A New Approach to Chemical Management – MAQs Deciphered

Brent Cooley, CIH, CSP
Megan Hall, Ph.D.
Christopher Kolodziej, Ph.D.
Russ Vernon, Ph.D.
Agenda

• Introduction & Challenges
• Fire Code Background
• Hazard Classes & Chemicals
• Risk & Safety Solutions Chemical Inventory System & MAQ Reporting
• MAQ Task Force Report & Recommendations
Introduction and Overview

Complex issue with multiple stakeholders

- Chemical owners (*Researchers*)
  - Purchase and use chemicals
- Chemical inventory administrators (*EH&S*)
  - Monitor and manage campus inventory
- Code enforcement (*Fire Marshals*)
  - Interpret and apply Building & Fire Codes
- Chemical procurement (*Procurement*)
  - Point of entry for most chemicals
- Facility construction (*Design & Construction*)
  - Support and apply occupancy classifications
- Facility maintenance (*Facilities Management*)
  - Ensure control area integrity
California Fire Code – Hazardous Materials

CFC establishes the *minimum* level of fire and life safety for building occupants and first responders in new and existing buildings

Why regulate hazardous materials?
California Fire Code – Hazardous Materials

CFC establishes the *minimum* level of fire and life safety for building occupants and first responders in new and existing buildings

*Why regulate hazardous materials?*

West Texas Fertilizer Plant, 2013

Beirut, Lebanon, 2020
California Fire Code – Hazardous Materials

CFC establishes the *minimum* level of fire and life safety for building occupants and first responders in new and existing buildings

Why regulate hazardous materials?

Univ. of Hawaii, 2016
How are hazardous materials regulated?

- Quantities of Hazardous Materials
- Types of Hazardous Materials
- Storage and Use
- Occupancy type
- Building and Construction Attributes
- Building Ventilation and Fire Suppression System (sprinklers)
How are hazardous materials regulated?

- Maximum Allowable Quantities (MAQs)
- Control Areas
How are hazardous materials regulated?

Maximum Allowable Quantities (MAQs) per control area. The maximum amount of a hazardous material allowed to be stored or used within a control area inside a building or an outdoor control area. The maximum allowable quantity per control area is based on the material state (solid, liquid or gas) and the material storage or use conditions.

Control Area: Spaces within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used or handled.
## Maximum Allowable Quantity (MAQ)

### TABLE 5003.1.1(1) MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CLASS</th>
<th>GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED</th>
<th>STORAGE&lt;sup&gt;b&lt;/sup&gt;</th>
<th>USE-CLOSED SYSTEMS&lt;sup&gt;b&lt;/sup&gt;</th>
<th>USE-OPEN SYSTEMS&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Solid pounds (cubic feet)</td>
<td>Liquid gallons (pounds)</td>
<td>Gas (cubic feet at NTP)</td>
<td>Solid pounds (cubic feet)</td>
</tr>
<tr>
<td>Flammable gas</td>
<td>Gaseous</td>
<td>H-2</td>
<td>NA</td>
<td>NA</td>
<td>1,000&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Liquified</td>
<td></td>
<td>(150)&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flammable liquid&lt;sup&gt;c&lt;/sup&gt;</td>
<td>IA or IB and IC</td>
<td>H-2</td>
<td>NA</td>
<td>30&lt;sup&gt;d&lt;/sup&gt;</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or H-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flammable liquid, combination (IA, IB, IC)</td>
<td>NA</td>
<td>H-2</td>
<td>NA</td>
<td>120&lt;sup&gt;d, e, h&lt;/sup&gt;</td>
<td>NA</td>
</tr>
<tr>
<td>Flammable solid</td>
<td>NA</td>
<td>H-3</td>
<td>125&lt;sup&gt;f&lt;/sup&gt;</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Inert gas</td>
<td>Gaseous</td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Liquified</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic peroxide</td>
<td>UD</td>
<td>H-1</td>
<td>5&lt;sup&gt;g&lt;/sup&gt;</td>
<td>(1)&lt;sup&gt;g&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>H-2</td>
<td>5&lt;sup&gt;g&lt;/sup&gt;</td>
<td>(5)&lt;sup&gt;g&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>H-3</td>
<td>50&lt;sup&gt;j, k&lt;/sup&gt;</td>
<td>(50)&lt;sup&gt;j, k&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>H-3</td>
<td>125&lt;sup&gt;j, k&lt;/sup&gt;</td>
<td>(125)&lt;sup&gt;j, k&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>NA</td>
<td>NL</td>
<td>NL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>NA</td>
<td>NL</td>
<td>NL</td>
<td></td>
</tr>
<tr>
<td>Oxidizer</td>
<td>4</td>
<td>H-1</td>
<td>1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(1)&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;k&lt;/sup&gt;</td>
<td>H-2 or H-3</td>
<td>10&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(10)&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>H-3</td>
<td>250&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(250)&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>NA</td>
<td>4,000&lt;sup&gt;e&lt;/sup&gt;</td>
<td>(4,000)&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>
MAQs and Control Areas

Control Area: Spaces within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used or handled.
MAQs and Control Areas

- Floor levels (relative to grade plane)
- Automatic Fire Sprinklers

Grade plane

<table>
<thead>
<tr>
<th>4</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
MAQs and Control Areas

- Floor levels (relative to grade plane)
- Automatic Fire Sprinklers
# MAQs and Control Areas

<table>
<thead>
<tr>
<th>Grade plane</th>
<th>MAQ Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1.25 lbs</td>
</tr>
<tr>
<td>3</td>
<td>5 lbs</td>
</tr>
<tr>
<td>2</td>
<td>7.5 lbs</td>
</tr>
<tr>
<td>1</td>
<td>10 lbs</td>
</tr>
<tr>
<td>B1</td>
<td>7.5 lbs</td>
</tr>
</tbody>
</table>
MAQs and Control Areas

<table>
<thead>
<tr>
<th>Grade plane</th>
<th>MAQ Limit</th>
<th>Sprinklers</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>1.25 lbs</td>
<td>2.5 lbs</td>
</tr>
<tr>
<td>B1</td>
<td>5 lbs</td>
<td>10 lbs</td>
</tr>
<tr>
<td>B1</td>
<td>7.5 lbs</td>
<td>15 lbs</td>
</tr>
<tr>
<td>B1</td>
<td>10 lbs</td>
<td>20 lbs</td>
</tr>
<tr>
<td>B1</td>
<td>7.5 lbs</td>
<td>15 lbs</td>
</tr>
</tbody>
</table>
MAQs and Storage
Potential solutions

Manage situations where specific Control Areas may exceed MAQs

L-occupancy

Li Ka-Shing Center for BioMedical and Health Sciences
Potential solutions

H-occupancy

Chemical stockroom
Chemicals
Obstacles to MAQ Compliance

• Uses of hazardous chemicals in research

• Nature of research funding

• Allocation of laboratory space
Use of Hazardous Chemicals in Research

- Chemistry & Engineering
  - Flammables
  - High-hazard
    - Explosives
    - Strong Oxidizers
    - Pyrophorics
    - Reactives
Use of Hazardous Chemicals in Research

- Biomedical
  - Oxygen
  - Formaldehyde
  - Alcohol
  - Bleach
Nature of Research Funding

- Uncertain
- Grant proposals increasingly competitive
- PIs must consider how to continue operations if funding is interrupted
- Lumpy
- Multi-year grants often funded up front
- Vendors often offer discounts for bulk purchases
- Unspent funds must be returned to funding agency

![Graph showing NIH Grant Funding (millions) from 1998 to 2022 with Proposal Funding Rate]
Allocation of Laboratory Space

• Lab space assigned by faculty
  • Not experts in fire code

• Competing priorities
  • Foot traffic
  • Security
Obstacles to Collecting Chemical Inventories

- Hundreds of independent research groups

- Autonomy

- Chemical Inventory System (CIS, 2014)
  - User-generated chemical data
  - Not connected to hazard data
  - Not connected to location data

- UC Chemicals (now RSS Chemicals, 2017)
RSS Chemical Inventory
RSS Chemical Inventory System

- MAQ KPIs
- Campus views of MAQ Compliance
- Building views Control Area Compliance reports
- Identify conditions (sprinkler/approved storage etc.)

- *Check out RSS booth for more information*
Current UC Systemwide Data in RSS Chemicals

10 campuses & 5 medical centers with 1.5 million containers across about 4800 separate inventories.

More than 89 thousand unique chemicals
Total mass of more than 25,000 metric tons
973 buildings with containers
2173 floors
12,434 rooms
2143 control areas
Campus Maximum Allowable Quantity Key Performance Indicators *(real-time reporting)*

### Control Areas and MAQ

- **22** Over Threshold Buildings
- **6** Near Threshold Buildings
- **514** Compliant Buildings
- **27** Incomplete Buildings

### Frequently Asked Questions

**What is a control area?**

A control area is a group of rooms used to track amounts of chemical inventory. Control area must comply with the Fire Code for Maximum Allowable Quantities (MAQ).
Campus view of MAQ Compliance

- View buildings
- Observe status
- Updated in real time
Building View Control Areas

• View all control areas in each building
• Access real-time limit compliance status for each control area
• Identify MAQ relevant building level details
Control Area View

- Code applied
- Occupancy, Floor Level, Indoor or Outdoor
- Any exemptions
- Approved storage hazard class & NTP state

<table>
<thead>
<tr>
<th>Physical Hazards</th>
<th>Solid</th>
<th>Liquid</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Actual</td>
<td>MAQ</td>
<td>Units</td>
</tr>
<tr>
<td>Pyrophoric</td>
<td>0.00</td>
<td>4</td>
<td>lbs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health Hazards</th>
<th>Solid</th>
<th>Liquid</th>
<th>Gas</th>
<th>Liquefied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Actual</td>
<td>MAQ</td>
<td>Units</td>
<td>Actual</td>
</tr>
<tr>
<td>Corrosive</td>
<td>218.22</td>
<td>10000</td>
<td>lbs</td>
<td>69.78</td>
</tr>
<tr>
<td>Toxic</td>
<td>139.96</td>
<td>1000</td>
<td>lbs</td>
<td>381.72</td>
</tr>
<tr>
<td>Highly Toxic</td>
<td>21.70</td>
<td>20</td>
<td>lbs</td>
<td>54.28</td>
</tr>
</tbody>
</table>
Fire Code Maximum Allowable Quantity Limit Details

2. Storage, Use open, Use closed
3. Approved storage (cabinets, day boxes, gas cabinets, gas rooms, exhausted enclosures or in listed safety cans)
4. Buildings … automatic sprinkler system
5. First floor above grade plane, the floors above & below
6. Allowed number of control areas or lab suites on a floor
7. Occupancy of the control area
8. Code and year
Report & Recommendations
MAQ Task Force Report & Recommendations

Location Recommendations:

L1. Each UC location MUST implement RSS Chemicals by [+30 months]. This includes ensuring control areas are defined and that substantially complete and accurate inventories have been entered into RSS Chemicals. Substantially complete is defined as 90% of the total true quantity.

L2. Upon acceptance of these recommendations, UC locations MUST consult the UC Laboratory Safety Design Manual in the process of planning and constructing new buildings with laboratories.
L3. Each UC location\textsuperscript{3} MUST develop a location-specific MAQ Management Plan for ensuring and maintaining compliance with MAQs for all hazardous materials categories in all buildings and control areas and submit it to the Office of the President, Office of Risk Services by [+36 months].

a. The plan MUST be designed for full implementation within [+6 years].

b. The MAQ Management Plan MUST identify milestones toward achieving full implementation by [+6 years].

c. In exceptional circumstances, a location MAY request an extension to the full implementation deadline for a specific building or control area. The request MUST include details on the alternative means of control to be implemented, how monitoring will be conducted, and a timeline for when the building or control area will achieve full implementation.

d. The MAQ Management Plan MUST include a funding plan and schedule for implementation. The funding plan MUST NOT directly recharge the costs of hazardous waste disposal to any researcher or Principal Investigator.

e. Training requirements MUST be included in the MAQ Management Plan.

f. The plan SHOULD focus on prioritizing the highest-risk areas first.

g. The plan SHOULD use one or more potential toolbox solutions identified in Section 4.
MAQ Task Force Report & Recommendations

L4. Each UC location MUST submit to the Office of the President, Office of Risk Services an annual report on the progress of implementing the MAQ Management Plan beginning 12 months after the submission of the final plan and continuing until substantial implementation has been achieved.

   a. Upon reaching substantial implementation, every UC location MUST submit an annual report on the overall status of MAQ compliance to the Office of the President, Office of Risk Services, using a format approved by the UC Council of Campus Fire Marshals.
Systemwide Recommendations:

S1. UC Finance MUST inform UC locations about funding options that may be allocated to support MAQ compliance goals as they become available.

S2. The Office of the President, Office of Risk Services MUST provide a series of educational tools, such as infographics and short videos, to help stakeholders (e.g., researchers, administrators, architects, and safety personnel) understand the basics of MAQ compliance and the management options available to them.

S3. The Office of the President, Office of Risk Services MUST coordinate a process to revise the UC Laboratory Safety Design Manual to include methods for evaluating the preferred building construction type and storage locations suitable for the planned chemical usage and associated MAQ needs.
S4. The Office of the President, Office of Risk Services MUST work with the Office of Design & Construction to update the Facilities Manual to strengthen integration with the Laboratory Safety Design Manual.

S5. The Office of the President, Office of Risk Services MUST provide a systemwide advisor to consult with locations about their progress on ensuring and maintaining MAQ compliance. This person will be responsible for aggregating the annual status reports.

S6. The Office of the President, Procurement Services SHOULD evaluate the feasibility of mandating a single, systemwide chemical ordering system that would integrate with RSS Chemicals.
Conclusions

• Complex Problem
  • Multiple stakeholders
  • Code compliance & enforcement
  • Monitoring & oversight

• MAQ Task Force Report and Recommendations

• Solutions and Assistance
  • RSS Chemicals
  • Systemwide Advisor
  • Consultant for LSDM
Contact Page

Brent Cooley, CIH, CSP
Deputy Director, Environment Health & Safety
brent.cooley@ucop.edu
(831) 212-2553

Megan C. Hall, PhD
Deputy Fire Marshal – Hazardous Materials
mchall@berkeley.edu
(510) 295-3580

Christopher Kolodziej, PhD
Chemical Hygiene Officer/Lab Safety Division Manager
ckolodziej@ehs.ucla.edu
(310) 794-5013

Russ Vernon, PhD
EH&S Business Development Manager
Russell.Vernon@RiskandSafetySolutions.com
riskandsafety.com
Questions?