

9.1 PURPOSE AND SCOPE

This document defines the Standard Operating Procedure (SOP) for abandoning borings at the Iowa Army Ammunition Plant (IAAAP) and gives descriptions of equipment and field procedures necessary to abandon borings. These procedures described are sufficiently detailed to allow field personnel to properly abandon a boring. Field procedures for boring abandonment were developed using USACE Omaha District Geology Scope of Services as guidance, and are detailed in this SOP. Applicable SOPs are listed below:

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- SOP No. 1 - Surface Soil/Sediment Sampling
- SOP No. 2 - Subsurface Drilling, Soil Sampling, and Logging

9.2 BORING ABANDONMENT PROCEDURES

9.2.1 Equipment List

The following is the recommended equipment list for boring abandonment:

- Portland cement (type I or II) and powdered bentonite for grouting
- Bentonite chips
- Potable water
- Drill rig or portable grout station
- Logbook
- Boring log sheets
- Waterproof and permanent marking pens
- Tremie pipe
- Appropriate health and safety equipment

9.2.2 Abandonment Procedures

Following completion of the borings each boring must be abandoned and plugged to provide a low-permeability zone that would retard movement of water through the boring backfill.

Where water was not encountered and the boring sidewalls are stable the boring may be backfilled using hydrated bentonite chips. The dry bentonite chips are poured into the boring from the ground surface filling the boring in 1-foot lifts. Hydration of the bentonite chips with 1 gallon of water is necessary for each lift of bentonite chips.

Where water was encountered in the boring and where the boring sidewalls are unstable the boring must be backfilled with a fluid cement/bentonite grout pumped into the boring. The grout will consist of a mixture that is blended to produce a thick, lump-free, cement/bentonite grout. The grout will be prepared in an above-ground rigid container by mixing the bentonite powder with potable water. Mix the grout until free of any clumps of powdered material. Pump the grout mixture into the base of the boring using drill rods or tremie pipe placed through the center

of the augers. Initially place the drill rods or tremie pipe 3 feet above the bottom of the boring. Pump grout into the boring maintaining a positive head of grout within the central core of the augers at all times. Pull the augers and the tremie pipe or drill rods incrementally until the boring is grouted to the ground surface. After the grout has set for 24 hours check the boring for settlement. Add grout as required to refill the boring.

9.2.3 Pavement Repair

Where borings penetrate surface pavements, walkways or sidewalks, it will be necessary to patch the pavement surface following backfilling. Concrete pavements should be filled with 3000 psi concrete mix. Asphaltic concrete pavements should be filled with asphaltic concrete patch mix and thoroughly compacted by ramming. The surface of any patch should be leveled upon completion. In freezing weather the concrete mix must be protected with tarps or blankets to keep from freezing for 48 hours after placement.

9.2.4 Documentation

Observations and data acquired in the field during boring abandonment will be recorded to provide a permanent record. These observations are recommended to be recorded with waterproof black ink in a bound weatherproof field logbook with consecutively numbered pages.

A boring log/diagram will be completed for each boring with observations and procedures recorded in the field logbook. A description of the well abandonment procedures, including drilling and the placement of well abandonment material, will be included in the field logbook. A description of drilling equipment and quality control procedures will be documented. A note will be placed on the boring log that the boring was abandoned and backfilled with hydrated bentonite chips or grouted with a cement/bentonite mixture to the ground surface or the pavement subgrade. The type of material used to patch the pavement surface will also be noted on the boring log and the field logbook.

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Standard Operating Procedure No. 10
Permits and Clearances

10.1 PURPOSE AND SCOPE

This document defines the Standard Operating Procedure (SOP) for obtaining permits and clearances at the Iowa Army Ammunition Plant (IAAAP). Permits and clearances are required for plant security, and for underground utility clearance (drilling, hand augering, excavating, etc.).

10.2 GENERAL REQUIREMENTS

Subcontractors will adhere to the IAAAP security and safety regulations while working at the facility. Subcontractors will inform each employee of the security and safety requirements and ensure that the regulations are strictly maintained. The Subcontractor will submit a list of the personnel anticipated to work on-site to the security department.

10.2.1 Citizenship

Personnel working in restricted security areas will be U. S. Citizens. Proof of U. S. Citizenship will be shown before entering any restricted security area. If required, the subcontractor will obtain and submit fingerprints of personnel working on-site.

10.2.2 Identification Badges

Subcontractor field personnel will obtain construction identification badges with photographs from American Ordnance (AO) Security in coordination with the Plant Protection Division. The identification badge will be displayed while working at the facility. Subcontractors will ensure the badges are returned to the AO Security upon completion of the work.

Subcontractors will display their identification badges to gain access to the facility general area and those limited areas specifically authorized on the face of the badge. Subcontractors will understand that any employee possessing a badge is bound by the Security Regulations of the Plant. The Plant Protection Division and/or AO Security may deny issuance or revoke any badge from an individual not complying with these rules.

10.2.3 Law Check

The subcontractor will ensure that each employee and all subcontractor personnel on-site have a law check performed and will request subcontractors to have law checks performed for its field staff. The subcontractor will send the form to the employee's local law enforcement agency to determine whether the employee has a police record. If any subcontractor employee has a police record, it will be forwarded to the Plant's security officials for review. Upon review, the security officials may deny issuance of a badge for that subcontractor employee.

10.2.4 Facility Access

Vehicle "Visitor" placards will not be issued. The badges will designate areas of access for the individuals and their vehicles. Vehicles must be visibly identified by a company name. All vehicles will be subject to search when exiting through access gates of the general plant areas.

Subcontractors will access the facility area through Vehicle Gate Number 4 and 5. Material delivered via commercial trucks will enter the facility through Gate No. 3 during the hours of 0700 to 1730 on Monday through Thursday. Special Arrangements can be made to accommodate Off-time deliveries. The plant gates and their primary uses and operating times are outlined in the following list:

- Gate 1 is a specially designated construction gate used only in the event of facility labor dispute. If a labor dispute occurs, subcontractor personnel must use Gate No. 1 to access the facility. (Currently, this gate is not utilized.)
- Gate 2, the East gate, is currently utilized at shift change. Monday through Thursday from 5:45 a.m. to 7:45 a.m. and from 3:45 p.m. to 6:00 p.m.
- Gate 3, the commercial gate, is open Monday through Thursday from 7:00 a.m. to 2:00 p.m.
- Gate 4, the main gate, is open 24 hours daily.
- Gate 5, the South gate, is open Monday through Thursday from 5:45 a.m. to 7:45 a.m. and from 3:45 p.m. to 6:00 p.m.

10.2.5 Camera Pass

Subcontractor personnel will obtain a camera pass from AO prior to entering IAAAP with a camera. Photographs taken within the installation will include only project sites and operations. No photographs will be taken of production facilities.

10.2.6 Permits and Licenses

Subcontractors will comply with the IAAAP requirements of an IAAAP Safety Work Permit. An IAAAP Safety Work Permit will be issued by the IAAAP (AO) Safety Manager after the site safety initiation briefing. If hot work is anticipated, this permit can be modified to include it.

10.3 UTILITY CLEARANCES

A utility locate will be performed for all subsurface drilling activities prior to initiating the work. Utility locates will be coordinated through the facility engineering. Subcontractors will notify the facility of on-site subsurface work one week in advance. When any intrusive work is being performed in the vicinity of utility and/or communication cables/lines, Civil Engineering and/or Communication monitoring personnel, as required, will be present. No work shall start if the required monitoring personnel are not present. No mechanical digging shall be performed within 5 (five) feet on each side of utilities and/or communication line(s) until they are physically

exposed by hand digging. If a utility and/or communication line is damaged, the designated representative of the U.S. Army shall be notified immediately for further directions.

10.4 OTHER PERMITS AND LICENSES

All field personnel, including subcontractors will be OSHA 40-hour trained. One member from the field team will have the 8-hour site supervisor training. All drilling will be done by a State of Iowa Licensed Driller. All surveying will be done by a Sate of Iowa Licensed Land Surveyor.

Standard Operating Procedure No. 11
Random Sampling

11.1 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) discusses the recommended procedures for random sample collection at pre-construction sites at Iowa Army Ammunition Plant (IAAAP). This SOP should be used on a graded approach so that the level of detail for each project-specific SOP will vary according to the nature of the work performed and the intended uses of data generated, and the requirements of participating organizations. However, a SOP that meets the acceptable level of detail for one project may not include an acceptable level of detail for a different project. While this SOP is provided as general guidance, deviations from this SOP should be clearly identified and fully documented.

These procedures give descriptions of equipment, field procedures, documentation procedures, and Quality Assurance/Quality Control (QA/QC) procedures implemented for the collection of random samples.

The following procedures are intended to be used together with FSAP. Health and safety procedures and equipment for the investigation are detailed in the IAAAP Health and Safety Plan (HSP). Applicable SOPs are listed below:

- SOP No. 1 – Surface Soil/Sediment Sampling
- SOP No. 5 - Sample Identification, Handling, and Documentation
- SOP No. 6 - Headspace Analysis
- SOP No. 8 - Equipment and Personnel Decontamination
- SOP No. 9 - Boring Abandonment
- SOP No. 10 - Permits and Clearances

11.2 PROCEDURE SUMMARY

- Pre-construction sites do not present safety risks and technical complications normally associated with hazardous waste sites. The primary problem for pre-construction site sampling is obtaining representative samples due to possible layering of materials, unknown site characteristics and the potential physical inaccessibility of sampling points.
- Most pre-construction sites are heterogeneous in nature with regard to physical and chemical characteristics. Therefore a type of probability sampling (e.g. simple random, stratified random, or systematic random) will most accurately represent the characteristic of a site.
- The probability sampling strategy should be developed prior to mobilization to the sampling site. The best guide to sample strategy development is site history, if available. Geologic history and topographic maps are also useful tools in determining sampling strategies for previously undeveloped land.

- Pre-construction sites may often be sampled by hand because of inaccessibility of drill rigs to the sample locations. Hand tools can be used to collect surface samples, and hand-augers or hand-pushed probes can be used to collect subsurface samples.
- Open landmasses with firm ground can be sampled by hand methods, but they are usually accessible to drill rigs which can be used for subsurface sampling.
- Composite sampling is appropriate for most chemical analytical parameters, including but not limited to: semivolatile organic compounds (SVOCs), most metals, pesticides/PCBs, and herbicides.
- Composite sampling is not appropriate for sampling and analysis of soils for volatile organic compounds (VOCs). If samples are to be collected for VOC analysis discrete soil samples will have to be collected.

11.3 DEFINITIONS

- Pre-construction Site – an undeveloped area (e.g., wooded lot, field, marsh, etc...) where future construction activities and man made structures will be installed.
- Probability Sampling – a type of sampling that relies upon mathematical and statistical theories to allow an evaluation of the effectiveness of sampling procedures.
- Field Log Book – The field logbook is a hard cover bound book with numbered pages. The field logbook is used to record all field notes such as sample weights, field calibrations, instrument readings, changes to the project-specific Sampling Plan, observations, and maps (drawn).
- Chain-of-Custody – The Chain-of-Custody (COC) is used to record pertinent (sample identification, date, analyses, etc.) information and accompanies the samples from the sample collection point location through analyses. The COC documents the transfer of custody between field personnel, the transfer between field personnel and the shipper and finally transfer from the shipper to the laboratory. The COC also serves as a check for the laboratory to ensure sample integrity and identifies the analytical parameters selected for the environmental samples.

11.4 HEALTH AND SAFETY WARNINGS

- Physical contact with materials should be avoided. Particular care should be exercised when sampling at depth. Minimum personnel protective equipment (PPE) requirements for sampling personnel does include hard hats, steel toe work boots, safety glasses, and chemical resistant gloves. Coveralls (e.g., Tyvek, nylon, etc...) may be worn to provide additional protection against dermal contact, in which case respiratory protection may also be required.
- Footing may be treacherous on loose material and uneven ground, which may become slippery when wet. Caution should be observed when traversing rocky outcrops, fallen timber, mud flats and loose sediments, especially when equipment is carried.

- It is possible for void spaces or sinkholes to be present that are covered by low-lying dense vegetation, shrubs, and/or fallen timber. A length of steel rod should be used to probe ahead of personnel walking across uneven and unfamiliar ground to test the firmness of the surface.
- Procedures described in the project-specific health and safety plan (HSP) must be followed at all times.
- Use a photo ionization detector (PID) or flame ionization detector (FID) and respiratory protection, as necessary.

11.5 CAUTIONS

- Subsurface sampling may require special location clearance and monitoring. Buried utility lines (i.e. gas, fiber-optic, water and or sewer) may cross or follow the boundaries of a site, especially in the presence of adjacent man-made structures (e.g. buildings and roads). Also subsurface sampling at marshes may require monitoring for methane gas, which may be released from the subsurface and which may build to explosive levels (consult project-specific HSP).
- Care should be taken to avoid cross contamination of sampling locations.
- Care should be taken to avoid contamination of sample containers from organic fumes in the laboratory, exhaust, or other organic fumes in the field.
- Sample containers should be stored in an area free of organic fumes and dust, and these containers should not be opened in the presence of exhaust, other fumes, or dust in the field.
- Jars and lids for collection of samples should be certified precleaned containers for the types of contaminants to be sampled. The containers should remain capped until opened to receive samples.
- Field QA/QC samples should be prepared in the same manner as field samples.

11.6 INTERFERENCES

- Chemical interferences for volatile organic analyses (VOA) can result from sample exposure to laboratory organic fumes and exhaust fumes in the field.
- SW-846 lists other possible interferences for VOA measurements. These include laboratory contamination and diffusion of organic compounds (especially methylene chloride, acetone, and fluorocarbons) through the septum seals on VOA vials during shipment and storage. Appropriate precautions should be taken to minimize these sources of interference. Analysis of appropriate blanks (e.g., method, storage, and trip blanks) will aid in assessing possible impacts of these sources of interference.
- Consideration should be given to sample tool construction. Stainless-steel tools are generally preferred for sample collection for organic and inorganic compounds (except for metals samples). If very small amounts of iron, chromium, nickel or molybdenum may interfere

with inorganic analyses, another material (e.g., high-density polyethylene or Teflon®) may be preferred.

- Material to be sampled may be homogeneous or heterogeneous. Homogeneous material resulting from known situations may not require an extensive sampling protocol. Heterogeneous and unknown wastes require more extensive sampling and analysis to ensure the different components are being represented.

11.7 EQUIPMENT LIST

The following is the recommended list of equipment for surface soil sampling:

Sampling points vary in nature from unconsolidated soils and sediments to compact clays and weathered bedrock. The type of sampler chosen should be compatible with the material sampled. Samplers commonly used for pre-construction sites include: stainless-steel scoops, shovels, trowels, spoons, and stainless-steel hand augers, sampling triers, and grain samplers. The following equipment should be used during waste pile sampling activities:

- Appropriate air monitoring equipment (consult the HSP)
- Appropriate personal protective equipment (consult the HSP)
- Stainless-steel, polyethylene, or Teflon® scoops, shovels, trowels, spoons, and stainless-steel hand augers or tirs
- Steel hand probe
- Drill rig with appropriate sampling equipment
- Plastic squeeze bottle filled with deionized water
- Decontamination equipment (buckets, brushes, etc.)
- Paper toweling or Kimwipes™
- Appropriate containers for decontamination fluids
- Waterproof and permanent marker
- Plastic sheeting for placement on working surfaces (e.g., at the sampling location or on a pick-up truck tailgate)
- Sample containers and labels. If sample preservatives are required (i.e., VOA samples) containers should have preservative reagents added at the laboratory. Several extra sample containers should be obtained in case of breakage or other problems.
- Coolers and ice
- Zip-lock® type plastic bags
- Bubble wrap or similar packing material for sample containers
- Field sample collection form, COC, and, field logbook

11.8 RANDOM SAMPLING PROCEDURES

The term "representative sample" is commonly used to denote a sample that has the properties and composition of the population from which it was collected, in the same proportions as found in the population. This can be misleading unless one is dealing with homogenous site characteristics from which one sample can represent the whole population. Since most site characteristics are heterogeneous in nature, a form of probability sampling will most accurately represent the composition or characteristics of a site or population.

The use of probability sampling to obtain the most "representative sample" from heterogeneous sites usually involves one or more of simple, stratified, or systematic random sampling. Simple random sampling is useful when all units in a population are identified and the random heterogeneity of a site remains relatively constant from one sample batch to the next (e.g. plowed fields). In more complex situations where there are known distinct strata, one wants to prove or disprove that there are distinct strata, or one is limited in sample number and desires to minimize the size of a "hot spot" that could go un-sampled, stratified or systematic random sampling would be more appropriate.

Stratified random sampling is appropriate if a site is known to be non-randomly heterogeneous in terms of its characteristics or non-random chemical heterogeneity is known to exist from one sample batch to the next. In such a case a population or sample is stratified to isolate the known source of nonrandom heterogeneity. Greater precision is likely to be realized if a site characteristic exhibits substantial nonrandom heterogeneity and stratification efficiently divides the site characteristic into strata that exhibit maximum between strata variability and minimum within strata variability. This strategy should be selected only if an intelligent identification of strata can be identified and a minimum of three samples can be collected in each stratum.

Finally, systematic random sampling involves sampling along a transect in which the first sampling point on the transect is from a randomly selected location and subsequent sampling points are located at precise intervals along the transect. An advantage of systematic random sampling lies in the ease with which samples are identified and collected, and in an increase in precision when encountering sufficiently random chemical characteristics with a limited sample number (e.g. sampling 'hot spots' or sampling across lagoons). Systematic random sampling is recommended only when a characteristic or population is essentially random and at most only slightly stratified.

Unless the population or characteristics of a site are homogenous, a representative sample will best be attained through a form of probability sampling. For a further discussion on simple, stratified and systematic random sampling, refer to U.S Environmental Protection Agency, SW-846, Revision 4, Chapter 9, Sampling Plan, December 1996.

11.8.3 General Procedures

- Decontaminated sampling equipment should be assembled and placed on clean plastic sheeting.
- Identification labels for sample bottles should be filled out for each location.
- A new pair of chemical resistant gloves should be used at each sampling location.

- The individual sample containers should be filled in the order given below:
 - Volatile organic compounds (VOCs)
 - Semivolatile organic compounds
 - Petroleum Hydrocarbons
 - Dioxins/Furans
 - Pesticides/PCBs
 - Herbicides
 - Metals
 - Other parameters (pH, reactive cyanide, ignitability)
- Time of sampling should be recorded in the field logbook.
- Field documentation should be completed, including the COC, in accordance with SOP No 5.

11.8.4 Sample Collection with Shovels and Scoops

Collection of samples from surface portions of soil and sediment can be accomplished with tools such as spades, shovels and scoops. Surface material can be removed to the required depth with this equipment, and then a stainless-steel or plastic scoop can be used to collect a sample.

Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by sample team members. Use of a flat, pointed mason trowel to cut a block of the desired material can be helpful when undisturbed profiles are required. A stainless-steel scoop, lab spoon, or plastic spoon will suffice in most other applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with implements such as garden trowels.

Use of the following procedure to collect surface samples:

- Carefully remove the top layer of material to the desired sample depth with a precleaned spade.
- Using a precleaned stainless-steel scoop, plastic spoon, or trowel, remove and discard a thin layer of material from the area which came in contact with people.
- If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless-steel lab spoon, plastic lab spoon or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless-steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.
- Composite sampling is appropriate for most chemical analytical parameters including but not limited to SVOCs, most metals, pesticides/PCBs and herbicides. Composite sampling is not appropriate for VOC analysis, discrete sludge or soil samples should be collected.

11.8.5 Sample Collection with Augers and Thin Wall Tube Samplers

This system consists of an auger, a series of extensions, a "T" handle, and a thin-wall tube sampler. The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin-wall tube sampler. The system is then lowered down the borehole and driven into the pile to the completion depth. The system is withdrawn and the core collected from the thin-wall tube sampler.

Several augers are available. These include: bucket, continuous flight (screw), and post hole augers. Bucket augers are better for direct sample recovery since they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from flights, which are usually at 5-foot intervals. The continuous flight augers are satisfactory for use when a composite of the complete soil/sediment column is desired. Post hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy areas.

Use the following procedure for collecting soil/sediment samples with the auger:

- Attach the auger bit to a drill rod extension and the "T" handle to the drill rod.
- Clear the area to be sampled of any surface debris. It may be advisable to remove the first 3 to 6 inches of surface material for an area approximately 6 inches in radius around the drilling location.
- Begin augering, periodically removing and depositing accumulated materials onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole and avoids possible contamination of the surrounding area.
- After reaching the desired depth, slowly and carefully remove the auger from the boring. When sampling directly from the auger, collect sample after the auger is removed from boring.
- Remove auger tip from drill rods and replace with a precleaned thin-wall tube sampler. Install proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the pile. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring as the vibrations may cause the boring walls to collapse.
- Remove the tube sampler, and unscrew the drill rods.
- Remove the cutting tip and the core from device
- Discard the top of the core (usually about 1-inch), as this represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.
- If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless-steel lab spoon, plastic lab spoon, or equivalent and secure

the cap tightly. Place the remainder of the sample into a stainless-steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into the appropriate, labeled containers and secure the caps tightly.

- Composite sampling is appropriate for most chemical analytical parameters including but not limited to SVOCs, most metals, pesticides/PCBs and herbicides. Composite sampling is not appropriate for VOC analysis, discrete sludge or soil samples should be collected.
- If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, making sure to decontaminate the auger and tube sampler between samples.

11.8.6 Sample Collection with a Trier

This system consists of a trier and a "T" handle. The auger is driven into the soil/sediment and used to extract a core sample from the appropriate depth.

Use the following procedure to collect soil/sediment samples with a sampling trier:

- Insert the trier into the material to be sampled at a 0° to 45° angle from horizontal. This orientation minimizes spillage of the sample. Extraction of the samples might require tilting of the sample containers.
- Rotate the trier once or twice to cut a core of material.
- Slowly withdraw the trier, making sure that the slot is facing upward.
- If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless-steel lab spoon, plastic lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless-steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or if composite samples are being collected, place samples from the other sampling intervals into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.
- Composite sampling is appropriate for most chemical analytical parameters including but not limited to SVOCs, most metals, pesticides/PCBs and herbicides. Composite sampling is not appropriate for VOC analysis, discrete sludge or soil samples should be collected.

11.8.7 Sample Collection with a Grain Sampler

The grain sampler is used for sampling powdered or granular material. This sampler is most useful when the solids are no greater than 0.6 cm (1/4 inch) in diameter.

This sampler consists of two slotted telescoping brass or stainless-steel tubes. The outer tube has a conical, pointed tip at one end that permits the sampler to penetrate the material being sampled. The sampler is opened and closed by rotating the inner tube. Grain samplers are generally 61 to 100 cm long by 1.27 to 2.54 cm in diameter and are commercially available at laboratory supply houses.

Use the following procedures to collect waste pile samples with a grain sampler:

- With the sampler in the closed position, insert it into the granular or powdered material being sampled from a point near a top edge or corner, through the center, and to a point diagonally opposite the point of entry.
- Rotate the sampler inner tube into the open position.
- Wiggle the sampler a few times to allow material to enter the open slots.
- With the sampler in the closed position, withdraw it from the material being sampled.
- Place the sampler in a horizontal position with the slots facing upward.
- Rotate the outer tube and slide it away from the inner tube.
- If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless-steel lab spoon, plastic lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless-steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

11.8.8 Field Quality Assurance/Quality Control Procedures and Samples

Field Quality Assurance/Quality Control samples are designed to help identify potential sources of external sample contamination and to evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

11.8.8.1 Field Blanks

No field blanks or QA split samples will be collected for soil sampling activities.

11.8.8.2 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. For the soil sampling, a duplicate sample will be collected at the same time as the initial sample. The initial sample bottles for a particular parameter or set of parameters will be filled first, then the duplicate sample bottles for the same parameter(s), and so on until all necessary sample bottles for both the initial sample and the duplicate sample have been filled. The duplicate soil sample will be handled

in the same manner as the primary sample. The duplicate sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory on the day it is collected. Duplicate samples will be collected for all parameters. The soil in the split spoon will be composited and containerized for nonvolatile analyses. Duplicate samples will be blind to the laboratory.

11.8.8.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the chain-of-custody form and on the bottles. It may be necessary to increase the sample volume for samples where this designation is to be made.

11.8.9 Sample Identification, Handling, and Documentation

Samples will be identified, handled and recorded as described in this SOP and SOP No. 5. The parameters for analysis and preservation will be specified in future FSAP addenda.

11.8.10 Documentation

Each field activity must be properly documented to facilitate a timely and accurate reconstruction of events in the field (see SOP No. 5).

11.8.10.1 Field Logbook

The most important aspect of documentation is thorough, organized, and accurate record keeping. All information pertinent to the investigation and not documented on the boring log will be recorded in a bound logbook with consecutively numbered pages. All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Entries in the logbook will include the following, as applicable:

- Project name and number
- Sampler's name
- Sample identification number
- Date and time of sample collection
- Sample number, location, and depth
- Type of sample
- Description of the soil sample
- Number of samples taken
- Preservation of samples
- Headspace analysis
- Record of any QC samples from site
- Sampling method
- Observations at the sampling site
- Unusual conditions
- Any irregularities or problems which may have a bearing on sampling quality

- Information concerning drilling decisions
- Decontamination observations
- Weather conditions
- Names and titles of any site visitors
- Location, description, and log of photographs (if taken)
- References for all maps and photographs
- Signature and date by personnel responsible for observations

Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook for a particular site. A site-specific logging procedure will be developed to include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

Appendix B

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FINAL

**CONSTRUCTION PROJECTS
SAMPLING AND ANALYSIS
HEALTH AND SAFETY PLAN**

**IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA**

Prepared for



**American
Ordnance**

17575 State Highway 79
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January 2002

URS

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Omaha, Nebraska 68154
45-F0000023.00

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Attachment B	Standard Operating Procedures
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Acronym List

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
CFR	Code of Federal Regulations
CGI	Combustible gas indicator
CIH	Certified Industrial Hygienist
cm ³	Cubic centimeter
COPC	Chemical of Potential Concern
dB	Decibel
CPR	Cardiopulmonary resuscitation
EPA	U.S. Environmental Protection Agency
eV	Electron volts
HSP	Health and Safety Plan
HEPA	High-efficiency particulate/air
HSO	Health and Safety Officer
HTRW	Hazardous, Toxic, and Radioactive Waste
IDW	Investigative Derived Waste
INAAP	Indiana Army Ammunition Plant
IDLH	Immediately dangerous to life and health
IP	Ionization potential
LEL	Lower explosive limit
m ³	Cubic meter
mg/l	Milligrams per liter
mg/kg	Milligrams per kilogram
mg/g	Milligrams per gram
ml	Milliliter
mm	Millimeter
mph	Miles per hour
MSDS	Material Safety Data Sheet
N/A	Not applicable
N/E	None established
N/I	No information available
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
OVA	Organic vapor analyzer
PCB	Polychlorinated biphenyl

Acronym List

PEL	Permissible exposure level
PID	Photoionization detector
PM	Project Manager
ppb	Parts per billion
PPE	Personal protective equipment
ppm	Parts per million
psi	Pounds per square inch
RCRA	Resource Conservation and Recovery Act
SCBA	Self-contained breathing apparatus
SSHO	Site Safety and Health Officer
SVOC	Semivolatile organic compound
TLV	Threshold Limit Value
TSP	Total suspended particulates
TWA	Time weighted average
UEL	Upper explosive limit
USACE	U.S. Army Corps of Engineers
UV	Ultraviolet
VOC	Volatile organic compound
°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/l	Micrograms per liter
µg/g	Micrograms per gram
µg/m ³	Micrograms per cubic meter

SECTION ONE

Project Identifications and Approvals

**HEALTH AND SAFETY PLAN
IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IOWA**

PROJECT APPROVALS:

Date

AO LLC Project Manager (PM)

Date

AO LLC Health and Safety Officer (HSO)

Date

AO LLC Site Safety and Health Officer (SSHO)

Date

Certified Industrial Hygienist (CIH)

Effective dates of this Health and Safety Plan (HSP): September 1, 2000 through August 31, 2001.

2.1 PURPOSE

The installation Health and Safety Plan (HSP) provides guidelines and requirements for field personnel which comply with applicable Occupational Safety and Health Administration (OSHA) regulations contained in 29 CFR 1910.120; State and local regulations or other requirements.

Before beginning field activities, all involved AO LLC personnel and subcontractors shall be required to review a written copy of the HSP and shall be fully briefed on the contents of the plans. All AO LLC employees and subcontractors involved in the project are required to abide by the provisions of this plan and to sign the Compliance Agreement presented in Attachment A of the HSP. In addition to this HSP, personnel shall comply with any AO LLC health and safety requirements. This HSP establishes guidelines and requirements for the safety of field personnel conducting field activities at the Iowa Army Ammunition Plant (IAAAP). A detailed description of IAAAP and general technical approaches are presented in the AO LLC construction projects sampling and analysis Work Plan (WP). Field activities are addressed in Section 3 (Field Sampling and Analysis Plan) of the WP and may include:

- Monitoring well groundwater sampling
- Drilling and installation of monitoring wells
- Surface water sampling
- Surface soil sampling
- Subsurface soil/sediment sampling
- Location survey of sampling locations

The standard operating procedures (SOPs) presented in Appendix A of the WP describe the specific field procedures that will be used to complete each task. The HSP SOPs presented in Attachment B of this document describe the health and safety standards to be implemented during field activities.

This HSP establishes the necessary controls, supervision, observations, and monitoring required for the investigative activities to be conducted at IAAAP. The health and safety guidelines and requirements presented in this document are based on a review of available information and on the evaluation of potential hazards. The HSP SOPs outline the health and safety procedures and equipment required for minimizing the potential for exposure to contamination during field activities. This plan may be modified in response to additional information obtained regarding the potential hazards to on-site personnel. Any modifications must be made in agreement with AO LLC.

2.2 FACILITY BACKGROUND

A detailed description of the facility background is presented in the Section 2 (Facility Background and Environmental Setting) of the WP.

2.3 FACILITY DESCRIPTION

Detailed descriptions of the facility location and geographical setting (site geology, site hydrogeology) are presented in Section 2 (Facility Background and Environmental Setting) of the WP.

2.4 PAST DATA COLLECTION ACTIVITIES

A Preliminary Assessment/Site Inspection was completed in 1980 and 1991 identifying 40 sites with possible contamination. A facility-wide Remedial Investigation/Risk Assessment was completed by Jaycor (1996). Subsequently, several surface water and groundwater long-term monitoring events have been completed (Harza 1997, 1998, and 2000).

Chemicals detected in groundwater and surface water from 1996, 1997, and 1999 sampling events (Harza 2000) are presented in Table 4-1. Analytical results from the Remedial Investigation/Risk Assessment (Jaycor 1996) were used to summarize the surface soil and subsurface sampling results and identify chemicals detected at each site. The chemicals detected in surface/subsurface soil and sediment are presented in Table 4-2.

SECTION THREE

Key Personnel/Responsibilities

3.1 PROJECT ORGANIZATION

The organizational structure and responsibilities of key personnel are designed to assure adequate protection of the on-site personnel from potential exposure hazards caused by investigative activities. Health and safety responsibilities and authorities are detailed in this section of the HSP.

AO LLC will assign a Site Safety and Health Officer (SSHO), whose responsibilities will include the evaluation of health and safety procedures and monitoring during all field activities.

3.2 KEY PERSONNEL

The following key personnel have been identified for the implementation and monitoring of this HSP:

- AO LLC Project Manager (AO PM)
- AO LLC Industrial Hygienist (CIH)
- AO LLC Health and Safety Officer (HSO) also Chemical Hygiene Office (CHO)
- AO LLC Site Safety and Health Officer (SSHO)

3.3 RESPONSIBILITIES

3.3.1 AO LLC Project Manager

The AO LLC PM has primary responsibility for completing this phase of the project so that all work meets the quality objectives, budget, and schedule. The AO LLC PM is the main point of contact for the project team. The AO LLC PM is responsible for overall coordination within the project team and assignment of field activities to team members. The AO LLC PM is responsible for implementation of the HSP at IAAAP during field activities.

3.3.2 Industrial Hygienist

The IH has the following responsibilities:

- Direct the implementation of the Health and Safety Program in their responsibility area
- Determine need for project HSP
- Maintain a high level of understanding regarding health and safety regulations
- Review and approve HSP
- Monitor implementation of HSP
- Investigate reports of incidents or accidents
- Provide employee health and safety training, particularly refresher training

- Determine whether an accidental exposure or injury merits a change in the affected individual's work assignments and/or changes in the work practices

The IH has the authority to take the following actions:

- Approve or disapprove HSP
- Direct preparation of project HSP
- Access and review project files
- Direct changes to work practices to improve health and safety of on-site personnel
- Remove on-site personnel from field activities if their conduct jeopardizes their health and safety or that of coworkers
- Suspend work on any project that jeopardizes the health and safety of on-site personnel

3.3.3 AO LLC Health and Safety Officer

The AO LLC HSO has the following responsibilities:

- Maintain a working understanding of key government health and safety regulations and AO LLC health and safety policies
- Assist project managers in matters of health and safety
- Develop or review, approve or disapprove project HSP prior to submittal to the IH for review
- Conduct staff training and orientation on health and safety-related activities
- Appoint or approve SSHO
- Monitor compliance with HSP and conduct site audits
- Assist personnel working at the site with regard to medical examinations and health and safety training
- Answer employee questions and concerns regarding health and safety

The AO LLC HSO has the authority to take the following actions:

- Suspend work or otherwise limit exposures to personnel, if health and safety risks are unacceptable
- Direct changes to work practices, if existing practices are deemed to be hazardous to the health and safety of on-site personnel
- Remove on-site personnel from field activities if their conduct jeopardizes their health and safety or that of coworkers

3.3.4 AO LLC Site Safety and Health Officer

The AO LLC SSHO has the following responsibilities:

SECTION THREE

Key Personnel/Responsibilities

- Implement the HSP
- Interface with the AO LLC PM regarding health and safety issues
- Report to the HSO or AO LLC PM on health and safety matters
- Conduct staff training and orientation on health and safety-related activities
- Monitor compliance with HSP
- Answer employee questions and concerns regarding health and safety

The AO LLC SSO has the authority to take the following actions:

- Suspend work or otherwise limit exposures to personnel, if health and safety risks are unacceptable
- Direct changes to work practices, if existing practices are deemed to be hazardous to health and safety of on-site personnel
- Remove on-site personnel from field activities if their conduct jeopardizes their health and safety or that of coworkers

4.1 CHEMICAL HAZARDS

Material safety data sheets (MSDSs) for any materials brought on site will be kept with the hazardous material. Hazardous materials which will be brought on site and used during the site investigation activities include instrument calibration substances (isobutylene, quinhydrone), sample preservatives (nitric acid, sodium sulfite, zinc acetate, hydrochloric acid, sulfuric acid), and other materials (cement, ferrous iron reagent, bentonite grout). MSDSs for hazardous chemicals brought on site are provided in Attachment C.

Personnel conducting the location surveys are not expected to encounter any chemical hazards since the work is not intrusive. The greatest risk of chemical exposure is likely to occur during drilling and soil and water sampling. The potential routes of exposure include inhalation, dermal contact, and incidental ingestion. Inhalation and dermal contact are expected to be the most significant exposure routes. Appropriate personal protective equipment (PPE) and/or monitoring will be used to minimize the exposure. The potential for inhalation of particulates from contaminated soils will be assessed if necessary. The potential for exposure to chemicals of concern by incidental ingestion is expected to be low. Personnel on site are expected to utilize good personal hygiene practices and PPE to minimize incidental soil ingestion or dermal contact.

This HSP provides the basis to avoid occupational exposure to chemical hazards by using PPE and work zone monitoring. The SSHO will take any additional measures necessary to avoid exposure to chemical hazards. The chemicals likely to be encountered in groundwater and surface water at the facility are presented in Table 4-1. The chemicals likely to be encountered detected in surface/subsurface soil and sediment are presented in Table 4-2. Table 4-3 presents the hazardous properties for chemicals detected in groundwater and surface water; and presents the hazardous properties for chemicals detected in surface/subsurface soil above the Region 9 Industrial Standards.

4.1.1 Explosives

Production activities at IAAAP include loading, assembling, and packaging of munitions which include projectiles, mortar rounds, warheads, demolition charges, anti-tank mines, and anti-personnel mines. The production activities use explosive materials and lead-based initiating compounds. Wastewater generated at various plant facilities and effluent from the treatment plants are discharged to surface water streams under provisions of a National Pollutant Discharge Elimination (NPDES) permit. The production activities at IAAAP have resulted in the contamination of soil and groundwater. Wastewater contains primarily explosives and explosive by-products. Explosives-contaminated groundwater and soil should be anticipated at all sites.

4.1.2 Volatile Organic Compounds

Solvents were used extensively in the Fire Training Area. Soil and groundwater may pose a dermal and/or inhalation risk due to the presence of volatile organic compounds (VOCs). In general, however, the concentration of a contaminant decreases quickly after exiting the borehole. Site procedures, including frequent monitoring, will be implemented to help protect

on-site personnel from these hazards. VOCs are of particular concern in the groundwater at the Fire Training Area and Load Line 9.

4.1.3 Semivolatile Organic Compounds

Very low concentrations of semivolatile organic compounds (SVOCs) were detected in the groundwater and soil at several sites. Since SVOCs are relatively immobile and low in volatility, they should not pose an inhalation risk.

4.1.4 Metals

Many sites may contain elevated soil metal concentrations. The metals contamination is generally confined to depths of less than 2 feet. Contaminated soils may pose a hazard when inhaled. Proper engineering controls should be used to minimize dust generation during sampling activities.

4.1.5 Radioactivity

Based on previous investigations, gross alpha and gross beta activity exceeded background and screening levels in one well at Load Line 1 and two wells at the Firing Site. Therefore, all personnel performing work activities at these sites will don radiation dosimeter badges to monitor radiation exposure according to 10 CFR 20.

4.2 PHYSICAL HAZARDS

Physical hazards can involve a risk of serious injury or death. This HSP provides the basis to avoid physical hazards by using PPE and safety SOPs. The SSHO will take any additional measures necessary to alleviate these hazards. This section contains the general physical and drilling hazards likely to be encountered at this site.

4.2.1 General Physical Hazards

Personnel are expected to perform manual labor tasks and have the potential to strain or otherwise damage their lower back. Personnel shall be instructed on the proper methods for lifting loads in excess of 60 pounds.

Slips, trips, and falls are the most likely accident to be encountered at this site. Good housekeeping is imperative in reducing the potential for slips, trips, and fall and in limiting other safety and health hazards. All personnel involved in the field activities are responsible for practicing good housekeeping on a daily basis.

4.2.2 Drilling/Direct Push Hazards

The hazards involved with the use of drill rigs and direct push rigs are significant and include the hazards of pinch points; entrapment in machinery; impact from moving parts; electrocution from lightning, overhead wires, or buried utilities; and improper operations. Use of hand tools,

moving a rig, and conducting repairs can increase physical risks. Excessive noise is typically generated from drilling and direct push rigs. SOP No. HS-1 - Safety Guidelines for Drilling is included in Attachment B.

4.2.3 Ordnance and Explosives

Propellants were manufactured, loaded, and packed at the facility, and it is very likely that explosives-contaminated soil and groundwater will be encountered during field activities. Concentrations detected during previous investigations indicate that soils will not fall under the definition of Ordnance and Explosives.

Ordnance and Explosives (OE) consists of either (1) or (2) below:

1. Ammunition, ammunition components, chemical or biological warfare materiel, or explosives that have been abandoned, expelled from demolition pits or burning pads, discarded, buried, or fired. Such ammunition, ammunition components, and explosives are no longer under accountable control of any DoD organization or activity.
2. Explosive soil. Explosive soil refers to mixtures of explosives in soil, sand, clay, or other solid media at concentrations such that the mixture itself can explode if given sufficient stimulus. This term differs from the term "explosives-contaminated soil," which means soil containing explosives at any concentration, explosive or not. Explosive soils are classified as containing explosives at concentrations greater than 10% (100,000 ppm).

Previous investigations have not detected explosives contaminated soil at concentrations considered explosive. Field activities will not be conducted in areas where there is a potential for encountering ordnance. Areas to be avoided will be determined by communication between the Facility contact and the SSHO.

4.3 ENVIRONMENTAL HAZARDS

Environmental factors (i.e., weather, insects, animals, and irritant plants) pose a hazard when working outdoors. The SHO will take all necessary measures to alleviate these hazards.

4.3.1 Biological Hazards

Field activities, including drilling, sampling, foot reconnaissance, and survey activities, will be conducted outdoors in grassed industrial areas, agricultural areas, woodlands, and along streams. Biological hazards present during these activities relate to contact with toxic plants, insects, reptiles, mammals, and birds. Procedures to minimize biological hazards are as follows:

- Learn to recognize toxic plants, such as poison oak, poison ivy, and poison sumac. Contact with these plants may cause skin irritation. Persons who come in contact with poisonous plants should immediately wash with soap and water, then apply hydrocortisone cream to the affected areas if necessary.
- Wear long-sleeved shirts, sturdy trousers, and boots when working near toxic plants to minimize the potential of skin contact.

- If exposed to toxic plants, shower as soon as possible with a strong soap (e.g., Fels Naptha). Launder clothing.
- Do not approach or agitate animals, especially ones behaving strangely or foaming at the mouth.
- Use insect repellent to avoid contact with ticks, mosquitoes, and other insects (disease carriers or poisonous), as necessary. Use a solid repellent to minimize potential contamination of field samples. Personnel should perform a "tick check" after being in a vegetated area. See SOP HS-2 (Attachment B) for further discussion of tick-borne diseases.
- If possible, avoid contact with poisonous snakes or other reptiles by quietly walking away. Care should be taken when lifting possible habitats of snakes and spiders such as debris and cover. If bitten seek medical assistance immediately.
- Avoid contact with rodents because they frequently are hosts to fleas, which can carry typhus and the plague.
- Avoid encounters with stinging insects.
- Refrain from placing hands and feet into concealed areas to avoid spider and insect bites.

4.3.2 Heat Stress

Warm ambient temperature can result in heat stress. Working in warm ambient temperature can involve a high risk of serious injury or death. Further details on heat stress are included in SOP No. HS-3 in Attachment B.

4.3.3 Cold Stress

Cold ambient temperature can result in cold stress. Working in cold ambient temperature can involve a high risk of serious injury or death. SOP No. HS-4 - Cold Stress is included in Attachment B.

4.4 NOISE HAZARDS

Hearing protection devices are required if workers must resort to yelling or raising their voices to be heard above the equipment noise. Both temporary and permanent hearing loss could potentially result from repeated exposure to excessively noisy operations. SOP No. HS-5 - Noise/Hearing Conservation is included in Attachment B.

4.5 ELECTRICAL HAZARDS

During drilling the potential of exposure to electrical hazards exists both below ground and overhead. Before beginning work the SSHO shall ascertain whether any electrical hazards exist according to SOP No. HS-6 - Electrical Safety is included in Attachment B.

4.6 SIGNS, BARRICADES, BARRIERS, AND FLAGGING

Signs, barricades, barriers, and flagging will be used to identify hazardous areas and to protect on-site personnel and the public from the hazards. Caution tape shall be placed around the exclusion zone when drilling activities are completed in public access (including all residential) areas. Traffic cones and/or traffic barricades will be used when field activities are being done near public roads.

4.7 NATURAL HAZARDS

Natural hazards potentially present during all field activities include exposure to the sun and severe storms or tornadoes, and there is a slight possibility of earthquakes. Procedures to be followed to minimize these hazards include the following:

- Wear long sleeves and/or sun block on sunny days.
- Cease field activities during severe storms. Seek shelter until the storm has passed.
- If a tornado occurs:
 - Seek shelter in the lowest level or interior wall of a substantial building.
 - Do not seek shelter in a trailer or vehicle. Lie flat in the nearest ditch.
- If an earthquake occurs while in a building:
 - Stand in an interior doorway or get under a large piece of furniture.
 - Do not use stairways or elevators.
 - Evacuate the building after the tremors have ceased. Be aware of the potential for aftershocks and the possibility of downed power lines.
 - Report to a predetermined assembly area.
- If an earthquake occurs while working outside:
 - Stay away from buildings, trees, and power lines.
 - If operating a motor vehicle or heavy equipment, stop immediately but stay in the vehicle or piece of equipment until the tremors have stopped.

All personnel completing any of the field activities are responsible to help monitor for severe weather conditions by obtaining the daily weather forecast and making visual observations. The SSHO should suspend all field activities when severe weather approaches. Additionally, all field activities must be postponed at the first sign of lightning.

TABLE 4-1

CHEMICALS DETECTED IN GROUNDWATER AND SURFACE WATER

IAAP Site	IAAP-1, 18 Line 1, Line 1 Impoundments	IAAP-2 Line 2	IAAP-3 Line 3	IAAP-4, 41, 29 Line 3A, Line 3A Pond, and Line 3A STP	IAAP-5 Line 4A/4B	IAAP-6 Line 5A/5B	IAAP-7 Line 6	IAAP-8 Line 7	IAAP-9 Line 8	IAAP-10 Line 9	IAAP-11, 44 Line 800/ Pink Lagoon	IAAP-12 East Burn Pads	IAAP-17 Pesticide Pit	IAAP-20 Inert Disposal Area	IAAP-21, 23 Demolition Area and Deactivated Furnace	IAAP-24 Contaminated Waste Processor	IAAP-25 Explosive Waste Incinerator	IAAP-26 Sewage Treatment Plant/Sludge Drying Beds	IAAP-27, 43 Flyash Landfill, Flyash Disposal Area	IAAP-28 Construction Debris Landfill	IAAP-30 Firing Site	IAAP-31 Ammunition Box Chipper Disposal Pit	IAAP-34, 35, 32, 33 West Burn Pads, West Burn Pad Landfill, Burn Cages, & Burn Cages Landfill	IAAP-36, 37 North Burn Pads & North Burn Pads Landfill	IAAP-38 Building 600-86	IAAP-39 Fire Training Area	IAAP-40 Roundhouse Transformer Storage Yard	None - Plant Boundary/ General Areas	Spring Creek	Brush Creek			
Chemical																	IAAP-25 Explosive Waste Incinerator											IAAP-39 Fire Training Area	IAAP-40 Roundhouse Transformer Storage Yard	None - Plant Boundary/ General Areas	Spring Creek	Brush Creek	
Volatile Organic Compounds (ug/L)																	There are no wells. No surface storm water samples were collected.											32000	No wells, no water samples.				
Acetone																												24					
Acrylonitrile																												87					
Benzene																												860					
1,1-Dichloroethylene																												9600					
cis-1,2-Dichloroethylene																												10000					
4-Methyl-2-Pentanone																												1800					
Methylene Chloride																												36					
p-Cresol/4-cresol/4-M																												110					
Tetrachloroethylene																												11000					
Trichloroethylene																												1800					
Toluene																												10					
1,1,1-Trichloroethane																																	
1,1,2-Trichloroethane																																	
Freon																																	
Semivolatile Organic Compounds (ug/L)																											230000						
Bis-(2-ethylhexyl)phthalate	6.8		97																														
Explosives (ug/L)																											34	14					
1,3 Dinitrobenzene		1.3																															
2,4 Dinitrotoluene	0.8		10								110																						
2,6 Dinitrotoluene	1.4										260																						
2-amino-4,6 Dinitrotoluene		77	91								350							2.9															
4-amino-2,6 Dinitrotoluene			26																														
Nitrobenzene			4																														
HMX	4.9	470		29							170																						
RDX	12.9	2700		250	3.2						2000							560															
1,3,5-Trinitrobenzene		13	14	1.1						5.5	14000	77			11			2600	1.5			2.8		9.4							3.2		
2,4,6-Trinitrotoluene				8.3							2600	2.9						11.5	1.7												3.6		
Tetryl									8.8		10000								4.9												7.5		
Metals (ug/L)																																	
Arsenic						3.5	6.1	3.6			89		5.7						8.1						3.1								
Barium	3080			97.4		159	159	110	194				5770		309			91	986						175								
Cadmium	46																																
Chromium (total)	550	103				8.5	157				249		7.2					19.1	21.1						15						148		
Iron																		1600															
Lead	310	17		9.8		6.1	6	2.4	3.6		97		240		2.2			140	4					4.1									
Manganese																					830												
Mercury													0.4																				
Nickel																																	
Selenium				3.7									4.1								160												
Silver				12.4															13.1														
Pesticides (ug/L)																																	
Endrin																																	
Endrin Ketone													0.1																				
Radioactivity (pCi/L)																																	
Gross alpha	ND																																20700

Groundwater detections based on Harza 1999 groundwater sampling event.

Definitions: PRG - Preliminary Remediation Goal

Notes:
 Nine sites (i.e., IAAP-13, -14, -15, -18, -19, -22, -42, -45 and -46) are not included in this list of potential sites to be sampled. American Ordnance has no future projects addressing groundwater at these sites. If groundwater is sampled at one of the nine sites it will have to be addressed as an addendum to HSP.

TABLE 4-2

CHEMICALS DETECTED IN SURFACE/SUBSURFACE SOIL AND SEDIMENT

Chemical	IAAP Site	Region IX Industrial PRGs	IAAP-1, 16 Line 1, Line 1 Impoundment	IAAP-2 Line 2	IAAP-3 Line 3	IAAP-4, 41, 29 Line 3A, Line 3A Pond, and Line 3A STP	IAAP-5 Line 4A/4B	IAAP-6 Line 5A/5B	IAAP-7 Line 6	IAAP-8 Line 7	IAAP-9 Line 8	IAAP-10 Line 9	IAAP-11, 44 Line 600/ Pink Lagoon	IAAP-12 East Burn Pads	IAAP-17 Pesticide Pit	IAAP-20 Inert Disposal Area	IAAP-21, 23 Demolition Area and Deactivated Furnace	IAAP-24 Contaminated Waste Processor	IAAP-25 Explosive Waste Incinerator	IAAP-26 Sewage Treatment Plant/Sludge Drying Beds	IAAP-27, 43 Flyash Landfill, Flyash Disposal Area	IAAP-28 Construction Debris Landfill	IAAP-30 Firing Site	IAAP-31 Ammunition Box Chipper Disposal Pit	IAAP-34, 35, 32, 33 West Burn Pads, West Burn Pad Landfill, Burn Cages, & Burn Cages Landfill	IAAP-36, 37 North Burn Pads & North Burn Pads Landfill	IAAP-38 Building 600-86	IAAP-39 Fire Training Area	IAAP-40 Roundhouse Transformer Storage Yard	None - Plant Boundary/ General Areas			
Tetryl				2.3				14000									0.46																
Metals (mg/kg)																																	
Antimony		820	73	36	2800	26	9.8	9.8	31	9.8	16	13	15			4400	65	9.8															
Arsenic		440/2.7	49	33	79	15	10	92	66.9	11.1	15	203	17	11	9.7	30.3	10.8	13	6.2	6.7	99	14	9.8	10.5									
Barium		100000	16000	2300	970	350	526	422	11000	242	220	421	651	1330	1120	1240	5100	371	190	212	250	520	720	523									
Beryllium		2200	3.2	5.5	3.6	2.3	1.4	2.6	2.9	2.2	0.25	1.6	2.8				1.6	1.6	99	0.7	3	72	2.4	0.08									
Cadmium		810	61	26	100	6.3	2.1	32.1	9.1	2.7	7.7	3.3	760				180	1.8		1	2		7.6										
Chromium (total)		100000	530	960	1500	260	41	48.5	3600	71	42	67.9	130	21.6	82.9	99	613	39	29	90.6	33	25	2800	28.4									
Lead		1000	5200	15000	6200	2400	1200	1600	3200	300	2300	830	2000	27.9	742	51000	6400	1600	28	28	97	23	260	23									
Manganese		32000	6900	7800	2900	2600	1100	690	1700	2900	1700	5000					1500	1500	510	140			1400										
Mercury		610	2100	230	10	3.8	0.31	0.75	1900	0.78	1.3	10	7.6	0.09	0.4	1.1	0.91	0.24	0.24	5.6	0.22		0.29										
Nickel		41000	270	550	270	87	37	62	8600	50	61	68.0	150				130	54	18	17		54	990	13									
Selenium		10000	1.9	1.6	1.3	0.6	0.5	1.1	0.7	0.4	0.5	0.6	0.5	0.4	0.8	0.4	2.1	0.5		0.8			0.7	0.7									
Silver		10000	110	68	250	3800	2.6	2.6	137	2.1	1.8	3.6	2.6				20	1.6		140	0.4		4.7										
Thallium		140	42	60	67	22	22	21	17	17	23	20	42				150				17		20										
Vanadium		14000	300	63	52	49	42	40			26	57	43				100	38	14	15			47										
Radioactivity (pCi/g)																																	
Gross alpha			2.7																				24.8										
Gross beta			5.3																				16.2										
Actinium 228			3.4																				1.7										
Bismuth 214			1.4																				0.8										
Cesium 137																							0.2										
Lead 212			0.7																				1.1										
Lead 214			0.6																				0.3										
Potassium 40																							19										
Radium 226			1																				12										
Thallium 208			0.7																				0.0007										

Soil detections based on HNFA based on PA/SI results (JAYCOR 1993, 1996)

Definitions: PRG - Preliminary Remediation Goal

Notes:

Nine sites (i.e., IAAP-13, -14, -15, -18, -19, -22, -42, -45 and -46) are not included in this list of potential sites to be sampled. American Ordnance has no future projects addressing soil at these sites. If soil is sampled at one of the nine sites it will have to be addressed as an addendum to HSP.

**TABLE 4-3
HAZARDOUS PROPERTY INFORMATION FOR CHEMICALS IDENTIFIED IN THE SOIL, SURFACE WATER, SEDIMENT OR GROUNDWATER**

Chemical	Physical Properties					Symptoms	Target Organs	Hazard Properties	Route of Entry
	IP (ev)	LEL (%)	VP	IDLH	PEL TLV				
SVOC									
Bis-(2-ethylhexyl)phthalate	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
Benzo(a)anthracene ^(a)	N/I	N/I	N/I	80 mg/m ³	0.1 mg/m ³	Dermatitis, bronchitis	resp, skin, bladder, kidney	Comustible solid	inh, con
Benzo(a)pyrene ^(a)	N/I	N/I	N/I	80 mg/m ³	0.1 mg/m ³	Dermatitis, bronchitis	resp, skin, bladder, kidney	Comustible solid	inh, con
Benzo(b)fluoranthene ^(a)	N/I	N/I	N/I	80 mg/m ³	0.1 mg/m ³	Dermatitis, bronchitis	resp, skin, bladder, kidney	Comustible solid	inh, con
Dibenzo(a,h)anthracene(a)	N/I	N/I	N/I	80 mg/m ³	0.1 mg/m ³	Dermatitis, bronchitis	resp, skin, bladder, kidney	Comustible solid	inh, con
Indeno(1,2,3-cd)pyrene ^(a)	N/I	N/I	N/I	80 mg/m ³	0.1 mg/m ³	Dermatitis, bronchitis	resp, skin, bladder, kidney	Comustible solid	inh, con
VOC									
Acetone	9.69	2.5	180 mm Hg	2500 ppm	250 ppm	irrit eyes, nose, throat, head, CNS	eyes, skin, resp, CNS	Flammable	inh, abs, con, ing
Acrylonitrile	10.91	NA	0 mm	85 ppm	1 ppm	irrit eyes, skin, asphy, head, nau	eyes, resp, CNS, CVS	Flammable	inh, abs, con, ing
Benzene	9.24	1.2	75 mm Hg	500 ppm	0.1 ppm	irrit eyes, skin, nose, resp, head, nau	eyes, skin, resp, blood, CNS	N/I	N/I
1,1-Dichloroethylene	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
cis-1,2-Dichloroethylene	9.65	5.6	180 mm Hg	1000 ppm	200 ppm	irrit eyes, resp, CNS	eyes, resp, CNS	Flammable	inh, abs, con, ing
4-Methyl-2-Pentanone	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
Methylene Chloride	11.32	13	350 mm Hg	2300 ppm	25 ppm	irrit eyes, skin, weak	eyes, skin, CVS, CNS	Combustible	inh, abs, con, ing
Tetrachloroethylene	9.32	NA	14 mm Hg	150 ppm	100 ppm	irrit eyes, nose, throat, nau	eyes, skin, resp, liver, kidney, CNS	Combustible	inh, abs, con, ing
Trichloroethylene	9.45	8	58	1000 ppm	100 ppm	irrit eyes, skin, head, verti, derm	eyes, skin, resp, heart, liver, CNS	Combustible	inh, abs, con, ing
Toluene	8.82	1.1	21 mm Hg	500 ppm	100 ppm	irrit eyes, nose, fig, weak, dizz, head	eyes, resp	Flammable	inh, abs, con, ing
1,1,1-Trichloroethane	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
1,1,2-Trichloroethane	11	6	19	100 ppm	10 ppm	irrit eyes, nose, CNS,	eyes, resp, CNS, liver, kidney	Combustible	inh, abs, con, ing
Freon (Dichloromofluoromethane)	12.39	NA	1.6 atm	5000 ppm	10 ppm	asphy, card, arrhy	resp, CVS	Gas	inh, con
Pesticides/PCBs									
alpath-Chlordane	N/I	NA	0.00001 mm	100 mg/m ³	0.5 mg/m ³	blurred vision, tremor, irritability	CNS, eyes, lung, liver, kidney	NA	inh, abs, ing, con
DDD ^(b)	N/I	N/I	0.0000002mm	500 mg/m ³	0.5 mg/m ³	irrit eyes, skin, headache, fatigue	eyes, skin, CNS, kidney, liver, PNS	Combustible solid	inh, abs, ing, con
Endrin	N/I	NA	low	2 mg/m ³	0.1 mg/m ³	convulsion, head, dizz	skin, CNS, liver, kidney, repro	NA	inh, abs, ing, con
gamma-Chlordane	N/I	NA	0.00001mm	100 mg/m ³	0.5 mg/m ³	blurred vision, tremor, irritability	CNS, eyes, lung, liver, kidney	NA	inh, abs, ing, con
Heptachlor	N/I	NA	0.0003 mm	35 mg/m ³	0.5 mg/m ³	tremor, convulsion	CNS, liver	NA	inh, abs, ing, con
Aroclor 1260	N/I	NA	0.001mm	5 mg/m ³	0.001 mg/m ³	irrit eyes, skin	eyes, skin, liver, repro	NA	inh, abs, ing
Explosives									
1,3 Dinitrobenzene	10.43	N/I	N/I	200	1 mg/m ³	anoxia, cyan, anemia, jaun, liver	blood, liver, CVS, CNS	Explosive	inh, abs, con, ing
2,4 Dinitrotoluene	N/I	N/I	1 mm	200 ppm	1.5 mg/m ³	anoxia, cyan, anemia, jaun	Blood, liver, CVS	Explosive	inh, abs, con, ing
2,6 Dinitrotoluene	N/I	N/I	N/I	N/I	1 mg/m ³	anoxia, cyan, anemia, jaun	blood, liver, CVS, CNS	Explosive	inh, abs, con, ing
2-amino-4,6 Dinitrotoluene	N/I	N/I	N/I	N/I	1 mg/m ³	anoxia, cyan, anemia, jaun	blood, liver, CVS, CNS	Explosive	inh, abs, con, ing
4-amino-2,6 Dinitrotoluene	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Explosive	inh, ing, con
Nitrobenzene	9.92	1.8	0.3mm	200 ppm	1 ppm	anoxia, irrit eyes, derm, anemia	blood, liver, kidney, CVS, skin	Explosive	inh, cont, ing
HMX	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Explosive	inh, con, ing
RDX	N/I	N/I	N/I	NE	1.5 mg/m ³	Irrit eyes, skin, resp	eyes, skin, resp	Explosive	inh, con, ing
1,3,5-Trinitrobenzene	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Explosive	inh, ing, con
2,4,6-Trinitrotoluene	N/I	N/I	0	NE	NE	CNS, irrit eyes, skin resp	CNS, CVS, eyes, skin	Explosive	inh, ing, con
Tetryl	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Explosive	inh, ing, con
Metals									
Antimony	NA	NA	0	50 mg/m ³	0.5 mg/m ³	irrit eyes, skin, nose, head, nau	eyes, skin, resp, CVS	Combustible fine dust	inh, con, ing
Arsenic	NA	NA	0	5 mg/m ³	0.01 mg/m ³	derm, resp	liver, kidney, skin, lungs	NA	inh, con, ing
Barium	NA	NA	0	50 mg/m ³	0.5 mg/m ³	irrit eyes, skin, resp	eyes, skin, resp, heart, CNS	NA	inh, con, ing
Cadmium	NA	NA	0	9 mg/m ³	0.005 mg/m ³	pulm edema, dysp, cough,	resp, kidney, blood	NA	inh, con, ing
Chromium (total)	NA	NA	0	25 mg/m ³	0.5 mg/m ³	irrit eyes, sens derm	eyes, skin	NA	inh, con, ing
Lead	NA	NA	0	100 mg/m ³	0.05 mg/m ³	weak, anorexia, anemia, kidney	GI, kidney, blood	Combustible fine dust	inh, ing, con
Manganese	NA	NA	0	500 mg/m ³	5 mg/m ³	Parkinson's, mental con, insom	resp, CNS, blood, kidney	Combustible fine dust	inh, ing, con
Mercury	NA	NA	0.0012mm	10 mg/m ³	0.05 mg/m ³	irrit eyes, skin, cough, head	eyes, skin, resp, CNS, kidney	NA	inh, abs, ing, con
Nickel	NA	NA	0	10 mg/m ³	0.015 mg/m ³	sens derm, asthma, pneu	nose, lung, skin	NA	inh, ing, con
Iron	NA	NA	0	2500 mg/m ³	5 mg/m ³	resp	resp	NA	inh
Thallium	N/I	NA	N/I	15 mg/m ³	0.1 mg/m ³	naus, diarr, chest pain	eyes, skin, resp, CNS, kidney	N/I	inh, abs, ing, con

**TABLE 4-3
HAZARDOUS PROPERTY INFORMATION FOR CHEMICALS IDENTIFIED IN THE SOIL, SURFACE WATER, SEDIMENT OR GROUNDWATER**

Chemical	Physical Properties					Symptoms	Target Organs	Hazard Properties	Route of Entry
	IP (ev)	LEL (%)	VP	IDLH	PEL TLV				
Radioactivity (pCi/L)									
Gross alpha (Uranium)	NA	NA	NA	10 mg/m ³	0.05 mg/m ³	cough, vomit, RBC, skin burns	resp, blood, liver, kidney, lymph, bone marrow	radioactive	inh, abs, ing, con
Gross beta	NA	NA	NA	10 mg/m ³	0.05 mg/m ³	cough, vomit, RBC, skin burns	resp, blood, liver, kidney, lymph, bone marrow	radioactive	inh, abs, ing, con

Notes

- (a) Hazardous property information for coal tar pitch volatiles is provided.
- (b) Hazardous property information for DDT is provided.
- PEL - Permissible Exposure Limit in Air (concentration not to exceed during 8 hour work shift of a 40 hour work week)
- Hazardous property information for coal tar pitch volatiles was used for all PAHs
- Hazardous property information for 2,6-Dinitrotoluene was used as a surrogate for all explosives if no information was available

IP - Ionization Potential (eV)

LEL - Lower Explosive Limit in Air (% by volume at room temperature)

VP - Vapor Pressure at 68 degrees F (mm Hg)

TLV - Threshold Limit Value - 8 hour time-weighted average concentrations

IDLH - Immediately Dangerous to Life or Health concentrations (mg/m³)

NI - No Information available

NA - Not Applicable

Symptoms

- | | |
|------------------------------|---------------------------------|
| abdom - abdominal | head - headache |
| anor - anorexia | hypox - hypoxemia |
| asphy - asphyxia | irrit - irritation |
| bron - bronchitis | jaun - jaundice |
| CNS - central nervous system | methemo - methemoglobinemia |
| CVS - cardiovascular system | musc - muscle |
| cyan - cyanosis | nau - nausea |
| derm - dermatitis | PNS - peripheral nervous system |
| diarr - diarrhea | pulm - pulmonary |
| dizz - dizziness | repro - reproductive |
| dysp - dyspnea | resp - respiratory |
| emphy - emphysema | sens - sensitization |
| GI - gastrointestinal | sys - system |

- Route of Entry:
- inh - inhalation
 - ing - ingestion
 - con - skin or eye contact
 - abs - skin absorption

The purpose of site control is to minimize potential contamination of on-site personnel and protect the public from the hazards associated with field activities.

5.1 DESIGNATION OF WORK ZONES

The exclusion zone will be clearly identified with caution tape to help minimize unauthorized intrusion. See SOP HS-7 in Attachment B for further description of work zones. Additionally, equipment decontamination areas will also be marked with caution tape to help minimize unauthorized intrusion. If unauthorized persons enter an exclusion zone or decontamination area, the field activities shall be stopped immediately, and shall not resume until all unauthorized persons have exited the delineated area.

5.2 BUDDY SYSTEM

All field activities will be conducted with a buddy who is able to:

- Maintain sight of his or her partner
- Provide his or her partner with assistance
- Observe his or her partner for signs of chemical or heat/cold exposure
- Periodically check the integrity of his or her partner’s protective clothing
- Notify the SSHO or others if emergency help is needed

5.3 PERSONNEL CLEARANCE

Employees must obtain health and safety clearances before beginning field activities at IAAAP. Personnel assigned to field operations must have been certified by an approved physician as being physically fit and able to perform their assigned fieldwork, successfully completed a 40-hour health and safety training course, completed annual refresher training, and been respirator fit tested. Field managers must have completed an 8-hour manager’s health and safety course, in accordance with 29 CFR 1910.120, in addition to all other clearance requirements.

5.4 SAFETY BRIEFINGS

Before fieldwork begins and at the discretion of the SSHO, all on-site field personnel, including subcontractor employees, must be briefed on their work assignments and safety procedures contained in this document. Each person must be provided with and read a copy of this HSP and will sign a safety compliance agreement form stating that they have read, understand, and agree to comply with the provisions of this plan. The SSHO will conduct safety briefings daily.

5.5 ACCIDENT/INCIDENT REPORTING

In the event of an accident or incident, the SSHO will immediately notify the AO LLC PM. The following are examples of accidents or incidents that are considered reportable:

- Illness resulting from chemical exposure or unknown causes
- Physical injury, including an injury that does not require medical attention
- Fire, explosions, and flashes resulting from field activities performed by AO LLC and its subcontractors
- Infractions of the HSP
- Unexpected chemical exposures

Work will be suspended to correct the cause of the accident/incident and to modify this plan as necessary. An accident /incident report form (see SOP HS-8 in Attachment B) must be submitted to the AO LLC PM within 24 hours of the occurrence.

Contractors are also responsible for notifying OSHA when one or more of their employees are seriously injured. An accident with any of the following consequences listed below shall be immediately reported to the AO LLC PM:

- a) Whenever a fatal injury occurs,
- b) When three or more persons are admitted to a hospital or,
- c) Property damage exceeding an amount specified by the designated authority occurs.

SECTION SIX

Protective Equipment

This section contains the various levels of personal protective equipment (PPE) that will be required for specific field activities. The primary objective of PPE is to ensure personnel protection and to prevent exposure to chemicals during field activities.

The SSHO will be responsible for implementing all aspects of PPE. This includes, but is not limited to, donning and doffing, temperature-related stress monitoring, inspection, and decontamination. The SSHO, in consultation with the HSO and AO LLC PM, will direct changes in PPE based on changing conditions.

6.1 ANTICIPATED PROTECTION LEVELS

Field activities are expected to be conducted in Level D or Modified Level D. Table 6-1 presents PPE and air monitoring requirements for each site. Level D consists of a work uniform affording minimal protection from nuisance contamination and will be used for field reconnaissance, survey activities, and field activities not requiring contact with contaminated groundwater or surface water. Chemical-resistant gloves should be worn during all field investigative activities.

Modified Level D is required during drilling, well installation, and field sampling in known contaminated areas with the potential for dermal contact when all types of airborne substances are known to be below the PEL/TLV.

It is very unlikely that site conditions will warrant the use of Level C for this project. However, the elements of Level C are detailed in Section 6.2.3 of this HSP as a contingency plan. Air purifying respirators should be readily available. The SSHO will inform the AO LLC PM if any upgrades in PPE levels are required.

6.2 PROTECTION LEVEL DESCRIPTIONS

This section contains the minimum requirements for several PPE levels that may be required. A copy of SOP No. HS-9 - Selection and Use of Personal Protective Equipment is included in Attachment B.

6.2.1 Level D

Level D consists of the following:

- Safety glasses with side shields or goggles (as required by OSHA)
- Hard hat (when working around heavy equipment or overhead hazards)
- Steel toe and shank work boots
- Work clothing as prescribed by weather
- Hearing protection (when noise levels exceed 85 db)
- Nitrile gloves (when handling soil, sediment, surface water or groundwater)

6.2.2 Modified Level D

Modified Level D consists of the following:

- Safety glasses with side shields or goggles (as required by OSHA)
- Hard hat (when working around heavy equipment or overhead hazards)
- Steel toe and shank work boots
- Work clothing as prescribed by weather
- Hearing protection (when noise levels exceed 85 db)
- Latex or nitrile inner gloves (when handling soil, sediment, surface water, or groundwater)
- Chemical-resistant gloves
- Tyvek coveralls

6.2.3 Level C

Level C consists of the following:

- Full-face, air-purifying respirator with combination cartridges (MSA, GMC-H, or equivalent)
- Hard hat (when working around heavy equipment or overhead hazards)
- Steel toe and shank work boots
- Work clothing as prescribed by weather
- Hearing protection (if needed)
- Latex or nitrile inner gloves (when handling soil, sediment, surface water, or groundwater)
- Chemical-resistant gloves
- Waterproof Tyvek coveralls

6.3 RESPIRATOR PROTECTION

Although it is not anticipated that respiratory protection will be needed for any of the field activities, organic vapor concentrations or contaminated soil dust levels in the breathing zone may warrant an upgrade to PPE Level C (air-purifying respiratory protection). The primary objective of respiratory protection is to prevent on-site personnel exposure to atmospheric contamination. Personal respiratory protection devices will be used when engineering measures to control contamination are not feasible or while they are implemented.

TABLE 6-1

PPE AND AIR MONITORING REQUIREMENTS BY TASK

Task	Air Monitoring / Frequency	Sites Requiring Level D PPE	Sites Requiring Modified Level D PPE**	Sites Potentially Requiring Level C PPE***
1. Groundwater sampling	PID every 30 min. during sampling. The Firing Site and Load Line 1 may require radiation monitoring.	All	Load Line 1*, Line 9, WBP, FTA, Line 800, and Firing Site*	FTA, Line 9
2. Drilling	PID every 30 min. during drilling and sampling. The Firing Site and Load Line 1 may require radiation monitoring.	All	Load Line 1*, Line 9, WBP, FTA, Line 800, and Firing Site*	FTA, Line 9
3. Surface soil and sediment sampling	The Firing Site and Load Line 1 may require radiation monitoring.	All	Load Line 1*, Line 9, WBP, FTA, Line 800, and Firing Site*	FTA, Line 9
4. Surface water and seep sampling	Not required	All	Load Line 1*, Line 9, WBP, FTA, Line 800, and Firing Site*	FTA, Line 9
5. Decontamination of heavy machinery	Not required	All	Load Line 1*, Line 9, WBP, FTA, Line 800, and Firing Site*	FTA, Line 9

Notes:

- * Radiation dosimeter badges will be worn during field activities at Load Line 1 and the Firing Site.
- ** Modified Level D is required while sampling at sites where groundwater, soil, sediment, or surface water contains significant concentrations of explosives, metals, volatile organic compounds, and/or radioactivity. Site-specific chemical evaluation will be completed for future phases of field investigative work. The evaluations will be included in HSP Addenda for each future phase of work.
- *** The groundwater at the Fire Training Area contains significant concentrations of Volatile Organic Compounds, therefore, PPE requirements will be based on organic vapor monitoring. Upgrade to Level C if PID readings exceed 5 ppm in the breathing zone.

Level D PPE - A work uniform affording minimal protection used for nuisance contamination only. The following will constitute Level D PPE, which may be used as appropriate:

- Coveralls or field clothing
- Gloves (optional as applicable) - Chemical resistant gloves will be worn during all sampling activities.
- Boots; steel toe and shank
- Hardhat (when overhead hazards exist)
- Earplugs (when noise levels exceed 85 db)
- Safety glasses with side shields

Level D PPE will be used for field reconnaissance and survey activities, and field activities which will not result in direct contact with contaminated groundwater, surface water, or sediment.

Modified Level D PPE - This level of protection applies when concentrations and types of airborne substances are known to be below the PEL/TLVs. Air purifying respirators should be readily available. The following constitute Modified Level D PPE, which may be used as appropriate:

- Chemical-resistant clothing (non-coated)
- Coveralls or field clothing
- Gloves, outer, chemical-resistant
- Gloves, inner, chemical-resistant
- Boots, chemical-resistant, steel toe and shank
- Safety glasses or chemical splash goggles
- Hardhat (when overhead hazards exist)
- Earplugs (when noise levels exceed 85 db)

TABLE 6-1

PPE AND AIR MONITORING REQUIREMENTS BY TASK

Face shield (optional as applicable)

Modified Level D PPE will be used for drilling, well installation, and field sampling activities as determined by the SSHO when site conditions warrant. At this time, drilling/monitoring well installation activities are only considered at Line 800. Other sites will be addressed in site-specific HSP Addenda.

Notes, continued:

Level C PPE - This level of protection applies when the concentration(s) and type(s) of airborne substances are known and exceed the PEL/TLV.

Half-mask, air purifying respirator (NIOSH-approved) with appropriate cartridges

Chemical-resistant clothing

Coveralls or field clothing

Gloves, outer, chemical-resistant

Gloves, inner, chemical-resistant

Boots, chemical-resistant, steel toe and shank

Safety glasses or chemical splash goggles

Hardhat (when overhead hazards exist)

Earplugs (when noise levels exceed 85 db)

SECTION SEVEN

Decontamination Procedures

7.1 PERSONAL DECONTAMINATION PROCEDURES

This section contains decontamination procedures for all personnel working within the exclusion zone. See SOP No. 10 in Appendix A of the WP and HS-8 (Attachment B) for further discussion of decontamination procedures.

- Remove as much potentially contaminated soil from boots prior to leaving exclusion zone. This will minimize the potential for contaminant migration.
- Deposit any equipment used on location (including disposable PPE) in a segregated container or bag upon leaving the exclusion zone. This segregation reduces the potential for cross contamination.
- Each person will wipe his or her hands, arms, neck, and face with a moistened towel or wipe before leaving the site.

7.2 PERSONAL HYGIENE

At a minimum, personnel must wipe hands, arms, neck, and face with a moistened towel or wipe before eating, smoking, or drinking. Personnel will also shower as soon as possible at the end of the workday.

7.3 OTHER DECONTAMINATION PROCEDURES

Any equipment, vehicles, or tools that have entered the exclusion zone will be cleaned prior to removal. Some equipment may require decontamination using pressurized water or steam cleaning. All water and material will be collected and placed in a designated waste disposal area.

7.3.1 Drilling Equipment

Decontamination procedures for drilling and direct push equipment will include:

- Scrape or brush off gross residue from any item that may have come into contact with contaminated media before leaving the exclusion zone.
- Pressure wash all items that may have come in contact with contaminated media.

7.3.2 Sampling Equipment

Decontamination procedures for sampling equipment will include:

- Scrape off soils with putty knife.
- Wash with detergent-water solution.
- Rinse with potable water.
- Double rinse with deionized water.
- Air dry.

SECTION EIGHT

Air Monitoring

Air monitoring for organic vapors will be conducted to reduce the potential of exposure to hazardous airborne contaminants. Please note, the majority of contaminants at the site are explosives and explosives byproducts which cannot be directly monitored.

8.1 ACTION LEVELS

The SSHO is responsible for implementing the following air monitoring action levels (in the breathing zone):

PID reading of 5 ppm or greater	Upgrade to PPE Level C
PID reading above 20 ppm	STOP WORK AND CONTACT HSO
CGI reading >10% LEL	STOP WORK AND CONTACT HSO
Observation of unusual odors or symptoms	STOP WORK AND CONTACT HSO
Observation of suspicious ordnance item	STOP WORK AND CONTACT HSO
Extremely dusty conditions	STOP WORK AND CONTACT HSO

8.2 ORGANIC VAPOR ANALYZER

An organic vapor monitor equipped with a photoionization detector (PID) will be used to measure organic vapors in ambient air. An organic vapor monitor provides a direct instrument reading to aid in determining if respiratory protection needs to be upgraded and defines the exclusion zone.

Organic vapor readings will be measured before field activities begin to determine the background levels of organic vapors naturally occurring at the site. This background level will be recorded in the field logbooks for future reference.

Organic vapor readings will be taken periodically during all intrusive field activities. During drilling operations, a reading must be taken at least once for every 5 feet drilled and recorded on the drilling log. If organic vapors are detected at the borehole, the breathing zone of the worker with the greatest potential for exposure will be monitored. Work in the exclusion zone will cease and corrective actions will be taken if organic vapor levels exceed the 5-ppm action level in the breathing zone. Work will not resume until organic vapor concentrations are below the action level, or PPE is upgraded to Level C.

8.3 CALIBRATION REQUIREMENTS

The organic vapor monitor will be calibrated daily before field activities begin. The instrument will be calibrated to a TCE equivalent using 100-ppm isobutylene calibration gas. Specific calibration procedures will be done following the manufacturer's instructions. The date, time, calibration gas, and name of person performing the calibration will be recorded in the field logbook.

SECTION NINE**Training Requirements**

9.1 HAZARDOUS WASTE TRAINING

The site personnel conducting hazardous waste field activities will be required to obtain and provide a certificate attesting to completing training in compliance with 29 CFR 1910, 29 CFR 1926 the SSHO prior to commencing work. Site supervisors will be required to supply documentation indicating that the additional 8-hour supervisors training has been completed.

9.2 SITE SAFETY MEETINGS AND INSPECTIONS

A site safety meeting will be held by the SSHO prior to the start of field activities to review and plan specific health and safety aspects of scheduled work. The HSP and safety briefing serve the purpose of informing on-site personnel of the hazards associated with IAAAP and field activities to be conducted. Safety briefings will be conducted by the SSHO at the beginning of each new activity or phase of work.

SECTION TEN**Medical Surveillance**

All AO LLC employees and subcontractors involved in hazardous waste field activities will participate in a medical surveillance program. Subcontractors are responsible for the medical surveillance program for their personnel. The medical surveillance program shall meet the requirements OSHA standard 29 CFR 1910.120 and 1910.134.

SECTION ELEVEN

Emergencies/Accidents

This section contains pertinent emergency information and the contingency plan. Local emergency response personnel must be contacted regarding field activities at the IAAAP prior to project kickoff. The emergency telephone numbers and route to hospital will be posted in the field trailer.

11.1 EMERGENCY TELEPHONE NUMBERS

Ambulance:	911 (or 17 for on-post assistance)
Police:	911 (or 17 for on-post assistance)
Fire Department:	911 (or 17 for on-post assistance)
Hospital:	Burlington Medical Center (319) 753-3011
CHEMTREC:	1-800-424-9300
AO LLC PM:	
AO LLC HSO:	

11.2 HOW TO REPORT AN EMERGENCY

When calling for assistance in an emergency situation, the following information should be provided:

- Your name
- Company affiliation
- Telephone number from which you are calling
- Date and time of the incident
- Location and type of incident (Be sure to indicate that the incident is in IAAAP if calling 911).
- Injuries, if any, and the number and type of those injuries
- Cause of the emergency, if known
- Details concerning the substance(s) involved (identification, amount, spill rate, size of area involved), if known
- Chemical hazard(s)
- Direction the spill is moving and the direction the wind may be dispersing airborne contaminants
- Surficial material on which the spill occurred (i.e., asphalt, gravel, etc.)
- Any first response action that has been taken
- Any additional pertinent information

The *recipient* of the call should hang up first - not the caller.

11.3 HOSPITAL ROUTE

Name of Facility: Great Rivers Hospital
 Telephone: (319) 753-3011
 Address: 1221 S. Gear Avenue, West Burlington, IA 52655

Specific Directions

From road "A" travel through the front gate to HWY 34. Turn right onto HWY 34. Travel east on HWY 34 for approximately 4 miles and get off at the Gear Avenue exit. Turn right onto Gear Avenue and travel south less than 1 mile. The hospital is at the intersection of Gear Avenue and West Agency Road.

11.4 EMERGENCY SIGNALS

In the unlikely event that an emergency situation occurs, all field activities at that site will cease. The following hand/body emergency communication signals should be used when other forms of communication are difficult or impossible:

Signal	Meaning
Hand clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm all right/I understand
Grip partner's wrist or both hands around partner's waist	Leave area immediately

If the emergency occurs in the Exclusion Zone, all field personnel will quickly move to the Contamination Reduction Zone for an appropriate decontamination before exiting to the Support Zone. In life-threatening emergencies, decontamination may not be appropriate. The emergency decontamination decision will be made by the SHO. Emergency situations occurring outside of the Exclusion Zone in Level D PPE will not require decontamination at the Contamination Reduction Zone before administering first aid.

Minor emergencies will be handled within the Support Zone utilizing the on-site first-aid kit. A portable emergency eyewash or a minimum of 32 ounces of eyewash fluid for use while en route to an emergency facility will be available in the field vehicle. Personnel who are exposed to other personnel's bodily fluids while administering first aid are to contact the Field Manager and the SHO as soon as possible for procedures to be taken as required by 29 CFR 1910.1030 or applicable state regulation concerning blood-borne pathogens. The appropriate emergency

SECTION ELEVEN

Emergencies/Accidents

response personnel (i.e., ambulance and fire department) will be contacted for major emergencies.

Routes to the nearest hospital are provided in Section 11.3 and Figure 11-1 and a laminated copy in all vehicles. The SHO must drive the hospital route before field activities begin. A written report of emergencies and/or incidents will be submitted to the AO LLC PM and IAAAP. Copies of these reports will also be sent to the appropriate agencies.

11.5 CONTINGENCY PLAN

This Contingency Plan presents procedures that on-site personnel must follow in the event of an emergency during field activities. A variety of events that are potential hazards to human health and the environment are discussed, including the following:

- A funnel cloud or tornado sighting
- An explosion
- A chemical or petroleum spill or accident
- Other events presenting a hazard to human health or the environment

This section also specifies the general procedures you should follow, who you should notify, and the information you should report if you are the first on the scene of an emergency.

11.5.1 Response Sequence for First Arrivals

If you are first on the scene, respond as follows:

- Evacuate the incident area (if necessary). Remember that your safety must be the primary consideration.
- Restrict access to the incident area.
- Restrict the use of ignition sources for incidents involving flammable substances.
- Call the Field Manager or the local emergency response organization (dial 17 for base security / 911 for off-base emergency services). Report the information listed in Section 11.2.
- Notify the SHO after the emergency response team has been contacted. The SSHO will then notify the AO LLC PM.
- Coordinate with emergency response personnel when they arrive.

11.5.2 Response for On-Site Incidents

If an incident occurs during field activities, personnel shall:

- Evacuate the area immediately.
- Decontaminate and remove PPE if the incident is not life- or health-threatening.

- Proceed to the predetermined assembly point (e.g., rally point).
- Make sure the SHO knows you are present.

11.5.3 Emergency Response for Severe Weather Conditions

This section specifies what you should do in the event of a severe weather emergency, including electrical storms, high winds, heavy rain, hail, or tornadoes.

Electrical Storms

- Cease field activities immediately.
- Seek shelter at the support facility or in the field vehicles.
- Do not stand near or under high objects, such as trees and drilling rigs.
- If possible, lower the drilling rig mast.

High Winds

- Seek shelter at the support facility (if anchored) or in the field vehicles.
- Do not drive high-profile vehicles at high speeds.
- Park vehicles heading into the wind.
- Don a respirator or wear safety goggles and a kerchief covering your nose and mouth until you are in a protected area.

Heavy Rain or Hail

- Seek shelter at the support facility or in the field vehicles.
- Do not attempt to drive a vehicle if you are in an area that is or has the potential for flooding unless you are moving out of a low area.

Tornadoes

- Seek shelter underground or in a closet, bathroom, or interior wall of a substantial building. Get under something sturdy and cover your head.
- Do not stay in a trailer or vehicle. Leave the trailer or vehicle and lie flat in the nearest ditch if substantial shelter is not available.
- Stay away from large areas of glass.
- Stay away from large unsupported roofs.

11.5.4 Emergency Response for Earthquakes

If an earthquake occurs while you are in a building, follow these instructions:

- Stand in an interior doorway or get under a desk or table.

SECTION ELEVEN

Emergencies/Accidents

- Stay away from areas containing a large amount of glass.
- Do not use stairways or elevators during the tremor.
- If possible, turn off gas supplies and ignition sources.
- Be aware of the potential for live downed wires.
- Make sure the telephone handset is on the hook. Do not use the telephone for non-emergency calls.
- Evacuate the building when the tremors have ceased. Be aware of the potential for aftershocks.
- Walk briskly. Do not run. Do not pick up personal items.
- Report to a predetermined assembly area and notify your supervisor or the area monitor that you are safe.
- Report missing persons.

If an earthquake occurs while you are outside, follow these instructions:

- Avoid buildings, trees, areas with large amounts of glass, and power lines.
- Avoid downed wires.
- If operating heavy equipment or a motor vehicle, stop immediately but stay in the vehicle until the tremors have stopped.
- If operating a motor vehicle on a bridge, proceed to solid ground if the end of the bridge is close.
- If operating a motor vehicle on a bridge at mid-span, get out of the vehicle and begin walking to the nearest solid ground.

11.5.5 Emergency Response for Flash Floods

If a flash flood warning is issued, climb to higher ground. Seek shelter on stable ground. Do not stay in an area that is characterized by uncompacted material on a steep slope.

11.5.6 Emergency Response for Fires

If a small fire occurs, extinguish it with the fire extinguisher if required. Remember to follow these directions to put out the fire:

- Aim at the base of the flame.
- Use the appropriate type of fire extinguisher (e.g., do not use a water type fire extinguisher for an electrical fire).
- Remember that the spray only lasts a few seconds. If a large fire occurs at the work site, follow these instructions:

- Move flammable and combustible items out of the path of the fire, if such action can be performed safely.
- Call the fire department and report the information outlined on page 1 of this section.
- Do not attempt to put out a large fire with the field vehicle fire extinguisher.
- Report the incident to the SSHO.

11.5.7 Fire Prevention

Steps to be taken to minimize the potential of a fire include the following:

- Obey "No Smoking" signs.
- Label and store flammable liquid containers in a protected, ventilated and approved area.
- Use only approved containers for flammable liquid storage.
- Use minimum amounts of flammable liquids.
- Shut off engines before refueling, if possible.
- Do not refuel a hot engine unless an ABC-rated fire extinguisher is nearby.
- Store oily rags in a self-closing metal container. Dispose containers properly.
- Bond and ground all flammable liquid containers and transfer equipment when transferring or filling product.
- Use intrinsically safe equipment in areas potentially containing flammable vapor.

11.5.8 Emergency Response for Explosions

If an explosion occurs, follow these instructions:

- Evacuate the site immediately.
- If feasible, decontaminate yourself and others.
- Do not address medical emergencies until you are out of danger.
- Call the SSHO, and/or local emergency response organization when you are out of danger to report the incident. Report the following information listed under Section 11.2.

11.5.9 Spills or Leaks

The procedures defined in this section comprise the spill containment program in place for field activities.

- All drums and containers used shall meet the appropriate DOT, OSHA, and EPA regulations for the materials that they will contain.
- Drums and containers shall be inspected and their integrity assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage

SECTION ELEVEN

Emergencies/Accidents

conditions, shall be positioned in an accessible location and inspected prior to further handling.

- Operations on site will be organized so as to minimize the amount of drum or container movement.
- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent, pillows, etc.) will be stationed in the immediate area.
- Fire extinguishing equipment meeting 29 CFR part 1910 Subpart L shall be on hand and ready for use to control fires.

In the event of a spill or a leak, site personnel will:

- Inform the Field Manager/SSHO immediately;
- Locate the source of the spillage and stop the flow if it can be done safely;
- Begin containment and recovery of the spilled materials.

11.5.10 Responsibilities of On-Site Personnel

Field Team Responsibilities

- Follow the first response directives in Section 11.2.
- Wear the correct and appropriate PPE for project completion.
- Use monitoring equipment applicable to the anticipated hazards (i.e., CGI, PID, etc.)
- Have a decontamination area set up for fieldwork.
- Use approved decontamination procedures.
- Have available a means to decontaminate affected personnel.
- Treat minor injuries using the onsite first-aid kit.
- Take personnel with serious injuries to Burlington Medical Center or contact a medical emergency response team.
- Contact emergency response for health- or life-threatening injuries. Victims should be taken to Burlington Medical Center by the medical emergency response team
- All personnel at the site where the incident has occurred must completely decontaminate and be debriefed by the SSHO before leaving the job site.
- Perform remedial actions as appropriate.

11.5.11 Emergency Response for Vehicular Accidents

If a vehicular accident occurs follow these instructions:

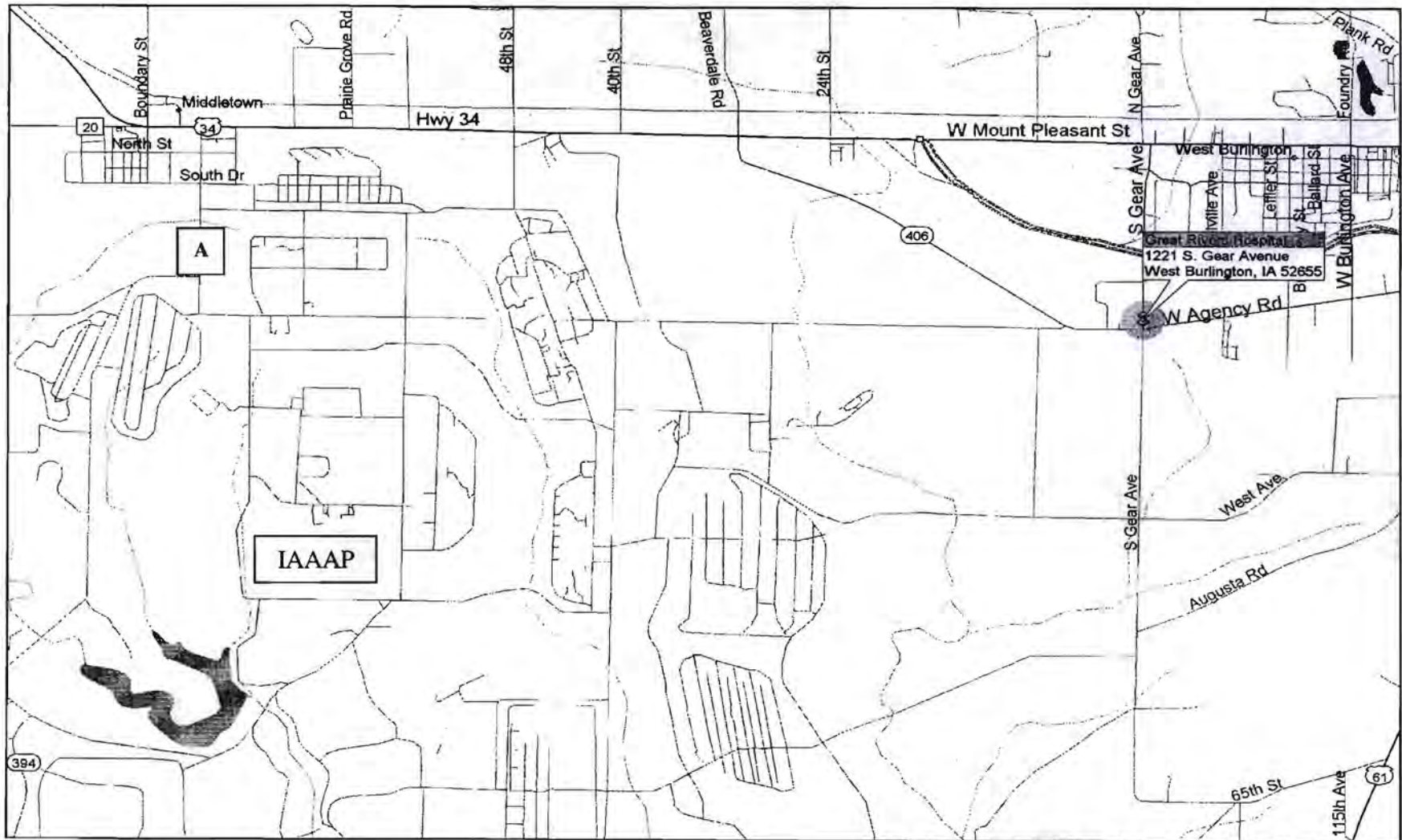
- Notify on-site personnel (Guard Head Quarters) about the incident.
- Size-up the situation based on available information.

- Evacuate the incident area (if necessary). Remember that your safety must be the primary consideration. Do not address medical emergencies until you are out of danger.
- Restrict access to the incident area.
- Assess casualties and contain/extinguish hazard (if present), only if it is safe to do so.
- Call the Field Manager or the local emergency response organization (dial 17 for base security/911 for off-base emergency services). Report the information listed in Section 11.2.
- Notify the SSHO after the emergency response team has been contacted. The SSHO will then notify the AO LLC Project Manager.
- Coordinate with emergency response personnel when they arrive. Survey and assess existing and potential hazards
- Replace or rejuvenate damaged or exhausted equipment.
- Document the incident within 24 hours.
- AO LLC Project Manager and/or SSHO will review and revise HSP and the Contingency Plan.

11.5.12 Emergency Response Equipment

The following is a list of recommended equipment that is required to be available for emergency response actions:

- 5-pound ABC-rated fire extinguisher
- First-aid kit
- Eyewash station or eyewash bottles (minimum 32 ounces) to be used while enroute to an emergency facility (Burlington Medical Center)



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 American Ordnance	
DRN BY: CSA	DATE: 1/9/02
CHK'D BY:	DATE:

ROUTE TO HOSPITAL IOWA ARMY AMMUNITION PLANT	
PROJECT NO. 45-F000023..00	FIG NO. 11-1

SECTION TWELVE

References

Code of Federal Regulations:

- 10 CFR 20. Standards for Protection against Radiation.
- 29 CFR 1910.120. Occupational Safety and Health Administration Standards. Hazardous Waste Operations and Emergency Response.
- 20 CFR 1910.134. Occupational Safety and Health Administration Standards. Personal Protective Equipment.
- 29 CFR 1910.1030. Occupational Safety and Health Administration Standards. Toxic and Hazardous Substances Bloodborne Pathogens.
- 29 CFR 1926. Occupational Safety and Health Administration/Department of Labor. Safety and Health Regulations for Construction.

Harza Engineering Company, Inc. 1997. Supplemental Groundwater RI Report, Iowa Army Ammunition Plant, Middletown, Iowa. December.

Harza Engineering Company, Inc. 1998. Work Plan, Supplemental Remedial Investigation, Line 800/Pink Water Lagoon, Iowa Army Ammunition Plant, Middletown, Iowa. July.

Harza Engineering Company, Inc. 2000b. Long-Term Monitoring Report – Fall 1999, Iowa Army Ammunition Plant, Middletown, Iowa. June.

Jaycor. 1996. Remedial Investigation/Risk Assessment, Iowa Army Ammunition Plant, Middletown, Iowa. Revised Draft Final. May.

U.S. Army Corps of Engineers (USACE). 1994. Safety and Occupational Health Requirements, Appendix B. Safety and Health Elements for HTRW and OEW Documents. ER-385-1-92. March.

U.S. Army Corps of Engineers (USACE). 1996. Safety and Health Requirements Manual. EM-385-1-1. September.

ATTACHMENT A

Safety Compliance Agreement Form

ATTACHMENT A

Safety Compliance Agreement Form

SAFETY BRIEFING AND COMPLIANCE AGREEMENT

Date/Time: _____ Project Name: _____
Site Location: _____ Project No.: _____
Site Safety and Health Officer: _____ Project Manager: _____
Activity: _____ Subsite Name: _____

I have received a copy of the Health and Safety Plan/HSP and attended a safety briefing. I agree to abide by its provisions and to aid the Site Safety and Health Officer in its implementation. I understand it is in the best interest of myself and my coworkers to ensure that site operations are conducted in the safest manner possible. I affirm that my safety training and medical are current and in compliance with OSHA regulations.

Name	Signature	Company

List of Operating Procedures

HS-1	Safety Guidelines for Drilling into Soil and Rock
HS-2	Ticks and Tick-Borne Diseases
HS-3	Heat Stress
HS-4	Cold Stress
HS-5	Noise/Hearing Conservation
HS-6	Electrical Safety
HS-7	Site Control
HS-8	Incident Reports
HS-9	Selection and Use of Personal Protective Equipment
HS-10	Decontamination

**Standard Operating Procedure No. HS-1
Safety Guidelines for Drilling into Soil and Rocks**

1.0 SAFETY GUIDELINES FOR DRILLING

1.1 PURPOSE

The purpose of this Operating Procedure is to provide an overview for working safely around drilling operations with truck-mounted and other engine-powered drill rigs. The procedure addresses off-road movement of drill rigs, overhead and buried utilities, use of augers, rotary and core drilling, and other drilling operations and activities.

1.2 APPLICATION

The guidelines shall be applied to projects in which truck-mounted, or other engine-powered, drill rigs are used. For drill rigs operated by contractors, the primary responsibility for drilling safety is with the drilling contractor.

1.3 RESPONSIBILITY AND AUTHORITY

Drill rig safety and maintenance is the responsibility of the drill rig operator. Employees are responsible for their own safety including recognizing and avoiding drill rig hazards. Employees that observe a drill rig condition believed to be unsafe, shall advise the drill rig operator of the unsafe condition.

1.4 SAFETY GUIDELINES

1.4.1 Movement of Drill Rigs

Before moving a rig, the operator must do the following:

1. To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.
2. Check the brakes of the truck/carrier, especially if the terrain along the route of travel is rough or sloped.
3. Discharge all passengers before moving on rough or steep terrain.
4. Engage the front axle (on 4x4, 6x6, etc. vehicles) before traversing rough or steep terrain.

Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator must conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility must be considered that the presence of drilling tools on the rig may reduce the ability of the rig to remain upright (raises the center of mass of the rig).

Logs, ditches, road curbs, and other long and horizontal obstacles should be normally approached and driven over squarely, not at an angle.

When close lateral or overhead clearance is encountered, the driver of the rig should be guided by another person on the ground.

Loads on the drill rig and truck must be properly stored while the truck is moving, and the mast must be in the fully lowered position.

After the rig has been positioned to begin drilling, all brakes and/or locks must be set before drilling begins. If the rig is positioned on a steep grade and leveling of the ground is impossible or impractical, the wheel of the transport vehicle should be blocked and other means of preventing the rig from moving or tipping over employed.

1.5 BURIED AND OVERHEAD UTILITIES

The location of overhead and buried utility lines must be determined before drilling begins, and the locations should be noted on boring plans and/or assignment sheets. Further information on electrical safety may be seen in HS-6.

When overhead power lines are close by, the drill rig mast should not be raised unless the distance between the rig and the nearest power line is at least 20 feet or other distance as required by local ordinances, whichever is greater. The drill rig operator or assistant should walk completely around the rig to make sure that proper distance exists.

When the drill rig is positioned near an overhead line, the rig operator should be aware that hoist lines and power lines can be moved towards each other by wind. When necessary and approved by the Project Manager (PM), the utility and/or powerlines may be shielded, shut down, or moved by the appropriate personnel.

1.6 CLEARING THE WORK AREA

Before a drill rig is positioned to drill, the area on which the rig is to be positioned should be cleared of removable obstacles and the rig should be leveled if sloped. The cleared/leveled area should be large enough to accommodate the rig and supplies.

1.7 SAFE USE OF AUGERS

Never place hands or fingers under the bottom of an auger flight or drill rods when hoisting the augers or rods over the top of another auger or rod in the ground or other hard surfaces, such as the drill rig platform.

Never allow feet to get under the auger or drill rod while they are being hoisted.

When the drill is rotating, stay clear of the drill string and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.

Move auger cuttings away from the auger with a long-handled shovel or spade; never use hands or feet.

Never clean an auger attached to the drill rig unless the transmission is in neutral or the engine is off, and the auger has stopped rotating.

1.8 SAFE USE OF HAND TOOLS

OSHA regulations regarding hand tools should be observed in addition to the guidelines provided below:

- Each tool should be used only to perform tasks for which it was originally designed.
- Damaged tools should be repaired before use or discarded.
- Safety goggles or glasses should be worn when using a hammer or chisel. Nearby co-workers and bystanders should be required to wear safety goggles or glasses also, or move away.
- Tools should be kept cleaned and stored in an orderly manner when not in use.

1.9 SAFE USE OF WIRE LINE HOISTS, WIRE ROPE, AND HOISTING HARDWARE

Safety rules described in Title 29 Code of Federal Regulations (CFR) 1926.552 and guidelines contained in the Wire Rope User's Manual published by the American Iron and Steel Institute shall be used whenever wire line hoists, wire rope, or hoisting hardware are used.

1.10 PROTECTIVE GEAR

1.10.1 Minimum Protective Gear

Items listed below should be worn by all members of the drilling team while engaged in drilling activities.

- Hard Hat;
- Safety Shoes (shoes or boots with steel toes and shanks); and
- Gloves.

1.10.2 Other Gear

Items listed below should be worn when conditions warrant their use. Some of the conditions are listed after each item.

1. **Safety Goggles or Glasses:** Use when working within 25 feet of a drill rig or when using hand tools or chemicals that may create eye hazards.

2. **Safety Harnesses and Lifelines**: Safety harnesses and lifelines shall be worn by all persons working on top of an elevated derrick beam or mast. The lifeline should be secured at a position that will allow a person to fall no more than six feet. OSHA Full Protection (1926 Subpart m) requirements apply.
3. **Life Vests**: Use for work over water.

1.11 TRAFFIC SAFETY

Drilling in streets, parking lots or other areas of vehicular traffic requires definition of the work zones with cones, warning tape, etc. and compliance with local police requirements.

1.12 FIRE SAFETY

- Fire extinguishers shall be kept on or near drill rigs for fighting small fires.
- If methane is suspected in the area, a combustible gas instrument (CGI) shall be used to monitor the air near the borehole with all work to stop at 10 percent of the Lower Explosive Limit (LEL).
- Work shall stop during lightning storms.

**Standard Operating Procedure No. HS-2
Ticks and Tick-Borne Diseases**

2.0 TICKS AND RELATED DISEASE

2.1 PURPOSE

The purpose of this Operating Procedure is to provide information to employees regarding the diseases transmitted by ticks, particularly Lyme disease, and how to reduce employee risk.

2.2 TICK-BORNE DISEASES

Tick-borne diseases represent a significant health risk in many parts of the world. The risk to URS field staff depends on the work location, the time of year, the clothing worn and other factors. Ticks are documented vectors of virus and bacteria for diseases such as Lyme disease (North America, Europe), Rocky Mountain Spotted Fever (North America), Encephalitis, (Asia, Africa), Boutonneuse Fever (Africa, India, Middle East), and Rickettsiosis (Asia).

While specific information in this SOP is limited to Lyme disease, the risk control measures apply to other tick-borne diseases.

2.3 LYME DISEASE

Lyme disease is caused by a coiled bacteria known as a spirochete and is most commonly transferred to humans through ticks. The disease has been found in almost all U.S. states and in Europe, but is most common in locations with a mixture of wooded areas and grasslands. The Lyme disease infection is spread in the wild by tick bites on animals, particularly mice and deer, and infection can include domestic animals such as cats, dogs, and cows. While a number of ticks can transfer Lyme disease, the very small deer tick is the most common.

The tick bite is usually not painful and because of the small size of the deer tick, is often not noticed. In most cases, the tick simply draws blood for its nourishment and after a few days drops off. If the tick is infected with the Lyme disease bacteria, it may be transmitted during this feeding process.

2.3.1 Lyme Disease Symptoms

A typical early symptom of infection is a slowly expanding red rash. The rash often starts as a flat or raised red area and slowly expands after several days, with partial central clearing, resulting in a red ring appearance. While most people will develop an observable red rash, some Lyme disease victims may lack this symptom.

Other common early symptoms of Lyme disease include fatigue, headache, muscle aches, neck stiffness, fever, and swollen glands.

Later symptoms, if untreated, include joint pain and swelling, nervous system problems, heart complications, and other effects. These later symptoms usually occur one to four months after the original infection and can result in permanent health effects.

2.3.2 Lyme Disease Treatment

Lyme disease is easily treated by use of antibiotics when detected early. Individuals that develop a rash or experience other early symptoms of Lyme disease should promptly see a physician for treatment. Although the disease is more difficult to treat if further advanced, it is still treatable using larger antibiotic (usually intravenous) doses.

2.3.3 Reducing Lyme Disease Risk

Field personnel can reduce the risk of tick-borne diseases through proper clothing, use of repellents, use of good work practices, and recognizing early symptoms.

Field personnel in grassy or wooded areas should wear long pants, long sleeved shirts (tucked in), hat, and consider taping or cinching clothing at the ankles. Work in areas of known high tick concentrations (e.g. wetland areas) should consider use of Tyvek coveralls taped at the ankles and wrists.

Follow label directions carefully for use of tick repellents as many are designed for use on clothing, not on skin. Repellent use should be in combination with proper clothing and is most recommended for the ankles and wrists.

After working in an area of possible tick exposure, it is recommended that the individual shower promptly and check for any ticks. If a tick is found on the skin, remove it promptly using tweezers or forceps, followed by disinfection with alcohol or iodine. It takes several hours for a tick to attach and feed; removing it promptly lessens the chance of being infected.

Standard Operating Procedure No. HS-3
Heat Stress

3.0 HEAT STRESS

3.1 PURPOSE

The purpose of this Operating Procedure is to provide general information on heat stress and the methods that can be utilized to prevent or minimize the occurrence of heat stress.

Adverse climatic conditions are important considerations in planning and conducting site operations. Ambient temperature effects can include physical discomfort, reduced efficiency, personal injury, and increased accident probability. Heat stress is of particular concern while wearing impermeable protective garments, since these garments inhibit evaporative body cooling.

3.2 TYPES OF HEAT STRESS

Heat stress is the combination of environmental and physical work factors that constitute the total heat load imposed on the body. The environmental factors of heat stress are the air temperature, radiant heat exchange, air movement, and water vapor pressure. Physical work contributes to the total heat stress of the job by producing metabolic heat in the body in proportion to the intensity of the work. The amount and type of clothing also affects heat stress.

Heat strain is the series of physiological responses to heat stress. When the strain is excessive for the exposed individual, a feeling of discomfort or distress may result, and, finally, a heat disorder may ensue. The severity of strain will depend not only on the magnitude of the prevailing stress, but also on the age, physical fitness, degree of acclimatization, and dehydration of the worker.

Heat disorder is a general term used to describe one or more of the heat-related disabilities or illnesses shown in Table 1.

3.3 METHODS OF CONTROLLING HEAT STRESS

As many of the following control measures, as appropriate, should be utilized to aid in controlling heat stress:

- Provide for adequate liquids to replace lost body fluids. Encourage personnel to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.
- Replace body fluids primarily with water, with commercial mixes such as Gatorade or Quick Kick used only as a portion of the replacement fluids. Avoid excessive use of caffeine drinks such as coffee, colas or tea.
- Establish a work regimen that will provide adequate rest periods for cooling down. The heat exposure Threshold Limit Values (TLV) may be used for guidelines.
- Provide shaded work areas, if possible.

- Wear cooling devices such as vortex tubes or cooling vests.
- Consider adjusting work hours to avoid the worst heat of the day.
- Take breaks in a cool rest area.
- Remove any impermeable protective garments during rest periods.
- Do not assign other tasks to personnel during rest periods.
- Inform personnel of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

3.4 MONITORING

3.4.1 Temperature

The environmental heat stress of an area can be monitored by the Wet Bulb Globe Temperature Index (WBGT) technique. When heat stress is a possibility, a heat stress monitoring device, such as the Wibget Heat Stress Monitor (Reuter Stokes) can be utilized.

The WBGT shall be compared to the TLV outlined by the American Conference of Governmental Industrial Hygienists (ACGIH) TLV guides, and a work-rest regimen can be established in accordance with the WBGT. Note that approximately 5°C must be subtracted from the TLVs listed for heat stress to compensate for the wearing of impermeable protective clothing.

3.4.2 Medical

In addition to the provisions of the medical surveillance program, on-site medical monitoring of personnel should be performed for projects where heat stress is a significant concern. Blood pressure, pulse, body temperature (oral), and body weight loss may be utilized.

Heart Rate: Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third. If the heart rate still exceeds 110 beats per minute at the next rest cycle, shorten the following work cycle by one-third.

Oral Temperature: Use a clinical thermometer or similar device to measure the oral temperature at the end of the work period (before drinking liquids). If the oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period. If the oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.

Do not permit a worker to wear a semipermeable or impermeable garment if his/her oral temperature exceeds 100.6°F (38.1°C).

Body Water Loss: Measure body weight on a scale accurate to ± 0.25 pounds at the beginning and end of each work day (also at lunch break, if possible) to see if enough

fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, nude. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Physiological Monitoring: Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work. The length of the work cycle will be governed by the frequency of the required physiological monitoring.

3.5 REFERENCES

American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents, 1992-1993.

EPA, Standard Operating Safety Guides, 1992, Pages 91-93.

National Institute for Occupational Safety and Health, Criteria for a Recommended Standard: Occupational Exposure to Hot Environments, 1986.

TABLE 1

CLASSIFICATION, MEDICAL ASPECTS, AND PREVENTION OF HEAT ILLNESS

Category and Clinical Features	Predisposing Factors	Underlying Physiological Disturbances	Treatment	Prevention
<p>Temperature Regulation Heatstroke</p> <p>Heatstroke (1) Hot, dry skin; usually red, mottled, or cyanotic; (2) rectal temperature 40.5°C (104°F) and over; (3) confusion, loss of consciousness, convulsions, rectal temperature continues to rise; fatal if treatment is delayed</p>	<p>(1) Sustained exertion in heat by unacclimatized workers; (2) lack of physical fitness and obesity; (3) recent alcohol intake; (4) dehydration; (5) individual susceptibility; and (6) chronic cardiovascular disease</p>	<p>Failure of the central drive for sweating (cause unknown) leading to loss of evaporative cooling and an uncontrolled accelerating rise in temperature; there may be partial rather than complete failure of sweating</p>	<p>Immediate and rapid cooling by immersion in chilled water with massage or by wrapping in wet sheet with vigorous fanning with cool dry air; avoid overcooling; treat shock if present</p>	<p>Medical screening of workers, selection based on health and physical fitness; acclimatization for 5-7 days by graded work and heat exposure; monitoring workers during sustained work in severe heat</p>
<p>Circulatory Hypostasis Heat Syncope</p> <p>Fainting while standing erect and immobile in heat</p>	<p>Lack of acclimatization</p>	<p>Pooling of blood in dilated vessels of skin and lower parts of body</p>	<p>Remove to cooler area; rest in recumbent position; recovery prompt and complete</p>	<p>Acclimatization; intermittent activity to assist venous return to heat</p>
<p>Water and or Salt Depletion</p> <p>(a) Heat Exhaustion</p> <p>(1) Fatigue, nausea, headache, giddiness; (2) skin clammy and moist; complexion pale, muddy, or hectic flush; (3) may faint on standing with rapid thready pulse and low blood pressure; (4) oral temperature normal or low, but rectal temperature usually elevated (37.5-38.5°C or 99.5-101.3°F); water restriction type: urine volume small, highly concentrated; salt restriction type; urine less concentrated chlorides less than 3 g/L</p> <p>(b) Heat Cramps</p> <p>Painful spasms of muscles used during work (arms, legs, or abdominal); onset during or after work hours</p>	<p>(1) Sustained exertion in heat; (2) lack of acclimatization; and (3) failure to replace water lost in sweat</p> <p>(1) Heavy sweating during hot work; (2) drinking large volumes of water without replacing salt loss</p>	<p>(1) Dehydration from deficiency of water; (2) depletion of circulating blood volume; (3) circulatory strain from competing demands for blood flow to skin and to active muscles</p> <p>Loss of body salt in sweat, water intake dilutes electrolytes; water enters muscles, causing spasm</p>	<p>Remove to cooler environment; rest in recumbent position; administer fluids by mouth; keep at rest until urine volume indicates that water balances have been restored</p> <p>Salted liquids by mouth or more prompt relief by IV infusion</p>	<p>Acclimatize workers using a breaking-in schedule for 5-7 days; supplement dietary salt only during acclimatization; ample drinking water to be available at all times and to be taken frequently during work day</p> <p>Adequate salt intake with meals; for unacclimatized workers, supplement salt intake at meals.</p>

TABLE 1

CLASSIFICATION, MEDICAL ASPECTS, AND PREVENTION OF HEAT ILLNESS

Category and Clinical Features	Predisposing Factors	Underlying Physiological Disturbances	Treatment	Prevention
<p>Skin Eruptions</p> <p>(a) Heat Rash (miliaria rubra, or "prickly heat")</p> <p>Profuse tiny raised red vesicles (blisterlike) on affected areas; prickling sensations during heat exposure</p> <p>(b) Anhidrotic Heat Exhaustion (miliaria profunda)</p> <p>Extensive areas of skin which do not sweat on heat exposure, but present gooseflesh appearance, which subsides with cool environments; associated with incapacitation in heat</p>	<p>Unrelieved exposure to humid heat with skin continuously wet from unevaporated sweat</p> <p>Weeks or months of constant exposure to climatic heat with previous history of extensive heat rash and sunburn</p>	<p>Plugging of sweat gland ducts with sweat retention and inflammatory reaction</p> <p>Skin trauma (heat rash; sunburn) causes sweat retention deep in skin; reduced evaporative cooling causes heat intolerance</p>	<p>Mild drying lotions; skin cleanliness to prevent infection</p> <p>No effective treatment available for anhidrotic areas of skin; recovery of sweating occurs gradually on return to cooler climate</p>	<p>Cool sleeping quarters to allow skin to dry between heat exposures</p> <p>Treat heat rash and avoid further skin trauma by sunburn; provide periodic relief from sustained heat</p>
<p>Behavioral Disorders</p> <p>(a) Heat Fatigue - Transient</p> <p>Impaired performance of skilled sensorimotor, mental, or vigilance tasks, in heat</p> <p>(b) Heat Fatigue - Chronic</p> <p>Reduced performance capacity; lowering of self-imposed standards of social behavior (e.g., alcoholic over-indulgence); Inability to concentrate, etc.</p>	<p>Performance decrement greater in unacclimatized and unskilled worker</p> <p>Workers at risk come from temperature climates for long residence in tropical latitudes</p>	<p>Discomfort and physiologic strain</p> <p>Psychosocial stresses probably as important as heat stress; may involve hormonal imbalance but no positive evidence</p>	<p>Not indicated unless accompanied by other heat illness</p> <p>Medical treatment for serious causes; speedy relief of symptoms on returning home</p>	<p>Acclimatization and training for work in the heat</p> <p>Orientation on life in hot regions (customs, climate, living conditions, etc.)</p>

**Standard Operating Procedure No. HS-4
Cold Stress**

4.0 COLD STRESS

4.1 PURPOSE

The purpose of this Operating Procedure is to provide information on cold stress and the procedures for preventing and dealing with cold stress. Adverse climatic conditions are important considerations in planning and conducting site operations. Ambient temperature effects can include physical discomfort, reduced efficiency, personal injury, and increased accident probability.

4.2 TYPES OF COLD STRESS EFFECTS

4.2.1 Frostbite

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite can be categorized into:

- **Frost Nip or Initial Frostbite:** (1st degree frostbite) Characterized by blanching or whitening of skin.
- **Superficial Frostbite:** (2nd degree frostbite) Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient. Blistering and peeling of the frozen skin will follow exposure.
- **Deep Frostbite:** (3rd degree frostbite) Tissues are cold, pale, and solid; extremely serious injury with possible amputation of affected area.

Frostbite can occur without hypothermia when the extremities do not receive sufficient heat. The toes, fingers, cheeks, and ears are the most commonly affected. Frostbite occurs when there is freezing of the fluids around the cells of the affected tissues. The first symptom of frostbite is an uncomfortable sensation of coldness, followed by numbness. There may be tingling, stinging, or cramping. Contact by the skin with tools or other metal objects below 20°F (-7°C) may result in contact frostbite.

The prevention of frostbite includes early recognition of problems, adequate protective clothing, recognizing the combination of wind and low temperature (see Table 1 Windchill Index), adequate fluids, work-rest regimens with heated rest areas, and use of controls such as wind-breaks and heaters.

The initial treatment for frostbite includes bringing the individual to a warm location, removal of clothing in the affected area, and placing the affected parts in warm (100-105°F) water. Do not massage or rub the frostbite area. After the initial treatment, wrap the affected area loosely in sterile gauze and seek medical attention.

4.2.2 Hypothermia

Hypothermia results when the body loses heat faster than it can be produced. When this situation first occurs, blood vessels in the skin constrict in an attempt to conserve vital internal heat. Hands and feet are first affected. If the body continues to lose heat, involuntary shivers begin. This is the body's way of attempting to produce more heat, and it is usually the first real warning sign of hypothermia. Further heat loss produces speech difficulty, confusion, loss of manual dexterity, collapse, and finally death. Wet clothes or immersion in cold water greatly increases the hypothermia risk. The progressive clinical presentation of hypothermia may be seen in Table 2.

Prevention of hypothermia includes planning for outside work in winter conditions, particularly work over water. Planning will include adequate layers of clothing, training employees in recognizing hypothermia in themselves and others, recognition of the combination of wind and temperature (see Windchill Index in Table 1), use of controls such as wind-breaks and heaters, a work-rest schedule, and adequate fluid intake.

Fatal exposure to cold among workers has usually resulted from immersion in low temperature water. Water transmits body heat over 200 times faster than air. Wetsuits or drysuits are recommended for work over water with water temperatures below 45°F. Individuals who fall into cold water without wetsuits or drysuits may not be able to swim due to the rapid onset of hypothermia.

Prompt treatment of hypothermia is essential. Once the body temperature drops below 95°F, the loss of temperature control occurs, and the body can no longer rewarm itself. Initial treatment includes reducing heat loss by moving the individual out of the wind and cold, removal of wet clothing, applying external heat (such as a pre-warmed sleeping bag, electric blanket, or body-heat from other workers) and follow-up medical attention.

4.3 EXPOSURE LIMITS

The American Conference of Governmental Industrial Hygienists (ACGIH) has adopted Threshold Limit Values (TLVs) for cold stress. These limits set maximum work periods based on a combination of wind and temperature.

4.4 REFERENCES

American Conference of Governmental Industrial Hygienists, Documentation of Threshold Limit Values, 1984

EPA, Standard Operating Safety Guides, 1992, pages 95-100.

TABLE 1
WINDCHILL INDEX¹

		ACTUAL THERMOMETER READING (°F)									
		50	40	30	20	10	0	-10	-20	-30	-40
Wind speed in mph	EQUIVALENT TEMPERATURE (F)										
	calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47	
10	40	28	16	4	-9	-21	-33	-46	-58	-70	
15	36	22	9	-5	-18	-36	-45	-58	-72	-85	
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113	
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	
Over 40 mph	Little Danger				Increasing Danger				Great Danger		
(little added effect)	(for properly clothed person)				(Danger from freezing of exposed flesh)						

TABLE 2
PROGRESSIVE CLINICAL PRESENTATIONS OF HYPOTHERMIA*

Core Temperature		
°C	°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 compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood pressure
33	91.4	Severe hypothermia below this temperature
32	89.6	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
31	87.8	
30	86.0	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
29	84.2	
27	82.4	Ventricular fibrillation possible with myocardial irritability
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent
26	78.8	Ventricular fibrillation may occur spontaneously
25	77.0	
24	75.2	Pulmonary edema
22	71.6	Maximum risk of ventricular
21	69.8	fibrillation
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

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

**Standard Operating Procedure No. HS-5
Noise/Hearing Conservation**

5.0 NOISE/HEARING CONSERVATION

5.1 PURPOSE

The purpose of this Operating Procedure is to establish procedures and responsibilities for the administration of a hearing conservation program. A proper hearing conservation program will reduce the risk of occupationally induced hearing loss and provide education and guidance for the prevention of "lifestyle" induced hearing loss.

5.2 HAZARD INFORMATION

Excessive noise exposure can cause both temporary and permanent effects on hearing. The temporary effects of excessive noise include ringing in the ears, interference with communication, and hearing threshold changes. The effect of long-term excessive noise includes varying degrees of noise induced hearing loss.

The damaging effects of noise are dependent on the noise intensity (decibels), the time of exposure, the noise frequency (Hertz), and individual susceptibility. The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) and American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) set exposure limits based on exposure per day (in hours) and sound intensity (in decibels A scale or dBA). Exposures above these limits require use of hearing protection (plugs or muffs) to reduce the sound level or the use of noise engineering controls to reduce the sound level.

It is known that noise intensity above 85 dBA for prolonged periods will induce hearing loss. Eighty-five dBA represents a noise level where normal conversation is difficult and individuals will be shouting or talking into the ear of the person to be understood.

5.3 REQUIREMENTS

OSHA regulations issued in late 1981 require a hearing conservation program for workers exposed to 85 dBA as an 8-hour time-weighted average.

The OSHA regulation addresses several requirements for a good hearing conservation program. These requirements are as follows:

- Noise exposure monitoring
- Audiometric testing
- Hearing protectors
- Training programs
- Access to information
- Recordkeeping and posting

5.4 RESPONSIBILITIES

Each employee has the responsibility to comply with all aspects of this Operating Procedure. Managers with input from the Health and Safety Officer (HSO)'s and Site Safety and Health Officer (SSHO)'s are responsible for enforcing the provisions of this Operating Procedure as it applies to field work. Scheduling of audiograms (accomplished through Medical Surveillance) and training are the responsibility of the HSO.

5.5 NOISE EXPOSURE MONITORING

The SSHO with assistance from the HSO will determine when noise monitoring is required for jobs where employees are potentially exposed to excessive noise. The SSHO/HSO will perform noise monitoring as necessary and make recommendations to assure compliance with Section 5.3 of this Operating Procedure. Engineering controls, ear protection, and posting may be required to comply with Section 5.3. In jobs where working in a client's noisy area, personnel will comply with the client's existing hearing conservation program. If a client has a noisy area and has no hearing conservation program, then establish a plan for its employees and subcontractors to be in compliance with Section 5.3.

5.6 TRAINING

All workers required to wear hearing protectors will be trained in their proper use. In addition, all workers who may be exposed to greater than 85 dBA will be provided refresher training. This training will include at least the following: (1) Effects of noise on hearing; (2) the purpose, selection, fitting, use and care of hearing protectors; and (3) the purpose of audiometric testing and an explanation of the test procedure.

5.7 HEARING PROTECTORS

When hearing protectors are required the employee must have received training on the proper use. Proper noise reduction ratings will be applied by the HSO to the noise in the environment.

Hearing protectors act as barriers to reduce sound entering the ear. Noise Reduction Ratings (NRR) for each product reflects the effectiveness of the protector chosen. Generally, muffs offer a greater NRR (25-30 dBA) than plugs (15-25 dBA). Comfort is an important factor when wearing ear protection over many hours; it is recommended to try different types of plugs or muffs to determine the best combination of comfort and fit.

5.8 AUDIOMETRIC TESTING

Audiograms are administered upon employment and annually thereafter. The audiograms are conducted by the medical clinics approved for physicals and must meet all the applicable requirements (including Appendices C, D, and E of the OSHA Std. Title 29 Code of Federal Regulations (CFR) 1910.95).

5.9 ACCESS TO INFORMATION, RECORDKEEPING

The facility shall have a copy of Title 29 CFR 1910.95 available for any employee requesting access to the standard. Employee training aids shall also be available to any employee. All noise monitoring data shall be retained for at least two years.

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Standard Operating Procedure No. HS-6 Electrical Safety

6.0 ELECTRICAL SAFETY

6.1 PURPOSE

The purpose of this Operating Procedure is to reduce the risk of employee injury from electrical shock and to present requirements under 29 CFR 1926, Subpart K and the National Electrical Code (NEC) for employees working with or exposed to electrically energized equipment.

6.2 SCOPE

Employees may be exposed to electrical hazards (i.e., underground or overhead utilities) each day. Certain employees design, install, and repair equipment (e.g. vapor extraction units); others provide oversight on construction sites; and many employees spend time in an office setting. Each environment has the potential of exposing employees to electrical hazards.

6.3 DRILLING AND EXCAVATIONS

Electrical hazards may exist on-site and general precautions must be taken to prevent accidental contact with energized sources.

- Overhead lines must be identified and equipment must be kept at least 20 feet from energized lines or any other distance required by local ordinances, whichever is greater. It is important to note that power lines and hoist lines can be moved significantly by wind.
- Drill rigs shall never be moved with the mast erect.
- Underground utilities must be located before drilling or excavating begins. Appropriate utility companies must be contacted before intrusive work begins in accordance with local or state requirements for utility company notification.
- For drilling and excavation at industrial or other locations where underground utilities are owned by the client, as-built drawings of utility locations should be obtained if possible.
- As a general precaution, employees shall avoid contact with operating drill rigs or backhoes to reduce the risk of electrical shock should a power line be contacted by the equipment.
- At the first sight of lightning, operations should be stopped and only resumed when conditions permit. Daily weather forecasts should be noted for predictions of electrical storms that may affect field operations.

6.4 HAND TOOLS

- All portable electric hand tools shall be equipped with a three-wire cord having the ground wire permanently connected to the tool frame and means of grounding to the other end. Tools may also be double insulated and labeled as "Double Insulated".
- All circuits shall be protected against overload with protective devices such as fuses, circuit breakers, or ground fault devices.

6.5 OFFICE ELECTRICAL SAFETY

To prevent fire from an overloaded wall plug or extension cord:

- Extension cords must be the right size or rating for the tools and appliances in use.
- Only grounded outlets may be used.
- Outlets should not be overloaded.
- The grounding post may never be removed from a three-prong plug to make it fit into a two prong plug wall outlet.
- Only one adapter may be used for each duplex outlet.
- Ground Fault Interrupters (GFI's) must be installed where electrical appliances or equipment can make contact with water or wet surfaces. Kitchens, bathrooms, and laboratory areas should have GFI devices.
- Switches, fuses, and automatic circuit breakers should be marked, labeled, or arranged for ready identification of circuits or equipment supplied through them.

6.6 CONSTRUCTION SITE REQUIREMENTS

- All installations shall comply with the National Electrical Safety Code (NESC) or the National Electrical Code (NEC).
- All electrical wiring and equipment shall be a type listed by UL, Factory Mutual Engineering Corp., or another recognized test or listing agent for the specific application.
- Ground Fault Interrupters (GFI's) shall be used for all temporary wiring.
- Temporary wiring can be used for up to 90 days if it carries less than 600 V and it is not subject to physical damage.
- Electrical wire or flexible cord passing through work areas shall be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching.
- Lamps must be protected from accidental contact or breakage by elevating them 7 feet from the surface or it must have a fixture with guard.
- Equipment, wiring methods, and installation of equipment in hazardous (classified) locations must be intrinsically safe and approved for the location or safe from the hazardous location. Hazardous (classified) location definitions are listed in Table 1. Flammable or combustible liquids must be transferred from containers with properly rated pumps and equipment.
- Lockout/Tagout Procedures must be followed where applicable.
- Specialized lighting and electrical requirements must be implemented for underground construction work under 29 CFR 1926.800.

6.7 GENERAL REQUIREMENTS

- Damaged electrical equipment shall immediately be removed from service and repaired or discarded. Frayed wires, electrical shock, sparks, overheating, physical damage, or other indicators require prompt de-energizing of the circuit or equipment.
- Electrical equipment may not be used unless the manufacturer's name, trademark, or other descriptive marking is placed on the equipment. Other markings shall provide voltage, current, wattage, or other ratings as necessary.
- Live parts of electrical equipment operating at 50 volts or more must be guarded against accidental contact by approved cabinets or enclosures.
- Electrical equipment and lines should always be considered to be energized until determined to be de-energized by tests or other appropriate means. Whenever possible, all equipment, as well as circuits to be worked on, shall be de-energized before work is started and personnel must be protected by clearance procedures and grounding.
- Only competent people shall be allowed to perform electrical maintenance tasks.
- Spliced conductor wires must be joined with splicing devices or soldering.
- All splices and joints and free ends of wires must be covered with insulation equivalent to that on the conductor or by using splicing devices designed for the conductor.
- Each disconnecting means for motors or appliances must be legibly marked to indicate its purpose.
- Sufficient access and working clearance must be provided and maintained about all electrical equipment to permit ready and safe operation and maintenance of the equipment. A minimum of 3 foot clearance is required around live parts operating at 600 volts or less. This is applicable to most circuit breaker panels.
- Warning labels spelling "DANGER" must be visible on compartments containing voltage of over 250v AC or DC.
- Extension cords or cables shall not be fastened with staples, hung from nails, or suspended by loose wire.
- Flexible cord must be used only in continuous lengths, without splices, except molded or vulcanized splices may be used when made by a qualified electrician.

6.8 REFERENCES

Subpart S - Electrical, OSHA 29 CFR 1910.

National Electrical Code (NEC) Handbook.

An Illustrated Guide to Electrical Safety, OSHA Publication No. 3073.

NFPA 70E-1988, Electrical Safety Requirements for Employee Workplace.

National Safety Council Data Sheets.

TABLE 1
HAZARDOUS LOCATIONS DESIGNATIONS

	Division 1	Division 2
Class I	A location in which ignitable concentrations of flammable gases or vapors may exist under normal operating conditions.	A location in which volatile flammable liquids or flammable gases or vapors are used, but would become hazardous only in case of an accident or some unusual operating condition.
Class II	A location in which the presence of combustible dust exists.	A location where dangerous concentrations of suspended dust would not be likely, but where dust accumulations might form on or in the vicinity of electrical equipment.
Class III	A location where easily ignitable fibers are handled, manufactured, or used.	A location in which easily ignitable fibers are stored or handled, except in process of manufacturing.

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Standard Operating Procedure No. HS-7 Site Control

7.0 SITE CONTROL

7.1 PURPOSE

The purpose of this Operating Procedure (OP) is to provide guidance in establishing site control during hazardous waste site investigation and remediation operations. Site control is necessary to control the activities and movement of people and equipment to minimize the potential for worker exposure to hazardous substances. Site control provides for developing a site map, establishing site security, delineating work zones, maintaining communications, monitoring weather conditions, and enforcing safe work practices.

A key aspect of site control is keeping unauthorized personnel from possible areas of exposure to chemical or physical hazards. The level of control necessary will vary depending on location, level of risk, and project duration.

7.2 DEFINITIONS

- **Buddy System**: A system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee of the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.
- **Site Safety and Health Supervisor/Site Safety and Health Officer**: The individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.
- **Decontamination**: The removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of adverse health effects.

7.3 SITE MAP

A site map should be developed to assist site personnel in planning and organizing response activities. The maps should include the following information:

- Prevailing wind direction.
- Site drainage points.
- All natural and man-made topographic features including the location of the buildings, containers, impoundments, pits, ponds, tanks, and any other site features.
- Assembly point for evacuations.

Site maps should be updated during the course of site operations to reflect new information and changes in site conditions.

7.4 SECURITY

Site security should be established to limit access to the site and prevent unauthorized personnel from entering the site area. The following should be considered when providing site security:

- Sites near residential areas, where children or neighbors may be interested require stronger site control measures than sites within an industrial complex.
- Site control shall be coordinated with the client including the facility, security, and emergency plans.
- The site should be secured with fencing (i.e., chain link fence, wire, or barriers), as appropriate.
- A security guard should be provided, if necessary, and located in the vicinity of the command post (office trailer).
- A controlled access to the regulated zones shall be established. This controlled access should pass through a decontamination unit or area.
- Only authorized personnel shall be permitted to enter regulated zones. No one shall enter the site without appropriate authorization. Training and medical clearance shall be reviewed prior to authorization.
- All persons entering the regulated zones shall be equipped with appropriate personal protective equipment.
- All persons entering the regulated zones must be familiar with and abide by the health and safety plan.

7.5 WORK ZONES

At a minimum during emergency response, three work zones must be established to minimize employee exposure to hazardous substances. The zones are identified as the Exclusion Zone, Contamination Reduction Zone (or Decontamination), and the Support Zone. Movement of personnel and equipment between these zones should be minimized and restricted to specific access control points to prevent cross-contamination from contaminated areas to clean areas.

7.5.1 The Exclusion Zone

The Exclusion Zone is the area where contamination is either known or expected to occur and where the greatest potential for exposure exists. The immediate areas (e.g. 25-foot radius) around intrusive activities (i.e. drilling, excavating, etc.) may be classified as regulated or exclusionary. The hotline separates the Exclusion Zone from the rest of the site and should be physically secured (e.g. using chains, fences, or ropes) or clearly marked (e.g. using lines, placards, hazard tape, and/or signs). All persons who enter the Exclusion Zone must wear the appropriate level of PPE for the degree and types of hazards present at the site.

7.5.2 Decontamination

Decontamination Zones are areas of transition between the Exclusion Zone and the Support Zone. The purpose of the Decontamination Zone is to reduce the possibility that the Support Zone will become contaminated or affected by the site hazards. Access Control Points between Decontamination and the Support Zone must be established to ensure that workers entering the Decontamination area are wearing the proper PPE and that workers exiting to the Support Zone remove all potentially contaminated PPE.

7.5.3 Support Zone

The Support Zone is the appropriate location for the command post, medical station, equipment and supply center, and any other administrative or support functions that are necessary to keep site operations running efficiently. Any potentially contaminated clothing, equipment, and samples must remain outside of the Support Zone until decontaminated. Whenever possible, line-of-sight contact with all activities in the Exclusion Zone should be maintained. Periodic monitoring and sampling should be done to ensure that this area remains free from contamination.

7.6 COMMUNICATION

Communication systems shall be established at a site for both internal and external communication. Internal communication involves workers communicating with each other in the Exclusion Zone or CRZ, or between workers and those manning the command post. External communication refers to communication between on-site and off-site personnel. An external communication system must be maintained in order to: (1) coordinate emergency response efforts with off-site responders; (2) report progress or problems to management; and (3) maintain contact with essential off-site personnel. The following methods of communication should be utilized as appropriate:

- Radios
- Cellular phones
- Hand signals
- Air horns
- Bells
- Flags, and
- Boards or signs.

Emergency information (routes, phone numbers, etc.) should be posted on-site.

7.7 WEATHER CONDITIONS

Monitoring of weather conditions should be performed during site investigation activities as appropriate. Monitoring for the following should be considered:

- Wind direction (vane, wind sock, flagging), for consideration of off-site effects and evacuation routes; and
- temperature for heat stress conditions; and
- temperature and wind for cold stress conditions.

7.8 REFERENCES

OSHA 29CFR 1910.120 Hazardous Waste Operations and Emergency Response.

EPA, Standard Operating Safety Guides, 1992.

NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, 1985.

Establishing Work Zones at Uncontrolled Hazardous Waste Sites, U.S. EPA, 1991, Publication 9285.2-04A.

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**Standard Operating Procedure No. HS-8
Incident Reports**

8.0 INCIDENT REPORTS

8.1 PURPOSE

All health and safety incidents shall be reported to management and health and safety staff. The prompt investigation and reporting of incidents will reduce the risk of future incidents, better protect employees, and reduce liability.

8.2 DEFINITIONS

A health and safety incident is any event listed below:

- Illness resulting from chemical exposure or suspected chemical exposure.
- Physical injury, including both those that do and do not require medical attention to employees or subcontractors.
- Fire, explosions, and flashes resulting from activities performed by AO LLC and its subcontractors.
- Property damage resulting from activities performed by AO LLC and its subcontractors.
- Vehicular accidents occurring on-site, while travelling to and from client locations, or with any company-owned vehicle.
- Infractions of safety rules and requirements.
- Unexpected chemical exposures.
- Complaints from the public regarding field operations.

8.3 REPORTING PROCEDURES

8.3.1 Reporting Format

Incident reports shall be prepared by completing Form MED-11. This form is attached to this operating procedure.

8.3.2 Responsible Party

Reports of incidents occurring in the field shall be prepared by the Site Safety Officer or, in the absence of the site safety officer, the supervising field engineer, witness, or injured/exposed individual.

8.3.3 Filing

A report must be submitted to the Health and Safety Officer within 24 hours of each incident involving medical treatment. In turn, the Health and Safety Officer must distribute copies of the report to appropriate personnel. When an injury or illness is reported, the Health and Safety Officer

must deliver a copy of the report to the individual in charge of Human Resources so that a Worker's Compensation Insurance Report can be filed if necessary. Reports must be received by Human Resources within 48 hours of each qualifying incident.

8.3.4 Major Incidents

Incidents that include fatalities, hospitalization of AO LLC employees or subcontractor's employees, or involve injury/illness of the public shall be reported to the HSO and Project Manager as soon as possible. Any contact with the media should be referred to the Project Manager.

FORM HS-8

HEALTH AND SAFETY INCIDENT REPORT

Project Name: _____

TYPE OF INCIDENT (Check all applicable items)

Project Number: _____

Illness

Fire, explosion, flash

Date of Incident: _____

Injury

Unexpected exposure

Time of Incident: _____

Property Damage

Vehicular Accident

Location: _____

Health & Safety Infraction

Other (describe) _____

DESCRIPTION OF INCIDENT (Describe what happened and possible cause. Identify individual involved, witnesses, and their affiliations; and describe emergency or corrective action taken. Attach additional sheets, drawings, or photographs as needed.)

Reporter: _____

Print Name

Signature

Date

Reporter must deliver this report to the Operating Unit Health & Safety Officer within 24 hours of the reported incident for medical treatment cases and within five days for other incidents.

Reviewed by: _____

Operating Unit Health & Safety Officer

Date

Distribution by HSO:

- WCGI Corporate Health and Safety Manager
- Corporate Health and Safety Officer
- Project Manager
- Personnel Office (medical treatment cases only)

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Standard Operating Procedure No. HS-9 Selection and Use of Personal Protective Equipment

9.0 PERSONAL PROTECTIVE EQUIPMENT

9.1 PURPOSE

The purpose of this Operating Procedure is to set forth the criteria and methodology to be used in selecting personal protective equipment (PPE). This SOP has been developed to help employees select the appropriate PPE and reduce the risk of occupational injury or illness.

9.2 GENERAL

Personal protective equipment is a means of isolating a worker from a hazard. Use of personal protective equipment places a high degree of responsibility for safety on the field worker. Exposure can occur during lapses in standard operating procedures, failure of protective equipment, removal of protective equipment at the end of work periods, or use of improper or damaged equipment. However, a properly administered personal protective equipment program can offer an effective means of control or as a supplement or backup to controls at the source of hazards.

Personal protective equipment can be divided into three categories:

- Safety equipment (e.g., hard hats, shoes, safety glasses, face shields)
- Protective clothing (e.g., gloves, aprons, coveralls)
- Respiratory devices (e.g., half and full-face air-purifying respirators, supplied air respirators, and self-contained breathing apparatus (SCBAs))

The proper selection of personal protective equipment is an extremely important task. The use of improper equipment can result in the lack of protection from a specific hazard causing potential injury or adverse health effects to personnel. Personal protective equipment should be appropriately selected for a given hazard (existing or expected) with a factor of safety. Over protection is not necessarily appropriate and can result in other potential problems (i.e., heat stress, fatigue, physical hazards).

9.3 IDENTIFICATION OF POTENTIAL HAZARDS

An evaluation of the potential hazards associated with a given task (job safety analysis) and planned work activities should be performed. The evaluation will identify the hazards and types of hazard control, including PPE, that may be utilized.

9.4 PHYSICAL SAFETY HAZARDS

Almost all work sites include various types of physical hazards. These include slipping, tripping, falling objects, electrical shock, puncture, scraping, and catching hazards. The effects of many of these types of hazards can be mitigated with the use of some basic safety equipment.

URS employees will follow all client, health and safety plans, and regulatory requirements for hard hats, safety glasses, steel toe shoes, and related protective equipment.

9.4.1 Head Protection

URS employees working in areas with overhead hazards shall use protective helmets (hard hats) that meet the requirements of American National Standards Institute (ANSI) Z 89.1. For proper protection, the hat and harness must be in good condition and worn frontwards.

9.4.2 Eye Protection

Safety glasses shall be used by employees when machines or operations present potential eye injury from physical or chemical agents. All eye and face protection shall meet the requirements of ANSI Z 87.1. Employees whose vision requires corrective lenses shall use safety glasses with optical correction or safety glasses or goggles that are designed to fit over the regular glasses.

9.4.3 Foot Protection

Employees working at field sites shall wear sturdy, closed toe shoes or boots. Specific footwear such as rubber boots, steel toe shoes, or overboots will be used as appropriate to the type of hazards and according to the safety plan or client requirements. If safety shoes or boots are worn, they shall meet the requirements of ANSI Z 41.

9.4.4 Hearing Protection

Employees working on tasks where the noise level is above 85 dBA (a level difficult to hear normal conversation) shall use hearing protection such as plugs or muffs to reduce the noise level.

9.5 LEVELS OF PROTECTION FOR HAZARDOUS WASTE SITES

Potential hazards associated with contaminants may be minimized by utilizing appropriate personal protective equipment. Personal protective equipment to protect the body against contact with known or anticipated chemical hazards has been divided into four categories (i.e., Levels A, B, C, or D) according to the degree of protection afforded. Level A provides the greatest degree of personal protection while Level D provides the least. A summary of the four levels of protection is presented in Table 1. The protection to be used will be specified in the Health and Safety Plan.

9.6 PROTECTIVE CLOTHING

The category of protective clothing includes: clothing, gloves, and aprons. The choice of clothing to be used should be based on the potential exposure hazards anticipated, the amount of body coverage required, and the material used in clothing construction. To protect the wearer from exposure, the clothing material should be impermeable or at least resistant to the particular hazardous agents expected to be encountered.

Data on the suitability of various types of protective clothing for particular hazards are often limited to manufacturers' bulletins, brochures, or information services. Literature on permeability of various materials includes the manual Guidelines for the Selection of Chemical Protective Clothing, published by the American Conference of Governmental Industrial Hygienists (ACGIH).

With certain compounds, where even minor skin contact may present potential problems, taping of the joints between sleeve and glove, leg and boot and entry seam on the protective clothing is a recommended practice. Removal of exterior pockets on coats and coveralls reduces accumulation of contaminants. Hair coverings may be needed to prevent scalp exposure. Disposable clothing that offers adequate protection (i.e., Tyvek, Polycoated Tyvek (Tyvek QC) or Saranex) is an excellent alternative, especially where there are problems with decontamination and cleaning of regular work clothing, and may be less costly than controlled laundering of clothing contaminated with toxic materials. Care must be exercised when removing contaminated clothing, to prevent exposure to any contaminant compounds present on the outer surface of the protective clothing.

9.7 RESPIRATORY PROTECTION

Respiratory protection is used to reduce exposures involving potential inhalation hazards. Cost effectiveness, acceptability, ease of use, and ability of the worker to wear devices are considerations in determining the proper use of respiratory protective devices.

Respiratory protection is generally used during the time period necessary to install or implement engineering or work practice controls, during plant maintenance, during emergencies or non-routine operation, or in situations where complete control is not achievable through feasible engineering measures such as with hazardous waste management sites. Also, if engineering controls are not sufficient to reduce exposure to within permissible limits with the necessary degree of confidence, then respiratory protection can be implemented, in addition to engineering controls, to further reduce the level of exposure.

TABLE 1
SAMPLE PROTECTIVE ENSEMBLES

LEVEL OF PROTECTION A			
Equipment	Protection Provided	Should be Used When:	Limiting Criteria
<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA. • Fully-encapsulating, chemical-resistant suit • Inner chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Two-way radio communications. <p>OPTIONAL:</p> <p>Hard hat. Coveralls. Cooling unit. Long cotton underwear. Disposable gloves and boot covers.</p>	<p>The highest available level of respiratory, skin, and eye protection.</p>	<ol style="list-style-type: none"> 1. The chemical substance had been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either: <ul style="list-style-type: none"> - measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or - site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin. 2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible. 3. Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection is determined. 	<p>Fully encapsulating suit material must be compatible with the substances involved.</p>

LEVEL OF PROTECTION B			
Equipment	Protection Provided	Should be Used When:	Limiting Criteria
<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA. • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit). • Inner and outer chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way radio communications. <p>OPTIONAL:</p> <p>Coveralls. Face shield. Disposable boot covers. Long cotton underwear.</p>	<p>The same level of respiratory protection but less skin protection than Level A.</p> <p>It is the minimum level recommended for initial site entries until the hazards have been further identified.</p>	<ol style="list-style-type: none"> 1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres: <ul style="list-style-type: none"> - with IDLH concentrations of specific substances that do not represent a skin hazard; or - that do not meet the criteria for use of air-purifying respirators. 2. Atmosphere contains less than 19.5 percent oxygen. 3. Presence of incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin. 	<p>Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin.</p>

TABLE 1
SAMPLE PROTECTIVE ENSEMBLES

LEVEL OF PROTECTION C			
Equipment	Protection Provided	Should be Used When:	Limiting Criteria
<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Full-facepiece, air-purifying, canister-equipped respirator. • Chemical-resistant clothing (coveralls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit). • Inner and outer chemical-resistant gloves. • Chemical-resistant safety boots/shoes. • Hard hat. • Two-way radio communications. <p>OPTIONAL:</p> <p>Coveralls. Disposable boot covers. Face shield. Long cotton underwear.</p> <p>Use of escape mask during initial entry is optional only after characterization [29 CFR 1910, 120(c)(5)(ii)]</p>	<p>The same level of skin, protection as Level B, but a lower level of respiratory protection.</p>	<ol style="list-style-type: none"> 1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin. 2. The types of contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant. 3. All criteria for the use of air-purifying respirators are met. 	<p>Atmospheric concentration of chemicals must not exceed IDLH levels.</p> <p>The atmosphere must contain at least 19.5 percent oxygen.</p>

LEVEL OF PROTECTION D			
Equipment	Protection Provided	Should be Used When:	Limiting Criteria
<p>RECOMMENDED:</p> <ul style="list-style-type: none"> • Coveralls • Safety boots/shoes • Safety glasses or chemical splash goggles. • Hard hat. <p>OPTIONAL:</p> <p>Coveralls. Escape mask. Face shield.</p>	<p>No respiratory protection. Minimal skin protection.</p>	<ol style="list-style-type: none"> 1. The atmosphere contains no known hazard. 2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals. 	<p>This level should not be worn in the Exclusion Zone.</p> <p>The atmosphere must contain at least 19.5 percent oxygen.</p>

1. Source: EPA Standard Operating Safety Guides, 1992.

**Standard Operating Procedure No. HS-10
Decontamination**

10.0 DECONTAMINATION

10.1 PURPOSE

Personnel engaged in investigations or clean-up of sites for hazardous materials can become contaminated in several ways, including being splashed with liquid chemical products or contaminated water while drilling, developing, testing, and sampling wells; handling chemical wastes, contaminated soil or water, or contaminated equipment; walking on contaminated soil or through contaminated surface water; and contacting chemical vapors, dusts, fumes, and mists. Although protective clothing helps prevent the wearer from becoming contaminated, contamination can occur. Decontamination reduces dermal exposure time. It also prevents hazardous materials from being transferred from protective clothing to wearer and to clean areas where unprotected individuals can be exposed.

Decontamination consists of removing contaminated clothing and washing the skin to remove contaminants. How extensive the decontamination process must be depends primarily on the types of contaminants and the nature of on-site activities planned. As the toxicity of the contaminants and the magnitude of potential contamination of personnel is increased, the decontamination process becomes increasingly more extensive and thorough. This Operating Procedure describes decontamination guidelines while procedures for field operations must be developed on a site-by site basis.

10.2 RESPONSIBLE AUTHORITY

Decontamination operations at each hazardous waste site shall be supervised by the Site Safety Officer (SSO). The SSO is responsible for ensuring that all personnel follow decontamination procedures and that all contaminated equipment is adequately decontaminated. The SSO is also responsible for maintaining the decontamination zone and managing the wastes generated from the decontamination process.

Site activities should be conducted with the general goal of preventing the contamination of people and equipment. Using remote sampling techniques, bagging monitoring instruments, avoiding contact with obvious contamination, and employing dust suppression methods that would reduce the probability of becoming contaminated and, therefore, reduce the need and extent of decontamination. However, some type of decontamination will always be required on site. A sample personnel decontamination set-up guideline is included in attachment 1 and a sample decontamination equipment and supplies list is included in attachment 2.

OSHA requires that proper PPE must be worn when operating steam or pressure washing equipment. A rainsuit, boots, hard hat, and a face shield are recommended to be worn. All personnel must be kept out of the path of steam or water spray.

Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potential harmful effects of exposures to hazardous substances.

OSHA also requires that when hazardous waste clean-up or removal operation commences on a site and the duration of the work will require six months or greater time to complete, showers and change rooms must be provided for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations. It must be assured that employees will shower at the end of their work shift.

10.3 DECONTAMINATION OF EQUIPMENT

Heavy equipment, hand tools, and sampling devices contaminated in the exclusion zone must be decontaminated before re-use or removal from the site. Equipment and tools must be cleaned periodically to reduce continual contact with contamination. All equipment must be decontaminated before it is taken off-site to leave contamination on the site. Sampling equipment must also be decontaminated between samples to prevent cross-contamination of the samples.

All major reusable equipment and other tools used for site investigation activities should be decontaminated prior to leaving the site area. Cleaning should consist of scrubbing to remove encrusted materials followed by a detergent-and water wash and potable water rinse using a high-pressure low volume water spray or steam cleaning unit. High pressure and/or heat should be used only as necessary and with caution because they can spread contamination and cause burns. Additional rinses with other solvents, such as methanol and hexane, may be used if warranted by the nature of the chemicals encountered. These solvents may present inherent hazards of chemical exposure and special precautions must be taken when handling these chemicals. An MSDS or other equivalent information must accompany the chemicals on-site.

Sampling equipment must be decontaminated to ensure the integrity of the samples and to prevent cross-contamination. It is common to use solvents and acids (e.g. acetone and nitric acid) to decontaminate equipment between samples. These chemicals must also be handled with care.

Decontamination should be performed at a designated equipment decontamination area on the site. A lined decontamination water collection area may be used to collect wash water as needed. Following decontamination, the clean equipment should be stored on plastic sheeting.

The under carriage of all vehicles (e.g. trucks, etc.) should be cleaned prior to driving them off the site. At the conclusion of site work, all major equipment should be thoroughly cleaned using the method described above.

10.4 LEVEL OF PROTECTION FOR DECONTAMINATION PERSONNEL

In some cases (e.g., wearing any level protection), decontamination personnel should wear the same levels of PPE as workers in the Exclusion Zone. In other cases, decontamination personnel may be sufficiently protected by wearing protection of one level lower (e.g., wearing level C protection while decontaminating workers who are wearing level B protection). Because all decontamination workers are in a contaminated area they must be decontaminated before entering the clean support zone.

10.5 DECONTAMINATION SOLUTION

A decontamination solution should be capable of removing, or converting to a harmless substance, the contaminant of concern without harming the object being decontaminated. The preferred solution is a mixture of detergent and water, which is a relatively safe option compared to chemical decontaminants. A solution recommended for decontaminating boot covers and gloves consists of 1 to 1.5 tablespoons of Alconox per gallon of warm water. Skin surfaces should be decontaminated by washing with hand soap and water. The decontamination solution must be changed when it no longer foams or when it becomes extremely dirty. Rinse water must be changed when it becomes discolored, begins to foam, or when the decontamination solution cannot be removed.

Organic or halogenated solvents may be needed to remove contaminants when detergents are not effective. These chemicals, themselves, present potential hazards of toxicity, flammability, and incompatibility with most types of PPE. Special handling and disposal procedures may be needed along with MSDS for the solvents.

10.6 DISPOSAL OF DECONTAMINATION SOLUTIONS

All decontamination solutions should be contained, collected, and packaged for disposal. Arrangements should be made with the client for disposal of the solutions. If the effluent is treatable it may be permissible to discharge it into a chemical or sanitary sewage system. Otherwise, it may need to be transported to a treatment facility. It is very important to generate minimum quantities of decontamination solutions. For additional information refer to Section 7.

10.7 EMERGENCY DECONTAMINATION

Hazardous waste facilities should also have in place emergency decontamination procedures, in order to prevent the loss of life or severe injury to site personnel. In the case of threat to life, decontamination should be delayed until the victim is stabilized; however, decontamination should always be performed first, when practical, if it can be done without interfering with essential lifesaving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing or equipment.

10.8 REFERENCES

EPA Standard Operating Safety Guidelines; Publication 9285.1-03, June 1992.
The Code of Federal Regulations, Title 29, 1910.120; July 1, 1993.
Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities; October 1985.

ATTACHMENT 1**RECOMMENDED SAMPLE DECONTAMINATION FACILITY SETUP**

The decon facility should have a minimum of four stations: (1) segregated equipment drop station, (2) coverall, boot, and glove wash and rinse station, (3) coverall and outer glove removal station, and (4) respirator, boot, and inner glove removal station.

Station 1 - Segregated Equipment Drop

Deposit equipment used in the exclusion zone (e.g. tools, sampling devices and containers, monitoring equipment, radios, clipboards, etc.) on a plastic drop cloth or in plastic lined containers.

Station 2 - Boot Cover Wash and Rinse

Step into the first container of decontamination solution and scrub bottom and sides of boot covers up to taped area to remove gross contamination. After boot covers have been scrubbed, step into the second container of decontamination solution and repeat the washing process. Finally, step into container of rinse water and rinse boot covers thoroughly. Proceed to Station 3.

Station 3 - Outer Glove Wash and Rinse

Place gloved hands in container of decontamination solution and wash gloves. Use a brush if necessary. After washing the gloves, place hands in container of rinse water and rinse gloves thoroughly. This station and Station 2 may be combined into one station if protective equipment is not grossly contaminated.

Station 4 - Coverall and Outer Glove Removal

If used, remove tape from legs and wrists as well as from coverall zipper. Then, remove outer gloves and coverall, in that order. Care must be taken to prevent transfer of contaminants from coverall to underclothes. Transfer can be minimized by rolling or folding the coverall as it is being removed so that the coverall is turned inside-out. Place tape, coveralls, and outer gloves in the plastic-lined receptacle provided at this station.

Station 5 - Respirator, Boot Cover and Inner Glove Removal

Remove respirator and boots and place them in receptacles provided at this station. Remove inner gloves and discard in receptacle provided.

Station 6 - Hand and Face Wash and Street Shoe Donning

Wash, rinse and dry hands and face, then don street shoes. If highly toxic, corrosive, or skin absorbable chemicals are known to be present, a shower facility should be set-up in the support area and personnel required to shower before leaving the site.

ATTACHMENT 2

RECOMMENDED SAMPLE DECONTAMINATION EQUIPMENT AND SUPPLIES

- 1 or 2 plastic drop cloths, minimum thickness of 3 mills and minimum size to 9 x 12 feet
- 4 to 7 containers, 30 to 50 gallon capacity (galvanized tub, stock tank, or children's wading pool), for washing and rinsing
- 1 or 2 receptacles (drums or plastic trash cans) for receiving contaminated disposable equipment and trash
- 1 or 2 55-gallon drums for storage of contaminated wash and rinse water
- Plastic trash bags of different sizes for temporary storage of contaminated equipment and for lining trash receptacles
- 2 to 4 long-handled soft bristled brushes (e.g. toilet brush)
- 3 to 4-inch diameter plastic pipe or 4x4-inch timber (or other methods) to raise edges of drop cloth to contain contaminated wash and rinse water spilled during decontamination
- Detergent (e.g., Alconox)
- Hand soap
- Fresh water
- Paper towels for drying hands, face, and equipment
- Chairs or benches for personnel to sit on while removing boots
- Shower facility with lockers (optional)

List of MSDSs

Bentonite
Ferrous Iron Reagent Powder Pillows
Hydrochloric Acid
Isobutylene
Nitric Acid
Sodium sulfite
Sulfuric acid
Quinhydrone
Zinc acetate

HILL & GRIFFITH -- WESTERN BENTONITE (SODIUM BENTONITE)
MATERIAL SAFETY DATA SHEET
NSN: 681000N036330
Manufacturer's CAGE: 28711
Part No. Indicator: A
Part Number/Trade Name: WESTERN BENTONITE (SODIUM BENTONITE)

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General Information
=====

Company's Name: HILL & GRIFFITH CO
Company's Street: 1262 STATE AVE
Company's City: CINCINNATI
Company's State: OH
Company's Country: US
Company's Zip Code: 45204
Company's Emerg Ph #: 800-424-9300 (CHEMTREC)
Company's Info Ph #: 800-543-0425
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 23APR90
Safety Data Review Date: 11NOV92
MSDS Preparer's Name: STEVE NELTNER
Preparer's Company: SAME
MSDS Serial Number: BQLYG
Hazard Characteristic Code: N1

=====
Ingredients/Identity Information
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Proprietary: NO
Ingredient: SILICON DIOXIDE. PEL/TLV AS SILICON.
Ingredient Sequence Number: 01
Percent: 2-6
NIOSH (RTECS) Number: 1002640SI
CAS Number: 7631-86-9
OSHA PEL: 10 MG/M3 TDUST
ACGIH TLV: 10 MG/M3 TDUST

Proprietary: NO
Ingredient: DUST, NUISANCE; (INERT NUISANCE DUST)
Ingredient Sequence Number: 02
NIOSH (RTECS) Number: 1002113DN
OSHA PEL: 10 MG/M3
ACGIH TLV: 10 MG/M3 TDUST
Other Recommended Limit: PEL:15 MG/M3 (MFR)

=====
Physical/Chemical Characteristics
=====

Appearance And Odor: PALE YELLOW TO WHITE W/EARTHY ODOR.
Boiling Point: N/A
Melting Point: N/A
Vapor Pressure (MM Hg/70 F): N/A
Vapor Density (Air=1): N/A
Specific Gravity: 2.5 (H*20=1)
Evaporation Rate And Ref: NOT APPLICABLE
Solubility In Water: NEGLIGIBLE
Percent Volatiles By Volume: N/A

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Fire and Explosion Hazard Data
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Flash Point: NOT APPLICABLE
Flash Point Method: COC
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: MEDIA SUITABLE FOR SURROUNDING FIRE (FP N).
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL
PROTECTIVE EQUIPMENT (FP N).
Unusual Fire And Expl Hazrds: NONE

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Reactivity Data
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 Stability: YES

Cond To Avoid (Stability): DUSTING.

Materials To Avoid: NOT ESTABLISHED.

Hazardous Decomp Products: NONE

Hazardous Poly Occur: NO

Conditions To Avoid (Poly): NOT RELEVANT
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Health Hazard Data

=====
 LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.

Route Of Entry - Inhalation: YES

Route Of Entry - Skin: NO

Route Of Entry - Ingestion: NO

Health Haz Acute And Chronic: ACUTE:OVEREXP COULD RESULT IN TEMPORARY MUCOUS MEMBRANE OR RESPIRATORY TRACT IRRITATION. CHRONIC:OVEREXP COULD RESULT IN IRREVERSIBLE MUCOUS MEMBRANE OR RESPIRATORY TRACT DAMAGE. TARGET ORGANS:LUNGS.

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Explanation Carcinogenicity: NOT RELEVANT

Signs/Symptoms Of Overexp: OVEREXPOSURE COULD RESULT IN COUGHING, SNEEZING, SHORTNESS OF BREATH OR OTHER RESPIRATORY PROBLEMS. OTHER SYMPTOMS MAY RESULT.

Med Cond Aggravated By Exp: MAY AGGRAVATE PRE-EXISTING MEDICAL CONDITIONS.

Emergency/First Aid Proc: INHAL:IMMEDIATELY REMOVE FROM EXPOSURE & SEEK MEDICAL ATTENTION. SKIN:WASH THOROUGHLY W/SOAP & WATER. IF IRRITATION DEVELOPS, SEEK MEDICAL ATTENTION. EYE:FLUSH W/CLEAR FLOWING WATER FOR AT LEAST 15 MINUTES. IF IRRITATION PERSISTS, SEEK MEDICAL ATTENTION. INGEST:DO NOT INDUCE VOMITING; CALL MD IMMEDIATELY.
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Precautions for Safe Handling and Use

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 Steps If Matl Released/Spill: AVOID DUSTING WHEN POSSIBLE. USE A VACUUM W/ FINE PARTICULATE FILTER TO CLEAN SPILL. A NIOSH/MSHA APPROVED DUST MASK FOR POWDERS IS RECOM. NOTIFY PROPER AUTHS IF NEED EXISTS.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Method: WASTE GENERATED DURING APPLICATION, DEMOLITION, BREAKAGE/SPILLAGE ARE NOT HAZ WASTES AS DEFINED BY RCRA (40 CFR 261). PLACE WASTE & SPILLAGE IN CLSD CNTNRS. DISP OF IN APPRVD LANDFILL I/A/W FED, STATE & LOCAL REGULATIONS.

Precautions-Handling/Storing: ALWAYS SEGREGATE MATLS BY MAJOR HAZ CLASS. DO NOT TRANSFER CONTENTS TO UNLABELED CNTNRS. COMPLY W/ALL FED, STATE & LOC REGS.

Other Precautions: MINIMIZE BRTHG VAPS, MISTS, FUMES/DUSTS. AVOID PRLNG/ RPTD CONT W/SKIN. KEEP CNTNRS & STOR CNTNRS CLSD WHEN NOT IN USE. SPECIAL CONSIDERATIONS FOR REPAIR/MAINT OF CONTAM EQUIP: PROVIDE ADEQ NIOSH/MSHA APPRVD RESP, EYE/SKIN PROT.
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Control Measures

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 Respiratory Protection: USE NIOSH/MSHA APPROVED ORGANIC CARTRIDGE TYPE 7 RESPIRATOR.

Ventilation: PROVIDE VENTILATION SUFFICIENT TO PREVENT EXCEEDING RECOMMENDED EXPOSURE LIMITS.

Protective Gloves: CHEMICAL-RESISTANT GLOVES.

Eye Protection: CHEM WORK GOGG/FULL LGTH FCSHLD (FP N).

Other Protective Equipment: OTHER CLOTHING & EQUIPMENT AS REQUIRED TO PREVENT CONTACT.

Work Hygienic Practices: REMOVE CONTAMINATED CLOTHES, LAUNDRER BEFORE REUSE. REMOVE CONTAMINATED SHOES; CLEAN BEFORE REUSE.

Suppl. Safety & Health Data: NONE SPECIFIED BY MANUFACTURER.
 =====

Transportation Data

=====
 Trans Data Review Date: 93118

DOT PSN Code: ZZZ

DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION

IMO PSN Code: ZZZ

IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
 =====

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IATA PSN Code: ZZZ
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI PSN Code: ZZZ
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
Additional Trans Data: NOT REGULATED FOR TRANSPORTATION

=====
Disposal Data
=====

=====
Label Data
=====

Label Required: YES
Label Status: G
Common Name: WESTERN BENTONITE (SODIUM BENTONITE)
Special Hazard Precautions: ACUTE:OVEREXP COULD RESULT IN TEMPORARY MUCOUS
MEMBRANE OR RESPIRATORY TRACT IRRITATION. CHRONIC:OVEREXP COULD RESULT IN
LUNGS. OVEREXPOSURE COULD RESULT IN COUGHING, SNEEZING, SHORTNESS OF BREATH
OR OTHER RESPIRATORY PROBLEMS. OTHER SYMPTOMS MAY RESULT.
Label Name: HILL & GRIFFITH CO
Label Street: 1262 STATE AVE
Label City: CINCINNATI
Label State: OH
Label Zip Code: 45204
Label Country: US
Label Emergency Number: 800-424-9300 (CHEMTREC)

Material Safety Data Sheet

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Ferrous Iron Reagent Powder Pillows
Catalog Number: 1037

Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

Emergency Telephone Numbers:
(Medical and Transportation)
(303) 623-5716 24 Hour Service
(515)232-2533 8am - 4pm CST

MSDS Number: M00024
Chemical Name: Not applicable
CAS No.: Not applicable
Chemical Formula: Not applicable
Chemical Family: Not applicable
Hazard: May cause irritation.
Date of MSDS Preparation:
Day: 30
Month: August
Year: 1999

2. COMPOSITION / INFORMATION ON INGREDIENTS

1, 10-Phenanthroline

CAS No.: 5144-89-8
TSCA CAS Number: 66-71-7
Percent Range: 1.0 - 10.0
Percent Range Units: weight / weight
LD50: Oral Rat LD₅₀ = 132 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

Sodium Bicarbonate

CAS No.: 144-55-8
TSCA CAS Number: 144-55-8
Percent Range: 90.0 - 100.0
Percent Range Units: weight / weight
LD50: Oral rat LD50 = 4220 mg/kg
LC50: None reported
TLV: Not established
PEL: Not established
Hazard: May cause irritation.

3. HAZARDS IDENTIFICATION

Emergency Overview:

Appearance: White powder

Odor: Not determined

MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION

HMIS:

Health: 1

Flammability: 0

Reactivity: 0

Protective Equipment: X - See protective equipment, Section 8.

NFPA:

Health: 1

Flammability: 0

Reactivity: 0

Symbol: Not applicable

Potential Health Effects:

Eye Contact: May cause irritation

Skin Contact: May cause irritation

Skin Absorption: None reported

Target Organs: None reported

Ingestion: Very large doses may cause: abdominal pain gastrointestinal disturbances alkalosis which causes abnormally high alkali reserve of the blood and other body fluids hypotension

Target Organs: None reported

Inhalation: May cause: respiratory tract irritation

Target Organs: None reported

Medical Conditions Aggravated: Pre-existing: Kidney conditions

Chronic Effects: None reported

Cancer / Reproductive Toxicity Information:

This product does NOT contain any OSHA listed carcinogens.

This product does NOT contain any IARC listed chemicals.

This product does NOT contain any NTP listed chemicals.

Additional Cancer / Reproductive Toxicity Information: None reported

Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.

Skin Contact (First Aid): Wash skin with soap and plenty of water. Call physician if irritation develops.

Ingestion (First Aid): Give large quantities of water. Call physician immediately.

Inhalation: Remove to fresh air.

5. FIRE FIGHTING MEASURES

Flammable Properties: Does not burn, but may melt in a fire, releasing toxic fumes.

Flash Point: Not applicable

Method: Not applicable

Flammability Limits:

Lower Explosion Limits: Not applicable

Upper Explosion Limits: Not applicable
Autoignition Temperature: Not applicable
Hazardous Combustion Products: Toxic fumes of: sodium monoxide nitrogen oxides. carbon monoxide, carbon dioxide.
Fire / Explosion Hazards: None reported
Static Discharge: None reported.
Mechanical Impact: None reported
Extinguishing Media: Water. Carbon dioxide Dry chemical.
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response Notice:

Only persons properly qualified to respond to an emergency involving hazardous substances may respond to a spill according to federal regulations (OSHA 29 CFR 1910.120(a)(v)) and per your company's emergency response plan and guidelines/procedures. See Section 13, Special Instructions for disposal assistance.

Containment Technique: Stop spilled material from being released to the environment.

Clean-up Technique: Scoop up spilled material into a large beaker and dissolve with water. Flush the spilled material to the drain with a large excess of water. Decontaminate the area of the spill with a weak acid solution.

Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation.

Special Instructions (for accidental release): Not applicable

304 EHS RQ (40 CFR 355): Not applicable

D.O.T. Emergency Response Guide Number: None

7. HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe dust. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product.

Storage: Keep container tightly closed when not in use. Protect from: moisture oxidizers

Flammability Class: Not applicable

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.

Personal Protective Equipment:

Eye Protection: safety glasses with top and side shields

Skin Protection: disposable latex gloves

Inhalation Protection: adequate ventilation

Precautionary Measures: Avoid contact with: eyes skin Do not breathe: dust Wash thoroughly after handling. Keep away from: oxidizers

TLV: Not established

PEL: Not established

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance: White powder

Physical State: Solid

Molecular Weight: Not applicable
Odor: Not determined
pH: Not determined
Vapor Pressure: Not applicable
Vapor Density (air = 1): Not applicable
Boiling Point: Not applicable
Melting Point: Not determined
Specific Gravity (water = 1): 2.10
Evaporation Rate (water = 1): Not applicable
Volatile Organic Compounds Content: Not applicable
Partition Coefficient (n-octanol / water): Not applicable
Solubility:
Water: Slightly soluble
Acid: Slightly soluble
Other: Not determined
Metal Corrosivity:
Steel: Not determined
Aluminum: Not determined

10. STABILITY / REACTIVITY

Chemical Stability: Stable when stored under proper conditions.
Conditions to Avoid: Excess moisture Heating to decomposition.
Reactivity / Incompatibility: Incompatible with: oxidizers
Hazardous Decomposition: Toxic fumes of: nitrogen oxides sodium oxides carbon monoxide carbon dioxide
Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:
LD50: None reported
LC50: None reported
Dermal Toxicity Data: None reported
Skin and Eye Irritation Data: Sodium Bicarbonate: Eye - rabbit - 100 mg/30 seconds - MILD; Skin - Human - 30 mg/3 days intermittent - MILD
Mutation Data: None reported
Reproductive Effects Data: None reported
Ingredient Toxicological Data: Sodium Bicarbonate: Oral rat LD₅₀ = 4220 mg/kg; 1, 10-Phenanthroline: Oral rat LD₅₀ = 132 mg/kg

12. ECOLOGICAL INFORMATION

Product Ecological Information: --
No ecological data available for this product.
Ingredient Ecological Information: --
No ecological data available for the ingredients of this product.

13. DISPOSAL CONSIDERATIONS

EPA Waste ID Number: None

Special Instructions (Disposal): Dilute material with excess water making a weaker than 5% solution. Open cold water tap completely, slowly pour the material to the drain.

Empty Containers: Rinse three times with an appropriate solvent. Dispose of empty container as normal trash.

NOTICE (Disposal): These disposal guidelines are based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

D.O.T.:

D.O.T. Proper Shipping Name: Not Currently Regulated

—

DOT Hazard Class: NA

DOT Subsidiary Risk: NA

DOT ID Number: NA

DOT Packing Group: NA

I.C.A.O.:

I.C.A.O. Proper Shipping Name: Not Currently Regulated

—

ICAO Hazard Class: NA

ICAO Subsidiary Risk: NA

ICAO ID Number: NA

ICAO Packing Group: NA

I.M.O.:

I.M.O. Proper Shipping Name: Not Currently Regulated

—

I.M.O. Hazard Class: NA

I.M.O. Subsidiary Risk: NA

I.M.O. ID Number: NA

I.M.O. Packing Group: NA

15. REGULATORY INFORMATION

U.S. Federal Regulations:

O.S.H.A.: This product meets the criteria for a hazardous substance as defined in the Hazard Communication Standard. (29 CFR 1910.1200)

E.P.A.:

S.A.R.A. Title III Section 311/312 Categorization (40 CFR 370): Immediate (Acute) Health Hazard

S.A.R.A. Title III Section 313 (40 CFR 372): This product does NOT contain any chemical subject to the reporting requirements of Section 313 of Title III of SARA.

—
302 (EHS) TPQ (40 CFR 355): Not applicable

304 CERCLA RQ (40 CFR 302.4): Not applicable

304 EHS RQ (40 CFR 355): Not applicable

Clean Water Act (40 CFR 116.4): Not applicable

RCRA: Contains no RCRA regulated substances.

C.P.S.C.: Not applicable

State Regulations:

California Prop. 65: No Prop. 65 listed chemicals are present in this product.

Identification of Prop. 65 Ingredient(s): None

World Headquarters
Hach Company
P.O.Box 389
Loveland, CO USA 80539
(970) 669-3050

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Trade Secret Registry: Not applicable

National Inventories:

U.S. Inventory Status: All ingredients in this product are listed on the TSCA 8(b) Inventory (40 CFR 710).

TSCA CAS Number: Not applicable

16. OTHER INFORMATION

Intended Use: Iron determination

References: TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19, 1989. pp. 2332-2983. 29 CFR 1900 - 1910 (Code of Federal Regulations - Labor). In-house information. Technical Judgment. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991.

Legend:

NA - Not Applicable	w/w - weight/weight
ND - Not Determined	w/v - weight/volume
NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

THE INFORMATION CONTAINED HEREIN IS BASED ON DATA CONSIDERED TO BE ACCURATE. HOWEVER, NO WARRANTY IS EXPRESSED OR IMPLIED REGARDING THE ACCURACY OF THESE DATA OR THE RESULTS TO BE OBTAINED FROM THE USE THEREOF.

HACH COMPANY ©1999

HYDROCHLORIC ACID (10%-33%)

MSDS Number: H3886 — Effective Date: 11/17/99

1. Product Identification

Synonyms: This MSDS applies to the concentrated standard used to make laboratory solutions and any solution that contains more than 10% but less than 33% Hydrochloric acid. For diluted product, see MSDS for Hydrochloric Acid (less than 10%). For saturated solution

CAS No.: 7647-01-0

Molecular Weight: 36.46

Chemical Formula: HCl in H₂O

Product Codes:

J.T. Baker: 0327, 4654, 4657, 4658, 5618, 5619

Mallinckrodt: 2608, 2609, 2625, H151, H168, V024, V035, V328

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	10 - 33%	Yes
Water	7732-18-5	67 - 90%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)

Flammability Rating: 0 - None

Reactivity Rating: 2 - Moderate

Contact Rating: 3 - Severe (Corrosive)

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:

Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.

Ingestion:

Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat,

esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea, and in severe cases, death.

Skin Contact:

Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.

Eye Contact:

Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Chronic Exposure:

Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:

DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard. May react with metals or heat to release flammable hydrogen gas.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Water or water spray. Neutralize with soda ash or slaked lime.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of

this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

For Hydrochloric acid:

- OSHA Permissible Exposure Limit (PEL):

5 ppm (Ceiling)

- ACGIH Threshold Limit Value (TLV):

5 ppm (STEL/Ceiling)

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear, colorless liquid.

Odor:

Pungent odor.

Solubility:

Infinitely soluble.

Density:

1.05 @ 15C (59F)

pH:

For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)

% Volatiles by volume @ 21C (70F):

100

285

Boiling Point:

101 - 103C (214 - 217F)

Melting Point:

No information found.

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.

Conditions to Avoid:

Heat, direct sunlight.

11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg. Investigated as a tumorigen, mutagen, reproductive effector.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:

When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.

Environmental Toxicity:

This material is expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 200L

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Hydrogen Chloride (7647-01-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	--Canada--		
		DSL	NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302-		-SARA 313-	
	RQ	TPQ	List	Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
 SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
 Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2R

Poison Schedule: No information found.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0

Label Hazard Warning:

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

Label Precautions:

Do not get in eyes, on skin, or on clothing.

Avoid breathing vapor or mist.

Keep container closed.

Use with adequate ventilation.

Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Product Use:

Laboratory Reagent.

Revision Information:

No changes.

Disclaimer:

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Prepared by: Strategic Services Division

Phone Number: (314) 539-1600 (U.S.A.)

AIR LIQUIDE AMERICA CORP-FMLY BIG THREE INDUS -- ISOBUTYLENE - CALIBRATION GAS CYLINDER
MATERIAL SAFETY DATA SHEET

NSN: 6665012148247

Manufacturer's CAGE: 17688

Part No. Indicator: A

Part Number/Trade Name: ISOBUTYLENE

=====
General Information
=====

Item Name: CALIBRATION GAS CYLINDER

Company's Name: AIR LIQUIDE AMERICA CORP-FMLY BIG THREE INDUSTRIES

Company's Street: 3535 W 12TH ST

Company's P. O. Box: 3047

Company's City: HOUSTON

Company's State: TX

Company's Country: US

Company's Zip Code: 77253

Company's Emerg Ph #: 800-424-9300 CHEMTREC

Company's Info Ph #: 713-868-0440 FAX: 800-231-1366

Distributor/Vendor # 1: HNU SYSTEMS INC

Distributor/Vendor # 1 Cage: 57631

Record No. For Safety Entry: 001

Tot Safety Entries This Stk#: 005

Status: SE

Date MSDS Prepared: 20FEB97

Safety Data Review Date: 19AUG97

Supply Item Manager: CX

MSDS Preparer's Name: UNKNOWN

Preparer's Company: CHEMICAL SAFETY ASSOCIATES, INC.

Preparer's St Or P. O. Box: 9163 CHESAPEAKE DR

Preparer's City: SAN DIEGO

Preparer's State: CA

Preparer's Zip Code: 92123-1002

MSDS Serial Number: CFCVY

Specification Number: NONE

Spec Type, Grade, Class: NONE

Hazard Characteristic Code: G3

Unit Of Issue: EA

Unit Of Issue Container Qty: 0.6 LB

Type Of Container: CYLINDER

Net Unit Weight: 0.6

=====
Ingredients/Identity Information
=====

Proprietary: NO

Ingredient: ISOBUTYLENE (CYLINDER CONTAINS 75 PPM IN AIR).

Ingredient Sequence Number: 01

Percent:

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*** CHEMICAL IDENTIFICATION ***

RTECS NUMBER : Q05775000
 CHEMICAL NAME : Nitric acid
 CAS REGISTRY NUMBER : 7697-37-2
 LAST UPDATED : 199712
 DATA ITEMS CITED : 43
 MOLECULAR FORMULA : H-N-O3
 MOLECULAR WEIGHT : 63.02
 WISWESSER LINE NOTATION : H N-O3
 COMPOUND DESCRIPTOR : Mutagen
 Reproductive Effector
 Human

SYNONYMS/TRADE NAMES :

* Acide nitrique
 * Acido nitrico
 * Aqua fortis
 * Azotic acid
 * Azotowy kwas
 * Hydrogen nitrate
 * Kyselina dusicne
 * Nitric acid
 * Salpetersaure
 * Salpeterzuuroplossingen

*** HEALTH HAZARD DATA ***

** ACUTE TOXICITY DATA **

TYPE OF TEST : LDLo - Lowest published lethal dose
 ROUTE OF EXPOSURE : Oral
 SPECIES OBSERVED : Human
 DOSE/DURATION : 430 mg/kg
 TOXIC EFFECTS :

Details of toxic effects not reported other than lethal dose value

REFERENCE :

YAKUD5 Gekkan Yakuji. Pharmaceuticals Monthly. (Yakugyo Jihosha, Inaoka Bldg., 2-36 Jinbo-cho, Kanda, Chiyoda-ku, Tokyo 101, Japan) V.1- 1959-
 Volume(issue)/page/year: 22,651,1980

TYPE OF TEST : LDLo - Lowest published lethal dose
 ROUTE OF EXPOSURE : Unreported
 SPECIES OBSERVED : Human - man
 DOSE/DURATION : 110 mg/kg
 TOXIC EFFECTS :

Details of toxic effects not reported other than lethal dose value

REFERENCE :

85DCAI "Poisoning; Toxicology, Symptoms, Treatments," 2nd ed., Arena, J.M.,
 Springfield, IL, C.C. Thomas, 1970 Volume(issue)/page/year: 2,73,1970

** OTHER MULTIPLE DOSE TOXICITY DATA **

TYPE OF TEST : TCLo - Lowest published toxic concentration
 ROUTE OF EXPOSURE : Inhalation
 SPECIES OBSERVED : Rodent - rat
 DOSE/DURATION : 1071 ug/m3/24H/84D-C
 TOXIC EFFECTS :

Behavioral - muscle contraction or spasticity

Kidney, Ureter, Bladder - other changes in urine composition

Biochemical - Enzyme inhibition, induction, or change in blood or tissue levels - true cholinesterase

REFERENCE :

GISAAA Gigiena i Sanitariya. For English translation, see HYSAAV. (V/O
 Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1- 1936-
 Volume(issue)/page/year: 38(3),6,1973

TYPE OF TEST : TCLo - Lowest published toxic concentration
 ROUTE OF EXPOSURE : Inhalation
 SPECIES OBSERVED : Rodent - rat

DOSE/DURATION : 50 ug/m3/4H/3D-I

TOXIC EFFECTS :

Lungs, Thorax, or Respiration - respiratory depression

REFERENCE :

INHTE5 Inhalation Toxicology. (Hemisphere Publishing Corp., c/o Taylor & Francis Inc., 1900 Frost Rd., Suite 101, Bristol, PA 19007) V.1- 1989-
Volume(issue)/page/year: 8,595,1996

** REPRODUCTIVE DATA **

TYPE OF TEST : TDLo - Lowest published toxic dose

ROUTE OF EXPOSURE : Oral

SPECIES OBSERVED : Rodent - rat

DOSE : 21150 mg/kg

SEX/DURATION : female 1-21 day(s) after conception

TOXIC EFFECTS :

Reproductive - Effects on Embryo or Fetus - fetotoxicity (except death, e.g., stunted fetus)

REFERENCE :

ZHYGAM Zeitschrift fuer die Gesamte Hygiene und Ihre Grenzgebiete. (VEB Verlag Volk und Gesundheit, Neue Gruenstr. 18, Berlin DDR-1020, Ger. Dem. Rep.) V.1- 1955- Volume(issue)/page/year: 29,667,1983

TYPE OF TEST : TDLo - Lowest published toxic dose

ROUTE OF EXPOSURE : Oral

SPECIES OBSERVED : Rodent - rat

DOSE : 2345 mg/kg

SEX/DURATION : female 18 day(s) after conception

TOXIC EFFECTS :

Reproductive - Effects on Newborn - biochemical and metabolic

REFERENCE :

ZHYGAM Zeitschrift fuer die Gesamte Hygiene und Ihre Grenzgebiete. (VEB Verlag Volk und Gesundheit, Neue Gruenstr. 18, Berlin DDR-1020, Ger. Dem. Rep.) V.1- 1955- Volume(issue)/page/year: 29,667,1983

*** REVIEWS ***

ACGIH TLV-STEL 10 mg/m3 (4 ppm)

DTLVS* The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996 Volume(issue)/page/year: TLV/BEI,1997

ACGIH TLV-TWA 5.2 mg/m3 (2 ppm)

DTLVS* The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996 Volume(issue)/page/year: TLV/BEI,1997

TOXICOLOGY REVIEW

ANAE3 Annals of Allergy. (American College of Allergists, POB 20671, Bloomington, MN 55420) V.1- 1943- Volume(issue)/page/year: 35,165,1975

TOXICOLOGY REVIEW

ARTODN Archives of Toxicology. (Springer-Verlag, Heidelberger Pl. 3, D-1000 Berlin 33, Fed. Rep. Ger.) V.32- 1974- Volume(issue)/page/year: 39,299,1978

*** U.S. STANDARDS AND REGULATIONS ***

MSHA STANDARD-air:TWA 2 ppm (5 mg/m3)

DTLVS* The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996 Volume(issue)/page/year: 3,181,1971

OSHA PEL (Gen Indu):8H TWA 2 ppm (5 mg/m3)

CFRGBR Code of Federal Regulations. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402) Volume(issue)/page/year: 29,1910.1000,1994

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OSHA PEL (Construc):8H TWA 2 ppm (5 mg/m3)
 CFRGBR Code of Federal Regulations. (U.S. Government Printing Office, Supt.
 of Documents, Washington, DC 20402) Volume(issue)/page/year:
 29,1926.55,1994

OSHA PEL (Shipyards):8H TWA 2 ppm (5 mg/m3)
 CFRGBR Code of Federal Regulations. (U.S. Government Printing Office, Supt.
 of Documents, Washington, DC 20402) Volume(issue)/page/year:
 29,1915.1000,1993

OSHA PEL (Fed Cont):8H TWA 2 ppm (5 mg/m3)
 CFRGBR Code of Federal Regulations. (U.S. Government Printing Office, Supt.
 of Documents, Washington, DC 20402) Volume(issue)/page/year:
 41,50-204.50,1994

*** OCCUPATIONAL EXPOSURE LIMITS ***

OEL-ARAB Republic of Egypt:TWA 2 ppm (5 mg/m3) JAN 1993
 OEL-AUSTRALIA:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) JAN 1993
 OEL-BELGIUM:TWA 2 ppm (5.2 mg/m3);STEL 4 ppm (10 mg/m3) JAN 1993
 OEL-DENMARK:TWA 2 ppm (5 mg/m3) JAN 1993
 OEL-FINLAND:TWA 2 ppm (5 mg/m3);STEL 5 ppm (13 mg/m3);Skin JAN 1993
 OEL-FRANCE:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) JAN 1993
 OEL-GERMANY:TWA 10 ppm (25 mg/m3) JAN 1993
 OEL-HUNGARY:STEL 5 mg/m3 JAN 1993
 OEL-JAPAN:TWA 2 ppm (5.2 mg/m3) JAN 1993
 OEL-THE PHILIPPINES:TWA 2 ppm (5 mg/m3) JAN 1993
 OEL-POLAND:TWA 10 mg/m3 JAN 1993
 OEL-RUSSIA:TWA 2 ppm;STEL 2 mg/m3;Skin JAN 1993
 OEL-SWEDEN:TWA 2 ppm (5 mg/m3);STEL 5 ppm (13 mg/m3) JAN 1993
 OEL-SWITZERLAND:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) JAN 1993
 OEL-THAILAND:TWA 2 ppm (5 mg/m3) JAN 1993
 OEL-TURKEY:TWA 2 ppm (5 mg/m3) JAN 1993
 OEL-UNITED KINGDOM:TWA 2 ppm (5 mg/m3);STEL 4 ppm (10 mg/m3) JAN 1993
 OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
 OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGIH TLV

*** NIOSH STANDARDS DEVELOPMENT AND SURVEILLANCE DATA ***

NIOSH RECOMMENDED EXPOSURE LEVEL (REL) :

NIOSH REL TO NITRIC ACID-air:10H TWA 2 ppm;STEL 4 ppm
 REFERENCE :

NIOSH* National Institute for Occupational Safety and Health, U.S. Dept. of
 Health, Education, and Welfare, Reports and Memoranda.
 Volume(issue)/page/year: DHHS #92-100,1992

NIOSH OCCUPATIONAL EXPOSURE SURVEY DATA :

NOHS - National Occupational Hazard Survey (1974)
 NOHS Hazard Code - 50742
 No. of Facilities: 18088 (estimated)
 No. of Industries: 197
 No. of Occupations: 101

No. of Employees: 132401 (estimated)

NOES - National Occupational Exposure Survey (1983)

NOES Hazard Code - 50742

No. of Facilities: 18239 (estimated)

No. of Industries: 201

No. of Occupations: 120

No. of Employees: 297627 (estimated)

No. of Female Employees: 76316 (estimated)

*** STATUS IN U.S. ***

EPA GENETOX PROGRAM 1988, Negative: Cell transform.-SA7/SHE

EPA TSCA Section 8(b) CHEMICAL INVENTORY

EPA TSCA Section 8(d) unpublished health/safety studies

EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1998

NIOSH Analytical Method, 1994: Acids, inorganic, 7903

OSHA ANALYTICAL METHOD #ID-127

*** END OF RECORD ***

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QUINHYDRONE

MSDS Number: Q3250 — Effective Date: 11/17/99

1. Product Identification

Synonyms: 2,5-Cyclohexadiene-1,4-dione, comp. with 1,4-benzenediol (1:1); p-Benzoquinone compd. with hydroquinone; green hydroquinone

CAS No.: 106-34-3

Molecular Weight: 218.20

Chemical Formula: C₆H₆O₂.C₆H₄O₂

Product Codes: U755

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Quinhydrone	106-34-3	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! MAY BE FATAL IF SWALLOWED. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE SKIN AND EYE IRRITATION. MAY CAUSE ALLERGIC SKIN REACTION. HARMFUL IF INHALED. CAUSES IRRITATION TO RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate

Flammability Rating: 1 - Slight

Reactivity Rating: 1 - Slight

Contact Rating: 1 - Slight

Lab Protective Equip: GOGGLES; LAB COAT

Storage Color Code: Orange (General Storage)

Potential Health Effects

Information on the human health effects from exposure to this substance is limited. Health hazards on this data sheet are based on two related compounds: hydroquinone (CAS 123-31-9) and p-benzoquinone (CAS 106-51-4).

Inhalation:

Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Systemic effects have not been proven by this route.

Ingestion:

For Hydroquinone:

Highly Toxic. May cause hyperactivity, stupor, fall in blood pressure, hyperpnea, abdominal pain, diarrhea, intense thirst, sweating, tinnitis, nausea, dizziness, a sensation of suffocation, an increased rate of respiration, vomiting, pallor, muscular twitching, headache, cyanosis, delirium, and collapse (from respiratory failure). Estimated lethal dose lies between 5 to 12 grams (usually because of respiratory failure from methemoglobin formation which leaves the blood unable to carry oxygen). May cause green to brownish-green urine.

For p-Benzoquinone:

No specific information found for this route of exposure. Expected to cause irritation to gastrointestinal tract. Animal data indicate a high level of toxicity.

Skin Contact:

Causes severe irritation, redness and pain. Alkaline solutions can cause skin sensitization.

Eye Contact:

Vapors and contact cause severe irritation and possible corneal ulceration.

Chronic Exposure:

Repeated exposure to vapor or dust can cause brownish staining of the conjunctiva which may be followed by changes to the cornea leading to loss of visual acuity. Repeated exposure may also cause skin effects.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin or eye disorders or impaired respiratory function may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Wipe off excess material from skin then immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

5. Fire Fighting Measures

Fire:

May pose a fire hazard when exposed to heat, flame, or oxidizing agents.

For Hydroquinone:

Flash point: 165C (329F) (closed cup).

Autoignition temperature: 516C (960F)

For p-Benzoquinone

Flashpoint: 38 - 93C (100 - 200F)

Autoignition temperature: 560C (1040F)

Explosion:

Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Fire Extinguishing Media:

Dry chemical, alcohol foam or carbon dioxide. Water or foam may cause frothing.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing

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apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Remove all sources of ignition. Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Clean up spills in a manner that does not disperse dust into the air. Use non-sparking tools and equipment. Reduce airborne dust and prevent scattering by moistening with water. Pick up spill for recovery or disposal and place in a closed container.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Isolate from oxidizing materials. Protect from direct sunlight. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

For Hydroquinone:

-OSHA Permissible Exposure Limit (PEL):

2 mg/m³ (TWA).

-ACGIH Threshold Limit Value (TLV):

2 mg/m³ (TWA)

For p-Benzoquinone:

-OSHA Permissible Exposure Limit (PEL):

0.1 ppm (0.4 mg/m³) (TWA).

-ACGIH Threshold Limit Value (TLV):

0.1 ppm (0.44 mg/m³) (TWA)

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a full facepiece respirator with organic vapor cartridge and dust/mist filter may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. **WARNING:** Air purifying respirators do not protect workers in oxygen-deficient atmospheres. This compound possibly exists in both particulate and vapor phase. A gas/vapor cartridge should be used in addition to the particulate filter. If the vapor concentration alone exceeds the exposure limits, use a supplied air respirator, because warning properties are unknown for these compounds.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Green crystalline solid.

Odor:

No information found.

Solubility:

Slightly soluble in cold water, soluble in hot water

Density:

1.4

pH:

No information found.

% Volatiles by volume @ 21C (70F):

0

Boiling Point:

Sublimes.

Melting Point:

171C (340F)

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Quinone and oxides of carbon may be formed when this material is heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Sodium hydroxide, strong alkalis, and oxidizers.

Conditions to Avoid:

Heat, flame, ignition sources, incompatibles, light, and air.

11. Toxicological Information

For Quinhydrone: Oral rat LD50: 225 mg/kg

Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Quinhydrone (106-34-3)	No	No	None

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved

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waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Quinhydrone (106-34-3)	Yes	Yes	No	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	--Canada--		Phil.
		DSL	NDSL	
Quinhydrone (106-34-3)	No	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----				
Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Quinhydrone (106-34-3)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----			
Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8(d)
Quinhydrone (106-34-3)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
 Reactivity: No (Pure / Solid)

Australian Hazchem Code: No information found.

Poison Schedule: No information found.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 2 Reactivity: 1

Label Hazard Warning:

DANGER! MAY BE FATAL IF SWALLOWED. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE SKIN AND EYE IRRITATION. MAY CAUSE ALLERGIC SKIN REACTION. HARMFUL IF INHALED. CAUSES IRRITATION TO RESPIRATORY TRACT.

Label Precautions:

Avoid contact with eyes, skin and clothing.

Avoid breathing dust.

Keep container closed.

Use with adequate ventilation.

Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately. In case of contact, wipe off excess material from skin then immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Get medical attention. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No changes.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

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SODIUM BISULFITE

MSDS Number: S3074 --- Effective Date: 11/17/99

1. Product Identification**Synonyms:** Sodium acid sulfite; Sulfurous acid, monosodium salt; Sodium hydrogen sulfite, solid**CAS No.:** 7631-90-5**Molecular Weight:** 104.06**Chemical Formula:** A mixture of NaHSO₃ (sodium bisulfite) and Na₂S₂O₅ (sodium metabisulfite)**Product Codes:** 3556, 3557**2. Composition/Information on Ingredients**

Ingredient	CAS No	Percent	Hazardous
Sodium Bisulfite	7631-90-5	58 - 99%	Yes
Sodium Metabisulfite	7681-57-4	1 - 42%	Yes

3. Hazards Identification**Emergency Overview**

WARNING! HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE ALLERGIC RESPIRATORY REACTION. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. REACTS WITH ACIDS AND WATER RELEASING TOXIC SULFUR DIOXIDE GAS.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate

Flammability Rating: 0 - None

Reactivity Rating: 1 - Slight

Contact Rating: 1 - Slight

Lab Protective Equip: GOGGLES; LAB COAT

Storage Color Code: Orange (General Storage)

Potential Health Effects**Inhalation:**

Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. May cause allergic reaction in sensitive individuals.

Ingestion:

May cause gastric irritation by the liberation of sulfurous acid. An asthmatic reaction may occur after ingestion. Large doses may result in nausea, vomiting, diarrhea, abdominal pains, circulatory disturbance, and central nervous system depression. Estimated fatal dose is 10 gm.

Skin Contact:

Causes irritation to skin. Symptoms include redness, itching, and pain.

Eye Contact:

Causes irritation, redness, and pain. Contact may cause irreversible eye damage. Symptoms may include stinging, tearing, redness, swelling, corneal damage and blindness.

Chronic Exposure:

No information found.

Aggravation of Pre-existing Conditions:

Some individuals are said to be dangerously sensitive to minute amounts of sulfites in foods. Symptoms may include broncho constriction, shock, gastrointestinal disturbances, angio edema, flushing, and tingling sensations. Once allergy develops, future exposures can cause asthma attacks with shortness of breath, wheezing, and cough.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:

Wipe off excess material from skin then immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Cautiously spray residue with plenty of water, providing ventilation to clear sulfur dioxide fumes generated from water contact. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Releases toxic sulfur dioxide gas when in contact with water, ice. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

-ACGIH Threshold Limit Value (TLV):

5mg/m³ (TWA) for sodium bisulfite & for sodium metabisulfite, A4 Not classifiable as a human carcinogen.

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face respirator with an acid gas cartridge may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. **WARNING:** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Coarse white granules.

Odor:

Slight odor of sulfur dioxide.

Solubility:

Very soluble in water, insoluble in alcohol.

Specific Gravity:

1.48

pH:

No information found.

% Volatiles by volume @ 21C (70F):

No information found.

Boiling Point:

Not applicable.

Melting Point:

150C (302F)

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Strength diminishes somewhat with age. Gradually decomposes in air to sulfate, generating sulfurous acid

gas. Contact with moisture (water, wet ice, etc.), will release toxic sulfur dioxide gas.

Hazardous Decomposition Products:

Burning may produce sulfur oxides.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Water, acids, alkalis, sodium nitrite, oxidizers, aluminum powder.

Conditions to Avoid:

Moisture, heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Sodium Metabisulfite [7681-57-4]: No LD50/LC50 information found relating to normal routes of occupational exposure. Investigated as a tumorigen, mutagen and reproductive effector. Sodium Bisulfite [7631-90-5]: Oral rat LD50: 2000 mg/kg. Investigated as a tumorigen and mutagen.

-----\Cancer Lists\-----			
Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Sodium Bisulfite (7631-90-5)	No	No	3
Sodium Metabisulfite (7681-57-4)	No	No	3

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----				
Ingredient	TSCA	EC	Japan	Australia
Sodium Bisulfite (7631-90-5)	Yes	Yes	Yes	Yes
Sodium Metabisulfite (7681-57-4)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----				
Ingredient	Korea	--Canada--		Phil.
		DSL	NDSL	
Sodium Bisulfite (7631-90-5)	Yes	Yes	No	Yes
Sodium Metabisulfite (7681-57-4)	Yes	Yes	No	Yes

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-----\Federal, State & International Regulations - Part 1\-----

Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Sodium Bisulfite (7631-90-5)	No	No	No	No
Sodium Metabisulfite (7681-57-4)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----

Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8 (d)
Sodium Bisulfite (7631-90-5)	5000	No	Yes
Sodium Metabisulfite (7681-57-4)	No	No	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
 Reactivity: No (Mixture / Solid)

Australian Hazchem Code: No information found.

Poison Schedule: No information found.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 0 Reactivity: 1

Label Hazard Warning:

WARNING! HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE ALLERGIC RESPIRATORY REACTION. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. REACTS WITH ACIDS AND WATER RELEASING TOXIC SULFUR DIOXIDE GAS.

Label Precautions:

Avoid breathing dust.

Avoid contact with eyes, skin and clothing.

Keep container closed.

Use only with adequate ventilation.

Wash thoroughly after handling.

For Reagent and Technical Grades: Not For Food Use. For TAC Grades: Do not use in meats or in foods recognized as a source of Vitamin B-1, nor in fruits or vegetables to be served or sold raw to consumers or to be presented to consumers as fresh.

Label First Aid:

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, wipe off excess material from skin then immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No changes.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

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SULFURIC ACID, 52 - 100 %

MSDS Number: S8234 — Effective Date: 07/13/00

1. Product Identification

Synonyms: Oil of vitriol; Babcock acid; sulphuric acid

CAS No.: 7664-93-9

Molecular Weight: 98.08

Chemical Formula: H₂SO₄ in H₂O

Product Codes:

J.T. Baker: 5030, 5137, 5374, 5802, 5815, 5889, 5960, 5961, 5971, 6902, 9673, 9674, 9675, 9676, 9679, 9680, 9681, 9682, 9684, 9687, 9691, 9693, 9694

Mallinckrodt: 2468, 2876, 2878, 2900, 2904, 3780, 4222, 5524, 5557, H644, H976, H996, V344

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid	7664-93-9	52 - 100%	Yes
Water	7732-18-5	0 - 48%	No

3. Hazards Identification**Emergency Overview**

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)

Flammability Rating: 0 - None

Reactivity Rating: 3 - Severe (Water Reactive)

Contact Rating: 4 - Extreme (Corrosive)

Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

Storage Color Code: White (Corrosive)

Potential Health Effects**Inhalation:**

Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. May cause lung edema, a medical

emergency.

Ingestion:

Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.

Skin Contact:

Corrosive. Symptoms of redness, pain, and severe burn can occur. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow skin contact or ingestion. Circulatory shock is often the immediate cause of death.

Eye Contact:

Corrosive. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.

Chronic Exposure:

Long-term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.

Ingestion:

DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.

Eye Contact:

Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

5. Fire Fighting Measures

Fire:

Concentrated material is a strong dehydrating agent. Reacts with organic materials and may cause ignition of finely divided materials on contact.

Explosion:

Contact with most metals causes formation of flammable and explosive hydrogen gas.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Do not use water on material. However, water spray may be used to keep fire exposed containers cool.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material

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(e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

For Sulfuric Acid:

-OSHA Permissible Exposure Limit (PEL):

1 mg/m³ (TWA).

-ACGIH Threshold Limit Value (TLV):

1 mg/m³ (TWA), 3 mg/m³ (STEL)

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge and dust/mist filter may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator.

WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear oily liquid.

Odor:

Odorless.

Solubility:

Miscible with water, liberates much heat.

Specific Gravity:

1.84 (98%), 1.40 (50%), 1.07 (10%)

pH:

1 N solution (ca. 5% w/w) = 0.3; 0.1 N solution (ca. 0.5% w/w) = 1.2; 0.01 N solution (ca. 0.05% w/w) =

2.1.

% Volatiles by volume @ 21C (70F):

No information found.

Boiling Point:

ca. 290C (ca. 554F) (decomposes at 340C)

Melting Point:

3C (100%), -32C (93%), -38C (78%), -64C (65%).

Vapor Density (Air=1):

3.4

Vapor Pressure (mm Hg):

1 @ 145.8C (295F)

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Concentrated solutions react violently with water, spattering and liberating heat.

Hazardous Decomposition Products:

Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Water, potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances.

Conditions to Avoid:

Heat, moisture, incompatibles.

11. Toxicological Information

Toxicological Data:

Oral rat LD50: 2140 mg/kg; inhalation rat LC50: 510 mg/m³/2H; standard Draize, eye rabbit, 250 ug (severe); investigated as a tumorigen, mutagen, reproductive effector.

Carcinogenicity:

Cancer Status: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Sulfuric Acid (7664-93-9)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:

When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.

Environmental Toxicity:

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LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified.
 This material may be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SULFURIC ACID (WITH MORE THAN 51% ACID)
 Hazard Class: 8
 UN/NA: UN1830
 Packing Group: II
 Information reported for product/size: 440LB

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID (WITH MORE THAN 51% ACID)
 Hazard Class: 8
 UN/NA: UN1830
 Packing Group: II
 Information reported for product/size: 440LB

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----

Ingredient	TSCA	EC	Japan	Australia
Sulfuric Acid (7664-93-9)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----

Ingredient	Korea	--Canada--		Phil.
		DSL	NDSL	
Sulfuric Acid (7664-93-9)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

-----\Federal, State & International Regulations - Part 1\-----

Ingredient	-SARA 302-		-----SARA 313-----	
	RQ	TPQ	List	Chemical Catg.
Sulfuric Acid (7664-93-9)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

-----\Federal, State & International Regulations - Part 2\-----

Ingredient	CERCLA	-RCRA-	-TSCA-
		261.33	8 (d)
Sulfuric Acid (7664-93-9)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: Yes (Pure / Liquid)

Australian Hazchem Code: 2P

Poison Schedule: No information found.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 2 Other: Water reactive

Label Hazard Warning:

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Label Precautions:

Do not get in eyes, on skin, or on clothing.

Do not breathe mist.

Keep container closed.

Use only with adequate ventilation.

Wash thoroughly after handling.

Do not contact with water.

Label First Aid:

In all cases call a physician immediately. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 1.

Disclaimer:

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