RIVERSIDE: AUDIT & ADVISORY SERVICES

August 2, 2010

To: Don Caskey, Campus Architect / Associate Vice Chancellor
Office of Design & Construction

Mike Miller, Associate Vice Chancellor
Facilities

Subject: Internal Audit of Laboratory Safety and Construction Safety

Ref: R2010-03

We have completed our audit of Laboratory Safety and Construction Safety in accordance with the UC Riverside Audit Plan. Our report is attached for your review. We will perform audit follow-up procedures in the future to review the status of management action. This follow-up may take the form of a discussion or perhaps a limited review. Audit R2010-03 will remain open until we have evaluated the actions taken.

We appreciate the cooperation and assistance provided by your staff. Should you have any questions concerning the report, please do not hesitate to contact me.

Michael R. Jenson
Director

cc: Audit Committee Members
Assistant Vice Chancellor Carlson
Assistant Vice Chancellor Racicot
EH&S Laboratory / Research Safety Manager Vernon

UNIVERSITY OF CALIFORNIA AT RIVERSIDE

AUDIT & ADVISORY SERVICES

MEMBER OF ASSOCIATION OF COLLEGE & UNIVERSITY AUDITORS

INTERNAL AUDIT REPORT R2010-03

LABORATORY SAFETY AND CONSTRUCTION SAFETY

AUGUST 2010

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UC RIVERSIDE
LABORATORY SAFETY AND CONSTRUCTION SAFETY
INTERNAL AUDIT REPORT R2010-03
AUGUST 2010

I. MANAGEMENT SUMMARY

Based upon the results of work performed within the scope of the audit, it is our opinion that, except for areas that need to be improved in the laboratory safety program, the systems of internal control over the processes of managing laboratory safety and construction safety are operating satisfactorily and are generally in compliance with University policies and procedures.

Positive observations included:

* The UCR Environmental Health & Safety Office (EH&S) has developed and started to implement a laboratory safety inspection process designed to promote a safe and healthy work environment, ensure compliance with applicable regulation, and prevent injury, death, and unsafe general conditions.

* By stipulation in all contracts for construction or construction management, the risks and responsibilities for campus construction safety and compliance with applicable regulation are effectively transferred to outside contractors working on campus-owned or leased property. Nonetheless, the Office of Design & Construction (OD&C) has control mechanisms in place to monitor on-going construction safety practices and/or issues under its purview.

Beginning January 1, 2010, UCOP Risk Services instituted an owner controlled insurance program (the University Controlled Insurance Program, UCIP) for all new UC construction projects over $25 million. Workers compensation and liability insurance coverage are now provided for all contractors and their employees working on projects under UCIP. UCR Risk Management will have greater interest and involvement providing guidance and reviewing construction safety. At present, Risk Management does not have personnel or resources devoted to construction safety. These will have to be addressed as the Campus assumes this additional risk and responsibility.

We observed some areas that need enhancement to strengthen internal controls and/or effect compliance with University policy:

1) Some confusion may exist regarding roles and responsibilities for laboratory safety. (Observation III.A.)

2) EH&S has not yet achieved its goal of conducting initial laboratory safety audits of all campus laboratories annually and subsequently re-inspecting selected laboratories on a periodic recurring basis. (Observation III.B.)

3) The Chemical Hygiene Plans of some departments have not been reviewed and updated for more than a year. (Observation III.C.)

4) Not all personnel working in UCR laboratories have undergone specific laboratory safety training. (Observation III.D.)

These items are discussed below. Minor items that were not of a magnitude to warrant inclusion in the report were discussed verbally with management.

II. INTRODUCTION

A. PURPOSE

UC Riverside Audit & Advisory Services (A&AS), as part of its Audit Plan, performed an audit of the EH&S Laboratory Safety program to evaluate compliance with applicable Federal and State regulations and University policies and procedures with respect to campus laboratory workplaces.

A&AS reviewed OD&C management and operating practices to evaluate whether current processes provide office and field administrative controls over construction job site safety and loss-control activities in compliance with applicable Federal and State regulations and University construction safety goals and objectives.

B. BACKGROUND

The University of California is committed to achieving excellence in providing a healthy and safe working environment, and to supporting environmentally sound practices in the conduct of University activities. It is University policy to comply with all applicable health, safety, and environmental protection laws, regulations, and requirements.

The University's goal is to prevent all workplace injuries and illnesses, environmental incidents, and property losses or damage. Achieving this goal is the responsibility of every member of the University community.

The University Policy on Management of Health, Safety, and the Environment and the guiding principles for its implementation were issued on October 28, 2005, with the goal of systematically integrating safety and environmental principles into all University activities. The Policy establishes high standards for systemwide EH&S activities, meeting both California Environmental Protection Agency (Cal/EPA) and California

Division of Occupational Safety and Health (Cal/OSHA) requirements for safety and environmental management programs.

Campus Policy No. 425-24 in part states that UCR shall conduct all operations and activities according to established standards relating to environmental protection and occupational health and safety in order to minimize the risk of injury or illness to people and minimize property damage at all locations where University operations and/or activities occur. EH&S is charged with advising the campus community of its responsibilities and recommending appropriate remedial or planning strategies, including the development of safety programs, and consulting with external agencies or regulatory or legislative bodies as necessary and appropriate, on behalf of the campus.

The UCR Research Integrated Safety Committee (RISC) was formed in 2000 under the authority of the Vice Chancellor for Administration in cooperation with the Vice Chancellor for Research to advise, consult, and participate with EH&S in developing & implementing programs and campus standards for the safe conduct of teaching and research at UCR, with emphasis on the management of hazardous materials and equipment.

In response to the UCLA incident that resulted in the death of a laboratory worker in January 2009, at the request of the EH&S Director, the RISC formed a Task Force to assess the hazards associated with research at UCR and processes to mitigate those hazards. In a report[1] to executive management, the RISC Task Force emphasized that the campus must communicate the importance of laboratory safety, identify hazards, monitor compliance with safety standards, enforce adherence with the existing safety programs, and improve the general "Safety Culture" of UCR.

The EH&S Laboratory Safety program incorporates the safety guidelines for hazards found in the laboratory setting including chemical safety, radiation safety, biological safety, field research safety, and general safety. EH&S, through the campus Laboratory/Research Safety Manager, assists campus departments establish and implement Chemical Hygiene Plans and comply with all other applicable Cal/OSHA requirements pertaining to the control of hazardous substances in laboratories. The Laboratory Safety Officers Committee comprised of EH&S and individual department Laboratory Safety Officers fulfills the Chemical Hygiene Officer requirements of the Cal/OSHA Laboratory Standard.

EH&S has developed and started to implement a laboratory safety inspection process designed to identify safe laboratory practices and promote a healthy work environment by focusing on key issues that may

[1] Laboratory Safety Report and Action Plan; An evaluation of safety issues in research laboratories at UCR, developed in response to the 2009 laboratory fatality at UCLA (attached).

result in injury and/or death, regulatory consequences, and unsafe general conditions. There are currently 20 campus departments that operate laboratories that meet the Cal/OSHA laboratory standard definition. These department laboratory operations are established in at least 800 locations across campus.

On Construction Safety, the interface between campus public and construction and alteration project sites is informally monitored by EH&S to ensure that potential hazards and disruptions have been minimized by using proper barricades, traffic controls (pedestrian, bicycle, vehicle), and noise and dust abatement measures. Contractors working on campus-owned or leased property are responsible for initiating, maintaining, and supervising all safety precautions and programs, in accordance with all applicable sections of the California Code of Regulations (CCR) and Cal/OSHA. This responsibility is written into all contracts for campus construction projects.

The OD&C provides reasonable assurance that contractors meet safety regulations and achieve campus safety goals by conducting regular on-site inspections and participating in weekly safety meetings with construction project staff. Inspections and safety meetings are typically documented by the contractor and maintained at construction job sites as well as at the OD&C facilities.

C. SCOPE

Laboratory Safety

Audit procedures were performed to evaluate whether EH&S Laboratory Safety management practices and program procedures are adequate and appropriate, operating as intended, and effective and efficient to provide reasonable assurance that campus laboratories are safe and healthy environments for faculty, staff, students, and visitors.

The scope of the audit was limited to activities during the period January 1, 2008 through November 30, 2009 and focused on the following Laboratory Safety program areas:

1. Policy and Regulation
2. Standards, Procedures, and Oversight
3. Delegation of Authority
4. Training and Education
5. Monitoring and Enforcement

We performed the following procedures:

- Reviewed University policy and procedures and applicable regulation including CCR, Cal/EPA, and Cal/OSHA requirements with regard to the operation of laboratories for research and educational purposes;
- Discussed details of Laboratory Safety program with EH&S management, campus Laboratory/Research Safety Manager, and selected campus/department personnel;
- Reviewed records, reports, minutes of meetings, correspondence, and other documents related to UCR Laboratory Safety standards and procedures including Laboratory Safety Rules, Chemical Hygiene Plans (CHPs), minutes of Laboratory Safety Officers (LSO) Committee meetings, RISC Reports and RISC Task Force case studies, other ad hoc reports and presentations, email, and memoranda;
- Reviewed documents supporting EH&S Laboratory Safety program activities, including training certificates and rosters, departmental CHP status reports, Laboratory Integrated Safety Audit Reports, summaries, and other records;
- Observed the conduct of laboratory safety inspections by EH&S Laboratory Safety staff in 7 selected locations in December 2009.

Construction Safety

Procedures were performed to evaluate whether OD&C project management practices and inspection procedures are adequate and appropriate to ensure that contractors provide safe and healthy environments at construction job sites and affected locations for construction workers as well as the campus community.

The scope of the review was limited to OD&C administrative oversight and job site inspection activities and selected contractor job site safety and health programs during the period January 1 through November 30, 2009.

We performed the following procedures:

- Reviewed University policy and procedures and applicable regulation including CCR and Cal/OSHA standards for construction;
- Reviewed campus construction safety goals and objectives and related OD&C administrative and operating processes through discussions with OD&C management and staff, EH&S management, and selected campus personnel;
- Selected one (1) major campus contractor (Barnhart, Inc.) and interviewed key project personnel, including the Field Safety Manager, Senior Project Manager, General Superintendent, and Project Manager. Reviewed and evaluated selected contractor's Injury & Illness Prevention Program (IIPP), Site Health and Safety Program, Emergency Response, and Safety and Health Procedures.
- Reviewed selected records of OD&C inspections that identify instances of potentially unsafe conditions and evaluated adequacy and

appropriateness of reporting. Examined evidence and evaluated effectiveness of subsequent follow-up by OD&C and adequacy of remedial action by contractor.

D. INTERNAL CONTROLS AND COMPLIANCE

As part of the review, internal controls were examined within the scope of the audit.

Internal control is a process designed to provide reasonable, but not absolute, assurance regarding the achievement of objectives in the following categories:

* effectiveness and efficiency of operations
* reliability of financial reporting
* compliance with applicable laws and regulations

Substantive audit procedures were performed during September through December 2009. Accordingly, this evaluation of internal controls is based on our knowledge as of that time and should be read with that understanding.

III. OBSERVATIONS, COMMENTS, AND RECOMMENDATIONS

A. Responsibility and Accountability

Some confusion may exist regarding roles and responsibilities for laboratory safety.

Managing laboratory safety at UCR is a collaborative effort by EH&S, academic departments, and faculty members. However, the specific role of each participant and the nature and extent of his/her responsibility may not be clearly communicated or appreciated. The attached RISC Task Force Laboratory Safety Report and Action Plan discusses the roles the entities involved in safety management at UCR play and the challenges they face.

COMMENTS

Laboratory safety is the responsibility of all employees, students, and other campus members working in UCR research laboratories. Through proper training and with management supervision, individuals gain knowledge of applicable health and safety regulations governing the laboratory setting and activities they engage in. Each person is then individually responsible for conducting safe work practices and complying with health and safety policies as they relate to their job duties and roles in the laboratory.

The role of EH&S is to advise the campus community of its responsibilities and recommend appropriate remedial or planning strategies, including the development of safety programs, and consult with external agencies or regulatory or legislative bodies as necessary and appropriate on behalf of the campus. EH&S is authorized to inspect all campus laboratories to assess risk and life safety exposures and make recommendations for the correction of hazards, compliance with regulations, and improvements in procedures, equipment, and/or protocols for safety.

Albeit the responsibility for establishing and supporting environmental health and safety programs and complying with University policy and applicable regulation may be shared and re-delegated to deans, unit heads, department chairs, directors, managers, principal investigators, and supervisors, primary accountability for ensuring laboratory safety remains with executive management.

RECOMMENDATIONS

Executive management should communicate an unequivocal commitment to safety and hold senior management at the college and department levels accountable for laboratory safety. This will entail clearly defining the delegation of authority and the assignment of roles and responsibility for laboratory safety through all levels of management as well as establishing a reporting system for accountability.

MANAGEMENT RESPONSE

Management concurs with the recommendation and will strengthen its commitment to laboratory safety by reconstituting the University's Laboratory Safety Plan and assigning accountability for laboratory safety by position. This will include establishing accountability for the college and departmental managers. The roles and responsibilities as well as authority levels will be outlined along with a quarterly report to senior management based on an accountability metrics system that is under development.

The role of EH&S will be clearly established as being in an advisory role with responsibility for program development, training, mentoring, monitoring, and auditing.

The program will be reinforced with a communication from the VC of Research, the Provost, and the VC of Finance and Business Operations.

This recommendation will be initiated by September 1, 2010 and will be ongoing.

B. Laboratory Safety Audits

To promote a safe and healthy work environment, ensure compliance with applicable regulation, and prevent injury, death, and unsafe general conditions, EH&S developed and implemented a laboratory safety inspection process. However, due to a lack of adequate resources and other competing priorities, EH&S has not yet achieved its goal of conducting initial laboratory safety audits of all campus laboratories annually and subsequently re-inspecting selected laboratories on a periodic recurring basis.

COMMENTS

During the period January 2008 through November 2009, EH&S conducted laboratory safety audits of about 300 out of approximately 600 suites of UCR laboratories with a potential for personnel occupational exposure to hazardous substances and processes. In general, the laboratory audit process consists of physical inspection of laboratory facilities, equipment, and materials, and completion of a multipart checklist. Observation of laboratory personnel behavior and practices, "behavior based safety", was beyond the scope of the inspection. The latest audit was conducted in April 2009, before a series of reductions in EH&S staffing levels occurred. EH&S has not been able to re-inspect any of the 300 laboratories initially audited, so the current status of any laboratory safety audit issues are neither certain nor on record.

The UCR Environmental Health and Safety Audit Data Management System is an online database developed in-house by EH&S to manage data generated when laboratory safety audits are conducted. The database appears to adequately archive lab audit results and allows users to easily share lab audit information with PIs, department chairs, and other parties by automatically sending electronic mail and/or weblinks to grant online access to specific lab audit data. However, summary reports and statistical analysis, as well as other desired functionalities are not available and further application development has been discontinued due to resource constraints.

RECOMMENDATIONS

EH&S should continue efforts to complete the initial safety audits of all UCR laboratories. The current status of laboratory safety audit issues should be tracked and, as deemed necessary, EH&S should conduct re-inspection of selected laboratories to verify corrective action by parties responsible for addressing laboratory safety issues.

EH&S should conduct a costs / benefits analysis and decide whether or not to resume further development of the UCR Environmental Health and Safety Audit Data Management System to include statistical and

management reporting capabilities and other desired functionalities. Management may also consider purchasing proprietary software designed for managing a variety of integrated environmental health and safety programs, including audits.

MANAGEMENT RESPONSE

Management concurs with the findings and the intent of the recommendation. Direction from the Executive Vice Chancellor/Provost is to fulfill the inspection goals by educating personnel within the departments on the audit process and requiring that they complete their own laboratory assessments. The laboratories will be provided access to an electronic audit system to gather the data. EH&S will develop the program, provide hands-on training, and provide oversight of the assessment process. Implementation will begin with the Chemistry Department effective September 1, 2010. The Chemistry Department plans to assign a new graduate student each quarter to fulfill this inspection function.

The Office of Risk Services at the UC Office of the President (UCOP) is planning to purchase or develop a universal EH&S audit tool. This tool will be used system wide so that the data can be standardized and reported through the Enterprise Risk Management Information System (www.ucop.edu/riskmgt/erm). Until this is accomplished, UCR will use a third party audit program as part of a 90 day beta test for UCOP. The program will allow for the transfer of data including protocols, findings, comments, recommendations, and follow-up data to the new UCOP system.

Based on the learning process with the Chemistry Department the assessment process will be rolled out through the Office of Research to all laboratories by June 30, 2011 dependent upon the adoption of the UCOP audit program and as accepted by the University's faculty .

As part of the laboratory safety oversight process, EH&S will develop and implement a revised laboratory audit system, including reporting metrics for use by EH&S staff. This reporting system will be used to monitor, reinforce, and verify the laboratory self assessment process and schedule formal audits of the laboratories by EH&S staff.

The formal EH&S laboratory audit will be based on the same protocols that the departments use in their laboratory self assessments. This EH&S audit system will ready for implementation by December 30, 2010.

C. Chemical Hygiene Plans

The Chemical Hygiene Plans of some departments have not been reviewed and updated for more than a year.

COMMENTS

The California Code of Regulations (CCR) requires that where hazardous chemicals are used in the workplace, the employer must develop and carry out the provisions of a written Chemical Hygiene Plan (CHP) capable of protecting the employees from the health hazards of the work. The CCR also states that employers review and evaluate the effectiveness of CHPs at least annually and update them as necessary.

Based on EH&S records, 12 of 23 department CHPs were not reviewed and updated during the period January 2008 through November 2009.

RECOMMENDATIONS

Department management should ensure that CHPs are reviewed and evaluated for effectiveness and updated at least once a year. EH&S should monitor and report on the status of the annual review and update of all department CHPs.

MANAGEMENT RESPONSE

Management concurs with the findings and recommendation.

EH&S will request copies of the updated CHP from academic departments with laboratories through the Laboratory Safety Officers.

EH&S will post copies of each department's CHP on the EH&S website and provided updated accounting to the Deans and executive management quarterly regarding compliance with this requirement.

EH&S will further facilitate the process by providing all laboratories with access to a model CHP. This will aid in the development process for those laboratories with little, to no, experience in developing a CHP.

These actions will be completed by September 1, 2010.

D. Laboratory Safety Training

Not all personnel working in UCR laboratories have undergone specific laboratory safety training.

COMMENTS

The CCR requires that where hazardous substances and processes are present in the laboratory workplace, employers shall provide employees with information and training to ensure that they are apprised of the hazards in their work area. Information should be provided at the time of

an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

EH&S provides information, guidance, and technical support as part of the Laboratory/Research Safety program. Information resources and training and education opportunities offered by EH&S to campus personnel include the subject matter areas of laboratory safety, bio-safety, agricultural/field safety, hazardous waste management, and laser/radiation safety. EH&S may recommend and offer safety training courses to all laboratory workers, but it is up to department management to enforce mandatory safety training for all employees who work in campus laboratories.

EH&S does not have a complete and current listing of all campus personnel working in UCR laboratories where hazardous substances and processes exist. As such, EH&S does not monitor the status of all campus laboratory workers' safety education and training development. However, EH&S keeps track of the training courses taken by Laboratory Safety Officers (LSOs). Based on records reviewed, 8 of 24 LSOs have not undergone laboratory safety training as of November 2009.

RECOMMENDATION

Department management should identify all personnel who work in campus laboratories where hazardous substances and processes are present. Management should ensure that all campus laboratory workers undergo laboratory safety training in accordance with University policy and applicable regulation.

MANAGEMENT RESPONSE

Management concurs with these findings and the recommendation. To assure that all laboratory workers undergo laboratory safety training in accord with University policy and applicable regulations, University management will ask each Department to establish a method of identifying all personnel who work in campus laboratories where hazardous substances and processes are present and their related training needs.

We are setting a target date of June 30, 2011 for the Departments to complete the development of the method of identifying the applicable workforce and develop a method of matching this list to the required training for their job assignment.

In the interim and until a method of identifying the exposed staff is completed, a voluntary program will be initiated by EH&S, by September 1, 2010 to assure laboratory workers have the opportunity to complete the

required training. A record of all who complete the training will be maintained and made available by department.

Laboratory Safety Report and Action Plan

An evaluation of safety issues in research laboratories at UCR,
developed in response to the 2009 laboratory fatality at UCLA

Presented by:

- Professor Daniel Schlenk, Chair of the Research Integrated Safety Committee (RISC)
- Professor Howard Judelson, Chair of the 2009 RISC Task Force on Laboratory Safety
- The Research Integrated Safety Committee

September, 2009

Laboratory Safety Report and Action Plan

1. EXECUTIVE SUMMARY

On December 29, 2008, a laboratory technician at UCLA was working with a chemical that accidentally ignited her clothes, caused severe burns, and culminated in her death 18 days later.

This event caused UCR's Research Integrated Safety Committee (RISC) to establish a Task Force to address overall safety issues, including whether UCR was at risk for catastrophic accidents in research laboratories. The Task Force has concluded that:

- While the University of California has a clearly stated policy regarding safety (www.ucop.edu/riskmgt/bsas/presidentialpol.pdf), and an infrastructure exists at UCR to identify and mitigate hazards in the research environment, improvements are needed at all levels of the campus.
- Safety is stressed in some units at UCR, but this is not universal. Additional emphasis on promoting a safety culture must be a priority throughout the campus.
- Efforts to identify and mitigate "low frequency, high severity" incidents should be increased.
- Failing to address the above places life, property, and the reputation of UCR at risk.

To address these issues, the RISC Task Force makes the following specific recommendations:

- The executive management of UCR must actively support efforts to improve the safety culture by UCR, including by making all levels of the UCR hierarchy accountable for safety.
- Colleges must facilitate communication between Department Chairs, faculty, and Environmental Health and Safety (EH&S) on safety issues including "best practices" related to safety management.
- At the Department and PI levels, procedures and protocols must be strengthened to enhance safety. This includes:
  - Procedures must be established to ensure that staff and students are not allowed to work in research laboratories until they have received the appropriate safety training, and that training must be documented.
  - Mechanisms must be improved for identifying hazardous activities, including the "low frequency, high severity" hazards.
  - Standard Operating Procedures (SOPs) for hazardous activities must be developed and implemented at a more universal level than currently exists.
- The Laboratory Safety Audit program run by Environmental Health and Safety (EH&S) is a valuable tool for monitoring and improving safety, and must be enhanced. This includes:
  - Resources must be identified to allow robust audits to be performed on a yearly basis.
  - Methods for ensuring that hazards detected by audits are corrected must be improved.

These findings and recommendations are consistent with those in a report issued by UCLA in response to the incident on their campus, although our Task Force did not attempt to specifically address the UCLA report. The findings and recommendations of our 2009 report are also consistent with those of a 2005 report that was also issued by UCR's RISC committee. The Task Force hopes that the current report will lead to a stronger campus response than the 2005 report.

2. INTRODUCTION

This spring, the UCR Research Integrated Safety Committee (RISC) formed a Task Force to assess the hazards associated with research at UCR, and processes to mitigate those hazards. This was done soon after the UCLA incident that resulted in the death of a laboratory worker in January 2009. RISC proposed to the Executive Vice Chancellor that it make recommendations to executive management regarding safety issues at UCR, which led to this report.

RISC is composed mostly of representatives of the faculty and administration of the College of Natural and Agricultural Sciences, Bourns College of Engineering, Division of Biomedical Sciences, and the College of Humanities, Arts and Social Sciences; chairpersons or designees of five campus research compliance committees; and various EH&S staff. The Task Force that prepared this report included selected faculty and staff of several of those colleges and EH&S staff. A full list of Task Force members are in Appendix 1.

The goal of this report is to make recommendations to improve safety in research laboratories at UCR. These will also limit financial risks to the campus. However, neither this report or one delivered to senior management by RISC in 2005 (excepts presented in Appendix 2) propose fundamentally new programs. Existing programs at UCR, at least on paper, resemble those used at institutions throughout the country to improve safety. However, the Task Force believes that additional emphasis must be made by the campus to communicate the importance of laboratory safety, identify hazards, monitor compliance with safety standards, enforce adherence with the existing safety programs, and improve the general "Safety Culture" of UCR.

3. MANAGEMENT OF SAFETY IN RESEARCH LABORATORIES AT UCR

Safety is managed at UCR to protect everyone who conducts work in the laboratory (faculty, staff, students, custodians, visitors, etc.) and to defend the institution from property loss and liability. This is accomplished largely through a partnership between Environmental Health and Safety (EH&S), academic departments, and the faculty. In addition, compliance committees oversee the use of biological agents, animals, and radioisotopes.

However, confusion may exist regarding who is actually accountable for safety and what their roles should be. Some entities involved in safety management at UCR are the following:

EH&S. In addition to various services such as waste management, this unit provides occupational health oversight to the campus. The latter includes providing general training and conducting audits of safety conditions in laboratories, which are discussed more in Section 4.

EH&S walks a fine line between maintaining constructive communication with faculty and enforcing regulations. It has limited enforcement power. The Task Force does not endorse the option of making the relationship between EH&S and the rest of campus more adversarial. Instead, EH&S needs to be used by the campus more effectively. This should include having colleges (Deans) develop more formalized interactions with EH&S, and by enhancing the EH&S Laboratory Safety Audit program (Section 4). More details of our specific recommendations on this topic are listed in Section 6, along with a summary of the other recommendations presented throughout this document.

Department Chairs. APM 245 states that chairs are "responsible for departmental observance of proper health and safety regulations." However, chairs may be unaware of their precise responsibilities, and safety may need to receive a higher priority within some units. It is also

common for Chairs to delegate safety affairs to a departmental safety committee, or the "Laboratory Safety Officer (LSO)." Even if the Chair is passionate about safety, the LSO or departmental safety committee may need to better understand their responsibilities. While formal processes exist for providing safety training to the general campus population, mechanisms for informing chairs of their responsibilities regarding safety management are currently informal within Colleges and must be improved.

Potential solutions to the above challenges include increased interaction with EH&S, to obtain advice for Chairs and Deans regarding safety management. A mandate from executive management to have EH&S meet with the Department Chairs within each college on an annual basis should increase safety and reduce the financial risks to the campus. For example, Chairs could attend a presentation by EH&S and receive a document on "best practices" for safety management. Such documents have already been prepared by EH&S.

Laboratory Safety Officers (LSOs). These were established in response to the Cal/OSHA Laboratory Standard, which requires employers to establish Chemical Hygiene Plans to set forth "procedures, equipment, and personal protective equipment and work practices" to protect employees. UCR relies on each department having a Laboratory Safety Officer to maintain a chemical safety program. Often, their tasks expand to encompass many of the safety-related activities within a department. Laboratory Safety Officers at UCR are either staff or faculty.

There are several challenges associated with the current Laboratory Safety Officer system:

- Chairs may have varying levels of expectations of their LSOs, since the "safety culture" of departments may vary and Chairs are not specifically trained in their safety responsibilities.
- Staff LSOs may not be given sufficient time to attend to their duties.
- Staff LSOs may lack stature and support within their department.
- When a staff LSO retires, "memory" of the required tasks may be lost.
- Faculty LSOs often rotate through the position, and may not pass instructions regarding their duties onto the successor.
- Faculty acting as LSOs (and chairs of departmental safety committees) may get little recognition for their service. Service as a LSO or a safety committee chair carries little weight compared to some departmental service roles, for example Graduate Advisors. However, management of a vigorous safety program can be equally time-consuming.

Some of the above challenges could be mitigated by training Chairs in their safety management responsibilities, as described above. This would help Chairs ensure that their delegates are fulfilling the safety responsibilities of their departments.

Principal Investigators (PIs). It is the legal responsibility of the PI to ensure that personnel conducting work are trained and follow safe procedures. Many PIs strive to operate a safe laboratory, but some do not. Also, while PIs are responsible for providing task-specific training to their research group, some seem to think that safety training is a job solely for EH&S.

Several factors may hamper the ability of faculty to provide an ideal safety environment:

- Some come from backgrounds in which safety was a low priority.
- Even faculty who place a priority on safety may not be aware of all requirements, such as keeping records of worker training, or may lack the skills to identify some hazards.
- Faculty responsibilities regarding safety are not well communicated in some departments, depending on each unit's "safety culture."
- Faculty are often not held accountable for safety by their Chairs, or during the promotion process.

- Faculty are busy, and safety may receive a low priority in the absence of more specific directives from administration.

Solutions to many of these issues could result from ehanced interactions with EH&S, including through the Laboratory Audit process, as described in Section 4. This would be enhanced by statements from executive management that safety is a priority in the research enterprise.

Chancellor. The implementation and support of safety policies and programs is the responsibility of the Chancellor (UCR Campus Policy 425-58). By defining how authority for safety is delegated through the campus, and establishing a reporting system to ensure accountability, a high standard of safety can be established within all campus units.

4. LABORATORY SAFETY AUDITS

Audits are conducted by EH&S to identify deficiencies and inform the responsible parties what to correct.

The process. The intent of the audit program is to proceed as follows. An auditor from EH&S informs the departmental Laboratory Safety Officer when audits will be scheduled. Ideally, the audit is conducted with the PI in attendance so that results can be reviewed at the end of the audit. It emphasizes physical conditions related to topics in Fire Prevention, General Safety, Electrical Safety, Chemical Safety, Biological Safety, Radiation Safety, and Hazardous Waste Management. The goal is to have an audit of each lab performed on an annual basis.

Reports and follow-up. Findings are uploaded into a custom database, and reports are emailed to the PI and the Laboratory Safety Officer. Once all labs in a department have been audited, a summary and web links to individual audit reports are sent to the chair of the department. When an issue is identified is of the highest priority (*i.e.* life-threatening), the PI is given a limited time to fix the problem and the inspector follows-up with a reinspection.

Challenges. The Task Force considers the audits to be critical to campus safety and should be performed once per year. In most departments, the audit is the only time when a PI's space is checked for safety by anyone beside the PI. It is also typically the only time when inspections are made by a "safety professional." However, the program faces several challenges:

- Only about 80% of laboratories were audited in the last four years (about 286), largely due to limited staffing in EH&S.
- Similarly, EH&S has a limited ability to track and check corrective actions. This is due to limited staff and weaknesses in the computer software currently employed.
- Chairs, Deans, etc. are not informed of critical violations and the status of corrective actions.
- Safety is not given sufficient priority by all departments or PIs, which reduces the impact of the audit program.
- PIs are not always present at the audit, resulting in a lost opportunity for EH&S to communicate the exact nature of hazards, suggestions for mitigation methods, etc.
- Some tasks that could be included in the visit by EH&S, such as developing a list of the chemical inventory (as required by law), are not possible with current resources.
- The audits are good at observing physical conditions, but not behavior or laboratory procedures.

Suggestions for improving the audit system are presented in Section 6.

5. ISSUES RAISED BY THE UCLA ACCIDENT

The incident. A 23-year-old staff member, on the job at UCLA for three months, was using a syringe to extract from a container t-butyl lithium, which ignites when exposed to air. The syringe came apart, spewing chemicals that set her clothing ablaze. She suffered burns over 43% of her body and died 18 days later.

Cal/OSHA citations to UCLA. The California Occupational Safety and Health Administration (Cal/OSHA) investigated and issued citations to the UCLA Department of Chemistry and Biochemistry for the following violations:

Citation 1: "No records of safety and health training on occupational exposure to hazardous chemicals in laboratories on employees working in the laboratory."
Citation 2: "Employer did not implement procedures for correcting unsafe or unhealthy conditions, work practices, and work procedures in a timely manner."
Citation 3: "Employees not trained on hazards of occupational exposure to chemicals in a laboratory."
Citation 4: "Appropriate personal protective clothing not worn in a laboratory while working with hazardous chemicals."

Issues raised. In its deliberations, the RISC Task Force took note of the following:

1. UCR is not immune to accidents causing damage to personnel and property. A partial list of notable incidents at UCR is shown to the right.

2. Safety programs at UCR resemble those employed in universities throughout the country, but nevertheless UCR is vulnerable to devastating incidents and citations. It is also notable that safety standards in most U.S. universities are more lax than in industry, even though both are subject to the same regulations. Also, safety standards are uneven in different UCR units. The RISC Task Force concludes that UCR should increase its efforts to ensure that workers and students obtain documented general and lab-specific training (refer to CAL/OSHA citations 1, 3 and 4); and that the laboratory audit program should be enhanced to more effectively identify unsafe conditions and ensure their mitigation (refer to citation 2).

3. Many risk assessment procedures on campus currently emphasize the common "high frequency, low severity" hazards such as cuts, small chemical spills and burns, etc. However, systems could be improved to provide equal weight to "low frequency, high severity" event that while rare may result in serious injury and death.

Selected incidents at UCR

2000 Pierce Annex: reactive metal in trash can resulted in a fire.
2000 CE-CERT: experiment set ceiling on fire.
2003 Webber Hall: flaming ethanol spilled on floor, nearly burned researcher.
2003 Pierce Annex: researcher caused fire, burned his hand
2003 Entomology: benchtop fire.
2004 Fawcett Lab 238 drying oven fire.
2005 Boyce Hall: student burned seriously during lab procedure; no evidence of training in safe execution of that procedure
2005 Science Lab: major fire in chemistry stockroom, causing injuries, thousands of dollars of damage, and cancelled classes; attributed to mishandled chemical waste.
2006 Pierce Hall contractor hot work caused a foam board to smolder
2007 Fawcett Lab: spill of flaming ethanol.
2008 Webber Hall: Major electrical fire destroyed several lab rooms.
2008 Bourns Hall: mishandled laser caused major damage to facility and lab equipment.

At other UC campuses, incidents include a 2001 fire at UCI that caused $3.5 million of damage, and a $5 million fire at UCSC in 2006.

UCLA's report on its incident. Near the completion of this UCR report, UCLA released its

own report on safety. RISC is continuing to evaluate the many issues raised by their report, which covers a broader range of topics than are addressed by our report. However, the Task Force notes that the UCLA study made five key suggestions (Appendix 3):

- Develop a strong safety culture
- Improve and expand outreach and training
- Increase accountability / oversight
- Improve laboratory design
- Improve inventory and record-keeping

These recommendations are concordant with our own, and a preliminary implementation plan for UCR is presented in the next section.

6. SPECIFIC RECOMMENDED ACTIONS FOR UCR

UCR must undertake the following immediately, if we are to avoid tragedies like that at UCLA. It is imperative that these be undertaken with sufficient resources to be successful.

Safety Culture, Management and Accountability

Issues	Actions
• Executive commitment is needed to ensure that all units of UCR embrace the safety culture. • Without this commitment, safety may receive a variable priorities in different units, and some units may not know what needs to be done.	• Executive management must express to the campus an unequivocal commitment to safety. • Chancellor must hold his direct reports accountable for safety. This will require developing a detailed delegation of authority and responsibility through all levels of management, and a reporting system to ensure accountability. • Deans must establish a dialogue with EH&S to ensure that Department Chairs and PIs are aware of "best practices" related to safety management. • Deans must encourage Chairs to enforce applicable rules, regulations, and policies, including the Lab Safety Rules and Chemical Hygiene Plans. Consequences for substandard behavior should be defined.

Risk Assessments and Inventories

Issues	Actions
• Hazardous procedures must be identified, including those that fall into the "low frequency, high severity" class. • The campus must have an up-to-date inventory of chemical hazards, to comply with state and federal regulations as well as to enhance	• Each PI should complete hazard assessments, and review and improve their safety protocols on an annual basis. • Each PI or department should develop Standard Operating Procedures (SOPs) to address their most hazardous activities. • On-line aids should be developed to assist PIs in risk assessments and SOP development.

general safety.	This might include a database of SOPs, and tools to integrate them into an on-line training system (see next section). • An inventory system for chemicals needs to be implemented, preferably using an on-line system. In previous years, resources were made available to EH&S to accomplish this, and this could be repeated.

Training and Controls

Issues	Actions
• Specific training is required both for laboratory workers and managers. • Both initial training and refresher training are required by Cal/OSHA and prudent practices. • Recurring training of management is required since people holding these positions change frequently. • Administrative controls can help reduce risk to people, equipment, and the campus.	• Colleges should educate Department Chairs about their roles as safety managers, preferably on an annual basis. This can be done by arranging for annual presentations by EH&S, which can also provide a written list of "best practices." • Colleges must ensure that new faculty PIs are trained in their responsibilities as safety managers, soon after their arrival on campus. This could be facilitated by providing EH&S with the names of faculty when they arrive. • A Learning Management System (LMS), which will soon be deployed on campus, should be embraced as a tool to deliver and document safety training, starting with the campus' general safety training. This may require the identification of resources to expand the information content of the LMS. • PIs should be trained on how to use the LMS to provide and document their lab-specific training, and annual refresher training. This would include SOP-related training. The centralized use of such a system would allow the monitoring of PI compliance and reduce campus risk. • Departments should not allow people to work in laboratories until they have received training. This will require a mechanism to track training, which can be achieved using a LMS system. • Certain classes of chemicals (pyrophorics, for example) should be subject to a purchasing restriction program. This could be modeled after the existing radioactivity program.

Laboratory Audits

Issues	Actions
• Regular audits are required to identify deficiencies and ensure that problems	• Audits must be performed on an annual basis. • Participation of the PI in the lab audit should be

are corrected.
- Safety professionals are best-equipped to identify hazards within PI labs; self-audits are not a substitute for an EH&S audit.

mandated.
- A means for quickly informing Chairs, Deans, and Vice Chancellors of critical violations should be implemented.
- A process for sign-off on audit corrections by PIs should be developed. This could be a self-certification program similar to the SAS112 financial audit system.
- The audit system should include sufficient follow-up spot audits to monitor the corrective action self-certification process. Where corrective actions are not completed, reports should be sent to higher levels (Chair, Dean, and/or Chancellor).
- Audits should expand beyond physical condition audits to check for compliance in other areas, such as checking for SOPs and training records (if not handled using the Learning Management System).

Resources for these actions. Many of these recommendations require no new resources, such as establishing stronger interactions between the colleges and EH&S, and increasing the visibility of management's commitment to safety. Others require new resources, such as improving the laboratory audit and chemical inventory systems. The RISC Task Force perceives that the number of FTEs allocated to laboratory and research safety at UCR (about 0.5) is much less than at other institutions (Appendix 4). This issue will require careful and independent study, and a balancing between UCR's limited financial resources and its exposure to risk.

7. Closing remarks

Our recommendations are a first step in recognizing and improving safety in the laboratory and research environment at UCR. The RISC committee looks forward to the administration's response to this report, and is prepared to take action on any assignments presented related to improving safety at UCR. This would include more detailed implementation plans for the recommendations proposed above.

> "As an institution of higher learning, it is essential that we teach students by example and demonstrate an unwavering commitment to ensuring the health and safety of all laboratory personnel. This commitment must be demonstrated from the top down so that those working in the laboratory respect this environment and those who enforce the safety rules. By instilling a sense of responsibility for laboratory safety in everyone working in the laboratory, we are better preparing our students to enter the workforce and be proactive in preventing accidents and injuries."
>
> —from the "Report to the Chancellor on UCLA Laboratory Safety", July 2009

Appendix 1.

Members of RISC Task Force

Name	Title	Department
Anita Jensen	Associate Director	Environmental Health & Safety
Arif Peshimam	Biosafety Officer	Environmental Health & Safety
Beiwei Tu	Accident Prevention Specialist	Environmental Health & Safety
Catharine Larsen	Assistant Professor	Chemistry
Daniel Schlenk	Professor	Environmental Sciences
Eugene Nothnagel	Professor	Botany & Plant Sciences
Howard Judelson	Professor	Plant Pathology & Microbiology
Ian Guajardo	Superintendent of Physical Plant	NPPS Administration
Janette Ducut	Training Manager	Environmental Health & Safety
Kevin Simpson	Academic Coordinator	Chemistry
Lisa Martin	Business Continuity Planner	Environmental Health & Safety
Margaret Wirth	Staff Research Associate	Entomology
Michele Coyle	Campus Counsel	Campus Counsel
Richard Hooley	Assistant Professor	Chemistry
Robert Lennox	Facilities Coordinator	Botany & Plant Sciences
Ross Grayson	Director	Environmental Health & Safety
Russell Vernon	Lab/Research Safety Manager	Environmental Health & Safety
Scott Corrin	Fire Marshal	Environmental Health & Safety
Steven La Shier	Director of Risk Management	Risk Management
Tim Willette	Principal Admin Analyst	Engineering (Dean's Office)
Tonya Talavera	Deputy Fire Marshal	Environmental Health & Safety

Appendix 2.

Excerpts from 2005 RISC Report on Lab Safety (UCR)

Issues

- Safety is not uniformly considered a high value on campus.
- Health, Safety and the Environmental (HSE) performance objectives have not been priorities.
- Accountability for safety is not apparent
- Deans and Department Chairs have not been requested to establish safety performance objectives or to report on safety performance.
- A common perception is that safety is the Laboratory Safety Officer's responsibility (not the Chair's, or faculty's).
- Department personnel are not routinely involved in reviewing accident investigations.
- Individual performance reviews do not include a component of Health, Safety and the Environment as specified by policy (Policy 425-24).
- The campus has no clear systematic process to include safety, health and the environment in all campus activities.
- The Academic Personnel Review Procedures "The Call" also does not include any apparent criteria for inclusion of consideration of performance for health, safety or environmental issues.

Recommendations

- The Chancellor's Leadership Council (CLC) to commit to establishing a campus "culture of safety."
- EVC/P to identify health, safety and environmental responsibility and accountability flow-through to the College, Division, Department, Institute, Center and Office level (i.e., control unit)
- CLC to affirm that the Integrated Safety and Environmental Management (ISEM) System as developed by EH&S be fully used throughout the campus to achieve the objectives of this report
- EVC/P to establish Health, Safety & Environmental goals for each control unit in consultation with the control unit and EH&S
- These goals to be assessed and reviewed by EH&S on a regularly scheduled basis and reported to the EVC/P. These periodic reviews to include: A) Assignment of Safety Partners (BSEC, BES, DSC & LSO) within the control unit; B) Fulfillment of Safety Partner's commitments (attend meetings, attend training, etc.); C) Review of all injuries and emergency responses within the control unit; D) Compliance of all appropriate people within the department for attendance at mandated safety training; E) Other initiatives instituted by the control unit as necessary to meet their goals
- HR to train all units in Policy 425-24; all performance reviews are to incorporate safety and environmental performance; conformance to be evaluated by EVC/P
- EH&S to issue revised Integrated Safety and Environmental Management(ISEM) system plan to replace campus Injury and Illness Prevention Plan
- Each control unit to be held accountable for safety, and to implement ISEM plan

Appendix 3.

Report to the Chancellor on UCLA laboratory safety

EXECUTIVE SUMMARY

Develop a Strong Safety Culture – A top down culture of safety consciousness should be developed that involves a management approach in which the Chancellor, Vice Chancellors, Deans, Department Heads and Principal Investigators embrace the necessity of laboratory safety, support efforts to improve safety, and stress to staff that the health and safety of each individual depends on teamwork and personal responsibility. Reward systems should be developed to encourage all laboratory personnel to willingly comply with all safety procedures in their facilities.

Improve and Expand Outreach and Training – A critical element of safety education includes developing and encouraging basic attitudes and habits of prudent behavior in the laboratory so that safety is valued as an inextricable component of all laboratory activities. To achieve this, improvements in the quality, frequency, availability, tracking, and documentation of training are needed. Additional personnel or IT resources may be necessary to facilitate these efforts.

Increase Accountability and Oversight – Oversight of safety in research activities should be expanded to ensure consistent maintenance of high professional standards and hold Principal Investigators and other laboratory staff accountable for implementation of safe laboratory practices and procedures. Extension of revised laboratory inspection procedures to all programs within the Research Safety Division will provide increased oversight by EH&S. The formation of a formal inter-departmental committee with delegated authority from the Vice Chancellor for Research that is charged specifically with oversight of research areas involving chemical and physical hazards would help to strengthen safety in these areas and bring oversight closer to that in more highly regulated areas such as Radiation and Biological Safety.

Improve Laboratory Design – It is essential that laboratories be designed by experts who are familiar with how laboratories operate. To prevent accidents, research should be viewed in the context of the entire laboratory system that includes facilities and equipment. EH&S and other laboratory experts should routinely be consulted to help ensure the safe design and renovation of laboratories and to ensure regulatory compliance. EH&S can also assist with ensuring adequate fire protection, ample chemical and hazardous waste storage capacity, and proper ergonomic design.

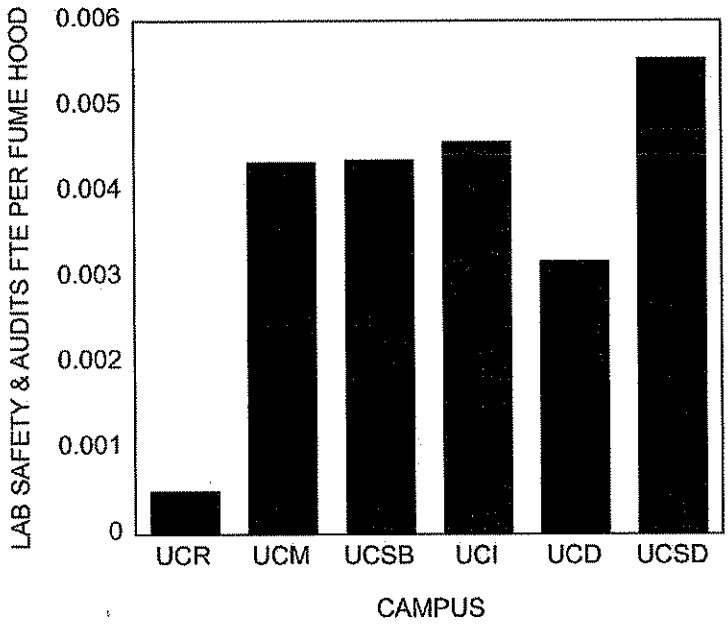
Improve Inventory and Recordkeeping – A more systematic approach for the tracking of laboratory space, laboratory personnel, laboratory hazards, chemical and hazardous material inventories, etc. should be developed and implemented. Resources should be allocated to allow the collected information to be regularly updated and analyzed.

Appendix 4.

UCR EH&S Lab Safety Resources

A study was made of the number of FTE assigned to Laboratory Safety & Audits at different UC campuses. These were compared to the number of chemical fume hoods on each campus, on the assumption that their number is roughly proportional to the research workload. Fume hoods represent significant and intensive technical and regulatory impacts and are an indicator of robust, challenging, dynamic, and often hazardous activities.

The results suggest that UCR is understaffed in this area:



(UCLA and UCB are not shown since they did not provide the appropriate information for this analysis)