Forest Service Handbook
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Forest Service Handbook 2809.15 – Minerals and Geology Handbook
Chapter 20 - Minerals and Geology Safety Practices

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Approved by: Glenn P. Casamassa, Associate Deputy Chief, NFS

Date approved: September 29, 2015

Responsible Staff:

Posting Instructions: Amendments are numbered consecutively by Handbook number and calendar year. Post by document; remove the entire document and replace it with this amendment. Retain this transmittal as the first page(s) of this document. The last amendment tothis Handbook was 2809.15-2012-2 to 2809.15_content.

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Superseded Document(s): 2809.15_20, Amendment 2809.15-2012-1, September 13, 2012

Digest: Following is an explanation of the changes throughout the directive by section.

25.01 thru 25.6: Incorporates ID 6709.11-2011-1. Revises coding to reflect applicable codes for section 25.

Table of Contents

20.1 - Authority

1. Title 29, Code of Federal Regulations, Part 1910 (29 CFR 1910). This regulation carries out the directive to the Secretary of Labor and contains occupational safety and health standards which have been found to be national consensus standards or established Federal standards.

2. Title 29, Code of Federal Regulations, Part 1926 (29 CFR 1926). This regulation sets forth the safety and health standards promulgated by the Secretary of Labor for construction workers.

3. Title 29, Code of Federal Regulations, Part 1960 (29 CFR 1960). This regulation assures safe and healthful working conditions for Federal employees and places the responsibility for establishing and maintaining an effective health and safety program to the Federal agency.

4. Title 30, Code of Federal Regulations, Parts 1-199. The Mine Safety and Health Administration, Department of Labor, establishes health and safety standards for surface and underground mines in the metal and nonmetal mining industry.

20.4 - Responsibility

1. Line Officers and Supervisors have the responsibility to:

   a. Ensure employees receive the appropriate training in hazard recognition and identification.

   b. Ensure employees are provided current training and are proficient in the use of tools or devices and personal protective equipment (PPE) for assigned tasks.

   c. Assign work projects and activities to employees with the appropriate level of experience and skill to safely complete the task.

   d. Discuss with employees the hazards and PPE necessary to perform work projects and activities and document with a Job Hazard Analysis (JHA) form, FS-6700-7.

   e. Determine tools, equipment, and facility needs necessary for safe and healthful operations.

   f. Ensure an adequate supply of tools and PPE are available to accommodate employee gender, size, other special needs and require use of the appropriate equipment.

   g. Provide and require use of the appropriate tools.

   h. Provide the global positioning system (GPS) training to field-going employees prior to using the GPS.

2. Employees have the responsibility to:

   a. Wear and maintain the required personal protective equipment.

   b. Participate in hazard analysis processes prior to starting work projects and activities.

   c. Maintain proper health and fitness to meet physical demands of work tasks as assigned. Consider performing stretching and other warm-up exercises appropriate to the work.

20.5 - Definitions

ALARA. Acronym for "as low as reasonably achievable" with social and economic factors being taken into account. The intent of the term is to minimize the risk of radiation exposure or other hazards while keeping in mind some may be unavoidable and acceptable in order to further the task at hand.

Alpha Radiation. An energetic particle ejected by a radioactive material. Alpha particles are positively charged.

Beta Radiation. An electron ejected by a radioactive material. In contrast to an alpha particle, it has a smaller mass and carries a negative charge.

Dosimeters. A portable electronic monitoring and measuring device that measures dose readings from milliRems or microSieverts.

Gamma radiation. A true ray of energy, in contrast to beta and alpha radiation which are particulate. The properties of gamma rays are similar to X-rays and other electromagnetic waves. Gamma radiation is highly penetrating, but relatively low in ionizing potential.

Job Hazard Analysis (Risk Management Assessment). An internally generated form identifying known and potential hazards at a work site and procedures to reduce the danger.

NORM. Acronym for "Naturally Occurring Radioactive Materials" such as drill core and cuttings from uranium exploration.

PPE. An acronym for "Personal Protective Equipment" and refers to protective clothing, helmets, goggles, or other garment or equipment designed to protect the wearer's body from injury by blunt impacts, electrical hazards, heat, chemicals, and infection, for job-related occupational safety and health purposes.

Radon. A radioactive gaseous element produced in the disintegration of radium.

Roentgen Equivalent Man (rem). A unit of measurement of the amount of ionizing radiation dosage absorbed by a person. One milliRem equals 0.01 milliSv.

Sievert (Sv). An SI unit (International System of Units), often measured in milliSieverts (mSv). One Sievert equals 100 rems.

TLD Badges - thermoluminesent dosimetry badges. A device worn and used to measure gamma radiation exposure.

X-Ray - Electromagnetic radiation. A high energy, short wave length of energy emitted by electrons outside the nucleus, capable of penetrating most substances except heavy metals, and considered a carcinogen.

20.6 - References

1. National Fire Protection Association. (NFPA), 1977: Protective Clothing and Equipment for Wildland Fire Fighting. Quincy, MA.

2. U.S. Department of Transportation, Federal Highway Administration. Manual on Uniform Traffic Control Devices. U.S. Government Printing Office, Washington, DC.

3. Naturally Occurring Radioactive Materials (NORM), North Dakota, Department of Health, Radiation Control: http://www.ndhealth.gov/AQ/RAD/norm.htm.

4. OSHA Home Page, Ionizing Standards, Safety and Health Topics, Ionizing Radiation, Radiation: http://www.osha.gov/SLTC/radiationionizing/index.html.

5. United States Department of Labor, Occupational Safety and Health Administration, Ionizing Standards, 29 CFR 1910.1096.

6. U.S. Nuclear Regulatory Commission, 10 CFR 20.1003, Definitions, ALARA.

7. EPA Federal Radiation Protection Guidance for Occupational Exposure, Federal Register, Vol. 52, No. 17, January 27, 1987.

21 - Work Projects and Activities

21.1 - Job Hazard Analysis

The Job Hazard Analysis (JHA) identifies hazards associated with work projects and worksites, and identifies protective equipment or modified work procedures required for safe operations. For Forest Service operations, the JHA is the mandatory technique required to assess risk.

21.2 - Job Hazard Analysis Procedures

1. Prepare a JHA for all work projects and activities (sec. 22.5, ex. 02).

   a. When preparing a JHA for work projects and activities, utilize form FS-6700-7. Follow instructions on page two of the form.

b. Additional information about the importance of JHAs and development tips is located on OSHA's website at: http://www.osha.gov/Publications/osha3071.pdf.

2. The JHA must be discussed and used at every tailgate session for field work projects and activities and signed by each employee.

3. A Line Officer documents and approves the assignment of employees to work alone, by signing the JHA. If a recognized hazard is determined to exist to a lone worker, assign additional personnel, and dependable, established communications.

4. Check-out/check-in systems. Develop or use the standard protocol for informing the Line Officer when and where field work will be completed, and when you will return to the office.

Discuss the approved JHA with employees before they start the job. Specifically:

1. Prepare instructions for each work project or activity not covered in other applicable documents.

2. Include methods to ensure safety and health.

3. Assess the risks associated with recognized hazards and mitigate to the lowest level before beginning work projects and activities.

4. Identify hazards that cannot be corrected. Inform all involved personnel of the hazards. Do not allow performance of work projects and activities having unacceptable risks.

5. Where hazardous chemicals/materials may be encountered, provide the applicable Material Safety Data Sheet (MSDS) and discuss any associated risks with all employees in accordance with 29 CFR 1910.1200, OSHA Hazard Communication Standard.

6. Develop emergency evacuation procedures and assign individual responsibilities for implementation.

7. Conduct and document tailgate sessions. Tailor the sessions to the JHA to provide more specific project/task safety concerns and requirements.

8. Have each employee read, sign, and date the JHA prior to beginning the activity.

22 - Mine and Mineral Surveys

22.1 - Standards

The standards for first aid are found in 29 CFR 1910.151. The authority for air contaminant protection is 29 CFR 1926.55.

22.2 - Qualifications

In addition to meeting the applicable training and certifications listed in FSH 6709.11, section 22.07, employees shall comply with the following requirements:

1. Abandoned and Inactive Operations.

   a. Employees who conduct mine safety assessments and mineral surveys shall be Certified Mineral Examiners (CME), Review Mineral Examiners (RME) or Qualified Minerals Safety Leads (QMSL) who have been designated as qualified in accordance with FSM 2804. CME/RME/QMSLs who wish to be designated as qualified to conduct mine safety assessments shall demonstrate the following written documentation, personal interviews or field review as determined by the reviewing CME/RME appointed in accordance with FSM 2804.

   (1) Qualifications as a Mining Engineer (Series 880), Geologist (series 1350) or Physical Scientist (Series 1301) as determined by the Office of Personnel Management (OPM) X-118 standards.

   (2) Demonstrated experience performing the function of safety lead to assess and mitigate hazards and associated risks in abandoned/inactive underground or surface mines. Due to the unique nature of abandoned and inactive mine safety hazards, previous work experience exclusively in an active mine or cave environment does not meet this requirement.

   (3) The ability to recognize various hazards present at abandoned and inactive underground and surface mine workings and deep cuts and assess/mitigate the risks to an acceptable level through the use of engineering controls, personal protective equipment, first aid, rescue and communication equipment and procedures, substitution or institutional controls with no oversight, guidance, and direction.

   (4) The ability to prepare a job hazard analysis based on failure modes effects analysis of abandoned and inactive mine workings or deep cuts with little or no available information provided.

   (5) Successful completion of Forest Service and/or Bureau of Land Management (BLM) mine safety training courses or equivalent as recognized by the reviewing CME/RME. These courses should address the following topics: confined space training, mine rescue, hazardous materials recognition and handling, and respiratory protection.

   (6) Instructor certification for courses listed in paragraph 5 of this section.

(7) Proficiency in field mapping methods, such as geologic mapping of surface and underground mine workings.

(a) Employees who conduct mineral surveys shall be certified as Mineral Examiners in accordance with FSM 2892.03. A certified Review Mineral Examiner (RME) or Certified Mineral Examiner (CME) appointed in accordance with FSM 2804, shall determine which RME/CMEs are qualified to conduct mineral surveys for abandoned/inactive underground mine workings and deep cuts based on education, training, experience, and the need to qualify the individual for the particular task. If an appointed RME/ME is not available, or if there are no RME/CME in the region, then a RME/CME from the Minerals and Geology Centralized National Operations Group (CNO) or from an adjacent region may be appointed.

(b) Employees who are not RME/CMEs, or QMSLs, but may need to enter abandoned/inactive underground mine workings and/or deep cuts to perform their jobs, shall obtain permission from the appropriate Line Officer in charge. The Line Officer shall consider the need to enter hazardous work areas, the training, and the work experience of the employee. Such noncertified employees shall be accompanied by a qualified RME/CME/QMSL, or a State or Federal Mine Inspector in order to enter abandoned/inactive underground mine workings or deep cuts.

2. Active Operations.

a. The prescribed safety practices of those companies that have a designated Safety Officer and a formal safety training plan must be recognized.

b. Active underground operations that do not have a designated Safety Officer and a formal safety training plan must be given the same consideration as abandoned/inactive workings.

3. All Operations.

a. Each field crew and office group shall have at least one person currently certified by a nationally recognized organization to render first aid and perform CPR (29 CFR 1910.151, 1910, 1030, and 1926.50).

b. Any Federal or State employee who enters underground mine workings or deep cuts at the request of the Forest Service shall have valid first aid and CPR cards.

22.3 - Personal Protective Equipment

Before employees or Mineral Examiners enter underground mine workings, they shall be trained in the use of personal protective equipment (PPE) and shall ensure equipment is in working order and suited for the work project or activity.

1. PPE required includes:

   a. Forest Service-approved hardhat.

   b. Nonskid safety-toed boots.

   c. Safety glasses, goggles, or face shield.

   d. Headlamp (battery operated only).

   e. Safety belt with ring for securing lifelines.

   f. Multi-gas meter that is:

   (1) Capable of detecting at least oxygen. Contact the Mine Safety and Health Administration, the State Mine Inspector, and/or local mining companies to determine additional gases to be detected based on regional geology and mineralogy.

   (2) Audible and visual display alarm indicators.

   (3) Calibrated for the gases to be detected (high/low alarm limits for toxic and combustible gases; and depletion/enrichment alarm limits for oxygen).

   g. First aid kit (refer to the FSH 6709.11 Glossary).

   h. Two-way radio for check-in (for use outside the underground workings).

   i. Specific items for conditions requiring extra protective measures as identified in JHA.

2. Optional PPE includes a self-rescuer.

22.4 - Procedures

Basic procedures are:

1. Complete the JHA and discuss it with involved employees prior to the work project or activity (FSH 6709.11, sec. 22.08).

2. Complete an itinerary that includes at least the following items and leave the itinerary with the radio dispatcher on duty.

   a. List of personnel going to the field.

   b. Addresses, home telephone numbers, emergency telephone numbers, and whom to contact in case of an emergency.

   c. Predetermined check-in schedule.

   d. A map showing the approximate location of entrances to the underground workings and/or the location of the deep cuts.

3. Identify underground hazards that must be addressed in the JHA:

   a. Slip, trip, and fall hazards around shaft collars, winzes, or other vertical mine openings.

   b. Rock falls and collapse of unstable rock in mines and around mine openings.

   c. Snakes, bats, spiders, and other insects and animals.

   d. Rotten mine timbers and other unsafe mine support features.

   e. Oxygen deficient atmosphere and/or an atmosphere containing toxic or combustible gases.

   f. Abandoned explosive devices.

   g. Chemicals/hazardous materials.

4. Ensure that a qualified Review Mineral Examiners/Certified Mineral Examiners/Qualified Mineral Safety Leads (RME/CME/QMSL), or State or Federal Mine Inspector determines that the underground mine workings or deep cuts are safe before other employees are allowed to enter such workings. This determination includes examining and testing the back (roof) and rib (walls) of the underground mine workings for loose rock and shall scale as appropriate to ensure the safety of personnel.

5. Ensure that noncertified employees allowed to enter abandoned/inactive underground mine workings or deep cuts enter such hazardous work areas only when accompanied by a qualified RME/CME/QMSL, or State or Federal Mine Inspector.

6. Consider all underground coal mine atmospheres explosive and keep open flames away.

7. Consider all underground atmospheres oxygen-deficient and containing toxic gases until testing and continuous monitoring prove otherwise.

8. Use a lifeline when working around hazardous openings and areas (FSH 6709.11, sec. 32.2 and 33.3).

9. Display the Abandoned Mine Hazards Poster (USDA, March 1993), in a conspicuous place near the entrance of known abandoned/inactive underground mine openings (sec. 22.5, ex. 01).

22.5 - Exhibits

22.5 - Exhibit 01

Mine Hazard Poster

22.5 – Exhibit 02

Job Hazard Analysis

FS-6700-7 (11/99)

U.S. Department of Agriculture Forest Service	1. WORK PROJECT/ACTIVITY Underground Entry-Abandoned	2. LOCATION Klamath Closures – Happy Camp Area	3. UNIT KNF
JOB HAZARD ANALYSIS (JHA) References-FSH 6709.11 and -12 (Instructions on Reverse)	4. NAME OF ANALYST Jim DeMaagd	5. JOB TITLE Certified Mineral Examiner #048	6. DATE PREPARED 08/25/2006

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
*Underground entry of abandoned mine workings	Portal Entry	Workings deemed safe to enter by qualified Certified Mineral Examiner (CME). Three person team (at least one a qualified CME)-- One person will remain at entrance. Notify home office before entering and upon leaving mine. Personal Protective Equipment: Hardhat, MSHA approved lighting, proper footgear (muckers or work boots w/ steel toe), safety glasses recommended, dust masks if conditions warrant.
	Bad air 1) O2 deficiency 2) High O2 conc. 3) CO 4) CH4 5) H2S 6) Radon	Qualified CME will be equipped with a multi-gas continuous monitor with visual displays of gas conc., warning lights, and audible alarms. All workers will immediately evacuate upon alarm or first sign of symptoms for bad air inhalation (i.e. headache, dizziness, slurred speech, nausea, etc.)
	Falling Hazards 1) Winzes 2) Raises	Qualified CME is lead person, who will point out all underground openings to avoid.
	Explosives	Suspected explosives will not be handled. All workers will be immediately evacuated and certifed blaster will be notified.
	Pools of water	Qualifed CME will lead to probe standing water.
	Disorientation	Must remain in voice contact w/ qualified CME..
	Wildlife	First aid kit
	HazMat	.Suspect hazmat will not be handled. Make note of any markings & notify safety officer.
	Changes	Qualified CME constantly checks for changing conditions (rock stability, airflow changes).

10. LINE OFFICER SIGNATURE	11. TITLE	12. DATE

22.5 – Exhibit 02—Continued

JHA Instructions (References-FSH 6709.11 and .12)

The JHA shall identify the location of the work project or activity, the name of employee(s) involved in the process, the date(s) of acknowledgment, and the name of the appropriate line officer approving the JHA. The line officer acknowledges that employees have read and understand the contents, have received the required training, and are qualified to perform the work project or activity.

Blocks 1, 2, 3, 4, 5, and 6: Self-explanatory.

Block 7: Identify all tasks and procedures associated with the work project or activity that have potential to cause injury or illness to personnel and damage to property or material. Include emergency evacuation procedures (EEP).

Block 8: Identify all known or suspect hazards associated with each respective task/procedure listed in block 7. For example:

a. Research past accidents/incidents.
b. Research the Health and Safety Code, FSH 6709.11 or other appropriate literature.
c. Discuss the work project/activity with participants.
d. Observe the work project/activity.
e. A combination of the above.

Block 9: Identify appropriate actions to reduce or eliminate the hazards identified in block 8. Abatement measures listed below are in the order of the preferred abatement method:

a. Engineering Controls (the most desirable method of abatement). For example, ergonomically designed tools, equipment, and furniture.
b. Substitution. For example, switching to high flash point, non-toxic solvents. Work Leader
c. Administrative Controls. For example, limiting exposure by reducing the work schedule; establishing appropriate procedures and practices.
d. PPE (least desirable method of abatement). For example, using hearing protection when working with or close to portable machines (chain saws, rock drills, and portable water pumps).
e. A combination of the above.

Block 10: The JHA must be reviewed and approved by a line officer. Attach a copy of the JHA as justification for purchase orders when procuring PPE.

Blocks 11 and 12: Self-explanatory.

Emergency Evacuation Instructions (Reference FSH 6709.11)

Work supervisors and crew members are responsible for developing and discussing field emergency evacuation procedures (EEP) and alternatives in the event a person(s) becomes seriously ill or injured at the worksite.

Be prepared to provide the following information:

a. Nature of the accident or injury (avoid using victim's name).
b. Type of assistance needed, if any (ground, air, or water evacuation).
c. Location of accident or injury, best access route into the worksite (road name/number), identifiable ground/air landmarks.
d. Radio frequencies.
e. Contact person.
f. Local hazards to ground vehicles or aviation.
g. Weather conditions (wind speed & direction, visibility, temperature).
h. Topography.
i. Number of individuals to be transported.
j. Estimated weight of individuals for air/water evacuation.

The items listed above serve only as guidelines for the development of emergency evacuation procedures.

JHA and Emergency Evacuation Procedures Acknowledgment

We, the undersigned work leader and crew members, acknowledge participation in the development of this JHA (as applicable) and accompanying emergency evacuation procedures. We have thoroughly discussed and understand the provisions of each of these documents:

SIGNATURE	DATE	SIGNATURE	DATE
_____		_____	
_____		_____	
_____		_____	
_____		_____	

Previous edition is obsolete (Over)

23 - Health and Safety Radiation Guidance for Administration of Uranium

23.02 - Objectives

Ensure employee safety for the administration of uranium exploration and development on National Forest System lands by the application of industry safety standards and the use of radiation exposure monitoring.

23.04 - Responsibility

Uranium deposits produce low levels of radiation in its natural state. Standard administration duties may expose Forest employees to these levels of radiation. In order to ensure safe work practices and employee safety:

1. Line Officers and Supervisors shall ensure proper safety procedures are followed and necessary detection equipment is acquired and used properly (http://fsweb.wo.fs.fed.us/mgm/).

2. Employees shall be trained on the proper use of safety equipment and use all required equipment and safety when in situations where there is the potential for radiation exposure.

23.1 - Standards

The following proposed health and safety Guidelines for Uranium Exploration were adapted from several sources including Occupational Safety and Health Administration (OSHA); Environmental Protection Agency (EPA); Nuclear Regulatory Commission (NRC); Saskatchewan Radiation Protection guidelines; and guidelines from the States of South Dakota, New Mexico, and Alaska; and several industry health and safety plans. Although developed primarily for private industry exploration crews, they are adopted here as Forest Service guidelines and apply to all Forest Service employees involved in the administration of uranium exploration operations on National Forest System lands.

23.2 - Health and Safety

23.2a - Exposure

Mineral Administrators, Geologists, and Certified Mineral Examiners (CME) administering and monitoring exploration operations searching for uranium may receive radiation exposures from uranium and its associated radioactive decay products in drill core and drill cuttings. Exposure can be externally by proximity to radioactive materials, or internally from ingestion or inhalation of radionuclides.

Since operations are outdoors and typically involve only small quantities of radioactive materials, and because they are working with “naturally occurring radioactive material

(NORM),"Forest Service Mineral Administrators and exploration crews are regulated by the States and/or the Occupational Safety and Health Administration (OSHA) (NORM, Naturally Occurring Radioactive Materials, North Dakota, Department of Health, Radiation Control). This is in contrast to personnel in operating uranium mines and mills who are usually classified as "radiation workers" and whose radiation exposures are closely regulated under the Federal Mine Safety and Health Administration (MSHA) and Nuclear Regulatory Commission (NRC) Standards.

Radiation exposure varies depending on the type of radiation.

1. Alpha radiation can be shielded with simple items such as paper and do not cause any external body damage since the particles cannot penetrate the layer of dead skin cells on the human body. Internal damage can occur in small volumes through ingestion and inhalation.

2. Beta particles can cause skin damage at high dose levels from outside the body and damage to cells and critical organs when emitted inside the body. Beta particles travel a few meters in air or up to 1 cm in tissue.

3. Gamma radiation can travel long distances and penetrate through the body and is a hazard to all organs from both inside and outside the body. Gamma radiation can be shielded by heavy materials such as the cab of a vehicle or a piece of equipment. Gamma rays are of the most concern for direct radiation exposure and particular precautions need to be addressed.

4. Radon progeny is the result of gas emanating from uranium-bearing core samples and drill cuttings. Proper core handling in well-ventilated areas or working outside will reduce the significance of exposure.

5. Radioactive dust is a common method of exposure of radioactive particles. Dust from cutting core in closed areas or re-suspension of dust in poorly ventilated or poorly maintained areas are common and can be reduced greatly by simple preventative measures.

23.2b - Exposure Management

The basic principle for worker radiation protection is that worker exposures should be kept "as low as reasonably achievable (ALARA)." It is assumed that for the NORM management category, a calibrated dose rate meter or dosimeter will be used to assess and minimize worker radiation exposures. Forest Service personnel encountering significant amounts of mineralized drill core should have access to a calibrated dose rate meter as a means of minimizing worker radiation exposure and wearing thermoluminesent dosimetry badges (TLD) to ascertain the quarterly and annual dose received by personnel.

In addition to radiation monitoring devices, common practices should be followed when working around radioactive materials. Reducing dust but proper ventilation and using wet applications in

splitting and sampling core, keeping work areas clean, and reducing dust collection on clothing and skin are common yet useful methods of greatly reducing the risk of exposure to radiation.

24 - Oil and Gas Operations

24.1 - Qualifications

All employees working on or near exploration or production operations shall have hydrogen sulfide (H_2S) awareness training.

24.2 - Personal Protective Equipment

1. Before any employees are allowed to work on or near any oil and gas exploration or production operation in a known H2S area, ensure that all employees are trained in the use of PPE and that equipment is in working order and is appropriate for the work project or activity.

2. In the JHA, identify specific items for conditions requiring extra protective measures.

24.3 - Procedures

Complete the JHA and discuss it with involved employees prior to the work project or activity. The JHA must include the potential safety hazards associated with H_2S on or near oil and gas operations.

25 - Cave Safety Standards

25.02 - Objectives

Visitor and employee safety is the foremost objective of the Forest Service's cave and karst management program. The purpose of the Forest Service Cave Safety Standards is to establish a course of action that can be followed to assure minimal risk to people (both Forest Service employees and the general public) entering caves on public lands. These standards consist of Cave Safety Guidelines, Cave Search and Rescue (SAR) Pre-Planning, and a Job Hazard Analysis. Most cave environments are safe for human use. A safe caving experience depends on sound decisions and staying within the abilities of each individual caver and the group as a whole. As with any activity in the outdoors, there may be possible risks for individuals entering caves for any purpose.

25.04 - Responsibility

District Rangers will ensure that cave entrants on their district are educated to the extent possible so they can make informed decisions about their own welfare. Public information and education efforts will continue within funding and manpower limits. Ill-prepared or uninformed personnel face the greatest risk in cave entry. Most cave accidents are avoidable with prior planning, training, and the use of the proper equipment. District Rangers will make certain that their

district, if it contains cave resources, will have a Cave Search and Rescue Pre-plan as a part of, or addendum to, a Cave Management Plan or the District's Search and Rescue Plan.

Forest Service employees tasked with cave management will contact National Speleological Society (NSS) affiliated Grottos or local caving groups associated with the NSS when information is needed on the locations and risks associated with caves in the area. The Forest Service has a Memorandum of Understanding (11-MU-11132424-018) with the NSS for assistance with managing cave resources. This MOU provides for cooperation between the Forest Service and the NSS local chapters for the cooperative development of cave management plans and cave search and rescue pre-plans including standards for equipment, experience, and rescue procedures. The NSS has Grottos in 47 States; a list of the Grottos can be obtained from the NSS. Under the MOU, the local caving community can assist the Forest Service with completing cave safety analysis and with making recommendations for personal protective measures for cave entry.

Forest Service personnel normally are in a supportive role in cave Search and Rescue (SAR) operations; however, Forest Service law enforcement will take the lead for expediency in life or death situations or when non-Forest Service SAR programs are not capable of providing cave rescue service. Forest Service employees tasked with cave management and Forest Law Enforcement will determine in cooperation the sufficiency and availability of existing cave SAR programs, assist and support local authorities, and cooperate with qualified cave organizations.

25.05 - Definitions

Cave. Any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the Earth or within a cliff or ledge, including any cave resource therein, but which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or manmade. Such a term must include any natural pit, sinkhole, or other feature which is an extension of the entrance.

Cave Ecosystems. All groundwater recharge and discharge areas connected to a cave, both discrete and diffuse, and the intermediary aquifers or flow paths; air flow into and out of the cave; vegetation, fauna, and aquatic communities in or linked to the cave; and all other cave resources. Cave ecosystems can be sensitive to changes in the temperature or chemical composition of the water or air. Some examples of the types of cave ecosystems include: karst, pseudokarst, lava tubes, ice caves, river undercuts, and erosional features.

Cave Resource. Any material or substance occurring in caves, including but not limited to, those which are biotic, cultural, mineralogical, paleontological, geologic, and hydrologic.

Karst. Terrain created by the chemical solution of the bedrock, including carbonate rocks (limestone and dolomite), gypsum, and to a minor extent, other types of rocks. Such terrain is characterized by disrupted surface drainage, abundant enclosed depressions, and

a well-developed system of underground drainage systems, which may include caves. The term "pseudokarst" is sometimes used to distinguish karst terrain formed on non-carbonate bedrock.

25.06 - References

Hudson, Steve. 1988. Manual of U.S. Cave Rescue Techniques. Huntsville, AL: The National Speleological Society. 260 p.

25.1 - Standards

Standards for the Forest Service are based on information from the Bureau of Land Management and the National Park Service, as well as information from the International Mountaineering and Climbing Association (UIAA), the National Cave Rescue Commission (NCRC), the National Outdoor Leadership School (NOLS), and the National Speleological Society (NSS). All safety or personal protective equipment used in caving activities should meet or exceed the UIAA standards. The standards for first aid are found in 29 CFR 1910.151.

25.2 - Personal Protective Equipment

Personal Protective Equipment (PPE) for entry into caves is specified in the Job Hazard Analysis (An example that can be taken as is or amended with additions to fit local circumstances is at sec. 25.6, ex. 01). Before employees enter caves, they should be instructed in the proper use of PPE and should ensure equipment is in proper working order and suited for the work project or activity.

PPE required for entry into all caves includes:

1. First aid kit (refer to the FSH 6709.11 Glossary).
2. Food and drinking water.
3. Durable gloves.
4. Appropriate footwear such as hiking or rubber boots.
5. Appropriate clothing for the specific cave environment:
    a. Warm, dry caves: Lightweight clothing.
    b. Cold caves: Coveralls and layered clothing.
    c. Wet caves: Waterproof coveralls, wetsuits, or drysuits.
6. UIAA approved helmet with a non-elastic chin strap.
7. Three independent helmet-mountable light sources with extra components.

8. Thermal protection (emergency blanket, trash bag, and so forth).

9. Additional PPE as identified in the JHA for the local area.

25.3 - Procedures

25.3a - Procedures for Work in Caves

The following procedures are the recommended course of action for Forest Service employees working in or entering caves:

1. Invite the local caving community (NSS affiliated grotto) to assist the Forest Service in conducting a safety analysis for each cave under Forest Service administration. The results of this analysis should be utilized to implement visitor awareness by informing all cave users (Forest Service and general public) prior to entry into the cave of the precautions necessary for a safe trip. These steps will include providing a list of known safety risks, and to inform the visitor of cave use authorizations necessary, cave use registration stations, and cave entry signs. Some caves may require additional monitoring to reevaluate conditions.

2. Be aware of any and all closures, whether seasonal or perennial, that may be in effect for any reason and may limit entry into caves on NFS lands.

3. Utilize current decontamination protocol and/or regional gear use prohibitions for entry into Forest Service caves in order to prevent the spread of non-native subsurface biota.

4. Develop and follow cave Search and Rescue (SAR) Procedures and put a Cave Rescue Pre-Plan in place (example at sec. 25.6, ex. 02). Forest Service Cave Specialists and other personnel responsible for cave use administration should attend any SAR workshops or meetings and should host such meetings or workshops, when possible, by offering facilities or organizational assistance.

5. Provide training to Forest Service Cave Specialists in Single Rope Technique (SRT) and climbing skills required for the safe use of vertical caves. Vertical cavers will know how to climb, change over from ascending to descending equipment and vice-versa, thumb down on ascending equipment, and pass knots and rigging points safely with SRT gear before using ropes and SRT gear underground**.** The Forest Service should take an active role by co-sponsoring and assisting in such training. Training will consist of above-ground orientation and underground experience with a qualified experienced cave leader. Employee technical skill training and experience are essential to aid in the prevention of injures and enable employees to better judge the skills of visitors.

6. Complete the Job Hazard Analysis (JHA) and discuss it with involved employees prior to the work project or activity (Example at sec. 25.6, ex. 01).

7. Conduct underground work in groups of three or more, never alone. If the cave trip requires technical bolt or aid climbing, the party will consist of at least four members, two of whom are experienced with subsurface climbing techniques such as use of a power or hand drill, setting of anchors, and lead belaying.

8. The trip leader will ensure that a belay is provided when necessary, including the use of fixed lines or belays in exposed areas. All permanent hardware for fixed anchors and rigging points underground or at the entrance will be stainless steel, including bolts, hangers, and maillons. Anchors will be placed only for safety purposes. Natural anchors should be utilized whenever possible. Anchors placed for aid routes (non-primary) or that will be removed in a short timeframe and not utilized for main cave routes can be non-stainless. Permanent ropes underground should be evaluated for replacement, and should be replaced every two years if replacement is not necessary before then. No permanent ropes will be left rigged in entrance pits.

9. Use a belay when negotiating uneven or slippery cave passages. Instruction in the proper procedure for belaying should be practiced before the trip with the device that will be used on the trip.

10. Never jump across openings or down drops. Distances underground are hard to judge and often greater than they appear. Always maintain three points of contact with the rock, moving only one hand or foot at a time while climbing.

11. Employees will lead underground operations only after receiving adequate instruction and having sufficient experience in the cave to be visited, which at the minimum consists of not less than four trips within the particular cave, or in the case of a larger cave system, two of the trips specifically within the area.

12. Provide training in relevant winter, desert, or other local climatic survival techniques for employees with cave management duties. Provide basic survival equipment to cave specialists.

13. Due to the twilight zone/entrance area of caves being utilized by wide variety of mammals, reptiles, and insects, caution should be used when entering or exiting the cave to avoid potential risk. Forest Service employees will be trained to avoid this risk and the proper actions to take should an employee be stung or bitten. Provide proper medications and first aid supplies to employees. As a part of the permitting process, caution visitors about entering these areas. In desert areas and warm climates, cave dust can additionally be a vector for histoplasmosis, a serious lung ailment.

In all cases of entry into caves that are heavily utilized by bats, rodents, or other animals, personnel will wear protective clothing including long pants, long sleeves, required PPE and masks to avoid possible health risks such as histoplasmosis introduced by the animal droppings. Personnel will avoid these areas when possible.

14. Forest Service employees tasked with cave management will receive Red Cross Basic First Aid Training or a Wilderness first aid training course as soon as possible. This can be part of the annual CPR/First Aid Training offered to all Forest Service employees.

15. Caving and cave rescues take place in a very fragile environment. Both cavers and cave rescuers should take all possible care to minimize impacts to this environment. Adhere to the Leave-No-Trace philosophy, including the seven principles (for more information see www.LNT.org). Whenever possible, Cave Specialists are to use established trails, are not to touch formations or disturb cultural or paleontological resources, and shall carry out all wastes and trash. This includes all human waste. The disturbance or discovery of cultural or paleontological resources should be reported immediately to the District Ranger and qualified Geologist and/or Archeologist.

16. A minimal number of caves may have atmospheric and/or physical conditions that are not favorable for entry. Cave atmosphere and other associated hazards where present will be evaluated as part of the JHA process and handled on a case-by-case basis. Caves with atmospheric hazards will be posted at the entrance, and a log kept at the area office of the inherent risks present at the time of the evaluation of the cave. A periodic reevaluation will be conducted as applicable or prior to entering by a Forest Service employee.

Carbon dioxide is a colorless, odorless gas, occasionally found in caves, which may reduce oxygen levels at the bottoms of pits or near sumps where it is produced by the biological decomposition of organic material. Carbon dioxide, in lethal concentration, is extremely rare in caves and may never be encountered by a caver. Be aware of situations where organic material has collected in areas of poor air circulation. At any sign of reduced oxygen leave the area immediately by moving upslope.

A naturally occurring colorless and odorless radioactive gas, radon is a by-product of decaying radioactive minerals. Radon is found in nearly all basements, homes, and caves. Forest Service employees shall regularly test and monitor for radon and other gas levels in commercialized caves where employees spend extended time periods underground. Safe and healthful working levels (time spent in the cave) shall be established for these commercialized caves. Radon is not a hazard to persons who infrequently visit caves; it is a health hazard for people exposed to high concentrations over long periods of time. It is only necessary to monitor caves where employees are required to work underground for hundreds of hours each year.

17. Caves subject to flooding, such as those in canyon bottoms and in run-off pits, must not be visited during periods of heavy precipitation. In the winter, ice often forms on cliffs and in cave entrances. In the spring or during periods of warming, ice masses can detach and fall without warning. Cavers will avoid walking beneath ice masses and crossing winter snow that has blown into and plugged the tops of pits.

25.3b - Procedures for Cave Search and Rescue (SAR) and Pre-Planning

This section offers simple procedures for cave search and rescue planning.

1. Each Forest and Ranger District with caves on the unit will have a concise and brief cave Search and Rescue Pre-Plan. A cave SAR Pre-Plan consists of a recommended course of action in the event of a caving emergency. Pre-Plans are especially important in areas with infrequent search and rescue incidents. The Pre-Plan is not intended to provide step-by-step instructions for all personnel. The Pre-Plan is a document from the District Ranger to their staff that uses the Incident Command System (ICS) to provide clear leadership and organizational guidelines in urgent situations. There are two very different types of Pre-Plans -- general and specific (FSH 2809.15, ch. 20, sec.25.6, ex. 2).

2. Cave Specialists, Managers, and Dispatchers will know how to quickly access the written cave SAR Pre-Plan. Pre-Plans facilitate organization of personnel and equipment for urgent incidents. They provide guidance through the initial response. For extended incidents, they are replaced by a plan drawn up during the first operational shift.

3. The Pre-Plan will be kept in the Forest and Ranger District dispatcher's notebook. It should also be posted on the wall in the Emergency Operations Center. The Emergency Operations Center is often either a room in the Sheriff's Office with a phone and a radio or the Forest Service District Office.

4. Dispatchers and Forest Service staff on the District will become familiar with the written Pre-Plan. Additionally, Forest Service staff should read appropriate parts of Cave Rescue Techniques (Hudson 1988). The staff should be comfortable with the first four chapters and aware of the rest of the book as reference material. A simple mock cave rescue by the local SAR team should be held annually to familiarize staff with the procedures.

5. To expedite SAR response, partnership agreements between the Forest Service and responsible authorities will be developed. Separately, Forest Service Law Enforcement should take whatever action is necessary if a SAR action involves a Forest Service employee.

6. Additional external training of Dispatchers and Forest Service staff with cave management or SAR responsibilities should be considered. The National Cave Rescue Commission (NCRC) runs annual week-long cave rescue seminars and currently offers four levels of training (four weeks total), as well as on-site training opportunities. Other external training includes ICS training and managing the Search Function (MSF), a 40-hour National Association for Search and Rescue (NASAR) course, and Managing the Search Operation (MSO). Local training is often the most important part of a cave SAR Pre-Plan, because it associates the SAR team with the people who are lifelong cavers.

25.6 - Exhibits

25.6 - Exhibit 01

Caving Job Hazard Analysis

FS-6700-7 (11/99)

U.S. Department of Agriculture Forest Service	1. WORK PROJECT/ACTIVITY General Caving	2. LOCATION	3. UNIT
JOB HAZARD ANALYSIS (JHA) References-FSH 6709.11 and -12 (Instructions on Reverse)	4. NAME OF ANALYST	5. JOB TITLE	6. DATE PREPARED

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Pre-trip planning	Surface conditions/ Weather	Where feasible, cave trips should take place during daylight hours, when the outside weather is expected to be optimal. Surface navigation in the dark, from remote locations, can be difficult and dangerous. Persons who become wet or hypothermic inside a cave often have to exit the cave to warm up or recover properly. Exiting a cave into stormy or windy conditions does not help people who are already bordering on hypothermia, and can make a bad situation much worse.
Pre-trip planning	Entrance Zone Animals	While in the entrance area of a cave all team members should be alert and aware that skunks, venemous snakes, spiders, and other potentially hazardous animals may be found. Avoid treading on accumulated guanos or middens.
Pre-trip planning	Weather/ Flooding	Flooding can be a major hazard in some caves. Make certain you know the dynamics of the cave system in which you are entering. If appropriate, check the weather to ascertain the risks of flooding due to precipitation/ storms. If there is a chance of rising water underground or flash flood through the cave in which you are planning to work, postpone the trip.
Pre-trip planning	No emergency contact	All caving trips should have a designated surface contact. This is generally Forest Service dispatch or regular check-in/check-out procedures. This is a person who remains on the surface, and who can and will initiate search and rescue operations, if the caving party does not return or check-in within a specified time period. The surface contact should know: • The location of the cave being visited, and how potential rescuers would get there • The names of all people on the trip • The nature and main hazards of the cave being visited • When the party is expected to return and report • When to initiate search and rescue operations (when to stop worrying and start a rescue) • Who to contact, to initiate appropriate search and rescue operations

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Pre-trip planning	**Unprepared for cave**	**If available, obtain a map and information about the cave to be visited, to be aware of hazards or problems specific to the cave in question. Some caves are wet or require swimming in frigid water, some caves are slippery or unstable, some caves are cold and drafty or contain ice, some caves require rope and technical climbing gear to visit safely, and some caves are complex and require careful navigation. Determine what equipment or experience will be needed to visit the cave in question safely.** **Make certain all cavers working in your party have the appropriate skills and equipment. If the cave will require ropework, make certain you are personally familiar with the appropriateness of each trip member's rope skills.**
Pre-trip planning	**Exertion/ Exhaustion**	**Each team member should have adequate knowledge of the length and duration of trip prior to heading into the cave, and should have cave-specific physical conditioning. People in good physical condition need less water and are less prone to injury.** **Push your endurance limit in gradual increments. Avoid overloading your pack; be creative to reduce weight and bulk. Prior to the trip, the trip leader should inquire about people with known physical conditions and treatment needs. Groups should avoid overexertion, and should stop at least every hour to eat and drink. Group speed should be tailored to the slowest person on the team. Should the trip become too much for one trip member, the whole trip plan will be modified to achieve a safe trip.**
Pre-trip planning	**Transportation loss**	**Ensure safety and retrievability of vehicle keys. Place vehicle keys in a safe and accessible location prior to entering any cave, and inform others of where the keys are located, in case you become incapacitated. Multiple sets of keys entrusted to multiple people in the group is the safest plan. Your friends can't go for help quickly, when all the car keys are in your pocket or backpack.**

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Personal Protective Equipment	**Natural cave and surface conditions**	**Depending on the cave, required or recommended protective equipment includes the following:** • **Approved Caving or climbing helmet, with non-elastic chin-strap and mounted headlight** • **3 helmet-mounted backup lights per person, in working order and with spare batteries** • **Durable boots, gloves, thermals, and other protective clothing** • **At least 1 Liter of water and quick-energy food, in case of unexpected delays in exiting the cave** • **Small heat source and additional thermal protection (emergency blanket, large plastic trash bag), in case of unexpected delays** • **Small first aid kit, and any needed personal medications** • **Dust mask or respirator, when visiting caves that are dusty, contain animal droppings, or are demonstrated to have atmospheric hazards requiring these PPE** • **Very few caves contain established restroom facilities. Take care of personal needs before entering the cave. Pack out what you pack in, including solid and liquid wastes.** • **Bring a watch. Time is difficult to judge when underground, because you can't see the standard visual clues in the sky, or at the office, or see distant objects to note how far you have traveled.** • **9 - 11mm Static nylon caving rope and personal (not shared) SRT climbing gear for pits or steep areas** • **Wetsuits or dry suits for caves requiring repeated or prolonged immersion in cold water** • **Crampons or other traction devices, to safely negotiate icy surfaces, in caves that contain ice.**
Personal Protective Equipment/ Pre-trip Planning	**Equipment malfunction**	**Inspect all equipment for safe and proper function before entering the cave. It is best that each person bring and use their own set of equipment. Critical equipment should not be shared, in case the party becomes separated, or a single set of critical equipment fails. If using new or borrowed equipment, be sure to test it out and understand how it works beforehand. Deep underground, in the cold and dark, is not a good place to figure out how (or if) life-critical equipment actually functions.**
Personal Protective Equipment/ Fieldwork	**Hypothermia**	**Caves can be cold and can be quite wet and drafty, making hypothermia a serious hazard for caving trips. Bring several layers of warm synthetic, non-cotton clothing, and be able to add or shed layers as needed. Keep as dry as possible. To stay warm on long trips, be sure to keep moving, and avoid sitting or resting for extended periods. Keeping properly hydrated is essential to keeping warm on long, cold caving trips. If any person on the trip becomes hypothermic, that person should immediately be escorted safely out of the cave, and fed and warmed as per First Aid Training procedures. Other types of injuries often lead to hypothermia, because of the inability to keep moving to keep warm in the cold humid cave.**

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Traversing Underground/ Cave Trip	**Slips, Trips, Falls**	**Most caves contain steep, slippery, or unstable surfaces where falling becomes a hazard. Stay away from steep, slippery, or unstable slopes and pits unless necessary. If it becomes necessary to traverse such areas, then webbing, ropes, belays, cable ladders, and/or appropriate technical climbing gear and expertise should be used, to prevent possible injury. Falls are the leading cause of caving accidents.** **Be aware that breakdown debris inside caves is often unstable, and prone to shift unexpectedly when disturbed. Cave breakdown is generally less stable than similar-looking surface debris, because there isn't any wind / rain / animals / etc within the cave to disturb delicately balanced rocks. Multi-ton boulders can sometimes be dislodged by a casual touch.** **Safely negotiating icy surfaces requires crampons or similar traction devices. Unless the ice is absolutely flat, sliding is not an acceptable method of crossing ice.**
Traversing Underground/ Cave Trip	**Rock fall**	**Helmets and other PPE should be worn at all time within caves. These will prevent many smaller injuries. Helmets will not prevent injury from large falling rocks, but can minimize the damage sustained.** **Almost all rock-fall experienced on caving trips is caused by human disturbance. Steep areas with loose or unstable debris should be noted and avoided where possible. Care should be taken in or near such areas, especially while on rope, to avoid dislodging loose debris onto yourself or others below you. Use proper etiquette while on rope or in the fall zone of a rappel. Don't be downhill from others when they are traversing a potential rock-fall area, warn others before traversing such areas yourself, and be sure they are clear of danger before proceeding.** **If you see or hear falling debris, immediately yell "Rock" to warn others of the danger, regardless of the nature of the material that is falling. You should still yell "Rock", even if something else is falling. Yelling other words can generate curiosity and confusion, causing people to look up and see what is happening, rather than staying where they are, or running or ducking as they should.**
Traversing Underground/ Cave Trip	**Orienteering underground/ losing the route to the surface** **Darkness**	**Always have 3 or more independant lights and back up components/ batteries per person, and stay together in groups of two or more.** **Never blindly follow a trip leader quickly through a complex cave. Anybody can get lost when traveling quickly through unfamiliar territory. Pay attention, turning around from time to time, and noting junctions and landmarks. For complex or extensive caves, you should bring a map of the cave. Periodically stop to examine your progress on the cave map, note where you think you are, and then compare the cave around you to what you see on the cave map.** **Go slowly and pay attention, and you shouldn't get lost. Lose all of your lights deep in the cave, and you will be lost until rescue arrives.**

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Traversing Underground/ Cave Trip	**Ropework**	**Using ropes and climbing gear inside caves is highly technical, and requires that proper training and appropriate equipment be obtained from reliable sources. Vertical rope training from climbing gyms, military, or youth-group sources is not acceptable. Rope and climbing equipment from hardware or surplus stores is unacceptable. Vertical cavers must know how to climb, change over from ascending to descending equipment and vice-versa, thumb down on ascending equipment, and pass knots and rebelays safely with SRT gear before using ropes and SRT gear underground.** **If you don't have appropriate cave SRT caving training and tested, approved standardized caving equipment, then you need to obtain it, or shouldn't be utilzing ropes in caves. All vertical cave trips should include at least three people.** **Inspect and test all climbing equipment before entering the cave. Equipment failures are fairly rare, when using appropriate and regularly inspected gear, but can quickly lead to serious problems. Inspect and test all rigging before use.** **Each person on the trip should have their own set of climbing equipment (no sharing the same gear). Passing gear can be difficult or impossible on long or angled pits, and if one set of vertical gear fails (or is damaged or lost), then the other sets of gear provide emergency backup.** **When on rope, loose or unstable debris should be noted and avoided where possible. If such debris cannot be avoided, it must be stabilized, or the rope drop should be redesigned. When on rope, a moving and stretching rope can and will dislodge debris above you. Ropes are easily damaged by rock-fall, and you cannot duck to avoid falling rocks, while firmly attached to a rope and hanging from it.** **While people are on rope, if you are above them, minimize movement or if possible be out of the drop zone / well away from the top of the pit, to avoid dislodging loose debris onto the climbers. If you are below someone climbing rope, if at all possible, you should locate yourself well away from the rock-fall zone, to avoid being hit by falling debris.** **Ropes should not be rigged across sharp edges, around sharp corners, or where they can rub on rough surfaces or dislodge loose debris – utilze redirectionals and rebelays and have the appropriate skills to navigate these rigging points. Modern caving ropes are very tough, but they can be damaged easily when weighted and then rubbed over sharp rocks. Always utilize proper rope protection equipement such as rope pads when necessary.** **Inform others in your group and wait for a response before attaching to a rope (On-Rope), when detaching from a rope (Off-Rope), and when away from the rope and clear from potential rock-fall zones (Clear). You should not approach or attach to a rope when others are still climbing it, or before they are clear and have said so. If in question, ask. Rocks can be dislodged getting on or off a rope, because of rope movement and stretch, as well as people traversing steep slopes near the rope.**

7. TASKS/PROCEDURES	8. HAZARDS	9. ABATEMENT ACTIONS Engineering Controls * Substitution * Administrative Controls * PPE
Traversing Underground/ Cave Trip	Dust/ Diseases	When possible, stay away from cave areas with massive quantities of animal droppings, and do not stir up dust. There are several rodent-related, bat-related, and fungal diseases that can be obtained from breathing dusty cave sediments. Use gloves and dust masks when crawling through such areas, do not put dirty hands near your mouth, keep foods well contained in your cave pack, and wash your hands before eating. If you must work in dusty areas, or enter or pass through areas that are particularly dusty, you should wear respirators to protect you. Histoplasmosis and hantavirus are some cave-related diseases you don't want to experience first-hand.
Traversing Underground/ Cave Trip	Bad air/ Atmospheric conditions	Carbon dioxide is a colorless, odorless gas, occasionally found in caves, which may reduce oxygen levels at the bottoms of pits or near sumps where it is produced by the biological decomposition of organic material, such as wood or leaves, which are washed into caves by floods. Carbon dioxide, in lethal concentration, is extremely rare and may never be encountered by a caver. Being heavier than air, carbon dioxide can concentrate in invisible pools near the floor or in depressions where it displaces air and reduces the availability of oxygen. Be aware of situations where organic material has collected in areas of poor air circulation.
Post-trip procedures	Lack of communication between trip leader and surface watch	The trip leader should verify that everybody gets home safely (or at least out of the cave, off the mountain, and down to a functioning vehicle) The trip leader should check in with the surface contact/ surface watch and confirm the safe return of all trip participants.
		Line Officer or Responsible Official shall approve and document the assignment of employees who work alone. If it is determined that there is significant potential hazard to a lone worker, additional personnel shall be assigned.
10. LINE OFFICER SIGNATURE	11. TITLE	12. DATE
Previous edition is obsolete		

JHA Instructions (References-FSH 6709.11 and .12)

The JHA shall identify the location of the work project or activity, the name of employee(s) involved in the process, the date(s) of acknowledgment, and the name of the appropriate line officer approving the JHA. The line officer acknowledges that employees have read and understand the contents, have received the required training, and are qualified to perform the work project or activity.

Blocks 1, 2, 3, 4, 5, and 6: Self-explanatory.

Block 7: Identify all tasks and procedures associated with the work project or activity that have potential to cause injury or illness to personnel and damage to property or material. Include emergency evacuation procedures (EEP).

Block 8: Identify all known or suspect hazards associated with each respective task/procedure listed in block 7. For example:

- **a. Research past accidents/incidents.**
- **b. Research the Health and Safety Code, FSH 6709.11 or other appropriate literature.**
- **c. Discuss the work project/activity with participants.**
- **d. Observe the work project/activity.**
- **e. A combination of the above.**

Block 9: Identify appropriate actions to reduce or eliminate the hazards identified in block 8. Abatement measures listed below are in the order of the preferred abatement method:

a. Engineering Controls (the most desirable method of abatement).
For example, ergonomically designed tools, equipment, and furniture.
b. Substitution. For example, switching to high flash point, non-toxic solvents.
Work Leader
c. Administrative Controls. For example, limiting exposure by reducing the work schedule; establishing appropriate procedures and practices.
d. PPE (least desirable method of abatement). For example, using hearing protection when working with or close to portable machines (chain saws, rock drills, and portable water pumps).
e. A combination of the above.

Block 10: The JHA must be reviewed and approved by a line officer.
Attach a copy of the JHA as justification for purchase orders when procuring PPE.

Blocks 11 and 12: Self-explanatory.

Emergency Evacuation Instructions (Reference FSH 6709.11)

Work supervisors and crew members are responsible for developing and discussing field emergency evacuation procedures and alternatives in the event a person(s) becomes seriously ill or injured at the worksite.

Be prepared to provide the following information:

- **a. Nature of the accident or injury (avoid using victim's name).**
- **b. Type of assistance needed, if any (ground, air, or waterevacuation).**
- **c. Location of accident or injury, best access route into the worksite (road name/number),__identifiable ground/air landmarks.**
- **d. Radio frequencies.**
- **e. Contact person.**
- **f. Local hazards to ground vehicles or aviation.**
- **g. Weather conditions (wind speed & direction, visibility, temperature).**
- **h. Topography.**
- **i. Number of individuals to be transported.**
- **j. Estimated weight of individuals for air/water evacuation.**

The items listed above serve only as guidelines for the development of emergency evacuation procedures.

<u>JHA and Emergency Evacuation Procedures Acknowledgment</u>
We, the undersigned work leader and crew members, acknowledge participation in the development of this JHA (as applicable) and accompanying emergency evacuation procedures. We have thoroughly discussed and understand the provisions of each of these documents:

SIGNATURE	DATE	SIGNATURE	DATE
_____		_____	
_____		_____	
_____		_____	
_____		_____	
_____		_____	
_____		_____	

25.6 Exhibit 02

Cave Search and Rescue Pre-Plans

General - Cave SAR Pre-Plans describe the Forest Service Field Office's response to any cave incident. They do not contain specific cave information, but should have a simple referencing system so the general Pre-Plan steers the responders to documents or people with specific information. Specifically, make sure certain people are able to access cave maps, coordinates, GIS data, and so forth, and that this is spelled out in the pre-plan. The components to consider in a general Pre-Plan include:

• **Search initial response plan:** Informs the District Ranger or Cave Specialist who initially takes charge (Incident Commander) how to respond and who to initially involve. This should only be about a page long. It should be the first part of the Pre-Plan since it describes the strategy the Forest Service will employ.

• **Rescue initial response plan:** Similar to the above, but specific to rescues.

• **Dispatcher's cave SAR "cheat sheet:"** Questions to ask the reporting party.

• **Cave rescue personnel lists:** Home phone numbers.

1) Internal
2) Local
3) State and Regional (Have a copy of the National Speleological (NSS) Member's Manual available.)

• **Cave rescue logistics**

1) Internal
2) Local (including County and State Emergency Management Coordinator)
3) Regional (identify the Regional Cave Rescue Coordinator by calling the NSS)

• **Medical pre-plan**

List of local medics who have cave training/expertise.

• **Forms**

1) Overdue caver questionnaire
2) Lost caver questionnaire
3) Injured caver questionnaire
4) Search Team debriefing sheet (maze caves need this more than others)
5) Master copies of cave-specific forms

25.6 Exhibit 02--Continued

• **References** (these could be kept in your Emergency Operations Center)

1) Manual of U.S. Cave Rescue Techniques, by Steve Hudson
2) Latest copy of the NSS Members' Manual
3) Next latest copy of the NSS Members' Manual (format alternates annually)
4) Any search text (for example. NASAR Field Commander's Notebook for SAR)
5) ICS Plans Book (contains master ICS forms to be photocopied)
6) Appropriate phone books for local area and agencies

Distribution of the written Pre-Plan: The Pre-Plan should be kept in the Dispatcher's notebook. It should also be posted on the wall in your Emergency Operations Center. The Emergency Operations Center is often either a room in the Sheriff's Office with a phone and a radio or the Forest Service District Office.

Generic Cave Search Pre-Plan: Search is an emergency. Search management involves a sequence of steps that are started in order, with each step progressing until the situation is resolved.

The search management sequence is:

1. Pre-plan - Be prepared. Know the hazards and resources.

2. Interview - Information must be gathered from first notice. The more information, the more focused the effort can be. The investigation scales up as the search progresses and more search areas are ruled out.

3. Call Out - Trained help should be enlisted. At this stage, it is time to evaluate the urgency of the situation. This will determine the size and type of response. It is critical that in-cave tasks are dealt with by experienced cavers who can make the judgment calls needed underground.

4. Establish the Search Area - In a cave incident, consider the entire cave at the early stages, but then establish segments within the cave and assign them priority or rank. Do not ignore the fact that the subjects may no longer be in the cave or that they may be in a portion of the cave not on the map.

5. Confinement and Attraction - Once you have established the search area, it is vital that you know if the subject leaves the search area. In a cave situation, it is also vital that you know if the subject moves from one segment to another. Guard the entrance(s) and maintain an accurate log of who entered and who left. Place lights with notes and other attraction devices at key cave intersections so wandering searchers will stay there.

25.6 Exhibit 02--Continued

6. Hasty Search - To begin an active search, the best action is to quickly check out the most likely places first. Speed is the primary objective here. Check the obvious, look for clues, report conditions.

7. Wide Search - The objective here is efficiency, not pure speed nor absolute thoroughness. Search the passages in order of priority segments. This allows for search of the maximum amount of cave with the cavers on the scene in the fastest time possible. The process can be repeated for increased coverage if needed.

8. Grid Search - As a last resort before suspending the mission, a grid search can be conducted. Grid searching is slow and highly labor intensive, and it is important that teams mark the territory covered in some way. You may have to mount a clean-up trip later to remove all of the notes and flagging. In a complex cave system this process could take a huge number of people and an extended period of time.

9. Rescue/Suspension - Whatever the method used, the goal is to find the person or determine that they are not within the search area. If found, the exercise becomes a rescue or recovery operation. The options if they are not located are to expand the search area (for example, to some other cave or some part of the cave we do not know) or to simply scale down the operation. The object is not to quit, but to scale back. The decision to scale back is a tough management decision and should be carefully documented.

10. Critique – Identify the problem areas and the efficiencies; what worked and what did not work. How can the cave search be improved the next time?

25.6 - Exhibit 03

Dispatch SAR Information Sheets
These sheets are guidelines that can be adapted for individual situations. These sheets are not forms. The sheets are filled with example information to guide use.

Overdue parties: (Cavers haven't returned home as expected.)

Date: 01/01/2015 Time of call: 1500

1. Who is calling? Joe Smith their phone number: 555-555-5555

2. Are they the contact person that the cavers were supposed to notify when they were out of the cave? Yes

3. What time was the group supposed to return? 1400

4. Where, other than the cave, could the group be? No other locations

5. Has this happened before? No

6. Please describe the vehicle they are in:
Tan Subaru Outback 2009, Colorado License Plate

7. What cave were they going to? What are the GPS coordinates?
(As a reminder: all cave location information must be kept confidential as per the Federal Cave Resources Protection Act) Big Cave, 35.9637° N, 92.1793° W

8. What type of equipment did they take besides lights and helmets? (ropes, wet suits, scuba gear?)
Basic caving gear, basic personal protective gear, 3 sources of flight, food for an 8 hour trip

9. Have you contacted anyone else to go see if their car is still at the cave?

Yes

10. Does anyone in the group have any known medical concerns?
No

25.6 - Exhibit 03 - Continued

Lost caver: (One or more cavers are missing inside a cave.)

Time of call: 1600 Reporting party: Joe Smith

Phone number: 555-555-5555

1. Who is missing? Name: Jane Smith Age: 25

Address: 1234 City Street, Town, State, Zip Code

Physical condition: Physically fit,

Medical concerns? (Asthma, Diabetic, Allergies, Medications) None/Uncertain

Experienced in caving? Yes

Been in this cave before? No

2. Where was the Point Last Seen? Large Room after survey station A15

What time were they last seen? 1200

What time did they enter the cave? 0800

When were they supposed to come out of the cave? 1400

3. Do you have any guesses where they are or what happened to them? I believe they are lost in the cave and cannot find the entrance

What equipment were they carrying? Basic caving equipment, personal protective equipment, 3 sources of light, food for a 10 hour trip

How long do you think their lights will last? Three days

4. Where are the other group members now? At the cave entrance

Can they do a hasty search of the most probable areas? No, they are too tired

Do any of them know basic first aid? Yes

Is someone watching the cave entrance to see if they come out? Yes

Have you contacted anyone else to help with the search? No

25.6 - Exhibit 03 - Continued

Injured caver: (A caver reports that another caver is injured and still in a cave.)

Date: 01/012015 Time of call: 1600

Reporting party: John Smith Phone number: 555-555-5555

1. Who is injured?

Name: John Doe Age: 35 Ht: 6'0" Wt: 180 Sex: M
Home address: 1234 City Street, Town, State, Zip Code
Physical Condition: Good – physically fit
Medical concerns: (Asthma, diabetes, allergies, medications)
Diabetes

2. What's wrong with the patient? Patient may have broken ankle

How did the accident happen?
The patient fell while climbing during the caving trip

What time did it happen? 1200

Did anyone do anything to keep them warm? Yes
What? The patient is sitting on their pack and is covered by an emergency blanket

Who is with them? Jane Doe

Will they be able to help drag themselves out? Yes

Can other members of your party help? Yes
How many? Two, Jane Doe and myself

We especially need a guide to take our Initial Response Team into the site. Who should do that?
I can do that, John Smith

Can you call some other cavers to come help? Yes
Please call us to let us know who's coming to help.

25.6 - Exhibit 03 - Continued

3. Where is the injured caver?

Cave name: Big Cave

Where are they inside the cave? In the first large room

How hard is it to get to that part of the cave?
Moderate, some climbing and crawling required

Are they in a safe spot? Yes

25.6 - Exhibit 04

Cave Search Team Debriefing Report
These sheets are guidelines that can be adapted for individual situations and are not forms.

Cave Search Team Debriefing Report

Filled out by the Search Team Leader and turned in to the Operations Director

Team Leader: ___John Doe_____

Team Members: __Jane Doe, John Smith_____

Headed into cave: date/time ____1800_____ Returned:___2100_____

Area of search assigned by Operations Director (general description)
____Big Room, Mud Crawl_____

Type of search: Hasty _____X_____ Detailed _____ POD____100____ (%)

Probability of Detection (POD): If the person was actually in the part of the cave that you searched, what is the chance you would have found them using your search techniques? 100% means that there is no way that they could still be in there. 5% means you could search that area forever and still not be sure that they were not there.

Area actually searched (detailed description, please put a map on the back):

_____(map atta hed to back of sheet)_____

Have all passages in this area been thoroughly checked?
_____Yes_____

Is additional searching required for this area?
_____No_____

Describe what you recommend we do next?
_____Continuing searching in other rooms and areas_____

25.6 - Exhibit 04 - Continued

Any comments, hunches or opinions?
_____We think based on the timing that the lost caver might be in the first ¼ of the cave

Critique- How do we do it better next time?
___N/A_____

Tips for Searchers

1. Look for clues more than the person.

2. Stop and listen for banging rocks once in a while. Banging rocks against the cave floor travels much farther than other cave noises. Call out the person's name and listen carefully for a response.

3. Tape off searched areas with labeled flagging (for example, Team B, 95 percent POD, 9/28/04 l0 pm).

4. Work in pairs, but keep the team together.

5. Be sure to return to the surface with enough time and energy to brief the next shift of rescuers.