HEALTH AND SAFETY PLAN

FOR SITE INVESTIGATION OPERATIONS

AT THE

MOLYCORP, INC. SITE

AT

WASHINGTON, PA

PREPARED BY

ENSERCH ENVIRONMENTAL

MAY 1994

REVISION:0

ENSERCH ENVIRONMENTAL COMPANY DOES NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THIS SITE. DUE TO THE HAZARDOUS NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE, AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS WHICH MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH BY TRAINED HEALTH AND SAFETY SPECIALISTS.

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1.0 APPROVALS

By their signature the undersigned certify that this Health and Safety Plan (HASP) will be utilized at the Molycorp Inc., Site at Washington, Pennsylvania.

Jayanti Chatterjee Health and Safety Officer	Jayanti Chatterjee Signature	05/03/94 Date
Les Skoski, PhD Project Manager	Les Skoski Signature	05/03/94 Date
Dan Mantooth, CHP Corporate Health Physicist	_____ Signature	_____ Date
Joe Sbarra, CIH Health and Safety Manager	Joseph L. Sbarra CIH Signature	05/03/94 Date

2.0 GENERAL

This Health and Safety Plan (HASP) has been prepared in conformance with the Enserch Environmental Health and Safety Program. It addresses all those activities associated with the offsite drilling and sampling activities at three offsite locations. Compliance with this HASP and the Radiological Health and Safety Plan found in Attachment 1[1] is required of all workers and third parties who enter this site[2].

2.1 SCOPE OF WORK

The purpose of this visit is to quantify the physical and chemical characteristics of radiological contamination and the extent of contamination distribution, including rates of migration of thorium and its daughter products in order to design an adequate decommissioning plan. To accomplish this the following operations will be conducted at the site:

- Soil boring and sampling operations at three offsite locations for installation of monitoring wells in the upper aquifer.
- Soil boring and sampling operations at onsite locations
- Piezometer installation
- Monitoring well installation
- Monitoring well development
- Surface water sampling
- Groundwater sampling
- Sewer water flow measurements

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[1] This plan is an intermediate step which addresses the specific requirements of site reconnaissance as well as generally addressing work activities. The content of this HASP may change or undergo revision based upon results of furthur investigation operations or upon additional information made available when the specific work programs have been developed.

[2] Responsibility for adherence to the contents of this HASP shall be limited to Enserch Environmental personnel, their contractors and subcontractors and Molycorp Inc.'s contractors and subcontractors.

3.0 ENSERCH ENVIRONMENTAL HEALTH AND SAFETY STAFF

The following briefly describes the health and safety designations and general responsibilities which will be employed during field activities at the Molycorp Inc. project Site.

3.1 HEALTH AND SAFETY OFFICER (HSO)[3]

The Enserch Environmental HSO has the responsibility to implement this site-specific Health and Safety Plan (HASP) in accordance with the Enserch Environmental Corporate Health and Safety Program. The Enserch Environmental HSO will execute appropriate monitoring techniques to ensure adequate protection for site personnel and conduct on-site inspections for safety and health hazards. He/She will investigate all accidents and incidents occurring on this site and will conduct safety briefings and site-specific training for all on-site personnel. The Enserch Environmental HSO together with appropriate Molycorp Inc. personnel will accompany all EPA, OSHA, PADER and other government agency representatives visiting the site in response to health and safety issues. The Enserch Environmental HSO is responsible for modifying and/or developing new procedures, after consultation with the Enserch Environmental Health & Safety Manager, when site or environmental conditions change or new operations are conducted.

The Enserch Environmental HSO has stop-work authorization if an imminent hazard or potentially dangerous situation exists during the course of on-going site activities. Authorization to again proceed with work will be verified by the Enserch Environmental Health & Safety Manager. The Enserch Environmental HSO will be responsible for implementing evacuation procedures, including the shutting down of appropriate equipment, removing equipment from downrange areas and coordinating emergency services on site.

3.2 HEALTH & SAFETY MANAGER (HSM)

The Enserch Environmental HSM has primary responsibility for ensuring that the policies and procedures of this HASP are implemented by the Enserch Environmental HSO. The Enserch Environmental HSM ensures that all personnel designated to work at the Molycorp Inc. project site are qualified according to Enserch Environmental Medical Surveillance and Health and Safety training requirements. The Enserch Environmental HSM is responsible for authorizing the appropriate monitoring, safety equipment and other resources necessary to implement this HASP.

The Enserch Environmental HSM or his designee will be contacted immediately after a stop-work order is issued by the Enserch Environmental HSO. The HASP and significant changes to the HASP must be approved by the Enserch Environmental HSM. The Enserch Environmental HSM has the authority to resolve outstanding H&S issues that arise during site operations.

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[3] The responsibilities of the HP may be delegated in their entirety to the HSO with the approval of the HSM and the CHP.

3.3 CORPORATE HEALTH PHYSICIST

The Enserch Environmental Corporate Health Physicist (CHP) has primary responsibility for ensuring that the radiological policies and procedures of this HASP are implemented by the site Health Physicist. The CHP is also responsible for evaluation of the degree of radiological hazard at the site and design of effective control measures so that radiation exposure to personnel will be As Low As Reasonably Achievable (ALARA).The Enserch Environmental CHP ensures that all personnel designated to work at the Molycorp Inc. project site are qualified according to Enserch Environmental radiological policies and procedures. The Enserch Environmental CHP is responsible for authorizing the appropriate radiological monitoring, providing direction and guidance to the site Health Physicist to implement this HASP.

The Enserch Environmental CHP or his designee will be contacted immediately by the site Health Physicist and/or the HSO when radiological action levels are exceeded. The HASP and significant changes to this HASP must also be approved by the Enserch Environmental CHP. The Enserch Environmental HSM will consult with the CHP to resolve outstanding H&S issues relating to radiological contamination and control that arise during site operations.

3.4 HEALTH PHYSICIST (HP)

The Health Physicist will assist the Health and Safety Officer in ensuring that the radiological control measures are effective and that the degree of exposure will remain within acceptable limits at all times.

3.5 SITE PERSONNEL

It is the responsibility of all site personnel to report unsafe or potentially hazardous conditions to the HSO. They should maintain knowledge of the information, instructions, and emergency response actions contained in this HASP. Additionally, they shall comply with rules, regulations and procedures set forth in this Health and Safety Plan and revisions which are instituted and prevent admittance of unauthorized personnel to the work site.

4.0 SITE BACKGROUND INFORMATION

The site consists of approximately 17 acres in Washington, Pennsylvania. Between 1964 and 1970, Molycorp, formerly the Molybdenum Corporation of America, primarily manufactured molybdenum but also produced a ferrocolumbium alloy from a Brazilian ore which contained natural thorium at concentrations of 1% to 1.5% by weight. The operation resulted in the production of thorium-bearing slag which were used as fill over portions of the site. The site includes a number of buildings, eight holding ponds and a large slag pile located in the southern part of the property. Molycorp is presently planning to decommission the site and terminate its license since they no longer process source material at this facility.

The site is bounded by Caldwell Avenue to the North, Green Street to the South and by the Chartier's Creek to the West. There is a fence around the site. Some contamination extends beyond the fenceline mainly on the banks of the Chartier's Creek. Low concentrations of thorium are present in soils and slags in the western portion of the site. There is no evidence of furthur spreading of contamination.

Molycorp retained Applied Health Physics in 1964 in order to assist Molycorp in obtaining an NRC Source Materials License to receive and process ore concentrations containing up to 2% natural thorium. The naturally occurring thorium in the ore concentrated in the slag resulting from the aluminothermic production of the ferrocolumbium alloys.

Recognizing the need to dispose of the low level radioactive slags in accordance with applicable regulations, Molycorp with assistance from Applied Health Physics, Inc. requested NRC and the Pennsylvania Department of Health to approve an onsite slag burial permit which would have enabled them to bury the radioactive slags in the same manner as other slags were buried on the Molycorp property. However no decision was ever made by the NRC. These slags were retained on plant site and were inadvertently buried on site. The NRC in June 1971 during a compliance inspection directed Molycorp to excavate these NRC licensed materials and to dispose of them in accordance with Title 10 CFR 20.

Additionally, attempts to dispose of these low level radioactive slags at suitable offsite locations were also investigated. As Molycorp was unable to obtain permission from the NRC to either bury these slags onsite or ship them to offsite locations, Molycorp as a last resort excavated and consolidated the radioactive slag into a pile containing 27,700 cubic yards of slag. This pile was located at the southern end of the plant site. A smaller pile of radioactive slag is located at the northern portion of the site near a telephone pole.

In July and August of 1990 Molycorp retained Radiation Surveillance Associates (RSA), Inc. to measure surface and subsurface radiation levels of the western portion of the site. The results of the subsurface survey indicated that there is considerable activity present within the study area examined by RSA. According to RSA's measure and calculations if the levels of activity found at subsurface parts of the site were on the surface, then the radiation exposure would be substantially elevated. They also state that external gamma radiation levels above a source

containing concentrations exceeding 0.1% thorium by weight would be about 31 uR/hr, or approximately double the natural background in the vicinity of the site.

The surface survey conducted by RSA in the same area, revealed only limited regions where levels of activity are elevated above twice the natural background. Specifically, there are only two regions, the first along the north fence in the vicinity of borehole #16 and the second is east of the Lanthanide Building, around water well #1, where surface exposure rates greatly exceed twice background.[4]

Extent of Radioactive Contamination

There is thorium spread in low concentrations in the soil throughout most of the site, often exceeding 10 picoCuries per gram (pCi/g) and in some locations as high as 2650 pCi/g. Average thorium concentrations over most of the site is between 100 and 200 pCi/g. It is estimated that there is approximately 36,000 kg of thorium onsite in the form of contaminated soils and slags. There is presently no indication of any chemical waste on site.

The concentration of thorium (Th-232) in the above ground slag pile in the southern part of the site has been measured to be up to 1250 pCi/g. The slag is present in a stabilized configuration in a 249,000 ft^3 pile covered with vegetation.

Contamination has also been detected in one of the buildings (Building 34) in the form of alpha, beta and gamma radiation.

Well, creek and storm drain lines have gross alpha levels less than 5 pCi/g and gross beta levels less than 20 pCi/l.

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[4] 1990 Report by RSA, Inc., Entitled "A Sub-surface Survey for Thorium Content at the Molycorp Plant Site in Washington, Pa"

5.0 HAZARD ASSESSMENT

The primary contaminant of concern at the Molycorp site is thorium. Thorium and its decay products emit alpha, beta and gamma rays. Gamma rays can be a hazard to an individual when the radioactive material is external to the body. However, the thorium series radionuclides emit gamma rays at such low intensity that contamination at the Molycorp site would appear to pose minimal risk to field personnel. Alpha and beta particles are easily blocked by protective clothing or skin and do not prose a threat to an individual when the radionuclide is external to the body.

If a radionuclide is taken into the body, it is incorporated into body tissue. Alpha and beta particles and to a lesser extent, gamma-rays then deposit their energy into the body tissue. The radionuclide continues to deposit energy into body tissue until it decays to a stable element or is eliminated from the body. Thorium, once taken into the body, is primarily deposited onto bone surfaces and is not readily eliminated. Because the body tissues are exposed to the radiation from thorium series radionuclides over an extended period of time, there is an internal potential for damage to body cells.

Additionally, the degree of toxicity is dependent upon the chemical form in which these nuclide are ingested or inhaled. The radiotoxic source of concern during site operations is primarily inhalation of dust particulates from contaminated soil. Secondary exposure is via ingestion, potentially occurring due to poor housekeeping, neglectful decontamination practices and/or lack of good contamination avoidance practice by field personnel. Additionally, dermatitis can also result from direct contact with thorium at elevated concentrations.

5.1 TASK HAZARD ANALYSIS

The following scope of work is covered under this HASP:

- Soil boring and sampling operations at three offsite locations for installation of monitoring wells in the upper aquifer.
- Soil boring and sampling operations at onsite locations
- Piezometer installation
- Monitoring well installation
- Monitoring well development
- Surface water sampling
- Groundwater sampling
- Sewer water flow measurements

The primary radiological hazard associated with onsite activities is the inhalation of dust containing radioactive thorium. Ingestion and absorption although much less likely, are other possible routes of exposure. Specific activities that carry the potential for radiological exposure are:

- Soil boring and sampling operations in radiologically affected areas, and
- Installation of monitoring wells in radiologically affected areas.

The overall radiological hazard is expected to be low for all activities.

The average external exposure rate above background in the north area of the plant is about 10 uR/hr. For occupancy of 200 hours/year the expected exposure would be about 0.2 R, well below the occupational external dose monitoring requirements in 10 CFR 20 of 0.5 rem/yr. It is not credible that a worker would be exposed to more than 10 times that exposure rate, even in the south lot, so that an exposure of 0.2 R is not possible. Individual external exposure monitoring devices are accordingly not required according to 10 CFR 20 paragraph 20.1502. However, film badges will be worn on a proportion of workers onsite and records of external gamma exposure rates will be kept available in the radiation safety office by Molycorp Inc.

It is unlikely that internal exposures in excess of 10% of the limits will be experienced by personnel drilling, sampling or moving contaminated soil or slag during the characterization study. An internal exposure evaluation program will be carried out to confirm this, including one or more of the following samples: urine, feces, air samples, nose swipes, whole body counting.

As mentioned above, the material of greatest concern is thorium containing slag. It is properly classified as a class Y (low solubility) material and the greatest exposure potential is by inhalation. Absorption of the thorium slag across the GI tract is expected to be negligible. Any wounds or cuts received while handling thorium slag will receive decontamination, medical attention, external radiation monitoring for residual imbedded material, and bioassay samples.

Some of the rationale for believing that thorium-232 does not pose a risk of exposure exceeding 10% of the Annual Limit on Intake (ALI) follows. The ALI for thorium-232 is 3000 pCi for a very fine aerosol (1 micron amad). For a 5 micron amad particle size the ALI would be 2.1 times greater. For an occupational exposure regimen of 50 weeks/year, 5 days/week or 250 days per year equivalent daily intake would be 12 pCi/day. Since the most radioactive material onsite is the slag pile with a mean specific activity of 1250 pCi/g, 12 pCi/day is equivalent to a mass inhaled of 9.6 mg slag/day, or over a year of 2.4 grams inhaled. For a standard worker inhalation rate of $10m^3$/day, the dust loading (total slag with a very fine particle size) would be 1.2 mg/day. Such a dust loading is very high in practice. In addition to control exposure and internal exposure a work permit will be required for work on the piles (area south of Caldwell Avenue containing the slag pile and the impoundment area on the northwest part of the site) and access will be limited to 500 hours/year. At 10% of the ALI this is equivalent to 240 mg airborne slag inhaled. It is unlikely this much dust could be inhaled by any one worker during site characterization.

The following sections describes the potential for exposure to the physical and radiological hazards present onsite and provides control measures for reducing potential exposure.

5.1.1 SOIL BORING, SAMPLING AND MONITORING WELL INSTALLATION OPERATIONS AT THE THREE OFFSITE (BACKGROUND) LOCATIONS

Drilling will be conducted with hollow solid stem augurs. Borings will terminate at the top of the bedrock at an average depth of 20 feet. Following this temporary PVC risers will be placed in each boring to allow for natural gamma logging to be completed. The PVC risers will then be removed and 3 boreholes will be converted to monitoring wells.

The primary hazards associated with this task are physical hazards such as those associated with working around heavy equipment (drill rig), getting caught in the moving parts of the rig (e.g. hands being pulled in by the rope driving the cathead), overhead hazards from ropes and chains snapping due to poor maintenance procedures, backstrains due to lifting of heavy equipment (e.g. augurs, wells etc.), the presence of underground utility lines and potential subsurface explosive atmosphere.

The control measures that address these physical hazards include the following:

- Personnel shall not wear any loose clothing that could potentially get caught in the moving parts of the rig.
- Drillers will perform daily maintenance inspections to ensure that cables, chains, ropes etc. are in good working order. Frayed ropes, chains, cables will be promptly replaced.
- Prior to commencing drilling activities local utility services will be contacted to mark out underground utility lines.
- Drilling operations will be conducted at least ten feet from overhead power lines.
- Personnel will use proper lifting techniques while lifting heavy equipment like augurs. When needed personnel shall seek assistance in lifting heavy objects.
- During subsurface boring operations, periodic monitoring will be conducted with a combustible gas indicator to detect potential explosive atmospheres. Project action levels for explosive conditions shall be strictly adhered to reduce the potential for explosions.

The likelihood of exposure to radiation during drilling operations at the three offsite location is expected to be low. Any exposure to radiological contamination would be primarily through inhalation and dermal contact and secondarily through ingestion. However, due to the nature of the invasive activities (hollow stem augur drilling operations) it is not expected that any significant amount of dust will be generated to be of occupational exposure concern to potential airborne radioactive particulates.

Radiation limits prescribed by title 10 of the U.S. Code of Federal Regulations for members of the public is 100 mrem/yr (total effective dose equivalent) as produced by the licensed facility. Short term exposure is limited to 2 mrem/hr. Enserch Environmental policies and procedures limits non radiation worker exposure to these regulatory limits. These procedures set conservative action levels for real-time monitoring for radiation exposure which is protective of

employee health.

Additionally, the use of personal protective equipment (PPE) such as boot covers, and gloves, will significantly diminish the potential for exposure to any beta or alpha particles through dermal contact and inhalation. Good hygiene practices, housekeeping and strict adherence to decontamination procedures will furthur reduce the potential for any accidental ingestion of radioactive materials.

5.1.2 SOIL BORING, SAMPLING, PIEZOMETER AND MONITORING WELL INSTALLATIONS AT ONSITE LOCATIONS

The physical hazards associated with these tasks are the same as in Section 5.1.1 above. The control measures are also identified in the above section.

The likelihood of exposure to radiological contamination during these tasks is expected to be low. Any potential exposure will primarily occur through inhalation and secondarily through dermal contact. However, routinely drilling operations with hollow stem augurs do not generate any significant amount of dust to be of serious occupational exposure concern. Additionally, personal monitoring for exposure to radiological contamination will be conducted during onsite operations and action levels have been set conservatively to be protective of employee health.

The use of PPE such as tyvek, boot covers and gloves will furthur reduce the potential for exposure to radiological contaminants present on site. Respirators will be worn during tasks that result in visible dust generation where thorium bearing slag is significantly involved. Good hygiene practices, housekeeping and adhere to proper decontamination procedures will also reduce potential exposure to the radiological contamination.

5.1.3 MONITORING WELL DEVELOPMENT

Monitoring wells will be developed to remove fine particles from the formation surrounding the well screen. Well development will be accomplished by a combination of pumping and surging. Either a centrifugal, peristaltic or a submersible pump will be used to pump water out of the well. Surging will be conducted by moving a surge block (a cylinder which is smaller in diameter than the well casing) up and down the well casing forcing water to flow back and forth through the well screen. Well developing water will be discharged on to the ground.

This operation does not generate any dust to be of inhalation concern. Any potential exposure to radiological contaminant present in the development water will be primarily through dermal contact and secondarily through accidental ingestion. The use of tyvek, gloves and boot covers will significantly reduce any potential occupational exposure concern to radiological contamination present in the development water. Good hygiene practices, housekeeping and adherence to decontamination procedures will furthur reduce exposure potential.

5.1.4 SURFACE WATER SAMPLING

Surface water will be sampled by filling a container either attached to a pole or manually held from just beneath the surface of the water. The water in the Chartiers Creek is shallow and the banks of the creek appear to be solid enough to allow personnel to stand without sinking. However, prior to collecting samples personnel shall make sure that the banks are indeed firm and if necessary will use a harness and a lanyard which will be tied off to a firm standing object near the bank.

The likelihood of exposure to radiological contamination is very low during this activity. The use of tyvek, gloves and boot covers along with good hygiene practice and proper decontamination procedures will significantly reduce any potential exposure.

5.1.5 GROUNDWATER SAMPLING

Prior to sampling operations, static water level will be measured using a water level indicator meter. The static water will then be purged using a centrifugal, submersible or peristaltic pump. Samples will be obtained using a teflon or stainless steel bailer suspended on teflon coated stainless steel bailer wire or polypropylene cord. The bailer will be lowered into the well casing and retrieved manually using a reel. The water from the bailer will be filled into appropriate sample containers.

The hazards associated with this task is physical (hand strain) due to continuous hand bailing operations. Personnel conducting this task will take turns in bailing operations and take adequate rest breaks as appropriate.

The likelihood of exposure to radiological contamination in the groundwater is very low. Any potential exposure will primarily occur through dermal contact and secondarily through accidental ingestion. As this operation dust not generate any significant amount of dust to be of occupational inhalation exposure concern. The use of tyvek, gloves and PPE will significantly reduce any exposure potential along with strict adherence to good hygiene practices and proper decontamination procedures.

5.1.6 SEWER WATER FLOW MEASUREMENTS

Flow measurements will be conducted from the surface and no person will be permitted to enter the sewer without following proper confined space entry procedures. It is anticipated that a weir will be attached to the end of a pole and lowered into the sewer to measure flow of water. This method does not pose any occupational exposure potential to contaminated sewer water. Additionally, the use of gloves will greatly reduce any accidental dermal contact with the contaminated (primarily with biological wastes and runoff water) sewer water.

5.2 PHYSICAL HAZARDS

A variety of physical hazards may be present during site activities. The most common hazards are slips, trips, falls, cold and heat stress. Other physical hazards are due to motor vehicle and heavy equipment operation, the use of hand and power tools and handling and storage of solvents and fuels. These hazards are not unique and are generally familiar to hazardous waste workers. Additional specific safety requirements may be covered during safety briefings at the project site.

During site activities, heavy equipment will be used which may require the use of ear protection due to elevated noise levels. Hearing protection will be used at the direction of the HSO.

6.0 TRAINING AND MEDICAL REQUIREMENTS

6.1 SITE SPECIFIC TRAINING

Prior to commencement of field activities, all field personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring and equipment for the site operations. It will include site and facility layout, hazards, and emergency services at the site, and will highlight all provisions contained within this HASP. This training will also allow field worker to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

6.2 ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given periodic on-site health and safety briefings by the HSO, or designee, to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or the site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements an to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

6.3 FIRST AID AND CPR

The HSO shall identify those individuals requiring first aid and CPR training in order to ensure that emergency medical treatment is available during field activities. It is expected that a selected number of field personnel will have first aid training and several members of the field team will have CPR training. The training will be consistent with the requirements of the American Red Cross Association. If any of the field team personnel has not been trained in First Aid and CPR then the HSO shall contact Molycorp personnel and identify qualified personnel at the Molycorp site.

6.4 ADDITIONAL TRAINING

Additional training, such as Radiation Safety Training for field personnel will be provided by Molycorp Inc. prior to start of project operations.

6.5 MEDICAL REQUIREMENTS

All personnel performing work at the Molycorp site shall be cleared for work by an occupational physician. The occupational physician shall evaluate the physical condition of the site employees to ensure that employees are in good health to perform the work that is required of them. Additionally, all site personnel shall be required to obtain medical clearance to wear respiratory protection pursuant to 29 CFR 1910.134.

7.0 SITE CONTROL, PERSONNEL PROTECTION AND COMMUNICATIONS

7.1 SITE CONTROL

A three zone approach will be employed in order to contain the potential spread of contamination from the site. The three zones will include the Exclusion Zone (EZ), the Contamination Reduction Zone (CRZ) and the Support Zone (SZ).

7.1.1 SUPPORT ZONE

The Support Zone (SZ) is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labelled samples.

7.1.2 CONTAMINATION REDUCTION ZONE

The Contamination Reduction Zone (CRZ) is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides for an area for decontamination of personnel and portable equipment. The CRZ will be used for general site entry and egress in addition to access for heavy equipment and emergency support services.

7.1.3 EXCLUSION ZONE

The area where contamination exists is considered to be the exclusion zone. All areas of drilling and sampling which contain potential contaminated materials are considered the exclusion zone (EZ). This zone will be clearly delineated by cones, tapes or other means. Entry and exit point(s) to and from the EZ will be strictly controlled and decontamination facilities will be set at all such points. Personnel exiting the EZ will decontaminate as per designated procedures. Personnel are not allowed in the EZ without the following:

- A buddy
- Appropriate personal protective equipment
- Site Specific Training.

7.2 PERSONAL PROTECTIVE EQUIPMENT

During site operations in order to minimize contact with potential radiological materials and to protect themselves from physical hazards (such as overhead hazards, splash, etc.) will use the following personal protective equipment:

- Plain, uncoated tyvek
- Gloves, inner latex

- Gloves, outer work gloves
- Boot covers (as needed)
- Steel toed safety shoes
- Hard hat
- Safety glasses
- Hearing protection (during drilling operations)

If it becomes necessary to wear respirators then personnel shall use a full face air purifying respirator with High Efficiency Particulate (HEPA) filters.

7.3 SAFETY EQUIPMENT

Basic emergency and first aid equipment will be available at the Support Zone and/or the CRZ. They will include:

- One standard industrial first aid kit
- One fire extinguishers rated at least 1A, 10BC
- One portable emergency eyewash unit
- Air horns (at least one)

7.4 COMMUNICATIONS

The nearest telephone is located in the adjacent buildings of Molycorp Inc. facility and can be used for contacting emergency response personnel in the event of an emergency. Hand signals will be employed by down range field teams where necessary for communications. Hand signals shall be reviewed during site specific training and understood by the entire field team prior to commencement of site activities. The following hand signals will be used when necessary:

Signal	Meaning
• Hand gripping throat	Out of air, can't breathe
• Grip partner's wrist	Leave area immediately No debate
• Hands on top of head	Need assistance
• Thumbs up	OK; I'm all right; I understand
• Thumbs down	No; negative

8.0 RADIOLOGICAL MONITORING

During site operations radiological monitoring shall be conducted fc. potential exposure to radiological materials. Both real time and personal monitoring will be conducted to monitor personnel exposure to potentially radiological contaminated wastes.

8.1 REAL TIME MONITORING

Before start-up of each day's activities the HSO or designee shall verify radiation background levels. Prior to start up of activities at each of the boring locations the HSO or designee shall conduct a radiological survey using alpha and gamma detectors. If the survey indicates that radiation levels are twice the established background levels (gamma) or greater than 500 CPM (alpha) then the HSO shall contact the HSM and the CHP and proceed on their advice. Drill cuttings, soil samples and bore holes shall be monitored periodically with the gamma detector (at least 4 times per shift). If the readings are twice background (gamma) or >500 CPM (alpha) then the HSO shall suspend operations and contact the HSM and the CHP. Work will proceed on their advice.

Frisking of personnel shall also be conducted when personnel are exiting the zone. Action levels for personnel frisking are identified in Table 8-1.

A combustible gas and oxygen indicator shall be used periodically, to monitor potential explosive conditions in the borehole during drilling operations. Action levels for the combustible gas and oxygen meter can be found in Table 8-1.

The following real time instruments shall be available for use during field operations:

- Combustible Gas Indicator (CGI)/Oxygen (O_2) meter, MSA or equivalent
- Alpha (scintillation probe) detector
- Gamma detector (uR meter)

8.2 PERSONAL MONITORING

During drilling and sampling operations, monitoring of personnel exposur will consist of radiation monitoring through the use of Thermoluminiscent dosimeter (TLD) badges. The badges will be analyzed at the end of every quarter or at the end of the project, whichever is first. Analyses of the TLD badges will remain as a permanent records of employee exposure.

The TLD badges will be worn on the front of the body between the neck and waist, with the lettered side facing out. The badges shall be worn only during work hours on the site, and upon exiting the site, following completion of the work shift, each employee shall turn his/her badge to the HSO or designee. The HSO or designee will distribute the badges to the employees at the start of each workshift. This routine shall remain in effect until completion of site operations.

The TLD badges should never be exposed to excessive heat. If it should become damaged or lost, personnel must report it immediately to the HSO to obtain a replacement.

8.3 AIR SAMPLES

Personal monitoring for total dust will be conducted during intrusive operations which have a potential for inhalation exposure to the radiological contamination present on site. Personal samples will be used to evaluate exposure of individual workers for control purposes and not for evaluation of the dose. The content of ^{232}Th on air filters will be evaluated by gross alpha counting, after sufficient time has be allowed after completion of sample collection for the natural aerosols containing Rn and Tn daughters to decay (approximately 72 hours). Air samples for total dust will be collected as per National Institute of Occupational Safety and Health (NIOSH) method 0500.

8.4 NOSE SWIPES

In the event that a significant exposure is suspected to have occurred based upon the observation of significant suspended slag in air, air sample results, or other evidence, nose swipes of both nostrils will be taken and counted by gross alpha counting. Table 8-2 provides action levels for nose swipe samples.

8.5 FECAL SAMPLES

Fecal samples will be taken whenever there is an expected exposure as indicated by nasal swipes, air sampling which indicates exposures exceeding 200 DAC-hours, or other indications of significant inhalation exposure. A number of investigative samples may be taken for persons with exposures exceeding 12 DAC-hours in one day or part of a working day.

TABLE 8-1

ACTION LEVELS

Instrument	Reading	Action
CGI/O_2 Meter	>10% LEL, in borehole	Proceed with caution
CGI/O_2 Meter	>20% LEL, in borehole	Stop work, allow to vent
Gamma detector	Twice Bkgd < 2 mrem/hr	Proceed with increased monitoring. Notify HP
Gamma detector	> 2 mrem/hr	Stop work. Notify HP
Contamination Action Levels: (assume monitoring with alpha scintillation probe:)		
Area monitoring:		
Alpha detector	0 - 100 CPM[5]	No action
Alpha detector	100 - 500 CPM	Notify HP. Proceed with increased monitoring.
Alpha detector	> 500 CPM	Stop work. Notify HP.
Equipment monitoring:		
Alpha detector	> 25 CPM	Decontaminate for release
Personnel monitoring:		
Alpha detector	> 100 CPM (clothing)	Change clothing
Alpha detector	> 25 CPM	Decontaminate

[5] Counts per minute

TABLE 8-2

ACTION LEVELS FOR NOSE SWIPES SAMPLES

SWIPE RESULTS	ACTION
< 80 dpm	No additional monitoring than routine urine required.
> 80 dpm < 240 dpm	Two or more fecal samples are required to evaluate exposure past the nose.
> 240 dpm < 800 dpm	Work restrictions. Continue fecal samples until levels in feces diminish. Initiate urine sampling after one week.

9.0 GENERAL STANDARD OPERATING PROCEDURES FOR FIELD OPERATIONS

- A Health and Safety Officer or designee will be present on-site at all times during drilling, sampling and monitoring well installation activities and shall provide all monitoring and health and safety support in order to ensure the adequacy of protective equipment and safety procedures.

- The proximity of water, sewer and electrical lines will be identified prior to all subsurface activity. The possibility for the presence of underground conduits or vessels containing materials under pressure will also be investigated before attempting any intrusive operation.

- Knowledge of the location of safety equipment and emergency evacuation procedures will be established prior to initiation of operations. Use of designated protective clothing will be required during all activities as described in the scope of work in this HASP.

- All radiological field sampling will be performed under the level of protection described in Section 7.2 and assigned by the HSO. The level of protection will be established by review of facility history, available data and updated, as necessary, by results of ongoing health and safety monitoring performed at each drilling location.

- The buddy system and line-of-sight shall be employed at all times when in an exclusion zone.

- If field personnel perceive an unsafe condition or situation, the HSO will be notified immediately.

- All field operations should be planned and discussed with personnel prior to the beginning of start up of site activities.

- Be cognizant of slip-trip hazards present due to areas of difficult terrain.

- Practice contamination prevention both on- and off-site.

- Safety briefings will be held prior to the onset of field activities and regularly during the progress of site activities.

- All drilling will be conducted in a safe manner including inspections of the drill rig by the subcontractor's safety personnel, testing of the emergency shut down switches; prohibiting the wearing of loose clothing, jewelry etc.; no driller shall work alone; following safe work practices when using the cathead, winches and when handling rods and augers.

- Drilling, boring, the use of drill rigs, movement of vehicles and equipment, and other activities will be planned and performed with consideration for the location, slope and natural features such as trees, boulders, water bodies, and terrain.

- Ignition sources in the vicinity of the potentially flammable material are prohibited.

- When working in areas where flammable vapors may be present particular care must be exercised with tools and equipment that may be sources of ignition. All tools and equipment provided must be properly bonded and/or grounded.

- Approved and appropriate safety equipment as specified in Section 7.2 of this HASP shall be worn where required.

- No smoking, eating, or drinking be allowed in the contaminated areas.

- Contaminated tools and hands must be kept away form the face. Do not unnecessarily touch a contaminated surface or allow your clothing, tools or other equipment to do so.

- Each sample must be treated and handled as though it was contaminated.

- Persons with long hair and/or loose fitting clothing that could become tangles in power equipment must take adequate precaution.

- Report the presence of open wounds to the HSO prior to work in contaminated areas. If a wound occurs which in such an area, report immediately to HSO and attend to the wound. Apply first aid immediately to any and all cuts, scratches and abrasions.

- Horseplay is prohibited in the work area.

- Follow good "housekeeping" practices to minimize the amount of material and equipment that has to be decontaminated or disposed off as contaminated wastes.

- Work under the influence of intoxicants, narcotics, or controlled substances is prohibited.

- Be alert to your own physical condition. Watch your buddy for signs of fatigue and/or exposure.

- Initiate a work/rest regime if ambient temperatures and protective clothing create a potential heat stress situation.

- Do not proceed or continue working unless adequate natural light exists and appropriate supervision is present.

10.0 DECONTAMINATION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-examination. Procedures for contamination avoidance include:

Personnel

- Do not walk through areas of obvious or known contamination
- Do not directly handle or touch contaminated materials
- Make sure that there are no cuts or tears on PPE
- Fasten all closures in suits, covering with tape, if necessary
- Particular care should be taken to protect any skin injuries
- Stay upwind of airborne contaminants
- Do not carry cigarettes, cosmetics, gum, etc., into contaminated areas

Sampling/Monitoring

- If possible, cover instruments with clear plastic, leaving openings for sampling ports
- Bag sample containers prior to placement of sample material

Heavy Equipment

- Care should be taken to limit the amount of contamination that comes in contact with the heavy equipment (augers, tires etc.)
- If contaminated tools are to be placed on non-contaminated equipment for transport to a decontamination area, plastic should be used to keep the equipment clean

10.2 PERSONNEL DECONTAMINATION

The HSO or HP shall be responsible for ensuring personnel are properly decontaminated. All personnel and equipment exiting the exclusion zone shall be thoroughly decontaminated. The procedure for personnel (radiologic) decontamination is outlined below and will be followed should radiation levels significantly higher than background levels be encountered. The HP will advice the HSO of such conditions and assist the HSO in personnel decontamination under such conditions.

In general the radiological decontamination procedures will consist of:

- Radiation frisk out;
- Segregated equipment drop;
- Tape removal;

- Outer glove removal and suit removal;
- Boot and inner glove removal;
- Refrisking* (if necessary)
- Soap and water rinse (or wipe with baby wipes) of skin areas, i.e., face, hands, arms, that have indicated contamination during frisking.

* Frisking will be conducted with the alpha scintillation probe or equivalent. If the instrument measures 25 counts per minute (CPM) above background, personnel shall pass through the CRC again for further decontamination. This procedure will be repeated until frisking of personnel indicates decontamination has been satisfactorily completed (i.e., <25 CPM). Should readings of > 100 CPM or more be obtained then personnel will be required to change clothing. The HSO will contact the CHP and the HSM for advice.

Equipment for personnel decontamination will include plastic wash and plastic rinse tubs, brushes, alconox, water and impervious lining material.

10.3 EQUIPMENT DECONTAMINATION

- Monitoring equipment shall be wiped down.

- All heavy equipment used during drilling, sampling and monitoring well installation activities will be steam cleaned prior to leaving the site. A location for this activity shall be determined by the HSO and the Project Manager or designee.

- The Field Operations Leader will be responsible for all equipment decontamination. Adequate performance of this task shall be verified by the Health and Safety Officer.

10.4 ADDITIONAL PROCEDURES

- Spent decon solutions may be required to be segregated from water rinses, drummed and disposed of as radioactive waste as per applicable regulations

- Decontamination shall be performed in a manner so as to minimize the amount of waste generated and necessary for disposal.

- Sample decontamination will be the responsibility of the sampler indicated on the Chain-of-Custody form. Samples will be dry wiped prior to packaging.

- Sampling equipment will be brushed clean with alconox solution and rinsed with distilled water and decontaminated following procedures in the Field Operations Plan.

10.5 EMERGENCY DECONTAMINATION

If emergency life-saving first air and/or medical treatment is required, normal decontamination procedures may need to be abbreviated or omitted. The site HSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances and/or medical personnel. Outer garments are then removed at the medical facility. No attempt will be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life to emergency response personnel or the person is suffering from heat stroke. For minor medical problems or injuries, the normal decontamination procedures will be followed. Note that heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention and removal of protective clothing immediately. Unless the victim is obviously contaminated, decontamination should be omitted or minimized and first aid begun immediately.

10.6 DISPOSAL PROCEDURES

All discarded materials, waste materials or other objects shall be handled in such a way as to exclude the potential for the spread of contamination, creating a sanitary hazard or causing litter to be left onsite. All potentially contaminated disposable wastes, e.g. nuke boots, gloves, tyvek, will be "frisked" to determine if they are radiologically contaminated. If contaminated, they will be bagged and/or drummed, labeled and segregated in a designated and secured area on-site for disposal. All contaminated waste materials shall be disposed of as required by the provisions included in the contract and consistent with Enserch Environmental guidelines and appropriate regulatory provisions. All non-contaminated materials shall be collected and bagged for proper disposal as normal domestic waste.

All disposable protective clothing: gloves, boot covers, tyveks, will be tightly double bagged and stored appropriately on-site in drums following completion of each day's work. These bags will be labelled appropriately. All drums used for storage of such waste will be clearly labelled as "PPE". All non-disposable contaminated personal protective equipment that will not decontaminate adequately will also be discarded and disposed of as above and immediately replaced with new or uncontaminated equipment. Steel toed field boots or shoes will be decontaminated thoroughly. If this procedure does not adequately remove all contaminated materials, they will also be disposed of as described above. Contaminated washwater and excavated materials will be collected and drummed appropriately. If possible, dedicated or disposable equipment should be used for sampling tasks. Dedicated equipment will be bagged for disposal as described above. All potentially contaminated materials will be collected and drummed upon termination of operations.

11.0 EMERGENCY PLAN

The emergency plan outlined in this section, will be known by all field personnel involved in site activities. The emergency plan will be available for use at all times during site work.

Various individual site characteristics will determine preliminary actions taken to assure that this emergency plan is successfully implemented in the event of a site emergency.

The emergency coordinator, (the Field Operations Leader), shall make contact with the Molycorp Inc. personnel prior to beginning of work on site. In these contacts, the emergency coordinator will inform Molycorp about the nature and duration of work expected on the site and the type of contaminants and possible health or safety effects of emergencies involving these contaminants. The emergency coordinator shall make necessary arrangements (e.g. informing local emergency services regarding the nature of the work, site contaminants, potential health effects, etc.) to be prepared for any emergencies that could occur.

The emergency coordinator shall implement the emergency plan whenever conditions at the site warrant such action. The emergency coordinator will be responsible for coordination of the evacuation, emergency treatment, and emergency transport of site personnel as necessary, and notification of emergency response units and the appropriate management staff.

11.1 EVACUATION

In the event of an emergency situation, such as fire, explosion, or significant release of toxic material, an air horn or other appropriate device will be sounded for approximately 10 seconds indicating the initiation of evacuation procedures. All personnel will evacuate and assemble near the Support Zone. The location shall be upwind of the site where possible. For efficient and safe site evacuation and assessment of the emergency situation, the emergency coordinator will have authority to initiate action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The HSO or designee must see that access for emergency equipment is provided and that all equipment have been shut down and secured once the alarm has sounded. Once the safety of all personnel is established, the emergency response groups, as necessary, will be notified by telephone of the emergency.

11.2 POTENTIAL OR ACTUAL FIRE

Immediate evacuation of site (air horn will sound in 10 seconds intervals), notify local fire and police department, and other appropriate emergency response groups if an actual fire or explosion takes place.

11.3 PERSONNEL INJURY

Emergency first aid shall be applied on site as deemed necessary. Then decontaminate and transport the individual to the nearest medical facility if needed. The HSO will supply medical data sheets to the medical personnel and complete the accident/incident reports in accordance with Enserch Environmental policy.

The ambulance/rescue squad shall be contacted for transportation to the hospital as necessary in an emergency situation. However, since some situations may require transport of an injured person by other means, the hospital route is identified below in Section 12.7. Only in non-emergency situations shall an injured person be transported to the hospital by means other than an ambulance.

11.4 OVERT PERSONNEL EXPOSURE

SKIN CONTACT:	Use copious amounts of soap and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention. An emergency eyewash is located in the Support or the Contamination Reduction Zone. Eyes should be rinsed for a minimum of 15 minutes upon chemical contamination.
INHALATION:	Move to fresh air and/or, if necessary, decontaminate/transport to hospital.
INGESTION:	Decontaminate and transport to emergency medical facility.
PUNCTURE WOUND/ LACERATIONS:	Decontaminate and transport to medical facility.

11.5 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the HSO or designee will determine if work can continue without compromising the health and safety of field personnel. Some of the items to be considered prior to determining if work should continue are the following:

- Potential for heat stress and heat-related illnesses
- Potential for cold stress and cold-related illnesses
- Treacherous weather-related working conditions
- Potential for electric storms.

Site activities will be limited to daylight hours (unless adequate artificial lighting is provided) and acceptable weather conditions. Inclement working conditions include heavy rain, fog, high winds, and lightning. Observe daily weather reports and evacuate if necessary in case of inclement weather conditions.

11.6 ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

1. Joseph Sbarra, H&S Manager: (201) 460-6301
2. Les Skoski, Project Manager: (201) 460-6178
3. The employer of any injured worker, if not an Enserch Environmental employee

Written confirmation of verbal reports are to be submitted within 24 hours by the HSO or designee. The report form entitled "Accident/Incident Report" (provided in Appendix G) is to be used for this purpose. All Enserch Environmental representatives contacted by telephone are to receive a copy of this report. If the employee involved is not an Enserch Environmental employee, his employer shall receive a copy of this report.

For reporting purposes, the term accident refers to fatalities, lost time injuries, spill or exposure to hazardous materials (radioactive, toxic, explosive, flammable or corrosive), fire, explosion, damage to property, or potential occurrence of the above.

Any information released from the health care provider, which is not deemed confidential patient information, is to be attached to the appropriate form. Any medical information which is released by patient consent is to be filed in the individuals medical records and treated as confidential.

11.7 EMERGENCY CONTACT INFORMATION

Enserch Environmental Personnel:

Project Manager	Les Skoski	201-460-6178
Health & Safety Manager	Joe Sbarra	201-460-6301
Corporate Health Physicist	Dan Mantooth	509-943-0550
Health and Safety Officer	Jayanti Chatterjee	201-460-6021
Field Operations Lead	Paul Anderson	201-460-6103

Emergency Services Contact Numbers:

Police	911
Fire	911
Ambulance	412-225-8050
Washington Hospital	412-225-7000
Washington County Emergency Services	412-228-6733/412-2228-9900
Pennsylvania Emergency Response Commission	800-424-7362

Directions to the Hospital: (Obtained from Molycorp's Emergency Response Procedures/Chain of Command, Section N)

- Proceed East on Caldwell Avenue and cross the railroad tracks.
- Turn left on Green Street
- Proceed to Shefield Street (approximately one quarter mile)
- Turn right on Shefield Street
- Drive through 2 stop signs to I-70 junction (approximately one half mile)
- Take I-70 East to Murtland Street exit
- Proceed on Murtland through first traffic light.
- Murtland Street will take a sharp left. Proceed straight and go up the hill.
- Turn right on Locust Street
- Turn left on Wilson Avenue
- Follow signs

12.0 LOGS, REPORTS AND RECORDKEEPING

The following is a summary of required health and safety logs, reports and recordkeeping for the Molycorp Inc. Project.

12.1 FIELD CHANGE REQUEST

To be completed for initiating a change to the HASP. The HSM and Project Manager approval is required. The original will be kept in the project file.

12.2 ON-SITE LOG

A log of personnel on-site each day will be kept by the HSO or designee. A copy of these logs will be sent to the Regional Records Coordinator for data entry. Originals will be kept in the project file.

12.3 EXPOSURE RECORDS

Any personal monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be kept in accordance with 29 CFR 1910.20. For Enserch Environmental employees, copies will be sent to the Records Coordinator. For subcontractor employees, copies will be sent to the subcontractor employer and a copy kept in the project file.

12.4 ACCIDENT/INCIDENT REPORTS

An Enserch Environmental accident/incident report must be completed following procedures given in Section 11.6 of this HASP. The originals will be sent to the appropriate Regional Records Coordinator for maintenance by Enserch Environmental. Copies will be distributed as stated. A copy of the forms will be kept in the project file.

12.5 OSHA FORM 200

An OSHA Form 200 (Log of Occupational Injuries and Illnesses) will be kept at the project site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the HSM for maintenance. Subcontractor employees must also meet the requirements of maintaining an OSHA 200 Form. The Enserch Environmental accident/incident report meets the requirements of the OSHA Form 101 (Supplemental Record), which must be maintained with the OSHA Form 200 for all recordable injuries or illnesses.

12.6 HEALTH AND SAFETY FIELD LOG BOOKS

The HSO or designee will maintain the logbook in accordance with standard Enserch Environmental procedures. Daily site conditions, activities, personnel, calibration records,

monitoring results and significant events will be recorded. The original log books will become part of the exposure records file and will be maintained by in the project files.

12.7 MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheets (MSDS) will be obtained and kept on file at the project site for each hazardous chemical brought to, used, or stored at the site. The MSDS will be kept in the project file.

13.0 AUTHORIZATIONS AND FIELD TEAM REVIEW

13.1 AUTHORIZATIONS

Personnel authorized to enter the site while operations are being conducted must be approved by the HSO. Authorization will involve completion of appropriate training courses and review and sign-off on this HASP.

13.2 FIELD TEAM REVIEW

Each field team member shall sign a field team review form after site-specific training is completed and before being permitted to work on site. A Field Team Review Form is provided in Appendix F.

ATTACHMENT 1

DRAFT RADIOLOGICAL HEALTH AND SAFETY PLAN
RADIATION SURVEILLANCE ASSOCIATES, INC. AND ENVIRONMENTAL
SURVEILLANCE ASSOCIATES INC.

Radiological Health and Safety Plan for Site Characterization

Molycorp Inc.
Washington, Pennsylvania

DRAFT

Prepared By

Radiation Surveillance Associates Inc.
and
Environmental Surveillance Associates Inc.

April 21, 1994

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200: Surface gamma Surveys
Radiological QAP Procedure Book

1.0 Introduction and Program Design

This radiological health and safety plan describes the program to be implemented by Radiation Surveillance Associates Inc. (RSA Inc.) for the radiological characterization of the Molycorp Inc. (Molycorp) division of UNOCAL at the Washington Pennsylvania site. The objective of this plan is to provide site specific procedures for protection of employees during the characterization of the site. All work will be performed in accordance with applicable federal, state, and local regulations and in general conformance to good practices in health physics. The primary federal regulation promulgated by the Nuclear Regulatory Commission, which has regulatory authority over the decommissioning of the site, is:

USNRC 10CFR20: Standards for Protection Against Radiation; Final Rule, May 21, 1991

Although not regulations, the following regulatory guides have been consulted in designing this radiation protection program.

U.S. NRC Regulatory Guide 8.9 "Acceptable Concepts, Models and Equations and Assumptions for a Bioassay Program," July 1993.

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US NRC Regulatory Guide 8.25, "Air Sampling in the Work Place"
US NRC Regulatory Guide 1.86. "Termination of Operating Licenses for Nuclear Reactors"

Other publications used in the design of the radiation protection program include but are not limited to:

International Commission on Radiological Protection Publications 10A, 30, 48, and 54

NUREG/Cr-5849, Manual for Conducting Radiological Surveys in Support of License Termination, ORISE.

RSA Quality Assurance Procedure (QAP 50), Health and Safety.

2.0 Program Organization and Responsibilities

Personnel responsible for the conduct of the radiological safety program and their responsibilities are:

McDonald E. Wrenn, PhD. Certified Health Physicist and RSA Radiation Safety Officer. Overall design, inspection and supervision in the laboratory and at the field site, and consultant to the Molycorp RSO, George Dawes.

Robert Pattison, Project manager, former manager of a uranium mill with administrative supervisory responsibilities for the Radiation Safety programs. On site direction. Responsible for the QA implementation of the RSA radiation safety procedures and compliance by RSA personnel with site specific Molycorp procedures for health and safety.

Luiz Bertelli, PhD. Internal dose calculations and evaluations of bioassay data. Dr. Bertelli designed the Brazilian regulations to control and evaluate internal dose.

Narayani P. Singh, PhD. Chief Radiochemist in charge of all radiochemical analyses used to evaluate internal dose including but not limited to urine, feces, and air samples.

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The above personnel constitute the radiation safety committee of RSA who will meet periodically with the Molycorp RSO (George Dawes) and Molycorp QA manager (Tim Mulloy). All annual or project specific internal dose assignments to Molycorp personnel, RSA personnel, and other on site contractors will be reviewed and approved by this committee and the Molycorp RSO.

3.0 Site Characterization and Radiological Assessment

3.1 Site Background (Radiation)

To be inserted. Section 5.1 of the Plan for site characterization.

3.2 Work Plan

Work will be conducted in accordance with the site characterization plan (August 5, 1993), modified to take into account comments of the NRC staff to this plan.

3.3 Radiation Hazards

3.3.1 Radioactivity on Site

The primary radioactivity on site consists of a glassy insoluble slag containing primarily 232Th in equilibrium with its daughters. Much of this slag is collected in a covered pile (11,200 tons) located in a controlled fenced area on the south portion of the property. The slag has a specific activity of 1250 pCi/g and a total activity of 13 Ci. The U series content (230Th) is about 6% of the Th series parent. The ^{238}U content of the slag is apparently lower (60%) than the ^{230}Th, based upon alpha spectrometric analysis of 2 samples of slag. The ^{226}Ra content has not yet been established. The inventory of ^{232}Th in slag distributed underground elsewhere on the site is to be established during the site characterization. Most of it is buried sufficiently deep so that surface gamma exposure rates are below about 20 uR/hr., excepting a local area along and inside the fence on the northwest area of the site. That area will be marked and cordoned off.

3.3.2. External exposure

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The highest exposure rates above the covered pile are 50 to 300 uR/hr., reflecting probably the variable thickness of the cover over the pile and the effects of geometry for a pile of finite extent. The theoretical maximum exposure rate over a half space of infinite extent with a 232Th content of 1250 pCi/g in equilibrium with daughters is 3.5 mR/hr.

Accordingly there is no "radiation area" on the site as defined in 10CFR20, since no person could be exposed to an external dose equivalent as high as 5 mrem in one hour. See section 5.1.3 for definition of restricted areas.

The average external exposure rate above background in the north area of the plant is about 10 uR/hr. For occupancy 200 hours/year the expected exposure would be about 0.02R, well below the occupational external dose monitoring requirements in 10CFR20 of 0.5 rem/year. It is not credible that a worker would be exposed to more than 10 times that exposure rate, even in the south lot, so that an exposure of 0.2R is not possible. Individual external exposure monitoring devices are accordingly not required according to 10CFR20 para. 20.1502. However film badges will be worn on a proportion of workers onsite and records of external gamma exposure rates onsite will be kept available in the radiation safety office. (SeeAppendix A for a more detailed discussion of external exposures on the site.)

3.3.3 Internal exposure:

It is unlikely that internal exposures in excess of 10% of the limits will be experienced by personnel drilling, sampling, or moving contaminated soil or slag during the characterization study. An internal exposure evaluation program will be carried out to confirm this, including one or more of the following samples: urine, feces, air samples, nose swipes, whole body counting.

The material of greatest concern is Th containing slag, described in paragraph 3.3.1. It is properly classified as a class Y material and the greatest exposure potential is by inhalation. Absorption of Th slag across the GI tract is expected to be negligible. Any wounds or cuts received while handling Th slag will receive decontamination, medical attention, external radiation monitoring for residual imbedded material, and bioassay samples.

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Some of the rationale for believing that ^{232}Th does not pose a risk of exposure exceeding 10% of the Annual Limit on Intake follows. The ALI for ^{232}Th is 3000 pCi for a very fine aerosol (1 micron amad). For a 5 micron amad particle size the ALI would be 2.1 times greater. For an occupational exposure regimen of 50 weeks/year, 5 days/week or 250 days per year the equivalent daily intake would be 12 pCi/day. Since the most radioactive material onsite is the slag pile with a mean specific activity of 1250 pCi/g, 12 pCi/day is equivalent to a mass inhaled of 9.6 mg slag/day. For a standard worker inhaling10 m^3 per 8 hou.: day day the dust loading with slag alone would be 1.2 mg per cubic meter. Such a dust loading is very high in practice. At 10% of the ALI this is equivalent to 240 mg airborne slag inhaled per year. It is unlikely this must dust could be inhaled by any one worker during site characterization.

Some useful conversion factors follow;

Specific activity;

^{232}Th metal 9.1 ug/pCi or 9.1 mg/nCi

^{232}Th in slag 800 ug/pCi or 800 mg/nCi

ALI:

^{232}Th 3000 pCi or 3 nCi 1 micron amad

6400 pCi or 6.4 nCi 5 micron amad

4.0 Medical Surveillance

No routine medical surveillance will be required other than those normally required for workers at the site.

For workers involved with an accident with potential to imbed Th bearing slag internally across broken skin as in a wound, medical attention may be required as indicated in paragraph 3 of section 3.3.3

An external detector capable of detecting a fraction of the ALI for ^{232}Th shall be employed in the event Th bearing slag is embedded in a wound as required by 20.1202(d).

A physicians determination every 12 months that an individual user is physicaly able to use the respiratory protection equipment.

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5.0 Exposure Control and Assessment

5.1 Control of exposure

5.1.1 Routine Practices

External exposure will be controlled by control of time of occupancy. The only area for which such a limitation is established is the vicinity of the slag pile. Occupancy is limited to 500 hours per year. The function of this limitation is to keep exposures ALARA and to maintain practices so that external exposure above 10% of the annual dose limit is not possible.

Internal exposure will be controlled by the avoidance of dusty operations and the avoidance of any work practice which could result in a wound with Th bearing slag. Control of access to working areas, limitation of exposure times, use of engineering controls when feasible, and working under wet conditions to control dust generation will be employed to avoid airborne exposure. A secondary means of avoiding exposure will be the use of respiratory protection, in accordance with established Molycorp procedures and the provisions of 20.1703(a). These require the use of OSHA/NIOSH approved respirators, air sampling and bioassay, written procedures for fitting, maintenance and use of respirators, written procedures on respirator usage, advice to respirator users on right to departure from respirator use area upon respirator failure or personal distress, and proper use of equipment.

5.1.2 Safe Work Practices During Drilling or Sampling Operations

These are detailed in the RSA QAP-50 which is included as Appendix E.

5.1.3 Site Work Zones

The only area normally requiring restrictions and work permits is the area defined as unit #2 on page 96 of the Site Characterization Plan, the fenced area south of Caldwell Avenue containing the slag pile.

Although there are no radiation areas as defined by 10CFR20 on the site, in order to assure compliance with the dose restrictions to minors and declared pregnant women, they will not be allowed

access to the affected areas of the site as defined in Figure 5-2 of the Site Characterization Plan. These areas are the fenced yard south of Caldwell Ave. containing the covered slag pile and the impoundment area on the northwest part of the site within the fenced area. This restriction will effectively assure that doses to minors and an embryo/fetus are kept below 10% of the limits specified in 10CFR20 20.107 and 20.108.

There are no high radiation areas on site and no very high radiation areas

Areas where operations such as crushing, grinding, or heating slag to high temperatures occur may be classified as "Airborne Radioactivity Areas". For purposes of this plan any single operation such as those above which generate airborne dust in significant amounts using 10000 times the ALI equivalent of Th bearing slag shall be considered an "Airborne Radioactivity Area". This is equal to 25 kg of undiluted slag. Experience has shown that persons have rarely if ever accumulated more than one millionth of material being handled internally even under accident conditions.

5.1.4 Prevention of Exposure and Contamination (ALARA)

Exposure to external irradiation will be kept as low as reasonable achievable by minimizing time spent in the vicinity of the tailings pile, by restrictions on local occupancy near the pile or other areas where the external exposure rates is elevated above 100 uR/hr. In short, distance and time will be used to control external exposure.

Internal exposure will be controlled by conducting dust making operations under wet conditions to the extent practical, by local exhaust ventilation during high speed drilling into the pile, by maintaining distance from exposure points, by respiratory protection, and by limiting the exposure to only necessary personnel during any particular operation.

5.1.5 Respiratory Protection

Operations requiring respiratory protection are listed in QAP-50. As a matter of prudence and to keep internal exposures as low as reasonably achievable, respirators will be worn on all jobs which result in visible dust where Th bearing slag is significantly involved.

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Respiratory protection is not used to achieve compliance with the dose limits in 10CFR20, as committed dose equivalents will be assessed using bioassay techniques, and not air samples.

5.2 Assessment of Exposure

5.2.1 External exposure

External exposures may be assessed in two ways, by the use of external exposure rate measurements and time and occupancy information for the three plant areas or by film or TLD badge monitoring. If badges are used the monitoring period should be no less frequent than quarterly..

It is expected that external exposure (deep dose equivalent) will not exceed 10% of the dose equivalent limits (see section 3.3.2).

5.2.2 Internal Exposure

5.2.2.1 Air Samples

Air samples will be used for purposes of control of exposure and assessment of actions required for the bioassay program. Doses will be assigned from the data generated in the bioassay program, and not from air samples unless the bioassay data are unavailable or for some reason unusable or unsuitable (i.e., as in sample contamination).

Area samples in the vicinity of the workplace will give the most sensitive method of air monitoring. Such samples should be taken with an air sampler capable of sampling several cubic feet per minute and operated for a time period of several hours to a week, depending upon the jobs or work practices being evaluated.

Personal air samplers may be used to evaluate exposure of individual workers for control purposes. Particular attention should be paid to avoid inadvertent physical contamination of the samples. In particular only closed face air filter holders may be used. It may be desirable to collect respirable aerosol only. Note that the purpose for collection of these samples is evaluation of exposure and its control, not evaluation of the dose.

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The content of ^{232}Th on air filters may be evaluated by gross alpha counting, provided sufficient time is allowed post cessation of sampling for the natural aerosols containing Radon and Thoron daughters to decay. This may require 7 half lives or 72 hours.

The activity of ^{232}Th, which is in equilibrium with its daughters, is given by:

$$A = (C - B)/(6 \times 2.22etV)$$

where A = activity in pCi/m^3 or 10^{-12} uCi/cc
C = counts obtained for the sample
B = counts obtained for the background
2.22 = dpm/pCi
e = efficiency of counter (cpm/dpm)
t = counting time (minutes)
V = sampling volume in m^3
6 = # of alpha decays in the Th chain

A personal air sampler with a flow rate of 2 liters/minute operated for 8 hours would collect a sample resulting in 12.8 dpm alpha if the air concentration were exactly 1 DAC (1 $pCi/.m^3$). Under this condition an airborne radioactivity area (20.1003) might exist. The concentration of suspended slag in air would have to be about 1 mg/m^3 to produce such an activity concentration in air

5.2.2.2 Nose Swipes

In the event that a significant exposure is suspected to have occurred based upon the observation of significant suspended slag in air, air sample results, or other evidence, nose swipes of both nostrils will be taken and counted by gross alpha counting The following action levels are defined, based upon the ICRP lung deposition model. For 1 micron amad particles 30% is presumed to deposit in the naso-pharyngeal region. We assume that half of that deposits in the nostrils, of which 80% is removed by swiping both nostrils. For 1 ALI (3000 pCi) this is equivalent to 360 pCi or about 800 dpm.

Action level	swipe results
1	less than 80 dpm.

No additional monitoring than routine urine required.

2	greater than 80 dpm

	or less than 240 dpm
Two or more fecal samples are required to evaluate exposure past the nose.	
3	greater than 240 dpm or less than 800 dpm
Work restrictions. Continue fecal samples until levels in feces diminish. Initiate urine sampling after one week	
4	greater than 800 dpm
Remove from work. Measure fecal excretion daily. Whole body counting for lung burden evaluation..	

5.2.2.3 Fecal Samples

Fecal samples will be taken whenever there is an expected exposure as indicated by nasal swipes (action levels 2 and above), air sampling which indicates exposures exceeding 200 DAC-hours, or other indications of a significant inhalation exposure. A number of investigative samples may be taken for persons with exposures exceeding 12 DAC-hours in one day or part of a working day or 0.6% of an ALI. The latter is equivalent to an intake of 18 pCi. In view of the fact that less than 10% of an inhaled Class Y aerosol with particle size 1 micron amad according to the ICRP lung model will be eliminated in feces/day, at most 2 pCi/day will be excreted in feces. This is about the amount of ^{232}Th expected in normal feces from intake of natural ^{232}Th in food. Thus fecal monitoring could only be useful in assessing inhalation exposures which significantly exceed 0.6% of an ALI. For larger particle sizes, fecal excretion will be indicative primarily of deposition in the naso-pharyngeal region. Accordingly, fecal samples will be used only as an indicator, and not for dose assessment, of exposure by inhalation or ingestion. Since the ALI for ingestion of ^{232}Th is 700,000 pCi, fecal samples are adequate to assess compliance with limits for ingestion. Ingestion is not considered to be a significant route of exposure since 560 grams of slag would have to be ingested in a year to reach this limit, or a continued ingestion of 2.2 grams per working day for 250 days/year.

5.2.2.4 Urine Samples

Urine samples will be used to assess exposure and dose. All personnel who will be working with quantities of slag exceeding 25kg or for which air sampling indicated exposures in excess of 10% of the ALI in any one year are possible should have preexposure measurements of Th in urine. A 24 hour sample of urine should be collected offsite, at home or elsewhere, under hygienic conditions. The protocol for collection is shown in Appendix C. Urine should be preserved using only Th free acids.

In order to measure the concentration of Th in normal urine a technique with sensitivity to measure 1 ng/liter is required. One such technique is neutron activation. Alpha spectrometric analysis of urine is not sufficiently sensitive.

The predictions of the ICRP and NUREG models for urinary excretion of ^{232}Th are shown in Appendix C. A plateau in excretion exists for the time period from 7 to about 800 days post inhalation.

For an inhalation of 1 ALI of 1 micron amad Th containing slag (3000 pCi) about 27.3 mg of ^{232}Th would be inhaled in about 2.4 grams of slag. Such a massive inhalation is unlikely. Since the fractional daily urinary excretion would be 3.1×10^{-6} at 90 days post inhalation (see Table 1, Appendix C), the expected daily excretion would be 85 ng/day or for a standard man urinary output of 1.4 liters, 60 ng/liter. Doses may be assigned on the basis of urine results. However if urinary excretion exceeding 30% of this value is measured (18 ng/liter), external chest monitoring is indicated. (see section 5.2.2.5).

5.2.2.5 Chest Monitoring (Whole Body Counting)

Measurement of a worker by in vivo chest counting in a well shielded whole body counter should be able to detect the lung burden equivalent to less than 1.0 ALI using a large Sodium Iodide (NaI) detector or 2 large high resolution GeLi detectors for several days post exposure by inhalation. Measurement by whole body counting is required whenever either urine sampling or air sampling indicates an inhalation exposure to a worker in excess of 30% of the ALI.

It is expected that the daughters of ^{232}Th will remain with the particles inhaled and will not be separately transported in lung fluids. Thus the 911 keV emission of ^{228}Ac or the 2620 keV gamma ray of 208Tl should be readily detectable in a large NaI crystal and the 239 keV emission from 212 Pb by GeLi detectors.

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Title: ~~Health and Safety~~ Radiological Health.	Procedure: QAP-050	PAGE 1 OF 6
	Revision: Original	
Approved by: Barbara K. Dankmyer Originated by: D.E. Wrenn, PhD, CHP	Date: 11/16/93	

1 Purpose and Scope:

This procedure describes the measures that Molycorp and its employees, contractors and consultants will undertake to insure the health and safety of all individuals working on-site during site characterization.

2 References:

2.1 10CFR 20
2.2 Molycorp Preparedness, Prevention and Contingency Plan (PPC) dated June 1992 and reviewed July, 1, 1993.
2.3 U.S. NRC Regulatory Guide 8.25, "Air Sampling in the Work Place"
2.4 U.S. NRC Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program," July, 1993.
2.5 NCRP Report 94: Exposure of the Population of the United States and Canada from Natural Background Radiation, 1989.

3 Background:

None

4 Equipment and Material:

Use standard safety equipment as listed in paragraph 5.4.4 of this procedure.

5 Procedures:

5.1 During all site characterization operations emergency actions will be performed according to the Molycorp Preparedness, Prevention and Contingency Plan (PPC) dated June 1992 and reviewed July, 1, 1993.

5.2 Where specific Molycorp material and operation safety procedures exist they will be followed in conjunction with the procedures listed in this procedure.

5.3 During the site characterization phase, the following classes of activity will be performed on-site in areas containing low levels of Th bearing

materials:

5.3.1 Borehole drilling

5.3.2 Sample collection and on-site measurements

5.3.3 Excavation using hand tools

5.3.4 Excavation using motorized equipment

5.3.5 Crushing, screening, and blending of Th bearing material

5.3.6 Cleaning of equipment for unrestricted use

5.4 During these operations personnel may be exposed to two types of radiological hazards: exposure to elevated levels of gamma radiation from FeCb slag, and exposure to respirable dust containing residual FeCb slag. The potential for personnel to receive significant doses by oral ingestion or by absorption due to contact with skin or open wounds is considered minimal at this site due to the low concentrations of Th and the refractory nature of the FeCb slag.

5.4.1 No single combination of personal protective equipment (PPE) and clothing is capable of protection against all hazards. PPE should be used in conjunction with safe work practices, decontamination, and good personal hygiene. All calculations demonstrating compliance with 10CFR20 assume that the workers are using no respirators or other PPE, even though such PPE will be used in practice. (see Appendix A)

5.4.2 Protection Against Exposure to External Gamma Radiation:

5.4.2.1 Personal monitoring is not required under 10CFR20, see appendix A.

5.4.2.2 Although the potential for exposure is so low that personal monitoring is not required, in accordance

with ALARA, all personal will abide by the following precautions.

5.4.2.2.1 Work assignments will be written such that no ~~one~~ ~~spends~~ more than 500 hours on the Th pile in any 52 week period.

5.4.2.2.2 All personnel are instructed to plan their work so that time spent on or in the vicinity of the pile is minimized.

5.4.2.2.3 All personnel working on-site will be informed of the location of areas where gamma exposure rates exceed 100 µR/hr. All areas, outside of the Th pile, with exposure rates exceeding 100 µR/hr will be marked with an identifing barrier.

5.4.3 Protection Against Exposure by Inhalation:

5.4.3.1 The Federal Code of Regulations 10CFR20 requires personal monitoring of individuals who are likely to receive more than 10% of the inhalation annual limit on intake (ALI). Although it is improbable that any worker will receive 10% of the ALI during site characterization, in order to demonstrate compliance with the regulations, Molycorp will monitor inhalation exposure during selected operations. See Appendix A of this procedure for the assessment of need for personal monitoring.

5.4.3.2 5.4.3.2 Air sampling. Air samples of the breathing zone will be collected during selected operations. QAP-220, "Air Sample Collection," provides the procedures for collecting air samples.

5.4.3.3 Bioassay. ~~Urine and/or~~ Fecal samples ~~will~~ may be collected from workers ~~before and~~ after selected

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Urine samples will be collected from workers who may be significantly exposed to finely divided airborn slag both before operations begin and after the cessation of operations.

operations. QAP-290, "Collection of Samples for Bioassay" provides the procedures for collecting urine and fecal samples.

If process and engineering controls can not reduce ambient dust in the work area to below the DAC for ^{232}Th, then worker exposure time must be limited such that no worker rerceives more than 40 DAC hours per week.

5.4.4 Specific Measures to Comply with ALARA:

5.4.4.1 Measures:

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- Half face respirator with HEPA filter (HF)
- Full respirator with HEPA filter (FF)
- Engineering and process controls to limit dust generation (EPC)
- Tyvek suites, blue or gray, (TS)
- Safety shoes (SS)
- Hard Hat (HH)
- Safety Glasses (SG)
- Gloves (GL)
- Rubber Boots (RB)
- Air Sampling (AS)

5.4.4.2 Operations:

5.4.4.2.1 Borehole drilling. ~~(AS)~~, (EPC), (SS), (HH), (SG)

5.4.4.2.2 Sample collection and on-site measurements. (SS), (HH), (SG)

5.4.4.2.3 Excavation using hand tools on FeCb slag pile. (AS), (HF), (EPC), (SS), (HH), (SG), (TS), (GL)

5.4.4.2.4 Excavation using hand tools in areas on-site other than FeCb slag pile. (EPC), (SS), (HH), (SG)

5.4.4.2.5 Excavation using motorized equipment. (EPC), (SS), (HH), (SG). If >100 mR (AS).

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5.4.4.2.6 Crushing, screening, and blending of Th bearing material. (AS), (FF), (EPC), (SS), (HH), (GL), (TS), (RB)

5.4.4.2.7 Cleaning of equipment for unrestricted release. (EPC), (SS), (HH), (SG), and other protective equipment as needed.

5.5 Emerging operations not described above will be evaluated using the Hazardous and Operability Study (HAZOP) prior to commencing work. The need for any necessary protective equipment will be determined by the HAZOP. Air sampling results may lead to increased engineering controls on any operation.

6 Quality Control Procedures:

6.1 Quality assurance audits will be performed in accordance with QAP-030.

6.2 The Quality Assurance Coordinator and Radiation Safety Officer (QAO) will perform periodic inspections on approximately 10% of the Work Orders to ensure that the safety procedures are being complied with.

6.3 Unsafe operations will be stopped and unsafe conditions corrected before the operation is permitted to continue.

6.4 A shutdown of operations may be issued by the: QAO, Radiation Safety Officer (RSO), Site Remediation Project Officer (SRPM), and Facility Manager (FM).

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6.5 Weekly safety inspections of field operations will be done by the RSO ~~or~~ his designate ? to insure compliance.

7 Changes To this Procedure Must Be approved By:

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SRPM, QAO, and RSO.

8 Requirements for Qualification and Training for This Procedure:

Any person conducting environmental characterization work on-site must: read and understand this procedure. After the individual has read the procedure the QAO or RSO will give a written test and oral quiz to the individual being qualified. The person will not perform work per the procedure until the individual understands the procedure. If an unsafe action is observed the QAO or RSO will take immediate action to ensure that approved safety procedures are used. ?

9 Required Frequency for Re-qualification:

Re-qualification on this procedure will be required every year or whenever a revision is issued. All changes will be reviewed with the affected personnel within 48 hours of approval or before a person next uses the procedure.

10 Qualification Must be Approved By:

QAO or Safety Officer.

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11 Qualified Personnel List for Procedure Number QAP-050

Name	Date of Qualification or Re-qualification	Qualification Approved by (please sign)

QAP50, Appendix A

Assessment of the Need for Personal Monitoring During Site Characterization

External:

The only significant source of external radiation on-site is gamma radiation from FeCb slag. The areas of highest exposure rate are the Th slag pile and a very limited area adjacent to a power pole in the NW storage yard. The gamma exposure rate in these areas is less than 300μR/hr (including background). In the remainder of the affected areas, the highest gamma rates to be found are less than 75 μR/hr and the average is less than 25 μR/hr.

The Site Characterization Plan calls for work assignments that have individuals working on or around the slag pile and the elevated area in the NW yard for a maximum of three weeks (120 hours) per individual, collecting samples and taking radiation measurements. The Site Characterization Plan also assigns individuals to work in the other affected areas for up to 16 weeks (640 hours), drilling boreholes, collecting samples, and making measurements. Other than the work detailed in the Site Characterization Plan, no employee has work assignments that require significant time spent in affected areas.

The following assumes that an exposure rate of 1 μR/hr corresponds to an effective dose equivalent rate of 0.7 μrem/hr (UNSCEAR 1982, NCRP-94, 1987).

Maximum Possible Dose (Worst Case Scenario, very unlikely):

For the worst case scenario, we assume that a worker spends 25% of a 2000 hour work year on the Th slag pile and 50% of the work year at a location having the highest exposure rate to be found in the remainder of the affected area.

(300μR/hr x 2000hr x 25% + 75μR/hr x 2000hr x 50%) x 0.7 μR/ μrem= **157.5 mrem**

Maximum Dose (Best Estimate, highest dose considered likely):

For the best estimate, we assume that the worker spends 120 hours on the slag pile and 640 hours at a location where the dose rate is equivalent to the average in the affected area, as per the Site Characterization Plan.

(300μR/hr x 120hr + 25μR/hr x 640hr) x 0.7 μR/ μrem = **36.4 mrem**

10CFR20.1502 requires that a licensee provide personal monitoring of occupational exposure to radiation for adults likely to receive in a 1 year period from sources outside the body a dose in excess of 500 mrem. The above calculations indicate that no adult, even under the worst case scenario, is likely to receive 500 mrem per year during the Site

Characterization phase. Therefore, no personal monitoring for external exposure will be performed during Site Characterization.

No declared pregnant women are currently involved in site characterization activities. If any declared pregnant women are assigned to site characterization activities, the need for personal monitoring will be assessed.

No minors will be permitted access to affected areas.

Internal:

The radionuclides available for intake at the Molycorp Washington PA site consist of ^{232}Th and its daughters in secular equilibrium. The following table lists the radionuclides and provides the occupational values from Appendix B, Table 1, of 10CFR20. The chemical forms of the thorium on site are class Y compounds (oxides and hydroxides). For other radionuclides in the series, the most restrictive class of compounds is given.

radionuclide	Oral Ingestion ALI	Inhalation ALI	Inhalation DAC
	µCi	µCi	µCi/ml
^{232}Th (class Y)	7E-1	3E-3	1E-12
^{228}Ra (class W)	2E+0	1E+0	5E-10
^{228}Ac (class D)	2E+3	9E+0	4E-9
^{228}Th (class Y)	6E+0	1E-2	4E-12
^{224}Ra (class W)	8E+0	2E+2	7E-10
^{220}Rn, w/daughters	-	2E+1	9E-9

The mean specific activity of ^{232}Th in FeCb slag has been measured at 1250 pCi/g. Since the daughters of ^{232}Th are in secular equilibrium, they also have a specific activity of 1250 pCi/g. In the following table, the occupational values from Appendix B, Table 1, of 10CFR20 are expressed in terms of mass of FeCb slag.

radionuclide	Oral Ingestion ALI	Inhalation ALI	Inhalation DAC
	grams FeCb slag	grams FeCb slag	(mg FeCb slag)/m^3
^{232}Th (class Y)	560	2.4	0.8
^{228}Ra (class W)	1600	800	400
^{228}Ac (class D)	1.6E+6	7200	3200
^{228}Th (class Y)	4800	8	3.2
^{224}Ra (class W)	6400	1.6E+5	560
^{220}Rn, w/daughters	-	1.6E+4	7200

The intake of FeCb slag is limited by the allowable limits for the intake of ^{232}Th.

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Inhalation:

Three activities with the potential for generating dust are planned for the first phase of site characterization: (1) collection of samples from the Th slag pile; (2) crushing, screening, and blending of slag taken from the pile; (3) drilling of boreholes.

During these operations, engineering and process controls will be applied to keep dust levels ALARA. These controls are expected to maintain dust levels well below the DAC for ^{232}Th (Y class compounds) of 0.8 mg/m^3 respirable FeCb slag.

In order to assess inhalation exposures during a typical dust generating activity, Molycorp will use, as a test case, an operation that requires excavation in the FeCb slag pile. The excavations will be performed using hand tools for the purpose of collecting six slag samples for analysis, as described in section 5.1.2.4 of the Site Characterization Plan. No single worker will spend more than 80 hours on this activity. We expect that the average concentration of respirable FeCb slag dust in air will be maintained below 10% of the DAC, so that workers should receive below 8 DAC hours. (This estimate is based on air sampling that was conducted during an excavation of soil contaminated with a Th bearing residue at Molycorp's York, PA site in which the average air concentration was about 1% of the DAC).

Both air samples and bioassay data will be collected during this test operation. The air sampling will include measurements of Th concentrations in the breathing zone. Total dust and respirable dust will be measured. Urine and/or fecal samples will be collected before and after the operation.

The purpose of the air sampling and bioassay data is to collect information that will be used to determine if any workers are likely to receive greater than 10% of the ALI in a year. The air sampling and bioassay data collection may be repeated for other dust generating operations, such as crushing, screening and blending of slag. A routine program for monitoring inhalation exposure will be developed once the results from these initial studies become available.

The results for analysis of ^{232}Th in urine may be used to assign committed dose; the enclosed plot shows that, after a single short term exposure by inhalation, urinary ^{232}Th is expected to remain below 5 ng/l for a year past exposure. In order to measure urinary excretion this low, neutron activation analysis is required (Ref: Twitty and Boback, Ana. Chem. Acta., vol. 49, 19-24, 1970)

In keeping with the principles of ALARA, workers will wear respirators during dust generating operations. However, respirator protection factors will not be used for the purpose of determining the number of DAC hours workers are exposed to per year.

No declared pregnant women are currently involved in site characterization activities. If any declared pregnant women are assigned to site characterization activities, the need for personal monitoring will be assessed.

No minors will be permitted access to affected areas.

Oral Ingestion and Absorption through Skin and Open Wounds

In order to exceed the ALI for ^{232}Th, a worker would have to ingest 560 grams of 100% FeCb slag in a year. This is considered highly unlikely. Due to the low specific activity and the highly insoluble chemical form of the slag, it is also considered unlikely that significant exposure could occur by absorption through skin or open wounds.

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as is even 10% of this limit!

APPENDIX A

MAPS/FIGURES

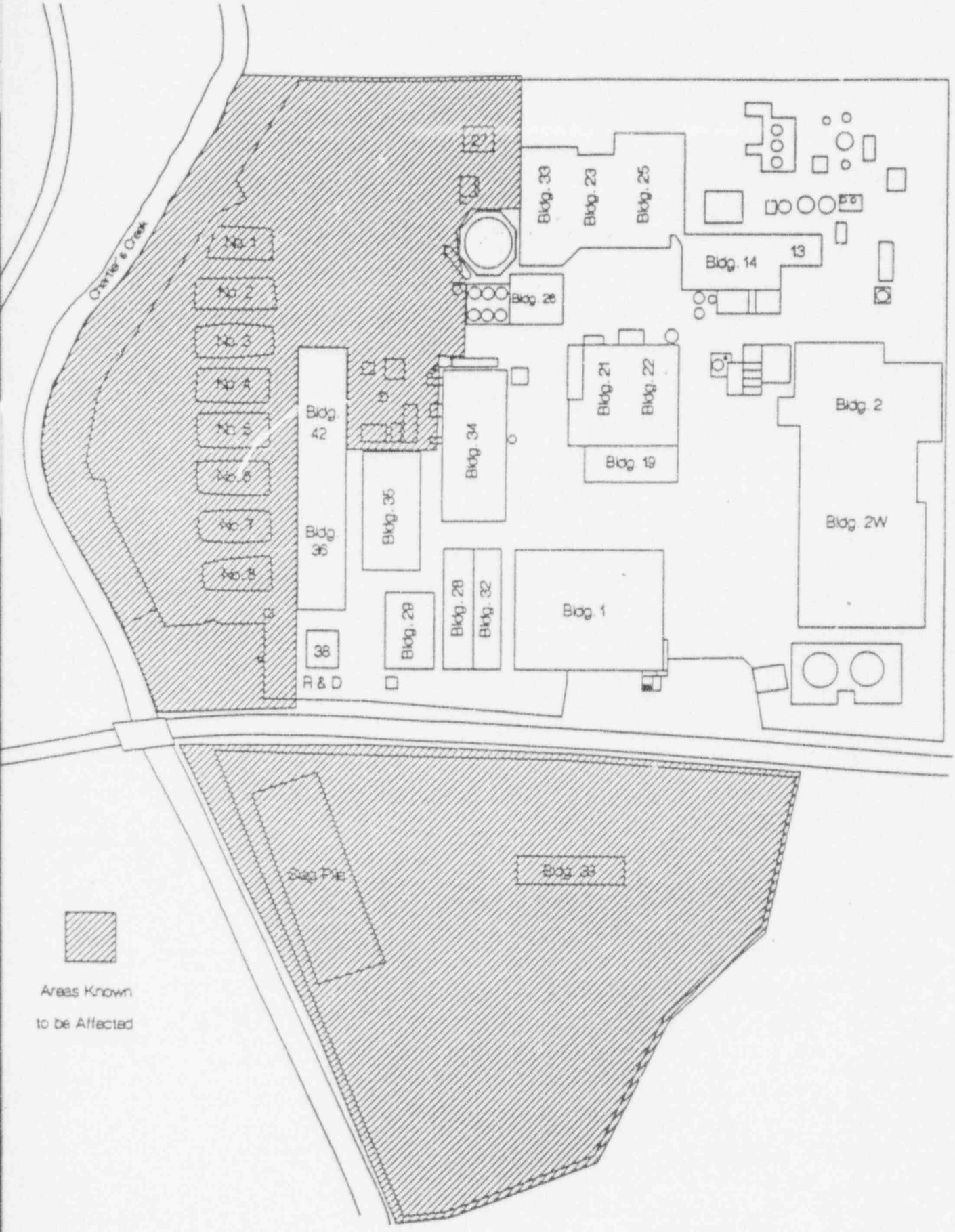

Figure 5-2: Areas at the Molycorp, Washington Pa Plant Site Currently Classified as Affected Areas (from "Plan for Site Characterization in Support of Decommissioning of the Molycorp Inc Washington, Pa Facility", August 1993)

Figure 5-3: Buildings at Molycorp, Washington Pa Plant Site which, Due to Historic Usage Patterns, May Be Classified as "Affected Buildings"


WASHINGTON MALL
HOSPITAL ROUTE
WASHINGTON
2
3
4

APPENDIX B

MATERIAL SAFETY DATA SHEETS/CHEMICAL DATA SHEETS

MATERIAL SAFETY DATA SHEET

Unocal Corporation
1201 West 5th Street
Los Angeles, California 90017

Product Name: FERROMOLYBDENUM
Product Code No: 2200

Issue Date: 07/23/91
Status: FINAL

Responsible Party:

MOLYCORP, INC.
UNION OIL COMPANY OF CALIFORNIA
1201 WEST 5TH STREET
LOS ANGELES, CALIFORNIA 90017

CONTACT FOR FURTHER INFORMATION:
MSDS COORDINATOR 213-977-7666

Transportation Emergencies:
CHEMTREC
(800) 424-9300 Cont. U.S.
(202) 483-7616 (Collect)
from Alaska & Hawaii
Health Emergencies:
LOS ANGELES POISON
CONTROL CENTER (24 hrs)
(800) 356-3129

PRODUCT IDENTIFICATION

PRODUCT NAME: FERROMOLYBDENUM

CHEMICAL FAMILY: METAL

SECTION I - COMPONENTS	PERCENT	EXPOSURE LIMIT	UNITS	AGENCY	TYPE
HAZARDOUS COMPONENTS					
NUISANCE DUST, TOTAL & RESPIRABLE, IF GENERATED					
CAS #: NONE		10.000	mg/m3	ACGIH	TWA-T-DUST
		5.000	mg/m3	ACGIH	TWA-R-DUST
		10.000	mg/m3	MSHA	TWA-T-DUST
		15.000	mg/m3	OSHA	TWA-T-DUST
		5.000	mg/m3	OSHA	TWA-R-DUST
		10.000	mg/m3	CAL OSHA	TWA-T-DUST
		5.000	mg/m3	CAL OSHA	TWA-R-DUST
MOLYBDENUM					
CAS #: 7439-98-7	60.000 - 72.000	10.000	mg/m3	ACGIH	TWA
		10.000	mg/m3	MSHA	TWA
		10.000	mg/m3	OSHA	TWA-T-DUST
		10.000	mg/m3	CAL OSHA	TWA
COPPER					
CAS #: 7440-50-8	<1	1.000	mg/m3	ACGIH	TWA-T-DUST
		0.200	mg/m3	ACGIH	TWA-FUME
		1.000	mg/m3	MSHA	TWA-T-DUST
		2.000	mg/m3	MSHA	STEL-T-DUST
		0.200	mg/m3	MSHA	TWA-FUME
		1.000	mg/m3	OSHA	TWA-T-DUST
		0.100	mg/m3	OSHA	TWA-FUME
		1.000	mg/m3	CAL OSHA	TWA-T-DUST
		0.200	mg/m3	CAL OSHA	TWA-FUME
OTHER COMPONENTS					
FERROMOLYBDENUM ALLOY					
CAS #: NONE	100	NOT ESTABLISHED			
IRON					
CAS #: 7439-89-6	31.000 - 37.000	NOT ESTABLISHED			

SECTION I

THIS PRODUCT CONTAINS THE FOLLOWING CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA 313 AND 40 CFR 372:

	CAS NUMBER	WEIGHT %
COPPER	7440-50-8	<1

SECTION II - EMERGENCY AND FIRST AID PROCEDURES

EMERGENCY
Have physician call LOS ANGELES POISON CONTROL CENTER (24 hrs) (800) 356-3129

EYE CONTACT:

IF IRRITATION OR REDNESS DEVELOPS, MOVE VICTIM AWAY FROM EXPOSURE AND INTO FRESH AI FLUSH EYES WITH CLEAN WATER. IF SYMPTOMS PERSIST, SEEK MEDICAL ATTENTION.

SKIN CONTACT:

FIRST AID IS NOT NORMALLY REQUIRED. HOWEVER, IT IS GOOD PRACTICE TO WASH ANY CHEMI FROM THE SKIN.

INHALATION (BREATHING):

FIRST AID IS NOT NORMALLY REQUIRED. IF BREATHING DIFFICULTIES DEVELOP, MOVE VICTIM AWAY FROM SOURCE OF EXPOSURE AND INTO FRESH AIR. SEEK IMMEDIATE MEDICAL ATTENTION.

INGESTION (SWALLOWING):

NO FIRST AID IS NORMALLY REQUIRED; HOWEVER, IF SWALLOWED, AND SYMPTOMS DEVELOP, SEEK MEDICAL ATTENTION.

SECTION III - HEALTH HAZARDS/ROUTES OF ENTRY

EYE CONTACT:

CONTACT WITH DUSTS MAY BE ABRASIVE AND IRRITATING TO THE EYES AND MAY CAUSE STINGING TEARING AND REDNESS.

SKIN CONTACT:

CONTACT WITH DUSTS MAY BE ABRASIVE AND IRRITATING TO THE SKIN AND MAY CAUSE REDNESS AND BURNING. SKIN ABSORPTION OF THIS MATERIAL IS UNLIKELY.

INHALATION (BREATHING):

PROLONGED OR REPEATED OVEREXPOSURE TO DUSTS MAY RESULT IN CHRONIC BRONCHITIS (LUNG INFLAMMATION) WITH SYMPTOMS OF COUGHING AND SHORTNESS OF BREATH.

INGESTION (SWALLOWING):

NO HARMFUL EFFECTS ARE EXPECTED FROM INGESTION OF THIS MATERIAL.

COMMENTS:

THIS MATERIAL HAS NOT BEEN IDENTIFIED AS A CARCINOGEN BY NTP, IARC OR OSHA. THIS MATERIAL IS MADE FROM VARIOUS COMPONENTS FUSED TOGETHER TO FORM AN ALLOY. HEALTH EFFECTS NORMALLY ASSOCIATED WITH THE INDIVIDUAL COMPONENTS ARE NOT EXPECTED.

SECTION IV - SPECIAL PROTECTION INFORMATION

VENTILATION:

IF CURRENT VENTILATION PRACTICES ARE NOT ADEQUATE TO MAINTAIN AIRBORNE CONCENTRATIONS BELOW THE ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), ADDITIONAL VENTILATION OR EXHAUST SYSTEMS MAY BE REQUIRED.

RESPIRATORY PROTECTION:

IF AIRBORNE CONCENTRATIONS EXCEED ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), A SUITABLE FILTER TYPE RESPIRATOR SHOULD BE WORN.

PROTECTIVE GLOVES:

THE USE OF GLOVES IMPERMEABLE TO THE SPECIFIC MATERIAL HANDLED IS ADVISED TO PREVENT SKIN CONTACT AND POSSIBLE IRRITATION.

EYE PROTECTION:

APPROVED EYE PROTECTION TO SAFEGUARD AGAINST POTENTIAL EYE CONTACT, IRRITATION OR INJURY IS RECOMMENDED.

OTHER PROTECTIVE EQUIPMENT:

IT IS SUGGESTED THAT A SOURCE OF CLEAN WATER BE AVAILABLE IN THE WORK AREA FOR FLUSHING EYES AND SKIN. IMPERVIOUS CLOTHING SHOULD BE WORN AS NEEDED.

SECTION V - REACTIVITY DATA

REACTIVITY:

STABLE UNDER NORMAL CONDITIONS OF STORAGE AND HANDLING.

CONDITIONS AFFECTING REACTIVITY:

NONE KNOWN

INCOMPATIBLE MATERIALS:

AVOID CONTACT WITH STRONG ACIDS WHICH MAY EVOLVE HYDROGEN GAS.

HAZARDOUS DECOMPOSITION PRODUCTS:

NONE KNOWN

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

POLYMERIZATION CONDITIONS TO AVOID:

NONE KNOWN

SECTION VI - SPILL AND LEAK PROCEDURES

HIGHWAY OR RAILWAY SPILLS
Call CHEMTREC (800) 424-9300 Cont. U.S.
(Collect) (202) 483-7616 from Alaska & Hawaii

PRECAUTIONS IN CASE OF RELEASE OR SPILL:

STAY UPWIND AND AWAY FROM SPILL/RELEASE. ISOLATE HAZARD AREA AND LIMIT ENTRY TO AUTHORIZED PERSONNEL. STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). PREVENT SPILLED MATERIAL FROM ENTERING SEWERS, STORM DRAINS,

SECTION VI - SPILL AND LEAK PROCEDURES

OTHER UNAUTHORIZED TREATMENT/DRAINAGE SYSTEMS AND NATURAL WATERWAYS. MINIMIZE DUST GENERATION. SWEEP UP AND PACKAGE APPROPRIATELY FOR DISPOSAL. NOTIFY APPROPRIATE FEDERAL, STATE AND LOCAL AGENCIES.

WASTE DISPOSAL METHOD:

DISPOSE OF PRODUCT IN ACCORDANCE WITH LOCAL, COUNTY, STATE, AND FEDERAL REGULATIONS

SECTION VII - STORAGE AND SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:

AVOID CONTACT WITH ACIDS. USE AND STORE THIS MATERIAL IN COOL, DRY, WELL VENTILATED AREAS. KEEP CONTAINER(S) CLOSED. STORE ONLY IN APPROVED CONTAINERS. KEEP AWAY FROM ANY INCOMPATIBLE MATERIALS (SEE SECTION V). PROTECT CONTAINER(S) AGAINST PHYSICAL DAMAGE. DO NOT ENTER CONFINED SPACES SUCH AS TANKS OR PITS WITHOUT FOLLOWING PROPER ENTRY PROCEDURES SUCH AS ASTM D-4276. THE USE OF RESPIRATORY PROTECTION IS ADVISED WHEN CONCENTRATIONS EXCEED ANY ESTABLISHED EXPOSURE LIMITS (SEE SECTIONS I AND IV). WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING OR SHOES. USE GO PERSONAL HYGIENE PRACTICE.

SECTION VIII - FIRE AND EXPLOSION HAZARD DATA

			HAZARD RANKING
NFPA	HEALTH HAZARD:	0	0 = LEAST
HAZARD	FLAMMABILITY:	0	1 = SLIGHT
CLASS	REACTIVITY:	0	2 = MODERATE
	OTHER:		3 = HIGH
			4 = EXTREME

EXTINGUISHING MEDIA:

USE THAT WHICH IS APPROPRIATE FOR THE SURROUNDING FIRE.

UNUSUAL FIRE & EXPLOSION HAZARDS:

NO UNUSUAL FIRE OR EXPLOSION HAZARDS ARE EXPECTED.

SPECIAL FIRE FIGHTING PROCEDURES:

WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. MOVE UNDAMAGED CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. WATER SPRAY MAY BE USEFUL IN MINIMIZING OR DISPERSING VAPORS AND COOLING EQUIPMENT EXPOSED TO HEAT A FLAME.

SECTION IX - PHYSICAL DATA

***UNLESS OTHERWISE NOTED, VALUES ARE AT 20 C/68 F AND 760 mm Hg/1 atm.

% SOLUBILITY IN WATER

VERY LOW

APPEARANCE

GRAY METAL POWDER OR LUMP

ODOR

NONE

SECTION X - DOCUMENTARY INFORMATION

ISSUE DATE: 07/23/91 PRODUCT CODE NO. 2200

PREV. DATE: 10/01/85 PREV. PROD. CODE NO. NONE

MSDS NO: NONE PREV. MSDS NO: NONE

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

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MATERIAL SAFETY DATA SHEET

Unocal Corporation
1201 West 5th Street
Los Angeles, California 90017

Product Name: MOLYBDENUM DISULFIDE
Product Code No: 2650, 2700

Issue Date: 04/16/92
Status: FINAL

Responsible Party:
MOLYCORP, INC.
UNION OIL COMPANY OF CALIFORNIA
1201 WEST 5TH STREET
LOS ANGELES, CALIFORNIA 90017

FOR FURTHER INFORMATION CONTACT:
MSDS COORDINATOR 213-977-7666

Transportation Emergencies:
CHEMTREC
(800) 424-9300 Cont. U.S.
from Alaska & Hawaii
Health Emergencies:
LOS ANGELES POISON
CONTROL CENTER (24 hrs)
(800) 356-3129

PRODUCT IDENTIFICATION

PRODUCT NAME: MOLYBDENUM DISULFIDE

SYNONYMS: MOLYBDENITE

CHEMICAL FAMILY: METAL SULFIDE

DOT PROPER SHIPPING NAME: NOT APPLICABLE

ID NUMBER: NONE

DOT HAZARD CLASSIFICATION: NOT REGULATED

PRECAUTIONARY WARNING

CAUTION!
CRYSTALLINE SILICA IS A PROBABLE CANCER HAZARD. MAY BE HARMFUL IF INHALED. DO NOT GET IN EYES, ON SKIN OR ON CLOTHING. DO NOT BREATHE DUST. DO NOT TASTE OR SWALLOW. KEEP CONTAINER CLOSED. USE ONLY WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. MAY IGNITE. KEEP AWAY FROM ALL SOURCES OF IGNITION.

SECTION I - COMPONENTS	PERCENT	EXPOSURE LIMIT	UNITS	AGENCY	TYPE
HAZARDOUS COMPONENTS					
SILICA, CRYSTALLINE QUARTZ CAS #: 14808-60-7	4-6	0.100	mg/m3	ACGIH	TWA-T-DUST
		20.000	mg/m3	MSHA	TWA-T-DUST
		0.100	mg/m3	OSHA	TWA-T-DUST
		0.100	mg/m3	CAL OSHA	TWA-T-DUST
OTHER COMPONENTS					
MOLYBDENUM DISULFIDE CAS #: 1317-33-5	86-91	10.000	mg/m3	ACGIH	TWA
		10.000	mg/m3	MSHA	TWA
		10.000	mg/m3	OSHA	TWA-T-DUST
		10.000	mg/m3	CAL OSHA	TWA-T-DUST

SECTION I - COMPONENTS	PERCENT	EXPOSURE LIMIT	UNITS	AGENCY	TYPE
WATER CAS #: 7732-18-5	3.4-5.3			NOT ESTABLISHED	
FERROUS SULFIDE CAS #: 1317-37-9	0-2.5			NOT ESTABLISHED	

THIS PRODUCT CONTAINS THE FOLLOWING CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA 313 AND 40 CFR 372:	CAS NUMBER	WEIGHT %
SILICA, CRYSTALLINE QUARTZ	14808-60-7	4-6
LEAD SULFIDE	1314-87-0	0.03-0.10

SECTION II - EMERGENCY AND FIRST AID PROCEDURES

EMERGENCY
Have physician call LOS ANGELES POISON CONTROL CENTER (24 hrs) (800) 356-3129

EYE CONTACT:

IF IRRITATION OR REDNESS DEVELOPS, MOVE VICTIM AWAY FROM EXPOSURE AND INTO FRESH AIR. FLUSH EYES WITH CLEAN WATER. IF SYMPTOMS PERSIST, SEEK MEDICAL ATTENTION.

SKIN CONTACT:

FIRST AID IS NOT NORMALLY REQUIRED. HOWEVER, IT IS GOOD PRACTICE TO WASH ANY CHEMICAL FROM THE SKIN.

INHALATION (BREATHING):

IF RESPIRATORY SYMPTOMS DEVELOP, MOVE VICTIM AWAY FROM SOURCE OF EXPOSURE AND INTO FRESH AIR. IF SYMPTOMS PERSIST, SEEK MEDICAL ATTENTION. IF VICTIM IS NOT BREATHING, IMMEDIATELY BEGIN ARTIFICIAL RESPIRATION. IF BREATHING DIFFICULTIES DEVELOP, OXYGEN SHOULD BE ADMINISTERED BY QUALIFIED PERSONNEL. SEEK IMMEDIATE MEDICAL ATTENTION.

INGESTION (SWALLOWING):

NO FIRST AID IS NORMALLY REQUIRED; HOWEVER, IF SWALLOWED, AND SYMPTOMS DEVELOP, SEEK MEDICAL ATTENTION.

SECTION III - HEALTH HAZARDS/ROUTES OF ENTRY

EYE CONTACT:

CONTACT WITH DUSTS MAY BE ABRASIVE AND IRRITATING TO THE EYES AND MAY CAUSE STINGING, TEARING AND REDNESS.

SKIN CONTACT:

CONTACT WITH DUSTS MAY BE ABRASIVE AND IRRITATING TO THE SKIN AND MAY CAUSE REDNESS AND BURNING. SKIN ABSORPTION OF THIS MATERIAL IS UNLIKELY.

INHALATION (BREATHING):

THIS MATERIAL HAS A LOW DEGREE OF ACUTE TOXICITY BY INHALATION. HOWEVER, PROLONGED OR REPEATED OVEREXPOSURE TO SILICA DUST, A COMPONENT OF THIS MATERIAL, MAY RESULT IN PROGRESSIVE AND AN IRREVERSIBLE LUNG DISEASE (FIBROSIS) CHARACTERIZED BY RESTRICTED BREATHING, CHEST TIGHTNESS AND COUGHING. RESPIRATORY SYMPTOMS ASSOCIATED WITH PRE-EXISTING LUNG DISORDERS (e.g. ASTHMA-LIKE CONDITIONS) MAY BE AGGRAVATED BY EXPOSURE TO THIS MATERIAL.

SECTION III - HEALTH HAZARDS/ROUTES OF ENTRY

INGESTION (SWALLOWING):

THIS MATERIAL HAS A LOW DEGREE OF TOXICITY BY INGESTION.

COMMENTS:

CRYSTALLINE SILICA, A COMPONENT OF THIS MATERIAL, HAS BEEN IDENTIFIED AS A PROBABLE HUMAN CARCINOGEN BY NTP AND IARC. LEAD ACETATE AND LEAD PHOSPHATE HAVE BEEN IDENTIFIED BY IARC AND NTP AS POSSIBLY CARCINOGENIC TO HUMANS BASED ON ANIMAL STUDIES. A SMALL AMOUNT OF HIGHLY INSOLUBLE LEAD SULFIDE IS PRESENT IN THIS MATERIAL. LEAD SULFIDE HAS NOT BEEN IDENTIFIED AS A CANCER HAZARD.

SECTION IV - SPECIAL PROTECTION INFORMATION

VENTILATION:

IF CURRENT VENTILATION PRACTICES ARE NOT ADEQUATE TO MAINTAIN AIRBORNE CONCENTRATIONS BELOW THE ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), ADDITIONAL VENTILATION OR EXHAUST SYSTEMS MAY BE REQUIRED.

RESPIRATORY PROTECTION:

IF AIRBORNE CONCENTRATIONS EXCEED ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), A SUITABLE FILTER TYPE RESPIRATOR SHOULD BE WORN.

PROTECTIVE GLOVES:

THE USE OF GLOVES IMPERMEABLE TO THE SPECIFIC MATERIAL HANDLED IS ADVISED TO PREVENT SKIN CONTACT AND POSSIBLE IRRITATION.

EYE PROTECTION:

APPROVED EYE PROTECTION TO SAFEGUARD AGAINST POTENTIAL EYE CONTACT, IRRITATION OR INJURY IS RECOMMENDED.

OTHER PROTECTIVE EQUIPMENT:

IT IS SUGGESTED THAT A SOURCE OF CLEAN WATER BE AVAILABLE IN THE WORK AREA FOR FLUSHING EYES AND SKIN. IMPERVIOUS CLOTHING SHOULD BE WORN AS NEEDED.

SECTION V - REACTIVITY DATA

REACTIVITY:

STABLE UNDER NORMAL CONDITIONS OF STORAGE AND HANDLING.

CONDITIONS AFFECTING REACTIVITY:

NONE KNOWN

INCOMPATIBLE MATERIALS:

AVOID CONTACT WITH STRONG ACIDS.

HAZARDOUS DECOMPOSITION PRODUCTS:

CONTACT WITH STRONG ACIDS MAY CAUSE EVOLUTION OF HYDROGEN SULFIDE.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR

SECTION V - REACTIVITY DATA

POLYMERIZATION CONDITIONS TO AVOID:

NONE KNOWN

SECTION VI - SPILL AND LEAK PROCEDURES

HIGHWAY OR RAILWAY SPILLS
Call CHEMTREC (800) 424-9300 Cont. U.S.
(Collect) (202) 483-7616 from Alaska & Hawaii

PRECAUTIONS IN CASE OF RELEASE OR SPILL:

MAY IGNITE. KEEP ALL SOURCES OF IGNITION AWAY FROM SPILL/RELEASE. STAY UPWIND AND AWAY FROM SPILL/RELEASE. ISOLATE HAZARD AREA AND LIMIT ENTRY TO AUTHORIZED PERSONNEL. STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). PREVENT SPILLED MATERIAL FROM ENTERING SEWERS, STORM DRAINS, OTHER UNAUTHORIZED TREATMENT/DRAINAGE SYSTEMS AND NATURAL WATERWAYS. MINIMIZE DUST GENERATION. SWEEP UP AND PACKAGE APPROPRIATELY FOR DISPOSAL. DISPOSE OF IN ACCORDANCE WITH LOCAL, COUNTY, STATE AND NOTIFY APPROPRIATE FEDERAL, STATE AND LOCAL AGENCIES. CLEANUP UNDER EXPERT SUPERVISION IS ADVISED. IF SPILL OF ANY AMOUNT IS MADE INTO OR UPON U.S. NAVIGABLE WATERS, THE CONTIGUOUS ZONE, OR ADJOINING SHORELINES, NOTIFY THE NATIONAL RESPONSE CENTER (PHONE NUMBER 800-424-8802).

WASTE DISPOSAL METHOD:

DISPOSE OF PRODUCT IN ACCORDANCE WITH LOCAL, COUNTY, STATE, AND FEDERAL REGULATIONS.

SECTION VII - STORAGE AND SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:

USE AND STORE THIS MATERIAL IN COOL, DRY, WELL VENTILATED AREAS AWAY FROM HEAT AND ALL SOURCES OF IGNITION. KEEP CONTAINER(S) CLOSED. STORE ONLY IN APPROVED CONTAINERS. KEEP AWAY FROM ANY INCOMPATIBLE MATERIALS (SEE SECTION V). PROTECT CONTAINER(S) AGAINST PHYSICAL DAMAGE. DO NOT ENTER CONFINED SPACES SUCH AS TANKS OR PITS WITHOUT FOLLOWING PROPER ENTRY PROCEDURES SUCH AS ASTM D-4276. THE USE OF RESPIRATORY PROTECTION IS ADVISED WHEN CONCENTRATIONS EXCEED ANY ESTABLISHED EXPOSURE LIMITS (SEE SECTIONS I AND IV). WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING OR SHOES. USE GOOD PERSONAL HYGIENE PRACTICE.

SECTION VIII - FIRE AND EXPLOSION HAZARD DATA

			HAZARD RANKING
NFPA	HEALTH HAZARD:	1	0 = LEAST
HAZARD	FLAMMABILITY:	0	1 = SLIGHT
CLASS	REACTIVITY:	0	2 = MODERATE
	OTHER:		3 = HIGH
			4 = EXTREME

EXTINGUISHING MEDIA:

DRY CHEMICAL, FOAM, WATER OR SAND IS RECOMMENDED.

UNUSUAL FIRE & EXPLOSION HAZARDS:

THIS MATERIAL MAY BURN, BUT WILL NOT IGNITE READILY.

SPECIAL FIRE FIGHTING PROCEDURES:

WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. MOVE UNDAMAGED CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. WATER SPRAY MAY

SECTION VIII - FIRE AND EXPLOSION HAZARD DATA

BE USEFUL IN MINIMIZING OR DISPERSING VAPORS AND COOLING EQUIPMENT EXPOSED TO HEAT AND FLAME.

SECTION IX - PHYSICAL DATA

***UNLESS OTHERWISE NOTED, VALUES ARE AT 20 C/68 F AND 760 mm Hg/1 atm.

% VOLATILE

NOT APPLICABLE

% SOLUBILITY IN WATER

NIL

APPROX. BULK DENSITY

100 lbs/ft3

APPEARANCE

BLACK POWDER

ODOR

NONE

SECTION X - DOCUMENTARY INFORMATION

ISSUE DATE: 04/16/92 PRODUCT CODE NO. 2650, 2700

PREV. DATE: 02/13/92 PREV. PROD. CODE NO. NONE

MSDS NO: NONE PREV. MSDS NO: NONE

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

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MATERIAL SAFETY DATA SHEET

Unocal Corporation
1201 West 5th Street
Los Angeles, California 90017

Product Name: MOLYBDENUM OXIDE
Product Code No: 2300/2370/2390

Issue Date: 04/16/92
Status: FINAL

Responsible Party:
MOLYCORP, INC.
UNION OIL COMPANY OF CALIFORNIA
1201 WEST 5TH STREET
LOS ANGELES, CALIFORNIA 90017

FOR FURTHER INFORMATION CONTACT:
MSDS COORDINATOR 213-977-7666

Transportation Emergencies:
CHEMTREC
(800) 424-9300 Cont. U.S.
from Alaska & Hawaii
Health Emergencies:
LOS ANGELES POISON
CONTROL CENTER (24 hrs)
(800) 356-3129

PRODUCT IDENTIFICATION

PRODUCT NAME: MOLYBDENUM OXIDE

SYNONYMS: MOLYBDENUM TRIOXIDE

CHEMICAL FAMILY: METAL OXIDE

DOT PROPER SHIPPING NAME: NOT APPLICABLE

ID NUMBER: NONE

DOT HAZARD CLASSIFICATION: NOT REGULATED

PRECAUTIONARY WARNING

WARNING!
PROBABLE CANCER HAZARD, HARMFUL IF INHALED OR SWALLOWED. CAUSES EYE IRRITATION. AVOID BREATHING DUST. KEEP CONTAINER CLOSED. USE WITH ADEQUATE VENTILATION. AVOID CONTACT WITH EYES, SKIN AND CLOTHING. WASH THOROUGHLY AFTER HANDLING. DO NOT TASTE OR SWALLOW.

SECTION I - COMPONENTS

COMPONENTS	PERCENT	EXPOSURE LIMIT	UNITS	AGENCY	TYPE
HAZARDOUS COMPONENTS					
NUISANCE DUST, TOTAL & RESPIRABLE, IF GENERATED					
CAS #: NONE		10.000	mg/m3	ACGIH	TWA-T-DUST
		5.000	mg/m3	ACGIH	TWA-R-DUST
		10.000	mg/m3	MSHA	TWA-T-DUST
		15.000	mg/m3	OSHA	TWA-T-DUST
		5.000	mg/m3	OSHA	TWA-R-DUST
		10.000	mg/m3	CAL OSHA	TWA-T-DUST
		5.000	mg/m3	CAL OSHA	TWA-R-DUST
MOLYBDENUM TRIOXIDE					
CAS #: 1313-27-5	88	10.000	mg/m3	ACGIH	TWA
		10.000	mg/m3	MSHA	TWA
		10.000	mg/m3	OSHA	TWA-T-DUST
		10.000	mg/m3	CAL OSHA	TWA

SECTION I - COMPONENTS	PERCENT	EXPOSURE LIMIT	UNITS	AGENCY	TYPE
SILICA-CRYSTALLINE CAS #: 14808-60-7	2.000 - 4.000	10.000	mg/m3	ACGIH	TWA
		10.000	mg/m3	MSHA	TWA
		10.000	mg/m3	OSHA	TWA-T-DUST
		10.000	mg/m3	CAL OSHA	TWA
IRON OXIDE CAS #: 1309-37-1	1.000 - 2.000	5.000	mg/m3	ACGIH	TWA-FUME
		5.000	mg/m3	MSHA	TWA-FUME
		10.000	mg/m3	OSHA	TWA-T-DUST
		10.000	mg/m3	OSHA	TWA-FUME
		5.000	mg/m3	CAL OSHA	TWA-FUME
COPPER CAS #: 7440-50-8	0.100 - 0.900	1.000	mg/m3	ACGIH	TWA-T-DUST
		0.200	mg/m3	ACGIH	TWA-FUME
		1.000	mg/m3	MSHA	TWA-T-DUST
		2.000	mg/m3	MSHA	STEL-T-DUST
		0.200	mg/m3	MSHA	TWA-FUME
		1.000	mg/m3	OSHA	TWA-T-DUST
		0.100	mg/m3	OSHA	TWA-FUME
		1.000	mg/m3	CAL OSHA	TWA-T-DUST
		0.200	mg/m3	CAL OSHA	TWA-FUME
LEAD OXIDE CAS #: 1317-36-8	0.0 - 0.150	0.150	mg/m3	ACGIH	TWA
		0.150	mg/m3	MSHA	TWA
		0.050	mg/m3	OSHA	TWA
		0.050	mg/m3	CAL OSHA	TWA
OTHER COMPONENTS					
ALUMINUM OXIDE CAS #: 1344-28-1	1.000 - 2.000	NOT ESTABLISHED			

THIS PRODUCT CONTAINS THE FOLLOWING CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SARA 313 AND 40 CFR 372:

	CAS NUMBER	WEIGHT %
MOLYBDENUM TRIOXIDE	1313-27-5	88
SILICA-CRYSTALLINE	14808-60-7	2-4
COPPER	7440-50-8	0.1-0.9
LEAD OXIDE	1317-36-8	0-0.15

NOTE: ALUMINUM OXIDE, MAY BE A PART OF A COMPLEX MINERAL SUCH AS FELDSPAR (ALUMINUM SILICATE).

SECTION II - EMERGENCY AND FIRST AID PROCEDURES

EMERGENCY
Have physician call LOS ANGELES POISON CONTROL CENTER (24 hrs) (800) 356-3129

EYE CONTACT:

MOVE VICTIM AWAY FROM EXPOSURE AND INTO FRESH AIR. IF IRRITATION OR REDNESS DEVELOPS, FLUSH EYES WITH CLEAN WATER AND SEEK MEDICAL ATTENTION. FOR DIRECT CONTACT, HOLD EYELIDS APART AND FLUSH THE AFFECTED EYE(S) WITH CLEAN WATER FOR AT LEAST 15 MINUTES. SEEK MEDICAL ATTENTION.

SECTION II - EMERGENCY AND FIRST AID PROCEDURES

SKIN CONTACT:

REMOVE CONTAMINATED SHOES AND CLOTHING AND FLUSH AFFECTED AREA(S) WITH LARGE AMOUNTS OF WATER. IF SKIN SURFACE IS DAMAGED, APPLY A CLEAN DRESSING, AND SEEK MEDICAL ATTENTION. IF SKIN SURFACE IS NOT DAMAGED, CLEANSE THE AFFECTED AREA(S) THOROUGHLY BY WASHING WITH MILD SOAP AND WATER. IF IRRITATION OR REDNESS DEVELOPS, SEEK MEDICAL ATTENTION.

INHALATION (BREATHING):

IMMEDIATELY MOVE VICTIM AWAY FROM EXPOSURE AND INTO FRESH AIR. IF RESPIRATORY SYMPTOMS OR OTHER SYMPTOMS OF EXPOSURE DEVELOP, SEEK IMMEDIATE MEDICAL ATTENTION. IF VICTIM IS NOT BREATHING, IMMEDIATELY BEGIN ARTIFICIAL RESPIRATION. IF BREATHING DIFFICULTIES DEVELOP, OXYGEN SHOULD BE ADMINISTERED BY QUALIFIED PERSONNEL. SEEK IMMEDIATE MEDICAL ATTENTION.

INGESTION (SWALLOWING):

IF SWALLOWED, SEEK EMERGENCY MEDICAL ATTENTION. IF VICTIM IS DROWSY OR UNCONSCIOUS, PLACE ON THE LEFT SIDE WITH THE HEAD DOWN AND DO NOT GIVE ANYTHING BY MOUTH. IF VICTIM IS CONSCIOUS AND ALERT, VOMITING SHOULD BE INDUCED FOR INGESTIONS OF MORE THAN ONE SWALLOW (1-2 TABLESPOONS FOR AN ADULT) PREFERABLY WITH SYRUP OF IPECAC UNDER DIRECTION FROM A PHYSICIAN OR POISON CENTER. IF SYRUP OF IPECAC IS NOT AVAILABLE, VOMITING CAN BE INDUCED BY GENTLY PLACING TWO FINGERS IN THE BACK OF THE THROAT. IF POSSIBLE, DO NOT LEAVE VICTIM UNATTENDED.

SECTION III - HEALTH HAZARDS/ROUTES OF ENTRY

EYE CONTACT:

THIS MATERIAL IS AN EYE IRRITANT. CONTACT WITH DUSTS MAY CAUSE STINGING, TEARING, REDNESS AND SWELLING.

SKIN CONTACT:

CONTACT WITH DUSTS MAY BE ABRASIVE AND IRRITATING TO THE SKIN AND MAY CAUSE REDNESS AND BURNING. THERE IS INSUFFICIENT INFORMATION AVAILABLE ON THIS MATERIAL TO PREDICT THE EFFECTS FROM SKIN ABSORPTION.

INHALATION (BREATHING):

THIS MATERIAL IS TOXIC BY INHALATION. BREATHING DUSTS MAY BE HARMFUL. EFFECTS OF OVEREXPOSURE MAY INCLUDE IRRITATION OF THE NOSE AND THROAT, DIARRHEA AND TREMORS. PROLONGED OR REPEATED OVEREXPOSURE TO SILICA DUSTS, A COMPONENT OF THIS MATERIAL, MAY RESULT IN PROGRESSIVE AND IRREVERSIBLE LUNG DISEASE (FIBROSIS) CHARACTERIZED BY RESTRICTED BREATHING, CHEST TIGHTNESS AND COUGHING. RESPIRATORY SYMPTOMS ASSOCIATED WITH PRE-EXISTING LUNG DISORDERS (e.g. ASTHMA-LIKE CONDITIONS) MAY BE AGGRAVATED BY EXPOSURE TO THIS MATERIAL.

INGESTION (SWALLOWING):

THIS MATERIAL IS TOXIC AND MAY BE HARMFUL IF SWALLOWED. EFFECTS OF OVEREXPOSURE MAY INCLUDE DIARRHEA AND TREMORS.

COMMENTS:

CRYSTALLINE SILICA, A COMPONENT OF THIS MATERIAL, HAS BEEN IDENTIFIED AS A PROBABLE HUMAN CARCINOGEN BY NTP AND IARC.

SECTION IV - SPECIAL PROTECTION INFORMATION

VENTILATION:

IF CURRENT VENTILATION PRACTICES ARE NOT ADEQUATE TO MAINTAIN AIRBORNE CONCENTRATIONS BELOW THE ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), ADDITIONAL VENTILATION OR EXHAUST SYSTEMS MAY BE REQUIRED.

RESPIRATORY PROTECTION:

IF AIRBORNE CONCENTRATIONS EXCEED ESTABLISHED EXPOSURE LIMITS (SEE SECTION I), A SUITABLE FILTER TYPE RESPIRATOR SHOULD BE WORN.

PROTECTIVE GLOVES:

THE USE OF GLOVES IMPERMEABLE TO THE SPECIFIC MATERIAL HANDLED IS ADVISED TO PREVENT SKIN CONTACT, POSSIBLE IRRITATION AND ABSORPTION.

EYE PROTECTION:

APPROVED EYE PROTECTION TO SAFEGUARD AGAINST POTENTIAL EYE CONTACT, IRRITATION OR INJURY IS RECOMMENDED.

OTHER PROTECTIVE EQUIPMENT:

IT IS SUGGESTED THAT A SOURCE OF CLEAN WATER BE AVAILABLE IN THE WORK AREA FOR FLUSHING EYES AND SKIN. IMPERVIOUS CLOTHING SHOULD BE WORN AS NEEDED.

SECTION V - REACTIVITY DATA

REACTIVITY:

STABLE UNDER NORMAL CONDITIONS OF STORAGE AND HANDLING.

CONDITIONS AFFECTING REACTIVITY:

NONE KNOWN

INCOMPATIBLE MATERIALS:

AVOID CONTACT WITH STRONG ALKALI METALS OR HOT MAGNESIUM.

HAZARDOUS DECOMPOSITION PRODUCTS:

NONE KNOWN

HAZARDOUS POLYMERIZATION:

NOT NOTED

POLYMERIZATION CONDITIONS TO AVOID:

NONE KNOWN

SECTION VI - SPILL AND LEAK PROCEDURES

HIGHWAY OR RAILWAY SPILLS
Call CHEMTREC (800) 424-9300 Cont. U.S.
(Collect) (202) 483-7616 from Alaska & Hawaii

PRECAUTIONS IN CASE OF RELEASE OR SPILL:

STAY UPWIND AND AWAY FROM SPILL/RELEASE. ISOLATE HAZARD AREA AND LIMIT ENTRY TO AUTHORIZED PERSONNEL. STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). PREVENT SPILLED MATERIAL FROM ENTERING SEWERS, STORM DRAINS,

SECTION VI - SPILL AND LEAK PROCEDURES

OTHER UNAUTHORIZED TREATMENT/DRAINAGE SYSTEMS AND NATURAL WATERWAYS. MINIMIZE DUST GENERATION. SWEEP UP AND PACKAGE APPROPRIATELY FOR DISPOSAL. NOTIFY APPROPRIATE FEDERAL, STATE AND LOCAL AGENCIES. CLEAN-UP PROCEDURE SHOULD INSURE MINIMIZING DUST; VACUUM DUST RATHER THAN SWEEP, FOR EXAMPLE. PREVENT SPILLED MATERIAL FROM ENTERING DRINKING WATER SUPPLIES.

WASTE DISPOSAL METHOD:

DISPOSE OF PRODUCT IN ACCORDANCE WITH LOCAL, COUNTY, STATE, AND FEDERAL REGULATIONS.

SECTION VII - STORAGE AND SPECIAL PRECAUTIONS

HANDLING AND STORAGE PRECAUTIONS:

AVOID CONTACT WITH STRONG ALKALI METALS, (PARTICULARLY SODIUM) OR HOT MAGNESIUM. USE AND STORE THIS MATERIAL IN COOL, DRY, WELL VENTILATED AREAS. KEEP CONTAINER(S) CLOSED. STORE ONLY IN APPROVED CONTAINERS. KEEP AWAY FROM ANY INCOMPATIBLE MATERIALS (SEE SECTION V). PROTECT CONTAINER(S) AGAINST PHYSICAL DAMAGE. DO NOT ENTER CONFINED SPACES SUCH AS TANKS OR PITS WITHOUT FOLLOWING PROPER ENTRY PROCEDURES SUCH AS ASTM D-4276. THE USE OF RESPIRATORY PROTECTION IS ADVISED WHEN CONCENTRATIONS EXCEED ANY ESTABLISHED EXPOSURE LIMITS (SEE SECTIONS I AND IV). WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING OR SHOES. USE GOOD PERSONAL HYGIENE PRACTICE.

SECTION VIII - FIRE AND EXPLOSION HAZARD DATA

			HAZARD RANKING
NFPA HAZARD CLASS	HEALTH HAZARD:	2	0 - LEAST
	FLAMMABILITY:	0	1 - SLIGHT
	REACTIVITY:	0	2 - MODERATE
	OTHER:		3 - HIGH
			4 - EXTREME

EXTINGUISHING MEDIA:

USE THAT WHICH IS APPROPRIATE FOR THE SURROUNDING FIRE.

UNUSUAL FIRE & EXPLOSION HAZARDS:

NO UNUSUAL FIRE OR EXPLOSION HAZARDS ARE EXPECTED.

SPECIAL FIRE FIGHTING PROCEDURES:

WEAR APPROPRIATE PROTECTIVE EQUIPMENT INCLUDING RESPIRATORY PROTECTION AS CONDITIONS WARRANT (SEE SECTION IV). STOP SPILL/RELEASE IF IT CAN BE DONE WITHOUT RISK. MOVE UNDAMAGED CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. WATER SPRAY MAY BE USEFUL IN MINIMIZING OR DISPERSING VAPORS AND COOLING EQUIPMENT EXPOSED TO HEAT AND FLAME.

SECTION IX - PHYSICAL DATA

***UNLESS OTHERWISE NOTED, VALUES ARE AT 20 C/68 F AND 760 mm Hg/1 atm.

MELTING POINT

795 C (SUBLIMES @ 750C)

% SOLUBILITY IN WATER

LOW

SECTION IX - PHYSICAL DATA

SPECIFIC GRAVITY

4.69 @ 25C

APPEARANCE

COLOR MAY VARY FROM YELLOW TO BIEGE

ODOR

NONE

SECTION X - DOCUMENTARY INFORMATION

ISSUE DATE: 04/16/92 PRODUCT CODE NO. 2300/2370/2390

PREV. DATE: 07/23/91 PREV. PROD. CODE NO. NONE

MSDS NO: NONE PREV. MSDS NO: NONE

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Date: 7/18/89
Update: 3/94
#21

CHEMICAL DATA SHEET

I. Chemical/Compound Name: Thorium
   A. Synonyms: Thorium metal, pyrophoric (DOT)
   B. CAS #:7440291
   C. Formula:

II. Physical Characteristics
   A. _____ Liquid __X__ Solid _____ Powder _____ Gas
   B. Color: Silvery-white
   C. Odor:
   D. LEL % Flash Pt. °F
   E. Boiling Point 4500 °C Melting Point 1750°C (Approx.)
   Ionization Potential:
   F. Other: At.Wt. 232.00; valence 4: density 11.72; no stable isotopes

III. Recommended Air Purifying Cartridge:

____Dusts, Fumes, Mists	_____Acid Gases
____Organic Vapors	_____Pesticides
____HEPA	_____Air Purifying is Inappropriate
____Ammonia/Amines	__X__Other: radionuclides

IV. Health Hazards Data
   A. Routes of Entry: __X__ Inhalation ____Skin Absorption __X__Ingestion
   B. Human Carcinogen: __X__ No ___Not Enough Data ___ Suspect ___ Yes
   Classifying Agency: ____NIOSH ___ACGIH ___OSHA
   C. Sensitizer: ___ No ___ No Data ___ Suspect __X__ Yes
   D. Acute Toxicity:
      Eye Contact:_____
      Skin Contact: dermatitis_____
      Inhalation: _____
   E. Chronic Toxicity:
      Target Organs: Ra 224-bones; Th 232/Th228; liver, kidneys, spleen, lymph nodes, bone marrow
      Long-Term Effects: If taken internally, as th 0,, carcinogenic due to radioactivity (IARC*).

V. Exposure Limits
   A. OSHA PEL:_____
   B. ACGIH TLV:_____
   C. IDLH:_____
   D. NIOSH REL:_____
   E. STEL:_____

VI. Other Pertinent Information/Special Precautions: Thorium is not easily eliminated from body; body tissue exposed to radiation may therefore suffer damage.

*IARC - International Agency for Research on Cancer

APPENDIX C

FIELD CHANGE REQUEST FORM

Health & Safety Plan
Change Notice

page_____ of_____

PROJECT: _____ H&S-CN

1) HASP VERSION:_____ SECTION:_____ PAGE(s):_____

RE: __ Change to existing HASP Anticipated Revision date _____

__ Addition to existing HASP

__ Other:_____

_____ CONT.__

2) PROPOSED CHANGE: _____

_____

_____

_____ CONT.__

3) REASON FOR PROPOSED CHANGE(s)

__ Required by SPEC or Change Order __ Other: _____

__ Disposition of Deficiency

__ Change in Regulatory or Other Requirement _____ CONT.__

__ Operational Experience

4) EXHIBITS ATTACHED __ NO __ YES (if YES, describe):_____

_____ CONT.__

5) EBASCO APPROVALS PROJECT MANAGER: _____ Date: _____

SITE MANAGER: _____ Date: _____

H&S MANAGER: _____ Date: _____

Client Approval Required __ NO __ YES (if YES, date submitted) _____

6) CLIENT APPROVAL __ APPROVED __ REMANDED __ REJECTED

Comments:_____

_____

_____ CONT.__

Client Representative:_____ Date: _____

7) DISTRIBUTION AFTER APPROVAL

X HASP UPDATE LIST __ OTHER: _____

X CLIENT _____

X PROJECT FILES _____

8) PREPARED BY:_____ _____ Date: _____

Title: _____

APPENDIX D

HEAT/COLD STRESS

ADOPTED
THRESHOLD LIMIT VALUES

Work - Rest Regime

These Threshold Limit Values (TLVs) refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without advrse health effects. The TLVs shown in Table 1 are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C.

1. Work Load Categories

Heat produced by the body and the environmental heat together determine the total heat load. Therefore, if work is to be performed under hot environmental conditions, the workload category of each job shall be established and the heat exposure limit pertinent to the workload evaluated against the applicable standard in order to protect the worker exposure beyond the permissible limit.

The work load category may be established by ranking each job into light, medium, and heavy categories onthe basis of type of operation. Where the work load is ranked into one of said three categories, i.e.,

(1) light work (up to 200 kcal/hr or 800 Btu/hr): e.g., sitting or standing to control machines, performing light hand or arm work,

(2) moderate work (200-350 kcal/hr or 800-1400 Btu/hr): e.g., walking about with moderate lifting and pushing, or

(3) heavy work (350-500 kcal/hr or 1400-2000 Btu/hr): e.g., pick and shovel work,

The permissible heat exposure limit for that workload shall be determined from Table 1.

2. Work-Rest Regimen

The permissible exposure limits specified in Table 1 and Figure 1 are based on he assumption that the WBGT value of the resting place is the same or very close to that of the workplace.

TABLE 1
Permissible Heat Exposure Threshold Limit Values
(Values are given in °C WBGT)

Work—Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	30.0	26.7	25.0
75% Work — 25% Rest, each hour	30.6	28.0	25.9
50% Work — 50% Rest, each hour	31.4	29.4	27.9
25% Work — 75% Rest, each hour	32.2	31.1	30.0

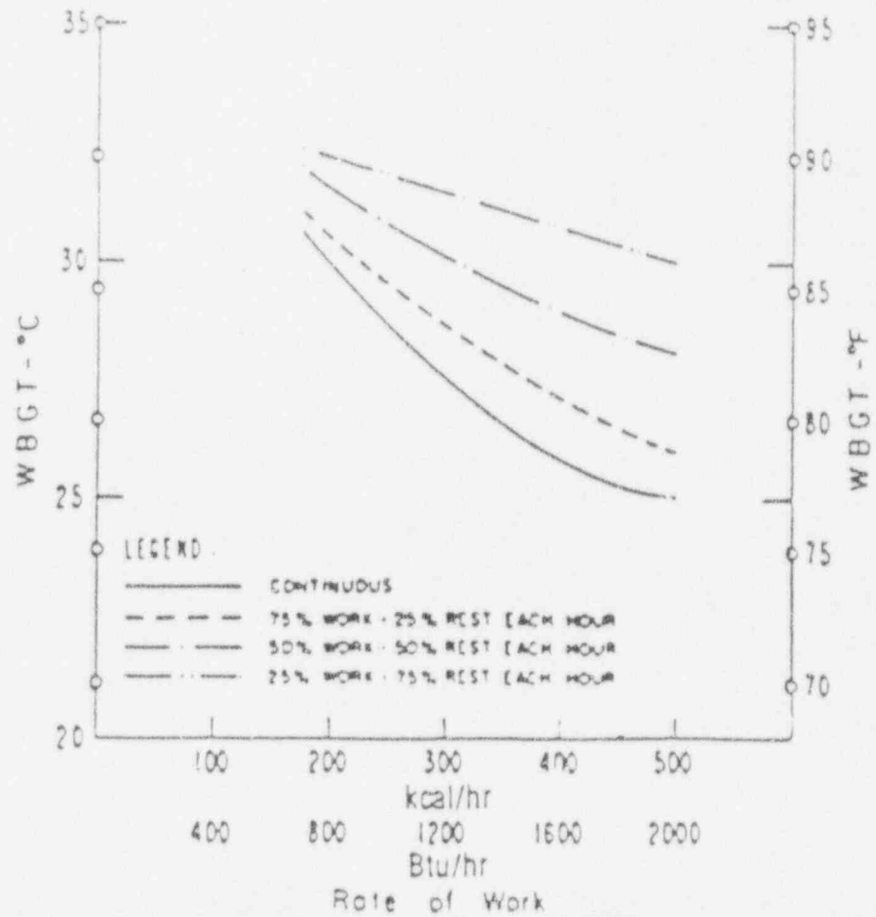


Figure 1 — Permissible Heat Exposure Threshold Limit Values.

HEAT STRESS (Preventive Management)

Adverse weather conditions are important considerations in planning and conducting site operations. Hot or cold weather can cause physical discomfort, loss of efficiency, and personal injury. Of particular importance is heat stress resulting when protective clothing decreases natural body ventilation.

Provide plenty of liquids. To replace body fluids (water and electrolytes) lost because of sweating, use a 0.1 percent saltwater solution, more heavily salted foods, or commercial mixes. The commercial mixes may be preferable for those employees on a low-sodium diet.

Body water loss (BWL) due to sweating should be measured by weighing the worker in the morning and in the evening. The clothing worn should be similar at both weighings; preferably the worker should be nude. The scale should be accurate to plus or minus 1/4 lb. BWL should not exceed 1.5 percent of the total body weight. If it does, the worker should be instructed to increase his daily intake of fluids by the weight lost. Ideally, body fluids should be maintained at a constant level during the work day. This requires replacement of salt lost in sweat as well.

Have workers drink 16 ounces of water before beginning work, such as in the morning or after lunch. Provide disposable 4-ounce cups, and water that is maintained at .50 - 60°F. Urge workers to drink 1 to 2 of these cups of water every 20 minutes for a total of 1 to 2 gallons per day. Provide a cool, preferably air conditioned area for rest breaks. Discourage the use of alcohol during non-working hours, and discourage the intake of coffee during working hours. Monitor for signs of heat stress.

Monitoring of personnel wearing impervious clothing should commence when the ambient temperature is 70°F or above. Frequency of monitoring should increase as the ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 80°F, workers should be monitored for heat stress after every work period. The following are important considerations:

1. Heart rate (HR) should be measured by the radial pulse for 30 sec. as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/min. If the HR is higher, the next work period should be shortened by 10 min. (or 33 percent), while the length of the rest period stays the same. If the pulse rate is 100 beats/min. at the beginning of the next rest period, the following work cycle should be shortened by 33 percent.

- Symptoms -- Acute painful spasms of voluntary muscles, e.g., abdomen and extremities.

- Treatment -- Remove victim to a cool area and loosen clothing. Have patient drink 1 to 2 cups water immediately, and every 20 minutes thereafter until symptoms subside. Total water consumption should be 1 to 2 gallons per day. Consult with physician.

2. Heat Rash

Heat rash is caused by continuous exposure to heat and humid air and aggravated by chafing clothes. The condition decreases ability to tolerate heat.

- Symptoms -- Mild red rash, especially in areas of the body in contact with protective gear.

- Treatment -- Decrease amount of time in protective gear and provide powder to help absorb moisture and decrease chafing.

3. Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of heat regulating mechanisms of the body -- the individual's temperature control system that causes sweating stops working correctly. Body temperature rises so high that brain damage and death will result if the person is not cooled quickly.

- Symptoms -- Red, hot, dry skin, although person may have been sweating earlier; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rate; unconsciousness or coma.

- Treatment -- Cool the victim quickly. If the body temperature is not brought down fast, permanent brain damage or death will result. Soak the victim in cool, but not cold, water; sponge the body with cool water or pour water on the body to reduce the temperature to a safe level (102°F). Observe the victim and obtain medical help. Do not give coffee, tea, or alcoholic beverages.

4. Heat Exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. The condition is much less dangerous than heat stoke, but it nonetheless must be treated.

2. Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 min. (or 33 percent), while the length of the rest period stays the same. However, if the OT exceeds 99.7°F at the beginning of the next period, the following work cycle should be further shortened by 33 percent. OT should be measured again at the end of the rest period to make sure that it has dropped below 99°F.

   Acclimate workers to site work conditions by slowly increasing workloads, i.e., do not begin site work activities with extremely demanding activities.

3. Provide cooling devices to aid natural body ventilation. These devices, however, add weight, and their use should be balanced against worker efficiency. Long cotton underwear acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing. It should be the minimum under-garment worn.

   Install mobile showers and/or hose-down facilities to reduce body temperature and cool protective clothing.

   In extremely hot weather, conduct nonemergency response operations in the early morning or evening.

   Ensure that adequate shelter is available to protect personnel against heat, cold, rain, snow, etc., which can decrease physical efficiency and increase the probability of accidents.

   In hot weather, rotate shifts of workers wearing impervious clothing.

4. Good hygienic standards must be maintained by frequent change of clothing and daily showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

HEAT STRESS CONDITIONS

1. Heat Cramps

   Heat cramps are caused by perspiration that is not balanced by adequate fluid intake. Heat cramps are often the first sign of a condition that can lead to heat stroke.

The permissible exposure limits for continuous work are applicable where there is a work-rest regimen of a 5-day work week and an 8-hour work day with a short morning and afternoon break (approximately 15 minutes) and a longer lunch break (approximately 30 minutes). Higher exposure limits are permitted if additional resting time is allowed. All breaks, including unscheduled pauses and administrative or operational waiting periods during work, may be counted as rest time when additional rest allowance must be given because of high environmental temperatures.

3. Clothing:

The permissible heat exposure TLVs are valid for light summer clothing as customarily worn by workers when working under hot environmental conditins. If special clothing is required for performing a particular job and this clothing is heavier or it impedes sweat evaporation or has higher insulation value, the worker's heat tolerance is reduced, and the permissible heat exposure limits indicated in Table 1 and Figure 1 are not applicable. For each job category where special clothing is required, the permissible hat exposure limit shall be established by an expert.

4. Acclimatization and Fitness:

Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during this first week of exposure to hot environmental conditions. The recommended heat stress TLVs are valid for acclimated workers who are physicall fit. Extra caution must be employed when unacclimated or physically unfit workers must be exposed to heat stress conditions.

- Symptoms -- Pale, clammy, moist skin; profuse perspiration and extreme weakness. Body temperature is normal, pulse is weak and rapid, breathing is shallow. The person may have a headache, may vomit, and may be dizzy.

- Treatment -- Remove the person to a cool, air conditioned place, loosen clothing, place in a head-low position and provide bed rest. Consult physician, especially in severe cases. The normal thirst mechanism is not sensitive enough to ensure body fluid replacement. Have patient drink 1 to 2 cups water immediately, and every 20 minutes thereafter until symptoms subside. Total water consumption should be about 1 to 2 gallons per day.

COLD STRESS

The cold stress TLVs are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body temperature from falling below 36°C (96.8°F) and to prevent cold injury to body extremities (deep body temperature is the core temperature of the body determined by conventional methods for rectal temperature measurements). For a single, occasional exposure to a cold environment, a drop in core temperature to no lower that 35°C (95°F) should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1. Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating dry clothing to maintain core temperatures above 36°C (96.8°F) must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill cooling rate and the cooling power of air are critical factors. [Wind chill cooling rate is defined as heat loss from a body expressed in watts per meter squared which is a function of the air temperature and wind velocity upon the exposed body.] The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required. An equivalent chill temperature chart relating the actual dry bulb air temperature and the wind velocity is presented in Table 2. The equivalent chill temperature should be used when estimating the combined co ing effect of wind and low air temperatures on exposed skin when determining clothing insulation requirements to maintain deep body core temperature.

2. Unless there are unusual or extenuating circumstances, cold inju to other than hands, feet, and head is not likely to occur witho the development of the initial signs of hypothermia. Older worke or workers with circulatory problems require special precautiona protection against cold injury. The use of extra insulating clothin and/or a reduction in the duration of the exposure period a among the special precautions which should be considered. Th precautionary actions to be taken will depend upon the physic condition of the worker and should be determined with the advic of a physician with knowledge of the cold stress factors and th medical condition of the worker.

TABLE 1. Progressive Clinical Presentations of Hypotherm

Core Temperature °C	Core Temperature °F	Clinical Signs
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases in an attempt to pensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with n blood pressure
33	91.4	Severe hypothermia below this temperature
32 / 31	89.6 / 87.8	Consciousness clouded; blood pressure bec difficult to obtain; pupils dilated but rea light; shivering ceases
30 / 29	86.0 / 84.2	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure cult to obtain; respiratory rate decreases
28	82.4	Ventricular fibrillation possible with myoca irritability
27	80.6	Voluntary motion ceases; pupils nonreacti light; deep tendon and superficial reflexes ab
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneou
24	75.2	Pulmonary edema
22 / 21	71.6 / 69.8	Maximum risk of ventricular fibrilation
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to reco
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patien recover

*Presentations approximately related to core temperature. Reprinted from the Jan 1982 issue of *American Family Physician*, published by the American Academy Family Physicians

under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee should make sure that clothing is not wet as a consequence of sweating. If clothing is wet, the employee should change into dry clothes before entering the cold area. The workers should change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change should be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.

If exposed areas of the body cannot be protected sufficiently to prevent sensation of excessive cold or frostbite, protective items should be supplied in auxiliary heated versions.

If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

Workers handling evaporative liquid (gasoline, alcohol or cleaning fluids) at air temperatures below 4°C (39.2°F) should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point that is just above ambient temperature.

ork–Warming Regimen

If work is performed continuously in the cold at an equivalent chill nperature (ECT) or below –7°C (19.4°F), heated warming shelters nts, cabins, rest rooms, etc.) should be made available nearby. The rkers should be encouraged to use these shelters at regular inter- s, the frequency depending on the severity of the environmental osure. The onset of heavy shivering, frostnip, the feeling of exces- fatigue, drowsiness, irritability, or euphoria are indications for nediate return to the shelter. When entering the heated shelter, the r layer of clothing should be removed and the remainder of the hing loosened to permit sweat evaporation or a change of dry work hing provided. A change of dry work clothing should be provided necessary to prevent workers from returning to work with wet hing. Dehydration, or the loss of body fluids, occurs insidiously in cold environment and may increase the susceptibility of the worker old injury due to a significant change in blood flow to the extremi- Warm sweet drinks and soups should be provided at the work to provide caloric intake and fluid volume. The intake of coffee ld be limited because of the diuretic and circulatory effects.

or work practices at or below –12°C (10.4°F) ECT, the following ld apply:

TABLE 3. Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shifts

Air Temperature—Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
–26° to –28°	–15° to –19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4
–29° to –31°	–20° to –24°	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4	30 min	5
–32° to –34°	–25° to –29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
–35° to –37°	–30° to –34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
–38° to –39°	–35° to –39°	40 min	4	30 min	5	Non-emergency work should cease					
–40° to –42°	–40° to –44°	30 min	5	Non-emergency work should cease							
–43° & below	–45° & below	Non-emergency work should cease									

TABLE 2. Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* In < hr with dry skin. Maximum danger of false sense of security				*INCREASING DANGER* Danger from freezing of exposed flesh within one minute.				*GREAT DANGER* Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Evaluation and Control

For exposed skin, continuous exposure should not be p when the air speed and temperature results in an equivalent perature of −32°C (−25.6°F). Superficial or deep local tissue will occur only at temperatures below −1°C (30.2°F) regardles speed.

At air temperatures of 2°C (35.6°F) or less, it is impera workers who become immersed in water or whose clothing wet be immediately provided a change of clothing and be tr hypothermia.

TLVs recommended for properly clothed workers for pe work at temperatures below freezing are shown in Table 3.

Special protection of the hands is required to maintain dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for mo 10–20 minutes in an environment below 16°C (60.8°F), provisions should be established for keeping the workers warm. For this purpose, warm air jets, radiant heaters (fue or electric radiator), or contact warm plates may be utilize handles of tools and control bars should be covered by insulating material at temperatures below −1°C (30.2°F).
2. If the air temperature falls below 16°C (60.8°F) for sedent (39.2°F) for light, −7°C (19.4°F) for moderate work, and fine al dexterity is not required, then gloves should be used workers.

To prevent contact frostbite, the workers should wear anti gloves.

1. When cold surfaces below −7°C (19.4°F) are within reach, a ing should be given to each worker to prevent inadvertent by bare skin.
2. If the air temperature is −17.5°C (0°F) or less, the hands sho protected by mittens. Machine controls and tools for use conditions should be designed so that they can be handled w removing the mittens.

Provisions for additional total body protection are required i is performed in an environment at or below 4°C (39.2°F). The w should wear cold protective clothing appropriate for the level o and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or cial ventilating equipment, the cooling effect of the wind sho reduced by shielding the work area or by wearing an easily re able windbreak garment.
2. If only light work is involved and if the clothing on the worke become wet on the job site, the outer layer of the clothing i may be of a type impermeable to water. With more severe

1. Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of ten (10) minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4 hour work period in a warm location. For Light-to-Moderate Work at a job with little physical movement: apply the schedule one step lower. For example, at –35°C (–30°F) with no noticeable wind (Step 4), a worker
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:
   5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m^2; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W /m^2. In general, the warmup schedule provided above slightly undercompensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges because windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

*Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labour.

1. The worker should be under constant protective observation (buddy system or supervision).
2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods should be taken in heated shelters and opportunity for changing into dry clothing should be provided.
3. New employees should not be required to work fulltime in the cold during the first days of employment until they become accustomed to the working conditions and required protective clothing.
4. The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
5. The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.
6. The workers should be instructed in safety and health procedures. The training program should include as a minimum instruction in:
   a. Proper rewarming procedures and appropriate first aid treatment.
   b. Proper clothing practices.
   c. Proper eating and drinking habits.
   d. Recognition of impending frostbite.
   e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
   f. Safe work practices.

Special Workplace Recommendations

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.
2. Special wind protective clothing should be provided based upon existing air velocities to which workers are exposed.

Special caution should be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain should be supplied. Special safety goggles

to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60.8°F) so that overall compliance with the requirements of the TLV can be maintained.

2. Whenever the air temperature at a workplace falls below −1°C (30.2°F), the dry bulb temperature should be measured and recorded at least every 4 hours.

3. In indoor workplaces, the wind speed should also be recorded at least every 4 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).

4. In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below −1°C (30.2°F).

5. The equivalent chill temperature should be obtained from Table 2 in all cases where air movement measurements are required; it should be recorded with the other data whenever the equivalent chill temperature is below −7°C (19.4°F).

Employees should be excluded from work in cold at −1°C (30.2°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below −24°C (−11.2°F) with wind speeds less than five miles per hour, or air temperatures below −18°C (0°F) with wind speeds above five miles per hour, should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissues in addition to providing for first aid treatment.

APPENDIX E

MEDICAL DATA SHEETS

MEDICAL DATA SHEET/FIELD TEAM REVIEW

This brief Medical Data Sheet will be completed by all on-site personnel and will be kept with the health and safety officer during the site visit. This Medical Data Sheet is not a substitute for the Medical Surveillance program requirements consistent with the Ebasco Health and Safety Program for Hazardous Waste Sites. This medical data sheet will accompany personnel offsite if medical assistance or transport to a hospital is required.

Project_____

Name_____

Address_____ Home Telephone_____

Age_____ Height_____ Weight_____

Emergency Contacts (List 2)

_____Telephone_____

_____Telephone_____

Allegeries/Drug Sensitivities_____

_____

Do you wear Contacts?_____

List any illness that was a result of known chemical-exposure.

_____

_____

Have you been hospitalized as a result of a known chemical exposure?

Date/Hospital/Length of Stay_____

What medications/drugs are you presently using?

_____

Medical Restrictions_____

Name of Personal Physician_____

Telephone_____

I have read and reviewed the Site-Specific Health and Safety Plan, understand the information contained therein and will comply with all provisions.

Name:_____

Signature:_____

Date:_____

Site/Project:_____

MEDICAL DATA SHEET/FIELD TEAM REVIEW

This brief Medical Data Sheet will be completed by all on-site personnel and will be kept with the health and safety officer during the site visit. This Medical Data Sheet is not a substitute for the Medical Surveillance program requirements consistent with the Ebasco Health and Safety Program for Hazardous Waste Sites. This medical data sheet will accompany personnel offsite if medical assistance or transport to a hospital is required.

Project_____

Name_____

Address_____ Home Telephone_____

Age_____ Height_____ Weight_____

Emergency Contacts (List 2)

_____Telephone_____

_____Telephone_____

Allegeries/Drug Sensitivities_____

_____

Do you wear Contacts?_____

List any illness that was a result of known chemical-exposure.

_____

_____

Have you been hospitalized as a result of a known chemical exposure?

Date/Hospital/Length of Stay_____

What medications/drugs are you presently using?

_____

Medical Restrictions_____

Name of Personal Physician_____

Telephone_____

I have read and reviewed the Site-Specific Health and Safety Plan, understand the information contained therein and will comply with all provisions.

Name:_____

Signature:_____

Date:_____

Site/Project:_____

MEDICAL DATA SHEET/FIELD TEAM REVIEW

This brief Medical Data Sheet will be completed by all on-site personnel and will be kept with the health and safety officer during the site visit. This Medical Data Sheet is not a substitute for the Medical Surveillance program requirements consistent with the Ebasco Health and Safety Program for Hazardous Waste Sites. This medical data sheet will accompany personnel offsite if medical assistance or transport to a hospital is required.

Project_____

Name_____

Address_____ Home Telephone_____

Age_____ Height_____ Weight_____

Emergency Contacts (List 2)

_____Telephone_____

_____Telephone_____

Allegeries/Drug Sensitivities_____

_____

Do you wear Contacts?_____

List any illness that was a result of known chemical-exposure.

_____

_____

Have you been hospitalized as a result of a known chemical exposure?

Date/Hospital/Length of Stay_____

What medications/drugs are you presently using?

_____

Medical Restrictions_____

Name of Personal Physician_____

Telephone_____

I have read and reviewed the Site-Specific Health and Safety Plan, understand the information contained therein and will comply with all provisions.

Name:_____

Signature:_____

Date:_____

Site/Project:_____

MEDICAL DATA SHEET/FIELD TEAM REVIEW

This brief Medical Data Sheet will be completed by all on-site personnel and will be kept with the health and safety officer during the site visit. This Medical Data Sheet is not a substitute for the Medical Surveillance program requirements consistent with the Ebasco Health and Safety Program for Hazardous Waste Sites. This medical data sheet will accompany personnel offsite if medical assistance or transport to a hospital is required.

Project_____

Name_____

Address_____ Home Telephone_____

Age_____ Height_____ Weight_____

Emergency Contacts (List 2)

_____Telephone_____

_____Telephone_____

Allegeries/Drug Sensitivities_____

_____

Do you wear Contacts?_____

List any illness that was a result of known chemical-exposure.

_____

_____

Have you been hospitalized as a result of a known chemical exposure?

Date/Hospital/Length of Stay_____

What medications/drugs are you presently using?

_____

Medical Restrictions_____

Name of Personal Physician_____

Telephone_____

I have read and reviewed the Site-Specific Health and Safety Plan, understand the information contained therein and will comply with all provisions.

Name:_____

Signature:_____

Date:_____

Site/Project:_____

APPENDIX F

FIELD TEAM REVIEW

FIELD TEAM REVIEW

Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read or have been verbally advised of all aspects of this Offsite Sampling Locations Health and Safety Plan for the Molycorp Inc., Washington, Pennsylvania, project site. I understand and will comply with the provisions contained therein.

Date	Name	Signature

APPENDIX G

ACCIDENT/INCIDENT REPORT

EBASCO ENVIRONMENTAL
A Division of Ebasco Services Incorporated

☐ Recordable ☐ Non-Recordable

ACCIDENT/INCIDENT REPORT

Page ___ of ___

☐ Original Submittal ☐ Correction Submittal	Report Prepared By (please print):	Date Prepared:
Project:	Project Location (Address, City, State, Zip):	

Involved Employee Name (Last, First, M.I.):			Social Security No.:	Severity of Injury/Illness 0 First Aid 1 Medical 2 Lost Time 3 Fatal 4 Non-Industrial	Lost Work Days: Est.: Actual: Restricted Work Days: Est.: Actual:	
Sex: M or F	Age:	Date Reported:	Accident Date:	Accident Time (Military):		

Home Address: _____
Street
_____ Phone: (___) _____
City State Zip

Company Name:	Department:	Work Phone: ( )
Regular Job Title:	Supervisor:	
Time on Job: Years: Months:	Time Employed: Years: Months:	Experience: Years: Months:

Witnesses to Incident:

1. Name: _____ Company: _____
   Address: _____
   Home Phone: ( ) _____ Work Phone: ( ) _____
2. Name: _____ Company: _____
   Address: _____
   Home Phone: ( ) _____ Work Phone: ( ) _____

If Hospitalized:

Name of Hospital: _____ Phone: ( ) _____
Address: _____
Street City State Zip

Physician's Name: _____ Phone: ( ) _____
Address: _____
Street City State Zip

Property Damage (describe property damaged and dollar estimate of damage):

_____
_____
_____
_____

ADMS:

ACCIDENT/INCIDENT REPORT (cont.)

Narrative Report of Accident/Incident (include date, time, location, etc.):

Causative Factors of Accident/Incident (i.e., training, carelessness, faulty equipment, weather conditions, etc.)

Use Space Below to Map Location of Accident/Incident (include landmarks such as well number, borehole number, cross street names, section number, etc.):

ACCIDENT/INCIDENT REPORT (cont.)

Additional Information:

Report Prepared By: _____ Date: _____
Signature

Accident/Incident Investigation Participants:

1. Name: _____ Date: _____
Print Signature

2. Name: _____ Date: _____
Print Signature

3. Name: _____ Date: _____
Print Signature

ACCIDENT/INCIDENT REPORT FOLLOW-UP

Date: _____

Name of Involved Employee:

_____
First Middle Last

Date of Accident/Incident: _____ Project: _____

Actions Taken to Prevent Recurrence:

Outcome of Incident:

Physician's Recommendations (attach return-to-work form if available):

Follow-up Report Prepared By:

_____ _____
Print Clearly Signature

Attach any additional information to this form.

ACCIDENT/INCIDENT REPORT (cont.)

Incident Analysis (circle one from each category):

Worker Class
1 technician
2 assistant
3 associate
4 engineer
5 other

Craft
01 administration
02 driller
03 laborer
04 electrician
05 engineer
06 technician
07 welder
08 geologist/hydrogeologist
09 health and safety
10 biologist
11 meteorologist
12 air quality
13 QA/QC
14 other

Work Phase
01 excavation
02 construction
03 general labor
04 mechanical
05 office
06 warehouse
07 welding
08 drilling
09 sampling (specify)
_____
_____
10 other

Employment Period
01 1 week or less
02 2–4 weeks
03 1–2 months
04 2–6 months
05 6–12 months
06 1–2 years
07 2–5 years
08 5–10 years
09 over 10 years
10 unknown

Approximate Age
01 under 20
02 20–30
03 31–40
04 41–50
05 51–60
06 over 61
07 unknown

Time of Accident
01 0801–1000
02 1001–1200
03 1201–1400
04 1401–1600
05 1601–1800
06 1801–2000
07 2001–2200
08 2201–2400
09 0001–0200
10 0201–0400
11 0401–0600
12 0601–0800

Injury Type
01 amputation
02 strain/sprain
03 crush/mash/smash
04 fracture
05 cut/puncture/laceration
06 burn
07 contusion/abrasions
08 foreign body/eye injury
09 faint/dizziness
10 bruises
11 blisters
12 hearing loss
13 none—refer to illness code
14 other

Body Part
01 head/face
02 eye
03 ear
04 neck/shoulders
05 arm/elbow
06 wrist/hand
07 thumb/finger
08 back
09 chest/lower trunk
10 ribs
11 hip
12 leg/knee
13 foot/ankle
14 toe
15 hernia/rupture
16 heart attack
17 internal
18 death
19 other

Injury Cause

Struck by Tool or Object
01 hand tool or machine in use
02 falling or flying objects
03 tipping, sliding, or rolling objects
04 object handled by others
05 moving parts of machine
06 object being lifted or handled
07 motor vehicle

Strain or Overexertion
10 lifting
11 using tool or machine
12 pushing or pulling
13 holding or carrying
14 reaching

Cut, Puncture, Scrape Injury by
15 hand tool/not powered
16 powered hand tool/appliance
17 object being lifted/handled
18 broken glass

Fall or Slip
21 on same level
22 from different level
23 slipped, but not fall

Striking Against
31 object being handled
32 stepping on sharp objects
33 stationary object
34 moving parts of machine
35 moving object

Motor Vehicle Injuries
41 collision with another vehicle
42 collision with a fixed object
43 vehicle upset

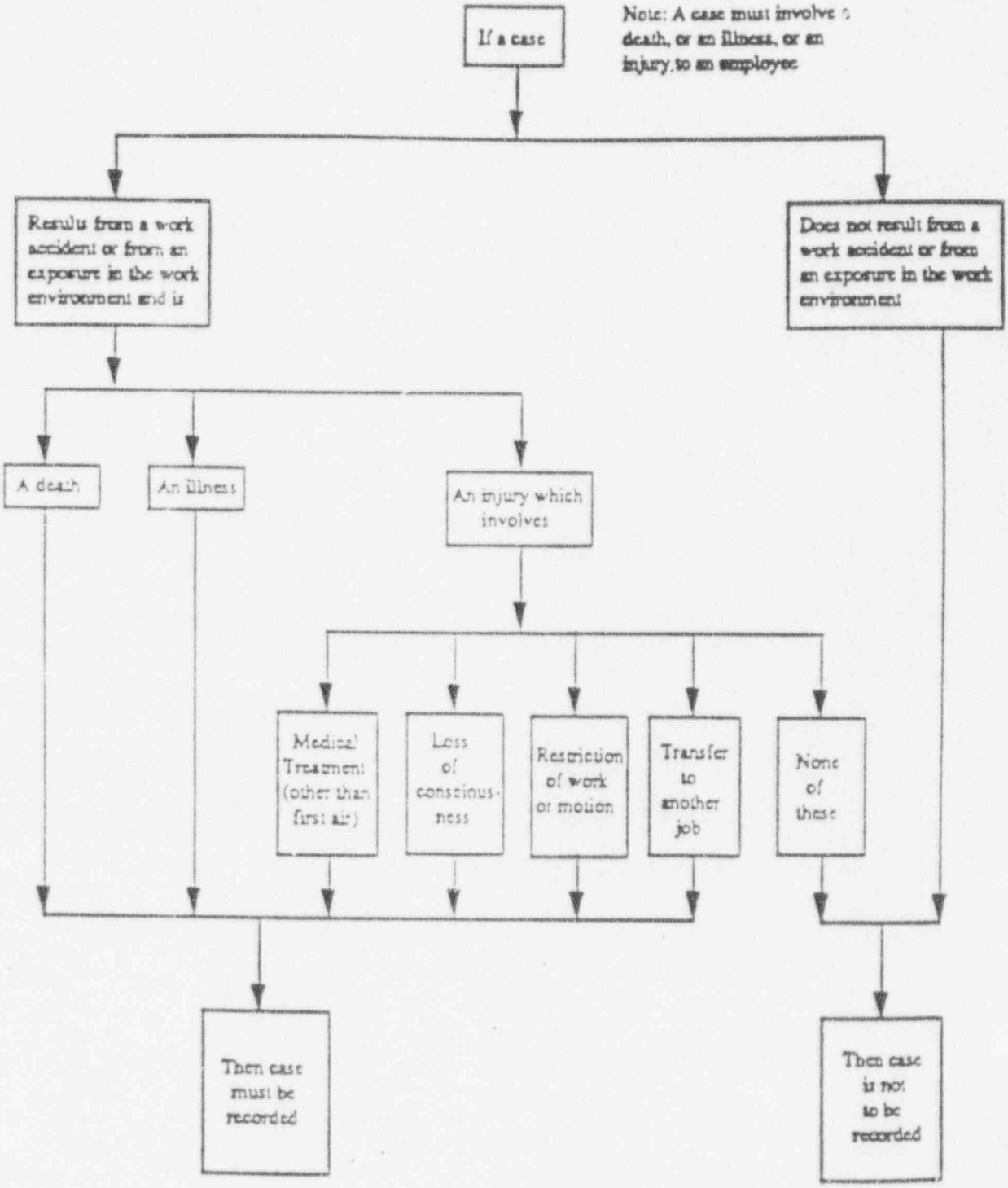
Caught On, In, or Between
51 machine or machine parts
52 mechanical apparatus
53 object handled/other object

Burn or Heat–Cold Exposure
61 steam or hot fluids
62 welding operation
63 fire or flame
64 contact with hot object
65 acids–chemicals
66 heat exhaustion
67 heat stroke
68 hyperthermia
69 frostbite

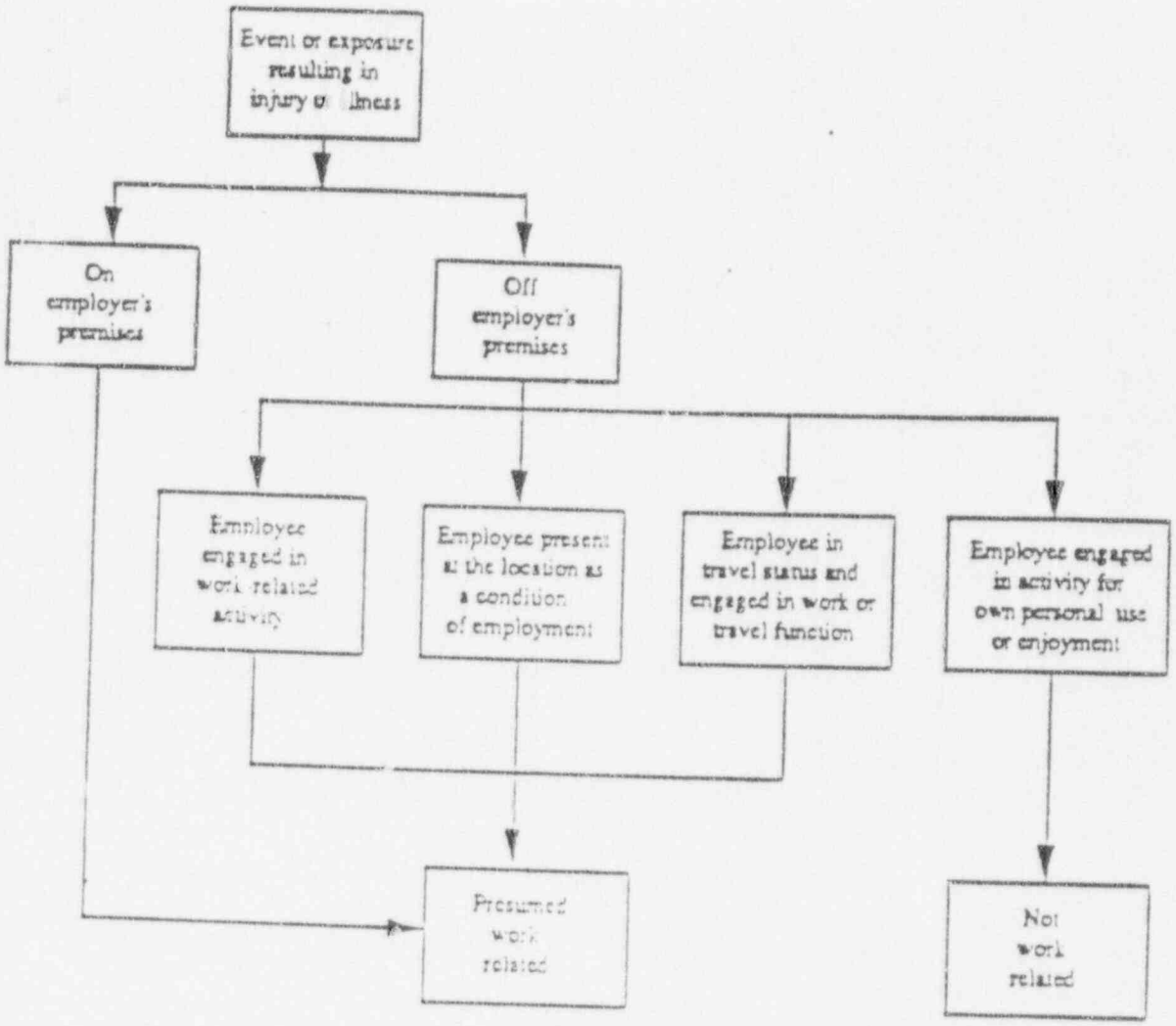
Miscellaneous Causes
71 contact with electrical current
72 suffocation
73 explosion or flashback
74 by animal or insect
75 foreign body in eye
76 miscellaneous describe

Illness
91 skin disease
92 respiratory disease
93 accidental poisoning
94 systemic effects
95 disorders due to physical agents
96 repetitive trauma disorders
97 other describe

Guide to Recordability of Cases Under the Occupation Safety and Health Act



Guidelines for Establishing Work Relationship



APPENDIX H

OSHA POSTER