



Ricardo
Energy & Environment

ICMC Tarkwa Gold Mine Recertification Summary Audit Report

Summary Audit Report

Report for Gold Fields Ghana Ltd

Customer:

Gold Fields Ghana Ltd

Customer reference:

ICMI Audit Tarkwa Gold Mine

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1 Summary Audit Report for Gold Mining Operations

Name of Cyanide User Facility:	Gold Fields Tarkwa Plant
Name of Cyanide User Facility Owner:	Gold Fields Ghana Limited
Name of Cyanide User Facility Operator:	Gold Fields Ghana Limited
Name of Responsible Manager:	Henry Atakora, Metallurgical Manager
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2 Location Detail and Description of Operation

Tarkwa Gold Mine, is majority owned and operated by Goldfields Ghana Limited (90%) and the Ghanaian Government (10%). It is situated in the Western Region of Ghana, approximately 350 km by road from the capital, Accra. Site conditions are tropical with annual rainfall of approximately 2,000 mm and temperature ranging between 25°C and 35°C.

In June 1993 the Government of Ghana entered into an agreement with Gold Fields Ghana for the operation of the mine by Gold Fields Ghana Limited (GFGL) under a management contract. Goldfields Ghana Limited developed a heap leach surface mining operation. The initial development, Tarkwa Phase 1, was completed in April 1998 processing 4.7 million tonnes per annum (Mtpa) heap leach feed ore. An expansion, Phase 2, was completed in July 1999 increasing ore production to the heap leach to 7.2Mtpa. Process improvements and optimisations resulted in the throughput increasing to 9.4Mtpa. In August 2000, GFGL acquired the northern part of the Teberebie lease.

These facilities increased ore production to the heap leach to 16Mtpa. The north heap leach has had a number of pad expansions, the latest Phase 5, to enable current production capacity to be sustained.

Cyanide addition ceased on the south heap leach in October 2012 with leaching continuing for a period thereafter. The south heap leach has been decommissioned. The north heap leach cyanide addition ceased in September 2014. The mixing facility for the north heap leach has since been decommissioned.

The Tarkwa Carbon in Leach (CIL) plant was commissioned in October 2004 and utilised a single semi-autogenous grinding (SAG) mill, designed to mill 4.2 mtpa (525 tonnes per hour). Through the



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installation of a Ball Mill, along with additional upstream and downstream equipment, the plant has now been expanded to 12 mtpa (1,500 tonnes per hour).

The CIL circuit consists of two trains of eight tanks in series fed from a common leach tank. The loaded carbon passes into a 15 tonne acid wash column. The gold is recovered from the loaded carbon in two 15 tonne elution circuits. Gold is recovered from solution by electrowinning and smelted in the CIL smelt house in an induction furnace.

Tailings from the plant is deposited on the Tarkwa tailings storage facilities (TSF's), which are paddock type impoundments located approximately 3.0 km north west of CIL plant site and immediately due south of the existing north leach pads. The Tailings Facility is comprised of TSF 1,2,3 and 5. TSF 5 was commissioned in 2018 but at the time of the recertification audit was not being used for the active deposition of tailings.

All of the ore is now processed through the CIL. In 2018 a new gravity separation system was installed at the Plant due to the amount of coarse gold in the ore being supplied to the Plant. This includes a Knelson concentrator as part of an Inline Leach Reactor. The gravity separation system was commissioned in August 2018.



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SUMMARY AUDIT REPORT**AUDITORS FINDINGS**

	<input checked="" type="checkbox"/> in full compliance with	The International Cyanide Management Code
Goldfields Tarkwa Gold Plant is:	<input type="checkbox"/> in substantial compliance with	
	<input type="checkbox"/> not in compliance with	
Audit Company:	Ricardo-AEA Ltd	
Audit Team Leader:	Ed Perry, Lead Auditor	
Email:	ed.perry@ricardo.com	

There has been one cyanide incident since the last recertification audit. This incident occurred on the 8th December 2017. There was a fish kill in an isolated wetland, wholly within the mine owned area, adjacent to the toe drain for TSF2.

The Environmental Incident and Investigation Report, 9 December 2017 indicated that after an investigation it was discovered that there was a trench along the TSF2 embankment, which had been dug for the TSF pipe as part of a previous wall raise but had not been subsequently filled. This then served as a pathway for seepage from TSF2 into the adjacent wetland.

The only remediation undertaken was the removal and burial of the dead fish. Following diversion of the seepage from TSF2 the cyanide in the wetland was allowed to naturally reduced to background levels over a period of 5 days.

This incident has led to an additional trench being constructed at the base of the TSF embankment to divert any seepage from entering the wetland. This is diverted to a sump and pumped back to the TSF.

This incident was reported to the Environmental Protection Agency and the Minerals Commission in Ghana. No regulatory action has been taken as the incident was wholly contained within mine owned and controlled land.

The inspection records since the last recertification audit were observed and this was the only wildlife incident associated with cyanide. This was also verified with personnel interviews as well as a review of all the environmental department reports issued following a record of wildlife mortality.

NAME OF OTHER AUDITORS

Marie Schlechter, ICMI pre-certified Mine Technical Specialist

DATES OF AUDIT

The Re-certification Audit was undertaken between 27 August 2018 and 30 August 2018.



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I attest that I meet the criteria for knowledge, experience and conflict of interest for Code Verification Audit Team Leader, established by the International Cyanide Management Institute and that all members of the audit team meet the applicable criteria established by the International Cyanide Management Institute for Code Verification Auditors.

I attest that this Summary Audit Report accurately describes the findings of the verification audit. I further attest that the verification audit was conducted in a professional manner in accordance with the International Cyanide Management Code Verification Protocol for Gold Mine Operations and using standard and accepted practices for health, safety and environmental audits.

The "International Cyanide Management Code For The Manufacture, Transport, And Use Of Cyanide In The Production Of Gold and Silver" (the Code) was developed by a multi-stakeholder Steering Committee under the guidance of the United Nations Environmental Program (UNEP) and the then, International Council on Metals and the Environment.

The Code is a voluntary industry programme for gold mining companies, and companies involved with the production and transport of cyanide to gold and silver mining companies; it focuses exclusively on the safe management of cyanide. Companies that adopt the Code must have their operations, which manufacture cyanide, transport cyanide or use cyanide to recover gold and silver, audited by an independent third party to determine the status of the Code's implementation. Those operations that meet the Code's requirements can be certified and are able to use a unique trademark symbol, which identifies the company as a certified operation. Audit results are made public to inform stakeholders of the status of cyanide management practices at the certified operation.

The objective of the Code is to improve the management of cyanide used in gold and silver mining and assist in the protection of human health and the reduction of environmental impacts (refer to www.cyanidecode.org). The Code is managed by the International Cyanide Management Institute (ICMI).



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Principle 1 – Production

ENCOURAGE RESPONSIBLE CYANIDE MANUFACTURING BY PURCHASING FROM MANUFACTURERS THAT 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.

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 1.1

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 1.1 to 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.

Orica International PTE Ltd's (Orica) West Africa Supply Chain (recertified 3 April 2008) covers the transportation of solid sodium cyanide from the Yarwun production facility (recertified 22 February 2017) to the Port of Brisbane (Australia) and from there via the Mediterranean Shipping Company to the Ports of Tema and Takoradi (Ghana), Conakry (Guinea), Dakar (Senegal), Nouakchott (Mauritania). Cyanide is then transported by road to various mine sites within West Africa by Code certified transporters. Within Ghana, some solid sodium cyanide is transported from the Port of Takoradi by road to Orica's Tarkwa cyanide transfer facility, with subsequent road transportation to various mine sites within West Africa by Code certified transporters.

Samsung C&T Deutschland GmbH is an independent distributor of cyanide sourcing sodium cyanide briquettes from certified producers - Tongshuh production facility (recertified 23 March 2017) or TaeKwang production facility (recertified 19 June 2017). Samsung Africa Supply Chain (recertified 30 January 2018) includes the Port of Pusan, South Korea, ocean transport by shipping companies MSC, Maersk and Safmarine, the Ports of Takoradi and Tema in Ghana, Conakry in Guinea, Dakar in Senegal, and Mombasa in Kenya, and Dar-es-Salaam in Tanzania, with subsequent road transportation to various mine sites by Code certified transporters.



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Principle 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.

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 2.1

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 2.1 to establish clear lines of responsibility for safety, security release prevention, training and emergency response in written agreements with producers, distributors and transporters.

The contracts with Orica International PTE Ltd and Samsung C&T Deutschland GmbH includes transportation and the delivery of the cyanide to the mine site. They both use subcontractors for the transportation of solid cyanide, from the ports of Takoradi and Tema respectively. Orica currently uses Stellar Logistics (certified on 14 April 2015 and recertified on 9 August 2018) for the transport of solid cyanide and Samsung uses Vehrad Transport and Haulage Limited (initially certified on 14 July 2008, with the latest recertification on 8 January 2018).

Both contracts with Orica and Samsung state in Appendix D that all third parties engaged by Orica for the manufacture, transport and use of cyanide will be a signatory to and comply with the requirements of the International Cyanide Code.

The operation has chain of custody records identifying all elements of the supply chain that handle the cyanide brought to its site.

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 2.2

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 2.2 to require that cyanide transporters implement appropriate emergency response plans and capabilities and employ adequate measures for cyanide management.

The contracts with Orica International PTE Ltd and Samsung C&T Deutschland GmbH includes transportation and the delivery of the cyanide to the mine site. They both use subcontractors for the



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transportation of solid cyanide, from the ports of Takoradi and Tema respectively. Orica currently uses Stellar Logistics (certified on 14 April 2015 and recertified on 9 August 2018) for the transport of solid cyanide and Samsung uses Vehrad Transport and Haulage Limited (initially certified on 14 July 2008, with the latest recertification on 8 January 2018).

Both contracts with Orica and Samsung state in Appendix D that all third parties engaged by Orica for the manufacture, transport and use of cyanide will be a signatory to and comply with the requirements of the International Cyanide Code.

The operation has chain of custody records identifying all elements of the supply chain that handle the cyanide brought to its site.



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Principle 3 – Handling and Storage

PROTECT WORKERS AND THE ENVIRONMENT DURING HANDLING AND STORAGE

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 3.1**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 3.1 to design and construct unloading, storage and mixing facilities consistent with sound accepted engineering practices, quality control/quality assurance procedures, spill prevention and spill containment measures.

The facilities for unloading storing and mixing solid cyanide (only solid cyanide is used) have been professionally designed and constructed, as highlighted in the previous recertification report. Since the last recertification audit, the cyanide mixing and storage tanks in the external reagent area have been replaced with fibreglass tanks.

All other documents regarding the CIL reagent area that were reviewed as part of the previous verification and recertification audit process are relevant.

It was confirmed during the site inspection that the CIL external reagent area (solid cyanide mixing tank) as well as dosing tank in the CIL area are located away from people and surface water. Both areas are located within a locked fenced area, and there is no surface water present in the vicinity of these areas. These areas are equipped with outer drain channels that report to the CIL plant sumps.

The external reagent mixing tank is controlled from the Plant Control Room. In addition, there is an automated cut off when the tank reached the 90% full point. The CIL dosing tank within the Plant cannot be filled from the mixing tank before it gets down to 40%, which allows the mixing tank to be pumped into the dosing tank without overflowing. There is an added safety mechanism in that the tank has an automatic cut off at the 85% fill point. In addition, the valves are automatically closed to prevent any syphoning.

Testing and maintenance of the automated cut-off instrumentation installed on the cyanide mixing and dosing tanks is undertaken through the SAP System for planned and preventative maintenance.

Site inspection verified that the mixing tank in the external reagents area as well as the dosing tank in the CIL area, are on a concrete slab in a concrete bunded area overlain by chemical resistant bricks, providing a competent barrier to leakage and prevent seepage to the subsurface.

The solid cyanide boxes are stored in the external reagents area in a shed, under a roof, on a concrete surface and on wooden pallets, with two open sides providing adequate ventilation. The cyanide boxes are stored separately from incompatible material, within a bunded secondary containment equipped with sump and sump pump



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The external reagents area where the cyanide boxes are stored and the mixing is carried out is located within a fenced and locked area with clear signage indicating that cyanide is stored in the area. There is also a security gate with guards 24 hours a day to control vehicle access prior to entrance into the reagents area. This is within the wider mine site that is also access controlled.

The cyanide mixing and dosing tanks are also located separately from any incompatible material, within their own secondary containment equipped with sump and sump pump. Both the mixing tank in the external reagents area and the storage tank in the CIL area are equipped with ventilation pipes.

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 3.2**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 3.2 to operate unloading storage and mixing facilities using inspections, preventative maintenance and contingency plans to prevent or contain releases and control and respond to worker exposures.

The empty containers are kept inside the cyanide storage area, before being securely placed back in the original sea container in which they were delivered. Stella Logistics collects the sea containers on behalf of Orica and Samsung, transporting it to the Orica local warehouse. Orica then transports the containers to the, EPA licenced, Vehrad yard in Tema for incineration.

The procedures as well as visual inspection shows that no containers are being used for any purposes than holding cyanide. No washing takes place on Site. No drums are used on site for cyanide containment.

The operation has developed and implemented plans or procedures to: prevent exposures and releases during cyanide unloading and mixing activities; handle cyanide containers without rupturing or puncturing; and for the timely clean-up of any spills during mixing.

The auditors reviewed a set of relevant procedures and visually witnessed a mixing event, checking the implementation of the procedure by the operator performing the mixing task, as well as interview of the operators performing the mixing. These include stipulating the required Personal Protective Equipment (PPE), the role of a buddy, and stating that the stacking height is limited to 2 containers high, as detailed in the procedures.



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Principle 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 preventative maintenance procedures.

in full compliance with

The operation is in substantial compliance with **Standard of Practice 4.1**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.1 to implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventative maintenance procedures.

Written management and operating plans or procedures have been developed for cyanide facilities including unloading, mixing and storage facilities, and tailings impoundments.

Tarkwa Gold Mine has developed a number of procedures for the operation of cyanide facilities including general cyanide safety and handling procedures, CIL plant procedures, TSF procedures and water treatment procedures. There are 28 general cyanide procedures, and 239 other procedures.

All the reviewed procedures have been developed adequately and are being revised on a regular basis (every 3 years or as appropriate if any changes in process occurs). The procedures detail special requirements, PPE, specific tools for the job, task methodology, including potential hazards and general notes.

The operation has a number of procedures identifying assumptions and parameters for design and operation of the cyanide facilities including the following:

Cyanide Emergency Response Plan, TGM 3 0 038 PR, Rev 05, 22 April 2017 states that the pH must be 10 or above in the process area. Procedure TGM 3 9 63 11 PR, Rev 4, 10 May 2017 - Process water balance management refers to freeboard >1.5m. Procedure TGM 3 0 023 PR, Rev 06, 22 April 2017 - Weak acid dissociable cyanide sampling and management states special measures in case where Weak Acid Dissociable (WAD) cyanide would exceed 50mg/l. Procedure TGM 3 9 48 05 PR, Rev 04, 12 05 2017 - TSF Process and underdrain water states that any seepage >50 ppm WAD Cyanide at the TSF area should be contained, pumped back, and /or detoxified.

Gold Fields Ghana Limited Tarkwa Gold Mine Tailings Storage Facility Operations Manual, Ref. 188/2, June 2004, Knight Piesold Ghana Limited. (TSF1, TSF 2, TSF3). GoldFields Ghana Limited Tarkwa Gold Project - Tailings Storage Facility 5 Operation, Maintenance & Surveillance Manual, June 2018, Knight Piesold Consulting. The TSF manuals require a freeboard of 1.5m and stipulate the requirement to contain a 1:100 year - 24 hours storm event, 274 mm.



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Tarkwa Gold Mine is operating with a number of inspections and checklists, as well as preventive maintenance activities describing the standards and practices necessary for the sound operation of the cyanide facilities, including the specific measures needed for compliance with the Code.

This includes: daily, weekly and quarterly inspections for the TSFs; daily and monthly inspections for the Plant; annual thickness inspections for storage tanks; monthly inspections and annual service of fire extinguishers. Two yearly inspection of the plant including thickness testing by the Inspectorate Division of the Minerals Commission.

Cyanide Internal and External Reagent Areas and Emergency Rooms, inspections include: checks for safety showers, integrity of bunds, Material Safety Data Sheet (MSDS) Sheet, leaking valves, pumps or pipes, signs of seepage, man down alarm, Hydrogen Cyanide (HCN) fixed monitors, emergency equipment and antidote kits.

TSF daily, weekly and monthly inspections are undertaken for the tailings distribution and decant return water pipelines.

Freeboard at the tailings dam and pond are measured on a daily basis. The spreadsheet records pond levels, beach levels, pool distance, underdrain, clarifier and toe sump levels. There are also stormwater trenches to direct runoff away from the TSFs, which are checked on a daily basis.

SAP System is used for planned and preventive maintenance as well as for corrective maintenance. Most of the equipment is on a monthly schedule of preventive maintenance, but variations may occur depending of the equipment. In the SAP system all activities undertaken are documented electronically, which was observed by the auditors. SAP Project Portfolio Management Software (PPMS) system covers scheduled maintenance for all pumps, pipes and valves. Random checks of this was undertaken over the recertification period.

The operation inspects cyanide facilities on an established frequency sufficient to assure and document that they are functioning within design.

The inspections are documented, including the date of the inspection, the name of the inspector, and any observed deficiencies; the nature and date of corrective actions and records are retained.

The operation has a procedure to identify when changes in a site's processes or operating practices may increase the potential for the release of cyanide and to incorporate the necessary release prevention measures.

There is a Change Management Procedure for the mine TGM 9 14 PR Rev.3, dated 15 March 2017. The procedure details the change management process used at Tarkwa Gold Mine to ensure a structured approach is applied to the management of change on site and information relating to changes to our business is communicated to all interested and affected parties.

A Change Committee is put together with representatives from all affected services disciplines and will be involved during the risk assessment process, these will include Protection Services, Health and Safety, Environment, Finance, Information Technology (IT), Engineering, etc. The Change Committee Chairman signs off the Change Management documentation on behalf of the Change Committee.

There are a number of procedures in place for contingencies situations such as upset in TSF water balance, temporary closure, or when inspections or monitoring identifies a problem, and the following procedures were reviewed.



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Procedure TGM 3 9 63 11 PR, Rev 04, 01 May 2017 - TSF Process Water Balance Management and TGM 3 9 48 04 PR, Rev 06, 24 August 2018 - Tailings Storage Facility Contingency Plan and procedure are indicating what to do when there is an upset in the facility water balance.

Procedure TGM 3 9 40 02 PR, Rev 07, 15 June 2018; CIL Train 1 Circuit shutdown and TGM 3 9 41 02 PR CIL, Rev 07, 15 June 2018 - Train 2 Circuit shutdown for the shutdown of the CIL circuit, showing that temporary closure /shutdown are being considered and planned for as part of normal operation.

Three generators provide 3.8MW. When the power is interrupted the mill valves open automatically and drain to the 'swimming pool'. This was observed during the site visit and it was confirmed that the 'swimming pool' is able to contain the content of both mills.

The cyanide pipeline has a non-return valve and will remain in the pipeline in the event of a power failure.

The generators are tested weekly and maintenance is undertaken as required. This is managed through the preventative maintenance on the SAP system.

Standard of Practice 4.2: Introduce management and operating systems to minimise cyanide use, thereby limiting concentrations of cyanide in mill tailings.

in full compliance with

The operation is in substantial compliance with **Standard of Practice 4.2**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.2; introducing management and operating systems to minimise cyanide use, thereby limiting concentrations of cyanide in mill tailings.

The operation conducts a program to determine appropriate cyanide addition rates in the mill and evaluate and adjust addition rates as necessary when ore types or processing practices change cyanide requirements.

The cyanide reduction programme consists of having a set point, monitoring cyanide content, and undertaking cyanide addition control via the TAC 2000 analyser.

The remaining grade in the tails are compared with the head grade, which informs the increase or decrease required in the setpoint.

Bottle roll test and external testing is used to determine the solid losses in the plant (gold still locked up in the ore). Gold reconciliation is used to determine the percentage recovery.

Cyanide addition control and analyse is undertaken with TAC 2000 and Manta cube software to control the addition, with measurement taken every 10 mins. The TAC 2000 performs an automatic titration.

In addition, manual titration is undertaken by the technical department (3 times per shift, every 4 hours). Titration is undertaken on the common tank.

The quantity of coarse gold in the ore has been increasing which has caused the set point to be increased and the WAD levels to increase causing the WAD levels in the tailings to be greater than 50



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mg/l. This has meant that a cyanide destruction system has been implemented using hydrogen peroxide to reduce the WAD cyanide levels leaving the Plant to acceptable levels.

The control strategy was therefore reviewed, and tests undertaken to determine the level of gravity recoverable gold. This determined there were sufficient levels to justify the installation of a new gravity separation system including a new inline leach reactor. This extracts the coarse gold reducing levels of cyanide allowing the WAD levels in the tailing to be reduced.

Standard of Practice 4.3: Implement a comprehensive water management programme to protect against unintentional releases.

in full compliance with

The operation is in substantial compliance with **Standard of Practice 4.3**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.3 to implement a comprehensive water management programme to protect against unintentional releases.

The operation has developed a comprehensive, probabilistic water balance.

The Tarkwa Gold Mine site wide water balance was initially prepared by Knight Piésold using the Goldsim software. Goldsim, the software used for the water balance is a probabilistic software as it allows the inclusion of variability for the water balance parameters, such as precipitation, deposition rates, changes in areas with changes in facility geometry, etc. Monte Carlo simulation can also be undertaken to derive probability of occurrence for some specific chosen events.

The Water Balance includes the following:

- solution application rates for heap leach;
- tailings deposition rates;
- precipitation, evaporation and seepage rates (including 1 in 100 year 24 hour storm event);
- undiverted runoff from external catchment areas;
- potential power outages; and
- the capacity and availability of treatment system for surface discharges.

The Water Balance was updated in August 2018 by SRK to exclude the heap leach's, which have been decommissioned, and to include TSF5.

The operating procedures incorporate inspection and monitoring activities to implement the water balance and prevent overtopping of ponds and impoundments and unplanned discharge of cyanide solutions to the environment including: daily inspections recording pond levels, beach level, pool distance, underdrain, clarifier, and toe sumps; annual report recording milled tonnes, raw water return, TSF return, total water demand, and extra water stored.

Ponds and impoundments are designed and operated with adequate freeboard above the maximum design storage capacity determined to be necessary from water balance calculations. All TSF are operated with a freeboard of 1.5 m as stated in the operational manual, and the raise design and construction reports.



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The operation measures precipitation, compares the results to design assumptions and revises operating practices as necessary. The site weather station is located at the north heap leach area and is used as a regular input into the water balance model. This is compared to the daily inspection of the TSF and ponds as ground truthing of the water balance.

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 4.4**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.4 to implement measures to protect birds, other wildlife and livestock from adverse effects of cyanide process solutions

The operation has attempted to maintain the WAD cyanide levels in all open waters below 50 mg/l.

Weekly WAD cyanide sampling was undertaken at the spigot with the following results being observed.

2015 – there were 13 exceedances with the highest being 92.4 mg/L WAD on 7 January 2015;

2016 – there were 6 exceedances with the highest being 91.91 mg/L WAD on 20 October 2016;

From the 1st April 2017 the monitoring frequency was increased to twice a week.

2017 – there were 31 exceedances with the highest being 178.95 mg/L on 15 December 2017.

1 Jan 2018 to 15 May 2018 - multiple exceedances with the highest being 105.3 mg/L WAD on 9 March 2018.

The high WAD levels were due to the high levels of coarse gold in the ore. In response to the high WAD levels hydrogen peroxide dosing was implemented in February 2018. From the 15 May 2018 to 30 September 2018 there were no exceedances.

A new gravity separator including an Inline Leach Reactor was commissioned at the end of August 2018 as a long term solution for the high levels of coarse gold. This should then reduce the quantity of cyanide being added and consequently reduce the quantity of hydrogen peroxide used.

The monitoring data for the Supernatant Pools was observed for 2016, 2017 and 2018 with no exceedances of 50 mg/l WAD cyanide.

The monitoring data for the Process Water Pond was also observed for 2016, 2017, and 2018 with 3 exceedances for 50 mg/l observed, all of them being in 2017, with the highest being on the 1 September 2017.

Any wildlife mortality is recorded during the TSF inspection and during the monthly surface and groundwater monitoring. The TSF is within the wider fenced area of the mine restricting the access by wildlife. The Process Water Pond is within the fenced area of the Plant, thereby restricting access by wildlife.

The only wildlife mortality caused by cyanide during the period since the last recertification was on the 8th December 2017. There was a fish kill in an isolated wetland, wholly within the mine owned area,



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adjacent to the toe drain for TSF2. This incident has led to an additional trench being constructed at the base of the TSF embankment to divert any seepage from entering the wetland. This is diverted to a sump and pumped back to the TSF.

This incident was reported to the Environmental Protection Agency and the Minerals Commission. No regulatory action has been taken as the incident was wholly contained within mine owned and controlled land.

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 4.5**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.5 to implement a comprehensive water management programme to protect against unintentional releases.

The operation has a direct discharge to surface water from the treatment plant. The discharge from the North Detox Facility is monitored before it is allowed to be discharged. All discharges have been shown to be below 0.002 mg/l free cyanide:

The Suman River is monitored at the discharge point (RCAD) on a monthly basis except when a discharge is occurring when it is monitored on a daily basis. All monitoring for 2016, 2017, and 2018 were below 0.005 mg/l WAD cyanide except for April 2016 when it was 0.006 mg/l WAD cyanide.

There is no indirect discharge to the surface water.

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 4.6**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.6 to implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of groundwater.

The operation implements specific water management measures to manage seepage to protect the beneficial uses of groundwater beneath and/or immediately down-gradient of the operation.

All of the TSFs are equipped with seepage collection trenches and sumps. The seepage water collected in the sumps is either directed back to the TSFs or to the treatment plant. From the treatment plant it is release to the environment. The water that is returned to the TSF is pumped from the TSF pond to the plant for reuse.



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TSFs 1,2 and 3 are clay lined and TSF 5 is High Density Polyethylene (HDPE) lined. All have finger drains that are directed to sumps that pump the seepage back to the dam.

All the TSFs have underdrain towers and pumps that reduce phreatic levels. There are also stormwater trenches to direct runoff away from the TSFs.

Groundwater is extracted some distance away from the TSF. Beneficial use is abstraction of drinking water by local communities. Ghanaian EPA cyanide levels for drinking water is 0.07 ppm free cyanide (CN).

The borehole monitoring data observed by the auditors showed all readings being acceptable for the drinking water standard.

Seepage from the operation has not caused cyanide concentrations of groundwater to rise above levels protective of beneficial use.

The mine does not use mill tailings for underground backfill.

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 4.7

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.7 to provide spill prevention or containment measures for process tanks and pipelines.

Spill prevention or containment measures are provided for all cyanide unloading, storage, mixing and process solution tanks

The cyanide mixing tank in the external reagents area and the dosing tank within the plant are installed on concrete foundations and located inside bunds which are of adequate capacity to take the volume of the tanks and any rainfall. The auditors verified during the site inspections that the secondary containments (floors and bunds) are in adequate conditions for the purpose of holding any solution. The floor of the bunds have recently been laid with chemical resistant bricks.

The CIL tanks are located within a concreted secondary containment area with concrete floors and bunds in adequate condition. The secondary containment for the CIL area is a combination of the concrete CIL bund, however this is not sufficient for a whole tank. If a whole tank were to leak the CIL bund would eventually overflow at a designated point and flow by gravity to the event pond, which is fully HDPE lined and located adjacent to the Plant.

Secondary containments for cyanide storage and mixing tanks are sized to hold a volume greater than that of the largest tank within the containment and any piping draining back to the tank, and with additional capacity for the design storm event.

Procedures are in place and being implemented to prevent discharge to the environment or any cyanide solution or cyanide-contaminated water that is collected in the secondary containment area.



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Tailings Contingency Plan TGM 3 9 48 04 PR, details that the TSF is equipped with pipeline to pump excess return solution to the North Detox Facility. The excess solution is treated by the North Detox Facility before it is tested and if of adequate quality released to the environment.

For the CIL mixing, storage and leaching facilities, all bunded areas are equipped with sumps and sump pumps for solution collection and preventing discharging into the environment. Any spills within the Plant Area will flow to the perimeter drain, which is then pumped to the event pond.

Spill prevention or containment measures are provided for all cyanide process solution pipelines to collect leaks and prevent releases to the environment. The tailings pipelines and return water lines are placed inside HDPE lined channels draining back to the plant or into the TSF valley area in case of leaks.

The reagent strength cyanide pipelines are pipe in pipe with drawing GFGH-ENG-CIL-001 showing the specification.

During the site inspection, the auditors confirmed that there was no area where the cyanide pipeline could present a risk to surface water and therefore no special protection needs are required.

Cyanide tanks and pipelines are constructed of materials compatible with cyanide and high pH conditions.

Site inspection verified that; tanks and pipes within the CIL plant, tailings pipelines, and return water pipelines are manufactured from mild steel or HDPE

The outside steel cyanide mixing tank in the external reagent area was replaced by one constructed of fibre glass.

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.

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 4.8

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 4.8 to implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications

Quality control and quality assurance programs have been implemented during construction of all new cyanide facilities and modifications to existing facilities, including cyanide unloading, storage, mixing facilities and other cyanide facilities.

The initial certification audit and subsequent re-certification audit detailed all of the quality control and quality assurance programs for the construction of the original cyanide facilities.

There have been three changes since the last recertification audit, which are: the construction of TSF5; the 6th raise for TSF2; and the construction of a new gravity separator in the Plant.



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The Quality Assurance/ Quality Control (QA/QC) documentation for TSF5 were observed by the auditors, these included the following: compaction tests; construction of the toe drain; sign off before HDPE liner installation; sign off before clay fill; falling head permeability test; field density; proctor test; geomembrane liner installation; HDPE panel placement log; Air pressure test; weld tests; and seam logs.

The QA/QC documentation for TSF 2 Stage 6 Raise were observed by the auditors, these included the following: concrete cube test results; aggregates test summary sheet; compacted rockfill layer sign off sheet, spent ore/ clay compacted fill layer, Bilal Mining Services (signed by Engineer and Project Manager); spent ore and clay analysis, Mates Engineering Limited; and particle size analysis; Sunway Engineering and Construction Ltd.

The QA/QC documentation for Gravity Separator was observed by the auditors. This included the following: design and construction sign off was undertaken by Wood Plc; Consep supplied the components of the InLine Leach Reactor (ILR); Structural Steel was undertaken by Group 5; and civil engineering was undertaken by Desimone.

The quality control and quality assurance programs addressed the suitability of materials and adequacy of soil compaction for earthworks such as tank foundations and earthen liners, the installation of synthetic membrane liners used in TSFs, and for construction of cyanide storage and process tanks.

Quality control and quality assurance records been retained for cyanide facilities including those prior to this recertification period.

Appropriately qualified personnel reviewed the construction of the cyanide facilities and provided documentation that the facility has been built as proposed and approved.

The construction of the TSF 5 was supervised by qualified consultants Knight Piésold and Glocal Engineering, which provide QA/QC services, detailing construction schedule, activities and progress, construction materials and construction methods, construction supervision and material testing.

The construction of TSF 2 Stage 6 Raise was supervised by Bilal Mining Services, which provided QA/QC services detailing construction schedule, activities and progress, construction materials and construction methods, construction supervision and material testing.

The construction of the Gravity Separator Project was supervised by Wood Plc. which provided QA/QC services detailing construction schedule, activities and progress, construction materials and construction methods, construction supervision and material testing.

There is quality control and quality assurance documentation or as-built certification for all cyanide facility construction as detailed in the certification audit and for the alterations to the plant since the last recertification audit. In addition the above information the following were observed:

Quarterly audits reports on the TSF by independent consultant (Glocal Engineering) - all signed by Richard Akoto (M.Eng;Dipl - Ing)

Annual Audit Reports for the TSFs - conducted by Glocal Engineering and signed by Richard Akoto, (M.Eng;Dipl-Ing).

Inspectorate Division of Minerals Commission, 6 December 2016, including visual inspection of the Plant, ultrasonic wall thickness monitoring and certification of cyanide facilities in the process plant - Gold Fields Ghana Ltd - Tarkwa Mine.



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Standard of Practice 4.9: Implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface and groundwater quality. in full compliance withThe operation is in substantial compliance with **Standard of Practice 4.9** not in compliance with**Summarise the basis for this Finding/Deficiencies Identified:**

The operation is in full compliance with Standard of Practice 4.9 to implement monitoring programs to evaluate the effects of cyanide use on wildlife, surface and groundwater quality.

The operation has developed written standard procedures for monitoring activities including the TGM-ENV-Env-01, rev 03 dated 20 April 2018 Procedure Water Quality Monitoring and Quality Assurance Program and the map showing the location, nature and denomination of all water related sampling points in and around the site.

The sampling and analytical procedure was developed by the Unit Manager Environment and reviewed and approved by the Environmental Manager. The Environmental Manager has an MSc in Analytical Chemistry from University of Ghana, 26 years experience in water quality and environmental management.

Procedures specify how and where samples should be taken, sample preservation techniques, chain of custody procedures, shipping instructions, and cyanide species to be analysed.

Sampling conditions (e.g., weather, livestock/wildlife activity, anthropogenic influences, etc.) and procedures are documented in writing. Water Quality Field Analysis Sheet, EVFAS 001 REC, Rev 01, 05 December 2006. Samples sheet are completed on a monthly basis during surface and groundwater sampling.

The operation monitors for cyanide in discharges of process water to surface water and in surface water and groundwater down-gradient of the site.

The operation inspects for and records wildlife mortalities related to contact with and ingestion of cyanide solutions.

Any wildlife mortality is recorded during the TSF inspection and during the monthly surface and groundwater monitoring.

The only wildlife mortality caused by cyanide during the period since last recertification was on the 8th December 2018. There was a fish kill in an isolated wetland, wholly within the mine owned area, adjacent to the toe drain for TSF2. This incident has led to an additional trench being constructed at the base of the TSF embankment to divert any seepage from entering the wetland. This is diverted to a sump and pumped back to the TSF.

This incident was reported to the Environmental Protection Agency and the Minerals Commission. No regulatory action has been taken as the incident was wholly contained within mine owned and controlled land.

Monitoring is conducted at frequencies adequate to characterise the medium being monitored and to identify changes in a timely manner.


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Groundwater and surface water monitoring is conducted monthly. When discharging water sampling of the receiving water is conducted daily. Wildlife monitoring is undertaken on a daily basis.



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Principle 5 – Decommissioning

MANAGE CYANIDE PROCESS SOLUTIONS AND WASTE STREAMS TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 5.1**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 5.1 to plan and implement procedures for effective decommissioning of cyanide facilities to protect human health, wildlife and livestock.

The operation has developed written procedures to decommission cyanide facilities at the cessation of operations. Including the following: Reclamation Plan for the Tarkwa Gold Mine, Ghana, SRK, V1, May 2018; and Tailings Storage Facility (TSF) 3 - Decommissioning and Closure Plan, Knight Piesold, AC 301-00014-64, July 2018.

The plan includes an implementation schedule for decommissioning activities. The Detailed Decommissioning and Closure Plan (Tailings Storage Facility (TSF) 3 - Decommissioning and Closure Plan, Knight Piesold, AC 301-00014-64, July 2018) - stipulates the closures phases namely: transition, active closure and passive closure.

A detailed closure plan must be submitted 60 days prior to decommissioning as required by MINCOM and the Ghana EPA. In the case of TSF3, the Decommission and Closure Plan will be submitted to the Department. Once approved by MINCOM, a detailed Gant Chart will be compiled informing the decommissioning and closure of TSF3.

The operation reviews its decommissioning procedures for cyanide facilities during the life of the operation and revises them as needed.

The specific decommissioning procedures (part of the standard operating procedures) are revised every two years or as necessary.

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 5.2**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 5.2 to establish an assurance mechanism capable of fully funding cyanide related decommissioning activities.



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The operation has developed an estimate of the cost to fully fund third party implementation of the cyanide-related decommissioning measures as identified in its site decommissioning or closure plan. The Reclamation Plan for the Tarkwa Gold Mine, Ghana, SRK, V1, May 2018 describes the closure objectives for the mining area including TSF (section 5.2), processing ponds (section 5.6) and Processing plant (section 5.8). Stipulates that the decontamination of the plant needs to happen in accordance with the requirements of the ICMC. Provides a high level description of closure activity per area.

The Reclamation Plan for the Tarkwa Gold Mine, Ghana, SRK, V1, May 2018 including the cost estimate is updated every two years.

The operation has established a financial mechanism approved by the applicable jurisdiction to cover the estimated costs for cyanide-related decommissioning activities as identified in its decommissioning and closure strategy.



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Principle 6 – Worker Safety

PROTECT WORKERS' HEALTH AND SAFETY FROM EXPOSURE TO CYANIDE

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 6.1

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 6.1 to identify potential cyanide exposure scenarios and take measure as necessary to eliminate, reduce and control them.

Goldfields Gold Mine has developed procedures describing how cyanide-related tasks such as unloading, mixing, plant operations, entry into confined spaces, and equipment decontamination prior to maintenance should be conducted to minimize worker exposure. This includes 28 Cyanide Procedures.

The Auditors confirmed that the procedures include the use of PPE and address pre-work instructions.

The operation implements procedures to review proposed process and operational changes and modifications for their potential impacts on worker health and safety, and incorporate the necessary worker protection measures.

There is a Change Management Procedure for the mine TGM 9 14 PR Rev.3, dated 15 March 2017. The procedure details the change management process used at Tarkwa Gold Mine to ensure a structured approach is applied to the management of change on site and information relating to changes to our business is communicated to all interested and affected parties.

A Change Committee is put together with representatives from all affected services disciplines and will be involved during the risk assessment process, these will include Protection Services, Health and Safety, Environment, Finance, IT, Engineering, etc. The Change Committee Chairman signs off the Change Management documentation on behalf of the Change Committee.

The operation solicits and actively considers worker inputs in developing and evaluating health and safety procedures. Procedures are updated every 3 years or if something significant changes. The specific supervisor will discuss the procedure with his team and get their comments. The comments are then passed on to the Senior Training Officer. She is responsible for reminding supervisors when procedures are due for updating and to receive all the updates and collate it into an updated version.

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.

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 6.2



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not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 6.2 to operate and monitor cyanide facilities to protect worker health and safety and periodically evaluate the effectiveness of health and safety measures.

The operation has determined the appropriate pH for limiting the evolution of HCN gas during mixing and production activities, the Sodium Cyanide Mixing Start up Procedure TGM 3 9 60 03 PR Rev 10, dated 14 December 2017, specifying pH >10.5. This is consistent with the Cyanide Emergency Response Plan, TGM 3 0 038 PR, Rev 05, 22 April 2017 that states that the pH must be 10 or above in the process area.

Where the potential exists for significant cyanide exposure, the operation uses ambient or personal monitoring devices to confirm that controls are adequate to limit worker exposure to HCN gas and sodium, calcium or potassium cyanide dust to 10 ppm on an instantaneous basis and 4.7 ppm continuously over an 8-hour period, as cyanide.

The operation uses ambient monitoring devices at locations that have been identified as cyanide hotspots. This includes on top of the Leach Tanks, the Cyanide Storage Tank at the CIL, the Cyanide Mixing Tank for the CIL at the external reagent area. In addition, personal monitors are used e.g. during the mixing operation and during the cleaning of the Leach Tanks bund.

The operation has identified areas and activities where workers may be exposed to cyanide in excess of 10 ppm on an instantaneous basis and 4.7 ppm continuously over an 8-hour period, and require use of personal protective equipment in these areas or when performing these activities.

The operation has identified areas where workers may be exposed to cyanide through an initial hotspot survey. The results identified the top of the Leach Tanks, the Cyanide Storage Tanks at the CIL, the Cyanide Mixing Facilities, and the InLine Leach Reactor (ILR), as hotspots. Notices at these locations identifying them as hotspots were observed. These areas have fixed HCN monitors.

Hydrogen cyanide monitoring equipment is maintained, tested and calibrated as directed by the manufacturer, and records are retained for at least one year. The personal hydrogen cyanide gas monitors (Pac 7000) and the fixed hydrogen cyanide gas monitors (Polytron 7000) are serviced every 6 months.

Warning signs been placed where cyanide is used advising workers that cyanide is present, and that smoking, open flames and eating and drinking are not allowed, and that, if necessary, suitable personal protective equipment must be worn.

Showers, low pressure eye wash stations and dry powder or non-acidic sodium bicarbonate fire extinguishers are located at strategic locations throughout the operation and they are maintained, inspected and tested on a regular basis.

Emergency showers with integrated low pressure eye washes are located at the mixing facility in the external reagent area, the cyanide storage tanks for the CIL Plant, on top of the Leach Tanks at the CIL Plant and at the dosing point for the ILR. Dry powder fire extinguishers were also observed at all these locations.



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Unloading, storage, mixing and process tanks and piping containing cyanide is identified to alert workers of their contents, and the direction of cyanide flow in pipes is designated. The reagent strength cyanide mixing and storage tanks and associated piping are coloured purple to demonstrate that they contain cyanide. The piping is also labelled 'Cyanide' and the direction of flow indicated. The pipelines containing tailings from the CIL Plant are labelled as 'Tails Pipe' with the direction of flow and which TSF the pipe is going to.

MSDS, first aid procedures and other informational materials on cyanide safety is in the language of the workforce available in areas where cyanide is managed.

The operational language for the mine and CIL Plant is English in written and verbal communications. This was confirmed through interviews. The MSDS and first aid procedures are located in the office/first aid room adjacent to the cyanide mixing area, in the first aid room adjacent to the cyanide solution storage tanks, on the first aid cabinet on top of the Leach Tanks.

Procedures are in place and being implemented to investigate and evaluate cyanide exposure incidents to determine if the operation's programs and procedures to protect worker health and safety, and to respond to cyanide exposures, are adequate or in need of revising.

There have been no incidents involving an employee related to cyanide since the last recertification audit.

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 6.3

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 6.3 to develop and implement emergency response plans and procedures to respond to worker exposure to cyanide. The operation has water, oxygen, a resuscitator, antidote kits, radios, cell phone, and alarmed safety showers readily available for use at unloading, storage and mixing locations and elsewhere in the plant. There are first aid cabinets at strategic locations in the Plant and the TSF containing appropriate PPE, oxygen and antidote for use in a cyanide emergency.

The operation has water, oxygen, a resuscitator, antidote kits (Tripac-Cyano) and a radio, telephone, alarm system or other means of communications or emergency notification readily available for use at cyanide unloading, storage and mixing locations and elsewhere in the plant. The Emergency Response Team has additional emergency equipment including a resuscitator in the ambulance and at the on-site clinic.

The operation inspects its first aid equipment, including medical oxygen, regularly to ensure that it is available when needed, and materials such as cyanide antidotes are stored and/or tested as directed by their manufacturer and replaced on a schedule to ensure that they will be effective when needed.

The operation has developed specific written emergency response plans or procedures to respond to cyanide exposures including the following:



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Sodium Cyanide First Aid Procedure TGM 3 0 002 PR Rev 7, dated 2 March 2018; Cyanide Emergency Response Plan, TGM 3 0038 PR, Rev 5, 22 April 2017; and Emergency Preparedness and Response Procedure, HSMP 3.08 PR, Rev 9, 22 February 2017.

The operation has its own on-site capability to provide first aid or medical assistance to workers exposed to cyanide. The Plant has seven individuals on each shift trained in first aid. In addition, they have a Mine Emergency Response Team that includes three people trained in first aid plus a paramedic for each shift (2 x 12 hour shifts). The Mine Emergency Response Team will respond to any cyanide emergency and will transport the patient by the Mine's ambulance to the on-site hospital. The on-site hospital is operated by Accra Medical Centre under contract to Gold Fields. If subsequently they require specialist treatment they will be airlifted to the necessary hospital in Accra, Ghana or if necessary to an international facility.

The operation is confident that the medical facility has adequate, qualified staff, equipment and expertise to respond to cyanide exposures.

Mock emergency drills are conducted periodically (every 6 months) to test response procedures for various cyanide exposure scenarios, and lessons learned from the drills are incorporated into response planning.



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Principle 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.

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 7.1

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 7.1 to prepare detailed emergency response plans for potential cyanide releases.

The Gold Mine has a Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 April 2017. In addition, there is a general mine Emergency Preparedness and Response Procedure HSMP 3.08 PR, Rev 9, 22 February 2017, and a specific Sodium Cyanide First Aid Procedure TGM 3 0 002 PR Rev 7, dated 2 March 2018. These address the potential releases of cyanide that may occur or require response.

The Plan considers the potential cyanide failure scenarios appropriate for its site-specific environmental and operating circumstances, including the following:

- Catastrophic release of hydrogen cyanide from storage or process facilities;
- Transportation accidents;
- Releases during unloading and mixing;
- Releases during fires and explosions;
- Pipe, valve and tank ruptures;
- Overtopping of ponds and impoundments;
- Power outages and pump failures;
- Uncontrolled seepage;
- Failure of cyanide treatment, destruction or recovery systems and
- Failure of tailings impoundments, heap leach facilities and other cyanide facilities

Transport related emergencies outside the mine are the responsibility of Orica as manager of the supply chain.

Cyanide Emergency Response Plan, TGM 3 0038 PR, Rev 5, 22 04 2017, section 5.3.2 and Emergency Preparedness and Response, HSMP 3.08 PR, Rev 9, 22 February 2017 describes specific response actions, as appropriate for the anticipated emergency situations, such as clearing site personnel and potentially affected communities from the area of exposure, use of cyanide antidotes and first aid measures for cyanide exposure, control of releases at their source, and containment, assessment, mitigation and future prevention of releases.



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Communication with local government, local communities, public emergency response services and media sources will happen via the Community Relations Department after permission from the General Manager is given.

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 7.2

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 7.2 to involving site personnel and stakeholders in the planning process.

The operation has involved its workforce and stakeholders in the cyanide emergency response planning.

The workforce are included in the emergency response planning process through the monthly health and safety meetings and through the testing of the Emergency Response Plan by the mock drills.

The operation has made potentially affected communities aware of the nature of the risks associated with accidental cyanide releases and consulted with them directly, or through community representatives, regarding appropriate communications and response.

Tarkwa Mine Community Consultative Committee Meeting meets quarterly, with representatives from the community, chiefs, elders, Assembly members, women's representatives from 9 communities, municipal representatives, health department, education, and community development.

The operation has involved local response agencies such as medical facilities in the cyanide emergency planning and response process.

The main response agencies are the Mine Emergency Response Team, and the on-site hospital. These have all been involved in the emergency planning and response process. Local outside responders are not involved in cyanide emergencies due to the lack of appropriate equipment and training.

The operation engages in consultation or communication with stakeholders to keep the Emergency Response Plan current.

The most recent communication was through the mock drill which involved the Emergency Response Team, the on-site hospital, and the staff of the CIL Plant.

The local communities and Tarkwa town emergency response services do not have designated responsibilities in the Mine Emergency Response Plan.

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 7.3



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not in compliance with**Summarise the basis for this Finding/Deficiencies Identified:**

The operation is in full compliance with Standard of Practice 7.3 to designate appropriate personnel and commit necessary equipment and resources for emergency response.

The Emergency Response Plan includes the following cyanide related elements.

Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 April 2017 Section 1.0 defines the response co-ordinators (Emergency Controller and Site Controller) roles and responsibilities. The Emergency Controller can "request the resources and people as dictated by the situation".

The Emergency Response Team is identified in Section 1.0 of the Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 April 2017.

Any member of a shift can be a first responder to a cyanide incident as they have all been trained in cyanide emergency response during the initial induction and subsequent refreshers.

All cyanide unloading, mixing, production and maintenance workers are trained in decontamination and first aid procedures as part of the initial Cyanide Induction for mine workers, and during the Refresher Training for individuals working in the Plant.

People working in the Plant take part in mock drills to improve their response skills. The main responders are the Mine Emergency Response Team (includes three people trained in first aid plus a paramedic for each shift, 2 x 12 hour shifts) who are trained in the following: Cyanide Emergency Response (Mandown), Sodium Cyanide First Aid, HCN Gas Detection using Draeger Detector, Sigma 2 Self-Contained Breathing Apparatus (SCBA) Donning, Cyanide Fire Emergency, Handling a Stretcher, Oxy-Pc Usage.

Emergency Preparedness and Response Procedure, HSMP3.08 PR, Rev 9, 22 February 2017 contains the Emergency Contact List in Appendix 3 as part of the call out procedures.

Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 April 2017 specifies the duties and responsibilities of the Emergency Controller, Site Controller, and Plant Supervisor.

Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 April 2017 lists the contents of the Emergency Response Trailer and the on-site PPE.

Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 04 2017 states that the emergency response equipment kept in the Emergency Response Trailer is inspected weekly and recorded on a checklist.

Plant Operator Daily Inspection Internal Reagents and CN Emergency Room includes; checks for safety showers, integrity of bunds, MSDS Sheet, leaking valves or pipes, signs of seepage, man down alarm, HCN fixed monitors, emergency equipment and antidote kits.

Inspection of hospital cyanide emergency equipment is inspected by the Mine Emergency Response Team on a monthly basis.

The local communities and Tarkwa town emergency response services do not have designated responsibilities in the Mine Emergency Response Plan and are therefore not included in mock drills.

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Standard of Practice 7.4: Develop procedures for internal and external emergency notification and reporting. in full compliance with

The operation is

 in substantial compliance with

Standard of Practice 7.4

 not in compliance with**Summarise the basis for this Finding/Deficiencies Identified:**

The operation is in full compliance with Standard of Practice 7.4 to develop procedures for internal and external emergency notification and reporting.

The Plan includes procedures and contact information for notifying management, regulatory agencies, outside response providers and medical facilities of the cyanide emergency.

The Emergency Preparedness and Response Procedure, HSMP 3.08 PR, Revision 9, 22 February 2017 includes the requirements for internal and external communication (regulatory authorities) as well as communication with the plant emergency response teams, the mine emergency response team, the on-site hospital, and the mine fire brigade.

The Emergency Preparedness and Response Procedure, HSMP 3.08 PR, Revision 9, 22 February 2017 states that emergencies posing a safety or health risk to local communities will be communicated through the Municipal Security Council via the Municipal Chief Executive or the Municipal Coordinating Director.

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

The operation is

 in substantial compliance with

Standard of Practice 7.5

 not in compliance with**Summarise the basis for this Finding/Deficiencies Identified:**

The operation is in full compliance with Standard of Practice 7.5 to incorporate in response plans and remediation measures monitoring elements that account for the additional hazards of using cyanide treatment chemicals.

The Plan describes specific remediation measures as appropriate for the likely cyanide release scenarios.

Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5, dated 22 April 2017 describes specific remediation measures including the recovery or neutralisation of solutions and solids (section 4.0, 5.1 and 5.2); decontamination of soils and other contaminated media (Section 4.2, 5.1 and 5.2); management and disposal of spill clean-up (section 4.2).

The Plan states the following. If there is a spill within the Plant on concrete areas this will be washed into the nearest bund from where it can be pumped back into the process.


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If the spill is not on concrete it will contaminate soils. If soils are contaminated the Plan describes how the soil will be covered with more soil to absorb the spill and how this soil will then be collected and disposed of at the TSF. Treatment chemicals are not used for the neutralisation of spills.

Provision of alternate drinking water supply is not required as local surface water is not in proximity to where process solution strength cyanide solution is used, solid cyanide is stored, or the TSF is located. In addition, the majority of drinking water is obtained from groundwater.

If soils are contaminated the Plan describes how the soil will be covered with more soil to absorb the spill and how this soil will then be collected and disposed of at the TSF.

Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 April 2017 section 2 prohibits the use of detoxification chemicals such as hypochlorite, hydrogen peroxide and ferrous sulphate.

The Plan addresses the potential need for environmental monitoring to identify the extent and effects of a cyanide release, and includes sampling methodologies, parameters and, where practical, possible sampling locations.

Cyanide Emergency Response Plan TGM 3 0038 PR Rev 5 dated 22 April 2017 section 5.2 stipulates the requirement to take samples of spilled solution for Free CN, WAD CN and pH analysis.

The protocol for water monitoring is contained in Water Quality Monitoring and Quality Assurance Program, TGM-ENV-Env-01.

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 7.6

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 7.6 to periodically evaluate response procedures and capabilities and revise them as needed.

The operation reviews and evaluates the cyanide-related elements of its Emergency Response Plan for adequacy on a regular basis.

Documentation and Control, HSMP 3.04 PR, Rev 8, 22 February 2017 states that all Health and Safety Management System procedures, work instructions and safe work procedures shall be reviewed three yearly or as required as a result of changes to process, incidents, etc.

The Cyanide Emergency Response Plan is on revision 5. The Emergency Preparedness and Response Procedure is on revision 9.

Mock cyanide drills are conducted periodically as part of the Emergency Response Plan evaluation process.

Mock emergency drills are conducted every 6 months to test response procedures for various exposure scenarios. The Emergency Preparedness and Response procedure is reviewed following mock drills however, there has been no requirement for an update due to mock drills.



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Principle 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.

in full compliance with

The operation is in substantial compliance with **Standard of Practice 8.1**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 8.1 to train workers to understand the hazards associated with cyanide use.

The operation trains all personnel who may encounter cyanide in cyanide hazard recognition.

All employees must attend induction at the start of employment and then again after each return from annual leave.

Cyanide hazard recognition refresher training is conducted periodically

Employees that return from annual leave are required to attend the Processing Plant induction programme prior to commencing work and after attending the two day mine induction. A form, provided by Human Resources (HR), is given to the employee to have signed off once the refresher training has been completed. The Metallurgical Senior Training Officer keeps a list of all employees working at the plant and TSF with the date of last training received.

Induction and Refresher Training Procedure, TGM 9.05 PR, Rev 05, 07 May 2018 - states that all B and C band employees and all contractors must attend refresher training, including first aid awareness, prior to resumption of work on return of annual leave.

The auditors observed Metallurgy Training Records CIL spreadsheet. The spreadsheet contains the person's name, Coy No., Grade, Designation, Sub-section and dates of training completed and are divided into sheets per department.

The required training is divided in the following: Cyanide Review Training, Plant Induction, Plant Reagent Safety at the Workplace (various modules), Safe Work Practices (various modules), Operational Control Requirements (various modules), Minerals and Mining regulations (various modules), Mobile Equipment Training (various modules), CIL Plant Specific Training.

The sheet contains the date when the next Plant Induction is due - conditional formatting, turns red when overdue and yellow when almost due.

Cyanide training records are retained for the duration of employment.



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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.

in full compliance with

The operation is in substantial compliance with **Standard of Practice 8.2**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 8.2 to train appropriate personnel to operate the facility according to systems and procedures that protect human health, the community and the environment.

The operation trains workers to perform their normal production tasks, including unloading, mixing, production and maintenance, with minimum risk to worker health and safety in a manner that prevents unplanned cyanide releases.

Procedures applicable to employees working in specific sections have been identified as well as the employees that should receive the specific training.

Training is presented to all new employees and when they move to a new section or when procedures are updated.

The training elements/procedures for each job are identified for each area/ team on the Training Matrix. The Training Matrix then generates an excel spreadsheet showing the training that is undertaken for each individual.

In addition, Planned Task Observations (PTOs) are undertaken by the Supervisors on individuals for the various procedures. This is undertaken on an as required basis.

Appropriately qualified personnel provide task training related to cyanide management activities. Benedicta Antwi the Metallurgical Senior Training Officer undertakes the majority of the formal training. Her training records were observed.

Workers are trained prior to working with cyanide.

All employees must attend an induction at start of employment and then again after return from annual leave.

The auditors observed the Cyanide Refresher Training presentation (presented by Metallurgy Trainer). A test is written after completion of the cyanide induction training. An 80% pass mark is required. Examples of the test were observed.

Procedures applicable to employees working in specific sections have been identified as well as the employees that should receive the specific training

Refresher training on cyanide management is provided to ensure that employees continue to perform their jobs in a safe and environmentally protective manner.

Induction training is refreshed on a regular basis after annual leave. Training on specific procedures is undertaken when any of the procedures are altered. PTOs are undertaken on a regular basis as and when required. Induction training records and PTO records were observed as detailed previously



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The operation evaluates the effectiveness of cyanide training by testing, observation or other means.

The Induction Training is followed by a test where a pass mark of 80% is required. There are also tests associated with the training on specific procedures. The pass mark for these is also 80%.

In addition, PTOs are undertaken on a regular basis by supervisors.

Records are retained throughout an individual's employment documenting the training they receive. The records 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.

in full compliance with

The operation is in substantial compliance with **Standard of Practice 8.3**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 8.3 to train appropriate workers and personnel to respond to worker exposures and environmental releases of cyanide.

All cyanide unloading, mixing, production and maintenance personnel are trained in the procedures to be followed if cyanide is released

Procedures applicable to employees working in specific sections have been identified as well as the employees that should receive the specific training. The auditors observed the training matrix for the employees working in the reagent section. Requires training on:

- Sodium cyanide mixing start-up;
- Sodium cyanide mixing shut down;
- Offloading sea container from trucks;
- Offloading & storage of sodium cyanide from sea container;
- Loading sea container unto a truck;
- Offloading & storage of hydrochloric acid;
- CN transfer- mixing tank to storage tank;
- Cyanide distribution start up;
- Cyanide protection control; and
- Sodium cyanide operational PPE control.

This training includes the response actions to be undertaken in the event of a cyanide release.

Training is presented to all new employees, if they move to a new section, or when procedures are updated.



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Site cyanide response personnel, including unloading, mixing, production and maintenance workers, are trained in decontamination and first aid procedures as part of the initial cyanide induction and refresher. They take part in routine mock drills to test and improve their response skills.

Emergency Response Co-ordinators and members of the Emergency Response Team are trained in the procedures included in the Emergency Response Plan regarding cyanide, including the use of necessary response equipment.

The operation does not have off-site emergency responders. For all emergencies the mine emergency personnel would provide the response team as the local responders are not trained in responding to cyanide emergencies. The Mine has a hospital on site which will treat any incidents of cyanide poisoning. If necessary individuals may be airlifted to Accra for further treatment.

The Emergency Preparedness and Response Plan details how external communications with the local communities in the event of a cyanide incident are undertaken

Employees that return from annual leave are required to attend the Processing Plant induction programme prior to commencing The Metallurgical Senior Training Officer keeps a list of all employees working at the plant and TSF with the date of last training received.

The Mine Emergency Response Team are trained annually as part of their refresher in response to cyanide exposures and releases.

Simulated cyanide emergency drills are conducted periodically for training purposes. They cover both worker exposures and environmental releases.

Cyanide emergency drills are evaluated from a training perspective to determine if personnel have the knowledge and skills required for effective response. Training procedures are revised if deficiencies are identified.

Records are retained documenting the cyanide training, including the names of the employee and the trainer, the date of training, the topics covered, and how the employee demonstrated an understanding of the training materials.



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Principle 9 – Dialogue

ENGAGE IN PUBLIC CONSULTATION AND DISCLOSURE

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 9.1

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 9.1 to provide stakeholders with the opportunity to communicate issues of concern.

The operation provides the opportunity for stakeholders to communicate issues of concern regarding the management of cyanide.

There is a Tarkwa Mine Community Consultative Committee Meeting (TMCCM), which is undertaken quarterly, with local chiefs, elders, Assembly Representatives, Women's Representatives, Representatives from the 9 local communities, Municipal Representatives, Health Department, Education Department, and Community Development.

Feedback from the TMCCM is taken to larger community meetings undertaken in each of the 9 communities twice a year. These meetings started in 2017.

The Community Relations Office is open to anyone from the local community to visit since they don't need to access the mine site.

The Community Relations officers reside in the local community and are therefore accessible to community. Any complaints are documented in the complaints register.

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

in full compliance with

The operation is

in substantial compliance with

Standard of Practice 9.2

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 9.2 to initiate dialogue describing cyanide management procedures and responsively address identified concerns.

There are opportunities for the operation to interact with stakeholders and provide them with information regarding cyanide management practices and procedures.

There is a Tarkwa Mine Community Consultative Committee Meeting (TMCCM), which is undertaken quarterly, with local chiefs, elders, Assembly Representatives, Women's Representatives,



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Representatives from the 9 local communities, Municipal Representatives, Health Department, Education Department, and Community Development.

Feedback from the TMCCCM is taken to larger community meetings undertaken in each of the 9 communities twice a year. These meetings started in 2017.

One specific day per year is dedicated to providing cyanide related information to the community.

In addition, there is a local radio programme, which on Thursdays communicates public health information including information about cyanide.

The local meetings and radio programme are conducted in the local language to make it understandable for everyone.

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

in full compliance with

The operation is in substantial compliance with **Standard of Practice 9.3**

not in compliance with

Summarise the basis for this Finding/Deficiencies Identified:

The operation is in full compliance with Standard of Practice 9.3 to make appropriate operational and environmental information regarding cyanide available to stakeholders.

The operation has developed written descriptions of how their activities are conducted and how cyanide is managed. These descriptions are available to communities and other stakeholders via notice boards in the local communities.

Written cyanide information is provided on notice boards in the community.

The operation has disseminated information on cyanide in verbal form where a significant percentage of the local population is illiterate.

Feedback from the TMCCCM is taken to larger community meetings undertaken in each of the 9 communities twice a year in the local language. One specific day per year is dedicated to providing cyanide related information to the community in the local language.

In addition, there is a local radio programme in the local language, which on Thursdays communicates public health information including information about cyanide.

The operation makes information publicly available on confirmed cyanide releases or exposure incidents.

Any such incident is notified to the EPA and the Mineral Commission in the first instance. If the incident involves a member of the local community the HR Department communicates with the local family. The wider community and media will be communicated with by the Community Relations Department once approved by the Mine General Manager. This process was followed with regards to the fish kill detailed in 4.4 above.



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