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Facility Safety Plan B360 Complex CMLS-411r0

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FACILITY SAFETY PLAN
BUILDING 360 COMPLEX

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Lawrence Livermore National Laboratory

Disclaimer

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Preface

Lawrence Livermore National Laboratory's (LLNL) Environmental, Safety and Health (ES&H) policy is that all operations must be planned and performed safely for the protection of workers, the public, the environment, and limit possible loss to property, facilities and equipment assigned to this directorate. In addition to observing LLNL policies contained in the *Environment, Safety, and Health (ES&H) Manual,* LLNL workers will comply with applicable federal, state, and local regulations when conducting any activity that the Chemistry, Materials and Life Sciences (CMLS) Directorate has managerial control or oversight. Management has determined that the safety controls specified within this Facility Safety Plan (FSP) must also be followed to ensure that the operation is successfully performed efficiently and safely within this facility. Any operations conducted in this Complex that involve activities not commonly performed by the public require an Integration Work Sheet (IWS) or IWS/Safety Plan (IWS/SP) that specifically assesses the responsibilities, hazards and controls to conduct the operation safely.

Everyone who enters this area (including students, workers, visitors, and consultants) must follow the applicable requirements in this FSP. Each person is expected to protect himself/herself and others from injury or illness. Regular facility occupants are expected to guide and govern visitors and assist new or temporary occupants in understanding and following this plan. When there are any doubts regarding the safety of any phase of work, workers and others will check with the facility manager.

Changes to this FSP will be approved by the Facility Associate Director (AD). This will undergo triennial review to establish, at a minimum, that its contents are appropriate and adequate for current operations.

The Hazards Control ES&H Team assists management in instituting and maintaining a minimum-risk and environmentally sound work environment. Any Laboratory worker has the authority to order any activity stopped immediately if, in his/her judgment, the procedure or circumstances represent an imminent threat to human safety, health, the environment, or buildings and equipment (see Document 2.0 “ES&H Management Requirements,” in the *ES&H Manual*).

Building 360 Complex Facility Safety Plan (FSP)

1. Facility Description

CMLS conducts basic and applied research in the fields of health and life sciences in support of national needs to understand the causes and mechanisms of ill-health effects, disease prevention, early detection of biological outbreaks, and lower health care costs. The facilities are administered by the CMLS Directorate and divided into the following Divisions: Bioscience and Biotechnology Division(BBTD), Chemical Sciences Division (CSD), and Materials Science and Technology Division(MSTD). This FSP covers operations in the following facilities assigned to the CMLS Directorate: 361, 362, 364, 367, 373, 376.

Safety regulations in this FSP and the *ES&H Manual* apply to all participants in 360 complex including, operations, staff members, contract workers, supplemental labor and service staff, participating guests, hosted short-term and long-term visitors, subcontractors, and summer students where CMLS has management oversight.

Covered Operations

- Use of sealed radioactive sources when used in compliance with Document 20.1, "Occupational Radiation Protection," and Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials," in the *ES&H Manua*l and controls described in this FSP.
- Use of unencapsulated radionuclides conducted in Type I or Type II workplaces is authorized when reviewed by the area Health Physicist and approved via an IWS. Compliance with Document 20.2 and related supplements is also required.
- This FSP allows for standard research projects such as, but not limited to, environmental monitoring, nucleic acid, protein and cell labeling, cell cultures, injections into animals or vessels, autopsy of animals, and other operations that have little potential to disperse radioactive material. In addition, these materials shall be used in compliance with controls described in this FSP.
- Use of flammable and/or reactive chemicals in approved quantities and in appropriate containers is allowed when used and stored in compliance with the procedures outlined in Document 22.5, "Fire," of the *ES&H Manual.*
- Use of lasers is allowed when the operation(s) are properly reviewed by the Hazards Control ES&H Team and determined to be operating in accordance with the provisions listed in Document 20.8, "Lasers," of the *ES&H Manual.*
- Use of acids, bases, and solvents in small quantities, and in combinations, are allowed when materials are not expected to produce any unusual hazards. Refer to Document 14.0, "Chemical," of the *ES&H Manual* for guidance when handling these materials.
- Biological materials are allowed when operations are limited to Biosafety Level (BSL) 1 or 2 controls involving use of small, non-production, research-laboratory

type scale amounts. Refer to Document 13.0, "Biological," in the *ES&H Manual*, as well as FSP Addendum 360.1, "Biohazardous Operations" for further guidance on biological operations.

- Use of flammable metals and powders in small quantities, and in combinations, are allowed when materials are not expected to produce any unusual hazards. Refer to Document 14.7, "Safe Handling of Alkali Metals and Their Reactive Compounds," in the *ES&H Manual* for further guidance in handling, storage and disposal of such materials.
- Use of animals in experiments is allowed when approved by the Institutional Animal Care and Use Committee (IACUC).

Operations and Use of Materials requiring additional documentation

The operations listed below and all other operations not covered by this FSP require additional review and documentation.

- Chemicals that could generate uncontrollable amounts or exceed acceptable limits of toxic fumes, dusts, or mists.
- Hydrogen and other flammable gas experiments using manifold or cylinder/tank storage to ensure that adequate alarm systems, proper ventilation, and equipment are used.
- Experiments using, or capable of generating, intermediate pressures, as defined in Document 18.1, "Pressure," in the *ES&H Manual.*
- The use of hazardous equipment or hazardous materials involving individuals under the age of 18 years old.
- The use of carcinogens.
- The use of chemicals that exceed small non-production research-laboratory scale amounts of chemicals.

Operations and Materials that are outside the Scope of this Plan and require an approved IWS/SP.

- Work with unencapsulated radionuclides exceeding moderate hazard Type II classification criteria as set forth in Document 20.1 and Document 20.2 in the *ES&H Manual*.
- High pressure experiments - refer to Document 18.1 in the *ES&H Manual.*
- Any activity involving a hazard so acute that the *ES&H Manual* specifically requires preparation of an SP.

2. Changes

Any changes in operations that increase the hazard level, introduce additional hazards, or decrease safety shall not be made until a revision of or supplement to this FSP has been reviewed and approved, consistent with the review and approval process for the original FSP. Proposed changes in building safety and environmental control systems require a design review and must be approved by the Facility Manager.

3. Review

This FSP will be formally reviewed and issued, at a minimum, every three years to ensure that its contents are appropriate and adequate for current operations. If changes are necessary before the triennial review date, the FSP will be amended and the changes approved by the Associate Director for CMLS.

4. Responsibilities and Authorities

4.1. General

All persons, including LLNL employees, students, supplemental labor personnel, contractor employees, and visiting scientists and engineers assigned to work in the Building 360 Complex are responsible for their own safety and for complying with the safety directives of this FSP. Personnel working within this facility and unescorted visitors are responsible for the following:

- Immediately stopping and reporting any operation when there appears to be an imminent danger to personnel, property, or the environment.
- Reporting any injuries, incidents, occurrences, or ES&H issues immediately to their supervisor and the FPOC.
- Knowing and complying with applicable portions of this FSP, any applicable SPs and IWSs, and the *ES&H Manual*.
- Participating in function-specific training required for the performance of work assignments. Training is to be kept current during the term of the research/work.
- Consulting with and following the guidance of the ES&H Team subject matter experts before performing potentially hazardous operations.
- Bringing to the attention of CMLS senior management, any ES&H-related issue that is not adequately covered by the *ES&H Manual*, an FSP, SP, or an IWS.

4.2. Associate Director (AD)

The AD is responsible for ensuring that ES&H is planned for all facilities and operations conducted in CMLS. The AD shall ensure ES&H plans are reviewed, approved, and properly implemented. The AD has delegated responsibility for oversight of ES&H concerns to the Directorate Assurance Manager.

4.3. AD Facility Manager (FM)

The Associate Director has delegated to the ADFM the authority for meeting the technical, ES&H, financial, and administrative responsibilities for facility operations. The ADFM is responsible for ensuring that all operations scheduled to take place in the facilities that are covered by this FSP are compatible with the facilities and that all controls required by the FSP and other applicable documents are in place and operational.

4.4. Facility Staff

Facility staff supporting the FM includes the CMLS Facility Point of Contact (FPOC).

<u>360 complex Facility Point of Contact (FPOC)</u>

The FPOCs are responsible for daily surveillance of all facilities covered by this FSP and for reporting and correcting any deficiencies in facility safety devices. The FPOCs are delegated authority for all facility maintenance, repair, and modifications with a value of less than $5,000; and for all matters in the absence of the ADFM.

4.5. Authorizing Individual

The AI is designated by LLNL to direct a project or program and is responsible for the technical, financial, administrative, and ES&H objectives of that project or program. CMLS Division Leaders or delegates are the Authorizing Individuals (AIs) for all IWSs covering activities within their respective organizations. Specific responsibilities for conducting work are:

- Presenting the work to be performed to the FM for initial screening.
- Ensuring that all workers listed on the appropriate ES&H and security documents have met the requirements to work in these facilities.
- Providing the necessary information for the conduct of research activities. The information will have been generated during the project approval process.
- Ensuring that the resources are available to do the proposed work.
- Designating the RI responsible for execution of the proposed work.

4.6. Room Responsible Person (RRP)

Each laboratory will be assigned an RRP. RRPs are responsible for ensuring that all work is performed in conformance with this FSP, SPs, IWSs, PWSs, the *ES&H Manual*, and other LLNL requirements as appropriate. RRPs will be assigned specific work activities by the RI, in coordination with the FM. Research work activities will have been defined and documented as part of the project approval process. The RRP is also responsible for janitorial issues and assisting the facility and ES&H staff in completing tasks.

In addition, RRPs are responsible for the following:

- maintaining surveillance of the work place and the conduct of operations to ensure worker safety and the prevention of damage to the building, equipment and environment receive the utmost attention.
- correcting, or requesting assistance from program management to correct, any ES&H deficiencies identified in their area of responsibility,
- conducting a prompt investigation in the event of an accident to determine the causes and initiating action to prevent a recurrence or similar incident.

4.7. Responsible Individual (RI)

RIs are those individuals who have the responsibility for the successful completion of specific activities which may be either facility or programmatic in nature, and who provide direction to personnel supporting their activities. The RI may be at any level within the organization and is formally identified by the Authorizing Individual (AI). The RI is responsible for assuring that the five ISM functions are fully implemented for all activities, in accordance with the seven ISM principles. The RI is responsible for preparing an IWS (or IWS/SP) for all activities not commonly performed by the public, with input from Experimenters and Subject Matter Experts (SMEs). Specific responsibilities are:

- Preparing the IWS for all activities with input from experimenters and subject matter experts.
- Submitting all required documentation needed for the project approval process.
- Assuring all activities conducted in facility are compatible with the requirements specified in this FSP.
- Stopping work and notifying the FM, AI, and appropriate management staff when safety or security issues are not promptly corrected or addressed.
- The RI is also responsible for maintaining all required records, including those regarding Select Agents, and for assuring that activities conducted are compatible with requirements specified in this FSP.

4.8. Experimenters (Workers, Students, Supplemental Labor, and Participating Guests)

Management is responsible for providing a safe working environment for employees, and employees are responsible for conducting work in a safe manner. Each employee, including those discussed in the management sections of this document, is responsible for the following:

- Knowing the ES&H plans, controls, and requirements of his/her assignments and the potential hazards, and emergency plans and procedures for the work area.
- Successfully completing and maintaining all required training and, if applicable, participating in personnel assurance programs and health monitoring programs.
- Performing work assignments in accordance with requirements listed in the *ES&H Manual*, established safety plans and procedures, and additional input from ES&H subject matter experts. Employees are only to perform work for which they are trained or qualified.
- Only performing work that has been authorized. Work commonly performed by the public may be self-authorized, so long as all applicable controls are followed and the activity does not conflict with other on-going activities within the facility or work area.
- Immediately correcting or informing the RI directing the work activity of ES&H-related problems.
- Warning fellow workers and visitors of hazards and defective equipment.
- **Requiring that work be stopped if it is observed that an operation presents an imminent or substantial danger to health, safety, or the environment. Each employee is empowered to stop his/her own work if there is an unsafe or unapproved condition.**
- Reporting work-related injuries and illnesses to his/her supervisor and to Health Services in a timely manner.
- Keeping his/her exposure to radiation, toxic materials, and other such agents As Low As Reasonably Achievable (ALARA).

- Consulting his/her manager for guidance when uncertain about any ES&H-related work requirements before conducting the work. Seeking assistance from the ES&H SME to assure the requirements are fully understood.
- Bringing to the attention of his/her supervisor opportunities for improvement associated with the work, governing procedures and safety.

Note: In accordance with Laboratory policy, individuals under the age of 18 years old are prohibited from working with specific hazardous materials or performing specific hazardous operations.

4.9. LLNL Responsible Official (RO)

Work with certain pathogens deemed by the government to have potential as terrorist weapons (see definition in Document 13.6, "Safe Handling and Use of Biological Research Materials," in the *ES&H Manual*) shall be approved by either the Centers for Disease Control and Prevention (CDC) or Animal and Plant Health Inspection Service (APHIS). Specific approvals shall be obtained for the work to be done, the pathogens to be used, the specific laboratory where the work will be done, and the PI and workers who will perform the work. The RO serves as LLNL's point of contact with CDC and APHIS to assist in obtaining these approvals. The RO shall:

- Register all LLNL Select Agent activities with CDC or APHIS, as appropriate;
- Approve all transfers of Select Agents within LLNL and between LLNL and external organizations;
- Conduct and document inspections of all Select Agent activities on a quarterly basis to verify that they are in compliance with federal regulations;
- Provide an archive for all Select Agent records that are required by federal regulations;
- Provide training and program updates to RRPs; and
- Make all reports to CDC or APHIS that are required by federal regulations.

4.10. ES&H Teams

ES&H Teams have been established to coordinate ES&H services for work activities within LLNL facilities. ES&H Team supports activities in CMLS Facilities. CMLS personnel working in non-CMLS facilities are supported by the ES&H Team assigned to that facility.

The ES&H Team provides guidance to CMLS personnel on safety and environmental issues in the workplace. ES&H Team activities include the following:

- Helping management and workers inspect and assess operations and facilities, including construction and maintenance, for adequate use of controls, compliance deficiencies, and opportunities for improvement.
- Performing Hazard Analyses of proposed and ongoing operations.
- Making recommendations for controls needed to reduce risk to an acceptable level and for ES&H compliance.

- Assisting in developing and processing of ES&H documents including FSPs, SPs, IWSs, etc.
- Assisting with emergency response to accidents, fires, spills, and other incidents in or on the grounds of CMLS facilities.
- Notifying CMLS management of unusual ES&H-related risks associated with CMLS activities.
- Providing integrated support from Hazards Control, the Environmental Protection Department and Health Services.
- Providing CMLS with injury, illness, and radiation dosimetry information for employees in the directorate.
- Participating in Management Pre-start Reviews when requested.
- Providing ES&H advice and guidance by subject matter experts to CMLS employees and management.
- Performing workplace evaluations for declared pregnant workers.

4.11. Environmental Protection Department

The Environmental Protection Department (EPD) assists Program workers with environmental compliance activities through the Environmental Operations Group Environmental Analyst (EA) who is assigned to the ES&H Team. The Radioactive and Hazardous Waste Management (RHWM) Technician assigned to CMLS assists waste generators with the management of medical, non-regulated biological (NRB), non-hazardous, hazardous, radioactive and mixed wastes, and retention tank systems. ChemTrack Operations Group technicians conduct periodic inventories of chemicals stored or used in CMLS facilities. Additional EPD staff is available to deal with specialized concerns including air and hazardous waste permitting issues, water discharges, and National Environmental Policy Act (NEPA) evaluations.

4.12. Materials Management

Materials Management (MM) is responsible for the transportation of certain radioactive and controlled materials to and from CMLS facilities. Before transporting radioactive and controlled materials, contact the H&S Technician, and Materials Management Department.

4.13. Visitors

Visitors to the 360 Complex are the responsibility of their host. Hosts shall coordinate visitor access with the RI to ensure that their visitors are adequately briefed, trained and provided with the appropriate personal protective equipment. Special attention shall be paid to those visitors who will require access to high hazard work activities within the 360 Complex.

4.14. Health Services Department

LLNL Health Services Department (HSD), which houses a decontamination facility, provides both emergency and non-emergency treatment services, as well as regular

physical examinations and preventative and diagnostic medical services (e.g., vaccinations, blood tests, serum banking) as part of medical surveillance and certification programs for LLNL employees.

4.15. Security Department

Select Agent activities require extensive security precautions. The security department shall prepare and maintain security plans for Select Agent activities. The Security Department shall also assist the FM and appropriate management staff in identifying necessary security measures for select agent activities.

5. General Building Safety Limits and Controls

A Hazards Analysis is performed to determine the level of occupational risk. The Hazards Analysis includes factors such as: pathogenicity of infectious materials; degree of chemical hazards; physical hazards; electrical hazards; exposure doses; routes of exposure; and host susceptibility of healthy individuals. Worker exposure may result from: use of toxic chemicals; laboratory-acquired infections; zoonotic-acquired infections; dermatitis from use of soaps, detergents, solvents, cleaners, and disinfectants; cuts, lacerations, punctures from needle-sticks or use of "sharps"; burns from handling hot or chemically treated items; exposure to intense electro-magnetic fields; and worker sensitization to specific allergenic substances.

5.1 Key Safety Limits and Operational Safety Requirements (OSRs)

The Building 360 Complex is comprised of Office, Light Science and Industry (LSI) and a Low Hazard facility (Building 364) as defined in Document 3.1, "Nonnuclear Safety Basis Program," in the *ES&H Manual*. Authorization for LSI facility operations is provided by a Screening Report. Authorization for Building 364 is provided by a Tier 2 Safety Basis Document.

5.1.1 OSR Administrative Controls

The facility will retain documentation for certified sealed source #401135, which has been excluded from the inventory, showing that the source or prototypes of the source, have been tested and passed the Special form tests specified by DOT in 49 CRF 173.469 or ANSI N43.6 "Sealed Radioactive Sources, Categorization."

5.2 Administrative Controls

5.2.1 Integration Work Sheets (IWSs)

The administrative control first used to mitigate hazards is the initial Integration Worksheet (IWS) that is prepared by the RI, reviewed, and approved as part of the project approval process.

Any operations conducted in this Complex that involve activities not commonly performed by the public require an Integration Work Sheet (IWS) or IWS/Safety Plan (IWS/SP) that specifically assesses the responsibilities, hazards and controls to conduct the operation safely.

5.2.2 Institutional Review

All research activities involving the use of human subjects, animal subjects, and biohazardous materials or DNA technology will require institutional review with the LLNL Biosafety Operations Committee (LBOC), the Human Subjects Committee, Animal Care and Use Committee, and the Biosafety Committee, respectively. Contact the area Industrial Hygienist supporting your activities for more information on working with these committees.

- The LLNL Biosafety Operations Committee (LBOC) provides experimenters with an initial single point of contact, determines the level of required review, identifies the associated hazards, recommends the level of training required, recommends the need for medical surveillance, proposes changes to the ES&H manual, and addresses biosafety issues requested by Council of Biosciences and Biotechnology

- Institutional Review Board (IRB): Federal regulations and Laboratory policy require that approval by the IRB be obtained before any research project involving use of human subjects or human tissue be initiated in order to protect the rights and welfare of individuals who volunteer to become subjects in research projects.

- Institutional Animal Care and Use Committee (IACUC): Approval by the IACUC must be obtained prior to initiating any research involving vertebrate animals. The IACUC must determine if the proposed work meets acceptable standards for the care and use of animals in research.

- Institutional Biosafety Committee (IBC): The IBC shall review all research protocol involved in the use of recombinant DNA technology, artificial gene transfer, biological agents (bacteria, viruses, protozoa, fungi, etc.), toxins (natural and synthetic), and biological materials from human and animal sources (e.g., tissues, body fluids, cell cultures, etc.). Federal regulations under 29 CFR 1910.1030 require that any work with human blood, other human materials, or human blood borne pathogens and under 42 CFR Part 72 for any work with infectious materials be reviewed to determine exposure potential for workers. The IBC approves and/or registers all biological research at LLNL. In addition, the IBC is responsible for determining whether a protocol complies with applicable rules and regulations and that it meets appropriate biosafety containment standards as set forth by the National Institutes of Health (NIH) Guidelines on recombinant DNA.

5.2.3 Medical Surveillance

Designated personnel working in the 360 Complex shall be enrolled in the Biohazards Medical Surveillance Program. They will receive appropriate immunizations and testing. An assessment will be made by an occupational health physician.

LLNL provides free medical monitoring to all employees who face workplace risks, including the potential health hazards associated with research and development activity with recombinant DNA, pathogenic organisms and agents, hazardous chemicals and heavy metals. An occupational physician in the Health Services Department who also works in close association with other ES&H personnel coordinates medical surveillance.

Medical surveillance includes the free provision of vaccination against organisms and agents with which a person must work, if a safe and effective

vaccine is available. A common example is Hepatitis B immunization for individuals who work with human source material.

Persons with severe immunological deficiencies or persons undergoing treatment with immunosuppressive drugs and certain other medical disorders are discouraged from working with infectious organisms. In addition, persons with any ongoing (acute, chronic, recurrent) medical conditions as well as women who are or may become pregnant, should seriously consider whether or not they should participate in any research activities involving pathogenic or potentially pathogenic agents. Consultation with a physician and other health and safety professions (including biohazard specialists) is available and strongly advised.

Any changes in the health status of research personnel or any illness which lasts four days or longer must be reported to the RI and Health Services. If there is any suspicion of an occupational exposure, a Health Services physician will be consulted.

All workers engaged in potentially hazardous work are encouraged to participate fully in the appropriate medical surveillance program(s).

If you have concerns regarding your potential risks, contact CMLS Assurance Manager or one of the LLNL Biosafety Officers. Annually, a review questionnaire will be sent to each worker known to use recombinant, biohazardous or carcinogenic materials. Our medical surveillance coordinator will review completed forms. Because patterns of illness among worker groups are an important part of the monitoring process, we encourage all workers to fully complete the survey every year. Employees' survey responses become part of their individual medical records and are strictly confidential.

5.2.4 Select Agent Human Reliability Program (SAHRP)

The SAHRP is established to ensure that all workers involved with Select Agents are fit for duty. The SAHRP Program evaluates workers' health and mental condition for safety and security concerns.

5.2.5 Termination of Employment/Permanent Conclusion of Work in CMLS.

Prior to terminating a position in CMLS, it is each individual's responsibility to ensure that all chemicals, samples, equipment, and supplies are either transferred to another employee or properly disposed of (non-hazardous, hazardous, mixed, biological and/or radioactive wastes must be managed out of the work area prior to termination or transfer). Notify the area Health and Safety (H&S) Technician at least one week prior to leaving CMLS. To transfer chemical ownership, contact ChemTrack at Ext. 4-4404 or use the internal LLNL website **http://chemtrack.llnl.gov.** If an individual has worked with radioactive materials, it may be required that the individual submit a final Bioassay sample. In this case, notify the area H&S Technician at least two weeks prior to leaving CMLS.

When shutting down operations, deactivating equipment or experimental facilities, or transferring responsibility for a workplace, the requirements of ES&H Manual, Document 12.7, "Shutdown or Transfer of Facilities, Operations or Associated Equipment" in the *ES&H Manual* shall be adhered to. The termination of relatively small-scale operations within CMLS facilities is governed by Document 12.7, Appendix A.

5.2.6 Standard Operating Procedures

Standard Operating Procedures (SOPs) are working documents prepared by the Programs with input from the Experimenters and RIs that include detailed, step-by-step instructions for all research operations performed. SOPs provide guidelines for operational consistency; protection of workers, the general public, and the environment; and compliance with applicable federal, state, local, and institutional requirements. SOPs are reviewed annually. For more information on SOPs, refer to Document 3.4, "Preparation of Work Procedures," in the ES&H Manual.

5.2.7 Safe Plan of Action (SPA)

Support organizations and/or groups are responsible for completing a daily SPA prior to performing the work activity. All non-resident workers (support organizations, contractors, etc.) must check in with the ADFM or Facility Staff before beginning work.

5.2.8 Permit for Minors

The Laboratory has developed special work restrictions for persons under 18 years of age and additional restrictions for persons under 16 years of age. See Document 2.0, "ES&H Management Requirements," of the *ES&H Manual* for further guidance. Some facilities, areas, and work operations have been identified as having a high potential for overexposure (as defined by Laboratory Policy) and persons under 18 will not be allowed to work in them without an exposure evaluation by the ES&H Team. Non-LLNL persons under 16 may not use hazardous equipment or chemicals. See the ES&H Team for more detailed information on this restriction. "Permits for Minors" are required and applications can be obtained from the CMLS Assurance Office.

5.3 Engineering Controls

Engineering controls, in combination with safe work practices that alter the manner in which tasks are performed, are expected to be primary means of eliminating or minimizing the risk of occupational exposure.

Engineering controls are used to isolate or remove hazards from the workplace in order to reduce the potential for exposure. Such engineering controls include, but are not limited to, mechanical aids, sharps containers, laboratory-type fume hoods, biological safety cabinets (BSC), shielding, High Efficiency Particulate Air (HEPA) filters, interlocks, plugs maintained in floor drains in certain areas, and negative air flow units, building construction and fixed protection systems, alarm and surveillance systems.

Mechanical Aids

Tongs or tweezers should be used whenever practicable when handling sources of penetrating radiation to reduce the radiation dose to the hands as much as possible. Exposure rates are reduced with distance from a source.

Shielding

Plexiglas shielding is required when handling P-32 to reduce radiation exposure. Plexiglas shielding is also required around P-32 waste collection containers.

Dead Air Boxes

Dead air boxes are commonly used to reduce the potential of contamination while diluting or transferring stock concentrations of biohazardous materials. Work areas must be decontaminated before and after each use to reduce the likelihood of cross-contamination.

Fume hoods

Fume hoods are commonly used in the laboratory to draw air away from the work area and away from the worker's breathing zone. Fume hoods are available in most laboratories within CMLS and shall not be used for long-term storage of materials and equipment merely as a matter of convenience.

Negative Air-Flow Units

All animals being injected with infectious materials or receiving mutagens or carcinogens supplemented into their food or water will be housed in negative airflow animal units. Cages will be labeled as to the type of hazard present, amount and route of exposure, and the date of administration. Signs placed on each unit will indicate if (1) animals are currently being exposed, (2) animals were exposed in the past, or (3) animals were not exposed.

Sharps Disposal Container

Sharps containers are used to dispose of contaminated sharps (e.g., needles, scalpels, broken glass, broken capillary tubes) that can penetrate the skin. These containers must meet the criteria set forth in Document 13.2, "Exposure Control Plan: Working Safely with Blood and Blood borne Pathogens," in the *ES&H Manual.*

5.4 Facility Safety Related Hazards and Controls

5.4.1 Access & Egress Control

Facility Access

The 360 complex is an authorized access area. All workers entering a laboratory or the Animal Care Facility must have knowledge of the operations being conducted and Program approval.

Roof Access

For facilities which are designated as ”restricted access” facilities, the planned work must be reviewed, and written permission to access the roof granted via a Roof Access Permit, by the building representative, with concurrence from the area Health and Safety (H&S) Technician. All hoods must be conspicuously posted when a roof access has been granted for “restricted access” facilities. Work in the hoods shall not be conducted while workers are on the roof, except for specific activities in biosafety cabinets that are approved in accordance with IWS #12639. Buildings 367, 373 and 376 and trailers 3649 are designated as “general access” and do not require a roof access control; all other CMLS facilities fall under “restricted access.” (See IWS #12639 for restricted roof access procedures.)

Confined Spaces

A confined space is defined as an enclosed area that has all three of the following characteristics: is large enough for a worker to enter into and work within; has limited or restricted means of entry or exit; and is not designed for continuous human occupancy.

A permit-required confined space is a confined space that has three or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an occupant; or has an internal configuration such that the occupant could be trapped or asphyxiated by inwardly converging floors; or contains any other recognized serious safety or health hazard. Examples of the types of hazards that may be found in permit-required confined spaces include hazardous atmospheres, material(s) that could asphyxiate personnel, and mechanical hazards (e.g. moving machinery parts).

All areas that are considered to be permit-required confined spaces shall be posted. All confined space entries shall meet the requirements of Document 18.7, “Working in Confined Spaces,” of the *ES&H Manual*.

Retention tanks are the most common example of permit-required confined spaces in 360 complex.

5.4.2 Safety Interlocks Systems

Mechanical and electrical interlocks reduce the chance of a serious exposure by preventing access to the hazardous area or material. Interlocks may be found on equipment panels, doors into rooms, and on power supplies.

Interlocks must never be bypassed or tampered with, except under very specific conditions approved by the area Industrial Safety Engineer, and/or the area Health Physicist. An IWS is required for all interlock bypass activities.

Electrical interlocks shall be checked for proper operation after each installation or modification and semiannually thereafter. Conditions found during the

inspection shall be noted in the equipment log or other record (e.g., Interlock Check Sheet).

5.4.3 Signs and Labeling

Warning signs are placed in a manner that is clearly visible to students, workers, visitors, and contractors. All posted HHC signs shall be strictly adhered to.

The Health Hazard Communication (HHC) signs are posted outside the doors of every laboratory, hazardous area, and on the entrances to the smaller buildings. These signs indicate the specific hazard information and instructions to be followed within a room.

Areas where radioactive materials are used or stored shall have a trefoil symbol on the HC sign and shall be posted, at a minimum, as "Radioactive Materials Areas."

In areas where biohazards are present, in addition to a biohazard symbol on the HHC sign, separate biohazard signs bearing the biohazard symbol shall be placed as a warning at the entry of each Biosafety Level 2 (BSL2) room where biohazardous materials of Risk Group (RG) 2 or 3 are handled or stored. The sign shall indicate the biohazard(s) present, the person(s) responsible for the work, and any restrictions on access to the room. See Document 13.1 and Document 13.6 for more information regarding signs and labels.

Additional signage, specific to activities, may be posted as appropriate (e.g., "High Noise Area").

The use of signs and warning devices shall be consistent with Document 12.1, "Access Control, Safety Signs, Safety Interlocks, and Alarm Systems," in the *ES&H Manual.*

5.4.4 Seismic Controls

To reduce the risk of personal injury, property damage, and programmatic interruption resulting from earthquakes, CMLS Program management, with assistance from Plant Engineering and Hazards Control, has the responsibility of ensuring that all equipment is properly secured or in a location that does not pose risk. All objects and materials shall be properly secured or stored according to Document 22.4, "Earthquakes," in the *ES&H Manual*.

5.4.5 Working Alone/After Normal Working Hours Hazards and Controls

Personnel may be required to work alone during normal working hours, after normal working hours (i.e., after 6 p.m.), or on weekends. During such work, the possibility exists for an accident or personal injury that may preclude self-rescue. It is the responsibility of all Laboratory personnel to perform work safely and to be accountable for their own safety.

5.4.5.1 Working Alone/After Hours Controls

Operations should not be performed that might render an individual incapable of self-rescue, without being in contact with another person by voice or other equally effective means.

Prior to working alone during the normal working hours, employees shall ensure that the RRP or designee is aware of the work to be performed. Employees shall work responsibly, recognizing and avoiding potential hazards and ensuring a "companion" is available for notification of problems.

Prior to working alone after normal working hours, personnel shall contact the FPOC for access and then notify Emergency Dispatch at Ext. 2-7595 to indicate the location and duration of the work they will be performing. The Off-Shift H&S Technician will then be notified by Emergency Dispatch to periodically check on personnel working alone. At the completion of work, prior to leaving the facility, personnel working alone shall notify Emergency Dispatch at Ext. 2-7595.

5.4.6 Unattended Activities

Unattended activities (e.g., overnight culture growth in the BSCs and/or overnight incubation). Controls will be addressed in appropriate safety documentation (e.g., IWS, IWS/SP, IBC, etc.).

5.4.7 Food Consumption Policies

There shall be no eating, drinking, smoking, applying cosmetics, or storing food in the Laboratories or any common areas where biological, chemical, or radioactive material hazards exist.

5.4.8 Housekeeping

Good housekeeping is important to protect workers from occupational hazards in the laboratory. All means of egress, as required in Document 22.0, “Emergencies/Earthquakes/Fires” in the *ES&H Manual,* shall be clear of storage, obstructions, equipment and debris that cause an unsafe condition to exist. Items large enough to fully or partially block egress pathways shall be secured to prevent the item from falling into the pathway.

All aisles and hallways must be kept clear. Access to emergency equipment and exits shall be clear and unobstructed.

Biosafety cabinets and chemical fume hoods shall not be used for long-term storage of materials, waste, or equipment merely as a matter of convenience. Separate storage areas shall be used to store equipment and materials in daily use.

5.4.9 Personal Hygiene

Personal hygiene is an important factor in reducing or minimizing exposure. Workers should change outer gloves whenever they come in contact with hazardous, dispersible, radioactive, or infectious materials. Hands should be washed with soap and water after removing disposable gloves, before leaving the work area.

5.4.10 Personal Protection Equipment (PPE)

Identifying and understanding a workplace hazard and then matching the needed PPE to the hazard is the key to selecting effective and appropriate protection. PPE is to be used only as supplemental protection if there is still a risk of exposure after engineering and work practice controls are implemented. Workers will use the appropriate PPE whenever there is potential exposure to occupational hazards.

Personal protective equipment (e.g., gloves appropriate for the hazard, gowns, face shields, mask, protective eyewear) is supplied to the workers when necessary. The practice of wearing appropriate PPE while working in the lab shall be followed to minimize exposure.

Safety glasses with side shields provide protection from laboratory eye hazards (e.g., acids, bases, chemical carcinogens, and possible glassware breakage, penetrating radiation) and shall be worn when performing any work in the laboratory when impact or splash hazards exist. Goggles and/or face shields may be worn to achieve greater eye protection. A face shield shall be worn to protect from splash hazards. It is also important to ensure that visitors in laboratories are provided with the temporary safety glasses provided in corridor boxes whenever hazards to eyes exist.

Disposable gloves shall be worn at all times when handling hazardous and/or biological materials and shall be removed upon task completion. Gloves shall be replaced whenever torn, and replaced with increased frequency whenever research activities cause glove fatigue. Recommendations will be detailed in the appropriate safety documentation (e.g. IWS, IWS/SP, HAC). Latex glove users should be aware of the potential for latex allergies. Gloves are not to be worn in non-laboratory areas. Anyone experiencing allergic reactions to latex should report to Health Services. Consult the area Industrial Hygienist for appropriate alternative glove selection.

Laboratory coats are required to minimize exposure and protect the skin and street clothes from contamination. Laboratory coats will be worn when performing chemical, biological, or radioactive work in the laboratory. Laboratory coats are not to be worn in non-laboratory areas.

In order to protect skin from exposure to hazardous materials, if skin on the legs is exposed (e.g., shorts), laboratory coats must be sufficiently long as to cover any exposed skin below the knee.

Closed-toed shoes shall be worn to protect the feet from common laboratory hazards, (e.g., acids, bases, solvents, broken glass, etc.). Wearing sandals or open-toed shoes in the laboratory is prohibited. In some operations where an impact hazard exists, safety shoes may be indicated. Contact the area Industrial Safety Engineer or the ES&H Team for additional information on safety shoes.

When working around rotating machinery, workers shall not wear loose clothing (including ties) and long hair shall be confined. Jewelry shall not be worn around rotating machinery or electrical hazards.

Respiratory protection, including nuisance dust masks, are not recommended and are unnecessary when engineering controls (e.g., biological safety cabinets or chemical fume hoods) are used. Contact the area Industrial Hygienist for a hazard assessment prior to using respiratory protection.

For any questions regarding selection and/or use of PPE, please contact the area Industrial Hygienist.

5.4.11 Vacuum Systems

The aspiration of tissue culture media from monolayer cultures or of supernatants from centrifuge samples into primary collection flasks are common laboratory procedures. Protection should be provided against drawing aerosols of hazardous and/or radioactive chemicals, biological materials, or overflow fluids into the house vacuum system. This protection is provided by the use of an air filter in the line immediately leading into the house vacuum line and an overflow flask for liquids between the collection flask and the air filter. For more information regarding the assembly of this device, see FSP 360.1, "Biohazardous Operations."

5.5 Hazardous and Biological Materials Controls

5.5.1 Biological Material Hazards and Controls

Biological materials are handled throughout the Building 360 Complex. Biological materials include, but are not limited to, human body substances, animals and animal tissues, biohazardous agents, and/or biohazardous materials.

Specific biohazardous agents or biohazardous materials and wastes are discussed in FSP 360.1, "Biohazardous Operations."

5.5.2 Animal Handling Hazards and Controls

The importance of handling animals in the correct manner cannot be overstated. Improper handling may result in injury to the animal, to the technician (e.g., bites, scratches, etc.), or most important of all, to the animal-human relationship. The Animal Care Facility (ACF) Staff are trained and experienced to correctly handle all commonly used laboratory animals. If bitten or scratched by an animal, the ACF worker must immediately notify the ACF Supervisor, their supervisor, or the area H&S Technician.

Animals pose special biohazards. They present the risk of bites and scratches. Because the animals to be used in the Building 360 Complex are purpose-bred for the laboratory and will pass through quarantine before being delivered to the facility, they pose very little risk of infectious (zoonotic) agent transmission to handlers. However, when experimentally infected, they pose an infection transmission risk during handling and observation. For this reason, and to protect their general health, they shall be housed in a fully enclosed, independently-ventilated caging system.

Animals may be exposed to hazardous materials by various means such as a collision nebulizer for creating aerosolized particles, injection by needle, topical application, or agents added to food or water. A hazard to personnel could be created if the equipment is used improperly or equipment and/or PPE failure occurs.

5.5.2.1 Animal Controls

- Ventilated Caging Systems

All animals will be housed in locked, ventilated caging systems. Cages will be labeled as to the type of hazard present, amount and route of exposure, and the date of administration. Signs posted outside of the door will indicate the hazardous agents present in the room.

The ventilated caging systems are inspected, tested, and certified biannually. Certification shall be posted on the cage unit and verified by the BSO and the ES&H Team or their delegate during routine walkthroughs.

- Animal Handling

All personnel working with the animals will be competent and trained to work with the animals. When appropriate, protective gloves will be worn and/or animals may be restrained in a restraint device for manipulations. If bitten or scratched by an animal, the ACF worker must notify immediately the Room Responsible Person, his/her supervisor, the FM, and Health Services. A protocol for the experimental use of live vertebrates must be approved by the LLNL IACUC. Acquisition of animals at LLNL is controlled through the ACF Supervisor.

- Biosafety Cabinet (BSC)

The animal care laboratory is equipped with a Class II, Type A2 BSC used to contain potential aerosolization from work activities (e.g., cage changing, nebulizing, etc.).

The collision nebulizer shall be used in a BSC and chemically disinfected in-place after each use.

- PPE

Refer to the PPE section above.

5.5.3 Chemical Hazards and Controls

General operations in the Building 360 Complex involving the use, storage, and disposal of chemicals present a variety of hazards. Such hazards exist due to the unique toxic, pyrophoric, radioactive, carcinogenic, and physical nature of each chemical, by itself or in combination with other chemicals.

All 360 complex Facilities are operated within "Light Science and Industry" thresholds for chemicals. As such, chemical inventories are subject to the limits identified in Document 3.2, "Safety Basis Thresholds," in the *ES&H Manual*. Exceeding these limits would violate the Facility Authorization Basis and could lead to a complete shut-down of operations in that facility.

Toxic Materials

Toxic materials include, but are not limited to, carcinogens, reproductive toxins, chemical biotoxins (i.e., Clostridium botulinum toxin), mutagens, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes.

Reactive Materials

Reactive materials that react with water and/or other materials may cause damage to equipment or personnel.

Solvents

Solvents (e.g., amyl alcohol, ethanol, isopropanol, methanol, or chloroform) are used. Many are flammable liquids and have flashpoints less than room temperature. Exposure to high airborne concentrations of these materials may cause headache, light-headedness, drowsiness, and eye and nose irritation. Prolonged skin contact can produce dermatitis. Methanol can also be absorbed through the intact skin. During normal usage, exposure by inhalation, dermal contact, and skin absorption should not be a significant concern.

Anesthesia

Anesthesia may be administered to animals prior to and during any procedures. Anesthetics are drugs or agents that are used to abolish the sensation of pain. One anesthetic used is isofluorane, which is a halogenated hydrocarbon that is a clear, colorless, volatile liquid at ordinary temperature and pressure. It has a mild, ether-like odor. Routes of exposure are dermal, inhalation, and eye contact. Signs and symptoms include nausea, vomiting, skin irritation, nose/throat/respiratory irritation, eye redness/pain, headache, dizziness, and drowsiness.

Although isofluorane is non-flammable, a fire can cause it to decompose to toxic and corrosive compounds, which include hydrogen chloride, hydrogen bromide and hydrogen fluoride.

Asphyxiants

Gases used in 360 complex (e.g., nitrogen and CO_2) are regarded as simple asphyxiants. Simple asphyxiants are gases that have negligible toxic effects, but can displace air, thus depriving the individual of oxygen. This can result in unconsciousness and death.

5.5.3.1 Chemical Controls

General

- Each room within B360 Complex are designated as either Chemical Hygiene Plan or Health Hazard Communication Plan in accordance with ES&H Manual Document 14.2 "LLNL Chemical Hygiene Plan for Laboratories" and Document 10.2 "LLNL Health Hazard Communication Program". The HHC sign and other hazard notice signs are posted outside each work area with the appropriate designation. Contact the area Industrial Hygienist for questions regarding the appropriate designation.

- In accordance with Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories," in the *ES&H Manual,* the Program Manager, Project Leader, or Principal Investigator is responsible for identifying and developing safety procedures, including SPs, to be followed during performance of each experimental task.

- Chemical reactions should be carried out in hoods devoid of combustibles. Ignition of finely divided powders in air (by an ignition source or by spontaneous combustion) is frequently overlooked as a fire and heat hazard.

- Handling, use, and storage of hazardous materials will be in accordance with the Document 14.1, "LLNL Chemical Safety Management Program," and Document 22.5, "Fire," in the *ES&H Manual*. Supervisors and RIs shall communicate hazards to employees per Document 10.2, "LLNL Health Hazard Communication Program," in the *ES&H Manual*. Employees must understand the hazards of the materials they use; therefore, MSDSs shall be made available to employees for review.

- Flammable and combustible liquids that require heating above their flashpoints shall be heated in a standard laboratory fume hood and attended at all times, with the ventilation system running. Work with flammable and combustibles shall not be performed in a biosafety cabinet. Provisions shall be made to contain liquid that might be accidentally released from glass apparatus containing more than 0.25 L (8.4 oz) of flammable liquid or combustible liquid heated to its flash point.

- ANSI-approved emergency eyewashes and safety showers shall be located in areas where an eye/skin splash hazard exists from irritating or corrosive materials. These shall be installed in accordance with the requirements of Document 14.1, Appendix B and located within an unobstructed 10-second travel distance from the site where material handling occurs. In-service eyewashes shall be flushed weekly and in-service safety showers tested monthly

to ensure proper operation and to purge the system. Program personnel shall ensure eyewash/showers are properly flushed.

Toxic Materials

- Chemicals should be used as outlined in Document 14.0, "Chemicals," in the *ES&H Manual*. Adequate ventilation, as defined in Document 12.2, "Ventilation," in the *ES&H Manual* must be provided for control of toxic dust, fumes, mist, gases, and vapors that may be generated from work operations. Worker protective clothing, as prescribed in accordance with Document 11.1, "Personnel Protective Equipment," in the *ES&H Manual* and in the appropriate section dealing with PPE of this FSP, shall be worn by all worker handling toxic materials. Application of safe work practices apply to the handling of chemicals as reagents and as waste. For more information regarding waste handling procedures, consult the area RHWM Technician or refer to the information provided in Documents 36.1, "Hazardous, Radioactive, and Biological Waste Management Requirements" and 36.3, "Management of Satellite and Waste Accumulation Areas for Hazardous and Mixed Waste" of the ES&H Manual, and online from course, EP0006-HAZ, "Hazardous Waste Generation and Certification Module."

- Acids and bases should be used as outlined in Document 14.0, "Chemical," in the *ES&H Manual*. Eyewashes may be required when handling corrosive materials. The RI shall ensure that the eyewash is tested weekly (to ensure proper operation) and that testing of the eyewash is documented. Consult the area Industrial Hygienist for further guidance.

- Solvents should be purchased and used in quantities as small as practical. A solvents review form must accompany each purchase order. Work with solvents should be done in Class I chemical fume hoods. Contact the area Industrial Hygienist for proper glove selection.

- Flammable liquids, including wastes, shall be used and stored in approved quantities and appropriate containers as defined in Document 22.5, "Fire," in the *ES&H Manual*. Questions should be directed to area Fire Protection Engineer.

- Flammable solids shall be used and stored in approved quantities and appropriate containers as defined in Document 14.7, "Safe Handling of Alkali Metals and their Reactive Compounds."

- Regulated materials shall require approval from the appropriate institutional committees. Consult the area Industrial Hygienist for further guidance.

Reactive Materials

- Water-reactive materials shall be kept in sealed containers away from water sources.

Solvents

- Care should be taken to limit skin contact with solvents. The RRP shall contact the ES&H Team Industrial Hygienist for an evaluation if the use of solvents is increased or changed in a manner that may increase the potential for personnel exposures.

Anesthetics

- All anesthetics shall be administered using adequate, authorized methods. If any chemical contact occurs, the exposed area shall be flushed with water and PPE changed out.

- Any new proposed anesthetics shall be reviewed by the Industrial Hygienist prior to purchase and use.

Asphyxiants

- Atmospheres containing less than 19.5% O_2 must be treated as oxygen-deficient atmospheres.

Further information regarding the hazards of the materials described above can be obtained by reviewing the Material Safety Data Sheets (MSDSs). MSDSs can be obtained from the internal LLNL website http://chemtrack.llnl.gov. If an MSDS cannot be found, or if help is needed in using the database, contact the ChemTrack Hotline at Ext. 4-4404.

5.5.4 Ionizing Radiation

Radiation Sources at the CMLS 360 Complex

Unencapsulated Radionuclides

The unencapsulated radionuclides used in the 360 complex are chemical compounds incorporating phosphorus-32 (P-32), phosphorus-33 (P-33), carbon-14, (C-14), tritium (H-3), and sulfur-35 (S-35). They represent primarily internal radiation hazards. Phosphorus-32 (P-32) may also present a significant external radiation hazard due to energetic beta emissions and bremsstrahlung potential. Use of other radionuclides requires the approval by the Facility Manager and the Team Health Physicist.

Sealed Radioactive Sources

Sealed radioactive sources are radioactive materials sealed in a metal container, embedded in plastic or ceramic, or fused on the surface of a metal planchet, and are not easily dispersed under normal use. These sources are typically used to calibrate or response check radiation detection instrumentation. The 360 complex usually has sealed sources which do not present an internal or contamination hazard if not damaged. However, they may pose an external radiation hazard.

Cesium-137 Irradiator: B364 houses a Mark I Irradiator that contains a Class IV sealed Cs-137 source and is capable of irradiating small objects with gamma radiation within a shielded interlocked enclosure. Significant radiation exposure is not expected to workers operating the device under normal operations.

Significant radiation exposure could occur in the event of an interlock malfunction or failure. The maximum unshielded dose rate at 1 meter is over 1,000 rem/hr. Exposure to the unshielded source at 1 meter could result in exceeding the allowable limit of 5 rem/year committed effective dose equivalent in only seconds. The radiation level at one meter from the exterior of the irradiator, under normal operating conditions, is less than or equal to 0.2 mR/hr. Mechanical injury to fingers/hands can occur if the door of the unit (1,200 lbs.) is closed improperly.

Radiation-Generating Devices (RGDs)

There are currently no RGDs in the possession of 360 complex. Prior to acquiring an RGD from any source, the Team HP shall be notified and this FSP amended as necessary. All the requirements of Document 20.3, "LLNL Radiological Safety Program for Radiation-Generating Devices" of the *ES&H Manual* shall be followed.

Radioactive Materials and Radiation-Generating Device (RGD) Controls

- Times-Distance-Shielding: The hazards associated with working with or around radioactive materials and radiation-generating devices vary depending upon on the type of radiation used, the length of exposure time, the distance from the radioactive source, the type of shielding utilized, and whether any radioactive material has entered the body through ingestion, inhalation, or absorption. The external radiation exposure can be minimized by increasing the distance from the source, by reducing the time spent being close to the source, and by use of shielding.

- New Operations: Prior to beginning any new operation involving radioactive material or waste, contact the Team Health Physicist to assess the radiation or activity levels and work environment.

- Worker Dosimetry: External dosimetry (badge dosimeters, and in some cases, finger rings) is required for workers handling radioactive materials, working with the Irradiator, and as specified by the Team Health Physicist. Lead Experimenters and RIs shall notify the area H&S Technician when a new worker is added to their staff or when a worker leaves their staff so an appropriate dosimetry can be provided. Dosimeters shall be exchanged at a frequency specified by Team Health Physicist. Finger ring/extremity dosimeters shall be worn when handling P-32 and as otherwise specified by the Team Health Physicist. Workers who lose, damage, or misplace their Thermo Luminescent Dosimeter (TLD) badge or finger rings shall notify the area H&S Technician as soon as possible; these personnel shall not work with radioactive materials or RGDs until their dosimeters are replaced. Additional information about the external dosimetry program can be found in Document 20.1, "Occupational Radiation Protection," and Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials," in the *ES&H Manual*. Additional information on ALARA can be found in Document 20.4, "LLNL Occupational Radiation Protection ALARA Program," in the *ES&H Manual*.

- Work Area Review: Radioactive material work areas must be reviewed by the Team Health Physicist and authorized by an IWS as specified in this FSP. Operations shall be conducted in such a manner as to minimize worker exposure to ALARA (As Low as Reasonably Achievable). Newly designated radiological work areas will be reviewed by the Team Health Physicist prior to beginning radiological work.

- Acquisition of Radioactive Material: Hazards Control (RPP SME) shall approve the acquisition of radioactive material whether purchased, borrowed, or provided by others. Requirements and prohibitions for the acquisition of radioactive material are detailed in Document 20.2 of the ES&H Manual.

- Receipt of Radioactive Material: Shipping containers and packing material must be checked for radioactive contamination by the Room Responsible Individual upon receiving all radioactive material. If contamination is detected greater than 10 times background on the *inside* of the shipping box or *outside* of the primary vial, immediately notify the area H&S Technician. Additional information about receiving radioactive material can be found in Document 20.2.

- Transportation of Radioactive Material: Radioactive material may be moved within a single building from one controlled area to another by a radiological worker provided the item is contained or packaged to prevent spills if dropped, there is no detectable contamination on the outside of the package, and the item is properly labeled. Radiological workers may move radioactive material between buildings in the 360 complex provided all the criteria above are met, and the package contains less than Class III limits given in Appendix E of Document 20.2. Materials Management and the H&S Technician must move material above this limit. Materials Management shall accomplish all offsite transportation of radioactive materials. Additional information about radioactive material movement and transportation can be found in Document 20.2.

- De-Posting Radioactive Materials Areas (RMAs), Contamination Areas (CAs), Radiological Buffer Areas (RBAs), and Radioactive Material Management Areas (RMMAs): RMAs, CAs, RBAs, and RMMAs may be down posted with the concurrence of the Team Health Physicist. The Team Health Physicist will specify survey requirements. Only the Team Health Physicist or H&S Technician is authorized to remove these signs.

Unencapsulated Radionuclides

- Facilities: Operations involving radioactive material must be performed in facilities/areas designed to minimize both worker exposure and the probability of releasing radioactivity into uncontrolled areas. Procedures that may release volatile radioactive materials or that could result in aerosols shall be conducted inside a chemical fume hood. Detailed criteria for radiological workplaces are given in Document 20.2.

• Material Amounts: The area H&S Technician maintains a radioactive material receipt log of radioisotopes received at 360 complex. The maximum amount at any one time (corrected for decay) in any CMLS facility shall not exceed the amounts listed in the table below. Room Responsible Individuals should minimize the amount of material handled at any one time. This reduces the consequences of a spill and reduces radiation exposure. Room Responsible Individuals shall maintain an inventory of the amount of radioisotopes under their control.

Radionuclide	Maximum Allowed
^{32}P	50 mCi
^{33}P	50 mCi
^{14}C	50 mCi
^{35}S	50 mCi
^{3}H	500 mCi

• Shielding: Shielding is required for work with P-32. Use ~1 cm thick Plexiglas shielding to reduce exposure to the worker while handling P-32. Also use shielded pipettes and syringes while dispensing P-32, and use plastic fixtures to hold stock source materials/solutions to reduce hand exposures. Use Plexiglas shielding to reduce radiation fields emanating from P-32 waste containers. Wear glass or plastic safety glasses to shield the eyes from P-32 radiation. *Do not use lead for shielding P-32. Beta radiation striking a heavy metal, such as lead, will produce Bremsstrahlung X-rays that can increase the dose to the worker.* Shielding is not required for work with P-33, S-35, C-14 or H-3.

• Personal Protective Equipment: Disposable gloves shall be worn at all times when handling unencapsulated radioactive materials or contaminated equipment. Safety glasses to protect the lens of the eyes from beta radiation shall also be worn when handling P-32. Lab coats and disposable gloves shall not be worn into non-laboratory areas such as cafeterias, conference rooms or offices. Liquid impervious shoe covers and face shields will be worn if splashes of radioactive liquids are likely. Closed-toed and closed-heeled shoes shall also be worn when handling all unencapsulated radioactive materials.

Workplace Contamination Surveillance Controls

• Surface contamination: Surface contamination surveys using a GM survey meter (for all radionuclides except H-3) and swipe tests are performed monthly and as needed by the area H&S Technician in areas where radioactive materials in dispersible forms are handled or stored. When working with dispersible forms of radioactive materials (except H-3), workers shall periodically survey their work area (e.g., benchtops and equipment used) and themselves (hands, arms, lab coats, shoes) with a GM survey meter. Upon completion of work with dispersible radioactive material (except H-3), a work area survey (including benchtop areas immediately outside the rad work area, and the floor) and a

whole body survey are required. See Appendix A for procedures on how to handle contamination or a spill.

• Internal Dosimetry: Bioassay samples may be necessary to assess radioisotope uptakes following spills or other incidents/accidents involving radioactive materials, or from routine handling of large activities of dispersible forms of radioactive materials. Individuals who handle a total of 5 mCi or more of dispersible radioactive material over a two week period will be requested to submit bioassay samples within one week of the handling activities. The Team Health Physicist may specify other times when workers are required to submit bioassay samples. Additional information about the internal dosimetry program can be found in Document 20.1 and the LLNL Internal Dosimetry Program Manual.

Sealed Radioactive Sources Controls

• Identification and Responsibilities: Each radioactive source or its container must have an attached identification tag indicating the radionuclide, the amount of radioactivity as of a specific date, hazard classification (I-IV), source number, and the person to whom it is assigned. Class IV sources must also have a metal identification tag firmly attached to the container, which lists all of the above information except the person to whom it is assigned. These tags are provided by Materials Management. Each sealed radioactive source is assigned to an individual who remains responsible for its proper handling, use, and storage until it is reassigned. Any alteration of sealed sources requires prior review by the Team HP. Portable radiation detecting instruments shall be used to minimize exposure to worker. Class I and II sources may be moved by Radiological Workers between controlled areas onsite. Class III and IV sealed sources must be moved by Materials Management personnel. Additional information about the classification and movement of radioactive material can be found in Document 20.2.

• Inventory and Leak Testing: Semiannually, source custodians, assisted by Hazards Control, shall conduct a leak test of each Class II, III, and IV sealed radioactive source. During the intervening quarters, a Materials Management representative, accompanied by the responsible source custodians, conducts an inventory of all Class II, III, and IV sealed radioactive sources. Lost or misplaced sealed sources must be promptly reported to the CMLS Assurance Manager and area H&S Technician. Notify the area H&S Technician and Materials Management whenever the assigned location of the source is changed. When not in use, Class IV sources must be stored in a locked, fire resistant compartment. Additional information about the inventory and leak testing of sealed radioactive material can be found in Document 20.2.

• Cesium 137 Irradiator: The Cesium-137 Irradiator has the following requirements unique to that device:

Access: Access to the unit shall be approved in writing by the primary RI and posted on the Irradiator room door. A list of qualified users is maintained by

the room responsible person and the Health and Safety (H&S) Tech. Only qualified users will be given access to the room.

Certification: See Section 5.1.1 OSR Admin Control.

Dosimetry: Operators shall be on a monthly TLD exchange cycle.

Instruments: Portable radiation detecting instruments including a Geiger-Mueller detector and ionization chamber shall be available in the irradiator room at all times. In addition, an alarming radiation area monitor shall be permanently mounted in the room.

Leak-Testing: Semiannually, the source custodian, assisted by the area H&S Technician, shall perform a leak test of the Cs-137 sealed source within the irradiator using the leak test procedure for the irradiator source.

Operators: Authorized operators shall be approved in writing by the primary RI after Radiation Worker training, and demonstrating individually that they can safely operate the irradiator and utilize the available radiation detecting instruments.

Procedures: Normal operating procedures including a lead test procedure shall be reviewed by the Team Health Physicist and approved by the ES&H Team Leader. Procedures shall be posted inside the room near the entrance.

Safety Checks: A complete check of the interlock system shall be performed and documented at least quarterly, in the presence of the area H&S Technician.

5.5.5 Cryogenic Materials Hazards and Controls

The Building 360 Complex has a liquid nitrogen system and equipment apparatus that use liquid nitrogen, presenting the normal hazards in storage and handling of cryogens. Exposure of tissue to cryogens can result in tissue destruction. Boil-off of cryogenic gases in an enclosed area can result in an oxygen-deficient atmosphere, resulting in asphyxiation. Excessive noise may be generated during the filling or venting of the liquid nitrogen storage and delivery systems.

5.5.5.1 Cryogenic Material Controls

Dewars and process vessels shall be labeled with the common name of the cryogenic liquid.

The minimum PPE required when working with cryogens is safety glasses with side shields and insulated utility gloves. When pouring cryogens or when the fluid in open containers may bubble, and when operating piping valves, a face shield is recommended. Loose insulating gloves (such as gauntlet style leather welding gloves) that can be readily tossed off in case they become soaked, shall be worn. Cryogen handlers shall also wear closed-top shoes, long-sleeved shirts, and full-length cuffless trousers.

In the event of skin exposure to freezing temperatures, report promptly to the Health Services Department for medical attention.

Noise exposure and control shall be in conformance with Document 18.6, "Hearing Conservation," of the *ES&H Manual*. Workers are individually responsible to stay away from the operation or to wear adequate hearing protection. In cases where excessive noise results in a significant increase in hazard of another operation, the risk of that operation will be reassessed and appropriate controls will be implemented to mitigate the risk.

In cases where an oxygen-deficient environment (e.g., confined space) may exist, oxygen deficiency alarms may be required. Assessment of each situation will be evaluated on a case-by-case basis.

For additional information regarding cryogen use, please contact the area Industrial Hygienist or refer to Document 18.5, "Cryogens," of the *ES&H Manual.*

5.5.6 Transportation Hazards and Controls

Biological and chemical materials shall be transported in a manner that does not pose a threat of injury to personnel or damage to property. Transportation of such materials requires the use of both proper packaging and shipping. See the Ionizing Radiation section for transportation of radioactive materials.

Onsite transportation of biological materials is performed using labeled, leak-proof secondary containers. Hazardous and biohazardous materials, substances, and/or wastes, excluding analytical samples, may not be transported in bicycle baskets, lab coats, automobiles, or personal vehicles. Biological and hazardous materials may be transported in a government vehicle. Transportation of chemicals in excess of one gallon needs to be discussed with the Health and Safety (H&S) Technician. For more information on the transportation of chemical and biological materials, see Document 21.2, "Onsite Packaging and Transportation Safety Manual," in the *ES&H Manual*.

Offsite transportation of articles or substance that are likely to pose a significant risk to health, safety, property, or the environment shall comply with the applicable regulations of the Department of Transportation (DOT), International Civil Aviation Organization (ICAO), U.S. Department of Agriculture (USDA), and the Centers for Disease and Control (CDC). Offsite shipping of biological and chemical materials must be done in accordance with Document 21.1, "Acquisition, Receipt, Transportation, and Tracking of Hazardous Materials," in the *ES&H Manual*. For specific packaging and shipping procedures, contact either the LLNL Transportation Office or the Materials Management Department.

Note: Transportation of radioactive materials is addressed in Section 5.5.4.

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5.6 Facility Hazards and Controls

5.6.1 Pressure Hazards and Controls

High Pressure

Several systems in the Building 360 Complex operate at high pressure, resulting in a hazard due to possible sudden release of stored gas, liquid, or mechanical energy. Compressed gas cylinders, boilers, steam lines, hydraulic and pneumatic systems are present throughout the facility. The energy released upon failure or rapid de-pressurization of these systems may be imparted as fragments or particles, or as high-intensity sound. The consequences of this hazard may include projectile injury, hearing impairment, oxygen deficient environments, and fire that may cause serious injury or death.

Chemical Reactions

Common chemical operations throughout the Complex present possible high-pressure hazards due to abnormal chemical reactions resulting in rapid generation of gaseous products. This hazard is particularly serious if the reaction is confined in a closed system with glass.

Cryogenic Materials

The Building 360 Complex has a liquid nitrogen system and equipment apparatus that use liquid nitrogen, presenting the normal hazards in storage and handling of cryogens. Exposure of tissue to cryogens can result in tissue destruction. Boil-off of cryogenic gases in an enclosed area can result in an oxygen-deficient atmosphere, resulting in asphyxiation. Over-pressurization of vessels / systems may cause failure resulting in injury or death due to high pressure release of flying glass or other parts ("shrapnel").

Vacuum Systems

Vacuum systems may be used to provide a suitable atmosphere for thermal processing, chemical processing or leak testing. Hazards associated with vacuum systems include damage to the system or components due to reduced internal pressure, over-pressurized use of backfill gases or oil vapors from pump exhausts. Over-pressurization of vacuum vessels may cause failure, resulting in serious injury to personnel.

5.6.1.1 Pressure Controls

- Pressure operations shall be performed in conformance with Document 18.1, "Pressure," in the *ES&H Manual*. It is recommended that workers working with safety-note-exempt pressure systems complete HS5030, "Pressure Safety Orientation."

- Noise exposure and control shall be in conformance with Document 18.6, "Hearing Conservation," of the *ES&H Manual*. Excessive noise may be generated during the filling or venting of the liquid nitrogen storage and delivery systems. Workers are individually responsible to stay away from the operation or to wear adequate hearing protection. In cases where excessive noise results in a significant increase in hazard of another operation, the risk of that operation will be reassessed and appropriate controls will be implemented to mitigate the risk.

- In cases where an oxygen-deficient environment (e.g., confined space) may exist, oxygen deficiency alarms may be required. Assessment of each situation will be evaluated on a case-by-case basis.

- Excessive pressure generated by a planned or unplanned chemical reaction should be minimized by working with as small as practicable amounts of chemicals, using appropriate reaction vessels, and providing adequate venting or pressure relief means. Personal protective equipment such as a lab coat, gloves, full-face shield, and bench top shields will provide some protection against flying glass and chemicals.

Cryogenic Material

- The handling and use of cryogenic materials will be conducted in accordance with Document 18.5, "Cryogens," of the *ES&H Manual.* The minimum personal protection required is safety glasses with side shields and insulated utility gloves. When pouring cryogens or when the fluid in open containers may bubble, and when operating piping valves, a face shield is required. The use of loose insulating gloves that can be tossed off readily in case they become soaked with a cryogen is also required. Workers using cryogenic materials shall also complete HS5030-W or HS5031-W, "Pressure Safety Orientation," or "Pressure Safety Re-qualification," respectively.

Vacuum Systems

- Vacuum systems will be designed in accordance with Document 18.1, "Pressure," and Document 18.2, " Pressure Vessel and System Design," of the LLNL ES&H Manual. Only systems and components rated for vacuum service will be used in the construction of vacuum systems. Backfill of vacuum systems will generally be from air, but if inert gas sources are used, they will be equipped with a suitably sized and tested relief valve. Pumps operated under conditions that generate oil vapor will be equipped with an oil vapor trap or be vented outside.

5.6.2 Centrifuge Hazards and Controls

Centrifuges are a common piece of equipment. Improper use can result in serious personal injury and/or damage to property. Aerosolization of products in a centrifuge can occur when a bottle or tube leaks or ruptures.

5.6.2.1 Centrifuge Controls

- Workers using centrifuges should review LLNL Lessons Learned for centrifuge safety. Lessons Learned can be found at http://www-r.llnl.gov/es_and_h/lessons/lessons.shtml. Do not operate any centrifuge before thoroughly reading the manufacturer's operating manual. Never attempt to open the door of the centrifuge while it is still running.

- Centrifuges shall be equipped with a containment feature (e.g., a secondary gasket to seal the rotor or centrifuge lid, or safety cups and canisters that contain

a ruptured tube and/or specimen) to protect the laboratory atmosphere from the release of potentially infectious aerosolized materials.

- Centrifuges that have an anchoring system provided by the manufacturer shall be anchored according to the manufacturer's specifications. Centrifuges that do not have an anchoring system provided by the manufacturer need not be anchored, unless deemed necessary by the Team Industrial Safety Engineer, provided that they are marked as follows: "CAUTION – TO REDUCE THE RISK OF INJURY TO PERSONS, DO NOT OPERATE WITH AN UNBALANCED LOAD."

- The Team Industrial Safety Engineer should be consulted if a question exists with respect to anchoring centrifuges.

5.6.3 Heat Hazards and Controls

Common operations throughout the complex present possible heat source hazards that could result in injury or death, equipment failure, or facility fire.

Steam

Boilers and steam autoclaves are present in various rooms and buildings in the Building 360 Complex (also see High Pressure Hazards section).

Chemical

Common chemical operations throughout the complex present possible ignition sources and fuel for fires.

Flames

Open flames from sources such as Bunsen-type burners, acetylene torches for glass blowing or sealing may be found in various areas throughout the Building 360 Complex. In addition to the items above, various repair and modification work to building equipment and systems may require the use of open flames to conduct the work.

Cell Culture Transfers (Plating)

A common operation performed in any microbiological research facility is transferring cell cultures from one container to another. This activity is usually performed by using a wire loop that is sterilized in alcohol and dried in an open flame. The presence of an open container of alcohol near an open flame is a significant fire hazard and the controls listed below are required for this activity.

Heat-Producing Appliances and Hot Surfaces

Electric hot-plate-type heaters, electrically heated water baths, and items such as small ovens, furnaces and other heat-producing appliances may be used in various areas throughout the Building 360 Complex. Ignition of containers or equipment could occur if the liquid involved is allowed to evaporate or if there is prolonged exposure to high temperatures.

5.6.3.1 Heat Controls

General

- Personal protective clothing, to include laboratory coat and appropriate insulated gloves, shall be worn when handling hot equipment. Where practical, all readily accessible hot surfaces (e.g., pipes, valves and heat radiation surfaces) should be insulated. Uninsulated readily accessible hot surfaces shall be labeled wherever feasible. Typical off-the shelf labels and signs include: "DANGER – HOT SURFACE" and "DANGER - HOT - DO NOT TOUCH."

- Workers will be familiar with the location and operation of fire extinguishers appropriate for the nature of the fuel and oxidizer. Training in the capabilities and limitations of fire extinguishers is provided in HS1670-CBT, "Fire Extinguisher," course. *Only trained workers are permitted to use fire extinguishers*.

- Fire egress shall comply with Document 22.5, "Fire," in the *ES&H Manual.* A minimum width of 36" aisle ways are required in shops and labs and 44"clearance is required for hallways and corridors in most office areas. In certain existing cases, corridors previously approved may be permitted to continue to maintain minimum unobstructed widths of 28." For further information, contact the ES&H Team Fire Protection Engineer.

Steam

- The Plant Engineering Department provides routine and recurring service to the Building 360 Complex boiler, autoclaves, and safety devices. Building 360 Complex workers are not authorized to service, adjust, modify, or otherwise tamper with the boilers or autoclaves. Building 360 Complex workers involved with the use and operation of autoclaves shall operate in conformance to the CMLS Safety Operating Procedure, *"Autoclave Operations."*

Flames

- All Bunsen-type burner operations involving use of open flames (i.e., welding, cutting, etc.) by LLNL maintenance/service staff and outside vendors will require the use of the LLNL Hot Work Permit System (issued by the Fire Department) and shall be reviewed by the CMLS Assurance Office and the ES&H Team staff to determine the safety requirements.

Cell Culture Transfers (Plating)

- Use the smallest amount of alcohol possible to reduce the fuel load in the area;

- Keep a watch glass or similar cover available to snuff out a fire in the alcohol container;

- Always work in a well-ventilated area to keep fumes from building up;

- Keep all other combustibles away from the work area;

- Never leave either an open flame or an open container of alcohol alone; and

- If the alcohol container does catch fire, never attempt to move.

Heat-Producing Appliances and Hot Surfaces

- Many standard laboratory procedures require the heating of various liquids and the use of electric hot plates or heated baths to achieve proper temperatures. Areas that regularly conduct these operations are considered "Permitted Hot Work Areas." Non-combustible containers will be used to contain the liquid being heated. Sufficient liquid shall be put into the container and the level checked on a regular basis to prevent evaporation of the entire contents (unless required by the process). This process, as well as processes involving the use of small ovens, furnaces, and other heat-producing appliances, shall be equipped with an over-temperature shut-off device and alarm. If not so equipped, then the operation shall be monitored by use of a timer and regular checks during operation. The immediate area around these appliances shall be free of combustible material whenever the unit is operating.

Note: Replacement equipment shall be equipped with a timer and over-temperature shut-off device. In addition, liquid baths shall be equipped with a low-liquid-level monitoring device to shut down operation when a certain level is reached or to replenish the liquid in the bath.

5.6.4 Ergonomic Hazards and Controls

There exists a high potential for cumulative trauma disorder (CTD) injury in several operations in 360 complex as a result of repetitive motion. These areas include continuous work at the computer, pipetting, and microscopes. Symptoms of CTD injuries are manifested in aches, tingling, numbness, pain, and discomfort in the upper extremities (arms, wrists, hands, back, neck, and eyes). Disregarding these symptoms can result in long-term injury or disability.

Improper lifting techniques may result in personnel injury.

5.6.4.1 Ergonomic Controls

- There are many ways to reduce or prevent CTD injuries. Using ergonomically designed equipment (e.g., ergonomic pipetters) can reduce the risk of CTD injuries. Ergonomically designed furniture will help provide flexibility and induce proper posture. Most importantly, periodic breaks are necessary to allow the tendons and muscles to rest and recuperate from repetitive motion. Formal training is available; contact the area Industrial Safety Engineer for assistance with ergonomic evaluations. For further information, review Document 19.1, "LLNL Ergonomics Program," in the *ES&H Manual* or area Industrial Safety Engineer.

- Proper use of ergonomically-designed equipment will reduce the risk of CTD injuries (i.e., furniture designed and positioned to provide flexibility and induce proper posture). Ergonomic, electronic or mechanical pipettes shall be used when possible. The worker should also take periodic breaks to allow the tendons and muscles to rest and recuperate from repetitive motion. The ES&H

Team is also available to conduct individual ergonomic evaluations. More information on ergonomics can be found in Document 19.1, "LLNL Ergonomics Program," of the *ES&H Manual* or contact the area Industrial Safety Engineer.

- Workers shall employ proper lifting techniques (e.g., bending at the knees and keeping feet together) and avoid strain by lifting with the legs and arms rather than the back. Workers shall utilize mechanical lifting and/or handling equipment or use another individual to assist, as appropriate, whenever handling loads in excess of 30 lbs.

5.6.5 Sharps Hazards and Controls

Sharps are defined in Document 13.1, "Biological Controls and Operations (Appendix A)," in the *ES&H Manual*, as any object that can penetrate the skin including, but not limited to, needles, syringes (both with and without needles), scalpels, broken glass, glass slides, razors, broken capillary tubes, and exposed metal edges (e.g., dental wires) that can result in an exposure incident. The potential for self-inoculation and the generation of aerosols is very real. Sharps present a cutting or penetration hazard to workers working with them. Aerosols can be produced by forcing materials through a needle, withdrawing a needle from a vial sealed under pressure, or from cutting or shearing a needle.

Improper management of waste sharps can have an adverse impact on worker safety and the environment. (Refer to the Environmental section of this FSP for waste sharps controls.)

5.6.5.1 Sharps Controls

Intrinsically-safe needles or scalpels (e.g., syringes or scalpels that re-sheath or needle-less systems) should be used, when practicable.

Animals receiving intravenous (IV) injections shall be mechanically restrained or anesthetized so that the worker can have both hands free while making the injection. Protective gloves will be used for other types of injections to un-anesthetized rats.

Use of sharps (i.e., needles, scalpels) in the facility shall be limited to the extent practicable.

Broken glass shall not be touched by hand. All broken glass shall either be picked up with tongs or swept into a dustpan with a brush.

Used sharps, contaminated or not, must always be placed in a durable, leak-proof sharps container for disposal.

For more information, see Document 13.1 and Document 13.2.

5.6.6 Electrical Hazards and Controls

Apparatus throughout the building operate with hazardous voltages (up to 10,000 volts). Some, such as non-commercial apparatus, may not be Underwriter Laboratory certified and may have electrical safety features that can be defeated through direct intentions, carelessness, or neglect.

Depending on the path, duration, and magnitude of electrical current through the body, an electrical shock can cause cardiac arrest, burns, or involuntary muscular reaction potentially leading to injury or death. Any voltage greater than 50 V may cause dangerous current to pass through the body.

5.6.6.1 Electrical Controls

All work with electrical equipment shall comply with the provisions of Document 16.1, "Electrical Safety," Document 16.2, "Work and Design Controls for Electrical Equipment (Appendix A)," Document 16.3, "LLNL AHJ Requirements for Approving Electrical Equipment, Installations and Work, and Document 12.6, "LLNL Lockout/Tagout Program," in the *ES&H Manual*. Electrical equipment that does not have an OSHA-approved NRTL label or approval from an LLNL AHJ shall not be brought into 360 complex facilities.

All authorized workers shall be educated and trained in the area of electrical/high-voltage safety and the specific hazards of the facility before being allowed to work in the experimental facilities.

The RI shall ensure that, whenever possible, electrical equipment is totally de-energized prior to being worked on. Applicable shorting, grounding, and lockout/tagout procedures shall be followed. When deactivating Electrical Hazard Class 3 or Class 4 systems, two qualified workers plus general supervision are required until total de-energization is confirmed. If unable to totally de-energize equipment, appropriate controls, including procedures and PPE, shall be implemented. Contact the area Industrial Safety Engineer for guidance in establishing additional controls and/or procedures.

When absolutely necessary, qualified personnel may perform limited testing, troubleshooting, and inspection activities as defined, analyzed, and controlled in IWS/SP #12005, "Working On or Near Energized 50-600 Volts AC." Personnel are responsible for consulting with their technical supervisor and the RI before proceeding with any energized work activity other than IWS/SP #12005-limited testing, troubleshooting, and inspection. Energized work being performed under the auspices of IWS/SP #12005 requires completion of Appendix D (Permit for Work on Energized Electrical System or Equipment Rated 50-600 Volts AC) and Appendix E (On-the-Job Checklist) of the IWS.

Personnel working on electrical and electronic equipment shall have completed HS5220, *"Electrical Hazard Awareness."* Workers working with or around high-voltage and having access to energized components shall have completed HS5230*, "High-Voltage Safety."*

Design modifications to any electrical equipment which operates with voltages over 50 V and current over 5 mA shall not be made without authorization from an LLNL Authority Having Jurisdiction (AHJ).

Working space around electrical enclosures or equipment (e.g., panel boards, switches, circuit breakers and controllers) shall be adequate for all anticipated maintenance and operations, including safety of personnel under emergency

conditions and rescue of injured personnel. These clearances shall be in accordance with the National Electric Code Section 110-16 for 600 volts or less.

Temporary electrical installations shall be allowed during periods of remodeling, maintenance, and repair of equipment or structures. However, such temporary installations are not substitutes for permanent installations. Temporary electrical installations shall have a "NOTICE - Temporary Wiring" tag. Temporary wiring configurations shall be guarded, buried, or isolated to prevent accidental contact by workers or equipment.

Portable electric tools and equipment shall be inspected prior to use and every 3 months. Components such as cords and plugs shall be examined for signs of chaffing, cracking, wear or other forms of faulty insulation; evidence of faulty grounding conductor, cracked plug or receptacle housing; bent or missing plug or connector prongs; dead front plugs, receptacle, or connectors; and/or missing, bent or otherwise defective switches. While in use, tools and equipment shall be monitored for any signs of overheating or excessive sparking. Portable electric tools and equipment shall not be handled or suspended by their cords. Tools and equipment shall only be used for their intended purpose, and when guards or interlocks are required, such guards or interlocks shall be operational.

5.6.7 Ultraviolet (UV) Radiation

Ultraviolet radiation at a wavelength of 253.7 nanometers can be used for inactivating microorganisms. Its usefulness is limited by its low penetrating power. UV radiation is commonly used in conjunction with unoccupied clean rooms, and biological safety cabinets; however UV shall not be used as a primary means of disinfection. UV intensity should operate greater than 40 mWatts/cm^2. Eye and skin damage can result from exposure to direct or strongly reflected ultraviolet radiation. Examples of UV sources within the 360 Complex include germicidal lamps within the BSCs and portable UV lamps.

5.6.7.1 UV Radiation Controls

The most effective methods of controlling UV radiation are enclosing or shielding the UV source and covering walls and surfaces with UV-absorbent materials. Where this is not practical, such as with portable sources, personal protective equipment and other controls such as the following shall be used.

Only workers familiar with the potential hazards and control measures shall use the ultraviolet source equipment. Contact your supervisor or the Industrial Safety Engineer for training.

Operator protective measures include usage of UV-shielding, eye protection, gloves, and long-sleeved clothing at all times. When working with equipment which emits significant levels of UV-B (280-320 nm), a face shield with UV-shielding properties is strongly recommended.

The UV equipment shall be used in a designated area with limited access, which affords protection to passers-by.

UV-emitting equipment shall be clearly labeled as an ultraviolet source with "Caution" signs. Additional warnings or limitations shall also be posted, as appropriate.

Photosensitive individuals should not be assigned to work with UV-emitting equipment. Workers who regularly work with UV equipment should temporarily discontinue if they are on prescribed medication with photosensitive effects. In each case, the individual should check with Health Services before working with UV equipment. Workers should be alert to the effects of such medications and notify their supervisors of any need for change of work procedures.

The UV lamp within the BSCs will not operate unless the sashes are fully closed (i.e., interlock system is active). Exposure to personnel is minimal.

The duration of exposure to UV radiation should be limited to maintain exposure to within acceptable guidelines, as determined by Hazards Control.

5.6.8 Noise Hazards and Controls

A significant noise hazard may exist during filling or venting of the liquid nitrogen storage and delivery system, and during the release of compressed air and other gases. Noise hazards may also be located in boiler rooms, near the Building 364 cage washer, and at autoclaves throughout the 360 Complex, as well as while using a sonicator. The consequences of this hazard include the potential for temporary or permanent hearing loss. Another important consequence is the increase in risk in concurrent exposure to other hazards due to an inability to hear over the noise.

5.6.8.1 Noise Controls

Operations in the Mechanical Rooms and in research laboratories may produce excessive noise. The ES&H Team shall determine when the noise is excessive and ensure that safe stay times and/or personal hearing protection is provided to room occupants or is available when working in rooms for an extended period of time.

5.6.9 Heat Stress Hazards and Controls

"Warm Rooms" (i.e., rooms where the temperature/humidity levels are increased for experimental purposes) exist within the 360 complex. Dependent on room temperature and humidity, etc., heat stress could result. Heat stress symptoms include, but are not limited to, fatigue, nausea, and light-headedness.

5.6.9.1 Heat Stress Controls

If work for extended periods is required, the ES&H Team Industrial Hygienist shall evaluate work tasks for potential heat stress exposures and recommend appropriate controls. Additional precautions will be detailed in task-specific safety documentation (e.g. IWS/SP, SOPs, etc.) and may include work-rest schedule, hydration, etc.

5.7 Facility Modification

All facility modification work that is to be executed in the 360 Complex is to be planned and coordinated through the FM and the ES&H Team. Facility modifications are coordinated through the FM in conjunction with the FPOC. All work conducted by outside support organizations requires either an IWS or PWS.

5.8 Environmental Hazards and Controls

Work planning for new or existing operations should include consideration of possible environmental requirements and consequences, and ensure that there is a disposal option for all wastes generated. Early identification of these issues is essential to avoid regulatory noncompliance and expensive disruption of programmatic activities. Obtaining an approved permit from an environmental agency, for example, can require several months.

General environmental protection assistance can be obtained by contacting the EA. Names of proper contacts for environmental protection activities can be obtained from the EA, Health and Safety (H&S) Tech, FPOC, or the ES&H Team Leader.

5.8.1 Waste Handling

Medical (Biohazardous) Waste

California regulates biohazardous and sharps waste as medical waste under the Medical Waste Management Act.

Solid medical waste must be collected in double red autoclave bags labeled with the international "Biohazard" symbol, and stored in rigid, leak-proof containers labeled on all sides and the top with the international "Biohazard" symbol. Solid medical waste may be stored at room temperature up to 7 days after the first date waste is introduced into the bags, or for up to 90 days at or below 0^{o} C. Medical waste which has reached the accumulation time limit must be treated using an approved treatment method, which is generally autoclaving for bagged waste.

Liquid medical waste must be collected in rigid, leak- and puncture-proof containers capable of withstanding autoclaving, and labeled with the international "Biohazard" symbol. Liquid medical waste may be stored at room temperature up to 7 days after the first date waste is introduced into the container, or for up to 90 days at or below 0^{o} C. Liquid medical waste may be treated by bleach or autoclaving, depending on the contents. Specific guidance can be found in the IWS for the experiment, or by contacting the ES&H Team EA or the BSO.

Medical waste sharps must be collected in red sharps containers and labeled with the international "Biohazard" symbol. Medical waste sharps are collected indefinitely until the sharps container fill line is reached, at which point they may be stored at room temperature up to 7 days, or for up to 90 days at or below 0^{o} C.

Mixed Medical Waste

Mixed medical waste consists of medical waste contaminated with hazardous and/or radioactive constituents. Depending on the contents, mixed liquid medical waste may be treated by bleach, or by filtration, with the filter contents being autoclaved. Contact the EA for waste disposal guidance prior to generating any mixed medical waste.

Additional hazards and controls for medical waste are found in FSP 360.1, "Biohazardous Operations."

Non-Regulated Biological Waste

Other biological waste not containing biohazardous components is termed non-regulated biological (NRB) waste. Non-regulated biological waste is generally managed as biohazardous as a best management practice (BMP). This includes double bagging the solid waste in clear autoclave bags, collecting sharps in clear sharps containers with a non-hazardous sticker placed over the biohazard symbol, and treating the waste by autoclave as appropriate. For more information on management requirements for NRB waste, refer to Document 36.1, "Hazardous, Radioactive, and Biological Waste Management Requirements," of the *ES&H Manual.*

Hazardous, Mixed, Radioactive, and Non-Hazardous Wastes

Management of hazardous, mixed, radioactive waste, and non-hazardous are described in Document 36.1, and Document 36.3, "Management of Satellite and Waste Accumulation Areas for Hazardous and Mixed Waste," of the *ES&H Manual*. More detailed management requirements and guidance are provided in the course manuals for EP0006-HAZ, "Hazardous Waste Generation and Certification Module", and EP0006-RAD, "Radioactive Waste Generation and Certification Module" courses. The RHWM Field Technician (RHWMT) or EA can assist with waste characterization.

The RHWMT provides day-to-day waste management assistance. This includes waste characterization, providing labels and containers, waste sampling, waste packaging, removal of waste from the Satellite Accumulation Area (see below for more details) and preparation and retention of waste disposal requisitions and other records as provided for in Appendix D, "Radioactive and Hazardous Waste Management Technician Services," of Document 2.1, "General Worker Responsibilities and Integrated Safety Management," in the *ES&H Manual*.

Persons generating hazardous, radioactive or mixed waste shall be current in their required environmental protection training per their training plans.

Waste generators are responsible for providing adequate information on the identity and composition of waste that they prepare for disposal. Material Safety Data Sheets, process knowledge, or sample analysis can be useful in properly characterizing waste. Assistance on characterization can be obtained from the RHWMT or EA.

Satellite (Workplace) Accumulation Area (SAA)

Hazardous, non-hazardous, radioactive, or mixed waste shall be collected in SAAs that meet all of the following requirements as described in Document 36.3, “Management of Satellite Accumulation Areas” of the *ES&H Manual*:

- The SAA shall be located near the point of generation (i.e., within the same room the waste is generated) and be under the control of the waste generator.
- Waste containers shall be appropriately labeled with a "Hazardous Waste", “Non-Hazardous”, "Radioactive Waste" or “Mixed Waste” label as the first amount of waste is added to the container.
- Wastes must be collected in Radioactive and Hazardous Waste Management (RHWM)-approved containers compatible with waste contents and segregated according to type.
- Collection capacity is limited to 55 gallons of hazardous/mixed waste for each compatible waste stream and one quart or 1 kilogram of acutely or extremely hazardous/mixed waste.
- Empty containers which formerly held extremely or acutely hazardous materials must be managed as hazardous waste.
- Collection containers shall be kept closed except when adding or removing waste.
- Secondary containment should be provided when collecting liquid wastes.
- Hazardous and mixed waste can be collected in the SAA for nine months or until the aggregate quantity reaches 55 gallons (one quart or 1 kilogram for acutely or extremely hazardous waste), whichever occurs first. There are no time limits or volume restrictions on the collection of radioactive or non-hazardous waste; however it is good practice to remove them from the lab within one year of the accumulation start date.
- After the collection limit has been reached, waste containers shall be moved to an approved Waste Accumulation Area (WAA) by the RHWMT within three days.
- Waste being generated in a Radioactive Materials Management Area (RMMA) must be surveyed for exterior radioactive contamination by the area H&S Technician before the container can be removed.
- Incompatible wastes shall be properly segregated.
- Waste generators shall notify the RHWMT a week before waste containers become full or they reach their nine-month accumulation time limit so the waste can be removed in a timely manner.
- Transport of waste from the SAA to a WAA shall be done only by RHWM personnel.

Bedding, carcasses, and lab trash from animal experiments must be characterized by the ES&H Team Environmental Analyst on an experimental

animal test worksheet prior to the start of each animal experiment. In particular, use of PCBs in animals must be evaluated prior to start of work by an environmental analyst to ensure there is a disposal option for carcasses and any other PCB waste which might be generated. Certain wastes such as PCB and controlled substance wastes have unique storage, labeling, and management requirements. Please consult the EA for guidance on management of these wastes.

More information on management of hazardous, radioactive, and mixed wastes can be found in Document 36.1, Document 36.3, and Document 14.14 "Management of Polychlorinated Biphenyls "of the ES&H Manual.

Personnel performing operations that generate wastes shall minimize the types and volumes of waste produced. Generators of waste should consider source reduction and recycling alternatives in planning work activities. The Chemical Exchange Warehouse (CHEW) should be used as a resource before purchasing new chemicals or disposing of existing chemicals. Additional guidance can be found in Document 30.1 "Managing Environmental Aspects Through Pollution Prevention" of the ES&H Manual.

Waste Sharps

Improper management of waste sharps can have an adverse impact on worker safety and the environment.

- General

Waste sharps, whether they are contaminated or not, must always be placed in a durable, leak-proof sharps container for disposal. For more information, see Document 13.1, "Biological Controls and Operations," in the *ES&H Manual*. Acceptable sharps containers are available in the supply area of Building 361. These containers generally come with a “biohazard” label affixed. The “biohazard” label is required for biohazardous waste. For non-regulated biological waste, which is non-biohazardous, the label must be defaced or peeled off and destroyed prior to use. A non-hazardous label should be affixed to the container so long as no other hazardous or radioactive components are present in the container. The containers are available in red, white and clear. Red containers must be used for biohazardous sharps. Only the white or clear containers should be used for non-regulated biological waste sharps.

- Biohazardous or Non-Regulated Biological Waste Sharps

Waste sharps that are contaminated only with biohazardous material (there is no hazardous and/or radioactive contamination) shall be collected in a red, durable sharps with a biohazard label affixed. Such waste shall be decontaminated by treating in a permitted autoclave prior to being sent offsite for incineration and disposal. Other waste sharps, including waste sharps contaminated with non-

regulated biological material, are autoclaved and incinerated as a precaution and as a best management practice (BMP).

- Hazardous and/or Radioactive Waste Sharps

Waste sharps that are hazardous and/or radioactive must be managed through Radioactive and Hazardous Waste Management (RHWM) in a sharps container with an appropriate overpack (typically a five-gallon bucket). Use an appropriate waste label on the sharps container. The overpack must be labeled that it contains sharps.

- Multiple Hazard Waste Sharps

Waste sharps that contain hazardous and/or radioactive and biohazardous contamination cannot be autoclaved, but must be decontaminated through alternative means. Contact the BSO and the ES&H Team EA prior to generating multiple hazard waste sharps.

- Waste Personal Sharps

Waste personal sharps, such as hypodermic needles and syringes used for self medical treatment, must be collected in a durable container (e.g., lidded coffee can) while onsite, and disposed offsite (at home).

5.8.2 Air Emissions

All new operations or equipment that could potentially emit toxic air contaminants (e.g., solvents, metals, radionuclides, etc.) require a review by the EA prior to installation and startup of the operation or equipment to evaluate compliance with Federal Clean Air Act regulations and National Emission Standards for Hazardous Air Pollutants (NESHAPs), and to determine if a Bay Area Air Quality Management District (BAAQMD) exemption or permit is required. The process required to obtain permits for air pollution sources is described in Document 31.1, "Nonradiological Air Quality Compliance," Document 31.2, "Radiological Air Quality compliance," of the *ES&H Manual*. The air permitting process can be lengthy so several months lead-time should be allowed for planning any new activity requiring a permit. Contact the EA to initiate an air permit evaluation.

The Main Site BAAQMD wipe-cleaning permit issued to LLNL covers all volatile solvent wipe-cleaning operations. The purchase of any solvent that will be used for wipe cleaning operations must be documented by the TRR on the purchasing notification documentation when the solvent is purchased. The requestor of the solvent is responsible for telling the TRR if the solvent will be used for wipe cleaning. Solvents purchased through other sources need to be reported to EPD's Terrestrial and Atmospheric Monitoring and Modeling (TAMM) Group, as well as to the FPOC. Any continual solvent wipe cleaning operation that will use a large volume of solvents must be evaluated for a separate air permit. The use of alternative solvents, which do not require a permit, is recommended.

5.8.3 Spill Prevention and Sewer System Controls

Liquid waste shall be stored in appropriate containers with secondary containment, as a best management practice to prevent accidental spills. Waste shall not be stored above sinks or near drains to prevent accidental releases.

- The amount of hazardous material stored in labs should be limited to that required for immediate use to minimize the potential of a spill.
- Good housekeeping shall be practiced to minimize the possibility of material spills.
- Appropriate spill containment supplies shall be maintained in an accessible location.
- Accidental discharges of hazardous materials or waste to the retention tank system or the sanitary sewer must be reported to the ADFM, FPOC, Health and Safety (H&S) Technician, or EA immediately.

5.8.4 Wastewater Management

Wastewater Systems

The sanitary sewer system is intended for the discharge of non-hazardous wastewaters. Hazardous and other regulated wastes must be collected for disposal or treatment. Contact the EA for guidance on what can be discharged to the sanitary sewer.

The contaminated cage washing sink in Building 364, Room 1704 is routed to a waste retention system. Water in these tanks is processed in accordance with LLNL practices for WRT systems. All other drains in 360 complex facilities are routed directly to the sanitary sewer system.

Storm Water Effluent

Discharges to the storm drainage system and protection of storm water quality is subject to LLNL's National Pollutant Discharge Elimination System. Non-storm water discharges to ground or storm drain systems require a permit. There will be no discharges to the ground without prior approval from the FM and EPD. Process water releases, spills, or run-off from an emergency, that may discharge to the ground or storm drain must be contained and reported to the FPOC. The FPOC reports the discharge to the FM and to the EA. Contact the EA for evaluation of discharges that may require a permit.

5.9 Facility Plans

All Experimenters shall be cognizant of the relevant documentation prior to being granted access to the facilities and shall be re-trained on them annually.

Chemical Hygiene Plan (CHP)

The LLNL CHP provides essential guidance on conduct of operations of chemical laboratories. Implementing the CHP, which is in Document 14.2, minimizes the risk to workers from chemical hazards. Workers in areas defined as "chemical laboratories" shall

be informed, by their work supervisor, of Document 14.2 requirements and the OSHA laboratory chemical hazard communication standard before being assigned to work with hazardous chemicals. Controls of chemical hazards include engineering controls (e.g., gas cabinets, ventilation), written plans (e.g., IWS/SP), protective equipment, and worker training.

5.10 Potentially Contaminated Equipment

The controls for transferring equipment and property onsite or offsite for repair, reuse, or maintenance are defined in the applicable IWS(s), PWS(s), or IWS/SP(s) in compliance with Document 21.5, "Requirements for Transfer of Equipment and Property for Repair, Reuse, Maintenance, Storage, Excess, or Scrap," and Document 20.2, Section 3.8, "LLNL Radiological Safety Program for Radioactive Materials; Handling Radioactive Materials (including Contaminated Items)" in the *ES&H Manual*. Based on user knowledge, the equipment must be characterized for chemical, biological, and/or radiological contamination. If approved, the Equipment/Property Release Form must be completed prior to transportation. RIs shall contact the ES&H Team H&S technician and FPOC to coordinate removal and repair of potentially contaminated equipment.

The RI shall comply with the guidelines in Document 12.7, "Shutdown or Transfer of Facilities, Operations, or Associated Equipment," in the *ES&H Manual* and take appropriate actions needed to ensure that any residual hazards associated with or created by this project are mitigated.

Space Renovation or Space Clean Out

Contact the Health and Safety (H&S) Technician before removing items from the area in question. The Health and Safety (H&S) Technician will arrange for the ES&H Team staff to inspect and monitor the items and area for toxic, biological, and/or radioactive materials and contamination. Once the area has been monitored, the following dispositions can be made:

- Uncontaminated (nonhazardous, non-biohazardous, and nonradioactive) material may be reused in another area, sent to salvage, stored, or thrown away.

- Hazardous and/or radioactive material may be used in another controlled area, disposed of through RHWM or, if properly labeled, may be stored in an area suitable for holding the items.

6. Maintenance, Inspection, and Quality Assurance of Safety Systems and Equipment

This document serves as the Maintenance Plan for B360 Complex to assure that all systems and equipment that are important to safety are operating properly.

The division of responsibility and Laboratory policy for implementing maintenance is established in the ES&H Manual.

All inspections listed in this document will be documented by means of a logbook maintained by the FPOC.

7. Facility-Specific Training Requirements

All workers working under this FSP must take training appropriate for the work being conducted. The training policy of the CMLS is described in the CMLS Training Program. Individual training plans and training status can be found in the *Laboratory Training Records and Information Network* (LTRAIN*)* at the internal LLNL website.

7.1 Responsibility for Training

The supervisor is responsible for assuring that all of the people he/she supervises have the training required for the tasks assigned. In addition, the supervisor is responsible for monitoring compliance with training requirements.

All records are kept in accordance with LTRAIN guidelines. Upon completion of the LTRAIN application, the Training Coordinator will submit the information to the electronic database. Employees will then access the LTRAIN web site for Employee Training Requirements. A monthly reminder will be sent to each employee by the LTRAIN Administrator.

7.2 Training Workers

All workers are required to complete job-specific training, including review of all relevant IWS/SPs and the FSP prior to working in the facilities. All on-the-job training is to be documented by the supervisor. All formal training is to be completed prior to starting a project. All job-specific training will be identified in the IWS.

Newly assigned personnel are allowed to work under the supervision of a qualified, trained supervisor for up to 60 days while receiving the required training. At a minimum, the new personnel must take job-specific courses during the 60-day period. All new employees are required to attend BR0092, “BIO ES&H Orientation.” All new employees involved in biological research at CMLS are required to attend BR1001, “Working with Biological Materials in the Laboratory,” and BR1003, “BSL2 Operations.”

8. Emergency Response Plans and Procedures

General emergency response guidelines are listed below.

- Responses to emergencies will vary. The recommended procedures listed below are guidelines to be followed. If total evacuation of any building in the 360 Complex is necessary because of fire, toxic gas release, radioactive spill, or other major hazard, notification of building occupants will be accomplished by using the building paging system and the emergency evacuation system controlled from the Emergency Dispatch Center. Verbal messages and specific instructions may be transmitted.

- Evacuate the building immediately by the nearest exit. Do not stop to secure documents or personal belongings. Upon evacuation, proceed directly to the assembly point designated for your normal workstation for further information.

- Injuries and medical illness that do not require an ambulance response, but do warrant medical attention, shall be transported to Health Services by an uninjured party. Under no circumstances shall injured persons transport themselves. If in doubt of the seriousness of the injury, dial 911.

- Incidents that exceed certain thresholds (severity of injuries, value of property loss, potential for adverse community reactions, etc.) must also be reported to DOE. As a general guideline, any incident that requires assistance from outside sources (Hazards Control, EPD, Safeguards & Security, or the Fire Department) must be reported to the FM and FPOC as soon as practical. The Assurance Manager is responsible for preparing formal Occurrence Reports to DOE, through the LLNL Occurrence Reporting Office.

8.1 Reporting an Emergency

8.1.1 Take the following action when an emergency situation arises:

- ***EVACUATE*** the immediate area**.**
- ***DIAL 9-1-1*** (925-447-6880 from a cell phone) from a safe location near the site of the incident.
- Give ***YOUR NAME*** and the ***PHONE NUMBER*** you are calling from.
- State the ***LOCATION OF THE EMERGENCY***.
- Describe ***WHAT HAPPENED*** and your estimate of the situation (i.e., number of injuries, spill of hazardous material, fire).
- ***ANSWER ANY QUESTIONS*** asked by the emergency dispatcher (***STAY ON THE LINE*** until the dispatcher hangs up).

8.1.2 Take Protective action, but only if you don't endanger yourself:

- Give emergency aid to the injured, but remove them only if there is threat of further injury.
- Isolate the affected area, and prevent fire or spills of hazardous materials or waste from spreading if this can be done safely.

- Stand by to meet emergency response workers at the building entrance reported to them and be prepared to assist them, if requested.

8.1.3 Notify supervisor(s).

9. References

9.1 LLNL *ES&H Manual,* UCRL-MA-133867.

9.2 LLNL Training Program Manual, UCRL-MA-106166.

9.3 *Biosafety in the Microbiological and Biomedical Laboratories*, 4th Edition, (US Department of Human Health Services, Centers of Disease Control, National Institutes of Health), Washington D.C, May 1999.

9.4 *Design Safety Standards,* Mechanical Engineering Department, M-012, Rev. 6.

9.5 CMLS Training Program.

9.6 LLNL *Pollution Prevention Plan*, UCRL-AR-127073.

9.7 Final Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement (DOE/EIS-0348, DOE/EIS-0236-S3)

9.8 *Occurrence Reporting and Processing of Operations Information*, LLNL Implementing Procedures for DOE Order 231.1A and DOE Manual 231.1-2.

9.9 Facility Safety Plan Addendum 360.1 “Biohazardous Operations”.

9.10 Facility Safety Plan Addendum 360.2 “Carcinogen Operations”.

9.11 *Occupational Exposure to Hazardous Chemicals in the Laboratory*, 29 CFR 1910.1450.

9.12 Code of Federal Regulations, Title 29, Part 1910, Section 1030, “Occupational Exposure to Bloodborne Pathogens.”

9.13 Autoclave SOP.

9.14 DOE-HDBK-1081, “Spontaneous Heating and Pyrophoricity”.

9.15 Disaster Evacuation Plan, April 1992.

10. Appendices

Appendix A: Worker, Area, and Equipment Contamination Control

1. Worker

If you become contaminated with radioactive material (as indicated by an announcement by a co-worker, the spilling of radioactive material, or monitoring of the workplace or yourself), then:

a. When possible, monitor yourself for contamination, with particular attention to your hands and feet. If you are not contaminated, leave the room or immediate area and wait nearby. If you are contaminated and your location is safe from airborne contaminants, wait where you are until help arrives. Try to reduce the spread of contamination. Call lists are posted near the phone in every lab.

b. Ask an uncontaminated co-worker to call Hazards Control for assistance. This, and waiting in the immediate vicinity, will avoid the spread of contamination.

c. If no one is immediately available to assist you, go directly to the nearest telephone and call the area H&S Technician (during normal working hours) at ext. 2-5784 or pager # 05245, or the Off-Shift H&S Technician (outside of normal working hours) at ext. 2-7595. If no one responds, dial extension 911. Stay where you are until you have been monitored and released by Hazards Control personnel. Instruct others to stay out of potentially contaminated areas. The procedures for personnel decontamination given in Document 20.2 of the *ES&H Manual* may only be applied under the direction of Hazards Control or Health Services.

2. Area Contamination

Always notify the area H&S Technician of area contamination. Small-scale decontamination of surfaces and equipment is similar to methods used for normal household cleaning. The use of paper towels or wipes with soap and water will be adequate for most situations. Wear disposable gloves, lab coats, and safety glasses, as a minimum, when decontaminating small objects or areas. Large areas, such as floors or labs, or areas that are difficult to access may require additional or special anti-contamination clothing to be worn. Consult the area H&S Technician or ES&H Team Health Physicist for assistance with the proper selection and use of anti-contamination clothing. All materials used in decontamination efforts (including mop or rinsewater) must be saved for evaluation as radioactive waste by EPD.

Appendix A: Worker, Area, and Equipment Contamination Control (cont'd)

3. Repair or Removal of Contaminated Equipment

Before equipment contaminated with radioactive material is disassembled for repair, or before it is relocated to a clean area or another facility, the ES&H Team shall evaluate the equipment. The area H&S Technician will perform a contamination survey and may sample the machine fluids, if appropriate. If contamination in excess of standards is detected, the area Health Physicist will determine what must be done before removal or repairs are permitted. If after-hours emergency repairs on contaminated equipment are necessary, contact the Off-shift H&S Technician at Ext. 2-7595 for assistance. Decontamination standards are stated in Document 20.1, "Occupational Radiation Protection," of the *ES&H Manual.* Disposable lab wear shall be used whenever possible. Any other contaminated equipment or glassware shall be washed until it is within the contamination limits set in the previously stated subsection listed in the ES&H Manual. If equipment contamination limits cannot be achieved, the equipment will be labeled as radioactively contaminated. Contaminated items may be stored until short-lived activity decays to acceptable levels. Before moving contaminated equipment into a different facility (other than Radioactive and Hazardous Waste Management), obtain written acceptance of the equipment from the manager of the facility receiving the equipment.

Appendix B: CMLS Operations Review

Operations in Building_____Room_____were reviewed by the Responsible Individual,_____, and the operating personnel assigned to the operations. The hazards and their controls are clearly understood.

Initial Review		
Name	Signature	Date

Review After 6 Months		
Name	Signature	Date

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Distribution of official copies, updates, and supplements of this FSP to workers in the Program will be controlled through the ES&H Team.

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Laboratory management requires that the controls specified in this Facility Safety Plan (FSP) be applied to all operations within this facility.

This FSP was prepared by:

Greg Cooper — 12/22/06

Greg Cooper
Facility Manager
CMLS Directorate

Date

This FSP was concurred by:

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Tracey Simpson
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Date

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12/29/06

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