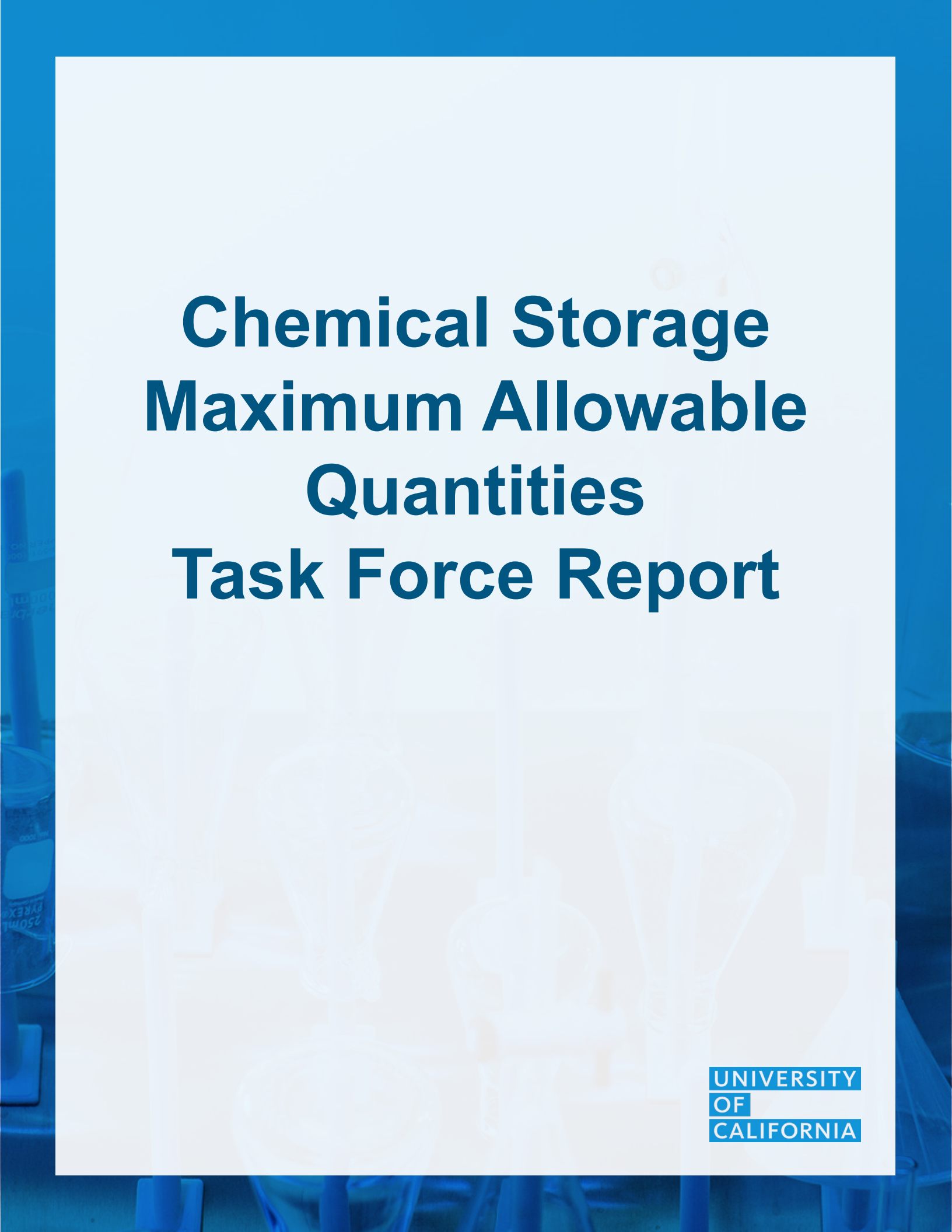
Chemical Storage Maximum Allowable Quantities Task Force Report



UNIVERSITY OF CALIFORNIA

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Section 1. Executive Summary

Scientific research and education are fundamental to the University of California's (UC) mission. An essential component of scientific research and teaching in UC laboratories is the use of chemicals with hazardous properties (commonly referred to as "hazardous materials"). Facilities and shops supporting campus infrastructure also require the use of hazardous materials.

The University is required by law to use and store hazardous materials in compliance with the California Fire Code (CFC) and the California Building Code (CBC). The CFC is the primary regulation governing the safe storage and use of hazardous materials inside and outside buildings. The CFC defines hazardous materials as those chemicals or substances that are physical hazards or health hazards[1]. Often, a hazardous material may exhibit both physical and health hazards. For instance, a flammable solvent may also be toxic.

The CFC hazardous material regulations establish the minimum requirements for providing a reasonable level of life safety and property protection from the hazards of fire, explosion, or dangerous conditions for building occupants. Most importantly to the charge of this task force, the CFC defines specific upper limits or Maximum Allowable Quantities (MAQs) for hazardous materials based on several determining factors. Some of these factors are based on the properties of the hazardous material (e.g., the hazard class and physical state), while other factors are based on the building's attributes (e.g., construction type, occupancy type, floor level, and presence of fire sprinklers throughout the building).

Hazardous material MAQs provide a reasonable level of safety to firefighters and emergency responders during emergency operations. Hazardous material quantities that exceed the MAQ limits not only present a risk to life, but they could also result in catastrophic damage to the building due to fires and explosions. For example, if buildings and outdoor storage areas have not been designed to accommodate the quantities of hazardous materials present, building occupants and first responders are at a much greater risk of injury or death.

Task Force Charges

1. Conduct an analysis of the current MAQ status by UC location.
2. Develop solutions and pathways to supporting MAQ compliance by engaging with key stakeholders, identifying necessary resources, and establishing possible implementation timelines.
3. Create educational resources and materials on both the challenges and potential solutions to supporting MAQ compliance.
4. Provide a report and recommendations to senior leadership by July 1, 2022.

This report provides a set of key recommendations for the Vice President of Research and Innovation and the Executive Vice President - Chief Financial Officer to consider to ensure that all University locations comply with the MAQs.[2]

[1] The CFC defines a physical hazard as "[a] chemical for which there is evidence that it is a combustible liquid, cryogenic fluid, explosive, flammable (solid, liquid or gas), organic peroxide (solid or liquid), oxidizer (solid or liquid), oxidizing gas, pyrophoric (solid, liquid or gas), unstable (reactive) material (solid, liquid or gas) or water-reactive material (solid or liquid)." The CFC defines a health hazard as "[a] classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term 'health hazard' includes chemicals that are toxic, highly toxic and corrosive."

[2] Please see the attached legal memorandum, which discusses associated legal issues.

Summary of Recommendations

The task force proposes ten recommendations - four to be implemented by each UC location and six for implementation systemwide by the UC Office of the President. Each recommendation reappears later in the report in the corresponding section that describes the justification for that recommendation.

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[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.

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.

[3] Each UC campus and affiliated health system is expected to submit a location-specific plan. The plans can be aggregated into one or the plans can be separate from each other.

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.

These recommendations factor in several challenges, including but not limited to aging infrastructure, building design, limited laboratory space, lack of MAQ compliance knowledge, limited personnel and funding resources, and diverse and evolving research programs that have competing chemical demands.

Section 2. Systemwide Concerns

Maximum Allowable Quantities (MAQs)

Maximum Allowable Quantities (MAQs) are the greatest amounts of hazardous materials that the California Fire Code (CFC) legally allows for storage or use within a building control area without becoming a High-Hazard occupancy. A control area is a designated area separated from the rest of the building by specified fire-rated construction. Each control area compartment is treated as a separate storage area regarding the acceptable amount of hazardous materials that can be present.

The CFC and the California Building Code (CBC) are the primary laws governing the safe storage, dispensing, handling, and use of hazardous materials (chemicals) in and outside buildings. The MAQs established in the CFC provide control to develop a minimum level of property protection and life safety for building occupants and first responders.

MAQ Calculations

The MAQs permitted in a single control area are established by the CFC. The CFC publishes a set of MAQ tables used as a starting point. In each of these tables, the MAQs are further delineated first by their hazard class (e.g., toxic, flammable, etc.) and then by their physical state (e.g., solid, liquid, or gas). The tables are further broken down by their intended purpose: storage or use. In general, the storage limits are higher because the MAQs account for the primary containers playing a role in preventing release of the materials. The “in use” limits tend to be lower as they consider the hazardous materials to be in active manipulation. The mechanisms to track the usage of chemicals differ from the inventory approach used to track compliance with storage limits.
To address the charge of the task force, the remainder of this report will focus on the storage limits.

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

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE			USE-CLOSED SYSTEM			USE-OPEN SYSTEM	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Inert gas	Gaseous Liquified	NA NA	NA NA	NA NA	NL NL	NA NA	NA NA	NA NA	NL NL	NA NA
Organic peroxide	UD I II III IV V	H-1 H-2 H-3 H-3 NA NA	1 5 50 125 NL NL	(1) (5) (50) (125) NL NL	NA	0.25 1 50 125 NL NL	(0.25) (1) (50) (125) NL NL	NA	0.25 1 10 25 NL NL	(0.25) (1) (10) (25) NL NL
Oxidizer	4 3 2 1	H-1 H-2 or H-3 H-3 NA	1 10 250 4,000	(1) (10) (250) (4,000)	NA	0.25 2 250 4,000	(0.25) (2) (250) (4,000)	NA	0.25 2 50 1,000	(0.25) (2) (50) (1,000)
Oxidizing Gas	Gaseous Liquified	H-3	NA	NA (150)	1,500 NA	NA	NA (150)	1,500 NA	NA	NA
Pyrophoric	NA	H-2	4	(4)	50	1	(1)	10	0	0
Unstable (reactive)	4 3 2 1	H-1 H-2 or H-3 H-3 NA	1 5 50 NL	(1) (5) (50) NL	10 50 750 NL	0.25 1 50 NL	(0.25) (1) (50) NL	2 10 750 NL	0.25 1 10 NL	(0.25) (1) (10) NL
Water reactive	3 2 1	H-2 H-3 NA	5 50 NL	(5) (50) NL	NA	5 50 NL	(5) (50) NL	NA	1 10 NL	(1) (10) NL

Table 1: Excerpt from the 2022 CFC showing the MAQ table values for chemicals with a physical hazard.

The values obtained from reading the "Storage" column in the MAQ tables serve as the foundation and starting point for performing the calculation. Several modifying factors must be determined and then applied to the initial tabular value to calculate final MAQs for a particular control area. First, the Designated Campus Fire Marshal (DCFM) or the Campus Building Official must assign the "group of occupancy". Occupancy type is the formal designation of the primary purpose of the building or a specific space within a building based on the design, engineering, and architecture of the facility. Examples of "occupancy type" include Assembly, Business, High-Hazard, and Residential.

Second, qualified individuals must determine the location and visually observe the structural integrity of control area fire-resistant rated separations by performing a plan review and physical inspection of the building's infrastructure. The sprinkler status of the building must be determined, as well as the floor levels above or below the grade plane for all control areas (this is not the same as the assigned building floor number commonly used by occupants). Once all of the above inputs have been determined, final MAQs for each hazard class and their physical states of matter are calculated for each control area in the building.

Floor Level		Percentage of the Maximum Allowable Quantity per Control Area	Number of Control Areas per Floor
Above grade plane	Higher than 9	5	1
	7 through 9	5	2
	6	12.5	2
	5	12.5	2
	4	12.5	2
	3	50	2
	2	75	3
	1	**100**	**4**
Below grade plane	-1	75	3
	-2	50	2
	Lower than -2	Not Allowed	Not Allowed

Table 2: Reduction in MAQ by story: above or below grade.

Risks of Exceeding MAQs

A number of core compliance or regulatory code risks are associated with exceeding MAQs. These include, but are not limited to, escalation of non-compliance to the DCFM who has the authority to red tag the facility and take it out of use, or a UC location would be required to inform other oversight agencies of its non-compliance, which can result in enforcement action that may carry administrative fines and/or civil penalties, and which could impact operations negatively.

If buildings and outdoor storage areas have not been designed to accommodate the safe storage and use of large quantities of hazardous materials, building occupants and first responders are at a much greater risk of injury or death. Excessive chemical quantities are also more likely to result in catastrophic damage to the building due to fires and explosions. Even small fires or accidents that originate in a control area can quickly accelerate and spread beyond the point of origin. These uncontained fires can cause permanent loss of experimental samples, data, intellectual property, critical equipment, and research funding. Adhering to the MAQs is essential for ensuring a building is safe for its occupants and first responders. Therefore, every effort must be made to ensure compliance with the MAQs.

Chemical Inventory System Needs

There are many regulations beyond the CFC that require UC to report hazardous material inventories to several regulatory agencies. UC locations have collected chemical inventory information for decades, but early versions of the chemical inventory tools used varied by location and were limited in their adoption. This meant that the University could not easily aggregate inventory data and review compiled analytics systemwide. Additionally, these historical chemical inventory software applications lacked a robust ability to properly classify a chemical substance into the correct hazard class. Improper classification due to inaccurate hazardous property reference data often resulted in incorrect MAQ reporting. The inventory systems could not compare the inventoried

chemical quantities with the final MAQs calculated using assigned control areas and building attributes as modifying factors.

In 2018, UC Risk & Safety Solutions (RSS), an Information Technology team located at UC Davis and funded by the Office of the President, Office of Risk Services (OPRS), developed a comprehensive chemical inventory solution called "RSS Chemicals" that addressed all of these shortcomings. For the first time, UC could use building attributes to accurately calculate final MAQs for each control area. RSS Chemicals was designed specifically for use by UC to collect the relevant information necessary to verify MAQ compliance.

At this time, UC locations continue to use various chemical inventory software solutions and, in some cases, have initiated the adoption of RSS Chemicals. Given the importance of MAQ compliance and the need for enterprise reporting, full adoption of the RSS Chemicals software by all UC locations is necessary.

Location Recommendation:

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.

One other benefit of using a common systemwide chemical inventory management system is that it would provide an opportunity for integration with chemical purchasing platforms. Integration might be difficult because there are multiple procurement systems in use at our locations. A singular, integrated procurement system would greatly enhance UC's ability to maintain compliance with MAQs. It is important to further explore whether it is feasible for a procurement system to perform a compliance check of MAQs before placing an order for additional hazardous materials.

Systemwide Recommendation:

S6. The Office of the President, Procurement services SHOULD evaluate the feasibility of mandating a single, systemwide chemical ordering system for use at UC locations that would integrate with RSS Chemicals.

MAQ Compliance Challenges

Although there are many common challenges across the system, the specific obstacles that a single location may encounter depend on several local factors. Listed below are some commonly cited challenges to a successful MAQ compliance program.

1. Communicating the requirements associated with MAQ compliance. MAQs involve complex code requirements and multiple stakeholders, making a full understanding of the topic difficult. Factors to consider in this area include:
    a. Faculty, staff, and student turnover in research laboratories;
    b. Consistency and clarity of available training and education resources;
    c. Laboratory rooms are located in a single control area managed by different departments and

multiple researchers, which makes discussions about allocating fair portions of shared MAQ limits challenging.

2. Establishing and maintaining accurate chemical inventories involves challenges, including:
    a. Lack of clarity regarding roles and responsibilities; a clear delineation of responsibilities between chemical owners, chemical inventory administrators, fire marshals, and design and construction professionals is critical. While faculty hold some responsibility for managing their chemical quantities, efforts should include reducing the administrative burden for faculty through collaboration with other stakeholders.
    b. Lack of a comprehensive enterprise software solution;
    c. Lack of accurate control area information in the chemical inventory system.
3. Existing buildings are often inadequate to maintain significant amounts of hazardous materials due to the following:
    a. Aging infrastructure. Numerous campus buildings were constructed well before the modern CFC, and CBC outlined prescriptive building attributes and conditions for safe storage of hazardous materials.
    b. They have limited laboratory space. Buildings have not kept up with the demand for adequate, appropriate space for the growing number of researchers in STEM fields, most of which utilize extensive inventories of hazardous materials.
    c. Location of laboratories within buildings. The CFC allows more generous quantities of hazardous materials in locations within buildings most accessible by emergency responders, particularly the ground floor and lower levels. Unfortunately, labs are often located on the highest, least accessible levels of buildings where MAQ allowances are drastically reduced. For example, a control area on the 1st floor of a building can have 120 gallons (aggregate) of flammable liquids. On the 4th floor of the same building, the MAQ limit is 15 gallons of flammable liquids.
    d. Lack of fire sprinkler coverage, fire-rated construction, sufficient ventilation, safety cabinets, storage facilities, and waste removal facilities. It is much more expensive and disruptive to address these deficiencies through renovations or additions to the facility after final construction.
4. Limited resources make it challenging to comply with MAQ requirements.
    a. Funding for building upgrades, new facilities, personnel, tracking software and equipment, and training is required to ensure MAQ compliance across the system.

Systemwide Recommendation:

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

Location Recommendation:

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.

Section 3. Analysis of the Current MAQ Status by UC Location

Survey Process

UC has partially adopted the "RSS Chemicals" software application. This software can document, track, and report chemical inventories at all UC locations. As part of its charge, this task force analyzed the inventory contained in RSS Chemicals and surveyed the locations to assess other inventories kept outside of this software.

The task force developed an electronic survey to evaluate critical elements of UC chemical storage practices and the current MAQ status of each UC location. The survey included a set of definitions for "chemical containers," "chemical inventory system," and "complete chemical inventory" to ensure a common understanding of key terms used throughout the questions.

The survey included questions broken down into general focus areas, including:

3. the chemical inventory software in use and its capabilities;
4. how the inventory is currently reconciled;
5. facility and building information (e.g., presence of sprinklers, control area designations, etc.); and
6. compliance monitoring and management of MAQ thresholds.

The survey was distributed to each of the ten UC campuses with directions noting that submitting the requested information would likely involve feedback from the campus chemical inventory administrator and the DCFM. Initial survey results were evaluated by a subcommittee of task force members. As part of this evaluation, several gaps and inconsistencies in campus responses were noted, most likely due to a lack of understanding of the question or what information was being requested.

Individual follow-up meetings were conducted with representatives from each campus to normalize the data and ensure that locations understood the basis of the survey questions. During these meetings, campus representatives were able to provide a more detailed explanation of their survey responses. These discussions achieved greater consistency through a common understanding of the survey questions. Ultimately, the campus follow-up meetings gave the task force a higher degree of confidence that each location was interpreting and responding to the survey questions more consistently.

Summary of Survey Results

The survey responses identified many key factors related to MAQ compliance and chemical inventory management in the UC system. These points include:

1. Each campus is at a different point in addressing MAQ compliance.
2. Ensuring compliance with MAQs is complex and not dependent upon an individual, department, or a single solution.
3. Campuses have challenges concerning the collection of complete chemical inventories. Some campuses

have already collected a complete chemical inventory, while others have stated they could do so within approximately 2 to 3 years if provided adequate staffing resources.

4. Campuses have similar challenges concerning reconciling and monitoring complete chemical inventories. Staffing levels would need to be augmented to support ongoing chemical inventory management.
5. Although there is a trend toward campuses adopting and using a standard chemical inventory management software (RSS Chemicals), full implementation and use varies across the UC, and some locations currently employ a different program or more than one software program to manage their chemical inventories.
6. Campuses use various approaches to reconcile chemical inventories, including:
    a. Having designated EH&S staff or student employees update inventories for chemical owners;
    b. Requesting chemical owners submit information to update their inventories (e.g., add new chemicals, delete used or disposed of chemicals, etc.);
    c. Tracking procurement activities to update inventories;
    d. Checking chemical inventory accuracies as part of routine safety inspection activities; and
    e. Focusing reconciliation efforts only on designated subsets of more highly regulated chemicals.
7. Campuses have similar challenges in identifying and tracking essential facility design information that is critical in determining the overall MAQ storage limitations for a designated area and the general building. These facility components include:
    a. Presence of automatic fire sprinkler systems;
    b. Identification of CFC-compliant control areas;
    c. The integrity of building systems (e.g., walls, floors, ceilings) within a control area;
    d. Use of chemical storage cabinets (e.g., flammable, corrosive, gas); and
    e. Determination of a facility's floor levels relative to grade plane.
8. The chemical inventory software may not be designed to accept facility component information, making determining MAQs inaccurate or difficult. This is a feature RSS Chemicals does perform.
9. Monitoring compliance with MAQ threshold levels is a challenge. Campuses are currently using a variety of mechanisms to monitor compliance, including:
    a. Reviewing procurement activities for designated chemical classes;
    b. Maintaining a comprehensive chemical inventory with MAQ reviews triggered by building renovation or construction activities; or
    c. Performing MAQ compliance checks as part of EH&S laboratory inspections or Fire and Life Safety inspections.
10. The frequency of MAQ compliance checks varies widely across the UC system, primarily based on available staffing resources and the accuracy of the chemical inventory software.
11. There is a broad range concerning how campuses prioritize MAQ challenges. One campus noted the use of hazardous materials as more of a concern than storage conditions. Other campuses indicated that subsets of more reactive and higher hazard classes (e.g., pyrophoric, toxic gasses) take priority due to the limited staffing resources available to monitor all hazard classes of MAQs on their campuses.

12. When asked what additional equipment resources they would need to ensure and maintain MAQ compliance, there was general consistency in campus responses. Those resources included installing full fire sprinklers in existing facilities and using approved chemical storage cabinets.
13. Campuses indicated various staffing needs to ensure and maintain MAQ compliance depending on their current FTE allocation and their longer-term program management plans. Campuses noted there would likely be more significant staffing needs initially to collect and reconcile the current chemical inventory. Long-term staffing provisions would be required to maintain and manage the chemical inventory program.
14. There was considerable variability in whether campuses have evaluated the possibility of leveraging their procurement systems to support chemical inventory management and MAQ compliance tracking. The general agreement was that having these capabilities within a procurement system would significantly improve chemical inventory management.

Section 4. Solutions to Ensure and Maintain MAQ Compliance

Toolbox of Solutions

There is no one-size-fits-all solution to addressing MAQ challenges. Instead, there are many options, some of which only partially support one component of compliance. The task force identified several proven solutions and has summarized them below to assist locations with developing their *MAQ Management Plans*. Several of these solutions are helpful as initial or one-time corrections. Others are designed to be longer-term or permanent but are less aggressive in their ability to reduce chemical volumes or increase MAQ limits quickly. It is up to the individual location to determine whether one or more of the following solutions will most effectively ensure compliance with MAQs. A solution matrix is included in Appendix C to aid locations in evaluating the options.

Location Recommendations:

L3. Each UC location[4] 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.

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.

New Building Design and Construction

The long-term ability of the University to fulfill its research mission while complying with the CFC will require that research buildings be designed to support current research needs and to consider future and growing scientific research fields to appropriately manage the types and volumes of chemicals these new fields may use.

Many design choices can impact the researchers' ability to store sufficient chemicals to meet their research needs. These include the building occupancy classification, the construction of closed or open-concept laboratories, the location of chemical-intensive laboratories within buildings, and the provision of designated common storage areas for chemicals. Relevant occupancy groups under the CFC for research laboratories include the Business Group B, Laboratories Group L, and High-Hazard Group H. Buildings classified as Group B occupancies are the most economical to build but allow the smallest amount of chemical storage. Buildings classified as Group H occupancies carry the highest construction cost but permit storing the largest quantities of chemicals.

[4] Each UC campus and affiliated health system is expected to submit a location-specific plan. The plans can be aggregated into one or the plans can be separate from each other.

In addition, laboratory buildings designed with fire resistance-rated separations between individual research groups can dramatically increase the quantities of chemicals stored within a building. This MAQ increase is particularly effective if the building is constructed as a Group L occupancy since more control areas[5] are permitted per floor relative to Group B occupancy. The amount of hazardous chemicals that may be stored in a given building decreases on higher floors. Prioritizing space on lower floors for chemical-intensive laboratories and reserving space on higher floors for classrooms or offices can increase the amount of chemicals a particular lab can store. A single building may also be constructed with individual control areas assigned different occupancy groups. This could allow a building with a shared chemical storage room to be built with a Group H-occupancy.

Accordingly, the design of laboratory spaces is best achieved through close collaboration among numerous key stakeholders, including designers, project managers, DCFMs, building managers, facilities and EH&S staff, and researchers. Each participant can discuss the building's or renovation's needs, scope, and constraints. This interactive design and planning process must start at the earliest phases for new buildings and must include consultation with the UC Laboratory Safety Design Manual, which contains extensive requirements and best practices for laboratory design and construction. For example, departments can explain the current need for chemical storage and how that might evolve over the life of the building. Designers can explain the available design choices. DCFMs can help everyone understand the constraints those design choices will impose on future operations. Project managers are vital in facilitating these conversations and allowing all stakeholders to evaluate the tradeoffs involved. A higher upfront cost for a well-designed lab building will likely save money over the long term by minimizing continual upgrades and retrofits.

The construction of dedicated support buildings may also significantly impact the ability to satisfy MAQ requirements by providing locations where large quantities of chemicals can be stored safely and reducing researchers' need to keep large quantities of chemicals on hand. Termed "central stores," such buildings can serve as stockrooms for campus researchers in one or more buildings. Such an operation could leverage campus buying power to acquire common research chemicals at a discounted price. These cost savings could then be extended to research groups making small purchases from the central store. This would reduce the incentive for researchers to make large purchases of chemicals based on extramural funding cycles. So long as the central store is adequately supplied and staffed, researchers could obtain the chemicals they need to perform their research more quickly and reliably than by placing orders directly from external vendors.

Existing Building Renovation and Retrofit

To increase the MAQs for hazardous materials categories, it is likely that some alteration of the building's construction or design will need to occur because the majority of chemicals are located in existing buildings that rely upon certain operating conditions. Many possible alteration approaches are described below, with a complete list in Appendix C.

First, before any new improvement projects are permitted, locations should determine the status of MAQ compliance for each control area in the building to identify what additional retrofits, if any, would permit an increase in the MAQ of the hazardous materials stored. Accordingly, if a MAQ overage exists, it can be corrected as part of the capital cost for the improvement. Example retrofits could include, but are not limited to, the installation of fire sprinkler systems or the construction of firewalls; the conversion of an existing storage room into an upgraded Group H occupancy storage room; or adding CFC-compliant storage cabinets.

[5] Control areas are referred to as "laboratory suites" in Group L occupancy.

Conversion to a Group H occupancy storage room is cost-effective because it would allow centralized storage of larger quantities of chemicals to reside within that newly constructed Group H occupancy storage room without necessitating renovation of the larger control area. Further, adding hazardous materials storage cabinets is a relatively inexpensive option that allows for doubling MAQs for certain hazardous materials. Storage cabinet installation may necessitate increased ventilation capacity in buildings to accommodate more exhausted enclosures (e.g., gas cabinets or fume hoods).

Education

It is very important to educate all stakeholders (e.g., faculty, deans, building managers, facilities support staff, EH&S, campus construction, and design professionals) on the implications of design choices concerning MAQ storage limitations and options for increasing MAQs during multiple phases of construction and space planning. Guidebooks and maps can be helpful to building occupants in understanding the specific MAQs for their floor, room, or control area and how inventories belonging to different researchers within the same control area impact the same MAQ.

Procurement

Locations need to comprehend that MAQ compliance is a dynamic process. Snapshot inventories can be taken and efforts expended to either reduce the number of chemicals present or increase the permitted storage limits to bring the control area into compliance. However, these steps only achieve momentary compliance. As research and operations continue, the number of chemicals will increase as new orders are delivered. At the same time, the activities conducted in that space will eliminate chemicals via normal consumption or elimination from the control area as hazardous waste. Eventually, equilibrium will be re-established, and the permitted MAQ may again be exceeded.

To help manage these dynamic quantities, locations could consider implementing procurement or other systems that can integrate directly with RSS Chemicals to improve the real-time accuracy of the inventory. This integration would save valuable staff time and flag purchases that will cause the MAQs to be exceeded.

Waste Removal and Disposal Costs

Hazardous waste stored in a building's control areas contributes to the overall volume of hazardous materials when calculating the MAQs. Thus, the storage of hazardous waste limits the number of new products that a control area can legally store and have on hand for conducting research.

Laboratory close-outs, retirements, and transitions tend to result in abandoned chemicals, samples and obsolete equipment. Campuses should develop a laboratory closure or checkout process before Principal Investigators and other researchers, including visiting scholars, post-doctoral researchers, and graduate students, leave the campus. This would allow for an organized decommissioning of the laboratory and grant the new occupants a clean space.

History has demonstrated that directly recharging a Principal Investigator's grant for hazardous waste disposal leads to researchers holding on to their hazardous waste and old chemicals to avoid paying the disposal price. This has the negative impacts of:

- Increasing the volume of hazardous materials/waste storage beyond the legal MAQs for the building control area or occupancy classification;

- Increasing the likelihood of a laboratory fire or explosion from storage of old and deteriorating materials; and
- Decreasing available laboratory storage space.

There is a benefit to centrally funding the removal and disposal of hazardous waste. Central funding helps the University stay compliant with the CFC because it incentivizes waste removal, lowers the quantities of hazardous materials stored in laboratories or control areas, and leads to a safer laboratory environment that more readily enables environmental compliance obligations and reduces institutional liability.

Accordingly, it is recommended that the cost of all hazardous waste disposal and removal is not charged directly to a researcher or their grants throughout the system. Instead, the cost of waste disposal should be funded centrally by campus resources. In addition, EH&S could provide annual waste amnesty days to make disposal and cleanouts easier for laboratory personnel.

Direct recharge for department-generated waste (e.g., asbestos or used paint generated from facilities) can be directly recharged to those generating it.

Inventory Management Practices

Appendix C includes several possible considerations for a location to improve its inventory management practices. As part of the overall MAQ compliance program, locations may need to perform routine inspections of existing buildings to ensure occupants have not altered control areas (e.g., wall penetrations or additions).

UC DCFMs regularly conduct inspections to comply with the CFC. To properly assess the state of MAQ compliance, relevant information regarding campus buildings must be collected and entered into a chemical inventory system. On many campuses, this information may exist in paper records or may never have been collected systematically. Hiring fire prevention specialists to collect and enter these records into RSS Chemicals would expedite determining the allowable chemical loads for existing buildings. DCFMs will require additional staffing to verify and update these data periodically.

Many UC campuses rely on chemical users (laboratory researchers or facilities staff) to update and maintain their chemical inventories. The reliance on researchers to update their inventories takes great effort and detracts from time spent on research. Furthermore, high turnover in labs makes maintaining accuracy difficult. The RSS Chemicals software was developed to be compatible with barcode and Radio Frequency Identification (RFID) labeling. Implementing RFID tagging for all chemicals across a location would greatly improve chemical inventory accuracy and allow for more streamlined MAQ compliance. An inventory system managed by EH&S staff is the most accurate method. A UCSF study revealed a 28% annual accuracy drift if not centrally managed. Permanent EH&S staff should be employed to initiate and maintain accurate chemical inventories across campuses.

Systemwide Toolbox Solutions

The Task Force identified several efforts that would allow for better efficiency and support of the locations if performed systemwide. Several recommendations are:

Systemwide Recommendations:

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 the 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.

Appendices

Appendix A: Task Force Membership
Appendix B: Glossary
Appendix C: Toolbox of Solutions Matrix
Appendix D: Flowchart of MAQ Management
Appendix E: Legal Analysis
Appendix F: UC MAQ Status Survey Results

Appendix A: UC Chemical Storage Maximum Allowable Quantities Task Force Membership

Name	Location	Title	Committee Role	Dates Active	Stakeholder Group
Bales, Karen	UC Davis	Professor, Department of Psychology	Voting Member	06/2021 - present	Academic Senate - UCORP
Carter, Bruce	UC Santa Barbara	Hazardous Waste Program Manager	Voting Member	06/2021 - present	Hazardous Waste Managers
Coulon, Rick	UC Irvine	Interim Chief Financial Officer and Vice Chancellor for Finance and Administration	Voting Member	12/2021 - present	COVCA
Cortez, Ron	UC Irvine	Chief Financial Officer and Vice Chancellor of Finance and Administration	Voting Member	06/2021 - 12/2021	COVCA
Ferguson, Tod	UC San Diego	Hazardous Materials Business Plan Manager	Voting Member	06/2021 - 06/2022	EH&S
Fish, Susan	UC Berkeley	Associate Director of Asset Management	Voting Member	06/2021 - 07/2022	Facilities Management
Fladd, Cara	UC San Francisco	Director of Real Estate Services	Voting Member	06/2021 - present	Space Planning
Hall, Megan	UC Berkeley	Deputy Fire Marshal - Hazardous Materials	Voting Member	06/2021 - present	Fire Prevention Services
Kolodziej, Chris	UCLA	Chemical Hygiene Officer	Voting Member	06/2021 - present	EH&S
Otis, Nick	UC Santa Cruz	Director of the Office of Emergency Services / Lead Designated Campus Fire Marshal (DCFM)	Voting Member	06/2021 - present	DCFM
Pratt, Brian	UC Irvine	Associate Vice Chancellor and Campus Architect, Design & Construction Services	Voting Member	06/2021 - present	Building Official
Smith, Brian	UC San Francisco	Chief Ethics and Compliance Officer / Senior Associate Vice Chancellor for Research	Voting Member	06/2021 - present	VCR / RPAC
Cooley, Brent	UC Office of the President	Deputy Director of EH&S, Office of Risk Services	Ex Officio Member	05/2021 - present	EH&S
Friedman, Lauren	UC Office of the President	Director of Design & Construction, Capital Programs	Ex Officio Member	05/2021 - present	Capital Programs
Owens, Ellen	UC Office of the President	Associate Director of Design & Construction, Capital Programs	Ex Officio Member	05/2021 - present	Capital Programs
Quiter, Sarah	UC Office of the President	Senior Counsel, Office of General Counsel	Ex Officio Member	05/2021 - present	UC Legal
Smith, Ken	UC Office of the President	Executive Director of EH&S, Office of Risk Services	Ex Officio Member	05/2021 - present	EH&S
Brostrom, Nathan	UC Office of the President	Executive Vice President & Chief Financial Officer	Sponsor	05/2021 - present	Finance and Administration
Maldonado, Theresa	UC Office of the President	Vice President for Research & Innovation	Sponsor	05/2021 - present	Research
Vernon, Russell	UC Davis	EH&S Program Manager, Risk & Safety Solutions	Technical Advisor	05/2021 - present	RSS
Bulawin, Elaine	UC Office of the President	Legal Support Specialist, UC Legal - Office of the General Counsel	Coordinator	05/2021 - 12/2021	UC Legal
Nelson, Veronica	UC Office of the President	Enterprise Risk Management Analyst, Office of Risk Services	Coordinator	05/2021 - present	OPRS

Appendix B: Glossary

California Building Code (CBC)

The California Building Code is a set of construction regulations established by the State of California to ensure the safety and accessibility of buildings and structures. The CBC sets standards for building design, construction materials and techniques, electrical systems, plumbing systems, energy conservation, and many other aspects of building and construction. The CBC is updated and published every three years to reflect advances in construction technology and changing regulations. The CBC is designed to be used in conjunction with other building codes, such as the California Fire Code (CFC), to provide a comprehensive framework for ensuring safe and accessible building construction in the state.

California Fire Code (CFC)

The California Fire Code is a set of fire safety regulations established by the State of California to ensure fire protection and life safety in buildings and structures. The CFC sets standards for the design, construction, maintenance, and use of buildings and structures to minimize the risk of fire and injury. It covers topics such as fire protection systems, fire alarms, fire department access, fire-resistant construction, and hazardous materials storage. The CFC is updated and published every three years to reflect advances in fire safety technology and changing regulations.

Certified Building Official (CBO)

The Certified Building Official is a University employee assigned to a campus and is responsible for enforcing the CBC for all campus buildings and construction projects.. The CBO issues building permits and also works closely with the Designated Campus Fire Marshal to ensure that applicable fire and life safety requirements are reviewed. The CBO's responsibilities are delegated from the Designated Campus Building Official, or the Designated Campus Building Official may satisfy the role of a CBO if the DCBO meets the CBC qualifications of a "Building Official" as defined in the CBC.

Chemical Container

Any hazardous chemical used, handled, or stored in quantities equal to or greater than the following:
Any amount of a chemical/compound/agent with a hazard characteristic of pyrophoric, water-reactive, potentially explosive, acutely toxic, peroxide forming, strong corrosive, strong oxidizing, or strong reducing;

- Any amount of a chemical/compound/agent listed as a regulated carcinogen or reproductive hazard;
- Any amount of compressed gas;
- 250 grams of solid substance;
- 100 milliliters of liquid substance.

Chemical Inventory System

A computer system that can calculate the amount of aggregated chemicals acutely by fire code hazard category and compare that aggregate amount against the California Fire Code (CFC) permitted MAQ. This system needs to account for the modifying factors of floor level relative to grade plane (also called a "story"), appropriate storage for doubling, and fully sprinklered building status (for doubling).

Complete Chemical Inventory
A chemical inventory is considered complete when all the hazardous chemical containers are represented in the inventory and any discarded or empty containers are removed.

Control Area
A control area, as defined by the California Fire Code (CFC), is a designated portion of a building or structure where hazardous materials are stored, used, or handled. The purpose of a control area is to minimize the risk of fire or release of hazardous materials by controlling access, regulating storage and handling practices, and requiring fire protection and life safety systems. Control areas must be approved by the local fire department and must comply with the regulations set forth in the CFC, including the Maximum Allowable Quantities (MAQs) of hazardous materials that can be stored in the area. The boundaries of a control area are defined by the location of fire protection and life safety systems, such as fire sprinklers, fire alarms, and emergency lighting, and by the construction of the building or structure itself.

Designated Campus Fire Marshal (DCFM)
A Designated Campus Fire Marshal is a University employee assigned to a campus and is responsible for overseeing the implementation and enforcement of fire safety regulations on campus properties administered or occupied by the University. The DCFM enforces the California Fire Code (CFC) and ensures that fire protection and life safety systems are in place and functioning properly, by conducting fire safety inspections, reviewing building plans and construction projects, and providing fire safety education and training to students, faculty, and staff. This responsibility is delegated from the California Department of Forestry and Fire Protection - Office of the State Fire Marshal through a Memorandum of Understanding.

Floor Level
In the California Fire Code (CFC), the term “Floor Level” as it applies to Maximum Allowable Quantities (MAQs) refers to the level of a building or structure at which hazardous materials are stored or used. Floor levels are used to determine the maximum amount of hazardous materials that can be stored or used in a building or structure, based on the height of the building, the fire-resistance rating of the floor and walls, and the type of occupancy. The CFC sets specific MAQs for each floor level, taking into account the potential for fire and explosion in the event of a release of hazardous materials. Hazardous materials that are stored or used at a higher floor level are subject to more stringent MAQs, as the release of hazardous materials from a higher floor level can cause greater harm to people and property. The determination of floor levels is an important aspect of the CFC regulations for hazardous materials, as it helps to ensure fire protection and life safety in buildings and structures.

Hazard Class
A Hazard Class, as defined by the California Fire Code (CFC), is a categorization of hazardous materials based on their physical and health hazards. Hazard classes are used to determine the appropriate storage, handling, and use requirements for hazardous materials in buildings and structures. The CFC recognizes several hazard classes, including flammable and combustible liquids, compressed gases, explosives, and toxic materials. Each hazard class has its own set of regulations, including Maximum Allowable Quantities (MAQs) for storage, fire protection and life safety requirements, and labeling and signage requirements. The classification of a hazardous material into a specific hazard class is based on factors such as its flammability, toxicity, reactivity, and corrosiveness.

Hazardous Materials

A Hazardous Material, as defined by the California Fire Code (CFC), is any substance or material that poses a significant risk to life, health, or property if released, misused, or mishandled. This can include flammable liquids and gases, explosive materials, toxic chemicals, and other materials that are capable of causing harm in the event of a fire or release. Hazardous materials can be found in many different forms, including solids, liquids, gases, and chemicals, and can be used in a variety of applications, including industrial processes, commercial products, and consumer goods. The CFC sets regulations for the storage, handling, and use of hazardous materials in buildings and structures to minimize the risk of fire, injury, and damage to property.

Maximum Allowable Quantities (MAQs)

Maximum Allowable Quantities (MAQs) are the maximum amounts of hazardous materials that can be stored in a building or structure as defined by the California Fire Code (CFC). The purpose of MAQs is to limit the potential for fire and explosion in the event of a release of hazardous materials, and to minimize the harm to people and property that could result from such an event. The MAQs are determined based on factors such as the type of material, the fire-resistance rating of the building or structure, and the type of occupancy. Buildings and structures must comply with the MAQs set forth in the CFC in order to receive a certificate of occupancy. Failure to comply with the MAQs can result in fines, legal penalties, and increased risk of fire and injury.

Occupancy Group

An Occupancy Group, as defined by the California Fire Code (CFC), is a classification of buildings and structures based on their use and the type of occupancy. Occupancy groups are used to determine the appropriate fire protection and life safety requirements for buildings and structures. The CFC recognizes several occupancy groups, including assembly, business, educational, factory, high-hazard, institutional, mercantile, residential, and storage occupancies. Each occupancy group has its own set of fire protection and life safety requirements, including construction requirements, fire alarm and sprinkler systems, and means of egress. The occupancy group of a building or structure is determined by the type of use and the nature of the occupancy, such as whether it is a place of assembly, a place of business, or a place of dwelling.

> **Business Group B occupancy** includes, among others, the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts. Nearly all laboratory rooms constructed at UC are Group B occupancy.
>
> **High-hazard Group H occupancy** includes, among others, the use of a building or structure, or a portion thereof, that involves the manufacturing, processing, generation or storage of materials that constitute a physical or health hazard in quantities in excess of those allowed in control areas. RSS Chemicals is the Chemical Inventory Management Software created and maintained by Risk and Safety Solutions.
>
> **Laboratories Group L occupancy** includes the use of a building or structure, or a portion thereof containing one or more laboratory suites. A laboratory suite may include multiple laboratories, offices, storage, equipment rooms or similar support functions, where aggregate quantities of hazardous materials stored and used do not exceed quantities set forth in the California Building Code.

RSS Chemicals is the Chemical Inventory Management Software created and maintained by Risk and Safety Solutions. This same system has been called ‘UC Chemicals’ and ‘UCOP Chemicals.’

Appendix C: Toolbox of Solutions Matrix

Solution	Cost to Implement	Annual Cost to Maintain	Time to Implement	Useful to Obtain Initial Compliance or Maintain Compliance	Effort to Implement (1 being lowest)	Effort to Maintain (1 being lowest)	Effect on Researchers (1 being smallest)	Relative Impact Towards Compliance (1 being high)
New Building Design and Construction								
Involve DCFM, Chemical Inventory Manager and other key stakeholders early in the building design process.	0	0	weeks	Both	1	1	1	1
Consider that open laboratory designs reduce allowable chemical loads which require greater coordination among users.	100k	$	years	Both	3	2	3	2
Plan for intended building occupancy in the design phase, costs of L versus B. consider H2/H3/H4 areas.	$$$	$	years	Both	4	2	2	1
Design and build more L occupancy. Offers the possibility of many more laboratory suites than control areas on upper floors.	$$$$$	$	years	Both	4	2	2	1
Design and build more H occupancy areas within laboratory buildings for chemical use. (H1 - H5).	$$$$$	$	years	Both	5	2	2	1
Include centralized H occupancy storage rooms on designated floors.	$$$$	$	years	Both	5	2	4	1
Design more control areas (or laboratory Suites for L) per floor.	$$$$$	$	years	Both	5	2	3	1
Design and build central chemical storerooms that researchers can easily access. (need multiple H rooms).	$$$$	$$$	years	Both	5	2	3	1
Add additional control areas per floor during initial construction.	$$$	0	No added time	Both	1	1	1	2
Install sprinklers in new construction.	$$$	$	months	Both	1	1	1	1

Solution	Cost to Implement	Annual Cost to Maintain	Time to Implement	Useful to Obtain Initial Compliance or Maintain Compliance	Effort to Implement (1 being lowest)	Effort to Maintain (1 being lowest)	Effect on Researchers (1 being smallest)	Relative Impact Towards Compliance (1 being high)
Existing Building Renovation and Retrofit								
Retrofit sprinklers in existing construction.	$$$$	$	years	Both	4	1	4	1
Provide and use CFC-compliant hazardous materials storage cabinets.	$$	0	months	Both	1	1	2	1
Retrofit additional control area separations. (e.g., fire barriers or firewalls).	$$$$	0	years	Both	4	1	4	2
Add H-occupancy shared storage rooms on each floor.	$$$$	0	years	Both	4	1	4	1
Require MAQ compliance for affected control areas before new tenant improvement.	$	$	months	Maintain	1	1	2	1
Education								
Identify and communicate to PIs their allotted chemical capacity when onboarding.	$	0	weeks	Both	1	1	1	2
Provide MAQ awareness training for PIs, researchers, campus leadership, and building advisory committees.	$	$	weeks	Both	1	1	1	2
Develop MAQ primer for building advisory committees.	$	$	weeks	Both	1	1	1	2
Develop guidebooks and maps indicating the locations of control area delineations in buildings.	$	$	weeks	Both	1	1	1	2
Fast access to real-time Chemical Inventory and MAQ percentages data.	$	$	weeks	Both	1	1	1	2
Procurement								
Integrate MAQ updates into the procurement process so the threshold is not exceeded upon purchase.	$$$$	$$$	years	Maintain	4	4	4	1

Solution	Cost to Implement	Annual Cost to Maintain	Time to Implement	Useful to Obtain Initial Compliance or Maintain Compliance	Effort to Implement (1 being lowest)	Effort to Maintain (1 being lowest)	Effect on Researchers (1 being smallest)	Relative Impact Towards Compliance (1 being high)
Reconcile chemical inventories as chemicals are being removed as waste to ensure that any procurement holds are necessary.	$$$	$$$	years	Maintain	3	3	4	2
Reconcile chemical inventories when a laboratory is closed, and a laboratory group moves out.	$$$	$$$	years	Maintain	3	3	1	2
Waste Removal								
Do not recharge for waste disposal.	Net neutral cost	0	months	Both	3	1	1	2
Waste amnesty day.	$$$	0	months	Initial	3	1	2	2
Provide EH&S staff support for considerable laboratory clean-up and waste removal efforts.	$$	0	months	Both	3	1	2	2
Inventory Management Practices								
Assess MAQ compliance during laboratory move-in and move-out processes.	$	$	months	Both	1	1	1	5
Provide resolution for proration allotment of MAQs when laboratories share a control area.	$	$	months	Both	1	1	3	2
Establish procedures for maintaining and verifying an EH&S performed and managed chemical inventory.	$	$	months	Both	1	1	1	1
Reserve institutional funds for MAQ compliance at the start-up phase of a laboratory.	$$	$	months	Both	1	1	2	2
Reserve institutional funds for chemical disposal at the shutdown phases of a laboratory.	$$	0	weeks	Maintain	3	3	1	4

Solution	Cost to Implement	Annual Cost to Maintain	Time to Implement	Useful to Obtain Initial Compliance or Maintain Compliance	Effort to Implement (1 being lowest)	Effort to Maintain (1 being lowest)	Effect on Researchers (1 being smallest)	Relative Impact Towards Compliance (1 being high)
Assign spaces to ensure compliance with Fire Code.	$$	$$	months	Maintain	3	3	1	4
Assign or reassign large chemical users to laboratory spaces on lower floors of buildings, allowing for the storage of larger volumes of chemicals	$$	$$	months	Maintain	3	3	1	4
Add more Chemical Inventory and MAQ management staff.	$$$	$$$	months	Both	2	1	1	1
Provide a central chemical inventory reconciliation service.	$$$	$$$	months	Maintain	2	1	1	1
Incentivize the continuous updating of RSS Chemicals inventory. For example, positive incentives to promote a safety culture (for example, “Safest Lab” competitions) are also helpful in driving MAQ compliance.	$	$	months	Both	1	1	1	5
Provide Deans and Chairs with reports on available allowances to inform faculty recruitment efforts.	$	$	months	Both	1	1	1	5
Provide storage capacity in connection with recruiting new faculty.	$$	$	months	Initial	1	1	1	1
Require inspections of existing buildings to ensure occupants have not altered control areas (e.g., wall penetrations or additions).	$	$	months	Both	1	1	1	3
Establish funding to correct any identified deficiencies (e.g., penetrations or unapproved alterations) in installed fire barriers.	$$$$	$$	months	Both	4	1	1	3
Establish funding for installing, maintaining, and repairing new equipment and equipment upgrades associated with storing and using hazardous materials.	$$	$	months	Both	1	1	1	5

Solution	Cost to Implement	Annual Cost to Maintain	Time to Implement	Useful to Obtain Initial Compliance or Maintain Compliance	Effort to Implement (1 being lowest)	Effort to Maintain (1 being lowest)	Effect on Researchers (1 being smallest)	Relative Impact Towards Compliance (1 being high)
Implement redistribution programs to encourage sharing of surplus chemicals and reduce the amount of unused material disposed of as hazardous waste.	$	$	months	Both	1	1	1	3
Provide campuses with resources to streamline the chemical inventory review process by purchasing barcoding or RFID equipment and providing support staff to oversee and maintain chemical inventories for their campus.	$	$	months	Both	1	1	1	5

The relative cost scales and effectiveness measurements in the table are a bit arbitrary but were created by consensus by the task force members. Relative scales for the $ symbol are as follows

$ less than 1k USD
$$ between 1k - 10k USD
$$$ between 10k - 100k USD
$$$$ between 100k - 1M USD
$$$$$ greater than 1M USD

Appendix D: Flowchart of MAQ Management

Chemical Inventory Management

- All chemicals entered (chemical name, volume, units, physical state, inventory owner, physical location)
- Accurate assignment of chemicals to Fire Code hazard categories

Building Attributes

- Construction type
- Occupancy
- Location of control areas
- Fire sprinkler coverage
- Level of all floors relative to grade plane
- Use of approved storage equipment

MAQ Assessments

- Actual amounts compared to MAQ limits for each Building
- Fire Hazard Class
- Control Area or Lab Suite

MAQ Accuracy Hurdles

accurate container size

identification of contents

correct storage location

adequate library data

correct hazard classification

accurate calculations

correct fire code selection

sprinkler coverage identified

accurate room occupancies

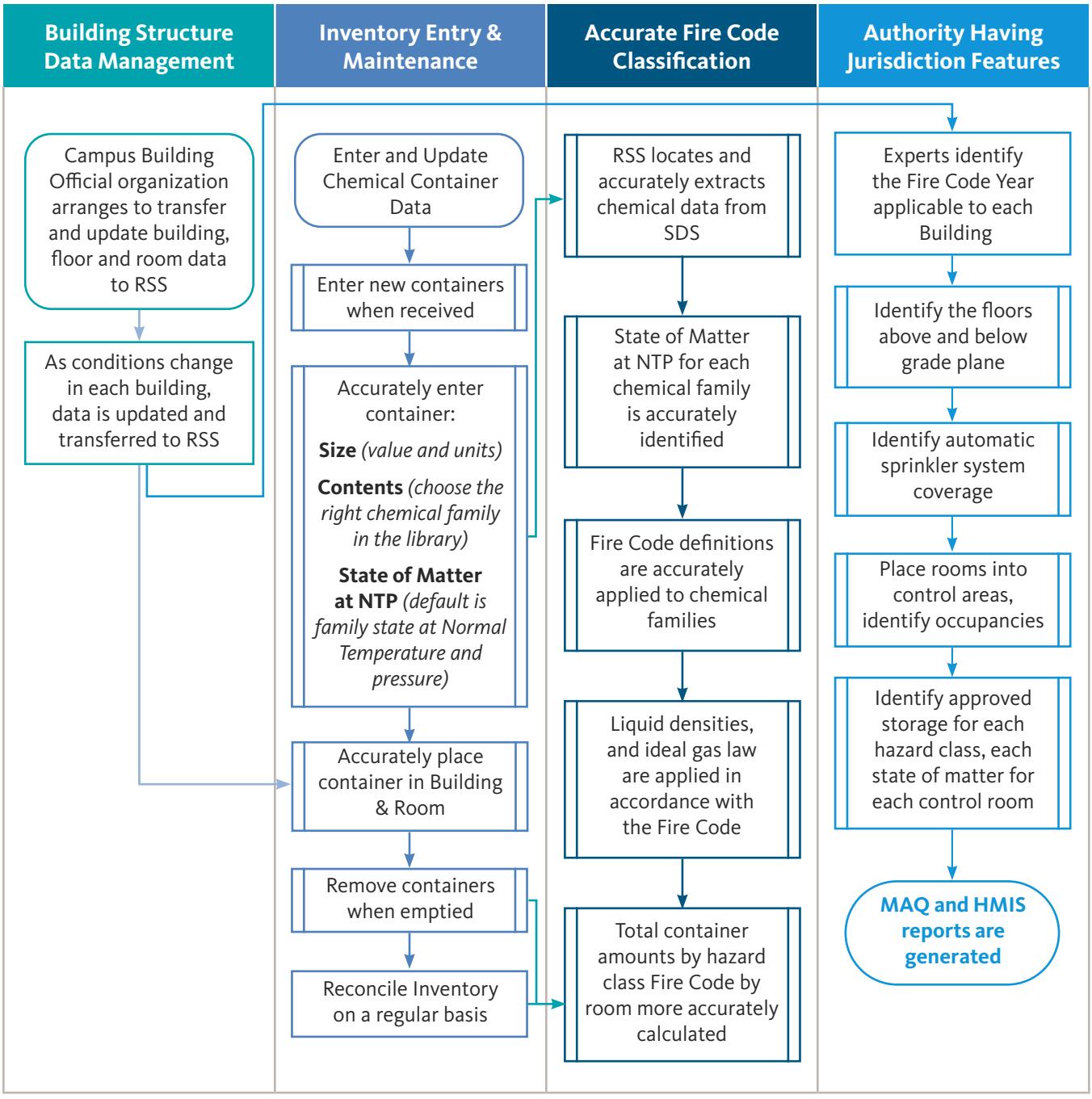
rooms placed into control areas

approved storage identified

floors arranged properly

RISK & SAFETY SOLUTIONS

Flowchart of MAQ Management



Appendix E: Legal Analysis

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
UC LEGAL - OFFICE OF THE GENERAL COUNSEL

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MEMORANDUM

DATE: March 27, 2023

FROM: Sarah Quiter, Principal Counsel

RE: Appendix E to Maximum Allowable Quantity Task Force Report; Status of Systemwide Compliance

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This memorandum supplements the Maximum Allowable Quantity ("MAQ") Task Force Report ("Report") and focuses specifically on the status of systemwide compliance with MAQs. Compliance with MAQs is essential because the exceedance of an MAQ can pose a risk to human health, property, and/or the environment, depending upon the type and quantity of hazardous materials and the location where they are stored on campus. Facilities throughout the University of California ("UC") system store hazardous materials in quantities that exceed applicable MAQs. The University's exposure to potential liability is significant; thus, the Task Force's recommendations are designed to help the UC system achieve and maintain compliance with MAQs.

The status of noncompliance with MAQs is based upon data compiled from the UC Risk & Safety Solutions chemical inventory software program ("RSS Chemicals"). Based upon an RSS Chemicals search at campuses where the software has been more fully adopted, there appears to be substantial MAQ compliance challenges across multiple chemical hazard classifications. It is important to acknowledge, however, that this data is not entirely accurate because there are many inputs that must all be accurately entered into the inventory software to perform the correct MAQ calculations. These inputs include, for example, the number of hazardous material containers – including chemical contents, volume, physical state, and their locations within the building, as well as many building attributes – including the sprinkling status, the floor above grade, and control area designation. It is challenging for EH&S and laboratory personnel to ensure that all of this information is well-tracked and kept up to date in RSS Chemicals. Accordingly, it is very likely that the RSS Chemicals data identifies

exceedances where there are none and undercounts the quantity of hazardous materials where there are actual exceedances. In addition, RSS Chemicals may also not capture all relevant information, which needs to be further investigated.

Notwithstanding the uncertainty of RSS Chemicals' data, the Task Force expects that every campus location has MAQ exceedances. Should an injury to life, property, and/or the environment occur, whether through a chemical spill, an explosion, or some other accident, UC could face liability based upon several theories:[1]

Administrative Liability

UC's most conspicuous exposure to liability pertains to noncompliance with the California Fire Code ("CFC"), which is where all MAQs are established. At each UC location, a Designated Campus Fire Marshal ("DCFM") is authorized to enforce the CFC through a statutory delegation from the Office of the State Fire Marshal ("OSFM"). DCFMs have the authority to red tag a laboratory that is out of compliance with MAQs and can even take the facility out of use. If a UC location refuses to comply with a DCFM order, the matter can be escalated to the OSFM. Because it is important to maintain OSFM's trust in the DCFM program, UC must achieve systemwide compliance with MAQs as quickly as possible.

Other state regulatory agencies could exercise administrative enforcement to the extent there is an MAQ-related accident. For example, Cal/OSHA has jurisdiction over workplace injuries; the local Certified Unified Program Agency and the Department of Toxic Substances Control have jurisdiction over the discharge or release of hazardous materials into the environment; and the Regional Water Quality Control Board has jurisdiction over water contamination. Each of these agencies have the authority to seek administrative penalties, and the environmental agencies could also order cleanup of any spill. Because state agencies are charged with enforcing these statutes and related regulations, administrative enforcement is more common than civil litigation.

Civil Liability

UC could face civil liability based upon a variety of claims. For example, statutory tort liability could arise from personal injury claims by non-employees, including students and researchers who use the hazardous materials in connection with ongoing research, as well as any other students and members of the public who access UC property and were injured. UC's exposure to tort liability is somewhat restricted by application of the Government Claims Act, which immunizes state government from liability in particular personal injury cases. However, a plaintiff could pursue claims against UC for creating a dangerous condition on public property. To prevail, a plaintiff would need to demonstrate that UC had actual or constructive notice of the dangerous condition a sufficient time before the injury to have taken measures to protect against the dangerous condition. A plaintiff could also pursue claims against UC for breach of a mandatory duty. To prevail, a plaintiff would need to demonstrate that UC breached the standard of care (ensuring that MAQs are not exceeded), and that the MAQ exceedance was a

[1] At this time, the Task Force is not aware of any MAQ-related accident that would give rise to liability for the University.

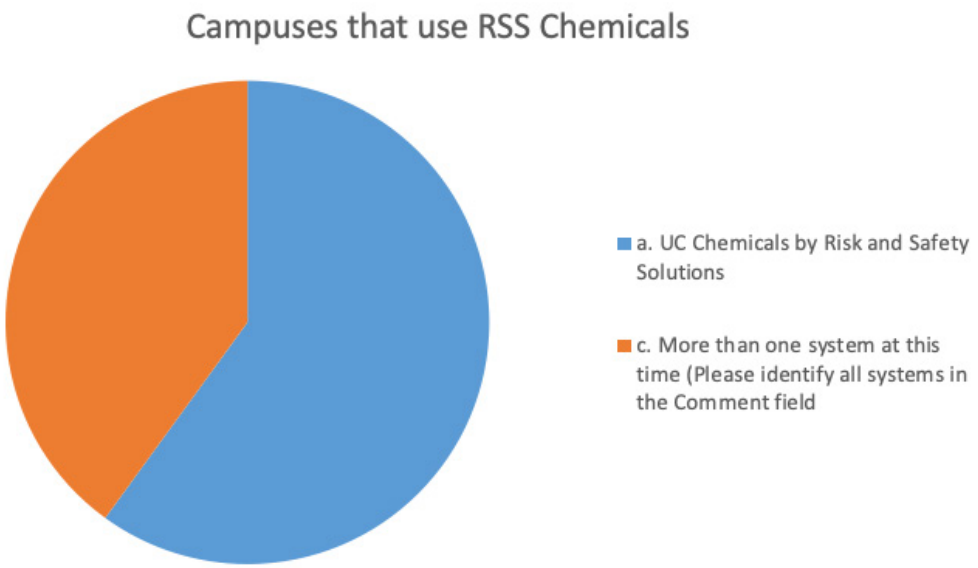
substantial factor in causing the injury. Similar proof could also support a wrongful death claim if somebody died from an MAQ-related accident.

In addition, civil liability could arise under several environmental statutes. One example would be where an MAQ exceedance were to cause a discharge or release of hazardous materials or waste into the environment. State and federal environmental laws allow the government and sometimes, citizens, to bring actions to protect the public interest and seek the payment of damages, civil penalties, and/or imposition of injunctive relief. As noted above, civil liability is less common than administrative, but the potential penalties can be much higher.

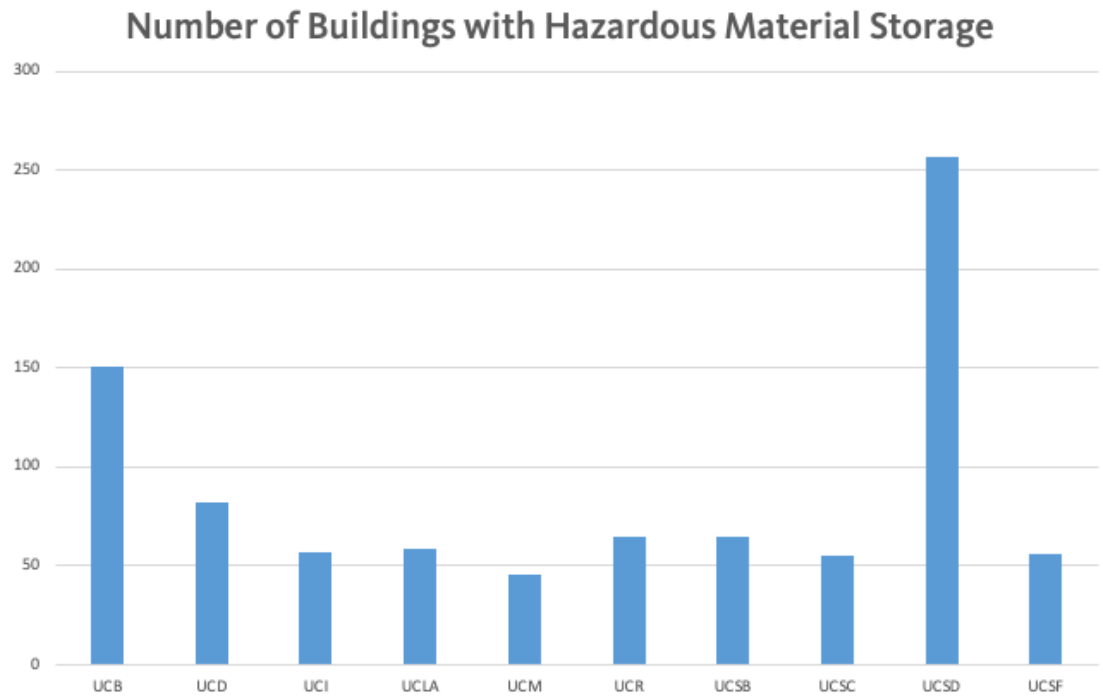
UC's exposure to MAQ-related liability must be minimized to the greatest and quickest extent possible. Due to the limitation of available campus resources, however, obtaining compliance with MAQs presents an enormous challenge. Until there are sufficient resources, it is unreasonable to expect 100% compliance in the short-term. The Report's recommendations provide a framework to help UC campuses minimize these risks. There is no one-size-fits-all solution, but the Task Force's proposed toolbox contains a variety of actions that will significantly reduce UC's liability overall. UCOP can also examine UC's liability insurance policies to determine the extent to which occurrence-based and claims-made policies may provide necessary coverage.

Appendix F: UC MAQ Status Survey Results

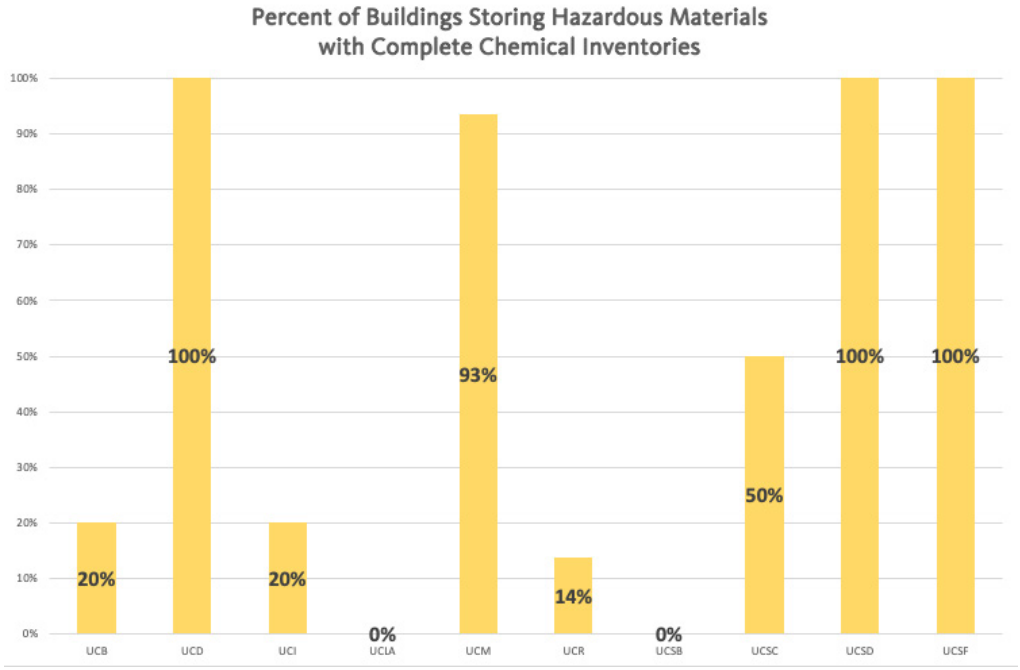
1c. What software system do you use to maintain the campus Complete Chemical Inventory?



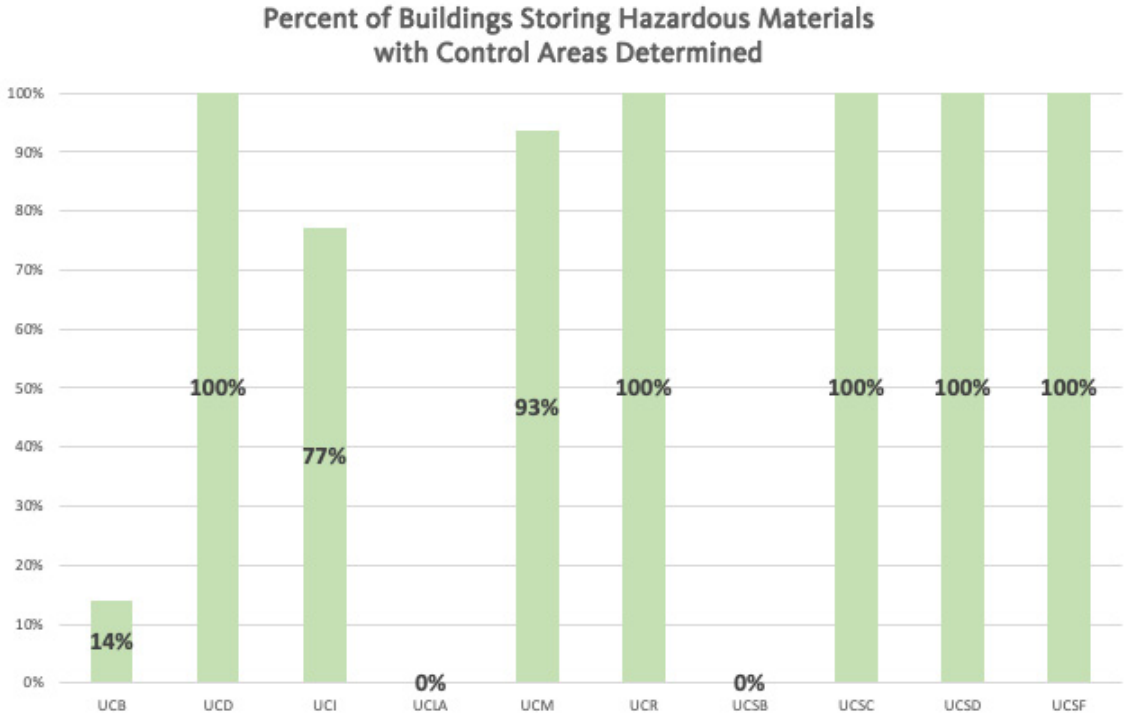
6. How many buildings at your location are used to store hazardous materials? (At a minimum, this needs to include your CUPA threshold submissions or alternatively, you can query from your campus Chemical Inventory System.)



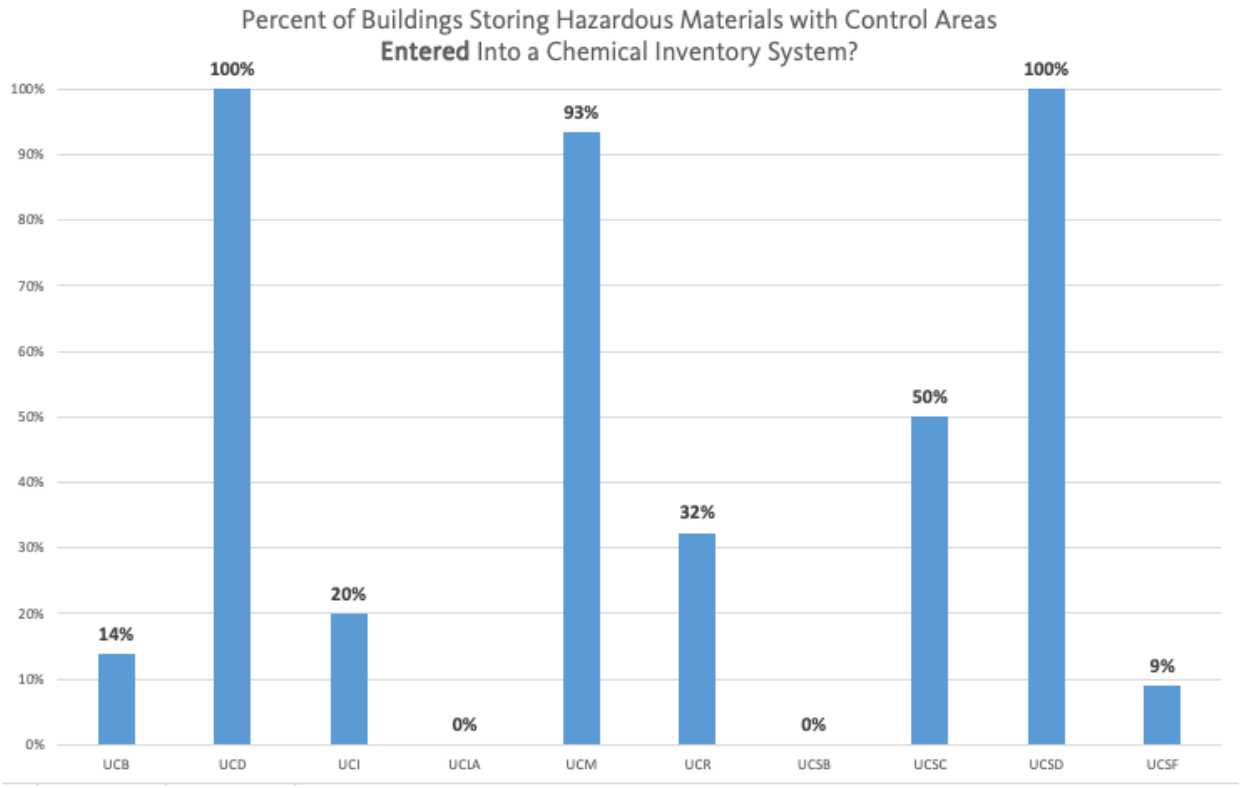
6a. Of the buildings reported in Q6 above, how many have a Complete Chemical Inventory recorded in a Chemical Inventory System?



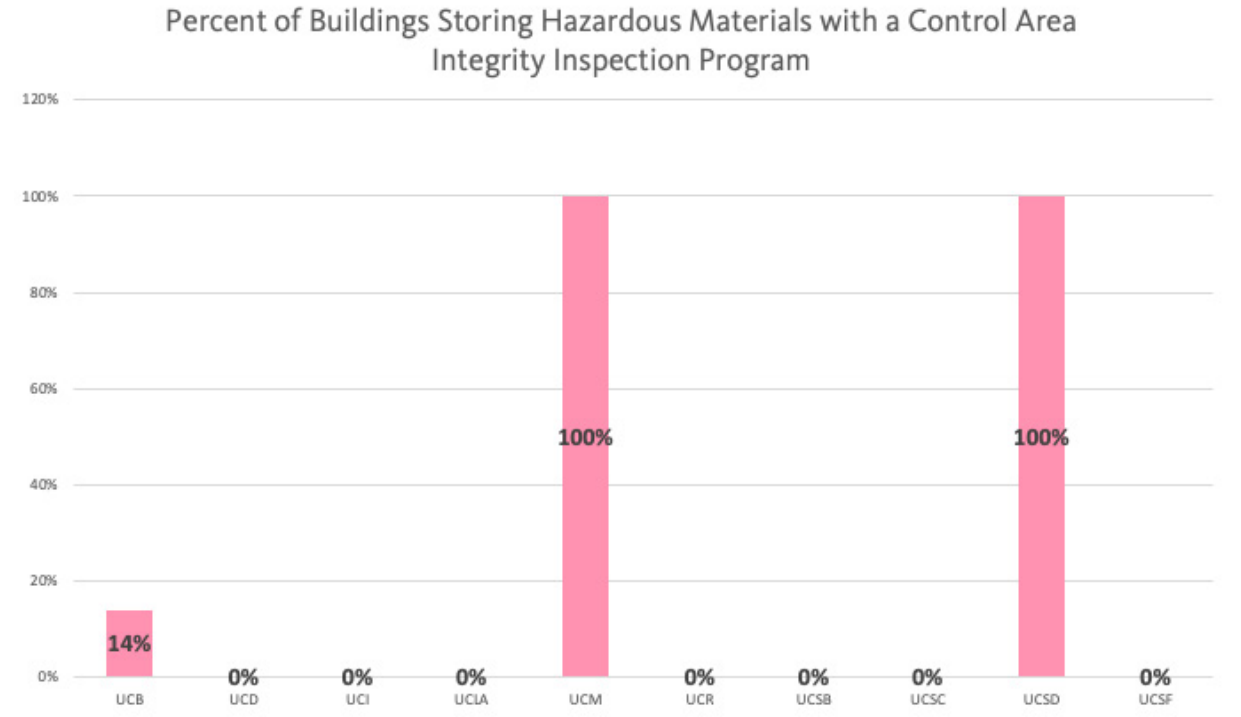
7a. Of the buildings reported in Q6 above, how many have had the separate control areas or laboratory suites used for chemical storage determined?



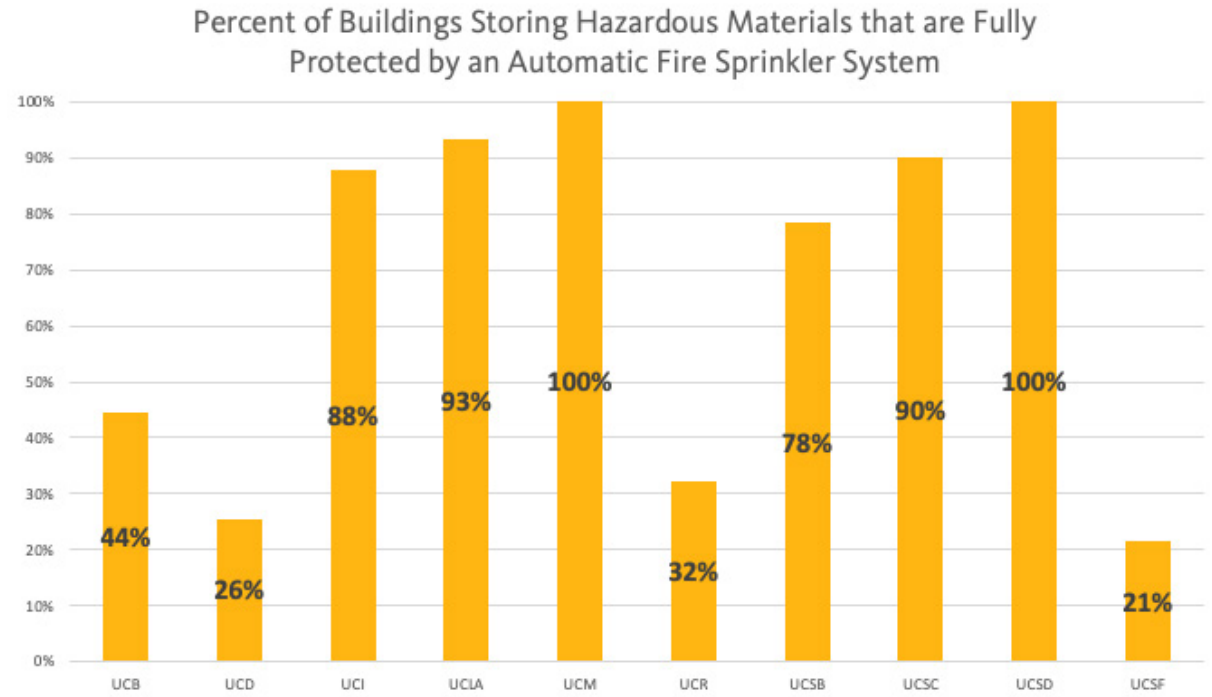
7d. Of the buildings reported in Q6 above, how many have had the control area information accurately captured in a Chemical Inventory System?



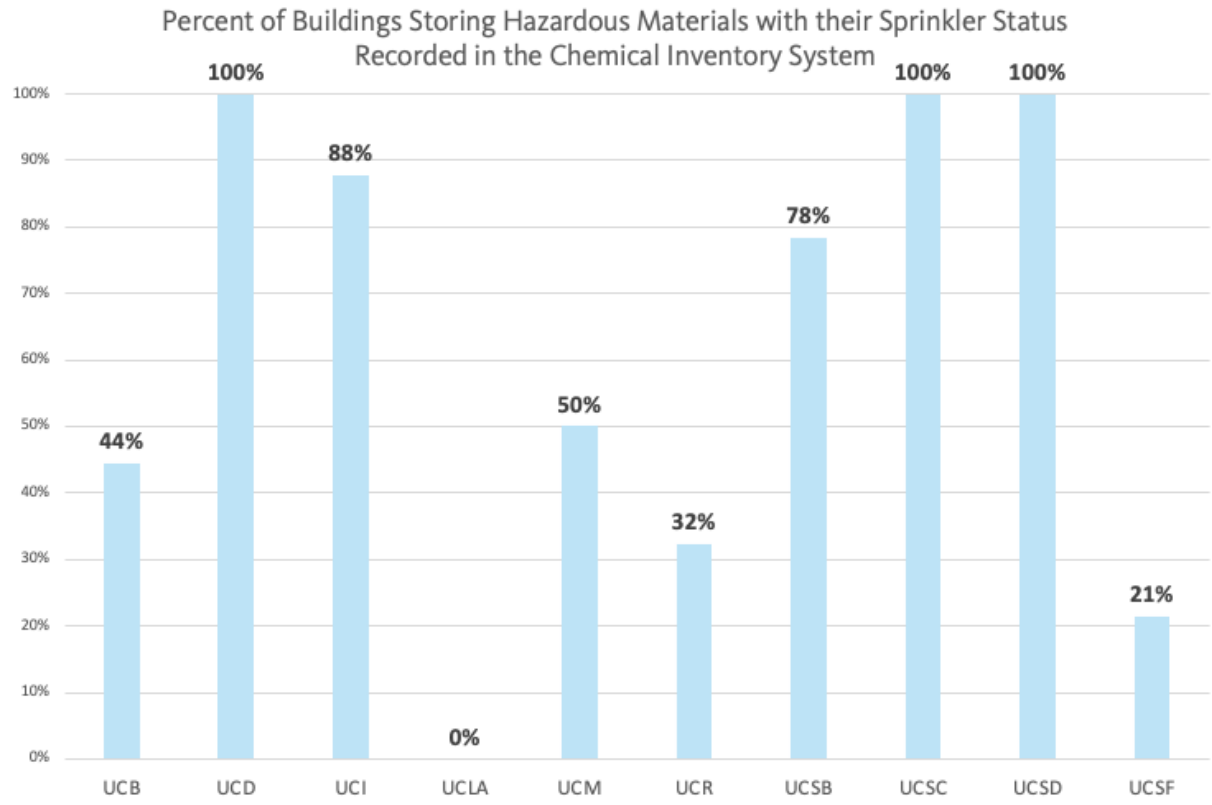
8. How many of them (the buildings referenced in Q6) have a program to inspect the integrity of control areas (e.g., that firewalls are intact, penetrations are properly sealed, doors close and are secure, etc.)?



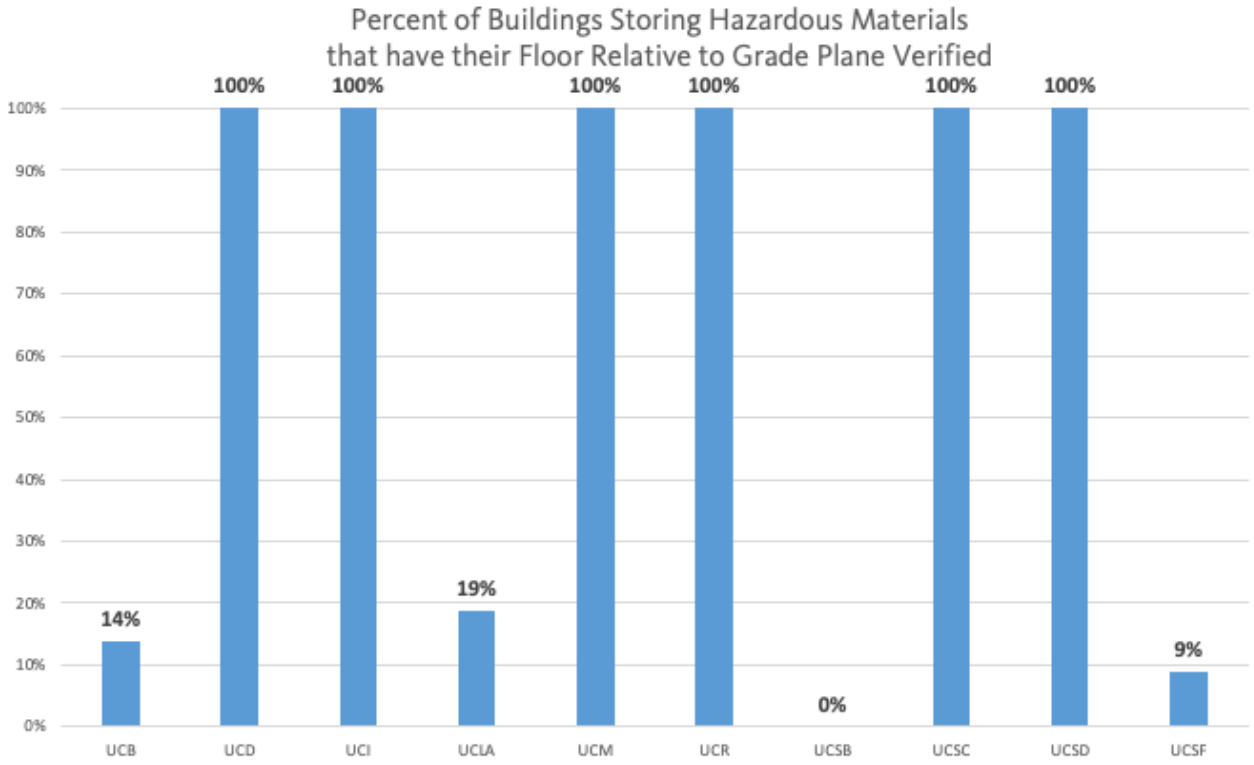
9a. Of the buildings reported in Q6 above, how many are fully protected by an automatic fire sprinkler system?



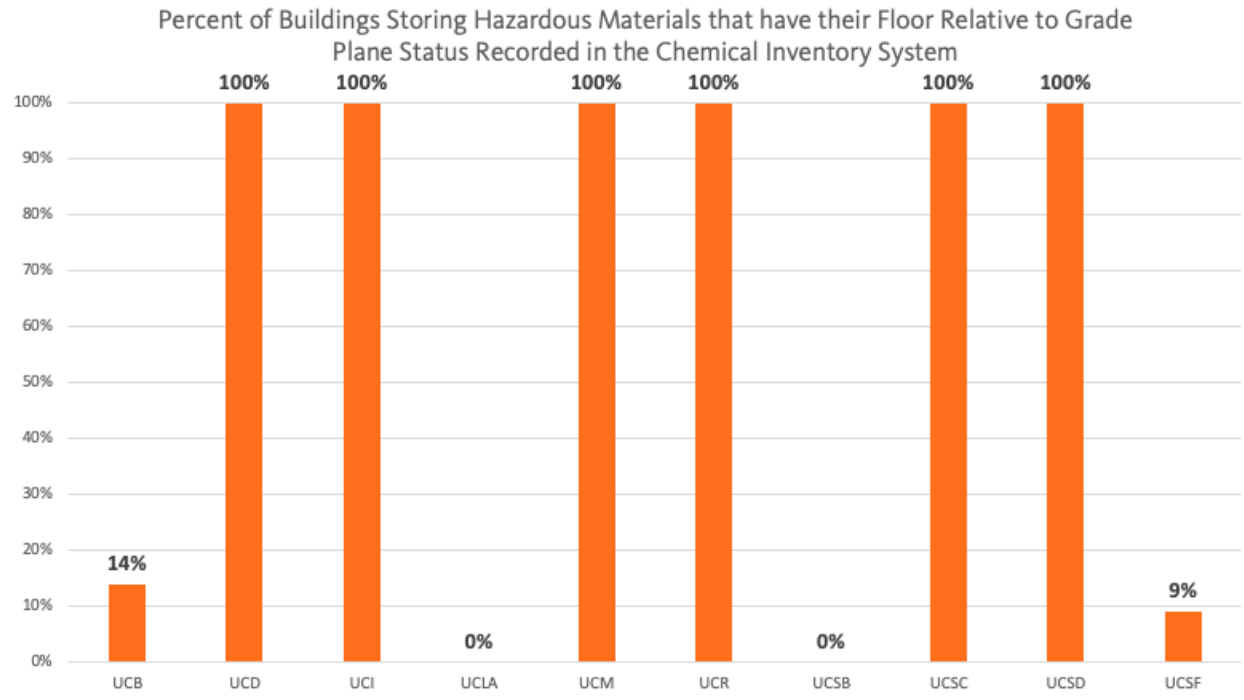
9b. For how many of the buildings reported in Q8 has the automatic fire sprinkler system information been accurately recorded in your Chemical Inventory System as being fully sprinklered?



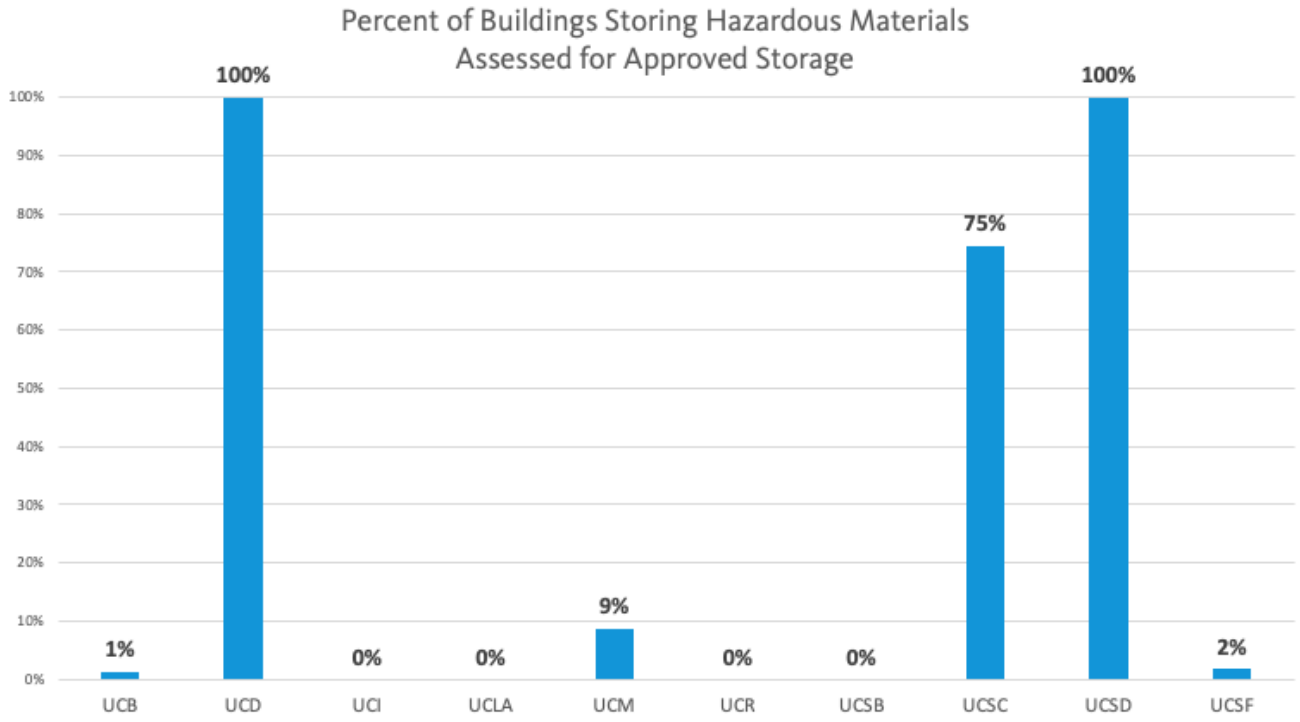
10a. Of the buildings to which you are applying the CFC or CBC with respect to control areas and MAQs, how many of them have the Fire Marshal or Building Official verified the floor level relative to grade plane?



10b. Of the buildings to which you are applying the CFC or CBC with respect to control areas and MAQs, how many of the buildings reported in Q9(a) have had the floor level relative to grade plane accurately recorded in your Chemical Inventory System?



11a. Of the buildings reported in Q6 above, how many have been assessed for the presence of approved storage (e.g., storage cabinets or exhausted enclosures) and the storage increase applied for one or more hazard categories?)



11b. For how many of these buildings reported in Q10(a) has the approved storage information been accurately recorded in your Chemical Inventory System?