assigned to emergency response personnel)
 - Close doors to tunnels, skyways, exterior



HVAC Response Modes

- Shelter-in-place areas (outdoor release)
 - Turn off HVAC and local ventilation
 - Reduce air exchange (local sealing)
 - Operate local filtration (if applicable)
 - Minimize air exchange during room entry (air lock, sliding door, etc.)
 - Provide 'safe' access to shelter areas, reduce plume entry into access pathways



HVAC Response Modes

■ Indoor Release

■ Isolate release area

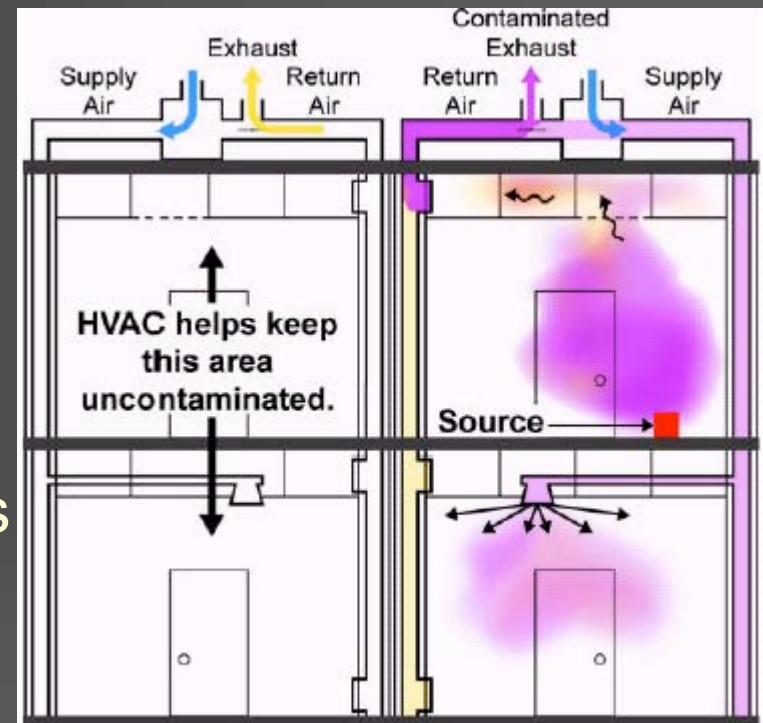
■ Chemical

- Maximize outdoor air supply, without compromising isolation

- Provide 'safe' evacuation routes

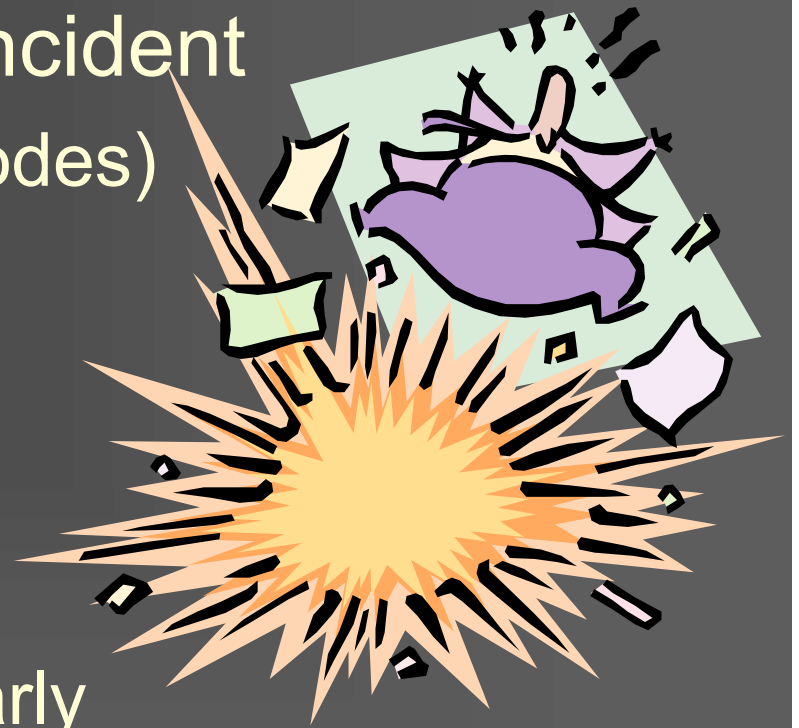
■ Biological

- Turn off HVAC and local ventilation to minimize spread



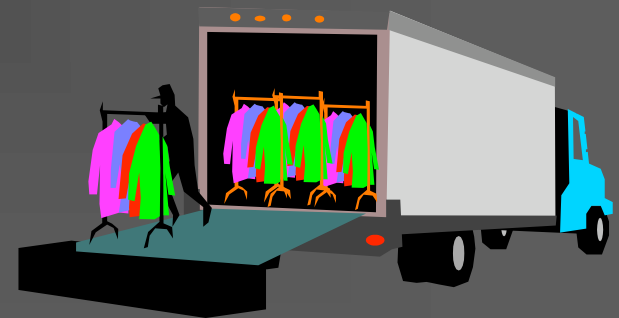
HVAC Control

- Need to be able to change HVAC system settings during an incident
 - Simple to operate (preset modes)
 - Accessible in an emergency
 - Rapid system response
 - Assign person(s) to modify controls
 - Test system response regularly



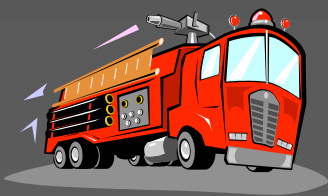
Special Hazard Areas

- Material handling (mailroom, loading dock), publicly accessible (lobbies), and chemical storage/use areas are at higher risk
 - Provide separate HVAC (no common return)
 - Provide floor to ceiling separation
 - Provide local ventilation
 - Reduce air exchange with rest of building (doors, sealing)



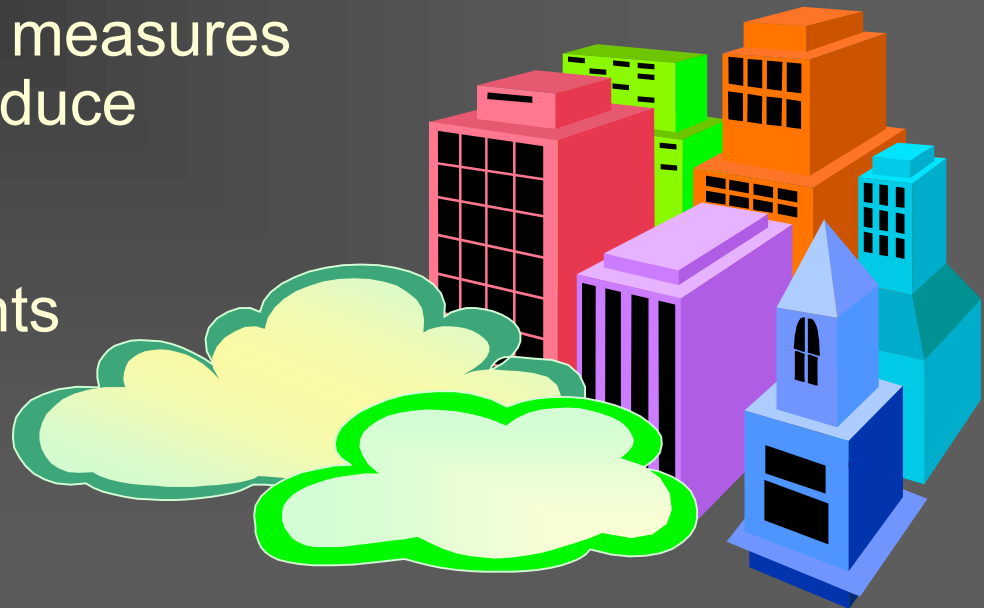
Emergency Response Planning

- Emergency response team
- Occupant training
- Communications
- Supplies
- Shelter-in-place area(s)
- Evacuation routes and areas



Conclusions

- It is important and relatively easy for facilities to assess their vulnerabilities to chemical, biological, and radiological agents
- There are often low cost measures which can be taken to reduce vulnerability
- Responses to CBR agents will not necessarily be the same as those for other emergencies



Acknowledgements

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Free copies of the building vulnerability assessment program and supporting materials can be obtained at
<http://securebuildings.lbl.gov>