INTERNATIONAL CYANIDE MANAGEMENT INSTITUTE

Implementation Guidance

For The
International Cyanide Management Code

www.cyanidecode.org

October 2009

Table of Contents

INTRODUCTION

Signatories of the International Cyanide Management Code commit to follow the Code's Principles and Standards in the use of cyanide. The Standards of Practice listed under each Principle in the Code set performance goals and objectives that an operation must achieve in order to be certified as in compliance with the Code.

The specific means of implementing the Code described in this guidance document are not mandatory in order for an operation to become certified as Code compliant. An operation can achieve certification if it is able to demonstrate that its methods achieve the performance goal as stated in the Standard of Practice.

This Document can be a useful tool for all stakeholders in that it describes an acceptable method that achieves the performance goals set by the Standards of Practice.

1. *PRODUCTION* **Encourage responsible cyanide manufacturing by purchasing from manufacturers who operate in a safe and environmentally protective manner.**

Standard of Practice 1.1
Purchase cyanide from manufacturers employing appropriate practices and procedures to limit exposure of their workforce to cyanide and to prevent releases of cyanide to the environment.

Guidance
Many cyanide manufacturers are members of the International Council of Chemical Associations' Responsible Care® Program, which promotes the adoption of Codes of Practice to limit workforce exposures to cyanide and to prevent, control and respond to environmental releases of cyanide. Most cyanide manufacturers pay great attention to product stewardship and employ management systems, procedures and practices to achieve these goals. Code signatories can play a significant role by encouraging cyanide producers to act responsibly and purchase cyanide from manufacturers that have signed the Code and had their production plant certified as compliant with the Code's Principles and Production Practices.

A company's primary purchasing arrangements for cyanide can be interrupted by production or transportation problems beyond its control, and it may occasionally be necessary to purchase cyanide from alternate sources for a limited time to ensure continued gold production. Operations should include the same requirements in all contracts developed with secondary cyanide distributors and producers.

The contract with an independent distributor of cyanide should require the distributor to provide cyanide that has been produced at a facility certified as compliant with the Code. A certification or chain-of-custody documentation stating that the cyanide delivered to an operation was indeed produced by the stated manufacturer must also be provided.

2. *TRANSPORTATION* **Protect communities and the environment during cyanide transport.**

Standard of Practice 2.1
Establish clear lines of responsibility for safety, security, release prevention, training and emergency response in written agreements with producers, distributors and transporters.

Guidance
Operations should establish written agreements with cyanide producers, distributors and transporters, designating the specific responsibilities for each aspect of cyanide transport. The following items should be addressed (as appropriate for the manner of transport):

1. Packaging as required by, and labeling in languages necessary to identify the material in the governmental jurisdiction/s the shipment passes through,
2. Storage prior to shipment,

3. Evaluation and selection of routes to reduce risks, including community involvement,
4. Storage and security at ports of entry,
5. Interim loading, storage and unloading during shipment,
6. Transport to the operation,
7. Unloading at the operation,
8. Safety and maintenance of the means of transportation (e.g., aircraft, vessels, vehicles, trains, etc.) throughout transport,
9. Task and safety training for transporters and handlers throughout transport,
10. Security throughout transport,
11. Emergency response throughout transport.

For international shipments, packaging and labeling should conform to Recommendations for the Transport of Dangerous Goods (a.k.a. the Orange Book), published by the United Nations Economic and Social Council's Committee of Experts on Transport of Dangerous Goods.

The written agreement should also specify that the designated responsibilities extend to any subcontractors used by the producer, distributor, transporter or the operation for transportation-related activities.

Standard of Practice 2.2
Require that cyanide transporters implement appropriate emergency response plans and capabilities, and employ adequate measures for cyanide management.

Guidance
Although it may not have direct control over the cyanide transport process, a mining operation is expected to make reasonable efforts to insure that the transporter, and any subcontractors involved in cyanide transport, make health, safety and environmental considerations a priority while transporting cyanide to the mine.

Operations should require in their transport contracts for cyanide that the transporter signs the Code and has its cyanide transport activities certified as compliant with the Code's Principles and Transport Practices.

For additional information, see:

- Cyanide Transportation Audit Protocol, http://cyanidecode.org/pdf/14_ICMITransportProtocol.pdf
- Auditor Guidance for Use of the Cyanide Transportation Verification Protocol, http://cyanidecode.org/pdf/TransportAuditorGuidance.pdf
- Principles for Storage, Handling and Distribution of Alkali Cyanides; Cyanides Sector Group, European Chemical Industry Council (CEFIC), May 2000, Revision 1
- Carrier Safety: Motor Carrier Assessment Protocol; American Chemistry Council (formerly Chemical Manufacturers Association), January 1994

- Awareness and Preparedness for Emergencies at Local Level for Transportation (TransAPELL); United Nations Environmental Programme, Technical Report No. 35, 2000
- International Maritime Organization, Dangerous Goods Code
- International Civil Aviation Organization, Technical Instructions for the Transport of Dangerous Goods, United Nations ECOSOC
- United Nations Recommendations for the Transport of Dangerous Goods (a.k.a. the Orange Book), United Nations ECOSOC

3. *HANDLING AND STORAGE* Protect workers and the environment during cyanide handling and storage.

Standard of Practice 3.1
Design and construct unloading, storage and mixing facilities consistent with sound, accepted engineering practices, quality control and quality assurance procedures, spill prevention and spill containment measures.

Guidance
To the extent feasible, unloading and storage areas for liquid and solid cyanide should be located away from people and surface waters. The potential for releases to surface water and/or human exposure associated with the storage location should be evaluated, and the operation should implement precautions as needed to prevent or minimize these potentials. Protective measures may include automatic sensors and alarms for hydrogen cyanide gas, enhanced or additional containment structures, and specific emergency procedures for notification, evacuation, response and remediation. Additionally many cyanide manufactures have guidelines for the design, construction and operation of unloading and storage facilities that may be helpful in the implementation of this practice.

Unloading of liquid cyanide should be done on a concrete surface to prevent leakage from contacting the environment. Systems and procedures should be in place to address potential recovery of released solution, remediation of any contaminated soil, and possible failures of the tank trucks as necessary to protect surface and ground water. A method to prevent the overfilling of cyanide storage tanks (other than by direct observation and manual gauging rod) should be provided, such as an automatic level indicator, high- level alarm, or integrated tank and tanker valve-shutdown device.

Storage areas for cyanide should be well ventilated to prevent the build-up of hydrogen cyanide gas. Measures such as storage under a roof and off the ground or in secure containers should be in place to minimize the potential for contact of cyanide with water. Cyanide should be stored within a secure location where public access is prohibited, such as the fenced boundary of the operation/plant or within a separate fenced and locked area. Cyanide should not be stored with acids, strong oxidizers, explosives, foods, animal feeds, tobacco products, or any other incompatible materials. Berms, bunds, walls or other barriers that will prevent mixing can be used.

Cyanide storage and mixing tanks should be located on a concrete surface to prevent seepage to the subsurface. Secondary containment should be employed to contain any releases from the tanks, and for any precipitation that may come in contact with the cyanide. Allowances must also be made for the recovery and return to the cyanidation process or proper disposal of any contaminated water or cyanide leakages.

Secondary containments used for this purpose should be constructed of concrete, asphalt, plastic or other materials that are demonstrated to provide a competent barrier. Containments, which may include multiple containments connected by piping, should be sized to hold a volume of leakage greater than that of the largest tank, any piping that drains back into the containment, and should have additional capacity for the design storm event. Procedures should be implemented to prevent discharge to the environment of any process solution or precipitation contaminated with cyanide that is collected in a secondary containment area.

Operations should employ quality control and quality assurance procedures in the construction of foundations, storage and mixing tanks, solution handling facilities and containments to ensure that design objectives have been achieved. Records should be retained documenting that these procedures have been followed.

Cyanide storage and mixing tanks and related pipelines should be constructed of or coated with materials compatible with cyanide and high pH conditions. Tanks and pipelines should be clearly identified as containing cyanide, and the direction of flow should be indicated on pipelines. This should be accomplished by using labels, tags, signs or other clearly legible markings. Some jurisdictions also have standardized color-codes for cyanide tanks and pipes containing cyanide.

Standard of Practice 3.2:
Operate unloading, storage and mixing facilities using inspections, preventive maintenance and contingency plans to prevent or contain releases and control and respond to worker exposures.

Guidance
The unloading, storage and mixing of cyanide at an operation involves concentrated solutions of cyanide and solid cyanide salts and therefore presents the potential for worker exposure and environmental releases involving potentially toxic concentrations of cyanide. Employing appropriate practices and procedures during these activities is critical to protect worker health and safety, prevent releases, and effectively respond to any exposures or releases.

Operations should develop and implement a written set of procedures designed to prevent or control exposures and releases during cyanide unloading, storage and mixing activities. These procedures may be in the form of an operating manual, standard operating procedures, checklists, signs, training documents, or other written formats as long as they address the elements discussed below, as appropriate for the site and its unloading, storage and mixing activities.

The procedures should include instructions for operating all valves and couplings, and requirements for use of personal protective equipment. Procedures for handling solid cyanide should include measures to insure that containers are neither ruptured nor punctured, and describe limits on stacking containers. Mixing procedures should include techniques to minimize the evolution of hydrogen cyanide gas, prevent loss of solid cyanide, and insure the handling and disposal of empty cyanide containers consistent with the Code.

Operations should develop contingency procedures for responding to releases and worker exposure that may occur during the unloading, mixing and storage of cyanide. These plans should address the issues identified under Principle 6, Worker Safety and Principle 7, Emergency Response, and may be incorporated into the operation's overall Emergency Response Plan.

At least two individuals also should be present when unloading liquid cyanide so that one can be available for immediate response in the event of an exposure. These individuals, who may be from the operation or the transport company, should be trained in the unloading procedures used at that site as well as in the applicable procedures for emergency response to worker and community exposure and environmental release. Remote video monitoring can be used in lieu of the second "observer" during the unloading of liquid cyanide.

At least two individuals should also be present when mixing cyanide with water unless an automated system is used or a remote video monitoring system is used. The cyanide manufacturer's recommended procedures for mixing or similar site-specific procedures should be followed closely to minimize the possibility of worker exposure. The pH of the mix water should be sufficiently high to minimize the evolution of hydrogen cyanide gas. The exact pH required at a given operation will depend on the concentration of cyanide in solution, the water chemistry, and the engineered controls built in to the mixing system.

Cyanide-specific first aid and emergency response equipment should be readily available for use at unloading, storage and mixing locations, including high-pH water for decontamination of exposed workers, oxygen, resuscitator and appropriate personal protective equipment. An antidote for cyanide poisoning must also be available. However, while any trained individual can administer oxygen and/or amyl nitrite, only certified medical personnel may administer intravenous antidotes. A means of communication or notification, such as a radio, telephone or alarm system, should also be available to summon help in the event of an exposure. Workers involved with unloading, storage and mixing should be trained in the use of emergency rescue equipment and in the first aid procedures for responding to cyanide exposures as discussed in Principle 8, Training.

Spill neutralization and clean-up equipment should also be readily available at unloading, storage and mixing locations. This may include water for cleaning up spills of liquid cyanide, shovels for cleaning up spills of solid cyanide, and chemicals to treat or neutralize cyanide and cyanide-contaminated soils, as well as cyanide-specific personal protective equipment. See the Guidance for Standard of Practice 7.5 regarding treatment of cyanide. Personnel engaged in unloading, storage and mixing activities should be trained in the operation's procedures to respond to cyanide spills, including notifications, clean up and detoxification.

Storage areas, pipelines, pumps, valves and tanks should be inspected regularly for evidence of leakage, presence of solution in secondary containments and integrity of the containment. Deficiencies should be noted and records retained documenting the inspection and the implementation of necessary corrective measures.

Empty cyanide containers should not be reused on or off the mine site for any purpose other than holding cyanide. Prior to disposal or re-use, cyanide drums should be rinsed three times with high-pH water to remove cyanide residue. All rinse water should either be added to the cyanidation process or assumed to contain cyanide and disposed of in an environmentally sound manner. The rinsed drum may then be crushed and placed in a landfill. Plastic bags and liners should also be triple-rinsed prior to disposal. Wooden crates are difficult to effectively decontaminate; it should be assumed that they have come in contact with cyanide and they should be burned or otherwise disposed of in an environmentally sound manner. Cyanide containers that are specifically meant for return to the vendor for reuse may not require internal rinsing, but any cyanide residue on the outside of the container should be washed off and managed consistent with the Code, and the container should be securely closed for shipment.

For additional information, see:

- Principles on Cyanide Management for Gold Mining, Chamber of Mines of South Africa, June 2001
- Best Practice Environmental Management In Mining, Cyanide Management; Environment Australia, June 1998
- Principles for Storage, Handling and Distribution of Alkali Cyanides; Cyanides Sector Group, European Chemical Industry Council (CEFIC), December 1997
- Technical Guide for the Environmental Management of Cyanide in Mining, British Columbia Technical and Research Committee on Reclamation, Cyanide Subcommittee, December 1995
- Cyanide Management Principles, Department of Minerals and Energy, Western Australia, July 1992
- The cyanide manufacturer's guidelines and government regulations where they have been established.

4. OPERATIONS: **Manage cyanide process solutions and waste streams to protect human health and the environment.**

Standard of Practice 4.1

Implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventive maintenance procedures.

Guidance
Written management systems, including operating plans and procedures, are the link between a site's design and its operation. On a daily basis, these systems provide a method to insure operational parameters are consistent with design criteria and assumptions. Although formalized plans are suggested, the Code does not require an operation to compile its cyanide-specific procedures into specified formats or documents or that the necessary cyanide management procedures be documented separately from an operation's other operating, training or environmental plans and procedures. Procedures may be in the form of manuals, standard operating procedures, checklists, signs, training materials or other forms, and may be separate for cyanide management or included with other documentation, as long as they demonstrate the operation's understanding of managing cyanide in a manner that prevents or controls releases to the environment and exposures to workers and the community.

Operating plans or procedures should be developed and implemented for both new and existing facilities such as leach plants, heap leach operations, tailings impoundments, cyanide treatment, regeneration and disposal systems for the use, management and disposal of cyanide and cyanide-containing solutions.

The plans or procedures should describe the standard practices necessary for the safe and environmentally sound operation of the facility and the specific measures needed for compliance with the Code, such as inspections and maintenance activities, and identify the assumptions and parameters on which the facility design was based. They should also identify any applicable regulatory requirements necessary to prevent or control cyanide releases and exposures, examples of which include the freeboard required for safe pond and impoundment operation and cyanide concentrations in tailings on which the facility's wildlife protection measures or permit limits are based.

The management system should also include procedures to identify when the initial design and operating practices at the site have or will be changed, and require a change in cyanide management practices. For example, the initial design of a facility may have been based on disposal of tailings with a sufficiently low Weak Acid Dissolvable (WAD) cyanide concentration, making no additional wildlife protection measures necessary. But if the mine encounters ore with a high copper content, the increased cyanide concentrations required for efficient leaching may result in a tailings solution that is harmful to birds. Therefore, a change in procedure would be warranted to prevent the exposure of birds to a tailings solution that may have a toxic concentration of cyanide. For example, the procedure may require the blending of ore types, or the use of a cyanide destruction or regeneration plant, to address this issue.

Management systems and operating plans or procedures should also include contingencies for situations where there is an upset in a facility's water balance, when inspections or monitoring identifies a problem, and when a temporary closure or cessation of operations may be necessary. Prior planning for these situations allows rapid responses and minimizes risks of cyanide exposures and releases.

Various programs and guidelines can be useful as models for development of environmental management systems. The *International Standards Organization's ISO 14000, British Standards BS 7750, European Community's Eco-Management & Audit Scheme (EMAS)* and the *Organization for Economic Cooperation and Development's (OECD) Guidelines for Multinational Enterprises, V. Environment* all provide frameworks an operation can use as a basis for its cyanide management system. However, the Code does not require the use of any single approach to environmental management nor accepts such systems in lieu of the development and implementation of the plans and procedures identified in the Code.

Facilities should be inspected on an established frequency to insure that they function within design parameters. Although specific inspection needs will depend on the facilities at a given site and the degree of automated instrumentation, some visual inspections are typically necessary at most sites. Tanks holding process solutions should be inspected for structural integrity and signs of corrosion and leakage. Secondary containments should be inspected for their integrity, the presence of fluids, and their available capacity to insure that drains are closed and, if necessary, locked, to prevent accidental releases to the environment. Leak detection and collection systems at leach pads and ponds should be inspected as required in the design documents. Pipelines, pumps and valves should be inspected for deterioration and leakage. Ponds and impoundments should be inspected for the parameters identified as critical in design documents to their containment of cyanide and solutions, maintenance of the water balance (such as available freeboard) and the integrity of structures for diversion of surface water and runoff.

Facility inspections should be documented on inspection forms, in log books or by other means, and should include the date of the inspection, the name of the inspector, and any observed deficiencies. The nature and date of corrective actions also should be documented.

Preventive maintenance programs should be implemented and their activities documented to insure that equipment and devices necessary for cyanide management function continuously. Pumps, pipelines, treatment, and destruction/regeneration equipment are examples of equipment that should be regularly maintained so that failures do not result in worker exposures or releases to the environment.

Operations should have a source of emergency power for pumps and other equipment to prevent unintentional cyanide releases and worker exposure when their primary power supply is interrupted. Back-up power generating equipment should be maintained and tested to insure its viability and reserves.

Standard of Practice 4.2

Introduce management and operating systems to minimize cyanide use, thereby limiting concentrations of cyanide in mill tailings.

Guidance

Limiting cyanide use to the greatest extent practicable has environmental and economic benefits because reducing the concentration of cyanide lowers the risk of potential seepage, and harmful exposures to wildlife, and minimizing the amount of cyanide that must be transported to the site lowers the potential of transport-related releases.

While facilities must use the amount of cyanide determined to be metallurgically necessary for efficient precious metal extraction, operations should use bottle roll or other test procedures to determine the optimal amount of cyanide, and should reevaluate and adjust addition rates as necessary when changes in ore type or processing plant practices occur. Operations should also evaluate various control strategies for cyanide additions, such as periodic sampling and automated systems to optimize efficiency, to reduce cyanide concentrations in mill tailings and/or recycled solutions, and then implement the chosen strategy.

Standard of Practice 4.3:

Implement a comprehensive water management program to protect against unintentional releases.

Guidance

The proper management of process solution and storm water is central to the prevention of releases from tailings impoundments and solution ponds. A comprehensive water balance should be developed in order to define the necessary parameters for design and operation of these facilities. Inspection and monitoring to maintain the water balance should become part of the facility's operating procedures, thus preventing an over-accumulation of water that can result in overtopping, unplanned discharge into the environment, and the potential structural failure of the facility.

The water balance should be probabilistic in nature, taking into account the uncertainty and variability inherent in the prediction of precipitation patterns. This entails considering precipitation and evaporation ranges, extremes and seasonal variations, as well as average conditions. Although a water balance must be developed on a site-specific basis, a number of basic factors must be considered in all cases.

The rates at which solutions are applied to leach pads and tailings are deposited into storage facilities are critical design parameters for sizing facilities. Once set (unless other engineering changes are made) these rates will limit the amount of tailings that can safely be discharged to an impoundment and the volume of leach solution that can be circulated through a leach operation.

Facility design must be based on a storm duration and return interval that provides a sufficient degree of probability that overtopping of the pond or impoundment can be prevented. Since precipitation falling on the facility and evaporation from it may represent a significant input and loss of water to the system, these rates should be evaluated on a regular (typically monthly) basis to account for seasonal variations in weather patterns. The selection of events and their recurrence interval should be based on the anticipated period of operations, rainfall distribution patterns, the relative safety, health and environmental risks at the site, applicable regulatory requirements and an adequate margin of safety. Examples include but are not limited to designs for containment of a 100- year, 24-hour event (the most precipitation anticipated to fall during a 24-hour period once every 100 years) and a 50-year, 72-hour event (the most precipitation anticipated to fall during a 72- hour period once every 50 years). The quality of existing data is also a factor, and conservative assumptions or adjustments may need to be considered when long-term data are not available or where the only data available do not represent actual site conditions.

The amount of precipitation entering a pond or impoundment resulting from surface run-on from the up gradient watershed must be considered in the water balance. While the design storm event used to calculate inflow from up gradient will be at least the same as that used for precipitation falling directly on the facility, it may be necessary to increase the anticipated volume of precipitation if the watershed includes significantly higher terrain, to account for infiltration into the ground and run-off entering the facility.

In regions receiving precipitation as snow or ice, an “inventory” of precipitation may accumulate for weeks or months during freezing conditions and be released as a single inflow during a thaw. The potential for such an occurrence must be considered in areas experiencing such conditions.

For leach ponds, the water balance should also include an evaluation of the amount of solution that can drain from the heap to a pond before pumping capacity can be restored. Site-specific parameters, such as the height and porosity of the heap, should be considered along with the design storm event and other potential failure scenarios such as pipe failure. A 48-hour period is used by some jurisdictions for drain-down calculations.

The water balance must also take into account various solution losses in addition to evaporation. These include the capacity of decant, drainage and recycling systems used to return solution to the process, seepage to the subsurface as authorized by the applicable jurisdiction, and whether the facility is allowed to discharge solution to surface water. Where pumps and other equipment will be used to remove solution from ponds and impoundments, the water balance must account for potential power outages or equipment failures, and the availability of back-up equipment and power.

Where discharge to surface water is allowed and deemed necessary to accommodate site design and climatic conditions, the capacity of cyanide treatment, destruction or regeneration systems must be considered in the water balance. Further, the on-line availability of these systems, and the implications of their failure or maintenance downtime, must be factored into the water balance and facility storage capacity.

Other aspects of facility design may have direct consequences on how the water balance must be determined, and these factors must be included when calculating the amount of water that can be stored in the impoundment. For example, the analysis of dam stability or potential seepage of a tailings impoundment may be based on an assumed phreatic surface within the dam.

Ponds and impoundments must be designed to maintain an adequate freeboard between the crest of the pond or impoundment and the maximum design level of solution determined to be necessary from water balance calculations. Heights of 0.5-1.0 meters are examples of freeboard requirements that are typically found in many regulations and guidance documents as a safety factor and to account for potential wave action in tailings storage facilities. Greater freeboard may be necessary in leach ponds since their surface areas are generally much smaller than those of tailings storage facilities, and they fill more rapidly during increased precipitation.

Operation of a rain gauge is necessary unless daily precipitation data is available from another nearby source that is representative of site conditions. Precipitation data should be compared with the assumptions used for facility design, and operating practices should be reviewed and revised as necessary to account for actual measured precipitation.

Standard of Practice 4.4:
Implement measures to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions.

Guidance
Process solutions impounded in a Tailing Storage Facility (TSF), leaching facilities and solution ponds can attract birds, wildlife and livestock. A concentration of 50 mg/l WAD cyanide or lower in solution is typically viewed as being protective of most wildlife and livestock mortality other than aquatic organisms. Where birds, wildlife or livestock have access to water impounded in TSFs, leaching facilities or solution ponds, operations should implement measures to limit the concentration of WAD cyanide to a maximum of 50 mg/l. Various treatment methods are available to reduce cyanide concentrations in mill effluents to achieve this concentration.

Measures to restrict access by wildlife and livestock should be instituted for all open waters where WAD cyanide exceeds 50 mg/l. These measures include fencing, filling in leach solution collection and transport ditches with gravel, and covering or netting water in ditches, ponds and impoundments. Hazing techniques such as use of air cannons are not effective in most cases. Fencing is also appropriate in most cases to prevent unauthorized access and potential exposure to humans.

Solution application methods for leach operations should be designed and operated to avoid significant ponding on the heap surface and limit overspray of solution off the heap liner. This should prevent contact with birds and other wildlife and potential contamination of surrounding soil, surface water and ground water. Ponding on a heap leach facility may indicate saturated conditions at depth in the heap that could lead to structural failure and release of process solution to the environment.

Standard of Practice 4.5:
Implement measures to protect fish and wildlife from direct and indirect discharges of cyanide process solution to surface water.

Guidance
Process solutions may be discharged directly or indirectly to surface waters. A typical direct discharge would be a permitted discharge of tailings water to a stream, while an indirect discharge could be seepage from a tailings storage facility that flows on the surface or through the subsurface and enters a stream. Direct discharges to surface water may be necessary in regions where precipitation exceeds evaporation. Operations should implement measures to protect against and manage indirect discharges so that cyanide concentrations are not harmful to fish and wildlife in these surface waters.

Discharges to surface waters should not exceed 0.5 mg/l WAD cyanide nor result in a concentration of free cyanide in excess of 0.022 mg/l within the receiving surface water body, and downstream of any mixing zone approved by the applicable jurisdiction. The 0.022 mg/l guideline is from the United States Environmental Protection Agency's National Water Quality Criteria for Cyanide, and represents a concentration to which a freshwater aquatic community can be briefly exposed without resulting in an unacceptable effect.

The lower quantification limit (LQL) for free cyanide analysis achievable by most laboratories is 1 mg/l. (See: Sampling and Analysis, http://cyanidecode.org/cyanide_sampling.php). If the analytical laboratory cannot accurately determine compliance with the 0.022 mg/l value, the operation may demonstrate compliance by determining the free cyanide concentration in the discharge and calculating the resulting concentration after dilution in the mixing zone (if applicable). In the event that the free cyanide concentration of the discharge is below the analytical limit of quantification, the operation should determine the WAD cyanide concentration in the discharge, assume that all WAD cyanide is free cyanide, and calculate the resulting concentration after dilution in the mixing zone (if applicable). Operations may also apply biotoxicity testing using species and techniques accepted by the applicable jurisdiction.

Free cyanide levels of 0.022 mg/l may not be appropriate in all cases, as the sensitivity of aquatic life to cyanide varies with the species present and the characteristics of the receiving water. It will usually be necessary to treat or regenerate cyanide prior to its discharge in order to achieve 0.022 mg/l free cyanide downstream of the mixing zone. Many jurisdictions have their own specific numerical standards for surface water discharges or surface water quality, or may limit cyanide species other than free cyanide.

Treatment may be passive (allowing sufficient residence time in an impoundment for natural processes to reduce cyanide concentrations or use of wetlands) or active (utilizing any of the various available technologies to oxidize cyanide or to regenerate hydrogen cyanide for reuse in production). It should be noted that some treatment methods could increase the concentration of cyanide degradation products (such as cyanate, ammonia and nitrate) in the discharge. These substances can themselves be harmful to fish and wildlife. Although control of these substances is not covered by the Code, operations utilizing such treatment systems should evaluate the effects of cyanide degradation products on exposed fish and wildlife and take measures necessary for their protection.

Monitoring surface water quality both up and down gradient of a cyanide facility can determine if an indirect discharge is causing harmful concentrations of cyanide in the surface water. In such a case, the discharge should be stopped either as soon as possible or intercepted and collected. The water balance and design parameters of a tailings storage facility should be reviewed to determine if the seep is from improper water management. Seepage that cannot be stopped should be collected in trenches, ponds or wells, and either returned to the production process or, if permitted, treated as necessary and discharged.

Standard of Practice 4.6:
Implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of ground water.

Guidance
Measures designed to manage seepage of leaching and tailings solutions should be incorporated into the design and construction of facilities to protect the existing beneficial uses of ground water, and/or the beneficial uses designated by the applicable jurisdiction. Where the beneficial use of ground water has been adversely impacted, mine operations should implement remedial measures to protect against further degradation and restore beneficial uses at the applicable monitoring location or point(s) of compliance.

For leach pads and leach solution ponds, this typically requires lining with a minimum of one synthetic membrane, such as high- or low-density polyethylene, HDPE or LDPE, placed on a prepared and compacted earthen liner. These and other liner systems, such as two synthetic membranes, can be designed and constructed with leak detection and recovery systems between the liners where significant hydraulic head exists (i.e., a solution pond or the internal solution collection trenches of a heap leach pad) to allow for periodic monitoring for leakage.

Verification of protection of the beneficial uses of groundwater is based on data, and not on the use of a particular technology. There are a number of techniques for limiting and controlling seepage from tailings storage facilities; these are identified for informational purposes only, and are not intended as verifiable elements of the Code:

1. Limiting the hydraulic head by maintaining a small pond area will reduce the force driving solution into the subsurface. The earthen floor of an impoundment can be compacted in its natural condition, or by adding clay materials to form a liner.
2. Deposition methods can be used to promote tailings compaction and reduce their permeability.

3. Dam designs are available to promote drainage to a collection system rather than to the subsurface, and cut-off trenches can be used to intercept and collect shallow seepage before it can impact ground water.
4. Remedial actions such as pump-back systems also can be used to manage subsurface flows and prevent existing ground water plumes from reaching potential receptors and interfering with the beneficial uses of ground water.

The need for and nature of seepage control measures is highly dependent on site-specific hydrogeological conditions. Such systems should therefore be factored into the initial design of a tailings storage facility and be incorporated into the facility's operating plan to protect the designated beneficial uses of ground water. Any measures to restrict or control seepage from tailings storage facilities must be integrated into overall facility design, as they are directly related to the overall stability of the engineered structures.

Information on design and construction of TSFs can be found in Bulletins # 74, 97, 98, 101, 102, 104, 106 and 121 published by the International Commission On Large Dams, ICOLD, as well as in documents developed by many political jurisdictions.

Where mill tailings are used as underground backfill, the operation should determine the cyanide concentrations in the liquid phase and evaluate the risks to worker safety and ground water quality. Where potential exists for worker exposure to hydrogen cyanide gas, or for the release of cyanide to ground water, treatments to chemically convert, remove available cyanide, or to complex it in forms that do not present risks to worker health or the beneficial uses of the ground water or other appropriate actions should be implemented.

Standard of Practice 4.7:
Provide spill prevention or containment measures for process tanks and pipelines.

Guidance
Tanks holding process solutions such as leaching vessels, CIL and CIP tanks and cyanide tanks associated with cyanide regeneration activities should be located on concrete or material impermeable to seepage of spilled solution. Secondary containment should be provided for potential failure of cyanide process solution tanks, with provisions for recovery of released solution or remediation of any contaminated soil as necessary to protect surface and ground water. Containments should be sized to hold a volume greater than that of the largest tank within the containment, any piping that drains back into the containment, and have additional capacity for the design storm event.

Spill prevention or containment measures should also be provided for process solution pipelines. Examples include secondary containment ditches, differential pressure sensing with alarms and/or automatic shutoff systems, and preventive maintenance programs with pipe thickness measurements. While a program of regular visual inspections should also be conducted, visual inspections alone are not typically sufficient unless the inspections are conducted at a frequency that can identify and prevent significant releases. If a risk exists for a release of process solution from a pipeline to adversely effect surface water, such as where pipes cross streams, operations should evaluate the need for special protection such as double-walled piping.

Cyanide process tanks and pipelines should be constructed or coated with materials that are compatible with cyanide and high pH conditions. Tanks and pipelines should be clearly identified as containing cyanide. The direction of flow should be indicated on pipelines. Labels, tags, signs or other clearly legible markings can accomplish this. Some jurisdictions also have standardized color-codes for cyanide tanks and pipes containing cyanide.

Standard of Practice 4.8:
Implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.

Guidance
Facilities for the management of cyanide should be constructed according to accepted engineering standards and specifications. Quality control and quality assurance programs should be implemented during construction of new facilities and modifications to existing facilities to insure structural integrity and the ability to safely contain process solutions and solids. Qualified personnel should review facility construction and document that the facility has been built as proposed and approved.

Existing facilities may not have been subject to quality control and assurance programs when originally constructed. If no records exist, to insure that the facility can operate consistent with the Code's Principles and Standards of Practice the facility must be inspected by appropriately qualified personnel and a report issued documenting the results.

The quality control and quality assurance program should address the suitability of the construction materials and the adequacy of soil compaction for earthworks such as tank foundations and earthen liners for leach facilities. Quality control and quality assurance procedures are also necessary for installation of synthetic membrane liners used in ponds and leach pads, for pipes, pipe fittings, for welds and bolts on cyanide storage and process tanks, and for any other equipment containing cyanide. Records should be retained to document that the specific quality control and quality assurance procedures have been followed.

Oversight by qualified personnel of all phases of construction and testing, and well-defined procedures for approval of changes to original design or construction techniques are also important aspects of quality control and quality assurance programs. The previously referenced ICOLD documents, as well as guidance documents developed by many individual countries and jurisdictions, provide information on quality control and quality assurance programs for construction of tailings dams and impoundments. In particular, the suitability of construction materials and the degree of compaction necessary for natural materials are of critical importance in most tailings storage facility designs. Other parameters may also be significant depending on the design.

Standard of Practice 4.9:
Implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface and ground water quality.

Guidance
Monitoring programs play a key role in release prevention and identification and provide a basis for effective worker training. Sites should develop written standard procedures for monitoring activities and conduct these activities in a uniform and consistent manner to insure good quality.

Operations should monitor cyanide in discharges to surface water, and in the surface and ground water up gradient and down gradient of the site to determine the effectiveness of the current management systems and take any necessary corrective actions. Sampling and analytical protocols should be developed by appropriately qualified personnel and should specify to the extent practical how and where samples should be taken, sample preservation techniques, chain of custody procedures and cyanide species to be determined. Sampling conditions and procedures should be documented on standardized written forms, in logbooks or by other means.

Monitoring should be conducted at intervals adequate to characterize the medium being monitored and to identify changes in a timely manner. Timing may vary from site to site, depending on the amount of existing data, the stability of the parameters, and the rate of ground water movement. Discharges to surface waters are typically monitored daily, while surface water monitoring may be weekly or monthly. Ground water monitoring may be monthly, quarterly or longer. Monitoring for wildlife mortality is normally part of a daily inspection of cyanide facilities.

For additional information see:

- Chemistry and Treatment of Cyanidation Wastes, Second Edition, T.I. Mudder, M.M Botz and A. Smith, Mining Journal Books, Limited, London, 2001
- Tailings Dams - Risk of Dangerous Occurrences: lessons learnt from practical experiences, ICOLD-UNEP, Bulletin 121, 2001
- Principles on Cyanide Management for Gold Mining, Chamber of Mines of South Africa, June 2001
- Water Quality Protection Principles No. 1-11; Department of Minerals and Energy, Western Australia, May 2000
- Bird Usage Patterns on Northern Territory Mining Water Tailings and their Management to Reduce Mortalities; David Donato; January 1999
- Principles on the Safe Design and Operating Standards for Tailings Storage; Department of Minerals and Energy; Western Australia; October 1999
- Best Practice Environmental Management In Mining, Cyanide Management; Environment Australia, June 1998
- Best Practice Environmental Management In Mining, Water Management; Environment Australia, June 1998

- Principles on the Development of an Operating Manual for Tailings Storage; Department of Minerals and Energy; Western Australia; October 1998
- Best Practice Principles: Reducing Impacts of Tailings Storage Facilities on Avian Wildlife in the Northern Territory of Australia; Northern Territory Department of Mines and Energy; October 1998
- Minesite Water Management Handbook, Minerals Council of Australia, First Edition, 1997
- Environmental Management Systems-General guidelines on principles, systems and supporting techniques; International Organization for Standardization, 1996
- Principles for Environmental Protection; The Engineering Design, Operation and Closure of Metalliferous, Diamond and Coal Residue Deposits; Volume 1/1979; Chamber of Mines of South Africa; March 1996
- Technical Guide for the Environmental Management of Cyanide in Mining, British Columbia Technical and Research Committee on Reclamation, Cyanide Subcommittee, December 1995
- Introduction to Evaluation, Design and Operation of Precious Metal Heap Leaching Projects, Chapter on Surface Water Control - Water Balance, D.J.A. Van Zyl, I.P.G Hutchinson, and J.E. Kiel, Eds., Society of Mining Engineers, 1988
- Sampling and Analysis, http://cyanidecode.org/cyanide_sampling.php

5. DECOMMISSIONING **Protect communities and the environment from cyanide through development and implementation of decommissioning plans for cyanide facilities.**

Standard of Practice 5.1:
Plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife and livestock.

Guidance
Prior to the start of new operations, the steps necessary to decommission the cyanide facility should be determined so that the facility can be closed in a manner that prevents adverse impacts to people, wildlife or the environment.

Issues related to cyanide are only one component of a site's overall decommissioning and closure strategy. An operation may incorporate procedures to address decommissioning of cyanide facilities in its overall site closure plan, or it may develop separate procedures for decommissioning and closing. The chosen strategy should address issues such as disposal of cyanide reagents, decontamination of equipment, rinsing of heaps and activities to prepare tailings storage facilities for closure, removal of water from pond surfaces or reduction of the cyanide concentration to a level protective of human health and wildlife, and the installation of any equipment necessary for long-term protection of ground and/or surface water quality during the facility's closure period. The plan should also include implementation schedules for each activity. The decommissioning strategy should be routinely reviewed and revised during the life of the operation to address changes in facilities or the development of new decommissioning technologies.

Standard of Practice 5.2
Establish an assurance mechanism capable of fully funding cyanide related decommissioning activities.

Guidance
A mining operation should develop an estimate of the cost to fully fund the cyanide-related decommissioning measures identified in its plan for site decommissioning or closure. The estimate should be based on the current cost for a third party to implement the identified decommissioning measures, and should be reviewed and updated at least every five years or when revisions are made that affect cyanide-related decommissioning activities.

An operation will be considered compliant with this Standard of Practice if it has met the financial assurance requirements imposed by the applicable political jurisdiction in an amount sufficient to cover its decommissioning costs as identified above.

In situations where there is no jurisdictional requirement for financial assurance for site decommissioning, an operation should establish an assurance mechanism capable of covering the costs of its cyanide-related decommissioning activities. One option is the establishment of a financial instrument, such as a bond, letter of credit or insurance in the amount estimated to be necessary for cyanide-related decommissioning activities. If the operation uses self-insurance or self-guarantee as its financial assurance, it must provide a statement by a qualified financial auditor that it has sufficient financial strength to fulfill this obligation as demonstrated by an accepted financial evaluation methodology such as those described in the U.S. Code of Federal Regulations at 40 CFR 264.143(f), 30 CFR 800.23, 10 CFR 30, Appendix A, or at Sections 13 through 20 of Ontario Regulations 240/00, Mineral Development and Closure, under Part VII of the Ontario Mining Act.

For additional information see:

- Strategic Framework for Mine Closure; Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia, 2000
- Best Practice Environmental Management In Mining, Rehabilitation and Revegetation; Environment Australia, June 1998
- Principles for Environmental Protection; The Engineering Design, Operation and Closure of Metalliferous, Diamond and Coal Residue Deposits; Volume 1/1979; Chamber of Mines of South Africa; March 1996

6. WORKER SAFETY Protect workers' health and safety from exposure to cyanide.

Standard of Practice 6.1
Identify potential exposure scenarios and take measures as necessary to eliminate, reduce and control them.

Guidance
Job functions and tasks should be evaluated to determine possible exposure scenarios and pathways. Process changes or engineering controls should be developed and implemented to eliminate these exposures and reduce or control them when they cannot be eliminated.

Operations should then develop and document procedures for performing cyanide-related tasks such as unloading, mixing, plant operations, entry into confined spaces, and equipment decontamination in a manner that minimizes worker exposures. These procedures should also address, where appropriate, the use of cyanide-specific personal protective equipment such as respirators, eye protection, protective gloves, coveralls or suits, pre-work inspections, emergency response, cyanide monitoring, communication and documentation. Personnel involved in cyanide management should be trained to handle cyanide in a manner that protects their safety and their co-workers' safety. Training should also include the proper use of equipment for personal protection, emergency rescue, and cyanide first aid.

Operations should also implement procedures to review any future proposed process or operational changes or modifications for their potential impact on worker health and safety, and to incorporate the necessary worker protection measures.

The workforce is a valuable source of information regarding where and how potential exposures can occur and how they can be managed. Worker input through safety meetings, suggestion boxes, or other methods should be factored into the development and evaluation of health and safety procedures.

Standard of Practice 6.2
Operate and monitor cyanide facilities to protect worker health and safety and periodically evaluate the effectiveness of health and safety measures.

Guidance
The pH of a solution containing cyanide significantly affects the amount of evolved hydrogen cyanide and the potential for workers to be exposed to toxic concentrations of hydrogen cyanide gas. In aqueous solution, the cyanide ion hydrolyzes to form hydrogen cyanide. At a pH of 9.3 - 9.5, the cyanide ion, and hydrogen cyanide are at equilibrium. Higher pH conditions result in greater concentrations of the cyanide ion. At a pH of 10.0, 88% will be in the form of the cyanide ion and when the pH is increased to 11.0, more than 99% will be in the ionic form. Below a pH of 9.3 - 9.5, hydrogen cyanide will be the predominant form of cyanide. While aqueous hydrogen cyanide is soluble in water, it volatilizes rapidly under the temperature and pressure conditions typically found in gold cyanidation operations. Therefore, maintaining process solutions at a sufficiently high pH is necessary to effectively prevent evolution of significant amounts of hydrogen cyanide gas. However, in high saline water or when processing certain ore types, solution chemistry limits how high the pH can be adjusted. Operations should evaluate their solutions to determine the appropriate pH for limiting the evolution of hydrogen cyanide gas, and develop operating procedures and controls to reduce risks to its workforce.

Process changes and engineering or administrative controls should be used to limit worker exposure to hydrogen cyanide gas and sodium and potassium cyanide to 10 parts per million (11 mg/m^3) as cyanide. This value is used by the United States Occupational Safety and Health Administration, the Australian National Occupational Health and Safety Commission, the South African Department of Minerals and Energy and the World Bank as an 8-hour time-weighted average, but is recommended as a ceiling or instantaneous limit. Additionally, workers should not be exposed to hydrogen cyanide gas and airborne sodium and potassium cyanide dust at concentrations exceeding 4.7 parts per million (5 mg/m^3) as cyanide for a period of 8 consecutive hours or more. This value is recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) as a Ceiling Limit and by the United States National Institute for Occupational Safety and Health (NIOSH) as a 15-minute short term exposure limit. Where the potential exists for significant worker exposure to hydrogen cyanide gas or sodium or potassium cyanide dust, the operation should monitor hydrogen cyanide concentrations with ambient and/or personal monitoring devices (either automatic or manual, passive or active) and evaluate the results to confirm that controls are adequate. Cyanide-specific personal protective equipment must be required in any areas and for any activities where process and engineering or administrative controls are not practicable or effective in limiting worker exposures to a maximum of 10 parts per million or where personnel are exposed to more than 4.7 parts per million for a continuous 8-hour period.

Cyanide monitoring equipment should be maintained, tested and calibrated as directed by the manufacturer, and records should be retained for at least one year. The need to monitor for hydrogen cyanide gas is increased in facilities where the solution chemistry is such that maintenance of a high pH in process solutions is difficult.

Warning signs should be placed where cyanide is used and should alert workers that cyanide is present, that smoking, open flames, eating and drinking are not allowed and that the necessary cyanide-specific personal protective equipment must be worn.

Showers, low-pressure eye wash stations and dry powder or non-acidic sodium bicarbonate fire extinguishers should be located at strategic locations throughout the operation where cyanide is present. This equipment should be maintained, inspected, and tested on a regular basis, and records should be retained.

Tanks and piping containing cyanide should be identified by color code, signs, labels, tags, decals or other means to alert workers of their contents. The direction of cyanide flow in pipes should also be labeled, marked or otherwise designated.

Material Safety Data Sheets (MSDS), first aid procedures and any other informational materials on cyanide safety should be written in the language of the workforce and should be available in areas where cyanide is managed.

All exposure incidents should be investigated and evaluated to determine if the operation's programs and procedures to protect worker health and safety, and to respond to cyanide exposures are adequate or if changes are necessary.

Standard of Practice 6.3
Develop and implement emergency response plans and procedures to respond to worker exposure to cyanide.

Guidance
Although every effort must be made to eliminate risks to workers from exposure to cyanide, operations must nonetheless be prepared for such exposures with effective response procedures and trained personnel. Cyanide first aid equipment including medical oxygen and a resuscitator must be on hand and inspected regularly to insure it is available when needed.

Antidotes for cyanide poisoning should be available at an operation. Preferred and permissible antidotes vary from country to country, and their selection at each operation must take local requirements into account. Intravenous antidotes such as sodium nitrite, sodium thiosulfate, cobalt edetate (Kelocyanor), and 4-dimethylaminophenol (DMAP) must only be administered by certified medical personnel. The antidote amyl nitrite is inhaled, and can be administered by trained non-medical personnel. However, all antidotes can themselves be harmful depending on the dose and the patient's overall health, and must be administered with great care and an understanding of the patient's pre-existing medical condition. Antidotes must be stored, tested and replaced as directed by their manufacturers.

Specific emergency response procedures should be developed to respond to cyanide exposure. Most cyanide producers have prepared detailed response procedures that can be adopted and implemented at mining operations. In general, procedures for responding to inhalation of cyanide gas or skin contact with liquid or gaseous cyanide should include the following elements:

1. Activate alarm or call for help to notify the appropriate site personnel (through alarms, radio, and telephone) so that medical assistance is available as soon as possible.
2. Call for assistance before responding to the emergency ("buddy-system"). Never try to rescue a cyanide victim on your own.
3. The responder must put on the personal protective equipment necessary to safely enter the area and come in contact with the exposed individual.
4. If possible, the responder must move the exposed individual to a safe area away from continued exposure. If removing the exposed individual from the area is not possible, the responder must attempt to prevent further exposure to the victim or seek assistance in moving the victim from the area of exposure.
5. All contaminated clothing must be removed from the exposed individual, and the exposed individual should be decontaminated by washing with water. Safety shower and eye wash stations using low-pressure water are recommended.
6. Oxygen must be administered, and medical help must be sought. Where authorized by the applicable jurisdiction, treatment with amyl nitrite is

recommended along with oxygen. A resuscitator should be used if the exposed individual is not breathing.

Medical opinions and accepted procedures vary with regard to first aid when ingestion of cyanide is suspected. In general, response to such exposure should include the following elements:

1. Notify the appropriate site personnel and put on personal protective equipment.
2. The exposed individual, when conscious, should spit or be made to vomit, and the mouth should be rinsed with water.
3. Continue with decontamination and administration of oxygen and amyl nitrite if permitted, or if the exposed individual is not breathing, a resuscitator should be used.
4. If the exposed individual is not conscious, or has impaired consciousness, treat with oxygen and amyl nitrite, if permitted.

Workers who may be called upon to respond to cyanide exposures must be trained in the operation's response procedures and should take part in routine drills to test and improve their response skills.

Operations must develop their own on-site capabilities to provide first aid and medical assistance to workers exposed to cyanide. This is especially important in remote areas where qualified medical personnel may be hours away. Where qualified off site medical facilities are locally available, the operation should develop procedures to transport exposed workers. Formalized arrangements should be made with local hospitals, clinics, etc. so providers are aware of the potential need to treat patients for cyanide exposure prior to incident. The medical facility should have qualified staff, equipment and expertise to be able to respond effectively. The operation may need to assist local medical providers with training and equipment to enhance its capabilities.

Mock emergency drills based on likely release/exposure scenarios should be conducted periodically to test response procedures. Lessons learned from the drills should be incorporated into response planning and other procedures.

For additional information see:

- Principles on Cyanide Management for Gold Mining, Chamber of Mines of South Africa, June 2001
- Best Practice Environmental Management In Mining, Cyanide Management; Environment Australia, June 1998

7. EMERGENCY RESPONSE ***Protect communities and the environment through the development of emergency response strategies and capabilities.***

Standard of Practice 7.1
Prepare detailed emergency response plans for potential cyanide releases.

Guidance
An Emergency Response Plan should be developed to address potential releases of cyanide requiring response. Although the Emergency Response Plan need not be specific to cyanide, these procedures should be formalized in a single document so that all necessary information is readily available. Operations should evaluate cyanide handling and management to determine how and where potential releases may occur and the potential impacts of such releases. The assessment may use a formal failure mode and effects methodology such as a Hazard and Operability Study (HAZOP), or a less formal process. In any case, it should consider the following failure scenarios appropriate for the nature of the operation's cyanide management activities and the site-specific environment, including weather conditions and anticipated seismic events:

1. Catastrophic release of hydrogen cyanide gas from cyanide storage, process or regeneration facilities,
2. Transportation accidents (for transporters or an operator who has assumed responsibility for any elements of transport under Standard of Practice 2.1),
3. Releases during unloading and mixing,
4. Releases during fires and explosions,
5. Pipe, valve and tank ruptures,
6. Overtopping of ponds and impoundments,
7. Power outages and pump failures,
8. Uncontrolled seepage,
9. Failure of cyanide treatment, destruction or recovery systems,
10. Failure of tailings impoundments, heap leach and other cyanide facilities.

Plans for transportation-related emergencies should consider the transportation route, the physical and chemical form of the cyanide, method of transport (e.g., rail, truck), the condition of the road or railway, and the design of the transport vehicle (e.g., single or double walled, top or bottom unloading).

The Plan should describe specific response actions, as appropriate for the emergency situations. These include clearing personnel and potentially affected communities from the area of exposure, notifying operational management and response personnel, use of cyanide antidotes and first aid measures, controlling releases at their source, containment of releases, assessment of the release and mitigation, procedures to examine the cause of the release, and implementation of measures to prevent its reoccurrence.

Due to its remote location, a mining operation may be the closest emergency responder in the event of a cyanide emergency at another mine or during cyanide transport. Although not an auditable Code requirement, it is a good practice for operations to enter into mutual aid agreements with other mines or entities located nearby or on its cyanide transport routes.

Standard of Practice 7.2
Involve site personnel and stakeholders in the planning process.

Guidance
The workforce and off-site stakeholders, including potentially affected communities, should be included in the emergency response planning process. The workforce can provide significant input in the identification of potential failure and release scenarios and response capabilities. Potentially affected communities should be made aware of the nature of the risks associated with cyanide and should be consulted regarding communication and response actions. It is especially important that the operation involve communities when the community has a role in the response action, such as when an evacuation may be necessary. The community may be involved directly through contact with potentially affected individuals or groups, or by contact with community leaders or representatives, depending on the nature of failure and effects scenarios.

Local response agencies such as outside responders and medical facilities in the community may be able to assist in a cyanide-related emergency. Their input should be solicited as appropriate to their capabilities and potential role in response actions.

Regular consultation or communication with the local community or its representatives should also be conducted as necessary to assure that the Plan addresses current conditions and risks.

Standard of Practice 7.3
Designate appropriate personnel and commit necessary equipment and resources for emergency response.

Guidance
The following actions and procedures should be implemented:

1. Primary and alternate emergency response coordinators should be designated.
2. The coordinator should have explicit authority to commit the resources necessary to implement the Plan.
3. Emergency response teams should be identified and appropriately trained and prepared.
4. The Emergency Response Plan should include call-out procedures and 24- hour contact information for the coordinators and response team members.
5. The duties and responsibilities of the coordinators and team members should be specified.

The Plan should identify all emergency response equipment available during transport of cyanide along transportation routes and/or on-site, including personal protective equipment. Procedures should be included to inspect this equipment regularly so that it will be available when required.

The Plan should describe the functions and responsibilities of outside responders, such as medical facilities and include necessary contact information. The operation should confirm that all outside entities included in the Emergency Response Plan are aware of their involvement and are included as necessary in mock drills or implementation exercises conducted by the operation.

Standard of Practice 7.4
Develop procedures for internal and external emergency notification and reporting.

Guidance
The Plan should include procedures with up-to-date contact information for notifying management, regulatory agencies, community leaders, outside response providers and medical facilities of an emergency. Procedures and contact information should be included for notifying potentially affected communities of the incident and/or response measures and for communication with the media. Communities may have responsibility for their own protection in terms of evacuations or avoidance of contaminated water. If appropriate, a back-up contingency communication system should be considered.

Standard of Practice 7.5
Incorporate into response plans monitoring elements and remediation measures that account for the additional hazards of using cyanide treatment chemicals.

Guidance
The Plan should describe specific remediation measures including procedures for the recovery or treatment of solutions or solids, decontamination of soils or other contaminated media and management and/or disposal of spill clean-up debris. Where a cyanide release could contaminate sources of drinking water, the Plan should provide for an alternate drinking water supply.

The two major chemical treatment methods used to remediate cyanide in the environment are oxidation (using chemicals such as sodium hypochlorite and hydrogen peroxide or biological treatment) and complexation (using ferrous sulfate). Although both can be effective in reducing the impacts of cyanide released onto the land, it must be recognized that there are no safe and effective options to treat cyanide once it has entered natural surface waters such as streams and lakes.

Sodium hypochlorite and ferrous sulfate must never be used to treat cyanide that has been released into natural surface water bodies. Both of these chemicals are toxic to aquatic life. Treatment with sodium hypochlorite can produce cyanogen chloride ($ClCN$), which is hazardous to humans and aquatic life. Moreover, these chemicals have very limited effectiveness in treating cyanide at the pH of natural surface waters. Their utility is further reduced by the practical difficulty of adding them to surface water in a manner that allows for adequate contact and mixing with a cyanide plume, especially in a flowing stream or river. Although hydrogen peroxide is a less toxic and persistent oxidant than sodium hypochlorite, it is also harmful to aquatic life and its effectiveness is similarly limited by the lack of a means to mix it with the cyanide.

Given the recognized adverse impacts to aquatic life and the limited effectiveness of using sodium hypochlorite, hydrogen peroxide and ferrous sulfate to treat cyanide released to surface waters, it is difficult to identify any situation where such a procedure would be acceptable. However, use of these chemicals may be appropriate in a sufficiently well defined and controlled situation where three conditions are met:

1. First, there must be a method to introduce the chemical into the water that ensures adequate mixing with a cyanide plume.
2. Second, effective treatment of the cyanide must be demonstrated at the pH of the surface water.
3. Third, the inevitable adverse impacts to aquatic life must have been considered and determined to be necessary in order to prevent human mortality. This implies that the technique has been fully evaluated prior to its use rather than done as an ad hoc response to an emergency. However, it must be recognized under Standard of Practice 7.4, an operation should develop an emergency notification procedure capable of providing sufficient warning to potentially affected individuals and communities to prevent contact with or ingestion of contaminated surface water.

Both sodium hypochlorite and ferrous sulfate can be used to treat releases of cyanide to land. Ferrous sulfate binds cyanide in an insoluble complex but does not chemically convert it to a less toxic substance. The complex formed is susceptible to photo-decomposition and can release cyanide back to the environment if it is not properly managed. Application of hypochlorite to neutralize a cyanide spill on land will oxidize the cyanide to the less toxic cyanate, which breaks down to ammonia and carbon dioxide. Hypochlorite and ferrous sulfate both must be used carefully to avoid their introduction into aquatic systems, and soil contaminated with these chemicals should be excavated and disposed of in compliance with the Code and applicable requirements (i.e., with mill tailings or on a leach pad). Biological treatment of contaminated soil is also possible but is much slower than chemical treatment.

The Plan should also address the potential need for environmental monitoring to identify the extent and effects of a release and mitigation. Sampling methodologies and parameters should be established in the Plan for a rapid evaluation of the consequences of the release. Where practical, possible sampling locations should be established.

Although it may not be possible to detail all remediation and monitoring actions in advance of an actual release, the Plan should include sufficient information to provide a basis for decision-making during an emergency.

Standard of Practice 7.6
Periodically evaluate response procedures and capabilities and revise them as needed.

Guidance
The Emergency Response Plan should include provisions for reviewing and evaluating its adequacy on a regular basis. Mock emergency drills reflecting the most likely incidents identified through the failure mode analysis should also be periodically used to test and evaluate the adequacy of the Plan. Drills can simulate a full-scale emergency situation or selectively isolate some aspect of the Plan. Including the potentially affected community in a simulation can enhance the benefits of the exercise, by creating a more realistic

event, testing the public's response, and allowing participants to become familiar with operations and response personnel.

The Plan also should be evaluated after any emergency requiring implementation. When a review or simulation has identified deficiencies, the Plan should be revised as soon as possible to insure its proper functioning.

For additional information see:

- Awareness and Preparedness for Emergencies at Local Level for Mining (APELL for Mining); United Nations Environmental Programme, Technical Report No.41 May 2001
- Principles for Dealing with Distribution Incidents Involving Alkali Cyanides; European Chemical Industry Council (CEFIC) Cyanide Sector Group, October 2000
- APELL Annotated Bibliography, United Nations Environmental Programme, Technical Report No.21, 1994
- Hazard Identification and Evaluation in a Local Community, UNEP, Technical Report 12, 1992
- Integrated Contingency Plan Outline, U. S. Federal Register, 61 FR 28649

8. TRAINING Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.

Standard of Practice 8.1
Train workers to understand the hazards associated with cyanide use.

Guidance
All personnel who may encounter cyanide must be trained on its inherent hazards. This training should include recognition of cyanide materials at the operation, information regarding the health effects of cyanide, symptoms of cyanide exposure, and procedures to follow in the event of exposure. Material Safety Data Sheets or other informational materials written in the language of the workforce are useful for this purpose. Re-training should be conducted periodically, and records of training should be retained.

Standard of Practice 8.2
Train appropriate personnel to operate the facility according to systems and procedures that protect human health, the community and the environment.

Guidance
Health, safety and environmental components are intrinsic to task training and should be considered part of each worker's responsibility. Each job position involving cyanide management should be evaluated to identify how the required tasks can be accomplished with minimum risk to worker health and safety and in a manner that prevents unplanned cyanide releases. The training elements necessary for each job should be identified in training materials. Personnel in these positions, including personnel involved in unloading and storage of cyanide, plant operators, tailings storage facility operators,

maintenance personnel and the environmental and management staff should be trained in the procedures, as appropriate to their job functions. Training should be provided by appropriately qualified personnel, and may include outside trainers for specialized areas such as environmental regulatory programs, and the operation's own staff.

Training must be provided prior to employees working with cyanide. Refresher training should be conducted regularly to insure that employees continue to perform their jobs in a safe and environmentally protective manner. Testing or observation to insure that employees conduct their activities in compliance with cyanide operating procedures should be used to evaluate the effectiveness of all training.

Records documenting employee training should be retained throughout an individual's employment, and should include the names of the employee and the trainer, the date of training, the topics covered, and if the employee demonstrated an understanding of the training materials.

Standard of Practice 8.3
Train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.

Guidance
All personnel involved in cyanide management should be trained in emergency cyanide release procedures, including notification of the appropriate site personnel, insuring worker safety, and stopping or containing the release.

Site personnel who may be called upon to respond to worker exposure to cyanide must be trained in decontamination and first aid procedures. This training should include the procedure for notifying appropriate site personnel and stress that the responder must first insure his own protection through use of cyanide-specific personal protective equipment.

Personnel acting as Emergency Response Coordinators and members of the Emergency Response Team should receive specialized training. Responders must be thoroughly familiar with the procedures included in the Emergency Response Plan, including the use of response equipment. Communities, local responders and medical providers included in the operation's Emergency Response Plan should be made familiar with the Plan and their responsibilities.

Records should be retained documenting all training on responses to cyanide exposures and releases, including the names of the employee and the trainer, date of training, topics covered, and how the employee demonstrated an understanding of the training materials. Refresher training should be conducted regularly.

Emergency drills simulating worker exposures and environmental releases are important training tools; these drills should be conducted periodically to provide hands-on training for the workers involved. Drills should be evaluated from a training perspective to determine if personnel have the knowledge and skills required for effective response, and training procedures should be revised if deficiencies are identified.

For additional information see:

- Principles on Cyanide Management for Gold Mining, Chamber of Mines of South Africa, June 2001
- Best Practice Environmental Management In Mining, Planning a Workforce Environmental Awareness Training Program; Environment Australia, June 1998

9. DIALOGUE Engage in public consultation and disclosure.

Standard of Practice 9.1
Provide stakeholders the opportunity to communicate issues of concern.

Guidance
Operations should provide the opportunity for stakeholders to communicate issues of concern. In order for the communication to be meaningful and productive, the frequency and format for this input should be appropriate for the issues discussed and the nature of the concern. Methods to foster public input include open public meetings, creation of citizens' advisory panels and site tours for interested parties. Opportunities for public input are also available during the development and review of environmental assessments, or reviews of permits and licenses required by applicable jurisdictions.

Standard of Practice 9.2
Initiate dialogue describing cyanide management procedures and responsively address identified concerns.

Guidance
Operations should create opportunities to engage concerned stakeholders and address their issues in a direct and responsive manner. Information regarding the operation's practices and procedures should be available to demonstrate that cyanide is managed responsibly and that the operation takes measures to improve cyanide management when deficiencies arise. Some of this dialogue may occur as part of a jurisdiction's environmental review, permitting or licensing process.

Standard of Practice 9.3
Make appropriate operational and environmental information regarding cyanide management available to stakeholders.

Guidance
It is important that stakeholders understand how mining operations manage cyanide to protect human health and safety and the environment. Operations should develop written descriptions of cyanide management activities in appropriate local languages, and make these descriptions available to communities and stakeholders. This information can be disseminated through brochures, newsletters or other educational materials at the operation or at locations in local communities, at public forums or meetings, libraries, local government offices, on websites, or through other means. Where a significant

percentage of the local populations are illiterate, operations should provide information through presentations or direct, regular consultations with community leaders.

Operations should also make available information on confirmed releases or exposures involving: a) incidents of cyanide exposure resulting in hospitalization or fatality; b) incidents where releases off the mine site required response or remediation; c) incidents where a release on or off the mine site results in significant adverse effects to health or the environment; d) incidents where a release on or off the mine site required reporting under applicable regulations; and e) releases that caused exceedances of applicable limits for cyanide. This information can be included in a company's Annual Report, its Health, Safety and Environmental report, its verification audit report, posted on a company website, reported as part of applicable governmental reporting requirements, or through other means.

For additional information see:

- United Nations Environment Programme. *Companies' Organization and Public Communication on Environmental Issue.* Technical Report No. 6. 1991.