CHTM Emergency Response Plan

Center for High Technology Materials

Emergency Response Plan

Revised October 14, 2016

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1. Overview of the Center for High Technology Materials

The Center for High Technology Materials (CHTM) is located at 1313 Goddard SE, in the UNM South Technology Park. Personnel occupying the CHTM facility include faculty, staff, UNM students, and some external users of the CHTM cleanroom. The main process in operation at CHTM is optoelectronic device fabrication. This process uses toxic, corrosive, pyrophoric, and reactive source materials. Additionally, there are numerous laser-labs in the facility where research is conducted.

An accident at CHTM could impose a substantial risk to the life and health of CHTM personnel and may impact the neighboring community. These hazards have been addressed by CHTM in consultation with the local (campus and city) emergency services community, and a safety system has been implemented.

The most significant hazards at CHTM are:

accidental release of a hazardous gas.
incident involving electrical/electromagnetic energy
accidental spill of corrosive liquid
exposure to laser emission

1.1. Emergency Call Numbers:

The most current emergency contact details are maintained at several locations as follows:
Primary - UNM Police Department (911 from any campus phone, 277.2241 from any other phone)
Alternate - Center for High Technology Materials (505.272.7800)
On-Site – Posted on front door of facility and throughout the facility (Appendix D- Sample Emergency Contact List)

The job function titles responsible for emergency responses addressed in this Emergency Response Plan are as follows:

1. CHTM Facilities Manager (UNM Classification – Building Systems Engineer)
2. CHTM Facilities Technician
3. CHTM- Master Electrician
4. CHTM Clean Room Technician (UNM Classification - Research Specialist / Lab)
5. CHTM Clean Room Technician (UNM Classification - Research Engineering Tech)
6. CHTM Clean Room Manager

1.2. Document Control:

The source document for this Emergency Response Plan, and the distribution of all copies, is strictly controlled by UNM's Center for High Technology Materials (CHTM}, specifically by the CHTM Document Control Manager. The document will be reviewed annually to ensure accuracy and timeliness. If revisions are necessary or desired prior to the annual review, the changes must be submitted in writing to the Document Control Manager, who will then circulate the proposed change through the review process. If approved, then each of the controlling or interested parties will signify approval of the change by signing and dating the appropriate Change Form.

1.3. Table of Acronyms

Acronym	Text
8-5	0800 hours to 1700 hours
AFD	Albuquerque Fire Department
AWN	Acid-waste Neutralization
BOE	Buffered Oxide Etch
CCTV	Closed-circuit television
CGM	Combustible Gas Monitors
CHTM	Center for High Technology Materials
CM4	Continuous Monitoring System 4 (Trade name for a four channel Continuous Toxic Gas Monitor)
DCM	Document Control Manager
EMO	Emergency - Manual Off
EGP	Evacuation Grouping Point
EHS	Environmental Health and Safety (UNM Department of)
EOHS	Employee Occupational Health Sciences (part of UNM School of Medicine)
ERP	Emergency Response Plan
ERT	Emergency Response Team
EPO	Emergency Power Off
HF	Hydrofluoric (acid or qas)
HGMSZ	Halogen Gas Monitoring - Single Zone
HVAC	Heating, Ventilations, and/or Air-conditioning
IDLH	Immediately Dangerous to Life and Health
LEL	Lower Explosive Limit
LSO	Laser Safety Officer
MBE	Molecular-beam Epitaxy
MDA or MDA System 16	MDA System 16 (Trade name for a sequential 16 channel Toxic Gas Monitor)
M-F	Monday through Friday
mq	Milligrams
MSDS	Material Safety Data Sheets
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
ppb	parts per billion
PIV	Post Indicator Valve
PPE	Personal Protection Equipment
ppm	parts per million
TGM	Toxic Gas Monitor

2. Hazard Analysis

2.1. Gases

Due to the nature of the processes utilized at CHTM, there are a variety of hazardous chemicals stored and used at the facility, generally falling into the following categories:

Toxic and Highly-Toxic gases (gases with high toxicity characteristics such as chlorine and fluorine are used, as well as gases of lower toxicity like ammonia and boron trichloride.

Pyrophoric gases, like Silane, will self-ignite when exposed to air;

Flammable Gases, like Hydrogen, ignite easily and burn vigorously;

Reactive gases, like chlorine and fluorine, are strong oxidizers and will react aggressively with many other materials;

Corrosive gases, like ammonia and boron trichloride are harmful to metals and destructive to human tissues; they can be either acidic or basic.

2.1.1. Exterior gas cylinder storage area

On pad directly behind (west) main CHTM Building.

2.1.2. Clean Room Gas Cabinets

Located in chase 134 at the northeast corner of building:

Boron trichloride
Chlorine
Ammonia
Silane
Hydrogen

2.1.3. Fluorine Gas Cabinet

Located in laser-lab chase behind Lab 169B (southwest corner of building.)

2.2. Hazardous Liquids

2.2.1. Flammable Liquids

Certain liquids having a flash point below 100 degrees F and which will burn when ignited are used at CHTM, often for cleaning and other maintenance purposes; some common flammables used are acetone, methanol, and isopropyl alcohol.There are also combustible liquids in use at CHTM {combustibles have flash points from 100 to 200 degrees F), including many of the photolithography chemicals.

2.2.2. Corrosive Liquids

Many liquid chemicals used at CHTM are corrosive-destructive to human tissues and metals- and can be either acidic (like Nitric Acid or Phosphoric Acid) or basic (like Ammonium Hydroxide). In the Cleanroom, these may be used as part of the wafer fabrication process, contained in equipment known as wet-benches (aka, acid benches).

2.2.3. Hazardous Waste

Some of the chemicals used in the processes at CHTM remain hazardous after the process is complete, and require further controls or processing before leaving the site; corrosive waste (mainly from the Cleanroom) is treated on-site in the Acid Waste Neutralization (AWN) room (lower level of the rear building).

2.2.4. Chemical Inventory

A more detailed list of the most-common hazardous chemicals used at CHTM can be found in Appendix A of this Plan. A complete listing (and accompanying MSDS library) can be found in the Safety Kiosk located in the connecting hallway across from the Electrical Shop.

2.3. Process Hazards

In addition to the chemical hazards illustrated above, CHTM processes utilize certain hazardous operations and equipment, including high-powered lasers (both visible and invisible light), ionizing radiation (X-ray), MBE reactors, Schlenk line, etc.

2.3.1. Laser Labs

Most of the central portion of the CHTM building is taken up by research labs using high power lasers.

2.3.2. Molecular-Beam Epitaxy

This is a growth process used to form crystals of a very precise and controlled composition, using a highly specialized piece of equipment known as an MBE Reactor.

2.3.3. Schlenk Line

This is a specialized chemical apparatus used to grow nano crystalline structures.

3. Safety System

3.1. Safety of Building Occupants

3.1.1. Access Control

Access to CHTM facility is open to persons having legitimate business there. During regular business hours (8am to 5pm, M-F), the main door is open, allowing students and other members of the public open access. Outside these times, however, the facility is normally locked at all times, and only those with electronic card access privileges or keys can enter the building.

3.1.2. Safety Awareness

Signs and posters are displayed at numerous locations throughout CHTM to advise building occupants as to emergency procedures. This includes evacuation procedures in general, evacuation routes to follow in case of emergency, and a simple explanation of the alarm-system warning devices. As part of the Hazard Communication program being developed at CHTM,

chemical containers and storage apparatus are labeled using a standardized, informative, and easy-to-understand system; this allows CHTM staff to quickly understand and evaluate the hazards associated with the individual chemicals that they may encounter. For more detailed information regarding chemical hazards, an SDS library {3-ring binders) and an up-to-date chemical inventory can be found at the Safety Kiosk bound by public corridor 119 on the south and the intersection of public corridor 184 (North/South) and 185 (East West).

3.1.3. Safety Training

All authorized users of CHTM hazard areas are trained in general safety policies / procedures, chemical and fire hazards, and emergency procedures. This training occurs prior to the authorization of access to the facility, and refresher training is required annually. Training is aimed at three distinct levels:

3.1.3.1. Awareness Training

For casual or infrequent users of the facility, including janitorial and maintenance (UNM Physical Plant or outside contractors) personnel-explains main hazards at CHTM and basic emergency procedures.

3.1.3.2. Chemical Safety Officer Training

For anyone handling chemicals or gases, or working in the clean rooms, service room, x-ray or laser rooms [provided by UNM-EHS].

3.1.3.3. Emergency-Responder Training

For anyone assigned to specific duties in the event of an emergency incident at CHTM.

3.1.3.4. Laser Training

Additional training for laser systems is controlled by the Laser Safety Officer (LSO). Refer to Appendix B CHTM Training Matrix for complete listing of training requirements.

3.1.4. General Safety Controls

Local Fire/Emergency Alarm System
Automatic Fire Sprinkler System-see section 3.2.4 below.
Ventilation System (both general ventilation and hazardous exhaust).
CCTV System (cameras are installed in the lobby area, in the hallway outside the loading dock and at multiple sites inside the clean room).

3.1.5. Gas Detection and Alarm Systems

3.1.5.1. Toxic Gas Monitor (TGM)

High-sensitivity continuous gas monitoring is in operation at CHTM. Air is sampled at several locations with a risk potential and tested for the presence of the target gas. (see Appendix C - Emergency Grouping Point & Evacuation Route Map for location)

Currently using electrochemical sensors and a MDA16 system.

Monitoring these six gases simultaneously:

- Boron Trichloride (BCl3)
- Chlorine (Cl2)
- Fluorine (F2)
- Hydrogen (H_2)
- Ammonia (NH3)
- Silane (SiH4)

3.1.5.2. Local Alarm System

Visual and audio notification devices are activated to warn occupants of the CHTM of the potential hazards when detected. A two-light flashing beacon provides visual indication that the gas monitoring system has detected a problem:

- Red beacon indicates a high-level alarm: Danger
- Yellow beacon indicates a low-level alarm: Warning.

3.1.5.3. Remote Alarm System

The gas detection systems automatically sends information to the remote alarm station at the UNM police station. This feature allows timely response to emergencies at CHTM at times when no personnel are in the facility.

Gas monitoring information, as well as status of various building systems, can be read at the System Monitor in Room 195 in the Facility Support Building.

3.2. Automatic Intervention Systems

3.2.1. Automatic Shutoff Valves

Toxic and flammable gases are shutoff automatically when detected by the monitoring systems.

3.2.2. Fire Alarm, Detection, and Notification Systems

The Fire Alarm system relies primarily on manual pull stations to alert building occupants (local alarm system). Activating the pull stations sounds an audible alarm throughout the CHTM Facility, using a sound distinct from either of the alarms signifying a gas alarm. The alarm is also transmitted to the Campus Police Station, where the alarm input is translated into several automatic response outputs, including dispatching a police officer to the Facility, contacting the Albuquerque Fire Department to initiate a fire response, and notifying CHTM emergency-contact personnel. Pull Stations are located at each exterior exit door, and at other locations throughout the facility.

3.2.3. Heat Detectors

Are installed at strategic locations at CHTM, providing early detection of fire in that location. (see Appendix C - Emergency Grouping Point & Evacuation Route Map for location)

3.2.4. Automatic Fire Sprinklers

Automatic fire sprinklers are installed throughout the CHTM main building (and in each gas cabinet inside the facility). In the Service/Support/Central Plant building (west of main building), only the AWN room on the lower level is sprinklered.

Activation of any sprinkler head will initiate an alarm, will sound the Water Gong (on the exterior wall outside the Main Sprinkler Valve), and will activate the Local Fire Alarm system (see above)-including the notification and automatic dispatch features at the UNMPD.

3.2.5. Control valves for the sprinkler system

3.2.5.1. CHTM – Main Bldg.

Interior control valve is located on the north wall of the shipping / receiving area. The exterior or post indicator valve (PIV) is located outside the building along the north sidewalk and has indicators to show if the valve is open or closed.

3.2.5.2. CHTM Service / Support Plant Bldg.

Interior control valve is located on the north wall of the lower level just west of exterior overhead door. The exterior or post indicator valve (PIV) is located outside the building roughly five feet north of the exterior overhead door and approximately twenty feet west but parallel to the northern wall. The PIV has indicators to show if the valve is open or closed.

3.2.6. System Testing

All fire alarm, detection, and intervention systems are tested on a regular schedule, at least annually and more often where indicated. Extinguishers and Fire Sprinklers are inspected and maintained by EHS.

3.2.7. Chiller Refrigerant Detector

In the event of a HVAC chiller refrigerant dump or leak in the mechanical annex building, an asphyxiation hazard may develop. A Bacharach HGMSZ (Halogen Gas Monitor Single Zone) detector is present in the annex building to detect the presence of R134a refrigerant gas. This alarm is not interfaced to the building alarm system. Therefore, it must be reviewed prior to entry into the lower levels of the annex building. The detector monitor is located at the top of the main stairwell.

The following limit values are programmed into the unit:

Leak limit	100 ppm
Spill limit	300 ppm
Evac limit	500 ppm

In the event that the evac limit is reached or exceeded, then all personnel are to evacuate the annex building. Prior to evacuation, activate the building refrigerant exhaust switch located slightly to the right of the HGMSZ unit.
Prior to reentry into the lower floor levels of the building, insure the HGMSZ unit is reading less than 500 ppm. The refrigerant gas R134a is heavier than air and should settle in lower levels of the building and not present a hazard to individuals checking the HGMSZ system. However, the use of SCBA equipment is recommended.

3.2.8. Manual Shutoffs

Many of the facility and equipment systems are equipped with manual shutoffs:

3.2.8.1. Gas Cabinets

Each gas cabinet has an emergency machine off (EMO) button

3.2.8.2. Ventilation System

The regular ventilation system (not the scrubbed exhaust system) can be shut-off by using the Emergency-Off control buttons which are located in the main corridors of the building. There are separate controls for the different parts of the system, so it must be determined which units are in need of shutdown in order to locate the proper switch. Or, simply shut off all the units if necessary.

- Switch A, located outside the Gowning Room: MUA-4, RCU-5, RCU-6 (ventilation units associated with the cleanroom)
- Switch B, located outside (north end) of the light-lab central corridor: MUA-3, MUA-3A, RCU-7, RCU-8 (ventilation units associated with the laser labs).
- Switch C, located outside Room 122 (west end of north corridor): Exhaust Fan 11A
- Switch D, located outside Room 122 (west end of north corridor): MUA-4, RCU-5, RCU-6
- Switch E, located outside the AWN room, lower level of Central Plant Exhaust Fan CP-31, MUA CP-30.

Note: these control switches are protected with a break-glass barrier

3.2.8.3. Refrigeration System

The refrigeration/chiller system can be manually shut-down by activating the control switch (after breaking the break-glass barrier), which is located at the main exit on the lower level of the Support Building, and another switch located at the main exit on the upper level of the Support Building.
Additionally, in the case of a refrigerant leak in the Chiller area, or an alarm at the HGMSZ monitor, the chiller room ventilation system can be activated from the switch at the right of the HGMSZ monitor on the upper floor of the Support Building.

3.2.8.4. Boiler Room

The boiler can be manually shut-down by activating the EPO button on the east wall of the boiler room, near the main door.

4. Emergency Procedures

4.1. Evacuation of Facility

4.1.1. Overview

When indicated by any of CHTM's emergency warning systems (gas detection system warning devices, fire-alarm system, or local alarm system (e.g., pull-stations)), all building occupants shall immediately evacuate the building, using the following basic philosophy:

Proceed directly to the nearest exit and leave the building.
Once outside the building, proceed directly to the Evacuation Grouping Point, remain there until accounted for and released by the Evacuation Warden, or other emergency personnel.

4.1.2. Exiting Procedures:

Procedure for employees operating critical equipment-shut down the equipment as soon as possible. Using EMO's, where available, only if it can be done safely and will not delay the safe evacuation of the facility.
Know your exit routes ahead of time, and always know two ways to exit in an emergency. Refer to the Evacuation Maps posted throughout the building for optimal exit routes.
Do not stop to pick up personal items, complete tasks or phone calls.
Do not congregate in front of the main doors, or any other location where emergency personnel are trying to resolve the situation.
Do not try to re-enter the CHTM facility until authorized to do so, regardless of whether the alarms have silenced or not.

4.1.3. Philosophy of Evacuation.

The basic evacuation procedure is to proceed directly to the nearest safe exit and leave the building. Once outside the building, all building occupants shall proceed to the Evacuation Grouping Point and remain there until accounted for and released by the Evacuation Warden or other emergency personnel.
The Evacuation Grouping Point (EGP) is located at the parking lot located southeast of the Dykewood Building. The EGP is marked with a sign. [see Appendix C - Emergency Grouping Point & Evacuation Route Map for location].

4.1.4. Exits

There are numerous exits from CHTM, and every building occupant is personally responsible for becoming familiar with their locations. Occupants should also take time to plan both a primary and a secondary evacuation route from their normal work location. Hazardous areas in the facility have at least two exits, in case one is blocked by an emergency condition, or otherwise unsafe or unusable. [see Appendix C - Emergency Grouping Point & Evacuation Route Map for location]

4.1.5. Headcount

At the EGP, all personnel are to congregate in an orderly fashion as part of the evacuation process-this includes personnel employed at CHTM, students at the facility, contractors, and visitors or other external personnel. Supervisors are responsible for accounting for their personnel and instructors for their students. The Evacuation Warden should determine as quickly as possible if everyone is accounted for, and communicate this information to the Incident Commander at the Command Post.

The Primary Evacuation Warden is the building facilities manager or designate
The Back-up Evacuation Warden is the clean room manager or designate

Note: The first person to arrive at the EGP should assume the duties of the Evacuation Warden in case either the Primary or the Back-up Warden is delayed.

4.1.6. CHTM Emergency Personnel

During an emergency evacuation of the CHTM facility, emergency personnel should assist in the orderly evacuation of all building occupants. If it can be done safely, emergency personnel in the facility at the time of an emergency evacuation should determine that areas have been cleared as they exit the building. Once outside the building, they should proceed to the Emergency Response Team (ERT) Staging Area at the Facilities Support Building west of the Main Building.

Strategically, the priorities of the emergency personnel are as follows:

Life safety, including building occupants, emergency-response personnel, and the surrounding community
The environment
The continued operability of the CHTM facility The
The university and/or private property

Tactically, this translates into attention to the following list of objectives for the emergency personnel to concentrate on during the initial response:

determine if everyone is out of the facility in an evacuation
complete the headcount of people at the Evacuation Grouping Point (EGP)

Then follow up with the following actions:

controlled sweeps of the building to ensure evacuation is complete
long-term status of the evacuees

establish control of the facility and location of command post
determine nature of emergency
determine the need for any additional outside-agency response
establish status of response
prepare to meet incoming emergency personnel

4.2. External Response Agencies

4.2.1. UNM Police Department.

Outside of normal business hours at CHTM, the UNMPD is the primary response agency to an alarm or other hazardous condition. Until the nature of the emergency is determined, they should always proceed with extreme caution. In general, police will not enter the building regardless of the type of alarm. Initially, they should respond to the Main Entrance (unless contraindicated by apparent hazardous conditions). In case of a bomb threat, the Incident Commander will be from the UNMPD.

4.2.2. Albuquerque Fire Department

Under some circumstances, the AFD will become the primary responding agency, and will assume command of the emergency utilizing the Incident Command System. This would include fires (active, extinguished, or smoke-only), hazardous material incidents involving significant threat to life-safety, and medical emergencies.

4.2.3. UNM-EHS Department

In emergency conditions, vital technical support can be obtained quickly from the University's Environmental Health and Safety. Post-emergency, they will also play an important role in recovery and cause-determination.

4.2.4. Private Contractors

In some emergency situations, outside contractors will be engaged to perform certain specific tasks. The current contractor for most chemical spills is Rinchem. Matheson Gas, Air Products or other gas suppliers may be involved in emergency operations designed to contain gas leaks.

4.3. Standard Response Procedures

4.3.1. Response Procedure for Gas Detector Alarm.

Determine if Alarm is for Flammable Gas or Toxic Gas
Determine if Alarm Level is Low- or High-Level

4.3.1.1. If Flammable Gas is High-Level

Insure building is evacuated, and deny reentry to building; have AFD respond to site (contact made via UNMPD); shut off supply of Hydrogen at gas cabinets and Natural Gas from exterior main control valves.

4.3.1.2. If Toxic Gas is High-Level

Insure building is evacuated, and deny reentry to building, call for ERT or equivalent to respond to site, and continue to monitor gas concentration levels to identify trend. If situation warrants, notify AFD HazMat Team (contact made via UNMPD) and request backup.

4.3.1.3. If Flammable Gas or Toxic Gas Alarm is Low-level

Monitor gas levels from exterior of building and determine need for entry. The Low-level or Warning alarm allows for intervention or additional monitoring while the threat level is still relatively minor. Generally, low-level alarms either continue to build, resulting in a high-level alarm; or they drop back towards zero. If the level remains stable in the low-level area, some sort of intervention is probably warranted.

If High-Level Toxic Gas Alarm drops down to a low-level alarm (or below), CHTM Personnel, trained and wearing appropriate PPE can make entry into the building, following all safe-operating procedures, in order to determine the cause of the problem and take corrective actions.

4.3.2. Response Procedure for Alarm Conditions on the Fire Alarm Panel.

Once building has been evacuated, determine the type of alarm if possible (preferably from outside).

If Alarm is due to heat detector, determine the location. Do not attempt to make entry into the room, wait for AFD to arrive.

If Alarm is due to smoke detector activation, determine the location of the detector.

If detector is in ductwork, further investigation may be necessary to determine the actual source of the smoke.

If detector is an area detector, caution should be used to investigate, and only if there is no visible smoke or other potential hazards.

If smoke or other products of combustion are visible, discontinue the investigation and proceed to the Fire Response listed below.

4.3.3. Response Procedure for Automatic Sprinkler Alarm.

Determine location of sprinkler which is in operation.

Sprinkler may be in hidden area such as inside a gas-cabinet, making it difficult to determine exactly where the water is flowing.

If any signs of a fire in progress or any visible smoke conditions are noticed while trying to locate the operating head, move immediately to Fire Procedure (below) and discontinue emergency operation inside the Facility.

If operating sprinkler head is inappropriately flowing water (due to mechanical damage or to material failure), the system should be shut down when all possibility of fire/heat has been positively eliminated.

If the Main Sprinkler Valve must be closed to stop the flow of water, only the following personnel / agencies are authorized to close the Main Sprinkler Valve:

Albuquerque Fire Department
UNM SAS
Western States Fire Protection (contractor)

When closed, the *valve* shall be tagged as Closed by UNM Fire Safety and the System identified as Out-of-Service (with the appropriate authorities notified of the out-of-service condition.)
The system will be returned to service as soon as possible, and in no case shall it be left out-of-service for periods longer than 24 hours. System outages of more than one hour require a firewatch on the facility during the outage. Fire watch personnel are provided by the building staff or department occupying the facility. Fire watch activity includes one or more personnel making physical rounds of the facility no less than *every* hour. More frequent rounds are strongly encouraged.

4.3.4. Response Procedure for Small or Incipient-level Fires.

4.3.4.1. Evacuate the building.

The easiest, quickest mechanism is to activate a pull station, which not only sounds the local alarm, but also notifies the UNM police department and the fire department.

4.3.4.2. Incipient Fires

by definition, are small, approachable, and confined to the immediate area of origin. This does not mean they should be treated lightly! If heat and/or smoke conditions make approaching the fire difficult, it has *evolved* beyond the incipient stage and has become a structural fire (whether or not the structure is involved yet).

4.3.4.3. Portable fire extinguisher

A portable fire extinguisher can be used to extinguish the fire, only when all of the following conditions are met:

- Ensure you have an escape route. There is at least one route of exit that will remain open *even* if the fire spreads during the extinguishing phase. Rule-of-thumb: have the exit at your back when you approach the fire with the extinguisher.
- The extinguisher is the type and size appropriate for the fire conditions at hand.
- The person operating the extinguisher has been trained in proper procedures for operating the device.
- The person operating the extinguisher feels comfortable making an attempt to extinguish the fire.

4.3.5. Response Procedure for Large or Structural Fires

[These procedures would apply regardless of whether the Fire was already large on discovery, or had expanded from a small / incipient-stage fire]

Immediately evacuate the building using the nearest pull-station to activate the local alarm. Make sure all occupants have left the building and deny entry until the arrival of the AFD.
Notify the UNM Police of the location, circumstances, and condition of the fire for an immediate response.
Make sure that the water gong is sounding (exterior of building on the east wall), indicating that the sprinkler system is in operation.
If possible to safely do so, shut off all natural gas systems from the exterior main control *valves* on the outside of CHTM.

4.3.6. Response Procedure for Spilled Liquid Chemicals.

4.3.6.1. Definitions

Chemical Spill – Any unplanned or uncontrolled release of any solid, semi-solid, liquid, or gaseous hazardous chemical that can pose a potential safety or health risk to people or the environment.

Facilities - Facilities covered under this program include all UNM-owned and all UNM-leased structures and property.

Hazardous Chemical - Any solid, semi-solid, liquid, or gaseous chemical that may pose a physical hazard or a health hazard. This would include the following:

- corrosives (acids, bases)
- paints [contact John Archuleta]
- petroleum products (gasoline, diesel fuel, oil)
- poisons
- oxidizers
- reactives
- solvents (paint thinners, alcohols)

Health Hazard – Chemicals that may cause various acute or chronic adverse health effects such as corrosives, carcinogens, irritants, mutagens, teratogen and sensitizers.

Major Spill - Any hazardous chemical spill that involves highly toxic, highly reactive, explosive or life-threatening chemicals. Any spill situation that presents significant fire, explosion, or other physical or health hazard risks, particularly if a person may be or has been significantly exposed, contaminated or injured to such an extent that medical or other outside assistance is required. Any spill situation that may adversely impact the external environment whether or not the spill occurred internal or external to a building. Note: If any chemical is present that, when spilled, could present a situation that meets this definition, then emergency procedures for spill response, including cleanup, must be included as part of the workplace's Standard Operating Procedures.

Safety Data Sheet (SDS) – A document prepared by the manufacturer of a hazardous chemical that contains information about the hazards of the chemical and the appropriate work practices required for safe use and spill response.

Minor Spill - Any hazardous chemical spill that does not involve highly toxic, highly reactive, or explosive chemicals in a situation that is not life threatening. This type of spill presents a manageable physical or health hazard to personnel who, when wearing proper Personal Protective Equipment (PPE), will not be exposed to any chemical at a level that exceeds any recognized OSHA action level or permissible exposure limit.

Physical Hazard - A hazardous chemical with physical characteristics that make it combustible, flammable, explosive, reactive, a compressed or cryogenic gas, organic peroxide or an oxidizer.

4.3.7. What To Do in The Event Of A Chemical Spill

Personnel can safely clean up the vast majority of chemical spills that occur. Whoever is most knowledgeable about the spill is responsible for prompt notification and proper clean-up, if safe to do so. It is the responsibility of the supervisor and/or Chemical Safety Officer to have spill clean-up materials and personal protective equipment, which are appropriate for the chemicals being handled, readily available for emergency use. They are also responsible for ensuring that spills are cleaned up as soon as possible.

The various types and quantities of hazardous chemicals used at **UNM** require preplanning in order for accidental chemical spills to be handled in a safe manner. Use the flow chart in Attachment A to plan an appropriate response to any spill. Two categories of chemical spills and response procedures are identified for the purposes of this plan.

4.3.7.1. Minor Spill

Evaluate the spill situation before making any decisions.

- What chemicals are involved?
- Where is the SDS for this chemical and what does it say about spill clean-up? o Is the appropriate spill kit available?
- Do you need to isolate the spill area (barrier tape or safety watch)?
- If the chemical is flammable, do you need to turn off any equipment, heat sources, electrical panels, or other potential ignition sources?
- Will you need to notify the Principal Investigator or your supervisor about the spill?
- Is personal protective equipment needed and is it available?
- Will you need to have another person to stand by or assist during the clean-up?
- Will you need to wear a respirator during the clean-up?
- Will you need to wear other protective equipment, such as gloves, face shield, etc.?
- Does the ventilation to the area need to be improved, or the windows opened?
- Will the spill have consequences in other areas and to other people?

Safe clean-up of a spilled chemical may include following several of these guidelines:

- Notify others in the immediate area that a spill has occurred;
- Advise other lab occupants and supervisor of the spill;
- Isolate the area so that nobody unknowingly walks into the contaminated area, by closing doors, posting other individuals at doors or hallways to warn others, barrier tape, etc.;
- Increase area ventilation, if needed, by turning on hoods and opening windows;
- Review the spill clean-up procedures recommended in the SDS sheet;
- Procure and open the chemical spill kit, and evaluate the contents;
- Plan the clean-up procedures you will follow;
- Wear protective equipment as needed, including safety goggles or face shield, gloves, Tyvek suit, apron, respirator, and/or long-sleeve lab coat;
- Avoid breathing vapors/fumes from the spill;
- Confine spill to small area with absorbent materials;
- Absorb spill with absorbent pads or paper towels;
- Acid and base spills should be neutralized prior to clean-up;
- Clean up spill area using other appropriate procedures as recommended in the SDS;
- Collect residue, place in disposal container, and label waste container;

- Decontaminate reusable cleanup supplies such as scoops, rubber boots, etc.;
- Place all contaminated PPE (gloves, Tyvek suits, etc.) into a plastic bag for disposal;
- Restock the chemical spill kit and return it to the normal storage location;
- Contact EHS at 277-2753 for waste pickup and proper disposal;
- In event of personal contamination, remove affected clothing and flush contaminated skin with water for fifteen minutes, and seek medical attention at EOHS (or equivalent); and,
- Complete the Chemical Spill Report Form and forward it to EHS.

4.3.7.2. Major Spills

If an area contains large quantities of any chemical, emergency procedures for spill clean-up must be included as part of the Standard Operating Procedures for that chemical in the UNM workplace. Employees should only attempt to clean up large or major spills after special training has been received, and when appropriate spill clean-up materials, and personal protective equipment are readily available and are properly utilized. Otherwise, in the event of a major spill for which personnel are not properly prepared, and particularly if any person has been significantly exposed, contaminated or injured to such an extent that medical or other outside assistance is needed, follow the EAR steps:

- Evacuate affected area and close doors.
- Alert Campus Police by calling 911 from a campus phone and a safe location, or 277-2241 from a non-campus phone.
- Remain close to the phone, if requested to do so, until contacted by emergency responders.
- Be prepared to provide more information about the spill, including SDS information. Assist emergency personnel upon arrival. For any chemical spill that occurs outside a building, with potential for adversely impacting the physical environment, call Campus Police at 277-2241 and request that appropriate EHS staff be contacted.

All 911 calls, dialed on campus phones are routed to UNM Campus Police, which is staffed 24-hours/day and 7-days/week. All 911 calls to Campus Police that are related to a chemical spill will be routed by Campus Police to the Albuquerque Fire Department's (AFD) dispatch center and to the appropriate EHS staff. The AFD, including the Hazardous Materials Incident Task Force (AFD-HazMat), will then be sent to the spill site.

In the event of a major chemical spill, Campus Police will work with AFD-HazMat and EHS to secure the affected chemical spill area. AFD-HazMat is responsible for responding to major chemical spills on campus. Specifically, AFD-HazMat is responsible for:

- Assessing the nature and extent of the chemical spill with assistance from EHS, Campus Police, and appropriate personnel from the spill location.
- Evacuating and securing the affected area of the chemical spill with assistance from Campus Police and appropriate personnel from the spill location.
- Removing injured personnel and transporting them to appropriate medical facilities.
- Containing the chemical spill.
- Notifying the New Mexico State Police, if appropriate.

The New Mexico State Police, as directed in the New Mexico State Emergency Management Act, has overall authority over all HazMat related emergency events and will be the Incident Commander when on the scene, unless otherwise delegated.

4.3.8. Response Procedure for Gas Vapor

Releases. Alarm levels for monitored gases:

Gas	Low	High
BCb	2.5 ppm	5.0 ppm
Cl_2	0.25 ppm	0.5 ppm
F_2	0.05 ppm	0.10 ppm
H_2	1% (volume	2% (volume
NH_3	12.5 ppm	25.0 ppm
SiH_4	2.5 ppm	5.0 ppm

Regardless of the gas involved, the immediate course of action is to ensure building is evacuated, and deny unauthorized entry to building, call for ERT or equivalent to respond to site, and notify the UNM Police of the event.

Shut off the flow of gas if possible:

- Exterior shutoffs should be closed from a safe position.
- Automatic shutoffs (tied to the gas-monitoring system) should close, causing the gas levels to drop back to zero in a short period of time. In cases where the gas-monitoring system is not in alarm, the automatic shutoffs can be activated by tripping a fire pull station.
- If gas continues to leak from the system, the cylinder may need to be closed manually. Although a simple operation, such entry into the hazardous atmosphere involves a certain level of risk, and can only be accomplished with the highest mobilization of the ERT (and, in most cases, the involvement of the AFD HazMat Unit or privately-contracted gas specialist teams).
- In a situation where the cylinder cannot be shut off, even manually at the cylinder-head, or cannot be shut off safely with personnel at hand, the gas provider should be contacted to bring specialized technical equipment (such as a "gas coffin") and personnel to the CHTM/CGF site for final determination of the incident (Air Products has a "gas- coffin" located at its Rio Rancho facility).

4.3.9. Response Procedure for Bomb Threat

Appropriate administration personnel will be coached in the process to handle a bomb threat using the "Bomb Threat" card supplied by UNM Police Dept. Other interested personnel that request it will also be coached as noted above.

4.3.10. Post-Incident Critique

In order to promote continuous improvement of the Safety and Emergency Response Systems at CHTM, a formal Critique shall be conducted of each Emergency Incident. This Critique will be officiated by senior management of the CHTM as soon as practicable following the conclusion of the incident. A report will be issued summarizing the findings of the Critique, including corrective actions or changes necessary to optimize the Emergency Response procedures and/or related documents.

5. Appendix A - Common Chemicals Used At CHTM

Common Chemicals in use at CHTM
[a list of chemicals is kept at the Safety Kiosk in the north-south corridor located on the west side of the building]

5.1. Silane

Flammable/pyrophoric gas will self-ignite on contact with air, may oxidize to siloxane, which is also pyrophoric and potentially explosive; the mixture @ CHTM is 5% Silane in argon, considered non-pyrophoric.

5.2. Boron trichloride ($BCL_{3)}$

Colorless fuming liquid. Fumes are corrosive and toxic. Strong irritant to tissue.

5.3. Hydrogen

Highly flammable gas with a flammable range of 4-75% in air, burns vigorously but flame is almost invisible under normal lighting conditions, gas is very light and will accumulate at upper levels in confined area, flame propagates so rapidly a deflagration explosion is likely; the gas is not actually toxic, but can be a simple asphyxiant in enclosed areas.

5.4. Ammonia

Corrosive gas that can cause damage to lungs, eyes, and other soft tissues; somewhat toxic in its effect on people (PEUTLV = 25ppm and IDLH = 300ppm); pungent, distinct odor detectable as low as 0.04ppm; technically, ammonia is also a flammable gas, although its flammable range is high and narrow at 16-25% in air.

5.5. Hydrogen Chloride

Corrosive and toxic gas (PEUTLV = 5ppm, IDLH = 50ppm, maximum concentration tolerated for 1 hour = 50-100ppm), exposures of 1300-2000ppm can cause death after brief exposure; sharp odor is detectable at 1-Sppm.

5.6. Gallium Arsenide

A form of arsenic, this is toxic and a suspected carcinogen, PEUTLV = 0.1mg/cubic meter (as dust); reacts with steam or acid to form Arsine.

5.7. Nitrogen

Inert gas with low hazard potential, although it could be a simple asphyxiant, displacing oxygen in an enclosed environment.

5.8. Argon

Inert gas with low hazard potential, although it could be a simple asphyxiant, displacing oxygen in an enclosed environment.

5.9. Hydrofluoric Acid

Corrosive liquid which presents not only the typical hazards associated with strong acids, but is also a special health hazard, due to its characteristic of deep tissue/bone damage and potential death; also, pain/burning and tissue damage may not be immediately noticeable-can be delayed up to 24 hours.

5.10. Hydrochloric Acid

Corrosive liquid with characteristic odor can result in destruction of living tissues and metals on contact, and even dilute solutions can cause skin rashes and burning.

5.11. Phosphoric Acid

Corrosive liquid with no odor can result in destruction of living tissues and metals on contact, and high concentration solutions can cause eye and lung burning, erosion of teeth.

5.12. Sulfuric Acid

Corrosive liquid with characteristic odor, can result in destruction of living tissues and metals on contact, and exposure can cause skin rashes, discoloration of the teeth, and chronic bronchitis.

5.13. Nitric Acid

Very active corrosive liquid which can cause destruction of living tissues and metals on contact; must be stored in glass containers, stains many materials yellow. At concentrations above 40%, nitric acid is also classified as an oxidizer and will react violently with many fuels, as well as bases. Can also be formulated as fuming nitric acid.

5.14. Ammonium Hydroxide

Corrosive liquid but basic rather than acidic (high pH), characteristic odor similar to ammonia, can result in destruction of living tissues and metals on contact, and even dilute solutions can cause skin rashes and burning, especially of the eyes.

5.15. Sodium Hydroxide

Corrosive liquid that is basic rather than acidic, contained in large tank (- 300 gallon) in the ACW room on the lower level of the Facility CHTM Service / Support Plant Bldg.

5.16. Buffered Oxide Etch

Mixture of ammonium fluoride and hydrofluoric acid used to etch the oxide layer, commonly referred to as BOE, it is a corrosive liquid and also presents similar hazards to HF.

5.17. Hydrogen Peroxide

Powerful oxidizer, can be extremely hazardous at high concentrations, causing burning of the skin/lungs/respiratory tract, and can react violently with many substances, generating heat and possibly reaching ignition temperatures.

5.18. Methanol

Flammable liquid (with a flash point of 52F) which is structurally polar, meaning common firefighting foams will not work to extinguish; also known as methyl alcohol or wood alcohol, methanol is somewhat toxic and a sensitizer/irritant to the skin.

5.19. Propanol

Flammable liquid, but structurally polar, meaning common firefighting foams will not work to extinguish; this is essentially an alcohol, similar to isopropyl alcohol.

5.20. Acetone

Flammable liquid (with a flash point at about 1.4 degrees F) which is organic in structure and a ketone with a very characteristic odor; commonly used as a solvent/cleaning agent, acetone is somewhat toxic and a sensitizer/irritant to the skin, requiring PPE.

5.21. Sodium hypochlorite

Fire risk in contact with organic materials. Toxic by ingestion, strong irritant to tissue. Strong oxidizing agent with disagreeable sweetish odor and pale greenish color.

6. Appendix B - CHTM Training Matrix

Position/Job	Safety Orientation	Chem Safety	HazWoper	Resp. Protection
Janitorial	X			
Students	X	X		
MOCVD Tech	X	X		X
ER Personnel	X	X	X	X
CHTM Faculty	X	X		
CHTM Staff and	X	X	X (as needed)	X (as needed)
Contractors	X			

7. Appendix C - Emergency Grouping Point & Evacuation Route Map