3.8. **Particularly Hazardous Substances** - Procedures for Safe Handling and Storage

The Occupational Safety and Health Administration (OSHA) Laboratory Standard requires that special handling procedures be employed for certain chemicals identified as "particularly hazardous substances." Particularly hazardous substances include chemicals that are "select carcinogens, reproductive toxins, and chemicals that have a high degree of acute toxicity." In addition, many chemicals used (including novel chemicals that are synthesized) in research laboratories have not been tested explicitly for carcinogenic or toxic properties and must therefore be handled as "particularly hazardous substances" since their hazards are unknown.

3.8.1. Carcinogen

A carcinogen is a substance that either causes cancer in humans or, because it causes cancer in animals, is considered capable of causing cancer in humans. OSHA defines those substances that are known to pose the greatest carcinogenic hazards as "select carcinogens" (see Appendix B). These materials include substances that:

- OSHA regulates as a carcinogen; or
- The National Toxicology Program (NTP) lists as "known to be a carcinogen" or "reasonably anticipated to be a carcinogen" in their Annual Report on Carcinogens; or
- The International Agency for Research on Cancer (IARC) lists under Group 1 ("carcinogenic to humans"), Group 2A ("probably carcinogenic to humans"), or Group 2B ("possibly carcinogenic to humans").

3.8.2. Reproductive Toxin

A reproductive toxin is a substance that causes chromosomal damage or genetic alterations (mutagens) or substances that cause lethal or physical malformations or defects in a developing fetus or embryo (teratogens).

Additional information and guidance can be found in SOP 3.21, Reproductive Toxins, Mutagens, Teratogens, and Embryotoxins – Procedures for Safe Handling and Storage.

3.8.3. Chemicals with a High Degree of Acute Toxicity

Acute toxicity is the ability of a chemical to cause a harmful effect rapidly after a single short term exposure. Acutely toxic chemicals can cause local toxic effects, systemic effects, or both. OSHA's "chemicals with a high degree of acute toxicity" includes both "highly toxic" and "toxic" chemicals that "may be fatal or cause damage to target organs as a result of a single exposure or exposures of short duration" (i.e., acutely toxic effects) as defined in 29 CFR 1910.1200, Appendix A (Mandatory). Combining the definitions from 29 CFR 1910.1200, Appendix A, yields the following table:

Route of Entry	Highly Toxic	Toxic
Oral LD_{50} (albino rats)	≤ 50 mg/kg	>50-500 mg/kg
Skin Contact LD_{50} (albino rabbits, 24 hour)	≤ 200 mg/kg	>200-1000 mg/kg
Inhalation LC_{50} (albino rats, one hour) as vapor	≤ 200 ppm	>200-2000 ppm
Inhalation LC_{50} (albino rats, one hour) as dust, mist, or fumes	or ≤ 2 mg/liter	or >2-20 mg/liter

Note: The lethal dose (LD50) is the dose (in mg/kg of body weight) and the lethal concentration (LC50) is the concentration in air (in ppm) at which 50% of the test subjects expire.

In general, "chemicals with a high degree of acute toxicity" include 1) "highly toxic" chemicals that have an Oral LD50 of ≤50 mg/kg (rats), Skin Contact LD50 of ≤200 mg/kg (rabbits), Inhalation LC50 of ≤200 ppm (rats for 1 hour) and 2) "toxic" chemicals with acutely toxic effects or those that have an Inhalation LC50 of ≤2000 ppm (rats for 1 hour).

Comparing the former OSHA definition to the Globally Harmonized System (GHS) of chemical classification and labeling, the GHS acute toxicity ratings of 1 and 2 account for the old OSHA "highly toxic" categories and the "toxic" inhalation category. Therefore, the GHS acute toxicity ratings of 1 and 2 can be used as to determine the laboratory chemicals that are considered "chemicals with a high degree of acute toxicity" and as such, "particularly hazardous substances."

Route of Entry	**GHS Acute Toxicity Ratings**			
	1	2	3	4
Oral LD_{50}	0-≤5 mg/kg	>5-<50	50-<300	300-<2000
Skin Contact LD_{50}	0-≤50 mg/kg	>50-≤200	>200-≤1000	>1000-≤2000
Inhalation (gas) LC_{50}	0-≤100 ppm	>100-≤500	>500-≤2500	>2500-≤5000
Inhalation (vapors) LC_{50}	0-≤0.5 mg/l	>0.5-≤2.0	>2.0-≤10.0	>10.0-≤20.0
Inhalation (dust & mist) LC_{50}	0-≤0.05 mg/l	>0.05-≤0.5	>0.5-≤1.0	>1.0-≤5.0

Using the National Fire Protection Association's (NFPA) 704 health hazard classifications, the NFPA health hazard ratings of 3 and 4 accounts for all the OSHA "highly toxic" categories and the "toxic" inhalation category. Therefore, the NFPA health hazard ratings of 3 and 4 can be used as practical guide to determine the laboratory chemicals that are considered "chemicals with a high degree of acute toxicity" and as such, "particularly hazardous substances."

Route of Entry	**NFPA 704 Health Hazard Classifications**				
	4	3	2	1	0
Oral LD_{50}	0-5 mg/kg	>5-50	>50-500	>500-2000	>2000
Skin Contact LD_{50}	0-40 mg/kg	>40-200	>200-1000	>1000-2000	>2000
Inhalation LC_{50}	0-1000 ppm	>1000-3000	>3000-5000	>5000-10,000	>10,000

3.8.4. Handling

- Designated areas (e.g., fume hoods, glove boxes, lab benches, outside rooms) for material use must be established and the areas identified by signs or postings.
- Containment devices such as fume hoods (if necessary) and personal protective equipment (e.g., gloves, lab coat, and eye protection) must be used when handling these hazardous substances.
- Procedures for the safe use of the material and waste removal must be established prior to use.
- Decontamination procedures must be developed in advance and strictly followed.
- Only laboratory personnel trained to work with these substances can perform the work, and always within the designated area. Prior approval is required by the Principal Investigator, Lab Manager or Lab Supervisor (see Section 2.1.1 Prior Approval of Hazardous Operations).
- Only the minimum quantity of the material should be used.

3.8.5. Storage

- These materials must be stored in areas designated for "particularly hazardous substances."
- Storage areas should be clearly marked with the appropriate hazard warning signs.
- All containers of these materials (even if the material is in very small quantities such as 0.1%) must be clearly labeled with the chemical name or mixture components and should be labeled with the appropriate hazard warning information.
- Chemical storage areas should be secure to avoid spills or broken containers.
- Storage areas or laboratory rooms must be locked when laboratory personnel are away or not present.