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Tier 2 safety Basis Document for the B151 Complex (B151, B152, and B154)

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TIER 2 SAFETY BASIS DOCUMENT

FOR THE

B151 COMPLEX
(B151, B152, and B154)

Revision 0
July 13, 2006

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FOR THE

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(B151, B152, and B154)

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Executive Summary

This Safety Basis Document (SBD) has been prepared for the B151 Complex at Site 200 to meet the current contractual requirements at Lawrence Livermore National Laboratory (LLNL).

B151 Complex consists of three separate and distinct buildings: B151, B152, and B154, represented within this document as facility segments.

- Based upon its chemical and radiological inventories, Segment B151 is classified as a **Low Hazard** facility segment. All other hazards associated with Segment B151 operations have been determined to be LSI.
- Based upon their inventories, Segment B152 and Segment B154 are each classified as LSI facility segments. However, for operational flexibility involving radiological materials, CMS *chooses to classify* each of these as **Low Hazard** facility segments.

Changes in operations, maximum inventories, materials, or release potential that could result in larger consequences, or that could negatively impact the safety of the facility, will necessitate a re-evaluation of these facility classifications.

This SBD is governed by the LLNL Non-Nuclear Work Smart Standards (WSSs) requirements including the *ES&H Manual*, Document 3.1, *Non-Nuclear Safety Basis Program* [LLNL, 2004a] and the *DOE Explosives Safety Manual* (ESM) [LLNL, 2004b]. This SBD demonstrates that the three segments of B151 Complex can be operated as **Low Hazard** facility segments without undue risks to co-located workers, the public, or the environment.

This SBD:

- Provides a systematic identification of the safety and health hazards associated with operations in the B151 Complex,
- Compares facility inventories of explosives, biological materials, chemicals, radioisotopes with LLNL threshold values for each facility hazard classification criteria,
- Examines standard and non-standard industrial hazards,
- Examines the hazards of greatest significance,
- Qualitatively discusses the programs that evaluate and control these hazards to ensure the protection of co-located workers, the public, and the environment, and
- Addresses the required administrative controls and design features that would eliminate, control, and/or mitigate the identified hazards.

There is one Specific Administrative Control and one Design Feature identified as B151 Complex Operational Safety Requirements for Segment B151. There are seven Administrative Controls considered General for the operation of Building 151 Complex.

Any proposed activity or discovery, or changes to segment or vehicle structure or configuration, or inventories of hazardous materials that could impact either facility's classification or the OSRs shall be evaluated using the LLNL *ES&H Manual*, Document 3.1 change control process.

1.0 Screening Reports for Building 151 Complex

1.1 LLNL Facility Screening Report (SCR) for Segment B151

Facility Name

Lead Preparer: Diane Rasch	Date Performed: 12-15-2005

Facility Description

The B151 Complex (B151, B152, and B154) provides laboratory and office space for various chemical, biological and radiochemical research. These are Chemistry and Material Science (CMS) Facilities. Based on their proximities to each other, an in-depth assessment of the chemical, biological and radiological inventories and a walk down of the buildings in the complex, buildings B151, B152, and B154 are considered as one complex.

Section 1 of this Safety Basis Document contains three screening reports describing the three segments of B151 Complex (B151, B152, and B154). Hereafter, B151, B152 and B154 are referred to as Segment B151, Segment B152, and Segment B154 respectively.

Segment B151 provides office, electronics, and laboratory facilities for a broad range chemical, radiological, and biological research in the Chemistry and Materials Science Directorate. Segment B151 is located in the West center portion of the Lawrence Livermore National Laboratory. It is within 520 meters of the fence bordering on Vasco road. The building is a multi-story concrete structure.

The Waste Accumulation Area (WAA), B151C, is Northwest of Segment B151. B151C stores mixed, hazardous, low-level radioactive and TRU wastes that are derived from the processes of B151 Complex. The Radioactive and Hazardous Waste Management Division of the Environmental Protection Department provides surveillance and inspection of B151C as well as advice on waste handling and documentation. B151C is situated on a 50 x 20 ft. concrete pad with two 9 x 23 ft. metal Safety Store structures. Each structure is divided into three separate sections by chemical separation walls for a total of six sections. Access to each section is provided through separate lockable doors.

A retention tank system is located on the North side of Segment B151. This retention system is designed and managed to routinely accept non-hazardous and non-radioactive wastewater from the laboratory sinks in Segment B151 and Segment B154. Currently, this system consists of four 11,000-liter above ground tanks with a secondary containment barrier surrounding the tanks. There are also two 15,000-liter underground storage tanks in standby mode. Wastewater is pH sampled, adjusted, and then released based on testing results to the plant outfall or sent to Waste Management for further treatment.

B151 Complex has standby power provided by a diesel generator that is located outside Segment B152.

Define facility type: Check: ☐ Single Structure or Area: (B/Tr/A) _____ ☐ Complex of Buildings: Designation _____ ☒ Segment* of Bldg or Complex: B151Complex __ Seg.# B151 *Attach justification for segmentation	**Owner Organization:** Directorate: Chemistry and Material Science Facility AD:Tomas Diaz de la Rubia

Final Facility Classification: (Check)

☐ LSI ☒ Low ☐ Moderate ☐ High ☐ Nuclear Facility ☐ Accelerator

Concurrence Signatures for Facility Classified as LSI:**

Lead Preparer :Diane Rasch Date: 01/04/2006

AB Section Leader or designee: _____ Date: _____

ES&H Team Leader or designee: _____ Date: _____

Approval Signature for Facility Classified as LSI:**

Facility Management: _____ Date: _____

Supporting Documentation Appended	**Comments:**
Check as appropriate: ☒ Justification for Segmentation (see Section 1.4) ☒ Chemical Hazard List ☒ Radiological Hazard List ☒ Explosive Hazard List ☒ Building Layout ** Signatures are not required on this form for facilities classified as Low, Moderate or High. Approval signatures for these are on the cover of the Tier 2 or Tier 3 SBDs.	

Identification of Operations, Inventories, and Hazards

B151 is a multi-purpose facility segment. It contains chemical, radiological, biochemistry, and analytical laboratories. Key operations of Segment B151 include:

1. A Nuclear Magnetic Resonance (NMR) facility that generates magnetic fields.

2. A BSL-2 laboratory that handles Risk Group 2 (RG2) agents.

3. A Type III radiological laboratory in the Dissolver Wing of the facility.

These activities involve the use of acids, bases, solvents, gases, cryogens, explosives, radiological materials, lead shielding, pressure vessels, as well as Magnetic Field (MF)/Radiofrequency Field (RF).

Quantity of lead shielding present in facility is approximately 9,600 lbs (4,350 kg). It is in the form of solid bricks and sheets for standard radiation shielding purposes. As such, this lead qualifies for the automatic exclusion defined for structural, machinery, or scrap metals present in bulk quantities (ES&H Manual, Document 3.1, Table 2, footnote 3).

From the chemical inventory of Segment B151, there are three chemicals exceeding LSI levels:

- Liquid Nitrogen (LN_2) (tank capacity is12,900 kg) that exceeds its LSI value of 10,000 kg.
- Sulfur dioxide (5.2 kg) that exceeds its LSI value of 1.4 kg.
- Chloride trifluoride (1.6 kg) that exceeds its LSI value of 1.2 kg

Radiological Inventory of Segment B151 exceeds LSI levels, but is below Nuclear Facility Category 3 threshold.

Hazardous waste is temporarily stored within the Waste Accumulation Area (WAA), B151C. These wastes derive from processes performed within the B151 Complex. Each waste container present in the WAA is managed by Radiological and Hazardous Waste Management (RHWM) and conforms to RHWM packaging and inventory requirements. Through process knowledge, as well as monitoring chemical and radiological materials received by each segment within the B151 Complex, facility management maintains the chemical and radiological inventories of Segment B151 below Low thresholds.

Did Facility Management receive any notifications of credible external threats from nearby facilities? yes ☐ no ☒

If yes, list the following for each notification:

Source Facility:	Facility Contact(s):	Phone # (s):

Describe Hazard(s):

Hazard Identification Table

Check the hazard types found in the facility.

Not Found	Found		
☐	☒	Biological Hazards	Complete block I, below

☐	☒	Chemical Hazards	Complete block II, below
☐	☒	Explosive Hazards	Complete block III, below
☐	☒	Radiological Hazards	Complete block IV, below
☐	☒	Industrial Hazards	Complete block V, below

I. Biological Hazards

Check BioHazard Type

☒ **Non-Select Agents**

Check highest group in facility:

- ☐ RG1 Agents
- ☒ RG2 Agents
- ☐ RG3 Agents

☐ **Select Agents**

Select highest group in facility:

- ☐ RG1 Agents
- ☐ RG2 Agents
- ☐ RG3 Agents

☒ Other BioHazards (e.g., Blood, nucleic acid, lab animals, contaminated needles/sharps, animal/human tissues)

Biological Safety Level (BSL)

Check highest level in facility:

☐ N/A ☐ BSL-1 ☒ BSL-2 ☐ BSL-3

II. Chemical Hazards

Check ChemHazard Type

- ☒ Flammable, volatile or fuming
- ☒ Toxic materials (acutely toxic, toxic, systemic toxin, toxic gases)
- ☒ Corrosives/irritants
- ☒ Reactive materials (e.g., air/water sensitive; pyrophoric; thermally, shock, or friction sensitive; perchlorate)
- ☒ Carcinogens, mutagens, reproductive hazards
- ☒ Pesticides
- ☒ Beryllium
- ☒ Materials of special concern (e.g., alkali metals, fluorine, asbestos, lead, mercury, PCB)
- ☒ Other regulated metals (e.g., chromium, copper, nickel, zinc)
- ☐ Other:_____

Do any chemicals exceed LSI classification?

☒ YES ☐ NO

For chemicals that exceed LSI classification, attach maximally planned chemical inventory listing.

III. Explosive Hazards

Check

☒ Primary High Explosives
☒ Secondary High Explosives
☒ Propellants/Low Explosives
☐ Firearms Ammunition

Do any of the explosive types checked above have any of the following associated hazards?

☐ Fragmentation Hazards (Primary Fragments)
☐ Group L Explosives

Attach maximally planned inventory listing for each explosive type checked.

IV. Radiological Hazards

Check **Sum of Ratio**

☐ <1 of RQ thresholds (40 CFR 302.4 Appendix B)
☒ >1 of RQ thresholds < Cat. 3 Thresholds (DOE-STD-1027-92, Table A.1)
☐ >Cat. 3 Thresholds (DOE-STD-1027-92, Table A.1) < Cat. 2 Thresholds (DOE-STD-1027-92, Table A.1)

Does facility contain the following?

Radiation Generating Devices:

☒ Radiation generating devices not covered by DOE O 420.2A (e.g., X-rays, Electron Beams, Radiography Equipment): class I
☐ Radiation generating devices covered by DOE O 420.2A (Accelerators).

Exempted materials:

☐ Radioactive Certified Sealed Sources
☐ Rad. In Type B Containers with current certificates of compliance
☐ Either in quantities>Cat. 3 thresholds (DOE-STD-1027-92, Table A.1)

Attach listing of maximally planned radiological materials inventory.

V. Industrial Hazards

Check if hazard present	Industrial Hazard	Examples of industrial hazard(s) for each general category. (Select Industrial Hazards found.)	List industrial hazard(s) that could directly impact the public (fence-line) or colocated worker (100 m).
☒	Electrical	☐ Battery banks, ☒ Cable runs, ☒ Diesel generators, ☒ Electrical equipment, ☒ Heaters, ☒ High voltage (> 600V), ☒ Motors, ☒ Power tools, ☒ Pumps, ☒ Service outlets, ☒ Fittings, ☒ Switchgear, ☒ Transformers, ☒ Capacitors, ☒ Magnetic fields, ☒ Transmission lines, ☒ Wiring/underground wiring, ☐ Other:_____.	
☒	Thermal	☒ Boilers, ☒ Bunsen burner/hot plates, ☒ Electrical equipment, ☒ Electrical wiring, ☒ Engine exhaust, ☒ Furnaces, ☒ Heaters, ☒ Lasers, ☐ Steam lines, ☐ Welding surfaces, ☐ Welding torch, ☐ other:_____	
☒	Kinetic	☒ Acceleration/deceleration, ☒ Bearings, ☒ Belts, ☒ Carts/dollies, ☒ Centrifuges, ☒ Crane loads (in motion), ☒ Drills, ☒ Fans, ☐ Firearm Discharge ☒ Fork lifts, ☒ Gears, ☒ Grinders, ☒ Motors, ☒ Power tools, ☒ Presses/shears, ☒ Saws, ☒ Vehicles, ☐ Airplane, ☐ Vibration, ☐ Other:_____	

☒	Potential (pressure)	☐ Autoclaves, ☒ Boilers, ☐ Coiled springs, ☒ Furnaces, ☒ Gas bottles, ☒ Gas receivers, ☒ Pressure vessels, ☒ Vacuum vessels, ☒ Pressurized system (e.g., air), ☐ Steam header and lines, ☒ Stressed members, ☐ Other:_____	
☒	Potential (height/mass)	☒ Cranes/hoists, ☒ Elevated doors, ☒ Elevated work surfaces, ☒ Elevators, ☐ Lifts, ☒ Loading docks, ☒ Mezzanines, ☒ Floor pits, ☒ Scaffolds and ladders, ☒ Stacked material, ☒ Stairs, ☐ Other:_____	
☒	Internal Flooding Sources	☒ Domestic water, ☒ Fire suppression piping, ☐ Process water, ☒ Other: Low Conductivity Water (LCW)	

Hazard Classification

Select the appropriate hazard level from the dropdown menu:	
Biological	**LSI**
Chemical	**Low**
Explosive	**LSI**
Radiological materials	**Low**
Radiation generators	**LSI**
Industrial	**LSI**

Controls for hazards associated with LSI facilities: (Low, Moderate and High facility controls are addressed in Tier 2 or Tier 3 SBDs.)

1. Biological operations and research are clearly defined to meet BSL-2 classification or less. All biological operations and research projects shall be reviewed via the IWS process and the LBOC prior to starting.

2. Chemical inventories are controlled to less than appropriate LSI Q-list values by maintaining a list of allowable limits that are compared with that of ChemTrack. The LLNL ChemTrack system shall be used to monitor the inventory of primary containers of hazardous chemicals. Liquid nitrogen, Sulfur dioxide, and Chloride trifluoride whose inventories are above LSI thresholds, are addressed in section 2.

3. Explosives are managed in accordance with Document 17.1, "Explosives" of the ES&H Manual. There is currently no explosives work in Segment B151. All explosives operations require preparation of an IWS and must be reviewed and authorized before work can begin.

4. Industrial hazards are managed by facility management.

Other controls? For toxic gas: To preserve alignment with key assumptions used in developing the Q-values, all toxic gas cylinders not stored within a facility area having one or more barriers to the facility's external airspace (airspace external to physical structure of the facility) shall have a suitable flow restricting device, an installed DOT approved valve cap, or remain within its original DOT approved shipping package. Segmentation: a) Independence of air handling systems between segments shall be maintained b) Adequate physical distance (25' minimum) between each of the segment structures shall be maintained
List what document(s) through which the controls will be implemented: Controls are implemented through the Facility Safety Plan for the CMS Complexes, multiple IWS's for specific operations, and Standard Operation Procedure (SOP).

Table 1 – Segment B151 Chemical Hazard List surveyed on December 15, 2005

CAS #	Chemical	ChemTrack Inventory Qty (kg)	Maximum Facility Inventory Limit or MFIL (kg)	CalARP value (kg)	LSI value (kg)	Low value (kg)	Mod value (kg)	High value (kg)	Chemical Classification
7727-37-9	Nitrogen	12,900*	18,000*	N/A	<= 10000	<= 10000	<= 10000	> 10000	Low*
7446-09-5	Sulfur Dioxide	5.2	5.2	N/A	<= 1.4	<= 5.2	<= 180	> 180	Low
7790-91-2	Chlorine Trifluride	1.6	6.8	N/A	<= 1.2	<= 8.5	<= 85	> 85	Low

* Liquid nitrogen is a non-toxic asphyxiant. It has been assigned an arbitrary Q value of 10,000 kg. Any amount over this quantity requires a hazard classification of Low, and subsequently a hazard analysis. Segment B151 is already classified as Low because of the sulfur dioxide inventory, so the liquid nitrogen inventory does not change the facility's classification.

Table 2 – Segment B151 Radiological Material Inventory provided by Facility Management on May 10, 2006

	DOE Category 3						Criticality Safety						
Isotope	Limit (µCi)	Current Inventory Subject to Limits (µCi)	Current Inventory as Fraction of Limit	Possible Inventory Subject to Limits ** (µCi)	Possible Inventory as Fraction of Limit		Limit	Current Inventory Subject to Limits	Current Inventory as Fraction of Limit (µCi)	Possible Inventory Subject to Limits ** (µCi)	Possible Inventory as Fraction of Limit		Other Current Inventory Exempt From Both Limits* (µCi)
Am-241	5.20E+05	7.63E+03	1.47E-02	7.63E+03	1.47E-02		3.43E+10	7.63E+03	0.00E+00	7.63E+03	0.00E+00		0.00E+00
Am-242m	5.20E+05	1.46E+04	2.81E-02	1.46E+04	2.81E-02		3.89E+07	1.46E+04	3.75E-04	1.46E+04	3.75E-04		0.00E+00
Am-243	5.20E+05	4.40E+03	8.46E-03	4.40E+03	8.46E-03		1.99E+09	4.40E+03	0.00E+00	4.40E+03	0.00E+00		0.00E+00
Cf-249	5.20E+05	1.65E+04	3.17E-02	1.65E+04	3.17E-02		1.64E+07	1.65E+04	1.01E-03	1.65E+04	1.01E-03		0.00E+00
Cf-252	3.20E+06	1.14E-14	0.00E+00	1.14E-14	0.00E+00		2.69E+11	1.14E-14	0.00E+00	1.14E-14	0.00E+00		0.00E+00
Cm-248	1.04E+05	1.08E+02	1.04E-03	1.08E+02	1.04E-03		2.12E+06	1.08E+02	0.00E+00	1.08E+02	0.00E+00		0.00E+00
Co-60	2.80E+08	0.00E+00	0.00E+00	4.67E+07	1.67E-01		NA	0.00E+00	0.00E+00	4.67E+07	0.00E+00		0.00E+00
Cs-137	6.00E+07	1.00E-05	0.00E+00	1.00E+07	1.67E-01		NA	0.00E+00	0.00E+00	1.00E+07	0.00E+00		0.00E+00
H-3	1.00E+09	2.83E-15	0.00E+00	2.83E-15	0.00E+00		NA	0.00E+00	0.00E+00	2.83E-15	0.00E+00		0.00E+00
Ir-192	9.40E+08	0.00E+00	0.00E+00	1.57E+08	1.67E-01		NA	0.00E+00	0.00E+00	1.57E+08	0.00E+00		0.00E+00
Np-237	4.20E+05	1.97E+03	4.69E-03	1.97E+03	4.69E-03		7.05E+06	1.97E+03	2.79E-04	1.97E+03	2.79E-04		0.00E+00
Pa-231	2.00E+05	2.36E+03	1.18E-02	2.36E+03	1.18E-02		4.73E+08	2.36E+03	0.00E+00	2.36E+03	0.00E+00		0.00E+00
Pu-238	6.20E+05	1.93E+04	3.11E-02	1.93E+04	3.11E-02		1.71E+10	1.93E+04	0.00E+00	1.93E+04	0.00E+00		0.00E+00
Pu-239	5.20E+05	5.67E+04	1.09E-01	5.67E+04	1.09E-01		9.02E+06	5.67E+04	6.29E-03	5.67E+04	6.29E-03		0.00E+00
Pu-240	5.20E+05	1.14E+04	2.19E-02	1.14E+04	2.19E-02		2.28E+09	1.14E+04	0.00E+00	1.14E+04	0.00E+00		0.00E+00
Pu-241	3.20E+07	4.82E+05	1.51E-02	4.82E+05	1.51E-02		6.18E+09	4.82E+05	0.00E+00	4.82E+05	0.00E+00		0.00E+00
Pu-242	6.20E+05	1.57E+03	2.53E-03	1.57E+03	2.53E-03		7.07E+07	1.57E+03	0.00E+00	1.57E+03	0.00E+00		0.00E+00
Th-232	1.00E+05	6.46E+02	6.46E-03	6.46E+02	6.46E-03		Unlimited	0.00E+00	0.00E+00	6.46E+02	0.00E+00		0.00E+00
U-232	8.20E+05	1.00E+03	1.22E-03	1.00E+03	1.22E-03		1.08E+10	1.00E+03	0.00E+00	1.00E+03	0.00E+00		0.00E+00
U-234	4.20E+06	1.00E-04	0.00E+00	1.00E-04	0.00E+00		3.12E+06	1.00E-04	0.00E+00	1.00E-04	0.00E+00		0.00E+00
U-235	4.20E+06	3.87E+02	0.00E+00	3.87E+02	0.00E+00		6.26E+02	3.87E+02	6.18E-01	3.87E+02	6.18E-01		0.00E+00
U-236	4.20E+06	3.00E-05	0.00E+00	3.00E-05	0.00E+00		Unlimited	0.00E+00	0.00E+00	3.00E-05	0.00E+00		0.00E+00
U-238	4.20E+06	4.77E-15	0.00E+00	4.77E-15	0.00E+00		Unlimited	0.00E+00	0.00E+00	4.77E-15	0.00E+00		0.00E+00
U-dep	4.20E+06	3.95E-16	0.00E+00	3.95E-16	0.00E+00		7.25E+06	3.95E-16	0.00E+00	3.95E-16	0.00E+00		0.00E+00
Total For B-151	**Sum of Fractions**		**0.288**		**0.788**				**0.626**		**0.626**		

*** Other Current Inventory Exempt From Both DOE Category 3 and Criticality Safety Limits**

- For isotopes with z<86, this includes inventory that is "Exempt" from DOE Cat 3 Limits. (criticality safety limits do not exist).
- For isotopes with z>=86, this includes inventory that is "Exempt" from DOE Cat 3 Limits AND that is either "Exempt" from Criticality Safety Limits or that has "Unlimited" as the Criticality Safety Limit.

**** Possible Inventory Subject to Limits**

- A Radioactive Materials Inventory System is maintained by facility management. It is reconciled as frequently as necessary to ensure that the facility radiological inventory and the excluded facility inventory each remain below the category 3 limits in Appendix A of DOE-STD-1027-92, on a cumulative sum-of-the-ratios basis for all isotopes. Inventory reconciliation more frequent than annual shall be performed if the inventory exceeds an administrative control level of 75% of the category 3 limits. Prior to receipt, each addition is verified not to cause the radiological inventory to exceed the category 3 limits. Additions not fully characterized are estimated using field measurements and owner knowledge.

Table 3 – Segment B151 Explosives Hazard List surveyed on December 15, 2005

Location Room Number	Primary Explosives Inventory Qty (mg)	Secondary Explosives Inventory Qty (mg)	Propellants/Low Inventory Qty (mg)	Explosives Operations Classification
Entire facility segment	**<1**	**<10**	**<10**	**LSI**

There is currently no explosives work in Segment B151. All explosives operations require preparation of an IWS and must be reviewed and authorized before work can begin. The possibility exists for the infrequent, temporary introduction of radiological materials contaminated with explosives residues. Preliminary screening of materials will be conducted in the field to determine the presence and estimate the quantity of explosives contained in the materials. Materials estimated to contain quantities of explosives equal to or greater than 10 mg of secondary explosives or greater than or equal to 1 mg of primary explosives will not be brought into the facility.

Figure 1: SEGMENT B151 - FIRST FLOOR (NORTH/WEST)

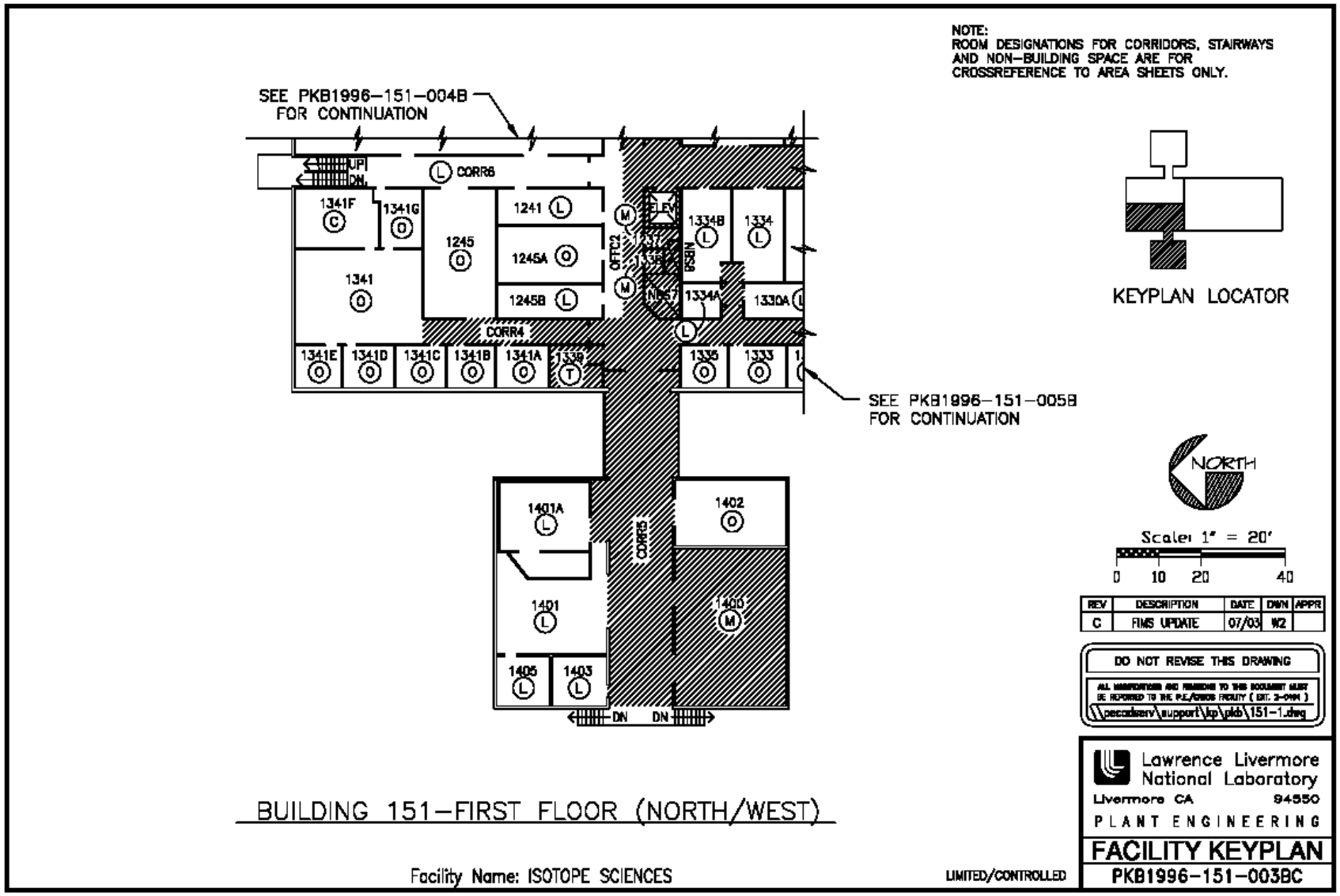


Figure 2: SEGMENT B151 – FIRST FLOOR (NORTH/EAST)

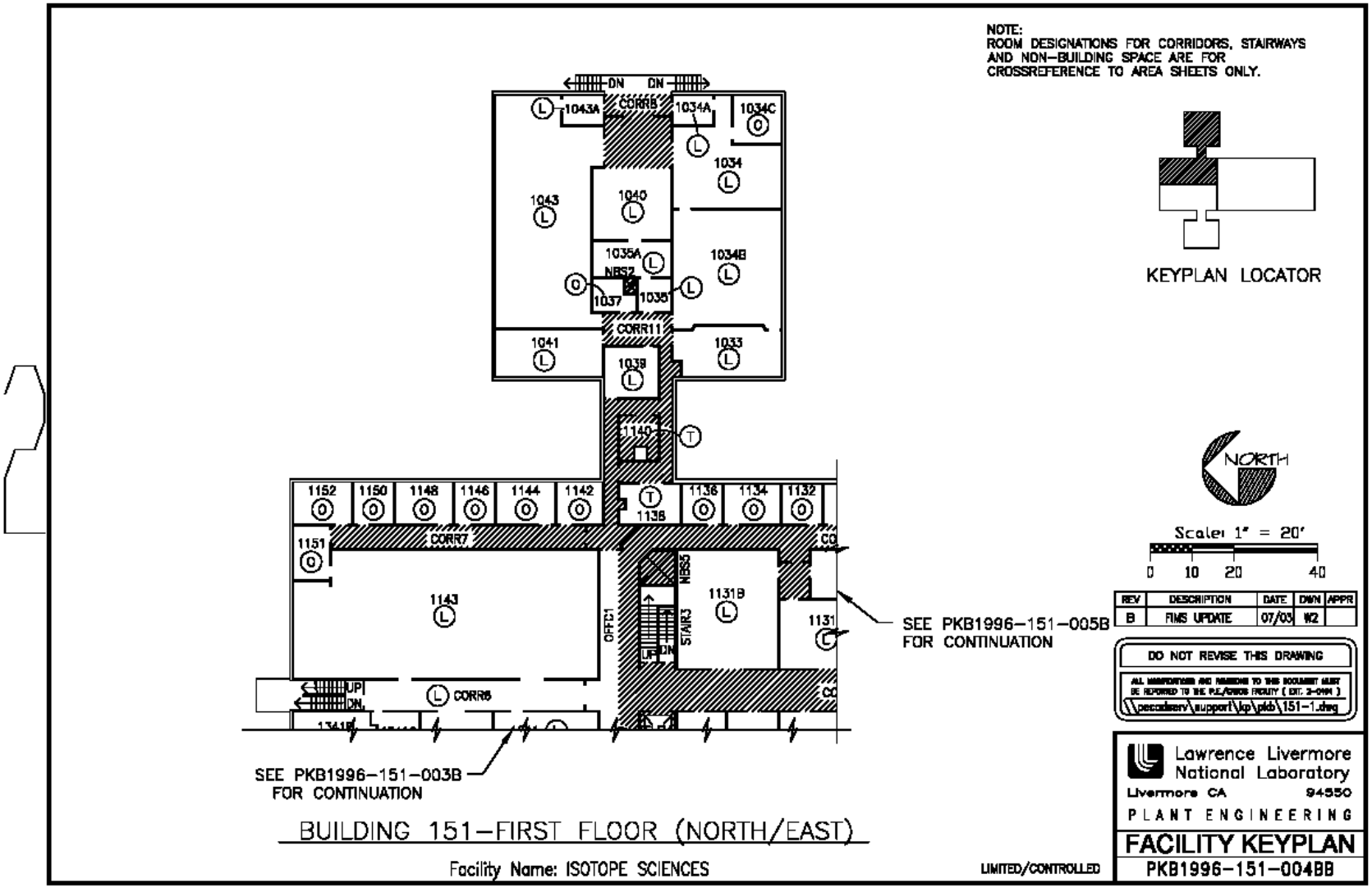


Figure 3: SEGMENT B151 – FIRST FLOOR (SOUTH)

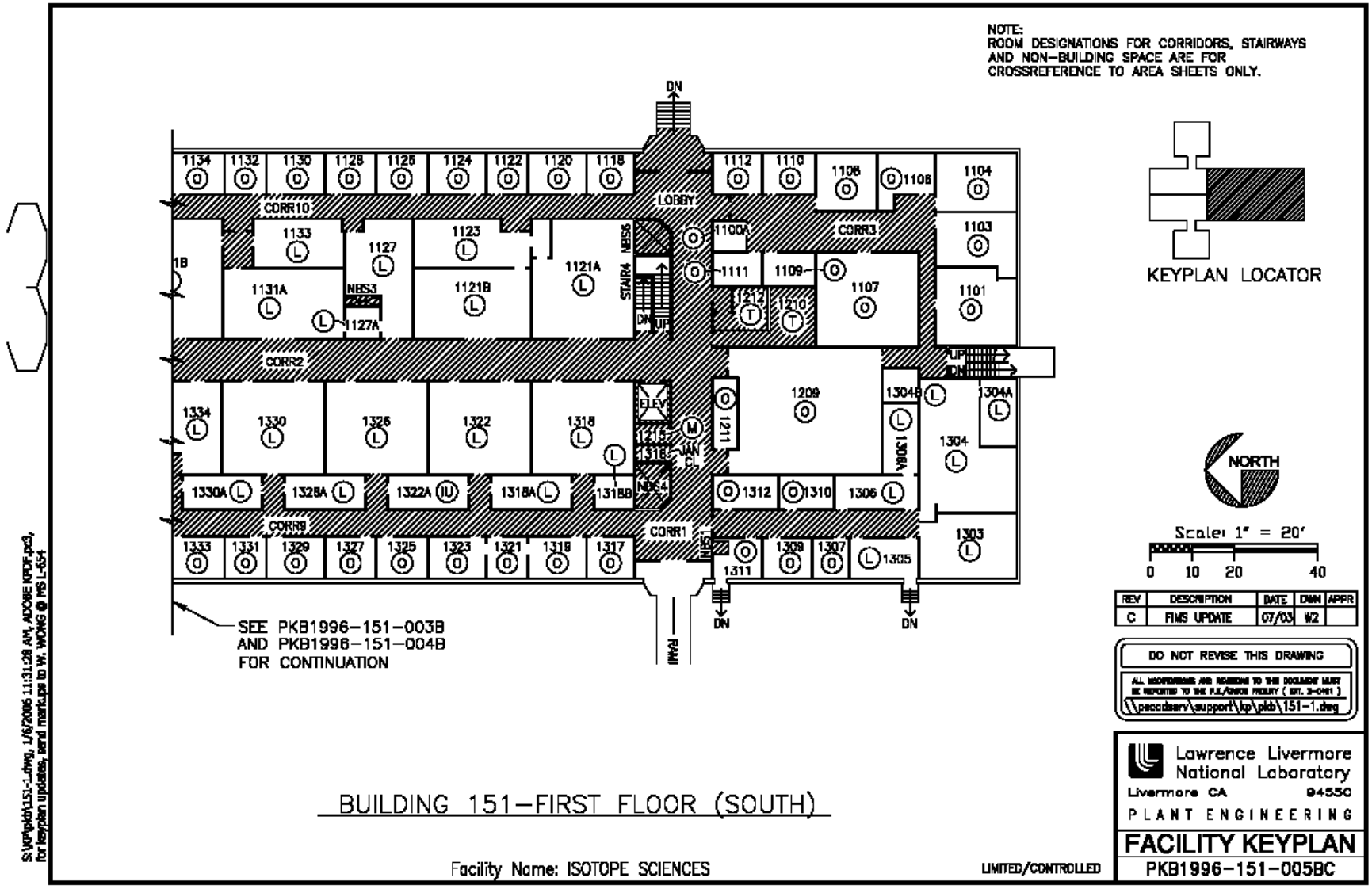


Figure 4: SEGMENT B151 – SECOND FLOOR (NORTH)

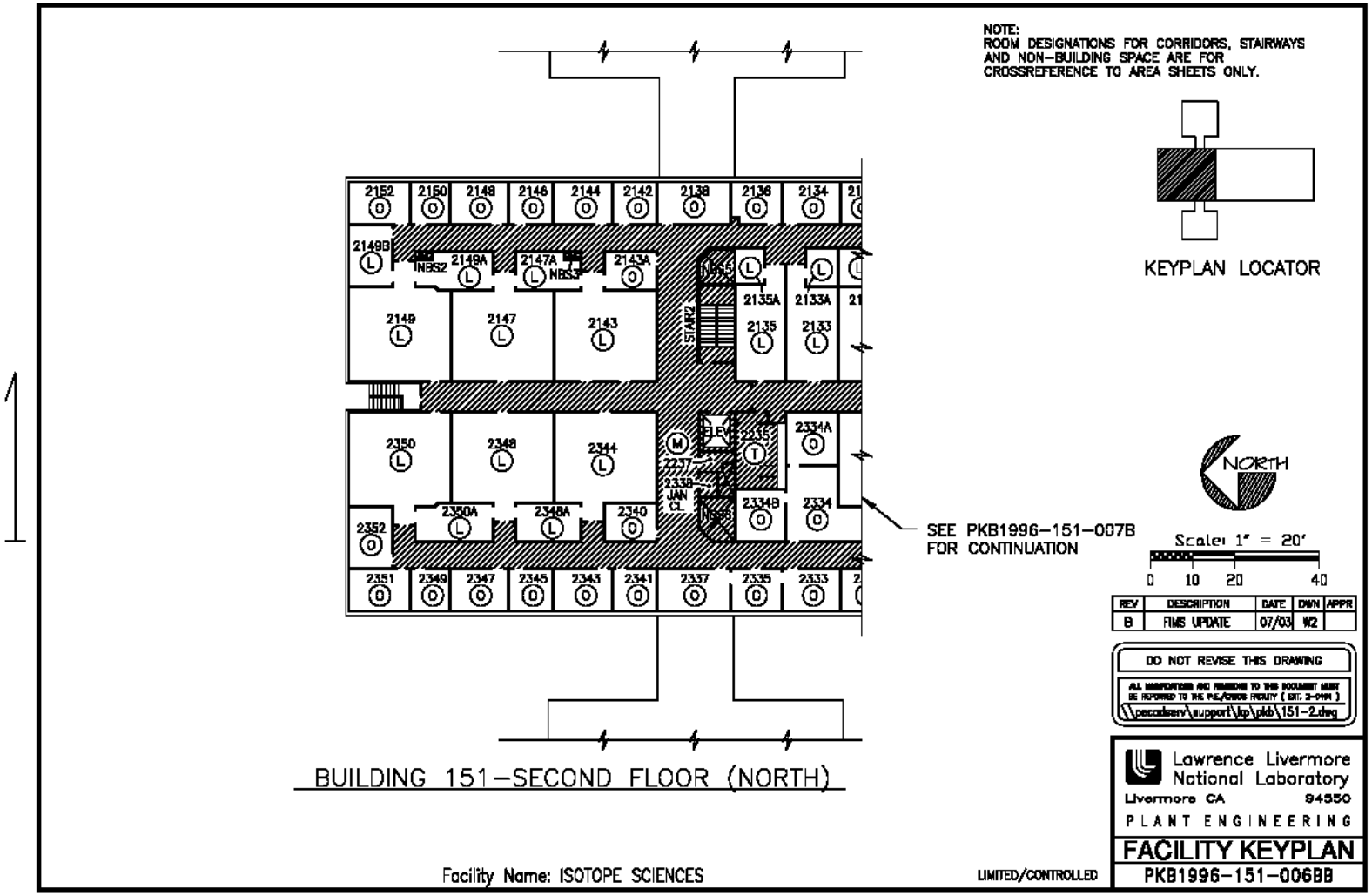
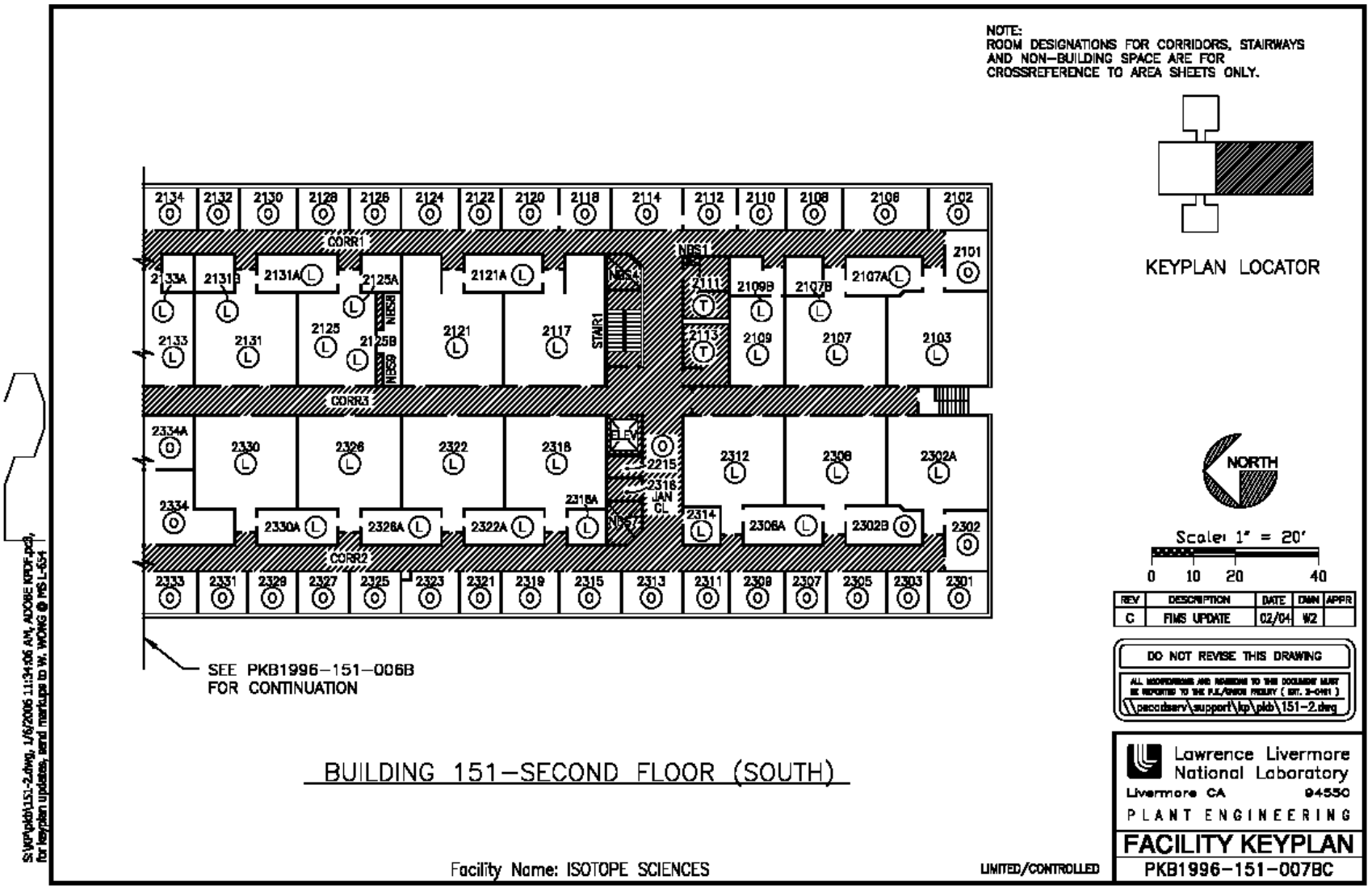


Figure 5: SEGMENT B151 – SECOND FLOOR (SOUTH)



REV	DESCRIPTION	DATE	DWN	APPR
C	FIMS UPDATE	02/04	W2	

Figure 6: SEGMENT B151 - BASEMENT

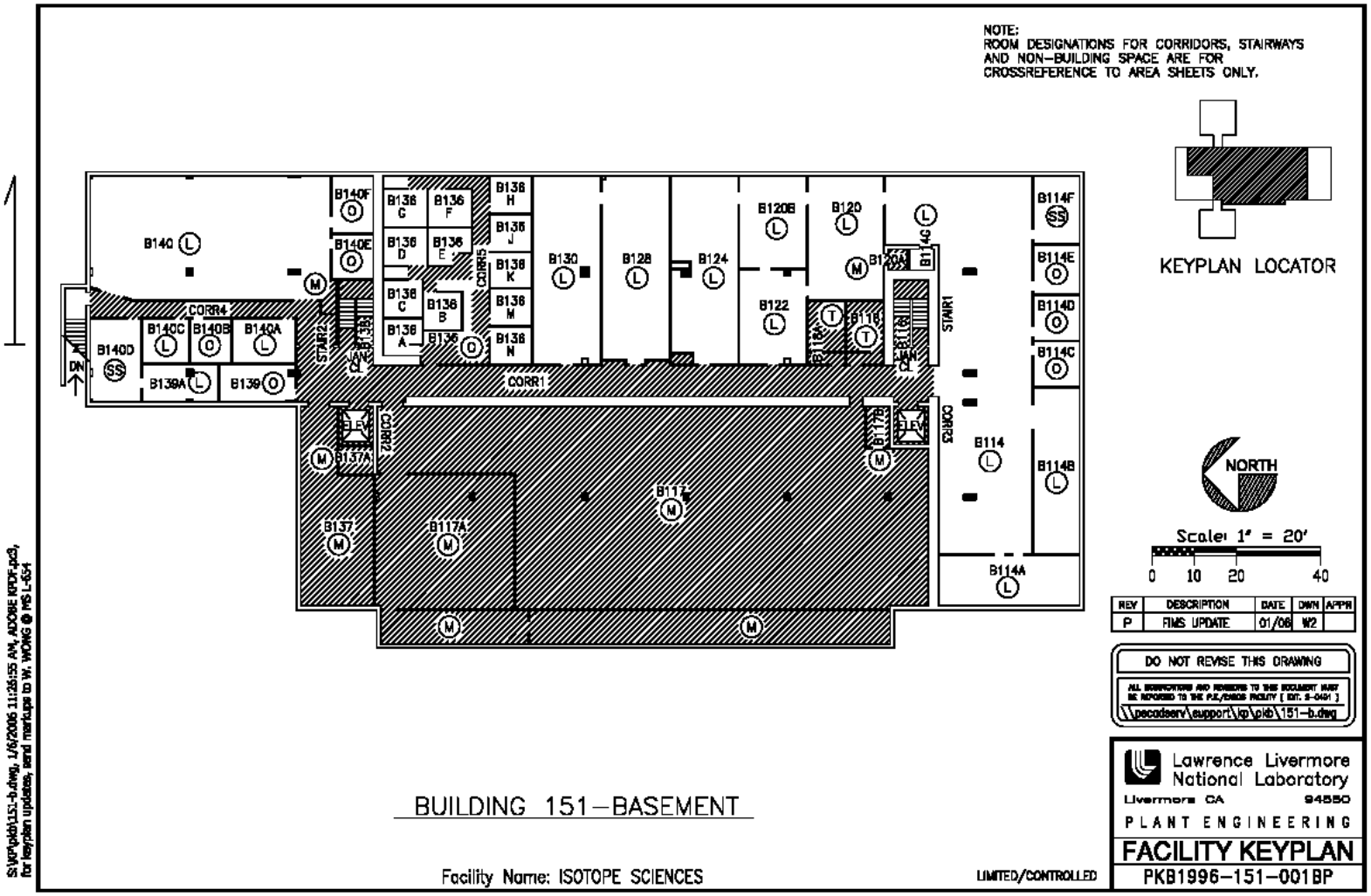
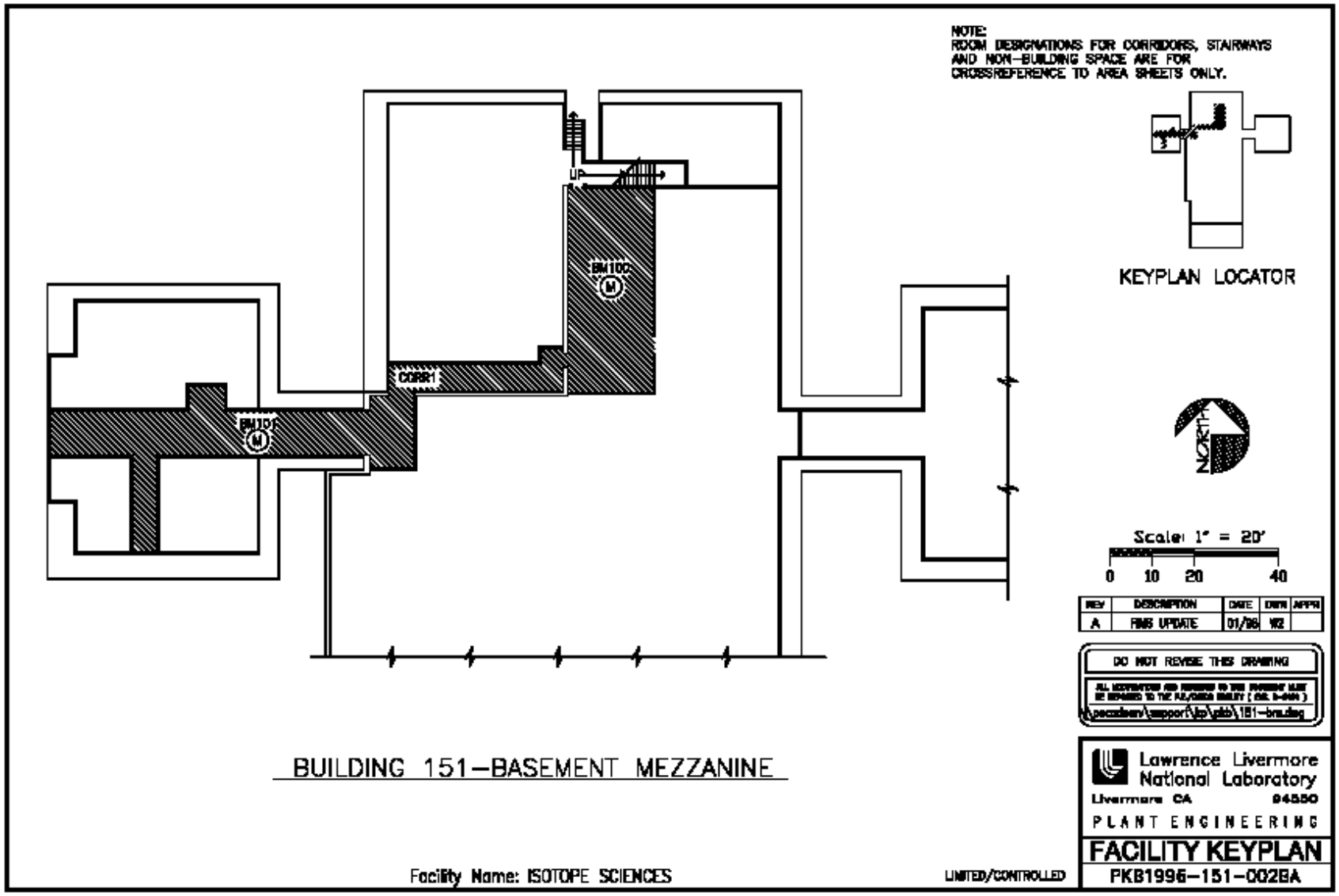


Figure 7: SEGMENT B151 – BASEMENT MEZZANINE



1.2 LLNL Facility Screening Report (SCR) for Segment B152

Facility Name

Lead Preparer: Diane Rasch	Date Performed: 12-15-2005

Facility Description

Segment B152 is a cement block structure located on the west side of Segment B151. It has approximately 780-sq.ft. floor area. The structure that is located within 520 meters of the fence bordering on Vasco Road.

There is a diesel generator exterior to Segment B152 that supplies power to B151 Complex.

Define facility type:	**Owner Organization:**
Check: ☐ Single Structure or Area: (B/Tr/A) _____ ☐ Complex of Buildings: Designation _____ ☒ Segment* of Bldg or Complex: B151 Complex Seg.# B152 *Attach justification for segmentation	Directorate: CMS Facility AD: Tomas Diaz de la Rubia

Final Facility Classification: (Check)

☐ LSI ☒ Low ☐ Moderate ☐ High ☐ Nuclear Facility ☐ Accelerator

Concurrence Signatures for Facility Classified as LSI:**

Lead Preparer: Diane Rasch Date: 01-09-06

AB Section Leader or designee: _____ Date: _____

ES&H Team Leader or designee: _____ Date: _____

Approval Signature for Facility Classified as LSI:**

Facility Management: _____ Date: _____

Supporting Documentation Appended	**Comments:**
Check as appropriate: ☒ Justification for Segmentation (see Section 1.4) ☐ Chemical Hazard List ☐ Radiological Hazard List ☐ Explosive Hazard List ☒ Building Layout ** Signatures are not required on this form for facilities classified as Low, Moderate or High. Approval signatures for these are on the cover of the Tier 2 or Tier 3 SBDs.	

Identification of Operations, Inventories, and Hazards

Segment B152 serves as a staging and storage facility.

1. Storage of corrosives and flammable liquids (R101).

2. Central collection and staging area for solid, liquid, or sharps non-regulated biological (NRB) or bio-hazardous waste generated primarily in the B151Complex. Generation and handling of these bio-wastes is covered under program-specific Integration Work Sheets (IWSs) and Radioactive and Hazardous Waste Management (RHWM) generic IWSs.

3. Potential future storage location (R102 and R104) of dry chemicals and non-corrosive, non-flammable liquids.

4. Storage of radioactive materials.

Did Facility Management receive any notifications of credible external threats from nearby facilities? yes ☐ no ☒

If yes, list the following for each notification:

Source Facility:	Facility Contact(s):	Phone # (s):

Describe Hazard(s):

Hazard Identification Table

Check the hazard types found in the facility.

Not Found	Found		
☐	☒	Biological Hazards	Complete block I, below

☐	☒	Chemical Hazards	Complete block II, below
☒	☐	Explosive Hazards	Complete block III, below
☐	☒	Radiological Hazards	Complete block IV, below
☐	☒	Industrial Hazards	Complete block V, below

I. Biological Hazards

Check BioHazard Type

☒ **Non-Select Agents**

Check highest group in facility:

- ☐ RG1 Agents
- ☒ RG2 Agents
- ☐ RG3 Agents

☐ **Select Agents**

Select highest group in facility:

- ☐ RG1 Agents
- ☐ RG2 Agents
- ☐ RG3 Agents

☒ Other BioHazards (e.g., Blood, nucleic acid, lab animals, contaminated needles/sharps, animal/human tissues)

Biological Safety Level (BSL)

Check highest level in facility:

☒ N/A ☐ BSL-1 ☐ BSL-2 ☐ BSL-3

II. Chemical Hazards

Check ChemHazard Type

- ☒ Flammable, volatile or fuming
- ☒ Toxic materials (acutely toxic, toxic, systemic toxin, toxic gases)
- ☒ Corrosives/irritants
- ☒ Reactive materials (e.g., air/water sensitive; pyrophoric; thermally, shock, or friction sensitive; perchlorate)
- ☒ Carcinogens, mutagens, reproductive hazards
- ☒ Pesticides
- ☒ Beryllium
- ☒ Materials of special concern (e.g., alkali metals, fluorine, asbestos, lead, mercury, PCB)
- ☒ Other regulated metals (e.g., chromium, copper, nickel, zinc)
- ☐ Other:_____

Do any chemicals exceed LSI classification?

☐ YES ☒ NO

For chemicals that exceed LSI classification, attach maximally planned chemical inventory listing.

III. Explosive Hazards

Check

☐ Primary High Explosives
☐ Secondary High Explosives
☐ Propellants/Low Explosives
☐ Firearms Ammunition

Do any of the explosive types checked above have any of the following associated hazards?

☐ Fragmentation Hazards (Primary Fragments)
☐ Group L Explosives

Attach maximally planned inventory listing for each explosive type checked.

IV. Radiological Hazards

Check **Sum of Ratio**

☐ <1 of RQ thresholds (40 CFR 302.4 Appendix B)
☒ >1 of RQ thresholds < Cat. 3 Thresholds (DOE-STD-1027-92, Table A.1)
☐ >Cat. 3 Thresholds (DOE-STD-1027-92, Table A.1) < Cat. 2 Thresholds (DOE-STD-1027-92, Table A.1)

Does facility contain the following?

Radiation Generating Devices:

☐ Radiation generating devices not covered by DOE O 420.2A (e.g., X-rays, Electron Beams, Radiography Equipment): class _____
☐ Radiation generating devices covered by DOE O 420.2A (Accelerators).

Exempted materials:

☐ Radioactive Certified Sealed Sources
☐ Rad. In Type B Containers with current certificates of compliance
☐ Either in quantities>Cat. 3 thresholds (DOE-STD-1027-92, Table A.1)

Attach listing of maximally planned radiological materials inventory.

There is very low level of radiological materials (as radioactive or mixed wastes) present in B152 Segment. The facility is classified as Low to allow operational flexibility and storage of radiological materials which may take place in a later date.

V. Industrial Hazards

Check if hazard present	Industrial Hazard	Examples of industrial hazard(s) for each general category. (Select Industrial Hazards found.)	List industrial hazard(s) that could directly impact the public (fence-line) or colocated worker (100 m).
☒	Electrical	☐ Battery banks, ☐ Cable runs, ☐ Diesel generators, ☒ Electrical equipment, ☐ Heaters, ☐ High voltage (> 600V), ☐ Motors, ☐ Power tools, ☐ Pumps, ☒ Service outlets, ☐ Fittings, ☒ Switchgear, ☒ Transformers, ☒ Capacitors, ☐ Magnetic fields, ☒ Transmission lines, ☒ Wiring/underground wiring, ☐ Other:_____.	

☒	Thermal	☐ Boilers, ☐ Bunsen burner/hot plates, ☒ Electrical equipment, ☒ Electrical wiring, ☒ Engine exhaust, ☐ Furnaces, ☐ Heaters, ☐ Lasers, ☐ Steam lines, ☐ Welding surfaces, ☐ Welding torch, ☐ other:_____	
☒	Kinetic	☐ Acceleration/deceleration, ☐ Bearings, ☐ Belts, ☒ Carts/dollies, ☐ Centrifuges, ☐ Crane loads (in motion), ☐ Drills, ☐ Fans, ☐ Firearm discharge, ☒ Fork lifts, ☐ Gears, ☐ Grinders, ☐ Motors, ☐ Power tools, ☐ Presses/shears, ☐ Saws, ☒ Vehicles, ☐ Airplane, ☐ Vibration, ☐ Other:_____	
☒	Potential (pressure)	☐ Autoclaves, ☐ Boilers, ☐ Coiled springs, ☐ Furnaces, ☒ Gas bottles, ☐ Gas receivers, ☒ Pressure vessels, ☐ Vacuum vessels, ☐ Pressurized system (e.g., air), ☐ Steam header and lines, ☐ Stressed members, ☐ Other:_____	
☒	Potential (height/mass)	☐ Cranes/hoists, ☐ Elevated doors, ☐ Elevated work surfaces, ☐ Elevators, ☐ Lifts, ☐ Loading docks, ☐ Mezzanines, ☐ Floor pits, ☒ Scaffolds and ladders, ☒ Stacked material, ☐ Stairs, ☐ Other:_____	
☒	Internal Flooding Sources	☒ Domestic water, ☒ Fire suppression piping, ☐ Process water, ☐ Other: _____	

Hazard Classification	
Select the appropriate hazard level from the dropdown menu:	
Biological	**LSI**
Chemical	**LSI**
Explosive	**LSI**
Radiological materials	**Low**
Radiation generators	**LSI**
Industrial	**LSI**

Controls for hazards associated with LSI facilities: (Low, Moderate and High facility controls are addressed in Tier 2 or Tier 3 SBDs.)

Briefly describe controls developed to assure that facility operations do not exceed the facility classification:

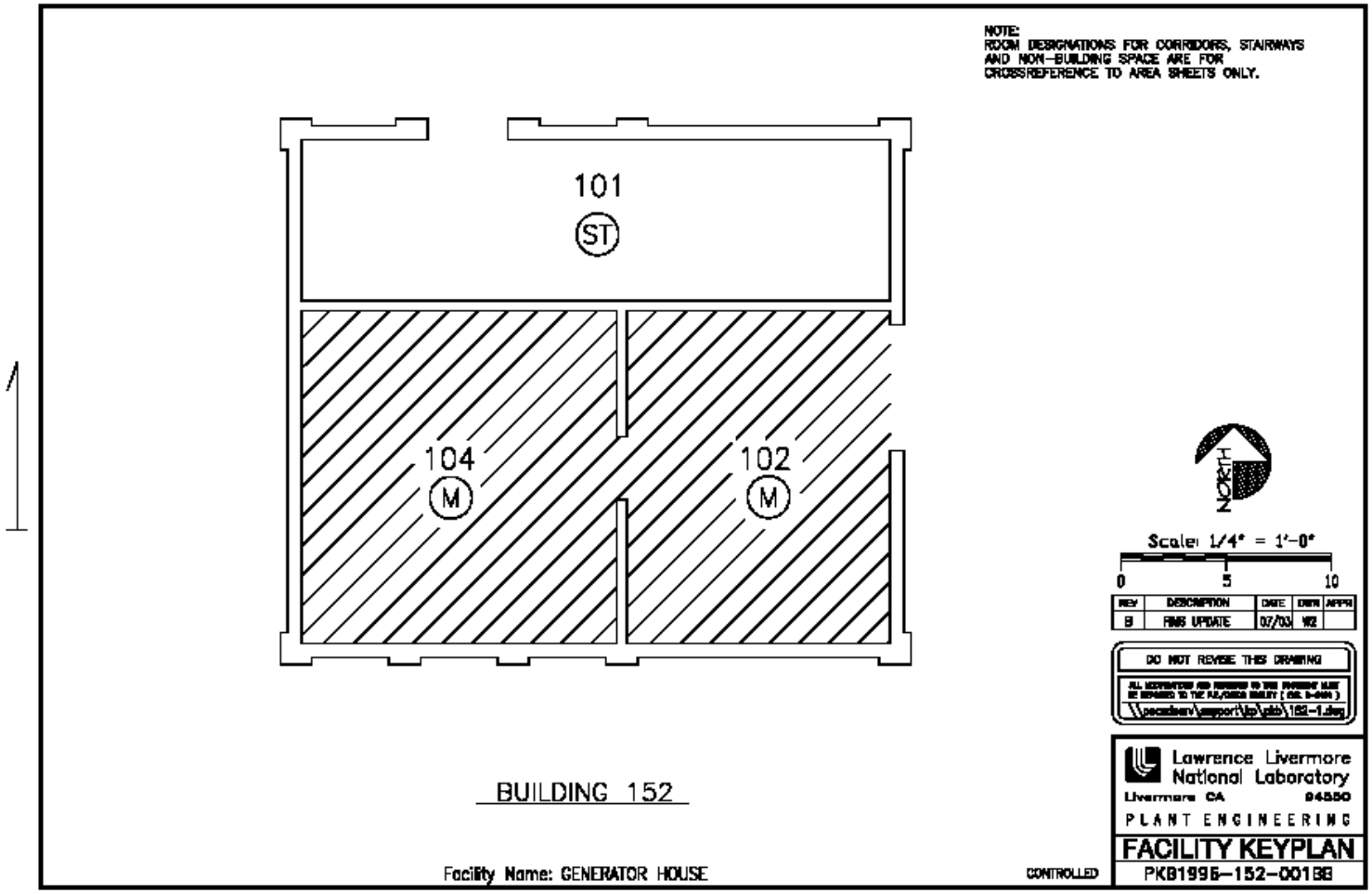
1) CMS manages its programmatic inventory of hazardous chemicals to maintain and comply with Facility Segment Safety Basis Envelope (SBE) of LSI for Segment B152. The LLNL ChemTrack system shall be used to monitor the inventory of primary containers of hazardous chemicals.

2) The only biological operation in the B152 Segment is the storage of biowaste.. All biological operations shall be reviewed via the IWS process and the LBOC prior to starting.

3) Industrial hazards are managed by facility management.

Other controls? Segmentation: a) Independence of air handling systems between segments shall be maintained b) Adequate physical distance (25' minimum) between each of the segment structures shall be maintained
List what document(s) through which the controls will be implemented: Controls are implemented through the Facility Safety Plan for the CMS Complexes and Integration Work Sheets (IWSs).

Figure 8: SEGMENT B152



1.3 LLNL Facility Screening Report (SCR) for Segment B154

Facility Name

Lead Preparer: Diane Rasch	Date Performed: 1-6-2006

Facility Description

Briefly describe facility use, physical structure, location and attach a building layout:

Segment B154, which is located directly across from the west side of Segment B151, is a single story facility with a mezzanine area. This building contains biological and radiological laboratories and facilities for wet chemistry research and office space.

Segment B154 has fourteen labs supported by offices and mechanical equipment rooms. It is located in the west center portion of LLNL, within 520 meters of the fence bordering Vasco Road. All facilities within the building are located on the first floor with the exception of a mechanical equipment loft which is located on a mezzanine accessed from the janitor closet adjacent to rooms 1007 and 1009.

Primary activities of Segment B154 include research in radiochemical and chemical analysis, transport of radionuclides in geo-materials, preparation of radionuclides and analysis of environmental and waste samples.

Define facility type:	**Owner Organization:**
Check: ☐ Single Structure or Area: (B/Tr/A) _____ ☐ Complex of Buildings: Designation _____ ☒ Segment* of Bldg or Complex: B151 Complex Seg.# B154 *Attach justification for segmentation	Directorate: CMS Facility AD: Tomas Diaz de la Rubia

Final Facility Classification: (Check)

☐ LSI ☒ Low ☐ Moderate ☐ High ☐ Nuclear Facility ☐ Accelerator

Concurrence Signatures for Facility Classified as LSI:**

Lead Preparer: Diane Rasch Date: 1-6-2006

AB Section Leader or designee: _____ Date: _____

ES&H Team Leader or designee: _____ Date: _____

Approval Signature for Facility Classified as LSI:**

Facility Management: _____ Date: _____

Supporting Documentation Appended	**Comments:**
Check as appropriate: ☒ Justification for Segmentation (see Section 1.4) ☐ Chemical Hazard List ☐ Radiological Hazard List ☒ Explosive Hazard List ☒ Building Layout ** Signatures are not required on this form for facilities classified as Low, Moderate or High. Approval signatures for these are on the cover of the Tier 2 or Tier 3 SBDs.	

Identification of Operations, Inventories, and Hazards

Activities include chemical, radiological, biochemistry, and analytical laboratories. Activities involve the use of acids, bases, solvents, gases, cryogens, pressure vessels, as well as an NMR facility which produces magnetic fields.
There is a BSL 2 laboratory in the facility.

Did Facility Management receive any notifications of credible external threats from nearby facilities? yes ☐ no ☒

If yes, list the following for each notification:

Source Facility:	Facility Contact(s):	Phone # (s):

Describe Hazard(s):

Hazard Identification Table

Check the hazard types found in the facility.

Not Found	Found		
☐	☒	Biological Hazards	Complete block I, below
☐	☒	Chemical Hazards	Complete block II, below
☐	☒	Explosive Hazards	Complete block III, below
☐	☒	Radiological Hazards	Complete block IV, below

☐ ☒ Industrial Hazards Complete block V, below

I. Biological Hazards	II. Chemical Hazards
Check BioHazard Type	**Check ChemHazard Type**
☒ **Non-Select Agents**	☒ Flammable, volatile or fuming
Check highest group in facility:	☒ Toxic materials (acutely toxic, toxic, systemic toxin, toxic gases)
☐ RG1 Agents	☒ Corrosives/irritants
☒ RG2 Agents	☒ Reactive materials (e.g., air/water sensitive; pyrophoric; thermally, shock, or friction sensitive; perchlorate)
☐ RG3 Agents	☒ Carcinogens, mutagens, reproductive hazards
☐ **Select Agents**	☒ Pesticides
Select highest group in facility:	☒ Beryllium
☐ RG1 Agents	☐ Materials of special concern (e.g., alkali metals, fluorine, asbestos, lead, mercury, PCB)
☐ RG2 Agents	☒ Other regulated metals (e.g., chromium, copper, nickel, zinc)
☐ RG3 Agents	☐ Other:_____
☐ Other BioHazards (e.g., Blood, nucleic acid, lab animals, contaminated needles/sharps, animal/human tissues)	**Do any chemicals exceed LSI classification?** ☐ YES ☒ NO
Biological Safety Level (BSL)	**For chemicals that exceed LSI classification, attach maximally planned chemical inventory listing.**
Check highest level in facility:	
☐ N/A ☐ BSL-1 ☒ BSL-2 ☐ BSL-3	

III. Explosive Hazards

Check

☒ Primary High Explosives
☒ Secondary High Explosives
☒ Propellants/Low Explosives
☐ Firearms Ammunition

Do any of the explosive types checked above have any of the following associated hazards?

☐ Fragmentation Hazards (Primary Fragments)
☐ Group L Explosives

Attach maximally planned inventory listing for each explosive type checked.

IV. Radiological Hazards

Check **Sum of Ratio**

☐ <1 of RQ thresholds (40 CFR 302.4 Appendix B)
☒ >1 of RQ thresholds < Cat. 3 Thresholds (DOE-STD-1027-92, Table A.1)
☐ >Cat. 3 Thresholds (DOE-STD-1027-92, Table A.1) < Cat. 2 Thresholds (DOE-STD-1027-92, Table A.1)

Does facility contain the following?

Radiation Generating Devices:

☒ Radiation generating devices not covered by DOE O 420.2A (e.g., X-rays, Electron Beams, Radiography Equipment): class I
☐ Radiation generating devices covered by DOE O 420.2A (Accelerators).

Exempted materials:

☐ Radioactive Certified Sealed Sources
☐ Rad. In Type B Containers with current certificates of compliance
☐ Either in quantities>Cat. 3 thresholds (DOE-STD-1027-92, Table A.1)

Attach listing of maximally planned radiological materials inventory.

There is very small quantity of radiological materials that are used in the research laboratories of B154 Segment. The facility is classified as Low to allow operational flexibility and storage of radiological materials which may take place in a later date.

V. Industrial Hazards

Check if hazard present	Industrial Hazard	Examples of industrial hazard(s) for each general category. (Select Industrial Hazards found.)	List industrial hazard(s) that could directly impact the public (fence-line) or colocated worker (100 m).
☒	Electrical	☐ Battery banks, ☐ Cable runs, ☐ Diesel generators, ☒ Electrical equipment, ☒ Heaters, ☒ High voltage (> 600V), ☒ Motors, ☐ Power tools, ☒ Pumps, ☒ Service outlets, ☐ Fittings, ☐ Switchgear, ☒ Transformers, ☒ Capacitors, ☒ Magnetic fields, ☒ Transmission lines, ☒ Wiring/underground wiring, ☐ Other:_____.	
☒	Thermal	☐ Boilers, ☒ Bunsen burner/hot plates, ☒ Electrical equipment, ☒ Electrical wiring, ☒ Engine exhaust, ☒ Furnaces, ☒ Heaters, ☒ Lasers, ☐ Steam lines, ☐ Welding surfaces, ☐ Welding torch, ☐ other:_____	

☒	Kinetic	☒ Acceleration/deceleration, ☒ Bearings, ☒ Belts, ☒ Carts/dollies, ☒ Centrifuges, ☐ Crane loads (in motion), ☐ Drills, ☒ Fans, ☐ Firearm discharge, ☒ Fork lifts, ☒ Gears, ☐ Grinders, ☒ Motors, ☐ Power tools, ☐ Presses/shears, ☐ Saws, ☒ Vehicles, ☐ Airplane, ☐ Vibration, ☐ Other:_____	
☒	Potential (pressure)	☐ Autoclaves, ☐ Boilers, ☐ Coiled springs, ☒ Furnaces, ☒ Gas bottles, ☒ Gas receivers, ☒ Pressure vessels, ☒ Vacuum vessels, ☒ Pressurized system (e.g., air), ☐ Steam header and lines, ☐ Stressed members, ☐ Other:_____	
☒	Potential (height/mass)	☐ Cranes/hoists, ☐ Elevated doors, ☒ Elevated work surfaces, ☐ Elevators, ☐ Lifts, ☐ Loading docks, ☒ Mezzanines, ☐ Floor pits, ☒ Scaffolds and ladders, ☒ Stacked material, ☐ Stairs, ☐ Other:_____	
☒	Internal Flooding Sources	☒ Domestic water, ☒ Fire suppression piping, ☐ Process water, ☒ Other: LCW, hot water from boilers, chilled water from chillers.	

Hazard Classification	
Select the appropriate hazard level from the dropdown menu:	
Biological	**LSI**
Chemical	**LSI**
Explosive	**LSI**
Radiological materials	**Low**
Radiation generators	**LSI**
Industrial	**LSI**

Controls for hazards associated with LSI facilities: (Low, Moderate and High facility controls are addressed in Tier 2 or Tier 3 SBDs.)

Briefly describe controls developed to assure that facility operations do not exceed the facility classification:

1) CMS manages its programmatic inventory of hazardous chemicals to maintain and comply with Facility Segment Safety Basis Envelope (SBE) of LSI for Segment B154. The LLNL ChemTrack system shall be used to monitor the inventory of primary containers of hazardous chemicals.

2) Biological operations and research are clearly defined to meet BSL-2 classification or less. All biological operations and research projects shall be reviewed via the IWS process and the LBOC prior to starting.

3) Manage explosives in accordance with Document 17.1, "Explosives" of the ESH&H Manual. All explosives operations require preparation of an IWS and must be reviewed and authorized before work can begin.

4) Industrial hazards are managed by facility management.

Other controls? Segmentation: a) Independence of air handling systems between segments shall be maintained b) Adequate physical distance (25' minimum) between each of the segment structures shall be maintained
List what document(s) through which the controls will be implemented: Controls are implemented through the Facility Safety Plan for the CMS Complexes, through multiple IWS's for specific operations and Standard Operational Procedure (SOP).

Table 4 – Segment B154 Explosives Hazard List surveyed on January 6, 2006

Location Room Number	Primary Explosives Inventory Qty (mg)	Secondary Explosives Inventory Qty (mg)	Propellants/Low Inventory Qty (mg)	Explosives Operations Classification
Entire facility segment	<1	<10	<10	LSI

There is currently no explosives work in Segment B154. All explosives operations require preparation of an IWS and must be reviewed and authorized before work can begin.

Figure 9: SEGMENT B154 – FIRST FLOOR

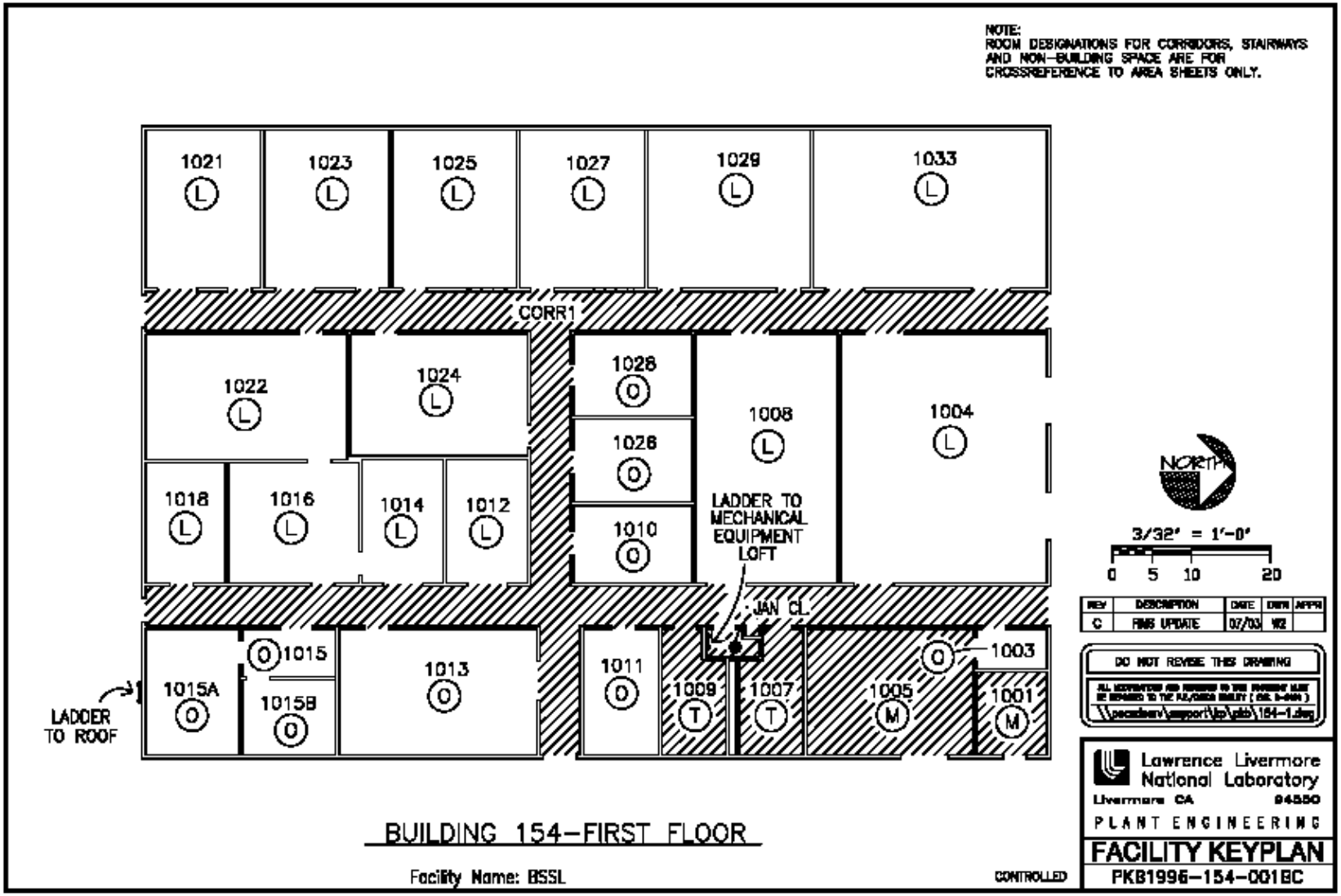
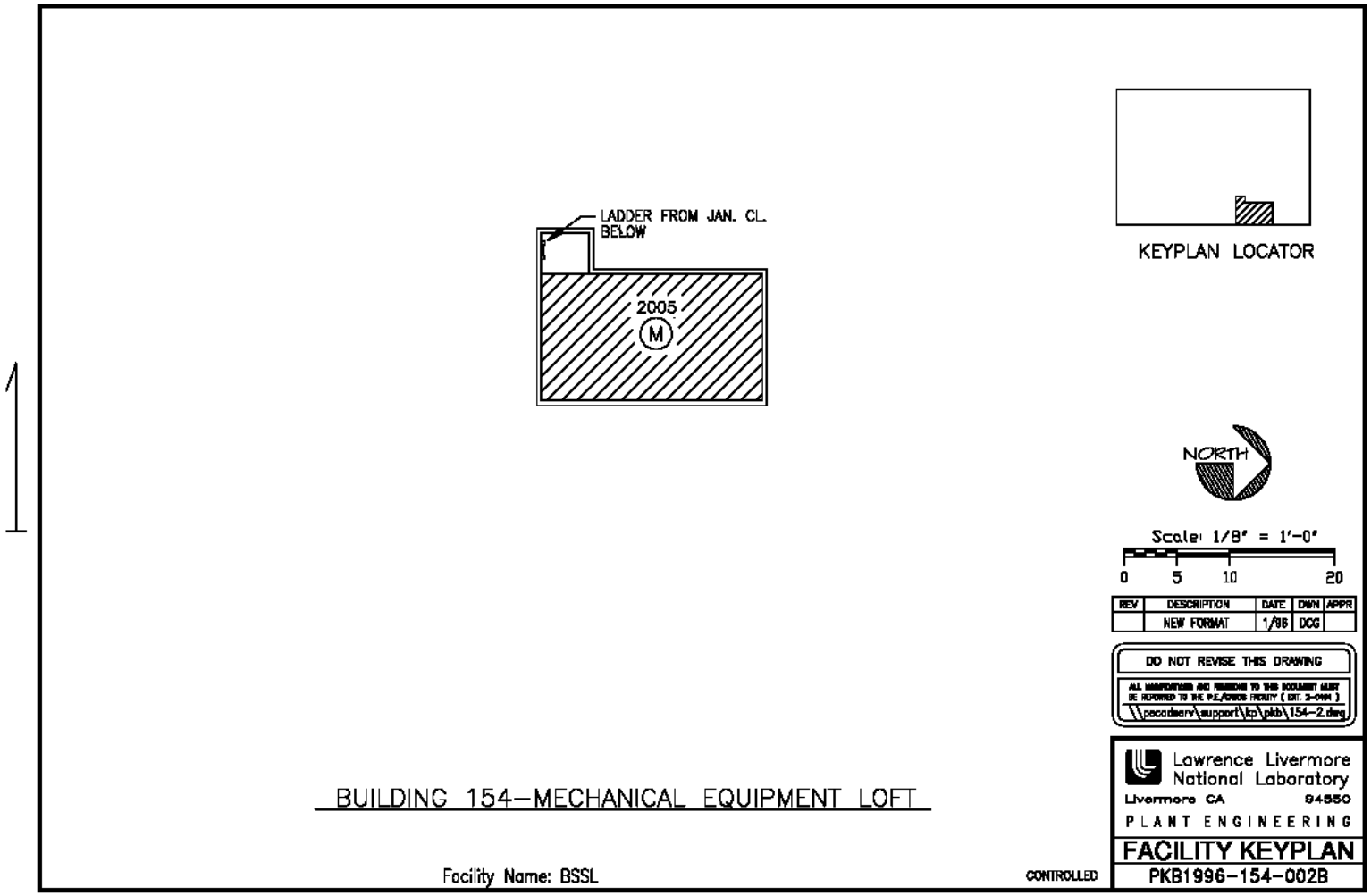


Figure 10: SEGMENT B154 - MECHANICAL EQUIPMENT LOFT



1.4 B151 Complex Segmentation Justification

1.4.1 Purpose

The purpose of this segmentation justification is to allow the facilities within the B151 Complex to be classified independently and their hazards analyzed separately.

1.4.1 Segment Definitions

The segments within the B151 Complex are defined as the physical, non-contiguous structures of buildings 151, 152, and 152, herein referred to as segments B151, B152, and B154 respectively.

1.4.2 Justification for Segmentation

Before segmentation can be justified, it must be determined that an accident in one segment will not initiate a hazardous release in any of the other segments.

1.4.3 Analysis of Accident in B151 Segment Initiating a Hazardous Release in either of the B152 or B154 Segments

The B151 segment is an individual and distinct structure. It is physically separated by open space from the B152 segment by no less than 100 feet, and B154 segment by no less than 40 feet. The air handling systems for each of these segments are completely independent. These segments do not share mechanical or electrical utility systems in any manner that allows an event in one structure to impact the others. The most probable accident scenarios originating in the B151 segment would be fire, the airborne release of toxic or corrosive material, or the release of dispersible radiological material. Although B151 shares fire riser, house gas supplies, retention system, hot water and chilled water with B154, given the above described physical and systems separation between the two facilities, a propagation of a fire in the B151 segment to either the B152 or B154 segments is improbable. In addition, no credit has been taken for fire suppression in the hazard and accident analyses.

Since the air handling systems in the B151 segment are independent from the other segments, releases of vapors or radioactive materials inside of the B151 segment are not expected to disable workers or safety systems and initiate a hazardous release in either the B152 or B154 segments.

1.4.4 Analysis of Accident in B152 Segment Initiating a Hazardous Release in either of the B151 or B154 Segments

The B152 segment is an individual and distinct structure. It is physically separated by open space from the B151 segment by no less than 100 feet, and B154 segment by no less than 110 feet. The air handling systems for each of these segments are completely independent. These segments do not share mechanical or electrical utility systems in any manner that allows an event in one structure to

impact the others. The most probable accident scenarios originating in the B152 segment would be fire, or the airborne release of toxic or corrosive material.

Given the above described physical and systems separation, propagation of a fire in the B152 segment to either the B151 or B154 segments is improbable.

Since the air handling systems in the B152 segment are independent from the other segments, releases of vapors or other dispersible materials inside of the B152 segment are not expected to disable workers or safety systems and initiate a hazardous release in either the B151 or B154 segments.

1.4.5 Analysis of Accident in B154 Segment Initiating a Hazardous Release in either of the B151 or B152 Segments

The B154 segment is an individual and distinct structure. It is physically separated by open space from the B151 segment by no less than 40 feet, and B152 segment by no less than 110 feet. The air handling systems for each of these segments are completely independent. Since the air handling systems in the B154 segment are independent from the other segments, releases of vapors or radioactive materials inside of the B154 segment are not expected to disable workers or safety systems and initiate a hazardous release in either the B151 or B152 segments. The air-intake of B151 is behind B-154. As a result in the event of a structural fire in B-154, smokes may enter B151; therefore, the B151 Segment air intake should be temporarily shut off when there is a fire in B154.

These segments do not share mechanical or electrical utility systems in any manner that allows an event in one structure to impact the others. The most probable accident scenarios originating in the B154 segment would be fire, the airborne release of toxic or corrosive material, or the release of dispersible radiological material.

Given the above described physical and systems separation, propagation of a fire in the B154 segment to either the B151 or B152 segments is improbable.

1.4.6 Segmentation Controls

The passive engineering features used to justify segmentation are:

a) Independence of air handling systems between segments,

b) Adequate physical distance between each of the segment structures

These features will be carried forward as controls in each facility segment.

1.4.7 Summary

For the purposes of hazard classification and analysis, segmentation of B151 Complex into three segments (B151, B152, and B154) is justified based on passive engineering facility features. Controls can and will be implemented where required to maintain these features.

Table 5 - Summary of B151 Complex Classification

Facility Segment #	Facility Segment Classification	Hazards	SBD requirement
151	Low	Chemicals, Radiological	Tier 2
152, 154	Low	Radiological	Tier 2

Based on their desired radiological inventory limits, Segment B151, Segment B152 and Segment B154 are classified as Low. Per ES&H Manual, Document 3.1, a Tier 2 Safety Basis Document (SBD) is required for these facilities.

1.5 B151 Segment Chemical Hazard List

B151 Segment is a Low Hazard facility based on its chemical and radiological inventories. The limits for a Low hazard facility allow B151 Segment to handle the following chemicals with their current inventories:

Table 6 - Building 151 Segment Chemicals Present in Greater than LSI Quantities

CAS Number	Chemical	Inventory Quantity (kg)	Maximum Facility Inventory Limit [kg]	LSI Value [kg]	Low Value [kg]
7727-37-9	Liquid Nitrogen	12,900	18,000	10,000.00	10,000.00
7446-09-5	Sulfur Dioxide	5.2	5.2	1.4	5.2
7790-91-2	Chlorine Trifluoride	1.6	6.8	1.2	8.5

1.5.1 Liquid Nitrogen

The Q-list LSI threshold for liquid nitrogen is 10,000 kg. Liquid Nitrogen is an inert, colorless, odorless, non-corrosive, nonflammable, cryogenic liquid. It creates an Industrial Hazard since it displaces or dilutes the room's oxygen and creates an unsafe environment for workers and audience members. This condition is called Oxygen Deficiency Hazard (ODH).

On exposure to ambient conditions, liquid nitrogen will boil or flash to its gaseous form, a simple asphyxiant with no toxic properties to be considered in safety analysis.

1.5.2 Sulfur dioxide (SO_2) gas

The Q-list LSI and Low thresholds for sulfur dioxide are 1.4 kg and 5.2 kg, respectively.

Sulfur dioxide is a colorless, nonflammable but highly toxic gas. It causes eye irritation. Burns to the eyes result in lesions and possible loss of vision. The inhalation of sulfur dioxide vapors may result in pulmonary edema and chemical pneumonitis.

1.5.3 Chlorine Trifluoride (ClF_3) gas (liquid under pressure)

The Q-list LSI and Low thresholds for chlorine trifluoride are 1.2 kg and 8.5 kg respectively.

Chlorine trifluoride is a toxic, corrosive, very reactive liquefied compressed gas packaged in cylinders as a liquid under its own vapor pressure of 22 psia at 70°F (~6.8 psig). Chlorine trifluoride as a gas is nonflammable, corrosive, and nearly colorless with a sweet, suffocating odor; as a liquid it is pale green; as a solid it is white. The gas has a density more than 3 times that of air. Chlorine trifluoride hydrolyzes rapidly with moisture to form mostly hydrogen fluoride along with hydrogen chloride, chlorine

monofluoride, and a variety of oxyhalogen compounds. The oxyhalogens may include chlorine dioxide, chlorous acid, chlorine oxyfluoride, and oxygen difluoride.

1.6 B151 Complex Radiological Hazard List

The B151 Segment radiological inventory is detailed in Table 2, Building 151 Radiological Inventory. There is very low level of radiological materials (as radioactive or mixed wastes) present in B152 and B154 Segments. These facilities are classified as Low to allow operational flexibility and storage of radiological materials which may take place at a later date.

2.0 Hazard Analysis

This chapter documents a brief hazards analysis, consistent with the provisions of ES&H Manual Document 3.1, for those hazards classified above the LSI level. Two hazards were identified for B151 Segment and classified in Chapter 1.0 as Low: (1) chemicals, and (2) radiological materials. This classification was determined in section 1, Screening Report. For operational flexibility involving radiological materials in B152 and B154 segments, CMS chooses to classify each of these facility segments as Low hazard. Thus, Hazard Analyses are also required for B152 and B154 Segments.

The operations examined are simple enough that all controls assumed for ranking in the Analysis Level Matrix are specified up front as initial conditions. These controls are further denoted by bold-face italics on the hazard analysis tables. Other controls listed, while relevant to safe operation in varying degrees, were not considered in ranking.

2.1 Chemicals

Chemicals are widely used in B151 Segment. The quantities involved are small relative to production scale chemical processing. Operations at B151 are deemed consistent, per 29 CFR 1910.1450, *Occupational Exposures to Hazardous Chemicals in Laboratories*, with U.S Department of Labor , Occupational Safety & Health Administration (OSHA)'s definition of "laboratory scale:"

> Work with substances in which containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of material.

The operations are further deemed consistent with OSHA's definition of "laboratory use of hazardous chemicals:"

> Handling and use of such chemicals in which all of the following conditions are met:
>
> i. Chemical manipulations are carried out on a "laboratory scale;"
>
> ii. Multiple chemical procedures or chemicals are used;
>
> iii. The procedures involved are not part of the production process nor in any way simulate a production process;
>
> iv. "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

These definitions are generally considered to define a regime of acceptable residual risk for personnel outside the immediate facility worker population. This is consistent with

the premise in ES&H Manual Document 3.1 of establishing an LSI classification that does not require detailed analysis. Several labs in Building 151 Segment handle small-scale analytical operations with very small quantities of explosive material (less than 10 mg of non-primary explosives and less than 1 mg of primary explosives) that does not require further analysis.

Bulk quantities of LN_2 is stored outdoor in a large storage tank behind B151; therefore, its asphyxiant hazard is negligible and does not require further analysis.

Liquid nitrogen creates two additional hazards:

a) Exposure to recently evaporated gas can result in frost bite and direct contact of the cryogenic liquid to the skin can cause blisters. The aforementioned hazards are unlikely to impact co-located workers at 100-meter distance and to the offsite public from the point of spill and it is not further considered here.

b) LN_2 in an un-vented container can cause a large pressure increase due to heat leakage into the container, which causes a change of phase from liquid to gas. Relief valves and rupture discs prevent tank ruptures that could result in large releases. This hazard is not further considered here.

2.1.1 Controls

Initial conditions assumed in assessing chemical hazards are as follows:

1) The maximum cumulative quantities of all hazardous chemicals in B151 Segment (other than LN_2, sulfur dioxide, and chloride trifluoride) are kept below their LSI thresholds.

- Sulfur dioxide is maintained within the Low Hazard limit of 5.2 kg.
- Chlorine trifluoride inventory is limited to 6.8 kg.
- Liquid Nitrogen inventory is limited by the tank capacity of 12,900 kg plus in use quantity for an overall B151 Complex limit of 18,000 kg..

2) The sulfur dioxide cylinders are equipped with Flow Restricting Orifice size 0.031 in. or less.

3) High Vacuum Fluorination System (HVFS) reaction vessel manifold is designed and constructed specifically for use with chlorine trifluoride as specified in Engineering Safety note LLSN04-503-AA.

4) The B151 Segment structure, as designed and built, provides a basic structural capacity.

These conditions effectively limit the amount of material that can be involved in a given accident or initiators that can cause the incident to occur.

2.1.2 Postulated Hazardous Events

A general event CHEM–1 is identified for Liquid Nitrogen: **Release by Impact to the Liquid Nitrogen Tank.**

A general event CHEM–2 is identified for sulfur dioxide: **Spill or Leakage of the Entire Inventory of Sulfur Dioxide.**

A general event CHEM–3 is identified for chlorine trifluoride: **Spill or Leakage of the Entire Inventory of Chloride Trifluoride.**

The initial conditions identified in section 2.1.1 are deemed to be credited in the hazard analysis.

Event CHEM - 1: **Release by Impact to the Liquid Nitrogen Tank**

Causes:	1. Direct human error – Tank or plumbing is struck by delivery vehicle 2. Movement error –Container dropped while being moved 3. Natural Phenomena -- seismic event results in the direct or indirect application of mechanical energy External Events were evaluated and dismissed.
Preventive Features	**Design:** - Seismic restraints affixed to the liquid nitrogen tank. - Stored liquid nitrogen tank in areas removed from normal vehicle movement routes - Physical barriers - Seismic restraints on equipment and plumbing **Administrative:** Not applicable
Mitigating Features	**Design**: Not applicable **Administrative**: - ***Inventory limits*** - General laboratory chemical safety training - Facility and institutional emergency response plans.
Unmitigated consequences:	Consequences for the spill of 18,000 kg of LN_2 at 100-meters distance from the facility and the site boundary are both Categories D.
Probability:	The probability of LN_2 spills by plumbing failure is Probable. The probability of LN_2 spills by tank puncture by a delivery vehicle is Marginal because there is a physical barrier (robust curbing) that prevents the delivery truck puncturing the LN_2 tank. The probability of LN_2 spills by a seismic event is Marginal.
Comments:	Accident analysis is not required for the LN_2 spills since the unmitigated consequences at 100-meters distance from the facility and the site boundary are both Categories D.

Event CHEM - 2: Spill/Leakage of the Entire Inventory of Sulfur Dioxide

Causes:	1. Direct human error – Cylinder is dropped or struck and the regulator is broken. 2. Movement error – Cylinder is dropped while being moved 3. Structural or assembly defects such as a faulty gas regulator or safety valve or line pressure or a defective container 4. Natural Phenomena -- seismic event results in the direct or indirect application of mechanical energy External Events were evaluated and dismissed.
Preventive Features	**Design:** - Stored sulfur dioxide cylinder in gas cabinet equipped with seismic restraints. - Stored sulfur dioxide cylinder in areas caged off from normal movement routes - Seismic restraints on equipment and shelving - Facility structure resistant to seismic stresses **Administrative:** - When the gas cylinder is not in use, cap the cylinder
Mitigating Features	**Design**: - ***Flow restricting orifices on toxic gas cylinders*** **Administrative**: - ***Inventory limits*** - General laboratory chemical safety training - Facility and institutional emergency response plans.
Unmitigated consequences:	Consequences for the release of entire inventory of sulfur dioxide (5.2 kg) (the cylinder is equipped with a 0.031 in. restricting flow orifice) at 100 m from the facility and the site boundary are Category C and D, respectively.
Probability:	The probability estimation for this event is **Marginal**.
Comments:	Accident analysis is not required because this event is unlikely to occur during the facility and operation lifetime and its consequence to the co-located workers is recoverable

Event CHEM - 3: Spill/Leakage of the Entire Inventory of Chlorine Trifluoride

Causes:	1. Direct human error – Cylinder is dropped or struck and the regulator is broken. 2. Movement error – Cylinder is dropped while being moved 3. Structural or assembly defects such as a faulty gas regulator or safety valve or line pressure or a defective container 4. Natural Phenomena -- seismic event results in the direct or indirect application of mechanical energy External Events were evaluated and dismissed.
Preventive Features	**Design:** - ***Manifold system designed and constructed specifically for chlorine trifluoride*** - Chlorine trifluoride cylinders are stored / used in toxic gas cabinet equipped with seismic restraints. - Chlorine trifluoride cylinders are stored in areas caged off from normal movement routes - Chlorine trifluoride cylinders are replaced / handled infrequently (generally less often than monthly) - Seismic restraints on equipment and shelving - Facility structure resistant to seismic stresses **Administrative:** - Cylinder valves are closed when not transferring ClF_3 from cylinder - Cylinders are capped when in storage; cylinders in the toxic gas cabinet are valve closed when not in use
Mitigating Features	**Design**: Not applicable **Administrative**: - ***Inventory limits*** - General laboratory chemical safety training - Facility and institutional emergency response plans.
Unmitigated consequences:	Consequences for the release of entire maximum inventory of chlorine trifluoride (6.8 kg) at 100 m from the facility and the site boundary are Category **B** (based upon Q-value S200 F stability 1 mps listing)
Probability:	**Cause 1 –** The probability estimation for this event is **Marginal** or less due to the very limited frequency of cylinder handling combined with the limited potential for cylinder failure from accidentally striking or dropping – particularly if capped (as per procedure). **Cause 2 –** The probability estimation for this event is **Marginal** or less due to the very limited frequency of cylinder handling combined with the limited potential for cylinder failure from accidentally dropping – particularly if capped (as per procedure). **Cause 3 –** The probability estimation for this event is **Marginal** or less due to the chlorine trifluoride system construction & testing controls **Cause 4 -** The probability estimation for this event is **Marginal** or less due both chlorine trifluoride system construction & testing controls plus the combined weight of the above additional design and administrative features.

Comments:	Accident analysis is not required because this event is unlikely to occur during the facility and operation lifetime and its estimated offsite consequence is recoverable

As the Q-list threshold values are calculated directly from the TEELs, Consequence Categories in Hazards Analysis may be determined using the F stability class, 1.0-meter-per-second Q-value listing - provided initial conditions for the unmitigated release of the material are consistent with Q-value assumptions.

Initial conditions for Event Chem-3 are consistent with the assumption set for the F stability class, 1.0-meter-per-second Q-value listing.

The maximum facility inventory for chlorine trifluoride of 6.8 kg is greater than the 1.5 kg Q-2 value for 100 m, but is less than or equal to the 16 kg Q-3 value for 100 m. This is consistent with a consequence category of **B**.
The maximum facility inventory for chlorine trifluoride of 6.8 kg is greater than the 0.65 kg Q-1 value for 300 m, but is less than or equal to the 11 kg Q-2 value for 300 m. This is consistent with a consequence category of **B**

2.2 Radiological Materials

B151 Complex handles radioactive material in three primary forms: (1) Class I and II sealed sources, (2) small quantity analytical samples, and (3) trace quantities in waste. The total facility inventory is well below the DOE-STD-1027-92 Category 3 nuclear facility thresholds.

2.2.1 Controls

Five initial conditions are assumed in assessing radiological material hazards:

1) The facility radiological inventory is less than the category 3 limits in Appendix A of DOE-STD-1027-92, on a cumulative sum-of-the-ratios basis for all isotopes. This basis includes materials contained in certified sealed sources or DOT Type B containers for which exclusion eligibility is no longer current. Facility management may choose to include within this basis materials meeting the exclusion eligibility criteria.
2) Addition of the **excluded** inventory to the facility inventory resulting in a total inventory exceeding 1.0 of sum of the ratios of individual radioactive material isotopes to their Hazard Category 3 thresholds defined in DOE-STD-1027-92 requires the change control process.
3) Material excluded from the facility inventory summation meets the exclusion eligibility criteria specified in attachment 1 of DOE-STD-1027-92.

    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 radiological inventory summation.

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

4) Radioactive sealed sources comply with the LLNL sealed source control policy (*ES&H Manual*, Document 20.2). Certified sealed sources failing periodic leak checks are no longer eligible for exclusion and will be included in the facility radiological inventory summation.

5) The buildings, as designed and built, provide a basic structural capacity

Initial conditions 1 and 2 (inventory limits) are deemed necessary to ensure no significant risk exists beyond the immediate workplace. They are designated as credited controls in the form of one Operational Safety Requirement (OSR) Administrative Control (AC).

Initial condition 3 is deemed necessary to ensure that materials excluded from the facility radiological inventory summation are eligible for exclusion per DOE-STD-1027-92. It is designated as a credited control in the form of an OSR AC.

Initial condition 4 is deemed necessary to ensure that materials excluded from the facility radiological inventory summation remain eligible for exclusion per DOE-STD-1027-92. It is designated as a credited control in the form of an OSR AC.

Initial condition 5 does not require special designation given the limits established. The analysis cited in ES&H Manual Document 3.1 for those limits already considers building failure stresses.

2.2.2 Postulated Hazardous Events

Two general events are identified: (1) **various physical stresses imposed on an uncertified sealed source or other significant material accumulation**, and (2) **various physical stresses imposed on an analytical sample or waste**. Tabular entries for these two events RM-1 and RM-2 are provided on the following two pages.

ES&H Document 3.1 states that Category C is the maximum consequence ranking for the reasonably foreseeable stresses (e.g., fire, spill, shock-impact) of a worst-case material accumulation at its Category 3 isotopic limit. No event significantly impacting that amount of material is Probable, as verified by walk-downs and a facility seismic design that, in current terms, generally correlates to Performance Category 2 for B151 Segment, & PC Category 1 for B152 and B154 Segments. Therefore, accident analysis is not required. If such analysis were required, per the residual Risk Matrix no credited controls would be necessary to support Facility AD approval for even a Probable event. The consequence rank for impacting trace material in waste or analytical operations is Category D, for which accident analysis is again not required even in the Probable frequency range.

Event RM - 1: Radioactive material is impacted by physical stress sufficient to compromise its integrity and initiate an airborne release

Causes:	1. Human error – source is dropped, struck, crushed, or exposed to heat 2. Facility initiated fire 3. Natural Phenomena – seismic or wind events results in the direct or indirect application of mechanical or thermal energy 4. External Events – vehicle accident results in the direct or indirect application of mechanical or thermal energy
Preventive Features	**Design:** - Source matrix provides resistance to physical stresses - Facility structure resistant to seismic inputs, vehicle impacts, and spread of fire - Fire suppression system limits potential for fire growth and propagation **Administrative:** - Source integrity and work area maintained per the provisions of ES&H Manual Document 20.2, *Radiological Safety Program for Radiological Materials* - Limited combustible loading to support fire propagation
Mitigating Features	**Design**: - Sources stored in designated secure locations - Building ventilation provides for significant dilution of any airborne release by directing it to an elevated stack - Building shell provides a significant deposition volume for any airborne release after loss of power (e.g., seismic event) **Administrative**: - ***Overall facility inventory limits*** - Facility and institutional emergency response plans.
Unmitigated consequences:	Category D as currently configured. If a single source close to the facility limit was introduced into the facility and impacted, that ranking could rise to Category C. Thus, while there is no consequence currently anticipated for this event to co-located workers or the public, the overall facility limit could allow a Low consequence.
Probability:	**Expected** for a simple spill with an associated consequence ranking of D; **Marginal** for significant impact to the radioactive material with an associated consequence ranking of D (current inventory) or C (maximally allowed inventory).
Comments:	Accident analysis is not required since the probability of this event is not likely to occur during the facility or operation lifetime and the worst consequences are either recoverable health effect onsite or mild sensation or odor offsite.

Event RM - 2: Trace quantities of radioactive material that are part of an analytical operation or associated with a waste stream are subjected to physical stresses creating an airborne release.

Causes:	1. Human error – material is dropped, struck, crushed, or exposed to heat 2. Facility initiated fire 3. Natural Phenomena – seismic or wind events results in the direct or indirect application of mechanical or thermal energy 4. External Events – vehicle accident results in the direct or indirect application of mechanical or thermal energy
Preventive Features	**Design:** - Facility structure resistant to seismic inputs, vehicle impacts, and spread of fire - Fire suppression system limits potential for fire growth and propagation **Administrative:** - Procedures for receipt and accounting of material to preclude accidental introduction of large quantities - Material and work area controlled per the provisions of ES&H Manual Document 20.2, *Radiological Safety Program for Radiological Materials* - Waste streams managed per the provisions of ES&H Manual Document 36.1, *Hazardous, Radioactive, and Biological Waste Management Requirements* - Limited combustible loading to support fire propagation
Mitigating Features	**Design**: - Building ventilation provides for significant dilution of any airborne release by directing it to an elevated stack - Building shell provides a significant deposition volume for any airborne release after loss of power (e.g., seismic event) **Administrative**: - ***Overall facility inventory limits*** - Facility and institutional emergency response plans
Unmitigated consequences:	Category D based on the quantities involved. If a single accumulation of material close to the facility limit was introduced into the facility and impacted (highly unlikely for this facility), that ranking could rise to Category C. Thus, while there is no consequence currently anticipated for this event to co-located workers or the public, the overall facility limit could allow a Low consequence.
Probability:	**Marginal** for any event with a consequence ranking in excess of D.
Comments:	Accident analysis is not required since the probability of this event is not likely to occur during the facility or operation lifetime and the worst consequences are either recoverable health effect onsite or mild sensation or odor offsite.

B152 Segment contains no radiological materials. The current radiological inventory in the facility is below LSI thresholds; however, B152 Segment is classified as **Low** to allow operational flexibility and storage of radiological materials which may take place at a later date. The Hazard Analysis for radiological materials of B152 Segment is similar to that of B151 Segment in Section 2.2.

B154 Segment contains very low level of radiological materials for research purposes. The current radiological inventory in the facility is below LSI thresholds; however, B154 Segment is classified as **Low** to allow operational flexibility and storage of radiological materials which may take place in a later date. The Hazard Analysis for radiological materials of B154 Segment is similar to that of B151 Segment in Section 2.2.

3. Controls

This chapter formally specifies the credited controls and associated Operational Safety Requirements for Building 151 Complex. These controls are limited to initial conditions specified in the hazard and accident analyses.

3.1 Chemicals

The following initial conditions are designated credited controls:

1. Inventory of all other chemicals shall stay within their LSI limits, except for liquid nitrogen, sulfur dioxide, and chlorine trifluoride. Sulfur dioxide shall be maintained within the Low Hazard limit of 5.2 kg. Chlorine trifluoride inventory shall be limited to 6.8 kg. Liquid Nitrogen inventory is limited by the tank capacity of 12,900 kg plus in use quantity for an overall B151 Complex limit of 18,000 kg. This limitation is not carried forward as an OSR because the worst consequence for the release of a full storage tank of liquid nitrogen is Category D.
2. Compressed gas cylinder with greater than 10% concentration by weight of sulfur dioxide shall be equipped with Flow Restricting Orifice size 0.031 in. or smaller.
3. High Vacuum Fluorination System (HVFS) reaction vessel manifold is designed and constructed specifically for use with chlorine trifluoride as specified in Engineering Safety note LLSN04-503-AA.
4. The B151 Segment structure, as designed and built, provides a basic structural capacity.

These controls preclude chemical operations at Building 151 Segment from presenting a significant risk to personnel outside the immediate operational area. The Flow Restricting Orifice is defined as the OSR specific AC. The inventory limits are specifically identified as part of one General AC defining an inventory control program. The HVFS reaction manifold and building structural capacity are covered as OSR Design Features.

3.2 Radiological Materials

Four items are designated as credited controls:

1) The facility radiological inventory is less than the category 3 limits in Appendix A of DOE-STD-1027-92, on a cumulative sum-of-the-ratios basis for all isotopes. This basis includes materials contained in certified sealed sources or DOT Type B containers for which exclusion eligibility is no longer current. Facility may choose to include within this basis materials meeting the exclusion eligibility criteria.

2) Addition of the **excluded** inventory to the facility inventory resulting in a total inventory exceeding 1.0 of sum of the ratios of individual radioactive material isotopes to their Hazard Category 3 thresholds defined in DOE-STD-1027-92 requires the change control process.

3) Material excluded from the facility inventory summation meets the exclusion eligibility criteria specified in attachment 1 of DOE-STD-1027-92.

    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 radiological inventory summation.

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

4) Radioactive sealed sources comply with the LLNL sealed source control policy (*ES&H Manual*, Document 20.2). Certified sealed sources failing periodic leak checks are no longer eligible for exclusion and are included in the facility radiological inventory summation.

These controls preclude the potential for radiological material storage and handling in the B151 Complex from presenting a significant risk to personnel outside the immediate operational area. They have been developed as two Operational Safety Requirement (OSR) general Administrative Controls (ACs); an inventory control program, and requirements for excluded radioactive sealed source documentation and maintenance.

3.3 OSRs

The controls cited in Sections 3.1 and 3.2 are implemented in the Building 151 Complex OSRs, as one specific AC mandating the use of Flow Restricting Orifice on sulfur dioxide cylinder and three general ACs for chemical and radiological inventory controls, excluded sealed source documentation and maintenance. The building structure, as designed and built, provides a basic structural capacity is covered as an OSR Design Feature. The High Vacuum Fluorination System (HVFS) reaction vessel manifold as designed and constructed is also covered as an OSR Design Feature. Additionally, per ES&H Manual Document 3.1, four general ACs are specified for deviations from OSRs, training, procedures, and emergency planning.

No Minimum Functional Requirements or associated Testing Requirements are defined.

3.3.1 Inventory Control Program

An inventory control program shall be established, implemented, and maintained to ensure that the chemical and radioactive material inventory remains consistent with the hazard-specific facility classification. Bounding limits are:

a. The maximum cumulative quantities of all hazardous chemicals in each of the three segments (i.e., B151, B152 and B154) (other than LN_2 ,sulfur dioxide and chlorine trifluoride for B151 Segment) shall be kept below their LSI thresholds.

- Sulfur dioxide shall be maintained within the Low Hazard limit of 5.2 kg.
- Chlorine trifluoride inventory shall be limited to 6.8 kg.
- Liquid Nitrogen inventory is limited by the tank capacity of 12,900 kg plus in use quantity for an overall B151 Complex limit of 18,000 kg.

b. The facility inventory, the sum of the ratios of individual radioactive material isotopes to their Hazard Category 3 thresholds defined in DOE-STD-1027-92 is limited to a value less than 1.0.

c. Addition of the **excluded** inventory to the facility inventory resulting in a total inventory exceeding 1.0 of sum of the ratios of individual radioactive material isotopes to their Hazard Category 3 thresholds defined in DOE-STD-1027-92 requires the change control process.

A Radioactive Materials Inventory System shall be maintained. It shall be reconciled as frequently as necessary to ensure that the above bounding limits are not exceeded. Inventory reconciliation more frequent than annually should be considered if inventory approaches inventory bounding limit (>=75%).

3.3.2 Excluded Radioactive Sealed Source Documentation & Maintenance

a. The facility will retain documentation for all certified sealed sources which have been excluded from the inventory, showing that the source or prototypes of the source, have been tested and passed the Special Form tests specified by DOT in 49 CFR 173.469 or ANSI N43.6 “Sealed Radioactive Sources, Categorization.”

b. Certified sealed sources excluded from the facility inventory will also be subject to the LLNL Radiological Safety Program for Radioactive Materials maintenance requirements for radioactive sealed sources. This includes periodic inventories and leak checks. Should it fail periodic leak checks, it shall be removed from service and added to the facility inventory.

3.4 Impacts on Nearby Facilities

B151 Complex operations represent minor risks to adjacent facilities or the public.

4. OSRs

This chapter formally defines the OSRs identified in section 3.3.

4.1 Specific Administrative Controls

One specific AC is defined.

4.1.1 Use Flow Restrictors on Sulfur Dioxide Cylinders

1. ***AC Statement**:* Compressed gas cylinder with greater than 10% concentration by weight of sulfur dioxide shall be equipped with Flow Restricting Orifice size 0.031 in. or smaller.

Justification: Using the flow restricting orifice on the sulfur dioxide cylinders will reduce the gas release risks to co-located workers.

4.2 General Administrative Controls

Three general ACs are defined.

4.2.1 Chemical Inventory Control Program

Inventory of all chemicals shall be maintained within their LSI limits, except for LN_2, sulfur dioxide, and chlorine trifluoride.

- Sulfur dioxide shall be maintained within the Low Hazard limit of 5.2kg.
- Chlorine trifluoride inventory shall be limited to 6.8 kg.
- Liquid Nitrogen inventory is limited by the tank capacity of 12,900 kg plus in use quantity for an overall B151 Complex limit of 18,000 kg.

4.2.2. Radioactive Materials Inventory System

The facility radiological inventory and the excluded facility inventory each remain below the category 3 limits in Appendix A of DOE-STD-1027-92, on a cumulative sum-of-the-ratios basis for all isotopes.

4.2.3. Excluded Radioactive Material Documentation and Maintenance

The Facility retains documentation for all radioactive material excluded from the facility inventory summation verifying that the material meets the exclusion eligibility criteria specified in attachment 1 of DOE-STD-1027-92.

Specifically:

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 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.

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

4.2.4 Deviations from OSRs

The OSRs define the controls needed to ensure that the facility/operation remains within the safety basis established. They shall be formally controlled with all changes requiring approval at the same level as the associated safety basis document.

A.1 Compliance

Facility Management is responsible for ensuring that the OSR requirements are met. Compliance is demonstrated by establishing, implementing, and maintaining the ACs identified in this document.

A.2 Violation

Violation of an OSR occurs as a result of failure to comply with an AC statement. Failure to comply with a specific AC constitutes an OSR violation. For general ACs, violation occurs when the failure is of sufficient magnitude that the overall intent of the referenced program is not fulfilled.

A.3 Response to Violations

If an Administrative Control is violated, proceed as follows:

1. Place the facility in a safe condition, and notify the safety basis signature authority.

2. Prepare an Occurrence Report.

3. Prepare a recovery plan, if appropriate, describing the steps leading to compliance with the Administrative Control.

4. Perform and document a technical evaluation, if appropriate, of the Administrative Control violation to determine if any damage occurred.

A.4 Emergency Actions

Emergency actions may be taken that depart from a requirement in the OSR provided that:

• An emergency situation exists;

• These actions are needed immediately to protect health and safety; and

• No action consistent with the OSR can provide adequate or equivalent protection.

Such emergency actions shall be performed by personnel trained and qualified for the necessary equipment or systems. If an emergency action is taken, the safety basis signature authority should be notified as soon as is practically possible.

The only foreseeable emergency action for B151 Complex is an immediate need to shelter inventory from an event affecting other facilities in the area.

4.2.5 Training

Facility-specific training requirements shall be identified and implemented consistent with the appropriate provisions of *ES&H Manual 3.1* for hazards that result in a facility being classified as low hazard or higher. Specifically, workers responsible for generating, maintaining, and ensuring compliance with this document shall obtain a facility-specific working-level awareness of the contents and controls of the facility safety basis and the process of document implementation, (e.g., through required reading, on-the-job training, or briefing). The training should include a review of the following:

- Classification level of each facility.
- The type of SBD associated with each facility and where to obtain a copy.
- Roles, responsibilities, and authority for maintaining and implementing the safety basis.
- Safety basis controls and the associated QA requirements needed to maintain them.
- The control implementation documents (e.g., FSP, SP, SOPs).
- Reporting requirements.
- Change control process.

- Configuration management as relevant to maintaining facility safety systems to ensure risk reduction and segmentation requirements
- What to do in case of a control nonconformance.

4.2.6 Procedures

The safety basis document assumptions and controls shall be implemented through facility- and activity-level documents for hazards that result in a facility being classified as low hazard or higher. These assumptions and controls shall flow down from this document to facility implementation documents such as FSPs, SPs, IWSs or facility and/or equipment operating procedures and ES&H programs.

4.2.7 Emergency Planning

An emergency preparedness capability shall be established, implemented, and maintained for hazards that result in a facility being classified as low hazard or higher. It should address the following subjects:

- Notification capability to support localized evacuations.
- Specification of knowledgeable individuals for area/room operations.
- Establishment of assembly points.
- Identification of special actions, if any, that need to be taken in the event of an abnormal situation, including those assessed in this document.

Note that knowledgeable individuals are not required to be continuously available. The intent is to demonstrate a baseline understanding of facility hazards.

4.3 Design Features

Two Design Features have been designated:

(1) High Vacuum Fluorination System (HVFS) reaction vessel manifold. This feature shall be controlled so as to maintain system configuration consistent with specifications of Engineering Safety note LLSN04-503-AA, Reaction Vessel for High Vacuum Fluorination System.

(2) Basic building structural capacity. This feature shall be controlled so as to maintain the design capacity as of the effective date of this OSR document.

For each facility segment structure, appropriate configuration management shall be established to maintain basic structural stability consistent with designed and built load capacity. This covers only general exterior wall integrity (i.e., do not add massive quantities of windows), load-bearing structural members and major modifications to those members (i.e., do not compromise fundamental support structures). It is not intended for this configuration management function to address individual penetrations, settling cracks, normal interior SSC mounting issues, normal internal modifications, etc.

It is intended solely to maintain a predominantly intact exterior shell for the original facility design loads.

References

1) 29 CFR 1910.1450, Occupational Exposures to Hazardous Chemicals in Laboratories.

2) 49 CFR 173.469, Test for Special form Class 7 (Radioactive) Materials.

3) ANSI N43.6, Sealed Radioactive Sources Classification.

4) Hazard Categorization and Accidental Analysis Technique for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, Table a.1, Threshold for Radionuclides, U.S. Department of Energy, Washington, DC. (DOE 1027. 92) (September 1997).

5) Environment, Safety, and Health (ES&H) Manual, Document 3.1, Nonnuclear Safety Basis Program, September 23, 2004.

6) Environment, Safety, and Health (ES&H) Manual, Part 14, Chemical.

7) Environment, Safety, and Health (ES&H) Manual, Part 17, Explosives, Lawrence Livermore National Laboratory, Livermore, CA, January 1997.

8) Environment, Safety, and Health (ES&H) Manual, Document 20.2, LLNL Radiological Safety Program for Radioactive Materials, January 19, 2006.

9) DOE Explosives Safety Manual, LLNL Work Smart Standards Version, DOE M 440.1-1, Revision 4, December 7, 2004, UCRL-AM-208565.

10) DOE O 420.2A, Safety of Accelerator Facilities, January 8, 2001.

11) LANL (2002), Development and Certification of a Special Form Capsule for Sealed Sources to Facilitate Transportation and Storage as a Special Form Material, LAUR-02-433, February 22, 2002.

12) NFPA 70, "National Electrical Code."

13) Homann, S., EPICode "Emergency Prediction Information," Homann Associates Inc., Fremont, CA, 1988, Version 7.0, September 2003.

14) LLNL Engineering Safety Note LLSN04-503-AA

15) Air Products Safetygram #39, Chlorine Trifluoride, Air Products and Chemicals, inc, 2004

Appendix A – EPIcode Runs

EPICode Table - 1: Release by Impact to Liquid Nitrogen Tank

EPIcode Version 7.0 Term Release
May 23, 2006 12:27 PM

Source Material	: NITROGEN
CAS Number	: 7727-37-9
Source Term	: 12900 kilograms
Release Duration	: 15 min
Airborne Fraction	: 1.000
Effective Release Height	: 0.00 m
Wind Speed (h=10 m)	: 1.0 m/s
Distance Coordinates	: All distances are on the Plume Centerline
Stability Class (City)	: F
Deposition Velocity	: 0.00E+00 cm/s
Receptor Height	: 1.5 m
Inversion Layer Height	: None
Sample Time	: 15.0 min
Maximum Concentration	:> 500,000 PPM
Max Concentration Distance	: 0.013 km
TEEL-0	: 7.00E+04 PPM
TEEL-1	: 2.10E+05 PPM
TEEL-2	: 3.50E+05 PPM
TEEL-3	: 5.00E+05 PPM
Exceeds TEEL-1 Out To	: 0.073 km
Exceeds TEEL-2 Out To	: 0.055 km
Exceeds TEEL-3 Out To	: 0.046 km

DISTANCE	MAXIMUM CONCENTRATION		ARRIVAL TIME
km	(mg/m3)	(PPM)	(hour:min)
0.030	> 500,000	> 500,000	00:01
0.100	130,000	120,000	00:04
0.200	37,000	32,000	00:08
0.381	12,000	10,000	00:16
0.400	11,000	9,300	00:17
0.500	7,300	6,300	00:21
0.525	6,700	5,800	00:22
0.700	4,100	3,600	00:30
0.800	3,300	2,900	00:35
0.900	2,800	2,400	00:39
1.000	2,300	2,000	00:43
2.000	830	730	01:27
4.000	200	180	02:55
6.000	72	62	04:22
8.000	43	37	05:50
10.000	29	25	07:17
20.000	9.0	7.9	14:35
40.000	3.0	2.6	>24:00
60.000	1.6	1.4	>24:00
80.000	1.0	0.89	>24:00

EPICode Table - 2: Release of entire inventory of Sulfur Dioxide (5.2 kg) through 0.031 in. Orifice (0.0287 lbm/min, 399 min. release duration)

EPIcode Version 7.0 Term Release
May 23, 2006 01:08 PM

Source Material	: SULFUR DIOXIDE
CAS Number	: 7446-09-5
Source Term	: 5.2 kilograms
Release Duration	: 399 min
Airborne Fraction	: 1.000
Effective Release Height	: 0.00 m
Wind Speed (h=10 m)	: 1.0 m/s
Distance Coordinates	: All distances are on the Plume Centerline
Stability Class (City)	: F
Deposition Velocity	: 0.10 cm/s
Receptor Height	: 1.5 m
Inversion Layer Height	: None
Sample Time	: 15.0 min
Maximum Concentration	: 15 PPM
Max Concentration Distance	: 0.013 km
ERPG-1	: 0.3000 PPM
ERPG-2	: 3.000 PPM
ERPG-3	: 15.00 PPM
Exceeds ERPG-1 Out To	: 0.16 km
Exceeds ERPG-2 Out To	: 0.047 km
Exceeds ERPG-3 Out To	: 0.014 km

DISTANCE	MAXIMUM CONCENTRATION		ARRIVAL TIME
km	(mg/m3)	(PPM)	(hour:min)
0.030	17	6.6	00:01
0.100	1.9	0.73	00:04
0.200	0.52	0.20	00:08
0.381	0.16	0.061	00:16
0.400	0.15	0.056	00:17
0.500	0.10	0.038	00:21
0.525	0.091	0.035	00:22
0.700	0.056	0.021	00:30
0.800	0.045	0.017	00:35
0.900	0.037	0.014	00:39
1.000	0.032	0.012	00:43
2.000	0.011	0.0042	01:27
4.000	0.0044	0.0017	02:55
6.000	0.0026	0.0010	04:22
8.000	0.0019	7.1E-04	05:50
10.000	0.0014	5.5E-04	07:17
20.000	6.6E-04	2.5E-04	14:35
40.000	3.1E-04	1.2E-04	>24:00
60.000	2.0E-04	7.8E-05	>24:00
80.000	1.5E-04	5.8E-05	>24:00

EPICode Table - 3: Release of entire inventory of Chlorine Trifluoride (6.8 kg – 0.12 lbm/min. release rate, 125 minute release duration)

EPIcode Version 7.0 Term Release
Jul 24, 2006 04:25 PM

Source Material	: CHLORINE TRIFLUORIDE
CAS Number	: 7790-91-2
Source Term	: 6.800 kilograms
Release Duration	: 125 min
Airborne Fraction	: 1.000
Effective Release Height	: 0.00 m
Wind Speed (h=10 m)	: 1.0 m/s
Distance Coordinates	: All distances are on the Plume Centerline
Stability Class (City)	: F
Deposition Velocity	: 0.30 cm/s
Receptor Height	: 1.5 m
Inversion Layer Height	: None
Sample Time	: 15.0 min
Maximum Concentration	: 44 PPM
Max Concentration Distance	: 0.013 km
TEEL-0	: 0.1000 PPM
TEEL-1	: 0.1200 PPM
TEEL-2	: 2.000 PPM
TEEL-3	: 21.00 PPM
Exceeds TEEL-0 Out To	: 0.46 km
Exceeds TEEL-1 Out To	: 0.42 km
Exceeds TEEL-2 Out To	: 0.096 km
Exceeds TEEL-3 Out To	: 0.027 km

DISTANCE	MAXIMUM CONCENTRATION		ARRIVAL TIME
Km	(mg/m3)	(PPM)	(hour:min)
0.027	79	21	00:01
0.096	7.7	2.0	00:04
0.100	7.1	1.9	00:04
0.200	1.8	0.49	00:08
0.300	0.86	0.23	00:13
0.400	0.50	0.13	00:17
0.420	0.46	0.12	00:18
0.460	0.39	0.10	00:20
0.500	0.34	0.089	00:21
0.520	0.31	0.083	00:22
0.600	0.24	0.065	00:26
0.700	0.19	0.050	00:30
0.800	0.15	0.040	00:35
0.900	0.12	0.032	00:39
1.000	0.10	0.027	00:43