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NOTE: This Section's Sign-Off Record is maintained in the ESH&A Office, G40 TASF.

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REVISION / REVIEW LOG

SECTION 8 – FIRE PROTECTION PROGRAM

Review Number:	Effective Date:	Contact Person:	Pages Affected:	Description of Revision:
0	10/11/99	G.P. Jones	All	Original Issue
1	06/01/00	G.P. Jones	Page 5	G:\Doc&Recs\DCP\Revision Description\Manual 10200.002 Section 8 Revision 1.doc
2	1/13/06	G.P. Jones	See Revision Description	G:\Doc&Recs\DCP\Revision Description\Manual 10200.002 Section 8 Revision 2.doc

SIGN-OFF RECORD

The Environment, Safety Health and Assurance Program Manual has been reviewed and approved as documented below:

Reviewed by: _____ Date: _____
Environment, Safety, Health & Assurance

Approved by: _____ Date: _____
Division Director, Chief Operations Officer

Approved by: _____ Date: _____
Division Director, Science and Technology

Approved by: _____ Date: _____
Deputy Director

Approved by: _____ Date: _____
Director

Note: Original Sign-off Record with signatures is on file with ESH&A.

8.0 FIRE PROTECTION PROGRAM

Applicability Statement: *This section applies to all Ames Laboratory Groups and Departments. This section also applies to Environment, Safety, Health and Assurance (ESH&A) which is charged with ensuring compliance with specific Codes, Standards and Regulations regarding Fire Safety.*

8.1 REFERENCES

29 CFR 1910 Subpart L Fire Protection
DOE Order 420.1A Facility Safety, Section 4.2 Fire Protection
NFPA 101 Life Safety Code
NFPA 45 Standard on Fire Protection for Laboratories Using Chemicals
Form 10200.096 Ames Laboratory Hot Work Permit
Manual 10200.002 ESH&A Program Manual, Section 4.3, Compressed / Liquefied Gases
Manual 10200.002 ESH&A Program Manual, Section 5.10, Welding, Cutting and Brazing Program
Manual 10200.002 ESH&A Program Manual, Section 9, Emergency Preparedness and Site Security Program
Plan 46300.001 Ames Laboratory Emergency Plan
Policy 10201.001 Hot Work Policy

8.2 BACKGROUND

Fire is one of the most destructive events that can happen to a facility. Once started, a fire grows rapidly, destroying resources and taking lives. For this reason, fire safety requires constant vigilance. The principles of fire safety are Prevention, Detection, Annunciation and Suppression. Each will be addressed in a section of this Program.

It is the policy of Ames Laboratory to minimize the fire potential in order to provide a safe work place. This includes complying with the regulations of the U.S. Department of Energy, the Life Safety Code, the National Fire Protection Association codes, and by controlling quantities and the use of flammables, combustibles, and explosives.

Compressed gases are often associated with fire or explosion hazards but are covered in Section 4.3 of this Manual. Procedures to follow to minimize fire hazards are outlined in the Program Information Section 8.3.

The Ames Laboratory Emergency Plan covers employee responsibilities in emergency situations, such as fire. Those requirements are found in Section 9, Emergency Preparedness and Site Security.

The Ames Laboratory Director has established the Fire Safety Committee (FSC) as a standing subcommittee of the Safety Review Committee, and empowered the committee to act as the local authority having jurisdiction for the Ames Laboratory. The committee reviews designs of new and modified fire protection systems, evaluates, interprets and applies the standards for fire safety, applies for exemptions and waivers from standards, and administers the Ames Laboratory Fire Safety Program.

8.2.1 Definitions

Annunciator: A device having a strobe, horn, claxon, or other means to notify occupants of the existence of a fire nearby.

Combustible Liquid: Any liquid having a flashpoint at or above 37.8C but below 93.3C, except any mixture having components with flashpoints of 93.3C or higher; the total volume of which make up 99% or more of the total volume of the mixture.

Exit: One of three required components of a means of egress, namely the exit access, the exit and the exit discharge. The exit is that portion of a means of egress separated from all other spaces to provide a protected way to the exit discharge.

Fire Classes: Rating for classifying fires into different types for extinguishing purposes.

CLASS A -- Combustible Material (e.g., wood, paper or rags).
CLASS B -- Flammable Liquids and Gases (e.g., paints, oils, propane, or gasoline).
CLASS C -- Electrical. This classification denotes that there is an electrical conduction hazard to the person using the extinguisher. Once the electrical current is turned off, the remaining fire is either Class A, Class B or a combination of both.
CLASS D -- Combustible Metals (e.g., Mg, Zr, NaK, Na, U, Pu, or Ti).

Fire Extinguisher: A pressurized or bulk device for the extinguishing of small, or incipient fires only. Users are cautioned to maintain a clear path to exit behind them, in case the fire can not be put out by the extinguisher.

CLASS A Extinguisher (Combustible Material). Use a pressurized water extinguisher.
CLASS B Extinguisher (Flammable Liquids and Gases). Use CO2 or dry chemical extinguisher
CLASS C Extinguisher (Live Electrical Parts)- Use CO2 or dry chemical extinguisher
CLASS D Extinguisher (Combustible Metals). Use lime from lime barrel.

Fire Protection: Comprised of the planning, engineering, implementation, inspection, and reporting of functions related to fire protection.

Flammable Liquid: Any liquid having a flashpoint below 37.8C, except any mixture having components with flashpoints of 37.8C or higher, the total of which make up 99% or more of the total volume of the mixture.

Incipient Fire: A fire that has just started, and is still fairly small. Usually used to describe the limited size of fire the typical fire extinguisher is capable of extinguishing.

Liquid Classes: Classification used when setting storage limits and based on flash and boiling points.

Class	Type	Flash Point	Boiling Point	Examples
I	Flammable	<100F (37.8C)	NA	
IA	Flammable	< 73F (22.8C)	<100F (37.8C)	anhydrous ether
IB	Flammable	< 73F (22.8C)	≥100F (37.8C)	toluene, acetone, gasoline
II	Combustible	≥100F (37.8C)& <140F (60C)	NA	kerosene
IIIA	Combustible	≥140F (60C)& <200F (93.3C)	NA	nitrobenzene, aniline

Manual Pull Station: A device occupants may use to initiate a fire alarm in a building. Typically, manual pull stations are located near exits.

Nationally Recognized Testing Laboratory (NRTL) an organization that is acceptable to the authority having jurisdiction, concerned with the evaluation of products, materials and services, whose listing states that the product, material or service has been tested and found suitable for a specified purpose.

Sprinkler: A device used to dispense a spray of a wetting agent, typically water, initiated by heat.

8.3 PROGRAM INFORMATION

8.3.1 Fire Prevention

The best way to reduce the damage caused by fire is to avoid having the fire. There are several actions that each employee should take to prevent the start of a fire in their work area.

1. Eliminate or reduce combustible fuel loading-

Good housekeeping practices will reduce the fire hazard associated with combustible materials. Waste materials should be removed regularly to prevent buildup. Work areas should be free of fuel paths that spread a fire. Combustible material usage and storage should be planned to limit amounts to the essential minimum, especially cardboard boxes and loose paper. Paper stock and similar materials should be stored in metal cabinets. Isolate combustibles from potential ignition sources such as burners, hot plates, soldering irons, and other electrical appliances. Dirty or oily shop rags are to be kept in a metal container with self-closing lid.

2. Eliminate electrical fire hazards-

Fires in electrical equipment are the leading cause of industrial fires. To minimize this potential, the following practices and procedures are to be observed.

- Wiring, conduit, and cables shall be protected from mechanical injury and from deterioration. Equipment should be inspected periodically and any defects repaired.
- All electrical apparatus shall be kept clean.
- All connections shall be kept tight and all moving parts shall be properly lubricated and replaced periodically.
- Electrical apparatus shall not be operated above its rated load.
- Coffee pots and hot plates for cooking food are allowed when there is no hazard to personnel and no fire hazard. These appliances are prohibited where smoking, eating, or drinking are prohibited (labs, shops and equipment rooms where toxic, carcinogenic, or radioactive materials may be present).
- Coffee pots and hot plates should be operated in plain view, never concealed under a desk or in a cabinet.
- Non-approved electrical apparatus shall not be used where explosive vapors or dusts may be present.

- Portable heating devices may be used when a sheet of noncombustible material is placed under the device, a clearance of at least 36 inches is maintained between the appliance and combustible materials, the appliance is properly grounded by a three-wire system, the appliance is approved by Underwriters Laboratories, Factory Mutual Engineering Corporation, or the Ames Laboratory Electrical Safety Committee, and the appliance is not left unattended for more than 15 minutes.

3. Eliminate or reduce flammable liquids fuel loading-

When spilled or released from their containers, flammable liquids form flammable vapors that can cause flash fires and explosions. Therefore, the quantity of flammable and combustible liquids kept in a room or laboratory is to be only that amount necessary for current operations and shall be at or below the fire protection storage limits shown below.

Room or Laboratory Unit Limits

Liquid Class	Total	In Glass or Metal	In Safety Cans
I & II	35 gal.	10 gal.	25 gal.
IIIA	60 gal-minus amount of I & II	60 gal.	60 gal.

Container Size Limits

Liquid Class	Glass Container	Metal Cans	Safety Cans
IA	1 pint	1 gal.	2 gal.
IB	1 quart	1 gal.	2 gal.
I	1 gal.	1 gal.	2 gal.
II	1 gal.	1 gal.	2 gal.
IIIA	5 gal.	5 gal.	5 gal.

NOTE:

Metric Units: The fire code is expressed in U.S. measurement units; for metric designations use the nearest common metric container size.
Safety Cabinets: The above storage limits apply only to storage outside of approved safety cabinets (see ESH&A).
NFPA 45 Standard on Fire Protection for Laboratories Using Chemicals

The following guidelines apply to the storage of flammable liquids:

- Storage of acids with flammable liquids immediately adjacent to, above, or below each other is prohibited.
- Storage shall be away from heat and ignition sources.
- Storage of flammable liquids should not be within 5 feet of either side of a doorway or exit.
- Storage of flammable liquids is not permitted in hallways or stairwells.

Approved metal cans and storage cabinets are an excellent way to store larger volumes of flammable liquids. The design of both cans and cabinets is such that the liquids will be protected from fire for a longer time, allowing occupants to safely exit the area. Containers and storage cabinets used for flammable liquids are regulated in the following ways:

- Flammable liquids should not be stored in glass or plastic containers unless such containers are required because of purity or technical reasons.
- Containers larger than one quart shall be approved (UL-FM) safety cans.
- Safety cans shall be red with the contents of the can stenciled in yellow over the red background. A yellow band at least 1 inch wide should girdle the can.

- Flammable liquid containers shall be maintained in good condition.
- Safety cans shall be filled in a location that provides adequate ventilation, fire protection, and control of ignition sources.
- Grounding wires are to be provided, where appropriate, to permit grounding of the storage container to the portable container. Storage racks shall be grounded to "earth".
- Storage cabinets shall have lettering that states, "FLAMMABLE - KEEP FIRE AWAY," in accordance with existing standards.
- Cabinet and components shall be constructed of metal. A cabinet approved by a Nationally Recognized Testing Laboratory (NRTL) is required.
- Cabinets normally should be located along an outside wall but not at any openings, not adjacent to combustible materials or sources of ignition, or within 5 feet of either side of a doorway or exit.
- Cabinets are not permitted in corridors or stairwells, and shall be situated where adequately ventilated.
- Cabinets for flammable liquid storage are to be kept clean and orderly, and shall not be used for the storage of any other materials.
- Refrigerators and freezers used for flammable liquid/gas storage in Ames Laboratory spaces shall meet the requirements of NFPA 45 *Standard on Fire Protection for Laboratories Using Chemicals*, NFPA 70 *National Electrical Code,* and 29 CFR 1910 *Occupational Safety and Health Standards for General Industry.* Refrigerators and freezers acquired for the storage of flammable chemicals shall be certified by a NRTL for that use. Under special circumstances (as an example, a one-of-a-kind research application) local approval or variances may be obtained utilizing the Readiness Review process with Fire Safety Committee approval and electrical inspection in accordance with the Electrical Safety Manual.
- In hoods- In 2005, the Safety Review Committee developed the following four guidelines for the safe use of flammable liquids in hoods:
    - At or below 4 liters of flammable chemical(s) in the hood, no action will be necessary other than prudent practice as approved in Readiness Review.
    - At greater than 4 liters of flammable chemical(s), electrical service/equipment in the hood will be removed, or all service/equipment will be made Class I Division 2 compliant.
    - Quantities exceeding the Guidelines will require the review/approval of the SRC.
    - These will be approved via the Readiness Review process (Lead Specialist Recommendation/SRC Approval) and assessed during Annual Independent Walkthroughs.

As a rule of thumb, flammable and combustible liquids in glass should be stored as low to the floor as possible, to reduce the spread if the bottle is dropped. Secondary containment is recommended if bottles are stored so closely together that breakage is likely during a search for a specific chemical, and while transporting the liquids in the lab.

8.3.2 Hot Work Permits

There will always be jobs that require the use of an open flame. Soldering, cutting/welding, brazing and annealing torches, Bunsen burners, and candles are all open flame devices commonly used throughout the Lab. High-speed grinding that produces hot sparks or slag can be considered Hot Work as well, as the sparks or slag may provide an ignition source. Additional welding, cutting and brazing concerns may be found in Section 5.10 of this Manual.

In areas where Hot Work is routinely done, the evaluation of the protection needs shall be done during the Readiness Review evaluations. This will provide an audit of the area every five years. Prior to starting a new Hot Work operation, the employee must complete a Readiness Review for a designated area. Readiness Review documents may be picked up from the Environment, Safety, Health & Assurance Office (ESH&A) in G40 TASF. Changes in fuel loading, materials used or type of Hot Work conducted will instigate a new Review.

Transient Hot Work is usually task driven, such as soldering plumbing pipes. It is typically done outside a recognized Hot Work area, and by employees who may lack day-to-day familiarity with the hazards of the area. A Hot Work Permit is required for a transient operation. Hot Work Permit forms (Form 10200.096) may be picked up from the Plant Protection Section Office in G34 TASF.

Hot Work Permit is the means whereby the conduct of a transient hot work operation may be documented by Plant Protection Section to expedite response to a fire or emergency condition.

The permit will:

- Identify and address all types of Hot Work to be performed,
- Address special precautions to be taken to prevent fire initiation and spread, as needed,
- Identify Personal Protective Equipment needed for the conduct of the work,
- Establish that all fire detection and suppression equipment will be operating prior, during and after the task,
- Establish that the workers are aware of the location of exits, manual pull stations, fire extinguishers appropriate for the task,
- Document that all combustible and flammable materials have been removed for a distance commensurate with the potential risk, as an example, a Bunsen burner may need a two-foot clearance, while a cutting torch operation may need thirty-five feet of clearance. Keep in mind that flammable vapors can travel great distances to an ignition source.
- Document that wall and floor penetrations have been covered to prevent the travel of sparks or flash to adjacent areas, and that compressed gas cylinders will be protected from flame and heat impingement,
- Document that back flow/backflash protectors have been installed on oxygen/fuel gas torch systems,
- Identify jobs where a Fire Watch may be deemed necessary. Where necessary, the Fire Watch will be maintained during and for thirty minutes after the Hot Work project. The Fire Watch will have responsibility for the safety of the worker doing the hot work, as well as the protection of property. The Fire Watch will be trained in the use of suppression equipment, and will be equipped with a method for communicating an emergency and a means to start fire suppression as warranted,

- Document whether the detection system in the area will need to be bypassed during the operation.

Hot Work Permits shall be kept on file for one year by the Plant Protection Section.

8.3.3 Fire Detection

The Ames Laboratory maintains a central station to which smoke and heat detectors, manual pull stations, and sprinkler flow alarms are sent. This station is monitored twenty-four hours a day, seven days a week by the officers of the Plant Protection Section. Alarms that are received at the station are telephoned to the appropriate emergency response service.

Smoke detectors are located in the hallways and those rooms deemed to have a higher fuel loading, higher ignition potential, or higher loss impact. Heat detectors are located in areas with a likelihood of dusty, damp or smoky conditions. Smoke and heat detectors are automatic detectors, notifying the central station of a fire condition and activating the building annunciation simultaneously. Manual pull stations are located as close to exits as possible. As the name implies, these are manually activated by area occupants as they exit the area when they have detected a fire. Manual pull stations also notify the central station of a fire condition and activate the building annunciation simultaneously.

Sprinkler Flow Alarms are installed at each zone, and alarm at either the flow of water through a single sprinkler, the flow through the main, or both. Sprinkler Flow Alarms notify the central station of a fire condition, activate the building annunciation and a Water Gong on the exterior of the building, where applicable.

8.3.4 Bypassing a Detection System

Bypassing a detection system silences the building annunciators, but continues to transmit a fire alarm to the building panel and the central station monitored by the Plant Protection Section. Bypassing is prudent for those tasks that may generate enough smoke, heat or dust to trigger a detector, initiating an evacuation by the building occupants. Unnecessary evacuations (false alarms) degrade the confidence the occupants place in a detection/annunciation system, causing the occupants to respond slowly or fail to respond at all to alarms. To affect a building bypass, contact the Plant Protection Section, arrange for two-way communication via walkie-talkie, assure that the bypass is on for the affected building before starting the task, and remain in the immediate area to respond to radio calls from the Plant Protection Section. If the building system detects a fire, the officer at the central station will radio the worker at the site and seek to confirm that the alarm was due to the task. Failing to reach the worker at the site, or failing to get confirmation that the task was responsible for the alarm, the officer will turn the bypass off and immediately evacuate the building, notify the Ames Fire Department and notify the Emergency Coordinator.

8.3.5 Fire Annunciation

Fire annunciation is a two-part system; one portion is the alarm system in each building that alerts occupants of the existence of a fire and the need to exit, the other portion is the system that is used to notify the fire department of a fire incident.

The building annunciation is triggered by the use of a manual pull station, automatic detection by a smoke/heat detector, activation of an automatic sprinkler, or by an area occupant telephoning a fire call to the Plant Protection Section. At the activation of the claxon/strobe alarms, all employees are to exit the area in a calm but prompt manner, turning off lights and closing doors ONLY if it is convenient. Group or Department people are to assemble in the pre-established point of congregation, and report to the Group/Department Accountability Coordinator. If a person is not accounted for, the Accountability Coordinator is to report to the Emergency Coordinator the information that someone may be left in the building and the area they may be in. This information will be given to the responding Fire Department officers, and a check will be made of the area by the Fire Department.

The silencing of the alarms may be done to assist the Fire Department fire fighters in communicating while within the building, and does NOT automatically mean that re-entry is permitted. At no time are people allowed to re-enter the building until the "All Clear" has been given by the Emergency Coordinator.

The activation of a manual pull station, a sprinkler or a smoke detector should be automatically received also by the monitored central station in the Plant Protection Section, however, failures may occur in an electronic system. It would be prudent for an occupant exiting a building during a fire alarm to contact the Plant Protection Section from a safe phone or in person (if close enough) to assure that prompt notification of the Fire Department has taken place, and to provide details of the incident that may improve responses.

8.3.6 Fire Suppression

Manual fire suppression (fire extinguishers) is to be attempted only by trained individuals. The suppression of an incipient fire requires the training and knowledge of the appropriate fire extinguisher and an awareness of that extinguisher's limitations. The use of a Class A water-type extinguisher on a live electrical fire can cause serious injury or death to the user by electrocution. Conversely, the use of a CO2 fire extinguisher on a paper fire may blow burning embers around, leading to a more rapid spread of the fire to other fuel sources. A trained individual will need to assure that a clear escape route is available, should the attempt to extinguish the fire fail. The fire alarms should always be activated before attempting to extinguish a fire, as this will allow others in the building to exit as early as possible, and it will initiate the emergency response crews to assist if the fire can't be extinguished. If the alarms have not triggered from the automatic detection system, use a manual pull station.

As a reminder to trained users, the mnemonic for fire extinguisher use is **PASS**:

Pull pin
Aim at the fire's base
Squeeze the handle
Sweep back and forth

Once a fire extinguisher has been used, it needs to be immediately replaced with a full unit. Please call the Plant Protection Section at 4-3483, to have the used extinguisher changed out and refilled. Any time a fire extinguisher is used, a report needs to be filed with Environment, Safety, Health and Assurance at 4-2153.

Once a fire has reached a stage where the ceiling temperature is at or near 165 degrees Fahrenheit, the sprinkler fusible link will open automatically, releasing a continuous spray of water. Only those heads that have been "melted" will flow water. As the fire grows, more heads will activate. During and after a fire, the sprinkler system may only be valved off at the order of the Emergency Coordinator or the Fire Department's Incident Commander. Once valved off, an individual capable of restoring water service if the fire re-ignites must tend the valve. The individual must remain at the valve until the sprinkler heads that had been activated have been replaced by fresh sprinkler heads.

Passive means of preventing the spread of a fire are the use of rated fire- or smoke-doors, fire resistant construction of walls, floors and ceilings, and the use fire- and smoke-stopping for wall and floor penetrations.

8.4 TRAINING

Detailed programmatic training is provided via the following institutional training modules:

GENERAL EMPLOYEE TRAINING (GET) FOR NEW EMPLOYEES	**#AL-001**
Intended Audience:	*Mandatory for all new employees.*
Module Format:	*Classroom Instruction. Estimated completion time: 1.5 hours.*
Associated Retrain Period and Format:	*Retrain is required if an employee has been terminated from the Laboratory for more than a one-year period. All Ames Laboratory employees receive the Laboratory's Annual Retrain Mailing, which covers, Fire Safety, Cyber Security, Physical Security, informational updates and policy reminders.*

FIRE EXTINGUISHER TRAINING	**#AL-017**
Intended Audience:	*Any employee wishing to use a fire extinguisher.*
Module Format:	*ISU EHS: Classroom instruction and hands-on practice.*
Associated Retrain Period and Format:	*Annual retraining mailing.*

Group / activity-specific training shall be given to each employee prior to work that includes a discussion of hazards and hazard mitigation, safety information and resources, emergency response measures and other procedural information. This training shall be documented by the Group Leader/Department Manager and the records maintained for a period of five years.

8.5 PERFORMANCE CHECKLIST

Group Leader / Department Manager shall:

- ❑ Keep their personnel and rooms in compliance with the provisions of this section.
- ❑ Maintain a current group emergency plan, and assure that their employees are aware of the plan and its requirements.
- ❑ Assure that their employees are familiar with the location and use of the fire extinguishers and fire alarm stations (manual pull stations).

Employees shall:

- ❑ Conduct their work in a way that minimizes the possibility of fires.
- ❑ Follow the procedures for safe chemical handling and storage.
- ❑ Respond in case of a fire, as outlined in the Ames Laboratory Emergency Plan and in the Group Emergency Procedures, such as knowing and using fire evacuation routes and relocation points.
- ❑ Know which extinguisher to use, its location, how and when to use it.
- ❑ Activate the building fire alarm station immediately when a fire is detected, know where alarm stations are located and how they operate.

Environment, Safety, Health & Assurance (ESH&A) shall:

- ❑ Maintain current standards, codes and regulations.
- ❑ Provide interpretations for Ames Laboratory situations.
- ❑ Provide fire safety evaluations annually, or as needed.
- ❑ Maintain a fire safety central station for the notification of occupants and off-site responders.
- ❑ Write and submit requests for variances and exemptions from safety standards as needed.

Fire Safety Committee shall:

- ❑ Act as the local Authority Having Jurisdiction for fire safety issues.
- ❑ Provide a competent technical resource for identifying, recommending resolution of, and communicating fire safety issues, initiatives and programs.
- ❑ Review designs for new or modified fire protection systems.
- ❑ Review designs for new or modified facilities.
- ❑ Evaluate, write and maintain requests for waivers, exemptions and equivalencies.
- ❑ Develop the Fire Safety Program, to document all fire safety system testing, inspection and maintenance, and assign ownership and responsibility for compliance.