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LAWRENCE LIVERMORE NATIONAL LABORATORY

Facility Safety Plan CMS Complexes

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Facility Safety Plan
CMS Complexes

Preface

Laboratory management requires that the controls specified in this Facility Safety Plan (FSP) be applied to efficiently and safely perform operations within these facilities. Any operation conducted in these facilities that involves activities not commonly performed by the public, requires an Integration Work Sheet to determine the appropriate level of safety documentation.

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1.0 Facility Description

This FSP covers operations in areas of B132N, B151, B152, B154, B235, and B241 (hereafter referred to as CMS Complexes) as described in Section 1.1 thru 1.4 of this FSP. Any building-specific exceptions are discussed as appropriate.

This FSP does not cover operations in B132 South. This FSP does not apply to the Defense and Nuclear Technologies (DNT) "Area B" office complex of B132N that has been partitioned out by the B132 Segmentation Justification attached to the Facility Screening Report (SCR) and determined to be Office classification.

1.1 B132N Complex

The B132N Complex includes the first and second floors and excludes "Area B". The B132N Complex houses laboratory operations in a broad range of chemical, biological, and radiochemical research and provides office, laboratory facility support space, and related structures and outbuildings such as "Chemstor" units, transportainers, retention system, etc.

1.2 B151 Complex

The B151 Complex includes B151, B152, and B154. Each of these facilities is considered a separate facility for the purposes of hazard classification and chemical/radiological inventory. B151 and 154 provide office, laboratory, and electronics shop facilities for laboratory operations in a broad range of chemical, biological, and radiochemical research. B152 is a cement block structure located on the west side of B151 that provides storage.

1.3 B235 Complex

The B235 Complex consists of research laboratories and offices and provides facilities for experimental research in chemistry and materials science and for performing various types of materials analyses. The two-story eastern portion of the building houses office and administrative areas; the western portion houses laboratory space in the basement and first floor. B235, Rm. 1251 has a 4-MV accelerator (that has been exempted from the requirements of DOE Order 420.2) and an Ion Implanter.

Typical activities in B235 include x-ray spectroscopy, metallurgy, minor beryllium activities, electron microscopy, ceramics, surface science, radiological materials research, electrochemical processes, general wet chemistry, and laser activities.

1.4 B241 Complex

The B241 Complex provides office, laboratory, hi-bay, storage, machine shop, and electronics shop facilities for laboratory operations in materials development, processing, measurement, and testing.

Typical activities in B241 include metallurgy, minor beryllium activities, ceramics, electrochemical processes, biomedical research, environmental sample testing, and general wet chemistry.

2.0 Responsibilities and Authorities

2.1 General

All work conducted in the CMS Complexes shall follow the Integrated Safety Management System (ISMS) model for ES&H responsibility: The organization authorizing the work is responsible for the safety of the work. Document 2.1, "General Work Responsibilities and Integrated Safety Management" and Document 2.2, "Managing ES&H for LLNL Work" of the *ES&H Manual*, contain a description of how ISM is implemented at LLNL. Directorate-specific implementation and roles, responsibilities, and authorities are further described in the following:

- ISMS Implementation Plan (CMLS 330 – available through CMLS website)
- NHI Integrated Safety Management Plan (for NHI operations in B132N – available through NHI website)

The authority for implementing facility-related ES&H requirements in the CMS Complexes is assigned by the LLNL Director to the Associate Director (AD) for CMLS.

Facility Management responsibilities are carried out for CMLS by the AD Facility Manager (ADFM) and Facility Point of Contact (FPOC). The FPOC and Alternates extension and pager numbers are posted in each building. The CMLS ADFM can be reached by email at adfm@cms.llnl.gov.

The CMLS Facilities are home to work conducted by several different authorizing organizations, some of them outside CMLS (e.g. EPD, NHI). The management chain (including the authorizing organization) for each activity is identified on the Integration Work Sheet (IWS) for that activity. The safety management chain for facility activities includes the Operations Manager, Deputy Associate Director for Operations (DAD/Ops), and the CMLS Associate Director.

Work planning, review, and authorization are coordinated by the Responsible Individual (RI) and should involve the worker(s) and the Room Responsible Person. In many cases, the RRP and RI may be the same person, if the entire space is used for one authorized activity. Facility management concurrence, through the Facility Point of Contact (FPOC), is required prior to the start of work (including set-up) and is documented on the IWS. This concurrence ensures that the work activity falls within the facility safety envelope and is compatible with surrounding activities in the building. Finally, the Authorizing Individual (AI) on behalf of the Authorizing Organization accepts ES&H responsibility for the activity by authorizing the work to commence.

The documents referenced above identify specific safety management roles for the following positions:

- Associate Director
- Assurance Manager
- Authorizing Individual
- Deputy Associate Director
- Deputy Associate Director for Operations
- Employee

- Facility Point of Contact (FPOC)
- Operations Manager
- Responsible Individual (RI)/Work Supervisors
- Room Responsible Person (RRP)

2.1.1 Self-Assessments

The ES&H Self-Assessment Plan (CMLS 305) describes the processes for assessing compliance with ES&H requirements and the management process through which compliance is obtained. CMLS 305 is used as the implementation plan for Facility Self-Assessments in the CMS Complexes. The NHI Directorate is responsible for establishing and implementing programmatic components of their ES&H Self-Assessment plan for their designated areas and operations, including identification and tracking of programmatic deficiencies, and to ensure necessary corrective actions are funded and executed. These requirements are found in the *ES&H Manual* and the LLNL Quality Assurance Program.

2.1.2 Responsibilities for NHI

Responsibilities for NHI are documented in the NHI Integrated Safety Management Plan or may be negotiated by an MOU with CMLS. The existing MOU (CMLS 720, found at: http://cmsonly.llnl.gov/nwsdocs.html [NHI formerly NAI]) defines Roles, Responsibilities and Authorities (RRAs) for safety management (including financial management) of work activities, and RRAs for operations, utilization, and strategic planning in B132N.

2.2 DOE Required Response—Occurrence Reporting

Any accidents, injuries, illnesses, or unplanned events should be reported to the responsible Authorizing Individual and cognizant FPOC as soon as possible. These individuals shall promptly notify the CMLS Assurance Office. The CMLS Assurance Office (AO) is responsible for categorizing all occurrences in the CMLS facilities and determining if the event is reportable to DOE as an Occurrence Report. For additional guidance, see the CMLS Occurrence Reporting Plan (CMLS 322). If you have any questions or are in doubt as to the proper course of action, call the CMLS Assurance Office (AO) at ext. 3-3866 or the AD Office at ext. 2-5609.

2.3 Room Responsible Persons (RRP) for Laboratories/Work Areas

The RRP is the primary liaison between the FPOC and the personnel working in specific CMLS laboratories. The RRP generally reports to the Authorizing Organization management chain. RRPs are to be aware of program and personnel activities in their designated rooms and may or may not be the Responsible Individual for specific activities in a given area. They are to be cognizant of the hazards that exist in their rooms and monitor activities to verify that the controls required by the FSP, IWS/SP, or IWS to mitigate hazards are implemented. As appropriate, the RRP works with the AI, RI, FPOC, and the ES&H Team to identify and correct activity and room related ES&H deficiencies.

Responsibilities are as follows:

- Concur with and be knowledgeable of persons and activities being conducted in room. Concurrence may be documented through the IWS (optional).
- Be knowledgeable and familiar with applicable sections of the FSP and room relevant ES&H procedures and appropriate controls.
- Assure approval of work activities has been obtained through responsible management (including facility modifications).
- Control user access to the room. Designate authorized key holders.
- Be knowledgeable of emergency evacuation procedures. Advise room occupants and visitors of what to do in unplanned events and emergencies.
- Advise room occupants of applicable lessons learned. Report lessons learned as appropriate.
- Take appropriate actions to stop any unsafe or inappropriate activities.
- Report facility deficiencies to the Facility Point of Contact.
- Report ES&H concerns or hazards to the Health and Safety Technician, FPOC, and authorizing organization.
- Be physically present in room often enough to maintain current knowledge of room activities and conditions.
- Be available for audits, inspections, and inventories and act as point of contact as appropriate.
- Participate in self-assessments.
- Ensure the practice of general housekeeping.
- Maintain, update and ensure accuracy of Hazard Notice Door Sign and hopper information, if applicable (information such as FSP, IWS/SPs, etc. in a bin on the outside of each lab).

2.4 Building Residents

Roles, responsibilities and authorities (RRAs) for each individual are specified in:

- ISMS Implementation Plan (CMLS 330)
- NHI Integrated Safety Management Plan
- Document 2.1, "General Work Responsibilities and Integrated Safety Management" of the *ES&H Manual*

CMLS and other resident directorates may have additional directorate-specific policies and procedures that apply.

Each individual is responsible for his/her own safety. The safety responsibility for visitors, students, guests, contractor personnel, etc. resides with their host. Employees, visitors (including students), and contract personnel working in this facility are responsible for:

- Performing their work using the appropriate controls, including attending and completing all assigned ES&H training courses required to perform their tasks in a responsible, safe, and environmentally sound manner,
- Reading and following the requirements of this FSP, IWS/SPs, IWSs, the *ES&H Manual*, and any other applicable ES&H documents,
- Taking all reasonable precautions to protect themselves and fellow personnel and to perform only those tasks that, once authorized, can be accomplished safely,
- Consulting with their RI or supervisor if there are any doubts regarding the safety of the work,
- Reporting any planned or accidental release or spill of hazardous materials to the environment to their work supervisor/host, and
- If it is determined that the work activity's operating limits or controls are not being followed, or when common sense indicates that people, property, or the environment are at imminent or substantial danger of being hurt or damaged, the work shall be stopped or suspended until appropriate remedial actions are taken.

2.5 Materials Management Section

The Materials Management Section of the Engineering Directorate controls all transfers of controlled materials to and from these facilities. Materials Management must notify the facility Health and Safety Technician of all incoming transfers. Controlled materials are described in Document 21.1, "Acquisition, Receipt, Transportation and Tracking of Hazardous Materials" of the *ES&H Manual*. Exceptions can be found for the transport of some radioactive material in Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials" of the *ES&H Manual*. The controls specified in that document and Appendix C of this FSP must be followed.

2.6 Plant Engineering

Plant Engineering (PE) provides support to the CMS Complexes to maintain and service mechanical, electrical, and structural components of the facilities. PE maintains configuration management control for building Life Safety Systems. While CMLS retains responsibility, PE has the authority, with CMLS facility management concurrence, to maintain and service mechanical, electrical, and structural components associated with the building.

Plant Engineering (PE) operates as an institutional service and supports CMLS facilities in the following areas:

- PE typically supports major construction and non-capital alterations. Construction and alteration must not degrade facility safety and environmental protection. Designs must be reviewed by the ES&H Team and approved by the AD Facility Manager before starting projects, and,
- PE typically provides building maintenance and custodial services.

Prior to beginning work in the facility, concurrence of the Facility Point of Contact must be obtained.

With respect to the B151 Complex, PE also provides maintenance to the B152 underground diesel fuel storage tank (152-D1U2).

3.0 General Building Safety Limits and Controls

3.1 Inventory Control

In order to maintain the CMS Complexes hazard classifications, the following controls are to be applied:

- Maintain a radiological inventory control program that is compliant with both DOE-STD-1027-92, Change 1, methodology and Document 20.6, "Criticality Safety" of the ES&H Manual to ensure that the maximum radiological inventory is less than the Category 3 (Nuclear) threshold as well as any additional Criticality Safety limits.
- Maintain a chemical inventory management program in accordance with CMLS 332, "Chemical Management Plan".
- Maintain explosives inventories in accordance with Document 17.1, "Explosives" of the *ES&H Manual.* Specific controls are identified in Appendix B of this FSP.

3.1.1 Chemical Inventory Tracking and Control

The LLNL ChemTrack system shall be used to monitor the inventory of primary containers of hazardous chemicals and beryllium metals/compounds in all CMLS facilities. CMLS-332, "Chemical Management Plan" shall be followed to ensure that chemical inventory quantities remain within the authorized facility hazard classification. Persons purchasing, using, or transporting hazardous materials in primary containers into a CMLS facility shall follow CMLS 332, Document 21.1, "Acquisition, Receipt, Transportation and Tracking of Hazardous Materials" and Document 14.1, "LLNL Chemical Safety Management Program" of the *ES&H Manual,* to ensure the materials are entered into the LLNL ChemTrack system database. Chemicals in primary containers (i.e., those shipped by the manufacturer) are bar-coded, entered into the ChemTrack system, and inventoried as required. Chemical custodians and users are responsible for;

- Ensuring that bar code labels are affixed to each chemical container as required,
- Removing the lower half of the bar code when disposing of or transferring the chemical container to a new location, and returning the bar code affixed to a ChemTrack Disposal/Transfer form (which can be found at http://chemtrack.llnl.gov) to ChemTrack, L-621, so the chemical record can be removed from the ChemTrack system, and,
- Notifying ChemTrack Technical Services Group (Hot Line ext. 4-4404) of the new custodian when terminating employment at LLNL and/or when operations involving hazardous materials are shut down or transferred.

The ChemTrack database is verified annually by a physical inventory. RRPs and/or chemical custodians will ensure that the ChemTrack inventory records are accurate for their assigned areas.

NOTE: The Tier 2 Safety Basis Document for the B151 Complex administratively separates the three facilities in the B151 Complex (B151, B152, and B154) to allow each facility to maintain separate and independent chemical inventories/limits.

3.1.2 Radiological Inventory Tracking and Control

With the exception of B241, all CMS Complexes are operated as Radiological (ref: DOE - STD-1027-92), Low Hazard Facilities. B241 is operated as a Radiological, Light Science and Industry facility. Appendix "C" of this FSP contains the operational limits and administrative control levels for radiological materials in the CMS Complexes. The IWS is used as a basis for designating the room as a Radioactive Materials Area (RMA) and, possibly, as a Radioactive Materials Management Area (RMMA).

3.2 Safety Basis Envelope

Facility Hazard Classification and Principal Controls

Document 3.1, "Nonnuclear Safety Basis Program" of the *ES&H Manual* specifies the methodology used to determine the inventory limits and controls for chemical, radiological, and explosive inventories for B132N, B151 Complex, B235, and B241. Implementation of these controls is coordinated through the ADFM. An IWS is required for new or changed operations not commonly performed by the public (i.e. WAL [Work Authorization Level] B and greater).

The safety basis envelope for the CMS Complex facility operations is defined by Tier 1, Tier 2 and Tier 3 Safety Basis Documents (see Table 3-1). The SBD for the B151 Complex administratively segments that Complex in terms of radiological and chemical inventory allowing each facility (B151, B152, and B154) to maintain separate and individual chemical and radiological inventories.

Table 3-1: ***Safety Basis Summary for CMS Complexes***

Facility	Safety Basis Document	Hazard Classification
132N	Tier 2 Safety Basis Document For B132N, Rev. 0, Sept. 28, 2005	Radiological, Low Hazard
151, 152, and 154	Tier 2 Safety Basis Document for the B151 Complex (B151, B152, and B154), Rev 0, July 13, 2006	Radiological, Low Hazard
235	Tier 2 Safety Basis Document For B235, Rev. 1, June 30, 2006	Radiological, Low Hazard
241	Tier 1 LLNL Facility Screening Report (SCR) for B241, March 14, 2007	Light Science and Industry

3.2.1 Key Safety Limits

There are several key safety limits defined in the Safety Basis Documents. These limits are summarized in Table 3-2 (Chemicals) and Table 3-3 (Explosives).

3.2.1.1 Key Chemical Limits

Table 3-2: *Key Chemical Limits Summary for CMS Complexes*

Facility	Chemical Name	Safety Basis Limit (lbs/kg)	FSP (administrative) Limit (lbs/kgs)
132N	All	Lesser of Q-List values Q1(100 meters) or Q0 (200 meters)	75% of Safety Basis Limit
151	Chlorine trifluoride gas	15 lbs/6.8 kg	11.25 lbs / 5.1 kg
151	Sulfur Dioxide gas	11.4 lbs/5.2 kg Restricting Flow Orifice less than 0.031" is required for cylinders with concentrations greater than 10% by weight.	8.55 lbs / 3.9 kg
151	All other chemicals	Lesser of Q-List values Q1(100 meters) or Q0 (300 meters)	75% of Safety Basis Limit
151	Liquid Nitrogen	39,600 lbs/18,000 kg	29,700 lbs/ 13,500 kg
152	All	Lesser of Q-List values Q1(100 meters) or Q0 (300 meters)	75% of Safety Basis Limit
154	All	Lesser of Q-List values Q1(100 meters) or Q0 (300 meters)	75% of Safety Basis Limit
235	All	Lesser of Q-List values Q1(100 meters) or Q0 (600 meters)	75% of Safety Basis Limit for the total facility inventory and less than 1 pound of Be Powder for the entire facility.
241	All	Lesser of Q-List values Q1(100 meters) or Q0 (600 meters)	75% of Safety Basis Limit

3.2.1.2 Key Explosive Limits

Table 3-3: *Key Explosive Limits Summary for CMS Complexes*

Facility / Room	UNO Hazard Class/Division	Quantity Allowed in Operations [a]	Total Quantity Allowed [a,b]
132N / 1901	1.1 and 1.5	Less than or equal to 10 grams	1000 grams
132N / 1903	1.1 and 1.5	Up to 10 grams low-risk contact operations	10 grams
132N / 2695	1.1 and 1.5	Sum of all operations less than or equal to 5 grams.	50 grams
132N / other labs	1.1 and 1.5	Less than or equal to 1 gram	Less than or equal to 1 gram
151 / any lab	1.1 and 1.5	Each operation limited to less than 10 mg of non-primary explosives. Multiple operations allowed per room. No primary explosives allowed.	Less than or equal to 1 gram
152 / any lab	1.1 and 1.5	Each operation limited to less than 10 mg of non-primary explosives. Multiple operations allowed per room. No primary explosives allowed.	Less than or equal to 1 gram
154 / any lab	1.1 and 1.5	No explosives work is allowed.	None
235 / any lab	1.1 and 1.5	Sum of all operations limited to less than or equal to 1 gram.	Less than or equal to 1 gram

Facility / Room	UNO Hazard Class/Division	Quantity Allowed in Operations [a]	Total Quantity Allowed [a,b]
241 / any lab	1.1 and 1.5	Each operation limited to less than 10 mg of non-primary explosives. Multiple operations allowed per room. No primary explosives allowed.	Less than or equal to 1 gram

[a] Excluding waste in non-detonable amounts and dilute samples less than 25% explosives by weight.

[b] When a repository is closed, the contents do not contribute to the room limit. When a repository is open only explosive materials not contained in a non-propagating array cubicle in the repository shall be subject to the operational limit of the room.

3.2.1.3 Key Radiological Limits

Buildings in the CMS Complexes each maintain independent limits for radiological materials. The inventory of radiological materials is expressed as the sum of the ratios of each isotope to the corresponding regulatory threshold for that isotope. For Low Hazard facilities, these thresholds are listed in DOE-STD-1027-92; Chg 1, 9/97, Attachment 1, columns 3 and 4. For Light Science and Industry facilities, these thresholds are listed in 40 CFR 302.4 Appendix B. For each of the buildings, the sum must be less that 1.0. Administratively, these sums are further restricted to 75% of the Safety Basis values. Additional limits apply for the purposes of Criticality safety, as described in Appendix C.

3.2.1.4 Key Biological Limits

Biological activities in all CMLS facilities are restricted to biohazardous materials that may be handled Biological Safety Level 2 or lesser conditions.

Select Agents (as defined in Document 13.6 of the *LLNL ES&H Manual*) are not permitted in any facility covered by this document. The only biological operation allowed in B152 is the storage of biohazardous waste.

3.3 Significant Systems or Equipment

Building Safety Features

Building Safety Features (BSF) include systems, subsystems, equipment, components, structures, or structural elements whose failure could adversely affect public or nearby (100 meter) worker safety. The Safety Basis documents for these facilities identify building safety features for which credit is taken to remain within the safety basis envelope. These features have been identified in Table 3-4 as Configuration Items according to the guidance in CMLS-405 "Configuration Management Plan". The Safety Basis documents also identify building safety features that provide additional margin of control as defense-in-depth for which no credit is taken to remain within the safety basis envelope. These and other features are listed in Table 3-4.

Normal facility operations require that all BSF be functional. Discovery of a non-operational BSF requires the following actions:

- Immediately and safely suspend operations in the affected area (unless otherwise approved by the ADFM, with the concurrence of the ES&H Team Leader or designee)
- Notify the FPOC and/or ADFM
- Within 24 hours, evaluate the potential for adverse ES&H impact and determine interim actions
- Within 72 hours, develop and implement a plan approved by the CMLS Operations Manager or designee to return the BSF to normal operation.

BSF (including computer-controlled safety systems) shall not be bypassed or disabled during normal operations, unless authorized by an IWS. FPOC must concur on IWSs authorized by other organizations providing maintenance or service. Modifications to the BSF require an Integration Work Sheet (IWS) and shall undergo a design review as appropriate by the ADFM and the ES&H Team Leader.

Table 3-4. Building Safety Features BSF

Facility	Description	Config Item?	Institutional
All (except B152)	Fire detection and alarm	Yes	X
All (except B152)	Fire suppression	Yes	X
B132N	B132N separation of the utilities infrastructure and the two-hour (minimum) fire-rated separation between the CMLS and DNT areas	Yes	
B132N	Non-propagating explosive storage arrays	Yes	
B132N	Ventilation and elevated Stack	No	
B151	Seismic Restraints on LN Tank	No	
B151	Physical Barriers around LN Tank	No	
B151	Sulfur Dioxide gas cabinet seismic restraints	No	
B151	Chlorine Trifluoride gas cabinet seismic restraints	No	
B151	Building exhaust directed to elevated stacks	No	
B151	High Vacuum Fluorination System reaction vessel manifold	Yes	

3.4 Facility Safety Related Hazards and Control

Performing Work in CMLS Facilities

The Integrated Safety Management (ISM) process applies to all activities carried out in CMLS facilities as defined in the ISMS Implementation Plan (CMLS 330) and NHI Integrated Safety Management Plan (for 132N). CMLS uses the electronic e-IWS system. Use of the IWS process ensures all new operations not commonly performed by the public or major changes to previously planned or ongoing experiments or operations will receive an appropriate ES&H review including review under the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). Document 3.6, "Environmental Planning" of the *ES&H Manual* provides guidelines for determining if the activity will require a NEPA and/or CEQA review.

Work activities must be monitored by the RI/AI to ensure they are within controls (including the facility safety envelope). If the work activity changes or a new hazard is introduced, the work must be reviewed and the IWS updated to reflect the change. Each employee has the responsibility and authority to stop unsafe work. Feedback and improvement is to be incorporated as part of the work planning/execution process.

3.4.1 Access and Egress Control

3.4.1.1 Access Control

Programs and/or directorates control access to their laboratories. Access to CMLS laboratories is defined by CMLS 403, Facility Access Control (S200). In cases where access may result in exceptional safety, security or other concerns, restrictions may be imposed. In such cases, the Room Responsible Person will;

- Make alternative arrangements with the appropriate Facility Point of Contact,
- Inform the Facility Point of Contact, of the access restriction, the reason, and the duration of the restriction, and,
- Post the entrances to the room or area with an access restriction notice, a point of contact, and, if a hazard is the cause for the restricted access, a description of the hazard.

The Hazard Notice Door Sign posted outside each laboratory is the method to inform Janitorial, Protective Service, Emergency Response, and other personnel of the hazards in the laboratory. This sign is updated by the Room Responsible Person.

3.4.1.2 Visitor Access

A "visitor" is a non-LLNL CMLS-sponsored individual who requires temporary access to a CMLS facility or a CMLS authorized work activity. Examples of visitors include summer hires, student guests, participating guests, invited guests, consultants, meeting participants, and anyone with a visitor badge. Special rules for persons under the age of 18 are described in the LLNL *ES&H Manual*. Visitors under the age of 16 may not work with hazardous materials. Visitors are the responsibility of their host. Hosts shall coordinate with the RRP to ensure that visitors are adequately briefed, trained, and provided appropriate personal protective equipment. Where applicable, an IWS shall specify visitors and any special requirements for visitor safety. Unescorted visitors shall check in with the FPOC before entering any laboratory room and shall be briefed by the

FPOC regarding hazards. Requirements for CMLS visitor access are found in CMLS 330 regarding visitor policy, and CMLS 315 (Visitor Safety) regarding visitor safety.

Special attention must be paid to visitors who may be exposed to a radiation hazard. Anyone entering a RMA must have a dosimeter and (unless escorted) General Employee Radiological Training (GERT). Unless otherwise stated in an approved IWS/SP, visitors working with radiological materials shall comply with Appendix C of this FSP.

3.4.1.3 Roof Access Controls

Roof access shall be in accordance with the approved roof access process as required by Document 15.1, "Roof Access" of the *ES&H Manual*. Procedures and controls for accessing Restricted Access roofs and for safeguarding hazard generating devices (i.e. hoods, gloveboxes, pumps, etc...) shall be documented in an approved Plan. Contact FPOC for authorization. Facility designation for roof access is summarized in Table 3-5.

Table 3-5: Roof Access Designation

Building	*Roof Access Designation*
132N	General Access Restricted Access for area demarcated around the stack of the perchloric acid fume hood
151	Restricted Access
152	General Access
154	Restricted Access
235	General Access Restricted Access for the portion above the laboratory wing. NOTE: Additional security requirements apply for all roof access.
241	Restricted Access

3.4.1.4 Egress/Fire Safety/Housekeeping

All means of egress, as defined in Document 22.5, "Fire" and 11.2, "Hazards --General and Miscellaneous" of the *ES&H Manual*, (aisle ways, exit ways, corridors, stairs, etc.) shall be kept clear of storage, obstructions, and debris. Fire doors (between building segments and in stairwells) shall be properly labeled and never propped open. General housekeeping practices shall be applied to ensure fire safety and to maintain clear egress routes. In the event of a power outage, personnel may become trapped in the building elevators. In a power outage, remain calm. An emergency light will come on in the

elevator, and the bell alarm system can be activated to summon help. The battery power should last about one hour.

3.4.1.5 Interstitial Space

The interstitial space between floors of B132N and B151 contains utilities and mechanical and electrical systems serving the laboratories. The FPOC, Alternate FPOC, or designee controls access to interstitial space. Storage in the interstitial spaces between floors requires AD Facility Manager approval and should be minimized due to the floor loading limitations and because the interstitial spaces are specifically reserved for the building infrastructure (no combustibles).

3.4.1.6 Door Interlock Systems

Door interlock systems shall comply with Document 12.1, "Access Control, Safety Signs, Safety Interlocks, and Alarm Systems" of the *ES&H Manual.*

3.4.2 Facility Hazards & Controls

3.4.2.1 Covered Operations

Operations in these facilities include a variety of chemistry activities.

The controls to conduct hazardous operations safely in CMLS facilities are specified in the LLNL *ES&H Manual,* this FSP, an IWS, IWS/SP or other documentation as required. All activities that are not commonly performed by the public or involve facility modifications require an IWS or IWS/SP to authorize work to begin.

Certain operations require additional controls as identified in Table 3-6. These operations are restricted to trained and qualified personnel with authorization via an IWS.

Table 3-6. Special operations addressed by this FSP.

Operation	Section
Working with Explosives	Appendix B
Radiological Operations	Appendix C
Working with Biohazards	Appendix D
Working with Beryllium and Beryllium Compounds	Appendix E

Surveillance to ensure operations remain within an established ES&H envelope is accomplished through on-going observations by the CMLS Facility staff and management, frequent walk-throughs by the members of the ES&H Team, and a self-assessment program (CMLS-305, "ES&H Self-Assessment Plan").

3.4.2.2 Operations and Materials requiring an additional Safety Plan

An IWS/SP is required for WAL C operations as defined in Document 2.2 "Managing ES&H for LLNL Work" of the *ES&H Manual.* For additional information on what

constitutes WAL C work activities, refer to Document 2.2 Section 1.4, "Work Authorization Levels" and Appendix B, "Examples of Work Authorization Level A, B, and C Work Activities".

3.4.2.3 Variances to Codes, Standards, and Regulations

Fume Hoods

The fume hoods in B151 are constructed of polyvinyl chloride (PVC) and do not comply with Section 6-8 of the NFPA 45, "Standards on Fire Protection for Laboratories Using Chemicals." DOE has granted a permanent exemption to this requirement, based on the following administrative controls:

- The quantity of flammable and combustible materials in a fume hood is limited to that necessary for one day of use ("day use" quantities).
- Periodic compliance inspections are made to minimize fire hazards.

Larger quantities of flammable and combustible materials must be stored in approved containers and cabinets in a location other than the fume hood.

Emissions

Permitted and exempt air emission sources are discussed in Section 3.5.2 of this FSP.

B151 Rooms BM100 and BM101 Egress[1]

The mezzanine in B151 (Rooms BM100 and BM101) includes areas that exceed the maximum distance to the nearest exit required by NFPA 101. Due to the infrequent occupancy of this space and the availability of escape hatches, the SME has accepted the following controls to provide equivalent protection:

Persons wishing to enter the mezzanine shall:

- Check in and out with the FPOC (or designated alternate),
- Adhere to a two person rule,
- Limit the maximum number of persons in the mezzanine to 10,
- Each party must carry a radio. A cell phone is an acceptable alternative if reception is adequate in the area,
- Each party should also carry a flashlight.

3.4.2.4 Hazards and Controls

Table 3-7 provides a description of hazard categories, a brief description of the consequences of the hazards, and the required controls for operations in CMS Complexes.

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[1] Do not remove this section in future revisions unless alternate methods of compliance with NFPA 101 are implemented. This section documents a corrective action to a deficiency identified in the B151 FHA.

Table 3-7: Hazards and Controls in the CMS Complexes

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Air Quality	Emissions of air pollutants can violate permit requirements and cause environmental, health, and safety impacts.	Permitted and exempt air emission sources are discussed in Section 3.5.2 of this FSP. All new or modified (includes relocated) operations or equipment that could potentially emit toxic air contaminants (e.g., solvents, metals, radionuclides, etc.) require a review through the IWS process. Use of volatile solvents will be minimized to the extent practical. The Bay Area Air Quality Management District (BAAQMD) has issued a permit to LLNL for usage of research and development quantities of volatile solvents. Volatile solvent usage, including solvents and amounts used for wipe cleaning, is tracked through the TRR procurement process. Solvents received outside of the TRR procurement system need to be reported to the Team Environmental Analyst so their use can be tracked. Any continual solvent wipe cleaning operation that will use a large volume of solvents (in excess of 5 gallons per year) must be evaluated for a separate air emissions permit. The emission of radionuclides to the atmosphere is subject to the National Emission Standards for Hazardous Air Pollutants (NESHAPs) under Federal Clean Air Act regulations.	• Document 12.2, "Ventilation" • Document 31.1, "Nonradiological Air Quality Compliance" • Document 31.2, "Radiological Air Quality Compliance"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Biological materials	The major hazard in work involving biohazards is the risk of contracting an infection, which can result in serious illness, possible permanent medical disabilities or death. Exposure to toxins produced by certain types of bacteria or fungi is another associated risk. Another hazard is the release of biological materials to the environment.	All research with biological materials shall be registered with the Institutional Biosafety Committee (IBC) office (form available on the IBC website). Additional controls are found in Appendix D of this FSP. Biosafety level 3 activities and Risk Group 3 materials are not allowed.	• Document 13.1, "Biological Controls and Operations" • Document 13.2 "Exposure Control Plan: Working Safely with Blood and Blood Borne Pathogens" • Document 13.4, "Research Involving Human Subjects" • Document 13.6 , "Safe Handling and Use of Biological Research Materials"
Chemicals	Chemicals present a variety of health and/or physical hazards. Routes of entry into the body are inhalation, ingestion, injection and skin absorption. Chemicals of special concern include beryllium, mercury and hydrofluoric acid. Adverse health effects include damage to hematopoietic systems, lungs, skin, eyes, mucous membranes and nervous system. Physical hazards include flammability, corrosivity shock sensitivity, unstable (reactive) or water-reactivity. The use of fuming perchloric acid in certain operations in fume hoods may result in an accumulation of perchlorate	Each room within the CMS Complexes falls under either Chemical Hygiene plan or Hazard Communication plan. The RRP works with the Team Industrial Hygienist to determine the proper classification. The room classification is listed on the hazard notice door sign. Hazard notice door signs should be maintained by the RRP. Chemical inventory quantities and management of bar code labels (per the ChemTrack program) shall be controlled in accordance with CMLS 332, "Chemical Management Plan." For the purpose of inventory quantity control under CMLS 332, each facility in the CMS Complexes has separate chemical inventory limits as established by Safety Basis documentation. Chemical usage shall be evaluated by the Team Industrial Hygienist and controls documented by an	• Document 10.2, "LLNL Health Hazard Communication Program" • Document 11.1, "Personal Protective Equipment" • Document 14.1, "LLNL Chemical Safety Management Program • Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories" • Document 14.3, " Toxic, Corrosive, or Reactive Gases" • Document 14.4, "Implementation of the Chronic

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Chemicals continued	residue in the hood ventilation system, presenting a fire or explosion hazard. Toxic, corrosive and reactive gasses may cause adverse health effects from mild to death.	IWS. Indirect vented chemical splash goggles, rather than safety glasses, are required when handling hazardous liquids such that a splash may occur. Lab coats, closed-toed and closed heeled shoes and leg coverings shall be used when working with hazardous chemicals. Operations involving heating perchloric acid above ambient temperatures shall have a safety plan and be performed in a fume hood designed and posted for work with fuming perchloric acid, unless the vapors are trapped and scrubbed prior to release. If a perchloric-designated hood is found to be inoperable, suspend all operations in that hood and notify the FPOC. Work on the fume hood exhaust system components shall be reviewed by an Industrial Hygienist prior to authorization to verify the residual risk of a perchlorate explosion is acceptable and that appropriate PPE is in use. Ventilation systems for heating perchloric acid hoods shall be inspected not less frequently than annually to verify the proper operation of the wash down system. An eyewash and emergency shower shall be available where corrosives are handled, including storage rooms. Controls for working with beryllium are specified in Appendix E of this FSP.	Beryllium Disease Prevention Program Requirements" • Document 14.6, "The Safe Handling of Fluorine" • Document 14.8, "Working Safely with Corrosive Chemicals" • Document 14.12, "Safe Handling of Carcinogenic Materials"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Chemicals continued		Before bringing any toxic, corrosive or reactive gasses into the CMS Complexes contact the FPOC and Team Industrial Hygienist for guidance. An IWS/SP is required for chemical operations that could generate amounts of toxic fumes, gases, vapors, dust, or mists that may exceed applicable occupational exposure limits with all engineering controls in place and the use of cryogenic liquids or solids that are reactive or toxic (e.g. fluorine) or flammable (e.g. hydrogen), or that may cause oxygen enrichment (e.g. liquid oxygen). See fire/heat section of this table for flammable liquid controls.	
Confined Space	Confined spaces include vacuum vessels, retention tanks, pits, and utility vaults that may present oxygen deficiency and/or asphyxiation hazards. Many permit required confined spaces are identified by a confined space number and are posted as such. Entry into confined spaces without atmospheric testing to ensure an oxygen concentration of at least 19.5% may result in injury or death. Other hazards in confined spaces may include exposure to toxic airborne contaminants and physical hazards such as electrocution.	If an unlabeled confined space is identified, contact the Team Industrial Hygienist for an evaluation. For entry into a permit required confined space contact the Team Health and Safety Technician to obtain a permit. Do not bring chemicals or compressed gasses into any permit or non-permit required confined space, or use a venturi vacuum without prior Industrial Hygienist review.	• Document 18.7, "Working in Confined Spaces"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Contaminated Equipment	The major concern from contaminated equipment is the protection of the health and safety of LLNL employees, the general public and environment.	Contact the ES&H Team for assistance in evaluating the potential hazards and necessary controls for the use, storage, and/or transfer of contaminated equipment. If after-hours emergency repairs on contaminated equipment are necessary, contact the off-shift Health and Safety Technician (ext 2-7595).	• Document 21.1, "Acquisition, Receipt, Transportation and Tracking of Hazardous Materials" • Document 21.5, "Requirements for Transfer of Equipment and Property for Repair, Reuse, Maintenance, Storage, Excess or Scrap"
Cryogens	Liquid cryogens pose two distinct types of hazards. Splashes or other contact with the liquid can cause tissue to freeze. Spills of cryogens in a small or poorly ventilated space will rapidly evaporate to form a gas, and may result in a reduction of oxygen content in the air by simple displacement. Pressure buildup can cause over pressurization and failure of lines or equipment. Cryogens can significantly lower the critical masses of fissionable materials.	The use of cryogens requires an IWS. The use of cryogens that are reactive or toxic (e.g. fluorine) or flammable (e.g. hydrogen), or that may cause oxygen enrichment (liquid oxygen) requires an IWS/SP. Some areas where cryogens are used will require mitigation of oxygen deficiency hazards, either by size reduction of the dewar, improved ventilation, use of a cryogen containment system or other method. Requirements for oxygen deficiency alarms are discussed in each IWS. If using the building elevator to transport a cryogen to another floor, do not accompany the dewar in the elevator. Use the barricade ropes in the elevators to prevent others from entering the elevator while a dewar is in transport. An IWS/SP is required if fissionable materials are intermixed with cryogens or have the potential to reach cryogenic temperatures through equipment failure or loss of administrative controls. Some exceptions are authorized (see Appendix C).	• Document 18.5, "Cryogens" • Document 20.6, "Criticality Safety"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Electrical	Electrical hazards include high voltage equipment, high energy capacitors, static electricity, exposed conductors, batteries, transformers, improperly grounded equipment. The potential consequences of receiving an electrical shock can be very serious including personal injury or death.	Only authorized and qualified individuals are permitted to perform electrical work. Energized electrical work will not be performed except as allowed by Appendix A, of Document 16.2, "Work and Design Controls for Electrical Equipment" of the ES&H Manual. All electrical equipment must be NRTL (Nationally Recognized Testing Laboratory) approved or pass an AHJ Inspection. Flexible cords and cables shall not be used as a substitute for fixed wiring, attached to building surfaces, or routed through walls, ceilings or floors. Flexible cords that are damaged cracked spliced or missing a ground pin shall be removed from service and repaired. LLNL practice prohibits use of multiple extension cords (daisy chaining). Tasks involving Class 3 electrical hazards require an IWS/SP with management approved written procedures specifically addressing the electrical hazards and controls. Tasks involving Class 4 electrical hazards require an IWS/SP authorized by the program leader or higher level.	• Document 12.6, "LLNL Lockout/Tagout Program" • Document 16.1, "Electrical Safety" • Document 16.2, "Work and Design Controls for Electrical Equipment" • Document 16.3, "LLNL Authority Having Jurisdiction Requirements for Approving Electrical Equipment Installations and Work"
Explosives	The major hazard from explosives is personal injury or property damage caused by heat, blast, noise, fumes, and flying debris or projectiles from the accidental ignition or explosion of such	ES&H Team Explosives Safety Engineer or approved alternate shall review and approve work controls and locations. Work with explosives and explosive waste	• Document 17.1, "Explosives" • Document 17.6, "LLNL Energetic Materials Processing Review Program"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Explosives continued	materials. Injuries ranging from minor to fatal could include trauma, lacerations, eye injury, hearing impairment, and burns. Property damage could range from minor to major. Improper management or disposal of explosive waste is a hazard.	management is covered in Appendix B. An IWS/SP is required for operations involving more than 10 mg of non-initiating explosives. Operations involving Group D explosives in inert solvents where the explosives concentration is less than 25 weight percent are not treated as explosives.	
Fire/Heat Fire/heat	Fire presents toxic, thermal, and mechanical hazards. Toxic fire gases (such as carbon monoxide, hydrogen cyanide, etc.) and smoke particles (such as soot, hydrochloric acid aerosol, etc.) are generated in fires and can cause injury or death. Thermal hazards include burns to skin and/or lungs, both of which can be fatal. Mechanical hazards includes falling of materials that have failed structurally due to fire (such as melted plastic duct) or over pressurization and rupture of containers that can also lead to chemical hazards. Fire causes include flammable liquids & gases, combustible materials, high temperatures, alkali metals, metal hydrides, pyrophoric materials, welding, ovens, furnaces, heaters, chemical reactions, lasers, open flames, etc.	Appropriate permits are required for open flame and other types of hot work including bench top Bunsen burner and torch use. Electrical soldering is considered a WAL A activity. Use of solders containing lead, cadmium or other toxic materials should be reviewed by the ES&H Team IH. Bulk quantities of flammable liquids shall not be stored in interstitial spaces or mechanical/electrical rooms. Heating of flammable liquids must be specifically analyzed via the IWS process. Do not use flammable liquids in equipment not specifically designed for such use. Elevators should not be operated during a fire. For activities where ignition of a person's clothing may occur, consult ES&H Team for guidance. Containers of flammable liquids may not be opened in the chemical storage units outside B132N, B152 or in the B151 storeroom. Bulk quantities of flammable liquids shall be stored in UL listed flammable liquids cabinets or listed flammable liquids storage refrigerators. Flammable liquids used outside of storage should be kept to	• Document 22.5, "Fire"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
continued		minimum quantities. All fires shall be reported to the LLNL Fire Department (911). Portable fire extinguishers are typically located in halls adjacent to offices or laboratories. LLNL personnel are to use these fire extinguishers in the event of fire only if they have been trained in the use of such extinguishers and then only if it safe to do so.	
Housekeeping	Poor housekeeping creates potential slip, trip, and fall hazards, fire and emergency egress issues.	Materials may not be stored in front of electrical panels. Storage and egress paths shall be kept free from accumulation of materials. Keep areas around eyewashes and showers clear at all times. Dispose of unneeded or unwanted materials promptly and appropriately.	• Document 11.2, "Hazards--General and Miscellaneous" • Document 16.1, "Electrical Safety"
Hydrogen	The hazards associated with the use of hydrogen gas include: The accidental release followed by ignition or explosion resulting in personnel injury, and/or death, and/or property damage. Reactivity with other materials causing rapid energy release. Hydrogen embrittlement causing material	The RI shall perform an operation-specific hazard analysis for each activity with assistance from the ES&H Team. Safety controls will be incorporated in an SP for any operation in an enclosed space or area capable of creating hydrogen air concentration greater than 4%. When a hydrogen generator is operated, it will be 100% attended or have self-shutdown capability and a water supply reservoir no larger than approximately 2 liters. For water volume > 2 liters, a	• Document 18.1, "Pressure" • Document 18.4, "Hydrogen"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Hydrogen continued	failure.	hazard assessment will be done by the ES&H Team and controls documented in the IWS or IWS/SP. All hydrogen gas generators with line pressure greater than 60 psig require an Engineering Safety Note. Where air or other oxidizing gases are connected to the same system as hydrogen, flash arrestors must be installed on both the hydrogen and oxidizer supplies.	
Ionizing Radiation Radioactive materials – **Dispersible**	Dispersible radioactive material exists throughout the facility within posted areas or within labeled equipment. Work with radioactive materials in unencapsulated, potentially dispersible forms presents the potential for radiation doses resulting from internal uptakes and external exposures. LLNL has defined several different hazard categories depending on the isotope, quantity, and type of operation. The level of hazard dictates the type of workplace where radiological material can be handled. These workplace categories, in order of increasing hazard, are Type O (storage), Type I (e.g., bench top), Type II (e.g., Fume Hood), & Type III (e.g., glove box). Operations with fissionable isotopes have the potential for an inadvertent nuclear chain reaction (criticality accident) if administrative controls are not followed.	Rooms with dispersible radioactive materials are designated as RMAs. Contact the Team Health Physicist to get an evaluation on personal monitoring, radioactive material handling controls, shielding, posting requirements, radioactive storage, and room controls. Radiological material being received or transferred out of CMS Complexes must follow the procedures outlined in Appendix C. Operations requiring the use of a Type III radiological workplace and operations involving fissionable materials in conjunction with cryogens, moderators, or reflectors as described in Appendix C require an IWS/SP.	• Document 20.1, "Occupational Radiation Protection" • Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials" • Document 20.6, "Criticality Safety" • Document 31.2, "Radiological Air Quality Compliance" • Appendix "C" of this FSP

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Ionizing Radiation Radioactive materials **Non-dispersible**	Sealed sources and solid radioactive material are used throughout the facility, however their proper use and storage prevents exposures to visitors and building occupants. Sealed sources or solid radioactive material is of minimal internal exposure hazard, but can be an external exposure hazard. LLNL has defined several different hazard categories of sealed sources depending on the dose rate and potential uptake hazard if the source is damaged. Use of class I sealed radioactive sources presents a minimal potential for radiation exposure and are easily controlled. Sealed sources of class II and above can present an external hazard and may present an internal hazard if they are damaged.	Class III and IV sealed source work must be authorized through the IWS process. All Class IV sealed source work also requires a Safety Plan. A sealed source inventory shall be maintained by the sealed source custodian. Sealed sources should be monitored by the custodian periodically (recommended every 6 months) to check for leakage and external dose hazard. Do not breach the source encapsulation (e.g., by dropping it, hitting it, heating it, chilling it, putting it in a vacuum chamber, getting it wet). If any breach in a sealed source is suspected, immediately stop work, leave the area, and call ES&H Team from the nearest phone, keeping in mind that you or your work area may be significantly contaminated. Restrict access to the area.	• Document 20.1, "Occupational Radiation Protection" • Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials" • Document 20.6, "Criticality Safety" • Appendix "C" of this FSP
Ionizing Radiation **Radioactive waste**	Improper management and disposal of radioactive waste is a hazard.	In addition to Appendix C of this FSP, the radioactive material controls found in the ES&H Manual will be followed. See also the source category Waste, general. Wastes containing fissionable isotopes are subject to criticality limits in Appendix C of this FSP. Wastes may satisfy these controls but may not satisfy applicable criticality safety controls in RHWM	• LLNL Implementation Plan for DOE Order 435.1, "Radioactive Waste Management" and the LLNL LLW Waste Certification Program administered through RHWM. • Document 36.1, " Hazardous, Radioactive, and Biological Waste Management

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Ionizing Radiation **Radioactive waste continued**		facilities. RHWM can provide guidance on fissionable material waste packaging, mass limits, and limits on non-fissionable materials so that such packages can be accepted into RHWM facilities.	Requirements " • Document 36.3, "Management of Satellite and Waste Accumulation Areas for Hazardous and Mixed Waste"
Ionizing Radiation **X-ray producing equipment**	RGDs are used in the CMS Complexes. RGDs typically have voltage potentials greater than 5 kV in a vacuum that can produce X-rays. LLNL has defined several different hazard categories of Radiation Generating Devices (RGDs) depending on the dose rate and potential exposure hazard. Operation of a Class I RGD is inherently safe unless damaged or modified. Class II and above RGDs can present an exposure hazard if improperly used or modified. Class III and IV RGDs (such as analytical x-ray machines) present the potential for severe and permanent localized radiation injuries if parts of the body are exposed to the primary radiation beam. Exposure rates on the order of hundreds of roentgens per second can be present in the primary beam. At such exposure rates, the DOE dose limit for extremities (50 Rem) and the threshold for tissue damage (500 to 1,000 Rem) could be exceeded within seconds. Operation of	All potential radiation generating devices, including equipment that operates with >5 kV in a vacuum, except for CRTs, are required to have a RGD characterization, to be performed by the Health Physicist, before start of operations. The characterization will determine the appropriate posting, personal monitoring requirements, survey frequency, and engineering controls. All RGDs, classified as Class II or greater, require a logbook, in the room, that includes a copy of the characterization, recent surveys, maintenance log, and a list of authorized RGD operators. Use of Radiation Generating Devices (RGDs) where interlocks and shielding cannot be effectively used or must be bypassed requires an IWS/SP.	• Document 20.1, "Occupational Radiation Protection" • Document 20.3, "LLNL Radiological Safety Program for Radiation-Generating Devices"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Ionizing Radiation **X-ray producing equipment** continued	analytical x-ray machines also presents a potential for exposure to low levels of scattered radiation (on order of a few milliroentgens per hour). Such scattered radiation fields are usually readily detected and controlled. None of the Class IV RGDs in CMLS are categorized as an accelerator, based on an evaluation of criteria in DOE Order 420.2 "Safety of Accelerator Facilities". It has been determined that the RGDs qualify for the Exemption from Accelerator status because they cannot create a high radiation area (100 mrem in one hours) or airborne radioactivity area from activation. They are also operated in accordance with Document 20.3 "LLNL Radiological Safety Program for Radiation-Generating Devices".		
Lasers	Lasers have the potential to cause severe eye injury including blindness. High power lasers such as Class IV lasers have the additional potential to cause severe burns or to ignite combustible or flammable materials that in turn could lead to personnel injuries, fire and subsequent smoke and water damage to equipment and the facility. There also exists possible exposure to electrical hazards associated with laser power	Work using lasers must be reviewed by the ES&H Team to determine necessary controls. Controls will be documented in an approved IWS or IWS/SP. Limitations on laser pointers are in Document 20.8, "Lasers" of the *ES&H Manual*. For laser dyes, an IWS/SP is required when controls deviate from the ES&H Manual. If you suspect that you have had a laser eye exposure or skin burn, perform the following actions: • If necessary, immediately call 911 [1 (925) 447-	• Document 14.11, "Laser Dyes" • Document 20.8, "Lasers"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Lasers continued	supplies and other laboratory instruments that could result in electrical shock. Some lasers use dyes. The dyes are often toxic and/or carcinogenic, and the solvent system carrying the dyes is often flammable.	6880 from a cell phone]. • During working hours report to HSD for evaluation; if after hours, report to emergency room or urgent care facility for evaluation (do NOT drive yourself). Remain in a sitting position during transport and examination to prevent further damage to the retina, if damage to a blood vessel in the eye is suspected. • Notify your supervisor and others in the work area. Ensure that you receive an examination by an ophthalmologist to determine whether an injury exists.	
Material Handling/ Transportation	Improper movement of hazardous or heavy materials may cause injury or property damage. Falling or shifting of heavy loads during lifts can cause serious injury and could be fatal. Cranes, forklifts and hoists could fail if improperly maintained or used.	Cranes in service must be inspected monthly as required by Document 15.3, "Cranes, Hoist and Rigging Safety" of the *ES&H Manual*. Cranes not in service must be administratively locked and tagged out of service. Prior to use, they must be inspected and serviced. Crane, forklift and hoist operators must have current certification and training All forklifts must be current on inspections prior to use.	• Document 15.3, "Crane, Hoist and Rigging Safety" • Document 15.4, "Powered Industrial Truck Safety"
Noise Noise continued	Some mechanical equipment produces loud noise. Repeated and prolonged exposure to loud noise may cause permanent hearing loss.	The ES&H Team Industrial Hygienist shall determine when the noise exceeds 85 dBA and recommend appropriate controls. Where feasible and reasonable, engineering controls will be implemented. People routinely exposed to levels of	• Document 11.1, "Personal Protective Equipment" • Document 18.6, "Hearing Conservation"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
		noise above 85 dBA are required to take specific training classes and participate in the LLNL Hearing Conservation Medical Surveillance Program.	
Non-Ionizing radiation	Intense light, infrared and UV optical radiation, magnetic fields, RF fields, microwaves are all forms of non-ionizing radiation. Interaction of radio frequency or microwave fields with tissue may result in burns of varying severity or other health effects, such as cataracts. Interaction of DC magnetic fields with magnetic material, such as hemoglobin, metal implants, and prostheses may result in adverse effects such as impaired capillary flow, malfunctioning of pacemakers and neurostimulators, and displacement of metal objects in the body. Ultraviolet light may burn skin or eyes. Repeated exposure may cause cancer.	Areas where strong magnetic fields are present must be characterized and posted. Controls for equipment that generates strong optical radiation, radiofrequency, microwave or static DC fields, must be evaluated and documented in an IWS.	• Document 11.2, "Hazards--General and Miscellaneous ", Section 8, "Optical Radiation Other Than Lasers" • Document 20.7, "Nonionizing Radiation and Fields (Electromagnetic Fields and Radiation with Frequencies Below 300 GHz)"
Physical hazards (other)	Physical hazards created by walking/working surfaces, elevated work areas, platforms, ladders, roof access, hand and powered tools, electrical extension cords and wet/damp floors are typical of those routinely encountered in	Keep work area free of tripping hazards. Maintain good housekeeping practices. Fall protection/restraint is required when the walking/working surface is 4 feet or more (6 feet for construction and alterations) above the next level.	• Document 11.2, "Hazards--General and Miscellaneous" • Document 15.1, "Roof Access" • Document 19.1, "LLNL Ergonomics Program"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Physical hazards (other) continued	industrial facilities and may be present. Sharps are also physical hazards. Exposure to these hazards may result in minor to serious injury. Repetitive motion can lead to ergonomic injuries.	Hand, power tools and extension cords are to be inspected before each use. In wet environments, an in-line GFCI should be used. Select ladders that are properly rated for the job (Class 1 or better) and inspect them to make sure they are in working order. Ladders, except stepladders, are to be tied off. From Lessons Learned, broken glass should be placed only into containers specifically designated and labeled for that purpose. If such a container is not available, place it directly into an outside trash dumpster. Do not place broken glass in office trash cans. Contact the custodian group listed below if you have questions or would like a container specifically for broken glass. Sharp metal objects should either be taped to eliminate any sharp edges or be placed in metal recycling bins. An ergonomic evaluation should be requested anytime an office/lab transfer is scheduled.	
Pressure Pressure	Industrial gases (e.g., nitrogen and air) may be piped throughout the experimental areas at pressure less than 150 psig. Cryogenic systems (e.g., liquid nitrogen cold traps and absorption pumps) may become pressurized if the cryogen is trapped and heats or if condensates are warmed in an unrelieved container.	Existing facility gas utility lines shall not be modified without approval from the FPOC. Connections to more than one building-supplied gas that result in a credible hazard of gas mixing, fire, or explosion shall be equipped with means to prevent gas mixing (e.g., a check valve). Quantities of gases that exceeds the amounts that could cause asphyxiation in the event of an accidental release or used in poorly-ventilated areas	• Document 12.6, "LLNL Lockout/Tagout Program" • Document 18.1 " Pressure" • Document 18.2 " Pressure Vessel and System Design" • Document 18.3, "Pressure Testing" • Document 18.4, "Hydrogen"

Source Category	*Hazard*	*Specific Controls*	*General Controls*
continued	See also Source Category: Cryogens Cylinders containing gases under intermediate pressure (less than 3000 psig) may be used throughout the facility. Examples include: Helium (vacuum leak checking), nitrogen/argon (dry purging), carbon dioxide (glove boxes), and methane (radioactive decay counting). Vacuum systems are not typically designed as pressure vessels and may contain large volumes. Vent systems may over pressurize the chambers causing a rupture.	requires additional controls. The ES&H Team Industrial Hygienist can help determine the quantities allowed in an area. Pressure systems that will be operated above 150 psig require an Engineering safety note or must be covered by a Plant Engineering Standard. An IWS/SP may also be required. Pressure systems greater than 150 psig and relief devices are inspected and recertified on a three (3) year interval. Contact the Instrument Shop or High Pressure Lab to arrange for inspection. The user is responsible not only to maintain and re-certify, equipment, but to notify the Pressure Safety Manager/PTRS database at hpl@llnl.gov of changes in status (i.e. stored, deleted, destroyed, off site), location, or user. Compressed gas cylinders will be secured using two chains; one around the top third and one around the bottom third of the cylinder. Vacuum chambers that are connected to pressurized gas sources shall be designed with a pressure relieving mechanism. If cryogenic fluids are to be used in pressurized vessels or piping systems not certified or built to the requirements of the American Society of Mechanical Engineers (ASME) or the Department of Transportation, a safety note and an Safety Plan (SP) are required.	• Document 18.5, "Cryogens" Section 4.1, "Design of Cryogenic Systems" • Toxic compressed gases need to comply with the Documents 14.3, "Toxic, Corrosive, or Reactive Gases" and/or 14.6, "The Safe Handling of Fluorine" of the ES&H Manual.

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Retention Tank System	The discharge of inappropriate wastes to a retention tank system could cause incompatible materials to be mixed, deterioration of the tank, or could require the wastewater to be regulated as hazardous, radioactive, or mixed waste. In such a case, the wastewater would have to be transported for treatment and disposal at significant expense. It is the intent of CMLS to maintain the retention systems as nonhazardous and nonradioactive waste water collection systems.	Collect all hazardous and radioactive waste and the first rinses in appropriate waste containers and do not discharge such waste to the retention system. Do not store radioactive or hazardous liquids at, in or above sinks plumbed to the retention tank system.	• Document 32.2, "Management of Retention Tank Systems"
Sanitary Sewer and Storm Sewer	Sinks and floor drains in CMLS facilities discharge directly to the sanitary sewer system or to the sanitary sewer system via a facility wastewater retention tank system. A few sinks may discharge to a carboy container. The discharge of inappropriate wastes into the sanitary system or the storm sewer system would result in negative impacts to the environment.	Containers of liquid hazardous chemicals kept near sink or floor drains will be stored in appropriate secondary containment (e.g., photo trays) to prevent accidental spills from reaching the environment. Lids to hazardous product and waste containers shall be kept closed unless material is being added or removed from the container. Sinks in CMLS facilities are labeled at or near the sink as to whether they discharge directly to the sanitary sewer or to a nonhazardous and nonradioactive wastewater retention system. All drains in kitchens, bathrooms and custodian closets discharge directly to sanitary sewer. Floor drains in labs are not typically labeled as to where they discharge. All floor drains in labs in B-151 (except the basement) and 154 discharge to the	• Document 32.3, "Preventing Storm Water Pollution and Oil Spills" • Document 32.4, "Discharges to the Sanitary-Sewer System" • Document 36.1, "Hazardous, Radioactive, and Biological Waste Management Requirements" • Document 36.2, "Managing Office and Shop Supplies for Disposal" • LLNL Storm Water Pollution Prevention Plan, UCRL-AR-110573-99.

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Sanitary Sewer and Storm Sewer continued		retention system. Floor drains in B132N, 235 and 241 typically discharge to the sanitary sewer and are generally provided removable plugs. Do not discharge any hazardous or radioactive waste, or the first rinses from containers that held such material, into the sanitary sewer, retention system or storm sewer systems. There are a number of discharges to the ground that are allowed such as uncontaminated city and rain water, air conditioner condensate, landscape irrigation, rinse water from building washing without soap, eyewash and safety shower discharges (periodic testing), and fire sprinkler system testing. There shall be no other discharges to the ground without prior approval from the Facility Point of Contact and EPD. In order to prevent spills to the ground, CMLS has adopted the SWPPP practices of providing secondary containment for hazardous liquids and cover for hazardous materials stored outside the buildings. Accidental discharges, and discharges from shower or eyewash stations as a result of use for personnel decontamination, are to be reported to the FPOC who reports the discharge to the ES&H Team Environmental Analyst. Non-storm water discharges to ground and storm drain systems require a permit per Document 32.3, "Preventing Storm Water Pollution and Oil Spills" of the *ES&H Manual.*	

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Seismic Safety	A seismic event may cause serious injury, death and major property damage.	Shelves and equipment over 5′ high or equipment that may move during an earthquake and block egress or cause injury, requires seismic anchoring. Equipment that may be damaged by an earthquake's movement that has the potential to significantly impact a programmatic mission should be anchored where possible.	• Document 22.4, "Earthquakes" • Facility Standards PEL-S-13082
Shop Operations	Mechanical and machine shop operations involve the use of machine tools, hand tools, welding equipment and various materials. There is the possibility of personnel injury being caused by objects projecting from moving machine parts, personnel or clothing becoming entangled in moving machine parts, contact with hot objects, or electrical shock caused by faulty electrical connections. There is the possibility of personnel injury or illness or environmental damage being caused by the use of hazardous materials.	Machine shop operations require an IWS. The IWS points to specific controls for each shop operation. Contact the machine shop supervisor and RI for authorization prior to using machine tools. Machine operators shall complete Engineering Machine Tool Operation Safety (MTOS) prior to use. The RI and/or the shop supervisor control key access for machine shop tools. Welding or hot-work operations are allowed only in specifically designed areas with a current hot work permit. All machinery shall be operated only with required guards in place.	• Document 10.2, "LLNL Health Hazard Communication Program" • Document 11.2, "Hazards--General and Miscellaneous" • Document 14.10, "Safe Handling of Lead and Lead Compounds in General Industry and Construction Operations" • Document 22.5, "Fire"
Unknowns	Unknowns, legacy samples, abandoned chemicals or materials and unlabeled radiological materials could possess one or more hazardous characteristics.	Unknowns shall not be brought into the building without an ES&H evaluation via the IWS process. For unknowns discovered in the building, contact the Building Health and Safety Technician ***before*** touching or moving the item.	• LLNL Waste Acceptance Criteria (UCRL-MA-115877), Section 3.6. (for unknown waste)

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Working alone/after hours	Working alone means performing any activity out of sight or communication with another individual for more than a few minutes at a time. The major danger in working alone is sustaining an illness or injury that precludes self-rescue.	Working alone/after hours requires specific approval through the IWS process for Work Authorization Level B and above. The IWS must specifically address unique hazards that may be encountered. Before allowing working alone/after hours operations, the RI shall evaluate the hazards of each activity and determine if work can be done safely alone/after hours It is recommended that you advise another person that you will be working after hours and when you expect to complete the activity.	• Document 11.2, "Hazards--General and Miscellaneous"
Waste	Waste is generated as a result of many activities. Improper management including storage, treatment and disposal of biological, hazardous, radioactive, mixed, and other regulated waste is a hazard. Biological waste includes biohazardous and non-regulated biological (NRB).	Waste minimization is a performance measure assigned to the responsible AD. Therefore, it is important for the waste generator to accurately identify the project account number on the waste disposal requisition to ensure the waste is assigned to the correct directorate. 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 surplus chemicals. Small quantities of laboratory hazardous or mixed wastes generated during experiments may be treated pursuant to the requirements of Section 25200.3.1 of the California Health and Safety Code. A separate procedure for such treatment will be developed by	Radioactive, mixed, and hazardous wastes shall be collected in Satellite Accumulation Areas (SAAs) and managed according to the requirements in: • Document 30.1, "Managing Environmental Aspects through Pollution Prevention" • Document 36.1, " Hazardous, Radioactive and Biological Waste Management Requirements, Section 3.4 "Administrative Controls for Biological Waste Management"; • Document 36.3 "Management of Satellite and Waste

Source Category	*Hazard*	*Specific Controls*	*General Controls*
Waste continued		the RI and approved by the environmental analyst as authorized by the AI. Personnel performing operations, which generate hazardous, radioactive or mixed wastes, shall minimize the types and volumes of waste produced. Refer to Appendix D for controls pertaining to Biological and Biohazardous Waste.	Accumulation Areas for Hazardous and Mixed Waste" • LLNL Livermore Site Medical Waste Management Plan and Emergency Action Plan

3.4.3 Room Designations

The Room Responsible Person is responsible for ensuring the proper designation of their work area as a Radioactive Materials Area (RMA) and/or Radioactive Materials *Management* Area (RMMA).

Laboratory rooms in the CMS Complexes are designated as either Chemical Hygiene Plan (CHP) or Health Hazards Communications (HHC) rooms in accordance with the *ES&H Manual,* Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories", and Document 10.2, "LLNL Health Hazard Communication Program". The Hazard Notice Door Sign and other hazard notice signs are posted outside each work area. The Hazard Notice Door Signs are maintained and updated by the Room Responsible Person.

3.4.3.1 Chemical Hygiene Plan

Workers in areas defined as "chemistry laboratories" (where the Chemical Hygiene Plan applies), shall be informed of Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories" of the *ES&H Manual* and the OSHA laboratory chemical hazard communication standard before being assigned to work with hazardous chemicals. Controls of chemical hazards in the CMS Complexes laboratory areas include a combination of engineering controls, written plans, protective equipment, and worker training. The IWS documents the hazards and controls associated with specific work activities.

3.4.3.2 Health Hazard Communication

Workers in shops, other non-laboratory areas and non Chemical Hygiene Plan laboratories shall be informed of the LLNL Health Hazard Communication Program before being assigned to work with hazardous chemicals.

3.4.3.3 Radioactive Materials Area (RMA) and Radioactive Materials Management Area (RMMA)

A Radioactive Materials Area (RMA) is the legal safety designation indicating that radioactive materials (dispersible or non-dispersible) are used or stored in the area. The ES&H Team Health Physicist shall make the determination of "encapsulation." The Room Responsible Person is responsible for ensuring the proper designation of their work area as an RMA.

A Radioactive Materials Management Area (RMMA) is an area where there is a possibility of generating mixed (hazardous and radioactive) waste (e.g., RMAs containing a Type I, II, or III workplace, or areas around high-energy accelerators that produce activation products). Rooms where there may be radioactive materials in ventilation or vacuum systems but where, in normal operations, there is no possibility of contamination of hazardous or municipal waste are not RMMAs.

Administratively designating an area as an RMMA pertains to waste disposal only; it is not a safety sign.

The waste generator is responsible to ensure that hazardous waste and other material/equipment leaving these areas do not contain and are not contaminated with, radioactive materials without being properly labeled or released. For more information

see Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials", section 3.6, "Free Release of Items from RMAs" of the *ES&H Manual*. The ES&H Team Health Physicist makes changes in RMA and/or RMMA status. Facility Management concurrence is required for any intended change in status.

3.4.4 Storage of Radioactive and Hazardous Materials in Offices [2]

Hazardous materials shall not be stored in offices in CMLS facilities. An office shall not be used for planned transition or storage of hazardous materials to or from an experimental laboratory.

The following exceptions to the storage of hazardous materials are allowed:

- Health & Safety Technicians may store necessary quantities of radioactive sources and hazardous chemicals in their office areas. Radioactive materials being received into the building portal may be temporarily stored in the H&ST office. The outside of the office shall be posted with a Hazard Notice Door sign to indicate the presence of hazards.
- Quantities of cleaning materials and other potentially hazardous office supply chemicals shall be kept at a minimum and commensurate with LLNLs procurement and supply practices. (No stockpiling of hazardous cleaning and office chemicals for long-term storage.) If you are not sure about a particular item, obtain prior approval from the Building Health and Safety Technician.
- Articles (finished products) made with hazardous materials (e.g. copper-beryllium compounds, lead paper weights, asbestos-containing chalk boards).
- Small display, training and commemorative samples and items if completely sealed or free of surface contamination and in secondary containment with any required labeling.
- Radioactive materials (all applicable controls as stated in Document 20.2 apply):
  - that are considered to be Generally Licensed items and articles,
  - qualified sealed sources containing less than Document 20.2 "LLNL Radiological Safety Program for Radioactive Materials", Appendix E of the ES&H Manual, thresholds (e.g. Class I and Class II sources).

If radioactive, explosive or unknown hazardous materials are discovered in an office or a location where it is not authorized, do not move the material, instead contact the FPOC or Building Health and Safety Technician immediately and also notify your work supervisor.

3.4.5 Food Consumption Policies

[2] Note: Do not delete in future FSP revisions. This section is required as Corrective Action No. 5 from a 1997 Occurrence Report involving high explosives stored in a CMS office SANL-LLNL-LLNL-1997-0007. C&MS Facility Safety Procedures will be amended to include a brief discussion on addressing materials for which the hazards or characteristics are unknown.

Eating and drinking in laboratories are not allowed unless specifically reviewed and authorized through the IWS process. Eating areas are required to be physically separate from work areas that are potentially contaminated. Per Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories" and Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials" of the *ES&H Manual*, eating, drinking, storing food or applying cosmetics is prohibited in areas where hazardous or radioactive materials are being handled or stored.

3.4.6 Restrictions During Roof Access

Equipment that may generate hazards to workers on the roof shall be secured and posted while workers are on the roof. Laboratory workers shall not reach into fume hoods or exhausted bio-safety cabinets that have been posted during roof access. Laboratory workers shall not operate other hazard generating equipment (RGDs, vacuum systems, gas systems, ovens, furnaces, etc) that have been posted during roof access.

4.3.7 Personal Protective Equipment

The Responsible Individual in consultation with the ES&H Team determines appropriate PPE. Appropriate attire for activities involving hazardous materials or operations generally includes lab coats, appropriate eye protection, gloves, covered legs and closed toed/heeled shoes. Hazard Notice Door signs are routinely marked to specify when eye protection is required for work in laboratories. For more information see Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories", Document 11.1, "Personal Protective Equipment" and Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials" of the *ES&H Manual*.

When required, the minimum type of eye protection is a pair of safety glasses with side shields. Visitor safety glasses are not to be used for programmatic work activities. Goggles are the preferred form of eye protection when there is a potential splash hazard or when working with large volumes of corrosives. Special eye protection is required when workers are exposed to lasers or ultraviolet light.

3.4.8 Facility/Plumbing Modifications

Modifications or renovations to offices or facilities (wall removal, doorway removal or installation, window removal or installation, etc.) require prior review and concurrence by facility management, typically through the IWS process. Modification to a Building Safety Feature (see Section 3.3 of this FSP) requires an IWS.

Modifications to plumbing, drains or connection of equipment to the potable water system may result in a cross-connection between the potable water, storm water, and/or contaminated water systems. Review all modifications to the facility plumbing system through the IWS process with the FPOC, Plant Engineering, and the Environmental Protection Department before work begins.

Changes to the building drainage system are to be documented in the Building Drain Management Database maintained by the Technical Services Group in Plant Engineering. Changes to the building drainage system are to follow the Guidelines for Specification and Use of Building Drain Connections.

3.4.9 Close-Out/Transfer Process

For CMLS-managed labs, when an on-going operation is terminated, when the Room Responsible Person (RRP) changes, or when the responsibility for the facility space is transferred to another organization, a walkthough of the space should be conducted to assure that all chemicals, radioactive materials, other hazardous materials, or programmatic equipment have been removed or transferred to the accepting room responsible person.

The walkthrough of the space should be conducted by the accepting RRP with the ES&H Team, the FPOC, and the releasing RRP to identify any issues and decide which will be mitigated before transfer or will be accepted by the accepting RRP. In the event that the releasing RRP is not able to complete this walkthough, the releasing RRP's work authorizing management shall assume responsibility for proper close-out or transfer of the space.

This process ensures that hazardous and radioactive wastes and materials are properly disposed of or reused, minimizes creation of legacy materials without a programmatic owner, and promotes efforts to minimize the generation of wastes. For NHI-managed rooms/labs, refer to the CMLS/NHI MOU and/or see Document 12.7, "Shutdown or Transfer of Facilities, Operations or Associated Equipment" of the ES&H Manual.

3.4.10 Windows in Laboratory Doors

Windows in laboratory doors, when present, are used for safety reasons and must not be blocked. In the event a programmatic or security need requires blocking the windows, permission of the AI must be obtained.

3.5 Facility Related Environmental Concerns and Controls

3.5.1 Waste Handling

Retention Tank Systems

The B132N retention tank system has a capacity of 30,000 gallons (6 tanks at 5,000 gallons each) and is located on the northwest side of B132N. This retention tank system is managed as a nonhazardous and nonradioactive system. The system control panel is in Control Room 1859. Notify the Facility Point of Contact if an alarm condition exists.

The B151 retention tank system has a working capacity of 18,000 gallons (4 tanks at 2640 gallons each and 2 emergency standby inground tanks at 3720 gallons each) and is located on the north side of B151. Sinks and floor drains in B151 and B154 that are connected to the retention system are so labeled. The retention system is currently managed as a nonhazardous and nonradioactive waste system.

The B241 retention tank system has a capacity of 2,800 gallons (2 tanks at 1,400 gallons each) and is located just southwest B241. This retention tank system is managed as a nonhazardous and nonradioactive system. Sinks and floor drains in lab areas that are connected to the retention system are so labeled.

The B235 retention tank system has a working capacity of 7,400 gallons (two 3,700 gallon above ground tanks) serviced by a 900 gallon sump located on the West side of B235. The system is designed and managed to routinely accept nonhazardous waste water that

enters the system from B235 laboratory sinks. The laboratory sinks are labeled to show that they discharge to this retention tank system.

Sinks in lab areas that are connected to the retention system are so labeled. The sinks in bathrooms, kitchens, and janitorial closets are labeled as draining to the sanitary sewer.

The retention tanks routinely discharge to the sanitary sewer after the tank contents are characterized by analysis.

The retention systems are designed and managed to routinely accept nonhazardous and nonradioactive wastewater.

Requirements for operating the retention tank system include:

- Prepare a written operating plan including training requirements
- Collect only waste that is compatible with the construction material of the system
- Label the tank
- Ensure that required maintenance is performed and documented

The purpose of the retention tank systems (RTS) is to verify that the aqueous effluent waste stream from certain laboratories meets the sanitary sewer permit discharge requirements before it is discharged to the sanitary sewer. This typically means the effluent cannot be hazardous, radioactive or biohazardous waste. All hazardous, radioactive and some industrial wastes and their first rinses are collected in containers in the laboratories and managed through the Radioactive and Hazardous Waste Management (RHWM) Division. Hazardous, radioactive, biohazardous and certain industrial liquid waste and their first rinses shall not be put into the RTS. Other regulated liquid wastes may be released to the retention system with prior approval of the EPD Water Guidance and Monitoring Group (WGMG) analyst.

Biohazardous waste is treated to inactivate or destroy the biohazard in the lab before discharge to the RTS. Treatment method(s) must be approved by the ES&H Team to ensure gases that could be a health hazard and hazardous waste are not generated as a result of the treatment method.

The B132N RTS has no working automated high-level alarm lights or audible alarms. The RTS is manually monitored daily by the RHWM Technician for liquid level in the tanks.

The B151 Complex RTS has automated high-level alarms (lights and audible) across from the building coordinator's office and at the RTS controls panel.

The B235 and B241 RTS have high-level alarm lights at their RTS control panels.

3.5.2 Air Emission Sources

Permitted and Exempt

The Bay Area Quality Management District (BAAQMD) regulates air emissions from sources such as fume hoods, glove boxes, boilers and internal combustion emergency generators. Generally, activities emitting regulated contaminants in minor research quantities from fume hoods and glove boxes are covered by the BAAQMD Site-wide emission permit which includes fume hoods and glove boxes. For a current list of the Permitted and Exempt Air Emission Sources, contact the ES&H Team Environmental Analyst.

Documents 31.1, "Nonradiological Air Quality Compliance" and 31.2, "Radiological Air Quality Compliance" of the *ES&H Manual*, discuss the types of pollutants that are regulated. Any non-permitted or accidental air releases shall be reported to the ES&H Team Environmental Analyst immediately upon discovery.

The glove box exhaust in B235, R1130 is the only emission source monitored for release of radioactive materials under National Emission Standards for Hazardous Air Pollutants (NESHAPs) requirements. Weekly filter samples are collected by the Health and Safety Technician and given to the Terrestrial and Atmospheric Monitoring and Modeling (TAMM) Group of EPD as required and described in ES&H Field Support Instruction #Env-3. The current version on Env-3 is maintained in the ES&H Team Discipline Action Plan.

All new or modified (includes relocated) operations or equipment that could potentially emit toxic air contaminants (e.g., solvents, metals, radionuclides, etc.) shall require a review through the IWS process to determine if a BAAQMD exemption or permit is required.

Emissions of volatile solvents through the fume hoods are generally exempt from regulation by the Bay Area Air Quality Management District (BAAQMD). Emissions of large quantities (typically >5 gallons per year per building) of volatile solvents for wipe cleaning must be evaluated by the Environmental Protection Department for a possible permit from the BAAQMD. Intentional evaporation of volatile solvents as a means of disposal is considered treatment of hazardous waste, which requires a permit and is not allowed.

4.0 Maintenance, Inspection, and Quality Assurance of Safety Systems and Equipment

4.1 Configuration Management, Maintenance Plans and Testing for Institutional Configuration Items

Certain BSF are the responsibility of the institution. Institutional BSF are marked in Table 3-4. Plant Engineering maintains a Master Equipment List (MEL) which includes Institutional BSF. Maintenance on Institutional BSF is provided by Plant Engineering Maintenance and Operations Division in accordance with *ES&H Manual* Document 3.1, "Nonnuclear Safety Basis Program". Maintenance procedures are documented in accordance with the Plant Engineering Quality Assurance Plan. Preventive maintenance activities shall be performed in accordance with approved procedures. Post-maintenance testing shall be performed to ensure that the maintenance activity did not adversely affect equipment operability or functionality. Records of maintenance provided by Plant Engineering are maintained by Plant Engineering.

4.1.1 Fire Suppression Systems

The Fire Department conducts periodic inspections and tests of automatic fire sprinkler system control valves and water flow detectors. The Fire Prevention Captain maintains the Fire Department records of their inspections, testing, and maintenance functions. Plant Engineering performs annual maintenance on various sprinkler system components.

4.1.2 Fire Detection and Alarm Systems

All buildings except B152 have a building fire alarm system, with automatic fire detection and manual fire alarm stations. The Industrial Electronics Electricians Group, who also performs maintenance and maintains records, tests the fire alarm system (including smoke detectors) every six months. Water flow detectors on the fire sprinkler system are part of the fire alarm system and are tested monthly by the LLNL Fire Department. Plant Engineering conducts inspection and tests of the fire detection and alarm system that monitors the sprinkler system valves and flow detectors. The Fire Prevention Captain maintains the Fire Department records of their inspections, testing, and maintenance functions.

4.2 Configuration Management, Maintenance Plans and Testing for Directorate Configuration Items

Configuration management and maintenance on directorate BSF is provided by the CMLS ADFM in accordance with the *ES&H Manual* Document 3.1, "Nonnuclear Safety Basis Program" and the CMLS Quality Assurance Plan. Additional information is found in the CMLS Quality Management Manual at: http://cmsonly.llnl.gov/qm2/index.html. Maintenance procedures shall be documented in accordance with the appropriate directorate specific Quality Assurance Plan.

4.2.1 B132N Segmentation Features

Segmentation barriers between Area A and Area B of B132N and between B132N and B132S consist of fire walls, fire doors, and various other utility separations. All building modifications that could potentially affect the boundary between the segments must go

through a formal design review and be approved by the ADFM. There are no maintenance or testing requirements for these segmentation features.

4.2.2 B132N Non-propagating explosives storage arrays

Non-propagating storage arrays for explosive materials have been identified as BSF for B132N in order to prevent the accidental detonation of one sample from causing a detonation of other samples. Acquisition of non-propagating arrays must be approved in advance by the ADFM and an Explosives Safety Engineer. There are no maintenance or testing requirements for non-propagating arrays.

4.2.3 B151 High Vacuum Fluorination System reaction vessel manifold

The High Vacuum Fluorination System (HVFS) reaction vessel shall be maintained in a configuration consistent with the specifications in Engineering Safety Note LLSN04-503-AA, Reaction Vessel for High Vacuum Fluorination System. Proposed changes to the Engineering Safety Note shall be reviewed and approved according to the requirements of the Engineering Design Safety Standards, Chapter D: ME, EE, and Eng. Dir. Safety Notes.

4.3 Other, Non-BSF Safety Related Equipment

4.3.1 Emergency Voice Alarm

The CMS Complexes have safety-related emergency evacuation paging systems. The Industrial Electronics Electricians Group in Plant Engineering performs preventive maintenance on a six month schedule using their standing Plans. The site wide system is tested remotely every week by the LLNL Fire Department dispatcher. Plant Engineering maintains the records of the inspections, testing, and maintenance functions.

4.3.2 Emergency Lighting

Emergency lighting (including self-illuminated EXIT signs) is provided in corridors, stairs, lobby, basement, and other major means of egress, for the purpose of safe evacuation of the building in event of a power failure. Emergency lighting is either powered from emergency generator circuits or is provided with battery backup in the event of primary power failure. Plant Engineering is responsible for the periodic testing and maintenance of the self-illuminated EXIT signs. Facility Management is responsible for the periodic testing and repair of emergency lights.

4.3.3 Oxygen Deficiency Monitors

Oxygen monitoring alarms are installed in various rooms in CMS Complexes to detect oxygen deficient situations associated with use of large amounts of cryogenic liquids. These monitors are maintained by Plant Engineering on a scheduled basis. Programs are responsible for assuring that monitors required for programmatic activities are properly maintained. Facility Management is responsible for ensuring that the monitors located in the B132N LN fill stations are properly maintained.

4.3.4 Retention Tank System

The RTS are operated by the RHWM Technicians in accordance with Document 32.2, "Management of Retention Tank Systems" of the ES&H Manual and the operational plans for CMS Complexes RTS (internal CMLS documents managed by RHWM). There

are no periodic maintenance requirements for the RTS piping and plumbing. Maintenance of the RTS plumbing (manual and solenoid valves, gauges and relays, and pumps) is performed in response to periodic inspection and testing. The RHWM Technicians visually monitor the liquid level of the tanks on a daily basis. The RHWM Technicians conduct weekly inspections of the RTS tank farms for leaks and other concerns per the RTS operating procedure. Past records of inspections are kept in the building coordinator's office. If there is a leak into the secondary containment of the system, the RHWM Technician will notify the FPOC who notifies residents not to use the RTS drains and takes appropriate corrective actions.

4.3.5 Standby Generators

Standby generators are provided for B132N, B151, B154, B235, and B241.

Plant Engineering performs routine quarterly and annual testing of the generators. Plant Engineering must inform the Facility Point of Contact of a generator test no less than five working days before the test. Plant Engineering maintains the standby generators. Records of testing and services on the generators are maintained by Plant Engineering.

Standby internal combustion generators have air emission permits issued by the Bay Area Air Quality Management District (BAAQMD). Plant Engineering is responsible for air emission. See also Section 3.5.2, "Air Emission Sources" of this FSP.

4.3.6 HEPA Filters

Local HEPA filters may be used on some programmatic equipment as deemed necessary. HEPA filter systems exist on the roofs of the dissolver wing of B151 and B235.

Inspection and testing of HEPA filters, where required, is generally performed yearly by Hazards Control, using the procedure described in Document 12.5, "High-Efficiency Particulate Air (HEPA) Filter System Design for LLNL Applications" of the *ES&H Manual*.

HEPA filters in biosafety cabinets used for Bio Safety Level 2 (BSL2) work are required to be tested by an outside vendor annually and whenever modified, whenever the cabinet is moved or whenever an operator becomes aware of possible HEPA filter malfunction (for example, by aberrant Magnahelic gauge readings). Used HEPA filters must be characterized for proper disposal as waste.

Hazards Control maintains documentation of filter inspections that it performs. Test results are marked on each filter.

All housekeeping HEPA filters that are not required by the ES&H Manual should be tested annually as a best management practice.

4.3.7 Warning and Alarm Systems

Refrigerant Alarm

The refrigerant monitor and alarms are installed in B151, and B235 to measure the level of a refrigerant in the machinery spaces. They alarm locally at a lower set level and to the Fire Department at a higher level. Maintenance is provided by the Industrial Electronics Group in Plant Engineering at least quarterly.

4.3.8 Fire Extinguishers

Fire extinguishers are located throughout the CMLS facilities, at the Waste Accumulation Area near B151 and the CMLS retention tank systems. Fire extinguishers are inspected monthly by the LLNL Fire Department and are serviced annually by Plant Engineering. Hydrostatic testing of fire extinguishers is performed at frequencies that depend on the extinguisher type, and is also performed by Plant Engineering.

4.3.9 Emergency Eyewashes/Showers

Emergency eyewashes and showers are located as required in the labs and work areas throughout the CMS Complexes including the retention tank systems and Waste Accumulation Area near B151.

Facility Management is responsible for ensuring that eyewashes are inspected and flushed on a weekly basis and showers are inspected and flushed on a monthly basis. Records of such testing are maintained in the Building Coordinator's office.

The ES&H Team is responsible for periodic testing of the eyewashes to ensure they operate in conformance with the applicable Work Smart Standards. Non-conforming eyewashes shall be reported to the FPOC as soon as possible.

4.3.10 Pressure Vessels/Systems

Pressure vessels/systems and relief devices are inspected and re-certified by an LLNL Pressure Inspector on a three (3) year interval.

The user is responsible not only to maintain and re-certify equipment, but to notify the Pressure Safety Manager/PTRS database at hpl@llnl.gov of changes in status (i.e. stored, deleted, destroyed, off site), locations, or user. To have relief devices or pressure systems re-certified, call:

- The **High Pressure Lab**, Building 343 at 3-2745, 2-8468, or 3-6579
- The **Plant Engineering Instrument Shop**, Building 511 at 2-3614 or 3-1640

4.3.11 Fume Hoods

Fume hoods are checked by the Health and Safety Technician twice/year for functionality and annually for flow velocity. Some fume hoods in CMS Complexes have a face velocity alarm that will sound if airflow falls below acceptable limits. The Health and Safety Technician adjusts the face velocity of fume hoods by lowering or raising the sash or changing the variable frequency drive systems.

Operations involving heating of perchloric acid shall only be performed in a fume hood designed and posted for work with perchloric acid. Work with perchloric acid may be performed in other hoods if the acid vapors are trapped and scrubbed before being released into the hood.
The fume hood sash positions shall be adjusted to comply with ES&H and programmatic requirements.

4.4 Work Controls for Maintenance, Repair, and Service Personnel

All non-residents must check in and obtain permission from the FPOC or designee before beginning work at least once per day unless otherwise agreed. The FPOC may designate other individuals who are qualified to concur on routine maintenance work such as Whiz Tag projects.

Work on exhaust and ventilation systems, filter units, or other equipment that may have chemical or radioactive contamination shall be reviewed by the appropriate disciplines in the ES&H Team. Modification of a building safety feature requires an IWS.

4.5 Quality Assurance

The ADFM is responsible for implementing the CMLS Quality Assurance Plan for the overall quality of maintenance of Real Property and Installed Equipment (RPIE) in CMLS facilities. The Authorizing Organization is required to apply the CMLS Quality Assurance Plan (or Directorate-specific Quality Assurance Plan as appropriate) to their Personal Property and Programmatic Equipment (PPPE).

5.0 Facility-Specific Training Requirements

5.1 General

Building residents and personnel working in facilities covered by this FSP shall complete CH2202-W, "Facility Safety Plan Training: CMLS Laboratories" training. Record of completion of this briefing is tracked through LTRAIN. Failure to complete the training could impact ability to access the facility and/or specific locations.

Maintenance, service personnel, and/or other personnel not normally assigned to work in the Complexes may receive an appropriate alternative briefing from the FPOC or designee to understand facility-specific hazards and controls related to their activity.

6.0 Emergency Response Plans and Procedures

6.1 Introduction

The CMLS Site 200 Employee Emergency Response Self-Help Guide (CMLS-409) contains detailed information for widespread emergencies (such as earthquakes) for which normal, institutional assistance may not be available. The Self-Help Guide is found at: http://cmsonly.llnl.gov

This guide gives employees information and instructions necessary to respond to emergency situations including Assembly Points for the CMS Complexes and the Building evacuation routes.

The FPOC is responsible for maintaining the Self Help Shed in their area.

The information in this FSP and associated documents applies to everyone assigned to or entering the CMS Complexes.

6.1.1 Credible Emergencies

The Tier 2 and Tier 3 SBDs identify B132N, B151, B152, B154, and B235 as Low Hazard, Radiological Facilities. B241 is identified by its Tier 1 SBD as a Light Science and Industry, Radiological facility. As such, effects of accidents are limited to minor on-site and negligible off-site impacts to people or the environment. Because no off-site effects are identified, this FSP does not address off-site or Emergency Operations Center actions.

Accidents that could result in credible emergencies in CMS Complexes include:

- Fire
- Explosion
- Uncontrolled chemical reaction
- Chemical/Radiological spill or release to the environment
- Earthquake

6.2 Alarms

6.2.1 Building Evacuation

The signals for a general evacuation of the CMS Complexes include a continuous klaxon sound or verbal instructions transmitted over the building emergency announcement system.

The klaxon alarm is transmitted from the Emergency Dispatch Center of the Fire Department when it is necessary to evacuate the building because of fire, toxic or radioactive spills, flammable gas release, or similar emergencies. Verbal instructions or notifications may be transmitted over the system. When a general evacuation is announced by klaxon or verbally, follow the instructions in the CMLS Site 200 Employee Emergency Response Self-Help Guide (CMLS-409). Local activation of the klaxon is *not* possible. If you are aware of fire or threatening conditions call 911 and ask Dispatch to announce building evacuation.

6.2.2 Fire Alarms

Upon activation of a sprinkler flow, smoke detector, or manual pull alarm, an electronic signal is automatically sent to the Fire Department. An advisory message will sound over the building evacuation page advising occupants that an automatic alarm has been received; successive messages will advise occupants what, if any, action is necessary on their part. The Fire Department will respond and determine whether the building should be evacuated. If fire or smoke is detected, call 911, and ask Dispatch to alert the other occupants of the building. If it is unsafe to remain in the immediate vicinity, leave the building and go to the assembly point.

There is no penalty or cost for using the laboratory 911 system, if you need assistance.

6.2.3 B151 and B235 Refrigerant Alarm

The B151 and B235 refrigerant safety systems consists of a chiller refrigerant ventilation system, and a monitor & alarm system. The alarm system consists of a very loud klaxon and flashing warning lights located outside entrances to the mechanical room. The B151 refrigerant ventilation system is located inside the mechanical room in the basement along with the alarm detector heads.

The alarm controller is directly connected to the Fire Dispatch Center, and whenever the refrigerant alarm goes into alarm mode, Fire Dispatch is automatically notified of the alarm and will dispatch fire unit(s) to the facility in response to the alarm. The FPOC and Health and Safety Technician will provide assistance to Fire Department and, Plant Engineering Industrial Electronics/ Air Conditioning personnel upon their arrival.

Building residents/visitors should stay out of the mechanical room and stay clear of the area near the alarm until the FPOC or his designee makes an announcement that the alarm has been cleared and activities may return to normal in the basement. During a refrigerant leak, there is no hazard to building residents other than the noise of the alarm, unless you are in the mechanical room.

6.2.4 Oxygen Deficiency Alarms

Oxygen deficiency alarms are located in multiple locations in the CMS Complex. The system located in B151 R B140 will contact the Fire Department automatically if the oxygen level drops below the alarm setpoint. If you are in a room and the oxygen deficiency alarm sounds, secure the source of oxygen displacing gas if it is readily apparent and if it is safe to do so and evacuate the room immediately. Contact the H&S Technician to evaluate the situation. If you are outside of a room where an oxygen deficiency alarm is sounding, do not enter the room. If you suspect that there might be workers in the room, call 911 immediately.

6.2.5 Radiation Monitoring System

B235 has gamma and neutron radiation detectors, as well as, area radiation monitors as part of the safety systems for the Class IV RGD in B235 R1251. If the radiation detector is alarming, leave the room and immediately contact the Health and Safety Technician.

B151, R1034B and B235, R1130 have alarming continuous air monitors (CAM) for airborne radioactivity. If the alarm is activating, hold breath and exit the room and prevent others from entering. Immediately contact the Health and Safety Technician.

Several hand and foot radiation counters are located throughout the B151 Complex and in B235 R1130. Use these counters to check hands, feet, and hand-carried items every time when exiting the associated work area where dispersible radioactive materials are handled. Notify the Building Health and Safety Technician if the alarm sounds after resetting the monitor and stay in the area until cleared to leave by the Health and Safety Technician.

6.2.6 Shelter In Place

If the nature of an emergency requires a shelter-in-place order, the Dispatch Center will make the required announcement. Personnel will remain in place, indoors until further information is received or they are released by the fire department.

6.3 Response Procedures

6.3.1 Emergency Response

The Hazard Notice Door Sign outside each lab will list personnel who are knowledgeable of the operations in each room. The list will be used to provide on- and off-shift response information.

Emergency shutdown procedures for complex programmatic equipment should be posted at the room door during any unattended operations.

6.3.2 Fire Extinguisher Use

A fire must first be reported to Emergency Dispatch (call 911) before an extinguisher may be employed. Fire extinguishers are intended for use by trained personnel under conditions where inhaling toxic fire gases and smoke is not a hazard, the fire is very small, and it is safe to do so. Personnel who have not taken HS 1670-CBT "Qualifications for Fire Extinguisher Users-CBT" within the last 12 months should not attempt to use a fire extinguisher.

Fire extinguishers should not be used where strong magnetic fields are present. Multipurpose dry chemical fire extinguishers typically contain monoammonium phosphate and ammonium phosphate and should not be used on or near incompatible chemicals such as strong alkali, magnesium, and oxidizers that can release chlorine.

6.3.3 Utilities Shut-off

Utility cutoffs to laboratories in the CMS Complexes are typically located in the ceiling in the central service corridor and outside each laboratory. Ladders are located in laboratory service corridors. Laboratory utilities may include oxygen, helium, vacuum, water, nitrogen, argon, compressed air, and natural gas.

Stand-by power is supplied to portions of each complex from a local generator. The Facility Point of Contact maintains a list of electrical circuits supplied by the generator.

- The single natural gas source to B235 is near the northwest corner of the building.
- The single natural gas source to B241 is on the outside west wall of the building.
- The B151 and B154 natural gas sources are both located in a below grade vault on the west side of B151.
- The single natural gas source for B132N is located outside the north wall of B132N.

Wrenches are attached to the gas valves. Although automatic valves will shut off the gas in the event of an adequately large earthquake, the manual gas valves should be turned off and an emergency reported to 911 by anyone suspecting a serious leak. Natural gas valves should only be turned back on after a review by the FPOC and the ES&H Team.

6.3.4 Spill Contingency Plans for Hazardous, Radioactive and Biological Material or Waste Releases

Releases/spills shall be classified as a "Large" or "Small" spill according to the criteria provided in EP0006-COR (Regulated Waste Generation and Certification Core Training):

- Small incident: nature and potential hazards known, release presents no actual/potential threat to health and the environment; no injury.
- Large incident: hazards unknown; unidentified waste; release into drains, unsafe without Fire Department, injuries, fire/explosion, evacuation required.

If the release is considered "Large," the Fire Department will be notified immediately by dialing 911. The supervisor will then be notified. Program personnel will cordon off the affected area and await the arrival of the Fire Department.

If the release is considered "Small," the Responsible Individual may clean up the material or waste (if properly trained) following the spill response procedures below:

- Contact the ES&H Team,
- Identify the spill,
- If safe, shut off source,
- If safe, eliminate ignition sources,
- Cordon off the area, and,
- Contact supervisor.

If the small spill is manageable and it is safe to do so, and in conformance with prior training, continue with steps below:

- Contain the spill,
- Absorb and neutralize,
- Clean up the affected area,
- Dispose of any hazardous waste,
- Decontaminate and restock spill equipment, and,
- Inform the ES&H Team Environmental Analyst.

If the spill is not manageable, call the Fire Department immediately at 911.

6.3.4.1 Spill Contingency Plan for Nonhazardous Material or Waste Releases

Small spills of non-hazardous material should be cleaned up by the Responsible Individual, but the help of the Facility Point of Contact (FPOC) or Custodian should be requested if assistance or additional supplies are needed. For large spills, the FPOC should be called for help. Report all environmental releases immediately to the FPOC who will contact the ES&H Team Environmental Analyst.

7.0 References

7.1 *LLNL Environment, Safety, and Health Manual* http://www.llnl.gov/es_and_h/esh-manual.html

7.2 *LLNL Emergency Preparedness Plan*

http://www-r.llnl.gov/director/ism/pdf/self_help_plan/DO_Self-Help_Plan_05.pdf

7.3 *CMLS Site 200 Employee Emergency Response Self Help Guide (CMLS 409)* *http://cmsonly.llnl.gov/esh.html#docs*

7.4 *Quality Assurance Plan (CMLS 901)* *http://cmsonly.llnl.gov/Documents/PandP.html*

7.5 *ES&H Self Assessment Plan (CMLS 305)* *http://cmsonly.llnl.gov/Documents/PandP.html*

7.6 *Training Program (CMLS 111)* *http://cmsonly.llnl.gov/Documents/PandP.html*

7.7 *ISMS Implementation Plan (CMLS 330)* *http://cmsonly.llnl.gov/Documents/PandP.html*

7.8 *Materials Management Material Control and Accountability Manual* http://www.llnl.gov/es_and_h/mmm.html

7.9 *Maintenance Engineering Procedure Maintenance Analysis Handbook (MOP-10)*

7.10 *Plant Engineering Quality Assurance Plan, Rev.3, June 1999*

7.11 *Plant Maintenance Management System (PM2S), (MOP-00)*

7.12 *CMS Policy Towards Work Authorization, in Response to LLNL Incident Analysis Report, Serial No. 0506 (September 14, 2001).*

7.13 *LLNL Facility Screening Report (SCR) for B241, March 14, 2007*

7.14 *Tier 2 Safety Basis Document for B132N, July 28,2006, UCRL-AR-223227*

7.15 *Tier 2 Safety Basis Document for B235, July 28, 2006, UCRL-AR-223230*

7.16 *Tier 2 Safety Basis Document for B151 Complex (B151, B152, and B154), July 13, 2006*

7.17 *Engineering Design Safety Standards, Chapter D: ME, EE, and Eng. Dir. Safety Notes*

Appendices

A. Facility Floor Plans

B. Working with Explosives

C. Radiological Operations

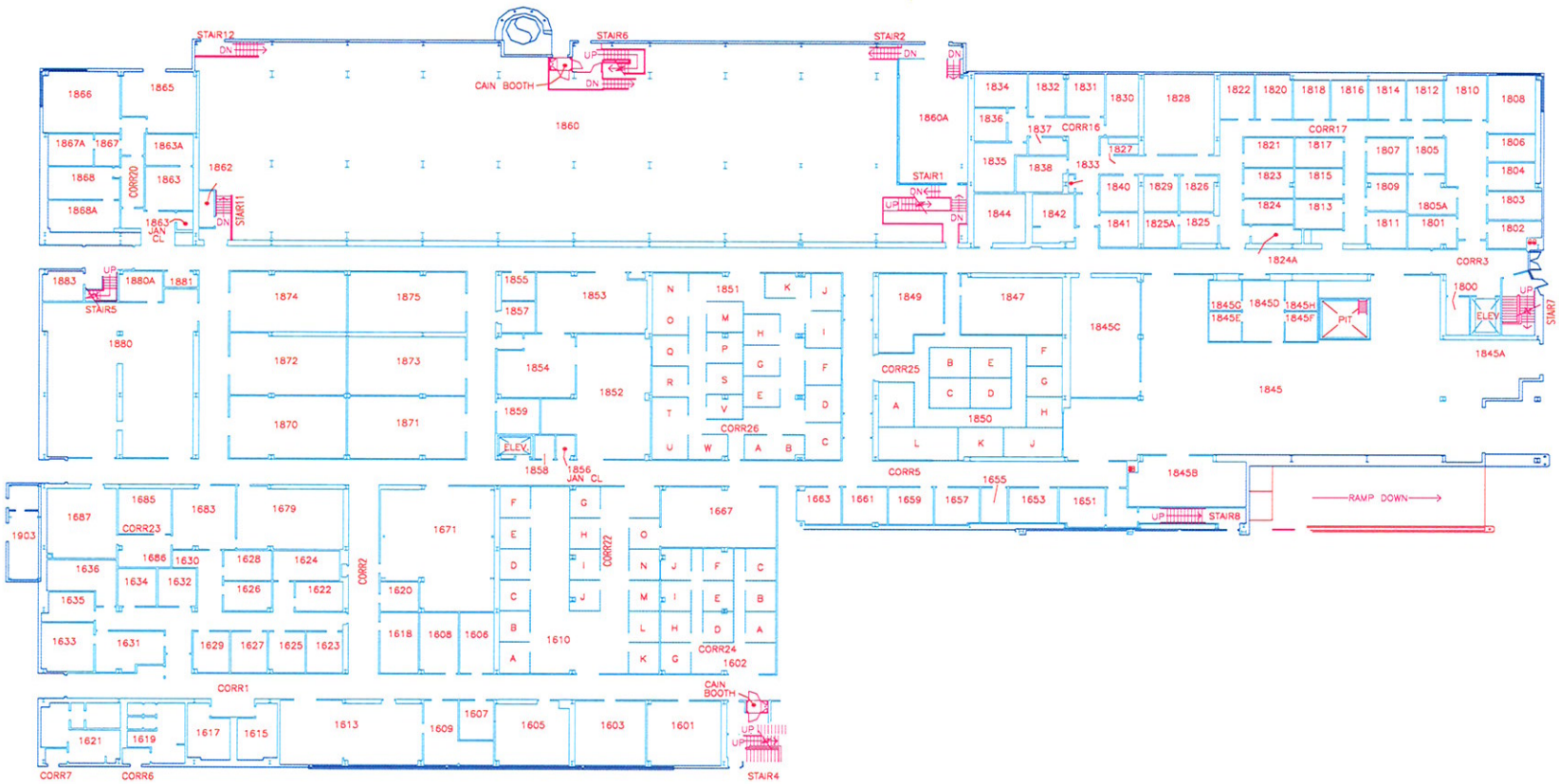
D. Working with Biohazards

E. Working with Beryllium and Beryllium Compounds

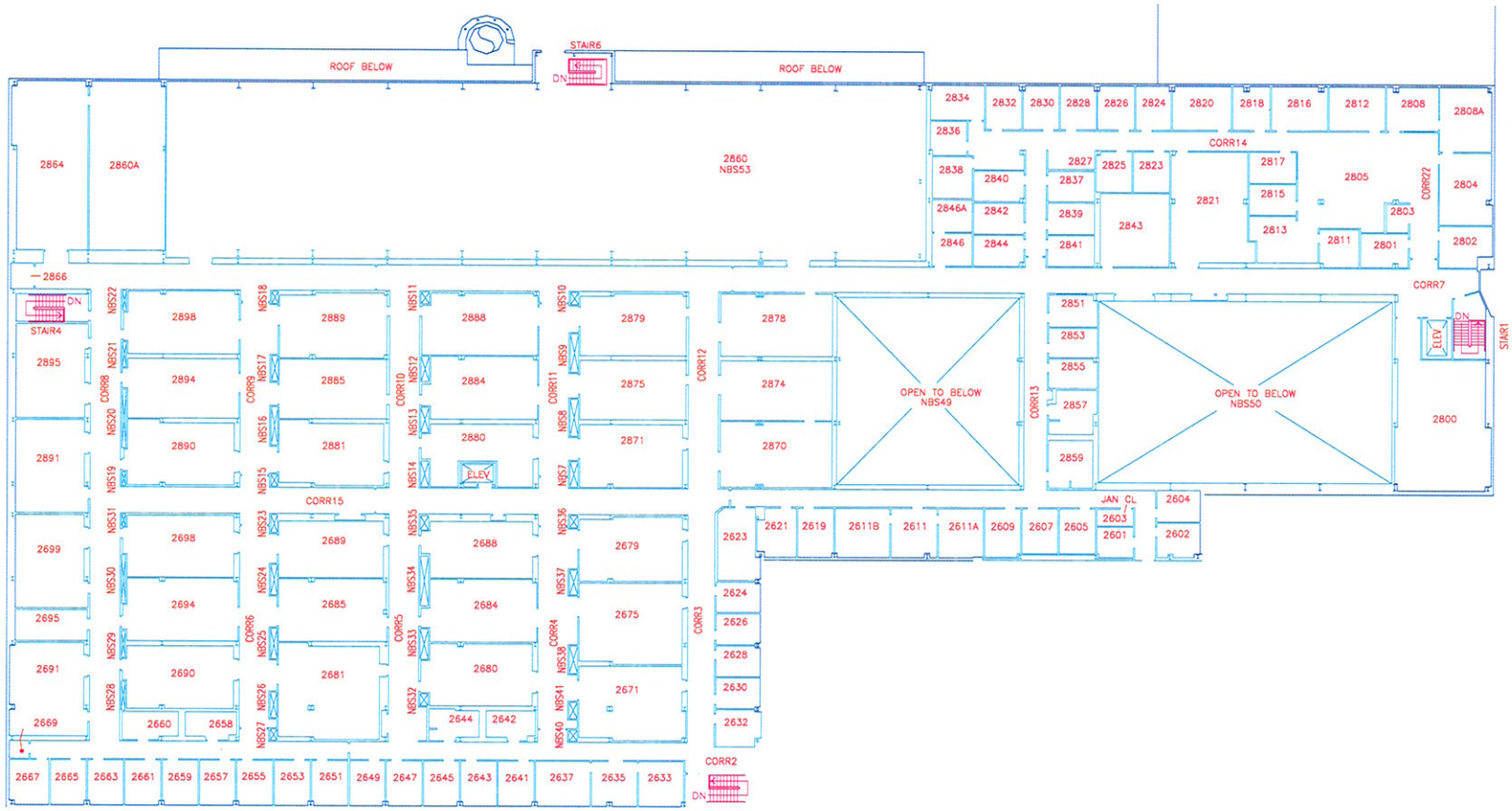
F. List of Acronyms and Abbreviations

DNT Area B First Floor: FSP 132N does not apply in cross-hatched area.

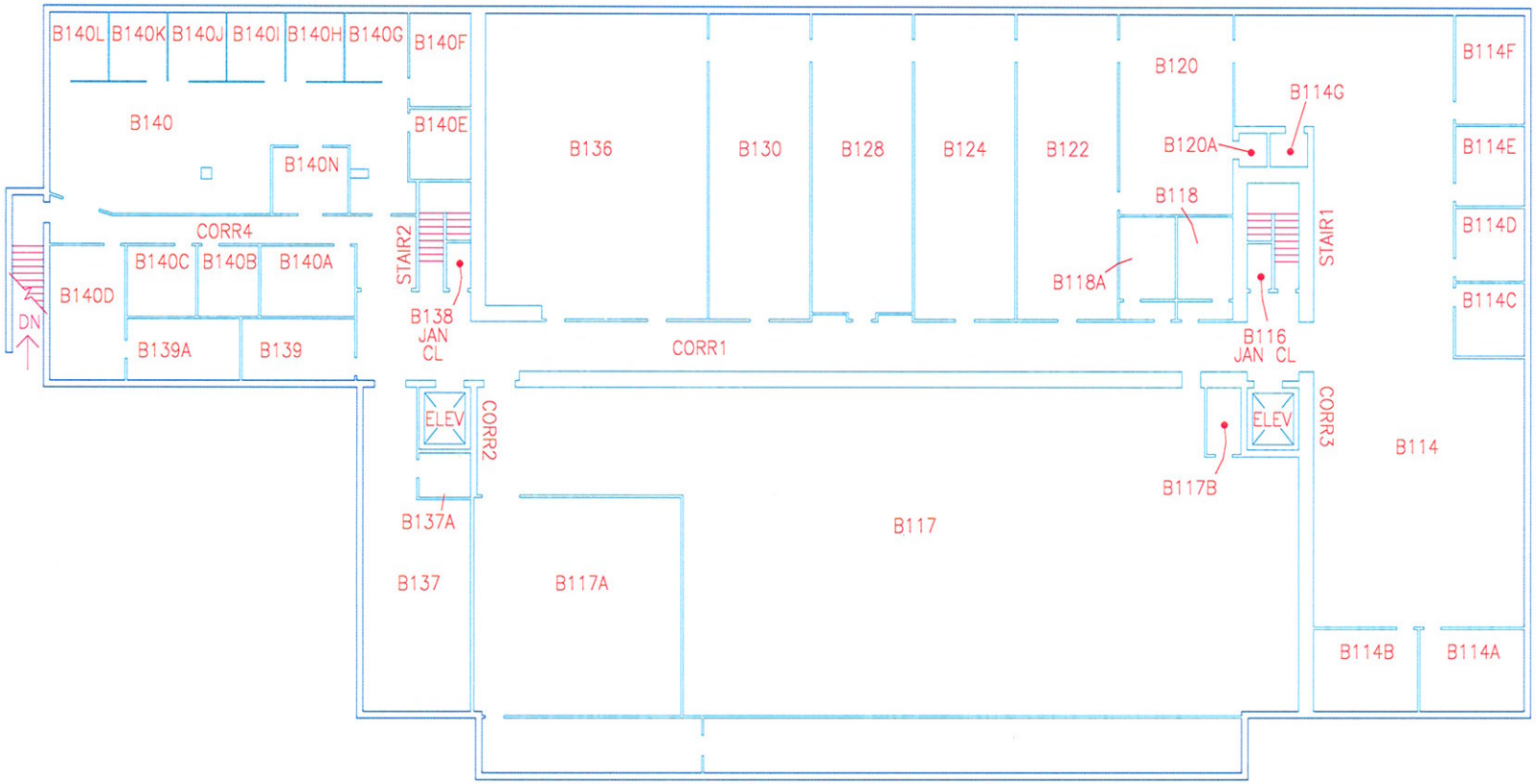
B-132N – First Floor



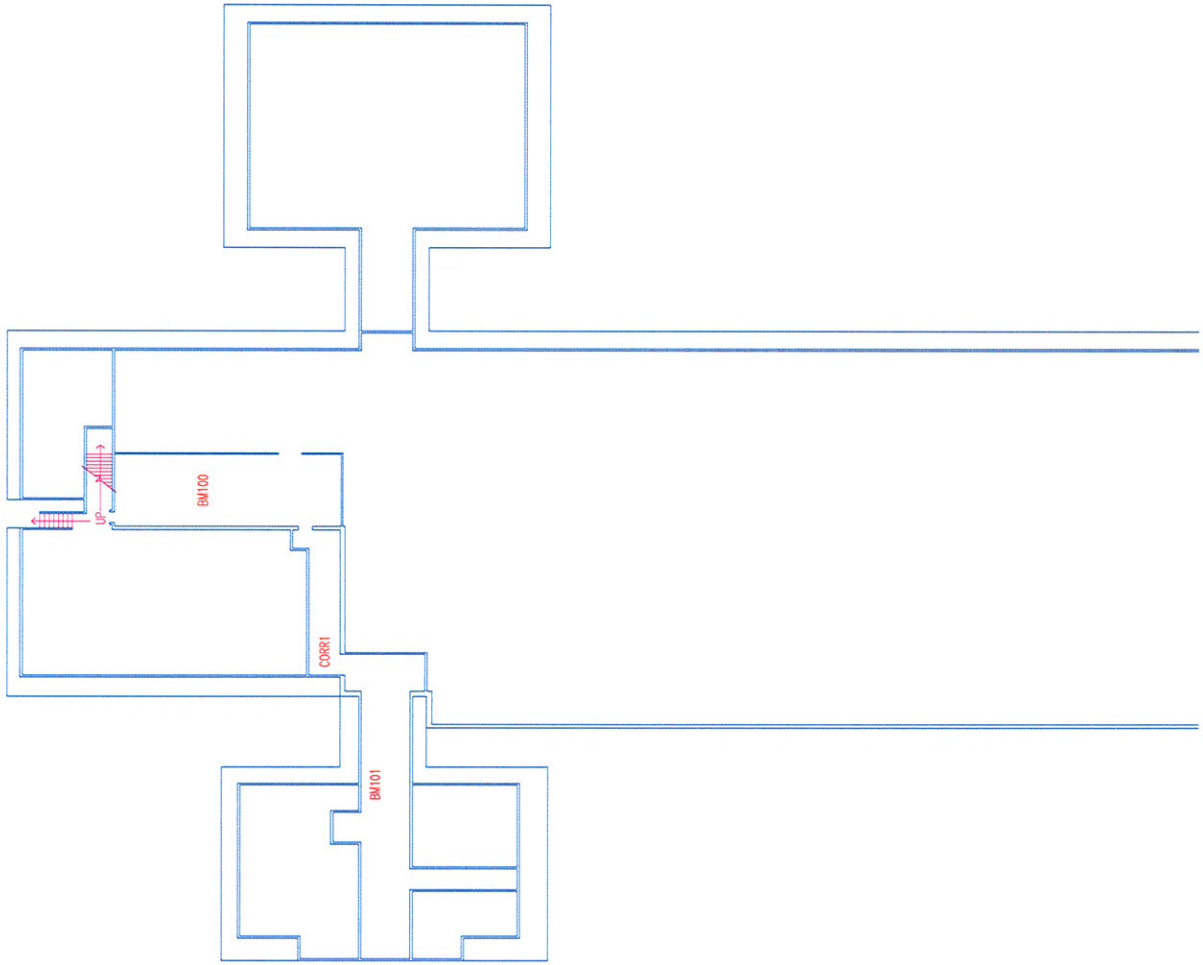
B-132N – Second Floor



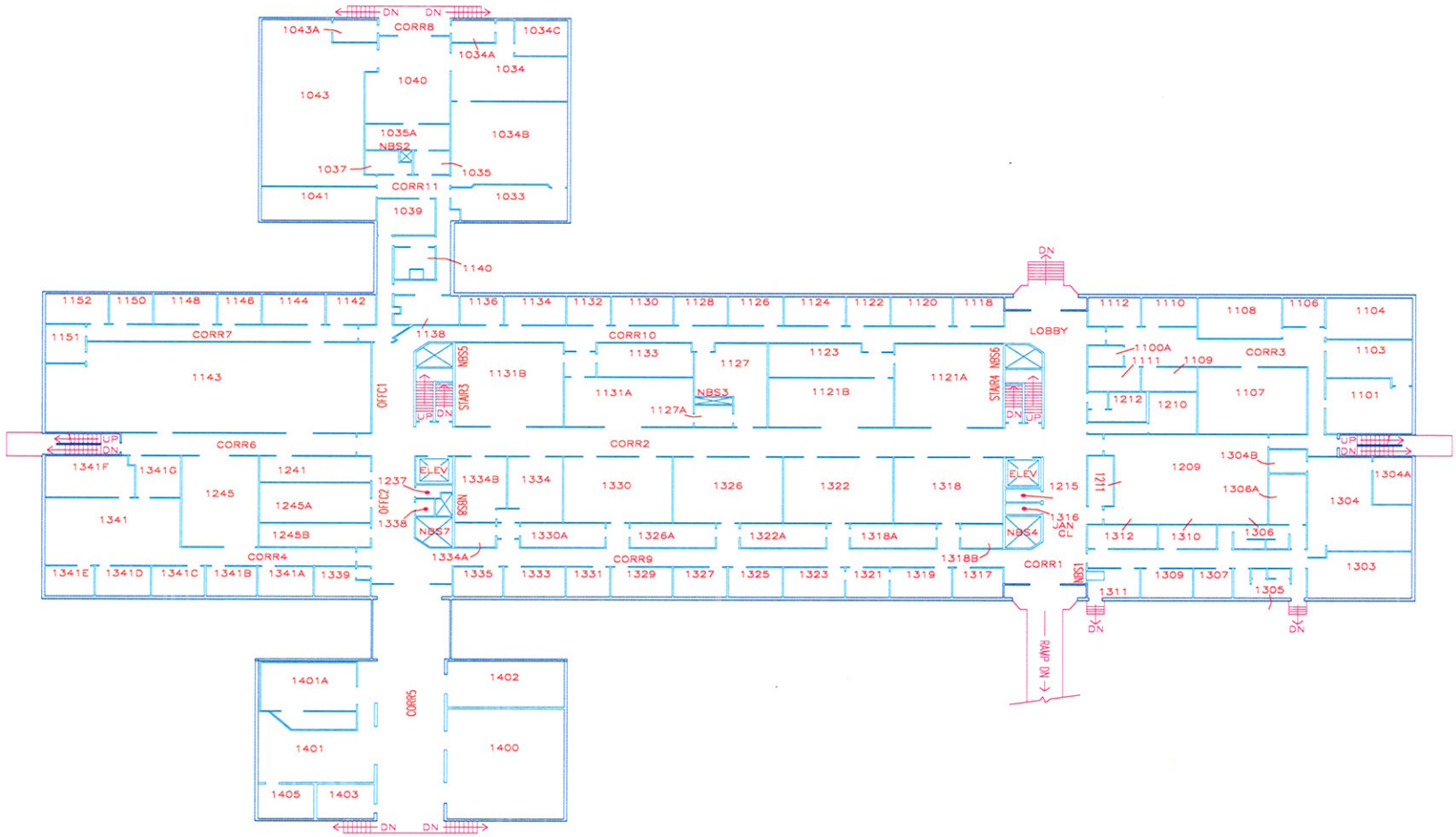
B-151 Basement



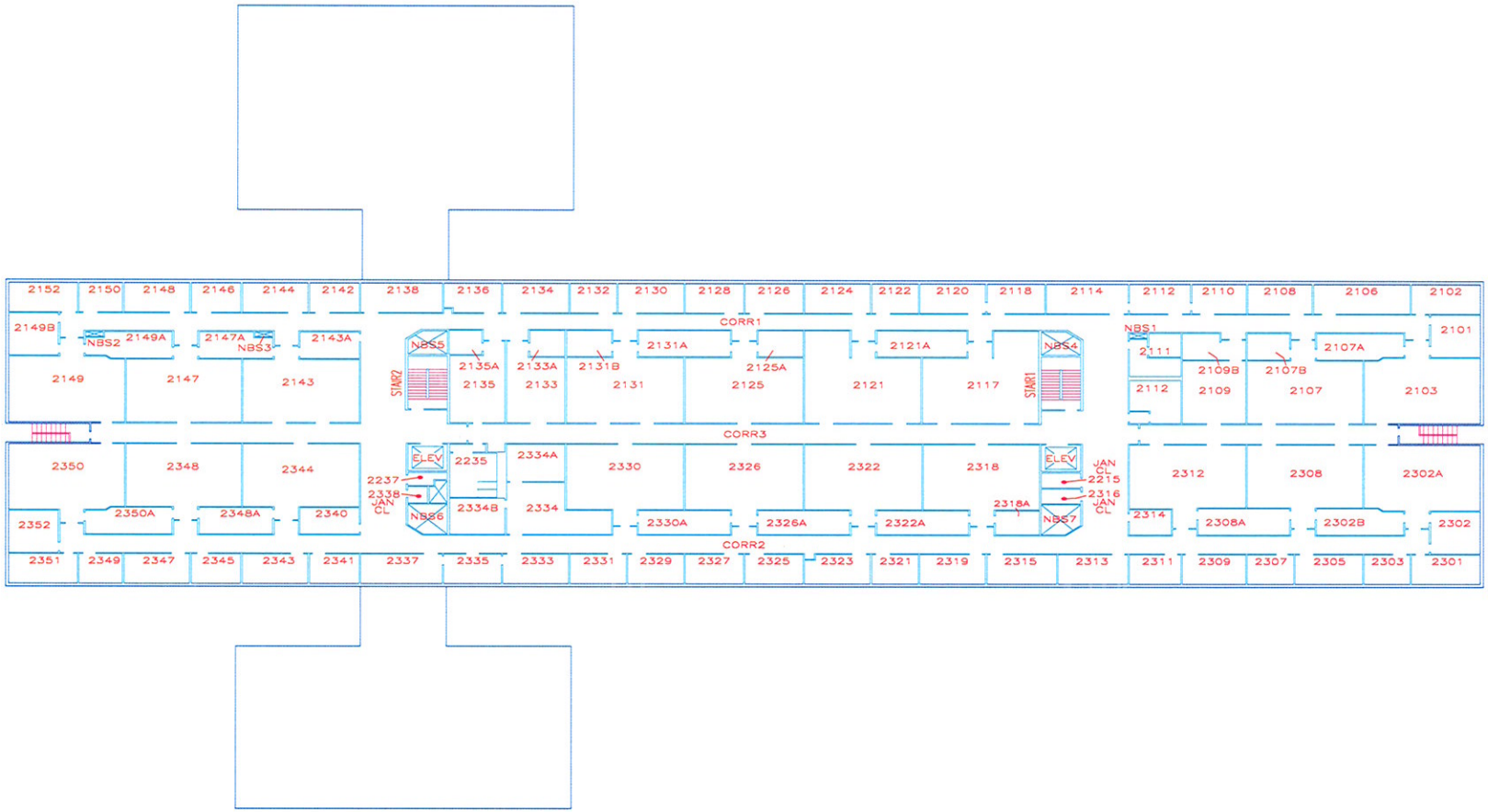
B-151 Basement Mezzanine



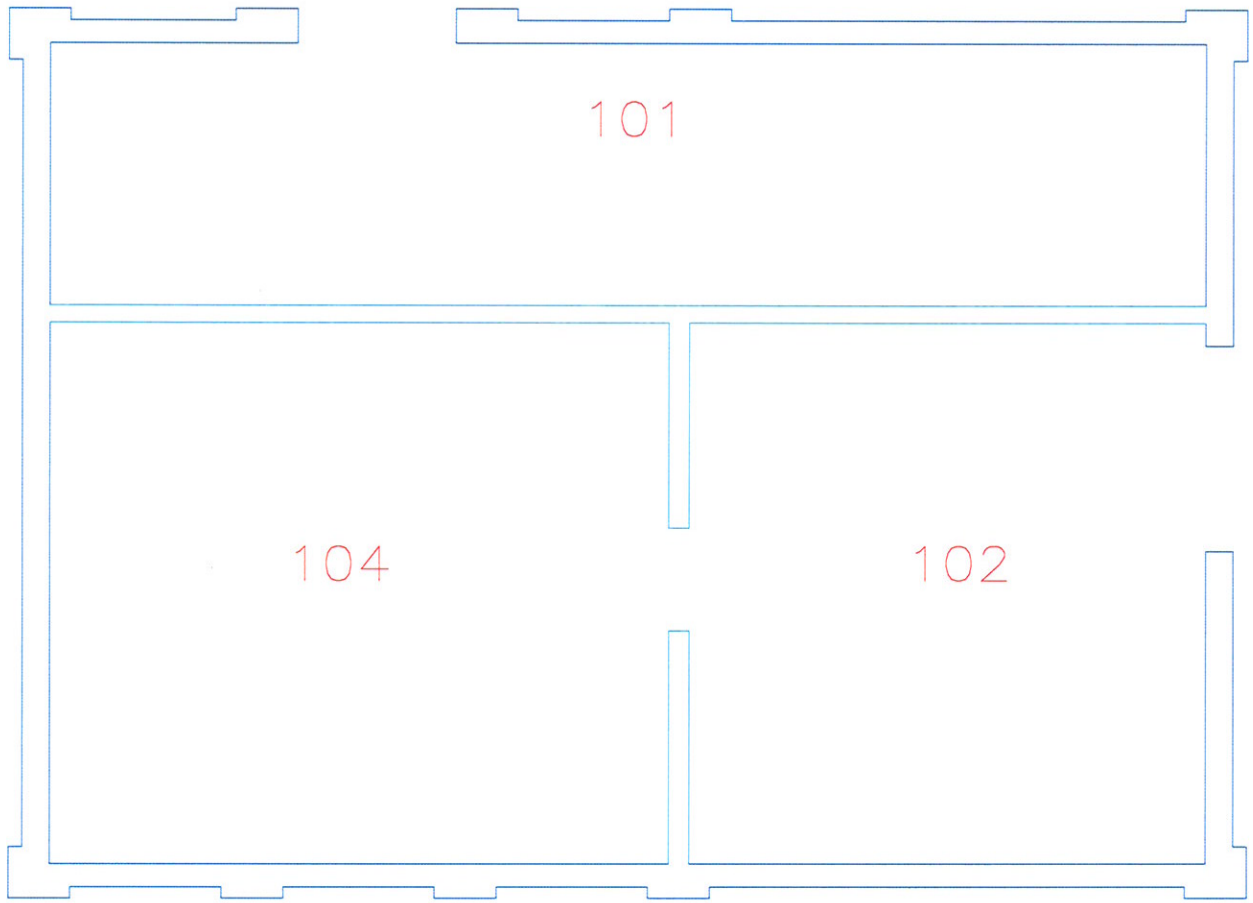
B-151—First Floor



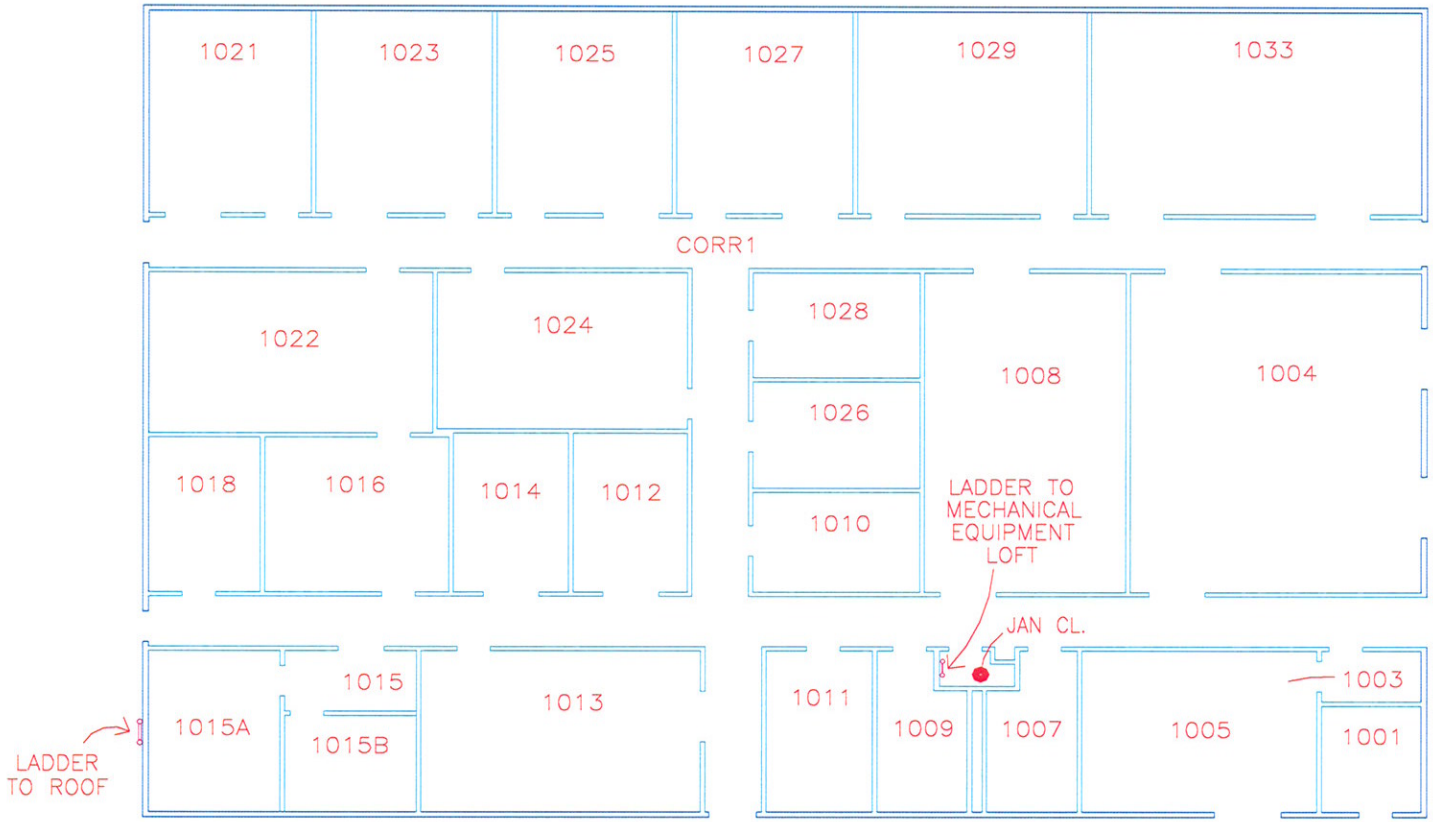
B-151—Second Floor



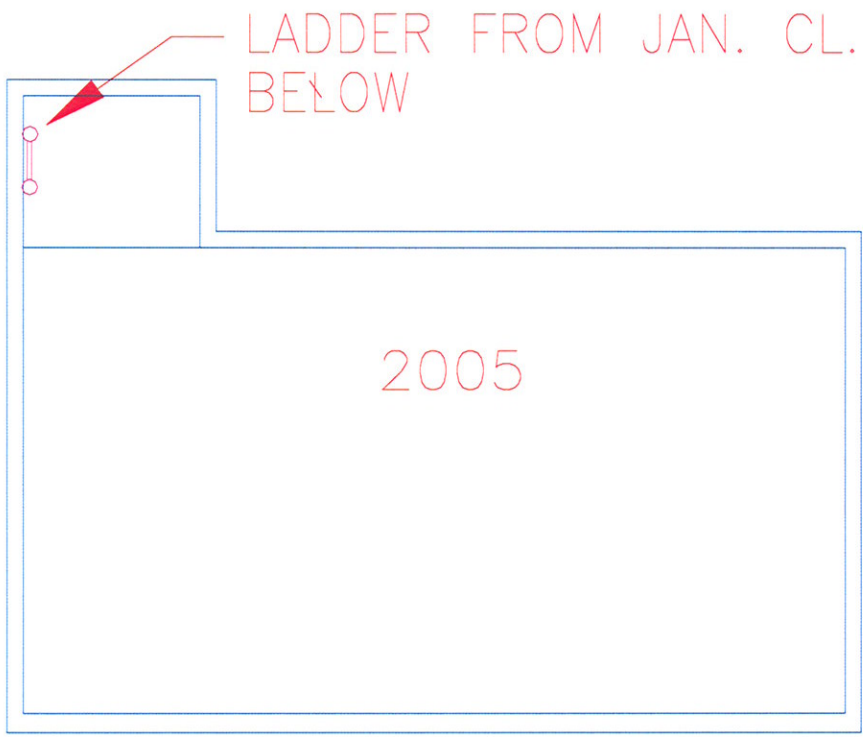
B-152 – First Floor



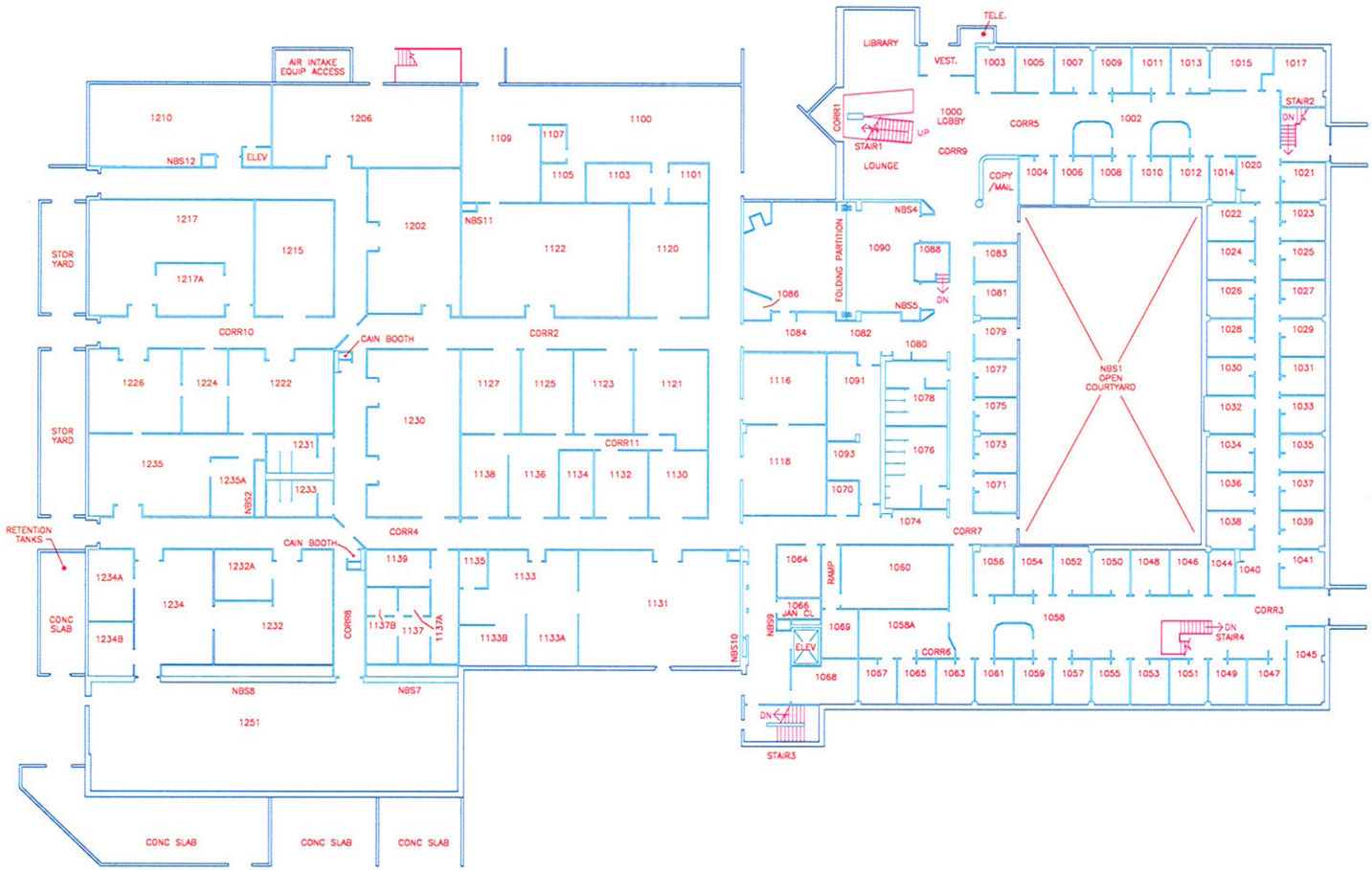
B-154 – First Floor



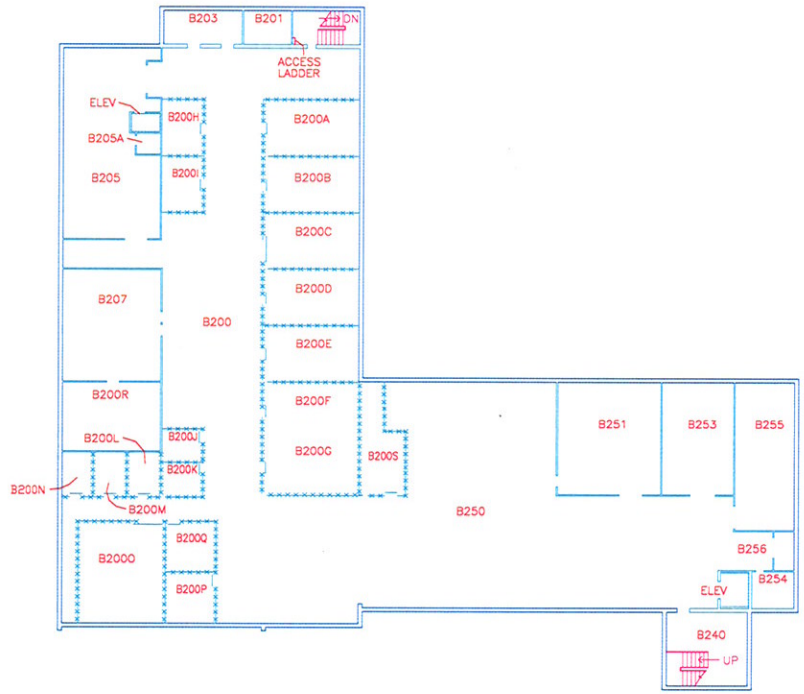
B-154 Mezzanine – Second Floor



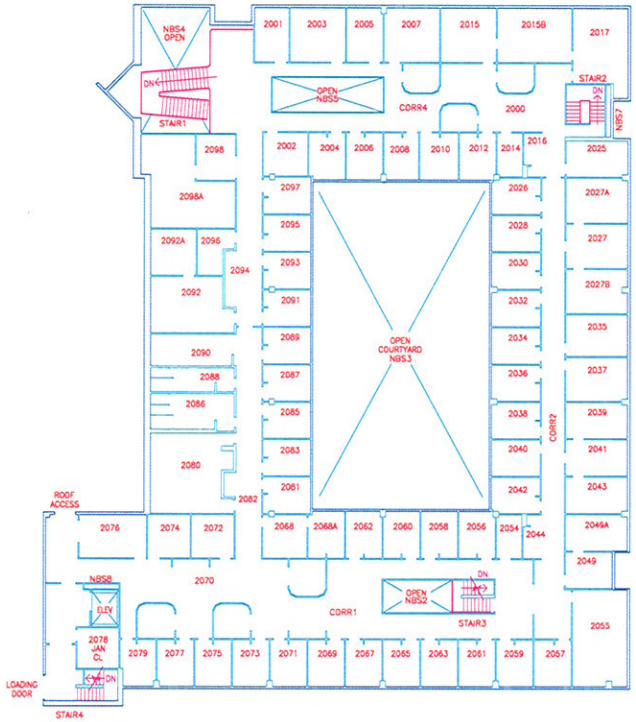
B-235 First Floor



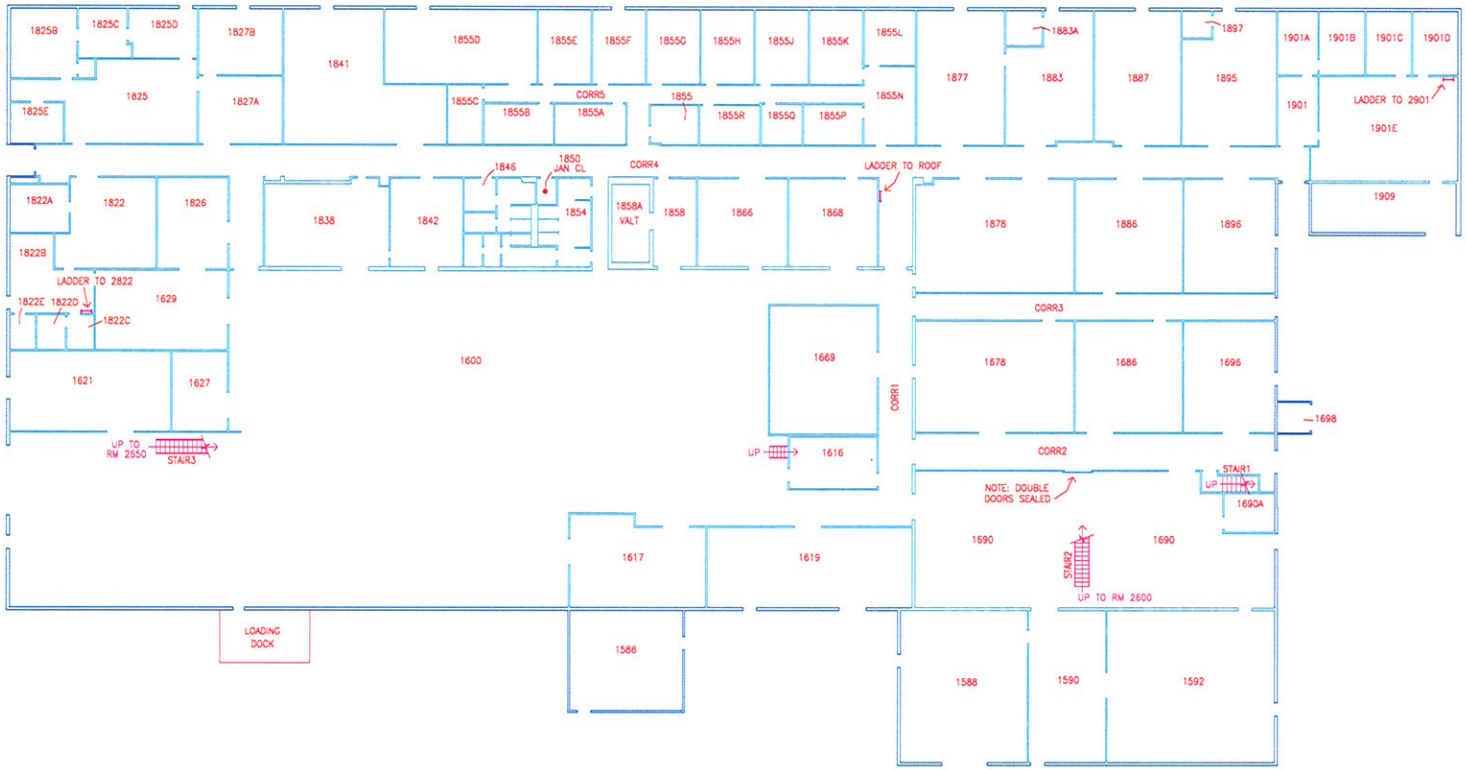
B-235 Basement



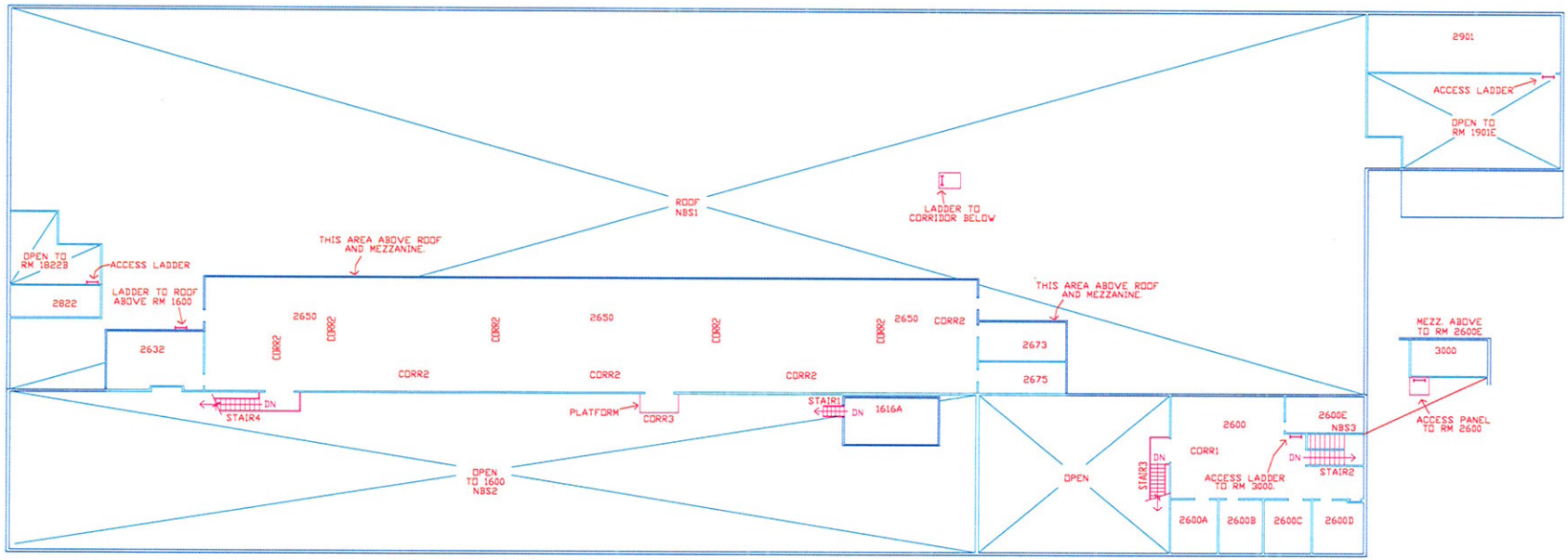
B-235 Second Floor



B-241 First Floor



B-241 Second Floor



Appendix B
Working with Explosives

1.0 General Information

Chemical analysis and small-scale analytical operations with explosives are conducted in several labs in B132N. This analysis involves various operations in order to determine the chemical composition and stability of the explosive material.

There are currently no explosives work areas >10mg in the B151, B152, B154, B235 and B241 Facilities.

Key inventory limits for operations and total quantities of explosives permitted in rooms are listed in Table 3-3.

As always, the cardinal rule with explosives is to only expose the minimum number of people, to the minimum amount of explosives, for the minimum amount of time.

2.0 Hazards Analysis

The major hazard from explosives is personal injury or property damage caused by heat, blast, noise, fumes, and flying debris or projectiles from unintentional or inadequately controlled ignition or explosion of such materials. Injuries ranging from minor to fatal could include trauma, lacerations, eye injury, hearing impairment, and burns. Property damage could range from minor to major.

Energetic materials are especially vulnerable to elevated temperature with possible consequences ranging from mild decomposition to vigorous deflagration or detonation. Energetic materials also are subject to initiation by input of mechanical work through friction, impact, or shock. Other stimuli (e.g., high-energy focused laser light, electrical spark or chemical incompatibility) can have consequences ranging from mild decomposition to detonation.

Spillage or dust from explosives could accumulate in or on pipes, sinks, floors, electrical connectors, and other crevices or areas of a laboratory when there is inadequate housekeeping. This material might be subject to ignition or other violent reaction.

Explosives may be toxic, with exposure pathways being inhalation of dust or vapor, ingestion, or skin contact. Most explosives are not highly toxic, but careless handling can result in systemic poisoning, usually affecting the bone marrow (blood-cell-producing system) and the liver. Some explosives are vasodilators, which cause headaches, low blood pressure, chest pains, and possible heart attacks. Some explosives may irritate the skin.

The major hazard from electrical equipment in explosive work and storage areas is the potential ignition of explosives and combustibles caused by heat, arcs, or sparks. Improperly installed or unapproved electrical equipment could be a source of ignition during either normal or abnormal operating conditions.

The principal hazard of the chemical analysis of explosive material is the accidental detonation or burning of a sample of explosive, resulting in injury. In addition, mineral acids may be used to digest samples of explosive material for trace metals analysis, and exposure to these acids may

cause damage to tissue and equipment. Also, the organic solvents that may be used to dissolve samples of explosive material for other analytical analyses may be flammable.

3.0 General Controls

This subsection describes controls to mitigate explosive hazards as identified in the Hazards Analysis Report and Tier 2 and Tier 3 Safety Basis Documents. All explosives operations shall be conducted in accordance with the requirements of Document 17.1, "Explosives" of the *ES&H Manual* and applicable sections of the *DOE Explosives Safety Manual.*

All explosives operations involving more than 10 mg of non-primary explosives or any amount of primary explosives must be reviewed and authorized by an IWS/SP.

Operations involving less than 10 mg of non-primary explosives conducted in areas where explosives are not otherwise permitted require an IWS and review by an Explosive Safety Engineer as described in Section 3.14 of *ES&H Manual* Document 17.1, "Explosives".

Operations involving explosives in solvents where the explosives concentration exceeds 25 weight percent are treated as explosives. When near other explosives, these materials become storage compatibility Group D unless otherwise indicated.

3.1 Controls for Explosives Operations (> 10 mg non-primary) B132N Complex

- All approved explosives work and storage areas shall have explosives weight limits and personnel limits posted at the entrance. Each of these explosive areas shall remain at or below the posted weight limits.
- A workroom inventory board shall be maintained near the entrance for each explosives lab (rooms with multiple entrances will provide direction on where the board is located). This board shall accurately list the type, amount, and owner of each explosive present in the room (excluding repository files) and the total amount of explosives present. Explosives waste shall be included in this inventory. The explosive inventory shall be updated by the person responsible for moving the explosive material into or out of the workroom. The Room Responsible Person is responsible for assuring that the inventory is accurate.
- Each repository drawer shall have an approved, non-propagating array.
- The RRP will ensure that inventory is taken periodically in accordance with Document 17.1, "Explosives" of the *ES&H Manual* and the DOE Explosives Safety Manual, Chapter II, Section 17. The inventory shall include the contents and total explosive weight in each drawer for each repository within the room.
- Mass fire hazard materials (UNO Hazard Class/Division 1.3), not exceeding 10 grams total weight can be brought into any of the first and second floor laboratory areas authorized for low risk contact explosives operations, provided **no** Hazard Class/Division 1.1/1.5 explosives are present. When 1.3 explosives and 1.1/1.5 explosives are used in the same lab room, the weights of both 1.3 explosive and 1.1/1.5 explosives must be added and must be less than the room limit of 1 gram.
- Fragment producing materials (UNO Hazard Class/Division 1.2) are **forbidden.**

- Explosive samples greater than 1 gram shall be moved between laboratory work and storage areas in approved HE containers. These samples must have adequate packing internally to secure the material within the container and must be transported by HE qualified handlers using the most direct and least congested route.
- Samples containing up to 1 g of explosive may be hand carried between adjacent labs without metal ammunition containers. However, if the explosive is to be moved to a lab which involves passage through an office area (non-adjacent lab), the material **shall** be moved using a metal ammunition container.
- B132N, Rm. 1903 can be used for low risk contact explosives operations (e.g., weighing, subdividing, shipment receivable, analytical research, etc.) of up to 10 grams total explosives weight (room limit).
- B132N, Rm. 1901 is limited to 5 grams of explosives per non-propagating array cubicle and a maximum of 25 grams per repository drawer.

3.1.1 Explosives Work Area/Operational Control Limits

- Exterior doors to B132N, Rm. 1901 and Rm. 1903 shall be closed when working with explosives materials.
- Flammable gas bottle storage shall be a minimum of 25 feet from any of the exterior walls of B132N Rm. 1901 and Rm. 1903.
- Fire Symbols and other applicable warning signs must remain in place.
- The floor drain in B132N, Rm. 1903 must remain sealed and covered to prevent explosive powder from entering the nearby liquid waste retention area. Cracks in the floor must likewise remain sealed (either with a single piece of sheet linoleum or resilient floor coating).
- A fence or other barrier shall be maintained to prevent personnel traffic and vehicle parking at a minimum distance of 15 feet to the west of the outer perimeter of B132N, Rm. 1901 and Rm. 1903. The area within shall not be used as a storage area.
- Steel sheeting 3 mm thick shall be maintained on the interior north and west walls in B132N, Rm. 1901 and on the south wall in Rm. 1903. Sheeting shall be applied from the floor level to a minimum height of 72 inches.
- Transport between the storage area and the labs shall be in an approved container with appropriate packing material. If explosives are to be moved to a lab that involves passage through occupied areas (non-adjacent lab), an approved container and packing material shall be used.

3.2 Personnel Controls

Only explosives handlers, or handlers in training with approved training plans when being directly observed by an explosives handler, shall handle HE.

Persons who are not trained as either Explosive Handlers or Explosive Aware may not enter labs that have exposed HE unless escorted by a trained Explosive Handler or Explosive Aware individual.

3.3 Labeling

Each sample will be identified as an explosive using the label with the following information: 1) name or designation of the explosive material, 2) UNO Hazard Class, 3) storage compatibility group, 4) weight, 5) date, 6) storage review date (if required), and 7) owner.

Follow the storage review date program and compatibility guidance provided by the LLNL Explosives Safety Committee. During laboratory operations only the minimum amount of explosives necessary for the operation should be exposed at any time.

3.4 HE Waste Disposal

All unused (non-waste) material will be returned to the originator when analyses are completed. This is the preferred method of management of surplus HE.

Waste HE and HE-contaminated lab wastes will be sent through Materials Management to the HE Waste Accumulation Area (WAA) at B191. Plans for packaging and shipping this material properly are detailed in Operational Plan 92-044, Revision 2, or the most recent version. Copies of this Plan are available from the Energetic Materials Program Element (EMPE) HE Safety Monitor. In addition, the waste generator must obtain permission from the WAA Coordinator at B191 before shipping any waste.

4.0 Mock Explosives

A mock high explosive (Mock HE) is a non-detonating material with a property that mimics compositional or physical properties of a given explosive. Mock HE is a controlled material, and guidelines for its proper use are given in Document 17.1, "Explosives" and Document 17.5, "Controlling Nuclear Explosive-Like Assemblies (NELAs) and Their Mock Components" of the *ES&H Manual*. If the Mock HE waste has hazardous components it will be managed according to the procedures described in EP0006-COR, "Regulated Waste Generation and Certification Core Training" course.

5.0 Training

The employee's payroll supervisor is responsible for verifying that the employee has completed appropriate Explosive Handler, Explosives Support, or Explosives Aware training and on the job training (OJT). Personnel become qualified explosives handlers by completing the training and other requirements as outlined in Document 17.1, "Explosives" and Document 17.7, "Explosives Training and Qualification Program" of the *ES&H Manual*.

6.0 Restricted Explosives

Operations with Low-Energy Initiators (LEIs) or primary explosives (explosives that are considered more sensitive than PETN) require an approved IWS/SP.

7.0 Low-Energy Initiators

LEIs are defined in *ES&H Manual* Document 17.3, "Low-Energy Initiator (LEI) Operations." LEIs, also referred to as low-energy EEDs, contain energetic materials that may be initiated by 0.1 J or less at a peak power level of a few watts. These devices by design typically contain primary (initiating) explosives or pyrotechnic material. By their nature, these materials may be sensitive to heat, impact, or electrostatic discharge (ESD). In preparing the IWS/SP, the safety controls, the

handling and characterization procedures, and the effects of all forms of radio frequency (RF) (e.g., radio transmitters, 2-Way Pagers, two-way radios and other such RF transmitting devices) will be evaluated and reviewed by the LEI Committee and must be included in the IWS/SP prior to the material being received into B132N.

8.0 Primary Explosives

For the purpose of this FSP, a primary explosive is defined as an explosive with a static sensitivity less than 0.1 J or impact or friction sensitivity greater than that of PETN. The use of primary explosives and devices containing these explosives as part of the "explosives train" requires special handling requirements. These requirements include but are not limited to grounding and bonding, restrictions on clothing material, and controls on equipment approved for each specific explosives operation. These explosives may be more sensitive to the various forms of external stimuli such as static (ESD), friction, heat, and impact.

In addition to a specific SP addressing primary explosives and the required training (HS2045), special consideration must also be given to the room or area where the work is performed. Items such as grounding, bonding, and equipment, as well as other items, must be reviewed by an explosives safety engineer and approved by the Authorizing Organization prior to these types of explosives being allowed into the room. All rooms and areas where these explosives or explosives devices are to be used must be approved prior to use. A Peer Review is required for all primary explosive operations.

Appendix C
Radiological Operations

1.0 General

This Appendix applies to radiological operations in the CMS Complexes. For the purpose of radioactive material inventory control, each facility in the B151 Complex (B151, B152, and B154) has a separate radiological administrative control level. Although B152 is a radiological facility, no radiological operations or and radioactive material storage is currently authorized.

2.0 Operational Limits, Administrative Control Levels, and the ALARA Program

2.1 Unintended Effects on Nearby Researchers

To help avoid any unintended effects on nearby researchers, each experimenter is responsible for remaining aware of the current and planned work in his/her vicinity and for keeping nearby researchers informed if there is a possibility that his/her work may affect the researchers' work.

2.2 Normal Operations

Administrative controls on the quantity of radioactive materials brought into the CMS Complexes or otherwise transferred between the facilities are required to ensure the building inventory does not exceed the limits for a radiological facility.

An IWS may be required for new or changed radiological operations. The IWS is used as a basis for designating the room as a Radioactive Materials Area (RMA) and, possibly, as a Radioactive Materials Management Area (RMMA). For information on sources classification, see Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials" of the *ES&H Manual*.

There are two levels of controls for the amount of radiological material that may be in the building: (1) the *operational limit* and (2) the *administrative control level*. The *operational limit* is the maximum inventory of any single isotope that may be present in the CMS Complexes without the approval of the original safety basis approval authority. (This would change the building's hazard classification). The *administrative control level* ensures the operational limit is not reached and represents the maximum facility inventory level that may be present for operations consistent with the controls in the *ES&H Manual* and this FSP.

2.3 Operational Limits

The operational limit for a specific *isotope* is the smaller (least) of:

- The Hazard Category 3 threshold quantity from DOE-STD-1027-92 for Low Hazard Facilities,
- The Reportable Quantity thresholds from 40 CFR 302.4 Appendix B for Light Science and Industry Facilities,
- The criticality limits for fissionable isotopes in Table 1, Document 20.6, "Criticality Safety" of the *ES&H Manual*.

In addition to the operational limit for each specific isotope, the operational limit for the *total inventory* of isotopes in each complex shall satisfy the following criteria:

[Equation C-1]

$$\sum_i \frac{\text{Inventory of isotope } i}{\text{Operational limit for isotope } i} < 1 .$$

The ADFM can provide the threshold values for isotopes not listed in the DOE standard or 40 CFR 302.4.

Operations with fissionable isotopes shall satisfy all controls and requirements specified in the LLNL *ES&H Manual*, Document, 20.6, "Criticality Safety". Mass limits for individual fissionable isotopes and the total inventory of fissionable isotopes in the facility, including those in sealed sources, waste containers, and Type A and Type B packaging, are provided by the operational limits. These limits are safe from a criticality safety perspective only if the following additional controls are also satisfied:

- Fissionable materials shall not be intermixed with or dispersed in a matrix of hydrogenous material with a hydrogen density greater than water (e.g. polyethylene, oils, plastics, etc.).
- Fissionable materials shall not be intermixed with or in close proximity* to beryllium, deuterium, or their compounds, or graphite.

  * If fissionable material is to be handled in conjunction with these other materials, contact the Criticality Safety Section for guidance with respect to conditions constituting "close proximity". If fissionable materials are separated from these reflector materials by 2 inches or more and are not contained within or otherwise partially surrounded, then it is not considered close proximity.
- Fissionable materials shall not be in gaseous form or at cryogenic temperatures, or have the ability to reach cryogenic temperatures due to equipment malfunction or failure of administrative controls.

Exception: for ^{239}Pu, ^{235}U, or ^{233}U in quantities of 1 gram or less within a single room, the preceding restrictions on moderators, reflectors, cryogen's, etc., are waived. Such quantities may be handled/stored in a single room without criticality safety restrictions. For other isotopes, contact the Criticality Safety Section of Hazards Control to determine if a waiver can be obtained.

Operations which cannot satisfy these controls or which require quantities of fissionable materials in excess of the pre-established mass limits require a safety plan with a criticality safety evaluation.

2.4 Administrative Control Levels

The initial administrative control level in each facility Complex is established below the operational limit as a means of initiating further management review. Table C-2 defines administrative control levels.

Table C-2. Facility administrative control levels

Facility	Administrative control level
B132N	0.75
B151	0.75
B152	0.00
B154	0.75
B235	0.75
B241	0.75

The *administrative control level* for the *total inventory* of radioactive materials for a building shall meet the following:

[Equation C-3]

$$\sum_i \frac{\text{Inventory of isotope } i}{\text{Threshold of isotope } i} < \text{Administrative control level}$$

and

[Equation C-4]

$$\sum_i \frac{\text{Inventory of fissionable isotope } i}{\text{Criticality mass limit of isotope } i \text{ from Table 1, ES\&H Manual Document 20.6}} < \text{Administrative control level}$$

The AD Facility Manager, with the concurrence of the Operations Manager may recommend changes to the administrative control levels for both the overall building inventory and for individual isotopes up to 0.85; these changes become effective upon approval by the Facility AD (CMLS)[3].

Radioactive material may be excluded from the administrative inventory summation of equation C-3 at the discretion of the ADFM and only if it meets the exclusion eligibility criteria specified in attachment 1 of DOE-STD-1027-92. These criteria include:

a. Material is contained within a sealed source capsule engineered to meet the special form testing specified by the Department of Transportation (DOT) in 49 CFR 173.469 or testing specified by ANSI N43.6 "Sealed Radioactive Source Categorization,"

   Sealed sources lacking documentation that the source or prototypes of the source have been tested and have passed the tests specified by DOT or ANSI are ineligible for exclusion and are included in the facility administrative radiological inventory summation, or

b. Material is stored within a DOT Type B shipping container with current certificates of compliance and the materials stored are authorized by the certificate.

[3] Note: Per Document 3.1 "Nonnuclear Safety Basis Program" of the LLNL *ES&H Manual*, radiological inventory above 80% of the Category 3 threshold requires an accident analysis.

Materials contained in DOT Type B shipping containers lacking current Certificates of Compliance are ineligible for exclusion and are included in the facility administrative radiological inventory summation.

c. Certified sealed sources excluded from the facility inventory comply with the LLNL sealed source control policy (*ES&H Manual*, Document 20.2). This includes periodic inventories and leak checks.

Sources failing periodic leak checks are no longer eligible for exclusion. They are removed from service and included in the facility administrative radiological inventory summation of equation C-3. Radioactive materials that have been excluded from the administrative inventory ARE NOT excluded from the operational inventory summation of equation C-1.

Fissionable isotopes used in operations covered by an IWS/SP may be excluded from the sum in equation C-4 provided the following criteria are satisfied:

- The IWS/SP establishes a workstation (controlled area) that effectively isolates the operation from all other fissionable isotopes in the facility.
- The IWS/SP includes criticality safety controls specific to the operation.
- The exclusion from the facility criticality safety mass limit sum is explicitly stated in the IWS/SP.

These isotopes are still subject to administrative control levels in Equation C-3 (and the facility operational limit in Equation C-1 where the operational limit for the specific fissionable isotopes in the denominator are taken as the Hazard Category 3 values).

Section 3.0 contains additional information about the inventory of radioactive materials.

2.5 ALARA Program

Individual worker radiation doses are not expected to exceed 100 mrem/yr., so a formal As Low As Reasonably Achievable (ALARA) program is not required as per Document 20.4, "LLNL Occupational Radiation Protection ALARA Program" of the *ES&H Manual*. However, the ISM process and additional provisions in this FSP are considered a means to minimize worker exposure to radiation.

2.6 Discovery of a Condition Exceeding an Operational Limit or Administrative Control Level

2.6.1 Discovery of a condition in excess of an operational limit:

- Stop work and place in a safe condition (see below if fissionable materials are involved). Notify the Facility Manager immediately.

- Follow Document 3.1, " Nonnuclear Safety Basis Program " of the *ES&H Manual*.
- Discovery of a non-compliance or potential non-compliance involving mass limits for fissionable isotopes or with other criticality safety controls in section 2.3[4] requires the

[4] Criticality mass limits are provided by the operational limits in 2.3. The administrative control level in 2.4 provides additional margin, but is not considered the criticality mass limit for compliance purposes.

actions specified in Document 20.6, "Criticality Safety" of the *ES&H Manual*. The immediate actions to be taken are summarized in the following Table C-5:

Table C-5: Actions to be taken upon discovery of a criticality safety non-compliance -

Condition	Actions to be Taken
A noncompliance with a criticality safety control or limit is found or suspected to have occurred, AND the activity CAN be safely suspended.	• Suspend all affected activities immediately and, if it is safe to do so, place these activities in a safe static situation (i.e., where the form and geometry of the fissionable material remain unchanged). • Leave the immediate area and prevent others from entering within 15 ft. of the fissionable material, if possible. • Report the suspected violation to the appropriate supervisor and AD Facility Manager.
The activity has been safely suspended and placed in a safe static situation.	• Prevent personnel from entering the area within 15 ft. of the fissionable materials. • Notify the appropriate ES&H Team of the noncompliance. The ES&H Team shall notify the Criticality Safety Group. • Develop a recovery plan mutually acceptable to Criticality Safety Group, ES&H Team, Responsible Individual (RI), and the AD Facility Manager, and carry out the recovery in accordance with the plan.
A noncompliance with a criticality safety control or limit is found or suspected to have occurred, AND the activity CANNOT be safely suspended (dynamic situation).	• If danger is imminent, evacuate immediately and notify others to evacuate and call 911 from an onsite phone. If the situation does not present immediate danger, consult with the RI or Senior Operator, Facility Management, ES&H Team, and the Criticality Safety Group to determine if the process could evolve into a more dangerous situation if permitted to proceed. • Determine any subsequent course of action in consultation with the ES&H Team and the Criticality Safety Group at the earliest opportunity. This is a function of the AD Facility Manager.

2.6.2 Discovery of a condition in excess of an *administrative control level*

Providing that the operational limit for the facility is not exceeded, this condition shall not constitute violation of the safety envelope of the building. The following actions are required:

- Stop work and place in a safe condition. Notify the ADFM immediately,
- The Facility AD (CMLS) authorizes a temporary, controlled excursion above the administrative control level but remaining below the operational limit, and,
- Action is taken to comply with the FSP.

2.7 Safeguards and Security for Nuclear Materials

Use of certain nuclear materials requires review for security and accountability controls. The Authorized Custodian is responsible for initiating a safeguards and security review by the LLNL Safeguards and Security Department, in coordination with the ADFM. The following table provides a list of materials that are defined as accountable, nuclear materials and the Reportable Quantities (RQs), to the nearest whole unit[d] from DOE M 474.1-1B and DOE M 474.1-2A. If your work activity uses accountable nuclear material, contact your Material Balance Area representatives. Accountable nuclear materials are subject to annual and unannounced audits.

Table C-6 - Examples of DOE Order 474.1 Reportable Quantities for Nuclear Materials

Material type	RQ	Material type	RQ	Material type	RQ
Depleted uranium	1 kg	Plutonium 239–241	1 g	Californium 252	1 μg
Enriched uranium[a]	1 g	Plutonium 242[c]	1 g	Curium	1 g
Normal uranium	1 kg	Americium 241	1 g	Neptunium 237	1 g
Uranium 233	1 g	Americium 243	1 g	Thorium	1 kg
Plutonium 238[b]	0.1 g	Berkelium	1 μg	Hydrogen - 3	0.01 g
Lithium – 6	1 kg	Hydrogen – 2	0.1 kg		

[a] Uranium with a U-235 content greater than 0.7% (weight).

[b] Report as Pu238 if the contained Pu238 is 10% or greater of the total by weight Pu; otherwise, report as Pu239–241.

[c] Report as Pu242 if the contained Pu242 is 20% or greater of the total Pu by weight; otherwise, report as Pu239–241.

[d] Example: If the RQ for a given material is one gram, an item with a mass of 0.5 gram is reported as 1 gram and the item is accountable.

3.0 Radioactive Material Inventory

Operations of a building near the DOE-STD-1027-92 limit for a Category 3 nuclear facility requires a robust radioactive material inventory system. The ADFM is responsible for maintaining the inventory system and ensuring its accuracy. The plan for managing radioactive materials is described in Radioactive Materials Inventory Management Plan (CMLS 406).

4.0 Radioactive and Mixed Waste

Activities generating radioactive waste require the preparation of an Information Gathering Document (IGD) prior to the generation of the waste. This requires the generator to meet with the Radioactive and Hazardous Waste Management (RHWM) Field Technician to discuss the process and materials involved. Any radioactive waste (TRU, LLW, mixed or California combined waste) without a disposal option must receive NNSA Livermore Site Office (LSO) approval before the waste is generated. Contact the ES&H Team Environmental Analyst or the RHWM Field Technician for assistance in completing these forms and confirming disposal options for the waste.

RHWM Division has Field Technicians assigned to assist waste generators in processing their radioactive, hazardous, and mixed waste. The RHWM Field Technician provides expert advice and a number of services to the researcher.

It is LLNL policy to manage radioactive waste the same as hazardous and mixed waste. Generators of low-level radioactive waste (LLW) shall follow the procedures outlined in EP-0006 RD, "Radioactive Waste Generation and Certification" and the LLNL LLW Waste Certification Program requirements to characterize, package and document the waste stream.

Accurately identifying isotopes, activities, and custodians of waste to avoid a buildup of unaccounted inventory is desirable. Waste that can be identified accurately without undue effort (examples of undue effort are assay, establishing a chain of custody, or performing a sample analysis) shall be tracked using Radioactive Allowance Tracking System (RATS), with the waste disposal requisition form as the hard copy record.

Tracking is not required for isotopes in waste whose activity cannot be identified without undue effort *and* having an estimated activity of less than 0.1% of the operational limit. Waste containing an isotope with an estimated activity of greater than 0.1% of operational limit for that isotope shall be maintained on the building inventory until it is removed from the complex.

Discharge of radiological and or hazardous materials into the facility retention systems could result in more intensive management of the retention system as a mixed or radioactive waste system, and is forbidden except for emergencies.

Wastes containing fissionable isotopes may satisfy the facility criticality safety controls in this FSP but may not satisfy criticality safety controls for RHWM facilities. RHWM can provide guidance on fissionable material waste packaging, mass limits, and limits on non-fissionable materials so that such packages can be accepted into RHWM facilities.

Appendix D

Working with Biohazards

1.0 Purpose/Applicability

This Appendix provides guidelines for safe work with biological or biohazardous organisms and materials. This includes work with Risk Group 1 and Risk Group 2 biological microorganisms (e.g., bacteria, fungal agents, parasites, and viruses), contaminated materials (e.g. sewage), and potentially infectious materials (e.g., human bodily fluids). For more information regarding Risk Group 1 and 2 agents, see the information as defined by the National Institutes of Health at:

http://www4.od.nih.gov/oba/ Work activities involving Risk Group 3 or 4 organisms are not covered under this FSP.

The requirements presented in this Appendix summarize key controls listed in Document 13.1, "Biological Controls and Operations", Document 13.2, "Exposure Control Plan:, Working Safely with Blood and Bloodborne Pathogens", 13.6, "Safe Handling and Use of Biological Research Materials" and Document 36.1, "Hazardous, Radioactive, and Biological Waste Management Requirements" of the *ES&H Manual.*

Table D-1 provides examples of work activities that are covered by this FSP. Work activities not listed in Table D-1 such as work with select agents or live vertebrate animals require a separate IWS/SP.

Table D-1: Examples of Work Activities Addressed by Appendix D

Activity
• Bioanalytical laboratory operations (e.g., mass spectrometry on biological and blood-derived molecules, polymerase chain reaction, electrophoresis, Nuclear Magnetic Resonance, atomic force microscopy, and optical microscopy techniques).
• Microbiological techniques needed to prepare samples for such analyses (e.g., protein synthesis, culturing, staining, affixing, and decontamination activities).
• Sewer/sludge, soil/air filter sample analysis.
• Animal tissue analysis (e.g., subsample, digest).
• BSNL (BioSecurity and Nanosciences Laboratory)-related biological sample preparation and analysis, including single cell identification techniques involving mass spectrometry and related analytical methods.
• Studies of aerosol transport, aerosol detection, and aerosol mitigation technology in closed systems.

2.0 Hazards

The hazards associated with biohazardous agents vary from personal exposure to accidental environmental releases. Personal exposure may result from the handling of infectious agents, biological tissues and fluids, or effluents. Potential consequences of personal exposure include infection or development of allergy. The effect of personal exposure will depend on a variety of factors including infectious or contaminated sources, immune status of the host, and the efficiency of the transmission of infection.

Accidental releases into the environment may cause an imbalance of the normal established micro-flora for a specific area. This may have an impact on specific food industries, sewage treatment facilities, public health, and individuals that may be immunologically compromised.

Biological Agents are categorized by Risk Group to assist in identifying the level of hazard and required controls. Risk Group definitions and some examples are shown in Table D-2.

Table D-2: Classification of Biological Agents

Risk Group	Definition	Examples[1]
Covered by this FSP		
1	Agents not associated with disease in healthy adult humans.	• Escherichia coli K-12 • Bacillus thurengensis
2	Agents associated with human disease which is rarely serious and for which preventive or therapeutic interventions are often available.	• Ecoli 0157:H7 • Vaccinia virus • Epstein-Barr virus • Herpes Simplex virus
N O T covered by this FSP		
3	Agents associated with serious or lethal human disease for which preventive or therapeutic interventions may be available. Activities presumptively involving RG-3 agents include work with animals and / or tissue that may harbor RG-3 agents.	• Not Covered
4	RG-4 agents are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are not usually available.	• Not Covered

Exemptions and exceptions to the Risk Group classifications in Table D-2 require the review and concurrence of the ES&H Team Industrial Hygienist and the Institutional Biosafety Officer.

3.0 Controls

3.1 Administrative Controls & PPE

This section specifies the administrative and personal protective equipment (PPE) controls for biological materials. Follow Administrative Controls as outlined in Documents 13.1, "Biological Controls and Operations", 13.2, "Exposure Control Plan: Working Safely with Blood and

[1] For more information go to: http://www4.od.nih.gov/oba/RAC/guidelines/appendix_b.htm If the web link is broken, the source document is: *NIH Guidelines for Research Involving Recombinant DNA Molecules.* Appendix B, "Classification of Human Etiologic Agents on the Basis of Hazard." Latest version per WSS. Department of Health and Human Services, National Institutes of Health (NIH). Office of Biotechnology Activities (OBA).

Bloodborne Pathogens" and 13.6, "Safe Handling and Use of Biological Research Materials" of the *ES&H Manual.*

Protocol Review

All new biological work shall be reviewed via the IWS process and the LBOC/IBC prior to starting. All IWSs involving Risk Group 2 agents shall be reviewed by the Institutional Biosafety Officer. To start the review process, experimenters should complete the registration form found at the IBC website http://ibc.llnl.gov.

Work involving human materials will be approved by the LLNL IRB (Institutional Review Board) and the collaborating institutions IRB. All applicable controls stated in Documents 13.1, "Biological Controls and Operations" 13.4, "Research Involving Human Subjects" and 13.6, "Safe Handling and Use of Biological Research Materials" of the ES&H Manual shall be implemented.

Personal Protective Equipment

Choice of personal protective equipment shall be consistent with Document 11.1, "Personal Protective Equipment" of the *ES&H Manual,* in addition to any controls specified in the governing IWS.

- Laboratory coats, safety glasses, and impervious gloves shall be worn when working with biological materials. Laboratory coats are required at all times in BSL-2 labs.
- If a glove is torn, the glove shall be removed and replaced promptly.

Work Practice Controls

- Follow "Universal Precautions" at all times (see Document 13.1, "Biological Controls and Operation" of the *ES&H Manual*).
- Wash hands or other skin surfaces immediately and thoroughly with antiseptic cleanser if contamination occurs, and after routine removal of gloves or protective clothing.
- All laboratory staff shall wash their hands after completing laboratory activities and must remove protective clothing before leaving the laboratory.
- Laboratory personnel who have exudative lesions or weeping dermatitis must refrain from handling infectious agents/materials.
- Handle, use, and dispose of sharp objects carefully to avoid accidental injuries. To prevent needle-stick injuries, needles should not be recapped, bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand. For operations generating sharps waste, sharps containers shall be used.

Decontamination

- Equipment shall be cleaned with bleach solution (1:10 dilution of household bleach per the LLNL Biosafety Officer's instructions, or as prescribed by the Industrial Hygienist) or with an appropriate chemical germicide (see Table H-1 in Appendix H of ES&H Manual Document 13.6, "Safe Handling and Use of Biological Research Materials") immediately after completion of laboratory procedures. Contaminated equipment should never be stored without the appropriate biohazard label.

- Spill response and decontamination techniques will be developed in accordance to Section 3.1.6 of Document 13.6, "Safe Handling and Use of Biological Research Materials" and Document 13.2, "Exposure Control Plan: Working Safely with Blood and Bloodborne Pathogens" of the *ES&H Manual.*

Medical Surveillance

- Appropriate vaccinations shall be offered when available to personnel that may be exposed to biohazardous agents. Contact the ES&H Team for referral to participate in the vaccination program at the Health Services Department.
- Pregnant employees and any employee who believes he or she has a medical condition that may place him or her at increased risk in the laboratory environment, should review their work practices involving biological agents with their supervisors, and Health Services.
- Other medical surveillance may be identified by the IWS.

Transportation:

- On-site: On-site transportation of biological materials is performed using labeled leak proof secondary containers. The labeling requirements used are the same requirements that pertain to the transportation of biological waste. RHWM Technicians will coordinate on-site movement of biohazardous waste between buildings.
- Off-site: Import and export permits are required for a number of biological materials that include plant and animal pest, animal products, soil, as well as for human and animal pathogens. Contact the Industrial Hygienist for guidance. For specific packaging and shipping procedures, contact either the LLNL Receiving Office in B411 at 3-0516, or Shipping in B411 at 2-7492.

3.2 Engineered Controls

Whenever possible, engineering controls should be used to minimize the risk to the worker, public, and environment.

Laboratory facilities include:

- Lockable doors for the laboratory to control access.
- Laboratory is located away from public areas.
- Laboratory contains a sink for hand washing in adjoining room.
- Laboratory has easy to clean floors, counters, and furniture to make decontamination easy.
- Laboratory bench tops are impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surfaces and equipment.
- Laboratory illumination is adequate for all activities, avoiding reflections and glare that could impede vision.
- Access to the experiment will be administratively controlled.

- The rooms used for BSL2 work must be under negative pressure relative to the hallway and must be provided with a pressure differential monitor. The laboratories will be brought up to BSL2 status before work is approved to start.
- Biological safety cabinets or local HEPA filtration shall be used whenever activities are conducted that have a high potential for generating aerosols. Decontamination shall be performed prior to servicing these hoods and/or filters.
- All specimens of bodily fluids shall be put in a properly labeled, well constructed container with a secure lid to prevent leaking during transport.
- After they are used, disposable syringes, needles, scalpel blades, and other sharp items must incorporate Engineered Sharps Injury Protection (ESIP) features and be placed in puncture-resistant sharps containers for disposal. These containers should be as close as practical to the area where disposable sharps are used.
- For routine procedures, such as histological and pathological studies or microbiological culturing, a biological safety cabinet is highly recommended.
- Mechanical pipetting devices shall be used for manipulating all liquids in the laboratory. Mouth pipetting is prohibited.
- Use of needles and syringes shall be limited to situations where there are no alternatives. Safety needles shall be used whenever possible. Employees should pay attention to their hands whenever handling needles and syringes. Needles, syringes and other sharps shall be collected in a sharps container that should be red as a precaution.

3.3 Waste Management

Medical waste: Medical waste is a regulatory term that includes biohazardous waste, sharps waste contaminated with a biohazardous component, and trauma scene waste.

Biohazardous waste includes any of the following:

- Animal parts, tissues, fluids, or carcasses that are known to be infected with diseases that are highly communicable to humans.
- Laboratory wastes containing human or animal specimen cultures, cultures and stocks of infectious agents, and waste from the production of bacteria, viruses, and spores, discarded human or animal vaccines, and culture dishes.
- Recognizable human blood, in fluid form, and items containing enough human blood that the item releases the blood upon compression (i.e., soaked bandages or clothing).
- Human or animal excretion, exudate, or secretions required to be isolated.
- Human surgery specimens or tissues removed at surgery or autopsy suspected of being contaminated with infectious agents communicable to humans.

General: All biological cultures, stocks, and other regulated waste are decontaminated before disposal by an approved decontamination method such as autoclaving. Methods include: solid biohazardous waste is autoclaved in special autoclaves permitted by Alameda County Health Care Services Agency and then placed in the municipal trash and liquid biohazardous waste may

be disposed of into the sanitary sewer on a case-by-case basis following proper decontamination procedures and prior approval from the area Environmental Analyst.

In general, waste to be autoclaved is transported to the B361 (on a designated day each week) where the waste is treated by steam sterilization. For several operations in B132N, biological waste can be treated by permitted autoclaves designed to handle small volumes from specific operations.

Biohazardous Waste: Biohazardous wastes must be collected in red biohazard bags labeled with the words "biohazardous waste" or with the international biohazard symbol and the word "biohazard" placed inside rigid containers with appropriate labeling. Double-bagging is done as a best management practice to prevent leakage of the waste into the rigid container. The inner bag does not have to be red in color. The rigid leakproof container must be labeled with the words "biohazardous waste" or with the international biohazard symbol and the word "biohazard" on the lid and on all the sides.

Storage Times: Biohazardous waste may be accumulated for up to 7 calendar days after the first waste article is placed in the container if the waste is stored above 0°C or accumulated up to 90 days if stored at below 0°C.

Hazardous, Radioactive, and Mixed Waste: If the medical waste contains hazardous and/or radioactive components, the waste is subject to hazardous, radioactive, or mixed waste regulations, respectively. In this case, the medical waste regulations do not apply. Two clear bags (i.e., no red bag) are used in a rigid container to accumulated such solid waste, and the waste shall not be autoclaved. Instead, this waste is managed through Radioactive Hazardous Waste Management (RHWM) using a waste disposal requisition (WDR). If hazardous or radioactive waste has non-regulated biological (NRB) contamination, note on the waste label and the waste disposal requisition that there is NRB contamination in the waste. The biohazardous component may have to be eliminated through chemical disinfection prior to disposal through RHWM. Chemical disinfection requires documentation of treatment. Contact the area Industrial Hygienist and Environmental Analysist prior to adding disinfectant for guidance in safe and proper disinfection, waste preparation, and waste characterization. Specific type, concentration, and volume of the disinfectant used must be noted on the WDR prior to submittal of the WDR to RHWM for approval.

Sharps Waste: Biohazardous sharps wastes must be collected at the site of generation in leakproof puncture resistant sharps containers that are labeled as "Sharps Waste" or with the international biohazard symbol and the word "biohazard". Sharps waste containing only biohazardous components are first autoclaved to eliminate the biohazardous component and are then sent offsite for incineration through RHWM for final destruction. Generators are required to complete waste disposal requisition forms for all sharps wastes generated at LLNL.

Sharps wastes contaminated with biohazardous components that are accumulated above 0°C (at room temperature) in the red sharps containers may accumulate until the container becomes ¾ full to prevent the lid from being punctured when full. This sharps waste must be treated within 7 calendar days after the waste container is ¾ full. However, if freezer space is available, sharps wastes may be transferred to the freezer and stored below 0°C for up to 90 days after the container becomes full following the accumulation time at room temperature. The waste must then be treated by the end of the 90-day storage period.

Waste Container Decontamination: Reusable rigid secondary containers used to hold biohazardous waste shall be thoroughly washed and decontaminated each time they are emptied, unless the surfaces of the container have been completely protected from contamination by disposable liners, bags, or other devices removed with the waste.

Non-Regulated Biological Waste: It is both CMLS and LLNL policy that non-regulated biological (NRB) waste be managed in the same manner as biohazardous waste. This ensures that the waste is treated prior to disposal in the unlikely event that the waste may contain an infectious component. While biohazardous waste is placed in red autoclave bags, NRB waste is placed in clear bags (double bagging is also a BMP for NRB waste). The words "biohazardous" and the international biohazardous symbol should not be used to avoid any confusion that the waste may be subject to the Medical Waste Management Act. Waste that is sent to autoclave should utilize the Medical Waste Delivery and Autoclave form (which can be found in Document 36.1 "Hazardous, Radioactive and Biological Waste Management Requirements" of the ES&H Manual) and the records should be retained by the generator. All containers (including clear sharps containers that have been contaminated with NRB) should be labeled simply as "Biological Waste." The Hazard Notice Door Sign posted at the entrance the laboratory should have the words "Biological Hazard" clearly displayed. In areas where both biohazardous and NRB waste is generated, ALL biological waste generated will be managed as biohazardous.

Approved methods of decontamination include the following:

- Exposure to hot water of at least 82°C (180°F) for a minimum of 15 seconds, or
- Exposure to chemical sanitizers rinsing with, or immersion in, a solution containing one of the following for at least 3 minutes: quaternary ammonium solution (400 ppm active agent), iodoform solution (100 ppm available iodine), phenolic solution (500 ppm active agent), hypochlorite solution (minimum 5% concentration).

Appendix E

Working with Beryllium and Beryllium Compounds

1.0 Purpose/Applicability

Handling of beryllium in a manner that may result in airborne beryllium dust requires special attention. Work with beryllium must be in accordance with Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements" of the *ES&H Manual* unless it is determined to be exempt as described below:

The following are exempt from the requirements of Document 14.4:

- Beryllium articles that meet the definition of an article as defined by 29 CFR 1910.1200, i.e., a manufactured item that is formed to a specific shape or design during manufacture, that has end-use functions that depend in whole or in part on its shape or design during end use, and that does not release beryllium or otherwise result in exposure to airborne concentrations of beryllium under normal conditions of use. Therefore, beryllium articles are those items meeting this definition of an article and whose surface contamination level is determined to be less than 0.2 μg Be/100 cm2.
- Work with small and/or delicate beryllium materials that are either too small to do surface contamination or too fragile, eg. metallography samples for surface studies (often mounted in plastic), very thin foils or windows held in a mount (wound counter probe). For these items, LLNL assumes that work with small parts (often delicate in nature) does not result in exposure or potential exposure to airborne beryllium. To be exempted, the item must be too small to swipe, must be as clean as feasible given its intended use, and the item should be in a fixture or other device that allows working with it without touching it. Although not considered beryllium work, work with these items should be done with impervious, nonporous gloves on surfaces that are covered with some disposable material such as paper. If the item appears to be significantly oxidized or damaged and loose particulate is visible, or if the item must be modified (e.g., cut, drilled, other action that will abrade the surface), there is a potential for exposure and the work is considered beryllium work. This work warrants more extensive controls as determined by the ES&H Team industrial hygienist.
- Invoking the article exemption requires a determination that the item in question cannot release a hazardous amount of beryllium under its intended use. Article status is determined by swipe sample results and then documented with the label shown in Document 14.4, Figure 5. See Section 3.14 of that same document for details.
- Laboratory use of beryllium must meet the definition of laboratory use of hazardous chemicals. See Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories" in the ES&H Manual for applicable controls. Medical surveillance shall be offered to laboratory workers as required by Document 14.4 "Implementation of the Chronic Beryllium Disease Prevention Program Requirements" section 3.5.10 and Appendix B of the ES&H Manual.

Beryllium work that does not have to meet the requirements of Document 14.4, may have to meet a number of the provisions of that document as best management practice and this should be

implemented in IWSs developed for work with beryllium. Work with soluble beryllium salts does not have to meet the requirements of Document 14.4.

This Appendix provides the safety plan for the safe conduct of authorized operations or activities in CMLS facilities that have the potential to produce airborne beryllium. This Appendix E provides or references the controls necessary to keep breathing zone airborne beryllium at levels less than the action level[5] of 0.2 μg beryllium/m^3 and as low as practicable.

This Appendix does not serve as the authorizing document for beryllium activities – an IWS is required to authorize work. In addition, a Hazard Assessment and Control (HAC) form, and/or IWS/SP may be needed to document the use of respirators and possibly other personal protective equipment in accordance with the requirements of Document 11.1, "Personal Protective Equipment" of the *ES&H Manual.*

Table E-1 defines the initial set of activities that are covered by this FSP. These activities are within the scope of allowable beryllium activities listed in the LLNL Chronic Beryllium Disease Prevention Program (CBDPP), Appendix C, "Current Beryllium Operations". Beryllium activities subject to the LLNL CBDPP but not addressed by the LLNL CBDPP shall not be authorized until Appendix C of the LLNL CBDPP is modified and approved. The LLNL CBDPP is available from the Hazards Control ES&H Team, or can be accessed at the following web location: http://www.llnl.gov/es_and_h/sourcematerial/UCRL-AR-144636r1_1.pdf. Contact the ES&H Team Industrial Hygienist for specific guidance.

Table E-1: ., Appendix C: Beryllium Analytical Operations, Storage and Legacy Locations

Location	Activity
132N, Room 2878, 2898, 2699	• Analytical laboratory doing particle analysis; planned work may involve beryllium.
235, Rooms 1121, 1131, 1133, 1136, 1138, 1215, 1251, basement	• Research, beryllium metallurgy, beryllium coating, sputtering, inspection of beryllium under electron microscopes, ion implanter, accelerator, maintenance of equipment and facilities. Storage of beryllium metal.
241, Room 1600, 1825, 1826, 1838, 1886, 1901	• Legacy equipment present in High Bay, vault, and ventilation systems. Decommissioning of obsolete equipment. Storage of beryllium stock for x-ray windows. Previous activities; research, beryllium metal and compounds (including oxide), sputtering, machining, maintenance of equipment and facilities.

2.0 Hazards

[5] As specified in Table 2, Document 14.4, the action level is the 8-hour, time-weighted average concentration, which is a requirement from 10 CFR 850.23. It is measured without regard to the use of respiratory protection.

Beryllium is potentially toxic in all forms; however, not all forms present the same level of hazard to workers (i.e. metal or insoluble compounds). Operations that may result in the formation of airborne dispersible beryllium through processes such as grinding, polishing, or cutting beryllium samples may pose more severe health hazards.

Health hazards of beryllium exposure are summarized below, with further details available in Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements" of the *ES&H Manual:*

- Inhalation, even of small amounts of beryllium dust or particulates can produce beryllium sensitization, Chronic Beryllium Disease (CBD), or lung cancer. Insoluble forms of beryllium, such as the metal and beryllium oxide are thought to be the most dangerous in this regard.
- Acute inhalation of high concentrations of beryllium dust can cause Acute Beryllium Disease, which is a form of chemical pneumonia. This can only happen at extremely high exposure levels that are not possible with current beryllium operations in CMLS. Soluble beryllium compounds, such as beryllium fluoride, are thought to be the most dangerous in this regard.
- Skin exposure to beryllium can result in a variety of skin problems including dermatitis, ulcers, or granulomas (lesions).

3.0 Controls

Laboratories and work areas where beryllium is handled are governed by either the OSHA Hazard Communication Standard (29 CFR 1910.1200) or by the OSHA Chemical Hygiene Standard (29 CFR 1910.1450). If a laboratory or work area is governed by the Hazard Communication Standard, the controls outlined in the LLNL CBDPP apply along with the provisions of this FSP. If a laboratory is governed by the Chemical Hygiene Standard, the general controls in this FSP along with the requirements of the IWS apply.

Controls for operations covered by the Chronic Beryllium Disease Prevention Program as described in section 1.0, of this appendix, are detailed in Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements" of the *ES&H Manual.* Controls found in Document 14.4 are not repeated verbatim in this Appendix but are incorporated by reference. The controls described below are applicable to these types of operations.

Controls shall be implemented in an order of priority where engineering controls are provided first, followed by administrative controls, followed by use of personal protective equipment (PPE). Applicable controls of each type shall be identified for all beryllium operations and implemented as part of the IWS process for each beryllium work activity.

Operations that are considered non-hazardous and are exempt from further controls include the use of beryllium articles in a manner that does not cause the release of beryllium dust and the use of aqueous solutions at <1000 ppm for the calibration of instruments. Small and/or delicate samples where dust generation is unlikely are also exempt according to the provisions in Document 14.4.

3.1 Engineering Controls

Engineering controls are the preferred means of mitigating employee exposure, especially routine activities.

Engineering controls can include:

- The use of enclosing ventilation systems such as fume hoods to capture dust. All beryllium work that creates dust shall be handled in a hood or other appropriate local exhaust ventilation system.
- The use of wet methods such as wet-sawing or wet-grinding. Unless it is incompatible with the nature of the work, any sawing, grinding or other similar process shall be done wet to minimize aerosolization of beryllium. Non-combustible machining fluids are preferable because combustible fluids require additional administrative controls (see section 3.2). Sludge from these wet operations shall be collected and disposed of in a damp condition. Sumps shall be lined with a plastic bag to ease removal of the sludge.
- The use of HEPA filtration on vacuum cleaners or other local exhaust systems used in conjunction with beryllium work.
- Work with dilute solutions of beryllium rather than concentrated solutions. Where feasible, beryllium standards for calibration of analytical equipment shall be purchased as a dilute solution rather than made up in the laboratory from powders or concentrated solutions.

Vacuum pumps used on beryllium or toxic coating chambers shall not be used to evacuate non-toxic coating chambers or environments. The exhaust from these vacuum pumps shall be discharged through a HEPA filter before being exhausted to the exterior environment.

3.2 Administrative Controls

3.2.1 Examples of administrative controls appropriate for beryllium work include:

- **Inventory Control:** Beryllium metals/compounds must be tracked for inventory control purposes. Beryllium items greater than 10 grams must be entered into ChemTrack.
- **Employee training:** HS4256, Beryllium Worker Training is required for all employees who work with beryllium in such a way that there is a potential for generating airborne beryllium. All other workers at LLNL are required to take HS4258-W, Beryllium Awareness.
- **Medical surveillance:** All employees who handle beryllium in a manner that has the potential to create airborne dust shall be offered the opportunity to participate in the beryllium medical surveillance program. This will include periodic testing with the beryllium lymphocyte testing.
- **Periodic swipe sampling to verify the adequacy of contamination controls:** Where beryllium is handled in a manner that may create dust, periodic surface swipe sampling shall be specified by the Industrial Hygienist in the Industrial Hygiene Discipline Action Plan,

- **Air monitoring to determine employee exposure:** Where beryllium is handled in a manner that may create dust, periodic air sampling shall be specified by the Industrial Hygienist in the Industrial Hygiene Discipline Action Plan,
- **Special work procedures:** Special procedures shall be detailed in the governing IWS,
- **Posting of beryllium work areas:** All areas where beryllium is used in a manner that could create dust must be labeled as described in Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements" of the *ES&H Manual.* Rooms where beryllium is handled must be marked on the Hazard Notice Door Sign,
- **Labeling of beryllium contaminated equipment:** Label all contaminated equipment and contaminated exhaust systems as described in Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements" of the *ES&H Manual,* and,
- **Segregation:** Segregation of beryllium work from other activities in a laboratory.

3.3 Personal Protective Equipment (PPE)

- Appropriate PPE shall be provided in accordance with Document 11.1, "Personal Protective Equipment" of the *E&SH Manual.* The need for PPE and the types to be used shall be identified in the governing IWS or a Hazard Assessment document.
- Beryllium-contaminated PPE shall be managed as hazardous waste at time of disposal.
- Lab coats should not be worn outside of the laboratory in general use areas. It is prudent to use disposable lab coats where they may become contaminated with beryllium. Never send potentially beryllium contaminated clothing to be laundered.

Appendix F
List of Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
AD	Associate Director
ADFM	Associate Director Facility Manager
AI	Authorizing Individual
ALARA	As Low As Reasonably Achievable
AM	Assurance Manager
AO	Assurance Office
BAAQMD	Bay Area Air Quality Management District
BSNL	BioSecurity and Nanosciences Laboratory
BSF	Building Safety Features
ChemTrack	Chemical Tracking Database
CHEW	Chemical Exchange Warehouse
CMLS	Chemistry, Materials, and Life Sciences
CMS	Chemistry & Materials Science
CEQA	California Environmental Quality Act
CHP	Chemical Hygiene Plan
CSG	Criticality Safety Group
DAD	Deputy Associate Director
DL	Division Leader
DNT	Defense and Nuclear Technologies
DOE	Department of Energy
DOT	Department of Transportation
EMPE	Energetic Materials Program Element
EPD	Environmental Protection Department
ES&H	Environment, Safety, and Health
FPOC	Facility Point of Contact
FSP	Facility Safety Plan
HAR	Hazard Analysis Report (formerly PHA)
HC	Hazards Control
HEPA	High Efficiency Particulate Air (filter)
HHC	Health Hazards Communications
H&S	Health and Safety
IBC	Institutional Biosafety Committee
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
ITR	Institutional Training Requirement
IWS	Integration Work Sheet
IWS/SP	Integration Work Sheet with Safety Plan
LBOC	LLNL Biosafety Operations Committee
LLNL	Lawrence Livermore National Laboratory
LLW	Low Level Waste

MM	Materials Management
MEL	Master Equipment List
MIP	Maintenance Implementation Plan
MOU	Memorandum of Understanding
NHI	Nonproliferation, Homeland, and International Security
NEPA	National Environmental Policy Act
NRB	Non-regulated Biological
OSHA	Occupational Safety and Health Administration
PE/MOD	Plant Engineering/Maintenance and Operations Department "Plant Engineering"
PHA	Preliminary Hazard Analysis (now called Hazard Analysis Report (HAR))
PPE	Personal Protective Equipment
PPPE	Personal Property and Programmatic Equipment
QA	Quality Assurance
RATS	Radioactivity Allowance Tracking System
RHWM	Radioactive and Hazardous Waste Management
RI	Responsible Individual
RMA	Radioactive Materials Area
RMMA	Radioactive Materials Management Area
RPIE	Real Property and Installed Equipment
RQ	Reportable Quantity
RTS	Retention Tank System
RRA	Roles, Responsibilities and Authorities
RRP	Room Responsible Person
SAA	Satellite Accumulation Areas
SBD	Safety Basis Document
SP	Safety Plan
SCR	Facility Screening Report
SSC	Structures, Systems or Components
SWPPP	Storm Water Pollution Prevention Plan
TLV	Threshold Limit Value
TRU	Transuranic Waste
WAA	Waste Accumulation Area
WAL	Work Authorization Level

Safety Plan Review Form

Lawrence Livermore National Laboratory **Issued/Revised/Effective:**_____

FSP or IWS/SP No._____ **Expires:**_____

In accordance with the requirements of the *ES&H Manual,* facility management, and/or the responsible individual shall verify and document that personnel working under the direction of this safety plan have been familiarized with the requirements outlined in the enclosed safety plan. Any changes in operations that increase the hazard level, introduce additional hazards, or decrease safety shall not be made until a revision to this safety plan has been reviewed and approved. Upon either the termination of this safety plan or completion of the project that it covers, facility management and/or the responsible individual shall comply with Document 12.7 "Shutdown or Transfer of Facilities, Operations or Associated Equipment," *of the ES&H Manual.*

All individuals listed below affirm that they have been familiarized with the attached safety plan and any applicable Change Memos.

☐ **Initial Review** ☐ **Annual Review** ☐ **Tri-Annual Review** ☐ **Major Change Review**

☐ **Minor Change Review**

Name	Signature	Date