BUILDING COLLABORATIVE COMMUNITIES
NAVIGATING CHALLENGES, CHARTING INNOVATIONS

2018 CSU FACILITIES MANAGEMENT CONFERENCE
Hazardous Materials in Buildings: Design, Maintenance, and Decommissioning
Presenters

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Learning Outcomes

Hazardous Materials in Buildings: Design, Maintenance and Decommissioning

• Understand CFC Fire rated control areas, types of hazards, maximum allowable quantities, and stored chemicals vs in use chemicals.

• Understand the ongoing permitting and inspection processes for hazardous materials.

• Explore tools to support effective management of hazardous materials, particularly as the building use and occupants change over time.

• Identify effective facility closeout processes including chemical disposal and facility/equipment decontamination.
Control Area & Maximum Allowable Quantities of Hazardous Materials
Building Use & Occupancy

All structures or portions of structures shall be classified with respect to occupancy and use in one of more of the following groups:

• 303 – Group A: Assembly
• 304 – Group B: Business
• 305 – Group E: Educational
• 306 – Group F: Factory
• 307 – Group H: High-Hazard
• 308 – Group I: Institutional
• 309 – Group M: Mercantile
• 310 – Group R: Residential
• 311 – Group S: Storage
• 312 – Group U: Utility
• 313 – Group L: Laboratory
Control Area

- Spaces within a building where quantities of hazardous materials not exceeding the maximum allowable quantities (MAQ) of hazardous materials are stored, dispensed, used or handled.

- Hazardous materials not permitted or strictly limited in some occupancies, such as Assembly and Institutional occupancies.

- If quantities of hazardous materials exceed the MAQ, a high hazard H-Occupancy is required.
Maximum Allowable Quantities of Hazardous Materials (MAQ)

- MAQ’s based on Material Hazard Class
- According to Storage & Use condition

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CLASS</th>
<th>GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED</th>
<th>STORAGE</th>
<th>USE-CLOSED SYSTEMS</th>
<th>USE-OPEN SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustible dust</td>
<td>NA</td>
<td>H-2</td>
<td>See Note q</td>
<td>NA</td>
<td>See Note q</td>
</tr>
<tr>
<td>Combustible fiber</td>
<td></td>
<td>H-3</td>
<td>(100)</td>
<td>NA</td>
<td>(100)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1,000)</td>
<td>NA</td>
<td>(1,000)</td>
</tr>
<tr>
<td>Combustible liquid</td>
<td>II</td>
<td>H-2 or H-3 or H-3 or H-3 NA</td>
<td>NA</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>IIIA</td>
<td></td>
<td></td>
<td>330</td>
<td>330</td>
</tr>
<tr>
<td></td>
<td>IIIB</td>
<td></td>
<td></td>
<td>13,200</td>
<td>13,200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Material Hazard Class

• The maximum allowable quantities of hazardous materials per Control Area shall not exceed:
  • CBC Table 307.1(1) for Physical Hazards
    - [Physical Hazard Icons]
  • CBC Table 307.1(2) for Health Hazards
    - [Health Hazard Icons]
  • Not Limited
    - [General Hazard Icons]
Storage & Use Condition

Storage:

• The keeping, retention or leaving of hazardous materials in closed containers, tanks, cylinders, or similar vessels; or vessels supplying operations through closed connections to the vessel.

Use:

• Placing a material into action, including solids, liquids and gases.
Is it Storage or Use?

- *Storage* is not intended to identify the condition the container is in most of the time, but the intended use of the container.
  - For example, a container may be stored closed 99% of the time, but is opened 1% of the time to dispense to or from.
  - In such instances the normal, or intended condition is for the container to be in use and appropriate control measures provided for such use.
Use-Closed & Use-Open

Closed System:
• The use of hazardous materials involving a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of compressed gases.

Use:
• The use of a solid or liquid hazardous material involving a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations.
Is it Closed or Open Use?

- IES’ practice is for fume hoods to be considered closed-use:
  - Hood must be provided with spill control,
  - Protected by automatic fire sprinkler system, and
  - Exhaust must be on emergency power.
Design & Number of Control Areas

• CBC Table 414.2.2 identifies:
  • Percent of MAQ allowed per floor
  • The number of control areas permitting per floor
  • Fire resistance rating of control area separations by floor

<table>
<thead>
<tr>
<th>FLOOR LEVEL</th>
<th>PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA (a)</th>
<th>NUMBER OF CONTROL AREAS PER FLOOR</th>
<th>FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS (b)</th>
</tr>
</thead>
</table>
| Above grade plane
| Higher than 9 |
| 7 to 9 |
| 6 |
| 5 |
| 4 |
| 3 |
| 2 |
| 1 |
| Below grade plane
| 1 |
| 2 |
| Lower than 2 |

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.7(1) and 307.7(2), with all increases allowed in the notes to those tables.

b. Fire barriers shall include walls and floors as necessary to provide separation from other portions of the building.
Percent of MAQ per Floor

Above the 3rd floor the MAQ are severely restricted, i.e. <12.5% of that allowed on the first floor.
Number of Control Areas per Floor

Number of Control Areas Permitted

Floor Level

Number of B-Occupancy Control Areas Permitted

0 5 10 15 20 25

BG 2
BG 1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

No. of B-Occupancy Control Areas

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Control Area Separations

- Vertical separations/walls between control areas shall be of fire-resistive construction:
  - 1-hour on the 3rd floor and below
  - 2-hour on the 4th floor and above
Control Area Separations

- Horizontal separations/floor assemblies between control area shall be of fire-resistive construction:
  - 2-hour floor assembly (and supporting structure)
  - Exception: 1-hour if: Type IIA, IIIA, VA construction, Building is fully sprinklered, and Building is 3 stories in height, or less.
Laboratory Occupancy

• Laboratories may be permitted as either:
  • B-Occupancy Control Areas, or
  • L-Occupancy Laboratory Suites
L (Laboratory) Occupancy

- Increases the MAQ’s permitted per lab suite.
- Increases the number of lab suites allowed per floor

<table>
<thead>
<tr>
<th>STORY</th>
<th>PERCENTAGE OF MAXIMUM ALLOWABLE QUANTITY PER LABORATORY SUITE</th>
<th>NUMBER OF LAB SUITES PER FLOOR BASED ON CONSTRUCTION TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type IA</td>
<td>Type IB</td>
</tr>
<tr>
<td>Above 20</td>
<td>0</td>
<td>NP</td>
</tr>
<tr>
<td>15 to 20</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>11, 12, 13, 14</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>Above grade plane</td>
<td>7, 8, 9, 10</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>4, 5</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>1, 2</td>
<td>100</td>
</tr>
<tr>
<td>Below grade plane</td>
<td>1</td>
<td>75'</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>50'</td>
</tr>
<tr>
<td></td>
<td>3 and below</td>
<td>0</td>
</tr>
</tbody>
</table>

UL = Unlimited, NP = Not permitted
Percent of MAQ per Floor

Percent MAQ Comparison

Gallons in Storage in a Sprinklered Building
Quantities may be doubled when stored in approved cabinets.

Above the 3rd Floor MAQ for B-Occupancy is less than for L-Occupancy

Below the 3rd Floor MAQ for B-Occupancy is greater than for L-Occupancy
### Number of Lab Suites per Floor

<table>
<thead>
<tr>
<th>Floor Level</th>
<th>No. of L-Occupancy Lab Suites</th>
<th>No. of B-Occupancy Control Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>BG 2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>BG 1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

No. of Lab Suites on 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> stored are unlimited.
L-Occupancy Requirements

- Construction requirements more restrictive than B-Occupancy:
  - Ventilation required to be on emergency power.
  - Increases when multiple exits are required.
  - Panic hardware required on all exits.
  - “Common path of travel” decreased from 100’ to 75’.
  - Travel distance to an exit reduced from 300’ to 200’.
  - Higher sprinkler density required for the entire building.
  - Fire alarm system required.
  - Fire-rated corridors required.
  - Liquid tight floors required.
Permitting & Inspection Requirements
Permits

• Construction Permits
  • Required to “install, repair, modify, abandon, remove, place temporarily out-of-service, or close systems and equipment.”

• Operational Permits
  • Required to conduct an operation or business
    • Cutting and welding, or Hot work
    • Hazardous Materials
    • High-pile storage

• Other Environmental & Regulatory Permits
  • POTW: Wastewater discharge
  • TSDF: Hazardous waste treatment
  • SWPPP: Storm water discharge
  • BAAQMD: Air emissions
Hazardous Materials Inventory

• The Hazardous Materials Inventory Statement (HMIS) is the basis for permitting & inspection:
  • Planning/Zoning Department Review
    • Environmental Impact Report (EIR)
    • California Environmental Quality Act (CEQA)
  • Building/Fire Department review
    • Occupancy Requirement
    • Operational Permits
  • Ca Health & Safety Code (H&SC)
    • Hazardous Materials Business Plan (HMBP)
    • Ca Electronic Reporting System (CERS)
# HMIS List for Building Occupancy

## Building Occupancy Classification Inventory Form

### (EXAMPLE)

<table>
<thead>
<tr>
<th>Room No.</th>
<th>Chemical Name &amp; Concentration</th>
<th>5. CBC Class*</th>
<th>4. Quantity Stored</th>
<th>5. Quantity in Use*</th>
<th>6. Stored in Approved Cabinet</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Acetone</td>
<td>FL 1B</td>
<td>~Ir</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>101</td>
<td>Hydrochloric Acid</td>
<td>Cor</td>
<td>5</td>
<td>○ Yes</td>
<td>○ Yes</td>
</tr>
<tr>
<td>101</td>
<td>Sodium Permanganate</td>
<td>Oxy-4</td>
<td>20</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>102</td>
<td>Gasoline</td>
<td>FL 1B</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>103</td>
<td>Tetrachloroethane</td>
<td>FL 1B</td>
<td>~Ir</td>
<td>50</td>
<td>10</td>
</tr>
</tbody>
</table>

### Aggregate

<table>
<thead>
<tr>
<th>TOTALS IN CONTROL AREA</th>
<th>FL 1B</th>
<th>0</th>
<th>0</th>
<th>11</th>
<th>○ Yes</th>
<th>○ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>5</td>
<td>○ Yes</td>
<td>○ No</td>
<td>10</td>
<td>○ Yes</td>
<td>○ No</td>
</tr>
<tr>
<td>80</td>
<td>5</td>
<td>○ Yes</td>
<td>○ No</td>
<td>11</td>
<td>○ Yes</td>
<td>○ No</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>○ Yes</td>
<td>○ No</td>
<td>20</td>
<td>○ Yes</td>
<td>○ No</td>
</tr>
<tr>
<td>60</td>
<td>0</td>
<td>○ Yes</td>
<td>○ No</td>
<td>10</td>
<td>○ Yes</td>
<td>○ No</td>
</tr>
</tbody>
</table>

Note: This example shows only the page which describes Control Area 85, Floor Area #1; Other areas would be listed on the additional pages (i.e., pages 2-9).
## HMIS Summary for Building Occupancy

### HMIS Summary Tables

<table>
<thead>
<tr>
<th>Physical Hazards</th>
<th>Storage*</th>
<th>Use-Closed Systems*</th>
<th>Use-Open Systems*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustible Dust</td>
<td>NA</td>
<td>Note*</td>
<td>0</td>
</tr>
<tr>
<td>Combustible Fiber</td>
<td>II, III,</td>
<td>IIA, IIB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>240°F</td>
<td>660°F</td>
<td>240°F</td>
</tr>
<tr>
<td></td>
<td>660°F</td>
<td>660°F</td>
<td>660°F</td>
</tr>
<tr>
<td></td>
<td>250°F</td>
<td>250°F</td>
<td>250°F</td>
</tr>
<tr>
<td>Cryogenic, Flammable</td>
<td>NA</td>
<td>60°F</td>
<td>90°F</td>
</tr>
<tr>
<td>Cryogenic, Inert</td>
<td>NA</td>
<td>90°F</td>
<td>90°F</td>
</tr>
<tr>
<td>Cryogenic Oxidizing</td>
<td>NA</td>
<td>90°F</td>
<td>90°F</td>
</tr>
<tr>
<td>Explosives</td>
<td>NA</td>
<td>90°F</td>
<td>90°F</td>
</tr>
<tr>
<td>Flammable Gas</td>
<td>Gaseous</td>
<td>200°F</td>
<td>200°F</td>
</tr>
<tr>
<td></td>
<td>Liquefied</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>300°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>300°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flammable Liquid</td>
<td>IA, IB, IC</td>
<td>60°F</td>
<td>60°F</td>
</tr>
<tr>
<td></td>
<td>240°F</td>
<td>240°F</td>
<td>240°F</td>
</tr>
<tr>
<td></td>
<td>250°F</td>
<td>250°F</td>
<td>250°F</td>
</tr>
<tr>
<td>Flammable Solid</td>
<td>NA</td>
<td>240°F</td>
<td>240°F</td>
</tr>
<tr>
<td></td>
<td>250°F</td>
<td>250°F</td>
<td>250°F</td>
</tr>
<tr>
<td>Inert Gas</td>
<td>UD</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10°F</td>
<td>(10°F)</td>
<td>(10°F)</td>
</tr>
<tr>
<td></td>
<td>100°F</td>
<td>(100°F)</td>
<td>(100°F)</td>
</tr>
<tr>
<td></td>
<td>250°F</td>
<td>(250°F)</td>
<td>(250°F)</td>
</tr>
<tr>
<td>Organic Peroxide</td>
<td>NA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>100°F</td>
<td>(100°F)</td>
<td>(100°F)</td>
</tr>
<tr>
<td></td>
<td>250°F</td>
<td>(250°F)</td>
<td>(250°F)</td>
</tr>
<tr>
<td></td>
<td>10°F</td>
<td>(10°F)</td>
<td>(10°F)</td>
</tr>
</tbody>
</table>

*Quantities reported as "Zero" may be present, but in quantities less than significant figures shown are omitted.

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CSU The California State University

Facilities Management Conference
October 28-31, 2018 | Monterey, California
Other Permit Submission Info

• Provide additional code compliance information on plans such as:
  • Code Compliance Notes
  • LEL Calculations
  • Reactive Vapor Calculations
  • Toxic Vapor Calculations
Include code compliance notes on drawing in permit package to address code elements impacted by hazardous materials:

• Sprinklers in fume hoods
• Explosion control
  • Classified electrical & Grounding
  • Venting & Ventilation
• Transportation
  • On Carts
  • In Corridors
  • On Elevators
Flammable Vapor Calculations

• CFC §903.2.11 specifies that sprinklers shall be provided in ducts where required by the *California Mechanical Code*.

• CMC §506.6 requires sprinklers in flammable product conveying ducts “having a cross sectional dimension exceeding 10 inches.

• CMC §505 defines flammable product conveying ducts as conveying vapors exceeding 25% of the LEL.
Reactive Vapor Calculations

• CMC §505.1.1 Incompatible materials shall not be conveyed in the same exhaust system.
• Materials of construction compatibility
Toxic Vapor Calculations

• IMC §510.4 ducts conveying hazardous materials in excess of 1% of the LC$_{50}$ shall be classified as a hazardous exhaust system.

• CFC § 606.12.6 and § 6004.2.2.7.2: Exhaust systems shall be designed to reduce the concentration of toxic vapors to less than ½ IDLH at the point of exhaust.
CODE ALTERNATIVES

Alternate Materials and Methods:

• Strict application of the code is impractical
• Is in accordance with the intent of the code
• Does not lessen health, life or fire safety
• Material and method of work is at least equal in quality, strength, effectiveness, fire resistance, durability and safety
Performance-based Design Alternative:

- Performance-based design alternatives shall be based on providing safeguards to minimize:
  - Risk of unwanted releases, fires or explosions
  - Consequences of unsafe conditions

- Approvals subject to review of:
  - Safeguards
  - Documentation; written plans & procedures, audits, etc.
  - Process hazard analysis
  - Mitigation measures
  - Engineering controls
  - Construction features
Special Inspection

Inspection of construction requiring the expertise of an approved special inspector in order to ensure compliance with this code and the approved construction documents.

• Concrete & Steel
• Smoke Control Testing
• Chemical Resistant Coatings
Change Management & Hazardous Materials

Tools to support effective management of hazardous materials
Hazardous Materials Management

- Awareness of storage locations
  - By Hazard Type
    - Fire Code
    - GHS Hazard Codes
    - Particularly Hazardous
  - By Expiration
  - By Quantity
- User access to hazard information
  - GHS Hazard statements
  - Classification Band
  - Fire Code Hazards

- Reporting
  - By User
    - Group
    - Organization
    - By Regulations
    - Agency & Classification
  - By Locations
    - Room
    - Building
    - Facility
    - Institution
- Track Changes
Hazardous Materials Storage

- Organization into ‘inventories’ allows flexibility with storage locations
- Storage locations collected by hazard types using GHS pictograms
- Storage conditions identified for CERS/CUPA reporting
Hazardous Materials Organized by Chemical

- Chemical Name
- Classification Groups
- Structure
- Essential identifiers
  - Chemical Abstracts System Identification Numbers
  - State of matter
  - GHS pictograms
  - NFPA 704
Building Shutdown

Exhaust Shutdown: Closing a Science building for 2 weeks replacement of exhaust fans