

***INTERNATIONAL CYANIDE  
MANAGEMENT INSTITUTE***

***Cyanide Code Compliance Audit  
Gold Mining Operations***

***Summary Recertification  
Audit Report***

***Harmony Gold Mines Limited  
Number One Gold Plant  
South Africa***

***16<sup>th</sup> – 20<sup>h</sup> September 2013***



**Name of Operation:** Harmony One Plant

**Name of Operation Owner:** Harmony Gold Mines Limited

**Name of Operation Operator:** Harmony Gold Mines Limited

**Name of Responsible Manager:** Johnny Botha, Plant Manager

**Address:** PO Box 1, Glen Harmony 9435

**Country:** South Africa

**Telephone:** +27 57 904 3000 / +27 84 802 1337

**Fax:** +27 57 904 3029

**E-Mail:** [Johnny.Botha@Harmony.co.za](mailto:Johnny.Botha@Harmony.co.za)

**Location detail and description of operation:**

Harmony One plant is located near Bambanani shaft, on the southern edge of the City of Welkom in the Free State Province of South Africa. It is the highest producing gold plant owned and operated by Harmony Gold. Harmony One Plant currently processes underground ore from multiple shafts, as well as ore from several surface sources (e.g. dumps). The plant was built in 1986, and the milling, leaching and carbon-in-pulp technology reflects the technology which was current at the time. Plant design capacity is 390,000 tpm (tonnes per month), steady state.

The operations at the Harmony One Plant consist of:- an ore receiving bay (where ore that is railed in is brought to the plant from the various ore sources); a milling plant (using six run-of-mine mills in parallel to grind the ore to the required sizing); thickeners to upgrade the density of the slurry to the density required for leaching and adsorption; three parallel leaching trains( followed by three parallel adsorption trains, where the gold is adsorbed onto activated carbon granules); Carbon elution and regeneration facilities; Gold recovery (zinc precipitation) and smelting operations.

**Ore Reception:**

The use of parallel processing starts at the ore receive bin, where there are two unloading stations for the railcars that bring the ore in from the various shafts and rock dumps. A unique feature of the plant is the Ore Reception facility, which has been designed to eliminate dead storage space, a serious constraint in railway ore storage bins. Ore is transported by rail to the plant. The railway hoppers discharge individually into one of the two concrete, rail-lined inverted cones, 12m in diameter and 8m deep. The apex of the cone is 57°. The ore is rapidly withdrawn from the apex of the cone via a

shuttle belt feed conveyor feeding onto a main silo feed conveyor. The twelve ore storage silos are constructed from concrete and are also rail-lined. Each silo has a live storage of approximately 3 000 tons. Ore is discharged onto the mill feed conveyor via a pneumatically operated Langlaagte chute. When filled to full capacity, the twelve ore silos provide approximately 60 hours storage for the six Run-of-Mine (ROM) mills. There are six parallel and independent milling lines with each one having a conveyor running underneath 2 silos (A and B) and taking the ore up into one of the six run-of-mine (ROM) mills. Generally ore is drawn only from one of the two silos for each mill whilst the other is being filled with ore. Hence, one silo is discharging onto the mill feed belt and the other refilled.

### **Milling:**

The ore is taken up the slow moving conveyers from underneath the silos and discharged directly into the feed hopper for the ROM mills. Fully autogenous (FAG) milling is a milling process in which the entire ROM ore stream is fed directly into the mills. The grinding media is generated within the mill from suitably sized pieces of ROM ore itself, supplemented by waste rock dump material. The feed rate to the mills is between 90 and a 100t/h.

The milling circuit consists of six single stage ROM mills that are controlled on maximum power, utilizing programmable logic controllers (PLCs). Variations in mill load are measured by load cells situated under the outlet trunnion bearings. Each ROM mill is 4.9m diameter by 10m long and powered by 3.3MW motors and grinds the ore to between 68 and 73% minus 75 $\mu$ m.

For control purposes the mill feed belts and the mill discharge pumps both have variable speed drives. Each mill is in closed circuit with a 1200mm primary cyclone with mass flow measurement on the feed. The primary cyclone overflow is screened on a 600 $\mu$ m linear screen for the removal of coarse woodchips and tramp steel. This has the purpose of preventing gold losses and carbon contamination in the downstream CIP circuit. Cyclone overflow, which has a low density, is pumped out to the thickeners. The current cyclone overflow size is 68% at -75 $\mu$ m.

### **Thickening:**

Calcium Oxide (lime) is added to the thickeners as slaked lime with levels of CaO being controlled at between 0.014 and 0.016% CaO. The lime maintains a protective level of alkalinity in the leach section to prevent the generation of poisonous HCN (cyanide) gas in the process. Thickening is carried out in six 60m diameter, cable torque thickeners. Flocculent is used to assist the settling rate and is added at the rate of approximately 1 to 3 g/t.

Each thickener is equipped with a fixed and variable speed underflow pump. The variable speed pump is used for transferring the thickened slime ( $\pm$  53% solids) to the leach circuit. The thickener underflow density is controlled by varying the flow to the leach circuit. The fixed speed pump is used in an emergency and for recycling or emptying of a thickener for maintenance purposes. The thickener overflow gravitates to two mill return tanks for re-use in the mill. There are six thickeners operating in three parallel trains, with the two thickeners in each train also working in parallel. The discharge from a pair of mills is combined and taken out to two thickeners that increase the density of the discharge slurry from the mills.

**Leach:**

The leach circuit consists of three streams, each with nine 800m<sup>3</sup> mechanically agitated draught tube circular tanks. The nominal residence time of the pulp per stream is approximately 27 hours. The feed to leach is screened for woodchips, using three Mintek circulating tanks fitted with 800µm aperture mesh screens. The concentrated woodchips are bled from the Mintek tank over a vibrating woodchip screen to dewater prior to removal of woodchips to a stockpile.

Air is injected under the draught tube impeller for oxygen distribution to the pulp. Liquid cyanide is automatically added to the leach reception tank, with the initial level of the cyanide being controlled by TAC1000 online automatic samples between 0.020% and 0.022% sodium cyanide to dissolve the gold. The underflow from the thickeners is at the appropriate density for leaching and adsorption and is pumped across to one of the three leaching trains. The concept is that should a reduction in output be required then one train can be shut down whilst the other two are running at full capacity, and hence at optimal efficiency.

By the time the slurry reaches the last vessel in the leach train, approximately 75% of the gold has been dissolved.

**CIP:**

The slurry then passes to one of the three adsorption trains, each of which has seven 450m<sup>3</sup> tanks where it passes through the tanks in counter-flow to the carbon movement, which adsorbs the gold that is in solution. The downwards gravitation of carbon from one tank to the next is prevented by 800 µm kambalda inter-stage screens. The gold depleted slurry from the seventh tank flows over a vibrating carbon safety screens and is pumped to the residue pachuca. The slurry from the residue pachuca is then sampled by an automatic online WAD cyanide analyser. The majority of residue is pump to the slimes dams, but a portion is also pumped to a backfill plant for the generation of backfill material. The backfill plant is located at the decommissioned Bambanani West shaft site. The carbon that has been pumped upstream is recovered at the first adsorption tank by pumping the slurry over vibrating carbon screen. This separated the gold loaded carbon from the slurry, which is then transferred to the carbon holding vessel at the elution section.

**Elution and Regeneration:**

The elution section has three separate elution modules that process the carbon from the three CIP trains. One 1.25m diameter elution column is used in each of the elution trains and the cycle of water/acid washing, first and second strips are all done in the one column by passing the various solutions through the column. The AARL process is used at 130°C and 450 kpa. All three elution modules are controlled by means of a PLC which makes the entire process automatic. The four oil heaters (a.k.a. Themopacs) that is used to provide the heat for the elution process are fired by polyfuel (a diesel equivalent supplied by Sasol) burners which have their fuel provided from a large storage tank mounted outside of the building.

---

After the carbon has been stripped it is taken through three 9m length regeneration kilns that use electrical resistance heaters mounted around them to provide the heat for regeneration.

**Recovery:**

The gold rich eluate from the columns is pumped across to the eluate tanks located inside of the smelt house. This is where the gold in solution is recovered by zinc precipitation rather than the usual electro-winning process.

The zinc precipitate is filtered out by rotary vacuum drum filters and then calcined in one of the 9 large ovens at 800°C to oxidise as much of the base metals as possible. Finally, the concentrate is mixed with silica-borax-Mn flux and smelted into gold bullion in one of three electric arc furnaces at ± 1400°C.



***Auditor's Findings***

**This operation is**

**X in full compliance**

in substantial compliance

not in compliance

with the International Cyanide Management Code.

This operation has not experienced compliance problems during the previous three year audit cycle.

Audit Company: Eagle Environmental

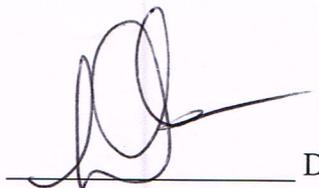
Audit Team Leader: Arend Hoogervorst

E-mail: [arend@eagleenv.co.za](mailto:arend@eagleenv.co.za)

Names and Signatures of Other Auditors:

Name : Dawid M. L Viljoen

Signature



Date: 24/4/2014

Dates of Audit: 16<sup>th</sup> – 20<sup>th</sup> September 2013

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.

Harmony One Gold Plant

Facility

Signature of Lead Auditor



24/4/2014  
Date

One Gold Plant

Signature of Lead Auditor

22<sup>nd</sup> April 2014

---

*Auditor's Findings*

**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.*

**X in full compliance with**

**The operation is**       in substantial compliance with **Standard of Practice 1.1**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

There is a Harmony Group-wide, cyanide supply contract, covering all Harmony Gold Plants, in place with SASOL Polymers, as the sole supplier of liquid Sodium Cyanide, delivered by bulk tanker. This supply contract includes Harmony One Plant. SASOL Polymers is a signatory to the Cyanide Code and was re-certified as a fully compliant Production Facility with the ICMI Cyanide Code on 2 March 2010 and again, on 7<sup>th</sup> May 2013.

**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.*

**X in full compliance with**

**The operation is**       in substantial compliance with **Standard of Practice 2.1**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

A Group-wide cyanide supply contract covering all Harmony Gold Plants (including Harmony One Plant) is in place with Sasol Polymers as the sole supplier of liquid Sodium Cyanide. Sasol Polymers is also responsible for the transport of cyanide solely

using Tanker Services, who started transporting Sasol Polymers-produced cyanide from July 2011. Tanker Services became a certified ICMI transporter on 13 December 2011. A Memorandum of Agreement (MOA) for the offloading of liquid sodium cyanide in terms of SANS 10231:2006 between Tanker Services Specialised Products Division and Harmony Gold Mining Company is in place. The supply contract and MOA cover the responsibilities and requirements for safety, security, unloading, emergency response (spills prevention and clean-up), route planning and risk assessments, community liaison, emergency response resource access and availability, training, and communication.

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

**X in full compliance with**

**The operation is**                     in substantial compliance with **Standard of Practice 2.2**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The Group wide cyanide supply contract covering all Harmony Gold Plants (including Harmony One Plant) in place with Sasol Polymers as the sole supplier of liquid Sodium Cyanide requires cyanide to be supplied by road tankers and the seller as well as the transporter will be ICMI Compliant over and above national regulations. Offloading is covered by a Memorandum of Agreement (MOA) for the offloading of dangerous goods between Tanker Services Specialised Product Division and Harmony Gold Mines' Harmony One Plant. The supply contract and MOA cover the responsibilities and requirements for safety, security, unloading, emergency response (spills prevention and clean-up), route planning and risk assessments, community liaison, emergency response resource access and availability, training, and communication.

There is a break in deliveries of cyanide to site by a ICMI certified cyanide transporter between July and December 2011. The auditors deem the break to be acceptable for Mine Code compliance purposes for the following reasons:-

- 1) The change of transporters was beyond the control of the mines,
- 2) There was only one ICMI certified transporter and one ICMI certified liquid cyanide supplier in South Africa and the mines were bound to the producer/transporter conditions,
- 3) Finding a replacement/alternate supplier/transporter in the short term was not feasible because the mines can only handle liquid cyanide on site and do not have the facilities to mix their own cyanide from briquettes,
- 4) the mines applied pressure upon the supplier to organise ICMI certification for the replacement transporter as soon as possible,
- 5) The interim cyanide risk was minimal because the new transporter, Tanker Services, took over all of the transporter resources of ICMI transport certified SiLog (dedicated bulk cyanide liquid tankers, trained and experienced owner-drivers and contract drivers, assessed route risk assessments, cyanide documentation and systems) and was, and still

is, covered in terms of Sasol's Product Stewardship and Responsible Care policies by the Sasol cyanide emergency response system (24 hour emergency control room, network of cyanide trained, emergency response spill and medical response service providers), dedicated cyanide tanker storage area and cyanide tanker decontamination facilities.)

**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/quality assurance procedures, spill prevention and spill containment measures.*

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 3.1**  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The operation uses only liquid cyanide, delivered by bulk tanker, and no mixing takes place on site. Design drawings for the cyanide off-loading and storage area were sighted and structures were designed and located on concrete and away from people and surface waters, away from incompatible materials, and built with materials appropriate for use with cyanide and high pH conditions. The liquid cyanide tanker is parked on a competent concrete pad close to cyanide area and all spillages or washings drain to cyanide bund area. The cyanide storage tanks, which are located inside concrete banded areas, have ultrasonic level indicators equipped with digital displays at the storage area with high level alarms set to go off at 90% of actual capacity in the control room system. The two tanks are interconnected and are interlocked with the offloading air which closes off at 90% level. The storage tanks are fenced and locked and located inside the Plant perimeter fence with controlled access. An Access and Key control procedure is in place and keys are only issued to the shift foreman and chemical handler.

*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.*

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 3.2**  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

Only liquid cyanide is used which is delivered via bulk tanker to storage tanks. The offloading procedure is detailed, spelling out PPE requirements, use of a buddy in the process, and clearly sequenced to prevent spillages and accidental releases during off-loading.

**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 utilizing contingency planning and inspection and preventive maintenance procedures.*

**X in full compliance with**

**The operation is**       in substantial compliance with **Standard of Practice 4.1**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The site has 89 cyanide specific procedures, covering both operational and engineering tasks and three cyanide-related environmental procedures and a set of 25 Backfill Plant procedures. These are supported by the Harmony One Plant Tailings Dams Mandatory Code of Practice (COP) for Mine Residue Deposits, and 8 procedures for TSF (Tailings Storage Facility) operations. Routine daily, weekly, monthly, quarterly and annual inspection reports, legal inspections, and checklists were sampled to check the effectiveness of systems and ensure that proactive and reactive management takes place. A Procedure to Respond to Abnormal and Emergency Conditions covers Pachuca overflowing, surge dam overflowing, precipitation tanks overflowing, and residue pipeline bursts. The plant will be stopped to do planned shutdowns and due to breakdowns requiring a plant stoppage. No scenario exists where the Plant will be stopped in case of water balance problems as the whole Harmony water circuit is interlinked.

The plant maintenance and inspection schedule includes preventative maintenance inspections on cyanide critical equipment using a Planned Maintenance System (PMS) called the DMS2000 system. Quarterly technical inspections with consultants of the TSF facilities are undertaken to ensure integrity and safety in addition to the monthly TSF inspections involving the site staff and TSF contractors. A change management procedure covering health, safety and environment is in place and operational.

There is no need for emergency power to prevent cyanide releases as a large volume of gravity fed, backup dams are in place thus there is no the need for emergency power. All spillages will be contained in banded areas when power trips occur.

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

**X in full compliance with**

- The operation is**
- in substantial compliance **with Standard of Practice 4.2**
  - not in compliance with
  - not subject to

*Basis for this Finding/Deficiencies Identified:*

There are seven different ore sources that are fed to the Plant and routine bottle roll tests, using standard leach parameters for each ore source, are done to determine cyanide consumption per ore and as residual pH. Optimisation programs are in place and studies such as “Improve solid residue by focusing on leach optimisation at Harmony 1 Gold Plant” have been undertaken.

Cyanide addition using ratio control and using the mass flow information from the thickener underflow pump system was considered. Thickener density control was also considered to assist with smoother cyanide control to the leach.

Leach feed control, using a TAC 1000 controller, is in place and a WAD 1000 on-line WAD CN analyser is installed on residue tank.

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

**X in full compliance with**

- The operation is**
- in substantial compliance with **Standard of Practice 4.3**
  - not in compliance with

*Basis for this Finding/Deficiencies Identified:*

A comprehensive, spreadsheet-based, complex-wide, probabilistic water (PWB) balance is in place which includes the TSFs used by Harmony One Plant and the Plant itself. The output of the water balance is used to establish parameters and procedures to manage the TSFs and return water dams to prevent overtopping to the environment. Information is included on rainfall, storm events, and solution deposition. Phreatic surfaces and stability analyses on the TSF are measured and checked quarterly and annually, where TSF COP parameters, including pool levels, are reviewed. The TSF freeboard is surveyed monthly and TSF pool levels and return water dam levels are checked routinely. The Environmental Department inspects the return water dams weekly.



---

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

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 4.4**  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The WAD cyanide results from the plant tailings tank are measured by an on-line WAD 1000 analyser, and although some exceedances above 50 mg/l WAD were noticed in 2011 and 2012, these were mostly for a short span, not presenting significant risk to wildlife. Back-up sampling at the tip points did not indicate significant exceedances. The incidents were investigated and linked to equipment malfunction, maintenance issues and zinc tail solution pumping practice. The problems were rectified and the results sighted for 2013 indicate that the problem areas are under control. It is thus concluded that no special measures to restrict access to the impoundments are necessary. Daily wildlife mortality inspections are conducted by the TSF contractors,. The Environmental department conducts weekly TSF wildlife inspections, and no bird mortalities have been reported for the period since certification. The return water dam WAD cyanide values were all below 0.5 mg/l WAD CN, thus making it not part of the cyanide facility classification.

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

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 4.5**  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

No direct discharge to surface water takes place. Verified during site inspection. The closest stream is 3 km away and no seepage could reach the stream. Borehole values around the TSF and the Plant between 2011 and Aug 2013 show all levels are below the limits of detection of 0.25mg/l WAD cyanide except for a few outliers, indicating that no seepage that could cause indirect discharges from the TSF's. The Witpan dam closer to the plant is also sampled and values between 2011 and August 2013 are less than the level of detection of 0.25 mg/l WAD cyanide, indicating that no indirect discharge takes place to the dam.

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

**X in full compliance with**

- The operation is**
- in substantial compliance with **Standard of Practice 4.6**
  - not in compliance with

*Basis for this Finding/Deficiencies Identified*

The TSF is equipped with under drains, paddocks and cut-off trenches with seepage pumped back to the TSF return water system for re-use in the process. Boreholes are sampled and monitored for cyanide. The Return Water Dam is clay-lined to prevent seepage. The Plant spillage dam is concrete lined to prevent seepage. Farmers are identified as beneficial users of underground water for animal use. Boreholes are sampled and analysed for WAD cyanide and the Mine uses the national Department of Water Affairs standards for groundwater which is 0.5ppm Free cyanide. Borehole samples from January 2011 to Aug 2013 are all less than 0.25 mg/l WAD cyanide which is limit of detection. Although there is a backfill plant, it was not commissioned or operational at the time of the audit.

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

**X in full compliance with**

- The operation is**
- in substantial compliance with **Standard of Practice 4.7**
  - not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The reagent strength cyanide tanks are placed in a concreted bund and are supported by steel legs on plinths. The elution reagent tanks and columns placed in bund areas on solid concrete bases. The CIL and Leach tanks placed on solid concrete bases, draining onto a competent concrete floor into a spillage pump returning spillage to tanks. The Plant floor area is covered by concrete and brick paving and linked to the emergency surge dam by concrete-lined spillage trenches. An emergency surge dam is installed downstream to contain Plant spillage, storm water and leach / CIP bund overflow. The residue tank and pumps are situated on concrete, and the bund drains into the emergency spillage dam via concrete lined trenches. The linked emergency containment dam of 6049m<sup>3</sup> provides sufficient capacity to contain 110% of the volume of the largest tank which is the leach tank at 758m<sup>3</sup>. The dam further would accommodate the 1:50 year storm event and an operating procedure requires that the emergency containment dam be kept empty at all times. The reagent strength pipelines were risk assessed and secondary containment was



*Basis for this Finding/Deficiencies Identified:*

Procedures for environmental monitoring (including sample preservation and chain of custody procedures) of surface water and borehole water, developed by a competent person, were sighted and checked. There are no discharges to surface water but boreholes are in place up and down stream of the plant. Surface and borehole sampling is done monthly, with plant borehole sampling being done weekly, and wildlife is monitored daily on the TSF for any mortalities and the Environmental Department monitors wildlife during sampling activities on a monthly basis.

**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.*

**X in full compliance with**

**The operation is**                       in substantial compliance with **Standard of Practice 5.1**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

A Decommissioning Plan for Harmony One Plant is in place which includes an implementation schedule for decommissioning activities. The decommissioning plan is reviewed annually.

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

**X in full compliance with**

**The operation is**                       in substantial compliance with **Standard of Practice 5.2**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The document, "Closure cost assessment for Closure cost assessment for Harmony Gold Mining Company Limited 2013, Bambanani Operations", dated June 2013 containing a line item of R429 617 being the allocation for cyanide decommissioning, was reviewed. The Armgold/Harmony/Freegold Joint Venture Company (Pty) Ltd, (Bambanani Operation) summary status of the rehabilitation trusts, 30 June 2013 documentation was

sighted. This trust fund is established by legal requirement in terms of the Minerals and Petroleum Resources Development Act. The estimates are updated annually and reviewed externally every two years.

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

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

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 6.1**

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The site has 89 cyanide specific procedures, covering both operational and engineering tasks and three cyanide-related environmental procedures and a set of 25 Backfill Plant procedures. Procedures include PPE requirements and appropriate pre-work inspections. These are supported by the Harmony One Plant Tailings Dams Mandatory Code of Practice (COP) for Mine Residue Deposits, and 8 procedures for TSF (Tailings Storage Facility) operations. Routine daily, weekly, monthly, quarterly and annual inspection reports, legal inspections, and checklists were sampled to check the effectiveness of systems and ensure that proactive and reactive management takes place. A Procedure to Respond to Abnormal and Emergency Conditions covers Pachuca overflowing, surge dam overflowing, precipitation tanks overflowing, and residue pipeline bursts. The plant will be stopped to do planned shutdowns and due to breakdowns requiring a plant stoppage. No scenario exists where the Plant will be stopped in case of water balance problems as the whole Harmony water circuit is interlinked.

The plant maintenance and inspection schedule includes preventative maintenance inspections on cyanide critical equipment using a Planned Maintenance System (PMS) called the DMS2000 system. Quarterly technical inspections with consultants of the TSF facilities are undertaken to ensure integrity and safety, in addition to the monthly TSF inspections involving the site staff and TSF contractors. A change management procedure covering health, safety and environment is in place and operational.

The Health and Safety Committee is used to ensure worker participation in health and safety issues. The Safety Representatives meetings also function as a communications channel. Shiftly toolbox talks are held daily and are a means of identifying health and safety issues. Participation and communication of the workforce via health and safety and safety representatives meetings was confirmed during interviews. Worker participation in risk assessments also provides worker input.



---

*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.*

**X in full compliance with**

- The operation is**
- in substantial compliance with **Standard of Practice 6.2**
  - not in compliance with

*Basis for this Finding/Deficiencies Identified:*

Currently, pH is controlled automatically in the thickener to 10.5 and controlled via lime titrations and measured using a handheld pH meter. There are 3 fixed HCN gas monitors at the cyanide dosing points, 5 at cyanide offloading, 1 at caustic cyanide make up, and 1 in smelt house. Use is made of HCN gas portable monitors (3 PAC IIIs, 1 Miniwarn, and 6 PAC 7000 personal HCN gas monitors) and the TSF Operations Supervisor is issued with a PAC 7000. An additional, Dräger CMS analyser data recorder is used for on-going hot spot monitoring. Cyanide hot spot identification was done and risk areas identified where cyanide gas risks exist. A review survey was done by the plant metallurgist in May 2013 confirming hot spots as : smelt house reactors, leach reception tanks, cyanide storage tanks, adsorption tanks and residue pumps. All monitors are calibrated six monthly and calibration records were sighted. Safety showers are located at appropriate places throughout the plant and inspected regularly. The use of dry powder fire extinguishers was confirmed during site inspections. Fire extinguishers are checked monthly and before offloading.

Pipes are colour coded, with reagent strength cyanide pipes and tanks as well as caustic cyanide tanks and pipes colour coded, and the direction of flow in pipes indicated. All other process pipes in the plant will be assumed to contain cyanide and this is reinforced in induction training. The TSF slurry line signage (“poisonous water”) is located where people are close to the line, the village, next to roads, and at informal crossing points. MSDS documents are located throughout the plant.

Accident and incident reporting and investigation procedures, based upon the site safety reporting requirements, were found to be in place and effective.

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

**X in full compliance with**

- The operation is**
- in substantial compliance with **Standard of Practice 6.3**
  - not in compliance with



*Basis for this Finding/Deficiencies Identified:*

The site inspection verified the existence of oxygen packs, first aid kits with tripac antidotes (stored in fridges at the offloading area and the emergency cabin), radios, and telephones with emergency numbers. Safety showers are linked to SCADA which alarm when operated. Running water is available at the offloading area. All plant staff trained on decontamination, administration of oxygen and antidote. An emergency trailer is available on site equipped with a cyanide emergency kit, including medical oxygen resuscitators, gas masks, and cyanide emergency safety PPE. The cyanide equipment is regularly checked and tested and mock drills are held regularly on site.

The Harmony Ernest Oppenheimer Mine Hospital was confirmed to be able to treat cyanide emergencies and Hospital staff are given cyanide awareness training by the Harmony's Metallurgical training department annually. Emergency exercises are conducted periodically from the plant to the hospital and additional cyanide drill training is done and documented. Netcare 911 is the contracted ambulance service undertaking patient transport.

**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.*

**X in full compliance with**

**The operation is**                       in substantial compliance with **Standard of Practice 7.1**  
  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The plant has developed site-specific emergency scenarios and responses for its emergency response procedures. The emergency procedures combine existing procedural responses and emergency provisions to deal with the various scenarios and includes and identifies the emergency response team and coordinators who are on all shifts. These preparations are regularly reviewed in the light of changes, mock drill learning points and employee feedback.

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

**X in full compliance with**

**The operation is**                       in substantial compliance with **Standard of Practice 7.2**

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The workforce is involved in the Emergency Response procedures process through safety meetings, training, risk assessments, and emergency drills. The community is not directly involved in the Emergency Response procedures but is informed on its contents during dialogue sessions. Drills are used to involve hospital and ambulance staff in planning processes.

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

**X in full compliance with**

**The operation is**

in substantial compliance with **Standard of Practice 7.3**

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The Emergency Response procedures detail clear duties, roles and responsibilities for the various emergency scenarios. The control room operator is the primary response coordinator, authorised to call ambulance, security, and plant management. The emergency equipment inventory was checked and site inspections confirmed availability and readiness. The procedures include contact references (telephone, cell phone, etc) of internal and external resources for the various scenarios, particularly with detail where external resources and skills might be needed. Periodic drills involving internal and external stakeholders ensure that roles and responsibilities are understood and clearly implemented.

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

**X in full compliance with**

**The operation is**

in substantial compliance with **Standard of Practice 7.4**

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The Emergency Response procedures include details for appropriate emergency notification and reporting (internal and external) and the call-out procedure and contact information lists which are updated regularly. Media communication is dealt with in the procedures.



*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.*

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 7.5**  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The environmental monitoring of surface water, liquid cyanide spillage, and use of ferrous sulphate procedures cover clean-up and remediation relating to releases, pipeline failures and spills, as appropriate to the site-specific identified scenarios. Use of neutralization processes and materials is clearly covered, as is disposal of contaminated materials and the use of treatment chemicals such as ferrous sulphate in surface water which is prohibited.

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

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 7.6**  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The Emergency Response procedures are required to be reviewed annually, following incidents and emergency drills or when new information regarding cyanide becomes available. The report of a drill which included a cyanide spill and cyanide related injury was sighted. Evidence was sighted of learning points emerging from the various cyanide man-down drills.

**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.*

**X in full compliance with**

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

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

All plant personnel inside the plant fence (including security and Fraser Alexander tailings (FAT) TSF contractors) are trained in basic cyanide awareness. The training matrix includes a flagging system to timeously indicate need for training and refreshers. This was confirmed during interviews with staff. Refresher training is done annually, based on schedules using a training shift system (which is also used for routine update training). Selected employees were checked in interviews on their understanding of cyanide hazards, first aid and emergency response and this was further verified through checking of their training records. Records are retained for 40 years on the Plant, after which the records are sent to the central Harmony archive.

*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.*

**X in full compliance with**

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

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

The training matrix includes the employee names and all task procedures required for training. All Trainers are trained and registered as Assessors, and further trained in basic facilitation and presentation skills, and how to conduct one on one training. The Harmony Metallurgy training establishment is formally ISO 9001 accredited. All employees are trained before being allowed to work on a cyanide section. Assessments are used to test knowledge and competency. A clock-in card to enter to the plant is only issued after cyanide training has been signed off. Written tests for modules are conducted, and PTOs (Planned Task Observations) are used for on-the-job competency evaluation as per schedule. A formal PTO system is in place and if identified by the PTO, specific re-training may be given. Records are retained for 40 years on plant, after which the records are sent to a central archive.

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

**X in full compliance with**

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

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

All employees are trained on how to respond to cyanide emergencies. A fully trained dayshift emergency team is also trained in higher level cyanide response and is in place to react to cyanide emergencies during the day shift. After hour shifts react as per specific training for the shift emergency teams. Cyanide drills are the primary training tool used to train the emergency procedures. The Emergency responders are involved in mock drills, and training is given to the Ernest Oppenheimer Hospital and Netcare 911 ambulance and Paramedic staff by a Harmony training staff. There are no community members in the area of the Mine and thus are not involved in the Emergency Response Plan. Periodic mock drills are undertaken and training personnel attend these drills and formally evaluate response and performance. Refresher training is done annually. Records are retained for 40 years on plant, after which the records are sent to a central archive.

**9. DIALOGUE: Engage in public consultation and disclosure.**

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

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 9.1**  
 not in compliance with

*Basis for this Finding/Deficiencies Identified:*

Dialogue meetings are two-way dialogue sessions involving both dissemination of information and the answering of questions on cyanide. ICMI presentation meetings with the local Community and Emergency Services were held in February 2012 and March 2013 at the Diggers Inn with 43 attendees and 53 attendees respectively. Questions asked related to treatment of cyanide poisoning, danger of cyanide to the community, information required by traffic officers to respond to a cyanide accident, treatment of cyanide patients by Ernest Oppenheimer Hospital and cyanide PPE. Fliers were handed out at the meetings in Sotho and English which included information on cyanide and emergency numbers.

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

**X in full compliance with**

**The operation is**  in substantial compliance with **Standard of Practice 9.2**



---

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

Dialogue meetings are two-way dialogue sessions involving both dissemination of information and the answering of questions on cyanide. ICMI presentation meetings with the local Community and Emergency Services was held in February 2012 and March 2013 at the Diggers Inn with 43 attendees and 53 attendees respectively. Questions asked related to treatment of cyanide poisoning, danger of cyanide to the community, information required by traffic officers to respond to a cyanide accident, treatment of cyanide patients by Ernest Oppenheimer Hospital and cyanide PPE. Fliers were handed out at the meetings in Sotho and English which included information on cyanide and emergency numbers.

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

**X in full compliance with**

**The operation is**

in substantial compliance with **Standard of Practice 9.3**

not in compliance with

*Basis for this Finding/Deficiencies Identified:*

Fliers are used to communicate cyanide issues and explain cyanide and its uses. Owing to literacy problems, most of the cyanide presentations have to be given verbally in the predominant local languages of Sotho and Xhosa, as well as English. Copies of presentations were made available to stakeholders who requested them.

Reporting on incidents has not been done because there have been no incidents. Injuries must be reported to the Department of Minerals Resources who do not necessarily make the information publically available. Similarly, spills and releases must be reported to the Department of Water Affairs and Environment. Transport related incidents are reported by Sasol Polymers and the transporter, Tanker Services, through their own reporting mechanisms.

The Harmony Group communication policy is followed. Cyanide incident response would need to be prepared by the Corporate Communications Department. The Harmony website contains an item, "Harmony and the Cyanide Code". The Cyanide Code is mentioned in the Sustainable Development Report, p124 (2012). Information on significant cyanide exposures and releases would be made available, after appropriate investigations, on the company website (<http://www.harmony.co.za/sustainability/governance/cyanide-code>) and via the annual Sustainability Report Report.

